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Harbour and Catchment Management Plan - Whangapoua 2015

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Acknowledgements

The impetus for this plan arose from various community stakeholder meetings and continuous messages about the desire and the need to preserve and enhance the values held in relation to the harbour and surrounding land. Numerous individuals have willingly given up their time, knowledge and experience to contribute to the Whangapoua Harbour and Catchment Management Plan. It is hoped that the stories and experiences shared have been captured in this overarching strategy to ensure that the wellbeing of the Whangapoua harbour, catchment and its people is enhanced.

We acknowledge the contributions that have been made by community members, by the iwi of Ngati Hei, Ngati Huarere, Ngati Tamatera and Ngati Whanaunga, by staff from Thames Coromandel District Council (TCDC), Department of Conservation (DOC) and Waikato Regional Council (WRC), and other agencies and people who have assisted in bringing the information together for this plan.

The combined communities that make up this catchment have helped us to prepare this document and their patience and support is appreciated. It is their vision, aspirations and support which makes this work possible.

It is now our collective responsibility as community, stakeholders, tangata whenua and agencies to bring this document to life and to seek to make a difference to the future of the Whangapoua harbour and catchment.

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Abstract

The Whangapoua Harbour and Catchment Plan is focused on integrated harbour and catchment management. Harbour and catchment management in the Waikato Regional Council's Coromandel zone has emerged out of the desire from people within small communities to better connect with their neighbours and with their environment and to recognise that the harbours and catchments of the Coromandel Peninsula have distinct communities and differing environmental priorities.

This local planning approach is based on the view that multiple hands and multiple agencies can increase people's understanding of environmental issues and co-ordinate a combined approach to actions, contributing to the overall objectives for the area. The plan combines scientific information with local knowledge and experience, along with identifying environmental priorities to be addressed. In this way a collaborative understanding can evolve of what actions or expectations are realistic and achievable for the future, and the plan can provide a way forward to address these issues within the harbour and catchment.

The HCMP will provide an overarching strategy and policy direction for priority issues within the harbour and catchment area and provide guidance for the more specific implementation actions that will subsequently be undertaken.

In addition, the HCMP is complementary to and will assist in delivering on the Coromandel Zone Plan and the key strategic and policy directions set out in key council policy documents such as: the Waikato Regional Policy Statement, Waikato Regional Plan, Waikato Regional Coastal Plan, Waikato Regional Council Long Term Plan and the Coromandel Peninsula Blueprint.

Executive summary

The Whangapoua harbour and catchment area has been recognised by the community and the Waikato Regional Council (the Council) as a priority area for an integrated harbour and catchment plan. The environmental changes occurring in this area have raised people's awareness of the need for careful management of resources into the future, along with the need to meet economic and social outcomes. **Part One** provides some contextual background and outlines the issues we heard from people. **Part Two** sets out the vision and objectives for driving changes in the area.

The Vision is:

A Healthy Catchment, a Healthy Harbour and an Engaged Community:

> ***The ability for people to access, enjoy and connect to our catchment and coastal environments, both now and for future generations.***
>
> ***Waters are clean, catchments stable and healthy and the mauri[1] of the area is enhanced.***
>
> ***Recognise the role of the harbour as a pataka kai[2] and retain the natural beauty and unspoilt nature of the area.***

Key themes identified included:

- The People: A focus on healthy communities, catchment and harbour; involvement of iwi in management approaches; partnerships between community, iwi, forestry and agencies.
- The Land: A focus on sustainable land use practices now and into the future.
- The Water: A focus on improving water quality and ecosystems in streams; addressing flood issues; increasing riparian plantings.
- The Coast and Harbour: A focus on the restoration of shellfish beds and fish stocks; protection of the natural state of harbour and coast and concern regarding the spread of mangroves
- Biodiversity: A focus on protecting and enhancing biodiversity values and environments; developing ecological corridors; re-establishing wetland areas.

The rate of harbour infill, the expansion of mangroves and a heightened awareness of the need to preserve community values for social, cultural, economic and environmental outcomes have been key drivers for the land owners and communities within the Whangapoua catchment.

Erosion and sedimentation are key issues that were raised by many people but they are also complex issues that will require a range of management approaches, while also recognising that there are natural processes in play and that harbour infilling is also a natural process. In addition poor land use practices and declining biodiversity were also key concerns regarding the future health of the harbour and catchment.

This plan, in **Part Three**, has taken this community information and added in background information and scientific information held by agencies, in order to provide an overview of the state of the catchment and harbour as it is currently. This provides a baseline snap shot of the current condition of the harbour and surrounding

[1] Mauri- the life principle instilled in objects by Atua (ancestors, deities). Mauri is also the life principle that gives being and form to all things in the universe.

[2] *Pātaka kai – traditional food storehouse*

catchment, against which future works and initiatives can be measured to demonstrate change.

Building on this, the plan outlines in **Part Four** the actions and initiatives that are currently being undertaken to address the key environmental issues that were identified through the community consultation and engagement with tangata whenua. It then sets out actions that are focused on the future, that are practical and that will make a difference to the state of the catchment and harbour.

The range of actions identified will involve partnerships between communities, iwi and agencies to achieve the outcomes sought for this area. These actions will be undertaken over a 10-year period and priorities reviewed regularly, to ensure progress is being made. The priorities will be budgeted and included into the annual plan process for agencies.

How successful this plan will be in addressing the desired outcomes, is dependent on community contribution and participation. It is also reliant on ongoing agency support and financial assistance.

Abbreviations used

Amsl	Above mean sea level
DHB	District Health Board
DOC	Department of Conservation
ha	Hectares
HCMP	Harbour and Catchment Management Plan
HMTB	Hauraki Maori Trust Board
ICM	Integrated Catchment Management
km	Kilometres
LRI	New Zealand Land Resource Inventory
LUC	Land Use Capability
M	metre
MPI	Ministry for Primary Industries
NHMS	Natural Heritage Management System
NZTA	New Zealand Transport Authority
PNA	Protected Natural Area
PTA	Pytophthora taxon Agathis
RAP	Recommended Area for Protection
RMA	Resource Management Act 1991
RPMP	Regional Pest Management Plan
SNA	Significant Natural Area
TCDC	Thames-Coromandel District Council
the Council	Waikato Regional Council
WWTP	Waste Water Treatment Plant

Part one:

1 Introduction

1.1 Whangapoua Harbour and Catchment

This plan focuses on the Whangapoua Harbour and its surrounding catchment, and is one of a series of integrated catchment plans that Waikato Regional Council (the Council) is developing to assist them in the management of catchments on the Coromandel Peninsula.

The Whangapoua catchment lies on the east coast of the Coromandel Peninsula and for the purpose of this plan extends from Matapaua Bay in the south to New Chums (Wainuiototo) in the north, includes the extensive harbour area and extends inland to the surrounding peaks as shown in Map 1.Within the overall management area delineated by the plan, six sub-catchments have been identified to allow for greater focus on issues and works required: Opitonui, Otama, Owera, Pitoone-Kuaotunu, Waitekuri and Pungapunga. Overall the catchment covers an area of approximately 16,700 hectares of land and 1300 hectares (or 13 km^2) of harbour.

The communities in the area include the coastal and rural settlements at Whangapoua, Te Rerenga, Matarangi, Kuaotunu, Otama and Opito (collectively referred to from this point on as the Whangapoua community). Although these areas have distinct characteristics of their own, the communities are strongly linked to each other by the harbour and catchment features, and through the consultation, people from the catchment have identified common issues to be addressed in this Harbour and Catchment Management Plan (HCMP).

1.2 What is harbour and catchment planning

Harbour and catchment management plans provide an integrated approach to the management of natural resources and the protection of community values. They seek to consider the values and uses of a catchment collectively in order to maximise long-term sustainability of our environment. The short, sharp nature of the Coromandel catchments provide for ease of connection between people and place, action and effect. Harbours and key water features connect people to a sense of place and a focus on waterways can encourage active participation in the preservation of 'their patch'.

The Council has an ongoing commitment to prepare and implement HCMP for all the major Coromandel Peninsula harbours and their surrounding catchments. The Council has identified twelve management areas within the Coromandel Zone (refer map 3 in Appendix 1).

These management areas are based on:

- Geography – water and harbour catchments
- Community – settlements and makeup
- Topography – of a similar nature and common issues.

To date plans have been completed for Whangamata, Wharekawa and Tairua. This commitment to integrated catchment management planning recognises the inter-relationships between land use and coastal environments and the need to address issues on a catchment-wide basis, while recognising community values and the increasing demands from communities for services.

***Thus HCMP provide an overarching strategy and non-statutory policy direction for priority issues within the harbour and catchment area, and provide guidance for the more specific implementation actions that would be subsequently undertaken*.**

In addition, the HCMP is complementary to and will assist in delivering on the Coromandel Zone Plan and the key strategic and policy directions set out in key council policy documents such as: the Waikato Regional Policy Statement, Waikato Regional Plan, Waikato Regional Coastal Plan, Waikato Regional Council Long Term Plan and the Coromandel Peninsula Blueprint.

1.3 Peninsula Project

Harbour and catchment planning is fundamental to the Council's Peninsula Project, and is based on the principles of integrated catchment management (ICM). ICM is an approach that has been used for many years in many countries to enable resources to be managed in a holistic manner taking into account localised and whole of catchment perspectives, and recognising the complex inter-relationships between different components of the environment and the communities that inhabit them. The ICM approach can be used to:

- Identify community values and objectives
- Provide a framework for making the best use of available time and funding, and
- Identify key actions and priorities that will make a practical and beneficial difference to the catchment.

For the Peninsula Project, (which includes this Whangapoua HCMP), ICM is focussed on works and outcomes that can be achieved for specified harbours and catchments.

The Peninsula Project aims to:

- Better protect people, property and essential services from flooding
- Reduce sedimentation in rivers, harbours and estuaries
- Improve water quality
- Reduce pests such as possums and goats
- Improve diversity of native plants and animals
- Improve and stabilise catchments
- Sustain the mauri of the peninsula from the mountain ranges to the sea.

This Project is the umbrella under which the HCMPs have been, and will continue to be, developed.

Integrated management, particularly for water body catchments, riparian areas and the coastal environment is a requirement of the Resource Management Act (RMA) and is a key policy driver within the Waikato Regional Policy Statement, the Waikato Regional Plan and the Waikato Regional Coastal Plan. The development of HCMPs is one means of implementing these policy directions and addressing significant resource management issues within a harbour and catchment area.

Guiding principles in the development of HCMPs include:

- Promotion of best practice techniques
- Focus on sustainability – economic, social, cultural and environmental
- Recognition of the importance of partnerships; both between agencies, iwi and with communities
- Enable the collaboration of resources to maximise outcomes.

The process of developing the HCMP aims to:

- Encourage partnerships between community, key agencies and stakeholders
- Create a proactive community working towards resolving identified issues

- Support sound economic, social, environmental and cultural outcomes.

The key factor behind HCMPs is the participation of communities. Community-based management initiatives are encouraged as people who live, work or have a strong connection to an area generally have a greater sense of ownership of the problems and the solutions, and this leads to greater success in achieving desired outcomes.

1.4 Regional context

The Coromandel is often referred to as the playground for the people of the Waikato, Auckland and beyond the "holiday maker's paradise". It is also the "jewel in the ecological crown", with key flora and fauna communities, many intact vegetation sequences and the presence of a number of threatened species. These factors, combined with increasing development pressures, mean its management (use, development and protection) is important for social, economic, cultural and environmental outcomes.

The responsibility to ensure appropriate management of the environmental resources of the Coromandel Peninsula falls to both the immediate community and those of the wider regional communities. The development and most importantly the implementation of HCMPs must take into account that less than half of the Peninsula's population are permanent residents, meaning services and physical contributions often fall to the few rather than the many.

Due to the above reasons, harbour and catchment management planning for the Coromandel Peninsula is recognised by the Council as a regional priority, and this is reflected in Council's current Long Term Plan which sets out the Council's commitment and funding to develop and implement these plans. It also recognises that HCMP's have an important role in delivering on key strategic RMA policy directions and the community aspirations set out in the Coromandel Peninsula Blueprint (Urbansimplus Ltd *et al*., 2011). In addition it also provides a mechanism for agencies and the community to give effect to the Hauraki Gulf Marine Park Act 2000.

Appendix 2 provides an overview of the Peninsula Project, Coromandel Blueprint, Hauraki Gulf Marine Park Act, the Waikato Regional Policy Statement and Sea Change - Tai Timu Tai Pari in relation to this harbour and catchment management planning process.

1.5 Purpose of the Whangapoua HCMP

The purpose of this plan is to provide an assessment of current environmental pressures and issues in the harbour and catchment and provide a practical strategy to alleviate these.

> We recognise that many of the issues identified have a long historical link; therefore we are focusing this HCMP on what actions we can do now which will make a difference to the environment in the next 10-50 years.

This plan is non-statutory but it has the capacity to inform and support statutory documents such as district, regional plans and regional coastal plans. Its success will rely on the uptake and goodwill of landowners and land managers within the catchment, as well as the support of key agencies, tangata whenua and community members.

This HCMP will provide the overall strategy for addressing issues within the harbour and catchment. It will be supported in the future by each agency, and community groups having action plans which will set out specific tasks, funding and timing, as well

as by site-specific plans prepared in conjunction with landowners and/or land managers for works or other actions at a property level.

The current baseline assessment of the harbour and catchment set out in this HCMP will also enable any future monitoring that may be undertaken to identify and demonstrate environmental change.

To achieve the above purpose, Council staff will work collaboratively with TCDC, the Mercury Bay Community Board, iwi, DOC, the Whangapoua catchment community, existing environmental groups, interested landowners, forestry operators, other agencies and stakeholders to implement this plan.

2 Legislative and planning framework

A number of legislative frameworks exist that guide and direct the Council in its various roles and functions. Additional statutes also govern and direct other agencies who have an interest in this catchment.

The key acts and plans that drive agencies in their work include:

- Soil Conservation and Rivers Control Act (1941)
- Resource Management Act (1991)
- Hauraki Gulf Marine Park Act (2000)
- Biosecurity Act (1983)
- Wild Animal Control Act (1977)
- Conservation Act (1987)
- Reserves Act (1977)
- Waikato Regional Policy Statement
- Waikato Regional Plan and Regional Coastal Plan
- Waikato Regional Pest Management Plan
- Coromandel Peninsula Blueprint
- Waikato Conservation Management Strategy
- Protected Natural Areas Programme
- Whaia to Mahere Taiao a Hauraki – Hauraki Iwi Environmental Plan
- Thames Coromandel District Council Community Plans and Reserve Management Plans
- Thames Coromandel District Plan
- Sea Change – Tai Timu Tai Pari.

It is therefore important to note that there are a wide range of statutory roles and responsibilities for dealing with the complex issues raised by communities for their harbour and catchment areas.

3 How we have structured the next sections of the HCMP

Building on the Issues identified through the community consultation in Section 4 below, we have identified five key themes which provide the structure for the following sections:

- In **PART TWO** (section 5) of this plan we have set out a **Vision and Objectives** based on the information we heard and have gathered.
- In **PART THREE** (sections 6 – 11) of this plan we have provided a **description of the harbour and catchment areas** and outlined what we already know about the key themes identified.
- Then in **PART FOUR** of this plan we have used these key themes to set out what **actions** are currently being undertaken in these areas, some proposed new actions to carry forward the aims of the plan into the future; and suggested actions that individuals can follow up on.

4 Consultation

4.1 What did we do?

The community's aspirations and concerns were collated from the Whangapoua communities through hui, open day drop-ins, meetings and one on one discussions. These community views were collated along with scientific information held by the Council and together have been used in developing the vision and objectives which form the basis of this HCMP.

The dedication of the Whangapoua communities to protecting the catchment as well as the Council's commitment through the Peninsula Project for integrated catchment management are the driving forces for this document.

The community process included:

- Area wide newsletters and surveys
- Rural landowner discussion groups
- Community drop in days
- Presentation and meetings with ratepayers associations and Community Board
- Hui with tangata whenua
- Healthy Harbours workshop
- Agency meetings
- Feedback opportunities on the draft plan including circulation of draft plan to community, iwi, industry and key stakeholders for consideration and feedback.

Healthy Harbour Workshop participants

4.2 What did we hear from the people we talked to?

Through the various opportunities we had for discussion and receiving feedback, there were a wide variety of issues raised, but there were also some clear themes. We kept a record of the information gathered from each consultation opportunity and in this section have aimed to summarise and capture the essence of the matters raised. From this we noted recurring themes. We have used these themes throughout the document. The five key themes that we have identified include:

- The People
- Land
- Water
- Coast and harbour
- Biodiversity.

4.2.1 The People

We heard that people want to see:

- A healthy harbour and catchment
- Vibrant, functioning communities
- Integrity and Rangatiratanga of each iwi group retained
- Traditional cultural resource use identified and added into the management of the harbour and catchment
- A partnership approach between the community, iwi, forestry and agencies
- Integration of existing works and initiatives by agencies and volunteers
- Greater links between groups and organisations in the catchment
- That people have better understanding of their actions and responsibilities
- Amenity and natural character of current areas protected – limited or no growth in settlements, no marina
- A better balance between commercial and recreational activities and environmental protection.

4.2.2 Land

We heard that people wanted:

- Land uses that are compatible with the type of land (e.g. steep slopes planted in indigenous forests)
- A discussion on whether there are alternative, sustainable land use practices that could also provide employment opportunities
- Reduced hill slope, stream bank erosion

- A reduction in loss of soils and less nutrients and sedimentation in our waterways
- Stock are excluded from riparian stream and harbour margins, wetlands and native bush areas
- Increase width of riparian plantings.

4.2.3 Water

We heard that people wanted:

- Improved water quality – clean clear streams
- Water that is safe for swimming/ drinking and for edible shellfish
- Rivers that flow naturally and no blockages to the sea
- Localised flooding addressed
- Thriving fish spawning areas and fish passages in all streams
- More riparian planting and less run-off into streams.

4.2.4 Coast and Harbour

We heard that people wanted to see:

- Restoration of shellfish beds
- Marine protected areas or no-take zones established within the harbour
- Shellfish and fish stocks that are healthy, abundant and edible
- Clear boat access channels
- Harbour weeds controlled and eradicated
- Salt marsh and chenier (shell) islands valued and restored
- Natural state of the beaches and coastline protected
- Control of boat sewage, septic tanks and waste water discharges
- A decrease in the spread of mangroves/ mangroves removed.

4.2.5 Biodiversity

We heard that people wanted:

- Enhanced biodiversity and an environment where native species can flourish
- Wetland areas re-established so that they can function as the “kidneys” of the estuary and as sediment traps
- Ecological corridors developed around the harbour and catchment
- Greater public appreciation of biodiversity, native species and significant habitat areas
- New restoration works and opportunities identified
- A catchment that’s weed free and pest free
- Bird nesting and feeding areas protected
- Geese and swan populations controlled.

4.3 What can we do about the issues raised?

While many of the above issues that we heard from the community can be addressed through the implementation of the HCMP, a number will not be and may not be appropriate to do so (for example because of existing legal rights, or complexity of issues such as employment opportunities). We also recognise that many of the issues raised have long histories and that we cannot “turn back the clock”. Therefore, we are focusing this HCMP on what actions can be done that will help to make a difference to the harbour and catchment in the next 10-50 years.

Part two: Our vision and objectives

5 What are we aiming for?

5.1 Vision

Based on the consultation undertaken the Vision for this plan is:

A Healthy Catchment, a Healthy Harbour and an Engaged Community:

- **The ability for people to access, enjoy and connect to our catchment and coastal environments, both now and for future generations.**
- **Waters are clean, catchments stable and healthy and the mauri of the area is enhanced.**
- **Recognise the role of the harbour as a pataka kai and retain the natural beauty and unspoilt nature of the area.**

5.2 Objectives

The following objectives will guide how we will achieve this Vision:

- Promote and support collaboration and co-ordination – involve tangata whenua, Whangapoua communities, key management agencies, volunteer groups and other groups in a way that seeks to maximise efforts contributing to the Vision and enhances strong relationships

- Protect and restore the natural values and qualities that make this area special to the people, and that support the species that live here
- Take an integrated approach to the protection and enhancement of the Whangapoua harbour and catchment: from the mountains to the sea and across all participants
- Promote 'best practice' methods for the management of Whangapoua's resources, while taking into account social, economic, cultural and environmental prosperity.
- Make a difference to the environment that people can see over the next 10 – 50 years.

Aerial view of Whangapoua Harbour

5.3 Outputs from this HCMP

There will be two main outputs resulting from the work of this HCMP project:

- Whangapoua HCMP – which is this document and which is the overall strategy for managing the Whangapoua harbour and catchment area – it sets the scene, identifies issues within the catchment and provides an overview of current and future actions.
- A detailed implementation action plan based on the actions set out in the HCMP, each external agency/ group may within their own respective work programmes, set more detailed actions, timeframes and budgets to drive the implementation of this plan. These work programmes sit outside the HCMP as they need to be incorporated into each group's annual planning and budgeting cycles.

Therefore this HCMP needs to be supported and implemented by all parties with an interest in the Whangapoua.

Part three:

6 About the harbour and catchment

6.1 Introduction

The information in this part of the HCMP sets out a snapshot of information held on the harbour and surrounding catchments. It identifies management issues and provides a background perspective to the actions which are identified in Part Four of this plan.

It is also anticipated that this information can be used in the future as a baseline of information against which environmental changes over time can be measured and compared. This will contribute to knowing what changes we have been able to make in the Whangapoua harbour and catchment.

This section is structured around the key themes that we identified from the consultation undertaken and provides background information on the issues raised in Section 4.2:

- The People
- Land
- Water
- Coast and harbour
- Biodiversity.

Some of the information provided relates to more than one of these key themes, and we have added cross-references to help with this.

7 The People

7.1 Overview

This section provides a brief overview of the locality of the Whangapoua catchment by describing the area, its settlements, transport infrastructure and land ownership. It also provides a brief history of the area and a cultural perspective from the tangata whenua. Tangata whenua of this area includes: Ngati Hei, Ngati Huarere ki Whangapoua, Ngati Tamatera, Ngati Whanaunga and Patukirikiri.

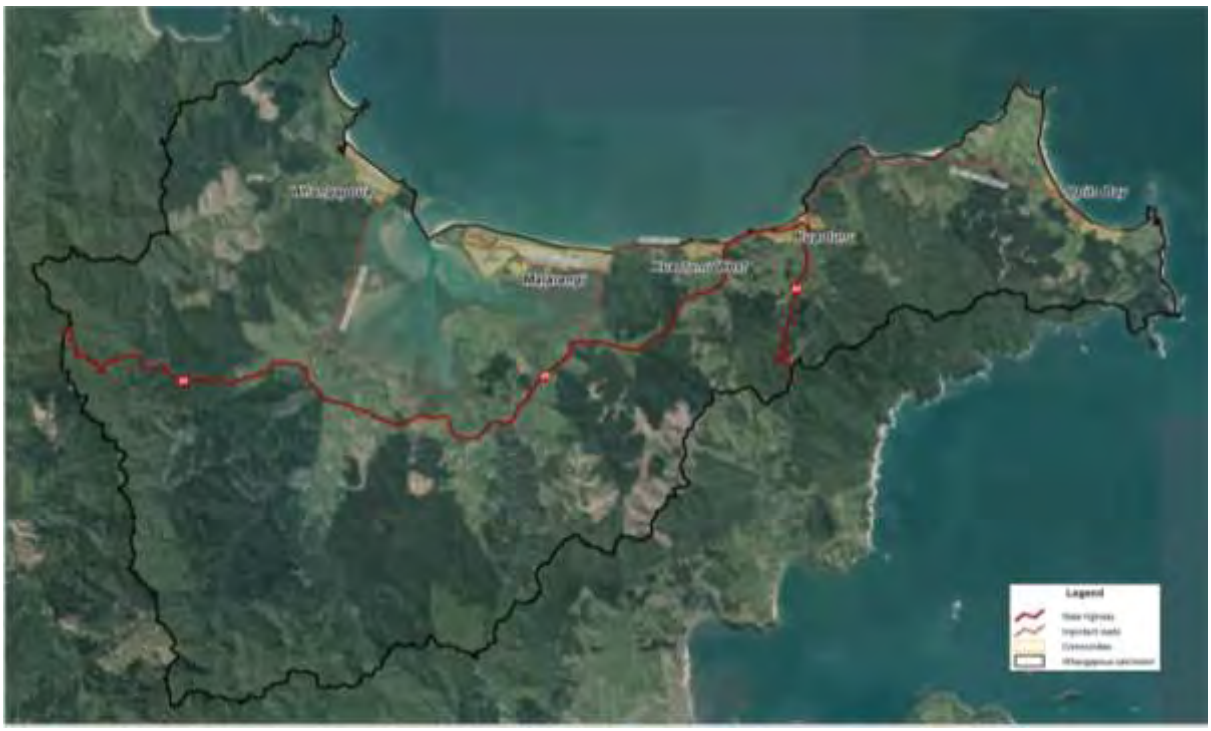
Key concerns and issues facing the People of the Whangapoua catchment and objectives sought, from an environmental management perspective include:

- The population of the area at approximately 800 permanent residents and 2,453 ratepayers is indicative of the “holiday home” nature of the area and the challenges this presents for economic resilience, volunteer capacity and provision of services.
- Maintaining and enhancing the natural character of the harbour and catchment are important to the Whangapoua communities.
- Subject to the Hauraki Iwi Treaty Settlement, it is anticipated that there will be co-management requirements for working together on managing this environment.
- Collaborative processes for involving iwi and matauranga Maori[3] are fundamental to the management of this catchment and harbour area.

[3] *Mātauranga Māori – traditional Māori knowledge - the body of knowledge originating from Māori ancestors, including the Māori world view and perspectives, Māori creativity and cultural practices.*

7.2 About the locality

The Whangapoua harbour and catchment is located on the north-eastern coast of the Coromandel Peninsula, as shown in Map 1.



Map 1 Overview of Whangapoua harbour and catchment plan management area

From a tangata whenua perspective the Whangapoua harbour and catchment is part of the rohe for Ngati Hei, Ngati Huarere ki Whangapoua, Ngati Tamatera, Ngati Whanaunga and Patukirikiri. From a TCDC perspective, it falls within the Mercury Bay North Community Board area. From the Council's perspective it is part of the Thames-Coromandel constituency and the Nga Tai ki Uta Maori constituency and the Coromandel zone. The catchment is also represented by the Coromandel Catchment Committee[4]. From a DOC perspective it is part of the Northern North Island region, with the closest offices being at Waiau/Coromandel, Whitianga and Thames.

In terms of settlements and roads, State Highway 25 passes through Kuaotunu, and Te Rerenga and fringes the southernmost reaches of the harbour, with local roads servicing the settlements of Whangapoua, Matarangi, Otama and Opito. There are also some local internal roads reaching back into the upper catchment areas and linking to both Whitianga and Waiau (Coromandel).

[4] There are eight management zones within the region, which provide the basis for integrated catchment management programmes.

Historic image (1959) showing coastline including Kuaotunu-Whangapoua

The landward area is approximately 16,700 hectares (ha), while the harbour covers an area of approximately 1,300 ha (or 13km^2). There is a small wharf facility near Whangapoua with boat launching facilities, and also formed boat launching facilities at Matarangi and Kuaotunu.

With respect to land ownership, 36% of the catchment is private property (or land held in trust), 43% is administered by Land Information New Zealand (LINZ) and 16% is DOC administered or custodian land (refer Table 1 and Map 14). The total urbanised area for the catchment is calculated as being 285 hectares. There are also some areas of foreshore vested as reserves and in TCDC or DOC ownership.

The indigenous forest is primarily public conservation land (16.49%) managed by DOC with some indigenous areas in private ownership.

The Whangapoua State Forest (approx 7,250 ha) is managed under a Crown Forest Licence, with Ernslaw One Ltd being the current licence holder. In the Treaty of Waitangi negotiations which are currently being undertaken with Hauraki iwi, it is anticipated that some public conservation land and LINZ-administered areas would be vested in Maori.

Table 1 Land ownership

Ownership type	Area ha	Area %
Private property and/or property held in trust	6085.72	36.27
Maori land blocks	32.24	0.19
Thames-Coromandel District Council owned land	169.7	1.01
Land Information New Zealand owned land (leased out)	7305.16	43.54
Dept. of Conservation owned land and/or custodian land	2765.74	16.49
Other crown owned land	1.95	0.01
Unspecified land ownership and/or no data	416.49	2.48

7.3 About the people

History of the area

Whitianga, which is the nearest major growth area, has featured in Maori lore since the first voyages of discovery to Aotearoa and traditions suggest that Te Arawa – the waka that was sailed from Hawaiki - made landfall in the Whangapoua area, and certainly at Mercury Island *Ahuahu*.

The coastal margins of the Whangapoua catchment were occupied predominantly by the tribes of Ngati Hei, Ngati Huarere, along with Ngati Whanaunga and Ngati Tamatera. They lived in this area and used the land and harbour for cultivation, fishing, building whare, waka, pa, and fashioning tools. For at least 700 years Maori travelled by canoe in this area with no roads and few tracks. According to Ngati Hei, Otama was once a large Maori settlement named 'Te Pepe-o-tama Tamateahua'.

European settlement of this area dates from the 1830s. Population was minimal until the 1860s, when the main industries being boat building, timber and flax milling, gold mining and gum digging. Timber and kauri gum were extracted from the Kuaotunu Valley in the early 1880s, and by the late 1880s, a small European population settled at Kuaotunu alongside Maori. This was followed shortly by gold mining at Kuaotunu and north at Opitonui. Further growth in the catchment took place during the late 1800s and early 1900s, with farming then becoming the main industry.

The first discovery of gold in the Kuaotunu valley was made by Charles Kawhine in 1889 and was named "Try Fluke". Other claims quickly followed but overall the exploitation of the Kuaotunu goldfield was short-lived and, with the exception of a short period in the 1920s when kauri was felled at the head of the valley, Kuaotunu changed from a noisy industrial area to a quiet rural community of scattered farms.

Plantation forestry was the next major industry in the catchment, with extensive planting of *Pinus radiata* in the 1960s – 1970s by the NZ Forest Service. In the early 1960s mains electricity reached the Kuaotunu valley and Whangapoua a few years afterwards, with private telephone lines installed in the 1970s.

In 1961, the first subdivision was located at the lagoon end of Whangapoua Beach. By 1970 the character of the open coastline was changing rapidly with coastal subdivisions at Whangapoua, Matarangi, Opito and Kuaotunu.

The people today[5]

Within the Whangapoua catchment area there are 2,453 ratepayers, compared with the 2013 Census data, which shows that there is a permanent population of approximately 800 residents. This reflects in part the "holiday home" nature of Whangapoua communities. Based on 2013 census data:

[5] These figures are based on the 2013 Census data. A more in depth profile of these communities can be found at TCDC: http://www.tcdc.govt.nz/Your-Council/News-and-Media/News-and-Public-Notices/News-Archived-Articles/March-2014/New-interactive-Community-Profile-website/

- Whangapoua settlement and harbour hinterland has an approximate permanent population of 177 residents
- The settlements and hinterland of Kuaotunu and the Opito peninsula have an approximate permanent population of 325 residents
- Matarangi has a permanent population of approximately 300 residents.

This permanent/non-permanent resident nature of the catchment communities provides challenges for the economic resilience of the area and to involving volunteers in community works. Notwithstanding this, there is a strong iwi and community interest in conserving and protecting the area's resources and values for the future. This is exemplified in numerous conservation/restoration volunteer groups working in the catchment. Iwi and community volunteer groups will continue to be supported by agencies such as the Council, TCDC and DOC whilst it is also acknowledged that there is limited capacity for additional 'hands-on' work by volunteers.

Today the main economic basis for the Whangapoua catchment is primary production (farming and forestry), with a range of small-scale supporting or service industries. During consultation on this HCMP, concerns were raised over the loss of people to other areas for work and the need to look at economic development opportunities locally. This was matched with a desire to protect the diversity and character of the harbour and catchment and to ensure iwi are involved in new opportunities (such as eco-tourism).

A recurring value held by the community is the need to maintain and enhance the natural character of coastal margins and limit residential and commercial development. It was suggested that ecological corridors/ green zone areas or similar methods could be established and more native planting around waterways and harbours. The majority of public land along the coastal fringes of the Whangapoua catchment is managed by DOC and TCDC. The community considered that it was important for public access to be maintained for recreational use of the harbour, beach and TCDC and DOC land. This included walkways, cycle ways, boating infrastructure and roading where appropriate to enable access, while large developments (e.g. a marina) were opposed as they would change the nature of the communities significantly.

7.4 Cultural heritage and issues of concern to iwi

The following iwi have interest in relation to this rohe[6]:

- Ngāti Hei
- Ngāti Huarere ki Whangapoua
- Patukirikiri
- Ngati Tamatera
- Ngāti Whanaunga.

Though they wish to retain the integrity and rangatiratanga of each individual iwi, there is recognition that their stories overlap.

These iwi recognise and support the need to look after the whenua (land), awa (waters) and wahapū (harbour) or Te Tai Tamahine (this refers to the Eastern Seaboard), and have expressed their vision of working together to protect these resources for future

[6] **Sources:**
www.teara.govt.nz/en/hauraki-tribes
www.teara.govt.nz/en/marutuahu-tribes
www.ngatihuarere.com/ngati-huarere
www.ngatihei.iwi.nz/
http://homepages.xnet.co.nz/~tamatera/Tikanga.html
www.sites.google.com/site/traiont/
www.ngaatiwhanaunga.maori.nz/home/
www.patukirikiri.iwi.nz/ Turoa T, 2000. Te Takoto O Te Whenua O Hauraki: Hauraki Landmarks.

generations. Mauri (the essence of wellbeing across all areas) is the over-riding philosophy.

They are cognisant that with the Waitangi Treaty settlement, there is likely to be co-governance opportunities that will need to be embedded into resource management activities. Their preference is to work with resource managers and applicants to have early input into projects/consents and that the focus is on action, not just more talk. To do this effectively will require some background research and mapping of cultural values and areas of particular significance.

7.4.1 Whangapoua Rohe iwi

7.4.1.1 Ngāti Huarere

The people of Ngāti Huarere trace their descent from Te Arawa waka. Their eponymous ancestor Huarere is a grandson of Tamatekapua the Ariki of Te Arawa waka and son of Tuhoromatakaka.

They have had a long connection with the Whangapoua Harbour and catchment over many generations and there are many places of significance such as battle sites, Urupa, pa sites, waahi tapu and other archaeological sites as well as place names that continue to connect them to this place. Ngāti Huarere has had a 700 year constant occupation in the Whangapoua area which is supported by their oral history. Numerous Ngati Huarere pa are recorded by Heritage NZ - Pouhere Taonga in and around the subject area. Though there is no built marae, an identified site on the hill behind the Whangapoua settlement is the intended location for the planned marae. Given the enduring ahi kaa roa[7] of Ngati Huarere and the kaitiakitanga[8] of the entire Whangapoua harbour and catchment, the WHCMP is of extreme importance to them.

Members of Ngati Huarere and botanist during Whangapoua Harbour survey

[7] *Ahi kā – central to the concept of ahi kā is the notion of occupation, occupying a place with iwi, or hapū to maintain a representational presence on the part of whānau. This concept is linked with mana whenua, the idea of maintaining strong links to areas by occupation gives a sense of higher and senior priority over decision making.*

[8] *Kaitiakitanga – is exemplified through the practices used by kaitiaki in safeguarding, protecting and caring for resources.*

7.4.1.2 Ngāti Hei

The people of Ngāti Hei trace their descent from the Te Arawa canoe. Their ancestor is Hei, uncle of Tamatekapua. Ngāti Hei also came into conflict with the expanding Marutūahu tribes. They were present when Captain James Cook arrived at Whitianga in 1769. Later, they suffered from Ngāpuhi war parties sweeping in from the north.

Ngāti Hei survived through these times of change and trouble and still live in the region, particularly in the district of Te Whitianga-o-Kupe (Whitianga Harbour), and their bloodlines extend throughout Hauraki and other related tribes throughout the country.

The Ngāti Hei rohe extends from the western end of Wainuiototo (New Chums Beach) at Anarake, to Ruahiwihiwi Pa/Whitipirorua Pa at the Wharekawa Harbour mouth at Opoutere in the south. Ngāti Hei has kaitiaki over Whangapoua Harbour; and with all the river and upper harbour water systems that feed into this harbour.

7.4.1.3 Ngāti Tamatera

Tamaterā was the second son of Marutūāhu and his descendants formed the tribe known as Ngāti Tamaterā. Ngāti Tamaterā is one of the major tribes of the Marutūāhu confederation of tribes.

According to Ngāti Tamaterā traditions, after Tamaterā took on his father's status, there was antagonism with his sibling that caused Tamaterā to depart his place of birth at Whakatiwai, after which he lived in several districts including Ohinemuri, Katikati and Whakatane.

Ngāti Tamaterā went on to establish their mana throughout the rohe maintaining strongholds at Moehau, Waikawau and Ohinemuri regions. Their leaders have been prominent in Hauraki tribal affairs for many generations.

7.4.1.4 Ngāti Whanaunga

Ngāti Whanaunga descends from the original tangata whenua of pre-fleet people, of Kupe-Toi, Ngaa Oho and also from descendants of the Tainui waka.

Whanaunga was the third son of Marutūāhu and his descendants formed the tribe known as Ngāti Whanaunga. Ngāti Whanaunga is one of the major tribes of the Marutūāhu confederation of tribes.

Whanaunga made his headquarters at Whakatiwa. After his father's death he broke away from the parent tribe and occupied parts of Ngāti Huarere and Ngāti Hei territories and Manaia. Further wars resulted in conceding substantial portions of their domain to their adversaries. This was followed by further wars with Ngā Puhi, and it was not until the 1830's that they returned to their tribal lands.

7.4.1.5 Patukirikiri

Patukirikiri descends from Kapetaua, in Tāmaki, and from the ancient tribe of Te Wai-o-hua. Kapetaua establishes his tribe within Hauraki. They took no part in the wars against the Marutūāhu, thereby retaining lands they owned. However they forced Ngāti Huarere from their lands at Kapanga. They have been at different times, part of various tribal divisions of Ngāti Paoa, Ngāti Tamaterā and Ngāti Whanunga. Most of their land was sold before the signing of the Treaty of Waitangi but they retained some areas around Coromandel and Moehau.

7.4.2 Values and issues

As tangata whenua and kaitiaki for the Whangapoua harbour and catchment area, Ngāti Hei, Ngāti Huarere, Ngāti Whanaunga and Ngati Tamaterā jointly seek to ensure that the mauri of the harbour is protected, along with the catchments and resources that lead to and from it.

The Whangapoua Harbour is a pataka kai, a significant resource for the area locally and for tribal members from other parts of the Coromandel Peninsula. The harbour has long been a playground for swimming and mahinga mataitai (seafood gathering), for example, pipi, mussels, sharks, eels, whai – stingray, nursery fisheries.

Kaimoana gathering is of great importance and the iwi want to see a safe continuation of this practice into the future. There is concern over the loss of pipi and mussel beds and seagrass beds in the harbour, and the proliferation of invasive species overtaking the habitat. Customary tools such as rahui or fisheries methods may be opportunities to assist with protection or restoration of harbour resources.

The tangata whenua of this area also wish to be able to return species to levels where undertaking traditional cultural harvest practices can be carried out, including for example, using native herbs and plants for medicinal purposes, flax for kete and skirts, capturing muttonbirds and kereru, and growing food sources such as kumara. It is important that these resources are restored and managed sustainably, including provision of opportunities for elders to teach their children these traditions.

As such managing the land, water, harbour and coast, and biodiversity are equally of importance to tangata whenua. Mātauranga māori is also an important knowledge base to be incorporated into the actions undertaken to manage the harbour and catchment.

Managing land activities to avoid sedimentation of the harbour is of particular importance to tangata whenua, along with concerns at mangrove expansion, illegally reclaimed harbour edges and invasive species. The return to iwi of forestry blocks may raise opportunities to consider land use changes.

Likewise water quality is important for food gathering and recreational activities. Concerns include the marine traffic and pollution, the waste water discharges from Matarangi and septic tank seepages from increasing developments, as well as toxic algal blooms.

Tangata whenua are supportive of the positive actions being taken by the wide range of community groups (refer Biodiversity Section 11.7), as pest plants and animals/birds have significant impacts on the environment. The importance of kiwi was noted in particular.

The iwi groups are also keen to explore employment opportunities for the future, but in a way that will retain the existing character of the settlements and environment. They do not support large-scale development of the area. They are also interested in establishing areas for papakainga.

8 The land

8.1 Overview

This chapter of the plan describes the characteristics of the land within the Whangapoua catchment. The volcanic geology of the area has significantly influenced the activities that have taken place to date and will do so into the future too. Overtime the soils have evolved from the weathering of the volcanic rocks and have also influenced land cover and land use capability (LUC) of the catchment.

Slope and erosion risk are factors which have a strong influence on this catchment, as they not only influence land use activities but are also drivers for erosion of hillsides and sedimentation in waterways.

From a hazard perspective land instability (from seismic sources and hill slope instability) and wildfire are the primary hazards.

Three significant land uses in the catchment include agriculture, forestry and conservation lands.

Key issues facing the management of land in this catchment and possible management options include:

- Land use activities need to be suited to the land characteristics (as identified through LUC system), in particular steep areas with a high erosion risk need to be managed carefully, and may need to be retired from productive uses, in order to protect soils and water.
- Erosion is a natural process and while vegetation cover can lessen the potential for erosion, it does not preclude it from occurring. Management approaches need to recognise natural processes and mitigate the potential effects as much as possible.
- Vegetation clearance and land use practices have led to accelerated sedimentation within the catchment. Soil loss reduces land productivity and increases the level of nutrients and turbidity of waterways. This has been identified as a priority issue for the harbour and catchment.
- Restoration of natural ecosystems such as wetlands and riparian plantings can assist in the management of sediment in waterways.

8.2 Geology

The Whangapoua catchment is flanked to the west by the central spine of the Coromandel Range, with the highest points being between 586 metres (Kaipawa) and 573 metres (headwaters of the Waingaro Stream).

Like much of the Coromandel Peninsula the Whangapoua catchment is underlain with a base rock of greywacke formed some 150 million years ago. This has been covered by more geologically recent volcanic rock (Malengreau et al. 2000). Some 20 to 10 million years ago, (during the Miocene era) widespread andesite volcanoes were present, depositing layers of volcanic tephra such as ash over the area. These landforms have been significantly eroded by intense rain events over millions of years, creating steep and heavily incised landforms.

Today the weathered remains of these volcanic cones are a feature of the landscape for example, Motutere (Castle Rock) (the distinctive remaining volcanic plug from the original volcanic vent). There are also areas of Diorite (an intrusive intermediate volcanic rock) and dacitic extrusive volcanic rock. The area also holds the gold bearing veins of quartz around Kuaotunu which led to gold mining in the late 19th century.

Motutere- Castle Rock

As shown in Map 5, deeply weathered volcanic lava and ignimbrite (Vo'.Vo and Vu') dominate the catchment. Areas of alluvium (Al) occur around major river deltas and the harbour margins. These will be reworked colluvial and alluvial deposits mostly of volcanic tephra. Peat (Pt) dominates the low lying areas of Otama and the Opitonui confluence. The Omara spit and Whangapoua spit are windblown sands (Wb) created through aeolian erosion and deposition. The underlying geology around Kuaotunu, and to the west, is both greywacke and deeply weathered greywacke (Gw and Gw'). Most people would be familiar with these areas as the main hills they have to traverse over when navigating the Black Jack Road over to Otama and SH25 to Whitianga or Coromandel.

Along the coast line there are areas of steep coastal cliffs where the sea has eroded into hard bed rock, including a relict area of eroded greywacke between Kuaotunu west and Otama Beach and minor areas of rhyolite and basalt near Opito Bay. Sandy beaches are also numerous within the bays and tidal mud flats that occur in the Whangapoua Harbour (Molloy & Smith 2002).

The volcanic geology has weathered over geological time to create the majority of the soils now present in the catchment.

8.3 Soils

There are a variety of soil types within the Whangapoua catchment as shown in Table 2 and Map 6.These soils have been mapped from the New Zealand Land Resource Inventory (LRI) database held with Landcare.

The relatively wet and warm climate combined with acidic leaf litter, especially from kauri and rimu over a long period of time, and weathering of the andesitic bed rock has produced soils dominated by clays of moderately low fertility. Most alluvial soils are derived from these same materials, deposited onto alluvial terraces during flood events. As a result alluvial terraces typically have dense gley soils which are prone to water logging though smaller areas of imperfectly and well drained soils occur (Molloy 1998).

The Whangapoua catchment is dominated by brown soils (84.09%) which are volcanic in origin (mostly andesite in this catchment) and have weathered from parent volcanic material or greywacke. The brown colouring is from iron oxides. These soils are typical in areas where total summer dryness is uncommon (rainfall exceeds 1000mm per year). These soils do not become waterlogged in winter, as they are generally well-drained and have moderate amounts of organic matter.

Allophanic soils (4.9%) in the catchment are loam soils derived from old volcanic tephra parent material and contain high amounts of the clay mineral allophane. They range in colour from brown to grey-brown top soils. The soils are favourable for deep root penetration as these soils have a friable profile which is often well-draining. They have between moderate to high organic matter. They tend to have high phosphorus retention.

Gley soils (7.86%) are formed from soils that become waterlogged and are usually a light grey in colour with distinctive red-brown flecks known as mottling. These soils are typical in wet areas where high water tables or seepages keep the soils continuously wet, including for example the Kuaotunu River delta These poorly drained soils require management (such as drainage and careful nutrient management) to become productive.

Raw soils (0.64%) are very young soils that have not formed a top soil or have rudimentary topsoil and usually occur where deposits of sediment or erosion are still active, such as beach sands and tidal estuaries. Raw soils have low fertility, are often unaggregated and are prone to further erosion.

Organic soils (1.29%) are associated with swamps, peatlands or wetlands where they are formed from the decomposition of plants. These soils are dominated by organic matter rather than mineral soil material. Otama Wetland and the Opitonui confluence with the Waingaro River are local examples of where these soils are found.

The Matapaua area is dominated by pumice soils (1.22%) high in volcanic glass and low in clay. They are relatively young soils (less than 3,500 years old) and are sandy or gravelly soil types. They may lack key trace elements, such as boron. They have weak soil strength and therefore soil erosion is potentially high.

Table 2 Soil order type

Soil order type	Area per ha	Area %
Allophanic	822.47	4.90
Brown	14107.43	84.09
Gley	1319.00	7.86
Organic	216.57	1.29
Pumice	203.87	1.22
Raw	107.98	0.64

8.4 Slope and erosion risk

8.4.1 Overview

This section describes slope characteristics of the Whangapoua catchment and the associated potential for erosion risk. Soil erosion is directly linked to slope, land cover and land use. Slope and erosion risk are important limiting factors for land use activities and consequently steep areas and areas prone to erosion require appropriate land use management methods.

Given the steep slopes, high rainfall and propensity for storm events, the potential for soil loss in this catchment is considered to be severe to moderate.

8.4.2 Slope class

The LRI data shows that much of the Whangapoua catchment, 81.84%, is moderately steep to very steep. Refer Table 3 and Map 7.

- Land above 21 degrees (classified as steep to very steep - categories E - G) is costly for cultivation and poses difficulties and risks in its management, particularly around soil retention and erosion prevention
- These slopes are rarely cultivated if at all (some pasture renewal may occur)
- Forestry is possible with tracked skidders on slopes up to 26 degrees
- Approximately 10% of the catchment is suitable for ploughing and cultivation without restrictions
- Slopes at 16 to 20 degrees are usually restricted by the number of crop rotations possible on these slopes and therefore lead to longer pasture rotations.[9]

Table 3 Slope Class (LRI)

Slope of catchment	Area by percentage
(A) - 0-3 deg - Flat to gently undulating	9.15
(B) - 4-7 deg - Undulating	2.99
(C) - 8-15 deg - Rolling	0.47
(D) - 16-20 deg - Strongly rolling	5.56
(E) - 21-25 deg - Moderately steep	30.93
(F) - 26-35 deg - Steep	48.76
(G) - >35 deg - Very steep	2.15

8.4.3 Soil erosion type and severity

The soil erosion type and degree of severity as shown in Map 8 indicates that most erosion in the catchment is sheet erosion and soil slip erosion. The higher the number the more severe the accompanying erosion type is.

Surface erosion such as the sheet erosion (Map 8) (Sh) is the most common form of erosion. Wind erosion (W) is also an issue particularly along the Omara sandspit (Matarangi).

Mass movement erosion is dominated by soil slips (Ss). These are shallow less than 1 metre deep but can be long leaving visible slip scars on the landscape.

8.4.4 Erosion potential

The Whangapoua catchment is dominated by steep slopes therefore high classes of land use capability (Class 6, 7 and 8) and these attributes consequently give the catchment a high potential for soil erosion risk (particularly if vegetation is removed from these areas). Combined with high rainfall and intense weather events, which are a characteristic of this catchment, the soil loss potential has 84.34% of the catchment area in the severe to moderate category (refer Table 4 and Map 9)

[9] Refer:http://www.landcareresearch.co.nz/__data/assets/pdf_file/0017/50048/luc_handbook.pdf.

Table 4 Soil erosion risk (LRI)

Erosion potential	Area by ha	Area by %
Severe	6147.37	36.64
Moderate	8002.87	47.70
Slight	2597.34	15.48
Bedrock (no soil)	29.73	0.18

In those areas that have moderate erosion risk the percentage of exotic forest is 48.54% and indigenous forest with manuka/kanuka is 24.81%. In the severe erosion risk areas indigenous forest and manuka/kanuka totals 52.15% and exotic forest is 32.21%.

While vegetation cover can lessen the potential for erosion it does not preclude erosion from occurring. It is best practice that steep areas with high erosion risk are left in permanent vegetation cover with browsing animal pests such as goats and possums managed accordingly or that the soils are managed to lessen erosion risks during harvest activities.

The Soil Erosion Risk and Vegetation Cover Map (refer Table 5 and Map 9) from the LRI and Land Cover Data Base shows that 73% of the areas of moderate risk and 84.36% of the high risk erosion areas are in forest (both exotic and indigenous).

Table 5 Soil erosion risk and vegetation cover

Vegetation cover of severe erosion risk	Area by ha	Area by percentage
Sand or gravel	2.84	0.05
Herbaceous saline vegetation	4	0.07
Mixed exotic shrubland	4.56	0.07
Low producing grassland	13.17	0.21
Urban parkland/open space	21.46	0.35
Built-up area (settlement)	55.99	0.91
Broadleaved indigenous hardwoods	114.17	1.86
High producing exotic grassland	270.96	4.42
Forest - harvested	471.32	7.69
Manuka and/or Kanuka	1315.34	21.45
Indigenous forest	1882.1	30.7
Exotic forest	1975.08	32.21

Vegetation cover of moderate erosion risk	Area by ha	Area by percentage
Sand or gravel	1.37	0.02
Herbaceous freshwater vegetation	1.8	0.02
Urban parkland/open space	1.92	0.02
Deciduous hardwoods	2.6	0.03
Orchard, vineyard or other perennial crop	2.77	0.03
Low producing grassland	3.94	0.05
Gorse and/or broom	3.97	0.05
Mangrove	4.38	0.05
Mixed exotic shrubland	26.84	0.34
Herbaceous saline vegetation	27.04	0.34
Built-up area (settlement)	69.75	0.87
Broadleaved indigenous hardwoods	154.46	1.94
Forest - harvested	441.92	5.54
Indigenous forest	696.19	8.72
Manuka and/or Kanuka	1129.47	14.15
High producing exotic grassland	1538.61	19.28
Exotic forest	3873.24	48.54

8.4.5 Accelerated erosion and increased sedimentation

The rate of erosion is influenced by natural events and anthropogenic[10] activities. For example cyclones and earthquakes can lead to natural increases in erosive events. Human activities (e.g. deforestation) too can lead to accelerated erosion and resultant increased sedimentation.

Increased sedimentation in the Whangapoua catchment arises from three key processes:

a) The natural processes of erosion in the form of sheet or rill erosion, slips and mass movement
b) Vegetation clearance and land use practices
c) Flooding, stream bank erosion and erosion to harbour margins.

[10] Anthropogenic-Human induced

Example of rill erosion

While sediment redistributed by flood waters onto floodplains and sediment entering harbours over time are natural processes, together these three processes deliver significant volumes of sediment to the lower reaches of waterways and eventually the harbour.

Sedimentation can increase the fertility of the land when deposited over flood plains during rainfall events, as well as influencing the bed of the harbour resulting in consequential changes in vegetation patterns.

However, soil loss reduces the productivity of the land and increases the turbidity of water. This in turn leads to issues such as the smothering of or clogging of gills of benthic biota or fisheries in streams and in the harbour, changes in vegetation patterns, (including for example the loss of sea grass beds or the expansion of mangroves), and accelerated infilling of the harbour.

Surface erosion of topsoils also reduces stock carrying capacity and as a consequence can reduce production. In the case of sheet and rill erosion losses of up to 60% can occur and where mass movement, such as earth flows and soil slips occur, losses as great as 80 to 100% can result. The cost of not managing soil erosion to prevent further damage to productivity or infrastructure can be significant.

Erosion also affects land productivity as it removes precious nutrients. Soil sediment particles also carry valuable nutrients away from productive land (e.g. phosphorous). These nutrients can then become concentrated in waterways and harbours where elevated concentrations lead to water quality issues (e.g. algal blooms, excessive plant growth). The loss of nutrients (through soil loss) also increases production costs due to the increased need for fertilisers.

In the catchment, suspended sediment is measured at Opitonui by the Council. Based on nearly 20 years of stream flow data, the mean annual sediment yield has recently been estimated to be 126 tonnes/km^2/year (Hoyle et al. 2012). Several years ago, the data from Opitonui was analysed to see whether there was any relationship between suspended sediment concentration and forestry harvesting in the catchment (Wild and Hicks, 2005). However it was not possible to discern any relationship (if one existed) due to a number of factors, including lack of pre-harvesting data from that stream, or forestry harvesting records for the catchment at an appropriate temporal resolution (Refer also to the discussion in Chapter 10 Coast).

Hamilton (2003) notes that the Opitonui River is very different from the Owera and Otanguru streams, due to variations in catchment size, catchment conditions,

hydrodynamics, surficial and suspended sediment size and mineralogy, floc characteristics and abundance. Sediments from the Opitonui are coarser and have different organic and clay contents, settling velocities, catchment size and stream length. By contrast the Owera and Otanguru streams have smaller catchments but appear to be considerably more turbid and have higher suspended material content (resulting from higher clay content).

Sedimentation was indentified through the consultation phase for this plan as being a priority environmental issue to be addressed within the Whangapoua harbour and catchment. Natural ecosystems within the catchment such as floodplains and wetlands play an important role in reducing sediment in waterways. Protection and restoration of these ecosystems coupled with good land management practices will be critical to the ongoing management of this issue.

8.5 Land cover and land use[11]

8.5.1 Overview

This section outlines the general land cover and land uses within the Whangapoua catchment. It also describes the land use capability (LUC) of the catchment. There are three major land use activities within the catchment, namely agriculture, forestry and public conservation land, and a brief description of these activities within the catchment is provided.

8.5.2 Land cover

Table 6 and Map 11 show that the majority of the catchment is in exotic plantation forest (*Pinus radiata*) with indigenous forest the second most common land cover. The steeper parts of the catchment are the outer upper reaches where land is predominately covered in either indigenous forest (Class 7 land) or exotic forest (Class 6e). Pastoral land is found on some of the steeper country and becomes the more dominant land cover on the undulating land, rolling land and flats where cultivation is able to be undertaken (Classes 6, 3 and 2).

Table 6 Whangapoua catchment land cover

Land cover type	Area in ha	Area as %
Exotic forest (incl. harvested)	7249.06	45.15
Indigenous forest and/or bush	5425.69	33.8
Grasslands	3379.68	21.05

8.5.3 Land use capability

The Land Use Capability (LUC) classification system is an effective tool to help in land resource planning and the promotion of sustainable land management (Lynn *et al*, 2009).

The system has two key components:

a) The Land Resource Inventory (LRI) which is an assessment of the physical characteristics of the land (geology, soil, slope, erosion, vegetation) considered critical for long term management to sustain one or more productive uses; and
b) On the basis of these characteristics a LUC classification has been developed. The LUC classes range from 1 to 8 with LUC Class 1 the most versatile land (the least limitations for productive use) and at the other end of the scale, Class 8 which is not suitable for productive use. Classes 1 to 4 are generally suitable for arable use while this is not the case for classes 5 to 8 (refer Table 7).

[11] Land cover and land use have been mapped using satellite imagery and are available as the Land Cover Database 4 (LCDB4) from Landcare Research Ltd NZ.

Table 7 Land use capability classes

LUC Class	Arable cropping suitability	Pastoral grazing suitability	Productive forestry suitability	General suitability
1	High ⇩	High ⇩	High ⇩	Multiple Land Use
2				
3				
4	Low			
5	Unsuitable			Pastoral or forestry land
6				
7		Low	Low	
8		Unsuitable	Unsuitable	Conservation Land

There are increasing limitations to use and decreasing versatility of use from LUC Class 1 to LUC Class 8 (Lynn et al, 2009).

LUC subclasses determine the dominant physical limitation or hazard for productive use and has four categories (e)rosion, (w)etness, (s)oil and (c)limate. LUC units are the most detailed components of the classification with each unit having similar physical characteristics, and having the same productive capabilities, limitations and management requirements. For example 6w1 has a Class 6 land use capability, limited by soil wetness(w) and all the 6w1 LUC units in the catchment require similar management. The LUC are shown on Map 12.
It should be emphasised that the classification is based on land *suitability* for productive use. Although most of our public conservation land is now restricted to land unsuitable for productive use, there are generally no physical limitations around land use for conservation purposes, i.e. it can occur on any of the land use classes.

The relative distribution of LUC classes within the Whangapoua catchment is shown in Figure 5 below. Within the catchment, 91.4% of land is LUC Class 6 – 8 of which the majority is hill country, while just 8.7 % is deemed suitable for arable use (LUC Class 1 – 4)[12].

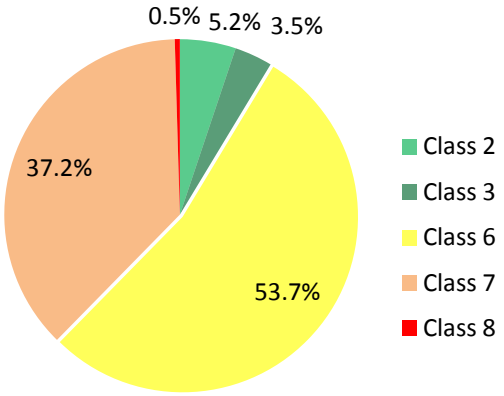


Figure 1 Percentage breakdown of LUC classes in Whangapoua HCMP area

[12] It should also be noted that these units were originally mapped at one inch to a mile (1:63360) scale and maps and should be used for planning purposes at that scale. At a farm scale (1:10,000) other LUC units may exist within the units mapped here.

Main LUC Classes in the Whangapoua Catchment are:

- LUC unit 2s1 is arable land and the most versatile, productive soils in the catchment. These areas are suitable for intensive farming operations such as dairying.
- LUC units 8e1 and 7e6 are the fragile coastal sand dunes which are subject to wind erosion (e). LUC unit 6s1 is the relatively stable part of the harbour sand spit, drought of the soils (s) a limitation to productive use.
- LUC units 6w1 and 7w1 are the peripheral marshlands of the Whangapoua harbour and are limited by wetness (w).
- The majority of the LUC classes 6 to 8 are in the hill country where slope creates limiting factors due to increased erosion activity (such as sheet and mass movement erosion). Where erosion (e) is the dominant limitation to productive use, appropriate management of these classes of land is critical to protect soil and water.
- LUC Classes 1-4 is the arable land of the catchment. It should be noted that activities such as cultivation but also earthworks and stock management, particularly around waterways, do require consideration with regard to potential impact on water quality and aquatic life.

8.6 Agriculture and forestry

8.6.1 Catchment condition

A catchment condition survey was undertaken in late 2012 to provide baseline information on privately owned land. It focuses on agricultural and lifestyle block land uses in the Whangapoua catchment (Jenks et al. 2013). Landscape features were recorded along with the condition of the harbour margins, the presence of riparian and soil erosion, the nature of riparian vegetation and whether or not stock were excluded from streams and harbour edges. Within agricultural land of the Whangapoua catchment, 1.11 ha of active hill country erosion was recorded; 80% of the riparian areas had successful stock exclusion in place; 53% had stock-proof native riparian vegetation dominant, and less than 0.05% (or 110 meters) of watercourse margins revealed recordable riparian erosion (Jenks, 2013).

The catchment condition survey covered six sub-catchments: Opitonui, Otama, Owera, Pitoone-Kuaotunu, Waitekuri and Pungapunga. These sub-catchments[13] are ranked in Table 8 below, based on the most intact features: i.e., least erosion, highest percentage of native vegetation, highest percentage of stock exclusion. Ranking from best (1) through to worst (6) has been undertaken (Jenks et al, 2013).

Table 8 Subcatchment ranking for management features

Subcatchment group	Riparian erosion	Landscape erosion	Riparian vegetation	Riparian stock exclusion	Average	Rank
Pungapunga	1=	1=	1	1	1	1
Pitoone Kuaotunu	1=	3=	2	4	2.5	2
Waitekuri	1=	5	3	2	2.75	3
Owera	1=	1=	5	5	3	4
Otama	1=	6	4	6	4.25	5
Opitonui	6	3=	6	3	4.5	6

[13] The Whangapoua harbour has been divided into six sub catchments where the major rivers and their watersheds denote the extent for each sub catchment. The sub catchments are for riparian management purposes only.

The catchment assessment (Jenks et al. 2013) noted:

- The Pungapunga sub-catchment has the best record of effective stock exclusion with only 8% of stream banks unfenced; it also has the most native vegetation, and little or no riparian or landscape erosion (refer Figure 2).
- The Otama sub-catchment has nearly 29% of stream banks vulnerable to stock access and contains the largest percentage of land affected by landscape (soil) erosion, with the largest individual site covering 0.2ha of mass movement of soil.
- The remaining four sub-catchments have riparian margins which are not “stock proof” ranging from 16% to 23%.
- The Opitonui and Pitoone-Kuaotunu sub-catchments contained approximately the same overall percentage areas of sheet and rill erosion, however due to the smaller size of the Opitonui sub-catchment, the scale of the erosion is almost double that of the Pitoone-Kuaotunu sub-catchment.
- Stock access to coastal areas is a widespread and serious problem, particularly around the harbour. The damage to the coastal edge by stock is extensive. (Refer also to the Coast and harbour Section 0.)

Stock damage to harbour margins

Stock damage to harbour margins

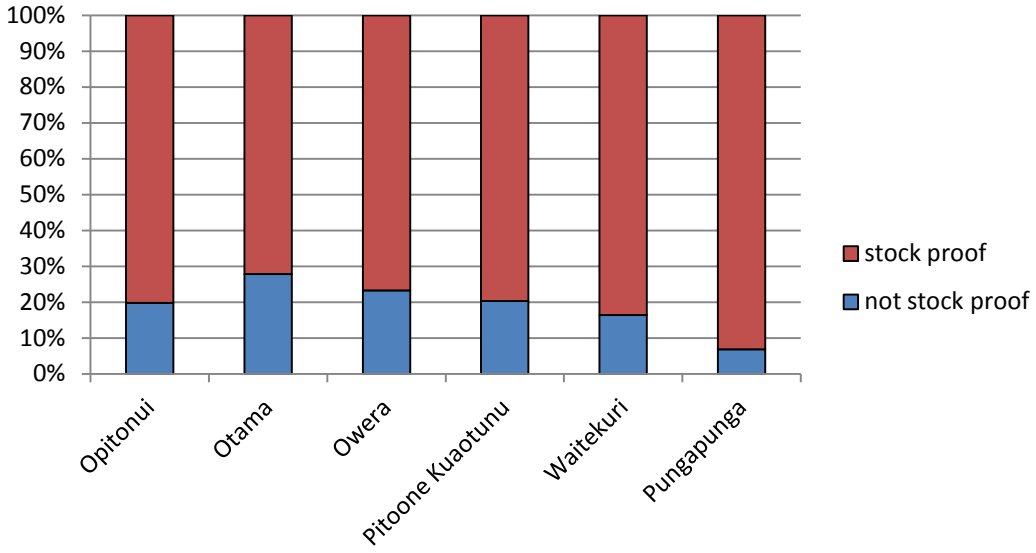


Figure 2 Percentage of stock proof/not stock proof riparian margins within each subcatchment group

In terms of riparian or stream bank vegetation, there is approximately 357 km of stream banks in the overall catchment. Of this, native flora occupies nearly 55% of riparian margins. Grass contributes just over 30%, and other exotic vegetation makes up the remaining 14% (as shown in Figure 3). The Pungapunga sub-catchment is dominated by native flora (88%), whereas grass and exotic plants were the most prolific within the Opitonui sub-catchment, occupying 58% and 26% respectively. This also meant that Opitonui contains the smallest amount of native vegetation.

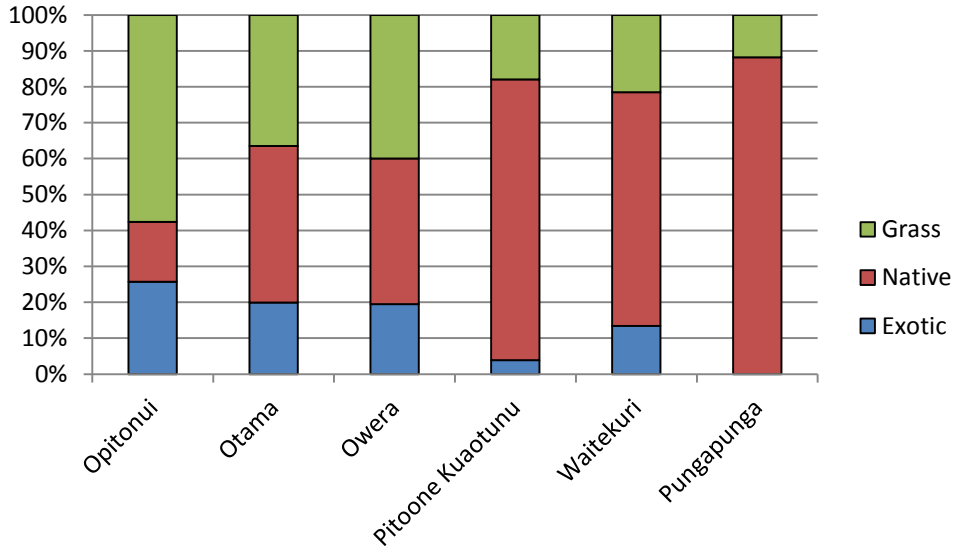


Figure 3 Percentage of exotic, grass and native riparian vegetation within each subcatchment group

Otanguru arm of Whangapoua harbour

8.6.2 Farm systems

Farming related land use makes up approximately 30% of the catchment area, with 5.5 % of land used for dairy farming 21.2% sheep and beef, 0.04% orchards and 1.7% lifestyle blocks. Sheep and beef farming and small scale orcharding/lifestyle block farming are the dominant agricultural land uses.

Increased production can mean increased pressures on soils and water. Greater use of fertilisers can lead to nitrogen leaching, and eutrophication of receiving water bodies. Increased stocking rates also add pressure in terms of increased nutrient inputs, and physical impacts on soil structure (e.g. pugging etc). Wet areas (including wetlands, seepages, boggy areas) are also under pressure from drainage, however these areas play an important role in purification of waters as well as absorbing storm waters.

Initiatives such as the Supply Fonterra Programme provide proactive initiatives that support farmers to sustainably manage their farm. Relevantly, the Supply Fonterra Programme requires:

- Annual Farm Dairy and Environmental Assessment
  - Farms are assessed annually to ensure they meet council regulations for example, effluent and water take/discharge requirements.
- Effluent Management
  - Every farm is required to have effluent management practices capable of 365 day compliance with Council regulations.
- Nitrogen Management
  - This programme aims to inform farmers about efficient nitrogen use. It lets farmers know where their farm sits in comparison to others in terms of nitrogen conversion efficiency and nitrogen leaching.
- Waterway Management
  - Including exclusion of stock from farm waterways that permanently contain water and are more than a meter wide and 30cm deep (it should be noted

this is considered a minimum requirement as it fails to provide for seeps and intermittently wet areas which also form part of watercourses).

- Water Use Management
  - Requires all farms to have water measurement capability by 2018/19, including optimising use of dairy wash down waters, irrigation systems designed and operated to minimise water use[14].

DairyNZ provides information, advice, support and training to farmers on a wide range of environmental and dairy related matters. This includes warrant of fitness checks on effluent systems, industry training with NZQA qualifications, advice on efficient use of water, feed management, effluent management, nutrient management, fertiliser management, best practice around waterways and compliance[15].

8.6.3 Plantation forestry

Overall approximately 30% of all land on the Coromandel Peninsula is in commercial pine plantation forest (*Pinus radiata*). Pine plantation forests were established in predominately steep, erosion-prone hill country by the former NZ Forest Service. The Whangapoua forestry activities commenced in 1949 with small scale planting trials in the Opitonui catchment, larger scale planting followed in the 1960s and 1970s when economic returns from pastoral farming were poor and erosion control plantings (both permanent forest cover and plantation planting for harvest) were deemed appropriate land uses by the then Government. The Whangapoua plantation forest (45% of the Whangapoua catchment- refer map 14 Appendix 1) is located on class 6 and 7 land (refer Section 8.4).

Forest harvesting in Whangapoua began in 1992. Within the Whangapoua forest there is currently 7,250 ha producing 120,000 tonnes of logs per year. The remaining areas within the forest are riparian area or permanent indigenous cover. Harvesting involves clear-cutting of the forests on an approximate 25 – 28 year cycle (Wright-Stow 2009).

Plantation forestry has multiple water and soil conservation benefits, until the trees reach maturity and are ready for harvesting. The steep slopes of the catchment are highly susceptible to shallow land-sliding for 6 – 8 years post-harvest until new plantings have established stabilising root systems, with years 2 – 4 being the most vulnerable period. Typically within the Whangapoua forest, only 3% of the total productive area is harvested in any one year, which limits the total area of vulnerability.

Ernslaw One Ltd (which manages the Whangapoua Forest) currently operates under three resource consents (valid until 2027) with a total of 60 consent conditions. These consents are considered by the forestry industry to be the most comprehensive and stringent of any forestry operation in NZ. The resource consents require Ernslaw One Ltd to develop and operate in accordance with an Environmental Management Plan, an Ecological Mitigation Plan and a Riparian Planting Plan. Consent conditions also include: a requirement to replant the winter following harvest. In addition protected riparian corridors are identified on all streams and re-vegetation of exposed soils is required (e.g. roading).

The management of Whangapoua Forest by Ernslaw One Ltd is certified by the Forest Stewardship Council, which is a stringent eco-certification system, via a process of independent third party audits involving, amongst other matters neighbour and stakeholder consultation.

[14] http://www.fonterra.com/nz/en/sustainability+platform/sustainable+dairying/new+zealand/new+zealand
[15] For more information visit http://www.dairynz.co.nz/environment/

View of coastline Otama Peninsula to Whangapoua from Ernslaw forest

The company has agreements in place with DOC for predator control over 1,500ha of brown kiwi habitat within its forest and partners with Project Kiwi Trust to implement these works. .

The potential impacts of forestry operations have been monitored over time and from 1992 until 2013, a series of annual monitoring and reporting has been undertaken on the effects of forestry activities on stream water clarity, temperature, stream habitat and biota (refer also to Appendix 5).

8.7 Public conservation land

Public conservation land, administered by the DOC makes up 16.49% of the Whangapoua HCMP area (refer map 14 in appendix 1). DOC is the central government agency responsible for the conservation of New Zealand's natural and historic heritage. Its key legislative mandate is determined the Conservation Act 1987, as well as other key statutes such as the National Parks Act 1980 and Reserves Act 1977.

DOC's key functions as set out in the Conservation Act are to:

- Manage land and other natural and historic resources
- Preserve as far as practicable all indigenous freshwater fisheries, protect recreational fisheries and freshwater habitats
- Advocate conservation of natural and historic resources
- Promote the benefits of conservation (including Antarctica and internationally) and to provide conservation information
- Foster recreation and allow tourism, to the extent that use is not inconsistent with the conservation of any natural or historic resource.

DOC has particular responsibility under Section 4 of the Conservation Act to interpret and administer the Act and to give effect to the principles of the Treaty of Waitangi. This involves building and supporting effective conservation partnerships with tangata whenua at a local level.

DOC also contributes to the conservation and sustainable management of natural and historic heritage in areas for which it is not directly responsible. Conservation management and the work of DOC are heavily reliant on a high level of public input and participation. Conservation is based on societal support, and on the concept that land is the common heritage of all New Zealanders.

Public conservation land within the catchment varies considerably in land cover from the steep upper catchments which form the backbone of the Peninsula; the Coromandel State Forest Park and Whangapoua Forest Conservation Area, through to coastal forest fragments, such as the Matarangi Bluff Scenic Reserve. It includes wetland remnants, such the Otama dune and wetland complex and reserves created for their historic importance, such as the Opera Point Historic Reserve. Within and adjacent to the harbour is the Matarangi Wildlife Habitat Reserve and the Opitonui River Mouth Wildlife Management Reserve, protected for their wildlife values (refer also to Chapter 11 Biodiversity).

Public conservation land plays a significant role in protecting headwaters and lowland forest biodiversity. However the value of these ecosystems services is reduced by the impacts from browsers and predators. (Refer also to section 10.5 and Appendix 6).

8.8 District council reserve's

There are a number of reserves within the HCMP area which are administered by TCDC; these include reserves classified as recreation reserves, scenic reserves, historic reserves and local purpose- esplanade reserves. These reserves are managed in accordance with their reserve classification; this includes protection of historic, ecological and scenic values, maintenance of open space and access.

These reserves provide important functions including public amenity areas, access to and along the coast, boat/kayak launching facilities, erosion protection/buffering (dunes), open space for community events and sporting activities, protection of historic heritage (e.g. pa sites) and habitat for shorebirds (TCDC.2007).

Matarangi Wildlife Management Reserve from Maupariki Stream

9 Water

9.1 Overview

This chapter provides an overview of the water resources in the catchment. The catchment has numerous rivers and streams flowing from the hills to the harbour or open coast. These waterways, combined with the high level of rainfall and steepness of the catchment headwaters have contributed over time to the development of the flood plains as described in Chapter 8 Land.

Under climate change scenarios for the area, there is likely to be an increase in flood and drought events and extreme winds, with subsequent requirements to respond to these events, through changes in environmental and land management practices.

In terms of water quantity, while there are resource consent limits set in the Waikato Regional Plan, there are currently no pressures within the catchment for takes from surface waters or from ground waters.

With respect to water quality, while the Council does not undertake any regular monitoring, some one-off studies have identified degradation in some streams. The water quality of the harbour was tested for comparison with other parts of the Waikato region, and showed that rainfall had a strong effect on water quality, but that there was also rapid dilution through natural flushing of the harbour. However, the effect on water quality from the waste water treatment plant (WWTP) at Matarangi was a concern to many people within the catchment.

The key management issues for water include:

- Recognising the link between land management and water quality, and the land management relationship between accelerated erosion and water turbidity and sediment loadings (refer also to Chapter 8)
- Addressing the issues that contribute to degraded water quality, and ensuring the discharges to the harbour (such as from the WWTP) are managed carefully
- Acknowledging that with climate change, there will be a need to manage for increased frequency and scale of flood events, drought events and an increase in extreme winds, in the future.

9.2 Rivers, climate and rainfall

The main rivers and streams which all source from the steeper slopes of the catchment, and traverse the flood plain before reaching the harbour or open coast, include the Pungapunga, Waitekuri, Waingaro, Opitonui, Owera, Otanguru, Mapauriki, Pitoone, Kuaotunu and Otama. Several tributary streams and smaller streams also make up the catchment (refer Map 1). In general the streams and rivers in this catchment build low flat flood deltas which tend to have quite extensive tidal reaches (Carter, 1991).

The climate, although temperate, is known for its frequent, high-intensity, localised storms, often of tropical origin. Such high-intensity rainfall events in the past have frequently centred on the main range, including parts of the Whangapoua Forest, and have often resulted in severe flooding and erosion.

The Council has a rainfall gauge for the Matawai Basin at Castle Rock which has recorded rainfall since 1991. The minimum annual rainfall recorded since this time was 1,499.5 mm (in 1993) and maximum recorded was 3,045.5 mm (in 2011) with the mean being 2,289 mm. This demonstrates the high level of rainfall in the area when compared to the NZ average of 600 – 1600 mm per annum.

With respect to climate change scenarios, Wang et al., 2014 have predicted an increase in precipitation of up to 4.6% for the northern parts of the Coromandel Peninsula by 2070, with less spring rains (2.7% decrease). There is also likely to be an increase in extreme daily precipitation changes, with associated increases in peak stream flow changes.

In addition, it is predicted that there will be more widespread drought-related stress on agricultural production systems and ecosystems. The growing season is expected to lengthen, which is beneficial for primary production and may enable new crops to be cultivated, however it will also impact on native species and biosecurity issues.

The Coromandel Peninsula is also identified as a “hot spot” for intense storms and extreme wind events.

Adaptation actions for future resilience will therefore need to focus on addressing both increased flood and drought potential, along with extreme wind.

9.3 Flood hazard

As outlined in Chapter 8 Land, significant areas of the catchment are relatively steep with high run-off, and as a consequence, ‘flash’ floods are commonly anticipated. The flood hazard is likely to be exacerbated by the effects of increased intense storms arising from climate change.

In terms of managing flood hazards, the rivers that form from the Whangapoua and Opito catchments and exit into the harbour or open coast are essentially natural and are not significantly managed to reduce flooding (e.g. there has been limited hazard protection works, realignment of stream beds/banks).

However, changes to the catchment hydrology, arising from human development and activities, are likely to impact on the dynamics of floods. Changes in catchment land use and management (i.e. farming, forestry, riparian vegetation, housing development) can alter the flood hydrograph to increase or reduce peak flood levels. (Refer also to Sections 8.4 - slope and erosion risk and 8.5 - agriculture and forestry.)

Opitonui River in flood (2000) prior to channel maintenance works

9.4 Water quantity

In order to manage the allocation and use of freshwater, the Council changed the policies and rules in the Waikato Regional Plan (Variation 6) in 2012. For surface water features it sets out water allocation limits for each catchment in the region, to ensure that a range of needs are met i.e. a healthy in stream environment as well as for people's uses. In the Whangapoua catchment allocation limits are set as percentages of the Q_5 flow (i.e. one in 5 year 7-day low flow). For upland catchments (i.e. areas above 20m amsl[16]) the minimum flow is set at 95% and for lowland catchment (i.e. below 20m amsl) the flow is set at a minimum of 90%.

In some instances there will also be the ability to "harvest" water during times of high stream flow and store it for future use. While there are some surface water takes that are permitted activities, for other water takes the ability to gain resource consent to take surface water in most instances is reliant on the stream/river not being fully or over-allocated, and is assessed on a river/stream-specific basis.

Allocation limits for groundwater, called sustainable yields, are not yet in place and will be set in future amendments to the Waikato Regional Plan. The ability to gain resource consent to take groundwater is reliant on a number of factors including whether the take will impact on surface water, other users or if it is considered sustainable for the aquifer. As shown in Table 9, the Regional Plan includes the following management levels for aquifers.

Table 9 Aquifer management levels in Whangapoua catchment
(taken from Table 3-6 Waikato Regional Plan)

Aquifer	Management level m^3(x1000) per year	Aquifer Map #
Kuaotunu West	80	1
Matarangi	1400	1
Whangapoua	180	1

In accordance with variation 6 of the Waikato Regional Plan, the Council is working with farmers to assess resource consent requirements for dairy shed water takes and plan to be finished this exercise by the end of 2015.

TCDC takes water from the Opitonui River (35 litres per second (l/s) for water supply to the Matarangi Beach township. It provides for a minimum flow of 150l/s to ensure sufficient flow for fish migration through the 30m section of the stream between the water take and the Awaroa confluence (Wilding, 2006).

9.5 Water quality

9.5.1 Catchment overview

Overall the quality of water in the Whangapoua catchment is high, and allows us to use and connect with it to meet both the needs of individual and communities as well as the needs of the environment (such as for fish). Our coastal waters are well-flushed and streams are generally of a swimmable standard. However, we need to be careful about what we put into our coastal and fresh water systems if we hope to continue to enjoy them the way we currently do.

In the Waikato region, coastal water is subjected to less pressure from contaminants than our fresh water systems. Coastal water is also better at coping with contaminants with most contaminants quickly diluted and dispersed by tidal flushing and waves.

[16] Amsl- Above mean sea level

Waves also constantly mix oxygen into open coastal waters, so the effects of any oxygen-depleting contaminants are not as severe as in a small stream.

The exception is in estuaries and harbours where the coastal water is enclosed and there is less tidal flushing and wave action. This contamination has in places resulted in estuarine areas becoming unsuitable for shellfish gathering.

9.5.1.1 Issues affecting water quality

Run-off from land greatly affects water quality. Sediments from natural forest slips, plantation forestry activities, roading and infrastructure, stock in and around waterways and stream bank erosion are the main contributors to the sediment in streams and the Whangapoua Harbour resulting in increases in turbidity and nutrient levels, increases in water temperature, and increases in bed levels. (Refer also to Chapter 8.4.5 accelerated erosion).

Run-off from the land flowing into rivers and catchments is the main source of contaminants flowing into our coastal water. Storm water discharges, spills, rubbish and sewage from boats, also contribute to water contamination.

Contaminants that cause the greatest concern and are triggers for declining water quality include:

- Bacteria
- Sediment
- Nutrients mainly nitrogen (N) and phosphorus (P)
- Heavy metals and chemicals.

Beadel, (2014) and Graham (2013) identified fencing and exclusion of stock from harbour margins as one of the highest priorities for the health of the harbour. Stock exclusion from wetlands, riparian margins, coastal habitats, minimises bank erosion, urine and faeces inputs, vegetation removal including damaging/ destroying whitebait spawning habitat, the spread of weeds and potential for increased sediment run-off into the harbour.

9.5.2 Water quality monitoring

While the Council does not currently undertake any regular water quality monitoring of streams within the catchment or harbour, the Council does undertake some one-off monitoring projects. For example, in February 2013 the Kuaotunu Stream was sampled at several locations, following community concern around observations of fish die-off. Sites sampled included the Booker Bridge, the stream mouth at the Kuaotunu township footbridge, at the State Highway bridge in Kuaotunu and State Highway bridge at the Waitaia Stream. Samples taken were tested for both human health *escherichia coli* (ecoli) and ecological health indicators (e.g. enterroccci). In two samples faecal coliforms and ecoli were found at levels that exceeded the recommended level for contact recreation. It is thought the fish may have perished due to elevated summer water temperatures and oxygen depletion in the Kuaotunu lagoon (Bill Vant pers com).

During the summer of 2014-2015 the Council undertook a water testing program around a number of Coromandel beaches. The Council collected weekly water samples from river and stream mouths at popular swimming locations and locations of interest around the Coromandel. This included four sites in this catchment, Stewart Stream (Opito), Otama Stream, Kuaotunu River and Pitoone Stream.

To investigate each stream's water quality the Council tested a range of water quality properties including water clarity (turbidity and suspended solids), oxygen saturation, nutrient concentration (nitrogen and phosphorous) and faecal coliforms (E.coli and enterococci) as indicators of pathogens.

While the final results are not as yet available, if high presence of faecal contaminants occurs, samples will be sent to the Cawthron Institute where a DNA marker process will be used to identify whether the source of the contamination is human, bovine or otherwise (sheep, pig, possum etc). This will then enable specific management actions to be devised in conjunction with TCDC and the District Health Board.

TCDC undertake regular monitoring of the Mapauriki Stream (which flows into Whangapoua Harbour), as part of resource consent conditions for the Matarangi WWTP. This includes monitoring of numerous water quality variables both up and downstream of the WWTP discharge point. This monitoring shows that in stream contaminants greatly vary and are strongly influenced by rainfall events.

9.5.3 Groundwater

Groundwater quality is influenced by the depth of the aquifer, the permeability of the land cover, land use activities (including leakage from septic tanks) and the source of the ground water. The Council does not monitor water quality from private groundwater bores – that is the responsibility of the owner. However, the Council does from time to time undertake surveys to detect potential aquifer contamination. For example, Hadfield (1997) reported on the groundwater quality at the settlement of

Whangapoua. The shallow sand aquifer at Whangapoua is the source of potable water for many private household supplies, but it is also vulnerable to contamination due to the shallow water table (2 – 6m) and poorly protective soil cover. Where contamination is detected, the results from such studies are forwarded to property owners, TCDC and the District Health Board.

9.5.3.1 Coastal groundwater

Groundwater quality in coastal areas is also at risk of getting mixed with seawater. This can happen when unusually high demand of fresh groundwater favours the entry of seawater into the sandy soil. Currently, within the Whangapoua catchment freshwater demand is estimated as being less than the freshwater aquifer recharge (meaning more fresh water in the system that is being extracted) as there has not been any indication of saltwater intrusion.

Whangapoua Harbour

9.5.4 Whangapoua Harbour water quality

With respect to water quality in the harbour, four sites were sampled for a number of water quality parameters, including turbidity, on nine occasions between July 2006 and May 2007 (for the purposes of collecting data for the Council's Estuarine Water Quality Indicator) (see next page). During routine sampling turbidity ranged between 0.5 and 3.7 NTU (turbidity measurement scale) this placed it in the "excellent" or "satisfactory" categories based on the indicator criteria. When samples were taken after high rainfall turbidity was increased to over 80 NTU at some sites (i.e. well into the "unsatisfactory" category). After heavy rainfall elevated faecal bacteria levels can occur due to rainfall washing faecal bacteria from land. This bacteria most likely comes from a variety of sources such as people, farms animals and wild animals (e.g. pigs, possums, birds). However the flushing ability of the harbour results in rapid dilution (Bill Vant pers comment).

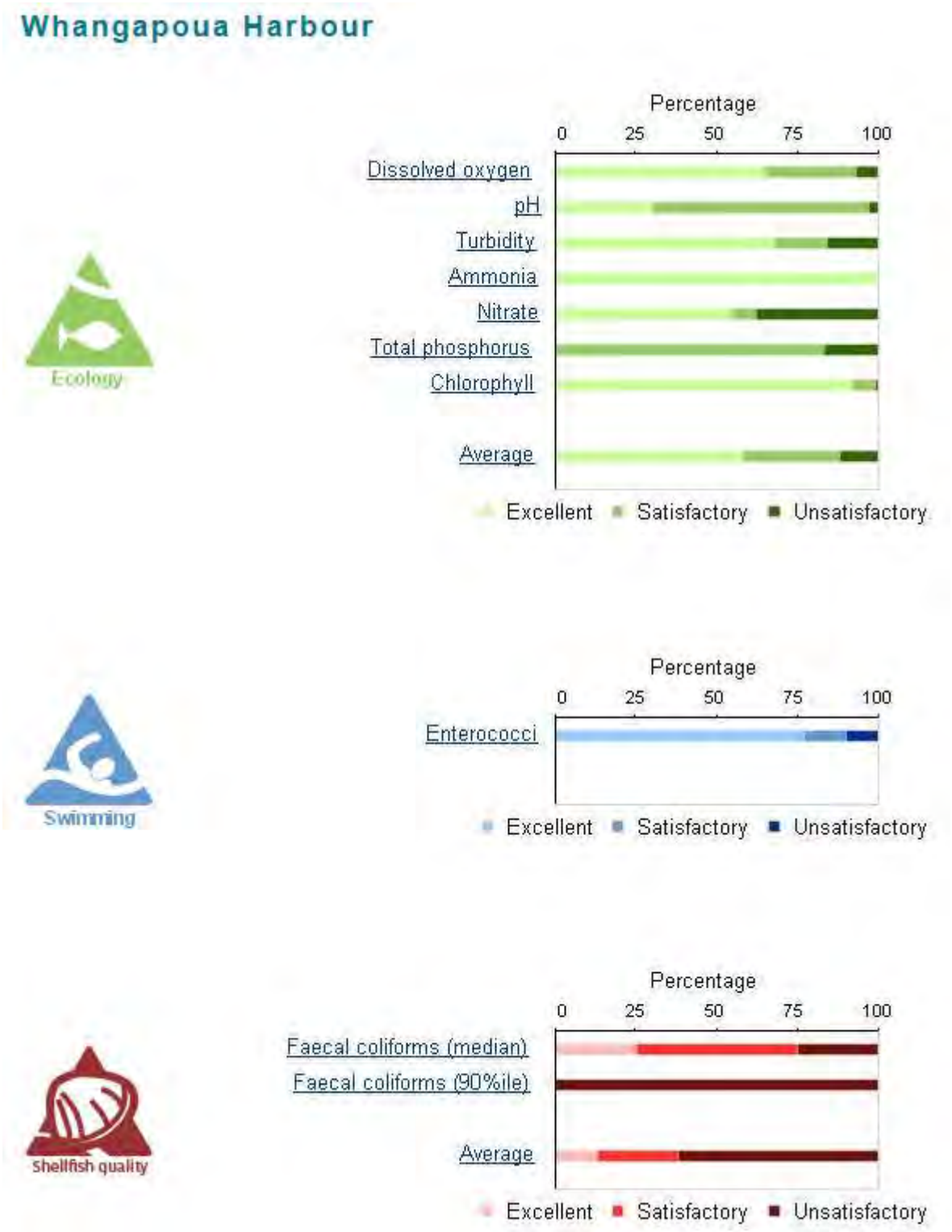


Figure 4 Whangapoua harbour estuarine water quality indicator

More information on this one off study can be found at
http://www.waikatoregion.govt.nz/Environment/Natural-resources/coast/How-healthy-are-our-estuaries/Estuarine-water-quality-monitoring-map/Whangapoua-harbour/

9.5.5 Waste water

On-site waste water systems (septic tanks) are used extensively by private property owners within the catchment. On-site waste water systems can pose a risk to the environment and public health where they are not designed, operated or maintained properly. TCDC manages on-site waste water systems primarily through building consents. While the Ministry for the Environment was considering a "warrant of fitness" type approach for on-going maintenance, this has not eventuated and maintenance remains the responsibility of the land owner.

The Council carried out a region-wide On-site Wastewater Risk Assessment (Beca, 2010). This risk assessment used modelling based on six key influencing risk factors - system age, soil type, lot size, depth to high ground water table, aquifer conductivity and proximity to surface water. Kuaotunu's risk assessment was mapped as an example community and this identified properties with varying levels of potential risk. This modelling information could be used in catchments to identify potential problem areas (e.g. system failure and effluent running off into waterways); or to determine the minimum area required for future on-site systems, or to signal where areas are low-lying and where system upgrades or other works may be required.

This work was followed up with on-site visits to improve correlation with the model. The Council is now carrying out further work in this area to assist in informing the up-coming review of the Regional Plan and Regional Coastal Plan.

Matarangi is the only settlement in the catchment with a public reticulated wastewater treatment plant (parts of Kuaotunu and Whangapoua have small private schemes). There are community and iwi concerns over the potential environmental impacts of the Matarangi WWTP system, particularly discharge quality during the peak summer season. The TCDC managed WWTP is a three pond system with initial screening of gross solids. The treated waste water flows through a sand filter, swales and drains into the Maupariki Stream. An interim consent has been granted for the WWTP operation whilst a number of further investigations are undertaken, this includes:

- Further assessment of the biological effects of the wastewater discharge on the Maupariki Stream, Whangapoua Harbour and Matarangi Wildlife Habitat Reserve
- An assessment of the WWTP discharge on the water quality of the Maupariki Stream
- Preparation of a report summarising faecal coliform and enterococci data and the potential risk posed by the discharge to human health in terms of contact recreation and shellfish gathering
- Investigation into potential seepage from WWTP ponds.

In the meantime, the consent sets upper limits for discharge water quality variables including for nutrients and faecal coliform inputs. TCDC undertakes weekly monitoring during January and February, and monthly for the remaining months.

10 Harbour and coast

10.1 Overview

This chapter provides an overview of the harbour and coast resources. There are some 54kms of coastal margin within the HCMP area, this includes New Chums Beach (Wainuiototo Beach), Matarangi Beach, Rings Beach, Grays Beach, Kuaotunu Beach, Otama Beach, Opito Bay, and approximately 34km of inner harbour and estuarine margins. Whangapoua Harbour is a relatively shallow tidal lagoon with a shifting sand bar at its mouth, it covers approximately 13 km^2 of which 80% are intertidal flats. In 1990 DOC identified Whangapoua Harbour as the best and largest estuarine system within the Colville Ecological District.[17]

Dune systems and coastal vegetation are dominant features of the coastline and play an important role in protecting the land and private property from coastal erosion. Active and relict chenier (shell) ridges are also a feature of the harbour. Abutting the coast line in some areas are reserves owned and managed by TCDC and DOC. These reserves include a significant natural dune system at Otama and modified dune systems at Kuaotunu, Grays Beach, Rings Beach, Opito, Whangapoua and Matarangi. There is also a significant wetland area at the Matarangi Wildlife Habitat Reserve.

The key issues facing the management of the coast and harbour include:

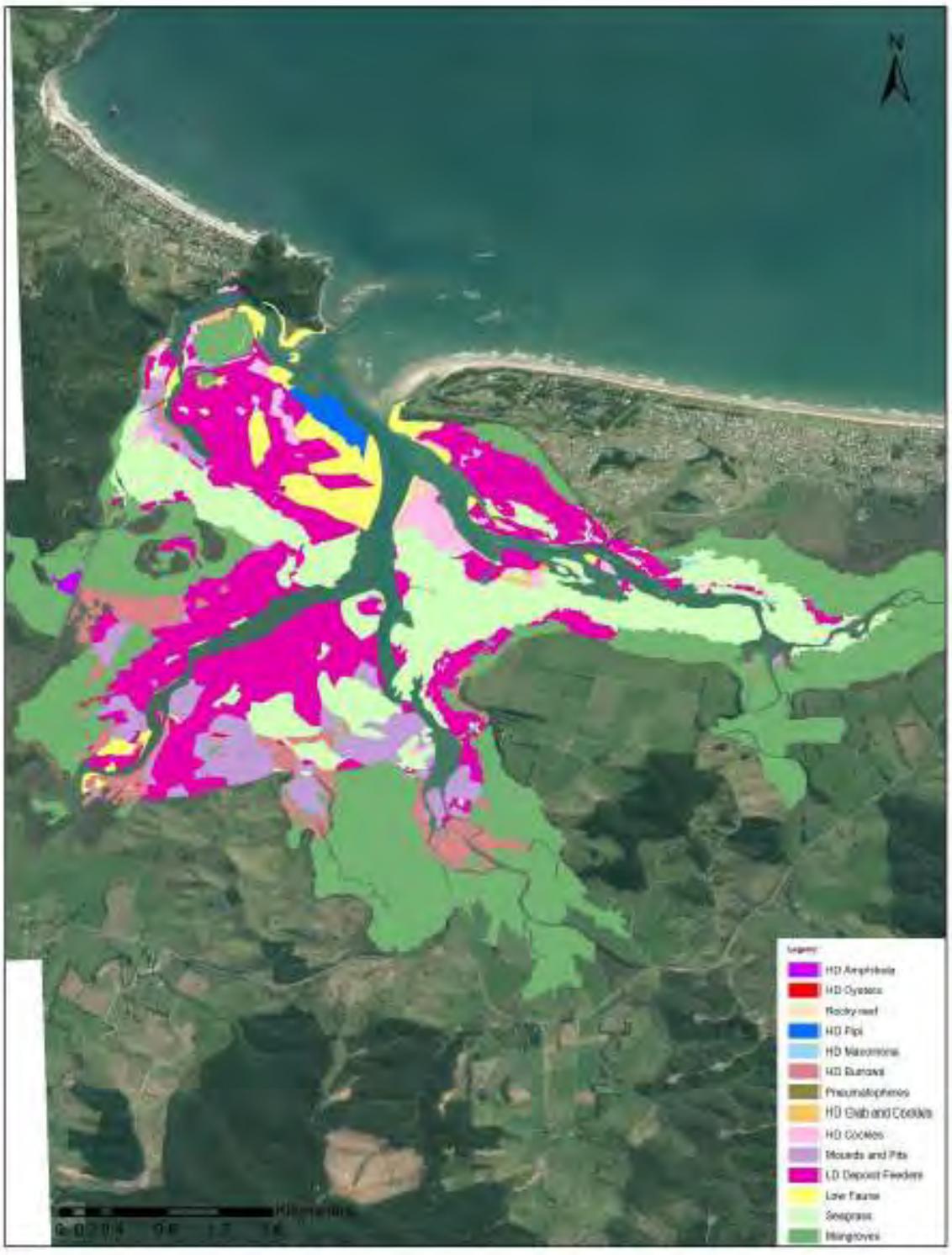
- The impact of elevated sediment inflows into the harbour, while recognising that this is also a natural process in the overall life of a harbour
- Coastal vegetation changes including the spread of saltwater paspalum and mangroves
- The need to protect and restore coastal ecosystems, such as native saltmarsh areas, fish populations, shellfish beds, shorebird areas, dunes and vegetation
- People wish to protect the high recreation and natural values of the coast and harbour
- The need to recognise the inter-linkages between land, water, biodiversity and coastal issues, along with the high recreation and natural values held by people (Refer also to Land, Water, Biodiversity and Coastal chapters).

Otama Beach from dune (photo taken by Simon Hoyle)

[17] An ecological district is defined as a particular geographical area that has closely related characteristic landscape and range of biological communities.

10.2 Harbour benthic habitats

Whangapoua Harbour contains a range of different benthic[18] habitat types including several dense cockle beds and a pipi bed near the harbour mouth, a small area with high densities of wedge shells south of the Matarangi airport, a small patch with high densities of oysters just west of the oyster farm, and a relatively small area with high densities of mud snails (*Amphibola crenata*) on the western side of the harbour (Needham et al. 2014) (refer Map 2).



Map 2 Whangapoua harbour benthic habitat map

Benthic communities in the Whangapoua Harbour are adversely affected by sediment inputs from erosion in the catchment caused by natural processes (e.g. rainfall,

[18] Benthic- The bottom of a body of water

storms), human activities (e.g. forestry, coastal development), habitat change (e.g. expansion mangroves and estuarine weeds), and excessive harvesting of shellfish (e.g. cockles and pipis). Loss of benthic habitats will also result in the loss of the ecosystem functions they provide as outlined in Table 10 and impact on the habitat structure and food for other ecological groups such as fish and birds.

Table 10 Intertidal habitat types and their links to ecosystem goods and services (Needham et al. 2013)

Habitat type	Ecosystem goods and services
Seagrass	Primary production, habitat structure, sediment stability and retention.
Mangroves	Primary production, carbon sequestration, gas and climate regulation, disturbance prevention, sediment stability and retention, habitat structure and coastal defence.
Pneumatophores	Nutrient cycling, sediment stability.
High density cockle or pipi beds	Secondary productivity, cultural harvesting, waste treatment[19], processing and storage, carbon sequestration.
Low density deposit feeders	Secondary productivity, cultural harvesting, waste treatment, processing and storage, carbon sequestration, sediment stability, nutrient cycling.
Mud snails (*Amphibola*)	Cultural harvesting.
Oysters	Biogenic habitat provision, cultural harvesting, waste treatment (filter feeders), sediment stability and retention.
High density wedge shells	Sediment stability.
High density crustacean burrows	Sediment stability and reworking rates, waste treatment (filter feeders), processing and storage, nutrient cycling, secondary productivity, habitat structure.
Mounds and pits	Secondary productivity, nutrient cycling, sediment stability habitat structure.
Low fauna	Sediment stability.

10.2.1 Cockle and pipi beds

Two cockle beds on the eastern side and one cockle bed and the pipi bed on the western side of the harbour were sampled in 2005, 2010 and 2015 as part of the northern shellfish surveys carried out by the Ministry for Primary Industries. A comparison of cockle densities within these beds between 2005 and 2010 found no evidence of a change in the cockle population.

However, the median cockle size in 2010 was 6 mm smaller than in 2005, and there was strong evidence of a decrease in the number of harvestable cockles (at least 30 mm) since 2005 (Pawley 2012).

The total abundance of pipis and the number and proportion of harvestable pipis (at least 50 mm) decreased between 2005 and 2010, and the median pipi size in 2010 was 3 mm smaller than in 2005 (Pawley 2012). These beds were sampled again in February 2015 (Berkenbusch personal comment).

[19] Waste treatment in this context refers to the filter feeding properties of shellfish

Table 11 Results of shellfish (cockles and pipis) surveys in Whangapoua Harbour (Source: Pawley 2012)

Cockles	**2005**	**2010**
Population estimate in sampled area (millions)	34.3	31.8
Average density (number per m^2)	685.5	610.5
Median size (mm)	26	20
Typical size range (mm)	23-29	16-24
Density harvestable size (number per m^2)	156.8	53.9
Proportion of harvestable size (% of total population)	23.7	8.8
Pipis	**2005**	**2010**
Population estimate in sampled area (millions)	6.2	2.7
Average density (number per m^2)	119.1	52.2
Median size (mm)	48	45
Typical size range (mm)	41-54	37-54
Density harvestable size (number per m^2)	54.3 (45.7%	22.5
Proportion of harvestable size (% of total population)	45.7	43.1

10.2.2 Other benthic communities

A long term monitoring programme to assess the effects of forestry activities in the harbour carried out between 1993 and 2006 identified gradual trends in abundance of 22 benthic taxa (Halliday et al. 2006). Most trends were consistent with increased sediment loading, but the observed changes were not sufficient to drastically alter macrofaunal communities (Halliday et al. 2006). However, at one site in the Orewa arm of the Harbour a long-term habitat change was observed from a soft-surfaced seagrass flat to unvegetated firm sand flat after a storm in March 1995 covered this site in mud (Halliday et al. 2006).

10.3 Open coast benthic habitats

The open coastline of the Whangapoua catchment consists of an alternation of sandy beaches and rocky reefs. Sub-tidal marine habitats mainly consist of coarse sands (to the north) and muddy sands to the west as shown below.

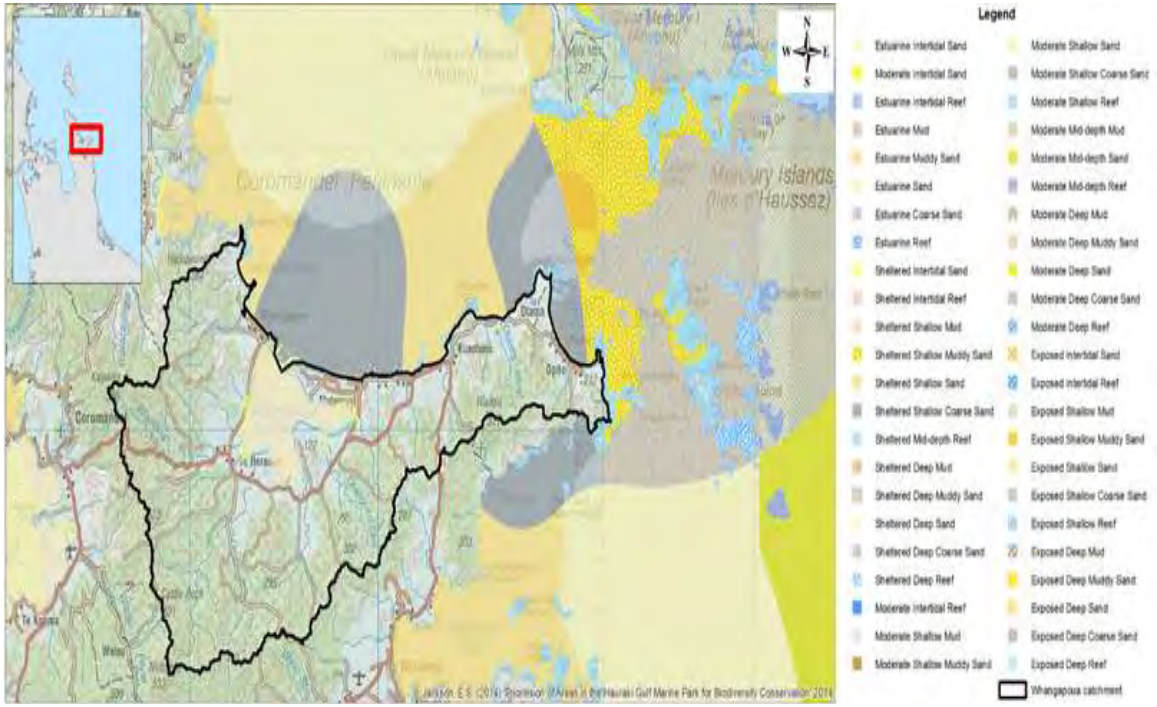


Figure 5 Estuarine and marine habitats defined according to the Marine Protected Areas Policy guidelines (www.seasketch.org; MetOceans Solutions Ltd. 2013; Jackson 2014; MFish & Doc 2008).

The offshore marine environment north and west of the Whangapoua catchment are important scallop fishing grounds both for commercial and recreational fishermen (Refer figure 6)[20]. By-catch data collected during a scallop survey in 2012 (Williams 2013) presented in the 2014 State of Our Gulf report (Hauraki Gulf Forum 2014) shows that horse mussels and dog cockles are also found in these areas (refer figure 7).

- Scallops, horse mussels and dog cockles are known as biogenic habitats with important values for biodiversity and fisheries (e.g. Morrison et al. 2014 and references therein).
- Horse mussel beds often support diverse species assemblages of sponges, macro-algae, bryozoans, filter feeding bivalves, and soft corals, and mobile species such as sea cucumbers, hermit crabs, and small benthic fishes depending on environmental setting (e.g. Hay 1990b; Ellis et al. 2002; Usmar 2010 in Morrison et al. 2014).
- Northern New Zealand horse mussel beds also provide a nursery function for juvenile snapper and trevally, as well as supporting other small fishes such as triplefins (e.g. Morrison & Carbines 2006; Jones et al. 2010; Usmar 2010; Lowe 2013 in Morrison et al. 2014).
- Infaunal bivalves such as dog cockles may provide various functions including bentho-pelagic coupling, nutrient transfer, phytoplankton abundance regulation, carbon sequestration, and food provision.
- Dewas & O'Shea (2011) quantified dog cockle shell beds ("large post-mortem deposits") around Otara Island (Noises Islands, inner Hauraki Gulf), as well as shell grit and rock gravel. Invertebrate diversities and densities were consistently higher in the dead shell beds over time.

The main pressures on scallop beds are from commercial fishing and recreational take. Additionally, scallops have been shown to be sensitive to suspended sediment concentrations under laboratory conditions (Morrison et al. 2009 and references therein). For example, recent work by Nicholls et al. (2003) found that scallops were able to feed at high levels of suspended sediments over short time intervals (one week), but that their condition was adversely affected by high concentrations over longer time periods. Sediment concentrations over 100 mg per litre were correlated with increasing variability in clearance rates, suggesting adverse effects on scallops' abilities to process the suspended particles (Nicholls et al. 2003).

[20] Commercial scallop fishing restrictions are in place in Opito Bay, Otama Bay and Kennedy Bay.

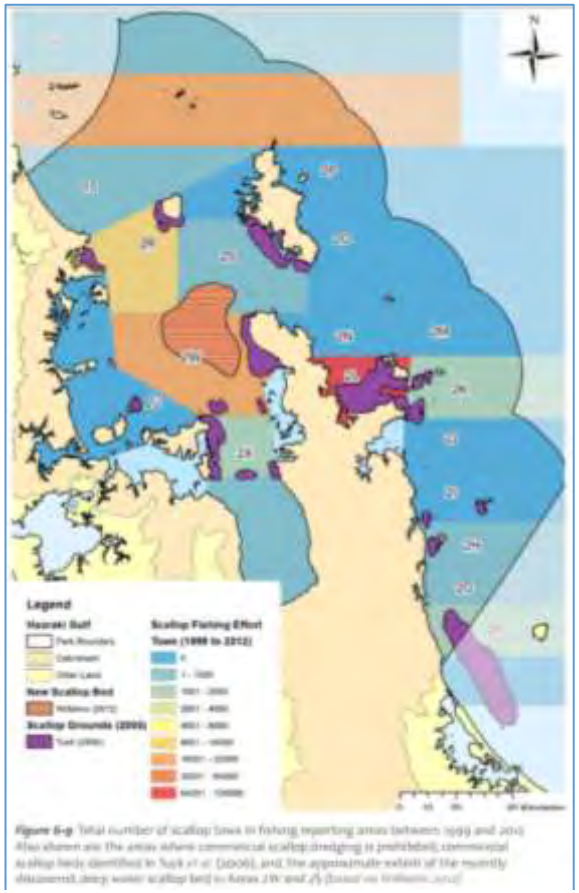


Figure 6 **Commercial scallop beds and number of scallop tows between 1999 and 2012 (Hauraki Gulf Forum 2014)**

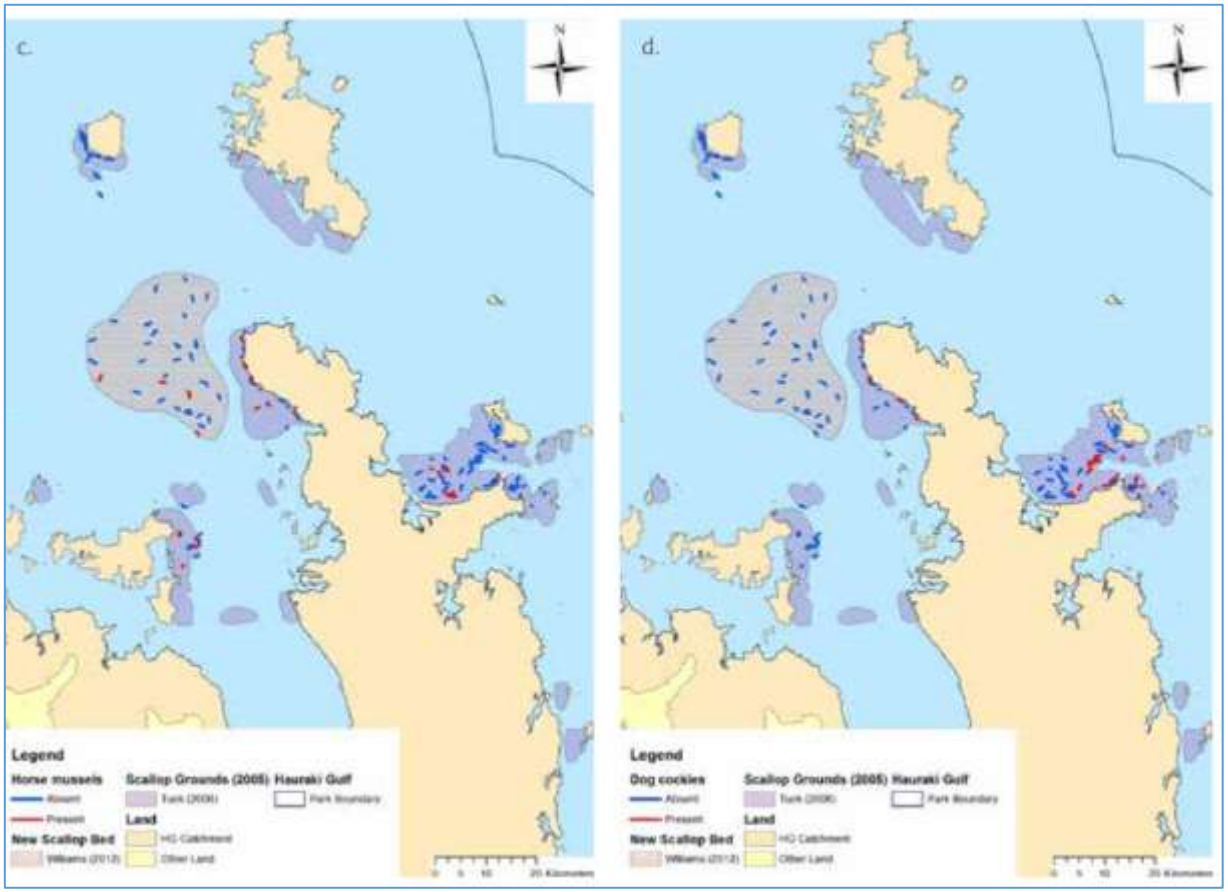


Figure 7 **The presence/absence of horse mussels (left) and dog cockles (right) obtained during scallop surveys in the Hauraki Gulf (Hauraki Gulf Forum 2014; original data from Williams 2013).**

10.4 Estuarine vegetation

10.4.1 General Comments

Whangapoua Harbour has a wide variety of estuarine vegetation, which is greatly enhanced by the presence of chenier ridges (Graeme, 2013).

Map 15 shows the spatial cover of mangroves, seagrass, saltmarsh and estuarine weeds in Whangapoua Harbour in 2012.

Beadel (2014) undertook an assessment of 32 sites within the harbour to identify key habitats and species present. This report noted that the harbour and adjacent natural areas provide suitable habitat for at least two “At Risk” indigenous plant species, one “Threatened” lichen species, and ten “Threatened or At Risk” indigenous fauna species (eight birds, one frog, and one reptile) (refer Appendix 4).

Graeme (2013) identified that estuarine vegetation was under threat from:

- High levels of sediment from catchments.
- Stock access to the Coastal Marine Area. This issue was considered to be a serious problem around the harbour, and the damage caused to the coastal edge was reported to be the most extensive seen in all the harbour surveys in the Waikato Region (refer also to Chapter 8 Land).
- The presence and expansion of coastal edge weeds including pampas, wilding pine and exotic grasses such as kikuyu, buffalo grass and mercer grass. Other weeds such as phoenix palm, cypress and gorse and woolly nightshade were observed at the tidal edge.
- The presence of marine pest plants, including saltwater paspalum and spartina.

Impacts on estuarine vegetation types can also have consequential effects (positive and negative) on other ecological groups such as benthic communities, fish and birds. For example, the habitat change in the Orewa arm of the harbour from a soft-surfaced seagrass flat to an unvegetated firm sand flat (as a result of a storm in 1995) decreased the area covered by seagrass and possibly the number of juvenile snapper that have reported to be associated with seagrass beds (Morrison et al. 2014), but

increased the abundance of cockles in that area (Halliday et al. 2006) which are used as a food source by birds such as South Island pied oystercatchers and the variable oystercatchers. Likewise the expansion of mangroves provides additional habitat for short-finned eels and juvenile mullets and birds foraging (e.g. banded rail), but decreases the area of open sand flats with associated change in benthic communities.

10.4.2 Seagrass

Within the Whangapoua Harbour large intertidal areas are covered by the native seagrass (*Zostera* spp.) and in 2010 small areas of subtidal seagrass were also present, particularly in the Mapauriki arm of the harbour (Graeme, 2013). Between 1945 and 1995 the total area of intertidal seagrass decreased from 32.53% to 13.6%[21], but slightly increased from 1995 to 2006 to 15.24% (Halliday et al. 2006). Comparing the distribution of seagrass in the harbour between 2006 (Halliday et al. 2006) and 2013 (Needham et al. 2014) shows very little change in seagrass cover[22].

Changes in the cover of intertidal seagrass, at the nine different sites included in the monitoring programme to assess impacts of forestry activities within the catchment, are described in Halliday et al. 2006 (refer Appendix 4). In particular it is noted that:

- No seagrass has been observed at sites 1 and 3 (refer Appendix 4)
- Site 2 contained small, sparsely vegetated patches of seagrass at the start of the monitoring programme (in 1993), but disappeared from this site after April 1996
- Sites 4 and 5 originally lay within a large dense meadow, but completely disappeared from site 4 and largely disappeared from site 5 as a result of deposition of sediment after the storm in March 1995 - some recovery was noted at site 5 in 1999
- At sites 6, 7 and 9 no consistent trends in the seagrass cover were observed.

[21] An area of dense seagrass disappeared from a site in the Orewa arm of the harbour after a storm in March 1995 covered this site in mud (Halliday et al. 2006).
[22] It should be noted that different methods were used to map the distribution of seagrass in 2006 and 2013.

10.4.3 Mangroves

Mangroves are commonly found along muddy coasts and in estuaries of the Coromandel Peninsula and have been in NZ for around 19 million years. Mangroves (*Avicennia marina)* are a native species to NZ and are part of the natural character of northern NZ estuaries. There is considerable variation in their productivity, their role in the local food webs, the diversity of plants and animals they support, and their response to changing conditions in their estuaries (Auckland Regional Council, undated). They support a range of fish (mangroves are known to be used by short-finned eels and grey mullets (e.g. Morrisey et al. 2007) and birds and have the capacity to mitigate the effects of coastal erosion and flooding.

Mangroves are sensitive to changes in climate, bed levels and sea level. Elevated sedimentation and the associated infilling of estuaries is expanding the habitat available for mangroves. In addition, a reduction in frosts has resulted in mangroves being able to colonise suitable open areas and survive through winter (i.e., in the past juvenile mangroves settling away from the shelter of other mangroves were generally killed by frosts, thereby controlling the seaward extension of the mangroves). It is unclear how mangroves will respond to sea level rise, but it is likely that all the vegetation zones will move inland.

Scharwz (2002) investigated the role of nutrients on mangrove expansion, with one of the case studies being Whangapoua Harbour. While the research suggested that nutrients may be important in influencing rates of growth and therefore potentially spread, there was no conclusive evidence that nutrients were the main driving factor for increased spread. Growth limiting factors for mangroves include tidal level, salinity, temperature, sediments and nutrients.

NIWA research on mangroves since 2007 has been investigating the role of mangroves on estuaries. A key finding of this work to date is that *"mangrove forests do not increase sedimentation rates in estuaries over a timescale of years to decades. It would appear, therefore, that mangroves are opportunistic colonisers of intertidal flats, and do not strongly influence the geomorphic evolution of estuaries*."[23]

The total area covered by mangroves remained relatively static at 12% between 1945 and 1978, but increased since then to 27.5% in 2006 (Halliday et al. 2006). In 2010 mangroves occurred around the whole harbour and dominated the more sheltered upper harbour arms (Mapauriki and Owera) (Graeme, 2013). An area of mangrove expansion was identified in the shelter of the islands beside the Whangapoua causeway road (Graeme, 2013). Comparing the distribution of mangroves in the harbour between 2006 (Halliday et al., 2006) and 2013 (Needham et al., 2014) shows a further expansion of mangroves especially on the western side of the harbour[2] (refer to Appendix 4).

Mangrove proliferation within the harbour was a relatively common concern raised during community consultation, in particular in relation to access, view shafts and impact on hydraulic function. However, there was also feedback that mangroves are a natural transition species and a valued natural habitat providing benefit for erosion control, bird habitat, fish spawning and recreational enjoyment (kayaking among mangroves).

[23] Refer: http://www.niwa.co.nz/freshwater-and-estuaries/projects/sediments-and-mangroves

Mangroves in Orewa arm of the Whangapoua harbour

10.4.4 Saltmarsh

While there is no information describing the trends over time for saltmarsh Graeme, 2013 described the status of these vegetation types as follows:

- Wide beds of sea rush and oioi are common around the harbour. Rush/sedgeland expansion (mainly oioi) was noted in various places around the harbour, particularly in the shelter of the islands beside the Whangapoua causeway road.
- Saltmarsh ribbonwood communities vary in size from thin bands where land use has extended out into the coastal marine area, to extensive undisturbed areas around the mouth of the Opitonui River and the Chenier Islands out from the Whangapoua causeway road.
- Sea meadow communities are scattered along the banks of the watercourses, in patches amongst rush/sedgeland, and along the rush/sedgeland - saltmarsh ribbonwood interface. The species that are present include sea primrose, remuremu, glasswort and coast spear grass.

Saltmarsh at Opitonui

10.4.5 Saltwater paspalum and spartina

Saltwater paspalum and spartina are invasive pest plants which can significantly reduce the ecological health of the estuary. They are extremely competitive and can dominate other native estuarine plant communities as well as establish over areas of open tidal flats.

While there is no information that can be used to describe trends over time of these estuarine plant pests Graeme 2013 described the status of these species as follows:

- Saltwater paspalum has not yet formed extensive and dense beds in Whangapoua Harbour as has occurred in other Coromandel harbours. However, saltwater paspalum is present in small-medium patches amongst rush/sedgeland, sea meadow and saltmarsh ribbonwood communities at various points around the harbour particularly where there has been mechanical or stock disturbance.

- Small patches of spartina were found in the wetland abutting the Matarangi golf course and remnants from DOC's spraying programme were found seaward of the Whangapoua causeway road. A few unsprayed patches were also found on both sides of the Whangapoua causeway road.

Beadel (2014) and Graham (2013) recommended on-going control of spartina to ensure eradication. Beadle (2014) recommends targeted control of saltwater paspalum where it has the greatest ecological impacts (e.g. SNAs, harbour islands, high tide bird roosts, isolated populations, edges of large populations). This report noted that a harbour-wide program of control for saltwater paspalum would be of significant benefit to harbour habitats; however it would require significant and long-term commitment of resources.

Graeme (2013) recommended harbour wide control of saltwater paspalum before it became too widely established. A more recent report has prioritised where saltwater paspalum control in Waikato estuaries is best undertaken for the greatest ecological benefit given that we have yet to find effective methods to eradicate this weed and its serious threat to estuarine values (Graeme & Kendal 2014).Whangapoua and Otama scored highly in the prioritisation (second equal) for eastern Coromandel estuaries."

10.5 Shorebirds and fish

10.5.1 Shorebirds

Dowding (2013) identified Whangapoua Harbour, including New Chums Beach, Whangapoua Harbour, and Matarangi Spit as a priority 1 site of importance for coastal and estuarine birds on the east coast of the Waikato Region. This means that '*the site regularly holds 1% of the global population of one or more species or subspecies that are classified as threatened under the New Zealand Threat Classification System List for 2012 (Robertson et al. 2013)*'.

Dowding (2013) also identified that shorebirds were threatened by:

- Periodic loss of roosting habitat
- Loss of breeding habitat for New Zealand dotterel (Tuturiwhatu pukenui) and Variable oystercatcher (Torea) (through erosion of the Matarangi Spit)
- Disturbance of breeding birds (Matarangi Spit and Whangapoua Beach) in late spring and summer
- Predation by mammalian and avian predators
- Loss of nests to king tides and storm surges.

A site inventory containing information on the importance of these areas for birds, threats, information gaps and references are shown in Appendix 2 of Dowding (2013) and is reproduced in Appendix 4. A map showing specific areas of importance for shorebirds (e.g. breeding, roosting) is also shown in Appendix 4.

The Matarangi Spit is a major breeding site for many migratory species and in particular the NZ dotterel and the Variable oyster catcher, with post-breeding flocks of respectively 150+ birds and 150-190 birds (Dowding, 2013). New Zealand dotterels and variable oystercatchers are also present on Otama Beach, Opito Bay and Whaorei Bay (Sarah's Gully).

Godwits at Matarangi spit roost

Caspian terns on Whangapoua Harbour islands

The harbour has been identified as an important wintering site nationally for indigenous shorebirds with winter flocks of pied stilts (20-80 birds), South Island pied oystercatcher (750-1,300 birds) and banded dotterel (Tuturiwhatu) (150-250 birds) (Dowding 2006; Dowding 2013). The harbour is also of national significance for eastern bar-tailed godwits (Kuaka) with flocks of 1,000+ birds and other arctic migrant shorebirds occurring in small numbers (e.g. turn stone, golden plover) (Dowding 2013).

Graeme (2013) noted that the Chenier Islands within the harbour also provide roosts and nesting sites for NZ dotterel, variable oystercatchers, caspian terns and pied stilts. To enhance the bird values of these islands (which are away from human disturbance) predator control and the control of weed species such as saltwater paspalum, marram and pampas are priorities.

Northern New Zealand dotterel

10.5.2 Off-shore fish

As part of the Tai Timu Tai Pari (Hauraki Gulf Marine Spatial Plan) project (refer to Appendix 2) NIWA estimated the importance of different parts of the Hauraki Gulf Marine Park for the conservation of demersal[24] fish using the predicted distributions of 56 species of fish caught in research bottom trawls. The distribution of these species was predicted by statistically modelling the relationship between occurrence and abundance of each species in a trawl and a variety of data describing the physical marine environment at the site, along with the characteristics of the research vessel and trawl. Reef fish, rare species and freshwater fish found in estuaries were excluded from the data set and no information on spawning or nursery areas was included in the analysis. The results show that an area north of the Whangapoua catchment is predicted to contain relatively high conservation values for demersal fish (refer figure 12).

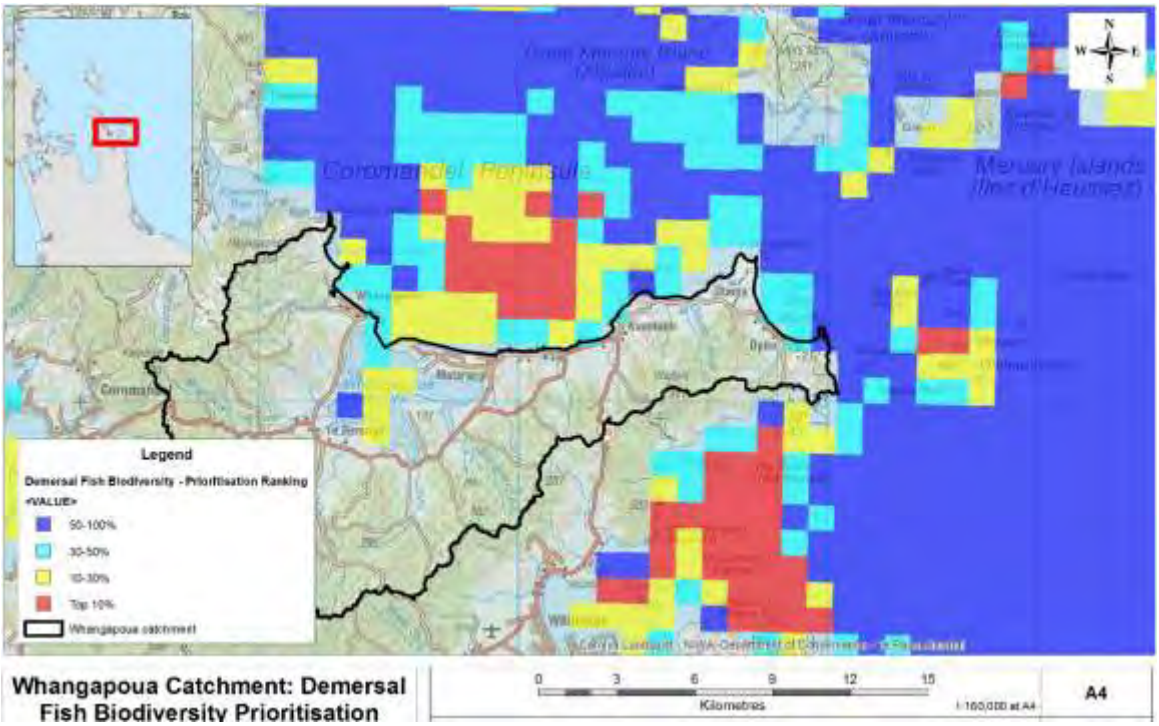


Figure 8 The importance of different parts of the Hauraki Gulf Marine Park for the conservation of demersal fishes (The top 10% shows the top 10% of cells with the highest conservation value) *(www.seasketch.org; data NIWA).*

10.5.3 Harbour fish

There is very little information on fish communities within the Whangapoua Harbour however many fish rely on the harbour environment during their juvenile phase. The low energy waters provide shelter, an abundant food supply, protection against predation (due to turbidity) and higher growth rates (due to higher water temperatures) (NIWA 2002).

Fourteen different fish species were caught in eight seine tows, carried out in 2001. The abundance of juvenile snapper was approximately 5 – 10 times higher than in Whitianga Harbour, Tairua Harbour and Whangamata Harbour (Francis et al. 2005). The relatively high numbers of juvenile snapper could be related to the presence of seagrass meadows which support high densities of juveniles of fish species, such as snapper and trevally, as well as the juveniles of other species such as parore, piper, and spotties (Lundquist et al. 2004).

Experiments with artificial seagrass structures in Whangapoua Harbour showed that juvenile snapper are attracted to seagrass beds and that increasing blade densities

[24] Demersal fish are dependent on sea floor for food and shelter; species include john dory, gurnard and snapper.

were associated with increasing fish densities (although the patterns of response varied across species) and species diversity (personal comment Morrison Feb 2015; unpublished data in Morrison et al. 2014).

Threats to estuarine fish species include sedimentation and loss and change of benthic habitats. There is very little research on the direct effects of suspended sediments on estuarine and marine fish species, but effects can include fish gill clogging, reduced finfish foraging abilities (e.g. juvenile snapper), and modification or loss of important nursery habitats (Morrison et al. 2009).

A limited number of records of diadromous fish species (fish species migrating between freshwater habitats and the marine environment) are included in the New Zealand freshwater fish database[25].

10.5.4 Marine protected areas

There are currently no marine protected areas within the harbour and open coast areas of Whangapoua. Froude (2004) identified that while many communities are engaged in discussions about marine protection, outside of marine reserves, there are few areas in which the restrictive provisions collectively result in a high degree of protection from potentially damaging activities. Many of the restrictive provisions are for fisheries management purposes, where the level of restriction on activities that damage ecological values is not usually high.

Area-based restrictions on commercial fisheries in the Whangapoua Harbour currently include: no taking of scallops, no taking of fish using a box or teichi net, purse seine, dutch seine, trawl net, lampara net, or set nets >1000m total length. In addition, there are a range of other general catch restrictions on all fishers.

10.6 Sedimentation in the harbour

Estuaries are transition zones between the land and the coast and over time all estuaries will in-fill. Sedimentation in estuaries is a natural process that can be and has been accelerated by changes in land use or land management within the catchment (such as farming, subdivision and vegetation clearance) (refer also to Chapter 8 Land). Estuaries on the east coast of the Coromandel Peninsula are at high risk of infilling because of the erosive nature of their catchments (steep topography and frequent high intensity rainfall events) and the physical nature of the estuaries (sandbars or barriers narrow the harbour entrances) (Jones, 2008).

Accelerated sedimentation rates can impact on the amenity values of an estuary by filling in channels and making sediments muddier. Increased suspended sediment in the water column, and deposition of sediment on tidal flats, can affect benthic communities (i.e. plants such as seagrass, and animals such as shellfish and worms that live on or in the estuary sediment), with knock-on effects to fish and shorebirds.

Jones (2008) provides the following overview of sedimentation issues in the Whangapoua Harbour:

- Whangapoua Harbour has been the focus of many studies. The estuary has a large tidal prism and so will most likely flush out some sediment, especially fine mud
- Sediment cores in 1992 estimated pre-human settlement sedimentation rates at 0.03 to 0.08 mm/year and post-European settlement sedimentation rates at 0.89 to 1.5 mm/year. This represents a 10 to 30 fold increase
- The estimates for sediment yield (SedRate and the Hicks and Shankar model respectively) are 140 and 58.8 tonnes/km^2/year
- There is evidence that sedimentation is having an adverse effect on benthic plant and animal communities and the potential effects on predator species is of

[25] Refer: https://nzffdms.niwa.co.nz/search

concern but is largely unknown. The decline in benthic communities in different parts of the estuary correlates with the amount of clear felling over previous years in the catchment feeding into those parts of the estuary

- Mangrove cover in the estuary has more than doubled, and seagrass cover more than halved, over the past 50 years.

The thesis by Roddy (2010) used sediment fingerprinting techniques to link estuary sediments in Whangapoua Harbour to potential source areas in the catchment. The study found that native forest[26] contributed the most to estuary sediment (through landslides and steep slope erosion), exotic forest also contributed significantly to estuary sedimentation (though landslides and bank erosion), and pastoral land contributed the least. Gibbs (2006), and catchment models (e.g. the sediment Yield Estimator and
NZ Empirical Erosion Model) found that exotic forestry contributed the most sediment, followed by native forest and smaller contributions from farmland. (Refer Appendix 6 for more detail). Other studies in the catchment (Marden and Rowan 1995, Marden et al., 2006) also identified landslides on steep slopes (both in native forest and exotic forest cover) as the dominant sediment source.

While it is clear that steep slopes are likely to generate larger amounts of sediment via land sliding, harvesting of exotic forest also influences sediment production, particularly from recently harvested areas (Marden and Rowan, 1995). It is unlikely that either of the sediment fingerprinting studies (Roddy (2010) or Gibbs (2006)) provide a definitive answer as to the sources of sediment in the estuary, but it is clearly important to keep steep slopes permanently forested.

NIWA carried out monitoring in Whangapoua Harbour for Ernslaw One Ltd between 1993 and 2007 to try to assess the potential effects of forestry activity on intertidal habitats. A data review in 2006 noted that changes in sediment characteristics in the estuary were transitory and associated with storm events (Halliday et al. 2006). Although it is difficult to determine cause-effect relationships, the report indicated that changes in benthic communities were consistent with increased sediment loading and that there were correlations between those trends and forest harvesting activity.

Millar (2006) also noted that sediment impacts do not appear to have changed the height of the intertidal bed, i.e. neither sediment composition nor bed height showed any long-term trends, and concluded that the effect of forestry on the harbour is unclear, as there was little opportunity to distinguish between forestry impacts and natural variability.

[26] Erosion of sediment from areas covered in native forest is exacerbated by the impacts of browsing animals (goats and possums) reducing forest structure (through loss of canopy and ground cover) and in turn reducing its ability to intercept rainfall. In addition forest structure has been altered through historic deforestation; this has set back forest succession resulting in forests with a younger structure.

Aerial view of harbour

10.7 Coastal hazards

10.7.1 Coastal erosion and sea level rise

Coastal inundation (from both storms and tsunami) and coastal erosion (of dunes or cliffs) are the two hazards facing the coastal edge.

As one method for addressing the potential for future erosion, coastal hazard assessments have been undertaken along the open coast sandy shorelines of Whangapoua and Matarangi. As a consequence, coastal development setback zones are included in the TCDC proposed District Plan. However there are limited methods for addressing situations where existing development is affected by erosion events. Existing development can live with the coast naturally, relocate or defend. The NZCPS has strong policy on these matters for guiding decision-making.

Erosion scarp at Whangapoua

Erosion at Matarangi spit

From a climate change perspective (refer also to Section 9.2), projected sea level rise is a significant issue for coastal areas, both from a hazards perspective (i.e. development located too close to the dunes/ sea) and also from an ecological perspective (i.e. the ability of coastal vegetation to adapt by progressively moving inland).

"Coastal squeeze" is the term used to describe the pressure between natural processes such as erosion, sea level rise, migration of vegetation ecosystems) and existing developments. The location of development needs to be managed carefully for the future to recognise the dynamic nature of the coast and natural processes, which will migrate inland.

The Council is currently undertaking a project to identify low-lying coastal land that is susceptible to current coastal inundation and also identifying the potential impacts of projected sea level rise. A web-based application will enable users to identify the extent of inundation and water levels at 0.2m increments. There will also be supporting information to guide the user as to tide and storm water levels (no wave effects) and projected sea level rise scenarios, in order to assess the sensitivity of a site to incremental change in water levels that is likely to occur over time.

10.7.2 Tsunami risk

Tsunami occur after large disturbances such as earthquakes, volcanic eruptions and deep sea landslides. There are two types of tsunami:

i. Near source - where the event and the impact on shore is local (one hour or less) or regional(between one and three hours)
ii. Distant source - where the impact is greater than three hours.

GeoEnvironmental Consultants (undated) were contracted to identify the history of tsunami on the eastern coast of the Waikato and Bay of Plenty regions. There have been approximately six large tsunami events (magnitude unknown) in the last 5,000 years or so, affecting the coast of the eastern Coromandel and Bay of Plenty. Otama Beach was one site assessed within this overall report. This report also noted that hazards related to tsunami are site specific, and influenced by the height of the wave run-up.

Tsunami are a threat to people and property in coastal and low-lying estuarine areas. The waves travel rapidly, resulting in rapid flooding and, depending on size can include debris destroyed and transported in its path. They can also travel inland up rivers.

The Council and TCDC are working on "The Eastern Coromandel Tsunami Strategy". To date scientific assessments have been carried out for Whitianga, Tairua and Pauanui, with work about to start on the Whangamata and Whiritoa communities. Over time, the councils will be working with each major settlement on the Coromandel's east coast.

10.8 Beachcare

Beachcare groups are community based groups involving community members, iwi, industries, DOC, TCDC and the Council. They are focused on protecting and restoring native vegetation on the coastal fore-dunes and back-dunes and building fences and access ways for people in order to protect the dunes and vegetation.

Dune restoration work has a number of important management objectives, including:

- Cultural values and resources managed through protection and restoration of dune-land areas
- Improved coastal hazard management and resilience to climate change through restoration of natural self-sustaining dunes to provide protection from coastal erosion, wind erosion, coastal flooding and tsunami
- Restoration of indigenous dune biodiversity and ecology through planting and control of plant and animal pests. Coastal dunes are one of the most modified and degraded of New Zealand's ecosystems and have suffered extensive loss of native plant and animal biodiversity. They are also an important part of the coastal ecosystem, providing habitat for native lizards, insects, butterflies and birdlife

- Improved management of public access – to enhance public access to and along the dunes, and to protect native dune vegetation and ecosystems from damage
- Restoration and enhancement of the natural character and landscape values of the beaches

Within the Whangapoua catchment there are four Beachcare groups (Whangapoua, Kuaotunu (east and west), Rings and Matarangi). The Kuaotunu and Rings Beach groups were established in 1994 while the Matarangi and Whangapoua groups were established more recently.

The primary focus of these groups is on the protection and restoration of the native plants spinifex and pingao along the seaward face of the frontal dunes, along with managing pest weeds and animals. These native plant species are critical to natural dune function as they trap windblown sand, thereby naturally repairing the dune following periods of erosion as well as preventing wind erosion. The general aim at all sites is to restore sufficient width of spinifex and pingao for the dunes to be naturally self-sustaining. The groups have also worked extensively with Council to improve beach access ways in order to prevent damage to stabilising dune vegetation and to improve public access.

At Rings Beach, the installation of beach access-ways was the initial priority to protect the existing native dune vegetation, and this was followed by a series of annual working bees to plant degraded areas. Weed control has become an issue at this site, with the invasive pest climbing asparagus becoming a problem in the back-dune areas along with other garden escapee species such as agapanthus and gazanias. Since 2009, the Rings Beachcare group has planted more than 1,900 native dune plants.

At Whangapoua, Beachcare volunteers have supported major earthworks and fore-dune restoration in response to a number of major erosion events following large storms. The restored fore-dune has proved to be resilient to major storms. In more recent years, the group has moved its focus to the restoration of the back-dune areas with help from TCDC. In these areas, large areas of weeds have been removed and replaced with native species that support local biodiversity. Since 2009 just over 19,000 plants have been planted by Beachcare volunteers.

At Matarangi, the community wanted to undertake a series of restoration trials before committing to any larger scale restoration work. There has been wind erosion at the areas cleared of weeds, leading to the installation of temporary wind break fences to manage wind-blown sand. The areas restored continue to be monitored with in-fill planting occurring as required. Since 2009, volunteers at Matarangi have been planted more than 19,000 native dune plants.

At Kuaotunu (east and west), dune restoration efforts have focussed on dune re-shaping, the removal of exotic species and dune replanting with native species. The frontal dune at Kuaotunu west is steeply eroded and badly damaged from historic sand extraction. Re-shaping and repair of the dune is currently precluded by an important archaeological layer at the top of the steep face. However a significant amount of back-dune planting has occurred including a significant area of back-dune shrub-land in 1995 that has provided valuable information for the Beachcare programme. Since 2009, approximately 4,500 plants have been planted by Beachcare volunteers.

In addition, at Otama, Council is intending to work with DOC to undertake pest control measures. Otama is the best condition dune in the Waikato region and plays an important role as a reference site for all restoration works.

10.9 Navigation safety

The Council's navigation safety team is focused on maintaining safe and navigable waterways and reducing the conflict between various types of water users. Council has undertaken an assessment of the Whangapoua Harbour from a safe operational perspective, to identify risks that should be managed. The Harbourmaster who is responsible for navigation safety in the Whangapoua Harbour and coastal areas, is based at Whitianga. The Harbourmaster is responsible for ensuring safe management of moorings, maintaining navigation aids (including markers and signage) and ensuring safe boating behaviours.

The Council's Navigation Safety bylaw sets out zones within the harbour for skiing and for 5 knot only speeds (See map 18). In addition the Council has prepared a range of educational information for water users, including for example, information on how to undertake safe bar crossings, a brochure on the key rules for boating and marine mate which is an app for nationwide boating information.

11 Biodiversity

11.1 Overview

This chapter focuses on the important role Council, TCDC and DOC have in managing the region's indigenous biodiversity, natural heritage, threatened species, and fragmented ecosystems under the requirements of the RMA. In particular Part II of the RMA sets out as matters of national importance:

1. The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development
2. The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.

Identification of Significant Natural Areas (SNA) Natural Heritage Management System areas (NHMS) and Areas of Significant Conservation Value (ASCV) is an essential part

of managing indigenous biodiversity. These areas provide a wide range of ecosystem services including habitat for indigenous plant and animal species, water quality improvement, flood and erosion control, provision of oxygen, climate regulation, as well as recreational and scenic values.

The Whangapoua catchment has undergone significant changes in its terrestrial ecology over the years, from full indigenous cover, to the current modified land cover as described in Section 8.5. Wetlands in particular have been heavily modified, but the remaining remnants are important habitat for a range of bird and fish species.

The key issues facing the management of biodiversity values in the harbour and catchment include:

- SNAs need to be identified and included into the RMA statutory plans, in a way that protects them for the future.
- Restoration of wetlands and other wet areas, in recognition of their role in helping to manage flood waters, as well as sediment and nutrient run-off.
- Pest plants and animals pose a significant threat to biodiversity values
- Riparian management and natural river connectivity through the catchment are critical for fish species, including whitebait species.
- The need for on-going support for the wide range of community-based biodiversity groups, as the contribution made by volunteers to achieving biodiversity outcomes is significant to the Whangapoua catchment.

11.2 Significant areas

11.2.1 Significant natural areas (SNA)

Identification of SNA is an essential part of managing indigenous biodiversity. The criteria for identifying an SNA in the Waikato region, is set out in the Proposed Regional Policy Statement 2010(PRPS, Table 11-1).

The SNA project led by the Council, has involved a comprehensive assessments of each district within the region by ecosystem type including terrestrial, wetland, lake, marine and coastal, geothermal, rivers and streams, and karst. This dataset is available to territorial authorities to assist in addressing biodiversity issues.

Kessels, (2010) undertook an inventory of the Thames Coromandel district to identify and prioritise SNA's, using the ecological significance criteria in the Waikato Regional Policy Statement. These areas include terrestrial, wetland, sand dune, shingle beach and off-shore ecosystems and identify nationally and locally important species. It is a provisional inventory and sites identified are subject to refinement through consultation and field surveys.

Kessels (2010) recommended that:

> "*In terms of ecological restoration and management priorities, shoring up buffers and recreating corridors by replanting, fencing fragments from stock and weed/animal pest control are absolutely essential if these significant natural areas are to survive in the Coromandel landscape*."

TCDC has identified on property LIMs (Land Information Memorandum) where the Council's SNAs apply, and added a note that property owners need to consider this information in more detail when they are considering any changes to their property that may require a resource consent.

In addition, TCDC is currently progressing with their proposed District Plan. Under Section 7 of the proposed plan there is a biodiversity overlay. The SNA maps can be used to indicate if your property might fall within an SNA. However it is a "site-specific" responsibility to determine if your property meets the SNA criteria set out in the

Council's RPS and TCDC's District Plan overlay provisions. The SNA maps are on the Council's and TCDC's website, and further information can be obtained from the Council. There are associated rules covering activities such as vegetation clearance, or subdivision of conservation lots, which aim to provide incentives to protect and/or restore biodiversity.

11.2.2 Natural heritage management system (NHMS)

As a part of its functions DOC has formulated the Natural Heritage Management System (NHMS) in order to prioritise its work and achieve a comprehensive range of healthy, functioning ecosystems across New Zealand.

Biodiversity specialists from DOC and the wider community have identified approximately 1,000 potential locations around New Zealand that together represent a comprehensive range of New Zealand's terrestrial and freshwater ecosystems. These locations are known as 'ecosystem management units'. Most of the ecosystem and species management units are on public conservation land, but some are not. Generally this will be because a threatened species or particularly unique ecosystem is located there.

Presently within this catchment, DOC has identified the Otama dune and as priority ecosystem management units which will be the focus of their work programmes in the 2015/16 financial year.

11.2.3 Area of significant conservation value

Under the Waikato Regional Coastal Plan the harbour is identified as an Area of Significant Conservation Value (ASCV) for the following characteristics:

- As a site of significance to Ngati Huarere, Ngati Hei and Hauraki iwi
- As a nationally important habitat for wildlife at the Matarangi Wildlife Habitat Reserve, administered by DOC
- Habitat for resident and frequenting rare and threatened wading, coastal and freshwater birds
- Shellfish beds and kai moana gathering
- Numerous archaeological sites around the harbour margins
- The Omara Spit landform.

Therefore when making decisions on resource consents in the coastal marine area, the effects of any proposed activities on these matters need to be considered by the decision-makers. These ASCV will be reviewed in the up-coming review of the Regional Coastal Plan.

11.3 Terrestrial ecology

Pohutakawa on coastal cliffs

11.3.1 Overview

The Whangapoua catchment is located within the Colville Ecological District and the Coromandel Ecological Region (McEwen 1987) it is part of the Auckland Botanical Province (Wardle 1991). The Auckland Botanical Province occurs north of approximately 38° latitude and it is ecologically characterised by the dominance of several forest trees of tropical or subtropical origin which are largely restricted to the north of this botanical province. Characteristic trees of importance include kauri (*Agathis australis*), taraire (*Beilschemdedia taraire*), towai (*Weinmania silivicola*), pohutukawa (*Metrosideros exclesa*) and puriri (*Vitex lucens*).

Within the catchment, the hill slopes are generally steepest along the main axial range while closer to the coast they are shallower, and in the lower reaches the main streams have formed areas of alluvial terraces. Numerous water courses dissect these hill slopes and have created ridge and gully landforms which provide diverse habitat for a wide variety of flora and fauna.

11.3.2 Historic context

Maori colonised the Whangapoua area between 1200AD – 1400AD (Furey et al. 2008). However unlike other areas of the Coromandel, such as south of Whitianga, deforestation was relatively minor (Leathwick et.al 1995). By 1840 AD at the time of European colonisation, indigenous vegetation of the catchment was still largely forest from the top of the Coromandel Range to the sea shore, although small areas of vegetation clearance had occurred around areas of Maori occupation (McGaskill, 1949 cited in Humphreys & Tyler 1995).

***Streblus banksii*- Kuaotunu**

Limited botanical or ecological information was published on the vegetation of the Coromandel Peninsula especially prior to major modification. The following ecological description of the original pattern has been amalgamated from historic descriptions from Humphreys & Tyler (1995) and other accounts, such as a visit to the northern Coromandel Peninsula by James Adams (1889), supported by current vegetation patterns of the most intact examples within the Coromandel Peninsula.

The dominant forest type on the Coromandel was a diverse kauri, podocarp and broadleaved forest on both steep and shallow hill slopes from approximately 1km from the coast to the summits of the Coromandel Range. Locally kauri (*Agathis australis*) would have been abundant, perhaps forming areas of dominant “Kauri Forest” on the poorer less fertile clay soils, especially on ridges. Kauri also occurred in gully areas along with

a wider range of species. The Coromandel region had magnificent kauri including the largest ever measured tree. This tree grew at Mercury Bay and had a circumference of 23.77 metres and a height of 24.3 metres to the first branch – twice the bulk of Tāne Mahuta in the Waipoua Forest (Te Ara).

On ridges kauri typically grew in association with tanekaha (*Phyllocladus trichomanoides*), rimu (*Dacrydium cupressinum*), totara (*Podocarpus totara*), white maire (*Nestegis lanceolata*), hinau (*Eleaocarpus dentatus*), towai (*Weinmania silivicola*), mangeao (*Litsea calicaris*) and rewarewa (*Knightia excelsa*). Nicholls (1980) considered that hard beech may have also been locally abundant on the eastern Coromandel forests though little now remains (Nicholls 1980; cited in Humphreys & Tyler 1995). Tawa (*Beilschemedia tawa*) was the most common canopy tree and was especially dominant in gully and hill slope areas where soils were more developed.

Coastal plants karo, pseudopanax and pohutakawa

Other podocarp and broadleaved trees such as miro (*Prumnopitys ferrigineus*) and rimu would have been present in association with tawa in similar sites. Historic accounts record rimu being just as abundant as tawa in some areas (Humphreys & Tyler 1995). Alongside tawa, kohekohe (*Dysoxlyum spectabile*), pukatea (*Laurelia novae-zelandiae*) and northern rata (*Metrosideros robusta*) would have also been common. At higher altitude towai, tawari (*Ixerba brexioides*), tawherowhero (*Quintinia serrata*) and Hall's totara (*Podocarpus cunninghamii*) would have been more common replacing the lowland species. Conversely, below 300m puriri (*Vitex lucens*) and taraire (*Beilschemedia taraire*), would have been present in gullies and shallow hillslopes. The abundance of taraire today suggest that while widespread in the Colville Ecological District it was only locally common, unlike in Northland where it is often the most common tree in association with kauri.

Alluvial floodplains along the major streams would have supported a mosaic of tall podocarp forest and wetlands (see Section 11.4 below for further details on wetlands). Kahikatea (*Dacrycarpus dacrydioides*) in association with pukatea and locally rimu and swamp maire (*Syzigium maire*) were common on the poor draining gley soils. In the smaller areas of imperfect and free draining alluvial soils, a wider range of canopy trees, in addition to kahikatea, would have been present including matai (*Prumnopitys taxifolia*), totara and a range of broadleaved trees. In these areas puriri was likely the most abundant broadleaved tree while titoki (*Alectryon excelsus*), kohekohe and locally taraire and tawa may have also been common, especially on older imperfectly and free draining river terraces of higher fertility. Kowhai (*Sophora microphylla*) would have also been present on the margins of river banks.

Coastal broadleaved forest would have dominated the coastal margin and may have extended inland up to 1km in the most exposed locations. Pohutukawa would have been abundant in this zone especially on steep cliffs and hillslopes prone to slipping where it was dominant. Coastal cliffs and steep hillslopes also included ngaio (*Myoporum laetum*), karo (*Pittosporum crassifolium*), haekaro (*P. umbellatum*), coastal kowhai (*Sophora fulvida*), wharangi (*Melicope ternata*), houpara (*Pseudopanax lessonii*), rangiora (*Brachyglottis repanda*), taupata (*Coprosma repens*), kawakawa (*Macropiper exclesum*), harakeke (*Phormium tenax*) and mawhai (*Sicyous mawhai*). On bare rock, ringaringa lily (*Arthropodium cirratum*), native flax (*Linum monogynum*), puha (*Sonchus kirkii*) and perching lily (*Astelia banksii*) were common. Close to the sea

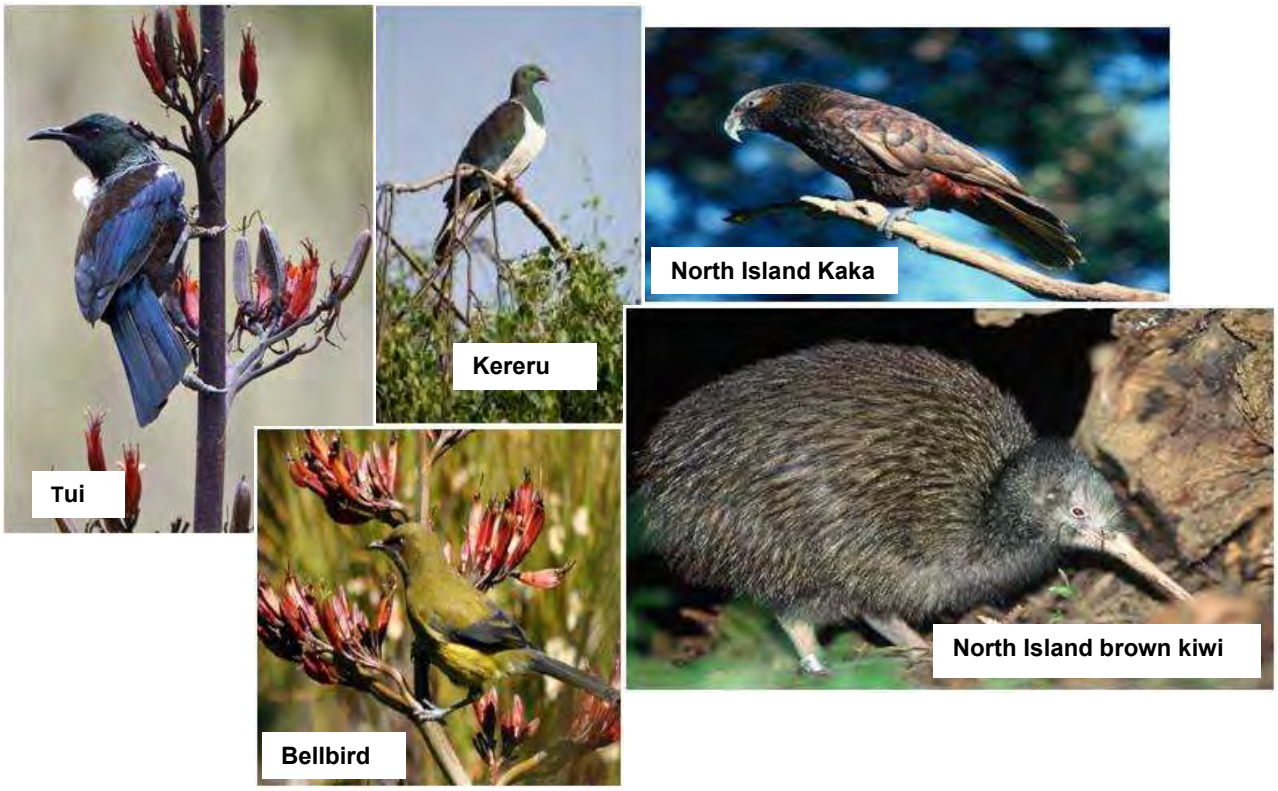
a range of halophytic plants such as New Zealand ice plant (*Disphyma australe*) and half star (*Selliera radicans*).

On less steep coastal hillslopes a mixed coastal broadleaved forest would have been present. In association with pohutukawa, puriri, kohekohe, karaka, tawa, and locally taraire would have been common. It is also likely that species now rare and largely now restricted to islands, such as tawapou (*Planchonella costata*), coastal milk tree (*Strebulus banksii*), coastal mahoe (*Melicytus novaezeelandiae*), parapara (*Pisonia brunoniana*) and coastal maire (*Nestegis apetala*) would also have been present. This broadleaved forest would have been most well developed on seaward facing hill slopes exposed to sea winds and periodic salt spray. While podocarp and kauri trees were likely present, they would have been comparatively uncommon compared to inland forests. Damp coastal gullies would have been filled with nikau palms, tree ferns, supple-jack and peppertree.

Coastal forest Bluff Road Kuaotunu

The Omara sand spit and other smaller sandy beaches would also have supported a range of vegetation types from grassland to forest. Omara is the most extensive dune area and is thought to have started developing 4000 years ago (Marks & Nelson 1979). On the fore-dune pingao (*Ficinia spiralis*), spinifex (*Spinifex sericeus*) and shore bindweed (*Calystegia soldanella*) would have occupied the front of the dune. On the foredune summit and further inland, sand coprosma (*Coprosma acerosa*), tauhinu (*Ozothamnus leptophyllus*), knobby clubrush (*Ficinia nodosa*), sand daphne (*Pimelea villosa*) and wire vine (*Muehlenbeckia complexa*) would have dominated. This foredune vegetation would have merged into bracken fern (*Pteridium esculentum*) and scrub of manuka (*Leptospermum scoparium*) and kanuka (*Kunzea* sp.) and further back into taller forest. Pohutukawa and karo were the likely dominant forest species on stable dunes along with other drought tolerant trees such as akekake, kanuka, mahoe (*Melicytus* spp.), houpara and maupo (*Myrsine australis*). Further inland totara, kauri and tanekaha may have occurred in association with pohutukawa on the oldest and most developed dune soils.

Coromandel forests would have supported a rich variety of fauna including forest birds, frogs and lizards, bats and large invertebrates, many of which are no longer present, such as the North Island kokako.



The catchment also had smaller areas of other habitat types such as freshwater wetlands which were most abundant on alluvial flood plains and in brackish and freshwater areas of the Whangapoua Estuary (see Section 11.4). Specialised vegetation was also associated with hard rock cliffs both along the coastal fringe and inland. Castle Rock still supports intact cliff vegetation including *Olearia townsonii*, *Celmisia adamsii*, *Leionema nudum*, *Pittosporum huttonianum*, *Chionochloa conspicua*, *Hebe macrocarpa* and *Gaultheria paniculata* (Clarkson and Smith-Dodsworth 1992).

11.3.3 Post 1840's modification

European colonisation resulted in a massive reduction in the integrity of indigenous vegetation. Commercial logging of kauri started in the Coromandel in 1838 and had mostly finished by 1914. Kauri logging was primarily undertaken by constructing kauri dams — a highly devastating method of removing cut timber from inland areas. In addition to kauri other merchantable species such as totara, puriri and tawa were logged (Humphreys & Tyler 1995). Logging facilitated other land uses which typically involved deliberate burning to clear the land to enable kauri gum digging and for farm development. This greatly reduced the abundance, distribution and quality of indigenous vegetation. Vegetation clearance, kauri dams and fire was also highly detrimental to the soil and a large amount of soil would have eroded or incinerated during fires, reducing the natural soil fertility of many areas. Remaining indigenous areas have to various degrees been affected by all of these pressures. Pastoral agriculture is now primarily restricted to lower alluvial land while cleared hill country has been developed into exotic pine forest.


Opitonui kauri

Human modification was greatest in the coastal and semi-coastal areas and as a result these areas contain the least indigenous vegetation today and what remains is typically highly modified (Humphreys & Tyler 1995; Kessels and Associates 2010). Within public conservation areas vegetation is largely dominated by younger aged canopy trees, which have established after disturbance. Very few large emergent or canopy trees, such as kauri, rimu and northern rata remain, though pohutukawa is still reasonably abundant around the coastline. Along the main Coromandel Range in the Coromandel Forest Park, the forest pattern is generally irregular often with a broken canopy of broadleaved shrubs and trees and scattered isolated emergent trees that survived logging and fire. Many areas of remaining indigenous vegetation are dominated by fire induced scrub or low forest of manuka, kanuka and associate broadleaved trees, both on public conservation land and private land. Later successional stages often have areas of regenerating "pole" and "ricker" kauri which can be locally abundant, usually in association with tanekaha, rewarewa and towai. These successional manuka and kanuka forests typically have been invaded by a range of weeds, particularly wilding pines (*Pinus pinaster* and *P. radiata*), gorse and hakea.

11.3.4 Present day vegetation

Despite the indigenous vegetation of the Whangapoua catchment having been severely modified over the last 165 years, significant areas of indigenous vegetation still remains and examples of most vegetation types are still present. The largest area of forest remaining occurs within the Coromandel Forest Park straddling the main Coromandel Range at the top of the Whangapoua catchment. In time, if sustained pest control is undertaken, this area will recover to an approximation of the kauri, podocarp, broadleaved forest which occurred there prior to European colonisation. Most of this forest is situated above 200m amsl and below this altitude only relict areas of coastal and semi-coastal forest remain, though reasonably large areas of manuka/kanuka scrub and young forest are present, especially on the Kuaotunu Peninsula. However much of this area is subject to possum browsing which in turn will affect forest composition.

Below 200m amsl within the coastal and semi-coastal areas several natural areas which contain remnant coastal forest occur at, New Chums Beach and inland of lower Pungapunga River. Areas of largely secondary manuka-kanuka vegetation also occur at Matarangi Bluff, Black Jack, Motuhua Point and parts of the Coromandel Forest Park on the Kuaotunu Peninsula. These areas still have some relict seed sources of coastal forest species and have the potential to regenerate back into coastal broadleaved forest with time and conservation management.

The dune vegetation is still largely intact at Otama Beach and is the best remaining example of dune vegetation within the Coromandel. Otama Beach is a NZ dotterel breeding site and is protected by intensive predator control. Inland it is also connected to a remnant coastal brackish / freshwater wetland, which is habitat for fernbird, an At Risk threatened species and the dwarf mistletoe (*Korthalsella salicornioides*).

Alluvial forest types have been the most modified, with only tiny areas now remaining. Areas which were once dominated by puriri have been almost completely lost. Of particular note is the remnant coastal taraire stand between the mouths of the Waitekuri River and Waingaro Stream. Threatened species in the area include:

Pittosporum virgatum and kawakawa (*Libocedrus plumose*), which are both identified as being "at risk – naturally uncommon" trees and are found in the northern and western coastal catchments of Whangapoua Harbour (Graeme, M pers.com).

Restoring these "rare and threatened" forest types represent the greatest challenge, and riparian restoration provides an opportunity to return some of these species to the landscape.

11.4 Wetlands

11.4.1 Overview

Wetlands once covered large areas of New Zealand. Now they are some of our rarest and most at-risk ecosystems. The RMA defines wetlands as "*permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions*". Wetlands can be classified as bog, fen, swamp, marsh, seepage, shallow water, ephemeral, pakihi and gumland, or saltmarsh (including mangroves) depending on their hydrology, nutrient level, altitude and vegetation (Johnson and Gerbeaux, 2004).

The Whangapoua estuary and freshwater wetlands in the catchment have been heavily modified with only small remnants of flax, sedge and raupo wetland remaining. Less than 10% of the former extent of wetland ecosystems in the Colville Ecological District exists today with many large flax swamps long since milled and drained (Humphreys and Tyler 1995). Wetlands have been altered, reduced or removed completely through drainage to facilitate reclamation for grazing, expansion of pine plantations, and coastal subdivision.

Within estuarine wetland areas seagrass and mangroves are still relatively common. However *Juncas sp.* rushland, manuka rush/shrubland, *Baumea sp*. sedge-shrubland, raupo-flax reedland, and lowland swamp forest have been critically reduced to small remnants (see Section 10.4 for more information on coastal wetlands).

Wetlands also support a wide range of wetland bird species, in particular the North Island fernbird (matata); and brown teal (pateke), as well as banded rail (mohopereru) and the Australasian bittern (matuku) (Dowding 2013).

Wetland areas, including freshwater and saline wetlands, have been identified as part of Council's SNA project in the Whangapoua harbour and catchment. Humphreys and Tyler (1995) describe three main remnant wetland areas in their survey report for the Protected Natural Areas Programme (PNA).

1. The Opitonui River Mouth Wildlife Management Reserve: This area is classified as "Government Purpose Reserve" and is protected by the S.22 Reserves Act 1977. The area of 2.5 ha covers a small section of an estuarine ecosystem.
2. The Waingaro Stream bog: A site covering 25 ha was described as a Recommended Area for Protection (RAP) in the PNA survey report (1990). The area includes manuka/Baumea rush-shrubland species as well as raupo-flax reedland and provides habitat for the *At Risk/Declining* fernbird (*Bowdleria punctata vealeae*) and spotless crake (*Porzana tabuensis*). Humphreys and Tylers (1990) discussion of the area states:

> *"This is the largest remaining example of this type of wetland in the Colville Ecological District and one of only a few peatlands in the Coromandel Ecological Region. It is unmodified by farming practices, and provides important wildlife habitat. Freshwater wetlands were once a feature of the upper reaches of many of the district's harbours and estuaries."*

Increased sedimentation associated with logging of the production forestry in the catchment is identified by Humphreys and Tyler (1995) as a key threat to the wetland ecosystem as well as alteration of drainage patterns.

3. Otama Bay: An area of 42 ha was described as a RAP in the PNA survey report which included approximately 20 ha of estuarine wetland. The wetland includes *Juncas maritimus-Leptocarpus similis* rushland and manuka-marsh ribbonwood rushland and provides habitat for the At Risk/Declining fernbird (*Bowdleria punctata vealeae*) and spotless crake (*Porzana tabuensis*). Regarding representativeness naturalness, the area is described as:

   > "*The best example of contiguous dune and estuarine wetland in the Colville Ecological District and the best in the Coromandel Ecological Region. The least modified examples of these communities in the district, although there are some impacts from farming practices and introduced plants."*

   Management of the Otama catchment was recommended by Humphreys and Tyler (1995) to protect the wetland values, and stock access, drainage and subdivision development were identified as threats to the site.

Otama wetland lagoon

The PNA survey report also recommended that the Whangapoua Harbour be included as a PNA as "*The most representative and largest estuarine system in the Colville Ecological District*." Threats identified included further development of the Matarangi Spit Beach Estate, water quality pollution from sewage and increased sediment loads during logging of production pine forests in the catchment, and agricultural pressures.

There is a highly significant coastal wetland at Matarangi Wildlife Habitat Reserve which is managed by DOC. Estuarine to freshwater wetland sequences are rare or highly fragmented on the Coromandel Peninsula. Beadel (2014) outlines a number of management objectives for this site, including control of pampas and agapanthus.

11.4.2 Role and restoration of wetlands

Wetlands are important storage areas for floodwaters and act as the 'kidneys' of the estuary because of their sediment and other contaminant-trapping properties. Wetland plants slow the flow of water off the land and in times of flood, water is absorbed into the organic wetland soils. In summer, stored water is slowly released to maintain water flows and provide better habitat for stream life. Wetland plants also trap sediment suspended in the water, improving water quality. Bacteria living in wetland soils absorb and break down nitrogen from farm run-off and leaching, also improving water quality. In addition, wetlands reduce the amount of nitrogen entering waterways and therefore help to prevent algal blooms and nuisance plant growth.
Wetland ecosystems also support fish populations and generally sustain diverse animal and plant communities. These ecosystems are under threat when drainage occurs.

Farming and settlement activities have disrupted most natural wetland sequences in the Whangapoua catchment, mainly impacting on freshwater vegetation communities. Extensive "wet" areas of the catchment (including remnant streams, wetlands and harbour margins) have also been drained. When modified or drained, these lower catchment environments are significantly less effective at buffering the impacts of flood waters, and drainage often leads to irreversible drying and shrinking of wetland ecosystems. In addition, they are also no longer able to operate as biodiversity corridors for plant and animal species.

To protect, enhance and restore the wetlands that remain it is essential the hydrology, vegetation and connectivity of wetlands to both terrestrial and aquatic environments are safeguarded.

The Council is currently developing guidelines for "Constructed Treatment Systems for Surface Water Inflows to Shallow Lakes". These guidelines will assist interested parties including local government agencies (such as regional and district council, DOC, Fish and Game, NZ Landcare Trust), landowners and care groups, consultants, agricultural advisors and contractors with the design of appropriate and effective constructed treatment systems for mitigating sediment and nutrient runoff from agricultural land use within the Waikato Region.

Constructed wetland treatment systems can effectively reduce inputs of sediment and nutrients to water bodies if carefully designed and maintained. The guidelines describe a number of possible designs including infiltration, open-water and floating wetlands as well as sedimentation ponds. Treatment systems as management tools, however, should be considered as secondary measures after best management practices have been implemented by landowners and all efforts made to minimise nutrient and sediment runoff to waterways. The principles of the guidelines may also be applicable for managing sediment and nutrient inputs to the Whangapoua Harbour through creating constructed wetlands and sedimentation ponds.

11.5 Pest management

Pest plants and animals are one of the greatest threats to New Zealand's unique biodiversity values (particularly possums, goats, rats, mustelids), with certain pests also posing a threat to our agricultural industry. Animal pests cause the decline of palatable flora such as kohekohe, pohutukawa and northern rata and vulnerable fauna such as kereru. Possums and goats in combination have the potential to cause hill-side slips, canopy collapse and regeneration failure of a wide range of species within these forests. Mustelids are a primary agent of decline for species such as kiwi; however targeted management is resulting in local increases in the kiwi populations.

Exotic plants or other organisms can invade habitats and displace, interfere with or infect indigenous species or ecosystems. The result is disturbed and depleted ecosystems or possibly even local extinction of individual species. Closed-canopy and more mature forests are highly resistant to weed invasion, though shade-tolerant ground-covers (e.g. wandering Willy, African clubmoss and ginger) and trees and shrubs (e.g. monkey apple and palms) can readily invade. In the Whangapoua/ Hukarahi Conservation Area, *Phytophthora* (taxon Agathis; PTA) has recently been discovered which is known to cause kauri dieback. (Refer to Section 0.)

The Waikato Regional Pest Management Plan (RPMP) guides the Council's pest management activities across the region. Pest management is a large scale job which relies on the support of landowners, land managers and volunteer based conservation focussed groups.

The responsibility for managing pest plants and animals largely sits with the land owner. This applies to private landowners and land owned or managed by public agencies (e.g. DOC, TCDC and Crown land). However, in certain circumstances, pest control is identified as a high priority and will be undertaken through direct control by Council contractors.

The Waikato RPMP focuses on high value biodiversity sites, identified by the Council as containing valuable indigenous plants and/or animals or their habitats. These include:

- Indigenous ecosystems or habitats that have been reduced to 20% or less of their original extent in an ecological district, ecological region, or nationally
- Wetlands and sand dunes
- Ecosystems that have always been limited in extent, including coasts and limestone formations
- Habitats for New Zealand's most threatened native species or those endemic to the Waikato region.

Evergreen buckthorn

Lantana

Specific issues in the Whangapoua catchment include:

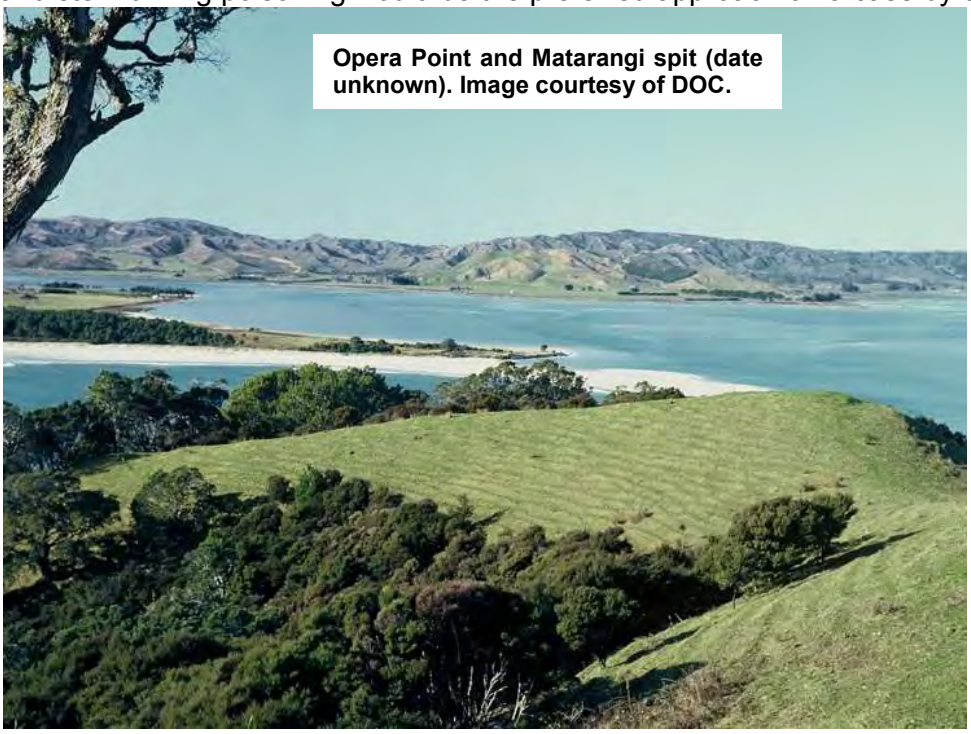
- Introduced pests (such as possums, goats and rats)
- Modification of wetland systems by invading species
- Stock access and weed invasion compromise the spawning habitat of native fish in river mouths and estuaries
- Access to the waterways and wetlands are under threat due to pest plant invasion along their boundaries (e.g. pampas)
- Estuarine pest plants found along the harbour margins in Whangapoua and Otama
- Presence of Canadian geese in the Whangapoua Harbour.

Beadle (2014) identified a range of pest plant species occurring in the freshwater margins of the harbour, including eucalyptus (*Eucalyptus* sp.) in the Matarangi Wetland (which was identified as a high priority for control) along with willow (*Salix* sp.), pampas, and woolly nightshade (*Solanum mauritianum*). Other weed species requiring control include marram (*Ammophila arenaria*), dimorphotheca (*Osteospermum fruticosum*), iceplant (*Carpobrotus edulis*), pines (*Pinus* sp.), willows, gorse (*Ulex europaeus*), agapanthus (*Agapanthus praecox*), boxthorn (*Lycium ferocissimum*), monkey apple (*Syzygium smithii*), and bamboo.

Beadle (2014) also identified pest animal control (particularly of rats and stoats) as a priority for increasing the breeding success for “Threatened” or “At Risk” bird species (such as NZ dotterel, caspian tern and North Island fern bird), the control of rabbits as a requirement for protecting dune vegetation, and the control of possum and goats as being important for indigenous plant species, particularly in SNAs.

Within the Whangapoua catchment pest animal control is primarily undertaken by community groups, Ernslaw One Ltd and DOC. The Council focuses on controlling plant species and supporting iwi, community groups and other agencies with their predator control programmes.

In 1995 DOC also removed many pinasta (pines) from the old mill/pa site on the on the southern side of Opera Point. DOC currently has a project for removing wildling pines and other weeds at Opera Point Historic Reserve. While there are a number of methods available for treating pines (ranging from selective felling, clear felling for extraction to poisoning through stem injection) due to the significance of the site and its location (bordered by the sea/ estuary), removing the pines will have to be a delicate operation as substantial damage could be inflicted on the Pa site, middens estuary embankment, houses and the visitor track. It is expected that a mix of selective felling and stem drilling/poisoning would be the preferred approach on a case by case basis.

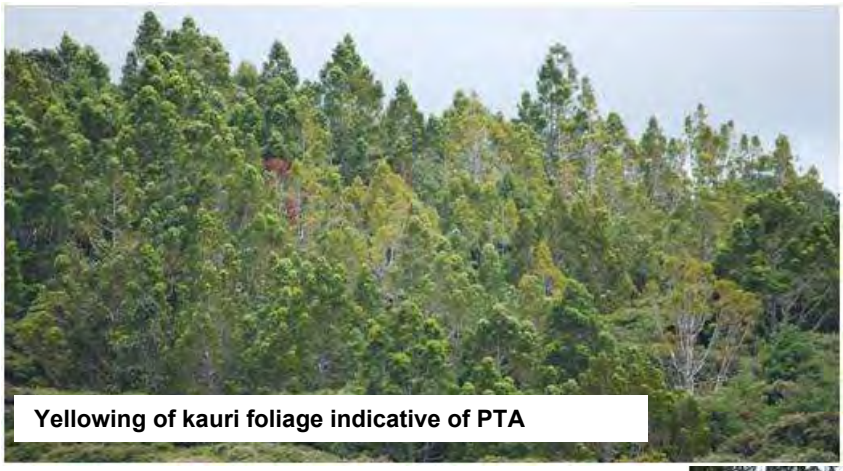


Opera Point and Matarangi spit (date unknown). Image courtesy of DOC.

11.6 Kauri dieback

11.6.1 Kauri PTA

Kauri dieback is the deadly kauri disease caused by Phytophthora taxon Agathis (or PTA). Following DNA studies, this fungus-like disease was formally identified in 2008 as a distinct and previously undescribed species of Phytophthora. Kauri dieback is specific to New Zealand kauri and can kill trees of all ages.



Yellowing of kauri foliage indicative of PTA

Dead kauri tree succumbed to PTA

Microscopic spores in the soil infect kauri roots and damage the tissues that carry nutrients within the tree. Infected trees show a range of symptoms including yellowing of foliage, loss of leaves, canopy thinning, dead branches and lesions that bleed gum at the base of the trunk. Some infected trees can show canopy dieback and even be killed without any gum showing on the trunks as kauri dieback also acts as a severe root rot below ground.

Nearly all infected kauri die. In the past 10 years, kauri dieback has killed thousands of kauri in New Zealand. Scientists are currently working to find control tools for this disease but there is no known treatment at this time.

11.6.2 Whangapoua Kauri PTA action plan

PTA was identified on the Coromandel Peninsula in March 2014, initially on DOC land known as the "Hukarahi Block". Further investigations have led to the detection of the disease on at least four other sites in the Whangapoua area with a further two areas being tested for the disease.

Intervention is needed to successfully manage PTA in the Whangapoua area. Implementation of measures aimed at containing the spread of this disease will rely on willing participation of land owners or their representatives. However, given that this is a reasonably small catchment with limited public access. Successful delimitation of PTA is anticipated.

It is proposed that a specific kauri dieback action plan will be formulated for the Whangapoua area. This will be an easy to interpret plan that depicts the risks and provides a concise "snapshot" of the kauri lands in the Whangapoua area. It will also include a series of actions which will assist Council in developing partnership agreements with landowners/managers to implement targeted actions aimed at containing kauri PTA.

This plan will be the result of a collaborative effort from agencies, mana whenua and land owners, with the aim to provide actions and guidance to all involved.

Bleeding Kauri tree indicative of PTA infection

11.7 Freshwater ecology

11.7.1 Fish

The fish assemblages in the Whangapoua catchment are typical of other streams and rivers in the Coromandel Peninsula. Species such as longfin eel, shortfin eel, red fin bully, banded kokopu, giant bully, common bully, inanga, torrent fish and koura are found within the catchment.

Banded kokopu

Giant bully

11.7.1.1 Issues affecting fish communities

- Ensuring natural river connectivity throughout the catchment (i.e. ensuring culverts or small water retention structures etc) do not impede native fish – this is particularly important in this harbour as all the fish species recorded in the streams of the catchment migrate between freshwater and the ocean at some stage during their life-cycle (i.e. it is a lifecycle requirement). Structures which disrupt the "connectivity" of streams contribute to the decline in aquatic biodiversity, particularly affecting the abundance and health of fish populations that migrate (Bruno et al, 2014).
- Riparian margin protection: Many fish species rely on riparian margins for a range of functions including terrestrial food inputs to stream (e.g. manuka beetles etc) and shade to keep water temperatures cool and oxygen levels high. Branches and wood that fall into streams also provide important habitat features for fish and stream invertebrates that use the structure for both feeding and refuge in the riffles and pools that form around these nature structures.
- Riparian margins are also critically important for many fish species with respect to reproduction. In particular some species require moist understory conditions for successful egg development (e.g. banded kokopu lay eggs in riparian margins during elevated flows and they continue to develop in air until the next rainfall event hatches them out). Moisture ensures the eggs remain viable and do not dry out. Similarly intact vegetation on riparian margins in tidally influenced areas is critical for inanga spawning.
- Riparian margins also maintain bank integrity (root systems hold erodible banks together). Many streams in this catchment have cobble/stoney substrates which provide complex streambed habitat for both stream invertebrates (which are also a food source that fish feed on) and some fish species. For instance, redfin bullies set up territories within submerged streambed rock spaces and will also use larger rocks for laying eggs and guarding nest sites. Excess sediment from unprotected banks can fill in many of these rock spaces and if sedimentation is severe, stream productivity (i.e. redfin bully and invertebrate abundance) will suffer.
- Sediment and to a lesser degree contaminant inputs from road run-off is a potentially major issue due to the frequency of rainfall events and the high energy nature of streams in this catchment.
- Potential development of impervious areas – if continued development occurs in this catchment (including any hard surfaces), it is important to ensure that changes to the natural balance of flows within the watershed do not change appreciably. Point source runoff from houses and other hard surfaces if not attenuated appropriately will result in even higher flash flood flows to these rivers with potential consequences for in-stream values (e.g. exacerbated erosion and downcutting of stream channels affecting fish and invertebrates).
- Some specialised fish species are more influenced by water abstraction than others e.g. torrent fish which have a specific preference for very fast water. Abstraction pressures will affect the habitat requirements of torrent fish to a much greater degree (proportionally) than other species.

Longfin eel

11.7.2 Invertebrates

The Council has been carrying out annual surveys of aquatic invertebrates and habitat (Regional Ecological Monitoring of Streams—REMS) since 1994 as part of its Environmental Indicators Programme to document the state and trend of the ecological condition of streams and rivers in the region. The composition of invertebrate communities provides an integrated measure of a stream's health influenced by local and upstream activities that affect water quality and the physical stream environment or habitat. Information on invertebrate community composition is condensed into 'metrics' that can be used as indicators to report on changes over time (trends) or patterns across the region (state) (Collier and Hamer. 2012).

The Council has collected seven invertebrate samples from four streams located within the Whangapoua HCMP area between 1995 and 2012. The locations and dates of this sampling are as follows:

Awaroa Stm at Wade Rd	9-Jan-97
Awaroa Stm at Wade Rd	29-Jan-98
Opitonui River at Opitonui Road	10-Feb-95
Opitonui River at Opitonui Road	9-Jan-97
Waitekuri River at Rd 41 Ford	29-Jan-98
Waingaro Stm (Te Rerenga)	13-Jan-09
Waingaro Stm (Te Rerenga)	8-Feb-12

The monitoring at Waingaro Stream forms part of the Councils current State of the Environment monitoring programme. This site was sampled in 2009, 2012 and 2015. This site forms part of Councils network of sites which have been randomly selected to provide an estimate of ecological health of the Regions wadeable streams and rivers (on developed land).

The marcoinvertebrate sampling from this location is indicative of Fair (probable moderate pollution) to Good (possible mild pollution) in terms of ecological stream health (See Appendix 7 for detail on the REMS programme). Pollution sensitive invertebrates (species such as mayfly, stonefly and caddisfly) are relatively rare at this site indicating it may be subject to some pollution.

The habitat assessments for this reach of stream place it in above average when compared with other sites on developed land across the Waikato region, and this appears to be largely due to the presence of riparian vegetation. However, bacterial growths of iron flocculent are abundant at the site, and fine sediment deposition at the site would be considered to be of a marginal quality for aquatic macroinvertebrates.

Nearby reference condition sites (3 sites chosen in catchments with >80% native vegetation cover on the Coromandel Peninsula) tend to have macroinvertebrate

communities indicative of excellent stream health (clean water). High habitat assessment scores at these reference sites also tend to reflect high quality instream and riparian habitats/protection (e.g. low amounts deposited fine sediment, and important functions provided by riparian buffers such as shade and food supply).

Low gradient, lowland sections of coastal freshwater streams are at risk from development and land use higher up in the catchment. Fine sediments and nutrients in particular can have negative impacts on downstream invertebrate communities (e.g. by smothering invertebrates and their habitat, and promoting algal growths). Agricultural development and loss of riparian shade, and increased demand for water, can all contribute to a loss of suitable habitat for sensitive species of aquatic macroinvertebrates.

11.8 Community biodiversity groups

There are a range of community-led groups taking action within the Whangapoua catchment to restore and enhance biodiversity, a summary of these is provided in as shown in Table 12.

The first release of kiwi into the Whangapoua Forest Biodiversity Block

Above left: (left-right) Ernslaw Whangapoua Forest Manager Norbert Klein, Project Kiwi Trust co-manager Jon Williams, Ernslaw One Managing Director Thomas Song and financial manager Leh Sieng Tang.

Above right: Representatives from Department of Conservation, Ngati Huarere, Te Rerenga School, and the Project Kiwi Trust attending along with employees of Ernslaw One Limited attended the release of Maui and Bear Claw.

Table 12 Community biodiversity groups

Group and contacts	A bit about the group
Kauri 2000 Trust	This group evolved out of a project to mark the start of the new millennium with a goal to plant 2000 kauri. To date the Trust has planted over 40,000 kauri on the Coromandel Peninsula and continues to plant kauri throughout the Coromandel. The Trust presently assists restoration groups in the Matarangi/Rings Beach Reserve and Waitaia/Kuaotunu areas.
Kuaotunu Beachcare Group	This group, focusing on Kuaotunu East and West and Otama beaches, is involved in building access ways, and planting dunes and reserves.
Kuaotunu Reserve Management Group	This group is involved in maintaining and enhancing reserves along the beach front and coastal strip of Kuaotunu and Rings Beach.
Matarangi Beachcare	This group is involved in restoring dune areas.
Mana Manu Trust	This group is based on the fringe of Whangapoua settlement and comprises a group of landowners who saw benefit in coordinating their pest control efforts. The group undertakes predator control, wilding pine control; wildlife monitoring and planting programmes.
Matarangi Wetland Biodiversity Restoration Project	This group is focused on restoring the Matarangi reserve wetland and surrounding forest (253ha), including planting, weed control and pest control.
Opito Bay Environment Group	This group began in 2002 and since then has planted over 17,000 native trees on a section of retired farmland off Black Jack Road. They have also have undertaken extensive plant pest removal (cotoneaster, pampas, tobacco weed, wilding pines, ginger and arum lilies), as well as predator control (possums, rats and stoats).
Project Kiwi Trust	This group has as its objective to protect and enhance the kiwi population and continue to restore the ecosystem on the Kuaotunu Peninsula. The Coromandel Brown Kiwi (*Opteryx mantelli)* has been identified as a Threatened-Nationally Vulnerable species (NZ Threat Classification System Lists 2008). The Trust was established in 1996 and has implemented a range of strategies for pest and predator control as well as captive-rearing of kiwi. The Trust manages 2,850 ha for kiwi habitat and 520 ha for pest and predator management.
Rings Beachcare Group	This group is involved in planting restoration of the fore dune and back dune.
Rings Beach Wetlands project	This group, working under the umbrella of the Coromandel Peninsula Coastal Walkways Society started in 2006. With the permission of DOC, they have developed a 4.7km (2 hour) walking track in the Rings Beach Reserve. In addition they have planted over 4,000 trees (since 2009), have focused on the restoration of a wetland area, and have undertaken predator control (over 3000 predators eliminated since 2009).
Whangapoua Beachcare Group	This group is involved in restoring dune areas.
Whangapoua Harbour Care Catchment Group	The aim of this group is to improve the quality of water entering the harbour from the catchment area, particularly through planting and fencing initiatives.
Whangapoua Ratepayers Association	This group has been involved in projects to preserve native bush.
Whangapoua Reserves Management Group	This group is involved in planting and maintaining Council Reserves, along with weed control, pest control, and fencing.

Part four: Key actions

12 Introduction

Part Four of the HCMP builds on the five key themes by identifying the current actions being undertaken, and recommending future actions appropriate to address the issues raised through community consultation (Section 4.2) and the information in Part Three of this plan.

The issues and actions are presented under the key themes identified in Section 4 of this plan:

- The people
- Land
- Water
- Coast and harbour
- Biodiversity.

It is acknowledged that there are inter-linkages between many of these issues and actions and therefore cross-references are made between them where appropriate.

It is also recognised that many of the issues have occurred through historic actions and complex processes. This HCMP shall focus on what actions we will be able to undertake in order to make a difference to the Whangapoua harbour and catchment in the next 10 – 50 years.

13 The people

Key issues which were raised during consultation and which underpin all activities within the harbour and catchment area included acknowledgement that:

- Co-management of environmental resources with tangata whenua is anticipated as a result of the Haruaki Iwi Treaty Settlement
- Involving iwi and maatauranga Maori into environmental decision-making and actions is required
- There is a declining permanent population and that the community has limited volunteers to help undertake actions
- There is a desire for economic development in the area
- Maintaining and enhancing the natural character of the harbour and catchment are important to the Whangapoua communities
- There are funding constraints.

What is the issue?	What is happening	Proposed future actions
• Lack of knowledge about traditional cultural resource use and sites of significance. • Lack of knowledge about archaeological sites of importance. • Concern with the decline of the mauri of the harbour.	• Community volunteer groups are involved in a range of different conservation or enhancement projects within the catchment. • TCDC has controls in its District Plan to manage sites of significance, including protocols for discovery. • DOC manages historic sites it administers. ***Refer also to Biodiversity actions***	• The Council will assist in preparation of an iwi environmental management plan, including discussion with iwi on including maatauranga maori. • The Council will undertake archaeological and sites of significance work as a sub-set of the RMA plan reviews. • DOC plans to increase interpretation of historic and cultural values at Opera Pont Reserve.
• There is a need to address co-governance framework and operation, once the Treaty of Waitangi settlement has been finalised, as this may alter actions in the catchment.	• Currently the Waitangi Tribunal negotiations are in progress.	• Post-settlement, the Council will discuss with iwi the review period of this plan (refer Section 18). ***Refer also to actions below***
• Lack of information about resources from a Maori perspective.	• Various legislation enables different tools for managing/ protecting resources. • A shellfish monitoring resource kit been developed for use in schools. Various agencies have research funding available by application (e.g. Te Pae o te Maramatanga	• Iwi, in conjunction with other agencies to collate a “tool box” of customary tools available to be used to safeguard/ protect resources (e.g. rahui). • Iwi alongside youth to undertake cultural mapping.

	for economic or environmental research, or Te Mana o Te Wai for water quality).	• Iwi alongside youth and/or agencies to undertake environmental monitoring including kaimoana.
• Insufficient reserves and recreational experiences. • People not understanding the importance of reserves.	• TCDC has Reserve Management Plans that outline the use, management, proposed improvements and work schedule for Reserves. Reserves are categorised according to their size and type of use to provide experiential opportunities based on natural, historic and cultural values, and recreational use. A key objective in these plans is the protection of natural areas representative of the range of natural ecosystems of the region, and the enhancement of natural ecosystems that have high ecological values or are under threat or under-represented (such as wetlands); or which function naturally (e.g. sand dunes). • DOC manages access to and information about reserves. They are currently focusing on Opera Point Historic Reserve. ***Refer also to Biodiversity actions***	• The Council, DOC, TCDC, iwi and community will explore opportunities for increasing or improving recreational opportunities for its communities and visitors e.g. bush walks, cycle trails, mangroves board walk.
• There is a need for papakainga developments within the catchment.	TCDC District Plan currently has provisions for papkainga housing.	• Iwi to undertake further work in identifying appropriate papakainga areas.
• Lack of co-ordination between groups and organisations in the catchment (including non resident ratepayers).	• The Council, TCDC and DOC have newsletters and websites that are used to inform residents and ratepayers. • Regular management level meetings are held between operational managers of the Council, DOC, TCDC, through the Peninsula Project.	• Subject to the Hauraki Iwi Treaty Settlement, agencies will discuss/ action management arrangements and/or other transitional matters. • The Council will work with iwi and community in applying for additional (external) funding for projects. • The Council, DOC, TCDC, Iwi shall meet annually (prior to the organisation's budget rounds) to discuss work programs and planned initiatives, and discuss or identify opportunities for collaboration. • The Council will take a facilitating role in discussing with community groups how best they would like to co-ordinate their actions and with agencies (e.g. newsletters, websites, contact lists etc).

		Refer also to Monitoring actions
• Lack of information about what the impacts could be of future land-use changes in the catchment and the need to address potential adverse effects.	• The Coromandel Peninsula Blueprint was the overall guiding document on growth areas of the Coromandel. Growth is concentrated in existing settlements and the natural seaside character of settlements outside these areas is to be maintained. ***Refer also to Land actions***	• Establish a "focus group" of the Council/ TCDC/ DOC/ Ernslaw/ Iwi/ community representatives to discuss issues and potential actions which may arise from management changes in the catchment, this might consider sustainable alternative uses and opportunities for economic development, and investigating a cost-benefit analysis for long term forestry use and/or potential alternatives. • Impacts of land use change may be considered through the review of the Regional Plan. • The Council will continue to build strong relationships with landowners. ***Refer also to Land actions***
• Loss of natural character	• DOC provides national direction on natural character within the coastal environment through the NZ Coastal Policy Statement 2010. • The Council and TCDC through the Regional Policy Statement, Regional Plan and District Plan identify areas of high natural character in the coastal environment. These areas are then subject to specific methods which outline use and development actions as appropriate for the location.	***Refer also to Biodiversity actions***

What can you do?

- View the **Mercury Bay North Reserve Management Plans** for detail on actions to be undertaken on the Whangapoua, Matarangi, Kuaotunu and Rings Beach, and Otama and Opito reserves.
- Find out about voluntary groups and get involved. The Waikato Biodiversity Forum can connect you with groups in your locality or provide advice and support for those wishing to create a group. See www.waikatobiodiversity.org.nz for further details and refer to section 10.8 of this plan.

14 Land

Key issues which were raised during consultation and from the information in Part Three included acknowledgement that:

- Land use activities need to be compatible with the land characteristics, such as soils and slope
- Erosion and sediment in waterways is a natural process, human activities have exacerbated this process. Soil loss reduces land productivity and increases the level of nutrients and turbidity of waterways.
- Restoration of natural ecosystems such as wetlands and riparian plantings can assist in the management of sediment and nutrients in waterways.
- Alternative land uses and/or land use practices may be required for the future.

What is the issue?	What is happening?	Proposed future actions
Agriculture: • Land erosion • Loss of productive soils/land/nutrients • Stream bank erosion	• The Council's Catchment Management Officer's work with landowners and other sections of Council (such the Environmental Management Unit) to advise landowners on actions such as; o Retirement and/or soil conservation planting of steep erodible land o Fencing and planting of riparian margins, wetlands and native forest boundaries and fragments. o Best practice with regards to placement and construction of stock crossings and races o Mitigating stream erosion issues, through control structures and /or planting • The Council provides substantial funding assistance for fencing and planting. • The Waikato Regional Plan includes rules relating to stock exclusion from waterways. It identifies priority stock exclusion areas (resource consent is required for any stock entering or crossing these streams/ rivers). Within the Whangapoua catchment, this	• The Council is developing a river management and restoration works programme for each sub-catchment (refer Appendix 8 for preliminary works costing). • The Council will work in agreement with landowners to develop comprehensive farm plans. These would include: nutrient budgets, assessment for placement/construction of race, crossings, standoff pads etc, best practice effluent management systems, fencing and planting of waterways, wetlands, and remnant forest areas, and assessment of erodible areas where most appropriate to retire/ exclude from stock. • The Council will work with landowners to where possible fence the remaining 20% of the catchment riparian margins, to exclude stock. • The Council will work with landowners to where possible fence remaining coastal and harbour margins, and wetlands, to exclude stock. • The Council will organise on farm discussions and field days.

	includes sections of the following streams/rivers: Awaroa, Horonoherehere, Kaipapaka, Kuaotunu, Mapauraki, Opitonui, Otama, Otanguru, Owera, Pekapekarau, Pitoone, Stewart, Tahunatorea, Waihaupapa, Waikarikia, Waimata, Waingaro, Wairiri, Waitaha and Waitekuri.	• The Council will encourage landowners to fence remnant bush areas to protect biodiversity values for the future. • The Council will work with landowners, TCDC and New Zealand Transport Agency (NZTA) to ensure culverts, bridges and drains are constructed and maintained so as to minimise sediment losses and maximise fish passage. • The Council will investigate opportunities to establish a "showcase catchment" where best practice and alternative methods for sediment minimisation techniques are demonstrated/ trialled. • The Council, TCDC and DOC along with community input will jointly identify opportunities for wetland/ dune restoration for the purposes of sediment retention. This may include investigation into areas currently owned/managed by TCDC/ DOC/ LINZ which would be suitable to fence/ re-plant. ***Refer also to Biodiversity and Water actions***
Forestry: • Land erosion • Loss of soils • Stream bank erosion • Potential land use conversion (e.g. pine-pasture)	• The Council undertakes compliance monitoring to ensure forestry operations are undertaken in accordance with resource consent conditions. • Protection of existing areas of indigenous forest, riparian margins and wetlands within forestry areas managed by Ernslaw One Ltd. • Ernslaw One Ltd provides information to the community on forestry activities and monitoring in the catchment.	• The Council will continue to work with Ernslaw One Ltd regarding best practice approaches to managing earthworks and effects on soils from harvesting. • Ernslaw One Ltd and the Council will continue to provide feedback to the wider community on forestry activities and monitoring in the catchment. • The Council will work with Ernslaw One Ltd in investigating further opportunities for retirement/protection of wetlands, riparian areas and in the development of a potential 'showcase catchment'.
Indigenous cover: • Loss of indigenous vegetation cover leading to erosion/slipping	• TCDC and the Council control indigenous vegetation removal through Regional and District Plans.	• The Council will explore opportunities (with DOC/ wider community) for broad scale possum control in the upper catchment, for the purpose of maintaining healthy canopy cover in native forest.

		• The Council will promote stronger controls on the removal of indigenous vegetation from erosion prone land, in the upcoming review of the Regional Plan. • DOC will investigate opportunities to expand current goat control operations into the upper ranges of the catchment. ***Refer also to Biodiversity actions***
Other land uses: • Inappropriate land uses can exacerbate erosion and soil loss	• The Council provides advice and education to landowner/ managers regarding impacts and alternative land uses for erosion prone land. • The Council will use the information outputs from the Waikato Regional Prioritisation Project to inform decision making around priority areas for sediment retention within the catchment.	• The Council will support community/ other agencies in exploring opportunities to purchase erosion prone land for retirement. • The Council will investigate regulatory controls on land use change and development in the up-coming review of the Regional Plan. ***Refer also to the People actions***

What can you do?

- **Ring the Council** and talk with a Catchment Management Officer. They are friendly, knowledgeable soil conservators who will visit you on your farm for free and talk through options for fencing, planting, weed control, pest management and farm management planning that is specific to your land and tell you about the funding assistance that's available to you.
- **Talk to other farmers**: We listened to many farmers within the Whangapoua catchment about their first-hand experience of farming this land for decades. Some are third generation farmers on the land.
- **Have a look at best practice guides** for farms. Here you will find information on land drainage, dairy effluent storage and management, land conversion, and the range of help available to farmers for planting, and managing waterways and wetlands.
- **Check out the following links:**
  http://www.waikatoregion.govt.nz/Community/Your-community/For-Farmers/Waterways-and-wetland-management/
  http://www.waikatoregion.govt.nz/Community/Your-community/For-Farmers/Water-takes/Water-takes/FAQs---Riparian-vegetation-management-plans/
- **Dairy NZ** is a source of information on dairy farmer and dairy industry environmental initiatives, such as the Sustainable Dairying: Water Accord http://www.dairynz.co.nz/file/fileid/47274, which commits to targeted riparian planting plans, effluent management, comprehensive standards for new dairy farms and measures to improve the efficiency of water and nutrient use on farms. The Council is among 'friends' of the Accord.
- **Beef + Lamb New Zealand** also provide information for farmers around sustainability and production *www.beeflambnz.com.*

15 Water

Key issues which were raised during consultation and from the information in Part Three included acknowledgement that:

- Land management and water quality are strongly related
- Areas of degraded water quality need to be addressed and point and non-point source discharges managed so that waters are safe for recreation and shellfish gathering
- Climate change will potentially bring increased flood and drought events, along with extreme winds
- Streams and riparian areas need to be managed for fish access and spawning
- Flooding of the floodplains is a natural process, but that some mitigation measures can be provided
- Restoration of natural ecosystems such as wetlands and riparian plantings, can assist in the management of water flows and quality.

What is the issue?	What is happening	Proposed future actions
Water Quality: • Declining water quality in streams, harbour and coastal areas • Increased nutrients and sediments are impacting on water quality (Refer also to Land section) • Bacterial contamination • Decline in water quality during peak summer periods	• The Council undertakes water quality monitoring for site specific areas, where potential problems have been identified or are areas of high recreational use. An example being the summer (2014/15) programme of water quality testing at four streams in the Whangapoua area. • The Council has water quality monitoring toolkits available for use by schools and groups. • The Council provides advice on septic tank location and operation to TCDC, through the rules in the Regional Plan and on request when new building applications are received. ***Refer also to Land actions*** relating to fencing, planting, farm plans etc • The Council will use the information outputs from the Waikato Prioritisation Project to inform decision making around priority areas for nutrient runoff minimisation in the catchment. • The Council are undertaking a regional review of all on-site wastewater risk information. • As a tool for managing water quality, the Waikato	***Refer to Land actions*** • TCDC will undertake investigations into the functioning and capacity of the Matarangi WWTP. This includes investigation into effects on human health, and ecological health in the Maupariki Stream and Matarangi Wildlife Habitat Reserve. There will also be a specific investigation into potential seepage from the treatment ponds. TCDC will work closely with iwi and community in identifying effects of the plant and opportunities to avoid, remedy or mitigate any adverse effects as appropriate. • The Council will analyse and follow-up on the results of the water quality monitoring programme (2014/15). The Council will liaise with TCDC and District Health Board regarding investigations into identifying sources of any contamination and any follow up actions as appropriate. • The Council will liaise with the local school(s) re: water quality monitoring. • The Council will work with TCDC and NZTA to manage point source stormwater discharges that feed directly into streams to determine if flow attenuation devices or

	Regional Plan defines water management classes and sets standards that must be met for each of these classes. The classes are based on characteristics and values of waterways and include: surface water, natural state, contact recreation and fishery. The standards defined for each class are to be taken into account for permitted activities and those activities requiring resource consents.	augmented plantings can be used to reduce the pressure variables within the watershed. • The Council will review the appropriate level of and methods for any on-going water quality monitoring in streams and the harbour • The Council will use the outcomes from the regional review of on-site wastewater risks to guide policy development in the upcoming review of the Regional Plan.
Water quantity/ flow/ flooding: • Rivers aren't able to function as natural systems • Natural river flows are interrupted • Wetlands are degraded and no longer accommodate flood flows • Lack of riparian vegetation exacerbates flood effects	• In accordance with variation 6 of the Waikato Regional Plan, the Council is working with farmers to assess resource consent requirements for dairy shed water takes, and plan to be finished this exercise by the end of 2015. • The Council regularly opens stream mouths where they have become blocked due to low flows or coastal sediment transport. This enables flushing, prevents stagnation of water in areas often used for bathing and alleviates flood potential.. • The Council has identified and mapped flood prone areas. This information is available on request at a property scale. It is also incorporated into the TCDC District Plan maps, where it can be used to guide subdivision and development. • The Council provides advice and assistance, along with some funding, to landowners for routine stream maintenance and improvements, primarily for flood mitigation purposes (e.g., erosion control structures, bed excavation, river diversions, removal of vegetation and blockages). • The Council holds a comprehensive consent for construction of erosion control structures and undertaking routine river works in the catchment • The Council and TCDC will utilise flood risk information	• The Council will in accordance with variation 6 to the Regional Plan, implement limits on water takes for streams and groundwater in the Coromandel, on a priority basis, where allocation issues are arising. • The Council and TCDC will promote water use minimisation techniques, reuse of grey water and on-site water storage. This might apply to both dwellings and storage of stock drinking water and dairy shed wash down water. • The Council will identify opportunities to proactively manage summer stream mouth closure events. This might involve investigating gradients and alignment of streams to allow for improved water flows. • The Council will investigate further opportunities to incorporate natural river system techniques in river/stream management works. • Through its work programmes the Council will work to identify and better utilise natural wetland areas and restore degraded wetland areas/functioning to assist in flood protection and water filtering. ***Refer also to Land and Biodiversity actions, as well as climate change actions in Coast and Harbour section***

	to ensure new applications for subdivision/development avoid risks on flood plain/ flood prone areas. • The Council provides advice to TCDC and landowners with respect to development in coastal and flood prone areas.	

What can you do?

- Find out more information on **water quality monitoring** on the Waikato regional council website http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Fresh-water-quality-monitoring/
- Get a plumbing and drainage contractor to inspect and maintain your septic tank. Know the capabilities of your system type so that the right sort and frequency of maintenance can be carried out. Replace your system if it is not working well.
- Sign up to the Civil Defence alert system http://www.waikatoregioncdemg.govt.nz/
- Find out about the risk from flooding on your property and mitigation options on the TCDC website. http://www.tcdc.govt.nz/Thames-Valley-Emergency-Management/Types-of-emergencies/Floods/

16 Coast and harbour

Key issues which were raised during consultation and from the information in Part Three included acknowledgement that:

- Sediment inflows into the harbour need to be addressed whilst acknowledging that this is also a natural process
- Potential areas for mangrove removal or associated management actions need to be identified and agreed with the community
- Coastal ecosystems, such as native saltmarsh areas, fish populations, shellfish beds, shorebird areas, dunes and vegetation, need to be restored and protected
- People wish to protect the high recreation and natural values of the coast and harbour.

What is the issue?	What is happening?	Proposed future actions
Information gathering; • Gaps in knowledge about coastal resources	• A Council project is currently underway compiling information on the coastal environment of the region. This information will be used to identify further research required, and to develop and implement priority actions. The project will investigate developing marine water quality standards, identifying coastal and marine significant natural areas (SNA) and seek to gain a better understanding of cumulative effects in the coastal environment.	• The outputs from this 5-year programme will be used to update the Whangapoua HCMP as they become available.
Bed of the Harbour: • Decline in shellfish • Access affected by channels filling up	***Refer to Land actions relating to*** sedimentation • District Health Board and Ministry for Primary Industries undertake monitoring programmes of shellfish. DHB can close areas from gathering where human safety is likely to be affected. • As part of food safety standards the oyster farm in Whangapoua Harbour undertakes water quality sampling to ensure safety of product for human consumption. • The Council has commissioned research into sediment source studies (refer section 9.2 of this	• Through the Seachange -Tai Timu Tai Pari Project agencies, iwi, stakeholders and industry are investigating options for marine protected areas. This work will then provide options to inform statutory processes as relevant to each agency. • The Council will support research on shellfish enhancement projects, and discuss options for progressing work in this area with iwi, DOC, and other key stakeholders ***Refer to Land and Biodiversity actions relating to sedimentation***

	plan).	
Coastal vegetation: • An increase in the spread of mangroves. • Increase in weed species. • Loss of coastal habitat from the expansion of weeds and elevated sedimentation	• The Council and TCDC, through Wildlands Consultants have identified areas within Whangapoua Harbour where mangrove seedling removal may be appropriate. • The Council commissions regular estuarine vegetation surveys for harbours. Whangapoua survey was undertaken in 2010. These surveys provide information on vegetation changes over time and hence inform management options. • DOC has a successful spartina control programme in Whangapoua Harbour. This has reduced spartina to a couple of discrete patches.	• The Council may as part of its wider vegetation management and harbour restoration activities undertake control of saltwater paspalum at key sites within the harbour. • DOC will continue its spartina control program. • The Council will consider long-term mangrove management options in the up-coming review of the Regional Coastal Plan. • The Council will consult iwi, DOC, TCDC and the community over options for mangrove management including options for a Whangapoua specific consent application and/or active involvement in mangrove control mechanisms (policy and rules) through the upcoming review of the Waikato Regional Coastal Plan. ***Refer also to Land and Biodiversity actions***
Coastal erosion • Dunes are vulnerable to impacts from sea level rise, people, and pest plants and animals. • Private property is vulnerable to the effects of sea level rise and potentially increasing numbers and intensity of storms (from climate change). • Areas of natural coastal vegetation needs room to migrate inland from the effects of sea level rise. • Coastal areas are vulnerable to tsunami risks.	• The Council takes an active role in restoring and protecting dune systems through its Beachcare programme. • DOC has a work program restoring the dunes at Otama. • The Council has prepared an Eastern Coromandel Tsunami Strategy and is currently working towards specific tsunami warning advice for coastal areas in the HCMP area. • TCDC has development set-back lines in their District Plan.	• DOC has an on-going role in managing the Otama reserve. • The Council has an on-going commitment to beachcare. • The Council and TCDC shall continue to work collaboratively on the coastal erosion strategy for coastal areas of the Coromandel impacted by coastal erosion. ***Refer also to Biodiversity actions***
Degradation of dunes • Dunes are vulnerable to impacts from storms, access by people and invasion	• The Council takes an active role in restoring and protecting dune systems through its Beachcare programme.	• The Council will undertake an assessment of dune-lands, including extent and condition, and will use this information to help prioritise actions and opportunities.

by pest plants and animals. • Plant species of cultural value have been lost from many dunes. • Dunes are one of the most modified and degraded of New Zealand's ecosystems. • Subdivision and development has been located too close in some areas, not allowing the dunes to migrate.	• The Council's Regional Policy Statement includes strong policy directives on protection and restoration of dune-lands. • The beach care co-ordinator undertakes annual reporting on progress of each Beachcare group • The Council is involved in a range of education and awareness activities. • The Council provides plants and materials as well as experienced advice from coastal scientists, to assist communities to design and implement actions.	• The Council is developing a strategic directions plan for the Waikato Beachcare programme.
Navigation safety • Conflicts between different water users • Crossing the bar at the harbour entrance can be difficult • Boat access channels can become shallow	• The Council has a number of navigation safety initiatives in place such as the marine mate phone app which provides updates on weather, bar crossing etc. A number of bar crossing videos are available and bar crossing advice is available from local harbour master. • The Council has prepared a Navigation Safety Bylaw which includes rules for safe use of waterways and a separate map for Whangapoua Harbour (refer Map18). NB: dredging would not be undertaken for boat access purposes. This would need to be fully funded by the community.	• The Council will continue to provide services from the Navigation Safety team.
Climate change: • Increased storminess leading to a potential increase in flooding and coastal inundation. Land use change and activities: • Location of human development in hazard risk areas. • Changes in land use practices that could exacerbate hazard risks.	***Refer also to Land and Water actions*** *(in particular future planning directives to increase flood hazard resilience on flood plains)* • The Council has undertaken coastal hazard assessments along the open coast sandy shorelines of Whangapoua and Matarangi. • Coastal development setback zones are included in the TCDC proposed District Plan.	• The Council will continue with the project to identify low-lying coastal land that is susceptible to coastal inundation and developing a web-based application to help identify the extent of inundation, along with supporting information on tide and storm water levels and projected sea level rise scenarios. • The Council will develop and provide information to the public and other stakeholders on projected climate change impacts on hazards.

Natural events: • Unexpected events such as tectonic movements, wild fire etc.		
Tsunami • Near-shore or distant tsunami cannot be predicted, but effects are likely to be experienced along the east coast of the Coromandel Peninsula.	• The Council and TCDC have initiated the Eastern Coromandel Tsunami Strategy Project.	• The Council will undertake tsunami modelling for the Whangapoua/Matarangi area. • The Council will work with TCDC, Civil Defence Emergency Management groups and emergency services to minimise the risk and damage to communities from tsunami and to prepare people for a tsunami and develop emergency response plans through our Civil Defence responsibilities.
Information sharing: • Information gathered from HCMP development and engagement processes linked to statutory processes.	• Regional Coastal Plan due for review 2016	• Provide information gathered through WHCMP process to inform the development of the Regional Coastal Plan process.

What you can do?

- Find out more about estuarine sedimentation in the two Council-commissioned publications:
- http://www.waikatoregion.govt.nz/Services/Publications/Technical-Reports/Estuary-sedimentation-A-review-of-estuarine-sedimentation-in-the-Waikato-region/ or
- http://www.waikatoregion.govt.nz/Services/Publications/Technical-Reports/TR-200812-Coastal-Sedimentation-What-We-Know-and-the-Information-Gaps/
- Learn more about mangroves and their role in the environment https://www.niwa.co.nz/freshwater-and-estuaries/research-projects/sediments-and-mangroves
- Join one of our Beach Care groups in your area. Register on the Council's Beachcare Links and Resources page for information about beachcare and about caring for our coasts. http://www.waikatoregion.govt.nz/beachcare/
- Sign up to receive our Beachcare newsletter at http://www.waikatoregion.govt.nz/Community/Your-community/Care-groups/Beachcare/
- Stay informed about tsunami risk and know the tsunami evacuation route in your town. Visit our page on the Eastern Coromandel Tsunami Strategy at www.waikatoregion.govt.nz http://www.waikatoregion.govt.nz/Services/Regional-services/Regional-hazards-and-emergency-management/Coastal-hazards/Tsunami/Eastern-Coromandel-Tsunami-Strategy/
- Read the information on tsunami provided on http://www.waikatoregion.govt.nz/Services/Regional-services/Regional-hazards-and-emergency-management/Coastal-hazards/Tsunami/

- Be prepared for a hazard event by checking out the Civil Defence Emergency Management website at: http://www.waikatoregioncdemg.govt.nz/
- If you have any concerns re the behaviour of water users, debris which is causing a hazard to navigation or you have ideas for the improvement of the harbour – please call 0800 800 401 and ask for Maritime Services or email harbourmaster@waikatoregion.govt.nz
- For more information about navigation safety have a look at www.waikatoregion.govt.nz/Services/Regional-services/Navigation-safety/
- Sign up to a bar crossing information day.

17 Biodiversity

Key issues which were raised during consultation and from the information in Part Three included acknowledgement that:

- SNAs need to be identified and protected for the future, including restoration in some areas
- Restoration of wetlands and other wet areas can help manage flood waters, as well as sediment and nutrient run-off
- Pest plants and animals are significant threats to biodiversity values
- Riparian management and natural river connectivity through the catchment are critical for fish species, including whitebait
- Community-based biodiversity groups make a considerable contribution to achieving biodiversity outcomes.

What is the issue?	What are we currently doing?	Proposed future actions
Habitat: • Decline in extent and health of indigenous habitats and species • Habitat fragmentation and barriers to migration of fish • Stock access destroying significant habitats and affecting waterways.	• The Council's Catchment Management Officers work with landowners to identify and protect biodiversity on private land (fencing waterways, wetlands and remnant bush). • The Council's SNA Project identified areas of significant indigenous vegetation and significant habitats of indigenous fauna within the Whangapoua catchment. • TCDC has added this SNA information to LIM reports for properties within the TCDC district, but it is a "site-specific" responsibility to determine the impact of the SNA on a particular property. The TCDC District Plan Biodiversity overlay and rules then apply to any land meeting the SNA criteria	• The Council will identify priority sites and opportunities for wetland/ dune/ forest fragment restoration in conjunction with DOC, TCDC, iwi and landowners, and opportunities to restore biodiversity corridors. This could include investigation of suitable areas currently owned/ managed by TCDC/ DOC/ LINZ. • The Council will explore opportunities to enhance fish passage and habitat within the catchment. This could involve working with landowners and with NZTA/ TCDC to retrofit or improve on structures which provide barriers to fish movement. • The Council will continue to inform people of its research with regards to fish passage and habitat enhancement. • The Council will identify opportunities for wetland and dune

	• The Council undertakes estuarine vegetation surveys, to measure trends over time. • A Council project is currently underway compiling information on the coastal marine environment. • The Council commissions regular estuarine vegetation surveys for harbours. Whangapoua survey was undertaken in 2010. These surveys provide information on vegetation changes over time and hence inform management options. • The Council in its Regional Policy Statement has included a method that local biodiversity strategies will be developed (Method 11.1.10). The Council is undertaking a pilot project (for the Waihou catchment) and this will then be reviewed and the learning's applied to other areas within the region. These strategies will be developed on a district-wide basis and in conjunction with District Councils. As a contributing piece of work the Council is also currently completing a biodiversity inventory for the region. Council staff have and continue to work on various research related to improving fish passage and habitat enhancement. This includes developing guidelines/ reports on the use of mussel spat ropes for improving fish passage through structures (e.g., perched culverts) and habitat enhancement opportunities for inanga spawning. • A wide range of community-led restoration projects are underway throughout the catchment which contribute to protecting and enhancing biodiversity values (see section 10.7). • There are various biodiversity prioritisation projects undertaken by various agencies (e.g. DOC - Natural Heritage Management System, The	restoration through involvement in the review of TCDC's reserve management plans. • DOC will discuss and promote an upgraded walkway at Opera Point, with better reflection of the historic and ecological values. • The Council will explore opportunities (with DOC/ wider community) for broad scale possum and goat control in the upper catchment ***Refer also to Land actions***

	Council's Waikato Prioritisation Project). • The Council, DOC, and TCDC provide varying contestable funds for biodiversity protection and enhancement projects. • DOC have a programme aimed at increasing populations of the threatened plant, pimelea. • The DOC and Newmont Gold New Zealand Dotterel Programme is a dedicated project focussed on the management of NZ dotterel breeding sites across the Coromandel. Within the catchment this includes: Opito, Otama, Rings Beach, Whangapoua, New Chums and Matarangi. • Planting on TCDC Reserves is in accordance with the TCDC Tree Master plan. • TCDC has controls in its District Plan for managing biodiversity outcomes, such as the proposed Conservation Lot Subdivision provisions. • TCDC in its Mercury Bay North Reserve Management Plan aims to work with reserve neighbours to establish linkages across ecosystems including wildlife corridors, estuarine and coastal margins.	
Introduced plant and animal pests can: • Degrade shorebird breeding areas • Adversely affect habitat of indigenous fauna, such as kiwi • Out compete native plant species.	• The Council's Catchment Management Officers, Biodiversity and Biosecurity officers provide support and advice to landowners and community groups on animal and plant pest control, including marine pests. • The Council supports MPI and DOC in management programmes, such as those targeting containment of Kauri PTA, or marine pest incursions. • The Council are involved in a nationwide biological control programme using natural (host specific)	• Community-led volunteer groups will undertake on-going predator and weed control. • The Council has an on-going role in containing the spread of weed species. • The Council and TCDC will assist in preventing the spread of kauri PTA by managing earthworks in the vicinity of SNA's and remnant areas containing kauri. • DOC will undertake on-going observations and promote interpretative information on kauri die-back and methods for cleaning boots etc. • TCDC will consider cat and dog free and/or avian aversion

	insect and fungal organisms to help control pest problems, including woolly nightshade in the Whangapoua forest. • DOC is monitoring for kauri PTA; has a new cleaning station in Coromandel; and will maintain interpretative information for the public. • DOC undertakes weed control, including wilding pine removal and predator trapping at Opera Point and at dotterel breeding sites. • DOC has a work program restoring the dunes at Otama. This includes: controlling pioneer woody weeds, hand pulling Lupin and other ground cover weeds such as ice plant, maintaining NZ dotterel nest sites at Otama and in Kuaotunu beach, and advocacy and interpretation signs to minimise horse riding in the dunes. • Animal pest control works are undertaken by a range of community groups (refer section 10.7 of this plan). • The Council has contestable funding for biodiversity projects. • TCDC and NZTA control pest plants on roadsides. ***Refer also to Coast and Harbour actions***	training requirements for new subdivisions where appropriate. • DOC are working with Ngati Huarere on funding options for increased predator control in the catchment. • DOC has a maintenance and works plan for Opera Point which includes: managing wildling pines and other weeds (e.g. ragwort, scotch thistle, blackberry and periwinkle), along with developing the tracks. • DOC will undertake on-going predator control as a part of the NZ Dotterel programme. ***Refer also to Land actions***
On-going degradation or loss of wetlands • Land drainage and cultivation of organic soils impacts on the hydrology of an area. This then affects ecosystems associated with wetland areas, often leading to irreversible drying and shrinking of wetland ecosystems.	• The Council is reviewing the Regional Plan provisions related to drainage with the aim of better protecting remaining wetlands. • The Council in conjunction with the NZ Landcare Trust has prepared guidelines on Best Management Practices for enhancing water quality through restoring wetlands. • Council has identified SNAs and this information is available to all property owners through the Council or TCDC website.	• Council is developing guidelines for “Constructed Treatment Systems for Surface Water Inflows to Shallow Lakes”. This will be of relevance to wetland management/restoration projects.

	• TCDC has included a biodiversity overlay in its proposed District Plan, and added a reference to SNAs on all LIM reports.	

What can you do?

- Have a look at the Council's restoration planting guides:
- For forests look at: http://www.waikatoregion.govt.nz/PageFiles/2900/Coromandel%20planting%20guide%20-%20part%201.pdf
- For wetlands have a look at: http://www.waikatoregion.govt.nz/Environment/Natural-resources/Water/Freshwater-wetlands/Restoring-a-wetland/Wetland-planting-guide/
- Other guides also at: http://www.waikatoregion.govt.nz/Environment/Natural-resources/Biodiversity/Planting-guides/
- Find out more about wetlands at http://www.wetlandtrust.org.nz/links.html
- Visit NatureWatch NZ - a "one stop shop" for natural history recording and monitoring. Post your wetland flora and fauna sightings here, or find out what has been spotted in a wetland near you.
- Visit Nature space www.naturespace.org.nz – for ecological restoration in NZ
- NIWA has a series of aquatic plant, fish and invertebrate identification guides and hosts New Zealand's freshwater fish database https://www.niwa.co.nz/our-services/online-services/freshwater-fish-database
- Struggling to identify that grass? Landcare Research has an easy-to-use key for grasses. http://www.landcareresearch.co.nz/resources/identification/plants/grass-key
- Visit the wetmak website at www.wetmak.org.nz for tools and advice on starting up your own wetland restoration project
- New Zealand Birds has a wealth of information on birds in NZ and Te Ara -The New Zealand Encyclopedia - has descriptions of wetland types and their inhabitants, including wading birds. http://nzbirdsonline.org.nz
- Covenant your land. Covenants can provide another level of protection altogether on special areas of private land, and provide opportunities for funding assistance to landowners. QEII National Trust is a non-government agency, which contributes funding towards fencing and legal costs. Nga Whenua Rahui Kawenata supports covenants for tangata whenua to retain ownership and control of their land, thus protecting cultural and ecological values.
- The Council and DOC provide varying contestable funds for biodiversity protection and enhancement projects
- If you are contemplating any works on your property, check the Significant Natural Areas report for biodiversity values in your area, and assess if you can assist in enhancing them. http://www.tcdc.govt.nz/Our-Services/Maps-Geographical-data-GIS/
- Get involved in local community-led groups. The Waikato Biodiversity Forum can connect you with groups in your locality or provide advice and support for those wishing to create a group. See www.waikatobiodiversity.org.nz for further details
- Contact TCDC about the Mercury Bay North Reserve Management Plan or the Tree Master Plan. Call TCDC on 07 867 2020 and request a copy.
- Talk to the Mercury Bay Community Board if you have any concerns about, or requests for, tree removal on TCDC reserves by calling 07 867 2010.

- Visit the Waikato Biodiversity Forum website for useful tips on how to increase biodiversity in your garden. www.waikatobiodiversity.org.nz
- If you have identified a restoration project talk to TCDC and the Council. One method of securing support for works is to ensure it is included in the Council's Long Term Plan. The Council and DOC have contestable funds available for conservation initiatives
- The Weedbusters website has a wealth of information about weeds and how to control them www.weedbusters.org.nz
- The Global Invasive Species Database (GISD) aims to increase awareness about invasive species that threaten native biodiversity and to facilitate effective prevention and management activities. This site contains descriptions and control methods for invasive plants and animals. www.issg.org/database/welcome/
- The New Zealand Plant Conservation Network has photos and descriptions of New Zealand's native and introduced plants. Visit http://www.nzpcn.org.nz/
- One of the core components of the New Zealand Dotterel Watch (NZDW) programme are the volunteer dotterel minders. Without their contribution and dedication the programme would not have the same success. Most minders are residents near to dotterel breeding sites and assist in regular monitoring and sometimes predator control. Find out more about the NZ dotterel watch programme through DOC. http://www.doc.govt.nz/get-involved/volunteer/
- Find out about the Regional Pest Management Plan www.waikatoregion.govt.nz/Council/Policy-and-plans/Regional-Pest-Management-Plan/
- Control pest plants and animals on your property, ask the Council's Catchment Management Officers for advice if needed. Phone 0800 800 401
- Have a look at the Best Management Practices for enhancing water quality through restoring wetlands: http://www.landcare.org.nz/Regional-Focus/Hamilton-Office/BMP-Guide-for-Water-Quality.

18 Costs

Waikato Regional Council funds river and catchment activities on the Coromandel Peninsula under the Peninsula Project Funding Policy (Waikato Regional Council document number 924353). This policy provides for Peninsula, Regional, General Rate and landowner or community contributions to soil conservation, river management, coastal marine area works and services and flood protection works.

At this stage, proposed costs for the river and catchment management works as identified in Appendix 8 total **$601,063**. This includes works and services around river maintenance, riparian enhancement and catchment new works (soil conservation) on agricultural land. It will be implemented through existing funding streams and requires both landowner and council contribution. This figure does not include ongoing annual maintenance costs, labour costs, coastal vegetation management (for example saltwater paspalum control or mangrove management), recreational facilities, sediment management, or plant and animal pest control. Costs associated with these activities are more difficult to estimate and depend on methods and scale. To provide some guidance on the cost of implementation the estimates below are provided.

Activity	Area or length (b)	Estimate (as per column b)
Restoration of natural areas (e.g. forest fragments, wetlands)	• 1ha forest: includes weed control, native plants (4000 plants(PB3)/hectare and fencing (assuming regular shaped block, 5 wire) • 1ha wetland: includes weed control, native wetland plants (4000 plants (PB3)/hectare and fencing (assuming regular shaped block, 5 wire).	• $25,000 • $23,000
Riparian planting	• 1km of stream length, 5 metre wide native planting, site preparation and fencing.	• $12,000
Animal Pest Control – Possums	• Costs will vary depending on the methods used (traps, bait stations or aerially applied toxin), topography, if target based contract, labour costs etc. It is also necessary to factor in maintenance of traps and bait stations, these costs too will vary dependant on location. An estimate of 30% of original set up cost should be applied annually to cover maintenance.	• $16-$150/ha
Animal Pest Control – Mustelids and rats	• Costs will vary depending on the methods used (traps, bait stations or aerially applied toxin), topography, if target based contract, labour costs etc. It is also necessary to factor in maintenance of traps and bait stations, these costs too will vary dependant on location. An estimate of 30% of original set up cost should be applied annually to cover maintenance.	• $60-$150/ha
Saltwater paspalum control	• 1 ha controlled with knapsack spray unit, includes herbicide and labour).	• $2000

Stream mouth opening (3 sites)	• 3 times/year.	• $13,500

The Peninsula Project Funding Policy also provides for targeted rates to be applied where there is significant local community benefit from works. This typically applies to flood protection programmes and larger scale mangrove management, but could equally apply to harbour and catchment management initiatives, such as saltwater paspalum control or large scale restoration activities, where the community supported significant works being undertaken in a short-term timeframe. The proportion of funds to be recovered from the particular community would be determined on a case- by-case basis. Consultation with the community on the cost of larger scale future works and services and how they might be funded would take place prior to their development.

The Peninsula Project is already significantly committed to existing projects in other communities and catchments. Under existing funding the implementation of the Whangapoua Harbour and Catchment Management Plan would be carried out over the next 10 years or so. In order to reduce this timeframe, targeted funding would be required and would only be explored as a result of community demand.

19 Monitoring and reporting

There are two main aspects to monitoring progress associated with this HCMP:

(i) Monitoring and reporting on the implementation of the HCMP actions
(ii) Monitoring changes in the environment over time.

19.1 Monitoring and reporting on the implementation of the HCMP

The Council will prepare an annual report on progress with the implementation actions identified in Part Four of this HCMP.

Actions underway and matters anticipated for the forthcoming year will be identified. This information will be conveyed to the people of the Whangapoua catchment by a variety of means including Healthy Harbour Newsletters and our website page.

The Council and TCDC both prepare Ten Year Plans and annual plans which provide work programmes and budgets for activities. Consultation on these plans is your chance to contribute to the decision-making about which activities could be included on the Council's work programmes.

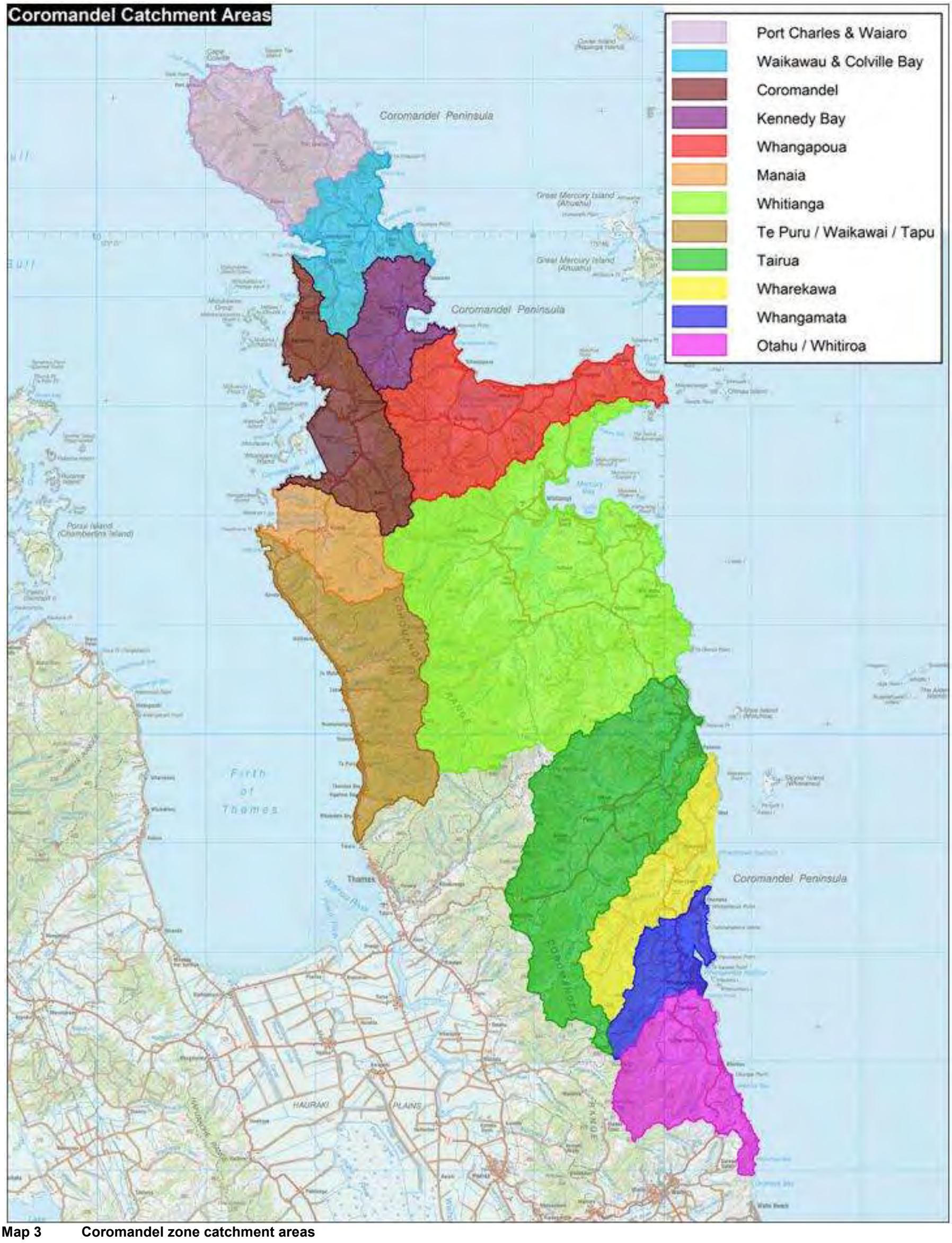
19.2 Monitoring changes in the environment over time

The Council and TCDC are required in accordance with the RMA to undertake environmental monitoring. There is also opportunity for schools, iwi and community groups to be involved in monitoring trends.

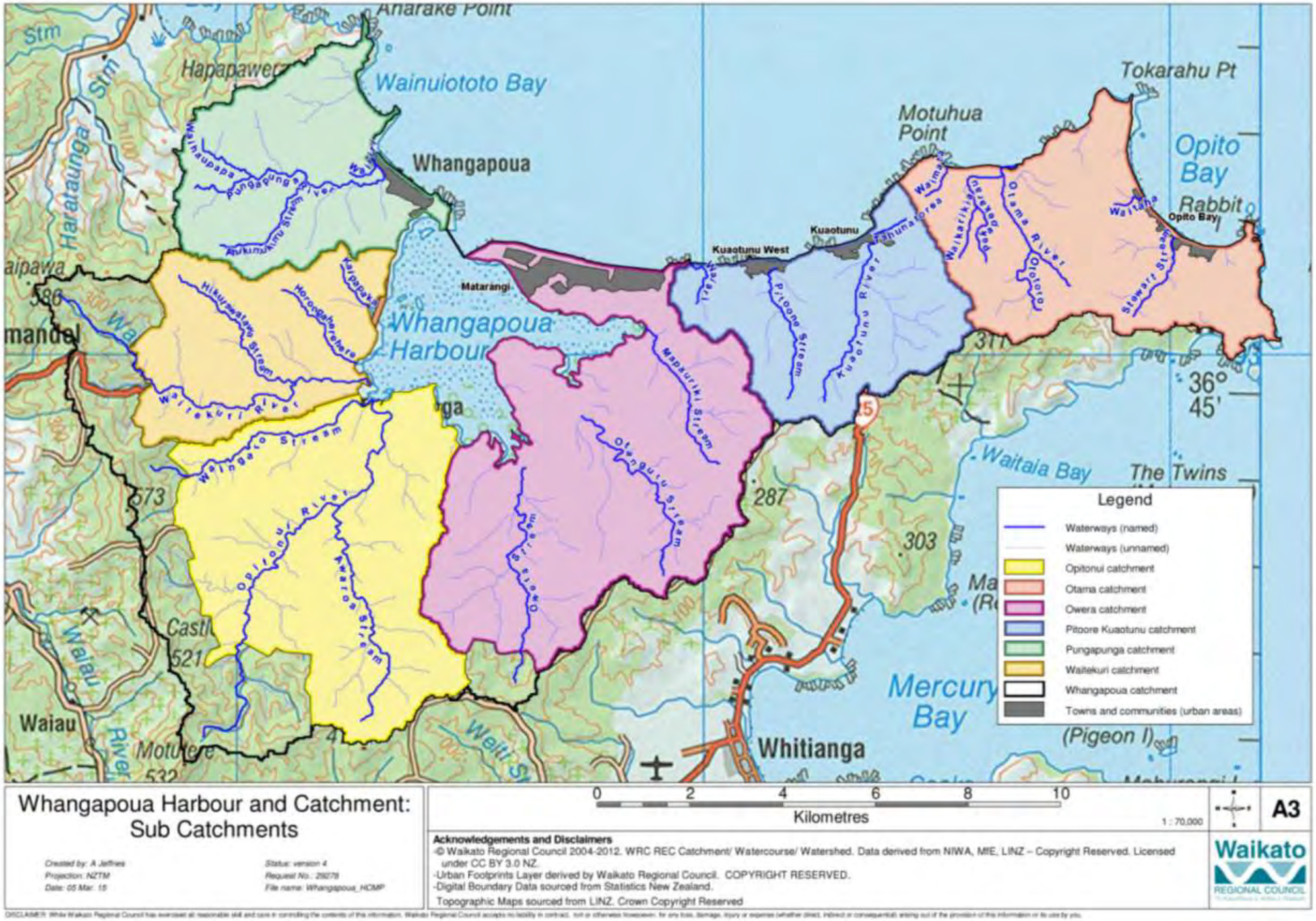
The Council will continue to gather information to inform its decision-making responsibilities and policy development. For example, the Council currently has a work programme in progress to improve its coastal information. In addition work on geographic information system estuarine vegetation mapping will be on-going to determine changes over time.

Part Three of this HCMP also provides a baseline of data available about the Whangapoua harbour and catchment area, and can be used in the future to assess changes in the environment.

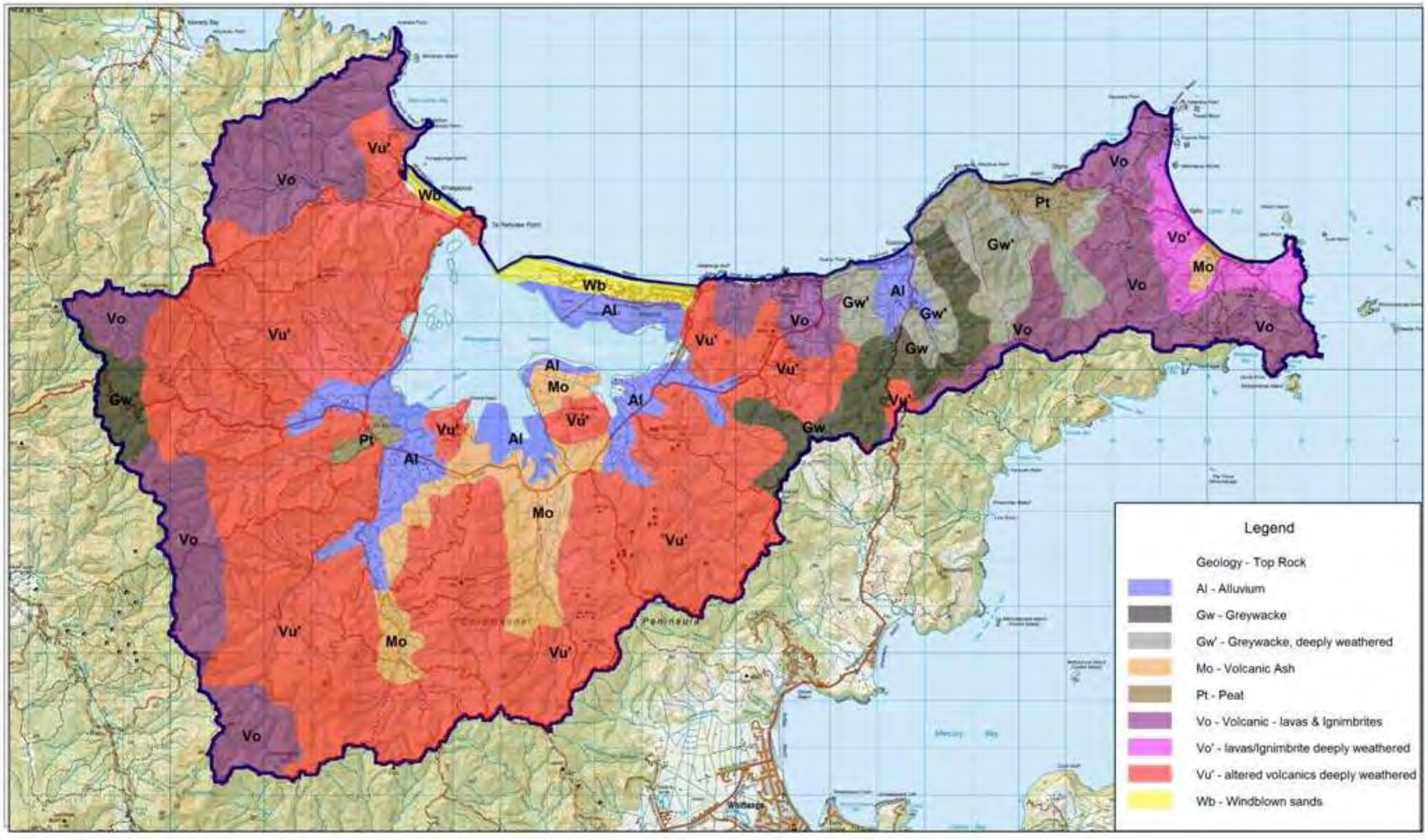
Appendix 1 Maps



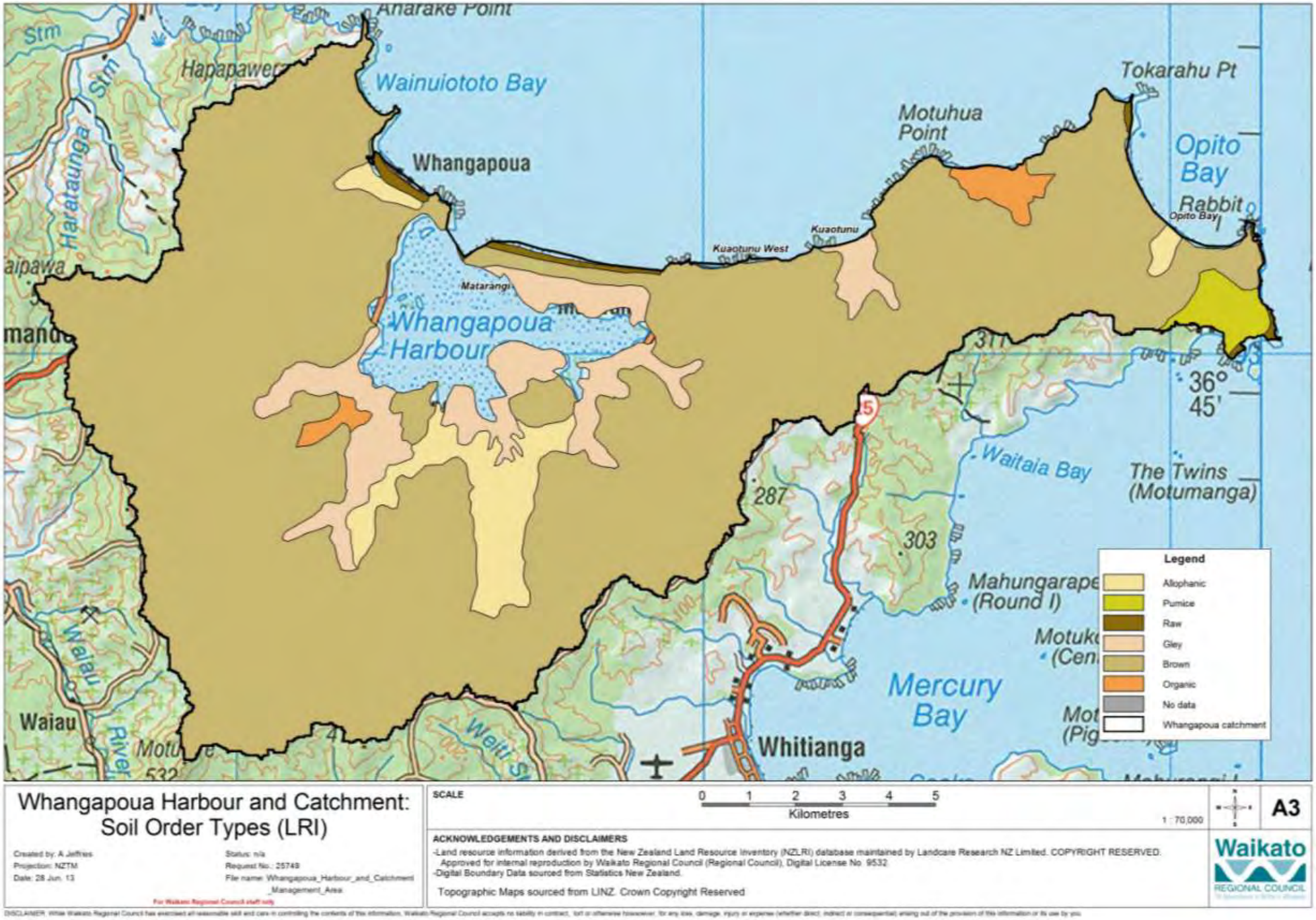
Map 3 Coromandel zone catchment areas



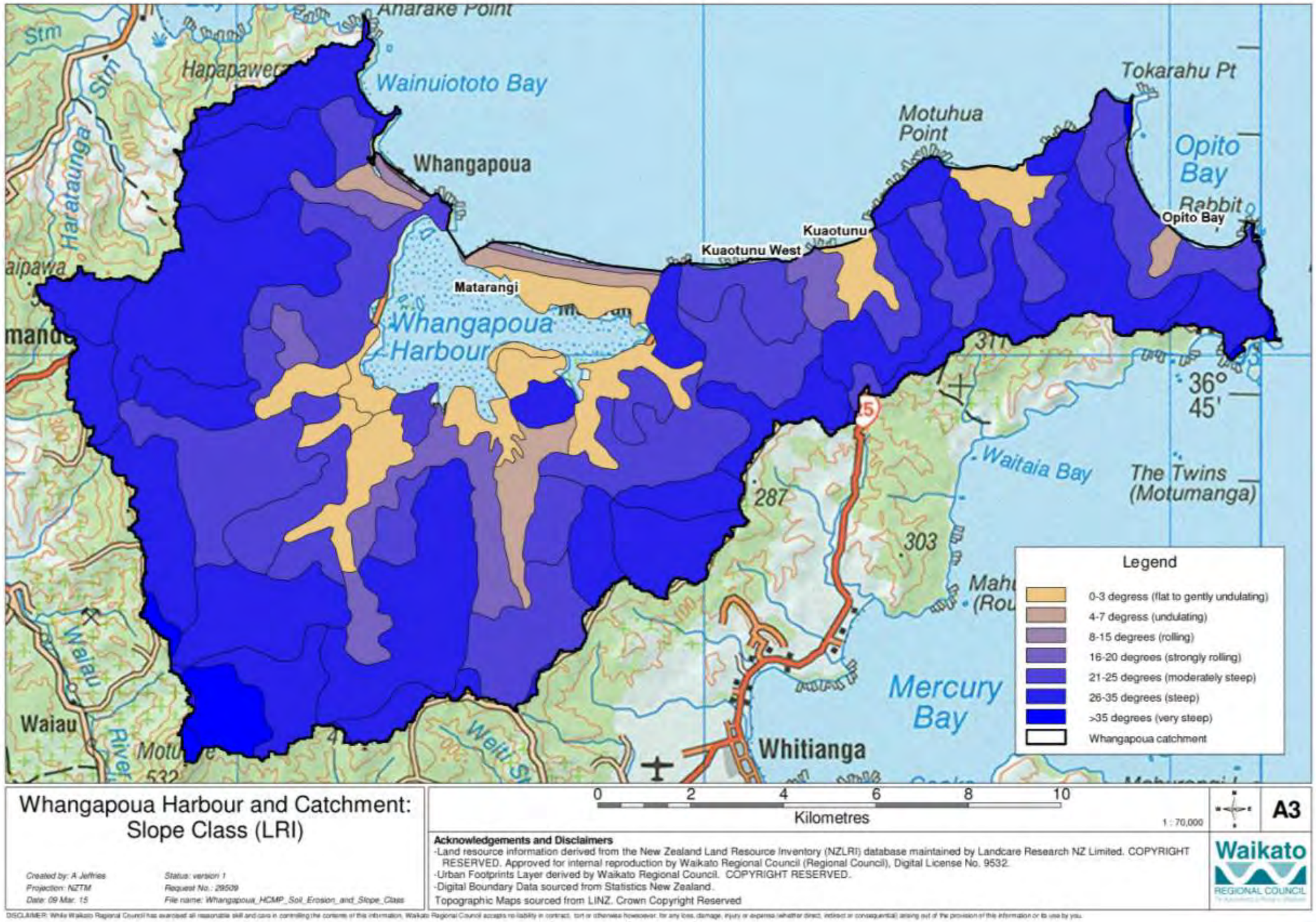
Map 4 Whangapoua harbour and catchment management plan area



Map 5 Whangapoua harbour catchment plan geology map (NZLR)



Map 6 Soil order types (LRI 1:50 000)



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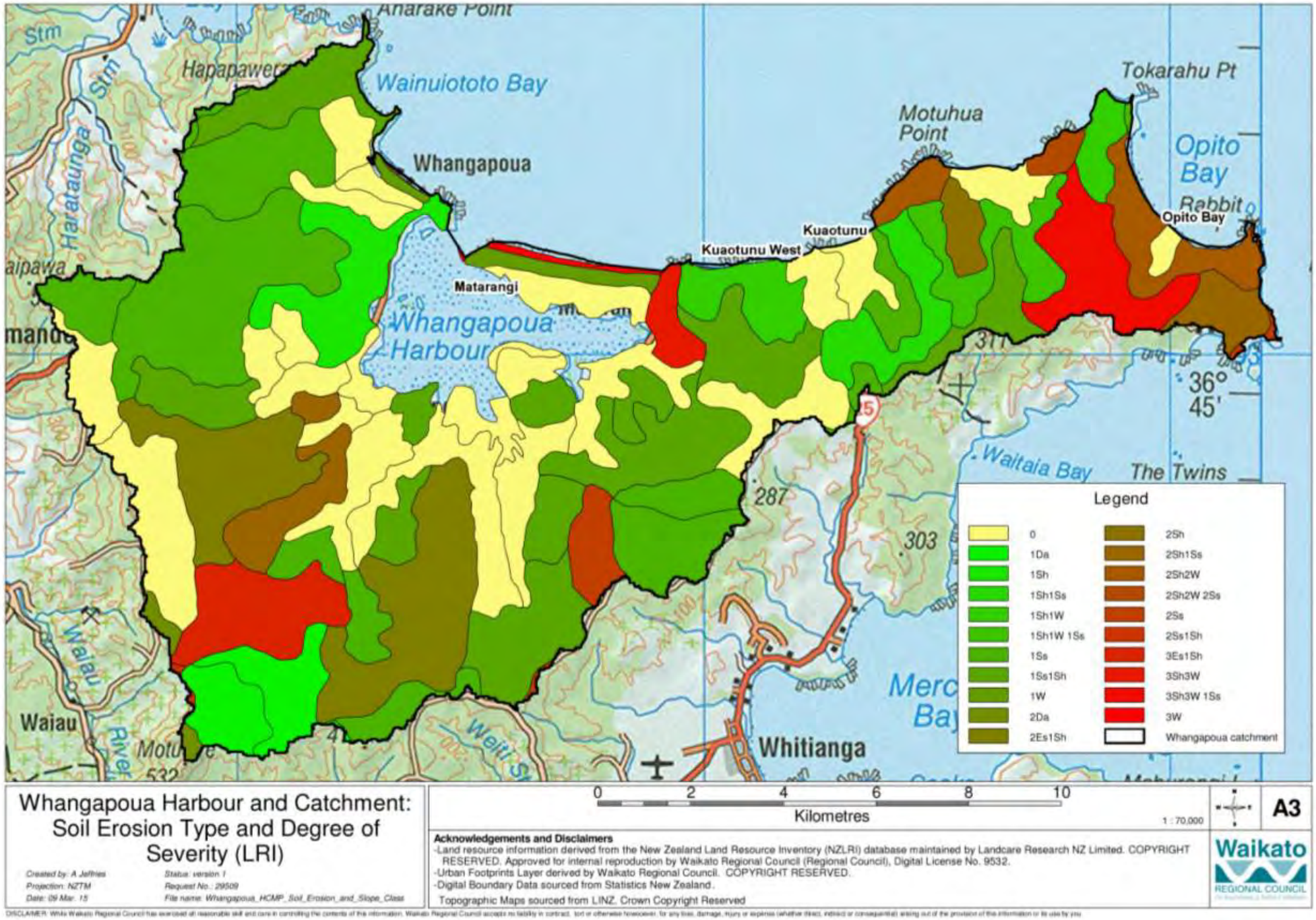
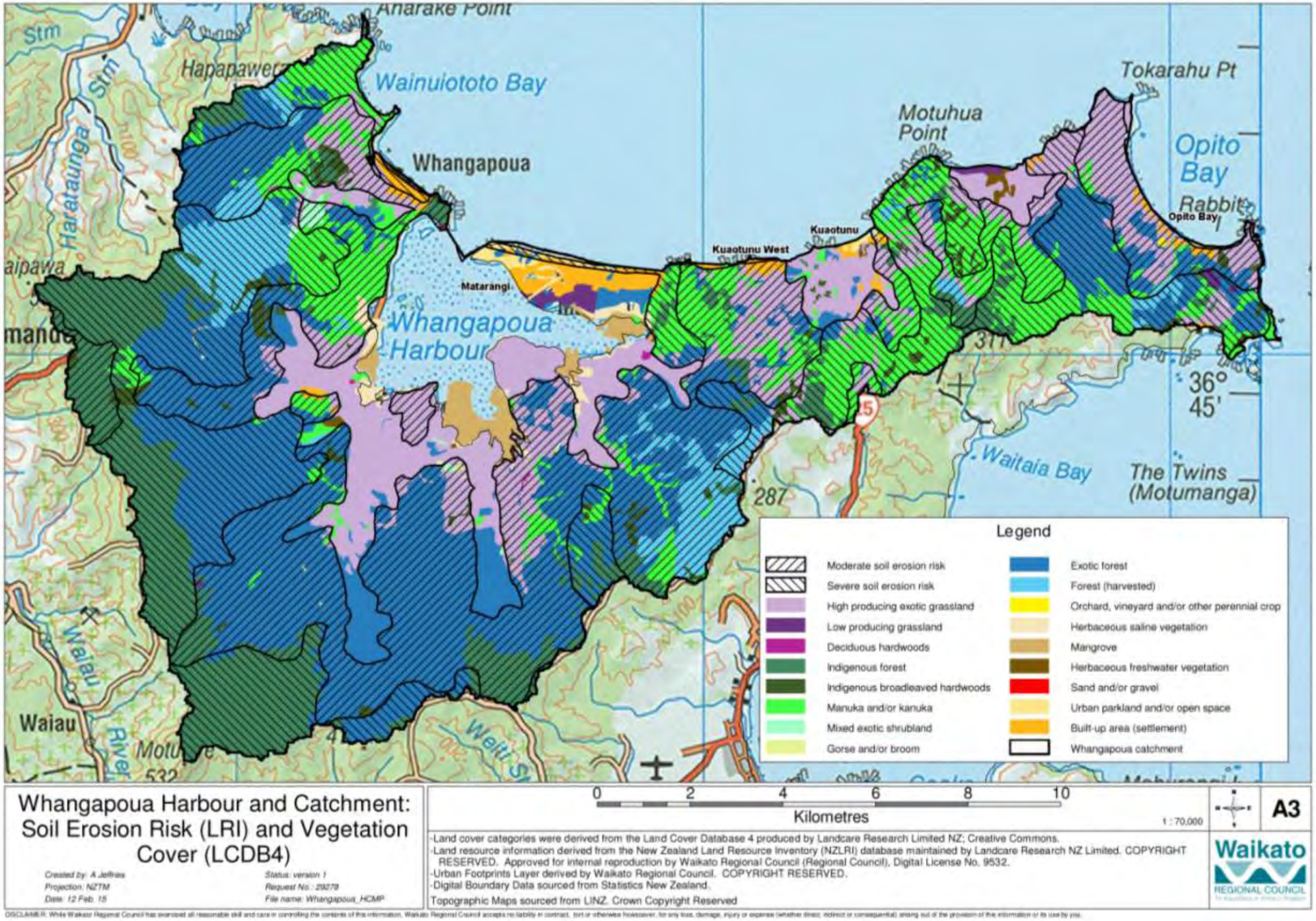
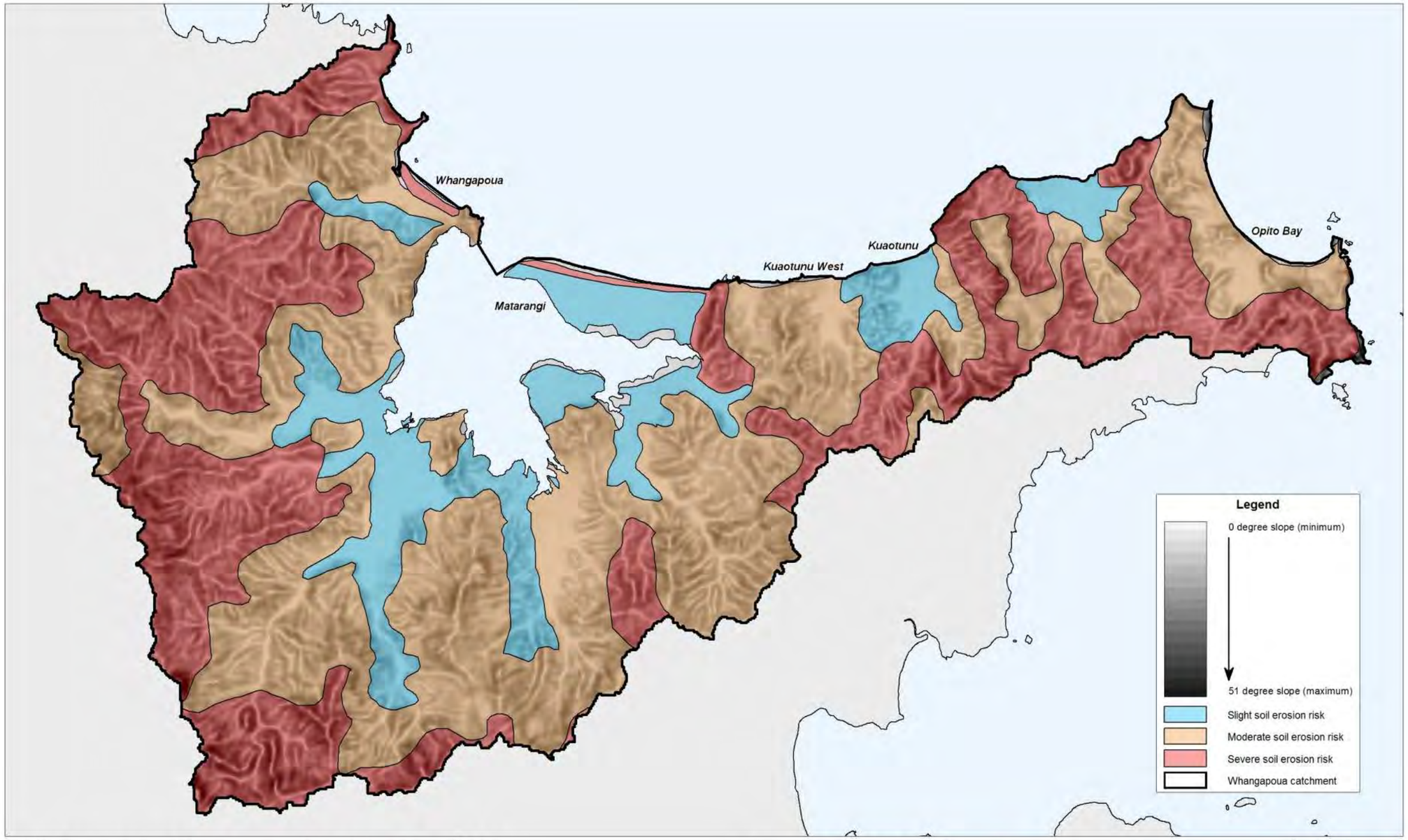
Map 7 Slope class (LRI)



Map 8 Soil erosion type and degree of severity



Map 9 **Soil erosion risk (LRI) and vegetation cover (LCDB4)**



Whangapoua Harbour and Catchment: Slope and Soil Erosion Risk (LRI)

Created by: A Jeffries
Projection: NZTM
Date: 09 Feb. 15

Status: version 2
Request No.: 25749
File name: Whangapoua_Harbour_and_Catchment_Management_Area

For Waikato Regional Council staff only

SCALE 0 1 2 3 4 5 Kilometres 1 : 70,000

A3

ACKNOWLEDGEMENTS AND DISCLAIMERS

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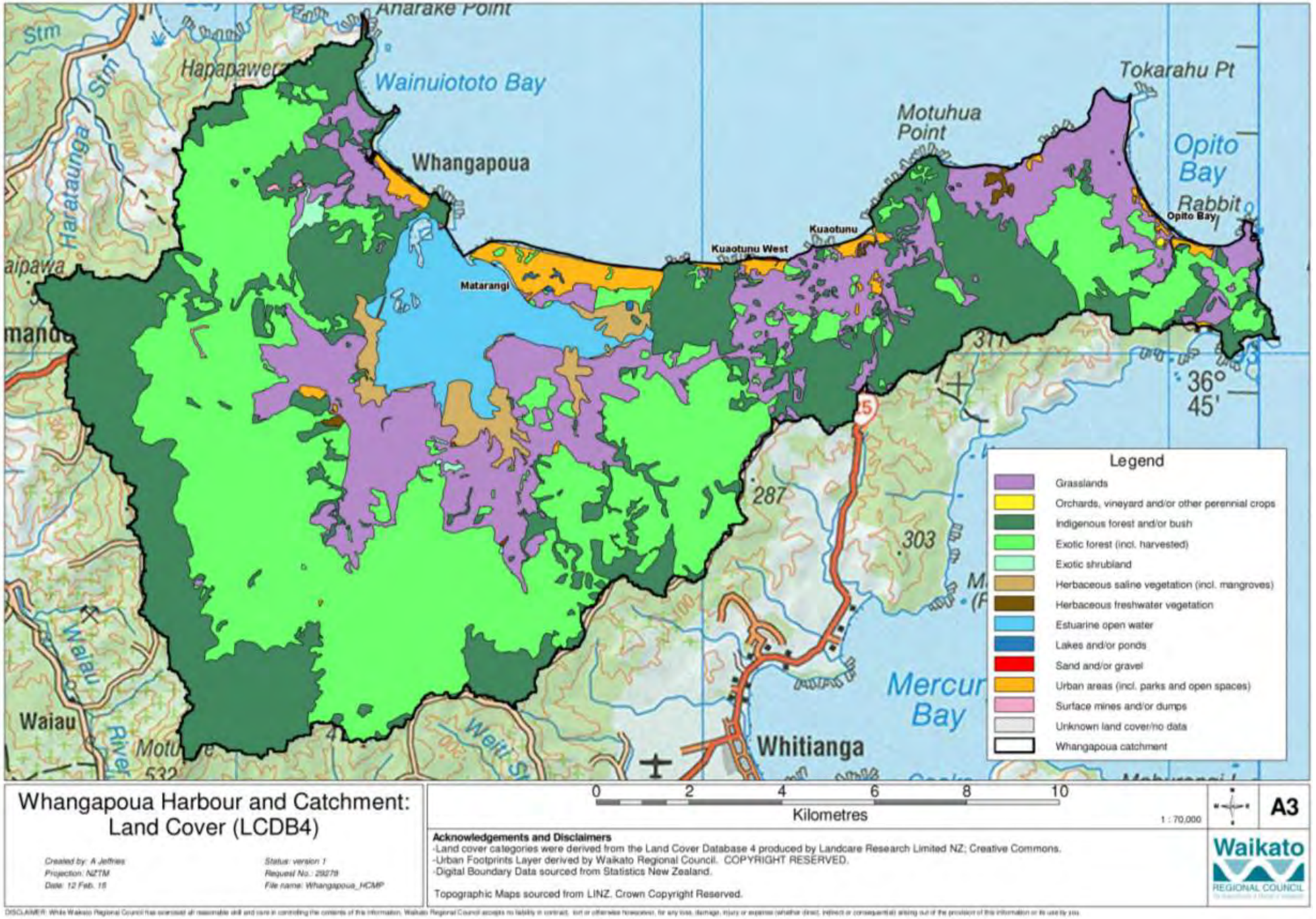
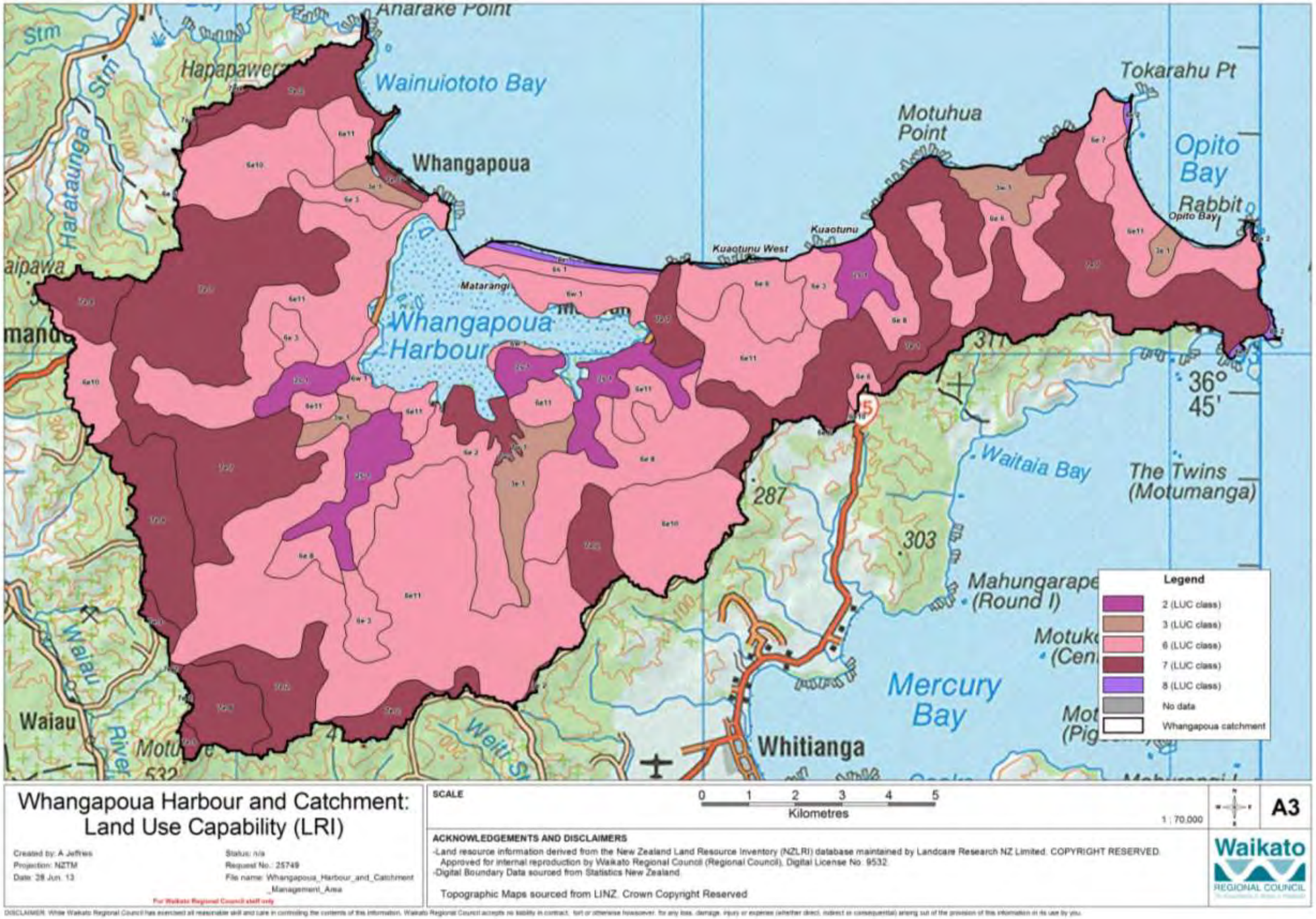
-Digital Boundary Data sourced from Statistics New Zealand.

Waikato Regional Council

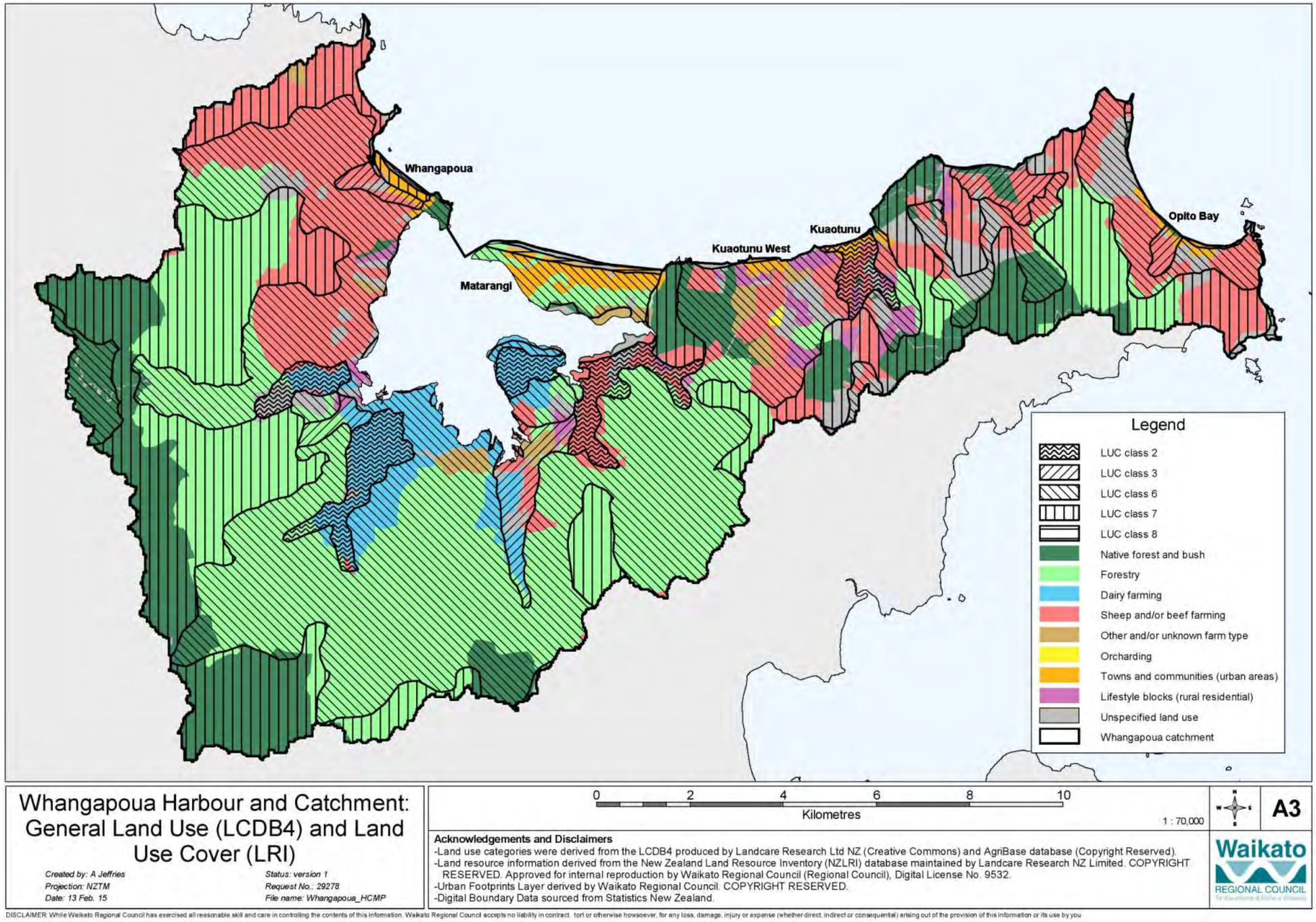
Map 10 Slope and soil erosion risk (LRI)



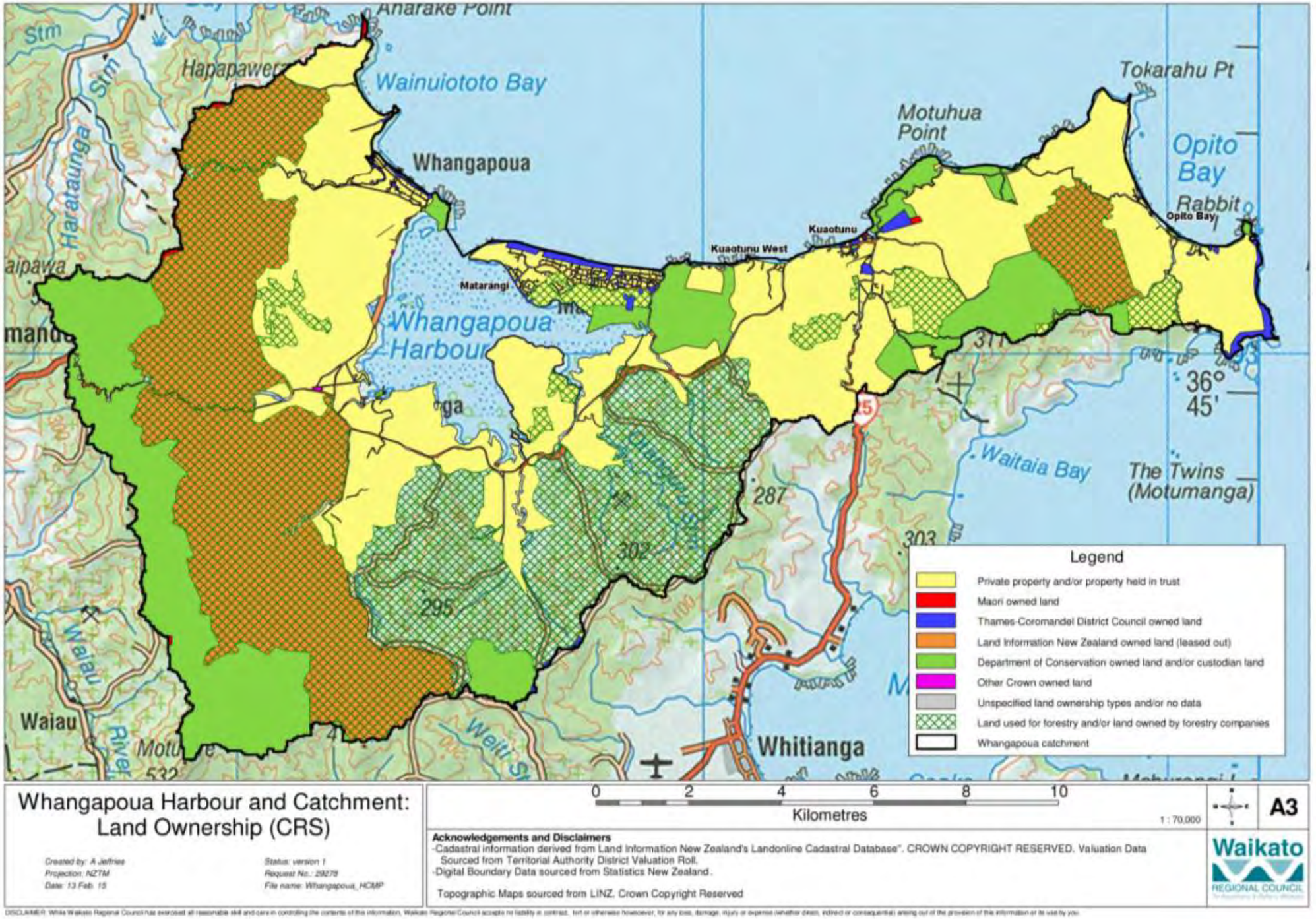
Map 11 Land cover (LCDB4)



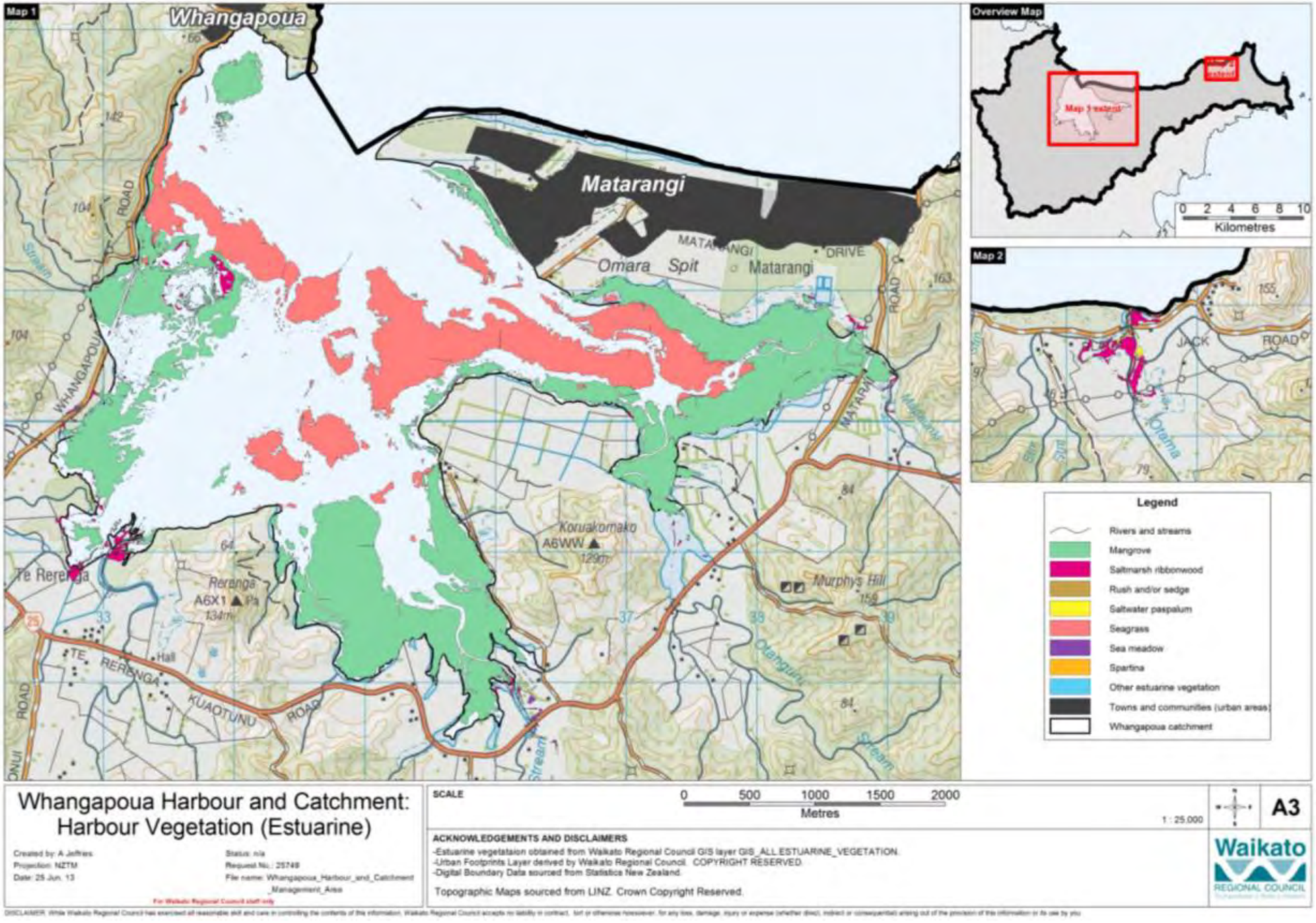
Map 12 Land use capability (LRI)



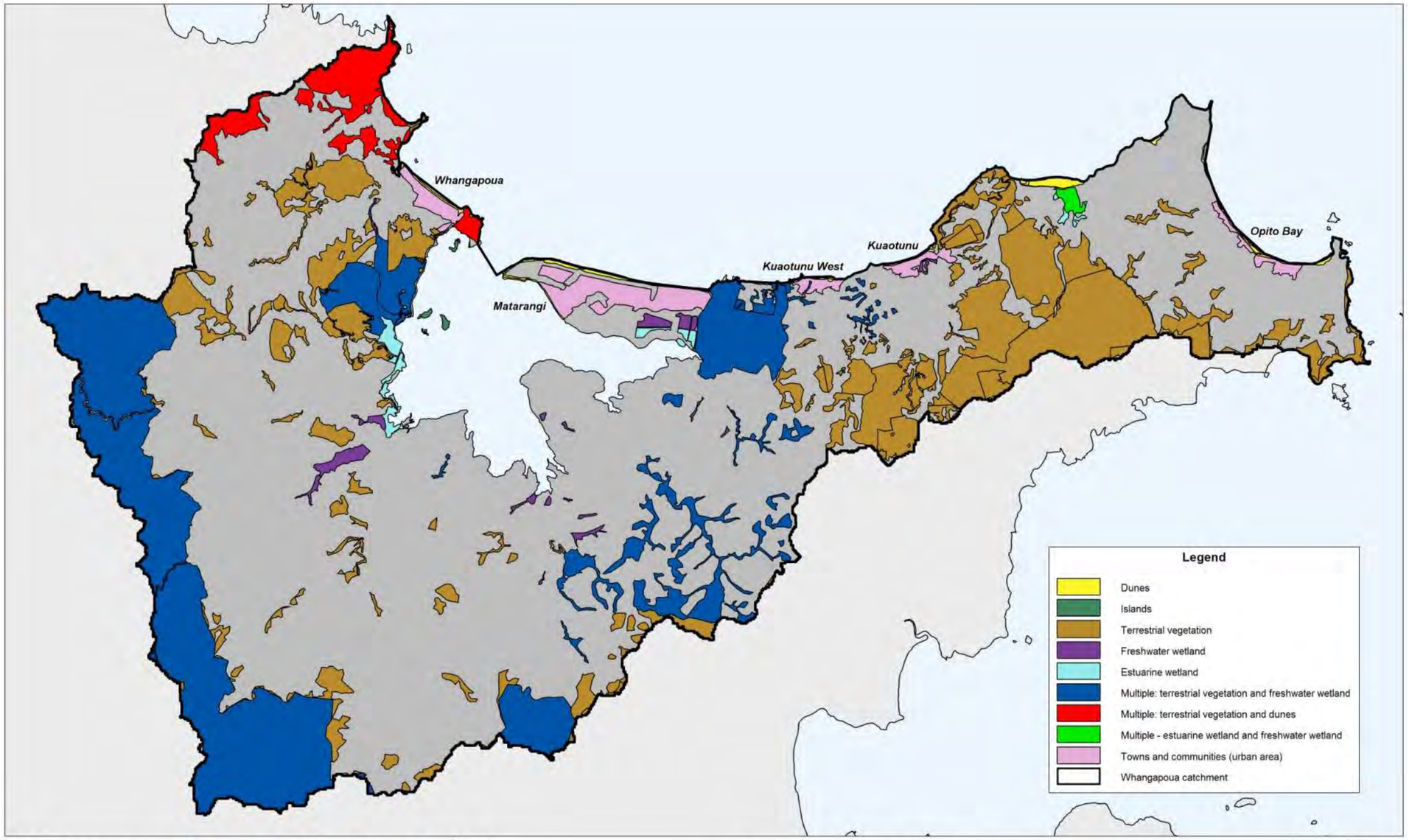
Map 13 General land use (LCDB4) and land use cover (LRI)



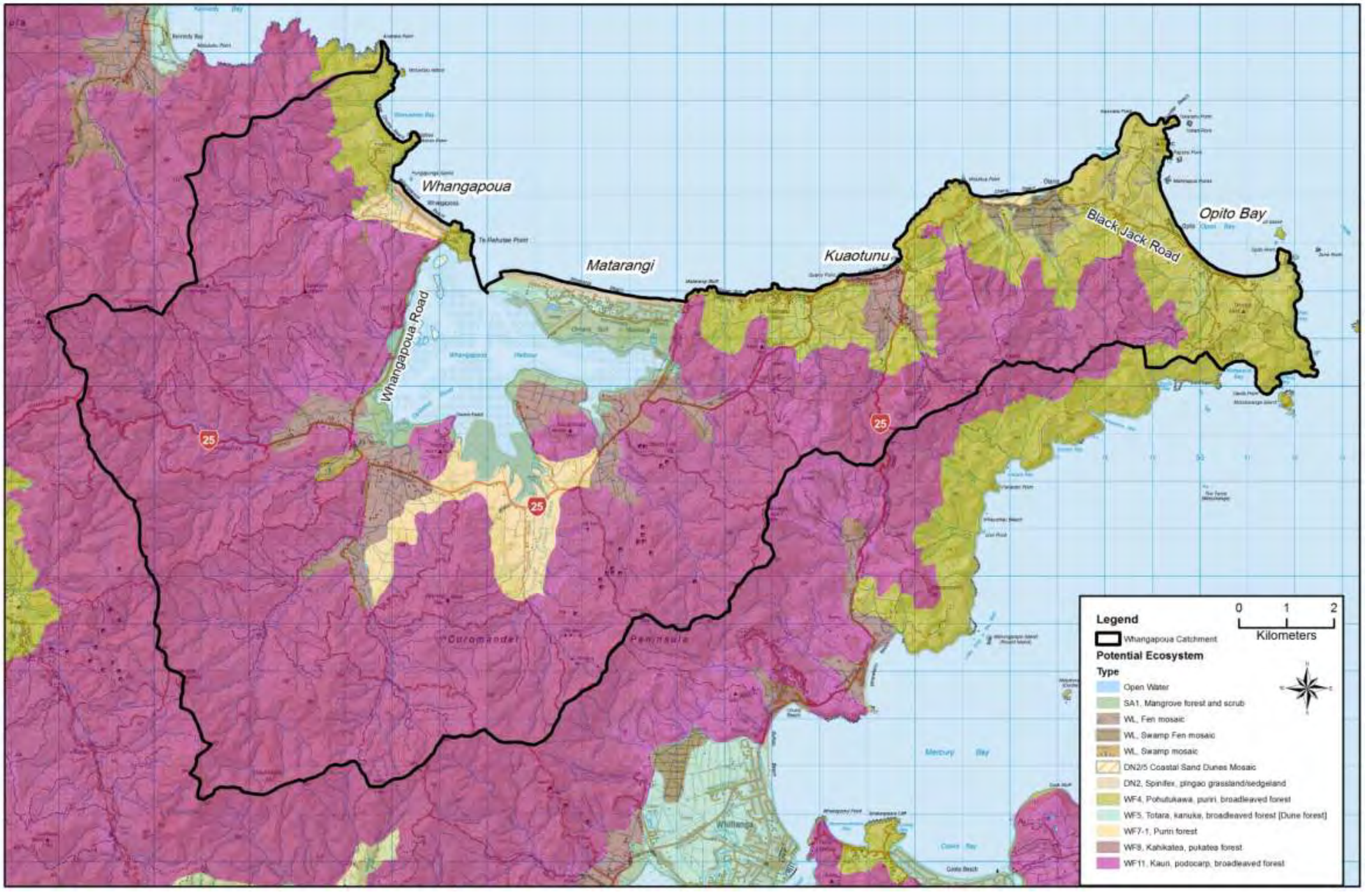
Map 14 Land ownership (CRS)



Map 15 Whangapoua harbour estuarine vegetation



Map 16 Significant natural areas (SNAs)



Map 17 **Potential ecosystems of the Whangapoua catchment based on a map developed by Nicholas Singers Ecological Solution Ltd for the Waikato region Ecosystem descriptions and unit codes are fully described within Singers and Rogers 2014**

Map 18 **Whangapoua harbour navigation safety bylaw map**

Appendix 2 Overview of related planning documents

The Peninsula Project

The Coromandel Peninsula is known for its beautiful environment. However, river bank erosion, debris blocking rivers and streams, the effect of animal pests on forest health and storms have caused widespread problems for communities.

The Peninsula Project aims to address these issues. It was established as a collaborative project between the Waikato Regional Council, Thames Coromandel District Council, the Department of Conservation and Hauraki Māori Trust Board, established in 2004. Over the next 20 years, the project will have far-reaching benefits for both the environment and the people who live and holiday on the peninsula.

The Peninsula Project team is responsible for the development and oversight of the implementation of this plan.

Coromandel Peninsula Blueprint

The Coromandel Peninsula Blueprint is a strategic planning document that identifies the development and protection of the Coromandel Peninsula for the next 20 - 50 years. It is an inter-agency project run by four partners: Waikato Regional Council, Thames Coromandel District Council, the Department of Conservation and Hauraki Whaanui.

The project is made up of two stages: The district-wide strategy "Framework of Our Future", and the "Local Area Blueprints".

The "Framework for Our Future" provides strategic direction(volume 1) via outcomes and goals for the future, and is accompanied by an implementation plan (volume 2). This "Framework for Our Future" is essentially non-spatial, apart from its identification of three growth centres: Thames, Whitianga and Whangamata, which helps focus future development impacts away from the peninsula's surrounding natural and landscape values. The non-spatial focus relates to four topics:

- natural values of biodiversity and landscapes
- diversity and vibrancy of the settlements
- social, economic and cultural requirements for communities
- avoidance of natural hazard impacts and resilience of communities.

The "Framework for Our Future" was adopted in 2010 and will be implemented through statutory plans, operational plans and "Local Area Blueprints".

The local area blueprints are catchment-based[27]. These local scale, 'zoomed in' versions are mainly spatial plans/maps that indicate areas for various development and protection needs as well as more general actions at a harbour or catchment scale. These maps/actions will inform the statutory and non-statutory planning processes and will be implemented through various management tools, including this harbour and catchment plan. The range of actions identified as part of the local area blueprints process that can be implemented through this plan are identified in appendix 11.

[27] Each local area blueprint is based on a number of water-based catchments so from a pure hydrological perspective they are actually groups of catchments.

Hauraki Gulf Marine Park Act 2000

The Hauraki Gulf Marine Park covers the Hauraki Gulf, Waitemata Harbour, Firth of Thames and the east coast of the Coromandel Peninsula, and associated landward catchments.

The Hauraki Gulf Marine Park was established by special legislation in February 2000. The Hauraki Gulf has a natural richness, environmental quality, biological diversity and landscape that makes it outstanding and distinctive within New Zealand.

By establishing some overall objectives for the gulf, its islands and catchments, the act provides integrated management across land and sea, so that the effects of urban and rural land use on the gulf are given proper attention and the life supporting capacity of the gulf is protected. The act provides for integrated management of the gulf across 21 statutes including the Resource Management Act, Conservation Act and Fisheries Act.

The HCMP processes, with their integrated mountain to sea focus, quadruple bottom-line approach and community engagement emphasis are ideal tools to assist in the achievement of the broader aims of the HGMPA at an operational level.

Proposed Waikato Regional Policy Statement

The purpose of a regional policy statement is to achieve the purpose of the Resource Management Act 1991 by providing an overview of the resource management issues of the region, and policies and methods to achieve integrated management across the region.

Integrated management requires the adoption of an approach that recognises and accounts for:

- the natural processes and basic principles that support life;
- the complex interactions between air, water, land and all living things;
- the needs of current and future generations;
- environmental, social, economic and cultural outcomes; and
- the need to work with agencies, landowners, resource users and communities.

The HCMP processes, with their integrated mountain to sea focus, quadruple bottom-line approach and community engagement emphasis are ideal tools to assist in the achievement of proposed WRPS policy directions[28] and to address those regionally significant issues of relevance to the Thames-Coromandel district.

Sea Change – Tai Timu Tai Pari

This project is developing a marine spatial plan for the Hauraki Gulf. It is focused on improving the gulf – its ecology, its economy and the health and wellbeing of its communities. Marine spatial planning is a methodology to bring together a wide range of people, views and knowledge to identify activities that might take place, areas and values that are important to safeguard and opinions and possible compromises to meet future needs. The plan is due for completion in September 2015. Refer www.seachange.org.nz for further information.

[28] The Whangapoua HCMP directly or partially addresses a substantial portion of the PWRPS objectives including: Objective 3.1 Integrated Management; Objective 3.5 Adapting to Climate Change; Objective 3.6 Coastal Environment; Objective 3.7 Ecosystem Services; Objective 3.8 Relationship of Tangata Whenua with the environment; Objective 3.12 Mauri and health of marine waters; Objective 3.13 Mauri and health of fresh water bodies; Objective 3.15 Riparian areas and wetlands; Objective 3.18 Ecological integrity and indigenous biodiversity; Objective 3.19 Outstanding natural features and landscapes; Objective 3.20 Amenity; Objective 3.21 Natural character; Objective 3.22 Public access; Objective 3.23 Natural hazards; and Objective 3.24 Values of soil.

Appendix 3 Trends of land use in each Land use capability class

Land use type for LUC 2	Area by hectare	Area by percentage
Indigenous forest and bush incl DoC	6.62	0.88
Communities	19.16	2.55
Lifestyle blocks	30.12	4.01
Forestry plus Earnslaw 1	69.34	9.24
Sheep and beef	258.64	34.45
Dairying	366.86	48.87
Land use type for LUC 3		
Communities	14.51	2.84
Lifestyle blocks	20.1	3.93
Unspecified and/or other farm type	29.98	5.86
Indigenous forest and bush incl DoC	46.26	9.05
Forestry plus Ernslaw	63.06	12.34
Dairying	98.12	19.19
Sheep and beef	239.18	46.79
Land use type for LUC 6		
Orchards	7.31	0.09
Unspecified and/or other farm type	167.8	1.95
Lifestyle blocks	186.84	2.17
Communities	191.38	2.23
Dairying	435.11	5.06
Indigenous forest and bush incl DoC	778.97	9.07
Sheep and beef	1950.16	22.7
Forestry plus Ernslaw	4873.36	56.73
Land use type for LUC 7		
Dairying	4.23	0.07
Unspecified and/or other farm type	20.37	0.34
Communities	31.85	0.53
Lifestyle blocks	48.42	0.81
Sheep and beef	1071.71	17.92
Indigenous forest and bush incl DoC	2062.71	34.49
Forestry plus Ernslaw	2740.95	45.83
Land use type for LUC 8		
Sheep and Beef	3.51	10.12
Indigenous Forest and Bush incl DoC	4.65	13.41
Forestry plus Ernslaw	6.8	19.61
Communities	19.72	56.86

Appendix 4 Harbour and coast

Table 1: Threatened and At Risk[1] indigenous plant, lichen, or animal species recorded from SNA contiguous or immediately adjacent to the Whangapoua Harbour.

Scientific Name	Common Name	Threat Classification	Source
Plants			
Pimelea villosa	Sand daphne, sand pimelea	At Risk- Declining	Kessels and Associates 2010
Coprosma acerosa		At Risk- Declining	Current survey
Ficinia spiralis	Pingao	At Risk- Declining	Current survey
Libocedrus plumosa	Kawaka	At Risk- Naturally Uncommon	Kessels and Associates 2010
Lichens			
Ramalina pacifica	mangrove lichen[2]	Threatened- Nationally Endangered	Current survey
Avifauna			
Botaurus poiciloptilus	Australasian bittern	Threatened- Nationally Endangered	Current survey
Egretta sacra sacra	Reef heron	Threatened- Nationally Endangered	Current survey
Apteryx mantelli	North Island brown kiwi	Threatened- Nationally Vulnerable	Kessels and Associates 2010
Charadrius obscurus aquilonius	Northern New Zealand dotterel	Threatened- Nationally Vulnerable	Current survey
Hydroprogne caspia	Caspian tern	Threatened- Nationally Vulnerable	Current survey
Larus novaehollandiae scopulinus	Red-billed gully	Threatened- Nationally Vulnerable	Current survey
Phalacrocorax varius varius	Pied shag	Threatened- Nationally Vulnerable	Current survey
Anthus novaeseelandiae novaeseelandiae	New Zealand pipit	At Risk- Declining	Current survey
Bowdleria punctata vealeae	North Island fernbird	At Risk- Declining	Current survey
Gallirallus philippensis assimilis	Banded rail	At Risk- Declining	
Himantopus himantopus leucocephalus	Pied stilt	At Risk- Declining	Current survey
Porzana tabuensis tabuensis	Spotless crake	At Risk- Relict	
Platalea regia	Royal spoonbill	At Risk- Naturally Uncommon	Current survey
Haematopus unicolor	Variable oystercatcher	At Risk- Recovering	Current survey
Frogs			
Leiopelma hochstetteri	Hochstetter's frog	At Risk- Declining	Kessels and Associates 2010
Reptiles			
Dactylocnemis pacificus	Pacific gecko	At Risk- Relict	Kessels and Associates 2010

Whangapoua Harbour- changes in mangrove and seagrass cover over time

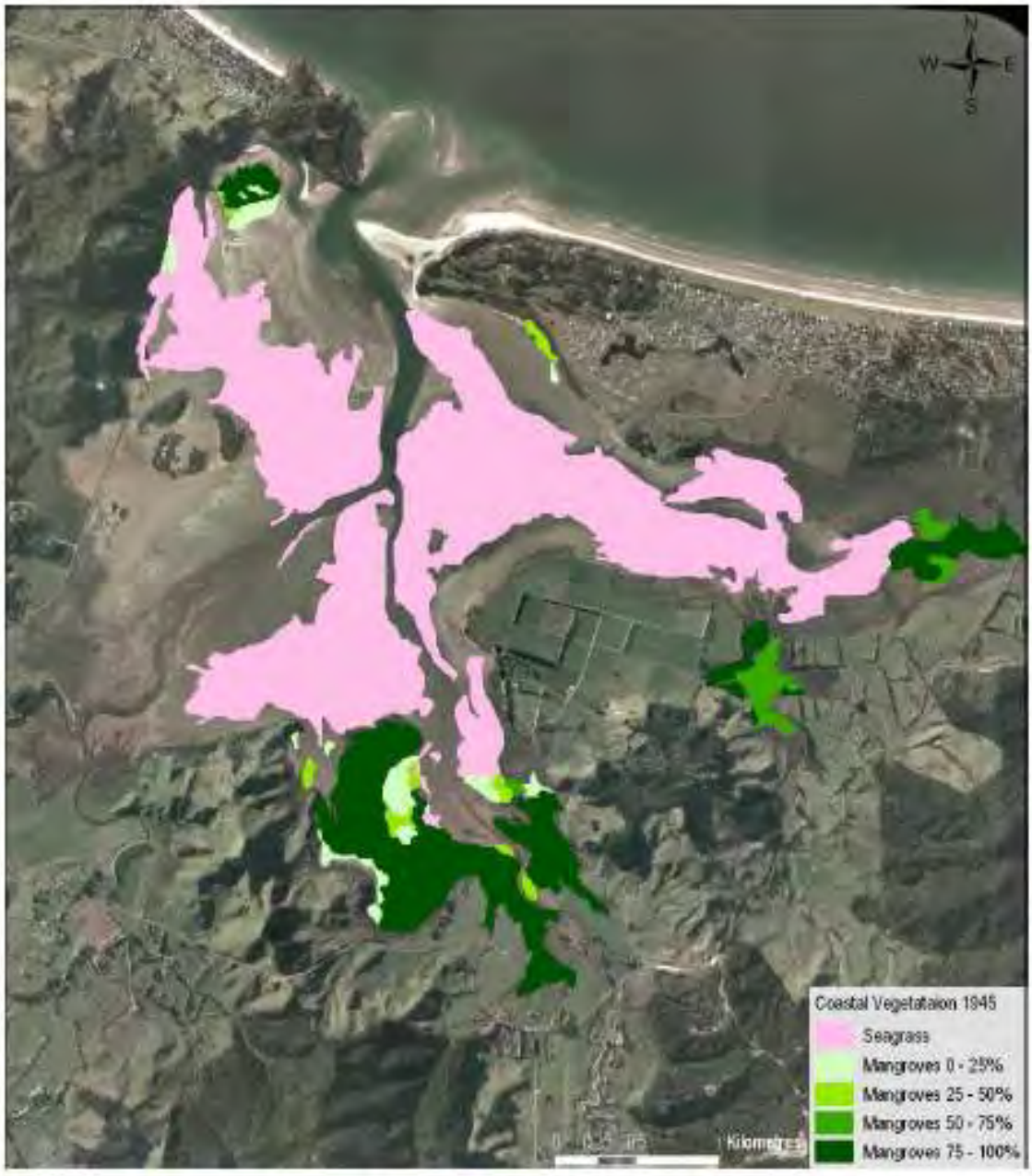


Figure 9 Aerial photograph showing mangrove and seagrass cover in 1945 (Halliday et al 2006).

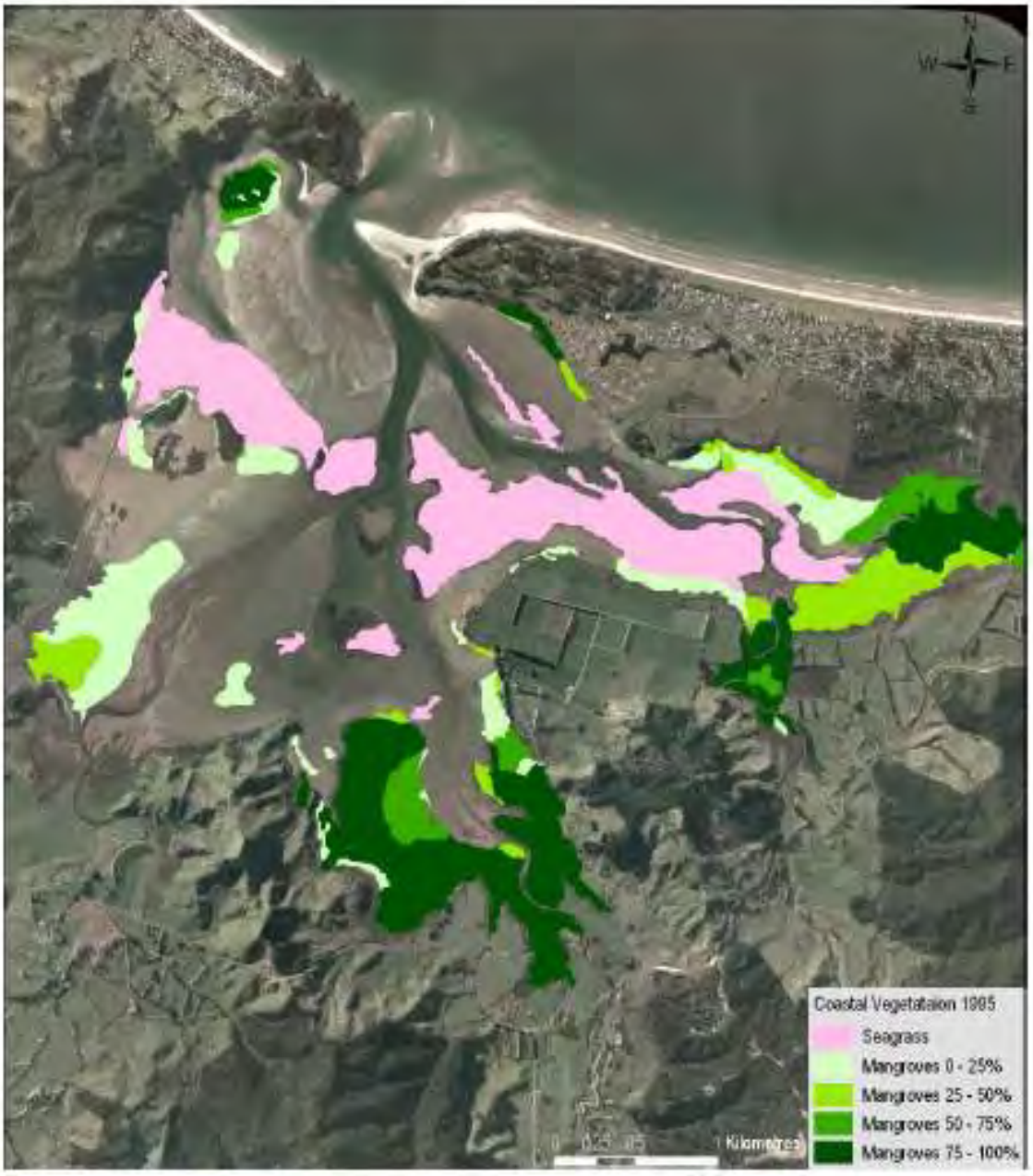


Figure 10 Aerial photograph showing mangrove and seagrass cover in 1995 (Halliday et al 2006).

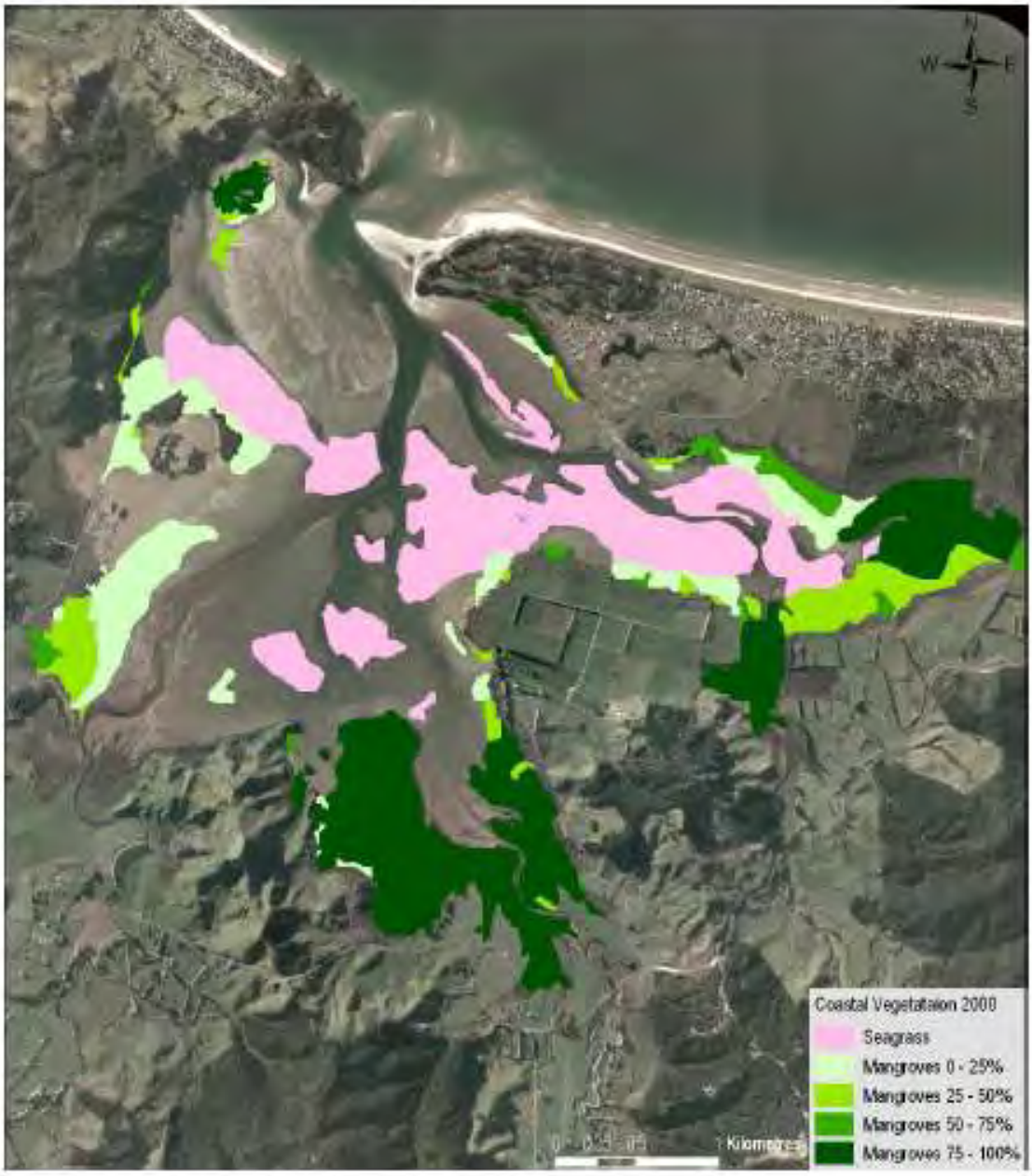


Figure 11 Aerial photograph showing mangrove and seagrass cover in 2000 (Halliday et al 2006)

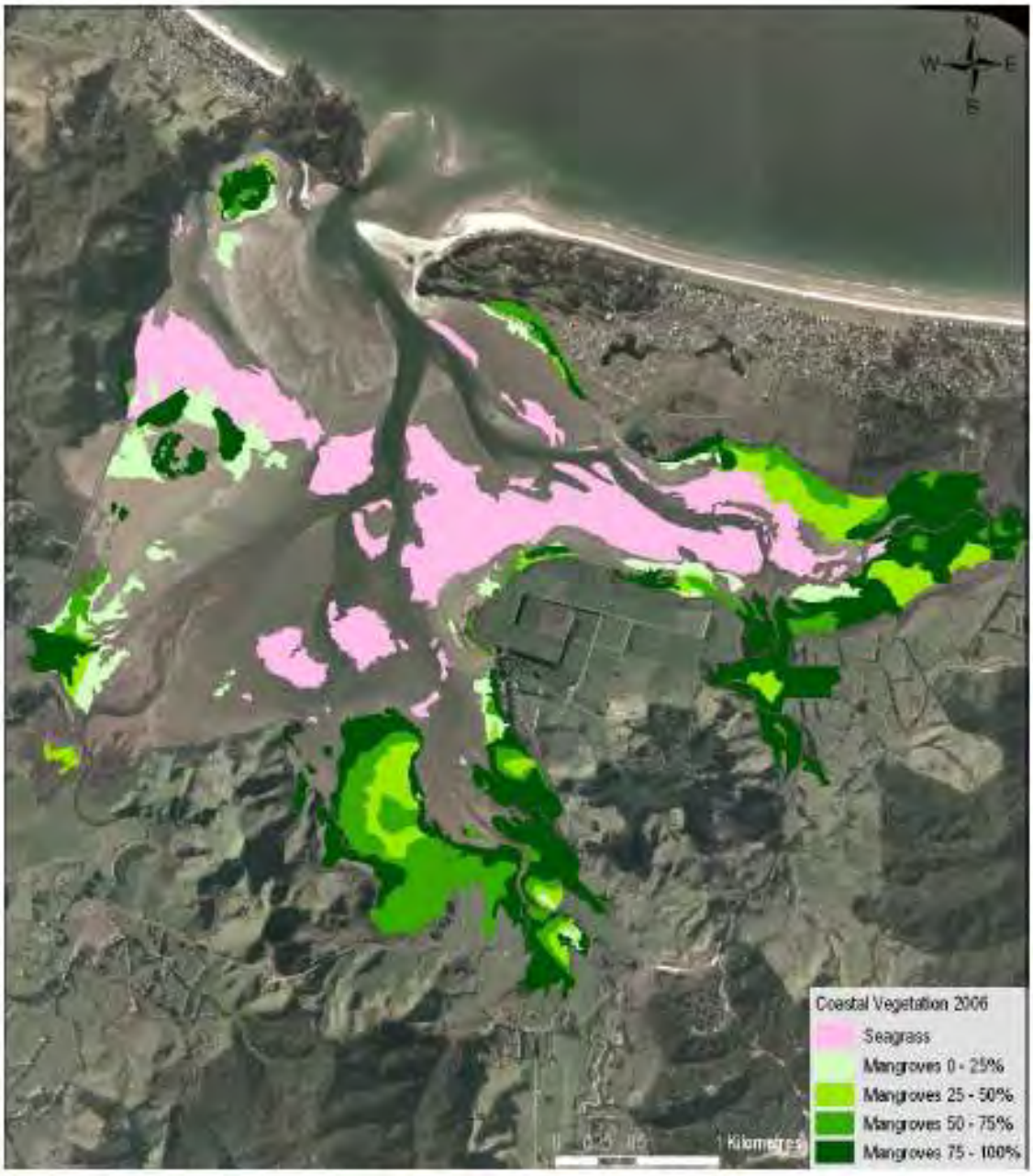


Figure 12 Aerial photograph showing mangrove and seagrass cover in 2006 (Halliday et al 2006).

Inventory of shorebirds habitat within the catchment taken from Dowding 2013.

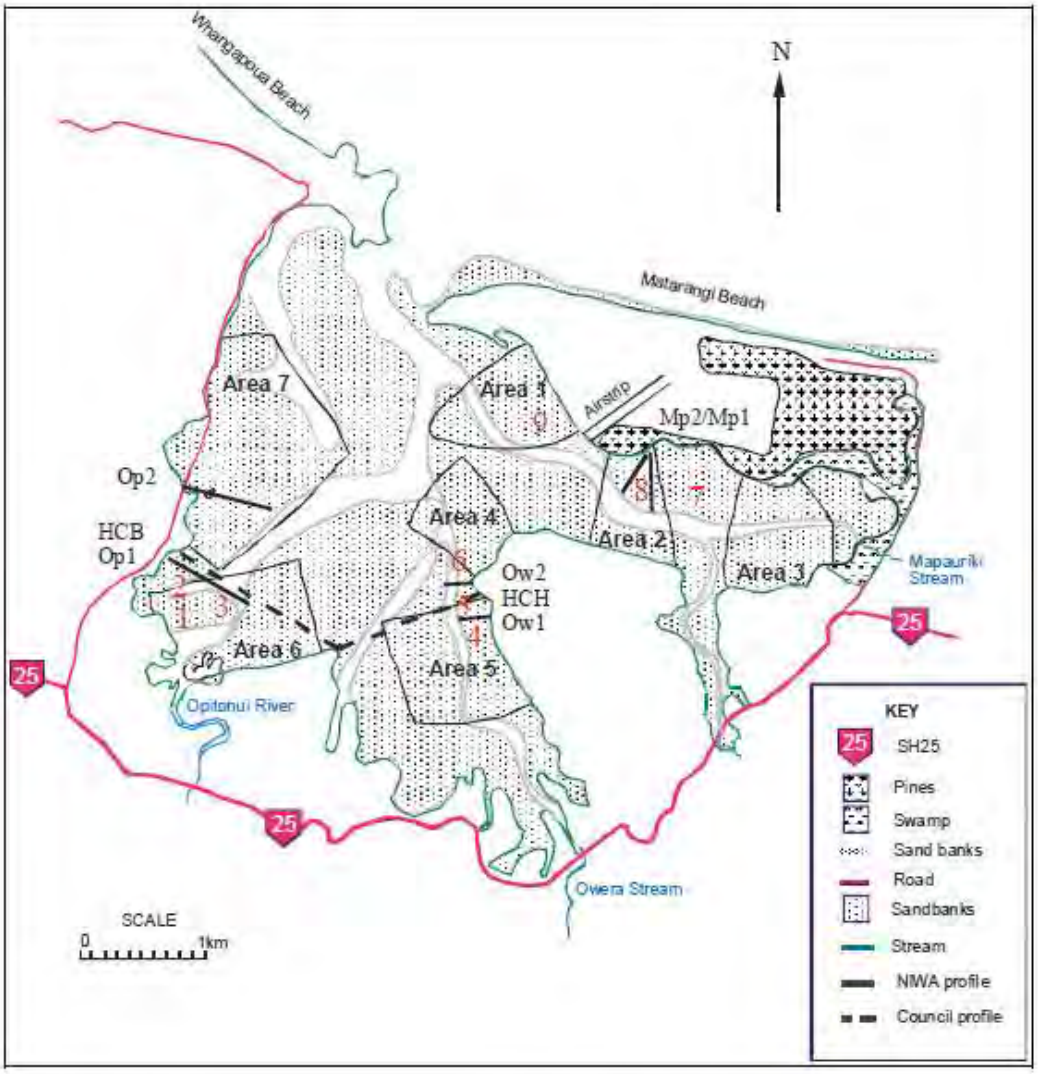
Site 15	**Whangapoua Harbour, including New Chums Beach, Whangapoua Beach, and Matarangi Spit**
Priority	1
Assets	*Pied stilt – winter flock of 20-80 birds. *Variable oystercatcher – Matarangi Spit is an important breeding site and holds a large post-breeding flock (commonly 150-190 birds), exceeds 1% level. *South Island pied oystercatcher – wintering site for 750-1300 birds; reaches 1% level in some years. **Northern New Zealand dotterel – Matarangi Spit is a major breeding site, one of the two most important post-breeding flock sites globally with 150+ birds, exceeds 1% level. **Banded dotterel – winter flock of 150-250, exceeds 1% in some years. *Eastern bar-tailed godwit – flock of 1000+; exceeds 1% level nationally. Other arctic migrant shorebirds in small numbers (turnstone, golden plover). **Australasian bittern – 2009 sighting in Matarangi Wildlife Habitat Reserve. *Banded rail – records from 1980s, probably still present. *North Island fernbird – records from 2000, probably still present. *Brown teal – recorded in 2009 and 2010 in the Pungapunga River.
Threats	Periodic severe loss of roosting habitat (all shorebirds) and breeding habitat for NNZD and VOC on Matarangi Spit through erosion; see comments in Dowding (2006, section 4.3.2). Disturbance to breeding birds (Matarangi Spit, Whangapoua Beach) in late spring and summer. Predation by mammalian and avian predators (reduced at Matarangi Spit by predator control during shorebird breeding season). Loss of nests to big tides and storm surges.
Detailed spatial information available?	Limited. Matarangi Spit is an important breeding site for variable oystercatcher and New Zealand dotterel, and a high-water roost for all waders.
Additional information	Overlap with Waikato Region ASCV 16. Significant habitat of indigenous fauna (EW 2010). Harbour identified as 1 of the top 19 wintering sites nationally for indigenous shorebirds.
Information gaps	Whether there are other HW roosts is not apparent, and the feeding areas used by the various species in the harbour are unknown. Whether shorebirds breed on any of the shellbanks in the harbour needs to be determined. The distribution and numbers of waterbirds in the upper reaches of the harbour are largely unknown.
References and sources	Dowding (2006), Dowding & Moore (2006), NNZD census 2011, DOC bittern and fernbird databases, Birding-NZ.net.

Map 15-1 (Whangapoua Harbour)
Areas shaded or arrowed green show breeding sites of New Zealand dotterels (and in most cases, variable oystercatchers). The yellow ellipse indicates the main shorebird high-tide roost at the tip of Matarangi Spit. The purple arrows show approximate locations of a recent bittern sighting, and the pink arrow the location of brown teal sightings in 2009 and 2010. Identification of areas important to shorebirds and waterbirds in this harbour is incomplete; areas of the upper harbour are probably important for cryptic waterbirds and intertidal areas important for shorebird foraging have not been identified. Shorebirds may also breed on islands and shellbanks within the harbour or along the western shoreline.

Site 16	Gray's Beach-Kuaotunu Beach
Priority	2
Assets	*Variable oystercatcher – a few pairs breeding. **Northern New Zealand dotterel – 4 pairs on each beach in 2012. **Caspian tern – recorded at Gray's Beach in 2011.
Threats	Disturbance to breeding birds in late spring and summer. Predation by mammalian and avian predators.
Detailed spatial information available?	Breeding sites of dotterel pairs known, exact locations vary annually.
Additional information	Significant habitat of indigenous fauna (EW 2010).
Information gaps	No.
References and sources	NNZD census 2011.

Site 17	Kuaotunu Peninsula (includes Otama Beach and Opito Bay)
Priority	1
Assets	**Australasian bittern – 2008 sighting in Otama Beach wetland reserve. *Variable oystercatcher – breeding on both beaches. **Northern New Zealand dotterel – breeding on both beaches; if considered a single site, easily exceeds the 1% level; if considered two sites, Opito Bay reached 1% level alone in 2012.
Threats	Predation, reduced by predator control. Disturbance, partly reduced by management.
Detailed spatial information available?	Breeding sites of dotterel pairs largely known, numbers and locations vary annually.
Additional information	Overlap with Waikato Region ASCV 17. Significant habitat of indigenous fauna (EW 2010).
Information gaps	List of important species probably incomplete; values of the wetland behind Otama Beach apparently not well documented.
References and sources	NNZD census 2011, DOC bittern database.

Map 17-1
Shaded green areas show areas used for breeding by New Zealand dotterels and variable oystercatchers on Otama Beach and Opito Bay. One pair of New Zealand dotterels usually breeds at Whaorei Bay (green arrow). The purple line shows the approximate extent of the wetland behind Otama Beach; there are records of bittern in this area, and it may be important for other wetland birds.



Whangapoua Harbour monitoring sites (1 – 9), sediment profile locations (Op1, Op2, Ow1, Ow2, Mp1 and Mp2) and areas for initial aerial vegetation mapping (Areas 1-7). Location of Environment Waikato profiles (HCA, HCB) are also given.

Appendix 5 Overview of forestry monitoring trends

Wright-Stow, 2013, reported on the trends occurring from 1992 – 2013. This report sought to determine both the relative magnitudes of impacts and the rates of recovery from progressive pine forest harvesting in Whangapoua Forest. Impacts and recovery were assessed in terms of stream water clarity (fortnightly), temperature (summer), and stream habitat and biota (summer and end of winter).

This report describes the findings from streams that differed in size and catchment harvest intensity. In particular the report noted that:

- Stream bank erosion varied among sites being more prevalent and greatest where channel morphology was meandering, where riparian buffers were removed, where sites were located in catchments with unconsolidated soil structures and where harvest debris altered flow patterns during storms.
- Channel width increases were observed at smaller sites following harvest of the area surrounding the study reach where the banks were steep and the riparian soils were unconsolidated and vulnerable to erosion. Channel widths also increased at some larger sites, independent of harvest activity, following major storm events. Increased water widths at some sites probably reflected increased water yields as evapotranspiration declined after harvest.
- Water clarity responses to logging varied among sites. The largest post-harvest reduction in annual median clarity was 49 % in a single year (exceeding the MfE guideline for the protection of water clarity from point source discharges) and occurred the year following riparian harvest. At most sites, harvest reduced annual median water clarity by around 35 % in the year after logging adjacent to the study reach. Harvest impacts on clarity were apparent up to 12.5 years at one site with exceptional pre-harvest clarity, but for most other sites reductions lasted less than three years.
- Water temperatures at all small sites (<50 ha catchment area) increased following harvest but did not exceed $25^{O}C$, or the $3^{O}C$ rise in average summer temperature set out by the Waikato Regional Plan standard. Results suggest that slash left suspended above the channel and riparian vegetation regrowth after harvesting were providing adequate shade to prevent exceedances. At sites exceeding 50 ha upstream catchment area, maximum summer temperatures increased by up to $8.5^{0}C$ following harvest, and both mean and maximum temperatures summer temperatures remained above reference condition up to 11.5 years post-harvest.
- Logging caused significant, local, short-term reductions in dissolved oxygen concentration where large amounts of slash were deposited in small streams after harvest. The depletions were relatively short-lived and mostly did not persist for more than a few months in the Coromandel stream systems where frequent high flows disperse deposited slash. Atmospheric re-aeration at most times adequately compensated for decaying suspended slash entering the water column.
- Epilithon (attached algae) responses were most pronounced in medium-large streams where logging reduced shade and increased temperatures. Spikes in abundance at the larger sites were often observed every 2-4 years, and surpassed MfE guidelines at one site up to 9.5 years after onsite riparian harvesting. The cyclic spikes at the larger sites are likely to reflect favourable growing conditions post-harvest (light, temperature, nutrients) and sampling time in relation to the last significant flood. In contrast, epilithon responses were least in small streams where shade provided by slash, topographic features and regrowth of riparian vegetation helped to reduce light levels and temperatures. Across all sites, epilithon spikes following harvest were preceded by a 1-2.5 year lag period.

- Invertebrate taxon richness at larger sites appeared more resilient to the impacts of logging in the years immediately following riparian and upstream harvest, but typically trended downwards 2-3 years post-riparian harvest for extended periods (12.5 years plus). At the smaller sites taxon richness was impacted more immediately by both upstream and riparian harvest, but generally recovered within 1-2 years. The impact of harvesting on invertebrate abundance across all sites was often observed as substantial increases either immediately or shortly after local riparian harvest and disturbance, and at some sites the spikes were observed up to 12.5 years after logging adjacent to the study reach.
- The Index of Biotic Integrity (IBI) showed shifts in invertebrate communities in relation to upstream logging, particularly with harvesting of riparian trees alongside the sampling reach. At larger sites, harvest adjacent to the study reach typically reduced IBI from “nonimpaired/ slightly impaired” to “moderately impaired”. Whilst some improvements were observed subsequently, impacts on invertebrate communities were apparent up to 12.5 years post-riparian harvest. At all the smaller sites, IBI values declined from “non-impaired” to “moderately/slightly impaired” immediately following harvest adjacent to the study reach then recovered to “non-impaired” for a period of between one and three years before further declines to “slightly/moderately impaired”. The length of this intermediate recovery phase may be related to the extent of slash providing protection to the stream following harvest. Ongoing monitoring is necessary to determine the duration of the second decline. Similarly, multivariate analysis of invertebrate community composition also showed different levels of change amongst the monitoring sites; with significant changes to community composition at sites when logging impact coincided with severe storm disturbance.
- Regardless of stream size, riparian buffers helped reduce harvest impacts on physical, water quality and biological stream variables.

Appendix 6 Harbour sedimentation studies

The thesis by Roddy (2010) used sediment fingerprinting techniques to link estuary sediments in Whangapoua Harbour to potential source areas in the catchment. This study characterised sediment based on the relative concentrations of a number of geochemical elements, such as silicon, phosphorus, selenium and uranium. The study found that native forest contributed the most to estuary sediment, and pastoral land contributed the least. It showed that exotic forest contributes significantly to estuary sediments but less than indicated in a previous study (Gibbs 2006), and in catchment models (e.g. the Sediment Yield Estimator and the New Zealand Empirical Erosion Model) which had suggested that deforested areas, such as pastoral land and harvested pine, generated the most sediment.

Gibbs (2006) used a different method than Roddy (2010) to fingerprint sediments in Whangapoua Harbour and catchment, based on plant compound specific isotopes of carbon. Both the Gibbs (2006) and Roddy (2010) studies indicate that, of the three land use types, pastoral land contributes the least amount of sediment to the estuary (c. 10 - 15% of estuary sediment). Note that this is proportional to the percentage of agricultural land in the catchment. However, Gibbs (2006) identified exotic forest as being the main contributor to estuary sediments (contributing c. 65% and making up c. 55% of land use in the catchment), whereas results in Roddy (2010) suggest that most estuary sediment is derived from native forest (contributing c. 60% and making up c. 20% of land use in the catchment).

Apart from using different elements in the sediment fingerprinting, the methods for the two studies differed in the number of samples taken and the depth of the soil samples taken. The study by Roddy (2010) was arguably more comprehensive; 50 sites were sampled in the catchment, with three samples taken at each site to characterise surface (0-2 cm depth), subsurface (> 20 cm depth) and stream bank positions. However, Gibbs (2006) sampled only 11 sites for surface soil, and 2 sites for subsurface soil in the catchment. On the other hand, the Gibbs (2006) study included more sites in the estuary than Roddy (2010), and so may have characterised the estuary sediments more comprehensively.

Native forest in the Whangapoua catchment is predominantly located on very steep slopes in the upper parts of the catchment. These areas receive more rainfall than areas at lower elevations, where the landuse is mostly exotic forest and pastoral (Jenkins, 2006). Consequently, these areas of native forest are prone to landslides, which can generate and deliver significant amounts of sediment to streams (and then to the estuary). Evidence for this is provided by the sediment fingerprinting done by Roddy (2010) which showed that the majority of estuary sediment was derived from subsurface areas, i.e. erosion of that sediment was caused by landslides and slips. This is also supported by other studies in the catchment (Marden and Rowan 1995, Marden et al., 2006) which have identified landslides as the dominant sediment source.

Clearly, steep slopes are likely to generate large amounts of sediment via landsliding, and steep slopes in the Whangapoua catchment are mostly in native forest, so native forest is likely to contribute sediment to the estuary. However, harvesting of exotic forest on steep land does influence sediment production; recently harvested areas contribute much more sediment than mature pines (Marden and Rowan, 1995). It is likely that the results of fingerprinting studies may be affected by the location of, and timing of, the collection of samples in the estuary. This is particularly relevant as sediment is typically moved across tidal flats and exported out of the estuary relatively quickly. It is unlikely that either of the sediment fingerprinting studies provides a definitive answer as to the sources of sediment in the estuary, but it is obviously important to keep steep slopes permanently forested as landslides would be more likely on deforested areas.

NIWA carried out monitoring in Whangapoua Harbour for Ernslaw One Ltd between 1993 and 2007 to try to assess the potential effects of forestry activity on intertidal habitats. A data review in 2006 noted that changes in sediment characteristics in the estuary were transitory and associated with storm events (Halliday et al. 2006). Although it is difficult to determine cause-effect relationships, the report indicated that changes in benthic communities were consistent with increased sediment loading and that there were correlations between those trends and forest harvesting activity.

Appendix 7 Regional ecological monitoring of streams (REMS) programme - summary

The Waikato Regional Council has been carrying out summer assessments of invertebrate community composition and habitat in streams and rivers annually since 1994 for the Regional Ecological Monitoring of Streams (REMS) programme. The aim of this work is to document the state and trend of ecological health in the Region's streams as part of State of the Environment monitoring. The current sampling network comprises (i) '**long-term sites**' that have been sampled for 10 years or more using consistent protocols for assessment of trends over time (40 sites including 3 reference sites and 6 'restoration' sites where riparian management has been implemented or is planned) (ii) '**random sites**' selected using a probability-based survey design to provide an unbiased estimate of the regional condition of perennial non-tidal wadeable streams on developed land (60 sites sampled once each year for 3 years–180 sites in total; this cycle is repeated every 3 years); and (iii) '**reference sites**' in undeveloped (native forest) catchments to provide a baseline against which to measure change (24 sites sampled annually since 2005). The sites include wadeable hard-bottom streams with stony beds, and wadeable soft-bottom streams with beds dominated by sand and silt. Some long-term sites on rivers that are not wadeable have been retained while appropriate non-wadeable monitoring protocols are developed. Stream ecological condition is assessed using four macroinvertebrate-based measures (referred to as 'metrics') derived from 200+ counts of individuals: number of different types of mayflies, stoneflies and caddisflies (excluding algal-piercing Hydroptilidae)— EPT* richness; the percent abundance of these sensitive insects—%EPT*; a measure of tolerance to organic pollution—the Macroinvertebrate Community Index or MCI for assessment of trends and its quantitative derivative the QMCI for assessment of state; and an integrative score of these three metrics (EPT* richness, %EPT* and MCI) benchmarked against reference site condition—Average Score Per Metric or ASPM.

Metrics are also calculated to assess (i) habitat quality based on qualitative assessments of 9 riparian, bank and channel conditions, and (ii) instream plant cover. Of the 37 long-term sites on developed land, almost half showed trends over time based on the MCI and ASPM metrics, with 10 sites showing 'clear' trends ($P<0.05$) and 10 sites indicating possible 'borderline' trends ($0.05<P<0.1$) for one or both of these metrics. Of the sites showing clear trends, 2 showed improvements in condition and 8 showed deteriorations in condition. Both metrics increased at the group of 'restoration' sites monitored where riparian management had been implemented and did not change significantly across the long-term reference sites, suggesting that riparian management was having a quantifiable benefit to stream ecological condition at these sites.

Unbiased estimates of wadeable stream condition on developed land based on the random site data indicated that, over 3 years of sampling, 60% of wadeable stream length was unshaded, 69% had 'clear' water at the time of sampling, and most (50-56% of stream length) had unconsolidated beds with high cover by fine sediment. Mean habitat score was 86 compared to 151 at reference sites, macrophyte cover averaged 29% (with 3% of this cover comprising native species), and mean cover by long algal filaments and thick algal mats was 8% at the time of sampling. Overall, median MCI and QMCI values for target wadeable streams on developed land in the Region were 98 and 4.2, respectively, EPT* richness was 7.5, %EPT* was 15.5 and ASPM was 0.39. QMCI (soft- or hard-bottom versions as appropriate) and interim ASPM condition classes indicated that, over the 3 years of sampling, around one-third (c.35%) of wadeable stream length on developed land was rated as 'good-excellent' and two thirds (c.65%) were rated as 'fair-poor'.

For more information on the REMS project go to:
http://www.waikatoregion.govt.nz/PageFiles/22680/TR201217.pdf

Appendix 8 Estimated costs for riparian enhancement and river works per subcatchment

Outlined below are examples and estimates of river and catchment management works in the Whangapoua Catchment, these are based on information collated in the report Whangapoua Catchment Assessment 2013 (Jenks et al. 2013). Estimated costs are broken down per sub catchment (Pungapunga, Waitekuri, Optionui, Owera, Pitoone-Kuaotunu and Otama) and include estimates for the catchment management and river maintenance and management on agricultural land. All costs are estimates only and do not include gst. The works rely on the uptake and commitment from affected/involved landowners.

Catchment Management
Includes riparian, wetland, forest fragment; fencing, some weed control, for both riparian and landscape erosion control, restoration of significant natural areas. It does not include animal pest control or all aspects of pest plant works.

River Maintenance and Management
Includes vegetation clearance, erosion control and stream bank works as well as removal of in channel blockages. Does not include capital works associated with flood protection schemes.

Fencing and Planting
In estimating fence costs an average for material and labour was used as there is the potential for great variance in fence type needed e.g. 2 wire electric versus 8 wire post and batten. Thus the costing for a 5 wire fence has been used as an average at $7.00 per metre.

Native plantings have been estimated at $3.00 per PB2/3 grade native plant plus planting labour and site preparation of $2.00. The number of plants is based on the prescribed formula of 4000 stems per hectare for re-vegetation, or 1.5m spacings.

Regional Council Contributions
Catchment management activities as described above are eligible for a grant of up to 35% of the total project cost.

River maintenance and management works area eligible for up to 50% cost contribution from the council.

In both cases the landowner contribution is often in kind e.g. their labour or machinery use, such as a tractor or digger.

Pungapunga

Tasks	Description of works	Estimated cost
River maintenance and management	Erosion control works are required on the Pungapunga River at the western end of the Whangapoua Beach. It is estimated that the works initially focus on the 2km upstream of the river mouth. There are a number of erosion sites, raw banks, fencing and planting required. Upper catchment is an Earnslaw forestry block, with good buffers and erosion methodologies in place. Good opportunities for fish spawning enhancement in the lower reaches.	$55,500
Catchment	Estimated fencing 1651 metres	$11,557

Management	Soil erosion management not evident at time of survey	

Waitekuri

Tasks	Description of works	Total estimated cost
River Maintenance and Management	The Waitekuri River requires some pest plant and blockage removal as well as erosion and stabilisation works. This will be followed by ongoing removal of vegetation blockages and minor erosion and stabilisation works as required. Good opportunities for fish spawning enhancement in the lower reaches.	$55,000
Catchment Management	Estimated fencing 2703 metres.	$18,291
	Management of 0.18 hectares of sheet and rill erosion evident at time of survey: - 720 native plants including planting labour	$3,600

Opitonui

Tasks	Description of works	Total estimated cost
River Maintenance and Management	A large number of vegetation blockages have been removed from the lower reaches of the Opitonui River, over the last few years. There are still a number of erosion sites to be remedied. The site upstream of the state highway bridge was chosen as a starting point as stream blockages, which caused the flood plain to flood very regularly and flood the highway. Further upstream of these initial works there are four additional riparian erosion sites identified, which need to be remedied. Costings also provide for continuing blockage removals and pest (willow/bamboo) species removal further upstream of works completed. Funds also made available to complete stabilisation planting works.	$52,500
Catchment Management	Estimated fencing 4628 metres.	$32,396
	Management of 0.12 hectares of sheet and rill erosion evident at time of survey: - 480 native plants including planting labour	$2,400

Owera

Tasks	Description of works	Total estimated cost
River Maintenance and Management	Little work has occurred in this area to date. Mapauriki, Otanguru and Owera Streams all hold good fish spawning stream enhancement capabilities. Cost estimates for enhancement works and unforeseen vegetation blockage removal and erosion works.	$34,500
Catchment Management	Estimated fencing 11929 metres.	$83,503
	- Soil erosion management not evident at time of survey	

Pitoone-Kuaotunu

Tasks	Description of works	Total estimated cost
River Maintenance and Management	Recent works in this area include the construction of two rock groynes on the Kuaotunu Stream just upstream of the	$70,000

	state highway bridge and the removal of fallen tree/vegetation just upstream of this. Other works on the Pitoone stream have included the removal of vegetation and gravel blockages over a 400m reach just downstream of the state highway. Kuaotunu and Pitoone stream mouths are also unblocked regularly during the summer months. Kuaotunu West and the Kuaotunu Campground are very low lying and suffer from localised flooding. There is some historic landowner built stop banks in the paddocks just upstream of the Kuaotunu West settlement. TCDC has a dune restoration project at this site. At the Pitoone Stream mouth there used to be a large buried log on the right bank which deflected the low flows straight out into the CMA. This unofficial structure was blown out in a storm surge, by wave action which also flooded houses in Bluff Road to the East of the stream. Maintenance works on the Pitoone Stream will continue above the state highway. Cost estimates include unforeseen remedy of erosion and vegetation blockages.	
Catchment Management	Estimated fencing 4899 metres.	$34,293
	Planting of 0.12 hectares of sheet and rill erosion evident at time of survey: - 480 native plants including planting labour	$4,320
Other planting	Planting of 416 metres of land held under unknown title (Likely LINZ). 832 native plants including planting labour.	$2,496

Otama

Tasks	**Description of works**	**Total estimated cost**
River Maintenance and Management	Opening of stream mouths for water quality purposes is the main activity in this area. Costings provide for remedying small erosion issues with stabilisation works (such as that currently required on an unnamed stream at Matapaua Bay). There is good scope for fish spawning enhancement works.	$52,000
Catchment Management	Estimated fencing 10,701 metres.	$74,907
	Planting of 0.69 hectares of sheet and rill erosion evident at time of survey: - 2760 native plants including planting labour	$13,800

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