# ENVIRONMENTAL ASSESSMENT OF THE WIDER TE PUNA AND WAIPAPA CATCHMENTS, WESTERN BAY OF PLENTY

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Prepared for:

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# EXECUTIVE SUMMARY

Environment Bay of Plenty commissioned Wildland Consultants Ltd to prepare an environmental assessment for the Te Puna and Waipapa catchments. A number of care groups are active in these catchments and the catchment management issues are representative and typical of many catchments between the Tauranga Harbour and the Kaimai Range.

The project area is strategically important as it is contiguous with and includes the 'Te Puna Ecological Corridor' previously identified by Environment Bay of Plenty, the catchments drain into a well-used part of Tauranga Harbour, Whakamarama (in the upper catchment) is a major entry point to the Kaimai Forest Park, there is already a very high level of general community engagement, tangata whenua support is evident, and Omokoroa has been identified as an urban growth node.

The physical character of the catchment environments, history of land use, current land cover, and current land management are key determinants of the types and geographic spread of biodiversity values and land management issues. Indigenous vegetation and habitats in the upper catchments have high biodiversity values, the streams are of high value as habitats for indigenous fish (and as migratory pathways to the upper catchments), and the receiving environments in the harbour are of very high value. Freshwater and estuarine wetlands in the lower catchments are special features. Middle sections of the catchments are primarily pastoral grassland.

With the general exception of streams, biodiversity protection and enhancement opportunities are mainly located in the upper and lower catchments. Opportunities for restoration of particularly degraded systems in the middle sections of the catchments, are mainly associated with riparian protection.

Besides the key strategic points identified above, key over-arching principles are associated with sustainable land use, provision and availability of ecosystem services, and the availability and application of good quality data and information resources. Protection and enhancement of indigenous biodiversity is a key element of sustainable land management and ecosystem services.

Care groups, landowners, tangata whenua, the wider community, and agencies have identified a range of environmental, biodiversity, cultural, and recreational issues within the Te Puna-Waipapa catchments.

Cultural and recreational issues in the coastal zone include protection and enhancement of the kaimoana resource, and maintenance and improvement of opportunities to use and enjoy the coastal environment. In the upper catchments there is a strong desire for improved access to Kaimai-Mamaku Forest Park.

Environmental and biodiversity issues in the coastal zone include ongoing sedimentation of inter-tidal flats and channels, nutrient inputs to the harbour from various sources, weed invasion of remnants of indigenous vegetation, restoration of indigenous vegetation and habitats, pest management in and adjacent to natural areas, and concerns about water quality and mangrove expansion (both of which are symptoms of 'problems' in the contributing

catchments). There is a considerable focus on the ecological restoration of estuaries and associated terrestrial margins, with care groups well-established and actively engaged in restoration works and ongoing monitoring. There is a notable gap in restoration activity and protective land management in the lower and middle reaches of the catchments. These gaps include a lack of riparian fencing, no management of willow problems in wetlands and along stream margins, and a general lack of protection management for freshwater wetlands in the lower catchments. Restoration activity in the upper catchments is primarily under the aegis of one care group and includes a well-established pest control and monitoring programme in the Puketoki Reserve and a funded initiative to fence and revegetate the riparian margins of the Patirawa Stream. There is a strong desire to continue and expand these initiatives, including larger areas of indigenous forest within and adjacent to Kaimai Forest Park and ongoing riparian protection extending down the catchments.

Erosion, sedimentation, pest plants, and pest animals are pervasive threats to biodiversity values throughout the catchments, and there is general community concern about these issues. These issues are well-recognised throughout the catchments, particularly in the upper and lower catchments, but there are notable gaps in terms of active response in the middle sections and in pastoral environments in general (a notable exception is the Patirawa Stream). Pest plants and pest animals pose the greatest threats to terrestrial biodiversity values, while sedimentation and water quality are the biggest issues in the harbour environment. There is sufficient information to indicate that disproportionate contributions of sediment originate within pastoral systems with steeper gradient streams, particularly within higher rainfall environments. These places must be a high priority for riparian protection.

Care group activities tend to be focused in the upper and lower catchments, generally coincident with current biodiversity values. Care groups, community and tangata whenua aspirations and goals for the catchments cover a diverse array of outcome areas, the fulfillment of which requires an integrated and staged approach to sustainable catchment management.

Monitoring of protection and enhancement works, and restoration activities, is critical to maintaining enthusiasm for projects, and is also an important 'marketable' output for encouraging further buy-in, and securing further funding. Monitoring plays a crucial role in informing management decisions.

This report provides a guiding vision and a set of related goals and objectives, and outlines potential stakeholder roles and responsibilities. These are underpinned by an overview of the current state of the environment in each catchment, an outline of current management, and a series of restoration options and opportunities, and key related actions.

A range of potential projects required to fulfil care group, tangata whenua, wider community, and agency aims have been identified and evaluated. Preliminary rankings of projects are provided, based on their relative contribution to the protection and/or enhancements of existing or potential values. For agencies, the most important actions are associated with the negotiation of stakeholder roles and coordination of stakeholder effort. For care groups, the critical issues are associated with ongoing maintenance and expansion of existing initiatives, and the maintenance and enhancement of community enthusiasm. The provision of ongoing funding is a critical issue for all parties.

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**Reviewed and approved for release by:**

_____
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# 1. INTRODUCTION

Environment Bay of Plenty (EBOP) commissioned Wildland Consultants Ltd to prepare a comprehensive catchment management assessment for the Te Puna and Waipapa catchments. Refer to Figure 1 for catchment boundaries. A number of care groups are active in these catchments and the catchment management issues are representative and typical of many catchments between the Tauranga Harbour and the Kaimai Range.

EBOP's goal is to protect and improve indigenous biodiversity within the Te Puna-Waipapa catchments and to ensure that sustainable land management is implemented. EBOP also wishes to use this assessment as a template for other catchments in the western Bay of Plenty.

The project area is strategically important for the following reasons:

- It is contiguous with and includes the 'Te Puna Ecological Corridor', as previously identified by EBOP.
- The catchments drain into a well-used part of Tauranga Harbour.
- Whakamarama is a major entry point to the Kaimai Forest Park.
- There is already a very high level of general community engagement.
- Tangata whenua support is evident.
- Omokoroa is an identified urban growth area.

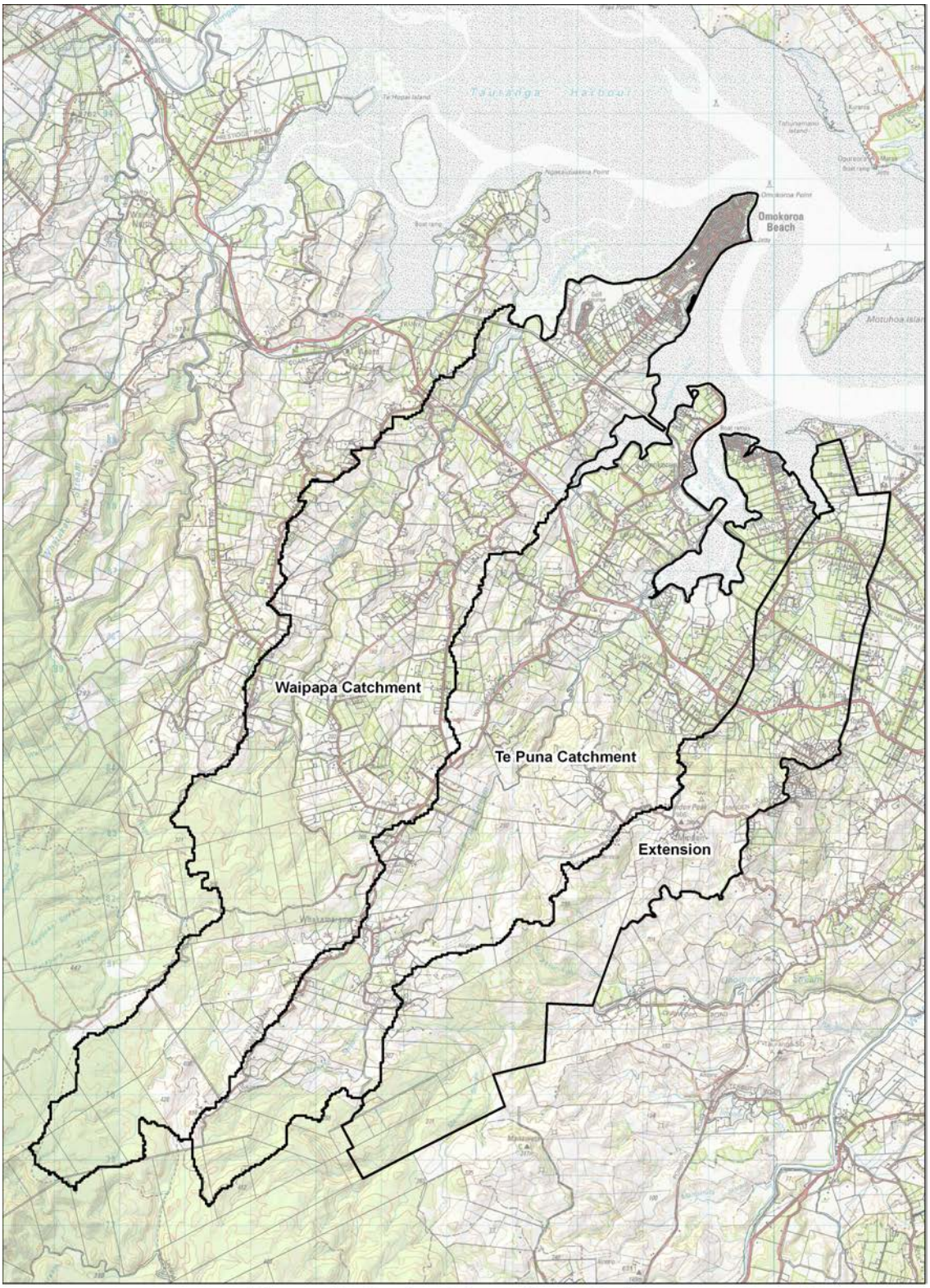
This report provides a guiding vision and a set of related goals and objectives, and outlines potential stakeholder roles and responsibilities. These are underpinned by an overview of the current state of the environment in each catchment, an outline of current management, and a series of restoration options and opportunities, and key related actions. Related background information is provided in the appendices.

# 2. GENERAL ENVIRONMENT

The upper Waipapa and Te Puna Rivers flow from the elevated Waiteariki ignimbrite sheet, which is one of several that form the Mamaku Plateau (Briggs *et al.* 2005). These ignimbrite sheets generally have low relief and are relatively flat, except where streams have cut steeply-sided gorges into the ignimbrite.

Pleistocene fluviatile terraces that rise to 150 m above sea level fringe the Tauranga Basin. These terraces are deeply dissected in parts, such as the middle stretches of the Waipapa River, and are interspersed by more recent terrace deposits at lower altitude. In the lower reaches alluvial flats flank streams and rivers.

The upper sections of the Te Puna and Waipapa catchments have a cover of indigenous forest. An extensive band of agricultural, horticultural, and lifestyle land occurs in the middle of both catchments, and the extension. Streams flow into Tauranga Harbour via estuaries.

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**Legend**

- Catchment Boundary
- Cadastral Boundary

**Figure 1. Project Area Boundaries Waipapa and Te Puna Catchments**

0 2.5 5 km

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Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

Tauranga Harbour is regionally and nationally significant (Wildland Consultants 2008), with significant ecological values also present in the lower reaches of both catchments associated with freshwater and saline wetlands, and saltmarsh. The streams, their riparian margins, and remnant areas of indigenous vegetation provide an opportunity to create improved ecological linkages between the harbour and the Kaimai Range. The area also includes relevant ecological corridors identified within the SmartGrowth Strategy.

## 3. WHAT DOES THIS DOCUMENT PROVIDE?

This document will guide active agency, community, and landowner-based protection and enhancement works within the Te Puna and Waipapa catchments over the next ten years. The assessment may play an important role in integrating and coordinating the significant initiatives either underway or under consideration by local care groups and agencies.

This document provides:

- A snapshot of the current environmental state of the Te Puna and Waipapa catchments.
- A tool to underpin future funding and other resourcing.
- A template for a coherent and integrated approach to long-term catchment management.
- A platform from which agencies, care groups, tangata whenua, and the broader community are able to identify knowledge gaps, and seek additional information.

The assessment will address all four goals by providing a sound-basis to approach ongoing work programmes, including the promotion of sustainable land management and biodiversity protection and enhancement.

The assessment provides a tool to underpin future funding and other resourcing; not as an end in itself but rather as a tool to demonstrate that an integrated approach is possible for long-term sustainable land management and biodiversity enhancement within the Te Puna-Waipapa catchments.

What This Document Does Not Provide

This document is not a plan, and as such it does not provide recommendations regarding implementation of proposed activities, although it does prioritise activities in light of current catchment management and community aspirations and objectives.

This document does not address the critical problem of the resourcing of proposed activities. Although funding options currently available for environmental activities are summarised, the matters associated with how and how much funding is provided to this project, is a matter for agencies to resolve in partnership with the community.

## 4. VISION STATEMENT

**That tangata whenua, landowners, residents and community groups work together to achieve improved terrestrial and aquatic environments through sustainable land practices.**

## 5. WHAT ARE THE ISSUES?

Changes in land use within the Te Puna-Waipapa catchments have had direct and indirect adverse effects on biota, waterways, and the landscape:

- Clearance of most indigenous vegetation within the catchment, particularly in the middle reaches.
- Increased numbers of pest plants and animals.
- Reduced water quality.
- Loss of ecological connectivity and integrity.
- Sediment mobilised by erosion is transported down streams to estuaries, where it encourages the spread of mangroves.
- Sediment is also deposited in harbour channels, from which it has to be dredged to keep shipping lanes open. Port of Tauranga is dredging more fine sediment than in the past (EBOP 2006 - Tauranga Harbour Integrated Management Strategy). Erosion in upper catchments could therefore have economic as well as ecological impacts. The issue of sedimentation is EBOP's main concern for Tauranga Harbour (EBOP 2006).

Environmental concerns held by care groups and the wider communities of the Te Puna-Waipapa catchments include the following:

- The retention of rural landscape character within catchments (i.e. Te Puna Heartlands Plan, March 2007).
- Sedimentation (Omokoroa Estuaries Restoration Group, Waikaraka Estuary Managers, Nga Tahatai o Te Puna Care Group, Pirirakau, Te Puna Estuary Managers).
- Water quality (Omokoroa Estuary Managers, Waikaraka Estuary Managers, Nga Tahatai o Te Puna Care Group, Pirirakau, Te Puna Estuary Managers).
- Some residents rely on streams as a water source and forested catchments produce clean streams that can be a source of drinking water (Whakamarama Community Inc. 2007).
- Siltation and the loss of beaches (i.e. Omokoroa Estuaries Restoration Group Management Plan 2006-2007, Draft v.4).

- Loss of bird roosts (i.e. Omokoroa Estuaries Restoration Group Management Plan 2006-2007, Draft v.4).

- Loss of access to water and shoreline (i.e. Omokoroa Estuaries Restoration Group Management Plan 2006-2007, Draft v.4).

- Loss of opportunities to enjoy coastal environments (Omokoroa Estuary Managers).

- The proliferation of mangroves to the extent that only a narrow channel of clear water remained, and the dumping of rubbish that disfigured estuary margins (Waikaraka Estuary Managers Inc. Management Plan October 2008).

- Sediment sources from roadsides (Te Puna Estuary managers) and development sites (Omokoroa Estuaries Restoration Group).

- Stormwater management (Upper Waikaraka Estuary Stream Care Group).

- Access to Kaimai Forest Park (Whakamarama Community Inc. community survey).

- Road maintenance (Whakamarama Community Inc. community survey).

- Pest animals, including possums, rabbits, rats, and stoats on public and private land (Whakamarama Community Inc. community survey, Pest Free Omokoroa, Pirirakau, Friends of Puketoki Forest, Whakamarama Community Inc.).

- Pest plants, including ragwort, gorse, blackberry and bracken (Whakamarama Community Inc. community survey).

- Roadside vegetation management (Whakamarama Community Inc. community survey).

Pirirakau are concerned about many of the above matters, and have additional concerns in relation to:

- Coastal erosion.

- The impact of sedimentation in the harbour, particularly on kaimoana.

- State of freshwater fisheries, i.e. tuna (eel) and koura.

- The identification (and protection) of important historical and cultural sites.

A survey of broader community interests and aspirations undertaken by Whakamarama Community Inc. (2007) suggested that some of the issues identified above are held by the broader Te Puna-Waipapa community. Concerns identified in that survey included:

- 50% of respondents were not satisfied with road safety and maintenance. Primary concerns were speed limits, seal, and roadside verges for walking. Some concerns were raised about roadside weeds and general vegetation management.

- 82% of respondents wished to see the rural character of Whakamarama preserved. Subdivision was a major concern, as was the provision of services. Some respondents saw restoration of riparian areas as a mechanism for enhancement of rural character.

- Pest plants identified as problems for landowners on their properties include ragwort, Scotch thistle, and Californian thistle, but also woolly nightshade, barberry, and blackberry, the last three of which are classed as environmental weeds as well as agricultural weeds.

- Pest animals - the respondents who identified pest animals as major or moderate problems for their properties noted rabbits (49%), stoats 13%, rats (27%), possums (35%), paradise shelduck (10%), and pukeko (23%). Pukeko and paradise shelduck are indigenous and protected, even though they are considered to be a pest in some situations.

A practical issue is promotion of care group activities within areas of high terrestrial biodiversity value within the study area. With the notable exception of Whakamarama Community Inc., most care group activities (yellow Figure 11 below) are associated with estuarine areas at the bottom of the catchments, in close proximity to urban areas. Areas of terrestrial diversity (green in Figure 3 below) are concentrated in the upper catchment in association with tall indigenous forest. This also emphasises the importance of remnant vegetation and restoration opportunities in the middle catchments, within areas now otherwise dominated by agricultural production landscapes.

# 6. COMMUNITY GOALS AND OBJECTIVES

## 6.1 Cultural goals and objectives

- Te Puna-Waipapa has a rich Māori and Pakeha history. By sharing this history, a sense of identity and pride can be fostered.

- Waahi tapu and sites of cultural significance need to be re-established and defined, and protected.

- Increase opportunities for recreation within the catchment.

- Emphasise and build on the ‘gateway’ role the Te Puna catchment and Whakamarama plays for the central zone of Kaimai-Mamaku Forest Park.

- Habitat maintenance and enhancement for tuna (eel), inanga (whitebait), and koura fisheries.

- Increase community ownership of natural heritage within catchments.

- Increased interaction and dialogue between community members.

- Protection of the kaimoana resource in Tauranga Harbour.

## 6.2 Ecological goals and objectives

- Improved sustainability of land uses within the catchments (Whakamarama Community Inc.)
- All waterways with riparian margins and riparian vegetation are monitored, managed, and weed-free (goal identified by Whakamarama Community Inc.).
- Reduce and eliminate sediment transport to estuaries and harbour (goal common to all care groups and Pirirakau).
- Clear and clean waterways (goal common to all care groups and Pirirakau).
- Protection and enhancement of indigenous biodiversity in indigenous forests (Whakamarama Community Inc. and Friends of Puketoki).
- Increase in indigenous birdlife in lower parts of catchment (Pest Free Omokoroa).
- Increase ecological linkages between top and bottom of catchments (Pest Free Omokoroa).
- Indigenous-rural character is maintained by integrating production, recreational, and residential land uses with biodiversity protection and enhancement (goal identified by Te Puna Heartlands (in part) and by Whakamarama Community Inc.).
- Hard packed white sands and beaches return to estuaries and harbour margins (goal identified by Te Puna Estuary Managers and Omokoroa Estuaries Restoration Group).

# 7. AGENCY GOALS AND OBJECTIVES

## 7.1 Ecological goals and objectives

- Maintain and enhance existing biodiversity values within the Te Puna-Waipapa catchments (EBOP), Western Bay of Plenty District Council (WBOPDC).
- Maintain environmental standards associated with water quality (EBOP).
- Maintain natural character of environments within catchments (EBOP).
- Maintain rural character of middle and upper catchments, consistent with SmartGrowth Strategy (EBOP, WBOPDC).
- Environmental impact of infrastructure development and urban-suburban expansion is minimised and appropriately mitigated (WBOPDC).

## 7.2 Economic goals and objectives

- Agreed best practice land management and infrastructure management is applied (WBOPDC).
- Sustainable use of land for primary production (WBOPDC).
- Recognition of ecosystem services potential (EBOP, DOC).

# 8. STAKEHOLDER ROLES AND RESPONSIBILITIES

An overview of the legislative and policy framework from catchment management is provided in Appendix 1.

## 8.1 Landowners and managers

Landowners and managers are responsible for the environmentally sustainable management of their properties.

## 8.2 Environment Bay of Plenty

One of the legislated purposes of local government is to promote the social, economic, environmental and cultural wellbeing of communities in the present and for the future. Environment Bay of Plenty is responsible for the sustainable management of the natural and physical resources of the region, under Section 30 of the Resource Management Act 1991 (RMA). Under the RMA, EBOP has a statutory responsibility for the maintenance of indigenous biodiversity on private land within the Bay of Plenty. The RMA also stipulates that "the relationship of Māori and their culture and traditions with their ancestral lands, ... is a matter of national importance to be recognised and provided for" (Section 6(e) of the Act). This encourages management of natural and physical resources in partnership with tangata whenua, in keeping with the spirit of the Treaty of Waitangi.

The maintenance of biodiversity on private land requires dialogue and interaction with landowners and the community. One of EBOP's key roles is to initiate interaction and dialogue between stakeholders, including tangata whenua and care groups. Careful management is required to ensure the establishment and maintenance of valuable relationships.

EBOP can inform the community about environmental issues, and encourage the participation of the community in the attainment of sustainable land management. EBOP can encourage participation by fostering partnerships and facilitating management actions.

EBOP can play a role in maintaining long term enthusiasm for biodiversity projects by supporting community groups through the process of applying for funding from other sources, by liaising with other agencies to ensure that available resources are distributed for maximum benefit.

EBOP can work with other agencies to ensure consistency in overall direction compatible with divergence in focus within and between agencies.

A range of policy documents, including the Regional Pest Management Strategy (RPMS), the Tauranga Harbour Management Plan, and the Regional Policy Statement (RPS), the Ten Year Plan provide detail on EBOP's environmental roles and responsibilities and the mechanisms through which they are enacted. The Regional Pest Management Strategy sets out EBOP's policy for pest management within the Region. The strategy is prepared under the Biosecurity Act 1993 and specifies pest species and responsibilities of land occupiers or owners, the Regional Council, and the Crown. Funding assistance may be available to assist in the cost of control for some pests. EBOP is also preparing Biodiversity Management Plans (BMPs) for specified projects where they are undertaking active management to protect and enhance biodiversity values.

## 8.3 Western Bay of Plenty District Council

Western Bay of Plenty District Council (WBOPDC) is responsible for the protection of existing indigenous biodiversity under Section 6(c) of the RMA and a schedule of ecologically-significant sites is provided in the District Plan. WBOPDC has environmental responsibilities complementary to those of EBOP. While WBOPDC's emphasis has been on developing measures to identify and protect areas of the natural environment, the district council recognises the need to become proactively involved in biodiversity enhancement, and to proactively involve the community in achieving this goal. Mechanisms for this include the Western Bay of Plenty District Plan, the resource consent process, and the Long Term Community Plan. The Western Bay of Plenty Long Term Council Community Plan (LTCCP) provides more detail on WBOPDC roles and responsibilities and the various mechanisms through which they are applied. The Council recognises that it must align its various planning processes and documents to ensure that community outcomes are delivered in a coordinated and consistent manner.

WBOPDC can play various roles in pulling community group activities together through their community development officer:

- Timing.
- People.
- Resources.
- Advice.
- Media coverage.
- Help to strengthen groups and pull in other stakeholders.
- Resourcing responsibility.

The decision by Central Government in 2006 to not release a National Policy Statement on Biodiversity and then to release a set of guidelines (MfE & DOC 2007) recognised that Regional and District Councils (and private landowners and managers) have the primary responsibility for biodiversity on lands beyond those administered by the Department of Conservation. The national guidelines clearly recognise the importance of the following:

- **National Priority 1:** To protect indigenous vegetation associated with land environments, (defined by Land Environments of New Zealand at Level IV), that have 20 percent or less remaining in indigenous cover.

- **National Priority 2:** To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.

- **National Priority 3:** To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already associated with Priorities 1 and 2.

- **National Priority 4:** To protect habitats of acutely and chronically threatened indigenous species.

## 8.4 Department of Conservation

The primary responsibility of the Department of Conservation is the management of land administered by the Department, under both the Reserves Act (1977) and the Conservation Act (1986). The Department of Conservation also administers two independent funds established in 1991 to protect natural values on private land, the Nature Heritage Fund and Nga Whenua Rahui, and also administers the Biodiversity Condition Fund and the Biodiversity Advice Fund.

## 8.5 Tangata whenua

Pirirakau have kaitiaki (duty of care) over both Te Puna and Waipapa catchments, which are part of their rohe. Pirirakau are cultural partners and land management partners in all community projects, and recognition of this relationship is critical for community projects to move forward. Tangata whenua have a responsibility to ensure that relationship is healthy and functional. Pirirakau have a responsibility for identifying historical sites, and communicating their significance to the broader community. A statement of Pirirakau interests and concerns is provided at Appendix 4.

## 8.6 Care groups

Care groups undertake a range of environmentally-orientated on-the-ground activities. Refer to Section 10 below.

## 8.7 Horticulture New Zealand

Horticulture New Zealand's objectives are to raise the profile of horticulture industry, advocate on environmental issues on behalf of horticultural sector, and to enhance business environment for growers within the sector. Horticulture New Zealand can be an advocate for agreed best practice management and sustainable land use. Similar roles can be played by the Tauranga/Te Puke and Katikati Fruitgrowers Association.

## 8.8 Federated Farmers

Federated Farmers aim to represent farmers' interests at regional, national, and international levels, to ensure its members get a fair deal. Federated Farmers advocates for sustainability through best use, where sustainability is defined as the unity of positive environmental management with economic reality (Federated Farmers Inc. 2008). A similar role can be played by the Small Farmers Association.

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## 8.9 Forest and Bird

Forest and Bird is an independent conservation organisation that advocates for the protection of the natural heritage and native species of New Zealand. Forest and Bird can advocate for protection and enhancement of indigenous biodiversity and the environment among its members, and the community at large.

## 8.10 QEII Trust

The QEII National Trust (QEII) is an independent statutory organisation with a core activity to secure long-term legal protection of natural and cultural features on private land. The Trust can play an important role in assisting councils to meet their responsibilities under the Resource Management Act 1991. Private property rights are not in contention as the landowner continues to own and manage the land, subject to agreed covenant terms and conditions. The Local Government (Rating) Act 2002 (LGRA) states that 'land owned or used by and for the purposes of the Queen Elizabeth the Second National Trust is non-rateable'.

## 8.11 Nga Whenua Rahui

Maori landowners can protect their indigenous ecosystems under Nga Whenua Rahui kawenata. The agreement is sensitive to Maori values in terms of spirituality and tikanga. Cultural use of these natural areas may be blended with the acceptance of public access within the agreements. The objective is long-term protection with inter-generational reviews of conditions.

## 8.12 NZTA and Inroads

The New Zealand Transport Agency (NZTA, formerly Transit New Zealand) and Inroads have responsibilities for the maintenance of road reserves throughout the catchment, in accord with a long-term strategy for pest plant control within the road corridor adopted by WBOPDC. EBOP assisted in writing this strategy and continues to assist its implementation. The long term strategy has a role in maintaining and enhancing indigenous biodiversity values and minimising erosion risk within road corridors.

## 8.13 OnTrack

OnTrack is responsible for vegetation management within the rail corridor in the lower catchment, and can play a role in enhancing indigenous biodiversity values along the rail corridor.

# 9. CURRENT STATE OF THE CATCHMENT ENVIRONMENTS

## 9.1 Hydrology and sedimentation

The Tauranga Basin receives approximately 1,200 mm rainfall annually (1,198 mm mean annual rainfall in Tauranga City), although this will be greater at higher altitude on the flanks of the ranges.

Upper catchments have moderate to high gradients, steep sections associated with the main channel in middle reaches, whereas many tributaries have only moderate gradients. The Te Puna and Waipapa Streams fall relatively steeply, with high gradients in their upper reaches, and meander over low gradients in their lower reaches (Figure 2). Within the Te Puna and Waipapa catchments high tides can further slow the movement of flood waters through the lower catchment. An overview of the relationships between stream flows and sediment transport is provided in Appendix 2. A summary of stream gradients and stream lengths within indigenous forest, pastoral, and urban environments in the project area is provided in Table 1. The following are key points:

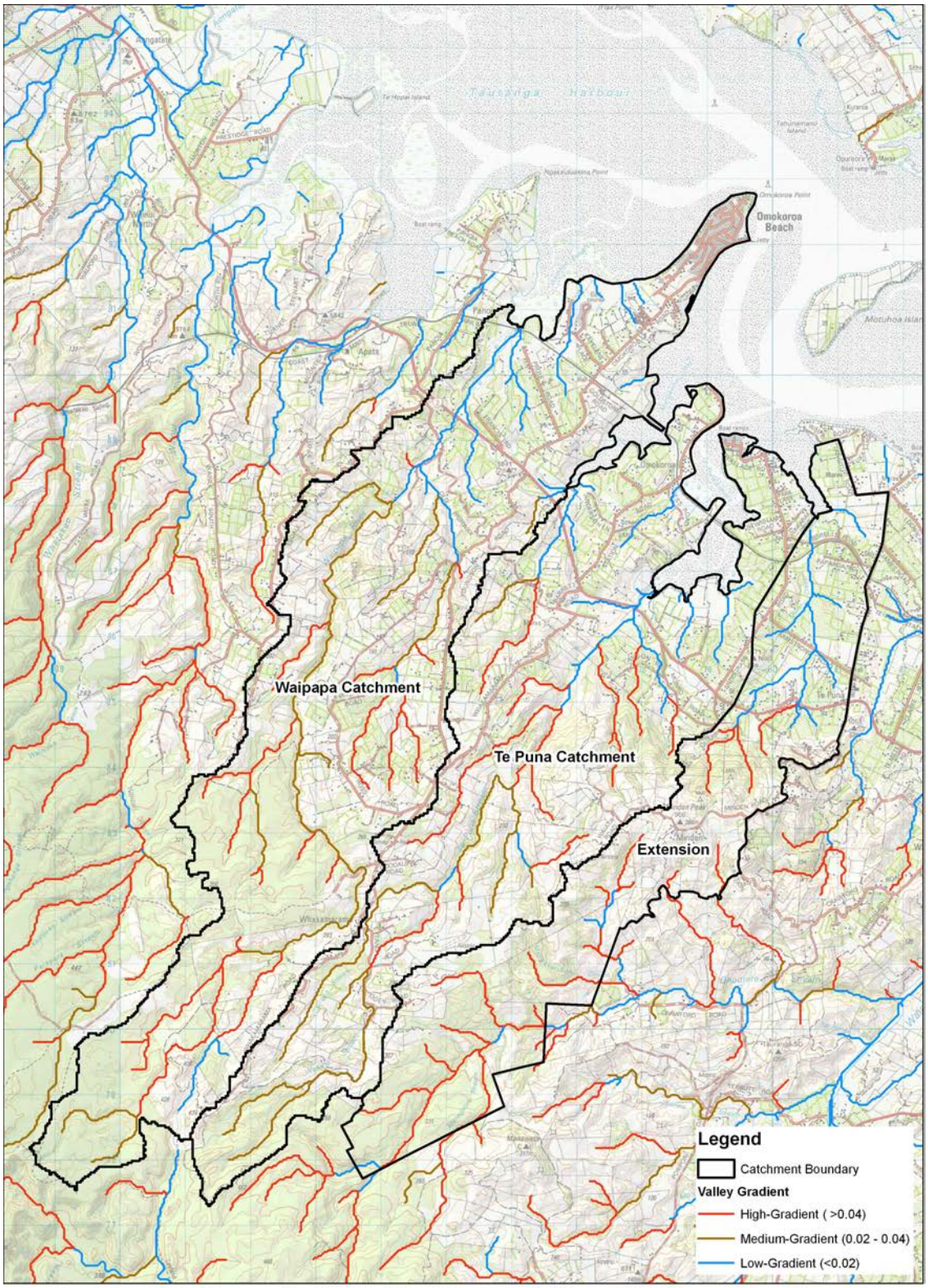
- About two-thirds of the high-gradient streams within the 'Extension' catchment is within a pastoral environment, with one-third in indigenous forest (about two-thirds of the 'Extension' catchment has high gradient streams).

- All high gradient streams within the Te Puna catchment are within a pastoral environment (high-gradient streams comprise *c.*38% of streams in the catchment).

- About half of high-gradient streams in the Waipapa catchment are in a pastoral environment, with the balance in forest (high-gradient streams comprise *c.*37% of streams in the catchment).

- For the 'Extension' and Waipapa catchments, most high-gradient streams are in the upper parts of the catchments and a significant proportion of these streams is within indigenous forest (refer to Figure 2). Both of these catchments also have high gradient streams within the middle reaches, within agricultural and horticultural environments.

- For the Te Puna catchment, the upper catchment (within forested and pastoral environments) has a predominantly medium gradient, but there are significant extents of high-gradient streams within the middle reaches of the catchment, within agricultural environments.

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Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 2. River Environment Classification Waipapa and Te Puna Catchments**

0 2.5 5 km

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Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

Table 1: Stream gradients and stream lengths (metres) within forested, pastoral, and urban land covers in the Te Puna and Waipapa Catchments.

| Stream Gradient | Land Cover | Catchment | | | Total |
|---|---|---|---|---|---|
| | | Extension | Te Puna | Waipapa | |
| High-Gradient | Forest | 6,435 | | 12,407 | 18,842 |
| | Pastoral | 13,957 | 19,747 | 10,703 | 44,407 |
| **High-Gradient Total** | | **20,392** | **19,747** | **23,111** | **63,250** |
| Medium-Gradient | Forest | | 1,945 | 6,198 | 8,144 |
| | Pastoral | | 15,999 | 16,335 | 32,334 |
| **Medium-Gradient Total** | | | **17,944** | **22,534** | **40,477** |
| Low-Gradient | Forest | 845 | | | 845 |
| | Pastoral | 9,784 | 13,855 | 15,446 | 39,086 |
| | Urban | | | 1,049 | 1,049 |
| **Low-Gradient Total** | | **10,629** | **13,855** | **16,495** | **40,980** |
| **GRAND TOTAL** | | **31,021** | **51,546** | **62,140** | **144,707** |

- A considerable amount of work is currently underway on sediment generation and management in the Tauranga catchment (Elliot *et al.* 2009, Green 2009 a & b, Hancock *et al.* 2009, Hume *et al.* in prep., Parshotam *et al.* 2008, Parshotam *et al.* 2009, Pritchard and Gorman 2009). This work indicates that, for the Te Puna catchment, a disproportionate amount of sediment originates from steeper pastoral streams subject to higher rainfall levels.

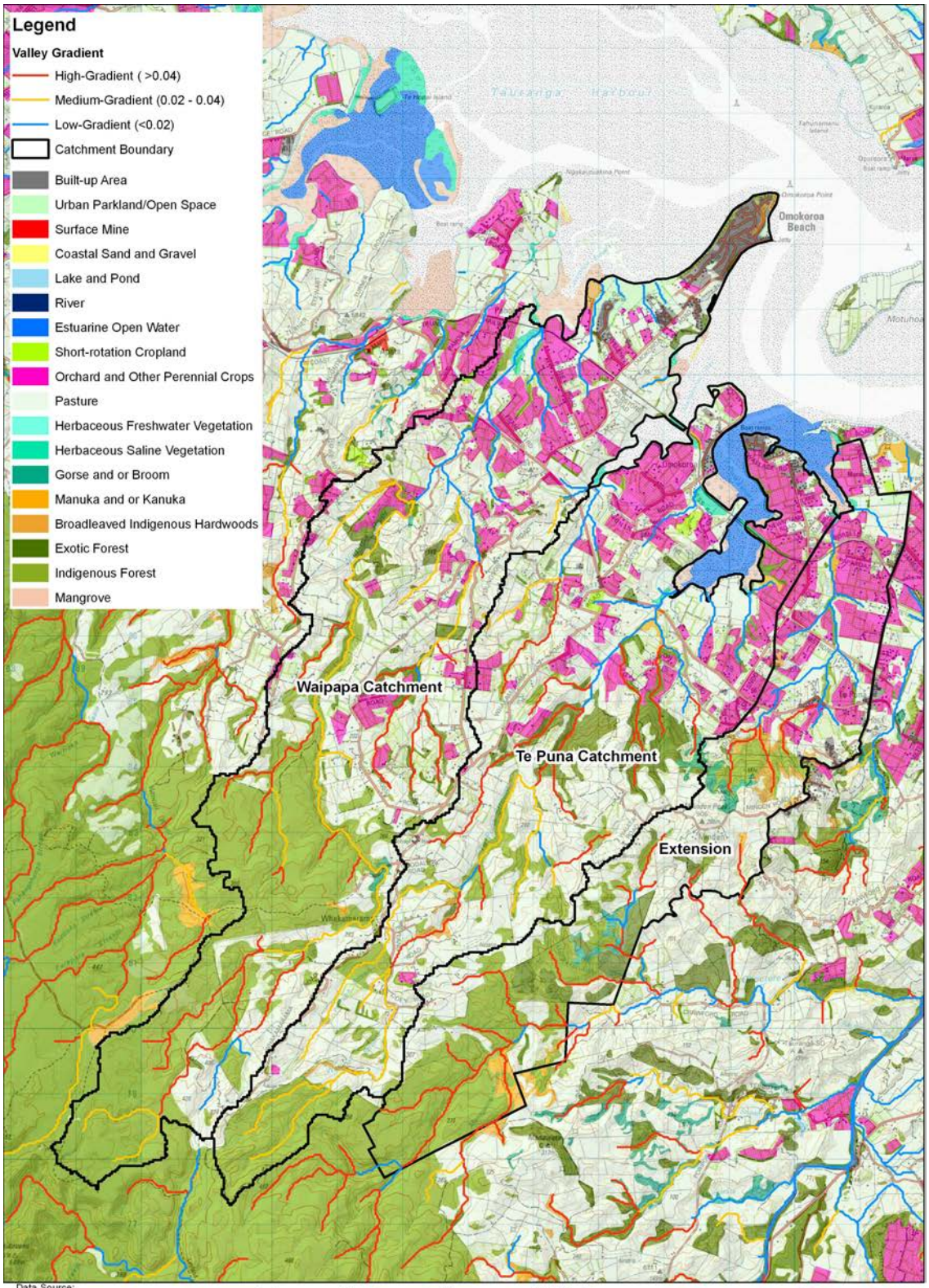
## 9.2 Land use and land cover

Pattern

Land use in the catchments is strongly rural (Figure 3). Just over half (51.8%) of the study area is covered by high-producing exotic grassland. In contrast, urban areas cover only 0.04% of the Te Puna catchment and 0.05% of the Waipapa catchment. Small urban areas are present in lower reaches of all three catchments, at Omokoroa, Plummers Point, Te Puna, and Wallace Road. Refer to Tables 1 and 2.

Indigenous forest in the upper reaches of all three catchments is contiguous with the extensive tract extending onto the Kaimai Range and the Mamaku Plateau. The middle and upper catchments are dominated by high-producing exotic grasslands on freehold land (42.5%, 60.4%, and 49.1% respectively). In the lower reaches of the three catchments, orchards, including kiwifruit, citrus, tamarillo, and avocado are cultivated above a groundcover dominated by exotic pasture grasses. These are prominent land uses, covering 14.0%, 15.4%, and 11.1% respectively of the total catchment areas, along with high-producing exotic pasture.

The main land use of arable lands at lower altitudes on low ridges and terraces is horticultural, kiwifruit, and avocado orchards. Lands on rolling hill country and steeper lands in the middle and upper catchments are mostly under pasture, including dairy and beef farming.




Data Source:
Ministry for the Environment, 2004: New Zealand Land Cover Database 2. Ministry for the Environment, Wellington, New Zealand.

New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

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**Figure 3. Land Cover of Waipapa and Te Puna Catchments**

0 1.5 3 km

E:\gis\w8\el\Waipapa-Te Puna Catchment\Figure 3 Waipapa-Te Puna Catchment_LCDB.mxd

Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

There is a band where no indigenous forest remains extending across the full width of the lower catchments, between the lower extent of riparian forests in river gullies and upper extent of freshwater and estuarine wetlands. This corresponds to the distribution of Acutely Threatened Land Environments within the Te Puna and Waipapa catchments (Figure 4).

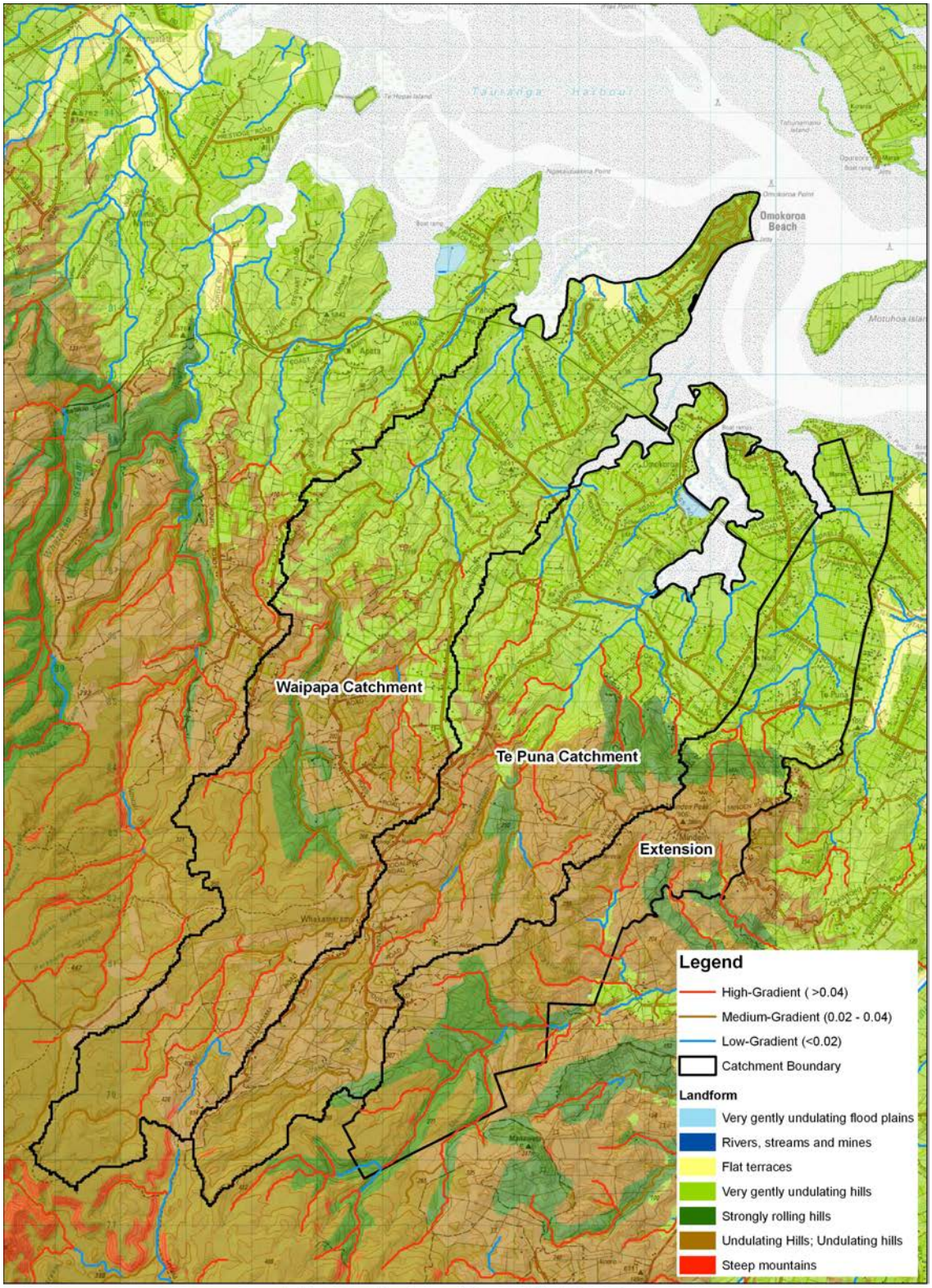
Table 2: Land cover and land uses (areas in hectares) within Te Puna and Waipapa catchments, Western Bay of Plenty District.

| Land Cover | Catchment | | | Total |
|---|---|---|---|---|
| | Extension | Te Puna | Waipapa | |
| Afforestation (imaged, post LCDB 1) | | 3.8 | 5.0 | 8.8 |
| Broadleaved Indigenous Hardwoods | 41.0 | 17.0 | 11.8 | 69.9 |
| Built-up Area | 18.4 | 36.9 | 95.0 | 150.3 |
| Coastal Sand and Gravel | | 0.2 | | 0.2 |
| Deciduous Hardwoods | 5.6 | 20.4 | 1.6 | 27.7 |
| Estuarine Open Water | <0.01 | 6.1 | | 6.1 |
| Forest Harvested | | 2.9 | | 2.9 |
| Gorse and Broom | 45.3 | 9.9 | 8.7 | 63.9 |
| Herbaceous Saline Vegetation | 2.6 | 18.7 | 14.4 | 35.8 |
| High Producing Exotic Grassland | 849.7 | 2,047.1 | 1,988.7 | 4,885.5 |
| Indigenous Forest | 582.6 | 410.2 | 1,192.2 | 2,184.9 |
| Low Producing Grassland | | 4.3 | 10.4 | 14.7 |
| Major Shelterbelts | | 9.0 | 3.9 | 12.9 |
| Mangrove | 0.5 | 5.7 | 4.1 | 10.2 |
| Manuka and or Kanuka | 35.7 | 19.2 | 9.9 | 64.7 |
| Orchard and Other Perennial Crops | 273.7 | 519.0 | 444.2 | 1,237.0 |
| Other Exotic Forest | 0.2 | 163.5 | 26.8 | 190.6 |
| Pine Forest - Closed Canopy | 94.6 | 38.7 | 94.7 | 228.1 |
| Pine Forest - Open Canopy | 2.1 | 12.9 | 47.5 | 62.5 |
| Short-rotation Cropland | | 14.4 | 1.5 | 15.9 |
| Transport Infrastructure | <0.1 | 2.5 | | 2.6 |
| Urban Parkland/Open Space | 6.9 | | 53.9 | 60.7 |
| (blank) | | 2.9 | 7.8 | 10.7 |
| **Total (Hectares)** | **1,959.0** | **3,365.6** | **4,022.0** | **9,346.6** |

In the upper catchments, pasture abuts patches of indigenous forest. In the upper Waipapa especially, some larger remnants of indigenous forest are more-or-less surrounded by pasture. Indigenous riparian forest extends downstream of bush blocks in upper catchments along gullies formed by rivers. However, riparian indigenous vegetation is lacking alongside many of the smaller streams flowing through pasture and orchards.

Soils and Land Use Capability

Land use capability is a measure of how versatile land is, and gives an assessment of the overall degree of limitation to land use imposed by physical factors including soils, topography and climate (Blaschke 1985). There is a reasonable correlation between patterns of commercial land use and land use capability (refer to Figure 4). More arable lands are more common in the lower catchment, where horticulture is the predominant productive land use, while less arable land classes are common in the upper catchment, where agriculture is the predominant land use. Exceptions to this pattern are the gorges and steep slopes around Minden in the middle catchment, and

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Data source:
Land Environments of New Zealand: Landcare Research and Ministry for the Environment, Wellington. Threat Classification from Walker et al. (2006).

New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 4. Landform Units of Waipapa and Te Puna Catchments**

0 2.5 5 km

E:\gis\wildlife\Waipapa-Te Puna Catchment\Figure 4 Waipapa-Te Puna Catchment_LENZ landform.mxd

Wildlands

Scale: 1:55,000
Date: 03/02/09
Cartographer: RPB

the area of LUC 7 around Te Puna Quarry is predominantly forested. However, there are small areas of LUC 7 in pasture in the upper catchments. Some of the most arable soils in the catchment are the sites of urban developments.

Yellow-brown loams in the middle-to-lower reaches of both catchments exhibit considerable versatility, which is reflected by the fact that virtually the entire area of the lower catchments has been converted to some form of agricultural or orchard land use. Most erosion of yellow-brown loams occurs with a pasture dominant cover (Blaschke 1985). The most common types of erosion are soil slip and sheet, with gully and rill erosion minor types. Soil slips and other mass movement erosion is typically the result of failure at the interface between different layers of underlying tephra during short duration, high intensity rainstorms (Blaschke 1985).

Along the foothills of the Kaimai Range, yellow-brown loams occur in rolling to steep hill country, which is heavily dissected by gullies. The yellow-brown loams may or may not have continuous underlying tephra, and overly rhyolite or unconsolidated sediments. Those overlying unconsolidated sediments are more erosion prone, with 79% of the map units identified by Blaschke (1985) recording slight erosion.

Soils overlying the Waitearikiignimbrite are dominated by podsolised yellow-brown loams, particularly above 300 m above sea level, where rainfall and temperature combine to enhance podsol formation. Sheet erosion occurs on podsolised yellow brown loams during high rainfall events during periods of poor pasture growth, or during recovery following grazing, and soil slip erosion occurs on steeper slopes.

Landform units in the project area are shown in Figure 5 and summarised in Table 3.

From Table 3, it is evident that most streams in the three project catchments are within ‘very gently undulating hills’ and ‘undulating hills’, with lesser areas of steeper landforms. The Waipapa catchment has nearly 1 km of streams in the ‘flat terraces’ landform type.

Table 3: Landform units within the project area.

| Landform Type | Te Puna Catchment | | Waipapa Catchment | | Extension | | Grand Total | |
|---|---|---|---|---|---|---|---|---|
| | Area (ha) | Streams (m) | Area (ha) | Streams (m) | Area (ha) | Streams (m) | Area (ha) | Streams (m) |
| Very gently undulating flood plains | 12.09 | | | | | | 12.09 | 0 |
| Flat terraces | | | 27.86 | 931 | | | 27.86 | 931 |
| Very gently undulating hills | 1,628.70 | 22,640 | 1,766.13 | 23,925 | 690.13 | 12,302 | 4,084.96 | 58,867 |
| Undulating hills | 1,498.16 | 23,368 | 2,039.05 | 29,507 | 901.10 | 8,296 | 4,438.31 | 61,171 |
| Strongly rolling hills | 216.89 | 5,144 | 171.38 | 6,811 | 365.43 | 10,423 | 753.70 | 22,378 |
| Steep mountains | 1.38 | | 2.52 | | 1.13 | | 5.02 | 0 |
| Not classified | 8.39 | 393 | 10.62 | 965 | 1.25 | | 20.25 | 1,358 |
| **Grand Total** | **3,365.60** | **51,545** | **4,017.56** | **62,139** | **1,959.04** | **31,021** | **9,342.20** | **144,705** |

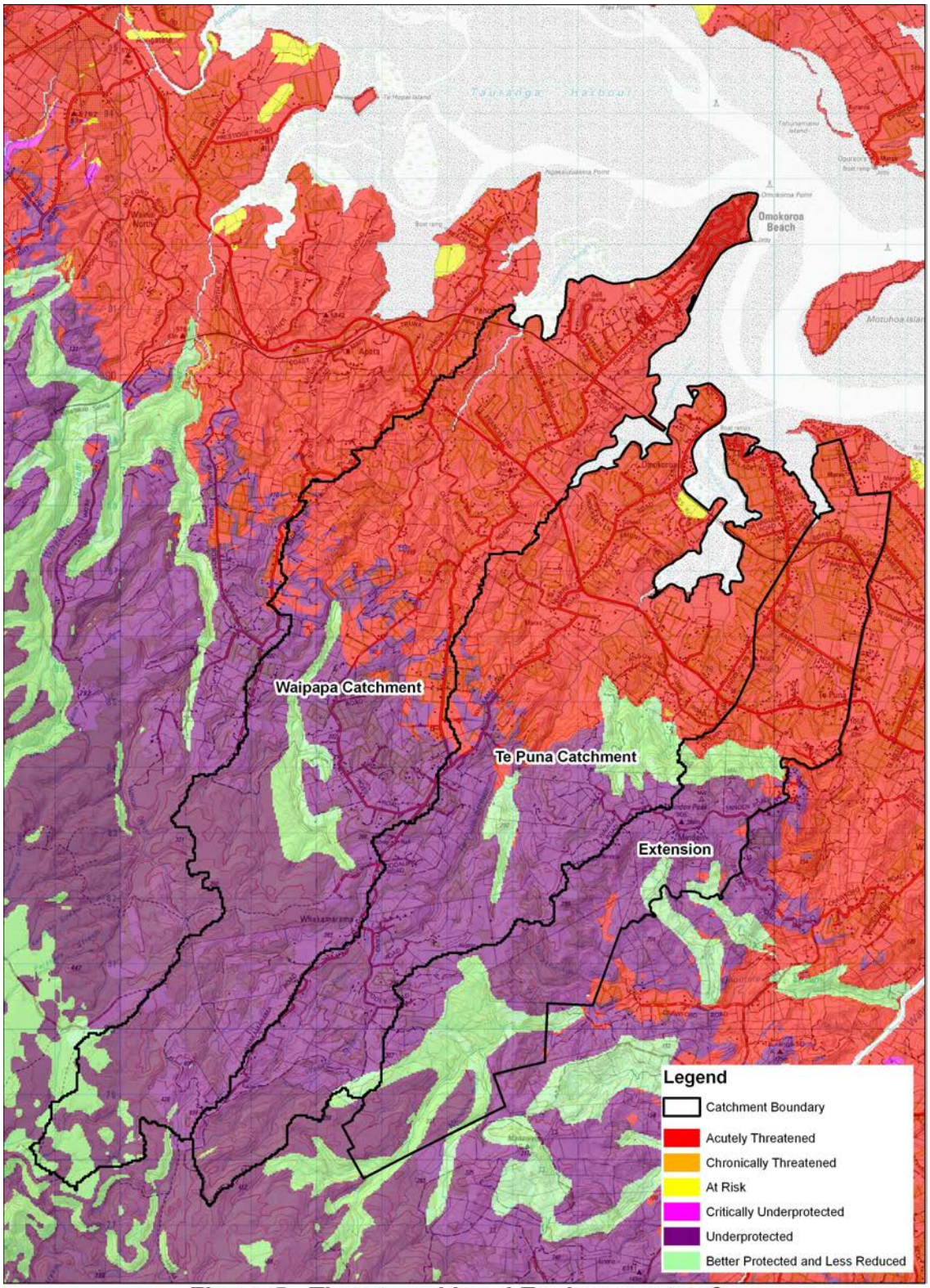



**Figure 5. Threatened Land Environments of Waipapa and Te Puna Catchments**

Data source: Land Environments of New Zealand: Landcare Research and Ministry for the Environment, Wellington. Threat Classification from Walker et al. (2006).

0 2.5 5 km

E:\gis\wildlet\Waipapa-Te Puna Catchment\Figure 5 Waipapa-Te Puna Catchment_LENZ.mxd

Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

## 9.3 Threatened environments

Land Environments of New Zealand (LENZ) categories have been analysed to indicate the degree of threat to various landscapes on a national level (Walker *et al.* 2006). Threatened environment classifications within the project area are shown in Figure 5. The order of threat category follows the national system for classifying species according to threat of extinction (Molloy *et al*. 2002), where 'Acutely Threatened' is the highest threat category, and 'Underprotected' the lowest, followed by 'Not Threatened' (see Table 4).

Table 4: LENZ environment threat categories and criteria (from Walker ***et al***. 2006).

| Category | Criterion |
|---|---|
| Acutely Threatened | <10% indigenous cover remaining |
| Chronically Threatened | 10-20% indigenous cover remaining |
| At Risk | 20-30% indigenous cover remaining |
| Critically Underprotected | >30% indigenous cover remaining |
| | <10% legally protected |
| Underprotected | >30% indigenous cover remaining |
| | 10-20% legally protected |
| No Threat Category | >30% indigenous cover remaining |
| | >20% legally protected |

Key issues within the project area are:

- Virtually the entire terrestrial environment below 200 m asl contour is classified as 'Acutely Threatened' (these environments are the most heavily modified in the country), with less than 10% indigenous cover remaining (note that less than 20% is National Priority 1 for protection of biodiversity on private lands).
- The Jess Road wetland is within an 'At Risk' environment.
- Virtually all areas between the 200 m contour and the upper catchment boundary are classified as 'underprotected' land environments. Exceptions to this are deeply-incised river gullies, steep landforms in the vicinity of the Te Puna quarry, and small areas of forest in the very head of the catchment, which are within land environments classified as 'not threatened'.

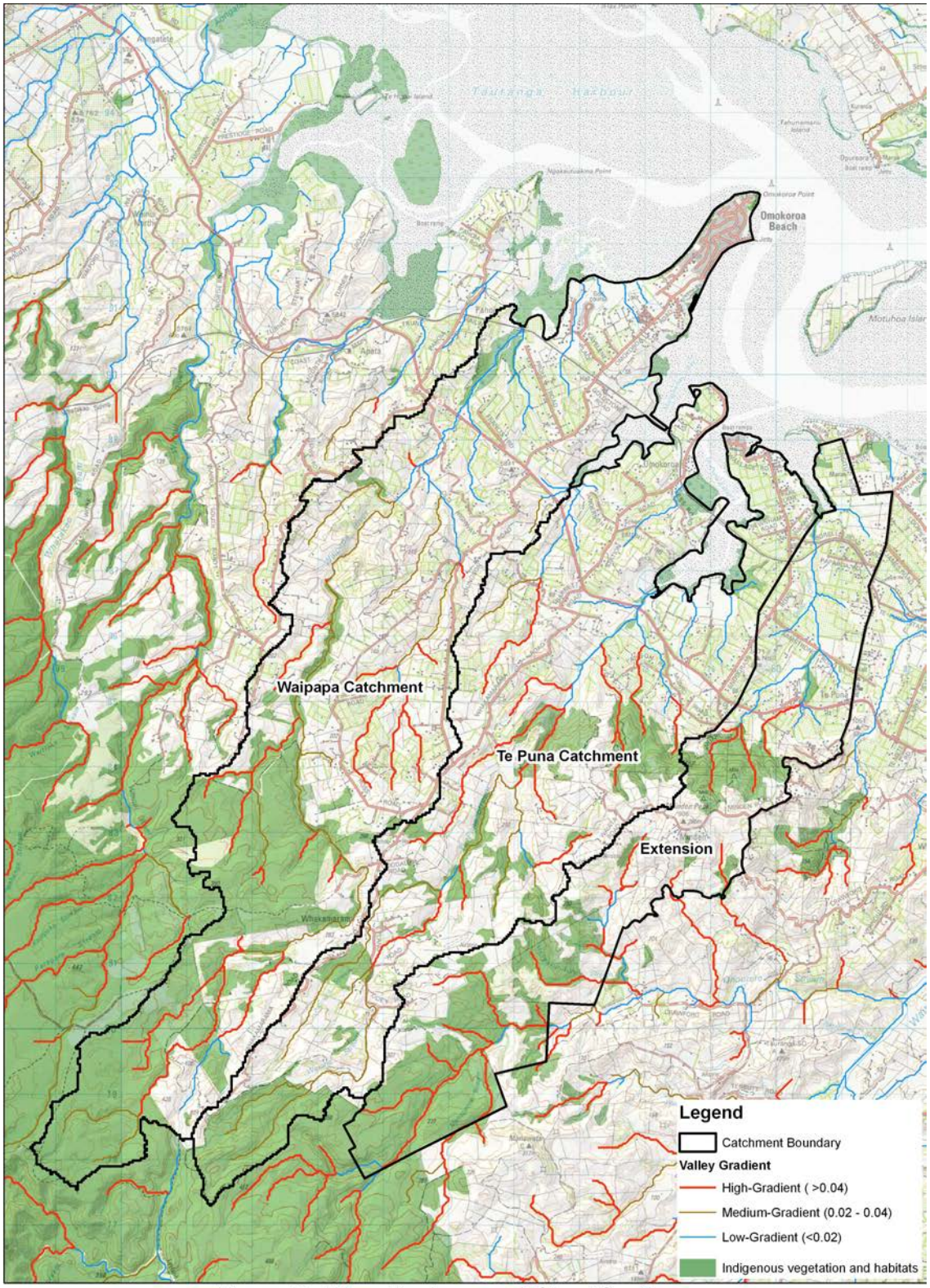
## 9.4 Indigenous vegetation and habitats

Streams and indigenous vegetation are shown in Figure 6.

Estuaries

There are four estuaries within the study area:

- Waikaraka estuary - *c.*67 ha.
- Te Puna estuary - *c.*165 ha.
- Jess Road wetland - *c.*11 ha.
- Mangawhai estuary - *c.*130 ha.
- Waipapa estuary - *c.*140 ha.

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Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 2. River Environment Classification and Indigenous Vegetation and Habitats Waipapa and Te Puna Catchments**

0 2.5 5 km

E:\gis\willie\Waipapa-Te Puna Catchment\Figure 2 Waipapa-Te Puna Catchment_River.mxd

Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

Mangrove (*Avicennia marina* subsp. *australasica*) scrub occurs on intertidal flats at Snodgrass Road Inlet, Te Puna Estuary, Newnham Road, and in Mangawhai Bay. Behind the mangroves, estuarine saltmarsh occurs at Te Puna estuary, Mangawhai Bay, Waipapa Estuary. Saltmarshes are dominated by oioi (*Apodasmia similis*) and sea rush (*Juncus kraussii* subsp. *australiensis*) and usually have a fringe of saltmarsh ribbonwood (*Plagianthus divaricatus*) along their inland margin. Small areas of *Olearia solandri* shrubland occur around margin of Waipapa Estuary, with manuka (*Leptospermum scoparium*) scrub around estuary and wetland margins.

Freshwater Wetlands

- Five small patches of freshwater wetland on the margins of the Te Puna River cover *c.*5.16 ha.
- Freshwater wetlands associated with Waikaraka estuary cover a total of 8.8 ha.

The transition from estuarine to freshwater wetlands is often marked by the occurrence of *Bolboschoenus fluviatilis*, which occurs on the edges of waterway immediately above the estuarine zone. Vegetation within freshwater wetlands is stratified by water depth. *Baumea articulata* and *Elaeocharis sphacelata* are the deepest-growing species, and form pure or mixed stands, being dominant in deep freshwater. *Carex secta* forms clumps in standing shallower water. Several species of *Baumea, Cyperus, Juncus, Schoenus* and *Schoenoplectus* form reedlands on saturated soils with shallow surface waters. Around the margins of wetlands, on soils that are seasonally inundated, a range of indigenous herbs occur, including *Rorippa palustris* and *Triglochin striata.* This pattern has been disturbed by invasion by pest plants, particularly grey willow (*Salix cinerea*) which has formed continuous forests in some areas previously dominated by indigenous species, such as at Waikaraka estuary wetland and the upper Waikaraka estuary.

Coastal Forest

On the north-western side of Omokoroa Peninsula, approximately 7 ha of coastal vegetation is present on coastal cliffs. Pohutukawa (*Metrosideros excelsa*) forest is present in the vicinity of Waihuri Pa, with karaka (*Corynocarpus laevigatus*) and hangehange (*Geniostoma ligustrifolium*) also present. The understory has been invaded by tradescantia (*Tradescantia fluminensis*), which is thick in places. Moth plant (*Araujia* sp.) and brush wattle (*Paraserianthes lophantha*) are also present. The northern side of Omokoroa peninsula has discontinuous pohutukawa forest, with tree privet-woolly nightshade-Chinese privet forest, with scattered hangehange and karamu (*Coprosma robusta*). Wild ginger and tradescantia are also present. Two areas of 9.1 and 2.2 ha of weedy vegetation is present on the south-eastern side, adjacent to the railway line.

Six remnants of coastal cliff vegetation on coastal cliffs at the eastern end of Te Puna Beach and around Te Puna estuary total 21.4 ha. Vegetation in at least one of these remnants is dominated by a mixture of indigenous and exotic species, including hangehange (*Geniostoma rupestre*), karamu (*Coprosma arborea*), tree privet (*Ligustrum lucidum*), woolly nightshade (*Solanum mauritianum*), Chinese privet (*Ligustrum sinense*), and kahili ginger (*Hedychium gardnerianum*). Other remnants were not visited, but given commonalities of disturbance history associated with land

use, proximity to source populations, and environment, the vegetation is likely to be similar.

Several small stands of mixed kamahi (*Weinmannia racemosa*), mamaku (*Cyathea medullaris*), and rewarewa (*Knightia excelsa*) occur on hillslopes above estuary margins.

Semi-Coastal and Lowland Forest

In the upper catchments, forests contiguous with the Kaimai Forest Park cover large areas. Indigenous forest covers 427.2 ha (12.7%) of the Te Puna catchment, 1,204.58 ha (30.0%) of the Waipapa catchment, and 624.60 ha (31.9%) of the 'Extension'. Vegetation in these forests is characteristic of late secondary successions initiated by major disturbance. In larger forest blocks at the head of the catchments, the diversity of forest composition increases, with pukatea-tawa forest, northern rata-rimu-rewarewa, pure kamahi, and rimu-totara-tanekaha forest. These stands reflect varying intensities of disturbance and changes in composition imposed by logging activities. Other species that occur as minor components include tawari (*Ixerba brexioides*), hinau (*Elaeocarpus dentata*), mangeao (*Litsea calicaris*), kohekohe (*Dysoxylum spectabile*), and tawheowheo (*Quintinia serrata*) (Beadel 2006).

Forest in the Puketoki Reserve is dominated by tawa (*Beilschmiedia tawa*) with miro (*Prumnopitys ferruginea*), matai (*Prumnopitys taxifolia*), kahikatea (*Dacrycarpus dacrydioides*), and pukatea (*Laurelia novae-zelandiae*) also present.

In the middle reaches of the Te Puna and Waipapa catchments, indigenous forest remnants are largely restricted to steepland sites within incised gullies adjacent to the main channels of the Te Puna and Waipapa Streams. These gully forests are dominated by rewarewa-rimu/kamahi forest. Similar stands with less rimu, occur on steep slopes adjacent to the Te Puna Quarry. Small stands dominated by mamaku, with mahoe (*Melicytus ramiflorus*) are present in the middle parts of the catchments.

Pasture

Half of the Te Puna-Waipapa catchment area (4,900 ha) has a cover of pasture. Although ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*), and white clover (*Trifolium repens*) and other common pasture species have traditionally dominated pastures, a change in composition of pasture from ryegrass dominance to kikuyu is currently occurring within the Te Puna-Waipapa catchments as a result of recent invasion by kikuyu.

Exotic Forest

Small stands of exotic pine forest are scattered throughout both catchments, with a total area of 290.5 ha. Shelterbelts associated with horticulture are a feature of lower catchments. Mixed stands dominated by black wattle (*Acacia mearnsii*), brush wattle (*Paraserianthes lophantha*), and tree privet, have established on a wide range of sites, including coastal cliffs, gullies, and some roadsides following disturbance.

Urban Areas

Small urban areas are present within the Te Puna or Waipapa catchments, at Plummers Point, Omokoroa, and Te Puna.

## 9.5 Flora (including threatened species)

The range of indigenous plants present reflects the character of indigenous vegetation and habitats:

- estuarine saltmarsh and mangroves.
- coastal forest.
- freshwater wetlands.
- various secondary forest types.
- semi-coastal lowland forest extending into the upper catchments.

While there is no comprehensive species list available specifically for the study area, a species list for the Bay of Plenty region has just been completed, within which species listed for the Tauranga and Otanewainuku Ecological districts will include those present in Te Puna-Waipapa Catchments (Beadel *et al*. 2009).

No threatened or uncommon species (*sensu* de Lange *et al*. 2009) are known to occur within the Te Puna-Waipapa Catchments. However, estuarine saltmarshes provide habitats for several regionally uncommon plant species, including ***Sparganium subglobosum*** in Mangawhai Bay inlet, and ***Austrostipa stipoides*** in Te Puna estuary (Wildland Consultants 2008).

## 9.6 Avifauna

An indicative list of avifauna using habitats in the project area is provided in Appendix 8. At least 29 indigenous species are present and a further 12 exotic species, although this will not be a complete list. Other waders utilise intertidal and high-tide roost habitats in the harbour, and other species will also visit from time to time.

## 9.7 Freshwater fish

There are recent records of indigenous fish from highly-modified streams such as an unnamed tributary of the Waipapa Estuary where banded kōkopu (*Galaxias fasciculatus*) occur, and an unnamed stream south of Omokoroa where short-finned eel (*Anguilla australis*) were abundant and a large long-finned eel (*Anguilla dieffenbachii*) was also present (Wildland Consultants 2000). These records suggest that the presence of indigenous fish, including threatened and uncommon species, can be expected in virtually any river or stream in this area that lacks natural or artificial barriers. The five species that make up the whitebait catch differ in their climbing ability, and waterfalls and poorly designed culverts can impede migration of some or all whitebait.

Giant kōkopu (*Galaxias argenteus*) is primarily a coastal species and does not usually penetrate inland very far. They are known from the Tauranga Ecological District, and

have been found in unnamed streams adjacent to Tetley Road at Katikati. Koaro (*Galaxias brevipennis*), banded kōkopu, inanga (*Galaxias maculatus*), shortjaw kōkopu (*Galaxias postvectis*) are all present within Tauranga Ecological District and are likely to occur, or to have occurred, within the Te Puna-Waipapa catchments. Koura (*Parenephrops planifrons*) are present in the Puketoki Reserve and will be present in many other places.

Unidentified bullies have been observed in streams in the lower Te Puna-Waipapa catchments. Common bully (*Gobiomorphus cotidianus*), and giant bully (*Gobiomorphus gobioides*) have been found in most regions in New Zealand although giant bully are never found more then a few kilometers inland and it is possible that they may spend a long period in estuaries before moving into freshwater (NIWA atlas of freshwater fish). Red-finned bully (*Gobiomorphus huttonii*) is strictly diadromous, being widespread in waterways with stable substrates.

## 9.8 Threats

Pest Plants

A diverse range of pest plants is present. Some are spread by wind (e.g. grey willow in wetlands) or birds (e.g. cotoneaster), while many others are dispersed by the dumping of garden waste into natural areas and "wasteland" alongside streams (resulting in major downstream dispersal of species such as tradescantia).

Pest Animals

Kaimai Mamaku Forest Park is considered by some to be a significant reservoir for possums, and a source for reinvasion of managed areas within the Te Puna catchment. Possums (*Trichosurus vulpecula*), rats (*Rattus* spp.), mice (*Mus* spp.), and stoats (*Mustela erminea*) are ubiquitous, with feral cats (*Felis catus*), ferrets (*Mustela furo*), and hedgehogs (*Erinaceus europaeus*) widespread. Feral goats (*Capra hircus*) have previously been an issue but are subject to control by the Department of Conservation. Feral red deer (*Cervus elaphus*) are present, but only in relatively low numbers.

Land Use Changes

Soil is an important agricultural and horticultural resource, and it is in the best interests of these industries to avoid or minimise soil loss. Sediment is a major threat to receiving waters, and elevated sediment losses are a major threat to Tauranga Harbour. Mobilisation and transport of sediment is probably the most widely recognised interaction between upper and lower catchments within the wider Tauranga catchment. Changes in land use can also change patterns of sediment mobilisation and transport. Different land uses do differ in their sediment yields, with disproportionate amounts originating from steeper streams and landforms in pastoral land uses (as compared with flatter landforms and forest cover). Sediment control is a key issue for sustainable management of all catchments that flow into Tauranga Harbour.

Farm Stock

Farmed cattle (*Bos taurus*) are present on dairy farms and dry stock farms throughout much of the project area, with local sheep (*Ovis aries*) grazing. Cattle have severe detrimental effects on indigenous vegetation (where they have access to it) and riparian margins (Figures 7a and b). Ongoing browsing by cattle and sheep can be responsible for the conversion of indigenous forest to treeland vegetation, and then to open grassy swards. In addition to their effects on vegetation, pugging and nutrient inputs from cattle will be having adverse effects on downstream water quality, including effects on the water quality of Tauranga Harbour.

Figure 7a: Grazed riparian margins in the lower Waipapa River, with banks collapsing into the waterway.

Figure 7b: Grazed and degraded riparian margins in the lower Waipapa River.

Land use changes can have severe adverse effects on waterways. Although waterways are not directly impacted by clearance of vegetation, direct access by stock to streams increases bank erosion, reduces water quality, and reduces streambed stability. However, pastoral land uses dominate the middle and some upper catchments, where most stream lengths are also located. Only about one quarter of waterways have formal legal protection (Table 4).

Table 4: Stream lengths and degree of legal protection in the three sub-catchments.

| Sub-Catchment | Length (m) | Protected Length (m) | Protected % |
|---|---|---|---|
| Te Puna | 51,547 | 8,319 | 16.1 |
| Waipapa | 62,139 | 15,396 | 24.8 |
| Extension | 31,023 | 8,314 | 26.8 |

Urban Growth

Urban growth results in the following pressures:

- Increased pressure on existing stormwater system due to decreases in permeable surfaces and consequent increase in impermeable surfaces.
- Increased sediment through construction process.
- Decreased green space.
- Potential sources of pest plants and animals.

Urban growth does, however, if well planned, also result in opportunities to formally protect significant ecological features, riparian strips, and harbour margins, and to restore degraded areas and to re-establish ecological connections.

Stormwater Management

Land development and related upgrading of stormwater systems often sets in motion a process of progressively detrimental stream modifications, beginning with straightening, channelisation and, as the "final solution", infilling/culverting. A number of waterways within the Tauranga Harbour catchment have been progressively modified in this way for intensive light industrial (and more recently retail) and urban development, with related 'enhancements' of stormwater systems. There have now been many instances where stream sections have been permanently lost, e.g. to increase car parking space.

Consent applications to modify a stream have rarely, if ever, been declined even though in some instances the effect has been to significantly compromise a stream's habitat and ecology. A review of streams on a catchment scale, detailing their upstream and downstream values, level of intactness and, if modification had

occurred, the proportion and type of modification, would provide a more useful basis on which to assess and, if necessary, to decline consent applications. For this to occur there would need to be:

- Judgments made on how much more modification - if any - can be sustained (where knowing how much stream habitat had already been lost from a catchment).
- Buy-in from territorial authorities.
- More meaningful mitigation offered to offset the permanent loss of physical stream habitat. It will reach a point where offsite mitigation involving the revegetation of another waterway will not offset sufficiently the permanent loss of physical wetted stream habitat.

Smaller streams in lower catchments have been straightened and channelised, however modification does not appear to have been any more serious than this, in that stop-banking and culverting has not been undertaken on streams within the study areas. The stream that formerly ran through Lynley Park at Mangawhai Bay was an important food source for Pirirakau, but has now been highly modified.

Sediment Management

Sediment loss is a unifying theme throughout the Te Puna-Waipapa catchments. Sediment, in places where it is not wanted, has the following adverse effects:

- Threatens kaimoana in estuaries and the sandbanks beyond (an issue of concern for Pirirakau).
- Increases water turbidity in Tauranga Harbour and contributes to decline of sea grass.
- Probably has economic impacts on Ports of Tauranga, which must dredge to keep shipping lanes open (Tauranga Harbour Integrated Management Plan 2006).
- Increases the elevation and mud content of estuary flats, and is directly correlated with estuary area covered by mangroves (Park 2004).

Mangroves impede access to estuaries and, over time, potentially reduce the habitat available to wading migratory birds (although they do also provide important habitats for other birds such as banded rail). Mangroves themselves contribute to the ability of estuaries to capture sediment transported by streams.

Sediment sources can be broadly classified into three types:

- Erosion associated with infrastructure and infrastructure construction.
- Erosion of streambanks.
- Erosion of land surfaces.

Riparian vegetation can help stabilise stream banks by buffering them from flood flows and mechanically binding banks together with plant roots.

Erosion Associated with Infrastructure

There are sediment sources within the Te Puna-Waipapa catchments associated with infrastructure and infrastructure development. These include road cuttings, development sites, farm races and tracks (refer to Figure 8).

- Impact mitigation at current and future development sites at Omokoroa.

  Soil transport from development sites on Omokoroa has been reported by Omokoroa Estuaries Restoration Group.

- Impact mitigation at Armstrong Road.

  Infrastructure may also contribute to elevated levels of stream bank erosion further down catchments, for instance where stormwater systems are under-designed and incapable of effectively buffering streams from peak storm event inputs from impermeable surfaces. Elevated stream levels during flooding events which are exacerbating streambank erosion and increasing sediment transport reported by Upper Waikaraka Stream Care Group.

Sediment Originating from Stream Banks and Land Uses

EBOP has commissioned NIWA to undertake a considerable body of work on the Tauranga catchments (Elliot *et al.* 2009, Green 2009a & b, Hancock *et al.* 2009, Hume *et al.* in prep., Parshotam *et al.* 2008 & 2009, Pritchard and Gorman 2009). Results have not been released to date, but this work includes analysis of sediment origins and proportions within all catchments, and will provide very valuable information to underpin priority setting for catchment management and the development of more sustainable land use practices.

Surman *et al.* (1998) previously assessed sediment origins in the Tauranga catchments, and relevant extracts for the Te Puna and Waipapa catchments are provided in Appendix 3. Brief overviews are provided below for the Te Puna and Waipapa catchments.

Te Puna Catchment

Upstream of Odey Road, the Patirawa and Waione tributaries are key catchments. The upper parts of the Waione are within indigenous forest, along with a section of the Patirawa Stream. The latter is currently subject to an approved riparian protection and fencing programme. Downstream of Odey Road, the stream channel is relatively stable due to the underlying geology (Waiteariki ignimbrite) and has a riparian margin of indigenous vegetation until *c.*4.8 km above SH2. Surman *et al.* (1998) recorded some management issues (e.g. eroding banks, grazing) but these were not major and much of the riparian margin was fenced. Farmed stream margins extended over three lengths of 1.6 km, 1 km, and 1 km in the lower catchment (Surman *et al.* 1998). Poorly drained areas and wetlands are present in the lower 800 m above SH2.

Figure 8: Eroding scarp and drains on road margin in lower Waipapa catchment.

Waipapa Catchment

The upper Waipapa catchment is within the larger Kaimai forest tract and a strip of indigenous vegetation extends down the main river to *c.*3 km from SH2. Catchment management issues are largely restricted to these lower reaches, including:

- grazing of riparian margins.
- willow infestations on riparian margins.
- willow blockages or restrictions of the main channel, especially within 2 km of SH2.
- erosion and sediment accumulations (with potential for future erosion).

# 10. CURRENT MANAGEMENT

## 10.1 Legal protection

Sixteen percent of the total project area is indigenous vegetation that has formal protection (see Figure 9; Table 5 below).

Table 5: Protected areas within the Te Puna and Waipapa catchments, Western Bay of Plenty District.

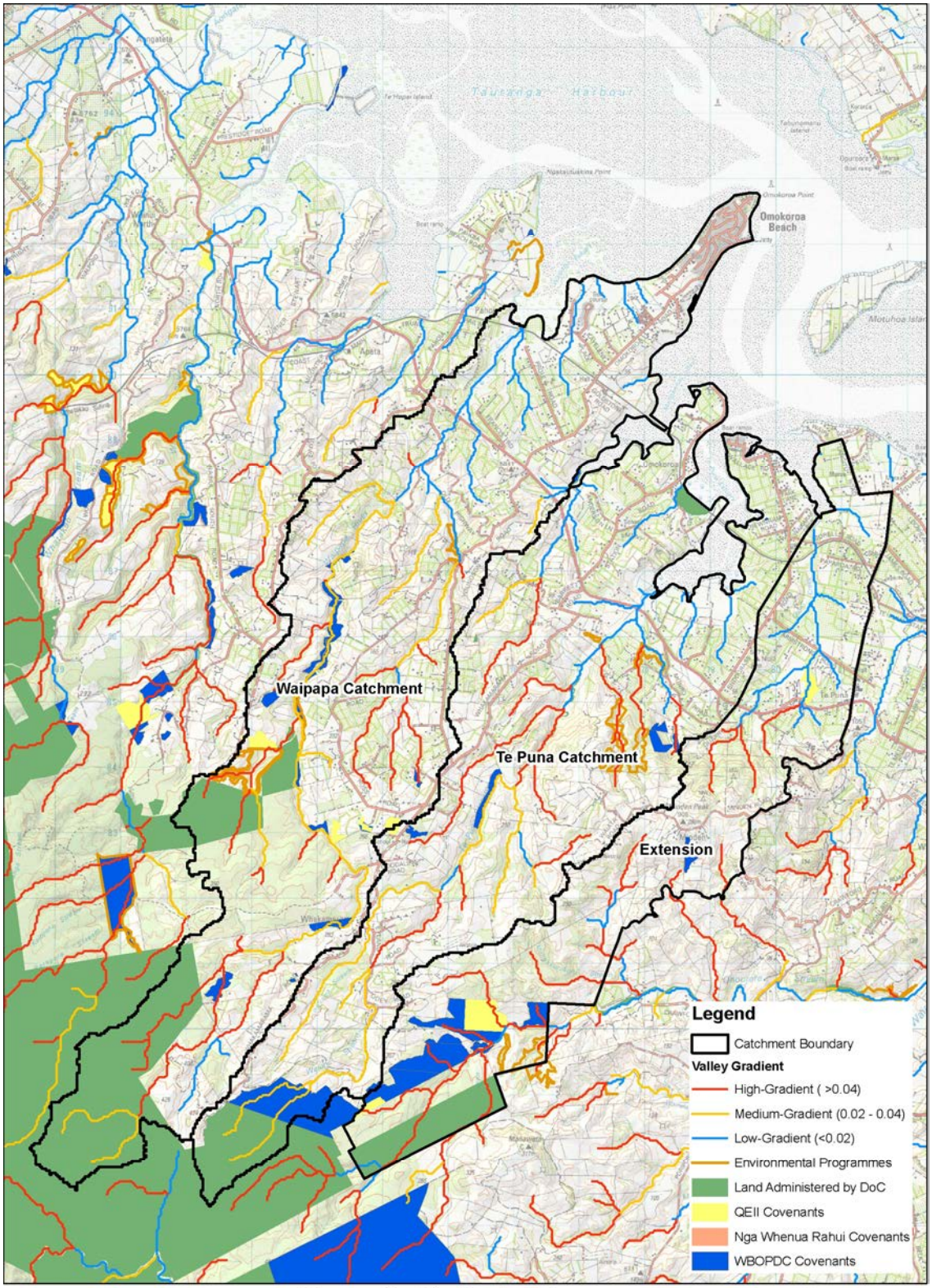
| Sub-Catchment | Total Area (ha) | Protected Area (ha) | Protected (%) |
|---|---|---|---|
| Te Puna | 3,363 | 311 | 9 |
| Waipapa | 4,013 | 648 | 16 |
| Extension | 1,960 | 327 | 17 |
| **Total** | **9,336** | **1,286** | **14** |

Formally-protected areas include QEII National Trust covenants, reserves administered by WBOPDC, protected land administered by DOC, covenants established as conditions of resource consents (generally subdivision consents) issued by WBOPDC, and EBOP 'Environmental Programmes' on private lands.

QEII Covenants

Refer to Table 6 below. Four covenants have been established in the 'Extension' catchment, one associated with wetlands near Te Puna, another over part of a large bush block in the middle upper extension, and the third for a smaller piece of forest contiguous with the Kaimai Range forests.

There are ten QEII covenants within the Te Puna-Waipapa catchment (Table 6), with several covenants over indigenous forest on the margin of the large bush block in the middle-upper reaches of the Waipapa catchment.

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Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 9. Protected Areas Waipapa and Te Puna Catchments**

0 2.5 5 km

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Wildlands

Scale: 1:55,000
Date: 02/11/09
Cartographer: RPB

Table 6: QEII covenants within the project area.

| QEII Covenant No. | Extension (ha) | Te Puna Catchment (ha) | Waipapa Catchment (ha) |
|---|---|---|---|
| 5/03/021 | 28.0 | | |
| 5/03/021B | 0.5 | | |
| 5/03/125 | 4.8 | | |
| 5/03/190 | | | 4.2 |
| 5/03/191 | | | 1.9 |
| 5/03/240.1 | | | 7.9 |
| 5/03/240.2 | | | 0.1 |
| 5/03/337 | | 1.7 | 1.4 |
| 5/03/429 | | | 1.5 |
| 5/03/430 | | <0.1 | 0.4 |
| 5/03/597 | | | 0.2 |
| P 17 | 10.2 | | |
| **Total** | **43.6** | **1.7** | **17.5** |

Western Bay of Plenty District Council Reserves

- Puketoki Reserve.
- Waipapa River Gully WBOPDC Reserve.
- Wetlands in lower Te Puna catchment.

Western Bay of Plenty District Council Covenants

Refer to Figure 9. There are various protected areas established as a condition of resource consents granted by WBOPDC, either for protection lots or transferrable development rights (Figure 9). These are scattered throughout the three catchments and are generally relatively small, except for one larger area in the upper 'Extension' catchment. Key sections of stream are protected in the Waipapa catchment. WBOPDC has a successful monitoring programme in place for all covenanted "protection lot" areas, with an expected three year turnaround.

Department of Conservation

The Department administers large areas of indigenous forest in upper parts of all three catchments, as part of Kaimai Forest Park. Jess Road wetland is administered by DOC, and is managed by Te Puna Estuary managers.

Nga Whenua Rahui

There are currently no Nga Whenua Rahui kawenata within the project area.

## 10.2 Ecologically significant private land

Several WBOPDC significant ecological areas (including RAP's) occur in the middle of the Extension and Te Puna catchments. Refer to Figure 10. Otherwise, significant ecological areas are distributed proportionally to the distribution of indigenous forest remnants. Many significant areas occur in the upper catchments, associated with tall forest, with few in lower catchments. Those that occur in the lower catchments are primarily associated with vegetation remnants along the harbour margin.

## 10.3 Care group activities

Refer to Figure 11. EBOP completed an analysis of patterns of mangrove spread in 2004 (Park 2004). This work showed significant increases in the extent of mangroves and coincided with increased community concern about the extent and effects of mangroves. Estuary care groups are now operating in various parts of the harbour and Environment Bay of Plenty has a permanent Estuary Care Officer to liaise with these groups. There are three estuary care groups within the project area:

- Omokoroa Estuaries Restoration Group.
- Te Puna Estuary Managers.
- Waikaraka Estuary Managers.

- Friends of Puketoki Reserve undertake sustained possum and rodent control over 31.4 ha of tall forest and *c.*6 ha of scrub and grassland within Puketoki Reserve.

- Waikaraka Estuary Managers are controlling mangroves over *c.*53 ha of Waikaraka estuary, in partnership with Nga Tahatai o Te Puna Care Group. This group was one of the first to embark on an estuary care programme and this is based on a detailed restoration plan. They also undertake detailed monitoring of various project components, some of which is being done in conjunction with NIWA.

- Pest Free Omokoroa controls rats over much of the 365 ha Omokoroa Peninsula, between the peninsula tip and the railway corridor.

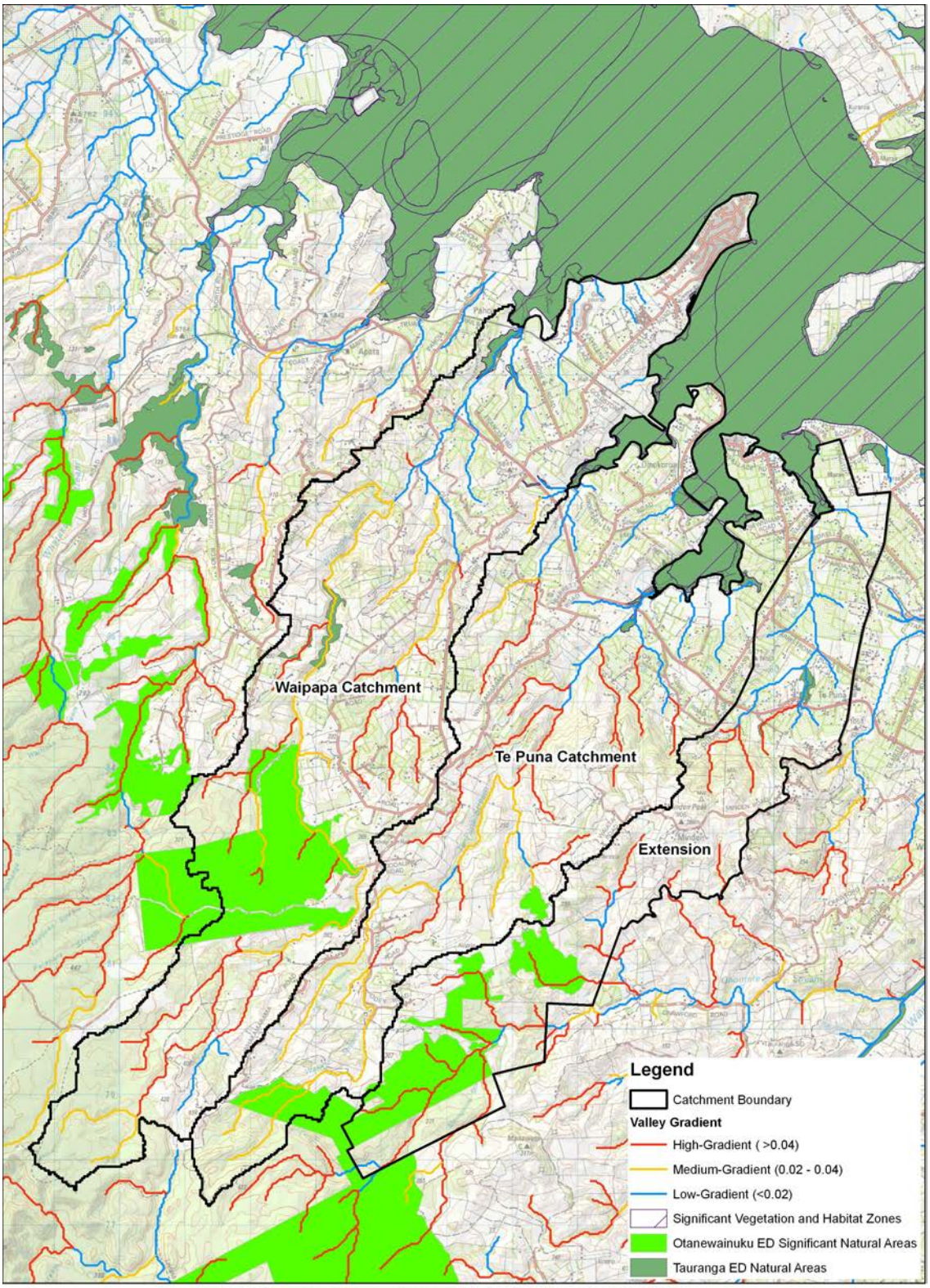
- Omokoroa Estuaries Restoration Group manages mangroves within *c.*130 ha of Mangawhai estuary, although the area of mangrove removal is smaller than this.

- Te Puna Estuary Managers controls mangroves over *c.*123 ha of estuary, and has restored 11 ha of estuarine saltmarsh and is restoring small areas of indigenous vegetation on estuary margins and roadsides in the vicinity of the Jess Road Wetland.

- Nga Tahatai o Te Puna Care Group is planting pohutukawa and other suitable indigenous species along a section (1.4 km; 2.7 ha) of coastal cliff vegetation, and on Motuhoa Island.

- Te Puna Quarry group have undertaken goat eradication, and are continuing weed control in 23 ha of forest adjacent Te Puna Quarry.

- Upper Waikaraka Streamcare Group (previously Oturu Stream Care Group) is being formed to enhance and protect the Upper Waikaraka Stream. This steam flows under the road from the Minden near the Te Puna Store and curves round the front of Armstrong Road properties to merge with the Oturu Stream, which flows from Te Puna Quarry Park through I'Anson Reserve. The upper Waikaraka and Oturu streams ultimately flow into the Waikaraka Estuary. The relatively short distance from the Minden to the harbour means that there is an opportunity to develop a 'green corridor' as the backbone to rural Te Puna, to enhance rural character and biodiversity.

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Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 10. Ecologically Significant Unprotected Private Land Sites (including RAPs) Waipapa and Te Puna Catchments**

0 2.5 5 km

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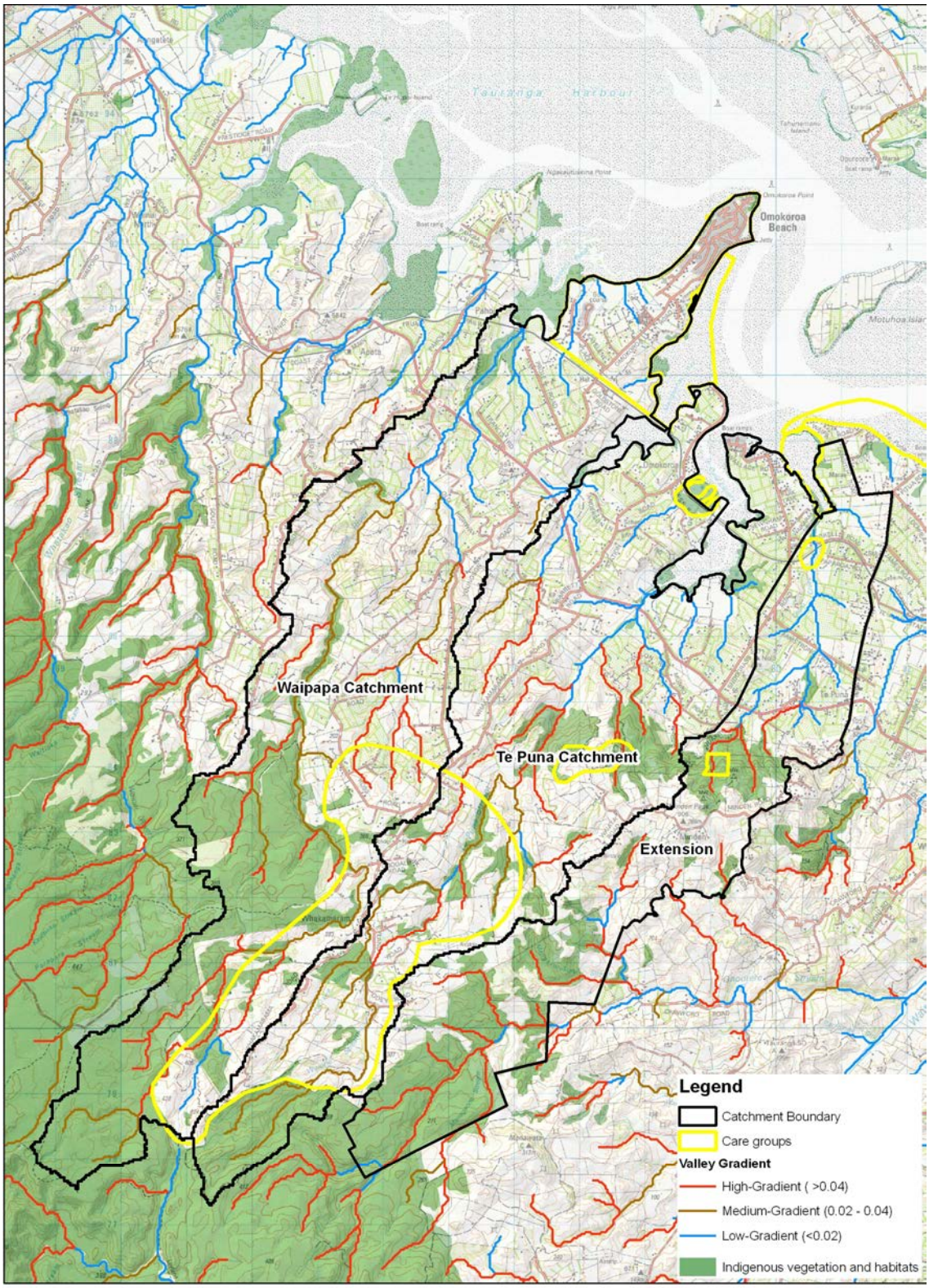
Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

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Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 11. Care Group Activities Waipapa and Te Puna Catchments**

0 2.5 5 km

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Wildlands

Scale: 1:55,000
Date: 21/07/09
Cartographer: RPB

## 10.4 Environmental programmes (EBOP)

Refer to Figure 10 for the locations of Environmental Programmes.

To date, environmental programmes have helped protect, 9.5 kilometres of stream riparian margins, 1.26 ha of wetland, and 10 ha of vegetation within the Te Puna-Waipapa catchments, as summarised in Table 7 below.

Table 7: Environmental programmes in the Te Puna, Waipapa, and 'Extension' catchments.

| Environmental Programme | Te Puna Catchment | Waipapa Catchment | Eastern Extension |
|---|---|---|---|
| Riparian/watercourse revegetation | 7.31 ha | 3 ha | 1.35 ha |
| Wetland revegetation | 1.26 ha | - | - |
| Riparian/watercourse protection fencing | 8,486 m | 1,912 m | - |
| Biodiversity native forest protection fencing | - | - | 9,509 m (10 ha) |

The large area of indigenous forest in the middle part of the Te Puna catchment is covered by an Environmental Programme.

## 10.5 Roadside vegetation management

Under the current RPMS, roadside verge control for all formed roads is the responsibility of the roading authority, in common with other pest management. In October 2005, Opus International Consultants Ltd wrote a strategy for the long term control of pest plants in the Western Bay of Plenty and the strategy has been adopted by WBOPDC. The NZ Transport Agency (NZTA) also works to the strategy's objectives. This long term strategy identifies the means by which WBOPDC and NZTA can attain compliance with the requirements of the Act and the Regional Pest Management Strategy, the latter of which ultimately identifies pest plant species for control. This involves regular field inspections, identification, and annual prioritisation of species and locations for control, identification of the appropriate control methods for plant pest sites, including indigenous revegetation, the implementation of annual control programmes, and annual monitoring and review of the control to assess effectiveness and potential improvements. In addition, the Honda Tree Fund supports the planting of major road corridors with indigenous species.

# 11. ENVIRONMENTAL EDUCATION

A summary of environmental education services provided by EBOP is included in Appendix 5.

Several opportunities for practical field-based environmental education within the Te Puna-Waipapa area have already been capitalised upon. In Puketoki Scenic Reserve, Whakamarama Primary School was involved with the initial establishment of monitoring, placing and recovering tracking cards, and analysing prints in tracking tunnels before predator control operations began. Omokoroa Point School and

Whakamarama Primary School measured water quality in the Puketoki Stream and Whakamarama Stream for world water day.

There is now an opportunity to communicate biodiversity benefits of community action at Puketoki Reserve as these become evident.

- Patirawa Stream: Opportunity to provide a useful resource for school environmental curricula. Media articles to inform the local and wider Bay of Plenty community of the progressive benefits of the replanting programme in the Te Puna Corridor could be released in association with restoration efforts here.

- Jess Road Wetland: History of site, changes in perspective and land use. Affirmation that community action can make positive changes.

- Huharua Park and the Māori-owned block of land at Whakamarama are good educational sites. Contact C. Bidois (Pirirakau) for entry and more information.

- Walkway and signage around wetlands at the Te Puna Road Bridge.

- WBOPDC intends to produce a CD on restoration projects in the catchments. The aim is to be able to provide this information resource to other landowners in the catchment where work is still required, and to care groups and landowners in other catchments.

# 12. GUIDING PRINCIPLES

## 12.1 Guiding principles associated with goal setting

Key over-arching principles are associated with:

- Sustainable land use;
- Ecosystem services;
- Information resources.

**Sustainable land use** requires functional ecosystems and processes that are able to buffer or mitigate adverse environmental influences and provide a sustainable basis for human occupation and land use. Practical outcomes associated with healthy functioning ecosystems include mitigation of high rainfall events and associated flooding, entrapment of nutrients and pathogen removal before reaching waterways, and greater resilience to pest impacts.

**Ecosystem services** contribute significant high value resources (in economic terms) essential for human well-being, such as clean ongoing water supplies, fisheries resources (e.g. inanga/whitebait), clean air, carbon sequestration, and a milieu of less obvious benefits such as pollination and mitigation of environmental contaminants. Indigenous biodiversity is a fundamental element of ecosystem services.

**Good quality data and information resources** are essential to underpin sustainable land management and related decision-making.

## 12.2 Guiding principles associated with management action

It is inevitable that there will be competition for resources to protect and enhance features within the project area, and there will be insufficient resources to address all areas/features that warrant protective actions. Because of these limitations, it is essential that:

- Communities and landowners work collaboratively with agencies.
- Agencies support active care groups and willing landowners.
- A clear set of priorities is developed to guide management and funding, although these priorities should be regarded as a "guide", rather than an inflexible code. In principle, using this approach, the key aims should include:
  - Existing high value 'reserves' (areas that have formal legal protection) should be protected from damaging influences and their condition improved by active management.
  - Protect and enhance privately-owned indigenous vegetation.
  - Link indigenous forest in the upper catchments (part of the wider Kaimai tract) with the harbour.
  - In the absence of intact 'corridors' of indigenous vegetation, streams should be used as the basis of 'corridor' restoration.
  - Identify sediment sources within the catchments and management requirements to stabilise and reduce sediment discharges. Use information on sediment sources (and relative amounts originating from different land uses on particular land types) as a key factor in priority setting for riparian protection.
  - Existing high value unprotected private lands should receive formal protection (e.g. QEII National Trust covenant or Nga Whenua Rahui kawenata) and receive active management to protect and enhance ecological values.
  - Where possible, unprotected grazed sections of high-gradient streams should be protected and fenced. Ideally, pasture riparian margins should be planted with locally-sourced indigenous species. If planting cannot be achieved, due to lack of funding or for other reasons, then it is still preferable to fence and retire streams and allow natural successional processes to occur (albeit that they will probably involve successions through exotic species such as blackberry and/or gorse, subject to an adjacent indigenous seed sources).
  - For stream riparian protection, it should be a high priority to retire and fence key linkages between existing protected areas or retired riparian margins.

- It will not be feasible, in the short to medium term, to retire and fence all sections of stream requiring protection. Creation of habitat islands along stream margins in the middle sections of the catchments could be undertaken along sections of high-gradient stream.

- Regulatory authorities (e.g. EBOP and WBOPDC) must continue to recognise the positive role that regulatory processes (e.g. resource consent conditions) can contribute to the wider picture of catchment protection and enhancement.

- Monitoring must be a key part of the process, to account for public (and private) funding, to account for the contributions made by volunteers, contractors, and agencies, and to provide feedback on the success (or otherwise) of management effort.

- Identify problematic sites in catchments (e.g. willow infestations) causing problems for riparian protection, sediment management, or indigenous biodiversity, and address management requirements and costs.

- Develop priorities for above and discuss with community in catchments.

# 13. RESTORATION OPTIONS AND OPPORTUNITIES

A key part of the project development (and evaluation) process is to capture the above information in a spatial environment, to enable GIS-based and other evaluations of key parts of the catchments. Key spatial information is shown in Figures 12a-d.

Project Development Process

- Focus attention on a single catchment.
- Analyse stream gradients.
- Analyse landform units (or Land Use Capability).
- Identify protected and unprotected indigenous vegetation and habitats.
- Identify previous and current active management.
- Identify stream margins in farmland requiring riparian protection, especially high gradient streams, or those flowing through unconsolidated sediments.
- Identify and rank biodiversity values.
- Identify threats to biodiversity values, including known sediment sources.
- Assess relative priorities.
- Identify interested relevant parties and mechanism(s) to achieve implementation.

Indigenous Forest - Upper Catchments

All larger examples of indigenous habitat are in the upper catchments. Forests in the upper catchments are dominated by tawa, in association with kamahi and podocarps, including miro and rimu. These areas are currently the largest 'single' repositories of terrestrial indigenous biodiversity in the catchment, and most are contiguous with the forests of the Kaimai Range, and most of these forests are associated with waterways, particularly in the Waipapa catchment. These forests are largely weed-free, although

dumping of garden waste has resulted in local small infestations of tradescantia (*Tradescantia fluminensis*) and German ivy (*Senecio mikanioides*).

These larger areas require ongoing control of pest animals, particularly possums and goats, and there may be scope for further intensive management of rodents and mustelids, similar to that currently occurring in the Puketoki Reserve. Pirirakau have also initiated ground-based pest control in their lands at Whakamarama.

Indigenous Forest - Middle Catchment

There is a network of indigenous forest in the middle section of the Te Puna catchment and the 'Extension' catchment, including patches of 80.25 ha, 71.84 ha, and 10.54 ha, not including the area in the vicinity of the Te Puna Quarry. Refer to Figure 11. This forest is primarily secondary, with a strong component of rewarewa-kamahi, although relatively large areas are dominated by mamaku. These comprise the largest forest blocks remaining within the middle and lower catchments.

Another forest remnant occurs to the west of this block, and is the largest block (15.72 ha plus 6.13 ha) of riparian forest in the middle reaches of the Te Puna catchment. This block is strategically important for its potential linking role, and because it occurs in 'Acutely Threatened' and 'Underprotected' land environments. Gully forests adjacent to this block have, in part, been inter-planted with pines.

These areas could become a focal area for restoration of forest within the Te Puna and Waipapa catchments. Opportunities for ecological enhancement include fencing, pest control, and weed control.

Indigenous Forest - Harbour Margin

There are small areas of coastal forest along coastal cliffs at Omokoroa. These include some large pohutukawa, although these tend to occur below sight-lines associated with houses on cliff tops. Otherwise they include a mixture of indigenous and exotic woody species, including pest plants, and mixed understory, which in parts is dominated by pest plant species such as tradescantia. A range of weeds are present in coastal forest remnants, including madeira vine (*Anredera cordifolia*), mothplant (*Araujia* sp.), woolly nightshade (*Solanum mauritianum*), Chinese privet (*Ligustrum sinense*), and tree privet (*Ligustrum lucidum*). Management to enhance ecological values should be directed primarily towards weed control, although pest control and planting (of locally-sourced indigenous species) are also important.

Ecological Linkages

Linkages between indigenous remnants, the Kaimai Range, and the harbour could be enhanced through the restoration of riparian corridors along the Te Puna and Waipapa Rivers. Riparian protection *per se*, however, is a potentially costly exercise due to the scale of the works required. Priorities need to be established that maximise returns on investment, with multiple benefits obtained from the establishment of ecological linkages.

Stream Riparian Restoration - General

Riparian protection presents an opportunity to:

- Protect soft sediment margins from elevated levels of erosion.
- Provide a linkage from the ranges to the harbour.
- Buffer streams from the impacts of adjacent land uses.
- Provide an ecological connection between existing areas of indigenous vegetation.

Efforts need to be directed, in the short term, to higher priority sites where:

- Multiple benefits can be obtained (e.g. protection of wetlands as well as streams).
- There are recognised problems such as grazing damage of streams or stream margins, erosion-prone sites, willow infestations, soft sediment banks.

Riparian Restoration in Catchment Headwaters

- Stabilise greatest length of stream riparian margin (e.g. complete the Patirawa Stream project).
- Smallest waterways have the greatest interface with adjacent riparian vegetation, therefore the greatest capacity to slow floodwater velocity and buffer stream banks through retirement, riparian planting, and restoration.
- Typically, the steepest parts of catchments and the streams with the steepest gradients are the highest energy regions and, depending on bedrock and soils, these can show the greatest benefits for reducing erosion by reducing flood-flow energy. Use results from NIWA project to guide priority setting for riparian protection.

Riparian Restoration in Middle and Lower Catchments

Stream riparian margins in some areas are actively eroding and contributing to sediment loads transported by flood waters. Riparian restoration in these areas may stabilise streambanks, reduce erosion, and increase corridor length down through catchments (see above).

Priorities for Riparian Protection

- Highest priority
  - Acutely threatened land environments (in lower catchments).
  - High gradient streams in agricultural (grazed) environments.
- Moderate priority
  - High gradient streams in horticultural (non-grazed) environments.

Water Quality

Parts of the community rely on streams for drinking water and some aspects of water quality are improved by good quality riparian vegetation. Riparian vegetation can

absorb nitrates in groundwater before it enters streams, and wetlands may be especially good at nitrate absorption.

Sustainable Land Management

Sustainable land management involves minimising negative impacts on land and the environment, and buffering of natural habitats from adverse influences that cannot be eliminated in-situ. Protection and enhancement of indigenous biodiversity must be an integral part of sustainable land management.

Gaps and Opportunities

The restoration of indigenous riparian vegetation is where the following high priority actions intersect:

- increase habitat available for indigenous species.
- buffer streams from erosion.
- enhance instream habitats.
- increase linkages throughout the catchments.
- contribute to improved water quality.

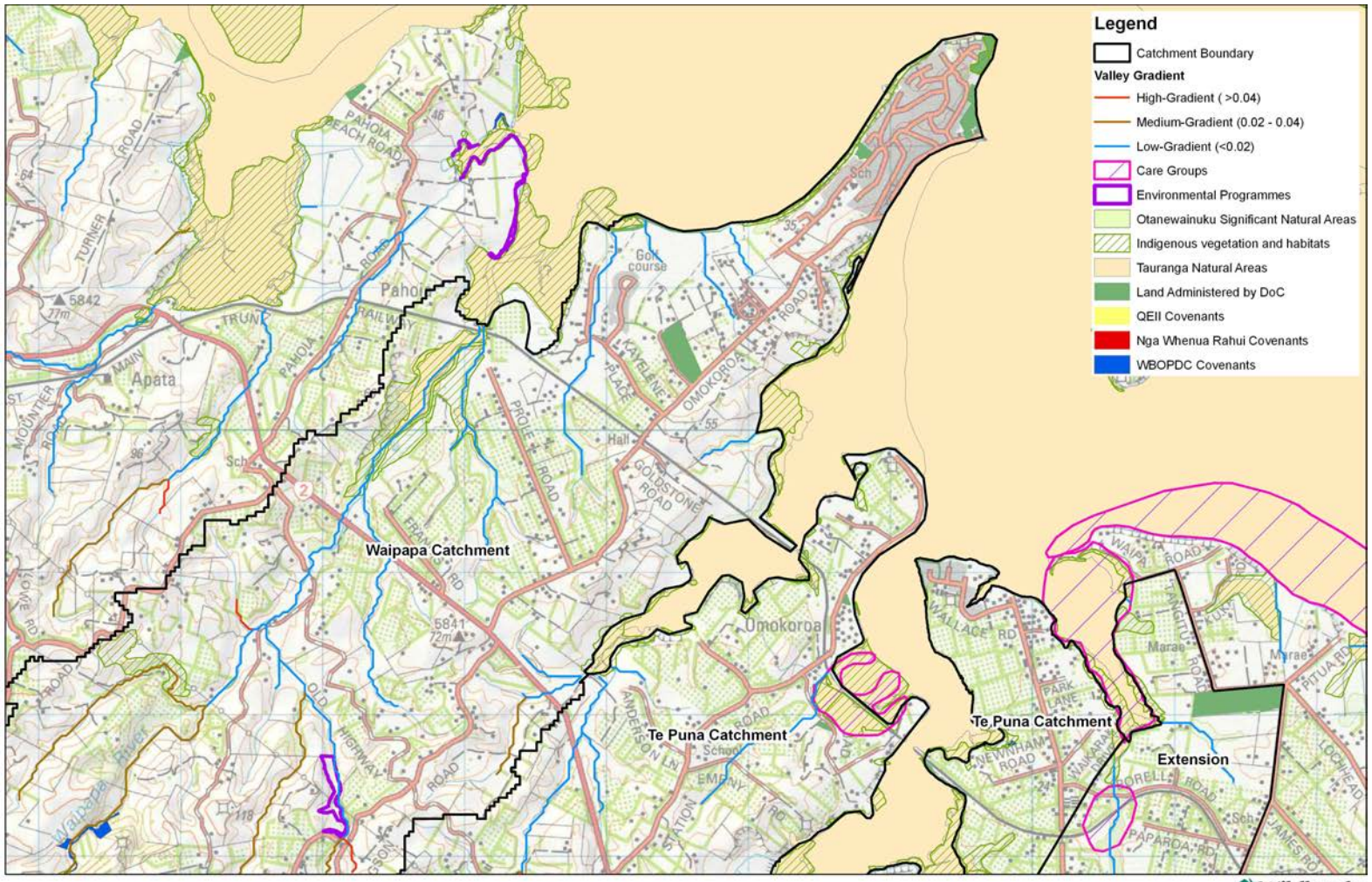
The middle reaches of both catchments have fewer options and opportunities for restoration than the upper catchments. Vegetation remnants within middle reaches have high value for the linkage function they may play within riparian corridors, and because they occur in an 'Acutely Threatened' land environment. Refer to Figure 12.

There is a general paucity of vegetation remnants in the lower Te Puna and Waipapa catchments, and the 'Extension' catchment, emphasising the importance of riparian restoration, and also the potential utility of road reserves in increasing habitat area, particularly with respect to Pest Free Omokoroa's aspirations for increasing the conspicuousness of indigenous birds on the peninsula.

From Figures 12a-d, it is readily evident where opportunities exist for protection management, as summarised below.

Opportunities for biodiversity protection and enhancement exist in upper and lower catchments where indigenous habitats remain (taller indigenous broadleaved forest in the upper catchments), estuaries and remnants of coastal vegetation in the lower catchments. Current care group activities are associated with biodiversity protection and enhancement in the upper and lower catchments. Many of the opportunities in these areas are being capitalised upon, however opportunities associated with wetlands in the lower Te Puna catchment are not currently included.

There are only limited opportunities for biodiversity protection and enhancement in the middle catchments, other than stream protection, as most indigenous forest has been converted to pasture and orchards, and the remaining indigenous habitats are on private land. Activities within the middle catchment will necessarily focus on habitat restoration on private land, primarily restoration of riparian vegetation.

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Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 12a. Indigenous Forest and Riparian Links through Waipapa and Te Puna Catchments**

0 0.5 1 km

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Wildlands

Scale: 1:25,000
Date: 21/07/09
Cartographer: RPB

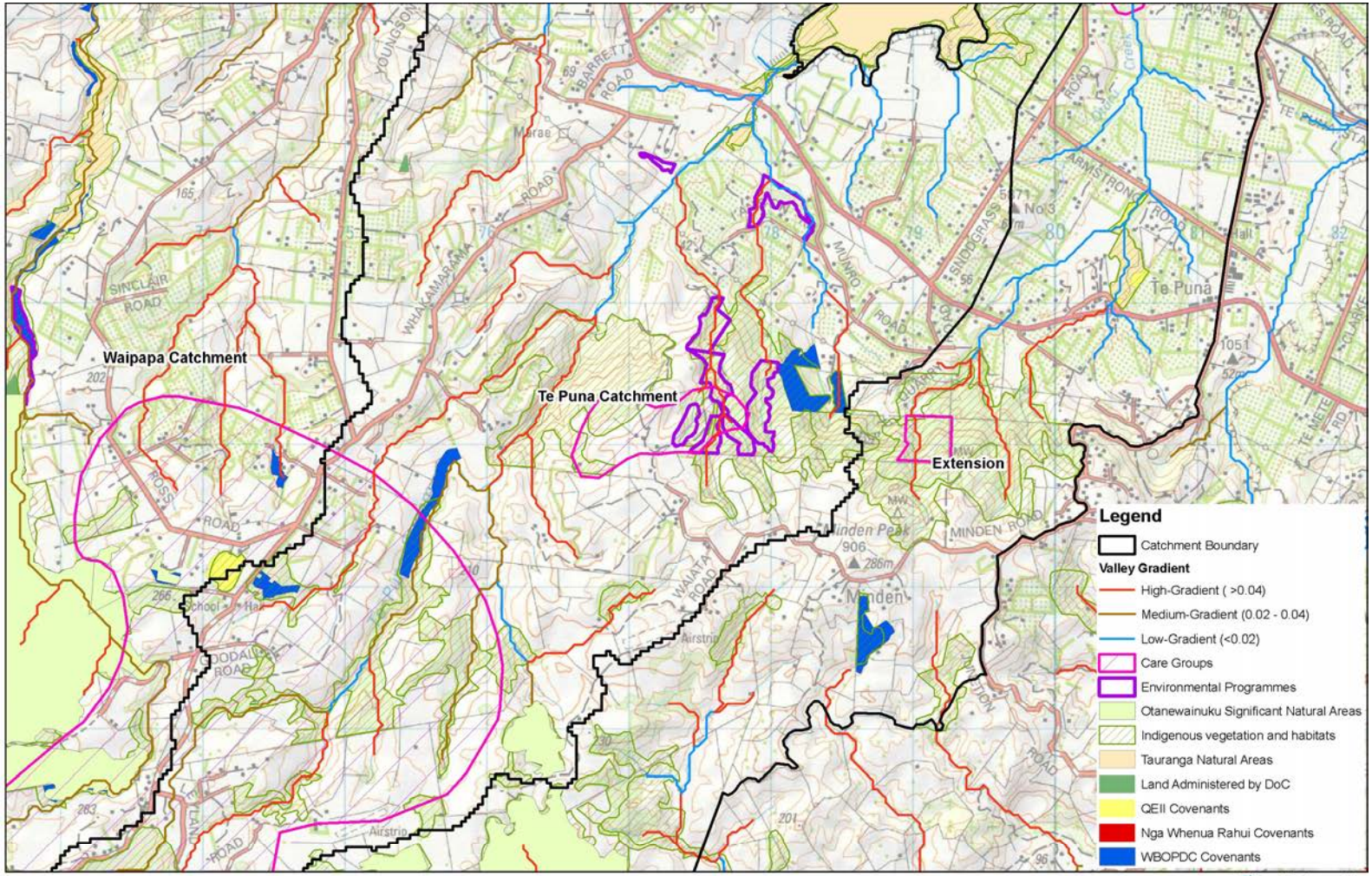
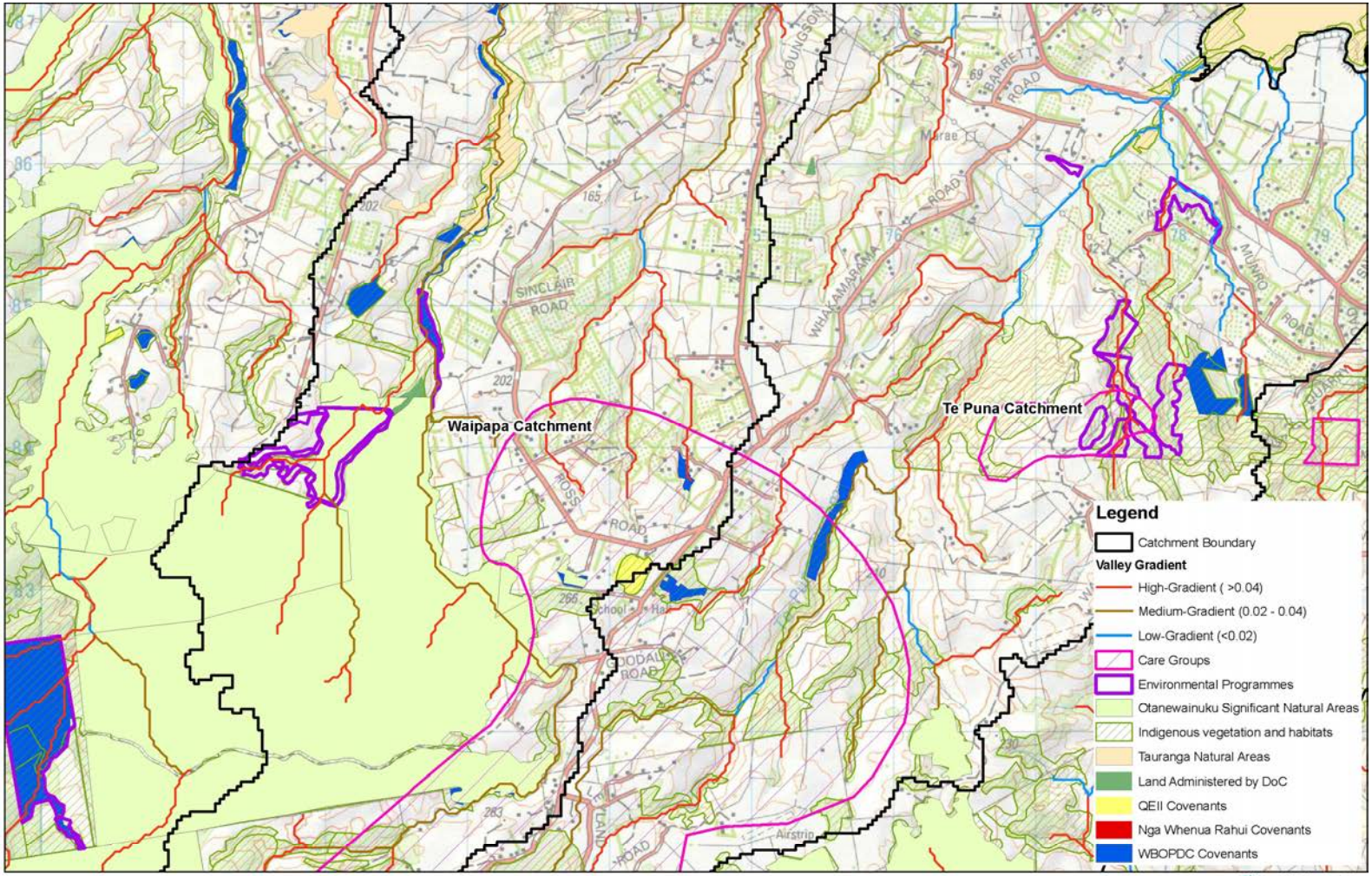



**Figure 12b. Indigenous Forest and Riparian Links through Waipapa and Te Puna Catchments**




N

Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

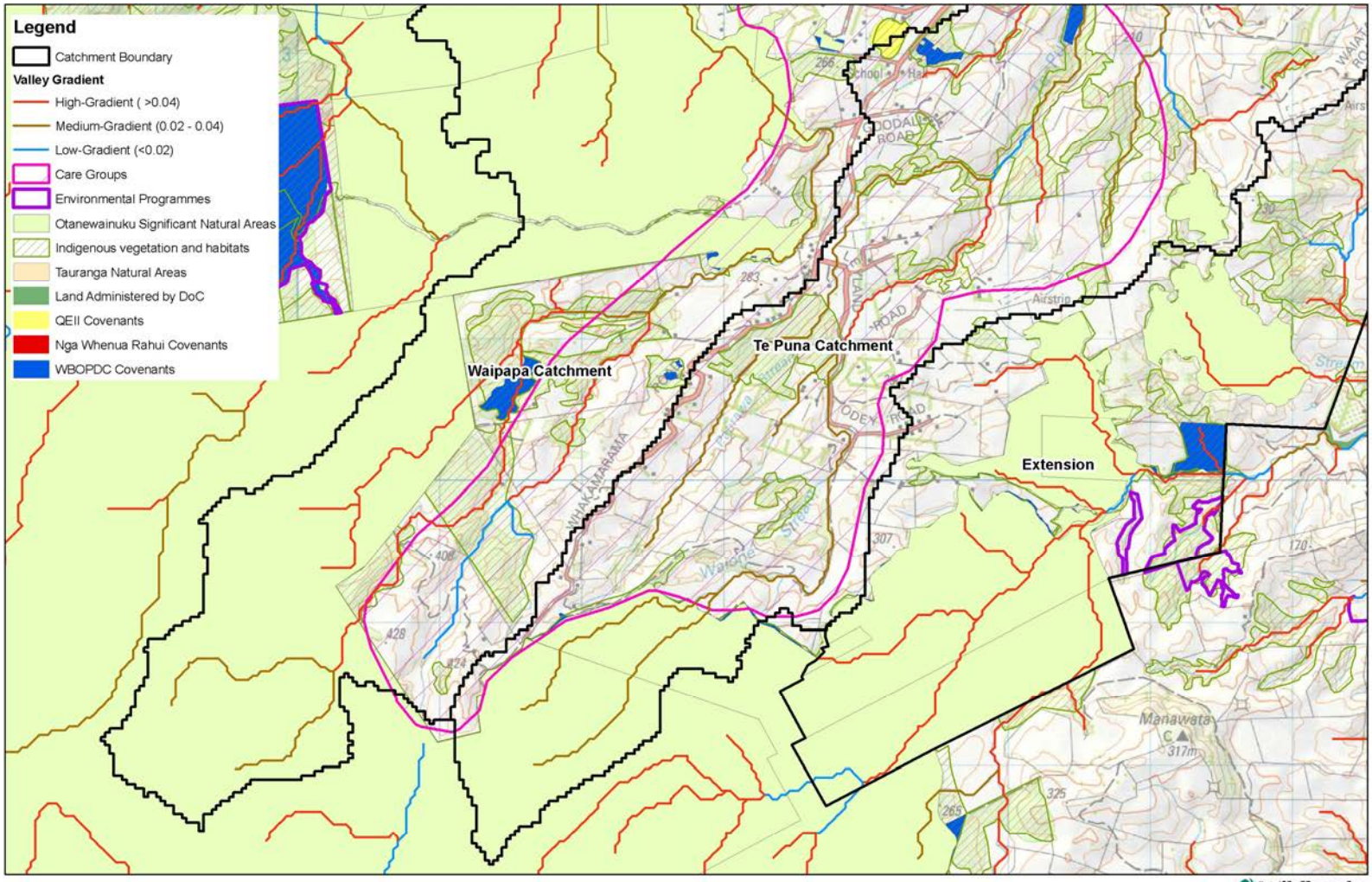
**Figure 12c. Indigenous Forest and Riparian Links through Waipapa and Te Puna Catchments**

0 0.5 1 km

E:\gis\wildlan\Waipapa-Te Puna Catchment\Figure 12c Waipapa-Te Puna Catchment_the works.mxd

Wildlands

Scale: 1:25,000
Date: 02/11/09
Cartographer: RPB




Data source: New Zealand River Environment Classification: National Institute of Water and Atmospheric Research and Ministry for the Environment, Wellington.

**Figure 12d. Indigenous Forest and Riparian Links through Waipapa and Te Puna Catchments**

# 14. MONITORING

Purpose of Monitoring

It is a standard assumption that ecological restoration is achieved if functional and spatial gaps are repaired and adverse impacts are removed. However, adherence to that assumption in blind faith is not enough to maintain community enthusiasm for restoration projects. The community must be certain that environmental and biodiversity projects are producing results that will improve biodiversity for the benefit of the catchment, its waterways, the harbour, and the related community. As such, it is imperative that data gathered, by Care groups or through agencies, is sufficient to inform decisions about project success, and environmental and economic benefit. Monitoring is the key to seeing the benefits of on-the-ground action. The economic benefit of data collection must be clear, and acknowledged by agencies as a requirement for good management decision-making.

Monitoring also plays a crucial role in informing management decisions, particularly when management actions need to change. An example is what has occurred in Puketoki Reserve, with monitoring to identify animals taking baits from rat stations. Possums were consuming the rat baits, but these were not designed to kill these larger mammals.

## 14.1 What is currently being monitored?

All Estuary Care Groups

- Biennial monitoring of silt depth in areas cleared of mangroves.
- Water clarity and sediment characteristics.
- Bird species and numbers, focussing on the numbers of migratory waders using the estuary.
- Quadrat counts of titiko (mud snail).

Pest Free Omokoroa

- Baits consumed from bait stations, and translation of this data into the number of rats killed by their control operations.
- Rat abundance using tracking tunnels. In August 2008 tracking tunnels did not detect any rats.
- The initial five-minute bird counts taken at a fixed time did not work well with many of the volunteers and for the last three years Pest Free Omokoroa has applied the concept of a regular, monthly, five-minute count either at a fixed or flexible time [for example at a time of observations of interest] the counts being increased to bi-weekly from September to November. The data collected is providing good results which are available to view on the Wild About New Zealand web site. They also keep a record of sightings of interesting or unusual birds or occurrences passed on by the community.

- Have installed and are monitoring occupancy of weta motels.

Friends of Puketoki

- Rat tracking to measure rat tracking rates.
- Possum trap-catch rates.
- Weta are monitored inadvertently: 60% of tracking papers showed weta tracks in April 2008, and no rats were detected. However, mouse density increased from 6% to 26%.
- The responses of invertebrate populations to possum and rat control is also being monitored using a combination of pitfall and malaise trapping. Both approaches are being undertaken by Friends of Puketoki Reserve. Pest monitoring is funded by WBOPDC, and invertebrate monitoring is carried out as part of an Environmental Enhancement Fund Grant.

Environment Bay of Plenty

- EBOP undertakes a range of broad scale monitoring associated with environmental issues such as:
  - mangrove spread (Park 2004).
  - estuary water quality within Tauranga Harbour includes a station at the Omokoroa Wharf (Scholes 2005).
  - monitoring of marine sediment and contaminants in Tauranga Harbour includes sites at Te Puna, Waikaraka, and Waipapa estuaries (Park 2003).
  - Environmental programme area monitoring, forest surveillance, and stock exclusion.
- A study of sediment budgets within streams and rivers flowing into Tauranga Harbour is in progress.
- Major pest plant control programmes, such as woolly nightshade, are monitored in the catchments.
- Other RPMS pest plants, e.g. wild ginger, are programmed for control, and surveillance is undertaken for low incidence and new-incursion pest plants.

Western Bay of Plenty

- Protection lots - ongoing management and implementation of conditions imposed when lots were established.

Pirirakau

- Pirirakau are currently involved in research (and monitoring) projects in the upper catchments, with Landcare Research, investigating interactions between small mammal pest and food resources, and TB in possums (refer to Appendix 4).

## 14.2 Gaps in current monitoring

- Annual surveillance of forest protection areas associated with Environmental Programmes and Biodiversity Management Plans.
- Identification of sediment sources.
- Sediment transport by Waipapa and Te Puna Rivers.
- Changes in water quality.
- Farm nutrient budgets.
- Biodiversity condition and trend in remnant indigenous vegetation (forests and wetlands).
- Bird breeding success in wetlands and forests.
- Health of forest processes.
- Rates of weed spread, changes in weed distribution and abundance.
- Changes wrought by weed invasion on vegetation structure and biodiversity condition.
- Ecosystem functions.
- Possum, mustelid, and rat populations.
- Investigation of areas utilised in exchange for transferable development rights (TDR) and the condition of the TDR blocks.

## 14.3 What should be monitored?

- Sediment transport by Waipapa and Te Puna Rivers (and sediment origins).
- Forest health:
  - canopy condition.
  - understorey composition (including seedling recruitment).
- Bird species and numbers.
- Pest animals:
  - presence/absence of domestic stock.
  - possum trap catch rates.
  - tracking indices of rats.
  - .
- Status and condition of estuary margins.
- Status, stability, and condition of stream riparian margins.

- Stream condition:
  - shading;
  - water quality.

## 14.4 Roles

Monitoring can be relatively simple but nevertheless needs to be designed and evaluated scientifically. This is not necessarily within the interest or capacity of every care group, and in this regard EBOP can play crucial roles in implementing monitoring programmes and analysing monitoring data.

EBOP and WBOPDC both have responsibilities to monitor or facilitate monitoring to:

- Ensure that restoration goals are met;
- Evaluate whether agency goals are being achieved;
- Ensure that resource consent conditions are met.

Care Groups can take on some or all of the responsibilities associated with data collection. However the requisite structured approach to data collection does not always fit seamlessly into the lives of care group volunteers. At least some monitoring may have to be the responsibility of paid agency representatives if it requires a commitment to a specific monitoring timetable. Alternatively, pecuniary remuneration can support monitoring by care groups, to facilitate a structured approach to monitoring.

Collating and retaining the monitoring data as permanent records is needed, and could be the responsibility of EBOP, to serve the dual purpose of reporting and backing up care groups and records.

Alternatively, monitoring programmes can be designed that account for the sometimes ad hoc nature of data collection by community groups, if a long term commitment to data collection by community groups is evident. (Ad hoc data collection introduces many variables that need to be overcome by larger sample sizes and longer monitoring timeframes in order to detect statistically significant changes in response variables).

# 15. KEY ACTIONS: PEOPLE

People are the key resource for achievement of implementation action on the ground. Key actions involve ongoing support for care groups and expansion of their activities. Information sharing and collective decision-making is also a key requirement.

**<u>KEY ACTION</u>: Ongoing support of existing care group activities.**

**People are the opportunity, and maintenance and enhancement of the human resource is crucial.**

- Facilitate and encourage ongoing activity (financially and otherwise).
- Encourage and advise on monitoring of success, and ensure this is undertaken.

- Provide material and personnel assistance.

The use of mechanical mangrove removal is being used to facilitate a shift in focus of volunteer labour from mangrove removal to restoration of estuarine margins.

**KEY ACTION: Negotiation of stakeholder roles and coordination of stakeholder effort.**

The implementation of a catchment-wide plan involves providing support for a multiplicity of objectives. Coordinating objectives and associated management actions will require dialogue between all stakeholders, possibly within some kind of forum.

Environment Bay of Plenty and other agencies would not only be members of this type of forum, they would also provide higher level support network for the forum. This higher level support network would need to have procedures in place to ensure the successful functioning of the forum.

The co-ordination of care groups, the monitoring and reporting of their activities, and the support for funding assistance could be the responsibility of a paid "catchment manager" or "catchment coordinator" who reports to the forum and works with the community. The aim of this type of approach would be to maximise benefits from having community-led management, with agency support of on-the-ground activities undertaken in a partnership between landowners, care groups, and agencies.

A forum would need to include:

- Those drafting the rules;
- Those with funding;
- Those at the coal face.

A forum would be a place to:

- discuss interface difficulties;
- identify how to bridge gaps;
- ensure that everyone knows their roles and responsibilities, enabling agencies and care groups to clarify their respective roles and responsibilities;
- identify grey areas and gaps in knowledge, and seek support to remedy those.

However, it is difficult to have stakeholder meetings unless stakeholders attend. Some form(s) of incentive(s) may be required to encourage/reward attendance. The authors of this report understand that a forum is already being planned by EBOP.

# 16. KEY ACTIONS: ON-THE-GROUND

**KEY ACTION: Biodiversity enhancement in indigenous forest in upper catchment, on public and private lands.**

- Complement and/or support existing initiatives in upper catchment (e.g. Puketoki Reserve, Pirirakau project).
- Undertake weed control and possum control as needed, and rat control at selected high priority locations, if not already being undertaken. Mustelid control should also be considered at high priority locations.
- Provide or facilitate start-up and ongoing funding for this work.
- Pest animal control.
- Pest plant control.
- Monitor recovery of healthy forests.
- Monitor recovery of indigenous animal populations.

**KEY ACTION: Riparian restoration in upper catchments.**

- Work in places where enthusiasm is already evident in priority areas for riparian restoration, that are adjacent to active restoration projects and areas of high terrestrial indigenous biodiversity.

- Patirawa Stream and surrounds are one of two significant stretches of the Te Puna River from which indigenous or exotic riparian forest is missing (the other is in the middle reaches of the catchments). However, unlike the middle reaches, there is already a high level of enthusiasm within the community for riparian restoration along the Patirawa stream. The restoration of riparian vegetation here complements work already being undertaken in Puketoki Reserve, and increases the linkage between this reserve and the Kaimai Ranges. However, this will also improve connectivity to indigenous forest, which can potentially be a significant source of pest animals. Issue of how pest management within forests is viewed by the community at large needs to be addressed to complement restoration aims in the Puketoki Reserve.

- Target sites producing, in relative terms, greatest contributions of sediment to waterways.

In the longer term, riparian restoration in lower reaches of catchment is desirable.

- Riparian restoration in areas with high levels of enthusiasm and community support.
- Fencing of riparian margins to exclude stock.
- Site preparation, planting, and ongoing maintenance.
- Monitoring of plant growth and weed invasion.
- Monitoring of habitat development and levels of use by indigenous fauna.
- Monitoring of natural establishment of indigenous plants.
- Monitoring of stream and river bank erosion.

**<u>KEY ACTION</u>: Forest restoration in lower and middle reaches of catchments.**

Forest remnants in the middle reaches of Te Puna and Waipapa catchments. Largest area of indigenous vegetation within lower Te Puna catchment, some of which occurs on 'Acutely Threatened' and 'Underprotected' land environments. These could be a focus area for forest restoration in the lower catchment.

- Fence forested areas.
- Protect riparian margins.
- Implement pest plant control.
- Implement pest animal control.
- Monitor condition.

**<u>KEY ACTION</u>: Wetland enhancement in lower Te Puna catchment.**

- Most prominent wetland sites are those in the vicinity of the Te Puna Road bridge and Waipapa Road bridge. These are the largest freshwater wetlands in the area, and may be significant repositories of a distinctive assemblage of indigenous plants and animals.

- The natural character of wetlands and wetland margins is currently being compromised by weeds and rubbish. Undertake weed control, particularly willows, and rubbish removal in highly visible wetland sites adjacent to highway corridor (Figure 13).

- Weed and rubbish removal within and adjacent to the highly visible wetland at the Te Puna Bridge (including the road corridor).

- Ongoing maintenance to maintain values.

Figure 13a: See caption below.

Figure 13b. Margin of highly visible wetland in lower Te Puna catchment adjacent SH2, showing rubbish and weeds, including woolly nightshade, brush wattle, black wattle, blackberry, and gorse, on a wetland margin, and pampas invading the wetland margin and interior.

**KEY ACTION: Address existing and future erosion and sediment sources associated with infrastructure and infrastructure development.**

- Some point sources of mobile sediment within the Te Puna-Waipapa catchments are associated with infrastructure. These include road cuttings, land development sites, and farm races and tracks. Infrastructure may also contribute to elevated levels of stream bank erosion further down the catchments, for instance where stormwater systems are under-designed and incapable of effectively buffering streams from peak storm event inputs from impermeable surfaces, as appears to be the case in the Oturu Stream catchment.

- Raising awareness of the existence and contribution of particular sediment sources to this catchment-wide issue is an important part of remedying this problem.

- Agencies have an opportunity to support community-based efforts by addressing known erosion sites and sediment sources.

  (a) Minimise risk of sediment transport from erosion-prone sites (roadsides, tracks, and development sites). Where planting is used as a risk minimisation tool, focus on indigenous alternatives to exotic species.

  (b) Quickly and effectively mitigate mobilised sediment, whether by removal or entrapment.

  (c) Stabilise eroded sites in a manner compatible with sustainable land management and biodiversity goals for the Waipapa and Te Puna catchments.

(d) Ensure appropriate farm track cutoffs are installed and maintained to direct contaminated stormwater away from entering streams directly.

- Remedy existing sediment sources.
- Monitor roadside erosion.
- Monitor soil transport from development sites.
- Road margins throughout catchments.
- Land development sites.
- Farm infrastructure.

**KEY ACTION: Innovative solutions to reduce sediment yields from catchments.**

Agricultural (and horticultural) landscapes generate a certain amount of sediment as a by-product of land use. Riparian margins may buffer streams from this by slowing overland flows, enabling water to percolate into soil, or enabling some suspended sediments to be deposited within riparian areas, but they will probably not entirely eliminate sediment yields from production land. Riparian restoration may make a tangible difference to rates of sediment transport.

Agricultural landscapes may be the primary source of sediment within the catchment, as a diffuse yield associated with land use. Innovative solutions to diffuse sediment yield associated with land use are needed to complement the riparian protection measures implemented to stabilise stream banks.

Information is due to be available shortly (from the NIWA study) to illuminate patterns of sediment origin and transport within agricultural land, to inform potential solutions (steep pastoral land that experiences high rainfall is a recognised priority).

One way the effectiveness of riparian plantings and changes in land management might be assessed is in measuring rates of sediment transport through time. Both rivers are accessible in their lower reaches through a major road corridor. Monitoring (of velocity, volume, suspended sediment load per unit) could inform changes in land management with the knowledge that the change is making a tangible difference.

**KEY STATUTORY ACTION: Omokoroa and Minden Structure Plans**.

Planning provisions in accordance with community aspirations with regards to landscape connectivity and biodiversity enhancement within catchments, in addition to the retention and enhancement of forest remnants in lower catchments and within Underprotected and Acutely Threatened Land environments.

Omokoroa will become the largest potential volunteer resource within the study area. Planning to foster the community's sense of place within the catchment may instil a duty of care among the community at large. This could start with restoration of coastal vegetation, as a habitat maintenance and enhancement project to complement the predator control projects already underway. Implementation of the Omokoroa Structure Plan is based on the protection of coastal margins, protection and enhancement of gullies, and enhancement of ecological (and recreational) connectivity, integrating urban development and enhancing ecological linkages with

indigenous habitats. The same approach is being used for the Minden Structure Plan, which is currently under preparation.

## 17. SUMMARY OF ACTUAL AND POTENTIAL PROJECTS

An overview of streams and stream gradients, indigenous vegetation and habitats (including significant sites), protected areas, care groups, and environmental programmes is provided in Figures 12a-d.

There are many issues and potential projects in common in the Te Puna, Waipapa, and 'Extension' catchments. A summary of actual and potential projects is set out below, along with an assessment of relative merit.

Assessment of relative merit is based on the following criteria:

**High (H):**
- High biodiversity values at the site (or downstream).
- Strategically important linkage.
- Readily achievable and cost-effective.
- Possibly more urgent, but not necessarily so.

**Moderate (M):**
- Moderate biodiversity values at the site (or downstream).
- Low to moderate threat levels (i.e. no particular urgency in terms of implementation).
- Achievable and cost-effective.

**Low (L):**
- Low to moderate biodiversity values at the site (or downstream).
- Low urgency.
- Achievable, but not cost-effective.

<u>Omokoroa Peninsula</u>

- Continue to protect and enhance margins of peninsula where it abuts the harbour (H):
  - weed control (H).
  - pest control (M).
  - planting of locally-sourced indigenous coastal species (M-H).

- Omokoroa Structure Plan
  - Coordination with implementation of Structure Plan provisions with respect to riparian protection and wetland enhancement adjacent to Waipapa Estuary and lower reaches of the Waipapa River (H).

- Monitoring (H).
  - weeds (M).
  - planting (L).
  - restoration projects (H).

Waipapa Catchment

- Downstream of SH2 (Waipapa River and Estuary):
  - Coordinate with implementation of Omokoroa Structure Plan provisions with respect to riparian protection and wetland enhancement adjacent to Waipapa Estuary and lower reaches of Waipapa River (as for Omokoroa Peninsula) (H).
  - Monitoring (H - management implementation).

- Upstream of SH2:
  - Remove willows (H).
  - Protect riparian margins (H).
  - Restore wetlands (if present) (H).
  - Indigenous planting (M).
  - Monitoring (H - management implementation).

- Middle Catchment:
  - Riparian fencing (M).
  - Planting (M).
  - Monitoring (M - management implementation).

- Upper Catchment:
  - Protect high gradient streams (M).
  - Riparian fencing (M).
  - Planting (M).
  - Monitoring (M - management implementation).

Te Puna Catchment

- Te Puna Estuary:
  - Jess Road wetland restoration (H).
  - Weed control on other estuary margins (M-H).
  - Monitoring (H - management implementation).

- Lower Catchment Below SH2:
  - Protect low gradient streams (H).
  - Riparian fencing (H).
  - Planting (M).
  - Weed control (H).
  - Wetland protection and enhancement (H).
  - Monitoring (H - management implementation).

- Lower Catchment Above SH2:
  - Protect low gradient streams (M).
  - Riparian fencing (M).
  - Planting (M).
  - Weed control (M).
  - Monitoring (L).

- Middle Catchment:
  - Protect high gradient streams in farmland:
    - Riparian fencing (H).
    - Planting (M).
    - Weed control (M).
    - Monitoring (L).
  - Protect and enhance existing indigenous forest:
    - Fence to exclude stock (H).
    - Pest control (H).
    - Weed control (H).
    - Use riparian fencing to link indigenous forest (H).

- Upper Catchment:
  - Riparian protection on steeper pastoral lands (H).
  - Complete Patirawa Stream riparian protection (H).
  - Continue Puketoki Reserve project (H).
  - Expand pest control in indigenous forest (H).
  - Assess potential for protection of riparian links with Kaimai tract (H).
  - Monitoring:
    - Pest control (H).
    - Vegetation recovery (H).
    - Birds (H).
    - Invertebrates (M - subject to results of project currently underway).
    - Stream protection in pastoral systems (H).

<u>Eastern Extension Catchment</u>

- Harbour Margins and Estuary:
  - Protect and enhance estuary margins (H).
  - Weed control (M-H).
  - Indigenous planting (L).
  - Monitoring:
    - Vegetation (H).
    - Management implementation (H).

- Lower Catchment Below Armstrong Road:
  - Protect low gradient streams in farmland (H).
  - Riparian fencing (H).
  - Planting (M).
  - Weed control (M).
  - Monitoring (H - management implementation).

- Middle Catchment Above Armstrong Road:
  - Protection of low gradient streams in farmland (M).
  - Riparian fencing (M).
  - Planting (M).
  - Weed control (M).
  - Monitoring (M).

- Minden:
  - Implement provisions of Minden Structure Plan (currently in progress), including: riparian protection, gully restoration, indigenous revegetation (H).
  - Monitoring (M).

- Upper Catchment:
  - Protect stream margins (high and low gradients) in farmland (H).
  - Protect stream margins (low gradients) in farmland (M).
  - Riparian fencing to exclude stock (H).
  - Create linkages between existing indigenous vegetation (H).
  - Explore options for community-based or landowner-based pest control project(s) (H).
  - Monitoring:
    - Management implementation (H).
    - Pest control (H).
    - Vegetation recovering (H).

## 18. FUNDING SOURCES

Information on short- to medium-term funding options (refer to Appendix 10) was provided by Glenn Ayo, Community Development Manager, Western Bay of Plenty District Council, a key contact for funding assistance for care groups within Western Bay of Plenty District Council, and WBOPDC and Environment Bay of Plenty have been a valuable source of assistance to many care groups.

Although there are many environmental funding options available, agencies and organisations need to be imaginative with regards to the security of the kind of long-term funding sources that successful implementation of this kind of project will require.

Serious consideration should be given to securing guaranteed funding for this project, to cover at least some costs. It seems unlikely that such funding could be derived from private sources, but public sources such as area-of-benefit rating levies, or an annual uniform charge are options that could be considered. Secure funding sources would allow communities to set medium- to long-term goals, and to work toward those goals knowing that the initial investment will not be jeopardised by the next funding round. However, funding, and particularly any public funding derived from the Te Puna-Waipapa communities, is an issue that needs to be negotiated with the community at large.

## 19. ENSURING ONGOING RETURN ON INVESTMENT

The best way to ensure that resources are not lost through time is to instill in the community a sense of ownership and satisfaction for the areas that they care for. Communities must also know that their efforts are making a difference. When these are coupled with knowledge of the pervasive and ongoing threat posed by pest plants and animals, the community is likely to become and stay motivated to protect its investment and the difference it has made. For this to occur, community enthusiasm

for a project must be maintained through time. Agencies play a crucial role in maintaining that enthusiasm through ongoing support and facilitation, particularly with regards to funding. The issue of funding has been raised repeatedly during discussions associated with this project, all focused on the key question: "where will funding come from?"

## ACKNOWLEDGMENTS

Project liaison was provided by Donna Watchman and Robyn Skelton of EBOP. Carlton Bidois shared aspirations, opportunities, and concerns on behalf of Pirirakau Hapu. Bob Cooper, Colin Hewens, and Gwenda Merriman of Whakamarama Community Inc. gave constructive input regarding the scope and content of this report, the relative importance of various facets, and also a frank appraisal of the value of this work. Glenys Kroon and Jo Gravit emphasised the importance of Western Bay of Plenty's Long Term Community Plan as it pertains to this project. Daryll Hall, John Mather provided details on the work that EBOP is actively involved in within the Te Puna and Waipapa catchments, Donna Watchman compiled information resources from within EBOP. Robyn Skelton and Daryll Hall provided feedback on first draft of this report, Matt Bloxham provided the section on current and potential threats to stream environments from stormwater. Glenn Ayo provided information on WBOPDC's involvement in Care Group activities within the Te Puna-Waipapa catchments. Glenn Whittaker provided comment from the Omokoroa Environmental Managers, Marny Bradley, Don Brebner and Mary Foster, Tim and Merry Cooney, Josie Law and Colin Pettigrew, Kirsty Walker, and Ian Cross shared their experiences, aspirations, and concerns from a Care Group perspective. Sandy Elliot and Terry Hume (NIWA) provided useful comments on information resources and sediment sources in the catchments.

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# LEGISLATIVE AND POLICY FRAMEWORK

There is a hierarchy of legislation which vests various roles with local government bodies in relation to management of the Te Puna and Waipapa catchments. At the top of this legislative hierarchy is the Resource Management Act (1991), and beneath this are various regional and district plans, policy statements, and management strategies.

Resource Management Act (1991)

The Resource Management Act (1991) prescribes mechanisms by which New Zealand's natural resources are governed. The purpose of the Act is to promote the sustainable management of natural and physical resources. In 2003, functions of regional councils were amended within the Resource Management Act by inclusion of the following statements:

- Section 30(1)(c) of the principal Act is amended by inserting, after subparagraph (iii), the following subparagraph:
  - "(iiia) the maintenance and enhancement of ecosystems in water bodies and coastal water"

- Section 30(1) of the principal Act is amended by inserting, after paragraph (g), the following paragraph:
  - "(ga) the establishment, implementation, and review of objectives, policies, and methods for maintaining indigenous biological diversity"

This means that Environment Bay of Plenty has an obligation to protect indigenous biodiversity and other natural resources within the Bay of Plenty Region on behalf of the Crown.

The RMA also stipulates that "the relationship of Māori and their culture and traditions with their ancestral lands... is a matter of national importance to be recognised and provided for" (refer Section 6(e) of the Act).

In addition to the RMA, two other high order documents govern the regulatory framework: the New Zealand Coastal Policy Statement (NZCPS) and the Bay of Plenty Regional Policy Statement (RPS). These are given effect by way of policies and rules in a range of regional and district plans, of which the following are relevant to management of Te Puna and Waipapa catchments:

- Regional Water and Land Plan.
- Regional Coastal Environment Plan.
- Regional Air Plan.
- Western Bay of Plenty District Plan.

Regional Policy Statement (Environment Bay of Plenty)

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 Bay of Plenty region and policies and methods to achieve integrated management of the natural and physical resources of the whole region. The policy presents objectives for the management of different resources, including:

8.3.1(a) **Water quality**
*Water quality is maintained, and where practicable enhanced, to a level sufficient to safeguard aquatic life, to sustain the potential of water resources to be used and developed to meet existing and reasonably foreseeable future needs, and to provide for the protection of aesthetic or cultural values associated with water.*

16.3.1(a) **Natural character**
*The preservation of the natural character of the region, including the protection of significant indigenous habitats and ecosystems, having particular regard to intrinsic values of ecosystems.*

16.3.2(a) **Ecological Restoration**
*The restoration or rehabilitation of natural communities and habitats in order to increase the survival probabilities of significant indigenous flora, fauna and ecosystems.*

The Regional Policy Statement mandates monitoring to ensure that sustainability is not compromised through competing or complementary uses. Research may be necessary, including modeling of the dynamic properties of resources, to increase the level and quality of knowledge and to make it accessible. The means that a data-based assessment of whether the aims of sustainable management is being achieved is essential to the success of the exercise.

Regional Water and Land Plan

The Regional Water and Land Plan addresses issues relating to management of the environmental effects of the use and development of land, water and geothermal resources that are within the scope of Environment Bay of Plenty's functions and responsibilities under the Resource Management Act (1991). The Regional Water and Land Plan vests in Environment Bay of Plenty the responsibility to encourage appropriate wetland management, to promote wetland maintenance and enhancement, to raise awareness of wetland conservation issues and benefits, and to encourage and support wetland care groups. It also specifies guidelines associated with the management of riparian vegetation, and the access of stock to waterways.

Regional Coastal Environment Plan

Significant examples of coastal vegetation and habitats are delineated in this Plan. The Regional Coastal Environment Plan also has Water Quality Classifications for contact recreation and shellfish gathering. The objective of Chapter 9 in this plan is "the maintenance and enhancement" of water quality, and there are a number of policies and rules to achieve this outcome.

Western Bay of Plenty District Plan

The Resource Management Act 1991 makes it compulsory for councils to prepare a District Plan. The Plan uses rules that have the force of law, as well as other methods such as education programmes and incentives. Everybody, including Councils, must comply with the plan. The District plan identifies two objectives with regards the natural environment in western Bay of Plenty:

- Protection of all significant native plant and animal habitats and ecosystems within the Western Bay of Plenty District;
- Preservation of the natural character of the District's coastal environment, wetlands, rivers, lakes, and their margins.

One of the policies by which the Western Bay of Plenty District Plan seeks to achieve these objectives is through recognising the off-site contributions of riparian areas to the health of adjoining habitats (wetlands, rivers, the sea, estuaries and other associated land/water interfaces).

Local Government Act 2002

The Local Government Act provides Councils with a broader power of general competence and the ability to become involved in economic, cultural, social, and environmental well-being issues. The Local Government Act requires local authorities to have a Long Term Council Community Plan (LTCCP) which reflects what the community wants as outcomes over a ten year time frame.

Western Bay of Plenty Long Term Council Community Plan (LTCCP)

The Western Bay of Plenty Long Term Council Community Plan sets out WBOPDC's contribution to help achieve Community Outcomes, and sets Council's strategic priorities for the next 10 years, which feed into a number of other Council planning processes. It also provides the community with important information on each group of activities, such as:

- What Council will do over the next 10 years;
- How it will do it;
- What it will cost;
- How it will be funded;
- How the Council will measure its performance.

SmartGrowth Strategy

The SmartGrowth strategy is a 50-year plan to manage growth in the sub-Region. The SmartGrowth work programme, which is based on social, economic, cultural, and environmental outcomes, is led by Environment Bay of Plenty, Tauranga City Council, Western Bay of Plenty District Council, and tangata whenua. SmartGrowth supports a fundamental shift in growth management from focusing largely on accommodating low-density suburban, residential development to support a compact and balanced "live, work and play" concept. This emphasises the concept of liveable urban and rural environment (definition and description from Western Bay of Plenty LTCCP 2009).

Omokoroa Built Environment Strategy

This aims to guide the expansion and development of Omokoroa, without compromising existing character of Omokoroa Village.

Wairoa River Valley Strategy

Part of the 'extension' area flows into the Wairoa River. Tauranga City Council and Western Bay of Plenty District Council have prepared a joint strategy for this area, between the McLaren Falls Bridge and the Tauranga Harbour. This includes an implementation plan, released in November 2005, including short term actions (to 2008/09), medium term actions (2009/10-2012/13), and long term actions (2013/14-2015/16 and beyond). These actions include education, assistance to the Landcare Trust, recreational use, riparian protection and planting, research on ecological values, statutory processes, protection of cultural landscapes and sites, and potential land purchase.

Conservation Management Strategy 2008-2018

The Bay of Plenty Conservation Management Strategy has statutory recognition under the Resource Management Act 1991. Bay of Plenty Conservancy's Conservation Management Strategy encourages the Department of Conservation to increase public participation in conservation by building co-operative relationships to support priority conservation outcomes. These relationships can involve creating ecological corridors with councils and private landowners and reducing the impact of fragmentation on biodiversity, and implementing projects which realise biodiversity and/or recreation gains with economic, social, and cultural advantages.

# STREAM FLOWS AND SEDIMENT TRANSPORT

Unmodified catchments in New Zealand typically have a high energy erosive upper zone, and a low energy depositional lower zone. Erosion of stream banks in upper catchments is a natural phenomenon, as is sediment transport by flood waters. All catchments have a natural background rate of erosion. In Te Puna and Waipapa catchments we must consider how much changes in land use might have accelerated catchment erosion.

Flow volumes within streams are a function of the physical parameters of the environment, including rainfall, catchment area, topography, land use, vegetation, and soil depth. Flow volumes increase for larger upstream catchment areas, more rainfall, steeper topography, non-forest land use, and shallower soils. Percentages of rainfall entering waterways during storm events is a primary factor determining peak flows.

Flow velocity is a function of flow volume, fall, stream course, channel depth, and characteristics of riparian vegetation. Water velocity increases for steeper falls, linear stream courses, narrower shallow channels, and smoothness and evenness of the side and bottom of the stream channel.

Stream bank erosion is, at least in part, a function of flow velocity. Faster moving water carries more energy and, with it, greater capacity to erode streambanks. Streambank erodibility is related to parent material. Hard substrates, such as the ignimbrite basement rock of the upper Waipapa and Te Puna catchments, are highly erosion resistant. However, soft substrates like the Pleistocene mud and siltstones present in many parts of the middle and lower reaches of the Waipapa and Te Puna catchments are soft and easily eroded.

During heavy rainfall events, streams must transport more water than normal, the typical response to this in upper catchments is to transport the same volume of water at a higher velocity, so that stream levels don't come up too much. Steep falls in the upper catchment make this possible. The response in the lower reaches is to transport a greater volume of water at the same velocity, a function of the inability of low falls to accelerate water. This means that water levels rise to the extent that a stream may overtop its banks, and extend onto its floodplain.

The increase in flow velocity in the upper reaches of the catchment means the water has higher energy, and is more likely to erode stream banks than during periods of normal flow. Most of the sediment resulting from these erosion events is transported downstream, again due to the capacity of high energy water to move large sediment particles, including sand, and even small stones and boulders.

The low flow velocities in lower reaches mean that even though flood waters may raise above streambanks, little damage is done to those streambanks because the water has relatively little kinetic energy, and hence capacity to do work. This also means that the capacity to transport sediment is less in lower reaches. When streams extend onto their floodplains, the water on the floodplain slows almost to a standstill, due to their low gradient. Flood plains play a critical role in capturing sediment transported through the catchment during flood events. On

unmodified floodplains, the combination of low gradient (almost zero), dense vegetation (whether wetland or forest), and high surface area (surface of vegetation) combine to slow water flows below those at which sediment deposition occurs. When floodplains are covered in dense vegetation, be it rush- or sedge- dominated wetland, or forest, the high surface area of the vegetation serves the dual purpose of further slowing the water, and facilitating deposition by presenting a large surface area to the flood waters. A significant portion of the sediment carried through flood events is deposited on flood plains (Lambert and Walling 1987). The proportion of transported sediment deposited on floodplain depends on a range of factors including flow velocity, distance from channel, microtopography, duration of inundation, and vegetation on a flood plain.

EXTRACTS FROM
SURMAN ***ET AL***. 1999 -
TAURANGA HARBOUR
SEDIMENT SOURCE SURVEY

# Chapter 11: Te Puna Stream

## 11.1 History

Reclamation and stopbanking for farming near the mouth occurred in the mid 70s. A major flood occurred in 1972 causing damage from silting of flood plains. Many tree blockages have been reported over the years. Stopbanks were built below SH2 in 1971 and 1972.

## 11.2 Current Situation – From Odey Road to SH2

Initially a small flow is bordered by around 5 to 10m of bush, consequently there is much dead wood on the bed. The water is very clear; the rock bed is covered by sands in pooling areas. There are some grasses growing on the streambed. Within this stretch there is a ford and weir.

*Figure 11.1 As the bush decreases, it is replaced by blackberry (that has been killed off by spraying), with some dragging in the stream. Grass patches line the 1.5m high bank, generally farmed hills rise on either side of a 50 to 100m of floodplain.*

The first substantial drop sees water falling around 7m over a rock shelf. The land level does not follow these dramatic changes in bed level and a gorge develops with bush extending to farmed land making access to water level more difficult. At each visible section of water it appears there is a substantial drop, from a topographical map it is estimated that the stream gradient in the top portion (i.e. down to around 2.5km above SH2) has at least 30m per 1km. There is little erosion because the rock base (Waitearíki ignimbrite) extends up the banks; the very steep and high banks are stable. Vegetation is on ledges and lower gradient banks where possible. A small moss covered area 2m either side of the 3 to 4m wide channel is available as a flood plain through some of the flatter sections (refer Figure 11.2).

*Figure 11.2 Within the gorge there is a few metres floodable area to either side of the channel.*

At 4.8km above SH2, the stream leaves its gorge setting. The next kilometre is bordered by farmed land. Just prior to leaving the bush surroundings, a small point of bank erosion was noted where trees were being undermined.

At 3.55km, there is a partial dam consisting of apparently planted trees (10cm diameter); there is a steady flow of water through the dam. Only 20m downstream of this there is another dam, however this is more significant (refer Figure 11.3). Stream banks are low and there is barely any evidence of erosion. A large rock shelf waterfall signals the end of this more open section.

*Figure 11.3 The second debris dam, low flows pass through the blockage.*

In the next gorge a series of large drops run on from one another, cascading into small pools. The rock banks again have some vegetation and are very stable. Gradually the gorge becomes deeper with access down the channel difficult because of steep banks.

At the conclusion of this gorge (2.6km above SH2), there is approximately a 200m wide floodplain. The banks are generally less than 1m high with good grass cover. The water is not as crystalline as earlier yet is still clear.

The bed now contains many loose rocks which form short bouldery rapids (refer Figure 11.4) each 50 – 100m in length over the following 1km. In this section, the stream meanders within the plains. Animals are generally fenced off from the river.

*Figure 11.4*
*At 1.8km above SH2, the steep gradient decreases.*

*Figure 11.5 From 200m above SH2, viewing upstream, adjacent land is swampy. The water is noticeably discoloured as it mixes with tidal harbour waters.*

Around 1.4km above SH2, the river becomes very still for the first time, the surface appearing to be hardly moving. There are substantial amounts of tree debris on the bed.

In the final 800m above the bridge, the floodplain decreases as high hillsides confine the stream. A few tributaries enter the Te Puna on the right bank; these are within their own deep gullies. In one of these gullies (0.9km above SH2), water has been retained in ponds which step down to the Te Puna. Each pond appears to be high in suspended solids and heavily discoloured. The Te Puna has many trees along its banks in this section, some of which drape into the water. The land immediately next to the stream is fully saturated in places.

At the SH2 road bridge the water appeared to be noticeably discoloured for the first time. This occurred over a short distance however the point of transformation was not identified because of lack of access to the water. One possible cause is thought to be tidal mixing from the harbour, which may have higher suspended sediments due to wind-induced suspension of sediments in shallow areas. The tide on the date of the survey was close to mid tide on an outgoing cycle. The other possible cause is that water of high sediment concentration is entering the stream on the right from one of the ponds mentioned above. This was not investigated further.

Again, the stream becomes part of an estuary of the harbour.

## 11.3 Conclusion – Te Puna Stream.

The foundations of this stream are dominated by layered ignimbrite rock; all large drops are over rock shelves. The banks are very stable despite their steepness; therefore erosion is not an issue for the bulk of this stream.

The stream is very clear until the final kilometre above SH2; the reason the stream becomes slightly turbid is unknown as access to the water was difficult in this region. If the sediment load in the water proved significant, identifying the source is recommended.

There is farmland adjacent to the stream only on three relatively short lengths, these were in the lower, middle and upper reaches surveyed and were of approximate lengths 1.6km, 1km, and 1km respectively. There is substantial tree debris on the bed both in the upper and lower reaches. The stretches within the gorge are generally clear of debris.

# Chapter 12: Waipapa River

## 12.1 History

River clearance works were done 1968-69, namely willow removal, especially around the Old Highway.

1980 – Dumped logs were cleared as they posed a potential hazard to downstream bridges and were suspected of damaging aquatic life in the reserve between the old and new highways.

Willows severely blocked the stream in 1980 causing floods to spread more than normal. Damage caused to nurseries.

Unauthorised straightening of a tributary in 1982 was discovered and stopped. Downstream of this water intake filters were blocking up.

## 12.2 Current Situation

Beginning 3.1km above SH2 and just below a large waterfall the river has many boulders forming the bed. The channel width is between 1.5 and 4m with around 7m area adjacent for floodwaters. The hills rise on either side from this point.

*Figure 12.1 Here the water is clear, the banks are well vegetated 0.3m above the water line, below which is a thick covering of moss.*

The river becomes generally flat from soon after this point with a more consistent width around 5m. A reasonable amount of tree debris can be seen on the bed. Vegetation cover is still good, with forestry on the left; banks are around 2 to 3m high. Deer are farmed on the right bank which is well fenced off from the river.

*Figure 12.2 From 2.8 till 2.2km above SH2 the river is flat, erosion is minimal; some tree debris is evident in patches.*

The first significant obstruction occurs at 1.9km above SH2 where a willow restricts the stream (refer Figure 12.3). Erosion (10m by 1.5m) follows shortly after. The surrounding land starts to open out.

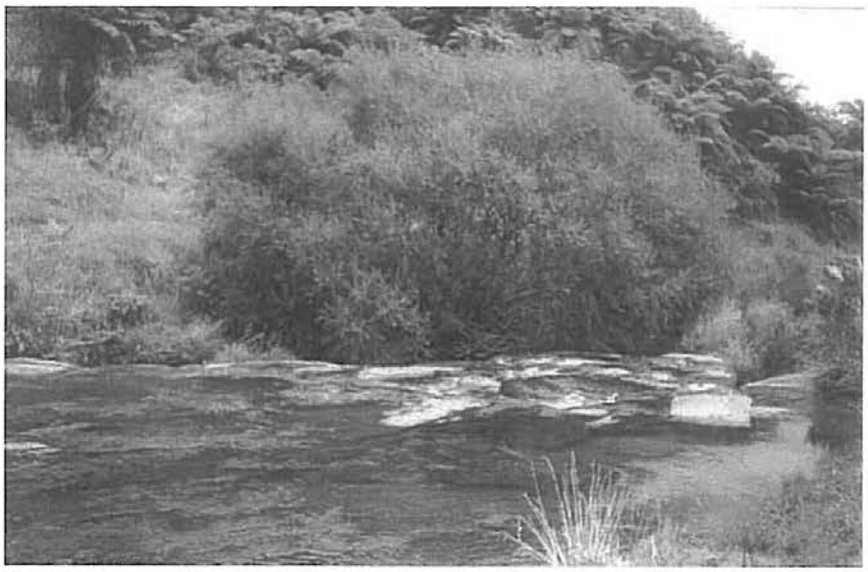

*Figure 12.3 The river drops over a 1m shelf and is restricted by a willow that is rooted on the left bank.*

*Figure 12.4 At approximately 1.4km above SH2 the river has previously been fully blocked by debris. A new route has eroded its path sharply to the true right leaving a 3m bare bank (shown on the left of this upstream view).*

Further downstream (until 1km) is a series of similar blockages, but which are not so advanced. Islands within the river divide the flow and can trap sediments behind them creating an obstruction (refer Figure 12.5).

*Figure 12.5 At 1.2km, growth of in-stream willows encourages sediment deposition. The consequential islands redirect flow, causing erosion.*

There are several overhanging willows which are potential contributors to blockages (refer Figure 12.6). Erosion on the left bank at 1.3km is of substantial length and is also very close to an unsealed farm road, with the possibility of undermining it if the erosion continues. At 1km there is a 100m section of erosion.

*Figure 12.6 Typical potential tree blockage at 1km above SH2, while extensive erosion is evident in the background.*

Between the Old Highway and SH2, banks are 1 to 2m high and are well vegetated in the river loops. There is a 15m wide flooding area adjacent. Three willows overhang the water in the first half of the loop with more in the latter half.

At SH2, there is a final drop in the river, which on the day of the survey the tide did not over top. The water lost much of its clarity at this point indicating the harbour's influence. Around 2km of river exist before transition to the harbour via the Waipapa estuary. Some low-lying land adjacent to the river is being cleared for grazing of stock; much of the land has little freeboard above the river level (refer Figure 12.7).

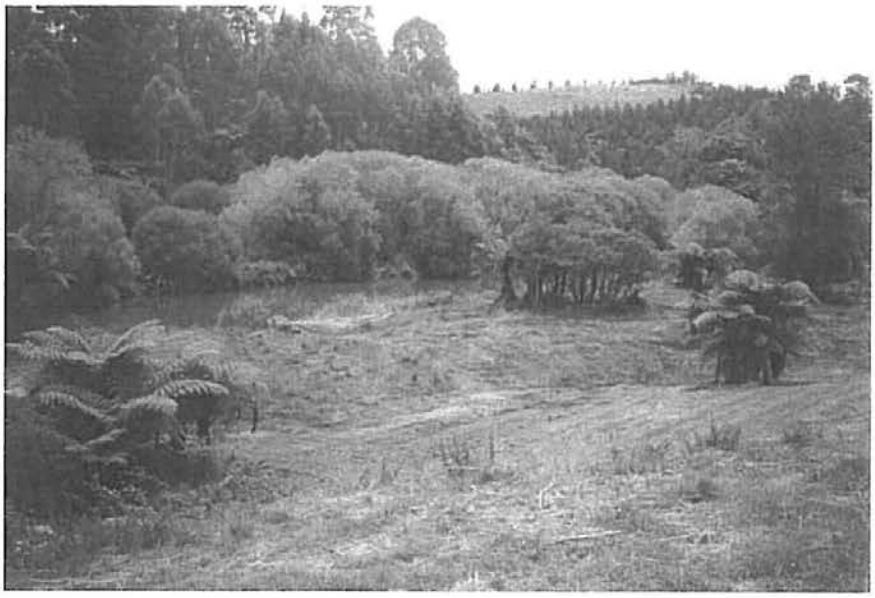

*Figure 12.7 Flats beside river at 400m below SH2 are cleared for grazing of stock. For the first 800m below SH2 the left bank is lined with willows.*

Estuarine vegetation dominates this lower region with marshland plants throughout grazing fields, indicating a groundwater level close to the surface.

## 12.3 Conclusion – Waipapa River

The survey began at the point at which farmland and bush interface; (the assumption is that the more significant effects occur in this stretch, with works not generally carried out amongst the bush).

The most notable problems were found to be concentrated between 1 and 2km above SH2. These were erosion, tree blockages, and deposition. It was noted that in some places the deposition contributed to further erosion.

APPENDIX 4

# STATEMENT OF PIRIRAKAU INTERESTS AND CONCERNS

**Acknowledgment**: The material below was supplied by Carlton Bidiois, and is gratefully acknowledged.

All Tangatawhenua have an inherent responsibility to care for their environment and this includes the protection and maintenance of natural resources for the enjoyment and sustenance of future generations. This is referred to in the Resource Management Act as Kaitiakitanga. Kaitiakitanga in its many realms can be very complex and may be conducted under different regimes by Tangatawhenua of any one Rohe (tribal estate). Consequently, when identifying the enactment of kaitiakitanga by Pirirakau as Tangatawhenua of the lands incorporating the Waipapa and Te Puna catchment areas, the Pirirakau Hapu Environmental Management Plan "Nga Taonga Tuku Iho" serves as an important reference into the aspirations of Pirirakau and the context in which they view the environment and the resource base it provides. The Waipapa Catchment, Te Puna Catchment, and the Extension areas are of equal environmental importance to Pirirakau. When assessing the state of the environment, parallel weighting is afforded to the cultural landscape and historical connection of Tangata (mankind), Ranginui (heaven), and Papatuanuku (Earth). Once full consideration has been given to the biodiversity of an area, and all matters physical, spiritual, animate and inanimate are deliberated, only then can Tangatawhenua apply the true attributes of Kaitiakitanga to any one area or situation in its restoration or enhancement. The Pirirakau rohe contains the areas of Te Puna, Minden, Poripori, Whakamarama, Plummers Point, Omokoroa, and Pahoia, through to Aongatete. The Pirirakau rohe is defined by its important geographical features and the relationship Pirirakau has with them. The Pirirakau rohe is bordered by two rivers, Te Awanui (Tauranga harbour) and the ridgeline of Te Hunga (Kaimai Ranges). Pirirakau have traditionally claimed manawhenua over the land and resources from the Wairoa River to the Waipapa River. However, overlapping interests and usage rights extended to the Aongatete River and continued to the top of the Te Hunga. Use rights also included the coastal and marine margins of the Tauranga harbour.

Land confiscation and the Te Puna/Katikati purchase in the 1860s were largely responsible for the alienation of Pirirakau from their tribal domain, leaving them with only small land grants mainly in the Te Puna area to sustain the Hapu. These acts of the Crown also limited the implementation of Kaitiakitanga. Subdivision and development have impacted severely on the terrestrial resources and cultural landscape, and water quality has taken its toll on the marine environments and Kaimoana. Taking all factors into consideration and applying historic knowledge, it would be our assessment that the state of the environment is **extremely poor**, and **underprivileged** in the weight awarded it by planners, consenting authorities, and many private land owners. Pirirakau have always supported meaningful environmental management and restoration whenever the situation permits, often leading the way in many community projects e.g. Waikaraka Estuary, Nga Tahatai and the restoration of Huharua Park and the Ongarahu pa site. Although there is commonality in the aspirations of both Tangatawhenua and local care groups, achieving best practice methods in the aid of environmental protection, restoration or enhancement can sometimes be difficult due to differentials in epistemology and cultural practice. This situation is evident when analysing the way in which members of the Pirirakau Hapu conduct their efforts toward pest management in the Kaimai/Whakamarama area, wherein deer and pigs are seen by the

majority as just feral pests. Notwithstanding their importance in the recreational sport of hunting, these two animal species fulfil a very important role in cultural practice in that they have played substitute for, if not completely replaced the harvesting of native species of bird and animals as a food source. Tangawhenua are highly reliant on these alternative food sources when catering for the multitudes at large gatherings such as Tangihanga, Unveiling and many other important events. The reliance has only increased over time as the financial stability of individual families and the economic base of the Hapu as a whole has decreased, more often do we see the meat destined for a Tangi go to a local family in need both Pakeha and Māori. This practice is known as manaakitanga, and is fundamental in our identity as a people. Therefore to have a balanced environment one must reciprocate. For example Pirirakau do not support the wayward use of toxins such as 1080 when attempting to eradicate pests, highlighting the collateral damage on the environment as unacceptable, yet maintaining a healthy relationship with the Department of Conservation, Environment BOP and Landcare Research. Several members of the Hapu are currently involved in two land Care Research projects in the Kaimai Forest Park between the Tahawai Clearing and the Wairere Falls. The first project is researching the interaction between small mammal pests (possums, rats, mice, stoats) and their food resources, and the other research project looks into the longevity of tuberculosis vaccination in wild possum populations. Both projects are expected to yield some good baseline data useful to care groups in both the upper and lower catchment areas. (Information is available from Landcare Research: Peter Sweetapple or Dan Tompkins). Hapu members also maintain leg-hold trap lines throughout the entire area of the seventeen hundred acre block of Māori land bordering the Kaimai Forest at Whakamarama. Pirirakau with the support of Ministry of Fisheries and the Customary Fish Committee are in the process of implementing a 186(a) Temporary Closure and Method Restriction on the gathering of Kukuroaroa (horse mussel) due to their depletion. Tangatawhenua have also been successful in an application to the Foundation of Research Science and Technology for major funding in aid of researching the environmental resilience of Tauranga Harbour and its ecosystems, and their services.

Pirirakau must applaud the determination and hard work of all the care groups in the catchment areas and will endeavour to offer ongoing support to their projects and inclusion into any Tangatawhenua initiatives that may be of interest. We must also thank Environment Bay of Plenty for their consideration and identification of the catchment areas as priority and acknowledge their support to the Hapu over the years.

APPENDIX 5

# ASSISTANCE PROVIDED BY ENVIRONMENT BAY OF PLENTY

Through their Sustainable Land Management and Biodiversity protection policies, Environment Bay of Plenty provides the following assistance to landowners managing environmental concerns on private land:

- Environmental management advice
- Resource support - aerial photos, maps, etc
- Financial support through grants (see below)
- Help in organising and implementing works
- Ongoing monitoring
- Legal protection of High Value Ecological Sites

This support has been successful throughout the region for the following reasons:

- It provides good incentives
- A clear partnership approach is required for implementing sustainable land management on private land
- Ongoing monitoring of sites ensures maintenance issues are identified and remedied at an early stage.

There has been strong demand for this service and at its peak this type of support enabled fencing of 30 km of stream and/or native bush a year in the Tauranga Harbour catchment. There are now 174 agreements to manage private land with most of these implemented in the last few years.

Environment Bay of Plenty offers grant rate funding for works with a high watershed or biodiversity benefit. For example a grant of between 25-75% is available for work associated with the following works:

- Protection fencing of native bush (terrestrial biodiversity)
- Protection of riparian margins (erosion control, stock exclusion, alternative water supply, restoration planting)
- Pest plant and animal control if required
- Forestry establishment
- Gully head erosion control
- Pole planting and other acceptable soil conservation practices

Grants are paid out upon completion of works and the signing of a suitable covenant to protect the investment of public money. This is an agreement to preserve environmental protection areas and other works that is registered against the title of the subject property. A range of options are available for formal protection, including:

- Conservation covenants
- Memorandum of Encumbrance

- Queen Elizabeth II National Trust Open Space Covenants
- Nga Whenua Rahui kawenata

Pest Plant Control

The Environment Bay of Plenty pest plant control programme is innovative and has made greater progress than any other region (John Mather, EBOP Senior Pest Plant Officer, pers. comm.). Within the next year, EBOP will be purchasing biocontrol agents for tradescantia, Californian thistle (two agents - one new), and a new agent for broom (the gall mite).

Environmental Enhancement Funding and other assistance under the Environmental Programmes scheme are available to assist landowners manage weeds on their properties.

Table 8: Biological agents for control of pest plants released in the Bay of Plenty to date (source: Environment Bay of Plenty)

| Host Plant | Biological Control Agent | Year | Number of Releases or Re-Releases |
|---|---|---|---|
| **Boneseed** | Leafroller caterpillar | 2007 | 1 |
| **Bridal Creeper (Smilax)** | Rust | 2006 (self-introduced) | Widespread |
| **Broom** | Psyllid | 1996 | 1 |
| | Broom Leaf Beetle | 2008 | 1 |
| | Broom Shoot Moth | 2008 | 1 |
| | Seed beetle | 1995 | 11 |
| **Buddleia** | Buddleia Leaf Weevil | 2006 | 2 |
| **Californian thistle** | Flea beetle | 1995 | 1 |
| | Green Beetle | 2008 | 1 |
| | Gall fly | 1997 | 2 |
| | Leaf feeding beetle | 1990 | 1 |
| **Gorse** | Colonial hard shoot moth | 2002 | 1 |
| | Pod moth | 1995 | 18 |
| | Soft Shoot moth | 1992 | 2 |
| | Spider mite | 1989 | 48 |
| | English Thrips | 1992 | 17 |
| | Spanish Thrips | 2002 | 2 |
| | Seed weevil | 1920s | Widespread |
| **Heather** | Heather beetle | 2001 | 4 |
| **Hieracium** | Gall midge | 2003 | 1 |
| **Mistflower** | Fungus | 1999 | 6 |
| | Gall fly | 2001 | 3 |
| **Nodding thistle** | Crown weevil | 1989 | 8 |
| | Gall fly | 1992 | 44 |
| | Receptacle weevil | 1972 | 100 plus |
| **Old Man's Beard** | Leaf fungus | 1998 | 8 |
| | Leaf miner | 1998 | 8 |
| | Sawfly | 2002 | 2 |
| **Ragwort** | Cinnabar moth | 1920s | 140 since 1990 |
| | Flea beetle | 1985 | 238 |
| | Seed fly | 1920s | ? |
| | Plume moth | 2006 | 3 |
| | Crown boring moth | 2007 | 1 |
| **Scotch thistle** | Gall fly | 2002 | 1 |

Pest Animal Control

The Regional Pest Management Strategy is a valuable tool in reducing the serious adverse effects that pest animals have on the natural environment and the economy. It is EBOP's role to coordinate and implement the strategy and to assist land occupiers to take an active role in managing pests on their land.
EBOP encourages this by providing pest management information through fact sheets, field-days, displays and advisory services
Environmental Enhancement Funding and other assistance under the Environmental Programmes scheme are available to assist landowners manage pest animals on their properties.

Environmental Education

Environment Bay of Plenty provides the following education and advice services:

- Biodiversity Protection

  - Preparation of a management plan for the protection of indigenous forest remnants and wetlands on farms.

  - Identify fauna and flora, including instream fauna, and demonstrate monitoring techniques

  EBOP also maintains educational fact sheets on pest plants and animals in Bay of Plenty on their website.

- Sustainable Land Management - Advice

  - Provide advice on maintaining optimum soil health, includes Visual Soil Assessment.
  - Provide advice on riparian protection.
  - Identify land use capability at farm level for maximum sustainable production.
  - Provide advice on erosion control for earthworks.
  - Provide advice on controlling soil erosion.
  - Advise on pest plant and pest animal control.
  - Provide a link between community land/coast/estuary care groups and farmers.
  - Provide advice on installing culverts or crossings, including fish passage requirements.
  - Provide interpretation of regional plans and rules.

- Technical

  - Farm planning.
  - Farm scale soil mapping and maps.
  - Support for Nutrient Management Planning and Overseer input/output training.
  - Support in relation to water use, supply, and development through national networks and specialists.

- Support for specific projects and research that require external funding support such as MAF SFF or AGS/PFSI.

- Environmental Education in Schools

  EBOP supports environmental education within schools through the Enviroschools programme, which integrates environmental education into the whole of school life, creating learning opportunities by working towards a healthy, peaceful and sustainable environment. EBOP also provides teaching resources for environmental issues associated with water quality and pest plants.

# RESTORATION MANAGEMENT GUIDELINES

## HUMAN RESOURCES

### Small Wins

Small wins reinforce a sense of achievement and reduce the apparent enormity of a restoration project, and the seemingly long distance to a restoration target. At a local scale, priorities have to be set on the basis of what can be achieved by community groups. At the same time, small wins can make a perceptible difference to the environment. Monitoring of the changes wrought by community groups produces a marketable product to sell to the community, which says "Look at where we were, look at where we are now".

Community initiatives snowball as the visual impacts of restoration activities become apparent, and community buy in to the project increases. For this reason, the best way to convince reticent community members to participate is to get on with the job where possible, monitor results of activities to generate a marketable product, and allow them to come to the table in their own time.

The best places to focus on to encourage community buy-in are those places already the subject of care group activities. Going with the energy and desires of a community keeps what has already been done relevant within the context of whole catchment management. If community enthusiasm grows sufficiently, new potential sites that could be the subject of new care activities are:

- areas in public ownership with or close to existing public access, or areas of private ownership where enduring commitment of landowners is already evident.
- areas in private ownership and areas in public ownership further from points of access, with landowner agreement and approval.
- key areas for attaining goals (e.g. middle reaches of the catchments).

### Community Buy-In

The community needs to engage with and act upon its guardianship role. Residents need to be given the opportunity to participate voluntarily in planning and implementation, and share in development of a restoration vision.

- Fulfillment of objectives will not be possible without participation of whole community.
- Strength of community contacts can draw people into projects.
- Benefits from community participation come in form of wide range of resources, not just volunteer time.

Landowners

Most landowners have a strong vested interest in sustainable management of their land and have the potential to become enthusiastic about protecting riparian sites and other places. However, some negotiation may be required as most farmers will become guarded about potential loss of grazing areas.

Periodic Detention Teams

Periodic Detention (PD) teams can be a valuable labour resource as one day's work by one team of twelve amounts to 96 hours of "free" labour. However there is a recipe for getting the most out of PD teams, which involves:

- Feed them up.
- Move through a diverse array of tasks through the day.
- Work with them.

PD team labour is a potentially useful resource if and when hand weeding needs to be done. Thanks to Kirsty Walker (Te Puna Estuary Managers) for this advice on PD Teams.

## PROTECTION AND ENHANCEMENT OF REMAINING INDIGENOUS VEGETATION AND HABITATS ON PUBLIC AND PRIVATE LANDS

**Protection of remaining indigenous vegetation and habitats is a high priority for biodiversity maintenance.**

Pest animals have detrimental impacts on a wide range of indigenous plants and fauna. Control or eradication of pest animals is necessary for the recovery of plant and fauna populations, and the restoration of healthy forest systems. This includes the effective control or removal of large browsers such as feral goats, deer, and possums, and particularly domestic stock. Protection and enhancement of populations of indigenous birds, lizards, and larger invertebrates also requires targeted control of rodents and mustelids, and perhaps cats. Indigenous habitats of high quality have:

- Greatest value as educational resource.
- Greatest opportunities for rapid restoration of indigenous biodiversity.
- Greatest restoration gains relative to input effort.
- These sites frequently have the lowest levels of invasion by pest plants. As such, they are the easiest wins due to the low propagule pressure exerted by local weed population, the low levels of competition and facilitation. The primary role of weed control is to curtail incipient invasions, and then cull individuals establishing from other sites within local metacommunity,
- Greatest biodiversity values.

## BIODIVERSITY MAINTENANCE AND ENHANCEMENT

Key elements of biodiversity maintenance and enhancement are:

- Improvement of existing habitat quality and ecological functions;
- Creation of new habitat for indigenous birds, insects, and plants;
- Fish habitat enhancement;
- Both achieved by riparian restoration.

## PEST PLANTS

- Find out which pest plants grow in the area.
- Survey weed invasions; GPS and map them if dealing with a large area.
- Decide what method of control is best.
- Photograph invaded sites before control and eradication gets underway.
- Start small, avoid creating large cleared areas.
- Work from smallest infestations to the largest in planned stages. Cleaning up small infestations first slows rate of weed invasion the most.
- Eradicate weeds before they flower and fruit.
- Plan disposal of weeds carefully if removing them manually. Take care not to spread fragments or seeds.
- Photograph invasion sites once weeds have been removed.
- Follow up with ongoing maintenance of sites from which weeds have been removed to maintain a high level of control, detect and deal with regrowth, or reinvasion, or replacement by other pest plant species. Monitor and photograph recovery of indigenous vegetation through time

Prioritisation for weed control can be based on:

- Impacts. Weeds with the greatest immediate impacts are vines and shade-tolerant shrubs that will continue to grow through the canopy
- Values being protected. Protecting existing indigenous vegetation, particularly mature forest and riparian margins, may be more important than the eradication of weeds in mixed indigenous-exotic scrub.
- Size of weed infestations. As a general rule the eradication of satellite infestations should come first.
- Biological considerations, i.e. removal of riparian weeds with water- or gravity- dispersed seeds or vegetative reproduction, should start upstream.

As a general rule, larger weed invasions should be left till last and this is certainly the case for pest plants that spread vegetatively or that have relatively low rates of reproductive output (reproduce vegetatively, or produce few seeds per plant per year or have gravity-dispersed seeds). However if large invasions are a significant seed source year-to-year (because they produce copious amounts of wind- or bird-dispersed seeds) consideration should be given to removing these first, to alleviate sites from the propagule pressure exerted by species whose colonisation and spread is primarily by seed dispersal and germination. Even so, it is usually best to work from the smallest to the largest infestations.

## PEST ANIMALS

Possums have detrimental impacts on vegetation and birds. Rats have detrimental impact on invertebrates, birds, and vegetation. Control of possums and rats is beneficial to indigenous plants and animals.

Possum control will be necessary in all restored and maintained areas, to protect vegetation. Possum control is relatively easy to achieve along riparian margins as these areas can be accessed and worked from adjacent farmland. Traps or bait stations can be attached to the riparian side of fence posts at spacings recommended by Environment Bay of Plenty best practice standards (typically 100 meters).

Possum control will also be necessary for bush blocks, in which case a grid of traps or bait stations can be set up at spacings of 100 meters or so, covering the entire area.

Rat control will not be necessary for establishment and maintenance of riparian vegetation, however any rat control will benefit indigenous fauna by reducing predation pressure. However, in key areas of forest, intensive rat control will be necessary if the restoration of indigenous bird and invertebrate populations, and the restoration of healthy forest processes is the aim. In this case, a grid of bait stations spaced at 50 meters or less should be established to cover the whole area. Baits such as Pindone, Ditrac or RatAbate can be used, and it can be beneficial to alternate between baits, to enhance control of rats averse to particular baits.

## FENCING

The fences used to protect indigenous habitats should be appropriate with respect to adjacent land use. The following guidelines are QEII National Trust recommendations:

- Setback areas between stream banks, road banks, and fence promote bank stability.
- The preferred fence type is the norm for the farm and one which the owner is willing to maintain.
- The wires should be on the outside (animals' side) of the posts and must be strained to prevent stock pushing through or over.
- An electric outrigger and/or barbed top wire can be a valuable addition to deter stock from pressuring a fence by reaching through or over.

- Battens are an optional extra preferred by most landowners, especially in the North Island.

Fenced areas should be maintained weed-free by periodic maintenance, either by landowners, or community groups or agencies. Responsibilities for ongoing maintenance should be established before fences are constructed.

## PLANTING

There are three critical components of revegetation success. The first is effective site preparation. The second is selection and planting of appropriate locally-sourced species. The third is ongoing follow up site maintenance. All three should be regarded as being equally important.

### Site Preparation

Site preparation aims to ameliorate the causal factors that underly the need for restoration. Typically these factors are the impacts of pest plants and animals, and preparation seeks to eliminate pests to enable revegetation to proceed.

Weed removal requires a combination of herbicide application, manual work, and follow up treatments to ensure elimination of target weeds has been achieved. Removal of target weeds from planting sites must occur before any soil is turned for planting. In many ways, the removal of weeds from a degraded site is a more significant component of revegetation than planting itself because, in some cases, it alone can achieve revegetation.

### Riparian Planting

Lower stature plants adjacent waterway, taller stature plants further back (ensure bank protection by maintaining vegetation boundary layer).

### Plants

Kanuka is ideal as it is light-demanding, drought tolerant, fast-growing, and relatively long-lived. It is also iconic in rural settings. Complement with fruit bearing shrubs, flower-bearing trees. Karamu is quick-growing, fruit bearing. Kohekohe is particularly valuable as autumn nectar resource. Puriri forms large trees on alluvial soils, valuable winter nectar source. Also produces berries consumed by kereru.

### Follow-Up Maintenance

Planting sites will require ongoing maintenance for at least 3-5 years. Ongoing maintenance is necessary to ensure that target weeds are completely suppressed, and new weeds eliminated at the planting site. Appropriate return times for maintenance work will depend on the invasion rates and growth rates of target weeds. These in turn are a function of proximity to weed sources and site openness. Initially return times for follow up control will be high, as open recently-disturbed sites are ideal for weed establishment and rapid growth. However, as planting sites mature the return time for follow up control will decrease, as canopy closure

reduces light levels at ground, reducing site suitability for some weeds, and reducing growth rates of others generally.

## FISH HABITAT ENHANCEMENT

### Habitat Restoration

The restoration and enhancement of fish habitat should focus on establishing stable in stream conditions (Richardson and Jowett 2005). This is achieved primarily by increasing energy dissipation during flood events, which helps prevent erosion and sediment transport. Restoring riparian vegetation, meanders, flood plains and flood plain vegetation in combination is the best way of increasing energy dissipation through an entire catchment. Riparian vegetation, meanders, and flood plains all reduce water velocity during high flows. This in turn reduces streambed erosion and stream bank scour. Although the reduction of water velocity during high flows minimises deleterious effects on habitat, the corresponding increase in water level can cause flooding (Richardson and Jowett 2005). River managers have traditionally removed riparian vegetation in an effort to decrease flood levels. However, the resulting increase in velocity often increases stream erosion, and it may flush fish downstream if no refuges exist (Richardson and Jowett 2005). Reducing overland flow and eliminating runoff from impermeable surface by increasing infiltration can also help to reduce flood velocities.

### In-Stream Habitats

The importance of cover for freshwater fish has been illustrated in a manipulation of a small stream known to be good habitat for inanga (Richardson 2002). All cover was removed from river banks, overhangs in river banks were cut back, and woody debris was removed from five stretches of stream. Five adjacent reaches were left in a natural state. The response of inanga was pronounced. Four times more inanga were found in the natural reaches compared to the cleared sections. Woody debris were particularly important because they helped create deep, slow-flowing pools, which are preferred inanga habitat.

### Inanga Spawning Sites

Most inanga spawning sites are found within 500 m of the upstream limit of the saltwater wedge. Inanga spawning sites need to be actively managed because very often a successful spawning ground may not stay in that state. Pastoral grasses may be overshadowed by willow, blackberry, and gorse, or overrun by weeds like old man's beard, tradescantia, Mercer grass, thistles, or *Glyceria*. Livestock can trample a site, and near roads and in urban areas, oil or chemical spills can kill the eggs.

Stream banks are often mown or grazed to stubble to ease water passage, but this also reduces their suitability for spawning. Potential spawning sites should be identified and managed appropriately.

Access to Habitats

Providing upstream access is an important means of increasing habitat for adult inanga as they have little climbing ability. Poorly-designed culverts can prevent access for many diadromous fish species.

Issue 46, as identified in the Regional Water and Land Plan: Activities in the beds of streams and rivers, including damming and diversion, can prevent the passage and migration of indigenous fish species. The following structures and activities can have adverse effects on fish passage and migration:

- Dams and weirs.
- Flood management structures, such as flood gates.
- Trash and debris racks.
- Groynes.
- Bank protection works.
- Diversion of water.
- Culverts.
- Fords.
- Dredging of the bed of a stream or river.
- Debris in the bed of a stream or river.
- Bridge and culvert aprons.
- Intake and outfall structures.
- Any structure in a stream or river that is not designed and installed to provide for fish passage.

Timing of Works

Any infrastructure works in waterways should be conducted in April-May-June, to avoid peak freshwater fish spawning and migration periods (Hamer 2007).

## LINKAGES

Linkages have many positive attributes with regards to restoring landscape scale processes. Linkages encourage the movement of indigenous fauna and the recolonisation of habitat patches by indigenous fauna may be facilitated by linkages. Dispersal of seeds by birds, increasing rain of indigenous seeds, resulting in indigenous species initiating successional sequences within riparian plantings, which then become self-sustaining, can also occur.

Using streams to link remnants through riparian corridors increases linkages between indigenous habitats in a manner synergistic with aims of restoring in stream fish habitats, riparian protection, and catchment protection.

# MONITORING - GENERAL PRINCIPLES

## METHODS

As alluded to above, a range of conventional and somewhat unconventional methods can be applied to monitoring. Most importantly, monitoring needs to be cost-effective within the context of the activities it is monitoring. NIWA is currently developing systems to monitor stream and riparian health and are considering a range of novel monitoring methods such as sieve trapping of invertebrates from stream surfaces to measure changes in numbers and diversity of invertebrates in restored streams, as one example of cost effective environmental monitoring.

The limits to monitoring methodology are imposed by four factors:

- The question of interest.
- The limits of our imagination.
- Our ability to analyse results in a meaningful way.
- Labour and time resources and other constraints.

Anything that is measurable and repeatable can become a successful monitoring protocol.

## HOW SHOULD MONITORING OCCUR?

**Guiding Principle: Are restored and managed areas attaining and retaining restoration goals?**

To know whether restoration activities are successful, you need to monitor. There are several steps in a monitoring programme, four of which occur before any data is collected.

**Typical Question: Are restored areas providing suitable habitat for indigenous species?**

Parameters for monitoring:

- Define success.
- Identify monitoring targets/performance indicators indicative of success.
- Design monitoring programme that can measure monitoring target. Establish at this stage how data will be analysed.
- Ensure that monitoring programme is feasible within time and cost constraints.
- Implement monitoring programme.
- Collect data.
- Analyse results.
- Assess results against monitoring targets/performance indicators.
- Communicate results to stakeholders.

Then modify management if targets are not achieved, or continue current management if this is demonstrated to be successful.

Much of the conceptual work needs to occur before the hard yards of data gathering. It is therefore worthwhile sitting down and carefully considering a monitoring programme before heading out to collect data. Poorly-designed "monitoring for the sake of monitoring" programmes are a drain on resources.

Well-designed monitoring programs are an integral component of all restoration projects. Monitoring can:

- Measure success of restoration activities.
- Provide a foundation for changes in management priorities.
- Be a foundation for further funding by demonstrating success.
- Detect invasion of new sites.
- Detect invasion by new pests.
- Detect changes in pest populations.

## MONITORING COMPONENTS OF CARE GROUP ACTIVITIES

- Weed control.
- Planting success.
- Bird numbers.
- Pest animals.
- Ecosystem functions and health.

Brief outlines of potential methods are set out below:

### Monitoring of Weed Control

Map weeds, systematically record their density and distribution. Re-map and record through time to evaluate effectiveness of weed control. Mapping can be catchment-wide, or can be undertaken site-by-site. Probably a combination of both is best, first to prioritise weed management effort, the second to assess the success of on-the-ground control activities.

Monitoring does not have to be overly-complex. For most purposes, a qualitative appraisal of weed density is sufficient if the aim of control activities is complete elimination of weeds from a site. Simple indices can be used to quantify density. Establishment of photopoints is an easy way of monitoring change in weed abundance through time.

Whatever method is used, the data collected should be capable of informing of the relative success of weed control activities.

Ongoing monitoring for weeds will be particularly important in riparian scrub and forest, as these areas retain high light environments and therefore remain susceptible to weed invasion.

Monitoring Success of Plantings

- Record numbers, species, and heights of plantings.
- Measure selected samples to record survival and growth rates.
- Take representative site photographs.

Monitoring Bird Numbers

- Periodic five-minute bird counts.
- Surveys for breeding activity.
- Monitoring of breeding success.
- Monitoring the causes of nesting failure.

Monitoring of Pest Animals

- Presence/absence of domestic stock.
- Trap catch rates for possums.
- Tracking indices for rats.
- Trap catch rates for mustelids.

Monitoring could be paired to measure effectiveness of pest animal control by comparing a site before and after control operation, or between controlled and uncontrolled sites.

Monitoring of Ecosystem Functions and Health

- Monitoring of invertebrates by conventional methods including pitfall, malaise and flight-intercept trapping, or hand collecting, alone or in combination, or by methods such as sieve trapping. The more trapping methods of invertebrates the greater the diversity of invertebrates trapped.
- Leaf decay rates in water.
- Riparian bank condition.

Sediment Transport

Need to establish baseline sediment transport rates to assess success of future catchment management. Easy access at road bridges at bottom of catchments, i.e. be able to calculate total sediment transported. As storm events may account for the bulk of sediment transport, monitoring programs measuring sediment transport will need to account for this. The Regional Policy Statement appears to stress the importance of this kind of catchment level monitoring, to measure the success of a catchment-wide management programme.

Pest Abundances

Rat tracking is a relatively simple and cost-effective way to monitor success of pest control operations targeting rodents.

Monitor Forest Health

Forest health can be monitored by assessing canopy condition, understory composition, fruiting, flowering, and seedling recruitment, as outlined below:

- Fruit availability

  If vegetation is healthy then there will be more fruit available than in unmanaged sites. Monitoring can be based on forest floor counts. Sample plots should be small and numerous, to spread workload and increase replication of sampling unit. Best used in a paired design but is also informative if applied as a time series at a single site.

- Flower density

  If vegetation is healthy then more flowers will be present than in unmanaged sites. Monitoring could be as simple as plot-based forest floor counts during flowering periods, recognising that there will be year-to-year seasonal influences. Keep plots small and numerous to spread workload and increase replication within a sampling unit. Best used in a paired design, but is also informative as a time series at a single site.

- Seedling density

  If a forest or patch is healthy then there will be a more diverse complement of seedlings in greater abundance than impacted areas, more indigenous species, and fewer exotics. Could be as simple as using plot-based forest floor counts, recording numbers and sizes (and species). Keep plots small and numerous to spread workload and to increase replication within a sampling unit. Best used in a paired design, but also informative as a time series at a single site.

  If impacts of seed predators are reduced then there will be more seedlings than in unmanaged sites.

Ecosystem Functioning

- Distribution of indigenous riparian vegetation. Simple mapping exercise, single response parameter, no statistical tests necessary.

- Shade on waterways. Qualitative assessment. Easy, but still need to include replication and analyse qualitative data (recorded in categories) to detect changes.

- Coarse woody debris in streams. Counts, estimates of size.

- Leaf litter decay rates in water. Quick and easy: easy to build replication and simple analysis, either in comparisons between sites or between years.

Recovery of Biodiversity Condition in Response to Care Group Activities

Establish paired sites, use one as a control, the other as the treatment site. Assess initial biodiversity condition for plants and/or animals. Continue to monitor through time and compare sites. The results can then be used to assess whether differences are the result of

care group activities. Might take several years to establish significant differences, but this would be a valuable tool for advocacy and education.

This type of monitoring could focus on plants, birds, or other fauna. Biodiversity or species richness for plants can be assessed on the basis of species lists generated for a range of small temporary plots distributed throughout a site. Different numbers of plots at different sites can be measured each year, so long as enough plots are located to take a representative sample of vegetation diversity. Ideally, same locations would be sampled though. Can calculate species density for area, compare species densities between paired areas, or establish time course of change.

Invertebrate trapping can be used to measure species richness. Methods need to be corrected for differences in sample size, and to allow direct comparisons between areas and years. Use best practice methods for biodiversity studies with regards question of interest, i.e. measuring abundance and diversity of ground fauna, including large flightless invertebrates pitfall trapping is appropriate, but to assess whether food supplies for say insectivorous birds have increased for example, other methods will be needed.

APPENDIX 8

# LIST OF AVIFAUNA

## INDIGENOUS

| Species | Habitat | Resident | Breeding |
|---|---|---|---|
| Banded rail | Wetland | Resident | |
| Black-backed gull | | Resident | |
| Kahu (harrier) | Pasture and forest | Resident | |
| Kahurihuri (pied shag) | Estuary | | |
| Kākā | Forest | Visitor | |
| Karearea (falcon) | | Visitor | |
| Kawau (black shag) | Estuary | | |
| Kereru | Forest | Resident | |
| Korimako | Forest | Resident | Breeding |
| Kotare | Pasture and forest | Resident | Breeding |
| Kuaka (godwit) | Estuary | Migrant | |
| Little black shag | Estuary | | |
| Matata (fernbird) | Wetland | Resident | |
| Matuku | Wetland | ?Resident | |
| Miromiro | Forest | Resident | Breeding |
| Paradise shelduck | Pasture | Resident | |
| Pipiwharauroa | Forest | Migrant | Breeding |
| Piwaiwaka | Forest | Resident | Breeding |
| Poaka (pied stilt) | Estuary | | |
| Popokatea | Forest | Resident | |
| Pueto (spotless crake) | Wetlands | Resident | Breeding |
| Pukeko | Pasture and wetland | Resident | Breeding |
| Red-billed gull | | Resident | |
| Riroriro | Forest | Resident | Breeding |
| Ruru | Forest | Resident | Breeding |
| Silvereye | Forest | Resident | Breeding |
| Spur-winged plover | | Resident | Breeding |
| Torea (pied oystercatcher) | Estuary | | |
| Torea (variable oystercatcher) | Estuary | | |
| Toutouwai | Forest | Resident | Breeding |
| Tui | Forest | Resident | Breeding |
| Welcome swallow | Pasture and Forest | Resident | Breeding |
| White faced heron | Pasture and estuary | Resident | |

## EXOTIC

| Species | Habitat | Resident | Breeding |
|---|---|---|---|
| Black swan | Wetlands and estuaries | Resident | Breeding |
| Blackbird | Throughout | Resident | Breeding |
| Eastern rosella | Forests | Resident | Breeding |
| Goldfinch | Rough pasture | Resident | Breeding |
| Greenfinch | Rough pasture | Resident | Breeding |
| Hedge sparrow | Rough pasture | Resident | Breeding |
| House sparrow | Pastures and urban areas | Resident | Breeding |
| Indian mynah. | Pastures and urban areas | Resident | Breeding |
| Mallard | River, wetland and estuary | Resident | Breeding |
| Song thrush | Throughout | Resident | Breeding |
| Starling | Throughout | Resident | Breeding |
| White-backed magpie | Pastures | Resident | Breeding |

# FEEDBACK FROM CARE GROUPS AND STAKEHOLDERS

## TE PUNA ESTUARIES MANAGERS INC.

1. *What is the aim of your group?*
   To restore and enhance Te Puna Estuary by protecting and enhancing biodiversity and conservation values through including and involving the whole community.

2. *What activities does it undertake?*
   Weed removal and planting of indigenous species. Mangrove removal. Monitoring of sediment, bird and pests.

3. *Where?*
   Jess Road wetland, Pukemanuka Pa and adjacent coastal margin of the Te Puna Estuary.

4. *How do you measure the success of those activities?*
   When the community rings you to tell you how bloody wonderful it is you know you are doing something right. When the worm turns - buy in by your biggest detractor. When the community puts their hands in their pockets. Getting more people for other activities. Seeing plants growing well. Unsolicited offers of support from the community. Increase in wading bird activity.

5. *What do you see as the restoration options and opportunities in your area?*
   Restoration of saltmarsh and hard-sediment (notably our Jess Rd project). Restoration of coastal margin with indigenous species.

6. *What are your key reference documents, and may we have a copy please?*
   Restoration plan for Te Puna Estuary. (Wildlands 2005)

7. *Are all opportunities being capitalised upon?*
   *1) in your area*
   No. Have more to do in the way of weed control or planting along the entire Te Puna estuary coastal margin. It is easier to attract people to planting events than it is to get volunteers for hand weeding, mangrove removal and burning, and spraying. It is easier to attract volunteer assistance with work easily visible (i.e. harder to get help to clear areas out of sight of many).

   *2) through the remainder of the catchment*
   EBOP/Landcare Trust have done an excellent job in helping establish, registering and supporting Tauranga Harbour Care groups. Our neighbours Waikaraka are role models. Omokoroa are keen and very active.

8. *What do you see as your responsibilities within the context of the management and restoration of Te Puna-Waipapa catchment?*
   Responsible for our area. Willing to work cooperatively and ensure all neighbouring areas are aware of our aims and initiatives.

9. *Where do your priorities lie, and why?*
   Mangrove removal and to return the estuary to something like the character it had 40 years ago. To achieve our aim which was established from community meetings and survey. (Refer Point 1)

10. *How do you think priorities should be set:*
    *1) within the Te Puna catchment*
    At the top of the catchment. Te Puna Estuary managers are the ambulance at the bottom of the catchment. Riparian planting with indigenous species along all waterways should be a priority.
    Priorities have to be set on the basis of what can be achieved by community groups.
    Priorities should lie in places that are
    - Close to volunteer resource.
    - Highly visible, to attract maximum buy-in and propel a snowball effect.

    *2) within the Tauranga region*
    We currently have 6-monthly Harbour Care group meetings. These could be expanded to include linking community action groups. The meetings to be of the same duration (approx) 2 hours with each group given a specific time allocation and asked to bullet point key activities and concerns. In that way an overall direction can be formed and priorities listed as they should fall out from the discussions.

11. *What do you see as key actions needed within the Te Puna-Waipapa catchments to ensure integrated protection of biodiversity and sustainable land use?*
    Communication between all environmental care groups of their aims and activities – so they gel.

12. *What would you need to ensure/guarantee the successful implementation of a catchment plan?*
    Give and take within the consenting process is critical.
    Continuity of contact within and between agencies is critical.

13. *What would be the best way* (*or ways*) *to ensure that resources invested in catchment management and restoration were not lost through time?*
    Volunteers get frustrated at having to jump through hoops set by full-time, paid, bureaucrats.
    By ensuring that projects gather support and community buy-in, provision of financial support is a big component of this.

14. *Do you have any cultural goals and objectives?*
    Happy to work with local iwi. We were very sorry to lose Peter Rolleston and are yet to find the correct current contact within Pirirakau.

15. *Why is the Te Puna catchment special? Is there any ecological reason why Te Puna-Waipapa should come first among catchments flowing into Tauranga Harbour?*
    As residents we are biased in favour of our area! It is special to us.
    The Jess Rd reserve has been formed as a result of the unnatural process of the harbour being dissected by a railway line. We look forward to its restoration.
    Pukemanuka Pa site is within our estuarine region.

**PEST FREE OMOKOROA**

1. *What is the aim of your group?*
   To create a healthy and diverse natural (especially native), environment through habitat restoration and the management of pests.
   Overall objectives of the group are to increase the native bird populations of Omokoroa Peninsula, reduce the rat population, provide safer nesting habitat for bird life, facilitate the establishment of appropriate trees and shrubs to provide year round food supplies for birds and encourage native regrowth, and to continue building support for the project through communication and engagement with the community.

2. *What activities does it undertake?*
   Bait-station based rodent control. Bait station network currently 380+ distributed around peninsula. Trakka monitoring, Bird counts

3. *Where?*
   Omokoroa Peninsula from tip to railway line.

4. *How do you measure the success of those activities?*
   On the basis of the numbers of baits removed from bait stations, which is approximately equal to twice the number of rats killed (two baits per rat), and by tracking tunnel monitoring of rodent abundance around the peninsula. Continuing bird counts show definite increase in both numbers and species. Observation of weta motels & the return of wetas.

5. *What do you see as the restoration options and opportunities in your area?*
   We see ours as a unique opportunity to develop a model for urban rodent control. There is no other urban model being used anywhere else.

6. *What are your key reference documents, and may we have a copy please? Andrew Jenks*

7. *Are all opportunities being capitalised upon?*
   *1) in your area*
   There are opportunities to attract more of the species that were here back to the peninsula. Opportunities exist for planting for bird food throughout the year, particularly in parks and reserves. We would like to see plantings for year round food supply for birds in reserves.
   Opportunities in Omokoroa are not capitalised upon. It is difficult to get doors open. Have to put submissions in. Local bodies have a tendency for our group to operate efficiently.

   *2) through the remainder of the catchment*
   Opportunities throughout the catchment are not yet capitalised upon. The project is too young. There are many dots that are not connected yet.
   Possibility of sponsored restoration of the Kaimai Range?

8. *What do you see as your responsibilities within the context of the management and restoration of Te Puna-Waipapa catchment?*
   To fulfill criteria outlined in our management plan. Promote birds, invertebrates, etc. Promote integration of biodiversity values and urban settings. Work with schools. Have a responsibility to preserve "The Ark" in our own backyard. It just so happens that our backyard is urban.

9. *Where do your priorities lie, and why?*
   The removal of the factor causing the greatest degradation – rodents.

10. *How do you think priorities should be set:*
    *3) within the Te Puna catchment*
    Get rid of the pests. Management of pests. Creating and maintaining a balance.

    *4) within the Tauranga region*
    To encourage the return of bird species and invertebrates by planting for year round food supplies.
    To encourage stream restoration.

11. *What do you see as key actions needed within the Te Puna-Waipapa catchments to ensure integrated protection of biodiversity and sustainable land use?*
    Development on the peninsula needs to be tailored and managed with regards increasing the linkage with the upper catchment.

12. *What would you need to ensure/guarantee the successful implementation of a catchment plan?*
    Continuity of funding.
    Agencies valuing the volunteer groups.
    Co-operation from landowners.
    Be willing to put finances in, the money has to come from somewhere and you can't expect volunteers to pay out of their own pockets.
    If you can't get 6K worth of operating costs per annum you cant guarantee ongoing support.
    Must be a freeing of bureaucratic impediment. Not all volunteers anticipate a post-retirement career in local-body politics.
    Free and open communication is essential.
    There must be a continuity of the labour resource.
    Must use and capitalise upon the knowledge and expertise that exists within the community. This saves both time and money.

13. *What would be the best way* (*or ways*) *to ensure that resources invested in catchment management and restoration were not lost through time?*
    Tap into organisations like Probus that are themselves ongoing.
    Tap into the schools that have a strong environmental program, and involve the kids. The area has large school populations.
    There is a demand from schools for involvement and assistance.
    Not lose sight of where you are heading. Have a body from which you can get answers and direction.

EBOP must be prepared to involve themselves/integrate/liase with the community. Agencies must work with the community, something along the lines of the Gullies project in Hamilton. Continuity of Agency involvement is an important component of success.
Must have clearly specified short and long term goals.
Targets and objectives must be specified and assessed in both the short and the long term.
Assess what is feasible in 5-6 years and set appropriate targets. It is amazing what can be achieved if those at the coal face can just get on with the job. Continuity of personal within agencies is important. Contacts within agencies need to be clearly designated. Change over in personnel should be part of the job description associated with community liaison roles.
Everyone involved needs a central point for liaison.
Meetings must be focused.

14. *Do you have any cultural goals and objectives?*

15. *Why is the Te Puna catchment special? Is there any ecological reason why Te Puna-Waipapa should come first among catchments flowing into Tauranga Harbour?*
Te Puna is special in terms of its Geographical location, the combination of shelter afforded by the Kaimai Range and the warming influence of the East Auckland current both enhance the quality of life for residents. Linkage with the Kaimai Range and the Harbour is valued by residents, who also identify with the wildlife in their backyards.
Te Puna is also special due to the rich historical background, right from the canoes, through the bush campaign, to the settlement today. Many places named for early settlers, some of whom played roles in significant historical events of Māori community, for example the Rev. Brown found Te Waharoa on the point.

## WHAKAMARAMA COMMUNITY INC.

1. *What is the aim of your group?*
To represent the residents of our district on issues of concern to them in accordance with our constitution; i.e.
**a.** To promote awareness and discussion of matters of interest to the residents of Whakamarama.
**b.** To represent the views of the residents of Whakamarama to the appropriate authorities.
**c.** To acquire information that is likely to be of benefit to the residents of Whakamarama, [this includes historical records, photos and recorded information from older residents, past and present.]
**d.** To take any actions the Organisation may from time to time consider beneficial to its members and the district.
**e.** To borrow or raise or give security for money in such manner as the Organisation sees fit.
**f .**To invest and use funds of the Organisation in any manner as it deems fit.
**g.** To do all such things as are incidental to the attainment of, or for the carrying into effect, the foregoing objectives.

2. *What activities does it undertake?*
- Environmental education and promotion.

- Survey our community and respond to their requests for action on issues, i.e. road safety issues, maintenance of rural character.
- Consult with, advise, submit opinion, request action and generally communicate with and lobby the local authorities and other N.G.O.s
- Fundraise.
- Hold meetings.
- Support community initiatives i.e. Friends of Puketoki pest control programme.
- Historical research, archiving and recording of heritage artefacts.

3. *Where?*
   The Whakamarama District has been defined as that area within the WBOPDC area defined as of rateable interest for the Whakamarama Hall, and outside that area where there is a direct or indirect effect on our residents. i.e. Roading access into town.

4. *How do you measure the success of those activities?*
   Success has been measured by:
   - feedback received at meetings , the AGM and committee meetings;
   - changes in policies or strategies as a result of submissions;
   - improved consultation with key agencies, for example quarterly meetings with CEO WBOPDC
   - feedback to members;
   - email responses and through the media etc.

5. *What do you see as the restoration options and opportunities in your area?*
   We see the following areas as being of key importance.
   - Ensuring the continuance of good work in Puketoki Reserve by Terry Edwards and the Friends of Puketoki
   - Planted Riparian strips on waterways in our area, making corridors linking harbour to KMFP
   - Protection of indigenous remnants in the area and providing assistance therein.
   - Access into KMFP, including 2WD vehicles into the "Blade".
   - Promotion of better pest control on private land in our area and in the KMFP.

6. *What are your key reference documents, and may we have a copy please?*
   Constitution
   Central KMSFP Recreational Users Survey and report
   WCI Submissions - BOP Conservation Management Strategy Review, specifically the Kaimai – Mamaku State Forest Park section. Various submissions to Councils over the past two years.
   WBOPDC District Plan, LTCCP and Annual Plan in 2008/2009
   EBOP Annual Plan and 10 year plan.

7. *Are all opportunities being capitalised upon?*
   *5) in your area*
   We are limited by the availability and enthusiasm of the residents of the district, their time, their commitment and their abilities.
   No, because we are also seriously limited by lack of vehicular access to the Blade, and no one is accepting responsibility for it.
   *6) through the remainder of the catchment*

There are various enthusiastic groups involved around the harbour edges and inland to the SH2. We know of no groups to our north [Esdailes Road] or immediate south [the Minden] To the West, DOC's inability to fund the pest control in KMSFP is a severe impediment.

8. *What do you see as your responsibilities within the context of the management and restoration of Te Puna-Waipapa catchment?*
   - To inform, educate, encourage and resource residents to undertake small care group projects. Projects presently include riparian fencing and planting and may include environmental monitoring in future.
   - To lobby local authorities to initiate the undertaking of and subsequent support of such projects.
   - To seek funding to facilitate such projects where they are not fully funded by said local authorities.
   - To have a more effective consultative role for issues affecting the District.

9. *Where do your priorities lie, and why?*
   Serve the community in as far as their expressed wishes are made known to us.
   We can only succeed with the support and co-operation of the existing residents.
   Therefore our key priority is to raise the level of Community awareness, enthusiasm and involvement for environmental issues and action.

10. *How do you think priorities should be set:*
    *7) within catchments*
    By way of consultation with the community, involving communication, education and motivation. This will need the input of EBOP, WBOPDC and DOC field staffers. There may be a need for a full and/or part time professional to assist in this stage.

    *8) within the Tauranga region*
    By EBOP in consultation with the concerned residents and affected stakeholders. There may be input from the full and/or part time professional as mentioned above.

11. *What do you see as key actions needed within the Te Puna-Waipapa catchments to ensure integrated protection of biodiversity and sustainable land use?*
    - An effective integrating strategy to maintain biodiversity and sustainable land use.
    - Ensure the involvement of neighbouring landowners by the Provision of incentives for land owners to undertake voluntary retirement and planting of their riparian strips without losing economic outputs on their properties.
    - Reduce excessive regulations for such fencing [9 wire fences??] and use more modern possibilities.[electric fencing]
    - Ensure subsequent monitoring of any such publicly financed retirements.
    - Wise legislation to prevent the development or continuation of unsustainable practices on rural properties.
    - Good consultation procedures in place prior to initiating activities or projects to be undertaken on land in which they have an ownership or neighbouring interest.

12. *What would you need to ensure/guarantee the successful implementation of a catchment plan?*

    More active, on the ground, field staff from EBOP and WBOPDC are needed, [such as the recent NZ Landcare district representative.] There currently seems to be too much emphasis in EBOP on revision and desk related tasks.

    Hopefully education and motivation will achieve the desired result of landowners coming on board with the protection of rural waterways.

    Greater efficiency with monitoring covenanted reservations on private land, by the use of a single monitoring body, rather than the current trend of each body monitoring separately and without inter agency consultation.

13. *What would be the best way* (*or ways*) *to ensure that resources invested in catchment management and restoration were not lost through time?*

    At the moment the only mechanism seems to be the covenanting of such projects to protect them long term. There is a body of antagonism against this with some. We believe there needs to be a simpler, cheaper, alternative mechanism that binds successive owners to continue with the ideology of protection of the environment that the project has encapsulated. This needs to be addressed through consultation with the landowners that we need to get on board, so that they embrace the projects concepts.

14. *Do you have any cultural goals and objectives?*

    We would very much like to have the full support of the local tangata whenua, and to make sure that all historic taonga and wāhi tapu are known to all, recognised and acknowledged in any projects that occur within our rohe. However, so far, requests for representatives to join our group have been unsuccessful.

    We have an active History group who are engaged in preserving the history of the District. They also wish to document the history and surviving route of the Leyland O'Brien tramway and have DOC assess remaining logging relics in the Kaimai Mamaku Forest Park. The tramway and associated milling remains form an iconic archaeological feature of the central Kaimai Mamaku State Forest Park.

    WCI is concerned that District residents are aware of the areas historical background and that it has a role in regional tourism and local education.

15. *Why is the Te Puna catchment special? Is there any ecological reason why Te Puna-Waipapa should come first among catchments flowing into Tauranga Harbour?*

    The Te Puna catchment is one of a number of significant waterways connecting the Kaimai Range and Tauranga Harbour.

    They are each significant because they are important representative systems that can be used to develop management approaches that can be applied across the range of catchment types in the Region. One should not forget that each catchment requires sufficient 'protection' and a knowledge bank that is adequate to maintain and enhance biodiversity and achieve sustainable development for primary producers.

    As a catchment Te Puna is significant because:

    - It is under threat from development and the intensification of rural land use, due to its proximity to the Tauranga City conurbation.
    - It is almost devoid of indigenous biodiversity. Puketoki Reserve is an iconic island of biodiversity, one of the best remnants of podocarp lowland forest remaining in the Bay of Plenty that is readily accessible to the Tauranga City population.

- It contains significant footprints of the Pirirakau people, including major trails between Bay of Plenty and Waikato.
- It is the major gateway to the KMSFP from the Tauranga area for trampers, hunters and mountain bikers.
- It contains an iconic mill tramway system and relatively protected remains of early 20th century mill operation.
- It is the site of a radical project to create a mainland island free of exotic pests, centred on the Puketoki Reserve.

APPENDIX 10

# POTENTIAL FUNDING SOURCES FOR CARE GROUPS

- Baytrust (Trustbank)
- Biodiversity Advice Fund
- Biodiversity Condition Fund
- BNZ Save the Kiwi
- Environmental Enhancement Fund
- Environmental Education Action Fund
- James Sharon Watson
- Lion Foundation
- Lottery Environment and Heritage
- Nature Heritage Fund
- New Zealand Water and Wastes Association
- NZ Community Trust
- Pacific Development and Conservation Trust
- Perry Foundation
- Ron Greenwood Environmental Trust
- Sargood Bequest
- Sustainable Management Fund
- TECT
- Tindall Foundation

APPENDIX 11

# OVERVIEW OF DESIRED COMMUNITY OUTCOMES WITHIN THE TE PUNA-WAIPAPA CATCHMENTS

| Community Outcome | What This Means | How Will We Achieve This? | We Know We Will Have Achieved This When | We Can Measure Progress by Monitoring Indicators Related to |
|---|---|---|---|---|
| **Riparian Management** | | | | |
| Increase catchment resilience to flood events | The frequency and extent of slips and streambank erosion decrease, and return to what are assumed to be natural background rates of erosion. | Riparian retirement, fencing (as appropriate) and planting, and ongoing suppression of weeds in riparian margins. Provision of appropriate stormwater retention and infiltration facilities in association with infrastructure. | All waterways have continuous riparian margins that are fenced as appropriate to adjacent land use. | Sediment transport, particularly during flood events.<br>Riparian vegetation. |
| Clean and clear waterways | Waterways have consistently high indices for clarity, | | Riparian restoration, erosion reduction associated with infrastructure has been achieved, and sediment, nutrient and faecal coliform inputs from productive landscapes to waterways have decreased. | Water quality, including turbidity and clarity, particularly at base flow. |
| **Tauranga Harbour** | | | | |
| Estuaries and beaches comprise coarse sandy sediment | Reduction in sediment transport from catchments and increase in sediment transport to harbour. | Riparian retirement, fencing (as appropriate) and planting, and ongoing suppression of weeds in riparian margins. | Riparian restoration, and erosion reduction within the catchment has been achieved, and mangroves in key areas have been removed | |
| Coastal environment is accessible for all to enjoy | Provision of access infrastructure, return of sandy sediment beaches and estuaries and removal of mangroves. | | Riparian restoration, and erosion reduction within the catchment has been achieved, mangroves in key areas have been removed, and appropriate access infrastructure (walkways and paths) have been provided. | |
| Protection and | Shellfish beds in sandbanks | Riparian retirement, fencing (as | Riparian restoration, and erosion | |

| Community Outcome | What This Means | How Will We Achieve This? | We Know We Will Have Achieved This When | We Can Measure Progress by Monitoring Indicators Related to |
|---|---|---|---|---|
| enhancement of kaimoana | around the harbour margin are not threatened by fine sediment. | appropriate), and planting, reduction in sediment input from development sites, mitigation of sediment sources associated with infrastructure. | reduction within the catchment has been achieved. | |
| Habitats for migratory wading birds are maintained and enhanced | Reduction in sediment transport from catchments and increase in sediment transport to harbour. | | Riparian restoration, and erosion reduction within the catchment has been achieved, and mangroves in key areas have been removed | Numbers of migratory birds using estuaries. |
| **Ecological Connections** | | | | |
| Increase linkage of mountains with sea | There are continuous or near-continuous corridors of indigenous vegetation linking the Kaimai Range with Tauranga Harbour. | Riparian retirement, fencing (as appropriate), and planting, and ongoing suppression of weeds and browsing animals within planted areas. | All waterways have continuous riparian margin that is dominated by indigenous vegetation and is weed free. Remnants of semi-natural and natural vegetation within the lower catchments have been restored and again function as habitat patches of indigenous vegetation for native birds. | Conspicuousness of indigenous birds in lower catchments.<br>Abundance and diversity of indigenous seedlings within habitat patches in middle and lower catchment. |
| **Indigenous Biodiversity** | | | | |
| Enhance and restore habitats for native fish | In-stream habitats enhanced and restored, impediments to migration removed | Riparian retirement, fencing (as appropriate), and planting, and ongoing suppression of weeds within planted areas. Survey of entire stream environments to locate and identify obstacles to migration, appropriate mitigation of obstacles on a case by case basis with landowner support. | All waterways have continuous riparian margin that is dominated by indigenous vegetation and is weed free. Poorly designed culverts that impede or prevent fish access are replaced or otherwise mitigated. | |
| Increase in native forest bird populations within the Te Puna-Waipapa catchment | Predators of native birds are controlled in key areas to facilitate recruitment and increase in native bird populations. Habitat | Predator control through trapping and/or poisoning. Habitat protection and enhancement through control of browsing animals (possums, goats) by | Indigenous birds become conspicuous within the Te Puna-Waipapa catchments. | Conspicuousness of indigenous birds within control areas |

| Community Outcome | What This Means | How Will We Achieve This? | We Know We Will Have Achieved This When | We Can Measure Progress by Monitoring Indicators Related to |
|---|---|---|---|---|
| | protection and enhancement throughout the catchment to encourage bird visitation and use. | shooting, trapping and/or poisoning, suppressing rodent populations if appropriate and desired, and through weed eradication and ongoing suppression. | | |
| **Infrastructure and Development** | | | | |
| Impact of infrastructure development on waterways reduced, eliminated or mitigated | Adequate provision of stormwater retention and infiltration facilities. | | Reported instances of erosion and sedimentation associated with heavy rainfall events in catchments with infrastructure development cease. | |
| **Sustainable Land Management** | | | | |
| Sustainable Land Use | Land use is sustainable from economic, environmental and social perspectives, in that it is both profitable and compatible with the full range of broader ecological goals identified by the Te Puna-Waipapa community. | Agricultural and Horticultural land use follows agreed best practice | Sediment, nutrient and faecal coli form inputs from productive landscapes to waterways have decreased. Indigenous forest remnants on private land are protected, with this protection in turn recognised, rewarded, and supported. | |
| **Recreation** | | | | |
| The Gateway role played by the Te Puna-Waipapa catchments is capitalised | Whakamarama Roadend is seen to be a primary point of access to the central Kaimai Range. | Provision of access infrastructure and amenities at head of Whakamarama road. State of Whakamarama Road itself is addressed | The access is well used, and enjoyed by all users. | Road end use. |
| **Cultural History** | | | | |
| The cultural history of Te Puna-Waipapa catchments is shared | Access to and interpretation of sites of cultural and historical significance throughout the catchment, as appropriate but particularly in the Upper Te Puna and Waipapa catchments that | Provision of appropriate recreational infrastructure and interpretation, restoration of some historical sites and artefacts in situ if appropriate. | Recreational infrastructure communicating the area's rich history has been established, and is being used. | |

| Community Outcome | What This Means | How Will We Achieve This? | We Know We Will Have Achieved This When | We Can Measure Progress by Monitoring Indicators Related to |
|---|---|---|---|---|
| | were not only the focus of the bush campaign and retain a tangible record of this conflict, but also retain relicts of land use during the pioneer phase following raupatu. | | | |