Ecosystem Services of Protected areas and Ecological Corridors within the Kaimai-Tauranga Catchments

TECHNICAL REPORT SERIES 2

Department of Conservation
Te Papa Atawhai

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Technical report series 2

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Abstract

This study focussed on the catchments that flow into Tauranga Harbour (not including Matakana Island), with a total catchment area of 123,539 ha. Most streams and rivers originate in the Kaimai Ranges, hence the study area is referred to as the Kaimai-Tauranga catchment. It includes parts of four ecological districts: Tauranga, Otanewainuku, Te Aroha, and Waihi. Indigenous vegetation and habitats in the coastal and semi-coastal zones are much reduced from pre-human times. Large tracts of indigenous vegetation remain inland on the Kaimai Ranges. Within the Kaimai-Tauranga catchment, nearly all remaining indigenous vegetation/habitats have been recognised as being of high value. Not all these areas are legally protected.

The study area is a population and commercial growth area, and the SmartGrowth Strategy was initiated and adopted by the three councils within the Western Bay of Plenty (Tauranga City Council, Western Bay of Plenty District Council, and Bay of Plenty Regional Council to manage that growth. The SmartGrowth Strategy acknowledges that environmental resources within the Western Bay of Plenty sub-region are finite and must be managed in a sustainable manner for future generations. The aims of the strategy include recognition that there is no further degradation of the environment, indigenous biodiversity is no longer under threat, and there is active enhancement and improvement. Increased land development can, however, have a range of adverse effects on indigenous biodiversity and high value habitats. Mitigation measures and incentives to address some of these effects are discussed.

The SmartGrowth Strategy has identified ecological corridors to protect some of the high value ecological sites, and to ensure that ecological processes remain functional and connected between the Kaimai Ranges and the sea. The currently proposed ecological corridors include an additional 5% (2,539 ha) of the study area that is not already legally protected. More ecological corridors may be required in the Tauranga Ecological District, to protect remaining high value sites. Some proposed ecological corridors need to be expanded to include a greater proportion of high value indigenous vegetation. Ideally, the need for ecological corridors should be assessed by sub-catchment, and there are still opportunities to protect high value sites in most sub-catchments. Major rivers and streams, and associated riparian vegetation, are particularly important for ensuring that ecological processes remain connected between inland and coastal high value sites, and also to protect water quality. Coastal habitats also warrant additional protection.

Retention (and establishment of) ecological corridors will protect more than just biological diversity. The study area provides a range of recreational opportunities, especially in the Kaimai Ranges. Most of these recreational assets are managed by the Department of Conservation. Ecological corridors and high value ecological sites also contribute to the economic well-being of the study area through ongoing provision of high quality ecosystem services. Ecosystem services are the renewable and non-renewable stocks of natural

resources and processes that support life and economic activities. Examples include soil retention and creation, water retention and purification, oxygen generation, air quality enhancements, and food and fuel provision.

Very few New Zealand studies of ecosystem services have been undertaken, and it is therefore difficult to accurately assess the value of these services within the study area. An overseas model was used to calculate an indicative economic value for ecosystem services. This model indicated that ecosystem services could amount to $NZ195 million per annum and could contribute about 5% of the sub-region's GDP annually. The value of potable water resources is a topical issue in many parts of New Zealand, and the study area is no exception, with many waterways providing high quality water to communities, landowners, and commercial enterprises. Some overseas and New Zealand examples of the economic value of water are provided.

Within the Kaimai-Tauranga catchment, one quarter of the land is managed by the Department of Conservation. Thus DOC-managed areas are a major source of ecosystem services, provide recreation opportunities, protect threatened species and high value sites, and are key components in the proposed ecological corridors and outstanding natural landscape features. Ongoing protection and enhancement of remaining natural values and resources will require the various land management agencies and the wider community to work collaboratively. Failure to do so will result in ongoing environmental degradation, and the loss of ecosystem services.

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1 Introduction

The western Bay of Plenty, including Tauranga City, is one of the fastest growing parts of New Zealand. These changes are being managed by 'SmartGrowth': a sub-regional, inter-agency planning initiative aimed at implementing managed growth within the SmartGrowth area. The expanding population within this area is concentrated into a relatively narrow strip of developed land that lies between the Kaimai Ranges and the Tauranga Harbour and the open coast.

Within the next twenty years further population pressure and land use issues are predicted within the SmartGrowth area, which includes the Kaimai-Tauranga catchment ('the study area'). Conservation efforts need to strategically align with and contribute to the social and economic policies of SmartGrowth and this can be achieved by proactive, long-term engagement with communities and providing information about "ecological services" provided by conservation lands. Ecosystem services include, but are not limited to, functions such as: the importance of forests in preventing soil erosion and maintaining water quality, the role of insects in pollinating crops, the relationships between wetlands and flood control, and the contribution of indigenous habitats to ecotourism.

This study summarises the natural values of the Kaimai-Mamaku catchment (the study area), and identifies actual and potential ecological corridors within it. It also assesses the relative economic, recreational and ecological benefits of conservation land and ecological corridors within the study area. Areas with high ecological value, but currently lacking legal protection, are identified, to ensure that those values are retained. An analysis is provided of the values of ecological services provided in the study area. Changing land use pressures that are likely to occur in the study area in the next 20 years or so are discussed. Incentives to maintain those services, the roles and responsibilities of stakeholders and land management agencies are summarised. Recommendations are provided for future management, in terms of inter-agency approaches.

2 Project Scope

This report on the Ecosystem Services of DOC land parcels and corridors within the Kaimai-Tauranga Catchment: seeks to address the following question:

"What are the priority sites and/or corridors for protection and restoration efforts within the Kaimai-Tauranga Catchment to promote long term ecosystem resilience and multiple benefits for the area's communities?"

The study area includes all catchments that flow into Tauranga Harbour. Most streams originate in the Kaimai Ranges, hence this wider catchment is referred to as the Kaimai-Tauranga catchment. The study area extends from just south of Waihi Beach east to the crest of the Kaimai Range. It follows the Range crest south to just north of State Highway 5 and from there angles towards Tauranga City, and includes the coastal area just south of Tauranga City. The Kaimai-Tauranga catchment, and the sub-catchments included in the study area is shown in Figure 1. The scope of this project includes:

- Identification of existing and potential "ecological corridors" within the study area;
- Identification of demands and pressures on the study area that will either increase or decrease as a consequence of SmartGrowth.
- Investigation of the relative economic, recreational and ecological benefits that DOC-administered land and vegetation corridors, and habitat corridors have within the Kaimai-Tauranga catchment.
- Investigation and quantification (in dollars) of ecological services provided within the study area, and relative values of the DOC land parcels and the existing, identified, and potential "corridors" within the Kaimai-Tauranga Catchment.
- Discussion of incentives to ensure ecosystem services are maintained and the importance of inter-agency and community "buy-in" and understanding.
- Recommendations for future management in terms of inter-agency approaches.

3 Methods

- Existing hard copy information on natural areas was collated and evaluated (refer to the references section for key information sources).

- Relevant digital data was compiled and evaluated, particularly data layers previously prepared for the evaluation of ecological constraints in the Smart Growth area by Wildland Consultants Ltd in 2003.

- Ecological features were mapped, including waterways, recommended areas for protection (Beadel 2006, Wildland Consultants 2008), significant ecological features (as per the Western Bay of Plenty District Plan), significant sites in the coastal marine area (as per the Regional Coastal Environment Plan and Wildland Consultants 2006), protected natural areas (covenants and land administered by the Department of Conservation), and other examples of indigenous vegetation and habitats.

- Actual and potential ecological corridors were identified using the above information.

- Ecological values, services and benefits associated with the proposed corridors were identified. Ecosystem services were estimated by applying the values obtained by Costanza *et al.* (1997) to land cover classes in the study area.

- Existing incentives for conservation protection and enhancement were identified through a literature search.

- Recommendations to promote inter-agency and community "buy-in", an environmental care ethic, and future inter-agency collaborative approaches were considered.

4 Ecological Context

The study area includes the entire watershed that flows from or through the Kaimai-Mamaku Conservation Area into Tauranga Harbour (thus Matakana Island is not included) (refer to Figure 1). The boundaries of the catchments and sub-catchments were defined using the River Environment Classification system (Snelder *et al.* 2004). The total study area comprises 123,539ha, and includes parts of four ecological districts: Tauranga, Otanewainuku, Te Aroha, and Waihi (refer to Figure 1).

Otanewainuku Ecological District

Approximately 60% (74,146 ha) of the study area lies within the Otanewainuku Ecological District. This ecological district extends across the coastal, semi-coastal, lowland, and montane bioclimatic zones and encompasses *c.*191,793 ha. The main characteristics of the ecological district are dissected ignimbrite plateaux with incised gorges. The few physiographic variations are due primarily to differing age of ignimbrites, local andesite outcrops, and minor rhyolitic domes.

Protected Natural Areas with formal legal protection (e.g. Scenic and Recreation Reserves) are relatively extensive, comprising 44,743 ha or 23.4% of the Ecological District. A relatively large proportion of these protected areas are in the lowland bioclimatic zone, with 46% of the zone legally protected. By comparison, the semi-coastal bioclimatic zone is under-represented in the existing reserve system, with only 8.9% protected overall.

Tauranga Ecological District

Approximately 27% (33,583 ha) of the study area lies within the Tauranga Ecological District. The Tauranga Ecological District encompasses *c.* 86,897ha in coastal and semi-coastal bioclimatic zones between Otamarakau in the east and Waihi Beach in the west. It includes Tauranga Harbour, Maketu Estuary[1], Waihi Estuary[1], Matakana Island[1], coastal dunes and plains, and the low rounded hills of the Western Bay of Plenty lowlands. Much of the original forest cover was destroyed by early Māori, with extensive wetland drainage following European arrival. As a consequence, relatively little indigenous vegetation remains in the Ecological District except for around the margins of Tauranga Harbour. Both freshwater wetlands and terrestrial ecosystems have been severely depleted. There are very few protected areas, and most are small. Most indigenous remnants left in Tauranga Ecological District are degraded by weed invasion but are still of ecological significance, even those of small size.

[1] Maketu Estuary, Waihi Estuary and Matakana Island are not situated within the Kaimai-Tauranga Catchment.

Estuarine wetlands are still relatively extensive around Tauranga Harbour despite considerable human modification by infilling, draining, clearance, and grazing. Freshwater wetlands extend inland of the estuarine wetlands at various locations on the harbour margins. Freshwater wetlands have been reduced considerably: from their estimated former extent in 1840. Of more than 10,000 ha only *c.*7% remain, and most are small and highly fragmented, with exotic species prominent, particularly willows. Freshwater wetlands covered approximately one-eighth of the Ecological District in 1840, but they now cover less than 2%.

Indigenous sand dune vegetation has also been subject to considerable human modification, although some good quality examples still remain. It has been estimated that indigenous vegetation on sand dunes has been reduced to less than 10% of its original extent (Wildland Consultants 2000b).

Apart from dunelands and the margins of Tauranga Harbour, relatively little indigenous vegetation remains on flat or low relief land. Only 0.6% of land in the coastal zone and 1.2% in the semi-coastal zone is currently protected (SmartGrowth 2007).

Te Aroha Ecological District

Approximately 11% (13,953 ha) of the study area is included in Te Aroha Ecological District (35,368 ha). In geological terms this Ecological District is part of the Coromandel Range. The climate and biota is mostly semi-coastal and lowland, with a strip of montane forest on the crest of the Kaimai Range. A study in the late 1980s found that most of the indigenous vegetation in the semi-coastal zone (i.e. below 200m, along the fringes of the Kaimai-Mamaku Forest Park) was present only as minor remnants comprising much less than 10% of their former extent and some types were not represented in protected areas at all (Humphreys and Tyler 1990). In comparison, about 15% of the lowland zone and 30% of the montane zone are currently legally protected.

Waihi Ecological District

Waihi Ecological District extends south from Whangamata to Waihi Beach, and includes *c.*1.5% (1,814 ha) of the study area (at its northern end). A band of hills forms a narrow coastal zone, with extensive semi-coastal, lowland and montane bioclimatic zones inland. Orokawa Scenic Reserve at Waihi Beach represents about 10% of the former extent of coastal forest in the Waihi Ecological District, and elsewhere in the coastal zone only small remnants remain (Humphreys and Tyler 1990). There are also only small remnants of semi-coastal forest.

Figure 1. Watercourses and catchments of Kaimai Range

Figure 1: Kaimai-Tauranga study area showing water catchments and ecological districts.

5 SmartGrowth Strategy

The SmartGrowth Strategy was initiated and adopted in May 2004 by the three Councils (Tauranga City Council, Western Bay of Plenty District Council and the Bay of Plenty Regional Council, previously known as Environment Bay of Plenty) that administer the Western Bay of Plenty. The Strategy was proposed after the community and tangata whenua raised concerns about continued rapid population growth, and the lack of leadership and coordinated planning to manage that growth. The strategy was revised in 2007 (SmartGrowth 2007) and is a significant document as it has resulted in a sub region-wide response to growth management. The Strategy has an outlook to 2051, providing a context for considering decisions and how they may affect the welfare of coming generations.

The focus of SmartGrowth is primarily important infrastructure-related issues such as the location of housing and employment and their impacts on transportation networks, and the need to protect versatile land resources that provide a strong base for the region's economy. It has also highlighted the need to address areas that have not traditionally been part of growth management in the sub-region, such as the development of resources by tangata whenua, strengthening the position of families, and the provision of affordable housing (SmartGrowth 2007).

The SmartGrowth Strategy acknowledges that environmental resources within the Western Bay of Plenty region are finite and must be managed in a sustainable manner for future generations. The Resource Management Act 1991 also places an emphasis on protection of significant natural and physical resources in the formulation of district or regional plans (SmartGrowth 2007). The stated vision for indigenous biodiversity and the environment is:

> "*Indigenous ecosystems (including estuaries, forest, wetlands, dunelands, streams and key ecological linkages) and species are highly valued and are an integral part of the landscape. Key habitats are in good condition, with healthy functioning ecological processes, and they are managed on a sustainable basis. Tauranga Harbour, the coastline, and other key ecological features have retained high levels of naturalness. There is ongoing enhancement of indigenous biodiversity*."
>
> (SmartGrowth 2007)

Specifically:

- There is no further degradation of the environment, indigenous biodiversity is no longer under threat, and there is active enhancement and improvement.
- The indigenous and statutory right of tangata whenua to exercise kaitiakitanga over taonga, which includes the retention of land in tangata whenua ownership.

- The outstanding landforms of the Tauranga Harbour, Mauao, and the Kaimai and Mamaku Ranges are maintained and enhanced.
- The quality of the sub-region's water resources (including harbours, estuaries, rivers, streams and aquifers) is improved.
- The quality and quantity of the sub-region's fisheries, indigenous plants and animals are improved.
- A successful balance between the use, development and protection of the coastal landscape has been achieved.
- Cultural heritage resources have been protected and enhanced.
- The visual integrity of important landscape features has been protected, including ridgelines and other key landforms.

Issues that have been identified by SmartGrowth as being of particular importance include the scarcity of indigenous ecosystems, particularly on the coastal plain and along the harbour edge, the importance of protecting remnants and restoring degraded areas, and the importance of preserving the natural character of the Tauranga Harbour (SmartGrowth 2007). Key environmental issues facing the sub-region include the loss of wetlands, and growing pressure on the marine environment from recreation, commercial activity, aquaculture, and coastal development. Sustainable development initiatives to address these issues are required at a regional level.

The SmartGrowth Strategy assumes that restraining the scale or rate of growth is not a practical option in many parts of the Western Bay of Plenty (Figure 2) but that it will be appropriate to constrain development in specific areas to protect important natural, physical, or cultural features. Policies outlined in the Strategy relevant to the natural environment and biodiversity have been summarised in Appendix 15.1. SmartGrowth has adopted a three-tier system for assessing the significance of relevant features, as follows:

Significance	1	2	3
For protection	Highly significant	Moderately significant	Not significant
For development	Highly constrained	Moderately constrained	Not constrained

A previous report (Wildland Consultants 2003) outlined ecological constraints to further development within the SmartGrowth study area. Figure 3 is a reproduction of one of the key figures from that report.

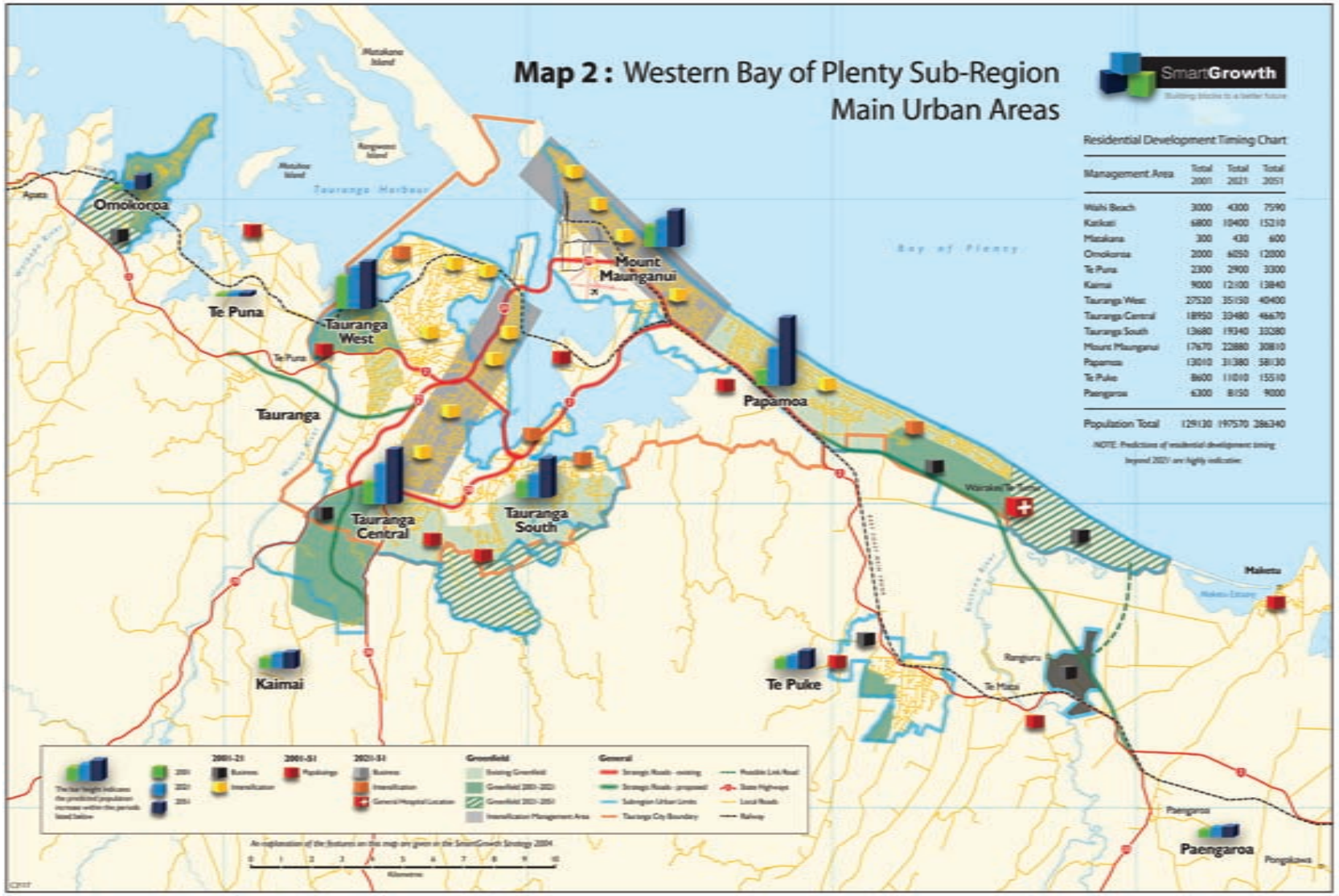


Figure 2: SmartGrowth strategy, expected growth areas and transport infrastructure for residential (Map 2) and industrial development (Map 3). Reproduced with permission from SmartGrowth (2007).


Map 3 : Business Land Staging Plan
SmartGrowth
Building blocks to a better future
Business Land Staging Plan
Growth Management Area Location
Land Available for Development Start Date
Additional Zoned Capacity (ha usable) by 2021
Additional Zoned Capacity (ha usable) by 2051
Katikati | Katikati | 2005 | 40ha
Omokoroa | Omokoroa (South of railway) | 2007 | 40ha
Te Puna | Te Puna Station Road | 2008 | 30ha
Tauranga West | Tauriko | 2008 | 150ha
Tauranga Central | Pyes Pa | 2006 | 15ha
Papamoa | Papamoa East - Wairakei (Stage 1) | 2008 | 120ha
Papamoa | Papamoa East - Te Tumu (Stage 2) | 2021 | | 100ha
Te Puke | Te Puke | 2008 | 50ha
Paengaroa | Rangiuru (subject to Eastern arterial timing) | 2007 | 150ha | 100ha
Subregional | To be determined (refer 7.2.4 Action 4)
Waihi Beach
Island View
Athenree
Tahawai
Te Aroha
Bay of Plenty
Tauranga Harbour
Matakana Island
Katikati
2005 (40ha)
Aongatete
Omokoroa
2007 (40ha)
Te Puna
2008 (30ha)
Tauranga
Tauriko
2008 (150ha)
Pyes Pa
2006 (15ha)
Wairakei
2008 (120ha)
Te Tumu
2021 (100ha)
Maketu
Little Waihi
Te Puke
2008 (50ha)
Rangiuru
2007 (150ha)
Paengaroa
Pukehina
Pongakawa
Waitaruna
Mount Maunganui
Omokoroa
2007 (40ha)
Indicative Date Land Available
Capacity (ha)
2001-21
Business
Intensification
2021-51
Business
Intensification
General Hospital Location
Greenfield
Existing Greenfield
Greenfield 2001-2021
Greenfield 2021-2051
Intensification Management Area
General
Strategic Roads - existing
Strategic Roads - proposed
Subregion Urban Limits
Tauranga City Boundary
Possible Link Road
State Highways
Local Roads
Railway
An explanation of the features on this map are given in the SmartGrowth Strategy
0
5
10
15
20
Kilometres

6 Protected and Unprotected Natural Areas

Natural areas in the Kaimai-Tauranga catchment have been identified and assessed in a number of reports and studies. Findings from these reports are summarised below and the sites are mapped in Figures 3 to 6. Data from these reports are used in the analysis of natural values provided in Section 8 below.

6.1 CATEGORY ONE NATURAL HERITAGE SITES

Environment Bay of Plenty previously commissioned Wildland Consultants Ltd to compile, assess and identify sites that were the most significant natural heritage sites, and where there were obvious management threats (Beadel & Shaw 2000). Ecological districts, landforms, and bioclimatic zones were used as evaluation frameworks.

Category One sites are the best quality or only remaining representative examples of indigenous vegetation or wildlife habitats on particular landform units within each bioclimatic zone in an ecological district. They contain some of the largest, best quality, or only remaining examples of indigenous vegetation or wildlife habitat. They also include intact altitudinal or geographic sequences that extend across an ecological district, or diverse assemblages of landform units, vegetation, and bioclimatic character (Beadel & Shaw 2000). These areas are mapped in Figure 5.

This work has since, in part, been updated in a report on natural areas in the Tauranga Ecological District (Wildland Consultants 2008).

6.2 AREAS IDENTIFIED AS ECOLOGICALLY SIGNIFICANT IN COUNCIL PLANS

6.2.1 Bay of Plenty Regional coastal Environment Plan

The Bay of Plenty Regional Coastal Environment Plan (RCEP) was developed in the 1990s and became operative in 2003. Chapter 6 of the RCEP identifies Significant Areas of Flora and Fauna. Three categories of sites were included: Coastal Habitat Preservation Zone (CHPZ), Significant Sites in the Coastal Marine Area (SSCMA), and Sites of Significance on Land (SSL).

The underlying resource document was updated in 2006 and natural areas in the coastal marine area were described and categorised as being either nationally, regionally, or locally significant. The relative significance of each site has been assessed using the Bay of Plenty Regional Policy Statement heritage criteria (Wildland Consultants 2006).

Sites within the study area include intertidal and freshwater wetlands on margins of Tauranga Harbour, and intertidal and subtidal parts of the harbour (refer to Figure 5). Tauranga Harbour was divided into key ecological zones which were each assessed separately. However, if considered as a whole, Tauranga Harbour would rank as being 'nationally significant' (Wildland Consultants 2006).

6.2.2 Outstanding Natural Features

In order to inform the Regional Policy Statement the Bay of Plenty Regional Council commissioned various reports (Boffa Miskell Limited 2006, 2009) to identify outstanding natural features and landscapes. Tauranga City Council has similarly identified such features in both the operative District Plan (Tauranga City Council 2009c) and the Proposed City Plan. Outstanding natural features are mapped in Figure 4 and include the entire coastal zone and inland areas such as the Kaimai Ranges, Papamoa Hill, and culturally and ecologically important sites such as Mauao (Mt. Maunganui).

6.2.3 Western Bay of Plenty District Plan

The Western Bay of Plenty District Plan was notified in July 1994 and included a schedule of 240 Sites of Ecological Significance (SES). This schedule has since been revised (Wildland Consultants 2005b). These areas are mapped in Figure 5.

6.2.4 Tauranga District Plan

The operative Tauranga District Plan (Tauranga City Council 2009d) also identifies Sites of Ecological Significance (SES) and the Proposed Tauranga City Plan (Tauranga City Council 2009b) identifies Special Ecological Areas (SEA). These are included in Sites of Ecological Significance in Figure 5.

6.2.5 Areas Identified as Ecologically Significant in the SmartGrowth Strategy

The SmartGrowth Strategy identifies areas of high ecological significance where further development should be constrained. It also identifies degraded areas that could be restored or provide linkages to high value areas. The areas most suitable for development tend to be rural/pastoral, or already partially developed. The SmartGrowth strategy identifies areas as 'highly ecological significant', 'moderately ecological significant', or 'not significant' (refer to Figure 3).

Areas of high ecological significance are those with remaining indigenous vegetation and habitats, including harbours, wetlands, freshwater streams and rivers, remaining areas of indigenous vegetation and protected areas. Within the study area, this includes Tauranga Harbour and its margins.

Areas of moderate significance are degraded natural areas with restoration potential, vegetation comprised of a mixture of indigenous and exotic species, and degraded drainage systems. Example areas within the study area include rivers and streams.

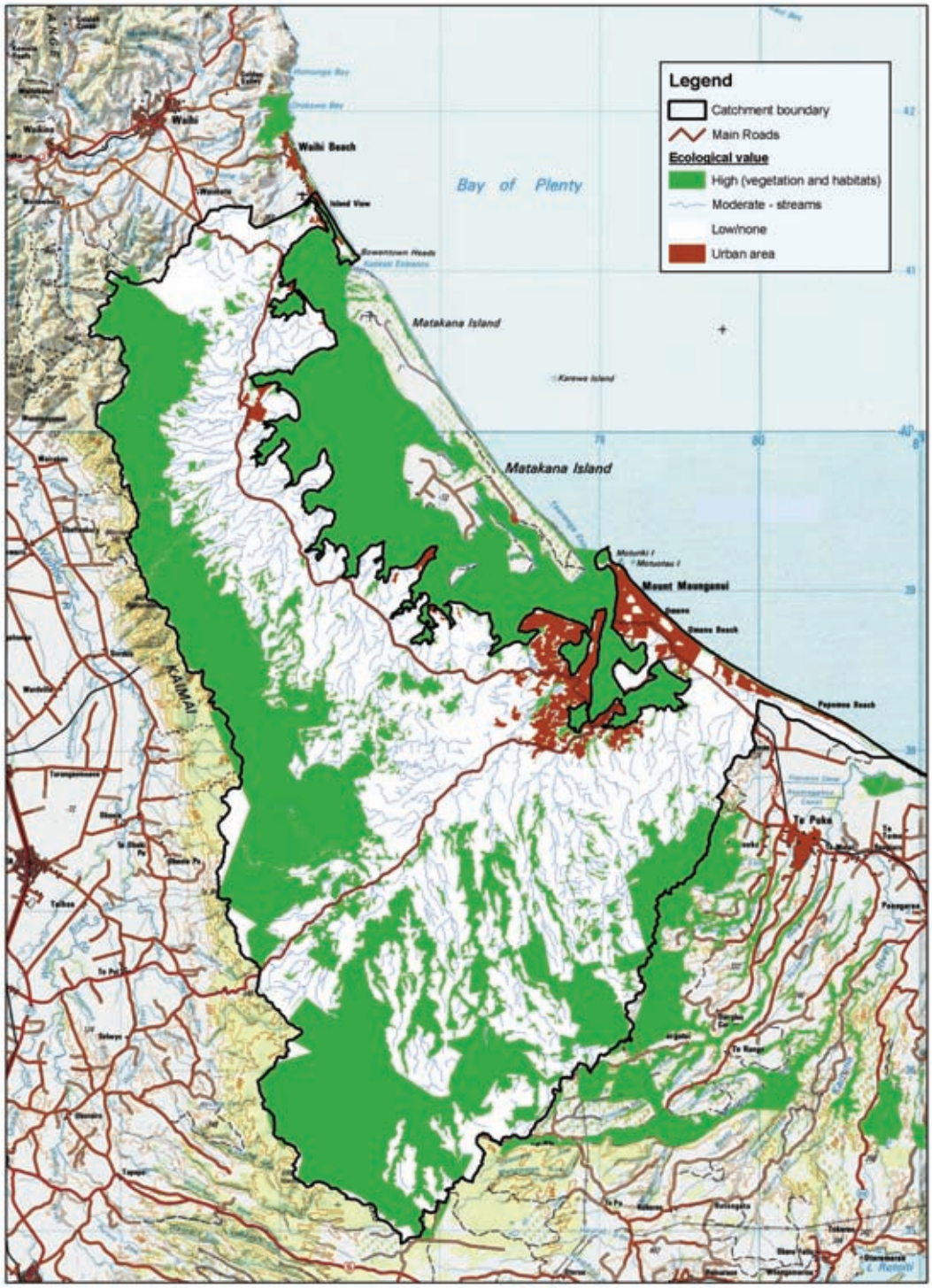


Figure 3. Areas identified as ecologically significant in the SmartGrowth sub-region, western Bay of Plenty

Figure 3: Areas identified as being ecologically significant in the SmartGrowth subregion, western Bay of Plenty.

Priorities for protection include the water quality and ecological and landscape values of Tauranga Harbour, and of stream corridors leading to the harbour. Increased emphasis needs to be placed on the restoration of degraded habitats as a means of offsetting the impact of anticipated growth pressure. Priority areas for restoration are:

- Kaituna estuary from the 'Cut' to the ocean at Maketu Township.
- Harbour edge wetlands.
- Freshwater wetlands.
- Wairoa River valley.
- Indigenous vegetation on dunelands.
- Key ecological linkages along rivers and streams.
- Mt Maunganui-Mauao.
- Kopurererua River Valley.
- Waimapu River Valley.

6.2.6 Ecological Corridors

The identification of ecological corridors is a key component of the SmartGrowth strategy (SmartGrowth 2007). Ecological corridors do not have to be linear and and/or physically connected, just close enough that plants and animals can disperse along them (Hilty *et al.* 2006; Wildland Consultants 2007a). SmartGrowth identifies the protection of key ecological corridors as being important and prioritises the protection of the water quality and ecological and landscape values of Tauranga Harbour including protection of stream corridors linked with the harbour.

SmartGrowth also notes that increased emphasis needs to be placed on the restoration of degraded habitats as a means of offsetting the impact of growth pressure. Priority areas for restoration within the study area are: harbour-edge wetlands, freshwater wetlands, Wairoa River valley, dunelands, key ecological linkages along rivers and streams, Mauao, Kopurererua River valley and Waimapu River valley.

A number of studies have been undertaken in the wider region to identify ecological corridors using somewhat different approaches. Sixteen ecological corridors have been identified to date (Figure 4).

Environment Bay of Plenty (2006) identified six ecological corridors within the Tauranga Harbour catchment. These corridors focussed more on opportunities to create potential links, than on identifying and linking remaining remnants. Corridors and potential corridors were identified as networks of significant natural areas that were adjacent, linked, or nearby and each corridor was evaluated using nine criteria: size and shape, representativeness, natural diversity, rarity, naturalness, long term viability, buffering and surrounding landscape, fragility and threat, and community support. The corridors were then ranked (i.e. relative priorities were assigned), based on the representation of "viable examples of all species and ecosystems in a given area" (Environment Bay of Plenty 2006).

In addition, ten ecological corridors were identified, described, and mapped for the area outside the Tauranga Harbour catchment (Wildland Consultants 2007a). The focus was to identify and link remaining remnants and capture habitats and vegetation types with high ecological values.

All 16 of the potential corridors were prioritised, based on relative ecological values, as set out below (Wildland Consultants 2007a, 2007b). Corridors entirely or partly within the study area are shown in italics.

Highest Priority Corridors Overall

The following corridors contain good quality or threatened vegetation and habitat types that are nationally or locally uncommon:

- *The Coastal Corridor* (including Matakana Island);
- *Margins of Tauranga Harbour (including Aongatete-Waipapa).*

Second-Priority Corridors Overall

Level 1

These corridors contain large areas of indigenous forest in the inland part of the corridor, a good diversity of ecological units and habitat types including riverine/stream habitats, most have freshwater and estuarine wetlands in the lower reaches, and restoration of corridors would create additional cross-linkages to other significant natural areas or ecological corridors.

- Kaituna (including Maketu Estuary);
- Mangorewa;
- *Papamoa Hills;*
- *Hidden Gorge.*

Level 2

All of these corridors connect to Tauranga Harbour with high values in the parts of Tauranga Harbour that they connect to.

- *Work Road;*
- *Te Puna;*
- *Tuapiro;*
- *Otawa.*

Level 3

These corridors will require more effort and resources to achieve ecological restoration but provide valuable linkages to other higher value corridors. The Waitahanui corridor is an entire catchment (located east of the current study area).

- Waitahanui;
- Raparapahoe;
- Ohineangaanga;
- Waiari.

Longer-Term Priority Corridors

These are corridors with large proportions that are highly modified and will require significant investment to restore functional corridors. For these reasons, and because there are much higher priorities elsewhere in the SmartGrowth project area, it is best to regard these corridors as being much longer-term issues, to be addressed when opportunities and resources allow.

- *Inland Corridor*
- Rotoiti Hills to Waihi Estuary

The corridors tend to be broader in their upper reaches, where there is more indigenous vegetation, and narrower in their middle reaches where indigenous vegetation is limited to riparian margins and gorges. The lower reaches of the corridors are also narrow because indigenous vegetation and habitats are largely absent, but have the potential to be restored. Threatened plant and animal species occur in many of the corridors, especially the inland portions, the corridors provide habitats for a range of native species and often encompass the last remnants of previously representative vegetation types and habitats (Wildland Consultants 2007a).

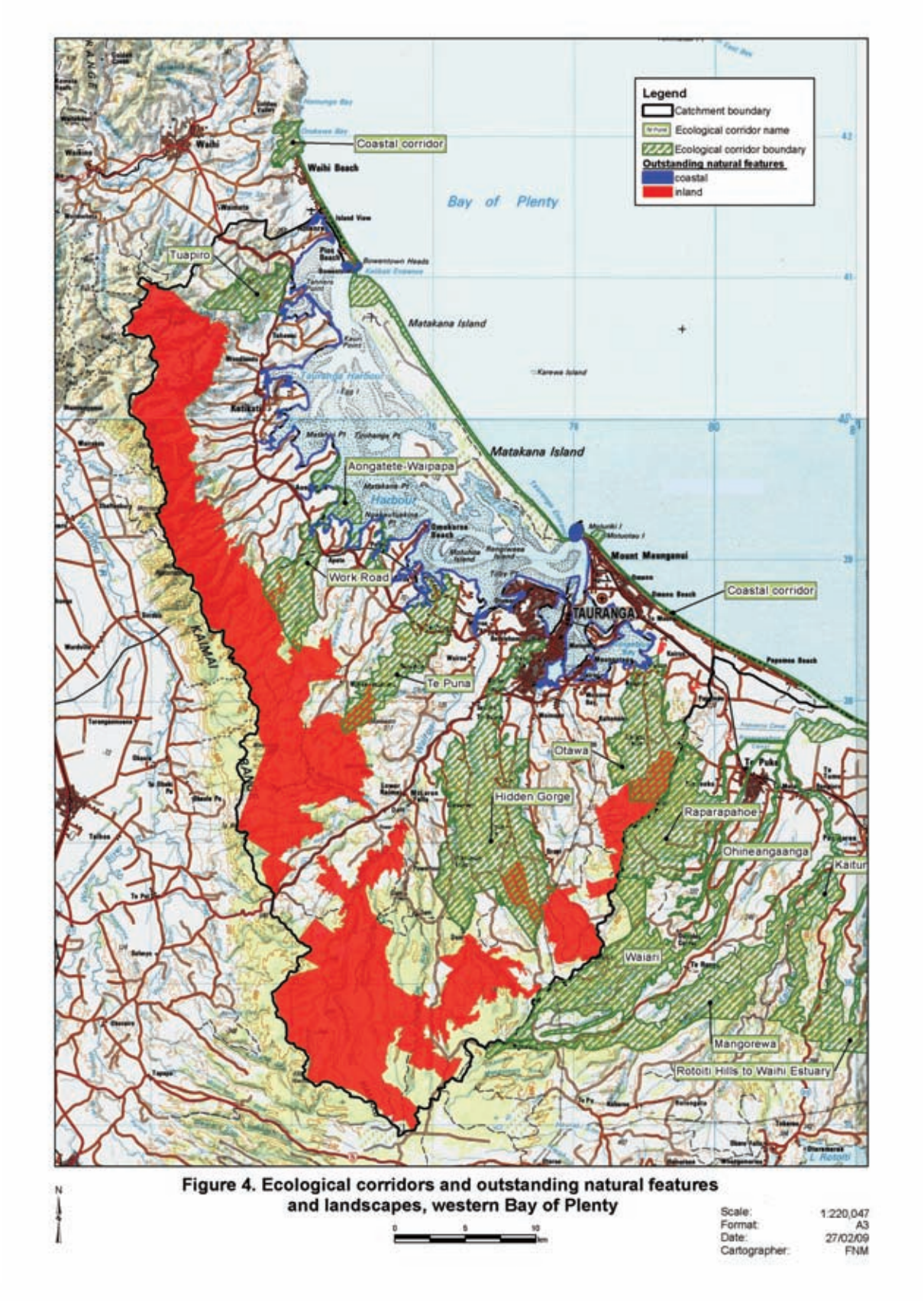


Figure 4: Ecological corridors and outstanding natural features and landscapes within the study area.

6.3 KEY EXISTING INFORMATION RESOURCES

New Zealand's physical environment is extremely diverse and this diversity is reflected in its indigenous plant and animal species, communities, and ecosystems. These features have been used as a basis for dividing New Zealand into 268 ecological regions and ecological districts. An ecological district is a local part of New Zealand where the topographical, geological, climatic, soil and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities (McEwen 1987). The study area includes parts of four ecological districts. An ecological region is an aggregation of adjacent ecological districts with closely related characteristics. The study area falls within two ecological regions: Coromandel and Northern Volcanic Plateau.

Various survey reports are are available and aim to identify the best remaining examples of particular habitat types. Table 1 provides a list of survey reports relevant to the various ecological districts.

Most protected areas are administered by the Department of Conservation and are located inland. Apart from estuarine and harbour sites, remaining unprotected areas are small and isolated, and most are less than 10 ha in size. All sites identified as having ecological values can be regarded as being significant under the Resource Management Act 1991.

Table 1: Key references on indigenous biodiversity for the study area.

Ecological District	Key References	Agency	Notes
All Coastal Ecological Districts	Beadel 1994	Environment Bay of Plenty	'Significant indigenous vegetation of the Bay of Plenty coastal zone'; field work in 1992.
	Wildland Consultants 2006	Environment Bay of Plenty	'Significant indigenous vegetation and significant habitats of indigenous fauna in the coastal environment of the Bay of Plenty region', field work in 2006.
Waihi	Humphreys and Tyler 1995	Department of Conservation	Protected Natural Areas Programme (PNAP) survey report; field work in 1987, 1988, and 1989.
Tauranga	Wildland Consultants 2005a	Tauranga City Council	'State of the Environment' monitoring 2000, 2002, and 2005.
	Wildland Consultants 2008	Environment Bay of Plenty	Natural Areas in Tauranga Ecological District. Field work 2007 and 2008 for sand dune sites in the semi-coastal zone of Tauranga Ecological District, existing data for remainder.
	Owen 1993	Department of Conservation	Marshbird survey of Tauranga Harbour; field work in 1991 and 1992.
	OSNZ 2006	Ornithological Society of New Zealand	Classified summarised notes (Bay of Plenty); regular coastal bird observations from 2003 to 2006.
	Beadel and Shaw 2000	Environment Bay of Plenty	Category 1 Natural Heritage Sites – Tauranga Ecological District.
Otanewainuku	Beadel 2006	Department of Conservation	PNAP survey report; field work in 1994.
Te Aroha	Humphreys and Tyler 1995	Department of Conservation	Protected Natural Areas Programme (PNAP) survey report; field work in 1987, 1988, and 1989.

6.4 NATIONAL PRIORITIES FOR PROTECTION OF RARE AND THREATENED INDIGENOUS BIODIVERSITY ON PRIVATE LAND

Four national priorities for biodiversity protection have been identified (Ministry for the Environment 2007a, 2007b), based on the latest and best scientific research available. Note that these priorities are not in order of importance but in order of scale, starting with the largest scale (Land Environments of New Zealand, LENZ, also called land environments) followed by smaller scale environments that are not adequately addressed in LENZ.

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 covered by Priorities 1 and 2 (the complete list of these originally rare habitats (Williams *et al.* 2007) is provided in Appendix 15.2).

National Priority 4: To protect habitats of acutely and chronically threatened indigenous species (these species are listed in de Lange *et al.* 2004 and Hitchmough *et al*. 2007).

Any areas that can be identified as falling within any one of these national priorities should preferably be protected by legal or other means, or at the very least excluded from further development and urbanisation.

High value ecological sites identified above are shown in Figure 5.

6.5 PROTECTED AREAS

Approximately 29.7% of the study area comprises legally protected natural areas (refer to Figure 6) which are likely to have significant ecological values. These areas include land administered by the Department of Conservation (32,641.08 ha or 26.4% of the study area), Queen Elizabeth II National Trust covenants (369.3 ha or 0.3% of the study area), Nga Whenua Rahui (covenants) (1,716.18 ha or 1.4% of the study area), land protected as a condition of subdivision consent notices, including land protected as a result of a transferable development right (792.4 ha, 0.6% of the study area), and retired land protected under Environment Bay of Plenty Farm Plans or Environmental Plans[2] (1,265.03 ha, 1.0% of the study area). Not all of these sites are considered to be high value ecological sites, but they all contribute to the network of ecological corridors in the western Bay of Plenty.

6.6 RESTORATION SITES

Community groups and individuals are involved in ecological restoration initiatives at 26 sites within the study area (refer to Figure 6). Most of these projects are being supported by local or central government agencies and will be of ecological value.

[2] The focus of the Farm and Environment Plans is water and soil conservation works which create significant off-site benefits. The work undertaken has direct benefits for significant ecological areas through land retirement, fencing, protection of riparian areas/native bush areas, native vegetation planting and indirect benefit by improving quality for riparian and downstream wetlands, and harbour and coastal habitats and ecosystems.

6.7 LAND COVER DATABASE

The Land Cover Database version 2 (LCDB2) (Ministry for the Environment 2001) is a national data set compiled using satellite imagery. Different land covers have different spectral attributes and this is used to identify and classify land use and land cover types, with spot checks on the ground to ensure accuracy (Ministry for the Environment 2001). Land cover is mapped to a minimum size of 1 ha.

Land cover types can be grouped into indigenous and non-indigenous vegetation types. Twelve indigenous and 19 non-indigenous land cover types were mapped in the study area (refer to Table 2 and Figure 7).

Table 2: Land Cover Data Base version 2 land cover types within the Kaimai-Tauranga catchment.

Indigenous Vegetation and Habitats	Non-indigenous Vegetation and Habitats
Broadleaved Indigenous Hardwoods	Afforestation (imaged, post LCDB 1)
Indigenous Forest	Afforestation (not imaged)
Landslide	Deciduous Hardwoods
Manuka and or Kanuka	Other Exotic Forest
Herbaceous Freshwater Vegetation	Pine Forest - Closed Canopy
River and Lakeshore Gravel and Rock	Pine Forest - Open Canopy
River	Major Shelterbelts
Lake and Pond	Mixed Exotic Shrubland
Coastal Sand and Gravel	Orchard and Other Perennial Crops
Estuarine Open Water	Forest Harvested
Herbaceous Saline Vegetation	Urban Parkland/ Open Space
Mangrove	Low Producing Grassland
	High Producing Exotic Grassland
	Short-rotation Cropland
	Vineyard
	Built-up Area
	Gorse and Broom
	Surface Mine
	Transport Infrastructure

6.8 THREATENED LAND ENVIRONMENTS

Threatened Land Environments of New Zealand (LENZ) is a classification system that groups together sites/areas with similar climatic and soil attributes throughout the country. This classification system has been combined with a map of extant indigenous vegetation to determine which land environments have the least amount of indigenous vegetation remaining and are therefore considered to be at most risk. This has resulted in the LENZ threat classification known as threatened land environments (Leathwick *et al.* 2002). The categories are described in Table 3 (as per Leathwick *et al.* 2002 definitions) and shown in Figure 7.

Table 3: Threatened Environments classifications and relative priority for protection.

Category	Criteria	Priority for Protection
Acutely Threatened	Less than 10% indigenous cover remaining	High
Chronically Threatened	Between 10-20% indigenous cover remaining	High
At Risk	Between 20-30% indigenous cover remaining	Medium
Critically Underprotected	Less than 30% indigenous cover remaining but less than 10% legally protected	Medium
Underprotected.	Less than 30% indigenous cover remaining but more than 10% but less than 20% legally protected	Medium

LENZ and LCDB2 provide relatively coarse classifications because they cover the entire country, do not have particularly fine resolution (1ha minimum mapping unit), and are models built on data that may include errors or extrapolations. These data also do not indicate whether an area already has some form of legal protection (e.g. reserve or covenant).

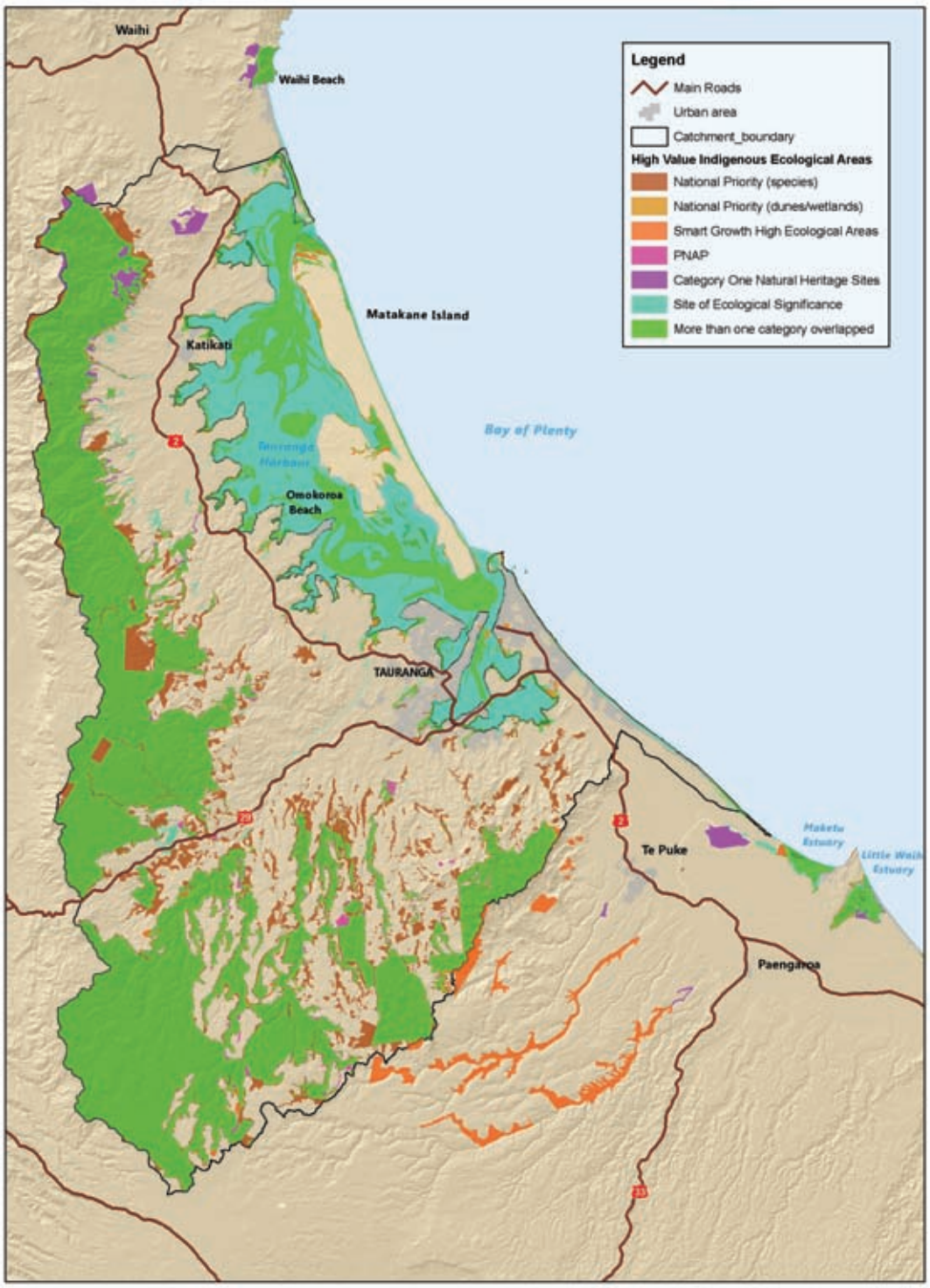


Figure 5: High value indigenous ecological features in the Kaimai-Tauranga catchment

Figure 5: High value indigenous ecological features in the Kaimai-Tauranga catchment.

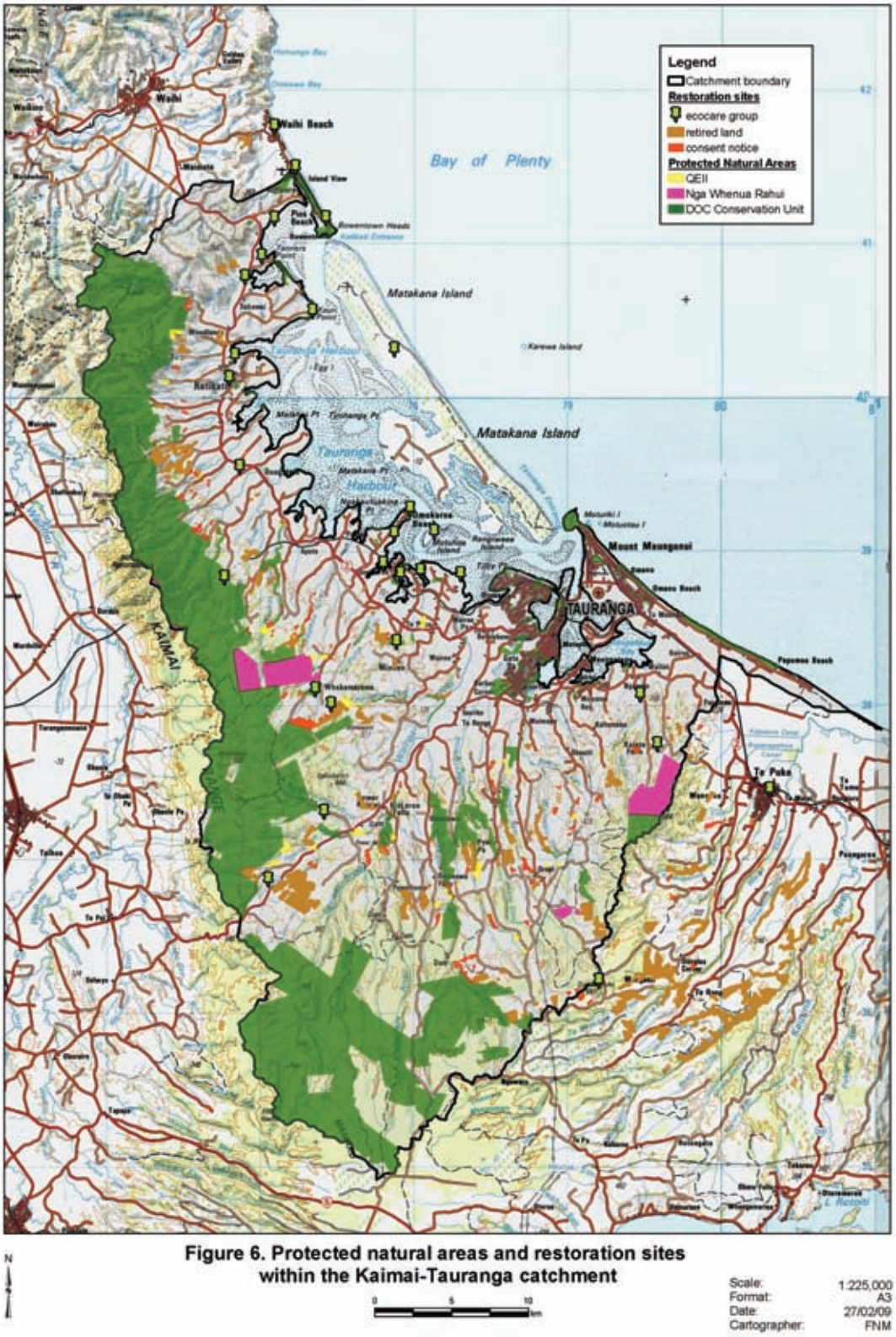


Figure 6: Protected natural areas and restoration sites within the Kaimai-Tauranga catchment.

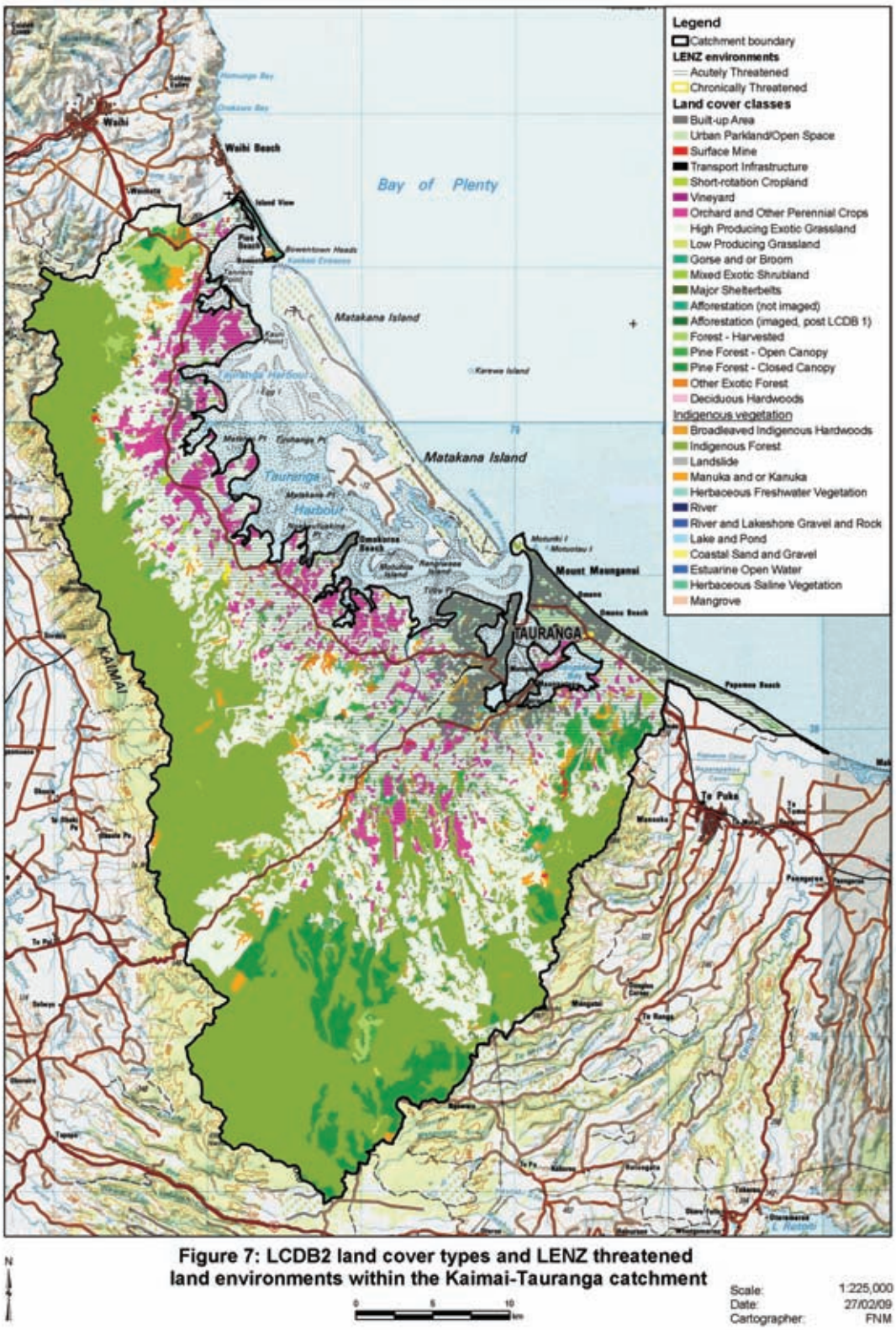


Figure 7: LCDB2 land cover types and LENZ threatened land environments within the Kaimai-Tauranga catchment

Figure 7: LCDB2 land cover types and threatened land environments within the Kaimai-Tauranga catchment.

6.9 ECOLOGICAL VALUES OF PARTICULAR HABITAT TYPES

Published information and the data sets discussed above have been used to identify the most important habitat types within the study area.

Tauranga Harbour

Tauranga harbour was identified in Cromarty and Scott (1996) as a Wetland of International Importance. It is an important spawning and nursery area for marine fish species, and is popular for recreational flounder fishing. The tidal flats support a valuable shellfish fishery. The harbour in general supports a wide diversity and number of birds, especially waders and shore birds. It is also important as a breeding and/or feeding area for a number of scarce or threatened species. Many other more common resident and migratory birds occur in the harbour, and the area is particularly important for wading birds that migrate annually from the northern hemisphere. The saltmarsh and mangrove areas are important for Australasian bittern *(Botaurus poiciloptilus*), banded rail (*Gallirallus philippensis assimilis*), marsh crake (*Porzana pusilla affinis*) and North Island fernbird (*Bowdleria punctata vealeae*).

Tauranga Harbour is classed a Wetland of International Importance for the following reasons:

- It is a particularly good example of a large ecosystem containing terrestrial, saltmarsh and mangrove vegetation communities.
- The harbour plays a substantial hydrological, biological, and ecological role in the functioning of a larger coastal system that comprises the Bay of Plenty coastal and marine environment.
- The harbour supports substantial populations of four globally threatened species of birds.
- The harbour is of special importance as breeding habitat for a number of bird species, and as wintering habitat for several species of international migratory shorebirds.
- The harbour is important for its fisheries, and has been ranked as being of outstanding value for fish at critical stages of their biological cycles.
- The harbour regularly supports 1% or more of the regional populations of four threatened or international migratory species.

(Cromarty and Scott 1996)

Dunelands and Saltmarsh

Relatively little indigenous vegetation remains in the coastal lowland zone except remnants around Tauranga Harbour and on sand dunes (Beadel and Shaw 1999). Therefore indigenous vegetation in these habitats, even though they may have a relatively high weed or non-indigenous component, can be considered to be significant. There still are good examples of saltmarsh where rivers or streams enter the Tauranga Harbour, including sites of very high botanical conservation value and of outstanding wildlife habitat value (Beadel 1992; Owen 1993), or those identified as being of significance in the Bay of Plenty Regional Coastal Environmental Plan (Beadel and Shaw 1999; Beadel 1992; Owen 1993).

Streams and Rivers

Many of the rivers and streams within the western Bay of Plenty contain whitebait spawning sites, provide aquatic habitat and migratory pathways for indigenous fish, and are considered to be a valuable food source (mahinga kai) by Māori (Beadel and Shaw 1999; Shaw 1998; Wildland Consultants 2000a, 2007c). They also provide physical and ecological linkages between the forests on the Kaimai Ranges and the sea, including Tauranga Harbour.

Ideally, small waterways should have indigenous riparian vegetation buffers 10-20metres wide, while rivers (e.g. Wairoa) would warrant wider buffers. Stream health is significantly improved by having riparian vegetation 10-20m either side of the stream of river. Riparian vegetation keeps the water temperature lower through shading (better for aquatic life) and captures some of the silt and nutrients washed down from more developed land. It also helps to stabilise stream banks, provides biotic input into the water (e.g. leaf litter, insects falling in), and provides breeding and feeding habitat for fish (algae and invertebrates attached to vegetation trailing in the water), birds and invertebrates. Improving the quality of water in the upper and middle catchments will also enhance water quality in the lower catchment, including Tauranga Harbour. Hence any riparian vegetation should also be considered to be significant, whether it is indigenous vegetation or not (Wildland Consultants 2000a). The width of riparian buffers will vary depending on the size of a waterway and associated topography (Wildland Consultants 2003).

Wetlands

Wetlands within the study area have been significantly reduced, including saline wetlands, and are a priority for protection.

Indigenous Forest, Scrub, and Shrublands

Within the study area there is *c.*52,041.4ha of indigenous forest, indigenous scrub, and indigenous shrublands. This amounts to 42.5% of the area and most is administered by the Department of Conservation. Forest, scrub, and shrublands provide or contribute to an extensive range of ecosystem services (refer to Section 9) and also provide habitat for a range of nationally vulnerable species (Miskelly *et al.* 2008) such as North Island kaka (*Nestor meridionalis septentrionalis*), North Island brown kiwi (*Apteryx mantelli*), North Island kokako (*Callaeas wilsoni*), and also short-tailed bat (*Mystacina*

tuberculata rhyacobia, Range restricted) (Hitchmough *et al.* 2007), *Dactylanthus taylorii* (Nationally Vulnerable) (de Lange *et al.* 2009) and Hochstetter's frog (*Leiopelma hochstetteri,* Sparse) (Hitchmough *et al.* 2007).

7 Analysis of Natural Values

In this section the various sources of data identified above have been analysed and compared in order to pinpoint where the greatest gains in protection of biologically important assets could be made, or where protection of vegetation is most required. To help pinpoint the location of these potential gains, analyses were undertaken within relevant ecological districts and catchments. For this analysis indigenous vegetation was grouped into three classes: terrestrial, freshwater, and estuarine. As riparian vegetation of any type (i.e. indigenous or non-indigenous) is important, the freshwater and estuarine vegetation classes includes a 20m buffer from the river or stream edge for freshwater vegetation and a 20m buffer from Mean High Water Springs (MHWS) for estuarine vegetation, as well as including any indigenous vegetation identified through the LCDB2 mapping.

7.1 INDIGENOUS VEGETATION AND THREATENED LAND ENVIRONMENTS

Coastal areas and plains are generally the most modified landscapes in New Zealand, with the least amount of indigenous vegetation remaining. This is also the case for the Kaimai-Tauranga catchment where the two most threatened land environments (Acutely and Chronically Threatened) occur mainly within 10 to 20km from the coast. The study area still has *c*.52,736ha (43% of the catchment) of indigenous land cover (as determined from LCDB2) but this is mostly present further inland.

Only *c*.1,833 ha (3.5% of indigenous land cover) falls within Acutely and Chronically Threatened land environments in the coastal area (refer to Figure 7). If at all possible, clearance of indigenous vegetation in these threatened land environments should be avoided. Vegetation types, and per threatened land environments are detailed in Appendix 15.3.

Of the areas currently classified as non-indigenous land cover, 31,054 ha (25.3% of the study area) would also be considered to be threatened if the land cover was indigenous. This means that any indigenous vegetation remnants in these areas of predominantly non-indigenous land-cover also have high ecological value and should be maintained and restored if possible.

7.2 INDIGENOUS VEGETATION AND THREATENED LAND ENVIRONMENTS WITHIN ECOLOGICAL DISTRICTS

Otanewainuku Ecological District

Fifty-four percent (40,416 ha) of the Otanewainuku Ecological District within the study area is still considered to be indigenous vegetation. Only a small percentage (8.2%) of this Ecological District has been classified as Chronically and Acutely Threatened land environments as most of this Ecological District is inland. Thus only a small amount of terrestrial (776 ha, 2% of Ecological District within the study area) and freshwater indigenous vegetation (30 ha, 0% of Ecological District in study area) still occurs in an Acutely Threatened land environment (Table 4).

Tauranga Ecological District

Tauranga Ecological District is coastal and thus has the largest amount of threatened land environments within the Ecological District (80.9% Table 4, also refer to Figure 7). The vegetation is highly modified with only 8% indigenous vegetation remaining. Thus any indigenous vegetation in the Tauranga Ecological District is ecologically important. Some indigenous vegetation still occurs in Acutely and Chronically Threatened land environments, and there are opportunities to protect or restore these areas. Specifically, 146 ha of indigenous freshwater, 586 ha of marine-influenced, and 765 ha of terrestrial vegetation (5%, 22% and 29% of Ecological District in study area, respectively).

Te Aroha Ecological District

Te Aroha Ecological District still has 79% (11,010 ha) indigenous vegetation cover within the study area. Less than one percent of the Ecological District within the study area is classified as Acutely and/or Chronically Threatened land environments, and only c. 6ha terrestrial indigenous vegetation can be found in these threatened land environments.

Waihi Ecological District

Not much indigenous vegetation (116 ha, 6.4%) remains in the Waihi Ecological District within the study area and only a small proportion (34 ha, c.2%) is classified as a threatened land environment. Very little of this indigenous vegetation (0.9 ha of terrestrial) occurs within threatened land environments.

Table 4: Indigenous vegetation remaining within each ecological district and proportion that occurs on Acutely and Chronically Threatened land environments within the Kaimai-Tauranga catchment.

Ecological District	Threatened Land Environment	Threatened Land Environment in ED		Indigenous Vegetation		Estuarine Indigenous	Freshwater Indigenous	Terrestrial Indigenous
		Hectares	%[1]	Hectares	%[1]			
Otanewainuku	Acutely Threatened	6,061.0	8.2%	806.7	1.1%		30.4	776.3
	Chronically Threatened	0.9	0.0%	0.0	0.0%			
	Total for ED	**74,163.7**		**40,416.2**	**54.5%**		**371.0**	**40,045.2**
Tauranga	Acutely Threatened	27,119.5	80.8%	1,494.7	4.5%	585.6	146.6	762.5
	Chronically Threatened	25.9	0.1%	3.4	0.0%	0.7	0.1	2.6
	Total for ED	**33,583.1**		**2,682.9**	**8.0%**	**1,044.0**	**315.5**	**1,323.4**
Te Aroha	Acutely Threatened	59.2	0.4%	6.0	0.0%			6.0
	Chronically Threatened	0.3	0.0%	0.1	0.0%			0.1
	Total for ED	**13,953.2**		**11,010.0**	**78.9%**		**5.7**	**11,004.2**
Waihi	Acutely Threatened	34.2	1.9%	0.9	0.1%			0.9
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for ED	**1,814.0**		**116.7**	**6.4%**			**116.7**
Total for Catchment[2]		**123,539.4**		**54,241.0**	**43.9%**	**1,054.2**	**693.3**	**52,490.2**

1. As a proportion of the total ecological district area that falls within the Kaimai-Tauranga catchment.
2. Total area (ha) within ecological district and area (ha) indigenous vegetation is slightly greater than the sum of the ecological districts due to some unclassified land included within the catchment.

7.3 HIGH VALUE INDIGENOUS VEGETATION IN EACH ECOLOGICAL DISTRICT

Any areas of vegetation and habitats identified in previous studies as being of ecological significance (Figure 5) have been ranked as having high ecological values. Within the Kaimai-Tauranga catchment, nearly all remaining indigenous vegetation/habitats have been recognised as being of high value (Table 5). The amount of high value vegetation/habitats varies by ecological district, with Otanewainuku Ecological District having the greatest amount and Waihi Ecological District the least.

Legal Protection

None of the high value vegetation/habitats are legally protected in the Waihi Ecological District, 23% is legally protected in Tauranga Ecological District, 61% in Otanewainuku Ecological District, and 90% in Te Aroha Ecological District. Overall, 86% of high value vegetation/habitats is legally protected. The large inland forest tracts managed by the Department of Conservation contribute significantly to the amount of legally-protected land.

There are still opportunities to legally protect high value vegetation/habitats within Acutely and/or Chronically Threatened land environments in all ecological districts, especially in the coastal and semi-coastal zones (Table 5).

Inclusion in Ecological Corridors

None of the high value vegetation/habitats within the Waihi Ecological District are included in a proposed SmartGrowth ecological corridor, and only 48% within the Tauranga Ecological District has been 'captured' (Table 5). Eighty-two percent, and 93% of high value vegetation/habitats are included in corridors in the Otanewainuku Ecological District and Te Aroha Ecological District respectively. About 84% of high value vegetation/habitats within the study area are included in proposed ecological corridors.

It would appear that more ecological corridors may be required in the Tauranga Ecological District, or that the proposed ecological corridors need to be expanded to include a greater proportion of the high value indigenous vegetation, especially within Acutely Threatened and Chronically Threatened land environments.

An assumption was made that inclusion in a currently proposed ecological corridor will, to some extent, provide a degree of 'legal' protection to those vegetation/habitats, such as prevention of vegetation clearance. The ecological corridors currently proposed 'protect' an additional 5% (2,539 ha) of the study area that is not already legally protected. This varies by ecological district, with none in Waihi Ecological District, 4% (418 ha) in Te Aroha Ecological District, 5% (1,879 ha) in Otanewainuku Ecological District, and 10% (242 ha) in Tauranga Ecological District.

Table 5: High value indigenous vegetation remaining within each ecological district, and the proportion that is legally protected and/or included in current ecological corridors within the Kaimai-Tauranga catchment.

Ecological District	Threatened Land Environment	Total Indigenous Vegetation	High Value Indigenous Vegetation[1]		High Value and Legally Protected[2]		High Value and Included in Corridors[3]		High Value, Legally Protected and Included in Corridors[5]	
		Hectares	Hectares	%[4]	Hectares	%[4]	Hectares	%[4]	Hectares	%[4]
Otanewainuku	Acutely Threatened	806.7	756.6	93.8%	135.2	17.9%	573.7	75.8%	131.8	17.4%
	Chronically Threatened	0.0[6]								
	At Risk	0.0		0.0%[6]						
	Critically Underprotected	0.0								
	Underprotected	27,951.8	27,832.3	99.6%	15,438.9	55.5%	22,375.8	80.4%	14,374.6	51.6%
	No Threat Category	11,657.6	11,635.3	99.8%	8,978.3	77.2%	9,973.8	85.7%	8,166.7	70.2%
Otanewainuku Total		**40,416.2**	**40,224.2**	**99.5%**	**24,552.4**	**61.0%**	**32,923.3**	**81.8%**	**22,673.1**	**56.4%**
Tauranga	Acutely Threatened	1,494.7	1,260.7	84.3%	131.7	10.4%	536.4	42.5%	78.4	6.2%
	Chronically Threatened	3.4	3.4	100.0%	0.6	18.5%	2.1	60.8%	0.6	18.2%
	At Risk	297.9	291.8	98.0%	94.1	32.3%	83.5	28.6%	40.5	13.9%
	Critically Underprotected	134.6	134.6	100.0%	95.4	70.9%	80.7	60.0%	51.0	37.9%
	Underprotected	228.7	204.0	89.2%	85.4	41.9%	24.7	12.1%	8.3	4.1%
	No Threat Category	523.6	522.3	99.8%	145.4	27.8%	330.2	63.2%	131.6	25.2%
Tauranga Total		**2,682.9**	**2,416.8**	**90.1%**	**552.7**	**22.9%**	**1,057.6**	**43.8%**	**310.5**	**12.8%**
Te Aroha	Acutely Threatened	6.0	5.3	88.1%	0.5	9.6%	1.9	36.0%		
	Chronically Threatened	0.1	0.1	100.0%	0.1	48.5%				
	At Risk	0.0								
	Critically Underprotected	86.0	50.6	58.8%	14.3	28.2%	41.1	81.2%	14.0	27.7%
	Underprotected	2,310.1	2,270.6	98.3%	1,957.8	86.2%	1,908.1	84.0%	1,808.2	79.6%
	No Threat Category	8,607.7	8,406.0	97.7%	7,749.0	92.2%	8,005.1	95.2%	7,482.0	89.0%
Te Aroha Total		**11,010.0**	**10,732.6**	**97.5%**	**9,721.7**	**90.6%**	**9,956.2**	**92.8%**	**9,304.2**	**86.7%**
Waihi	Acutely Threatened	0.9		0.0%						
	Chronically Threatened	0.0								
	At Risk	0.0								
	Critically Underprotected	0.0								
	Underprotected	29.4	4.0	13.4%						
	No Threat Category	86.4	32.4	37.5%						
Waihi Total		**116.7**	**36.3**	**31.1%**						
Total for Catchment		**54,241.0**[7]	**53,410.0**	**98.5%**	**34,826.8**	**86.2%**	**43,937.2**	**84.0%**	**32,287.8**	**27.7%**

1: Includes vegetation and habitats identified as having high values by the National Priorities (threatened species, sand dunes and wetlands), and/or Category One Natural heritage Sites, and/or Sites of Ecological Significance and/or Smart Growth High Ecological Areas and/or Ecological Constraints High Value Vegetation and Habitat and or recommended for protection in Protected Natural Areas Programme surveys.

2: Legally protected includes land managed by the Department of Conservation, covenanted under Queen Elizabeth II National Trust, under Nga Whenua Rahui kawenata, retired land subject to Environment Bay of Plenty Farm and Environment Plans, and protected under a Council consent notice.

3: Ecological corridors as identified in Figure 4 and includes the outstanding landscape feature corridors also.

4: Percentage of the total indigenous vegetation within that land environment threat category

5: Overlapping subset with both ecological corridors and legally protected, i.e. these areas are also included in the totals for ecological corridors and legally protected where relevant.

6: Indicates less than 0.05 hectares or less than 0.05%.

7: The total area (ha) for indigenous vegetation is slightly greater than the sum of the ecological districts, due to some unclassified land environments included within the catchment.

7.4 HIGH VALUE INDIGENOUS VEGETATION WITHIN SUB-CATCHMENTS

The location of sub-catchments is illustrated in Figure 1. Sub-catchments that still have a good proportion of indigenous vegetation cover (regardless of whether it is considered to be of high value or not) are: Uretara/Te Rereatukahia (63.7%), Aongatete (57.7%), Wainui (57.6%), Wairoa (57.1%), and Tuapiro (51.8%) (Table 6). Sub-catchments with the greatest area of indigenous vegetation are: Wairoa (27,740.9 ha), Aongatete (4,662.3 ha), Waimapu (3,949.9 ha), and Tuapiro (3,627.1 ha).

Sub-catchments with the smallest proportion of indigenous vegetation remaining are: Kaitemako (10.6%), Waiau (14%), Te Puna (14.7%), and Uretara/McKinney (16.6%). Any indigenous vegetation in these catchments should be considered to be of high value, for its scarcity, but also to ensure that ecological processes within the catchment can still function, albeit to a more limited extent. Sub-catchments with the smallest area of indigenous vegetation and habitats are: Kaitemako (201.1 ha), Mania (267.5 ha), Uretara/McKinney (349.8 ha), Tahawai (395.7 ha), Waiau (430.5 ha), and Te Puna (710.7 ha). More than 90% of the remaining indigenous vegetation and habitats in the majority of sub-catchments have been identified as being of high value. The exceptions are Kaitemako (85.6%), and Waiau (75.5%).

Legal Protection

More than half of the high value indigenous vegetation has legal protection in most sub-catchments, but legal protection is low in Kaitemako (4.9%), Waimapu (14.7%), Kopurererua (19.5%), Waiau (36.4%), and Te Puna (37.5%).

Inclusion in Ecological Corridors

Proposed SmarthGrowth corridors include 81% of the high value vegetation/habitat, but this ranges from 0.6% to 95.2% for different sub-catchments. Additional corridors or corridor extensions may be required in the Kaitemako (0.6%), Waiau (38.3%), Mania (50.3%), and Te Puna (50.7%) sub-catchments (Table 6). The focus for expansion should be coastal and riparian margins, high value vegetation/ habitats, within vegetation/habitats on threatened land environments (Appendix 15.4).

An assumption was made that inclusion in a currently proposed ecological corridor will, to some extent, provide a degree of ‘legal’ protection for those vegetation/habitats. The currently proposed ecological corridors ‘protect’ an additional 5% (2,542 ha), but both the total hectares ‘protected’ (4.6 ha to 1,594.8 ha) and the proportion (0.2% to 20.8%) of high value vegetation/habitats protected varies greatly between sub-catchments (Table 6).

Sub-catchments with the smallest additional area ‘protected’ include Wainui (4.6 ha), Tahawai (6.5 ha), Kaitemako (9.9 ha), Waitekohe (10 ha), Kaiate (13.5 ha), Uretara/McKinney (21.6 ha), and Kopurererua (25.2 ha). Sub-catchments with the smallest additional proportion protected include Wainui

(0.2%), Kaiate (0.6%), Waitekohe (0.8%), Kopurererua (1.0%), Aongatete (1.2%), Tahawai (1.7%), Uretara/Te Rereatukahia (4.1%), Waipapa (4.4%), and Waimapu (4.8%).

Table 6: High value indigenous vegetation within each sub catchment and the proportion that is legally protected, and/or included in current ecological corridors within the Kaimai-Tauranga catchment.

Sub Catchment	Land Environments	Sub-Catchment Size	Total Indigenous Vegetation		High Value Indigenous Vegetation[1]		High Value and Legally Protected[2]		High Value and Included in Corridors[3]		High Value, Legally Protected and Included in Corridors[4]		Additional High Value 'Protected' by Corridors	
		Hectares	Hectares	% of sub-catchment[5]	Hectares	% Indig[6]	Hectares	% Indig[6]	Hectares	% Indig[6]	Hectares	% Indig[6]	Hectares	% Indig[6]
Aongatete	Acutely Threatened	1,960.6	60.4	3.1%	46.1	76.4%	1.5	2.4%	9.3	15.4%	0.5	0.8%	1.0	2.2%
	Chronically Threatened	7.0	1.2	17.7%	1.2	100.0%	0.1	4.9%	0.0	0.1%				
	At Risk	91.5	2.5	2.7%	2.5	100.0%	0.2	7.5%	1.4	57.7%	0.0	1.9%		
	Critically Underprotected	95.5	0.2	0.2%	0.1	66.0%								
	Underprotected	2,893.2	1,835.8	63.5%	1,827.3	99.5%	1,659.9	90.4%	1,755.8	95.6%	1,648.9	89.8%	11.0	0.6%
	No Threat Category	3,037.9	2,762.2	90.9%	2,759.8	99.9%	2,495.2	90.3%	2,621.3	94.9%	2,450.6	88.7%	44.6	1.6%
Aongatete Total		**8,085.7**	**4,662.3**	**57.7%**	**4,637.0**	**99.5%**	**4,156.7**	**89.2%**	**4,387.9**	**94.1%**	**4,100.0**	**87.9%**	**56.7**	**1.2%**
Kaiate	Acutely Threatened	6,959.6	570.6	8.2%	534.2	93.6%	32.4	5.7%	253.7	44.5%	19.6	3.4%	12.8	2.4%
	Chronically Threatened	12.1	0.7	5.9%	0.7	100.0%	0.2	31.3%	0.6	77.8%	0.2	29.9%	0.0	0.0%
	At Risk	0.9		0.0%										
	Critically Underprotected	1.6		0.0%										
	Underprotected	2,858.8	1,215.9	42.5%	1,206.9	99.3%	834.0	68.6%	1,150.1	94.6%	833.8	68.6%	0.2	0.0%
	No Threat Category	576.2	466.0	80.9%	466.0	100.0%	286.4	61.5%	416.4	89.3%	285.8	61.3%	0.6	0.1%
Kaiate Total		**10,409.1**	**2,253.2**	**21.6%**	**2,207.8**	**98.0%**	**1,153.0**	**51.2%**	**1,820.7**	**80.8%**	**1,139.5**	**50.6%**	**13.5**	**0.6%**
Kaitemako	Acutely Threatened	1,265.7	130.6	10.3%	112.6	86.2%	7.4	5.7%	1.1	0.9%	0.0	0.0%	7.4	6.6%
	Chronically Threatened													
	At Risk													
	Critically Underprotected													
	Underprotected	636.9	69.4	10.9%	58.5	84.2%	2.4	3.5%						
	No Threat Category	2.7	1.1	40.0%	1.1	100.0%	0.0	0.9%	0.2	16.6%	0.0	0.4%	0.0	0.0%
Kaitemako Total		**1,905.3**	**201.1**	**10.6%**	**172.1**	**85.6%**	**9.9**	**4.9%**	**1.3**	**0.6%**	**0.0**	**0.0%**	**9.9**	**5.8%**
Kopurererua	Acutely Threatened	3,056.6	263.1	8.6%	249.3	94.8%	30.8	11.7%	226.1	85.9%	28.9	11.0%	1.9	0.8%
	Chronically Threatened													
	At Risk	57.8	2.6	4.6%	0.3	13.2%	0.1	4.3%	0.0	0.0%				
	Critically Underprotected	39.4	3.8	9.7%	3.8	100.0%			0.2	6.4%				
	Underprotected	4,769.1	2,274.1	47.7%	2,274.0	100.0%	444.4	19.5%	1,948.3	85.7%	421.5	18.5%	22.9	1.0%
	No Threat Category	142.7	75.5	52.9%	75.5	100.0%	36.7	48.6%	65.7	87.0%	36.4	48.1%	0.3	0.4%
Kopurererua Total		**8,065.6**	**2,619.2**	**32.5%**	**2,603.1**	**99.4%**	**512.0**	**19.5%**	**2,240.4**	**85.5%**	**486.8**	**18.6%**	**25.2**	**1.0%**
Mania	Acutely Threatened	338.3	1.0	0.3%	0.3	27.8%			0.1	8.5%				
	Chronically Threatened													
	At Risk	26.3	1.0	3.8%	1.0	100.0%			0.4	36.9%				
	Critically Underprotected													
	Underprotected	610.2	112.5	18.4%	104.1	92.5%	42.5	37.8%	16.5	14.7%	14.2	12.6%	28.3	27.2%
	No Threat Category	311.7	153.0	49.1%	150.9	98.6%	124.3	81.2%	117.5	76.8%	99.2	64.8%	25.1	16.6%
Mania Total		**1,286.6**	**267.5**	**20.8%**	**256.3**	**95.8%**	**166.8**	**62.3%**	**134.5**	**50.3%**	**113.4**	**42.4%**	**53.4**	**20.8%**
Tahawai	Acutely Threatened	552.4	58.0	10.5%	54.5	94.1%	7.6	13.0%	14.7	25.4%	6.1	10.5%	1.5	2.8%
	Chronically Threatened													
	At Risk	3.8	3.6	95.7%	3.6	100.0%			3.3	92.4%				
	Critically Underprotected	2.3	0.2	8.2%	0.2	100.0%			0.0	0.1%				
	Underprotected	597.2	85.8	14.4%	84.3	98.2%	33.2	38.6%	65.0	75.8%	28.1	32.8%	5.1	6.0%
	No Threat Category	280.3	248.1	88.5%	248.1	100.0%	203.0	81.8%	246.5	99.3%	203.0	81.8%	0.0	0.0%
Tahawai Total		**1,436.0**	**395.7**	**27.6%**	**390.7**	**98.7%**	**243.7**	**61.6%**	**329.6**	**83.3%**	**237.2**	**59.9%**	**6.5**	**1.7%**
Te Puna	Acutely Threatened	2,889.6	204.2	7.1%	156.3	76.6%	14.0	6.9%	69.6	34.1%	8.7	4.2%	5.3	3.4%
	Chronically Threatened	1.0		0.0%										
	At Risk	24.3	16.4	67.4%	16.4	100.0%	10.3	63.3%	0.2	1.4%				
	Critically Underprotected													
	Underprotected	1,592.5	401.4	25.2%	381.1	94.9%	225.8	56.3%	221.6	55.2%	178.9	44.6%	46.9	12.3%
	No Threat Category	314.5	88.8	28.2%	88.8	100.0%	16.1	18.1%	68.8	77.5%	15.7	17.7%	0.4	0.5%
Te Puna Total		**4,821.9**	**710.7**	**14.7%**	**642.5**	**90.4%**	**266.2**	**37.5%**	**360.2**	**50.7%**	**203.2**	**28.6%**	**63.0**	**9.8%**
Tuapiro	Acutely Threatened	1,887.0	73.8	3.9%	68.5	92.8%	3.5	4.8%	40.4	54.7%	1.1	1.6%	2.4	3.5%
	Chronically Threatened													
	At Risk	42.4	36.3	85.6%	36.3	100.0%	32.9	90.6%	5.9	16.2%	3.5	9.7%	29.4	81.0%
	Critically Underprotected	367.8	85.8	23.3%	50.4	58.7%	14.3	16.6%	41.1	47.9%	14.0	16.3%	0.3	0.6%
	Underprotected	1,459.6	851.0	58.3%	823.3	96.7%	761.5	89.5%	642.9	75.5%	631.6	74.2%	129.9	15.8%
	No Threat Category	3,240.9	2,580.2	79.6%	2,404.2	93.2%	2,127.1	82.4%	2,231.2	86.5%	2,007.8	77.8%	119.3	5.0%
Tuapiro Total		**6,997.7**	**3,627.1**	**51.8%**	**3,382.7**	**93.3%**	**2,939.2**	**81.0%**	**2,961.4**	**81.6%**	**2,658.1**	**73.3%**	**281.1**	**8.3%**
Uretara/McKinney	Acutely Threatened	719.8	50.3	7.0%	39.8	79.1%	0.2	0.3%	28.9	57.6%				
	Chronically Threatened													
	At Risk	58.3	14.7	25.1%	14.7	100.0%			13.0	89.0%				
	Critically Underprotected	1.1	0.1	6.4%	0.1	100.0%								
	Underprotected	1,046.1	70.4	6.7%	57.7	82.0%	26.8	38.1%	15.5	22.0%	14.9	21.2%	11.9	20.6%
	No Threat Category	277.8	214.4	77.2%	214.3	100.0%	172.0	80.2%	197.3	92.0%	162.4	75.7%	9.6	4.5%
Uretara/McKinney Total		**2,103.0**	**349.8**	**16.6%**	**326.5**	**93.4%**	**198.9**	**56.9%**	**254.8**	**72.8%**	**177.3**	**50.7%**	**21.6**	**6.6%**
Uretara/ Te Rereatukahia	Acutely Threatened	615.7	15.9	2.6%	14.1	88.6%	1.4	8.9%	3.5	22.0%	0.1	0.7%	1.3	9.2%
	Chronically Threatened													
	At Risk	57.9	5.8	9.9%	5.4	94.3%	0.5	9.0%	1.2	21.5%	0.5	8.1%	0.0	0.0%
	Critically Underprotected													

Sub Catchment	Land Environments	Sub-Catchment Size	Total Indigenous Vegetation		High Value Indigenous Vegetation[1]		High Value and Legally Protected[2]		High Value and Included in Corridors[3]		High Value, Legally Protected and Included in Corridors[4]		Additional High Value 'Protected' by Corridors	
		Hectares	Hectares	% of sub-catchment[5]	Hectares	% Indig[6]	Hectares	% Indig[6]	Hectares	% Indig[6]	Hectares	% Indig[6]	Hectares	% Indig[6]
	Underprotected	803.9	108.1	13.4%	106.8	98.8%	66.3	61.4%	39.1	36.2%	32.9	30.4%	33.4	31.3%
	No Threat Category	2,460.7	2,378.5	96.7%	2,378.5	100.0%	2,280.3	95.9%	2,301.7	96.8%	2,211.7	93.0%	68.6	2.9%
Uretara/Te Rereatukahia Total		**3,938.2**	**2,508.3**	**63.7%**	**2,504.9**	**99.9%**	**2,348.6**	**93.6%**	**2,345.6**	**93.5%**	**2,245.2**	**89.5%**	**103.4**	**4.1%**
Waiau	Acutely Threatened	460.0	20.9	4.5%	20.0	95.5%	6.5	31.0%	7.9	37.8%	5.2	24.6%	1.3	6.5%
	Chronically Threatened													
	At Risk	207.5	95.6	46.1%	95.6	100.0%	45.9	48.0%	37.8	39.5%	36.4	38.1%	9.5	9.9%
	Critically Underprotected	191.9	113.7	59.2%	113.7	100.0%	95.4	83.9%	66.3	58.3%	51.0	44.9%	44.4	39.1%
	Underprotected	995.7	38.5	3.9%	11.4	29.7%	5.2	13.4%	5.6	14.7%	4.9	12.6%	0.3	2.6%
	No Threat Category	1,210.2	161.8	13.4%	84.3	52.1%	3.7	2.3%	47.4	29.3%	2.7	1.7%	1.0	1.2%
Waiau Total		**3,065.2**	**430.5**	**14.0%**	**325.0**	**75.5%**	**156.7**	**36.4%**	**165.0**	**38.3%**	**100.2**	**23.3%**	**56.5**	**17.4%**
Waimapu	Acutely Threatened	3,290.7	405.6	12.3%	353.1	87.1%	71.5	17.6%	189.2	46.6%	53.0	13.1%	18.5	5.2%
	Chronically Threatened													
	At Risk	52.4	14.1	27.0%	10.8	76.2%	4.1	28.9%	1.1	7.6%	0.0	0.1%	4.1	38.0%
	Critically Underprotected	0.9		0.0%										
	Underprotected	8,133.4	3,363.8	41.4%	3,361.0	99.9%	466.3	13.9%	2,450.2	72.8%	310.7	9.2%	155.6	4.6%
	No Threat Category	254.2	166.4	65.4%	166.4	100.0%	36.8	22.1%	142.3	85.6%	28.5	17.1%	8.3	5.0%
Waimapu Total		**11,731.6**	**3,949.9**	**33.7%**	**3,891.2**	**98.5%**	**578.7**	**14.7%**	**2,782.7**	**70.5%**	**392.2**	**9.9%**	**186.5**	**4.8%**
Wainui	Acutely Threatened	761.3	68.9	9.1%	48.0	69.7%	10.4	15.1%	44.1	64.1%	10.4	15.1%	0.0	0.0%
	Chronically Threatened	6.7	1.5	22.6%	1.5	100.0%	0.4	26.9%	1.5	100.0%	0.4	26.9%	0.0	0.0%
	At Risk	12.2	1.3	10.3%	1.3	100.0%			1.3	100.0%				
	Critically Underprotected	0.0												
	Underprotected	2,053.4	1,351.8	65.8%	1,345.5	99.5%	913.4	67.6%	1,284.0	95.0%	909.8	67.3%	3.6	0.3%
	No Threat Category	706.5	616.8	87.3%	614.9	99.7%	498.4	80.8%	611.5	99.1%	497.4	80.6%	1.0	0.2%
Wainui Total		**3,540.1**	**2,040.4**	**57.6%**	**2,011.2**	**98.6%**	**1,422.6**	**69.7%**	**1,942.4**	**95.2%**	**1,418.0**	**69.5%**	**4.6**	**0.2%**
Waipapa	Acutely Threatened	2,546.0	103.3	4.1%	83.8	81.1%	4.7	4.6%	62.5	60.5%	3.2	3.1%	1.5	1.8%
	Chronically Threatened	0.0												
	At Risk	17.9	0.9	5.0%	0.9	100.0%	0.0	0.1%	0.7	77.8%				
	Critically Underprotected	0.0												
	Underprotected	2,130.7	936.8	44.0%	933.1	99.6%	686.7	73.3%	701.4	74.9%	654.4	69.9%	32.3	3.5%
	No Threat Category	290.6	246.2	84.7%	246.2	100.0%	161.5	65.6%	200.5	81.4%	140.4	57.0%	21.1	8.6%
Waipapa Total		**4,985.2**	**1,287.2**	**25.8%**	**1,263.9**	**98.2%**	**853.0**	**66.3%**	**965.2**	**75.0%**	**798.0**	**62.0%**	**55.0**	**4.4%**
Wairoa	Acutely Threatened	5,111.9	266.8	5.2%	227.4	85.2%	75.0	28.1%	160.7	60.2%	73.4	27.5%	1.6	0.7%
	Chronically Threatened	0.2	0.1	33.3%	0.1	100.0%								
	At Risk	330.2	102.9	31.2%	102.9	100.0%	0.1	0.1%	17.0	16.5%	0.0	0.0%	0.1	0.1%
	Critically Underprotected	47.7	17.0	35.6%	17.0	100.0%			14.4	84.5%				
	Underprotected	30,557.0	17,584.4	57.5%	17,521.4	99.6%	11,173.3	63.5%	13,868.8	78.9%	10,374.4	59.0%	798.9	4.6%
	No Threat Category	12,502.7	9,769.8	78.1%	9,750.6	99.8%	7,559.1	77.4%	8,103.9	82.9%	6,764.9	69.2%	794.2	8.1%
Wairoa Total		**48,549.8**	**27,740.9**	**57.1%**	**27,619.3**	**99.6%**	**18,807.5**	**67.8%**	**22,164.6**	**79.9%**	**17,212.7**	**62.0%**	**1,594.8**	**5.8%**
Waitekohe	Acutely Threatened	859.9	16.4	1.9%	16.0	97.5%	0.5	3.3%	1.5	9.1%	0.0	0.2%	0.5	3.1%
	Chronically Threatened													
	At Risk	65.7	0.2	0.4%	0.2	100.0%			0.2	67.8%				
	Critically Underprotected													
	Underprotected	729.2	220.4	30.2%	214.6	97.4%	140.4	63.7%	143.7	65.2%	132.3	60.0%	8.1	3.8%
	No Threat Category	963.6	960.1	99.6%	960.1	100.0%	875.4	91.2%	944.7	98.4%	874.1	91.0%	1.3	0.1%
Waitekohe Total		**2,618.5**	**1,197.1**	**45.7%**	**1,190.9**	**99.5%**	**1,016.4**	**84.9%**	**1,090.1**	**91.1%**	**1,006.4**	**84.1%**	**10.0**	**0.8%**
Grand Total		**123,539.4**	**54,241.0**	**43.9%**	**53,425.2**	**98.5%**	**34,830.0**	**64.2%**	**43,946.3**	**81.0%**	**32,288.1**	**59.5%**	**2,541.9**	**4.8%**

1: Includes vegetation and habitats identified as having high values by the National Priorities (threatened species, sand dunes and wetlands), and/or Category One Natural heritage Sites, and/or Sites of Ecological Significance and/or Smart Growth High Ecological Areas and/or Ecological Constraints High Value Vegetation and Habitat and or recommended for protection in Protected Natural Areas Programme surveys.
2: Legally protected includes land managed by the Department of Conservation, covenanted under Queen Elizabeth II National Trust, under the Nga Whenua Rahui kawenata, retired land subject to the Bay of Plenty Farm and Environment Plans, and protected under a District Council consent notice.
3: Ecological corridors as identified in Figure 4 and includes the outstanding landscape feature corridors also.
4: Overlapping subset with both ecological corridors and legally protected, i.e. these areas are also included in the totals for ecological corridors and legally protected where applicable.
5: Percentage of the total area within that land environment threat category of the sub-catchment.
6: Percentage of the total area (ha) indigenous vegetation within that land environments threat category

7.5 NATURAL VALUES THAT WARRANT ADDITIONAL PROTECTION

Tauranga Harbour is a very large example of high value habitat that has no legal protection and can be significantly affected by activities within the Kaimai-Tauranga catchment. It is strongly recommended that additional ecological corridors, including legal and other protection mechanisms, be identified for the major streams and rivers that enter Tauranga Harbour. Protection of existing vegetation and initiating restoration along waterways will help improve water quality, which will assist with protection of the values within Tauranga Harbour.

Otanewainuku Ecological District

Nearly all high value indigenous vegetation of the Kaitemako sub-catchment, in the Otanewainuku Ecological District, is not protected or included in proposed ecological corridors (98% not protected; a total of 91 ha) - refer to Appendix 5. High value vegetation remnants may still exist in gullies and along waterways and high value vegetation linking to Department of Conservation-managed lands warrants legal protection and/or inclusion in a network of corridors. More than 50% of indigenous vegetation and/or high value habitat is either protected or included in proposed corridors in other sub-catchments.

Tauranga Ecological District

Within Tauranga Ecological District, most indigenous vegetation with high values is currently not legally protected, nor is it included in any of the proposed ecological corridors (Appendix 15.5). Unprotected remnants of pohutukawa forest on headlands on the margins of Tauranga Harbour warrant legal protection and active management. Vegetation within the following sub-catchments also needs to be urgently assessed, in order of priority: Kaitemako (89% of high value indigenous not protected), Wairoa (71.9%), Waitekohe (71%), Aongatete (60%), Tahawai (59.5%), Kaiate (54.5%), Te Puna (53.9%), Waimapu (53.2%), Uretara/Te Rereatukahia (49.8%), Waipapa (37.5%), and Uretara/McKinney (34.4%). Table 7 provides a breakdown of vegetation types within each ecological district that are neither currently protected nor included in an ecological corridor. This Table and Figures 8a-d should help pinpoint where further legal protection and inclusion into the corridor network is warranted.

Te Aroha Ecological District

More than 50% of indigenous vegetation and/or high value habitat is protected and/or included in proposed ecological corridors. However, there is still some 359 ha of high value indigenous vegetation/habitat that warrants protection. High value vegetation linking to Department of Conservation-managed lands warrants legal protection and/or inclusion in a network of corridors. Protection and restoration of riparian vegetation should be encouraged, as Te Aroha Ecological District encompasses the head waters of a substantial number of catchments.

Waihi Ecological District

Very little of the indigenous vegetation (and none of the high value sites) in the Waiau sub-catchment of Waihi Ecological District is protected, and none is included in proposed ecological corridors, thus there is potential to protect up to 36 ha. High value indigenous terrestrial vegetation may still exist in the vicinity of Woodlands and Walls Roads, Steele and Emerton Roads, and along Seaforth Road.

Table 7: Opportunities for protection of unprotected high value vegetation/habitats within the Kaimai-Tauranga catchment, by vegetation type.

Ecological District	Indigenous Vegetation Type	High Value Indigenous Vegetation	Indigenous Vegetation	Total
Otanewainuku	Freshwater indigenous	138.1	8.9	147.0
	Terrestrial indigenous	5,283.3	136.5	5,419.9
Otanewainuku Total		**5,421.5**	**145.4**	**5,566.9**
Tauranga	Estuarine indigenous	406.0	2.2	408.2
	Freshwater indigenous	226.0	13.8	239.7
	Terrestrial indigenous	488.3	191.0	679.2
Tauranga Total		**1,120.2**	**206.9**	**1,327.1**
Te Aroha	Freshwater indigenous	2.3		2.3
	Terrestrial indigenous	356.6	78.1	434.7
Te Aroha Total		**358.9**	**78.1**	**437.0**
Waihi	Terrestrial indigenous	36.3	78.9	115.2
Waihi Total		**36.3**	**78.9**	**115.2**
Grand Total		**6,937.0**	**509.2**	**7,446.2**

7.6 THE NEED FOR ADDITIONAL CORRIDORS

High value indigenous vegetation and habitats tend to be concentrated along the margins of the harbour and on the Kaimai Range and its foothills. Within Tauranga Ecological District there are very few sites in between other than vegetation associated with rivers and streams. In Otanewainuku Ecological District there still are many high value sites, again often associated with waterways. The inland and coastal sites are part of a ranges-to-the-sea ecological sequence and the connections between them should be maintained and enhanced.

There is a need to restore ecological corridors between the inland forests (and inland outstanding features) and the coast. Opportunities for restoring ecological corridors exist along the major rivers and streams within the study area (refer to Table 8 and Figures 8a to 8d).

Corridors between the Kaimai Ranges and the coast would allow ecosystem service benefits gained inland to be expressed all the way to the coast, with subsequent protection (and improvement) of water quality in Tauranga Harbour. These ecosystem services include clean fresh water, reduction in

sedimentation and other water-borne nutrients/contaminants, physical linkage of habitat allowing the interchange and flow of genetic material and movement of fauna (terrestrial and aquatic), potential reductions in flood event magnitude, habitat for pollinators and predators of pest species, and increased scenic and recreation appeal. Degraded portions warrant restoration, and creation of wetlands adjacent to and linked with the rivers and streams could hugely increase ecosystem services.

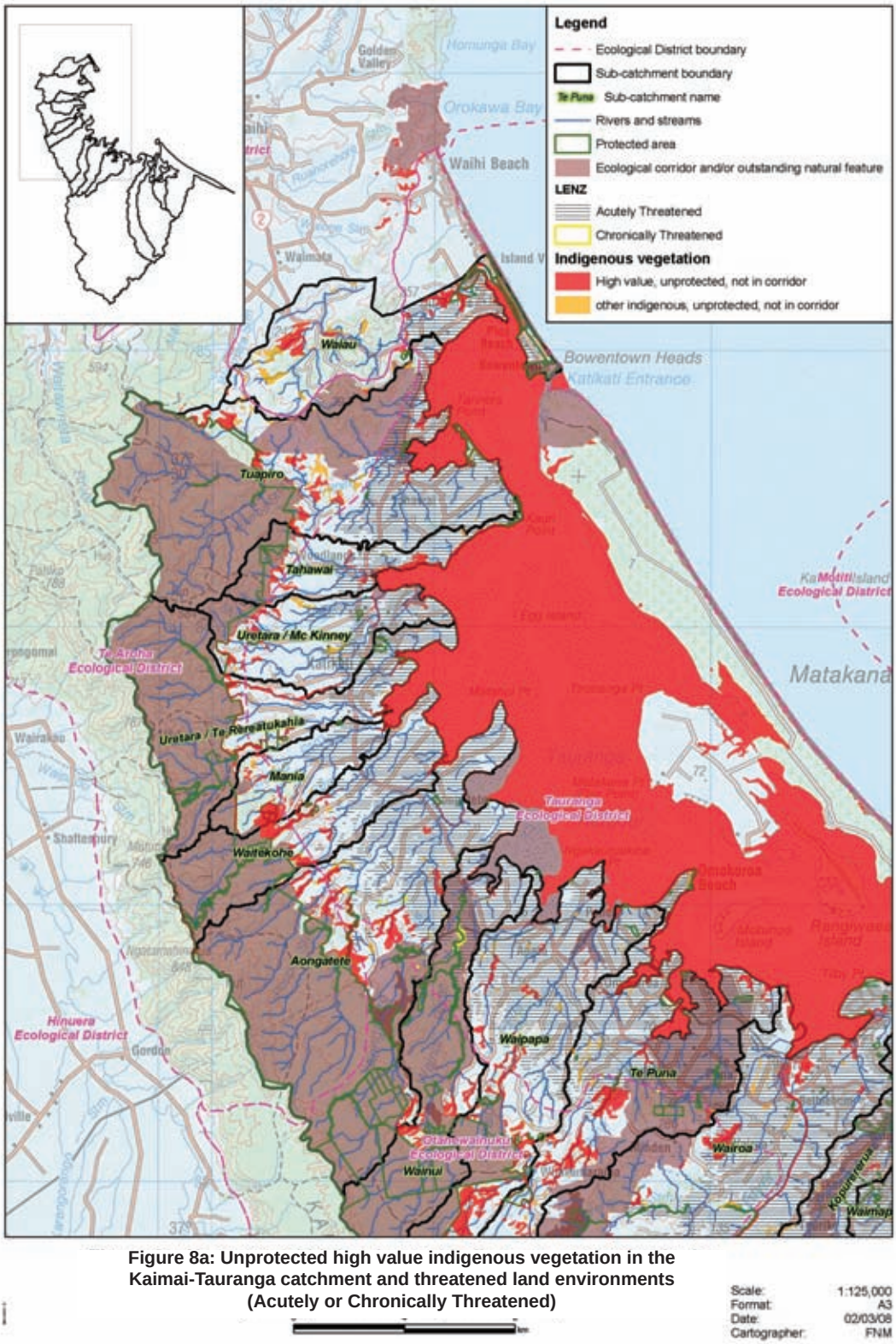


Figure 8a: Unprotected high value indigenous vegetation in the Kaimai-Tauranga catchment and threatened land environments (Acutely or Chronically Threatened)

Figure 8a - 8d: Unprotected high value indigenous vegetation in the Kaimai-Tauranga catchment and threatened land environments. (Acutely or Chronically Threatened).

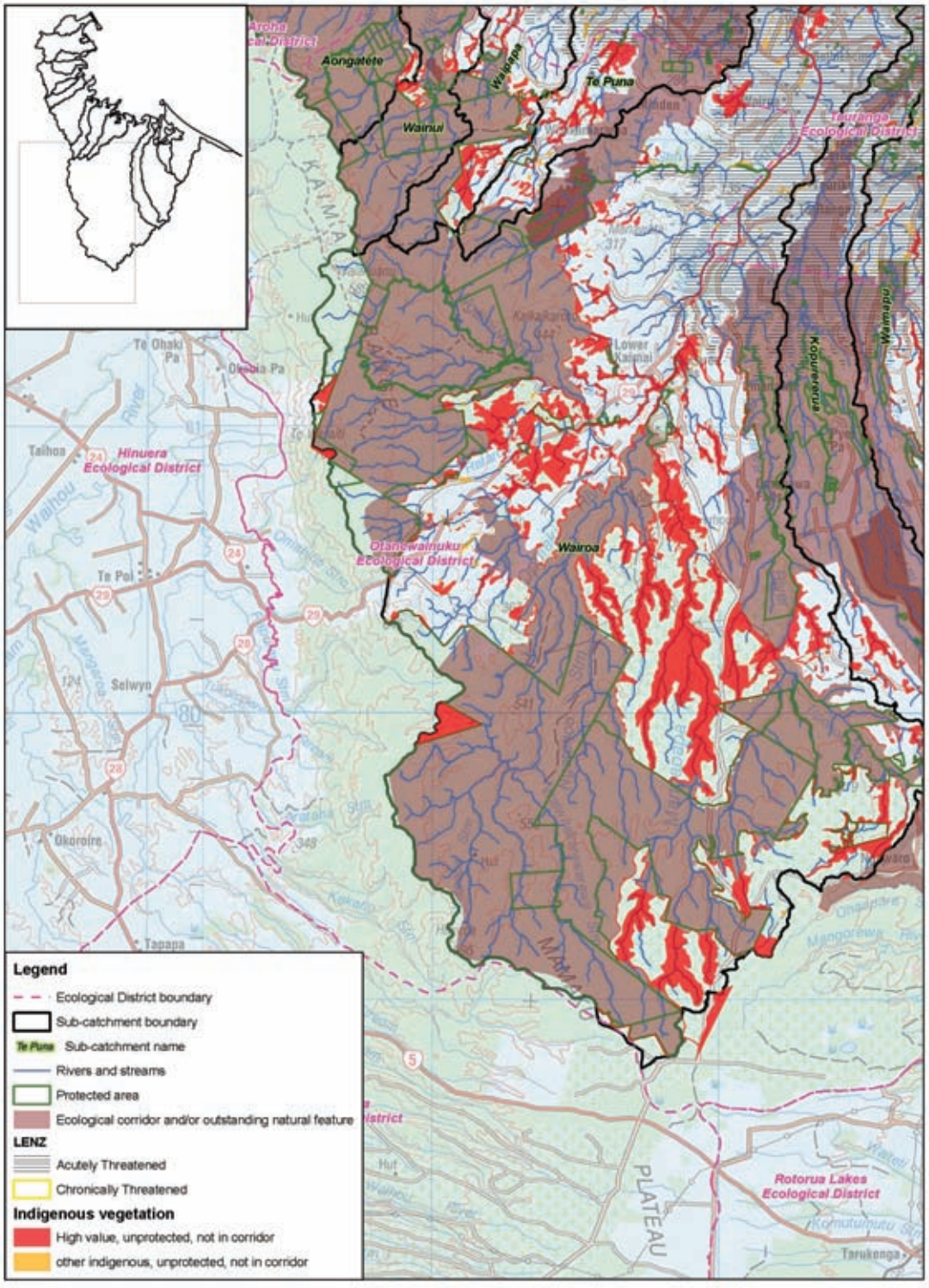


Figure 8b: Unprotected high value indigenous vegetation in the Kaimai-Tauranga catchment and threatened land environments (Acutely or Chronically Threatened)

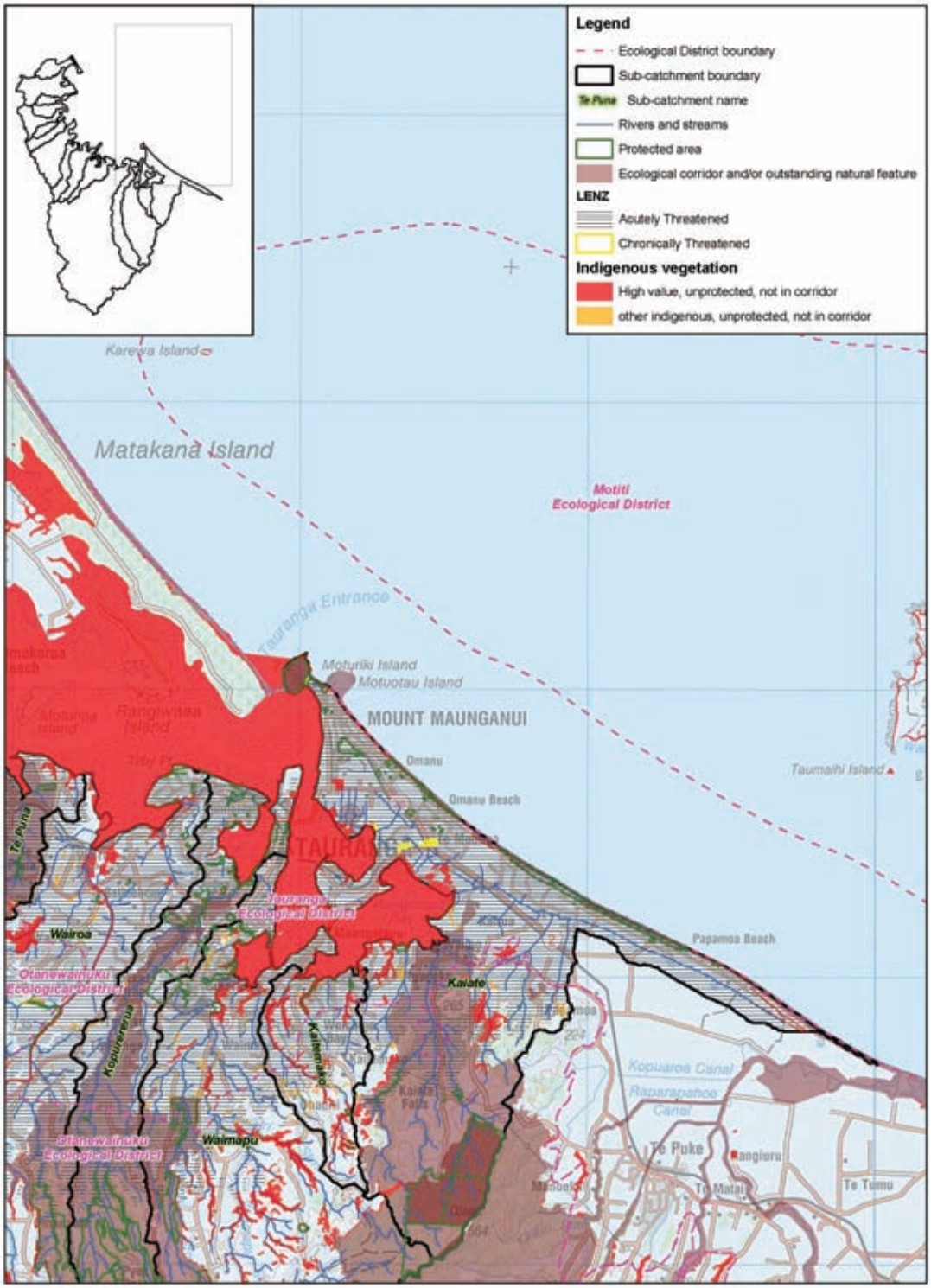


Figure 8c: Unprotected high value indigenous vegetation in the Kaimai-Tauranga catchment and threatened land environments (Acutely or Chronically Threatened)

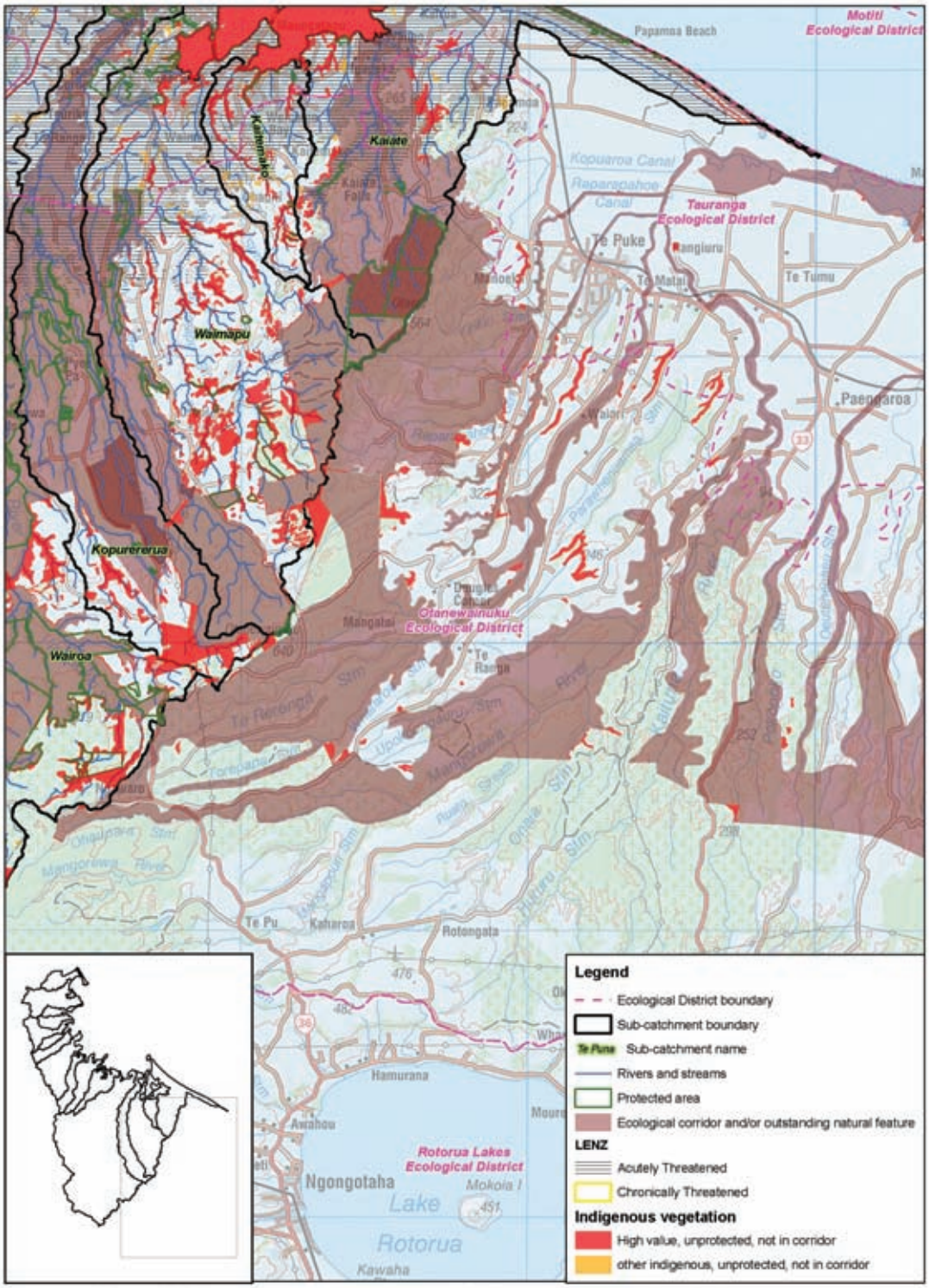


Figure 8d: Unprotected high value indigenous vegetation in the Kaimai-Tauranga catchment and threatened land environments (Acutely or Chronically Threatened)

Table 8: Streams and rivers that warrant protection within the study area, but not currently included in ecological corridors.

River/Stream Name	Reason for Inclusion
Wairoa River	The Wairoa River and tributaries are considered to be nationally important for biodiversity (Ministry for the Environment and Ministry of Agriculture and Forestry 2004). Most of the Wairoa catchment is within an Acutely Threatened land environment and there is considerable opportunity to protect additional areas of high value indigenous vegetation. Restoration of Wairoa River valley is considered to be a priority in the SmartGrowth Strategy (SmartGrowth 2007).
Ngututuru and Te Rereatukahia Streams	Ngututuru/ Te Rereatukahia Streams are considered to be nationally important for biodiversity (Ministry for the Environment and Ministry of Agriculture and Forestry 2004). There is considerable opportunity to protect additional areas of high value indigenous vegetation.
Waimapu Stream	There is considerable opportunity to protect additional areas of high value indigenous vegetation, including Chronically Threatened land environments, and the Waimapu Valley is considered to be a priority for restoration by the SmartGrowth Strategy (SmartGrowth 2007). Stream ecological corridors would also link to Otawa and Hidden Gorge ecological corridors.
Te Puna Stream	Large areas of high value indigenous vegetation along and adjacent to the stream, including some areas that are Acutely Threatened land environments, conserve vegetation linkages with Te Puna ecological corridor.
Aongatete River and Poupou Stream	Large areas of high value indigenous vegetation along and adjacent to the stream, including some areas that are Acutely Threatened or Chronically Threatened land environments, conserve vegetation linkages with Work Road ecological corridor.
Waitekohe Stream	Large areas of high value indigenous vegetation along and adjacent to the stream. No other ecological corridors nearby.
Tuapiro Creek	Considerable areas of high value and other indigenous vegetation along the river, maintain vegetation linkages to Tuapiro ecological corridor.
Waipapa River	Considerable areas of high value indigenous vegetation along the river.

8 Recreation Values

The study area also provides significant recreation opportunities. The 37,000 ha Kaimai Mamaku Forest Park forest park is a living museum of natural and human history. Fifteen tracks and walks, comprising some 400km of tracks (including seven huts, numerous bridges, and seven huts, toilets and other visitor facilities), cater for all fitness levels, including overnight tramps and day walks. There are also opportunities for mountain biking, rock climbing, and trout fishing. The Kaimai Range also has a rich industrial past that can be explored, including mining tunnels tramways, logging works and haul lines.

The Waitawheta River offers some of the best trout fishing in the area, alongside the historic tramway. Cyclists and dog walkers are welcome on the Karangahake Historic Walkway. Monthly and fortnightly releases of 15 cumecs of water from the McLaren Falls Dam provides opportunities for recreational white water canoeing and rafting on the Wairoa River above State Highway 29.

Many of these recreational assets are managed by the Department of Conservation.

9 Ecosystem Services

9.1 CONTEXT

The western Bay of Plenty is seen as a desirable place to live and work and is therefore considered to be under long-term growth pressure. The vision of the SmartGrowth Strategy for growth management is centred on sustainable development. It focuses on growth accommodation, emphasising the quality of outcomes, but is not promoting growth *per se* (SmartGrowth 2007).

Clothier *et al*. (2008) note that sustainable economic growth depends on financial capital, economic capital (infrastructure, as well as money), human capital (knowledge, skills, and competencies), institutional capital (civic, political, and legal arrangements), cultural capital (values, histories, traditions and practices binding people together), social capital (networks of shared norms, trust and understanding) and **natural capital** (the renewable and non-renewable stocks of natural resources and processes that support life and economic activities). This natural capital is also known as 'ecosystem services'.

In New Zealand we are highly dependent on our natural capital (or ecosystem services). Our waters, soils and indigenous and non-indigenous biodiversity are important for sustaining wealth-generating capabilities, especially for our farming systems. Twenty percent of New Zealand's Gross Domestic Product (GDP) is said to come from the top 15 cm of soil (Parliamentary Commissioner for the Environment 2004). The last few decades have seen significant land use changes and land use intensification, mostly relying on natural resources (natural capital or ecosystem resources).

A key piece of legislation relating to ecosystem services is New Zealand's Resource Management Act (RMA 1991), the purpose of which is to promote the sustainable management of natural and physical resources.

Components of the RMA that define sustainable management include managing the use, development and protection of these resources, while:

- **sustaining their potential;**
- **safeguarding their life-supporting capacity;**
- **Avoiding, remedying, and mitigating adverse effects.**

The series of 5 actions above (bold) rely on ensuring that ecosystem services are sustained and safeguarded, and adverse effects are minimised through avoidance, remediation, or mitigation. More use of the RMA could be made to highlight ecosystem services and ecosystem values.

9.2 WHAT ARE ECOSYSTEM SERVICES?

Ecosystem services have been variously defined since the concept was first mooted in the 1950s. In general, the concept referred to flows of materials, energy, and information from natural capital stocks to produce human welfare. However, this initial concept created confusion between goods, functions, benefits, and services, and it also proved difficult to measure the values of natural capital and ecosystem services (Clothier *et al.* 2008).

The Millennium Ecosystem Assessment (MEA) programme was established by the United Nations (UN) in 2001. Over 1,360 experts worldwide were tasked with assessing the consequences of ecosystem change for human well-being and providing the scientific basis for actions to enhance their contribution to human well-being. The MEA categorised ecosystem services into four broad and overlapping groups: provisioning services, regulating services, cultural services and supporting services (Clothier *et al.* 2008) (Table 9 below). In 2005 the MEA was modified to recognise human well-being as the central concept, and it acknowledges that biodiversity and ecosystems have intrinsic values. In other words, those aspects of ecosystems and their constituent parts have value in their own right, including their biological and genetic diversity and the essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience.

Ecosystem services contribute to the well-being of individuals and communities and are influenced or driven by various factors that directly influence or impinge on ecosystem services, including: land use, species introductions, changes in technology, harvest techniques, climate change, and other natural factors. More subtle or diffuse factors that can influence or impinge on ecosystem services include demographics, socio-political change, culture, religion, science and technology (Clothier *et al.* 2008). The MEA found that approximately 60% (15 out of 24) of the ecosystem services evaluated (including 70% of regulating and cultural services) are being degraded or used unsustainably world-wide (Parliamentary Office of Science and Technology 2007).

Examples of processes or ecosystem functions that might be supplied by New Zealand ecosystems are shown in Table 10 below (modified from Golubiewski 2007). This table illustrates that there are often many facets that drive or contribute to a particular ecosystem service. Disruption to any of the ecosystem functions will have an effect on the ability of the ecosystem to provide a particular service.

Some ecosystem functions can contribute to multiple ecosystem services; for instance accumulation of organic material is a key function in soil formation and fertility, but also assists with water regulation and erosion regulation. A single ecosystem service is often the product of two or more ecosystem functions, for instance potable water needs both water quality and water storage. A single ecosystem type can produce more than one service. For instance, vegetation in inland areas linked to downstream marine habitats trap silt (water purification and waste treatment) and provide breeding

grounds for fish (food). Many ecosystem functions are also interdependent, for instance a lack of organic material will also affect most of the nutrient-cycling functions. It can therefore be difficult to assess how one ecosystem function should be valued economically.

Table 9: Summary of ecosystem services generated by the Millennium Ecosystem Assessment Programme.

Provisioning services

Products obtained from ecosystems

- Food
- Fresh water
- Wood
- Fibre
- Fuel
- Genetic resources
- Biochemicals, natural medicines, and pharmaceuticals
- Ornamental resources

Regulating services

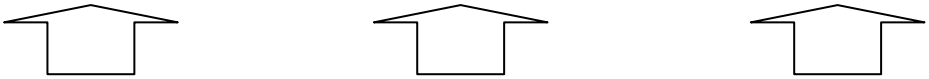
Benefits derived from regulation of ecosystem services

- Air quality maintenance
- Climate regulation
- Water regulation (including flood regulation)
- Erosion control
- Water purification and waste treatment
- Regulation of human diseases.
- Biological control
- Pollination
- Storm protection

Cultural services

Non-material benefits derived from ecosystems

- Cultural diversity
- Spiritual and religious values
- Knowledge systems
- Educational values
- Inspiration
- Aesthetic values
- Social relations
- Sense of place
- Cultural heritage values
- Recreation and ecotourism



Supporting services

Services necessary for the production of all other ecosystem services

- Soil formation and retention
- Nutrient and water cycling
- Primary production
- Production of atmospheric oxygen (and other gasses)
- Provision of habitat

Table 10: Potential ecosystem services supplied by New Zealand ecosystems.

Functional Category	Ecosystem Service	Ecosystem Function
Supporting services	Soil formation and fertility	Organic material (accumulation)/decomposition.
		Weathering of rock.
		Soil organisms (e.g. Nitrogen fixers).
		Soil carbon.
		Soil nitrogen.
		Cation exchange capacity.
		Water infiltration (closely correlated with SOM).
		Water holding capacity.
		Vegetation cover (removal leads to increased runoff; decreased soil recharge).
	Nutrient cycling (storage, cycling, and/or capture and processing of nutrients)	Nitrogen fixation.
		Other nitrogen cycles.
		Phosphorus.
		Carbon storage- soils and vegetation (tons C/ha).
		Other carbon cycles.
		Other elemental cycles.
	Primary production	Primary production.
		O_2 as provided by photosynthesis.
	Water cycling	Flow volumes.
	Habitat provision/ refugia	Nurseries.
		Habitat for migratory species.
		Measure of connectivity/fragmentation.
Provisioning services	Food	Crops.
		Livestock production.
		Forage land cover (intermediate for livestock).
		Capture fisheries abundance/presence/production.
		Aquaculture.
		Wild foods.
		Waterfowl.
		Other food products.
		Area of habitat for food species (e.g. Fisheries).
	Fibre	Timber.
		Flax.
		Wood fuel.
		Other fuels/energy sources.
		Raw materials for industry.
	Genetic resources	Particular populations identified.
		Seed abundance/dispersal.
		Biodiversity.
	Biochemicals, medicines	Vegetation cover for source materials.
		Biodiversity.
	Freshwater	Water volume- rivers, lakes.
Regulating services	Air quality regulation	CO_2/O_2 balance.
		Contribution to O_3 for UV protection.
		Contribution to O_3 as smog.
		Contribution to SOX levels.
	Climate regulation- global	Green house gas emission.
		Green house gas sequestration.
		DMS production affecting cloud formation.
		CO_2, N, and S cycles (*see green house gas above).
		Biomass (and land cover change, e.g. Deforestation/heat retention).
	Climate regulation- local and regional	Land cover (as affects temperature and precipitation).
	Water regulation	Water volume for agriculture, industry, transport.
		Irrigation.
		Water supply by watersheds, reservoirs, aquifers.
		Lake storage.
		Land cover (as affects water storage potential and timing of flows).
		Land cover change (wetlands conversion or forest to crops).

Functional Category	Ecosystem Service	Ecosystem Function
	Erosion regulation	Vegetation structure for soil retention and preventing landslides.
		Rooting/belowground biomass.
		Storage of silt in lakes and wetlands.
		Soil "abundance" (volume, as potential to be lost).
	Water purification and waste treatment	Water volume.
		Decomposition of wastes/ filtering.
		Impurities.
	Disease regulation	Vector populations (e.g. Mosquitoes).
		Pathogen population abundance (e.g. Cholera).
		Habitat of vectors.
		Habitat of predators of vectors.
	Pest regulation/ biological control	Predator populations (of pest species) - for crops.
		Herbivory measurements.
		Habitat for keystone species.
		Ecosystem change as indicator of prevalence of pests and diseases.
	Pollination	Pollinator populations (abundance, distribution)-managed and wild bees (esp. Honey bees); other insects (beetles, butterflies); birds.
		Pollinator habitat.
	Natural hazard/ disturbance regulation	Vegetation structure (affecting storm, flood, drought protection and control).
		Coastal ecosystem presence.
		Streamflow.
Cultural services	Educational	
	Parks, scenic drives, residential locations	Aesthetic values.
	Recreation and ecotourism	Visitor and business statistics.
		Water volume and flow (as basis of water sports).
	Inspirational, sense of place	Art, folklore, national symbols, architecture, advertising.
	Cultural heritage and spiritual and religious values	Ornamental resources, e.g. Animal skins, shells, flowers.
		Significant species.
		Historical/cultural landscapes.

9.3. HOW TO VALUE ECOSYSTEM SERVICES

Attempts to assign dollar values to the environment and ecosystems are not new. The valuation of ecosystem services is, however, a new approach that offers a systematic way of thinking about how to ensure that ecosystems and the services they provide are taken into account in policy appraisal (DEFRA 2007). Even so, there is still a range of methods and techniques available to value ecosystem services, and even with improved knowledge and data, economic valuation will still be challenging (Clothier *et al.* 2008). What is known, in general terms, is that the value of ecosystem services is likely to be huge. One way to think about the value of ecosystem services is to determine what it would cost to replicate them in a technologically-produced, artificial biosphere. Experience with manned space missions and with Biosphere II in Arizona indicates that this is an exceedingly complex and expensive proposition (Costanza *et al.* 1997).

Little work has been undertaken in New Zealand to value ecosystem services. A small number of studies have been completed and others are underway, including a project to study the values of water catchments (Davie *et al.* 2004). A study in 1997 estimated the value of ecosystem services in the Waikato region to be 2004 NZ$10.6 billion (Patterson and

Cole 1999; Kaval 2004[1]). Ecosystem values were included in the economic analyses of Te Kouma Farm Park (Kaval *et al.* 2004) and Maungatautari Ecological Island (Kaval, 2004) and research institutions have set up centres to study and quantify ecosystem services (e.g. Massey University, Landcare Research, and the Sustainable Land Use Research Institute). In the international literature, one study that is referred to frequently is an article published by Costanza *et al.* in Nature in 1997, and which is used here as a basis for assigning ecosystem service values in the study area.

Costanza *et al*. (1997) reviewed existing literature and synthesised estimates of the value of ecosystem services. Essentially they tried to estimate value to human welfare if the quantity or quality of various types of natural capital and ecosystem services changed. They grouped ecosystem services into 17 major categories, included only renewable ecosystem services (excluding non-renewable fuels, minerals and the atmosphere), and avoided 'double counting' where this could be identified.

They noted that a minimum level of ecosystem 'infrastructure' is necessary in order to allow production of the range of services, and that often the 'infrastructure' in itself is a contributor to the total value, but they were unable to source sufficient data to include the 'infrastructure' value in the calculations. One example of the scale of the contribution of ecosystem infrastructure is the dollar cost to replant an entire water catchment to improve water quality. Once the vegetation is mature enough, it will contribute more ecosystem services than just water quality, but without the 'minimum infrastructure' of vegetation cover these ecosystem services are either not available or very limited in extent.

They did, however, attempt to include ecosystem services that were marketed, as well as those that were not. An example might be buying slightly more expensive timber from a plantation that is managed sustainably. People may be willing to pay this premium as they see that sustainable management contributes to soil conservation, and aesthetic, and conservation values. However, the forest could also be providing additional, unmarketed ecosystem services such as water quality, carbon storage, and air quality improvements.

In many instances, the studies included in the review were based, either directly or indirectly, on attempts to assess the "willingness-to-pay" by individuals for the particular ecosystem services. For instance, if ecological services provide a $50 increment to the productivity of a timber forest, then the beneficiaries of this service should be willing to pay $50 for it. If, in addition to the ecosystem services, this forest also provided aesthetic, existence and conservation values of $70 then those individuals receiving this non-market benefit should be willing to pay up to $70 for it. Thus, the total value of ecosystem services for this timber forest would be $120 (the marketed and unmarketed values added) (Costanza *et al.* 1997). Some examples of this willingness to pay for ecosystem services are included under the section below on Value of Water.

[1] Kaval (2004) estimated the value of ecosystem services provided by indigenous forest, in the Waikato, at $1,618/ha/yr. This value, if applied to the Kaimai-Tauranga catchments, would equate to a value of NZ$80 million/yr.

The values derived by Costanza *et al.* (1997) are average values, and the biomes described do not directly match the data available for the Kaimai-Tauranga catchment (Table 11). However, the derived economic values can be used to get some idea of the magnitude of ecosystem services in the Kaimai-Tauranga catchment. The Costanza *et al.* (1997) paper also acknowledges that the estimates derived are a crude approximation, with many data gaps. The key sources of error, limitations and caveats for the data can be summarised as:

- Incomplete data (not all biomes and/or ecosystem services have been well studied, and some have not been studied at all).
- Distortions in current prices are carried through the analysis. For instance it is not possible to determine the actual price for ecosystem services, or estimate the value of the informal economy including bartering, and household labour.
- Most estimates are based on current willingness-to-pay or proxies, and this is usually based on incomplete understanding of ecosystems and ecosystem services by the participants.
- The authors felt that they were probably underestimating changes in supply and demand curves as ecosystem services become more limiting. A good example of this is the rush on supermarkets and hoarding of food that occurs when a food-supply crisis is looming. The timing and magnitude of this behaviour often cannot be easily predicted.
- The paper assumes smooth responses in ecosystem functions, with no thresholds or discontinuities. This is almost certainly not the case, e.g. once vegetation has been drought-stressed it may not fully recover, therefore the ecosystem services provided by that vegetation may never fully recover, or may take a very long time to recover.
- The paper assumes spatial homogeneity of services within biomes; that is, all parts of the biome or habitat all supply the same level of service.
- It was not possible to accurately determine the inter-relationships between the various ecosystem services, and how much a reduction in one ecosystem service might affect other ecosystem services, and hence the value of those services.
- The data are not necessarily based on sustainable use levels, as some ecosystem services are currently over-utilised.
- Does not fully include the “infrastructure” value of ecosystems.
- Difficulties and imprecision of making inter-country comparisons, e.g. differences in income between countries.
- Discounting (for the few cases where we needed to convert from stock to flow values).
- Static snapshot; no dynamic interactions.
- Values in the paper are expressed in 1994 US $, and these have altered due to because of subsequent inflation, changes in currency exchange and global market trends. May no longer adequately represent current, actual values.

Most of these issues (except perhaps the 6th bullet point above, which could go either way) are likely to have led to an underestimate of ecosystem service values (Costanza 2008; Costanza *et al.* 1997).

9.4 INDICATIVE VALUE OF KAIMAI-TAURANGA CATCHMENT ECOSYSTEM SERVICES

To assess the contribution of ecosystem services to the Kaimai-Tauranga catchment we assigned each land cover in the study area (derived from LCDB2) to one of the biomes listed by Costanza *et al.* (1997) (Table 11) and calculated the area of each biome (in ha) within the study area (Table 13).

Table 11: Assigning Land Cover database classification to Costanza *et al.* (1997) biome classification.

LCDB2 Classification	Area (Ha)	Biome Classification
Broadleaved Indigenous Hardwoods	829	Forest
Indigenous Forest	49,940	Forest
Landslide	3	Ice/rock
Manuka and or Kanuka	1,273	Forest
Herbaceous Freshwater Vegetation	37	Swamps/floodplains
River and Lakeshore Gravel and Rock	0	Lakes/rivers
River	95	Lakes/rivers
Lake and Pond	76	Lakes/rivers
Coastal Sand and Gravel	45	Coastal
Estuarine Open Water	38	Estuaries
Herbaceous Saline Vegetation	353	Seagrass/algae beds
Mangrove	48	Tidal marsh/mangroves
Gorse and Broom	657	Temperate/boreal
Afforestation (imaged, post LCDB 1)	240	Temperate/boreal
Afforestation (not imaged)	41	Temperate/boreal
Deciduous Hardwoods	158	Temperate/boreal
Other Exotic Forest	960	Temperate/boreal
Pine Forest - Closed Canopy	7,976	Temperate/boreal
Pine Forest - Open Canopy	1,172	Temperate/boreal
Major Shelterbelts	171	Temperate/boreal
Mixed Exotic Shrubland	99	Temperate/boreal
Orchard and Other Perennial Crops	7,755	Cropland
Forest Harvested	1,132	Cropland
Urban Parkland/ Open Space	975	Urban
Low Producing Grassland	491	Grass/rangelands
High Producing Exotic Grassland	42,620	Grass/rangelands
Short-rotation Cropland	273	Cropland
Vineyard	18	Cropland
Built-up Area	4,862	Urban
Surface Mine	100	Ice/rock
Transport Infrastructure	84	Urban
Grand Total	**122,522**	

The most valuable biomes in the study area, expressed in terms of the $ value of ecosystem services provided per ha, are aquatic and wetland systems (Table 13). Listed in order of priority, from most to least valuable, they are: estuaries, swamps/floodplains, seagrass/algae beds, tidal marsh/mangroves, lakes/rivers, and other coastal habitats. Next most valuable are indigenous forest (including manuka and/or kanuka), non-indigenous forest (classified as temperate/boreal, also includes gorse/broom

and mixed exotic shrublands), grass/rangelands, cropland, urban and ice/rock (low value partially due to lack of knowledge about the ecosystem contributions of this biome).

The total annual value of ecosystem services within the study area is crudely estimated to be around 1994 US$75.7 million per annum (converts to *c*. NZ$195 million per annum, inflation-adjusted to fourth quarter of 2009). This compares with the total Gross Domestic Product (GDP) the Tauranga-Western Bay of Plenty region of *c*.$NZ4,000 million during 2008 (information provided by APR Consultants Ltd, 22 July 2009, Table 12). The percentage contribution of ecosystem services to the region is likely to be at least 5% of GDP (however this is indicative estimate only[1]). It must be emphasised that these results need to be treated with a great deal of caution, and only be used as an indication of the possible magnitude of ecosystem services within the study area.

Table 12: Per Capita GDP for the Tauranga/Western Bay of Plenty area, for the past six years (source: APR Consultants Ltd.).

September Years	Real GDP $M[1]	Est. Resident Population[2]	Real GDP Per Capita ($)			
			Tauranga/ Western Bay of Plenty	Annual % Change	New Zealand	Annual % Change
2003	3,165	139,600	22,672	-	29,341	-
2004	3,417	143,300	23,845	5.17	30,278	3.19
2005	3,506	146,800	23,883	0.16	30,795	1.71
2006	3,640	150,000	24,267	1.61	31,055	0.84
2007	3,875	152,700	25,377	4.57	31,587	1.71
2008	4,066	154,900	26,249	3.44	31,813	0.72

Source: Data compiled from information sourced from Infometrics and Statistics New Zealand

Notes:
(1) GDP in inflation-adjusted dollars for Tauranga/Western Bay of Plenty.
(2) Sourced from Statistics New Zealand (SNZ) population estimates.
(3) Figures presented are in current dollars.

The biome which makes the largest total annual contribution to the value of ecosystem services is the largest in the study area: indigenous forest contributes 66% of annual value, followed by grass/rangelands, seagrass/algae beds, non-indigenous forests (temperate/boreal), lakes/rivers. Estuaries, cropland, swamps/floodplains, tidal marsh/mangroves, and other coastal habitats each contribute less than 1% of the annual value, but this is mostly due to the small remaining sizes of these habitats. Urban and ice/rock biomes have a negligible ecosystem services contribution.

The Department of Conservation manages 25% of indigenous forests within the study area, thus maintenance of the health and vitality of these forests contributes significantly to the health and wellbeing and the economic benefit of the wider Kaimai-Tauranga catchment.

[1] Indicative estimate only as the Tauranga-Western Bay of Plenty area, for which GDP estimated in Table 12, is larger and not directly comparable to the study area. Furthermore, the method used to derive the ecosystem services values only provides crude estimates, for all the reasons outlined in this document (Section 10.3) and also because there wasn't a direct match between biomes and LCDB2 vegetation descriptions.

Table 13: Crude estimation of the magnitude of the value of ecosystem services within the Kaimai-Tauranga catchment.

Biome	Area (ha)	% of Total Area	Gas Regulation	Climate Regulation	Disturbance Regulation	Water Regulation	Water Supply	Erosion Control	Soil Formation	Nutrient Cycling	Waste Treatment	Pollination	Biological Control	Habitat/refugia	Food Production	Raw Materials	Genetic Resources	Recreation	Cultural	Total Value per Ha (1994 US)	Total Annual Value Kaimai-Tauranga Catchment (1994 US $/yr total area)	$NZ Annual Value #	% Annual Value
Marine																							
Open ocean			38							118			5		15	0			76	252	0		0.0%
Coastal	45	0.0%			88					3,677			38	8	93	4		82	62	4,052	180,598	464,948	0.2%
Estuaries	37.72	0.0%			567					21,100			78	131	521	25		381	29	22,832	861,223	2,217,217	1.1%
Seagrass/algae beds	353.43	0.3%								19,002						2				19,004	6,716,584	17,291,831	8.9%
Coral reefs					2,750						58		5	7	220	27		3008	1	6,076	0		0.0%
Shelf										1,431			39		68	2			70	1,610	0		0.0%
Terrestrial																				0	0		0.0%
Forest	52,041	42.5%		141	2	2	3	96	10	361	87		2		43	138	16	66	2	969	50,428,097	129,827,033	66.6%
Tropical		0.0%		223	5	6	8	245	10	922	87				32	315	41	112	2	2,008	0		0.0%
Temperate/boreal	11,475	9.4%		88		0			10		87		4		50	25		36	2	302	3,465,535	8,922,012	4.6%
Grass/rangelands	43,111	35.2%	7	0		3		29	1		87	25	23		67		0	2		244	10,519,135	27,081,492	13.9%
Wetlands			133		4,539	15	3,800				4,177			304	256	106		574	881	14,785	0		0.0%
Tidal marsh/mangroves	48	0.0%			1,839						6,696			169	466	162		658		9,990	483,416	1,244,554	0.6%
Swamps/floodplains	37	0.0%	265		7,240	30	7,600				1,659			439	47	49		491	1761	19,581	732,134	1,884,876	1.0%
Lakes/rivers	171	0.1%				5,445	2,117				665				41			230		8,498	1,450,779	3,735,026	1.9%
Desert																					0		0.0%
Tundra																					0		0.0%
Ice/rock	103	0.1%																			0		0.0%
Cropland	9,178	7.5%										14	24		54					92	844,418	2,173,953	1.1%
Urban	5,920	4.8%																		0	0		0.0%
Total (1994 $US)	**122,522**		**443**	**452**	**17,030**	**5,501**	**13,528**	**370**	**31**	**46,611**	**13,603**	**39**	**218**	**1,058**	**1,973**	**855**	**57**	**5,640**	**2,886**	**110,295**	**$US75,681,918**	**$NZ194,842,943**	

Shaded cells indicate services that do not occur or are known to be negligible in that biome. Open cells indicate lack of available information.
New Zealand value calculated by using a conversion rate from $US to NZ in the first week of 1994 of 1.78632, and then inflation adjusting this amount using the New Zealand CPI Inflation Calculator on http://www.rbnz.govt.nz/statistics/0135595.html. Inflation adjusted to the 4th quarter of 2009.
These findings need to be treated with considerable caution, and only used as an indication of the possible magnitude of the ecosystem services within the catchment. There are many sources of potential error (refer to text), LCDB2 classification does not have a good match to biome classification, and information is missing for all ecosystem services.

9.5 THE VALUE OF WATER

One of the key ecosystem services provided by indigenous ecosystems is the capture, storage, gradual release, and purification of water. Fresh water is a resource that is used by every human being, and by many different sectors including agriculture, horticulture, industry, municipal authorities, and private individuals. Seasonal water shortages are becoming an issue in many parts of New Zealand (e.g. recent droughts in Northland and Waikato), and especially so on the drier east coast, including in the study area, and lack of access to potable water is recognised as a worldwide issue (Millennium Ecosystem Assessment Board 2005).

Within the study area, there are numerous resource consents to take water from streams and bores, including consents held by Tauranga City Council, as well as numerous permitted, but unquantifiable, household and farm water supplies, and it s not possible to assess the overall amount of water abstracted.

Tauranga City obtains its water from the large underground aquifer in the foothills of the Kaimai Ranges, via the Tautau and Waiorohi Streams. The Council has a water right to take up to 37,000 cubic metres from the Tautau Stream and up to 54,000 cubic metres per day from the Waiorohi Stream. The combined area of these two catchments is 45 km^2 and Tauranga City Council owns approximately 26 km^2 of land, which helps to protect key parts of the catchments. Both streams are partially spring-fed from the aquifer. This is very useful as it gives them a semi-constant flow, even in summer when demand is high and rainfall is low (Tauranga City Council 2009a).

Water is not just valuable for drinking and the agricultural and horticultural sectors. Water from the Kaimai catchment is also used for hydro-electricity generation, and significant loss of vegetation, and related increases in sedimentation, have, in the past, affected the amount of electricity generated (Choudhry and Bardsley 1997). As well as providing benefits to people, the entire catchments of the Wairoa River and tributaries and the Ngututuru/ Te Rereatukahia Streams are considered to be nationally important for indigenous biodiversity (Ministry for the Environment and Ministry of Agriculture and Forestry 2004). Moreover, work by the Cawthron Institute has also highlighted that New Zealand indigenous fish species, and introduced sport fish such as trout, require higher river flows than initially thought. In order to maintain populations of these fish, river flow systems may need to be managed differently (Hawkes Bay Regional Council 2007), and this could reduce the amount of water available for other purposes, also increasing its value.

Within the Tauranga Harbour, large areas of saltmarsh have been destroyed or affected by direct or indirect human activity, with a subsequent loss in waste treatment capability. On the other hand, the area of mangroves (*Avicennia marina* subsp. *australasica*) is increasing, mainly because mangroves trap silt released by land development, assisting with the

reduction of silt-loading in harbour waters (Environment Bay of Plenty 1997).

No local estimates for the value, or cost, of supplying good quality water could be readily found, but some overseas examples and New Zealand regional examples may help illustrate the scale of the value.

New York City

New York City found it could avoid spending $US 6-8 billion on the construction of new water treatment plants by protecting the upstate watershed that has traditionally accomplished these purification services for free. Based on this economic assessment, the city invested $US1.5b in buying land around its reservoirs and instituting other protective measures. Results of these actions were stated as not only keeping New York's drinking water pure but also enhancing recreation, wildlife habitat, and other ecological benefits (World Resources Institute 1998).

The population of New York was determined to be 19,490,297 people during the 2008 US census (U.S. Census Bureau 2009) (compared with 103,632 people in Tauranga during the 2006 census; Statistics New Zealand 2006). Using a figure of $US4.5b saved, this equates to nearly $NZ300 (exchange rate at 11 December 2009) of cost savings per New Yorker. In other words, protecting a watershed ecosystem service provided at least $NZ300 per New Yorker.

The water-catchment scenarios are likely to be very different for New York and Tauranga, including different population size, different catchment size, different proportions of woody vegetation remaining, and different water usage rates and patterns. Other than the Lammermoor study (below) very little work has been undertaken on assessing the value of water in New Zealand. In many parts of New Zealand water allocation and water quality are becoming major issues. An indicative level of ecosystem services value can be obtained by assuming that protection of the Tauranga water-catchment, to produce potable water, is also valued at $NZ300 per person. In which case this ecosystem service would be valued at a minimum of $NZ31 million.

Nigeria

In the traditionally prosperous Hadejia-Jama'are floodplain region in northern Nigeria, where more than half of the wetlands have already been lost to drought and upstream dams, ecosystem valuation was used to evaluate the costs and benefits of proposals that would divert still more water away for irrigated agriculture. The net benefits of such a diversion were priced at $US29 per hectare. Yet, the intact floodplain already provides $US167 per hectare in benefits to a wider range of local people engaged in farming, fishing, grazing livestock, or gathering fuel-wood and other wild products and benefits which would be greatly diminished by the project. Thus, even without accounting for such services as wildlife habitat, the wetlands are far more valuable to more people in a current state than if diverted for irrigation (World Resources Institute 1998). Thus natural

ecosystems, such as wetlands, can add far more value to the local economy than diverting water to a few specific users.

New Jersey

A two-year literature review study of the economic value of New Jersey's (USA) natural capital found that wetlands provided the largest dollar value of ecosystem services: $US9.4 billion/year (b/yr) for freshwater wetlands and $US1.2 b/yr for saltwater wetlands (all values in 2004 $US). The most valuable services were found to be disturbance regulation (the buffering of floods, and storm surges contributed $US3.0 b/yr), water filtration ($US2.4 b/yr), and water supply ($US1.3 b/yr) for freshwater wetlands, and waste treatment ($US1.0 b/yr) for saltwater wetlands (Costanza *et al*. 2006).

Lammermoor Range, New Zealand

Te Papanui Conservation Park on New Zealand's Lammermoor Range provides the Otago Region with water for 'free' that would cost $NZ 136 million to bring in from elsewhere. This 22,000ha tussock grassland area acts as a natural water catchment, supplying water flows valued at $NZ31 million/year (m/yr) for hydroelectricity, $NZ93 m/yr for urban water supply and $NZ12 m/yr for irrigating 60,000ha of Taieri farmland. The total benefit ($NZ 136 m/yr) is equivalent to the cost that would have to be paid to get the water currently provided 'free' of charge from somewhere else (Department of Conservation 2006; TEEB 2009).

Hawkes' Bay Region

A MAF study of the 2007 drought showed a decrease of $161 million in Value Added/GDP for sheep and beef farms in the Hawkes Bay Region, and with other industry included, a total decrease in GDP of $236 million compared to a potential increase of $375 million had the drought not occurred (Hawkes' Bay Regional Council 2007). This illustrates that water is currently a highly valuable resource, and is likely to become more valuable as demand increases.

10 Importance of DOC-managed land

Within the Kaimai-Tauranga catchment (the study area), a quarter of the land is managed by the Department of Conservation and legally protects a diverse range of indigenous vegetation types and habitats, and a wide range of indigenous species, including threatened plants and fauna. Most of the land cover (96%) within these areas is indigenous vegetation and/or habitat. Most comprises indigenous forest, but DOC-managed land also includes substantial areas of "Herbaceous Saline Vegetation", areas of "Coastal Sand and Gravel", lakes and ponds, and threatened land environments and originally rare habitat types.

DOC-managed areas are a major source of ecosystem services, provide recreation opportunities, and are key components of the proposed ecological corridors and the outstanding natural features corridors. Proposed ecological corridors include 2,311ha of DOC-managed land (12% of total proposed ecological corridors in the study area) and 28,043ha of identified outstanding landscape features (71% of total area, inland and coastal).

DOC-managed lands in inland parts of the study area are the major sources of potable water in the study area (the headwaters of most waterways are managed by the Department). These areas are also a major carbon store, and provide an important element of clean air production.

11 Ecological Effects of Land use Intensification

Ecological effects of land use intensification for housing and other ancillary uses depend very much on where and how a particular land use is applied (Wildland Consultants 2003). Potential effects include:

- Vegetation clearance for house sites, roads, access-ways, timber and firewood extraction, leading to increased fragmentation of natural areas;
- Increased invasion of natural areas by invasive pest plants and other weedy species originating from residential houses, road margins, and the margins of public open space (where people often dump domestic garden refuse);
- Drainage and infilling of wetlands, and alteration of wetland catchments and hydrology;
- Grazing by domestic stock;
- Nutrient enrichment of wetlands and flowing waterways from increased numbers of septic tanks;
- Water abstraction from rivers, streams, and wetlands;
- Sedimentation of streams, wetlands, and estuaries, particularly during construction phases;
- Increased predation of indigenous fauna (birds, lizards, invertebrates) by domestic pets;
- Disturbance of roosting or nesting avifauna by people and domestic pets;
- Inflows of storm-water and water-borne contaminants to wetlands and streams from roads and other sealed surfaces;
- Increased human visitation and associated recreational activities in adjacent natural areas;
- Collection of indigenous plants from natural areas;
- Encroachment into natural areas for gardens, boundary fences;
- Increased incidence of fires originating from rubbish fires;
- Noise disturbance of avifauna;

- Increased planting of introduced species (e.g. Kermadec pohutukawa) that have the potential to hybridise and to alter the genetic makeup of indigenous species that occur naturally in the area.

- Loss or reduction of ecosystem services, especially those relating to water flows and quality, but also gene flow, fauna 'safe' routes, habitat for pollinators and beneficial predators of pest species, provision of food and raw material (e.g. firewood, flax), and scenic values.

11.1 SMARTGROWTH PREDICTED GROWTH AREAS AND THE ENVIRONMENT

11.1.1 Areas identified for growth

The SmartGrowth Strategy identifies areas predicted to be developed for residential subdivision, commercial development, and/or transport network infrastructure. For each of the areas identified in the SmartGrowth process, potential environmental effects of development, and mechanisms that could help to prevent or mitigate negative effects are summarised in Table 14.

Key potential effects include sedimentation of waterways and the harbour, destruction of unprotected high value vegetation and/or habitat, severing of existing vegetation/habitat corridors through vegetation clearance, increased human presence disturbing indigenous fauna, increased weediness and rubbish dumping, and increased predation of indigenous fauna by household pets. Any developments that occur close to or within proposed SmartGrowth ecological corridors or outstanding natural features need to take account of the values that warrant protection. Coastal and riparian areas are often the most ecologically valuable and fragile, and a development-free buffer zone of at least 50m for inland systems and 100m for coastal systems may assist with protection of ecological values. High value vegetation/habitats have been mapped (location and extent), to provide information on where to avoid these areas.

11.1.2 Areas not identified for Residential Growth

Several areas have not been suggested as potential sites for significant future urban residential development, but have not been identified as development areas. These areas, the reasons for their exclusion, and environmental features that will be protected as a result, are listed in Table 15.

The SmartGrowth Strategy outlines the types of land or habitat that should be considered for purchase for new regional parks. The following range of regional park land types are proposed: coastal (open coast, headlands and spits), harbourside and estuarine, freshwater (lakes, rivers and wetlands), unique cultural landscapes and features, outstanding natural features and landscapes, indigenous vegetation, rural/ farm and specific amenity. To date, a cultural heritage park has been purchased (Papamoa Hills) and others that

fulfil the policy criteria will be considered for purchase in the future such as a coastal park in the sub-region (SmartGrowth 2007).

The Western Bay of Plenty also has a national and international reputation for its high quality coastal environment and iconic landscape features, such as Mauao and the Kaimai Ranges, and these features need to be appreciated and protected. Commercial fishing and aquaculture is prohibited in Tauranga Harbour, to protect landscape character and to retain ecological, recreational, and cultural values.

Table 14: Residential and commercial growth areas, within the Kaimai-Tauranga catchment, identified in the SmartGrowth strategy and possible environmental impacts.

Proposed Development Areas	Description Proposed Development (Taken from the SmartGrowth Strategy)	Likely or Possible Environmental Effects
Greenfield Residential Development	Subdivision and/or housing development of previously undeveloped, commonly rural land. Increase development density from 10 dwellings per hectare to an average minimum of 15 dwellings per hectare	Impact is likely to be low overall, unless adjacent high value or corridor areas are affected. Impacts could include increased levels of sedimentation, destruction of unprotected habitat, increased human presence disturbing indigenous fauna, increase in weediness, littering.
Waihi Beach	Is a beach holiday community that will more than a double in size by 2051. High rates of second and holiday homes	Development has the potential to impact on identified high-value sites (coastal and salt-water systems) especially through increased sedimentation. Other impacts could include destruction of unprotected habitat, disturbance of indigenous fauna, increase in weediness and littering.
Katikati	A rural service centre that will more than double in size by 2051, partially through increased density.	Development could impact on coastal systems, streams and protected natural areas through increased sedimentation, increase in weediness, littering, disturbance to fauna and interruption and degradation of natural processes. The latter could be remedied by encouraging community restoration groups and/or a proposed ecological corridor centred around streams to connect the coast to inland forest. Coastal and wetland systems are particularly valuable for ecosystem services.
Omokoroa	A recent development area that will have significant future growth. Will encourage increased density and the provision of employment land to promote “live, work, and play” outcomes.	Development could impact on coastal systems and streams. Coastal systems and streams are particularly valuable in connecting the inland forests to the coast. Development could increase sedimentation, destroy unprotected high value indigenous vegetation and interrupt or degrade natural processes. There are still opportunities to enhance natural processes by protecting riparian vegetation and creating stream-based corridors.
Bethlehem	Existing zoned areas and structure planning. It reaches capacity by 2036.	Areas of high value unprotected indigenous vegetation need to be identified prior to additional development to ensure that they are not inadvertently eliminated. Care also need to be taken to protect coastal and stream systems. A formal ecological corridor is required for Wairoa River. Development could increase sedimentation, destroy unprotected high value indigenous vegetation, interrupt or degrade natural processes, disturb indigenous fauna. Increased weediness and rubbish dumping.
Pyes Pa	Significant urban development with full capacity, of an additional 4,319 households, reached by 2046. No further extensions within the planning period are intended	Most of Pyes Pa lies within the Hidden Gorge ecological corridor. Increased urbanisation will need to be congruent with the ecological corridor concept. Criteria for development should be drawn up well before subdivision is approved. There are also sizable areas of high ecological value outside the proposed corridors and these areas need to be formally mapped and/or identified to ensure they are not inadvertently eliminated. Development could increase sedimentation, destroy unprotected high value indigenous vegetation, increase weediness, interrupt or degrade natural processes, disturb indigenous fauna and lower the ecological value of the proposed “ecological corridor”.
Welcome Bay and Ohauiti	Additional residential development at Welcome Bay from 2016 and Ohauiti after 2031. Transport constraints at Welcome Bay need to be resolved	Development could impact on coastal systems, streams and protected natural areas, especially through sedimentation, fauna disturbance, weediness and littering. The tidal mudflat systems have high ecosystem services functions. Coastal systems and streams are particularly valuable in connecting the inland forests to the coast. It would appear that a significant amount of high value riparian margin still exists in this area, which would warrant protection or inclusion in an ecological corridor to prevent accidental destruction.
Papamoa	The current Papamoa Urban Growth Area is full by 2021 but there are ongoing infill opportunities. Papamoa East (Wairakei) development begins from 2007 and the second part (Te Tumu) after 2021. Land ownership, heritage and ecological values need to be resolved, especially at Te Tumu prior to development.	Although Papamoa is outside the Kaimai-Tauranga catchment, the proposed development area includes both the “coastal corridor” and the seaward link to at least 5 proposed ecological corridors. Criteria for development should be drawn up well before subdivision is approved to ensure ecological corridors are adequately protected.
Te Puke	Continues to grow steadily, limited in extent to protect highly versatile and productive horticultural land. Population increases by 60% by 2051.	Although Te Puke is outside the Kaimai-Tauranga catchment the proposed development area includes at least 5 river-based proposed ecological corridors. Criteria for development adjacent to the rivers should be drawn up well before subdivision is approved.
Intensification Areas	➢ Sometimes called “Urban Villages”, are selected centres where intensive housing is developed. This form of development is expected to accommodate around 21% of new development to 2051.	Many of the intensification areas are adjacent or close to outstanding natural features and/or proposed ecological corridors (Figure 4). Increased urbanisation will need to be congruent with the “outstanding natural features” and “ecological corridor” concept. Criteria for development should be drawn up well before subdivision is approved. Any areas of high ecological value outside the proposed corridors need to be formally mapped and/or identified to ensure they are not inadvertently eliminated.

Proposed Development Areas	Description Proposed Development (Taken from the SmartGrowth Strategy)	Likely or Possible Environmental Effects
	➢ ***Tauranga Central Isthmus***: Tauranga Central area, 11th Avenue, Gate Pa, Greerton, and Pyes Pa (5,960 households). ➢ ***Mount Maunganui***: The existing residential area from the Residential H (higher density zone) eastwards to Bayfair including higher density nodes around Central Parade, Downtown Mount and Bayfair Shopping Centre (4,700 households). ➢ Other sites offering smaller scale potential over the long term are: ➢ Matua, Cherrywood, Bureta, Brookfield, Omokoroa (Stage 2), Domain Road and Parton Road (Papamoa) and Waihi Beach	
General Intensification	➢ This form of development is relatively limited, intensification at identified nodes (see above) is preferred. Expected to accommodate around 8% of new development to 2051. ➢ Tauranga South: 980 households. ➢ Tauranga West: 1000 households. ➢ Tauranga Central: 550 households. ➢ Mount Maunganui: 1150 households.	Any areas of high ecological value need to be formally mapped and/or identified to ensure they are not inadvertently eliminated, and appropriate planning constraints applied.
The areas most constrained for intensive development	➢ Tauranga Harbour, Maketu Estuary and Little Waihi Estuary. ➢ Adjacent to Tauranga Harbour. ➢ Adjacent to other harbours and the coastline. ➢ Adjacent to natural areas, including highly fragmented indigenous vegetation and habitats.	Criteria for development in constrained areas should be drawn up well before subdivision is approved and appropriate planning constraints applied.

Table 15: Areas not identified for potential residential development within the Kaimai-Tauranga catchment, and environmental features that should be protected.

Proposed Development Areas	Description	Environmental Features that Should be Protected
Matapihi and Rangataua Bay	Outside current settlement pattern, culturally significant area, potential harbour impact issues, not favoured in consultation with Tangata Whenua. It should be noted that Māori land in Matapihi may be developed for the use by its owners. However no urban residential development is provided for.	Protection of Tauranga Harbour water quality, mud flats and riparian margin, habitat for indigenous and threatened species
Matakana Island	Culturally significant area, potential harbour impact issues, outside current settlement pattern, and uncertainties regarding access and servicing. Small-scale development takes place relating to Marae, or possibly small-scale resort-type development.	Outside Kaimai-Tauranga catchment, but immediately adjacent to and intimately connected via Tauranga Harbour. Dune and salt-water riparian systems, significant dune and wetland systems, habitats of threatened and indigenous species.
Tanners Point, Ongare Point and Kauri Point	Development only provided for within current footprint.	Outstanding coastal features, Tauranga Harbour, habitat of indigenous species.
Te Puna	Although logical from an infrastructure and services perspective as a consolidation of development between Omokoroa and Tauranga, the area is not required during the planning period. The area has highly versatile land in productive use. There is also cultural significance in some areas, particularly alongside the harbour. The area remains largely rural, with some limited intensification within the footprint of existing small settlements, particularly in preferred coastal locations.	Integrity of the Te Puna ecological corridor, considerable areas of high value indigenous vegetation including those identified in natural areas survey report, habitat for threatened indigenous species

11.2 OPPORTUNITIES FOR PREVENTION AND MITIGATION OF POTENTIAL ADVERSE EFFECTS

As indicated above, increased urbanisation has the potential to impact on high value sites (such as coastal and salt-water systems, rivers and streams, and protected natural areas), disturb indigenous fauna, and interrupt and degrade natural processes. High value unprotected natural areas and habitats are potentially at risk from development, unless they have been specifically mapped and identified in plans or regulations. This section outlines some options to prevent the loss of further high value sites, or in part mitigate for the effects of any development or urbanisation.

Dunes

Considerable effort is warranted to reduce the risk of physical trampling and vehicle damage to dunes and duneland vegetation. A setback between duneland vegetation and residential housing or commercial development helps to reduce the risk of domestic pets straying into habitats of vulnerable threatened shorebirds such as New Zealand dotterel. A prohibition on domestic animals in these areas helps to protect vulnerable indigenous species (Wildland Consultants 2000a). Vigilance is required to detect and remove new weeds, and to educate people not to deposit garden waste in dunes. Linking of currently separate areas of duneland vegetation will increase the ecological viability of these features (Wildland Consultants 2000a).

Waterways

The best way to protect waterways is to fence and revegetate the entire margin of key river and stream systems. This should include all low-lying land (some of which is currently degraded wetland) on river margins and consider including old channels associated with rivers and streams, to protect hydrological systems. Fencing a buffer of 20 m minimum width from channel margins would facilitate the recovery of degraded wetland habitats. Wider buffers should be considered in some situations (Wildland Consultants 2000a).

Restore and plant riparian margins and significant habitat margins with indigenous species, which helps to reduce weed invasion and buffer sensitive environments. Fencing and replanting of riparian margins may also help with the protection or creation of whitebait spawning sites. Planting should only use locally-sourced species, and species will need to be matched to site conditions (Wildland Consultants 2000a).

Improve fish access through the use of fish-friendly culverts or passages and enhance habitats for indigenous fish species such as common bully (*Gobiomorphus cotidianus*), giant kokopu (*Galaxias argenteus*), banded kokopu (*Galaxias fasciatus*), and short-finned eel (*Anguilla australis*).

Consider the creation of bunds around sensitive habitats and plant these with suitable indigenous species. Such bunds could also help mitigate for increased noise levels of development and roading, and may assist with the

retention of ‘shy’ fauna species (Shaw 2001; Wildland Consultants 2003). Bunds can also be used to control sediment originating from adjacent developments.

Sedimentation

Development of an area generally requires that vegetation is removed and for soil to be reshaped in some way, which can result in increased amounts of sediment entering waterways. All developments should have a rigorous and enforceable sediment control plan, and if possible, leave a strip of woody vegetation between a development and any waterways, to trap any sediment losses.

Existing Natural Areas

If a development area includes, or is adjacent to an “ecological corridor”, “outstanding natural feature”, and/or areas containing high value indigenous vegetation then the values that warrant protection need to be identified prior to a subdivision occurring. Appropriate planning rules and/or mechanisms need to be formulated to protect the values identified, and to ensure that those values are not degraded. Where areas of high value indigenous vegetation are not protected, or have been included in an ecological corridor, then these areas need to be formally mapped in a format that is accessible to council planning staff to ensure that such areas are not overlooked.

Water Supply and Waste Infrastructure

Water supply and waste is a critical issue, requiring consideration of provision and allocation from surface and groundwater sources and the location of reservoirs to avoid adverse landscape and cultural impacts. Wastewater treatment for the main urban area continues to be centred on Te Maunga, with an ocean outfall, and improved technology has improved the quality of the discharge. Water conservation and re-use reduces the amount of discharge relative to population growth and will help improve receiving water quality. The use of Low Impact Urban Development (LIUD) practices will also assist with retaining existing surface and sub-surface flow patterns and maintaining, and sometimes improving, water quality.

Introduction of Pests and Weeds

Increased urbanisation can result in a greater diversity and density of introduced plant species establishing in natural areas. Vigilance will be required to ensure that new weedy species are detected early and removed. Education programmes are also likely to be required to encourage people not to dump garden waste in natural areas and to report weedy species to the appropriate authority.

If a development is close to habitat that supports threatened species then pets can also pose a problem (e.g. dogs killing kiwi, cats catching indigenous birds and lizards). In some instances it would be prudent to impose a no pets rule for those areas. In other areas, a small increase in pets may be offset by predator control and the subsequent increase in breeding success and adult survival.

11.2.1 Incentives to Maintain Ecosystem Services

A range of incentives are already available to land owners to help protect and enhance ecological sites. Protection and enhancement of these sites will also assist with maintaining ecosystem services. Options include:

Protection Lots and Transferable Development Rights

Western Bay of Plenty District Council (WBOPDC) provides for the creation of Protection Lots, by way of a legal covenant, for any ecological feature which meets a set of ecological and size criteria. Protection lots provide the option of Transferable Development Rights (TDRs) to the landowner. An ecological report is required to demonstrate that the feature meets the criteria and provision of a long-term management plan is encouraged. This has resulted in the creation of a substantial number of protection lots, especially indigenous forest. The principles guiding protection lots have been adjusted so that less common habitats (i.e. coastal areas, wetlands) have become more valuable to protect (potentially provide a greater number of TDRs per area protected). However, WBOPDC jurisdiction does not extend below mean high water springs, so protection lots are not provided for there, meaning that saline coastal wetlands on private land are not eligible for protection lot status, although they can however be protected by means of covenant.

Sustainable Land Management

Environment Bay of Plenty supports sustainable land management and farm practices through land improvement agreements with landowners that can include retirement of areas with natural values, and riparian fencing and planting. This is a formal agreement, registered on a title, usually as a Farm Plan for soil and water conservation purposes or an Environmental Plan. Grants are provided for fencing and re-vegetation. Not all areas protected under a land improvement agreement will qualify for WBOPDC protection lot status, as plantings may include exotic species (e.g. tree lucerne) or inappropriate indigenous species (e.g. purple akeake, various odd cultivars) or they may not meet the size criteria (e.g. riparian margin less than 20m wide). Nevertheless, the areas retired can make a valuable contribution to the protection of ecosystems and ecosystem services (and the establishment of ecological corridors).

Environment Bay of Plenty also supports initiatives such as the Fonterra and Dexel Clean Streams Accords with dairy farmers.

Community Groups

Various councils seek to work with the community to promote awareness of restoration and provide support for these activities. Such work includes providing funding (partial or full) for weed and pest control, fencing of natural areas, indigenous revegetation and, in some instances, technical advice from a council officer dedicated to assist community groups. WBOPDC will consider areas that have been restored under protection lot criteria once they are at a self-sustainable level, particularly riparian and wetland sites.

CoastCare Bay of Plenty is a community partnership programme, between Environment Bay of Plenty, District Councils, and the Department of Conservation, working collaboratively with a range of community groups, using local knowledge and enthusiasm to restore the form and function of the dunes and natural coastal environment in the Bay of Plenty. One of the main aims has been to plant native sand binding plants onto dunes, to improve the buffering between the land and the sea. Financial contributions and support is available from CoastCare.

The New Zealand Landcare Trust encourages communities to get involved by organising events, such as field days and workshops, to share information and find out about the latest research. They also help landowner to apply for grants from DOC, MfE, and MAF and provide advice on how to maintain project momentum and community engagement. Regional and Project Coordinators aim to understand the needs of rural communities, and work closely with them to improve the environment and ensure sustainable, productive land use. A regional coordinator has recently been appointed for the Kaimai catchments project.

Covenanting of Natural Areas

Covenanting agencies, such as the Queen Elizabeth II National Trust (QEII- for private and/or Māori land) and Nga Whenua Rahui (for Māori land) can assist landowners with the legal protection of natural, geological, landscape, and cultural features. Usually, a financial contribution towards fencing is provided by these agencies and Environment Bay of Plenty often also contributes towards fencing costs. Landowners can apply for rates remission for areas covenanted by QEII or covenanted as protection lots under the District Plan and rates relief and/or postponement can be applied for on Māori freehold land. Some councils will waive reserve contributions where a natural heritage area is covenanted.

Other covenanting opportunities include:

- Department of Conservation Conservation Covenants (under the Reserves Act or the Conservation Act). This is an agreement between DOC and the landowner, and some costs may be met by DOC. The agreement is registered on the land title and binding on subsequent landowners.
- A Department of Conservation Management Agreement (under the Conservation Act). This is a legal contract between DOC and the landowner. Some costs may be met by DOC. The contract is not binding on future landowners.
- District Council Conservation Covenant, usually as a result of subdivision. Fencing and pest control is usually required and secured through a bond. Costs normally lie with the landowner. The covenant is registered on the land title and is binding on subsequent landowners.
- Fish and Game New Zealand can enter into covenants, give advice, and assist landowners with applications for funding for enhancing wetlands and streams for game birds. Fish and Game-managed lands may not necessarily protect natural features in perpetuity.

- NZ Historic Places Trust Heritage Covenant. This covenant is specific to sites of special historic values. The Trust contributes to costs for surveying and legal fees.

Reserves, Gifts, and Bequests

Land can be gifted or bequeathed to most of the organisations listed under the covenants section above, or to environmental groups such as Forest and Bird and the NZ Native Forest Restoration Trust. Land can also be gifted to local councils, with their agreement, as a reserve. Money donated to these agencies can also be used to protect special sites.

Other Mechanisms

- Strategic Property Purchase - some councils have set aside funds to purchase property for strategic purposes. These purposes include development of regional parks, improvement of access, collection and storage of potable water, and infrastructure requirements such as additional sewage treatment sites. Some of these purchases will protect natural areas, thus protecting ecosystem services, and others will improve and/or contribute to ecosystem services (e.g. improved sewage treatment).
- Provision of information to the public about the rules and requirements with regards to natural heritage and the options to protect natural heritage. Outlining incentives such as covenanting and rates relief may encourage more people to choose these options.
- Recognition of conservation and protection efforts by means of plaques, interpretation signs at a site, publication of stories in newspapers and/or on the web, including the site in a heritage trail, and annual and/or local and regional award.

11.2.2 Inter-agency and Community Support

The best way to ensure that natural areas and ecosystem services are not lost through time is to instil in the community a sense of ownership and satisfaction for the areas that they care and pay rates for. Communities must also know that their efforts are making a difference and are appreciated. When 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. Key roles for land management agencies are the negotiation of stakeholder roles, coordination of stakeholder effort and providing the public with a clear understanding of what particular roles each agency has. There are also instances where the various agencies are working together across territorial or title boundaries to provide a more collaborative approach to ecological protection. Collaboration is especially important when considering resources that flow or move across the land, such as water and indigenous species.

Various stakeholders that have a role to play in maintaining natural values and ecosystem services are briefly summarised in Appendix 15.6

It may be worthwhile to set up stakeholder forums for particular projects or geographic areas to ensure that all stakeholders have a voice and that collaborative projects stay focussed and address the issues identified. These forums can also be useful to generate ideas and interest at the beginning of a project.

11.2.3 Standards of Care

Ideally each identified high value site or natural area would be managed in such a way to maximise the biodiversity and other important values at that site. However, budgets tend to be limited and many sites receive little or no management input. This section outlines some minimum management standards (standards of care) that should be considered for the various vegetation and/or habitat types.

Standards of care vary, depending on which agency manages an area (e.g. DOC, QEII, local councils, private landowners, Landcare Groups,), the natural values of an area (e.g. threatened species habitat, intact wetland *vs.* degraded wetland) and the pressures on the habitat (e.g. proximity to urban areas or development area, physical linkages to other natural areas). Some mechanisms may provide a level of care without legal protection (e.g. community restoration projects) whilst others specify what can or cannot be undertaken in identified areas.

There are no nationally consistent standards of care and management of high value areas can often be hampered by lack of funds or other resources. Few agencies have specified what the minimum standards of care should be for the areas that they manage or oversee, or have the means to enforce standards. Priorities for setting minimum standards of care are often not consistent between management agencies, within management agencies, or within a national or regional framework.

It would be useful if minimum standards of care could be agreed upon between relevant management agencies, with a consistent approach to the values being protected and the relative significance of an area. In the meantime, a list of generic standards of care is provided to give some guidance for different types of habitat. If sites have already been identified as high-value indigenous sites, then their protection and care should be considered to be a high priority. Sites that have not yet been assessed can be identified and prioritised using the recently published "Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land" (Ministry for the Environment 2007a). Priority should be given to those sites that fulfil more than one criterion, with perhaps less emphasis on sites that only contain one of the priorities indicated.

The following are general guidelines that could be used to help assess the standard of care required for each site.

All Sites That Are Not, or Are Only Partially, Legally Protected

- Investigate if legal protection is required. Use mechanisms such as the Conservation Act, the Reserves Act, covenanting (QEII, Nga Whenua Rahui, district council), rules in Regional or District Plan, gifting to Crown or territorial authorities, listing in Regional or District Plan to ensure the site is protected.
- Prevent further clearance, drainage or changes to hydrology.

Wetlands, Lakes, and Riparian Margins

- Prevent further drainage or negative alteration to hydrology.
- Maintain riparian vegetation.
- Exclude stock (generally requires fencing).
- Eradicate or intensively control invasive plants and fish species, control other species that may be impacting on hydrology or flora and fauna values.
- Consider restoration planting or other restoration activities (e.g. reinstatement of original hydrological regime).

Special Habitat, Plant, or Animal Species

- Prevent further clearance.
- Assess fencing requirements to exclude stock and/or pest species.
- Assess and or monitor stock and/or pest species and/or human impact.
- Eradicate or intensively control invasive plants, and, where possible, stock, mustelids, feral cats and rats.
- Consider restoration planting.
- Assess whether increasing urbanisation will pose problems and whether resource consent conditions can be imposed to prevent further degradation and if possible enhance the native system.

Sites Inadequately Surveyed

- Prevent further clearance until a site is fully assessed.
- Map and describe vegetation and habitats.
- Undertake species survey.
- Assess and or monitor stock and/or pest species and/or human impact.
- Determine features present and their relative values.
- Identify management requirements and indicative levels of resourcing.

12 Conclusions

Ecological corridors proposed in the SmartGrowth Strategy are a useful tool to help identify wider areas and sites that are more valuable for purposes other than urban or industrial growth. The principles applied to ecological and biological values within the SmartGrowth strategy are generally sound. However, the assessment of potential ecological corridors appears to have been applied inconsistently, with some areas having a reasonable representation whilst other areas appear to be under-represented (especially coastal Tauranga Harbour, north of Tauranga City). Additional areas have been suggested for inclusion in potential corridors.

The SmartGrowth Strategy also acknowledges that there are other high value ecological sites that need to be protected that do not fall within ecological corridors, such as land administered by the Department of Conservation and privately-owned land. The Strategy identifies a number of mechanisms that may assist with protection of these other areas (Appendix 2), but it is suggested that the high value indigenous vegetation or habitats be mapped and made available to land management and planning staff and that prescriptive policies (e.g. tight controls on vegetation clearance) be applied to those areas. Failure to do so may result in the destruction of some high value areas.

Increased urbanisation and development has the potential to adversely affect high value sites, especially coastal and saltwater systems, rivers and streams, and other habitats that support threatened fauna and flora. Increased development could also interrupt and degrade natural processes by further habitat fragmentation, increased sedimentation, increased weed and pest densities, and increased human disturbance.

There is also a need to outline what values are being protected in each ecological corridor and to ensure that planning and policy guidelines/rules are consistent with the aim of protecting those values (if necessary different policies or guidelines for different ecological corridors). These guidelines/rules should be developed well in advance of any land development plans, so that developers know the limitations and constraints of the sites and can help protect and enhance ecological values.

DOC-managed lands make a substantial contribution to the ecology, financial economy, visual backdrop, and recreation opportunities within the study area. This study has crudely estimated the total annual value of ecosystem services within the Kaimai-Tauranga catchment at about $NZ195 million per annum, and it is likely that the actual contribution of ecosystem services is considerably larger than estimated. The lack of readily-available data, especially in a New Zealand context, prevented a more accurate

estimate. The contribution of ecosystem services to GDP for the region could be at least 5% (indicative estimate only[1]).

The Department of Conservation manages about one quarter of indigenous forest within the study area (the single largest contributor to ecosystem services, principally based on total area), and thus its management of indigenous forest is likely to contribute at about one quarter of the total value of ecosystem services. The most valuable ecosystems, in terms of providing ecosystem services, are wetland systems such as freshwater and near-coastal ecosystems.

There is already a range of incentives available to help encourage landowners to protect and enhance indigenous biodiversity and high value sites. Coastal areas on private land below Mean High Water Springs may perhaps require additional incentives. Within the study area there is a range of agencies and stakeholders that manage and/or administer land and they have varying responsibilities. Many of these agencies and/or stakeholders already cooperate and collaborate on a range of projects, and it is very important to keep the wider community informed of and engaged with conservation and restoration projects. Without community support it will be difficult to enforce legal responsibilities and gain support for projects and project funding.

[1] Indicative estimate only as the Tauranga-Western Bay of Plenty area, for which GDP estimated, is larger and not directly comparable to the study area. Furthermore, the methods used to derive the ecosystem services values only provides crude estimates, for all the reasons outlined in this document (Sections 10-12) and also because there wasn't a direct match between biomes and LCDB2 vegetation classification.

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15 Appendices

15.1 ENVIRONMENTAL AND BIODIVERSITY POLICY IN THE SMARTGROWTH STRATEGY

In terms of the environment and biodiversity the Strategy identifies the following policy statements:

Type No.	Description
	Natural Environment and Biodiversity
Specific 1	Develop a sub-regional biodiversity strategy that will identify existing and potential ecological corridors and formulate recommendations and priorities for protection and enhancement of ecological corridors in the SmartGrowth area. Record current integration between agencies for biodiversity work in the sub-region and recommend further actions to enhance this integration.
Specific 2	Undertake a stocktake on current initiatives to consider if a sub-regional approach is needed that addresses the role of private landowners and existing property rights in the maintenance and enhancement of ecosystems.
Ongoing 3	Protect the natural heritage values of public conservation land.
Ongoing 4	Take into account the areas of significant indigenous habitat and ecosystems in developing Structure Plans.
Ongoing 5	Protect, and restore, remaining areas of natural environment within urban areas.
Ongoing 6	Develop and implement Environment Action Plans in partnership with Community Action groups.
Ongoing 7	Raise awareness and understanding of the importance of ecosystems through education and advocacy.
	Open Coast
Complete 1	Concentrate any new coastal development in and around areas already compromised by existing development.
Ongoing 2	Identify and protect significant coastal landscape features, and maintain significant public views and visual corridors associated with significant coastal landscape features through regulation in district and regional plans.
Ongoing 3	Protect the ecological values of significant indigenous habitats through regional and district plan regulation, and land acquisition and management.
Ongoing 4	Require land to be set aside for public access to the coast as subdivision or major development takes place.
Ongoing 5	Undertake identification of "Aquaculture Management Areas".
Ongoing 6	Avoid placing new development in areas that are, or are likely to be subject to coastal hazards.
	Harbours
Complete 1	Concentrate any new harbour coast development in and around areas already compromised by existing development and avoid further development in the western areas of Tauranga Harbour.
Specific 2	Scope and prepare a sedimentation study to: Inform our current and future policies and management mechanisms (consent practice, regional and district rules) in an integrated way. To predict the effects of (and best management of) urban growth and other future landuse changes. To predict effects of climate change.
Ongoing 3	Confine port related activities to the Port Zone, non port related activity requiring a coastal location to the Harbour Development Zones and investigate the need for further Harbour Development Zones.
Ongoing 4	Provide for Marina Developments and associated commercial land uses outside the urban limits line while ensuring that associated residential land uses are permitted only on an ancillary basis.
Ongoing 5	Identify and protect significant harbour coast landscape features, and maintain significant public views and visual corridors associated with significant coastal landscape features through regulation in district and regional plans.
Ongoing 6	Protect the ecological values of significant indigenous habitats through regional and district plan regulation, and land acquisition and management.
Ongoing 7	Require land to be set aside for public access to the harbour and as protection and enhancement areas as subdivision or major development takes place.
Ongoing 8	Avoid discharges making water unsuitable for bathing or shellfish gathering in harbours.
Ongoing 9	Avoid placing new development in areas that are, or are likely to be subject to harbour coastal hazards.
	Land
Complete 1	Take into account the loss of highly versatile land in determining the location and form of future urban development.
Ongoing 2	Control discharge of sediment particles to the air or water, through controls on large scale earthworks, vegetation disturbance, and stream crossings.
Ongoing 3	Identify and protect significant riparian areas (Riparian Management Zones) for their soil conservation and water quality values.
Ongoing 4	Take into account the loss of highly versatile land in determining the location and form of future urban development.
Ongoing 5	Educate and inform the community about good land management practices to improve natural waterways and ultimately harbour health.

Type No.	Description
	Fresh water
Specific 1	(a) Implement the Regional Water and Land Plan to protect the water quality in the rivers of the western Bay of Plenty sub-region including the Kaituna and Wairoa Rivers. (b) As part of the Kaituna River and Maketu Estuary Strategy develop policy in respect of wetlands, aquatic ecosystems and water quality in the Kaituna River and its catchment.
	Landscape
Specific 1	Review landscape protection measures, particularly in the foothills of the Kaimai Range, the harbour and coastal edge.
Specific 2	Investigate opportunities to protect significant view shafts to Mauao (Mt Maunganui).
Ongoing 3	Develop a settlement pattern that takes into account the landscapes, natural features, and marae sightlines within the sub-region.
Ongoing 4	Apply regulation through the District Plan to limit adverse effects of development on outstanding or significant landscape features.
Ongoing 5	Where necessary purchase land or provide protection incentives to owners of land containing outstanding or significant landscape features.
Ongoing 6	Use reserve management plans to protect the quality of significant landscapes in public ownership such as Mauao.
Ongoing 7	Develop community education programmes to advise of methods available for protection of rural land and natural landscapes and of why areas are significant.
	SmartSpace (Open Space, Sport, Arts and Leisure)
Specific 1	Implement "Active Communities" initiatives to 2021. These include: • Aquatic strategy. • Indoor Sports and Exhibition Facility. • Baypark Outdoor Stadium. • Extreme Sports Park. • United Greens Facility. • Regional Indoor Sports Facilities. • Events Strategy. • Regional Parks. • Future Land Purchases.
Complete 2	Develop and implement a sub-regional Arts and Culture Strategy including a policy for art in public places, supporting the "Artsville" concept, and developing community arts, services and facilities.
Specific 3	Implement "Creative Expression" initiatives to 2021. These include: _ Mobile Stage. _ Flat Floor Space/Concert Hall. _ Libraries and Community Centres.
Specific 4	Implement "Cultural Heritage" initiatives to 2021. These include: _ Tauranga Museum Development (Tauranga CBD). _ Kopurererua Valley Development.
Specific 5	Prepare an integrated strategy to inform relevant statutory documents on the planning and management of recreational use of Tauranga Harbour.
Specific 6	Sub-regional parks; Secure land for active rural and passive rural sub-regional parks and review policy after implementation.
Ongoing 7	Provide appropriate opportunities for public access to rural and natural areas.
Ongoing 8	Promote initiatives for trails to showcase heritage values and the environment.
Ongoing 9	Review and enhancement of walking and cycling strategy with priority implementation between nodes of intensification and widen it to include western Bay of Plenty sub-region.
Ongoing 10	Implementation and review of the Walking and Cycling component in the Integrated Transport Strategy for Tauranga to a neighbourhood level.
Ongoing 11	Provide a network of open space and leisure opportunities via community partnerships with public and community agencies.
Complete 12	Identification of all private protected areas and public land already in reserve (or other) and identification of the potential linkages and priorities for securing linkages.
Specific 13	Review District Plan greenbelt corridors to enhance use and identify opportunities for securing land for green corridors.
Ongoing 14	Develop stream and gully enhancement plans.
Specific 15	Coastal Regional Park – purchase and develop land for a passive coastal regional park and review policy post implementation.
Ongoing 16	Explore other opportunities to provide large areas of coastal land and access and maintenance and enhancement to open coast areas.
Specific 17	Harbourside Sub-regional Park (Huharua) – develop land as outlined in the Huharua (Plummers Point) Management Plan for a passive harbour side sub-regional park.
Ongoing 18	Provide, restore and maintain continuous harbour margins that provide for public access and natural character.
Specific 19.1.	Identify mechanisms to complete mountains to the sea connectivity and development of corridor plans.
Specific 19.2.	Identify and implement opportunities such as purchase, land management transport, and stormwater catchment opportunities to increase mountains to sea connectivity.
Specific 19.3.	Protect sea to mountain top view shafts.
Ongoing 20	Develop educational material and information that can communicate to landowners, developers and general community on ways to assist with access to riparian margins.

15.2 ORIGINALLY RARE ECOSYSTEMS

(Ministry for the Environment 2007a; Williams *et al.* 2007)

NATIONAL PRIORITY THREE

To protect indigenous vegetation associated with 'historically rare' terrestrial ecosystem types not already covered by Priorities 1 and 2 in the Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land.

The following list has been compiled from scientific research being undertaken by Landcare Research, and our knowledge of these ecosystems will evolve as the research progresses. The ecosystem types listed are not necessarily found in all regions or districts, and some will be protected on public conservation land.

Coastal systems

- Dune deflation hollows
- Shell barrier beaches (= "Chenier plain")
- Coastal turf
- Stony beach ridges
- Shingle beaches
- Coastal rock stacks
- Coastal cliffs on silicic bedrock
- Coastal cliffs on silicic-intermediate rock
- Mafic coastal cliffs
- Calcareous coastal cliffs
- Ultramafic sea cliffs
- Marine mammal influenced sites

Other inland systems

- Inland saline (= "salt pans")
- Strongly leached terraces and plains (= "Wilderness" vegetation)
- Cloud forest

Semi-subterranean

- Sinkholes
- Cave entrances

Inland and alpine systems with raw or recent soils

- Volcanic dunes
- Calcareous screes
- Ultramafic screes
- Young tephra (<500 years) plains and hillslopes
- Recent lava flows (<1000 years)
- Old tephra (>500 years) plains (= "frost flats")
- Frost hollows
- Boulderfields of silicic-rocks
- Boulderfields of silicic-intermediate rocks (non-volcanic)
- Volcanic boulderfields
- Debris flow or lahar
- Boulderfields of calcareous rocks
- Ultramafic boulderfields
- Cliffs, scarps and tors of silicic rocks
- Mafic cliffs, scarps and tors
- Calcareous cliffs, scarps and tors
- Ultramafic cliffs, scarps and tors
- Ultramafic hills
- Inland sand dunes
- Inland outwash gravels
- Braided riverbeds
- Granitic sand plains
- Granitic gravel fields
- Sandstone erosion pavements
- Limestone erosion pavements

Taken from (p18) "Protecting our Places; Information about the Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land (Ministry for the Environment 2007a)" which provides technical information around the Statement of National Priorities. See the New Zealand Biodiversity Strategy website for further details: www.biodiversity.govt.nz or Ministry for the Environment website; www.mfe.govt.nz or the Department of Conservation website: www.doc.govt.nz, or refer to (Williams *et al.* 2006) for more detailed explanations of the rationale and habitat.

15.3 LAND COVER UNITS WITHIN THREATENED LAND ENVIRONMENTS WITHIN THE KAIMAI-TAURANGA CATCHMENT

LCDB2 land cover units and the proportion of each that is considered to be acutely or chronically threatened within the Kaimai-Tauranga catchment.

Indigenous Land Cover Units	Native	Chronically Threatened Land Environments			Total Within Catchment	% of Cover Within Catchment that is Threatened
		Acutely Threatened (ha)	Chronically Threatened (ha)	Total Threatened (ha)		
Broadleaved Indigenous Hardwoods	Yes	319.9		319.9	828.7	39%
Indigenous Forest	Yes	777.1	2.7	779.8	49939.6	2%
Landslide	Yes				3.1	0%
Manuka and or Kanuka	Yes	420.0	0.1	420.1	1273.1	33%
Herbaceous Freshwater Vegetation	Yes	12.3		12.3	37.4	33%
River and Lakeshore Gravel and Rock	Yes	0.1		0.1	0.1	100%
River	Yes	11.5	0.1	11.6	94.8	12%
Lake and Pond	Yes	22.7		22.7	75.9	30%
Coastal Sand and Gravel	Yes	19.6	0.3	19.9	44.6	45%
Estuarine Open Water	Yes	15.3		15.3	37.7	40%
Herbaceous Saline Vegetation	Yes	193.8	0.4	194.2	353.4	55%
Mangrove	Yes	37.3		37.3	48.4	77%
Gorse and Broom	Pot.[1]	195.9		195.9	656.7	30%
Afforestation (imaged, post LCDB 1)	No	49.1		49.1	240.3	20%
Afforestation (not imaged)	No	3.3		3.3	40.7	8%
Deciduous Hardwoods	No	106.3		106.3	158.2	67%
Other Exotic Forest	No	439.8		439.8	960.5	46%
Pine Forest -Closed Canopy	No	866.5	0.4	866.9	7976.5	11%
Pine Forest -Open Canopy	No	394.6	0.3	394.9	1172.5	34%
Major Shelterbelts	No	87.9		87.9	171.4	51%
Mixed Exotic Shrubland	No	55.6		55.6	98.6	56%
Orchard and Other Perennial Crops	No	6112.9	0.0	6112.9	7755.4	79%
Forest Harvested	No	35.7		35.7	1131.9	3%
Urban Parkland/ Open Space	No	900.1	1.7	901.7	974.6	93%
Low Producing Grassland	No	246.3		246.3	491.5	50%
High Producing Exotic Grassland	No	16815.1	12.6	16827.7	42619.7	39%
Short-rotation Cropland	No	226.3		226.3	273.4	83%
Vineyard	No	3.3		3.3	17.8	18%
Built-up Area	No	4588.2	8.3	4596.5	4861.8	95%
Surface Mine	No	34.8		34.8	99.7	35%
Transport Infrastructure	No	65.0		65.0	83.8	78%
Grand Total (ha)		**33056.2**	**26.8**	**33083.0**	**122521.6**	**27%**

[1] Has the potential to be a linkage between other natural areas, likely to become increasingly indigenous and has potential to provide ecosystem services through such mechanisms as soil retention, honey production, carbon sequestration.

15.4 INDIGENOUS VEGETATION, WITHIN EACH SUB-CATCHMENT, THAT OCCURS IN ACUTELY AND CHRONICALLY THREATENED LAND ENVIRONMENTS WITHIN THE KAIMAI-TAURANGA CATCHMENT

Sub Catchment	LENZ Categories	Land Environments		Indigenous Vegetation		Estuarine Indigenous	Freshwater Indigenous	Terrestrial Indigenous
		Hectares	%	Hectares	%			
Aongatete	Acutely Threatened	1,960.6	24.2%	60.4	0.7%	13.8	12.0	34.6
	Chronically Threatened	7.0	0.1%	1.2	0.0%			1.2
	Total for sub-catchment	**8,085.7**		**4,662.3**	**57.7%**	**22.3**	**19.5**	**4,620.5**
Kaiate	Acutely Threatened	6,959.6	66.9%	570.6	5.5%	187.8	45.9	336.9
	Chronically Threatened	12.1	0.1%	0.7	0.0%	0.7	0.0	
	Total for sub-catchment	**10,409.1**		**2,253.2**	**21.6%**	**258.9**	**61.9**	**1,932.4**
Kaitemako	Acutely Threatened	1,265.7	66.4%	130.6	6.9%	7.8	2.3	120.6
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**1,905.3**		**201.1**	**10.6%**	**8.0**	**3.1**	**190.0**
Kopurererua	Acutely Threatened	3,056.6	37.9%	263.1	3.3%	17.2	3.6	242.3
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**8,065.6**		**2,619.2**	**32.5%**	**24.3**	**12.7**	**2,582.1**
Mania	Acutely Threatened	338.3	26.3%	1.0	0.1%	0.1	0.9	
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**1,286.6**		**267.5**	**20.8%**	**1.2**	**1.4**	**265.0**
Tahawai	Acutely Threatened	552.4	38.5%	58.0	4.0%	15.0	0.4	42.5
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**1,436.0**		**395.7**	**27.6%**	**20.3**	**0.6**	**374.8**
Te Puna	Acutely Threatened	2,889.6	59.9%	204.2	4.2%	68.8	13.9	121.6
	Chronically Threatened	1.0	0.0%	0.0	0.0%			
	Total for sub-catchment	**4,821.9**		**710.7**	**14.7%**	**96.3**	**17.1**	**597.4**
Tuapiro	Acutely Threatened	1,887.0	27.0%	73.8	1.1%	39.2	9.2	25.4
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**6,997.7**		**3,627.1**	**51.8%**	**55.5**	**13.1**	**3,558.6**
Uretara/McKinney	Acutely Threatened	719.8	34.2%	50.3	2.4%	32.4	6.3	11.6
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**2,103.0**		**349.8**	**16.6%**	**49.3**	**10.7**	**289.8**
Uretara/Te Rereatukahia	Acutely Threatened	615.7	15.6%	15.9	0.4%	9.1	5.7	1.1
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**3,938.2**		**2,508.3**	**63.7%**	**14.7**	**22.4**	**2,471.2**

Sub Catchment	LENZ Categories	Land Environments		Indigenous Vegetation		Estuarine Indigenous	Freshwater Indigenous	Terrestrial Indigenous
		Hectares	%	Hectares	%			
Waiau	Acutely Threatened	460.0	15.0%	20.9	0.7%	15.8	2.6	2.5
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**3,065.2**		**430.5**	**14.0%**	**182.9**	**30.5**	**217.1**
Waimapu	Acutely Threatened	3,290.7	28.1%	405.6	3.5%	79.0	18.1	308.5
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**11,731.6**		**3,949.9**	**33.7%**	**92.7**	**43.6**	**3,813.5**
Wainui	Acutely Threatened	761.3	21.5%	68.9	1.9%	19.7	6.1	43.2
	Chronically Threatened	6.7	0.2%	1.5	0.0%			1.5
	Total for sub-catchment	**3,540.1**		**2,040.4**	**57.6%**	**25.1**	**8.4**	**2,006.9**
Waipapa	Acutely Threatened	2,546.0	51.1%	103.3	2.1%	43.8	10.7	48.8
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**4,985.2**		**1,287.2**	**25.8%**	**50.3**	**12.1**	**1,224.8**
Wairoa	Acutely Threatened	5,111.9	10.5%	266.8	0.5%	28.8	36.2	201.8
	Chronically Threatened	0.2	0.0%	0.1	0.0%		0.1	
	Total for sub-catchment	**48,549.8**		**27,740.9**	**57.1%**	**139.4**	**431.4**	**27,170.1**
Waitekohe	Acutely Threatened	859.9	32.8%	16.4	0.6%	8.7	3.3	4.5
	Chronically Threatened		0.0%	0.0	0.0%			
	Total for sub-catchment	**2,618.5**		**1,197.1**	**45.7%**	**13.0**	**4.7**	**1,179.4**
Total for Catchment		**123,539.4**		**54,241.0**		**1,054.2**	**693.3**	**52,493.4**

15.5 UNPROTECTED HIGH VALUE INDIGENOUS VEGETATION/HABITATS

Ecological District	Sub Catchment	Sub Catchment Area (ha)	Area (ha) indigenous	Area (ha) High Value	Area (ha) Protected	% Sub Catchment Protected	Not Legally Protected Or Included In Proposed Corridors				
							Indigenous (ha)	% of total indigenous	high value (ha)	% of Total High Value	Indigenous High Value
Otanewainuku	Aongatete	1,982	1,440	1,483	1,690	85%	37	3%	55	4%	33
	Kaiate	4,807	1,816	1,910	3,431	71%	165	9%	160	8%	147
	Kaitemako	1,235	118	105	2	0%	116	**98%**	102	**98%**	91
	Kopurererua	5,519	2,489	3,024	4,242	77%	303	12%	418	14%	303
	Te Puna	2,040	493	738	908	45%	140	28%	229	31%	126
	Waimapu	9,294	3,667	3,963	3,834	41%	808	22%	964	24%	797
	Wainui	2,466	1,822	1,895	2,206	89%	60	3%	76	4%	60
	Waipapa	1,875	1,134	1,176	962	51%	197	17%	228	19%	194
	Wairoa	44,945	27,453	29,010	25,920	58%	3,743	14%	4,739	16%	3674
Otanewainuku Total		**74,164**	**40,416**	**43,287**	**43,183**	**58%**	**5,567**	**14%**	**6,967**	**16%**	**5421**
Tauranga	Aongatete	2,718	164	201	148	5%	105	**64%**	128	**64%**	88
	Kaiate	5,589	437	797	954	17%	243	**55%**	260	33%	226
	Kaitemako	670	83	110	12	2%	74	**90%**	97	**89%**	70
	Kopurererua	2,547	130	323	1,078	42%	40	31%	45	14%	34
	Mania	794	28	64	66	8%	9	32%	12	19%	4
	Tahawai	985	76	116	55	6%	47	**62%**	67	**58%**	43
	Te Puna	2,782	218	231	1,171	42%	122	**56%**	111	48%	93
	Tuapiro	2,036	118	157	256	13%	30	26%	52	33%	28
	Uretara/McKinney	1,710	112	122	72	4%	53	47%	53	44%	31
	Uretara/ Te Rereatukahia	1,317	78	131	74	6%	41	**52%**	58	44%	37
	Waiau	866	249	352	265	31%	64	26%	92	26%	64
	Waimapu	2,437	283	341	254	10%	171	**60%**	133	39%	125
	Wainui	1,074	218	237	621	58%	8	3%	7	3%	4
	Waipapa	3,111	153	197	166	5%	70	45%	85	43%	50
	Wairoa	3,592	287	319	125	3%	215	**75%**	223	**70%**	186
	Waitekohe	1,356	48	72	25	2%	34	**72%**	51	**71%**	32
Tauranga Total		**33,583**	**2,683**	**3,769**	**5,344**	**16%**	**1,324**	**49%**	**1,474**	**39%**	**1117**
Te Aroha	Aongatete	3,386	3,059	3,154	3,046	90%	72	2%	112	4%	71
	Mania	493	240	275	197	40%	70	29%	81	30%	64
	Tahawai	451	320	367	349	77%	13	4%	24	6%	12
	Tuapiro	4,958	3,510	3,482	4,030	81%	172	5%	140	4%	112
	Uretara/McKinney	393	238	272	240	61%	21	9%	33	12%	19
	Uretara/Te Rereatukahia	2,621	2,430	2,482	2,441	93%	19	1%	42	2%	19
	Waiau	388	64	54	185	48%	9	15%	7	13%	3
	Waitekohe	1,262	1,150	1,163	1,095	87%	62	5%	73	6%	59
Te Aroha Total		**13,953**	**11,010**	**11,249**	**11,581**	**83%**	**437**	**4%**	**513**	**5%**	**359**
Waihi	Waiau	1,814	117	67	8	0%	115	**98%**	66	**99%**	36
Waihi Total		**1,814**	**117**	**67**	**8**	**0%**	**115**	**98%**	**66**	**99%**	**36**
Grand Total		**123,539**	**54,241**	**58,387**	**60,128**	**49%**	**7,446**	**14%**	**9,023**	**15%**	**6937**

15.6 STAKEHOLDER ROLES AND RESPONSIBILITIES

Landowners and Land Managers

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

Environment Bay of Plenty

Environment Bay of Plenty is responsible for the sustainable management of the natural and physical resources of the region (under the Resource Management Act 1991, RMA) including maintenance of indigenous biodiversity on private land within the Bay of Plenty.

The maintenance of biodiversity on private land requires dialogue and interaction with landowners and the community. One of Environment Bay of Plenty'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.

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

Environment Bay of Plenty 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.

Environment Bay of Plenty 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, the Regional Policy Statement (RPS), and the Ten Year Plan provide detail on Environment Bay of Plenty's environmental roles and responsibilities, and the mechanisms through which they are enacted. The Regional Pest Management Strategy sets out Environment Bay of Plenty'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. Environment Bay of Plenty is also preparing Biodiversity

Management Plans (BMPs) for specified projects where they are undertaking active management to protect and enhance biodiversity values.

Western Bay of Plenty District Council

Western Bay of Plenty District Council (WBOPDC) is responsible for the protection of existing indigenous biodiversity (under the RMA), and a schedule of ecologically-significant sites is provided in the District Plan. WBOPDC has environmental responsibilities complementary to those of Environment Bay of Plenty. 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, including organising the timing, people and other resources. Providing ecological information, or advice on whom to contact to get the relevant information. Organise media coverage to help to strengthen groups and pull in other stakeholders.

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.

Tangata Whenua

Pirirakau have kaitiaki (duty of care) over 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.

Care Groups
Care groups undertake a range of environmentally-orientated, on-the-ground activities.

New Zealand Landcare Trust
Coordinates and assists a wide number of care groups. They provide advice and assist with funding applications.

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 Fruit Growers Association.

Federated Farmers
Federated Farmers aims 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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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.

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 retained, as the landowner continues to own and manage the land, subject to voluntarily 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'.

Nga Whenua Rahui
Māori landowners can protect their indigenous ecosystems under Nga Whenua Rahui kawenata. The agreement is sensitive to Māori-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.

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. Environment Bay of Plenty 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.

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.