



# **Ngaruroro River Flood Protection and Drainage Scheme Ecological Management and Enhancement Plan**

Prepared for Hawke's Bay Regional Council

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A view upriver from the Fernhill Road Bridge of the Ngaruroro River during Cyclone Bola. The photograph was taken during early March 1988 by Riordan Kemp, a resident of Omahu.

## ACKNOWLEDGEMENTS

This project was commissioned by the HBRC Asset Management Group. Gary Clode (Engineering Manager) oversaw the engagement. Many people contributed to this project. In particular Simon Beale (MWH) assisted with the vegetation survey, and provided technical support. The river bird assessment was undertaken by Dr. Brent Stephenson (Eco-Vista Photography and Research Ltd.). The bird photographs contained within Figure 1-15 of Chapter 2, and the bird photographs contained within the Management Zones of Chapter 3 were taken by him. Dr. Tim Martin (Wildland Consultants Ltd.) undertook the lizard survey and interpretation. Dr. Darren Ward (Landcare Research) undertook the identification and interpretation of terrestrial invertebrate samples. Pauline True (MWH) undertook GIS analysis. Cultural values were delineated through an oral history of Mr. Matt Love, with the support from Jenny Mauger and Riordan Kemp. The write-up of cultural and recreational sections was undertaken by Andrea Sinclair (MWH).



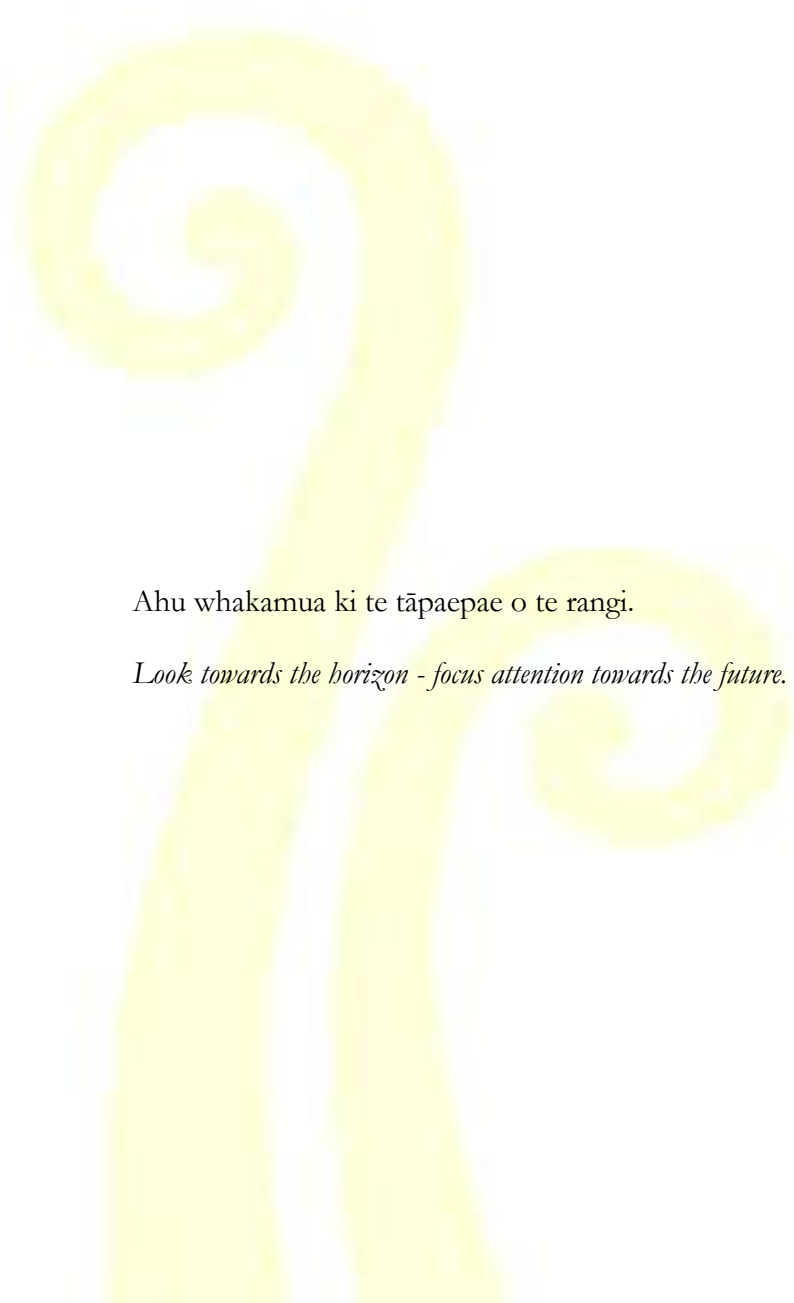


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## CHAPTER 1: INTRODUCTION





Ahu whakamua ki te tāpaepae o te rangi.



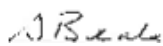

*Look towards the horizon - focus attention towards the future.*



## QUALITY STATEMENT

PROJECT MANAGER
Grant Russell

PROJECT TECHNICAL LEAD
Adam Forbes

PREPARED BY		11/03/2011
Adam Forbes		
CHECKED BY		11/03/2011
Sheree Gillgren		
REVIEWED BY		11/03/2011
Simon Beale		
APPROVED FOR ISSUE BY		11/03/2011
Grant Russell		



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# 1 Introduction

## 1.1 Document purpose

The primary purpose of the Ngaruroro River Ecological Management and Enhancement Plan (“the EMEP”) is two-fold.

Firstly, the Management Plan (Chapter 3) focuses on the physical activities and associated ecological effects of the Ngaruroro River Flood Control Scheme<sup>1</sup> (“the Scheme”). The ecological effects of Scheme activities are considered in relation to the spatial arrangement and significance of ecological values within the Scheme area. Where conflict between Scheme activities and notable ecological values may occur, a range of specific management controls are recommended.

Secondly, the EMEP sets out a strategy and prioritised plan (see Ecological Enhancement Plan, Chapter 4) for the enhancement of existing ecological values, and for the creation of new ecological sites. The enhancement plan has a particular focus on providing habitat for threatened species, and promoting the functional value of the management area<sup>2</sup> as a wildlife corridor – facilitating movement of plants and animals between the more intact upper river reaches, downstream to the coast and urban areas on the Heretaunga Plains. Where possible, enhancement activities are planned to achieve outcomes across multiple values, in particular to achieve ecological as well as cultural and/or recreational benefits.

Both the management and enhancement plans are informed by the preceding values assessment which is contained in Chapter 2.

## 1.2 Document rationale

The Scheme area encompasses a substantial area of braided riverbed, estuarine and coastal beach habitats. The Scheme’s berms and escarpments contain large areas of exotic grassland/herbfield, forest and treeland and, where conditions have allowed, a small (in area and number) yet important collection of native forest and shrubland sites remain. In addition to the wetland habitat provided by the riverbed itself, a range of freshwater (riverine and palustrine) wetlands are present on the berm areas of the Scheme.

Collectively, these habitats support a range of ‘common’, ‘uncommon’ or ‘threatened’ plants and animals. Many of the threatened species, most obviously river birds, are threatened with extinction because they have specialist requirements<sup>3</sup>, which when interrupted, reduce their viability and contribute to their population decline.

The management plan sets out specific guidance for management of Scheme activities to protect important ecological features of the Scheme. This guidance is based on a new level of ‘river specific’ detailed information on the Scheme’s ecological values and in some respects the guidance contained in the management plan is a refinement of previously employed management practices.

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<sup>1</sup> Any reference in this document to “the Scheme” or “Scheme area” relates to the 36km reach of the Ngaruroro River between the sea at Waitangi and Mangatahi.

<sup>2</sup> The term “management area” refers to the reach of the Ngaruroro River between the sea at Waitangi and Whanawhana.

<sup>3</sup> For example, the endemic Nationally Endangered bird, the black-billed gull has a national population of only about 15,000 birds (Stephenson, 2010), and the Ngaruroro River is one of two Hawke’s Bay sites used for nesting and brood rearing. However, the species is vulnerable to a range of often interacting factors, such as disturbance and nest destruction from physical activities, weed encroachment of habitat, predation by introduced mammals, island habitat loss and nest destruction from spring/summer flood flows.

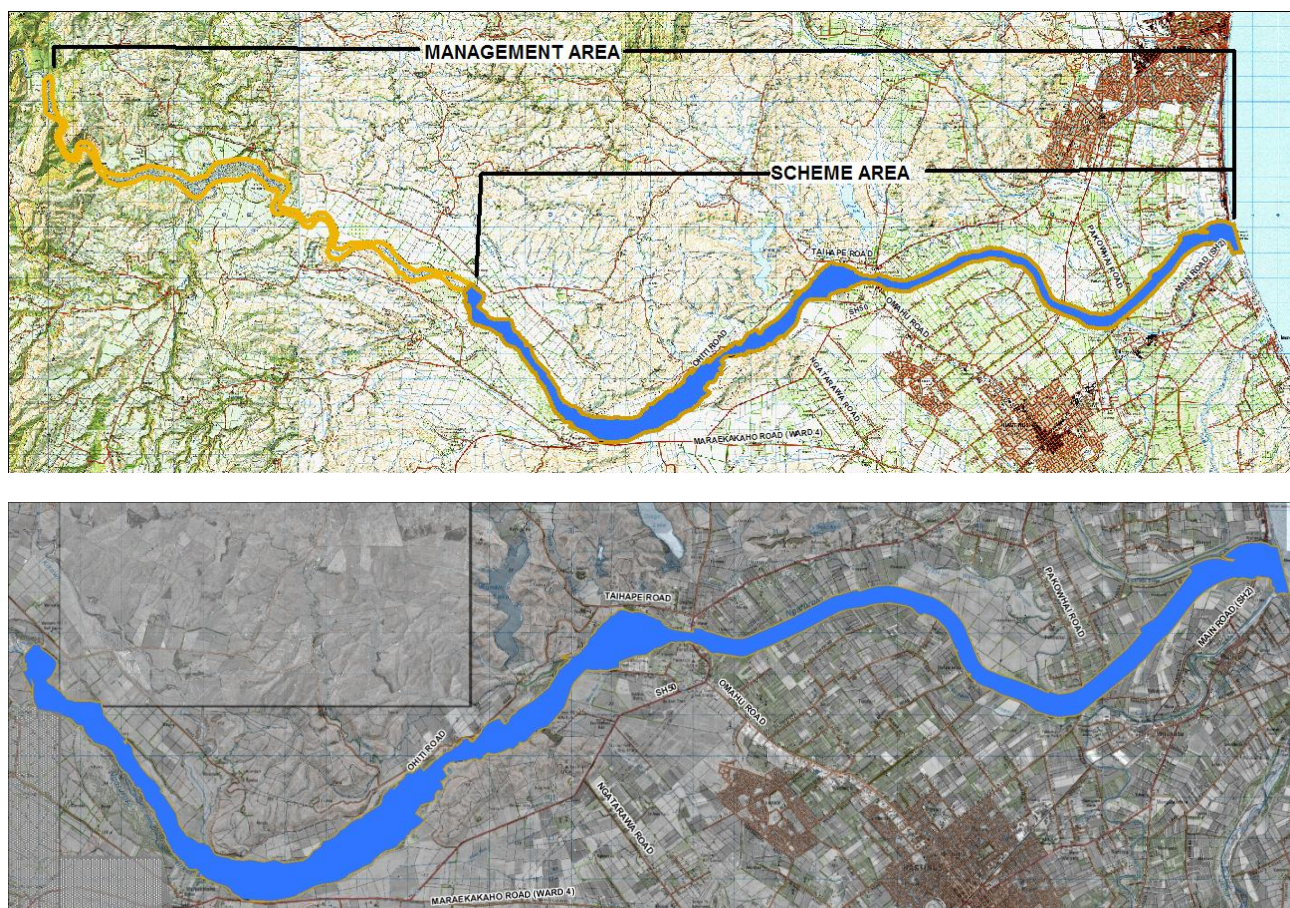
## 1.3 Document scope and structure

### 1.3.1 Scope

The EMEP covers two contiguous areas of the Ngaruroro River (see Figure 1-1 below). Primarily it focuses on the HBRC's flood control Scheme area, which is the reach of the Ngaruroro River from its mouth, upstream approximately 36km to a point above the Mangatahi area (see Figure 1-1 below).

However, typical of studies of many ecological systems, many of the management and enhancement issues associated with the Scheme have aspects which reach beyond the Scheme area proper. For that reason, aspects of the EMEP's coverage (such as functioning wildlife corridors and particular aspects of the Enhancement Plan) relate to the river corridor as far up-stream as the Omahaki Stream confluence, near Whanawhana.

For the purposes of this EMEP, the entire area of river covered by this document is referred to as the "management area", and the seaward most 36km of the river corridor (i.e. a subset of the management area) is termed the "Scheme area".



**Figure 1-1 : Extent of management area and Scheme area in relation to surrounding environment.**

The EMEP includes the findings of literature review and survey of flora of the Scheme and sampling and studies of river bird, terrestrial invertebrates, freshwater fish and lizard communities of the management area, which as outlined above covers the reach of the Ngaruroro River from the sea inland as far as Whanawhana at the foothills of the Ruahine Ranges.

Maori cultural values of the river were assessed by way of oral-history.



Recreational use (type, location and intensity) of the river was investigated through site visits, knowledge of the river and publicly available information.

The management plan uses management zones to control the effect of Scheme activities, or other impacting activities, on ecological values. Management zones are either 'location specific' or 'values specific'. An additional layer of protection termed "*ecologically sensitive sites*" also form part of the management plan (see Table 1-1 below).

**Table 1-1 : Overview of management zone types.**

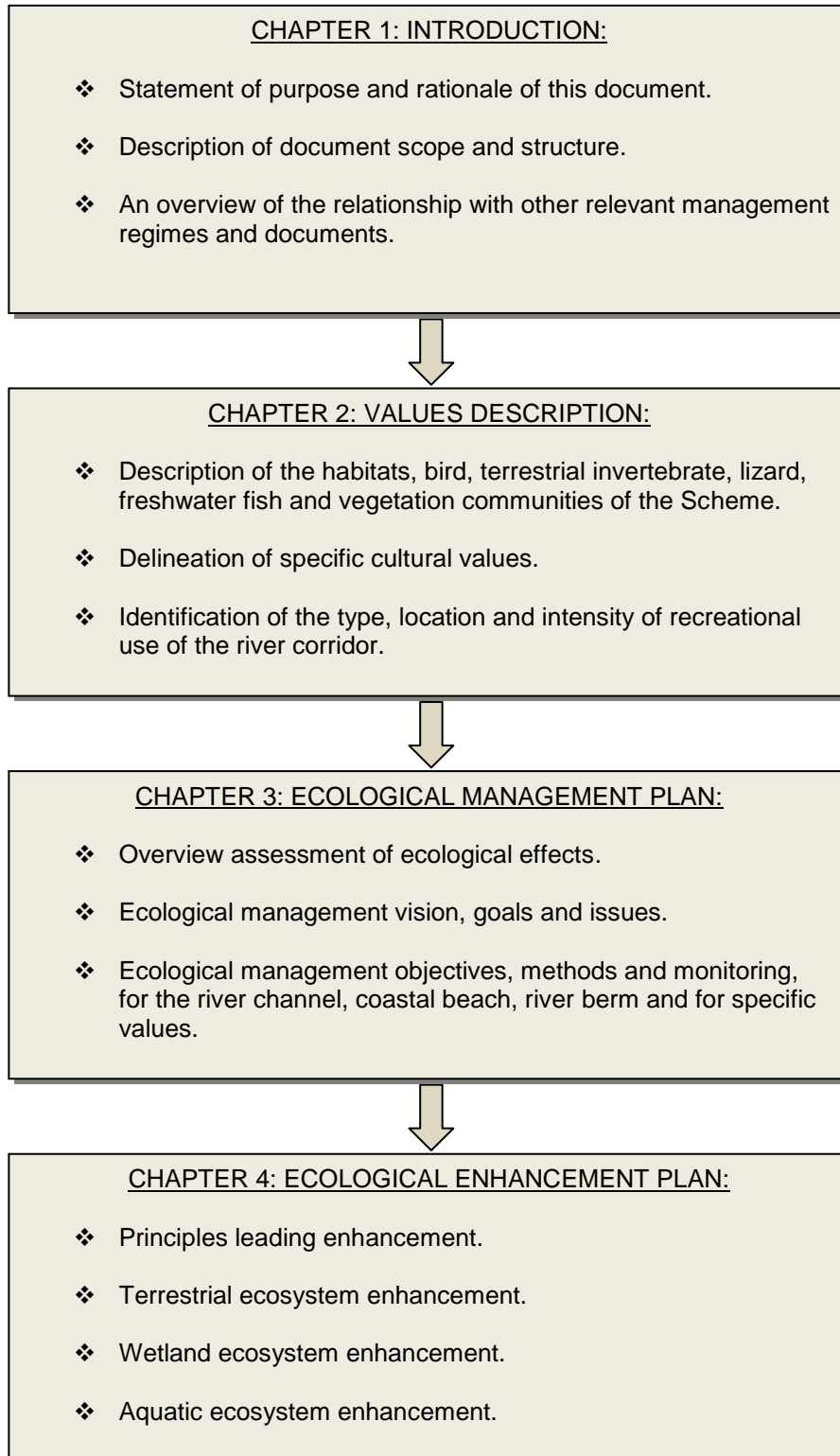
Active River Channel	Coastal Gravel Beach	River Berm
<b>Location specific management zones</b>		
Gravel riverbed management zones (x 4):	Coastal beach management zone (x 1).	River berm management zones (x 2):
• beach raking.		• sustainable management.
• commercial gravel extraction.		• herbicide application.
• herbicide application.		
• edge retreat and channel diversion works.		
<b>Values specific management zones</b>		
• black-billed gull/South Island oystercatcher management zone.		• native vegetation management zones.
		• whitebait spawning management zones.
<b>Ecologically sensitive sites</b>		
		Located on the river berm, and:
		• are covered by a values specific management zone, or
		• are existing ecological features which have been prioritised for enhancement in Chapter 4, or
		• is a new area of revegetation or wetland creation.

As described in Section 1.4 below, the EMEP relates to many other management regimes and Hawke's Bay Regional Council ("HBRC") documents, and it is envisaged that it will be used for a range of purposes, such as:

- The values assessment (Chapter 2) presents a recent (2009/2010) inventory of the ecological values of the river and can be used as a stand-alone ecological resource document for the study area.
- The assessment of the Scheme's ecological effects (Chapter 3) can be used by HBRC staff when assessing gravel extraction applications, or when planning their own physical Scheme activities.
- Many of the management goals, issues, objectives methods and monitoring will provide context and guidance to HBRC staff and gravel extraction contractors when undertaking physical scheme activities. Chapter 3 contains specific management zones which contain 'rules' to control activities and associated ecological effects.
- The enhancement plan (Chapter 4) will be used by HBRC staff primarily for the implementation of future enhancement activities within the Scheme, but also in the wider context of strategic biodiversity planning for the Heretaunga Plains.

### 1.3.2 Structure

The broad structure of the EMEP is presented below:



## 1.4 Relationship with other management regimes and Council documents

### 1.4.1 National management regimes

#### 1.4.1.1 Resource Management Act (1991)

Many ecological features of the Scheme covered by this EMEP are 'significant' in terms of Section 6(c) of the Resource Management Act 1991 ("the RMA"). Under the RMA, HBRC is required to "*recognise and provide for the protection of areas of significant vegetation and significant habitats for indigenous fauna from inappropriate subdivision, use and development*".

#### 1.4.1.2 The New Zealand Biodiversity Strategy (2000)

The New Zealand government has implemented the New Zealand Biodiversity Strategy ("NZBS"), of which "Goal Three" seeks to "*halt the decline in New Zealand's indigenous biodiversity*".

Specifically, Goal Three aims to:

*Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and do what else is necessary to maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity.*

This EMEP is a key method for HBRC to use in addressing the intent of Goal Three of the Government's NZBS for the management area.

### 1.4.2 Regional documents

#### 1.4.2.1 Hawke's Bay Regional Resource Management Plan (2006)

The Hawke's Bay Regional Resource Management Plan (Operative 2006) ("HBRRMP") provides for "*river control and drainage works*" as a permitted activity provided that (amongst other conditions) the works are carried out in accordance with the HBRC Regional Council Environmental Code of Practice for River Control and Drainage Works (1999) ("the Code").

This EMEP provides a new level of detailed information on specific types and locations of ecological values of the Scheme, and measures which should be taken to avoid inappropriate impacts to those values when implementing the Code as discussed below.

The HBRRMP classes "*large scale riverbed gravel extraction*" as a "*restricted discretionary*" activity, meaning resource consent from HBRC is required. The HBRC is restricted to a discrete list of matters which they have discretion over when assessing a gravel extraction resource consent application.

In addition to the new level of detail on ecological features of the Scheme, the EMEP provides spatially and temporally specific rules and protocols for gravel extraction, the intent of which can be used by HBRC as conditions of any gravel extraction resource consent.

#### 1.4.2.2 Hawke's Bay Regional Council Code of Practice for River Control and Drainage Works (2003)

The Code relates solely to river control and drainage works, and sets environmental outcomes, defines river control and drainage activities and provides 'standard operating procedures' ("SOPs") for river works.



This EMEP covers river works which are described in the Code, and builds on the SOPs contained within the Code by providing a new level of detail on the type of ecological features, as well as their spatial and temporal character in specific relation to the Ngaruroro River. Given this, the EMEP then provides guidance on how river works should be carried out to sustainably manage the ecology of the Scheme.

It is recommended that the information contained within this EMEP is considered and incorporated as appropriate during future reviews of the Code.

#### 1.4.2.3 *Heretaunga Plains Flood Control Scheme Asset Management Plan (DRAFT) (2009)*

Section 6 of the draft Heretaunga Plains Flood Control Scheme Asset Management Plan (“Rivers Asset Management Plan”) sets out an environmental strategy for the Heretaunga Plains Flood Control Scheme. A list of actions are set out, for the short and long term, which would be required to meet the objectives of the environmental strategy.

This EMEP directly addresses many of the actions required to meet the Heretaunga Plains Flood Control Scheme Environmental Strategy, for the Ngaruroro River Scheme.

#### 1.4.2.4 *Waitangi Estuary Management Plan (2008 to 2013)*

The Waitangi Estuary Management Plan sets out the wetland protection and enhancement programmes for the five year period 2008 to 2013. This EMEP overlaps in area of coverage with the Waitangi Estuary Management Plan, and it is recommended that the 2013 review of the Waitangi Estuary Management Plan takes into account the management zone information contained in Chapter 3 of this EMEP.

## 1.5 Document lifespan and review

This EMEP has a 10 year lifespan, and will be reviewed during the year 2021.

## 1.6 Areas for further work

Local Maori have raised concern that the flounder population of the Ngaruroro River has declined over time. This aspect has not been investigated as part of this project, and it is recommended that if HBRC wish to pursue this, they should seek specialist advice on this matter.

As discussed later in the document, Fish and Game have some concern over the effect of beach raking and gravel extraction of riffle-pool sequences and/or pool morphology, and whether there are any follow-on effects to the trout population of the river. It is not clear whether these activities affect these aspects of riverbed morphology. Although an attempt was made to investigate this, based on the information available at the time to support a desk-top study, this was not a feasible study. It is recommended that a study be progressed to investigate this matter, and it is thought that some field surveys will be required to inform the study.

This EMEP does not cover ecological effects of changes in the flow regime of the Ngaruroro River. At some point flow regime changes, such as reduced low flows or reduced flood frequency would impact on the ecological values of the river bed. Key terrestrial aspects needing consideration would be effects to bird communities resulting from loss of river bird island habitat, reduced habitat quality and nesting success from plant pest encroachment, and altered river bird feeding dynamics.

It is envisaged that as Council prepares further EMEPs for the other rivers in the Hawke's Bay region, some of the timing constraints imposed on Scheme activities by this and other EMEPs (such as avoidance of beach raking during the critical nesting season) may coincide between rivers, forcing a large amount of physical works to be done within a relatively short time period. This may require further planning and prioritisation of works, and perhaps an iteration of EMEP rules to allow sufficient time to practically complete the Scheme works while effectively protecting ecologically sensitive sites.

## Appendix A: References

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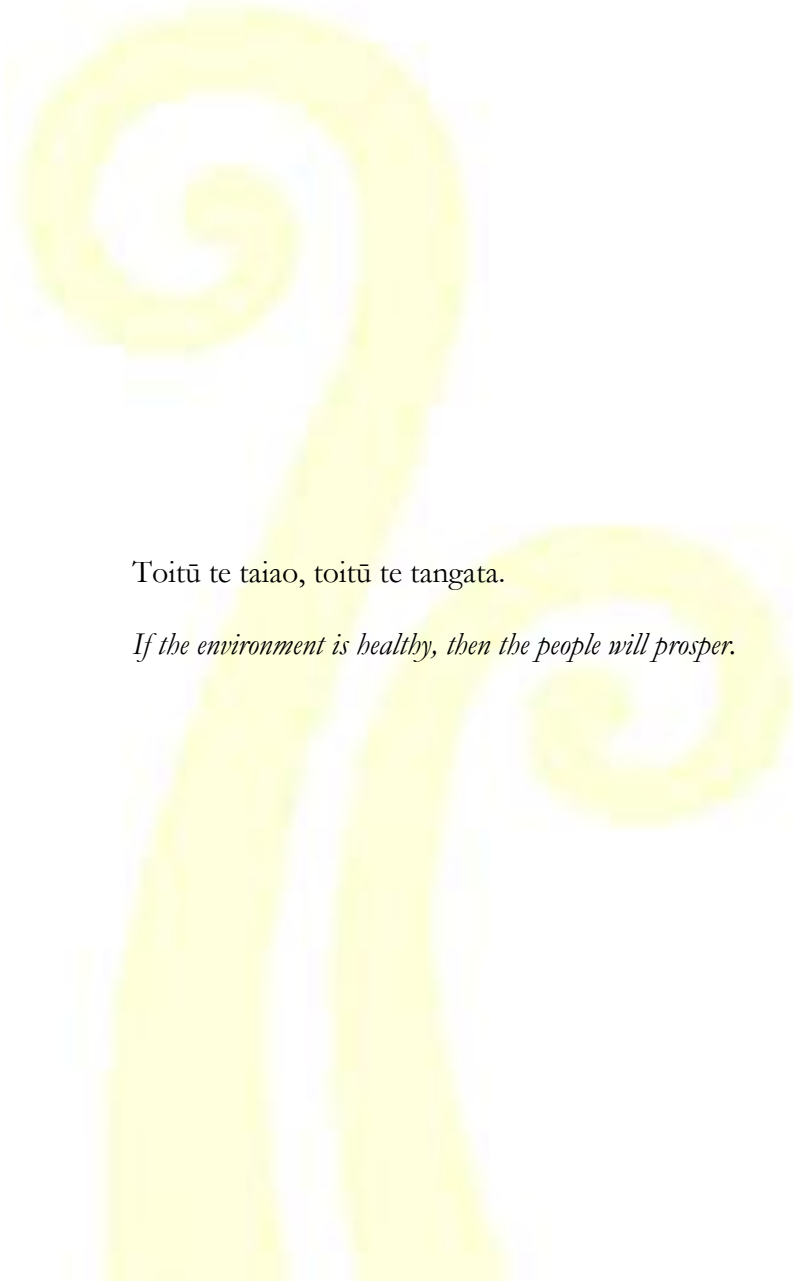
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## CHAPTER 2 : VALUES DESCRIPTION







Toitū te taiao, toitū te tangata.

*If the environment is healthy, then the people will prosper.*

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# 1 Ecological values

## 1.1 Ngaruroro River habitat values and their ecological significance

### 1.1.1 Overview of habitat areas of the Scheme

The Ngaruroro Scheme area contains a range of habitat types. A comparative summary of habitat types and their approximate areas within the Scheme is presented in Table 1-1 below.

**Table 1-1 : Comparison of relative areas of habitat types within the Scheme area.**

Habitat Class	Area (ha)	Habitat Class	Area (ha)
<b>Terrestrial habitats</b>			
Riverbed (braided & single channel) <sup>1</sup>	856	Exotic treeland	65
Exotic grassland / herbfield	676	Native shrubland	3.9
Exotic forest	555	Native treeland	2.0
Exotic scrub	92	Native forest	1.2
Coastal gravel beach	11.3		
<b>Wetland and aquatic habitats</b>			
Estuarine <sup>2</sup> open water	34	Riverine <sup>3</sup> ephemeral wetland	1.1
Palustrine <sup>4</sup> shallow water wetland	4.2	Riverine shallow water channel wetland	1.0
Estuarine saltmarsh	3.8	Palustrine floodplain wetland	0.95
Palustrine swamp	2.8	Riverine shallow water wetland	0.78
Estuarine channel	2.7	Palustrine ephemeral wetland	0.40
Reedland	1.6		

The above summary shows that the terrestrial habitats of the Scheme area are dominated by riverbed, exotic grassland / herbfield, and exotic forest habitats. Collectively these habitats make up around 90% of the total Scheme area. In contrast, the cumulative area of native shrubland, treeland and forest make up about 0.3% of the Scheme area.

Around 37% of the Scheme area is braided riverbed or wetted river channel. Exotic grassland or herbfield makes up around 29% of the Scheme, and exotic forest comprises about 24%. Exotic scrub and treeland are relatively minor components of the Scheme area (3% and 2.8% respectively). The majority of wetland / aquatic habitat area are associated with the Waitangi Estuary, with estuarine open water, estuarine saltmarsh, and estuarine channel habitats. In total wetland areas (aside from the river channel itself) make up around 2.3% of the Scheme area. The remaining areas of wetland habitat within the Scheme are non-estuarine habitats, and occupy around 0.6% of the scheme area.

<sup>1</sup> This measurement incorporates the entire area of the scheme which is either (1) braided riverbed (including wetted braid areas) or (2) single river channel downstream from Chesterhope to the Waitangi Estuary. In this context it is classed as 'terrestrial habitat', however it should be noted that this area has considerable aquatic habitat values as well.

<sup>2</sup> Estuarine open water refers to the tidal reaches and mouths of coastal rivers and coastal lagoons.

<sup>3</sup> Riverine wetlands are defined as: wetlands associated with rivers, streams, and other channels where the dominant function is continually or intermittently flowing freshwater in open channels.

<sup>4</sup> Palustrine wetlands are defined as: all freshwater wetlands fed by rain, groundwater, or surface water but not directly associated with estuaries, lakes, or rivers.



### 1.1.2 Habitat values of the braided riverbed

The braided riverbed of the Ngaruroro River is of regional and national significance for the wildlife values it supports.

The significance of the riverbed's wildlife values have been highlighted by the Department of Conservation through their Protected Natural Areas Survey (RAP 12<sup>5</sup>)<sup>6</sup> and Sites of Special Wildlife Interest inventory (SSWI)<sup>7</sup>. Lee (1994) classified the reach of the river between Fernhill and Mangatahi as a 'RAP', with a significance of "High". The justification for that ranking was that the river is the best and largest example of a braided river system in Hawke's Bay, and has high landscape and wildlife values. It was explicitly noted that within the RAP large areas of relatively undisturbed habitat are available to a range of birds, the most significant being black-fronted and banded dotterels.

The Hawke's Bay Region provides the greatest cumulative area of braided riverbed habitat in the North Island<sup>8</sup>. The region contains 10,375ha of riverbed area, which equates to 4.2% of New Zealand's total braided riverbed area<sup>9</sup>. The Ngaruroro River quite possibly provides the largest single area of braided riverbed habitat in the North Island of New Zealand.



**Figure 1-1 : Examples of the expansive nature of the braided riverbed of the Ngaruroro River. Photographs taken near Maraekakaho, (left) and; Ohiti, (right).**

### 1.1.3 Specific bird habitats of the river corridor

The key justification for the river's nationally significant wildlife values is the diverse bird fauna which the river corridor supports. Gravel rivers such as the Ngaruroro provide a variety of habitats for bird species, including areas for breeding, brood rearing, feeding and roosting. Each species use specific parts of the riverbed and adjacent land<sup>10</sup>. On that basis the Ngaruroro River provides bird habitat which spans wetland, terrestrial and aquatic ecosystems (see illustrations of habitat examples in Figure 1-2 below).

<sup>5</sup> "RAP 12" is the abbreviation for the DoC's 'Recommended Areas for Protection' classification. The RAP classification was established in 1994 as part of the Heretaunga Ecological District Protected Natural Areas Survey.

<sup>6</sup> Lee, 1994.

<sup>7</sup> Parish, 1988.

<sup>8</sup> Caruso, 2006.

<sup>9</sup> Caruso, 2006.

<sup>10</sup> Parrish, 1988.



**Figure 1-2 : Bittern feeding habitat at wetland near Kommerens, (top left); native and exotic forest provides habitat for a range of terrestrial bird species, (top right); shallow water wading and gravel spit habitat near Carrick Road provides feeding and nesting habitat, (bottom left); and pool and run channel characteristics below Chesterhope provide aquatic feeding habitat for shags and other deep water feeders, (bottom left).**

In total 83 bird species have been recorded on the Ngaruroro River and its associated margin habitats<sup>11</sup>. Eighteen of those species are native to New Zealand, and a further 18 species are endemic to New Zealand. Of the 36 native or endemic bird species associated with the Ngaruroro River Corridor – 14 species are formally classified by the Department of Conservation as being threatened with extinction, and a further 8 species are either declining in number, biologically scarce, recovering from previous threatened status, or survive only in relictual populations<sup>12</sup>.

A number of those 'threatened' or 'at risk' bird species have specialist breeding requirements, and rely on the open gravel habitat presented by the braided riverbed for nesting and raising of their young. With the continued decline in quality of South Island braided riverbed habitats the quality of alternative habitats in the North Island becomes more important for bird species which rely on the nationally and internationally rare braided riverbed habitat<sup>13</sup>.

<sup>11</sup> Stephenson, 2010.

<sup>12</sup> Townsend *et al*, 2008.

<sup>13</sup> Stephenson, 2010.

Specific habitat types for birds of the Ngaruroro River corridor are presented in Table 1-2 below.

**Table 1-2 : Parrish's description of aquatic and terrestrial habitat types for riverbed birds.**

Habitat Type	Used By
<b>Aquatic</b>	
Unbroken flowing pools or runs	Mainly shags, white-fronted terns in lower reaches; edge and shallow side runs used by dotterels, stilts, gulls and some waterfowl
Riffles/rapids	Shallow slower-moving riffles are important feeding habitat for dotterels, oystercatchers and stilts
Backwater	Mainly dotterels, stilts, oystercatchers, herons and gulls
Seep	Waders
Disconnected pool (enclosed small pond on gravel flats)	Waders
Swamps/ox-bow wetlands	Bittern, spotless crane, dabchick, black-fronted dotterel and waterfowl
Man-made aquatic habitats (drains, irrigation races or irrigated pasture)	Supplementary feeding habitat for spur-winged plover, pied stilt, gulls, shags and some waterfowl
<b>Terrestrial</b>	
River terraces (raised level areas beside a river resulting from successive down-cutting of river)	Feeding and loafing by gulls, paradise shelducks and some breeding by spur-winged plover
Low flood terrace or island on river (young terraces immediately adjacent to river)	Heavily-vegetated areas are used by small passerines and upland gamebirds. Willow areas are frequented by passerines and shining cuckoo, and provide breeding habitat for waterfowl
Bar, flat or spit (areas of gravel within the active river floodplain)	Main riverbed breeding habitat for dotterels, stilts, oystercatcher, black-backed and black-billed gulls. Feeding habitat for dotterel and pipit
Exposed rocks in river channel and cliffs and rock outcrops on edge of river	Roosting for shags and rock pigeons
Dry watercourse	Feeding habitat for dotterel, stilt and pipit

Note: The above content is adapted from Parrish (1984).

#### 1.1.4 Habitat values of the gravel beach

Gravel beaches in New Zealand have over recent years been categorised as “*Originally Rare*”<sup>14</sup> terrestrial ecosystems<sup>15</sup>. The protection of native vegetation associated with ‘originally rare’ terrestrial ecosystems is “*National Priority 3*” in Central Government’s statement of national priorities for protecting rare and threatened biodiversity on private land<sup>16</sup>. The beach at Waitangi meets the criteria<sup>17</sup> used nationally for positively identifying the substrate size of a coastal beach as a ‘gravel’ type.

The beach provides nesting habitat for black-billed gulls, white-fronted terns and dotterel. It is also an important overwintering site for black-fronted terns and banded dotterel.

The beach also provides habitat for various lizard and invertebrate species, although further inventory work is required to fully understand these values.

<sup>14</sup> Originally rare ecosystems are ecosystem types which were present when Maori arrived and still exist today, and which at the time of Maori arrival (and today) occupy <0.5% of New Zealand’s total area (of 268,680km<sup>2</sup>) (MfE 2007).

<sup>15</sup> Williams *et al*, 2007; MfE, 2007.

<sup>16</sup> MfE, 2007.

<sup>17</sup> Within the top 10 cm of the surface, > 50% of the volume comprises particles > 2mm in diameter (upper size of sand). No greater than 50% of the surface can be covered with boulders (rocks > 256 mm). (Landcare Research 2010).





Figure 1-3 : Example of the character of the gravel beach at Waitangi.

## 1.1.5 Habitat values of the Schemes' riparian margins and escarpments

### 1.1.5.1 Forests, treelands, shrublands, scrublands, and grasslands/herbfields

The Heretaunga Plains were once covered in a dense stand of podocarp-broadleaved forest<sup>18</sup>. Today, the Heretaunga Plains contain very little area of forest and what forest there is, is almost exclusively comprised of exotic tree species.

The riparian margins of the Scheme contain substantial areas of exotic forest (555ha) and grassland/herbfield (676ha). Relatively less, although still substantial, areas of scrubland (92ha) and exotic treeland (65ha) are present.

Exotic forests of the Scheme are primarily the close plantings of the willow edge protection areas (see example in Figure 1-6 below). These areas are typically frequented by passerines and shining cuckoo, and can be used by waterfowl for breeding habitat. Kereru have been known (seasonally) to feed on the young leaf buds of crack willow.

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<sup>18</sup> Grant, 1996; Lee, 1994.



**Figure 1-4 : A pair of shining cuckoo near Higgins Bluff.**



**Figure 1-5 : Leaf buds of crack willow provide a seasonal food source for kereru.**

Given the lineal nature of these forests, and their course across the Heretaunga Plains, the forests of the Scheme present a unique potential to function as wildlife corridors – facilitating movement of mobile species, such as tui, bellbird and kereru across the Heretaunga Plains. Their functional performance as wildlife corridors can be enhanced by increasing the diversity of the plant species present within the Scheme.

In the upper areas of the Scheme, around Mangatahi, the crack willow forest provides nursery conditions for natural colonisation of native fern, shrub and tree species (see Figure 1-7 below). These forest conditions and the types of species naturally recolonising them provide a good model for ecological revegetation in the lower reaches of the Scheme.



**Figure 1-6 : Exotic forest of the lower Scheme, above Chesterhope.**



**Figure 1-7 : Natural colonisation of edge protection planting by native ferns, shrubs and trees in the upper Scheme, near Matapiro.**



Exotic scrublands of the Scheme tend to be comprised of woody exotic shrub species, such as gorse and tree lupin interspersed with occasional trees, such as willow or poplar. These areas provide good cover for the gamebird species, pheasant and quail, and provide cover for passerines.

Exotic grasslands and herbfields within the Scheme are extensive, some are held under grazing leases and others are unmanaged.



**Figure 1-8 : Example of exotic grassland habitats of the Scheme, near the Roys Hill Rifle Range, (left); and grazed pasture upstream of the Tutaekuri / Ngaruroro River confluence, (right).**

Relatively small and isolated areas of native forest and shrubland remain within the Scheme. These features tend to be associated with the sloping ground of river escarpments and bluffs, and are most commonly located on faces with aspects to the southern quarters; perhaps a reflection of the relatively cooler and moister conditions compared to sunny north facing sites.

A gradient of decreasing abundance of naturally occurring native vegetation occurs in a down river direction within the management area, from extensive areas of broadleaf and kanuka forests near Whanawhana reducing to isolated patches of native vegetation, and individual native specimens within the top half of the Scheme. Very little naturally occurring native vegetation occurs within the Scheme downstream of Roys Hill. Some examples of native forest and shrubland habitats within the Scheme are presented in Figure 1-9 below.



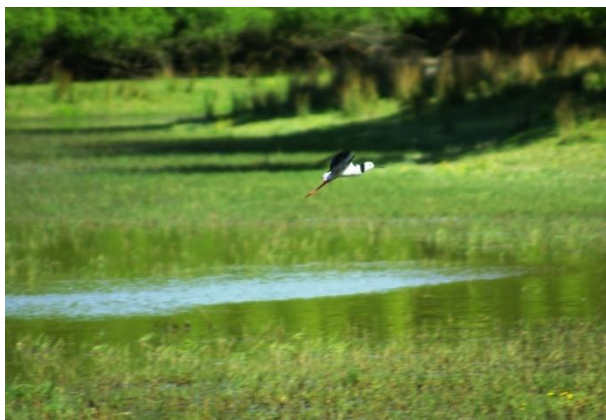


**Figure 1-9 : Native broadleaf forest on south facing escarpments, (top left and right, and centre left); kaunka grove at Kommerens, (centre right); hebe shrubland, (left); and flaxland with emergent manuka, (right).**



### 1.1.5.2 Riparian wetlands

The Scheme area contains a variety of wetland types. Upstream of the estuarine area, broad areas of the berm which are rarely flooded provide space and topography for small palustrine<sup>19</sup> wetlands. These are often grazed, yet still provide habitat for a range of bird species of wading and shoreline habitat guilds, such as pied stilt, black-fronted and banded dotterels, white faced heron and waterfowl.



**Figure 1-10 : Pied stilt above palustrine wetland, near the expressway road crossing.**



**Figure 1-11 : Small palustrine wetland, probably ephemeral, near the expressway road crossing.**

Berm areas of the Scheme also feature riverine<sup>20</sup> wetlands, fed either by the flow of tributary streams, river water from the Ngaruroro River, or groundwater springs in the highly permeable gravels of the river's margins. Examples of both permanent and ephemeral riverine wetland are present within the Scheme.



**Figure 1-12 : Ephemeral riverine wetland, near Kommerens.**



**Figure 1-13 : Riverine wetland runs along the toe of the terrace riser. To the left of frame this wetland flows under edge protection plantings and supports a variety of native fish and plants.**

<sup>19</sup> Defined as: water regime not subject to surface inundation; wetland not immediately adjacent to flowing water (as defined by the wetland classification system of Johnson and Gerbeaux, 2004).

<sup>20</sup> Situated in river or stream channels, or immediately adjacent to water courses; influenced by continuous or intermittently flowing water (as defined by the wetland classification system of Johnson and Gerbeaux, 2004).

A characteristic form of riverine wetland in the upper reaches of the Scheme (and more so in the management area between the upper Scheme reach and Whanawhana) are relict meanders traversing the toe of tall river escarpments (see Figure 1-13 above). These features would typically once have been part of the main river flow proper, and today either remain linked to the mainflow, or are backwater features. Collectively these features provide a considerable area of wetland habitat for indigenous plants, birds and freshwater fish.

An example of this wetland type is located near the upper extent of the Scheme, below Matapiro Road. The wetland features a good diversity of naturally occurring native sedges, ferns, shrubs and trees and provides habitat for a range of native freshwater fish, including the species dwarf galaxias and longfin eel. Populations of both these species are regarded by the Department of Conservation to be in decline due to factors induced by human activity<sup>21</sup>.

At the lowest extent of the Scheme, the estuary contains a range of wetland habitats, which have and continue to be the subject of inventory and management under the Waitangi Estuary Management Plan<sup>22</sup>. These wetlands are both man made (e.g. the horseshoe wetland) and naturally formed. Wetland types range from open estuarine water which provide habitat for deepwater feeding birds (e.g. gannet, shag, white-fronted terns) to estuarine channels and saltmarsh. The tall perennial herbs, raupo and three-square form areas of dense marginal vegetation which provide habitat for specialist wetland birds, in particular Australian bittern and spotless / marsh crake.



**Figure 1-14 : Example of estuarine channel with three-square marginal vegetation.**

<sup>21</sup> Townsend *et al*, 2008.

<sup>22</sup> see Eyles, 2008.



## 1.1.6 Aquatic habitat values

### 1.1.6.1 Freshwater fish

Table 1-3 : New Zealand freshwater fish database records for the Ngaruroro River mainstem.

Freshwater Fish Presence Data for the Ngaruroro River			<i>Aldrichetta forsteri</i>	<i>Anguilla australis</i>	<i>Anguilla dieffenbachii</i>	<i>Cheimarrichthys fosteri</i>	<i>Galaxias brevipinnis</i>	<i>Galaxias divergens</i>	<i>Galaxias maculatus</i>	<i>Gambusia affinis</i>	<i>Geotria australis</i>	<i>Gobiomorphus basalis</i>	<i>Gobiomorphus cotidianus</i>	<i>Gobiomorphus gobioides</i>	<i>Gobiomorphus hubbsi</i>	<i>Gobiomorphus huttoni</i>	<i>Grahamina</i> sp.	<i>Oncorhynchus mykiss</i>	<i>Retropinna retropinna</i>	<i>Rhombosolea retiaria</i>	<i>Salmo trutta</i>
Distance from sea (km)	Reach of river	Yelloweyed mullet	Shortfin eel	Longfin eel	Torrentifish	Koaro	Dwarf galaxias	Inanga	Gambusia	Lamprey	Crans bully	Common bully	Giant bully	Bluegill bully	Redfin bully	Estuarine triplefin	Rainbow trout	Common smelt	Black Flounder	Brown trout	
		0 to 6	Hawke Bay to Chesterhope Bridge																		
6 to 36	Chesterhope Bridge to Mangatahi																				
98 to 136	Upstream of Whanawhana																				

For the mainstem of the Ngaruroro River, NIWA's freshwater fish database contains the fish survey records shown in Table 1-3 above. These results show that the Scheme area contains the most diverse freshwater fish community of the Ngaruroro River's mainstem.

The Hawke's Bay Regional Council Environmental Code of Practice for River Control and Drainage Works<sup>23</sup> ("the Code") identified known whitebait spawning areas within the estuary. The Code identified two whitebait spawning sites in the Waitangi Estuary. One in the relict estuarine channel of the Tutaekuri River above the State Highway Road Crossing, and a second in the estuarine channel above State Highway 2 on the true right of the estuary<sup>24</sup>. Porter identified whitebait spawning on both sides of the main river channel approximately 2km upstream from the rivermouth.

The Department of Conservation recognise that the middle reaches of the river provides habitat for the native fish, dwarf galaxias ("*Gradual Decline*")<sup>25</sup>.

Fish and Game consider the middle and lower reaches of the river (within the Scheme and wider management area) to be a regionally important habitat for trout<sup>26</sup>, and consider it to be intrinsically linked

<sup>23</sup> Tennant, 2003.

<sup>24</sup> These two sites remain important spawning habitat for the Ngaruroro River (pers. comm. Hans Rook (July 2010)).

<sup>25</sup> Hitchmough *et al*, 2007.

<sup>26</sup> Richardson *et al*, 1987.

to the “*National Outstanding*” trout fishery in the upper river<sup>27</sup>. In consultation held during preparation of this management plan, Fish and Game express some concern over the effect beach raking has on pool morphology of the braided river, and the effect that may have on habitat quality for trout.

The Code also provided some guidance on pool habitat creation. The objective of this activity would be to create artificial deep pools to mitigate potential loss of permanent deep pools. There do however remain some uncertainties around the effectiveness and longevity of artificially creating pool habitats in a braided riverbed.

#### 1.1.6.2 Water quality

The water quality state, trends and contaminant loads of the Ngaruroro River are described in detail by Ausseil (2009), and are not repeated here. However in summary, Ausseil's (2009) analysis of aquatic macroinvertebrate communities of the river concludes that below Kuripapango, Macroinvertebrate Community Index (MCI) scores remain consistently above 100 which indicates relatively healthy aquatic invertebrate communities. The exception of this is at Chesterhope, within the Scheme, where scores between 90 and 100 are regularly obtained, which is indicative of moderate degradation in water quality.

Water clarity gradually decreases in a downstream direction within the river, from “excellent clarity” in the upper river reaches (above Kuripapango) to levels well below the ANZECC guidelines for recreational waters<sup>28</sup> and the national median for similar sites<sup>29</sup>. The cause of this decline in water clarity could not be narrowed to one specific factor, and is likely to be contributed from multiple sources within the catchment.

## 1.2 Bird values

### 1.2.1 ‘Common’, ‘threatened’ and ‘at risk’ birds of the management area

The Ngaruroro River and its surrounding wetland, estuarine and riparian margins form a considerable network of various bird habitats between the axial ranges and the coast.

Stephenson lists 83 bird species that have either been recorded within the river corridor, or would be expected to be present. Almost one third (27%) of those species are considered by the DoC to be ‘Threatened’ or ‘At Risk’<sup>30</sup> (see Table 1-5 below). The most common bird of the riverbed is the black-backed gull, followed generally by banded dotterel, and then by pied stilt. Populations of spur-winged plover and black-fronted dotterel have increased over the period of formal riverbed bird surveys (1962 to 1992), with a substantial increase in spur-winged plovers during only two decades, and a slower and seemingly stabilised population growth for black-fronted dotterel<sup>31</sup>. Common and widespread bird species of the management area are presented in Table 1-4 below.

<sup>27</sup> pers.comm. Iain Maxwell (October 2009).

<sup>28</sup> ANZECC, 2000.

<sup>29</sup> Ausseil, 2009.

<sup>30</sup> Miskelly *et al*, 2008.

<sup>31</sup> Stephenson, 2010.



**Table 1-4 : Common and widespread species found within the management area.**

Species	Designation
Australasian shoveler	Native
black-backed gull	Native
grey fantail	Native
grey gerygone (warbler)	Endemic
grey teal	Native
morepork	Endemic
New Zealand bellbird	Endemic
New Zealand pigeon	Endemic
paradise shelduck	Endemic
sacred kingfisher	Native
shining bronze-cuckoo	Native
silvèreye (waxeye)	Native
tui	Endemic
welcome swallow	Native

*Note: Adapted from Stephenson (2010).*

**Table 1-5 : Species that occur in the management area and are classified as 'Threatened' or 'At Risk' by Miskelly *et al*, (2008). Threat status and endemic<sup>32</sup> or native<sup>33</sup> classification also included.**

Species	Designation	Status
great egret (white heron)	Native	Nationally Critical
Pacific black (grey) duck	Native	Nationally Critical
shore plover	Endemic	Nationally Critical
Australasian bittern	Native	Nationally Endangered
black-billed gull	Endemic	Nationally Endangered
black-fronted tern	Endemic	Nationally Endangered
banded dotterel (double-banded plover)	Endemic	Nationally Vulnerable
caspian tern	Native	Nationally Vulnerable
eastern reef egret (heron)	Native	Nationally Vulnerable
New Zealand falcon	Endemic	Nationally Vulnerable
New Zealand grebe (dabchick)	Endemic	Nationally Vulnerable
New Zealand plover (dotterel)	Endemic	Nationally Vulnerable
red-billed gull	Native	Nationally Vulnerable
wrybill	Endemic	Nationally Vulnerable
New Zealand fernbird	Endemic	At Risk, Declining
New Zealand pipit	Endemic	At Risk, Declining
pied (black-winged) stilt	Native	At Risk, Declining
south Island oystercatcher	Endemic	At Risk, Declining
white-fronted tern	Native	At Risk, Declining
variable oystercatcher	Endemic	At Risk, Recovering
baillon's (marsh) crane	Native	At Risk, Relict
spotless crane	Native	At Risk, Relict

*Note: Adapted from Stephenson (2010).*

<sup>32</sup> 'Endemic' is defined as: any species found only in a specific geographical area. In the context of this EMEP, the term endemic refers to species endemism at a national scale (i.e. species unique to New Zealand).

<sup>33</sup> 'Native' is defined as: living (or growing) naturally in a particular place or region; indigenous. Species native to New Zealand occur here naturally (i.e. have not been introduced from other countries by humans) and are also present in localities outside of New Zealand.

### 1.2.2 Significance of birds of the river corridor and rivermouth

According to Stephenson (2010) the Ngaruroro River meets the criteria of a site of “high” wildlife interest<sup>34</sup>. The significant aspects of the bird fauna which lead to this classification are cited by Stephenson as follows:

- *Dabchick (Nationally Vulnerable) currently utilise wetland areas adjacent to the river (around 25% of the Hawke's Bay population and 5% of the National population).*
- *Australasian bittern (Nationally Endangered) inhabit freshwater wetlands adjacent to the river channel as well as riparian margins both within and above the Scheme. With such low numbers of this species nationally, this area is an important one.*
- *Grey duck (Nationally Critical) still seem to occur in relatively high numbers on the river.*
- *Spotless crane (At Risk, Relict) inhabit the freshwater wetlands adjacent to the river, and may also inhabit riparian wetlands as well.*
- *One of only two nesting sites in the North Island (and possibly the only one currently used) of South Island oystercatcher. This species is currently considered 'At Risk, Declining'.*
- *The river holds very high numbers of banded dotterel (Nationally Vulnerable), the highest per kilometre of any of the main Hawke's Bay rivers, and may hold as much as 2% of the National population (25% of the regions river breeding population).*
- *A colony of around 100-300 pairs of black-billed gulls (Nationally Endangered) may nest annually on the river at Mangatahi. This is probably one of only two main breeding colonies in Hawke's Bay, and in some years 3-5% of the estimated breeding population may breed on the river and at the rivermouth.*
- *A remnant population of fernbird (At Risk, Declining) may still be present at Pigsty Swamp beside the Ngaruroro River. This species is widely but patchily distributed and this may be one of the few isolated sites for this species away from the main ranges.*
- *A relatively healthy population of pipit (At Risk, Declining) still exists on the river, both above and within the Scheme.*

According to Stephenson (2010) the Ngaruroro Rivermouth meets the criteria of a site of “high” wildlife interest<sup>35</sup>. The significant aspects of the bird fauna of the rivermouth which lead to this classification are cited by Stephenson as follows:

- *Dabchick (Nationally Vulnerable) currently utilise wetland areas adjacent to the rivermouth.*
- *Great egret (Nationally Critical) still regularly use the estuary and brackish wetlands in this area during winter.*
- *Australasian bittern (Nationally Endangered) inhabit freshwater and brackish wetlands in this area. As above this is a key species to protect.*
- *Many of the banded dotterel (Nationally Vulnerable) that breed on the river probably overwinter on or near the coast around the rivermouth.*
- *Some years a mixed colony of black-billed gulls (Nationally Endangered) and white-fronted terns nest at the rivermouth, with around 200-300 pairs nesting. Again this may represent about 3-5% of the National population.*
- *The rivermouth is an overwintering site for 30-75 black-fronted terns (Nationally endangered) each winter. This is one of the key sites in the North Island for this highly endangered tern.*

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<sup>34</sup> According to DoC's SSWI criteria for ranking sites of special wildlife interest.

<sup>35</sup> According to DoC's SSWI criteria for ranking sites of special wildlife interest.

### 1.2.3 'Threatened' and 'at risk' bird species to be positively affected by altered Scheme management, and enhancement

The following bird species<sup>36</sup> are either 'threatened' or 'at risk', and are the subject of specific management and/or enhancement initiatives outlined in Chapters 3 and 4 of this plan.



*Pacific black (grey) duck (native; nationally critical)*



*Australasian bittern (native; nationally endangered)*



*black-billed gull (endemic; nationally endangered)*



*banded dotterel (endemic; nationally vulnerable)*



*dabchick (endemic; nationally vulnerable)*



*New Zealand falcon (endemic; nationally vulnerable)*

<sup>36</sup> All photographs of this Figure were taken by Brent Stephenson of Eco-Vista Photography and Research.





*red-billed gull (native; nationally vulnerable)*



*South Island oystercatcher (endemic; at risk, declining)*



*pied (black-winged) stilt (native; at risk, declining)*



*New Zealand pipit (endemic; at risk, declining)*



*variable oystercatcher (endemic; at risk, recovering)*



*white-fronted tern (native; at risk, declining)*



*marsh crake (native; at risk, relict)*



*spotless crake (native; at risk, relict)*

**Figure 1-15 : 'Threatened' and 'at risk' birds subject of management or enhancement actions under this plan.**

## 1.3 Terrestrial invertebrate values

It is known that the composition of terrestrial invertebrate communities is influenced by many environmental factors, but the key habitat variables include: vegetation type, history of disturbance, stock grazing, size and isolation of site<sup>37</sup>.

Ground dwelling invertebrates were surveyed using pitfall traps across (1) gravel substrate sites, (2) willow edge protection forest and (3) native shrubland and forest, in locations within the management area - between the coastal beach and Whanawhana.

It was found that native vegetation sites support a significantly (statistically significant) greater richness and abundance of beetles (Coleoptera) and Hymenoptera<sup>38</sup>, but also more of the functional groups – decomposers (millipedes), and fungus feeding invertebrates.

Willow sites have a high grass cover and the dominant vegetation is willow. Previous research into the invertebrate communities of willow forests indicate lower diversity of native invertebrates<sup>39</sup>. As a consequence the invertebrate characteristics of these sites were of fewer invertebrates, and high numbers of landhoppers (Amphipods) which are common in moist, grassy areas.

The gravel riverbed and coastal beach feature comparatively little cover in terms of vegetation or litter, and are dynamic habitats which can change rapidly. The invertebrate characteristics of these sites were of scavengers, opportunistic, with the ability to colonise sites where recent disturbance (i.e. floods, waves, etc) has occurred.

A notable find was the collection of six specimens of *Maaminga marrisi* which is one of only two species of a newly discovered endemic wasp family – the *Maamingidae* family<sup>40</sup>. *Maaminga marrisi* is a leaf litter inhabitant of bushy scrub in exposed sites, and is typically distributed from near the shoreline to montane shrubs and snow tussock at about 800m above sea level<sup>41</sup>. Five other specimens of this species were collected from good quality flax shrubland on the south facing headland on the Kommeren property, on the true left of the river, roughly opposite Maraekakaho. The sixth specimen was collected from the gravel beach to the south of the rivermouth at Waitangi.

### 1.3.1 Summary of habitat signs from the biota

A summary of the terrestrial invertebrate characteristics of the three general habitats of the Ngaruroro River study area is presented in Table 6-1 below.

**Table 1-6 : Habitat quality signs provided by terrestrial invertebrates.**

Invertebrates Characteristic	What the Feature Indicates
<b>Native Vegetation Sites</b>	
High numbers beetles, and native wasps	High general diversity
Millipedes	Abundant leaf litter for decomposition
<i>Pachycondyla</i> (native forest ant)	Common in forests
Spider hunting wasps	Diversity of prey for these top predators
Parasitoid wasps (Diapriidae, Mymaridae)	High general diversity
Beetle predators (Trogossitidae, Carabidae)	High general diversity
Fungus feeding beetles ( <i>Hypodacnella</i> , Corylophidae, <i>Epuraea</i> sp24.)	Ecosystem function, with dead wood, decomposition, nutrient cycling

<sup>37</sup> Didham *et al*, 2009.

<sup>38</sup> Hymenoptera is one of the largest orders of insects comprising the sawflies, wasps, bees, and ants.

<sup>39</sup> Landcare Research unpub. data.

<sup>40</sup> Darren Ward, pers.comm (2010).

<sup>41</sup> Early *et al*, 2001.



Invertebrates Characteristic	What the Feature Indicates
<b>Gravel Sites</b>	
Earwigs	Scavengers, opportunistic species
Spiders	Ability to colonise habitat which changes rapidly
Relatively low numbers of beetles and wasps	Lower general diversity
Introduced ants and bumble bees	More disturbed habitat, flowering plants in riverbeds
Endemic parasitoid wasp - <i>Maaminga</i>	Found in coastal/open habitats
Common beetles are scavengers ( <i>Odontria</i> , Staphylinidae, <i>Heteronychus</i> , <i>Anthicus</i> )	More disturbed habitat, opportunistic species
<b>Willow Sites</b>	
Amphipods	Common in moist habitats, decomposers
Crickets	Common in grass habitats
Relatively low numbers of beetles and wasps	Lower general diversity
Ichneumonid and Braconid parasitoid wasps	Probably parasitise moths on willow and other vegetation

## 1.4 Lizard values

### 1.4.1 Overview

On New Zealand's mainland, where mammalian predators are often abundant and a high level of habitat loss has occurred, populations of lizards are typically isolated, and at very low densities. On the mainland, abundant reptile populations are either restricted to areas with intensive predator control, or to sites with an abundance of refugia, such as small gaps and crevices into which reptiles can move but larger animals cannot, as these provide protection from predation by mammalian predators, and in particular, rats.

In less modified landscapes, refugia are provided by dense vegetation (including rank grassland), holes in tree trunks, cracks in rock outcrops, and cavities under rocks and debris lying on the ground. In built environments, refugia can be provided by features such as piles of broken concrete and rubble, log piles, loosely stacked rock walls, refuse, and even compost heaps. If there is an abundance of refugia or if intensive predator control is undertaken lizard populations on the mainland can attain densities of 5,000 per hectare<sup>42</sup>.

### 1.4.2 Lizard survey of the management area

Three study sites were chosen within the management area between the sea and Whanawhana. Each study site contained a range of habitat types that were likely to be utilised by lizard species, and were present throughout the project area.

The western-most site, near the western end of the RAP 12 at Whanawhana, comprised a steep south-east-facing hillslope covered in indigenous forest and scrub that was contiguous with crack willow forest and braided river gravels on the river edge.

The central site was within the Scheme and RAP 12. The site was on a steep south-facing hillslope near Ohiti Pa. The hillslope vegetation graded from crack willow forest along the river edge, up slope to indigenous forest with limestone outcrops, and higher again to rank cocksfoot grassland.

The eastern-most site, which was immediately downstream from Fernhill, also within the Scheme, and below RAP 12, comprised exotic grassland and herfield on river gravels that were contiguous with planted willow forest.

<sup>42</sup> Towns *et al.* 2002.

In addition to these three survey sites, other habitat types not represented within the three sites were searched. This also included searches within high use public areas, such as the rivermouth at Waitangi, where the installation of in-situ survey equipment was not feasible.

Total search time was 23 hours which was spread over four days and two nights (18 hours during daylight and 5 hours after dark).

### 1.4.3 Lizards of the management area

No reptiles were seen, or recorded in the tracking tunnels, at any of the sites surveyed. However the lack of sightings does not prove lizards are absent from the management area. Small populations of New Zealand reptile species are likely to persist alongside the Ngaruroro River, but at a very low density due to habitat loss and predation by mammalian predators. Species that are likely to be present in the study area are further described and discussed below.

#### 1.4.3.1 Common skink

##### Ecology

Common skink occurs throughout the southern half of the North Island, and throughout the South Island. This species is one of the smaller of the New Zealand skink species, with a snout-vent length of up to 77mm. Colouration is quite variable, and differs from region to region. The back and sides of common skink are mostly brown, with a darker band along the sides, but some specimens are dark brown to almost black. The undersides are grey or yellowish<sup>43</sup>.

Common skink favour dry, open areas with cover from either low vegetation such as shrubs and grasses, or logs and loose rocks. These habitats can be found in riverbeds<sup>44</sup>, and in tussock grassland, farmland, coastal areas, and urban gardens<sup>45</sup>. Common skink is diurnal and is often seen sun basking<sup>46</sup>. Their diet is predominantly invertebrates and small fruit<sup>47</sup>.

##### Threats and conservation status

Common skink is widespread, and populations at mainland sites can attain densities of 5,000 skinks per hectare<sup>48</sup>. However, like most indigenous reptile species, common skink are preyed upon by a range of introduced mammalian predators, and are unable to persist in modified environments, for example improved pasture that lacks cover and suitable refugia.

##### Possible distribution and abundance within the management area

Common skink may be present in low densities on well-vegetated river gravels, in areas of rank grassland where shrubs, rocks, or logs provide cover, and amongst driftwood on the cobbles at the rivermouth.

#### 1.4.3.2 Spotted skink

##### Ecology

In the North Island, spotted skink has a scattered distribution throughout lowland areas from southern Hawke's Bay to Wellington. Spotted skink is also found on islands in the Marlborough Sounds, and is widespread in the eastern South Island. The species, with a snout-vent length of up to 95mm, is one of

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<sup>43</sup> Gill, Whitaker, 1996.

<sup>44</sup> Towns *et al.* 2002.

<sup>45</sup> Gill, Whitaker, 1996.

<sup>46</sup> Gill, Whitaker, 1996.

<sup>47</sup> Towns *et al.*, 2002.

<sup>48</sup> Towns *et al.* 2002.

the larger skinks remaining on the New Zealand mainland. Spotted skinks are typically brown, olive green, or bright green along the back, with pale green spits edged in black, with an unspotted pink, grey or red belly. Spotted skink is ground-dwelling and diurnal, and favours open habitats such as grassland, scrub, rocky coasts, and alpine areas. The diet of this species includes invertebrates, carrion, and nectar<sup>49</sup>.

#### Threats and conservation status

Spotted skink is sensitive to predation, and on off-shore islands where predators are absent, densities can reach up to 8,000 skinks per hectare. The species has a conservation status of “Chronically Threatened-Gradual Decline”<sup>50</sup> because of recent loss of populations on the North Island mainland<sup>51</sup>.

#### Possible distribution and abundance within the management area

Spotted skink could potentially occur in any open habitats with abundant cover. However sightings of this species along the Napier coast, as recently as 2006<sup>52</sup> suggest that the most likely location for this species is the gravel beach on the southern side of the Ngaruroro River estuary.

#### 1.4.3.3 *Common gecko*

##### Ecology

Common gecko, as the species is currently described, is probably the most widespread and abundant lizard species throughout New Zealand<sup>53</sup>. However recent genetic studies have shown that the genus *Hoplodactylus* is likely to comprise many more species than are currently recognised<sup>54</sup>

Common gecko is a small gecko, with a snout-vent length of up to 82 mm. Colour is predominantly grey or brown, with variable, irregular markings of black, white, yellow-orange, and olive-green<sup>55</sup>. The species is nocturnal and mainly ground dwelling. Populations can be found in a wide range of vegetation types, including forest, scrub, and grassland, but their presence is almost always characterised by an abundance of refugia such as scree slopes, rock piles, driftwood, and rock outcrops with crevices.

##### Threats and conservation status

Despite its name, common gecko can no longer be regarded as common. The species is vulnerable to both predation by mammalian predators and habitat loss, and is now absent or in very low numbers throughout much of the mainland. The species is not listed as threatened because of many viable populations on predator free offshore islands, and because abundant, albeit localised populations, occur on the mainland in habitats that provide refugia from rodents.

##### Possible distribution and abundance within the management area

Common gecko are likely to be present near the mouth of the Ngaruroro River where there is an abundance of driftwood, and could be present in any areas of forest, scrub, or grassland where loose rocks, rock outcrops, tree holes, or woody debris provide cover from mammalian predators. A study in 1996 found an abundant population of this species under loose rocks in Mangarakau Stream Bush, approximately 6 kilometres upstream from Whanawhana<sup>56</sup>.

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<sup>49</sup> Towns *et al.* 2002.

<sup>50</sup> Hitchmough *et al.* 2007.

<sup>51</sup> Towns *et al.* 2002.

<sup>52</sup> DOC Herpetofauna database.

<sup>53</sup> Gill, Whitaker, 1996.

<sup>54</sup> Hitchmough *et al.* 2007.

<sup>55</sup> Gill, Whitaker, 1996.

<sup>56</sup> Townsend, 1996.

#### 1.4.3.4 *Pacific gecko*

##### Ecology

Pacific gecko occurs throughout the North Island and on many offshore islands<sup>57</sup>. Pacific gecko is similar in appearance to common gecko, but are larger, with a snout-vent length up to 94mm, and often more brightly coloured. The species is nocturnal and feeds on small invertebrates, nectar, fruit, and honeydew<sup>58</sup>, which it usually finds in the canopy and shrub tier. During the day, Pacific gecko take refuge in crevices or under loose rocks.

##### Threats and conservation status

Pacific gecko has a conservation status of “Chronically Threatened-Gradual Decline”<sup>59</sup>. The species is vulnerable to predation and is becoming increasingly rare on the mainland.

##### Possible distribution and abundance within the management area

There is only one record of this species for the Hawke’s Bay area (from Portland Island off the Mahia Peninsula, in 1984), and Pacific gecko if present, is likely to be very uncommon. The species may be found in coastal habitats at the Ngaruroro rivermouth, and in forest and scrub at Ohiti Pa and Whanawhana. The species is most likely to be found where there is mature, species-rich forest growing on rock outcrops.

#### 1.4.3.5 *Forest gecko*

##### Ecology

Forest gecko is found throughout most of mainland New Zealand, including Hawke’s Bay. This species is brightly coloured, with patches of grey, brown, black, white, and sometimes yellow, and reaches a snout-vent length of 89 mm. Forest gecko are arboreal and favour forest and scrub habitats. Forest gecko are nocturnal, but can occasionally be seen sun-basking<sup>60</sup>. During the day this species hide in trees under loose bark, or in tree holes or crevices.

##### Threats and conservation status

Forest gecko is widespread and not threatened. However this species is vulnerable to predation and habitat loss. This species is particularly vulnerable to predation by ship rats because they feed at night in vegetation.

##### Possible distribution and abundance along the Ngaruroro River

Forest gecko may potentially be found in any forest and scrub habitats alongside the Ngaruroro River. This species is most likely to be found in areas of older vegetation, where there is an abundance of crevices and tree holes, and in areas with a dense, species-rich understorey.

### 1.4.4 Mammalian predators

Mammalian predators either known to be, or highly likely to be, present in habitats alongside the Ngaruroro River include ship rat, Norway rat, house mouse, European hedgehog, stoat, ferret, weasel, and feral cat. All of these species are likely to take reptiles as part of their diet.

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<sup>57</sup> Gill, Whitaker, 1996.

<sup>58</sup> Whitaker, 1987.

<sup>59</sup> Hitchmough *et al.* 2007.

<sup>60</sup> Gill, Whitaker, 1996.

Mice were recorded at two of the five tracking tunnels at Fernhill. This species is likely to be present in most habitats alongside the Ngaruroro River, and is probably particularly abundant in rank grassland and herbfield. Mice in New Zealand have a very diverse diet, including caterpillars, spiders, weta, seeds, leaves, birds, and lizards<sup>61</sup>.

Rats were recorded at five of the six tracking tunnels in the forest at Ohiti Pa. Ship rats are likely to be most abundant in areas of forest and scrub as this species is an agile climber, and feeds on a wide range of invertebrates, fruits, seeds, flowers<sup>62</sup>, and small vertebrates, including birds, eggs, and lizards<sup>63</sup>. Norway rats are relatively poor climbers, and strongly favour habitats beside water, such as estuaries, rivers, wetlands, and streams. On braided riverbeds this species prefers side streams and wetlands, and avoids open areas of exposed gravel. Norway rat also have a very diverse diet, including seeds, fruits, leaves, small invertebrates, and occasionally birds, eggs, lizards, and carrion<sup>64</sup>.

## 1.4.5 Probable locations for reptile populations

### 1.4.5.1 *Scrub on steep hillslopes and cliffs at Whanawhana*

The indigenous scrub at Whanawhana is species-rich, providing a wide range of fruit and nectar sources. The native plants pate, mahoe, cabbage tree, karamu, makomako, and pohuehue all produce small fleshy berries, and most of the site has a well-developed litter layer with scattered woody debris. Canopy gaps are typically filled with dense thickets of blackberry that provide cover for ground-dwelling reptiles. Some of the older trees, including willows along the river edge, have various holes and crevices. These habitat characteristics suggest that it is highly likely that this area, despite no evidence of rodent control, would support at least low density populations of lizards. The species most likely to be present at this site are common gecko and forest gecko. Common skink may also be present where the scrub is adjacent to river gravels or grassland.

Conditions within this area provide a model of potential lizard habitat for indigenous forests with the management area.

### 1.4.5.2 *Forest on limestone outcrops near Ohiti*

The two forest remnants within the Scheme, near Ohiti, have a canopy of mature broadleaved species, including karaka, titoki, kowhai, and ngaio. Tree holes, and trees with partially hollow trunks are common, and the forest is therefore possible habitat for Pacific gecko and forest gecko. Where these trees are on limestone outcrops, with loose rocks and rock crevices, additional refugia are provided by the rock substrates. Common gecko is likely to be present on the outcrops, at least in very low numbers.

### 1.4.5.3 *Ngaruroro Rivermouth*

The estuary at the mouth of the Ngaruroro River is formed by extensive deposits of cobbles, and on the southern side of the estuary, these cobbles are backed by intertidal wetlands. Bands of driftwood and other marine flotsam have been deposited between the high tide line and the saltmarsh, which comprises dense, low bushes of saltmarsh ribbonwood, purua grass, and occasional taupata.

The loosely-deposited cobbles, driftwood, and saltmarsh ribbonwood provide abundant cover for reptiles, and coastal environments typically support abundant populations of invertebrates upon which reptiles prey. Species that are likely to be present at this location, at least in small numbers, are common gecko and common skink. Spotted skink is known to occur on the Hawke's Bay coastline at Haumoana and Awatoto, and may also be present here.

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<sup>61</sup> Ruscoe, Murphy, 2005.

<sup>62</sup> Daniel, Baker, 1986.

<sup>63</sup> Innes, 2005b.

<sup>64</sup> Innes, 2005a.



## 1.5 Flora values

### 1.5.1 Overview

#### 1.5.1.1 Broad vegetation patterns

The Scheme is located within the rain-shadow area east of the axial ranges. Consequently the climate of the Heretaunga Plains is characteristically 'dryland'. Vegetation of the Heretaunga Plains frequently experiences drought.

Historical vegetation patterns reflected the declining moisture gradient seaward from the main divide. Current vegetation patterns continue to be influenced by climate; however the overriding influences of disturbance and flood control planting are strong determinants of today's vegetation communities of the management area.

Historically, in dry and less fertile areas totara, tawa, titoki, maire, ngaio, black beech and kowhai would likely have been the abundant forest trees. The driest forests may not have been continuous, with climatic events producing clearings and gaps in which grew tussocks, various shrubs and trees like kanuka and manuka<sup>65</sup>.

Prior to European arrival (and the associated introduction of numerous exotic herbs) the active areas of the Hawke's Bay gravel riverbeds would have been sparsely vegetated with indigenous mat-forming plants, principally species of *Raoulia* and *Epilobium*.<sup>66</sup>

Today the Heretaunga Ecological District ("*Heretaunga ED*") (within which the management area is located entirely) retains only an estimated 3% of cover in native vegetation<sup>67</sup>, with much of that vegetation being unassociated with the Ngaruroro River corridor, instead being located in the moister southwestern parts of the Heretaunga ED. That scarcity of naturally occurring native flora increases the ecological value of existing native vegetation remnants.

The Waitangi Estuary contains saltmarsh and freshwater swamp vegetation communities<sup>68</sup>. The large dominant indigenous plants in the saline and brackish area are sea rush, marsh clubrush and saltmarsh ribbonwood<sup>69</sup>. The raised gravel beach features the threatened plant *Mimulus repens* (*At Risk-Sparse*)<sup>70</sup>.

#### 1.5.1.2 Plant pests

The smothering effect of the vigorous exotic climber, old man's beard, presents a significant threat to the integrity of the live edge protection plantings. While a management regime is in place for the management of plant pests within the buffer zone, there appears to be room for development of a strategy for further reducing this weed problem in the medium to long term.

During the late 20<sup>th</sup> century tree lupin was sown in areas of the adjacent mountain ranges for erosion control purposes. Today this provided a weed seed source which is readily transported down river. The management area is now infested with tree lupin, which rapidly colonises river gravels and recently disturbed areas of the river berms. In addition a vast array of annual and perennial weeds rapidly colonise large areas of the gravel riverbed. Weed infestations of the riverbed within the Scheme area are currently managed on an annual basis by beach raking, and weed invasion of the remainder of the management area is left to be managed by the natural scouring associated with larger flood events.

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<sup>65</sup> Fromont, Walls, 1988.

<sup>66</sup> Parrish, 1988.

<sup>67</sup> Fromont, Walls, 1988.

<sup>68</sup> Eyles, 2008.

<sup>69</sup> Eyles, 2008.

<sup>70</sup> Hitchmough, *et al.* 2007.

A number of exotic tree species used in flood control plantings are potentially invasive, including willow, English elm, black locust and silver poplar. This invasiveness is noted at a number of locations within the Scheme.

## 1.6 Detailed description of vegetation communities of the Scheme

In the following section the vegetation covering the river bed, riparian margins, buffer zones, escarpments and stop banks of the Scheme are described by way of a commentary of representative sites or reaches. For presentation purposes, the Scheme area is broken down into sections (e.g. rivermouth to Chesterhope Road Bridge). Each site or reach is specific to either the 'true left' or 'true right' of the river channel and features are described in the order they would be encountered if moving in an upstream direction.

In summary the vegetation types encountered within the river corridor can be broadly classified as:

- Exotic forest
- Exotic treeland
- Exotic scrub
- Exotic grassland/herbfield
- Native forest
- Native treeland
- Native shrubland
- Wetland vegetation.

For each section of the Scheme described, representative areas of these broad vegetation types are described and their locations shown on the corresponding aerial photographs of the river corridor.







## 1.7.2 True right side

### 1.7.2.1 Waitangi 1

Upstream of the State Highway 2 and Rail Bridges is a small area of exotic forest, surrounded by exotic grassland. The exotic forest is dominated by crack willow, and also comprises pine and Chinese tamarisk. The exotic grassland in this area is ungrazed and forms a dense continuous coverage of the ground. Portions of this area are managed for whitebait spawning, primarily by stock-proof fencing of potential spawning habitat.



**Figure 1-17 : Exotic forest and grassland at Waitangi 1.**



**Figure 1-18 : Raupo vegetation managed for whitebait spawning.**

Vegetation species presenting potential whitebait spawning habitat in this area are raupo, marsh clubrush and soft rush. Rank exotic grassland also contribute to riparian vegetation / spawning habitat in this area and would likely contribute structural habitat and assist with maintenance of favourable microclimate conditions (i.e. cool humid conditions) for egg development during whitebait spawning.

### 1.7.2.2 Waitangi 2

Waitangi 2 features a small exotic treeland of the invasive tree, Chinese tamarisk. This area is grazed as part of the exiting floodplain management regime. This exotic treeland would inevitably provide a seed source of this invasive species to the Waitangi Estuary.





**Figure 1-19 : Exotic treeland of the invasive Chinese tamarisk, with grazed pasture grass ground cover.**

### 1.7.2.3 *Waitangi 3*

Adjacent to the two sites described above is a channel network of estuarine saltmarsh wetland systems. Vegetation communities of these wetlands typically follow a gradient from a non-vegetated substrate (i.e. gravels, silts and clays) in permanently inundated areas to rooted aquatic plants such as bachelors button and horse's mane weed. Green macroalgae is abundant, covering areas of bare aquatic substrate, and vegetation of the aquatic and intertidal zones within these wetlands.

Colonies of marsh clubrush are common at the landward margin of the riparian zone and clusters of native sedges (e.g. soft rush, sea rush) occur on the saturated and poorly drained soils of the riparian margin. Riparian zones are dominated by a range of exotic herbaceous and grass species, which are grazed by cattle.

Setback from wetland areas, on higher dryer soils, tree lupin, crack willow and Chinese tamarisk occur in discrete clusters.



**Figure 1-20 : Green algae (left), bachelors button (erect) and horse's manna weed (right) within saltmarsh wetland.**



**Figure 1-21 : Typical gradient from terrestrial exotic grassland through marginal native rushes and exotic aquatic vegetation.**

#### 1.7.2.4 Waitangi 4

The expansive floodplain landform between the main-stem Ngaruroro River channel and the confining true-right stopbank for the reach of the river between the Waitangi Estuary and the Chesterhope Road Bridge is predominantly exotic grassland, with other herbaceous exotic species common or abundant. Colonies of tree lupin inhabit higher ground on the floodplain. This area is held under a regime of cattle grazing.





**Figure 1-22 : Floodplain landform and exotic grassland of the Waitangi 4 area.**

Three areas of linear shelterbelt planting of lombardy poplar are present near the foot of the stopbank in the middle and lower reaches of this area. A small cluster of crack willow and occasional specimens of black poplar and *Eucalypt* sp. are also present.

Various localised depressions within the floodplain form small discrete areas of ephemeral wetland habitat, hosting wetland plant species such as bachelors button, water buttercup and in wetter areas the erect leaves of narrow leaved water plantain emerge above the surface of ponding water.

#### 1.7.2.5 *Chesterhope 1*

A network of riverine ephemeral wetland habitat receives groundwater infiltration and some runoff from the small contributing catchment on the surrounding floodplain. Three ponds, one with a small island are drained by a small channel incised into the floodplain. The wetland features the aquatic plants water buttercup, narrow leaved water plantain and mercer grass. Riparian areas are exotic grassland, with a component of exotic herbaceous species typical of grazed pastures.



**Figure 1-23 : Water buttercup in flower with the emergent leaves of narrow leaved water plantain.**



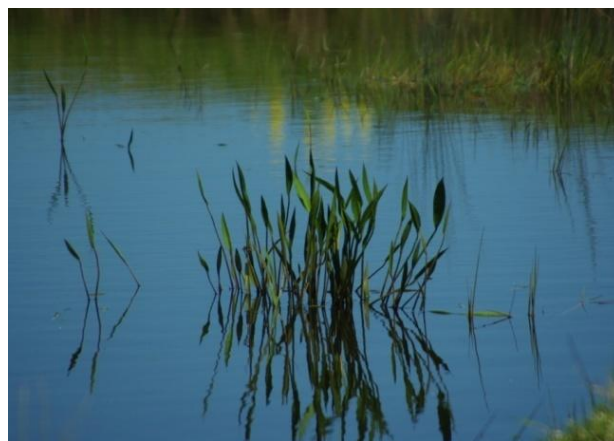
**Figure 1-24 : Typical vegetation gradient from open water to an aquatic fringe of submerged water buttercup and emergent narrow leaved water plantain phasing into riparian cover of exotic grass and herbaceous species.**

#### 1.7.2.6 *Chesterhope 2*

Approximately 1.65 kilometres downstream of the Chesterhope Road Bridge are two small square ponds which given their shape and the contour of the surrounding land have clearly been excavated from the floodplain. These two ponds feature deeper water depths, and little aquatic vegetation was present at the time of the site visit. Small areas of narrow leaved water plantain emerge above the pond surface, and native rush is present in the shallow aquatic marginal areas.



**Figure 1-25 : Excavated ponds on the lower floodplain.**



**Figure 1-26 : Foliage of narrow leaved water plantain emergent above the water surface.**

### 1.7.3 True left side

#### 1.7.3.1 *Chesterhope 3*

The vegetation of the reach of the true left buffer zone between the Chesterhope Bridge and the State Highway 2 road crossing at Waitangi is predominantly exotic grassland, with patches of tree lupin. A wide range of other exotic herbaceous species are common within this area. A row of willow trees extend much of this length in an alignment near to, and parallel with, the toe of the stopbank.





**Figure 1-27 : Exotic grassland with tree lupin.**



**Figure 1-28 : Expansive exotic grassland.**

### 1.7.3.2 *Waitangi 5*

A shallow open water wetland, lies in a basin landform created from past silt extraction. This wetland features the exotic specialist wetland plants found in other wetlands of this type downstream of the Chesterhope Road Bridge. A number of pied stilt were using the wetland and its margins at the time of the survey. Stock have full access to the wetland. A lack of structural diversity is a clear shortcoming to the habitat value of this wetland.



**Figure 1-29 : Shallow water wetland created by past silt extraction.**



### 1.8 Chesterhope Road Bridge to Fernhill Road Bridge

#### 1.8.1 Spatial arrangement of vegetation and habitat features

The vegetation and habitat types of the Scheme between the Chesterhope Road Bridge and Fernhill are mapped in Figure 1-30 below. Site references for the following narration of vegetation and habitat types are included in the figure for reference.

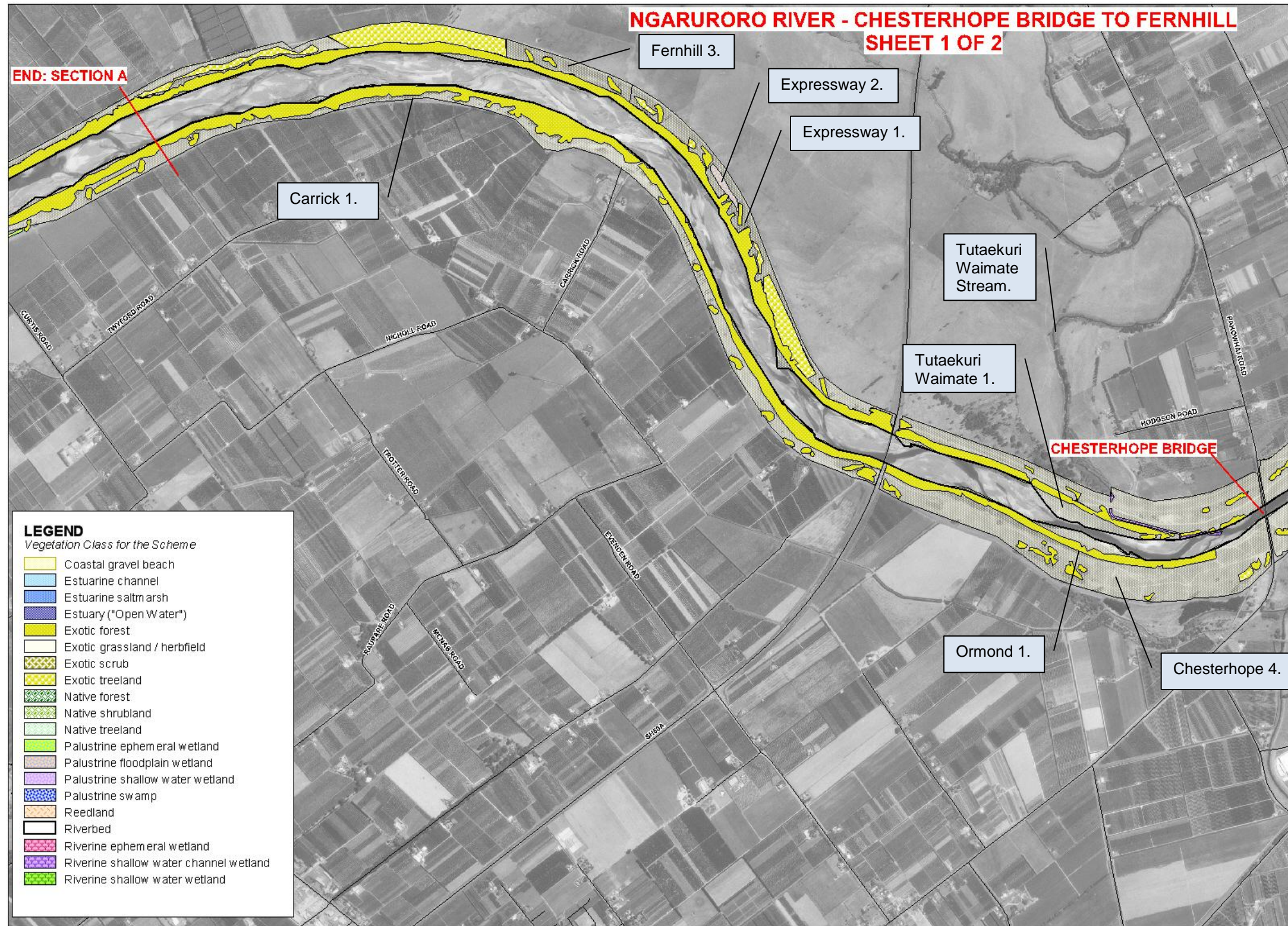


Figure 1-30 : Vegetation and habitat map of the lower reach of the Scheme between Chesterhope Road Bridge and Fernhill Road Bridge.



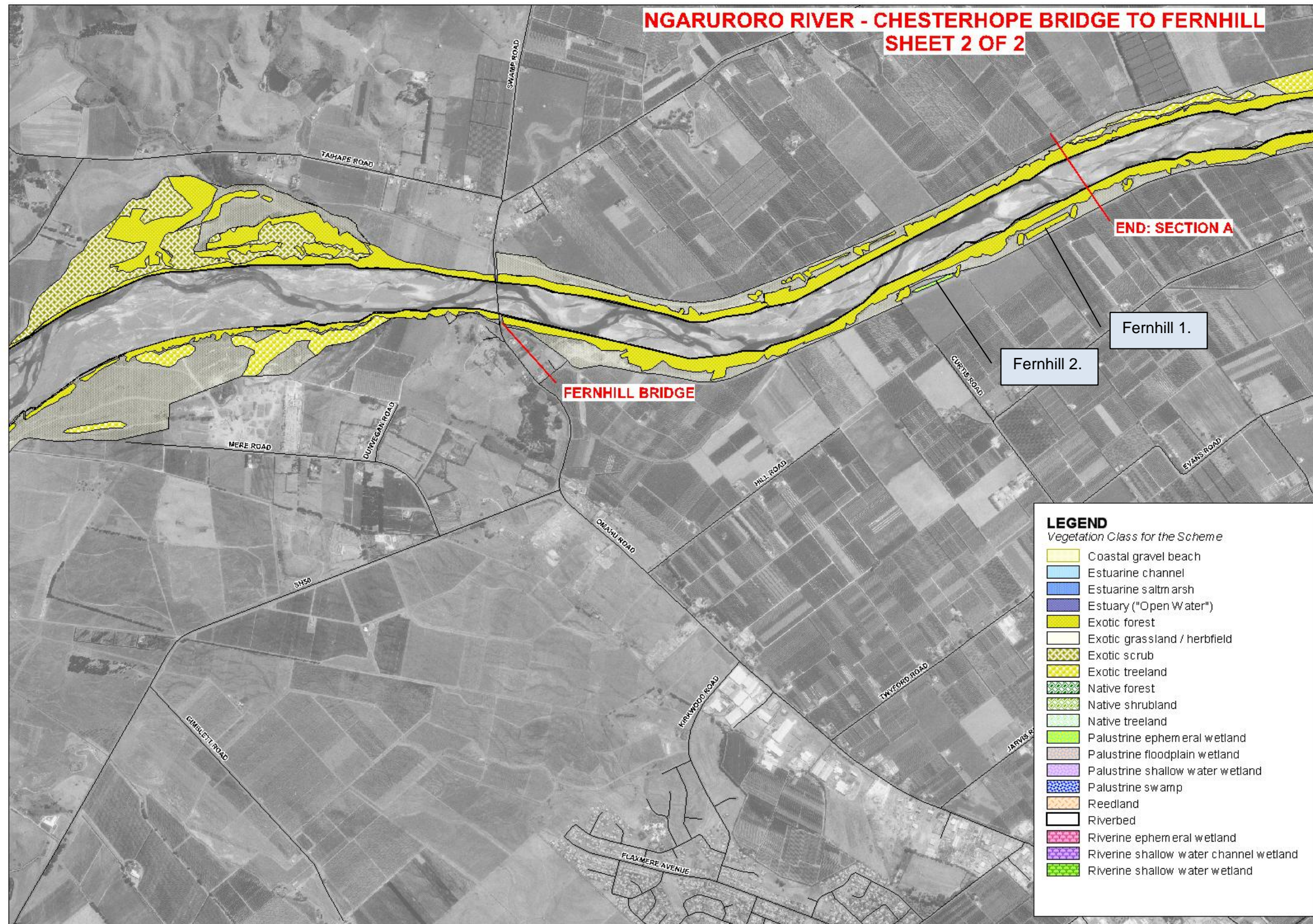


Figure 1-31 : Vegetation and habitat map of the upper reach of the Scheme between Chesterhope Road Bridge and Fernhill Road Bridge.



## 1.8.2 True right side

### 1.8.2.1 Chesterhope 4

Above the Chesterhope Road Bridge the true right buffer zone is dominated by exotic grassland with a secondary component of exotic herbfield. Amongst the exotic grassland between the edge protection planting and the stopbank are discrete areas of willow dominated exotic forest. The densely planted crack willow edge protection plantings in this area forms an almost continuous corridor of exotic forest for 10.5 kilometres upstream to the Fernhill Road Bridge.



**Figure 1-32 : Typical character of exotic grassland with clusters of tree lupin and discrete patches of willow dominated exotic forest.**



**Figure 1-33 : Typical character of the buffer zone above the Chesterhope Road Bridge, dense willow dominated edge protection corridor with expanses of exotic grassland.**

Unforested clearings within the fenced edge protection plantings are typically vegetated in exotic rank grasses or contain extensive areas of tree lupin dominated herbfield, and other semi-woody naturalised plant pest species such as broom, gorse, blackberry and fennel.



**Figure 1-34 : Typical character of exotic herbfield with secondary exotic grassland component within fenced edge protection plantings (exotic grassland on stopbank batter in foreground).**



### 1.8.2.2 Ormond 1

The buffer zone landward of the edge protection planting in this area is dominated by exotic grassland, and features patches of tree lupin, and discrete areas of willow dominated exotic forest.

The edge protection plantings in this area are a dense stand of narrow diameter willow trees. Growing under that cover are exotic grasses (e.g. ripgut brome) and exotic herbs (e.g. cleavers and the plant pest climber old man's beard). Several specimens of the native shrub karamu were present within the dense willow forest of the live edge planting.

The river side of the live edge planting features a stabilised riverbed vegetated in exotic grassland with a secondary component of herbaceous plants. This area features silty soils. Species present include tall fescue, tree lupin, pampas grass, willow and poplar saplings. Nearer the river margin an expansive area of the exotic herb - field horsetail was noted.



**Figure 1-35 : View upstream towards expressway road crossing of exotic grassland on stabilised riverbed at Ormond 1.**

### 1.8.2.3 Carrick 1

At Carrick 1 evidence of planting of native shrubs amongst the live edge protection was noted<sup>71</sup>. Under willow canopy cover one kohuhu, three specimens of flax, two specimens of ribbonwood, and one specimen of cabbage tree are present. These specimens have reached a maturity where competition for light from surrounding exotic herbs and grasses is no longer a threat to their survival. These specimens were noted to be at wide spacings, insufficient to create enough canopy cover to out compete exotic ground cover.

English ivy is abundant in this location, climbing vigorously up trees of the edge protection plantings and forming dense blankets of ground cover.

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<sup>71</sup> Specifically, planted shrubs were noted at the following locations: TVM:1926959.8E 5612045.0N and NZMG: 2836927.0E 6173679.0N.



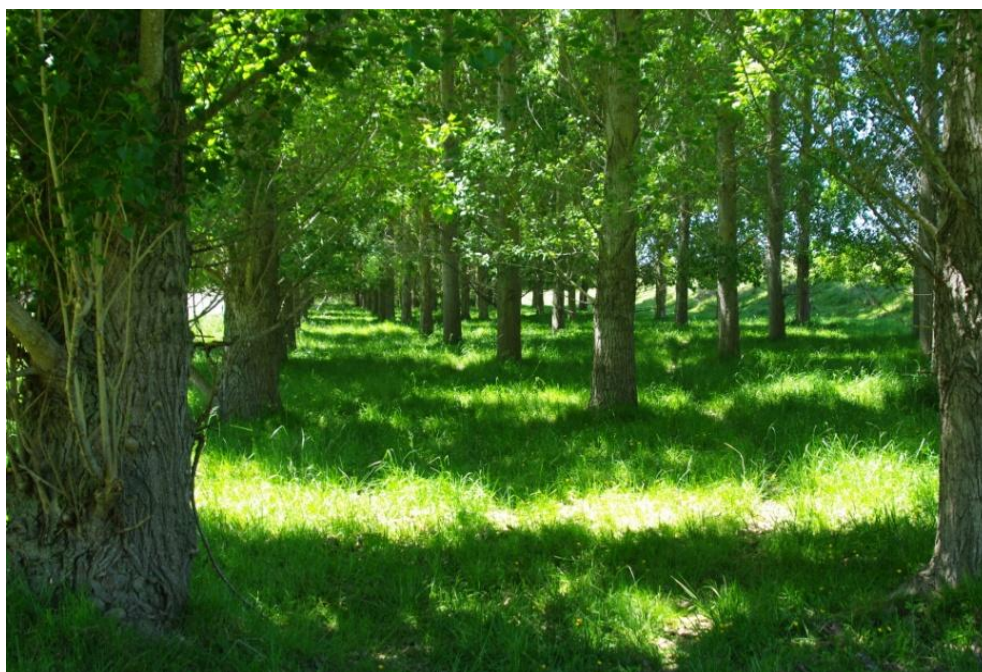
**Figure 1-36 : Foliage of kohuhu, present under willow forest cover.**



**Figure 1-37 : English Ivy climbing edge protection planting.**

#### 1.8.2.4 Fernhill 1

A neatly planted grove of poplar trees run parallel to the stopbank and provide some nursery opportunities for underplanting with native shrubs. In particular the shelter provided by the established tree cover and the thinning of exotic ground cover by shading presents some advantage to establishment of native vegetation.



**Figure 1-38 : The protection from wind, direct sunlight and (to some degree) frost provided by the canopy cover of this poplar grove presents some potential for native underplanting.**



#### 1.8.2.5 Fernhill 2

The wetland feature identified in the Code at 'Benchmark 33R' features an area of rushland of the common native rush of poorly drained soils, soft rush. The remaining vegetation comprises low-growing exotic herbs and grasses, most notably pennyroyal and spearwort. At the time of the November 2009 site visit, stock had open access to the wetland and pugging of the wet soil by cattle was widespread.



Figure 1-39 : Palustrine ephemeral wetland featuring mosaic of *Juncus effusus* rushland and exotic herbfield.

### 1.8.3 True left side

#### 1.8.3.1 Tutaekuri Waimate stream

A short distance upstream of the Chesterhope Road Bridge the Tutaekuri Waimate Stream enters the true left buffer zone. The stream flows within a channelised alignment for approximately 550 metres before converging with the Ngaruroro River main stem. Emergent macrophytes and water buttercup are backed by various grasses, tree lupin and willow edge protection.



**Figure 1-40 : Channelised alignment of the Tutaekuri Waimate Stream within the buffer zone.**

### 1.8.3.2 *Tutaekuri Waimate 1*

The true left buffer zone between the Chesterhope Bridge and the Expressway Bridge features exotic grassland and herbfield, and a dense ribbon of live edge protection exotic forest.

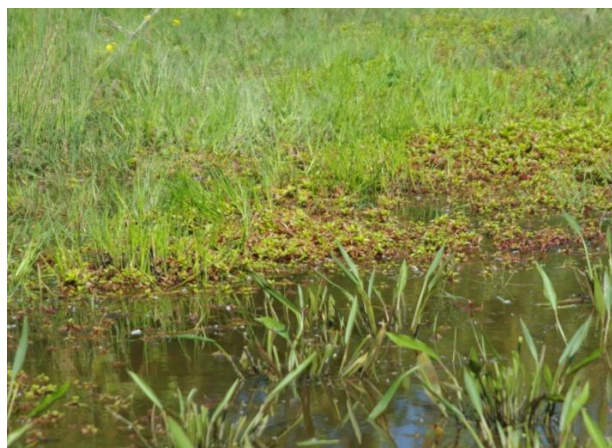
It is noted that the ground in this area is typically rockier and dryer than ground conditions above the expressway bridge.

### 1.8.3.3 *Expressway 1*

This small ephemeral wetland features a vegetative gradient from open water in the central area of the wetland, grading into cape pondweed, extensive mats of mercer grass, creeping buttercup and soft rush. Common exotic pasture grasses are dominant on higher ground.



**Figure 1-41 : Discrete wetland within depression in buffer zone.**



**Figure 1-42 : Typical vegetation of the wetland.**



#### 1.8.3.4 Expressway 2

This area features two discrete areas of palustrine floodplain wetland. The westernmost is the smaller of the two wetlands. The vegetation cover grades from open water to a marginal exotic plant community of mercer grass, water buttercup and broad-leaved dock. Soft rush is occasional at the wetland margin and amongst adjacent pasture. Stock have free access to this area and soil pugging and trampling of vegetation is common. Water quality in this small wetland feature is also likely to be significantly impacted from the uncontrolled stock access.

The easternmost wetland features a swale depression containing shallow open water. The vegetation composition of this area is similar to the smaller, adjacent site described above. A number of mature willow trees, either individual specimens or small forest groves surround the site. Again stock has free access to the wetland and the site clearly provides a stock watering source.



**Figure 1-43 : Easternmost wetland feature at Expressway 2.**

#### 1.8.3.5 Fernhill 3

The vegetation of the buffer zone between the Fernhill Road Bridge and the Expressway Road Bridge is characterised by exotic grassland with a notable exotic herbaceous component. Areas of the buffer zone outside of the edge protection planting are periodically grazed, which maintains a cover of exotic grass and herbaceous species, rather than a progression to, and ultimate dominance by, woody plants.

The buffer zone is bordered by edge protection planting, mainly willow with *Populus* spp. and other exotic tree species are also present. As well as edge protection planting, exotic trees have been planted to form treeland and forest areas. Extensive patches of nettle occur under shaded conditions of willow cover within the buffer zone.



**Figure 1-44 : Example of nettle patch under willow cover.**

The localised occurrence of soft rush delineates areas of poorer soil drainage. In several discrete areas this species becomes abundant, often co-occurring with creeping buttercup and exotic pasture grasses.



**Figure 1-45 : Soft rush and creeping buttercup mark areas of poor draining soils.**



### 1.9 Fernhill Road Bridge to Mangatahi Stream

The vegetation and habitat types of the Scheme between the Fernhill Road Bridge and the uppermost extent of the Scheme at Mangatahi are mapped in Figure 1-46 to Figure 1-48 below. Site references for the following narration of vegetation and habitat types are included in the figures for reference.

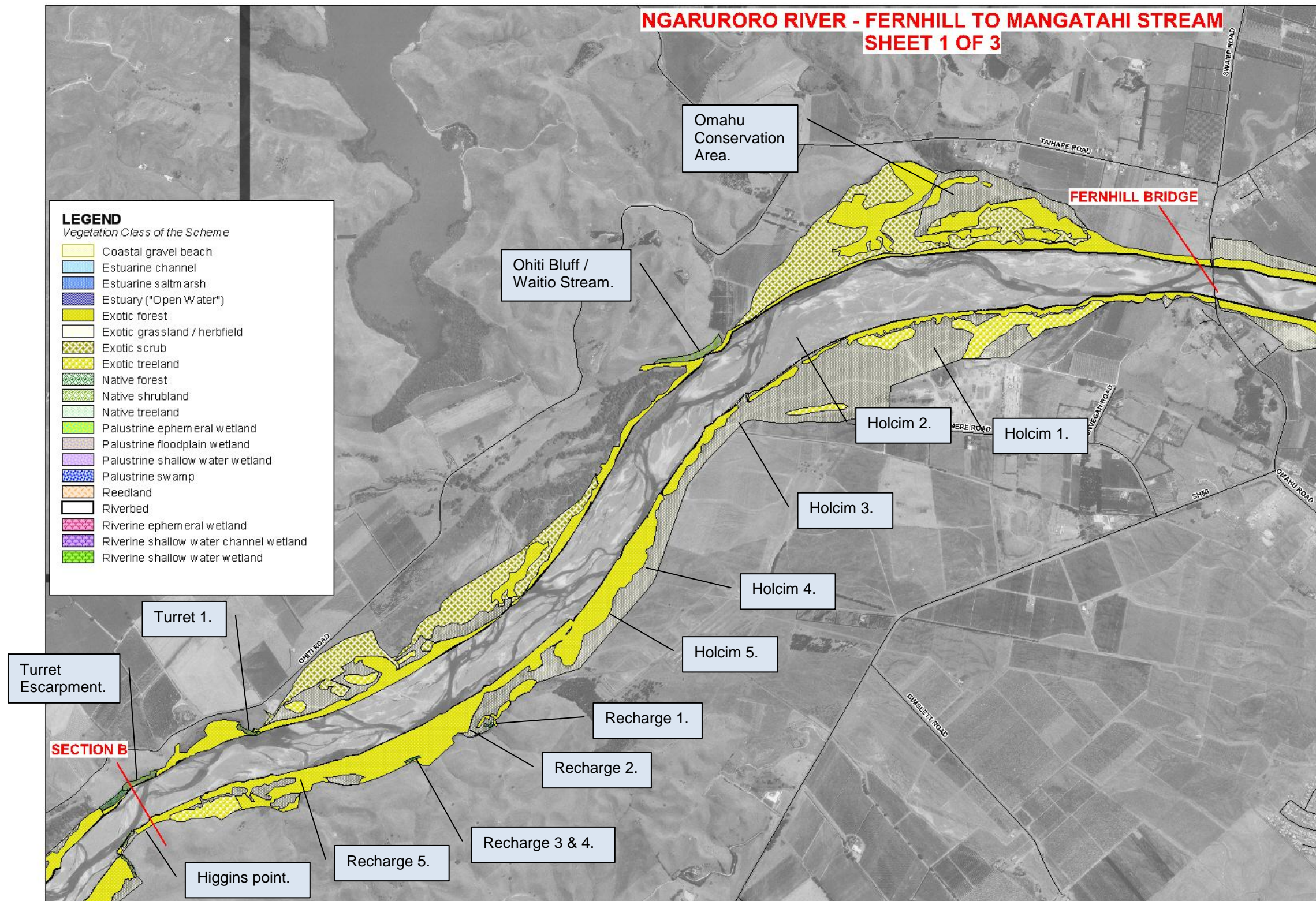


Figure 1-46 : Vegetation and habitat map of the Scheme between Fernhill Road Bridge and Higgins Bluff.



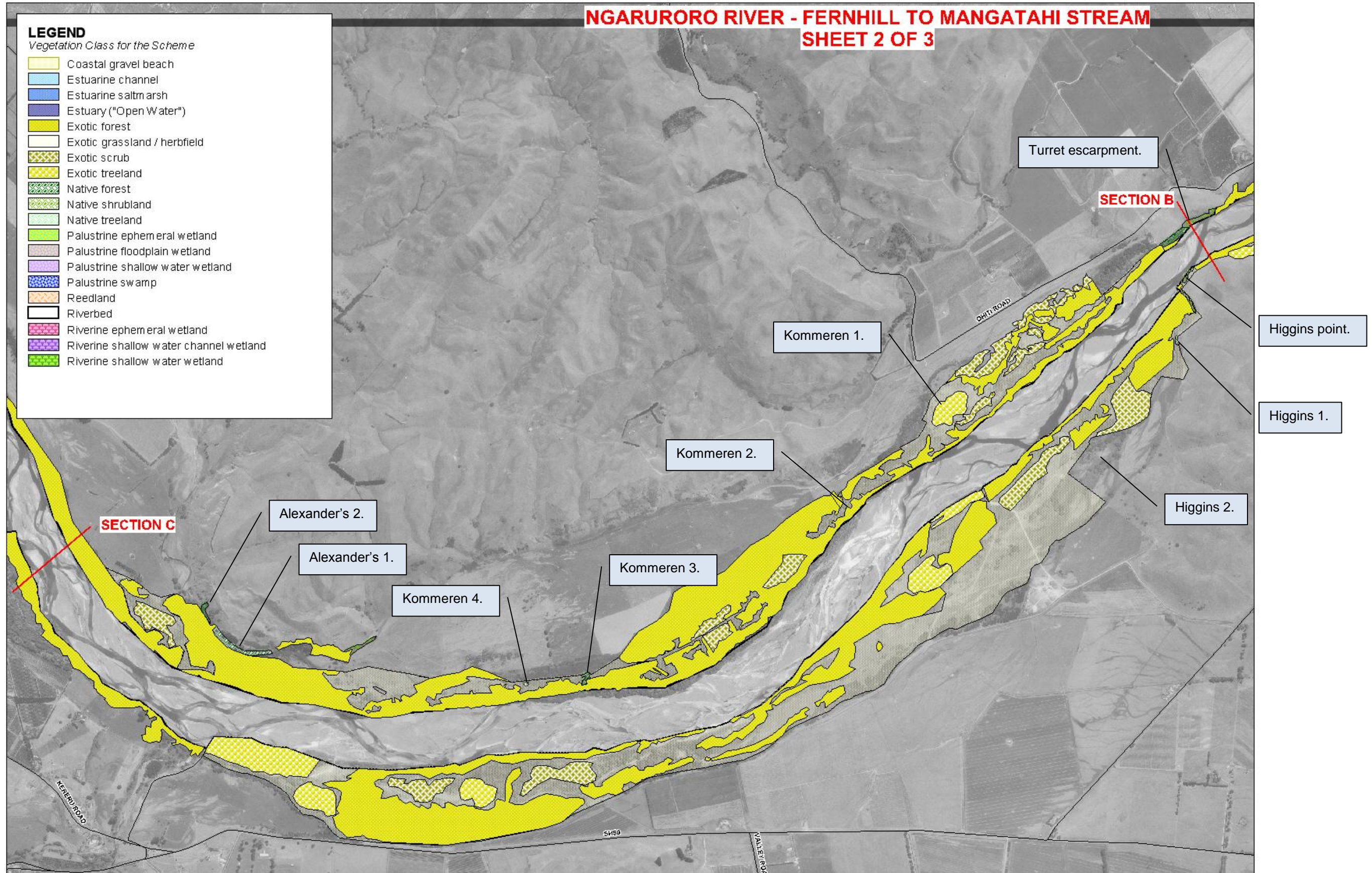


Figure 1-47 : Vegetation and habitat map of the Scheme between Higgins Bluff and Maraekakaho.



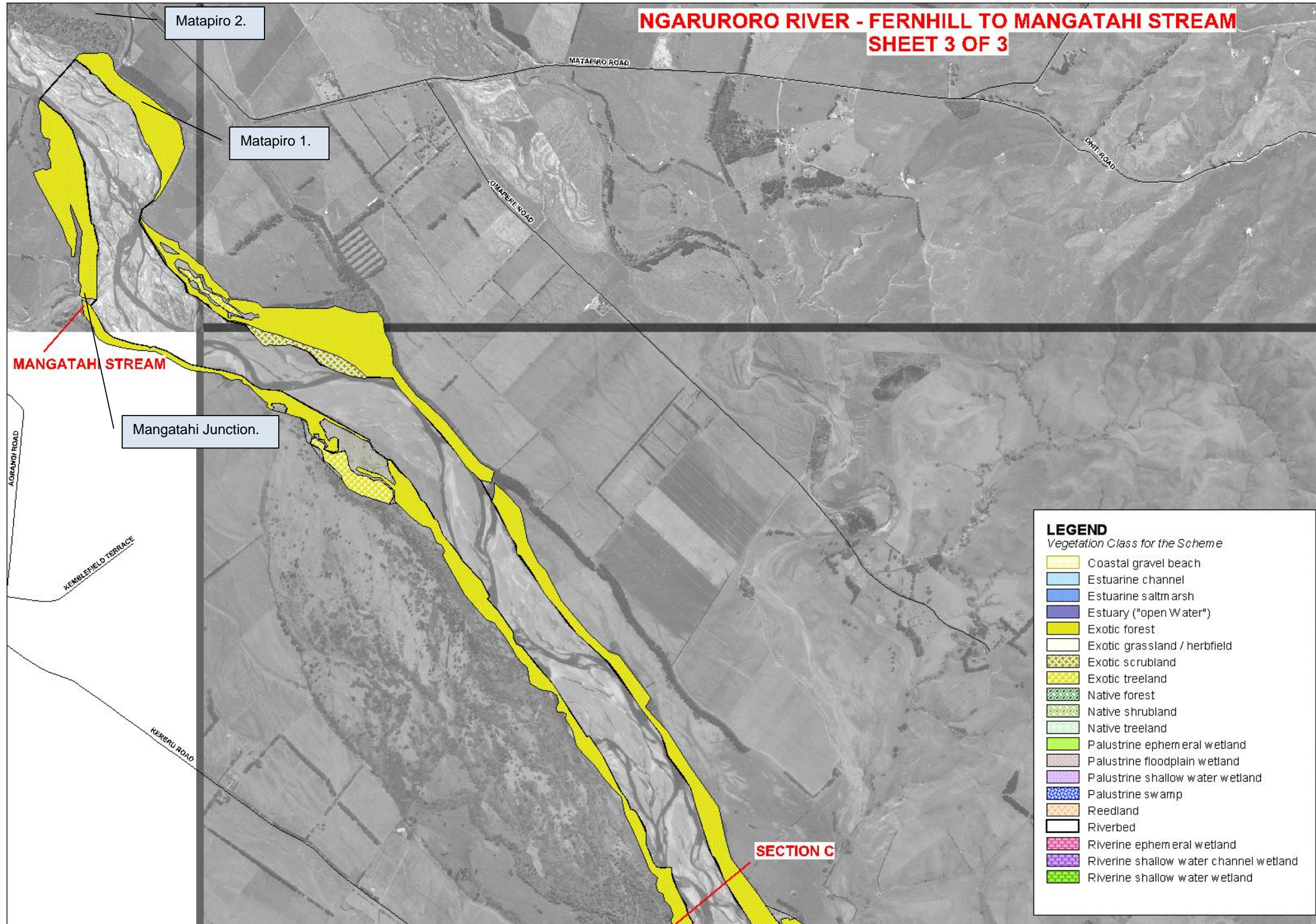


Figure 1-48 : Vegetation and habitat map of the Scheme between Maraekakaho and the uppermost extent of the Scheme.



## 1.9.1 True right side

### 1.9.1.1 *Holcim 1*

The Holcim 1 site is part of an extensive berm bordering the stopbank immediately to the north of the Holcim aggregate processing plant. The vegetation cover almost exclusively consists of naturalised vegetation dominated by tree lupin and fennel. Plants of a lesser stature commonly encountered amongst the tree lupin and fennel includes thickets of blackberry, swards of rippgut brome and numerous wild turnips and sow thistles.

Isolated trees of silver poplar and crack willow occur around the toe of the stopbank. Several shrubs of kanono were observed amongst thickets of blackberry near the stopbank and access track leading to the Holcim site.



**Figure 1-49 : Willow edge protection planting (middle-ground) and mosaic of other exotic grasses and herbaceous plant species beyond.**

### 1.9.1.2 *Holcim 2*

The Holcim 2 site includes part of the berm and adjacent riverbed. The berm vegetation comprises exotic grassland dominated by extensive swards of tall fescue, soft brome and rippcut brome. In places the grassland is punctuated by clumps of the ox-eye daisy and tree lupin while silver poplar and crack willow trees of varying age occur sporadically along the outer margins of the berm near the stopbank. Several black locust and cabbage trees are present.

The riverbed proper features extensive although somewhat discontinuous cover of the bright green legume, the King Island melilot interspersed with clumps of tree lupin, fennel and sand primrose.



### 1.9.1.3 *Holcim 3*

Holcim 3 comprises a small recently disturbed area of land within the berm and adjacent to Holcim 2. The vegetation cover here is exclusively a diverse array of exotic or adventive herbaceous plants such as ox tongue, Scots thistle, scrambling fumitory, creeping buttercup, mallow, hemlock, prickly sow thistle, dandelion, fennel, broad-leaved dock and narrow leaved plantain.

### 1.9.1.4 *Holcim 4*

Holcim 4 features an extensive area of willow forest merging into an adjacent area of exotic grassland covering the berm and stopbank.

The adjoining riverbed features scattered plants of King Island melilot, fennel and sand primrose.

The willow forest, while dominated by crack willow includes mature trees and propagules of silver poplar, English elm and black locust. These trees occur on the edge of the forest in scattered groups and extend as small stands into the adjoining grassland along with young crack willow.

The tall grassland cover across the berm is dominated by ripgut brome and to a lesser degree soft brome and sweet vernal. Sand primrose, fennel and birdsfoot trefoil are common within the grassland. Tall fescue tends to dominate the grassland cover along the shady woodland margins in association with herbaceous plants such as vetch, wild turnip and cleavers.

Several indigenous species occur within the interior of the forest. These include scattered shrubs of kanono and koromiko, while the vines pohuehue and bridal creeper are commonly entwined around a number of trunks and lower branches of willow and elm trees. In the damper zones near a side channel on the edge of the riverbed (being an overflow to an irrigation channel situated further upstream), the ground cover includes the indigenous ferns swamp kiokio, common shield fern and tender brake growing amongst woody debris and leaf litter.



**Figure 1-50 : Native shrub koromiko and native fern swamp kiokio in foreground.**



**Figure 1-51 : The native climber, pohueue, under willow and elm forest.**

#### 1.9.1.5 *Holcim 5*

Holcim 5 encompasses a mature and open canopy of silver poplar trees within an underlying tier featuring scattered shrubs of karamu, occasional cabbage trees and two mahoe specimens, plus young willow and poplar trees festooned with old man's beard.



**Figure 1-52 : Lush foliage and small white flowers of the native shrub mahoe, at Holcim 5.**

#### 1.9.1.6 *Recharge 1*

Recharge 1 relates to an area that is contained between the stopbank and the steep toe slopes of Roys Hill. This area includes a section of irrigation channel immediately downstream of a culvert associated with the stopbank and features flat terrain bordering the channel as well as the toe slopes.

The area features a mosaic of exotic vegetation in the form of thickets of gorse, blackberry, fennel and tree lupin. Swards of rank grasses and small stands of mature crack willow trees are present.

The area also possesses a significant indigenous component in the form of a stand of mature mahoe (growing in association with the crack willow trees) which occupy flat terrain and adjacent toe slopes along with a small stand of mature kowhai (*Sophora tetraptera*) situated upslope from an extensive thicket of blackberry. Several specimens of button fern and sweet fern grow on the toe slopes beneath the mahoe canopy.

The area is affected to a degree by old man's beard and is heavily affected by stock grazing.





Figure 1-53 : Kowhai (*Sophora tetraptera*) (dull green) on escarpment with mahoe, gorse and tree lupin also prominent in figure.



Figure 1-54 : Mahoe grove with emergent willow and fennel as well as old man's beard in foreground.



#### 1.9.1.7 Recharge 2

The recharge 2 area lies on the riverbed side of the stopbank and includes part of the irrigation channel and extensive willow woodland extending across the berm from the channel to the riverbed.

Distinctive vegetation bordering the channel near the culvert includes raupo and wild parsnip. The woodland is dominated by group willow plantings and intervening areas of rank grass. Understorey plants encountered within the open interior of the woodland include young grey willow, pampas grass and tree tutu. A solitary kanuka occurs within the woodland near the irrigation channel upstream of the culvert.

Vetch and lotus are a dominant component of the grassland cover. Small clusters of horsetail were observed across the ground where grass cover was lacking.

#### 1.9.1.8 Recharge 3

Recharge 3 encompasses a small stand of mature kanuka on the toe slopes immediately above the irrigation channel approximately 500m upstream of Recharge 1. Several mature specimens of mahoe, kowhai, cabbage tree and flax occur in association with kanuka along with pampas grass, gorse bushes and young crack willow trees. It is quite likely that this stand of kanuka is providing the seed source for the establishment of the individual specimen observed within the willow woodland at Recharge 2.



**Figure 1-55 : Kanuka and cabbage trees on escarpment toe slopes amongst willow, gorse and pampas grass.**

#### 1.9.1.9 Recharge 4

Recharge 4 is a localised area encompassing part of a toe slope adjacent to the irrigation channel and slightly upstream of Recharge 3. This area has been separately defined as it contains two or three specimens of the tree hebe which occur as a discrete unit amongst several crack willow trees.



**Figure 1-56 : Tree hebe specimens on irrigation channel bank (centre of figure).**

#### 1.9.1.10 Recharge 5

Recharge 5 covers a large area of land on both sides of the upper section of the irrigation channel, extending from the toe hill slopes to the edge of the riverbed.

The area features a mosaic of woody and grassland vegetation, notably willow treeland, featuring a variety of willow trees and the occasional black poplar hybrid. The intervening open areas feature swards of rank grasses along with adventive plants such as fennel, gorse, pampas grass, woolly mullein and tree lupin. Large parts of Recharge 5, both within the willow woodlands and across the grassland areas are affected by old man's beard and wandering jew.

Several large kowhai trees occur along the crest of the steep toe slopes above the irrigation channel in association with shrubs of boxthorn. Tussocks of the sedge *Carex virgata* occur sporadically along the banks of the irrigation channel.

#### 1.9.1.11 Higgins Point

Higgins Point is a prominent landform along the mid-reaches of the Scheme where the riverbed abuts a steep grassy hillside with a low rocky bluff toe. The steep nature of the hillside and nearby fenceline appears to afford a degree of protection, particularly to woody vegetation. A large proportion of this vegetation is indigenous and represents the greatest degree of indigenous biodiversity encountered along the true right bank of the Ngaruroro River between Fernhill and the Mangatahi junction.

A distinctive floristic feature of this area are the 1-1.5m tall conical shaped shrubs of tree hebe that are scattered over a small area amongst the prevailing grassland cover. A number of younger plants are evident within the grassland between and upslope of the older plants, indicating a more extensive hebe cover will develop across the area in the absence of fire and grazing.

Other woody indigenous plants occurring on the steep grassy slopes include karamu which overhangs the riverbed and the occasional koromiko and native broom (*Carmichaelia* sp.). The broom tends to be associated with the drier sites upslope of the tree hebes while the karamu and koromiko tend to occur amongst the discontinuous line of crack willows just above the riverbed. The distinctiveness of the area is heightened by several large flax bushes which occur just above the riverbed. The fern, tender brake, is present in reasonable numbers beneath the willow-karamu canopy.

The major constituents of the grassland are ripgut brome and cocksfoot while the fragrant catmint is the dominant herb. Thickets of blackberry are locally common particularly at the southern and northern end of this area.



**Figure 1-57 : Riparian native shrubland above limestone outcrop.**

#### 1.9.1.12 Higgins 1

Higgins 1 is a distinctive knoll with a steep west facing slope above a narrow strip of improved pasture and an extensive willow woodland associated with the floodplain. The broad crest of the knoll is a Maori burial site featuring a distinctive line of shallow depressions or pits.

Several large ngaio, mahoe and kowhai trees occur near the base of the knoll between two small stands of mature willow trees.

#### 1.9.1.13 Higgins 2

Higgins 2 is a large artificial pond created by land based gravel extraction. It is situated on the edge of the berm near the existing aggregate processing site. The HBRC have been responsible for extensive willow pole plantings on the landward side of the pond. These have been inter-planted with kanuka and English oak while a more extensive area between the pole plantings and the pond edge have been planted out in flax.

Parts of the lower lying shoreline have been extensively colonised by water speedwell with its distinctive rose-purple flowers.



#### 1.9.1.14 Mangatahi Junction

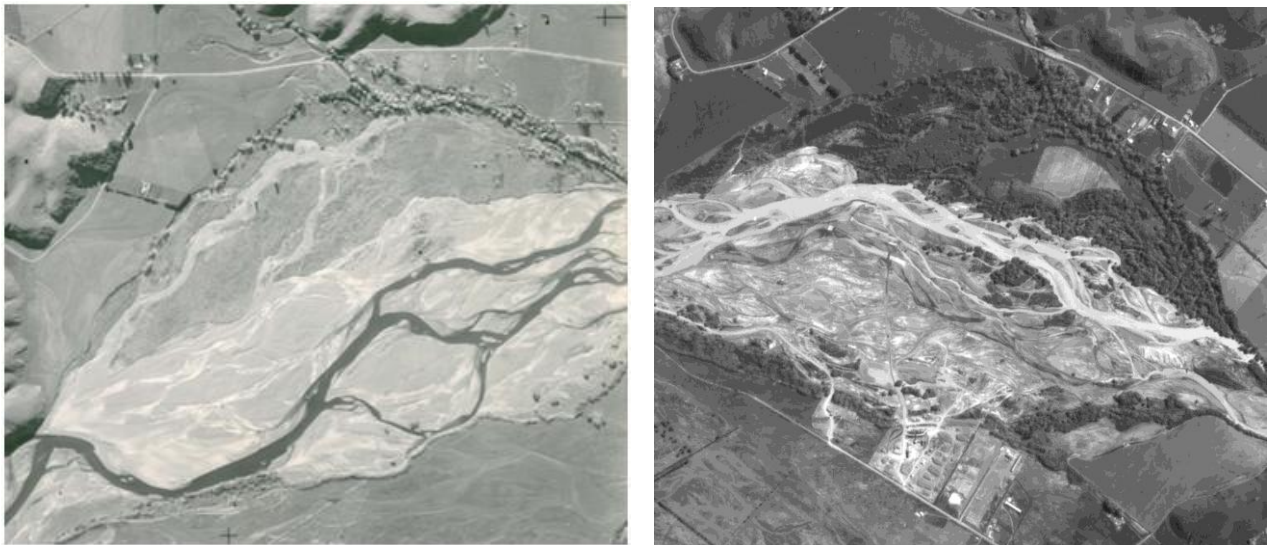
At Mangatahi Junction, a narrow section of dry riverbed borders the lower reaches of the Mangatahi Stream near the confluence with the Ngaruroro River. The riverbed here is covered in patches of tree lupin and an array of herbaceous plants such as fleabane, King Island mellilot, narrow leaved plantain, wild turnip, hedge mustard and buddleja. Plants bordering the damp stream margins include clustered dock and Maori musk.

The adjacent willow woodland covering the more elevated part of the riverbed and adjacent escarpment is dominated by crack willow and in several places small stands of a hybrid willow. Within the interior of the woodland the occasional shrub of karamu and specimens of cabbage tree are encountered. An isolated shrub of tauhinu occurs beside a fenceline separating the willow woodland from improved pasture near a track leading to the river.

### 1.9.2 True left side

#### 1.9.2.1 Omahu Conservation Area

The Omahu Conservation Area is an area of stabilised riverbed. The Ohiwia Stream flows through the area to its point of convergence with the Ngaruroro River main stem. Today the area features exotic pasture, scrub and forest, however as recently as 1950 this area featured active river braids (see Figure 1-58 below).



**Figure 1-58 : Omahu Conservation Area in 1950, (left); and 1977, (right).**

#### 1.9.2.2 Ohiti bluff / Waitio Stream

The Waitio Stream flows along the base of the Ohiti Bluff, under cover of willow forest. Of note is the native flaxland on the south facing headland. This area was viewed from the air and flax as well as hebe were noted.



**Figure 1-59 : Ohiti Bluff from the air, note flax and hebe on steep ground.**

### 1.9.2.3 Turret 1

The Turret 1 site comprises a small area of shrubland vegetation covering a very steep bank abutting the Ngaruroro River near a Maori burial ground off Ohiti Road. This site has a S to SW aspect.

A diverse assemblage of woody indigenous flora is encountered on the steeper lower bank, including a number of kowhai trees of varying age, mature mahoe trees, karamu, rangiora, koromiko, native broom (*Carmichaelia* sp.), tree tutu shrubs, cabbage trees and numerous flaxes.

Exotic grassland covers the bank above the shrubland with brown top and tall fescue being a major component.



**Figure 1-60 : koromiko (left), native broom (centre) and karamu (rear).**



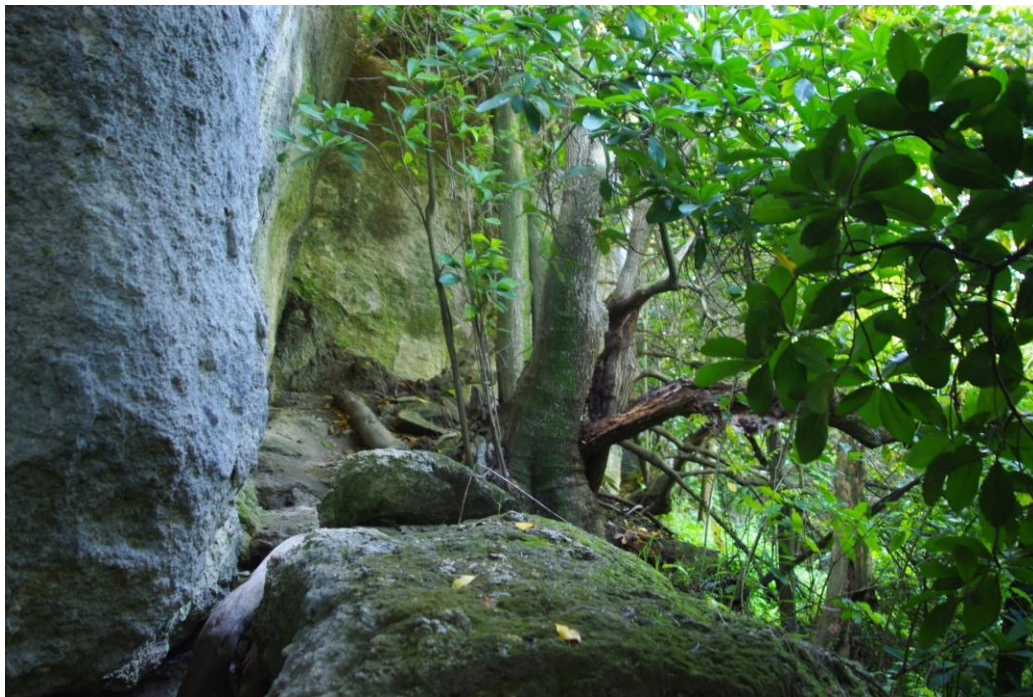
**Figure 1-61 : Regenerating and mature kowhai occurring with flax on south facing escarpment.**



#### 1.9.2.4 Turret Escarpment

The Turret Escarpment site is located approximately 600m upstream of Turret 1, and consists of an extensive area of low indigenous shrubland and forest vegetation covering a steep bank. The site lies between a house with a prominent turret structure (at the upstream end) and a HBRC water level recorder and stand of mature pine trees (at the downstream end).

The site has a southerly aspect and contains several prominent limestone bluffs and outcrops. Those outcrops feature occasional crevices. A fenceline defines the landward or upslope limit of the site with improved pasture beyond.



**Figure 1-62 : Characteristic limestone outcrop with mature karaka rooted in rock crevices.**

Mature crack willow trees line much of the river bank at the upper and lower end of the site while shrubland vegetation extends upslope from the riverbed merging with thickets of gorse and grassland that dominate the upper slopes towards the fenceline. The downstream end of the site (beneath the pine trees) features native shrubland vegetation dominated by manuka, koromiko and flax

The area of greatest botanical interest is a mixed stand of mature titoki, karaka, ngaio and mahoe trees (up to 8 metres in height) that are situated immediately upslope of crack willow trees towards the upstream end of the site. The canopies of these trees generally overlap and provide for a degree of structure within the forest interior as well as affording suitable conditions for the germination and regeneration of the canopy trees, and the existence of a range of shade tolerant indigenous vascular plants.

Young mahoe, karaka and titoki trees and rangiora shrubs are encountered in the forest interior while fern growth is luxuriant in places. Seedlings and saplings of karaka are particularly numerous across the rockier parts of the forest floor while those of mahoe, titoki and rangiora tend to be confined to the moister sites where there is deeper soil.

Ferns commonly encountered across the forest floor include hen and chicken fern, drooping spleenwort, tender brake, kiokio, common shield fern and common maidenhair.



Of concern in this area is the presence of wandering jew and ivy which are prevalent across part of the forest floor. The invasive nature of these plants and their growth form can have a significant adverse effect on the regenerative capacity of canopy species. Several garden escapees were also observed in the forest interior, including cotoneaster, agapanthus and *Mahonia* sp.



**Figure 1-63 : View over the upstream extent of terrace escarpment. Note crack willow at river margin (left of frame) grading into native forest canopy cover of karaka-titoki-mahoe, backed by grassland on the upper escarpment slopes.**

The ground cover beneath the shrubland canopy at the downstream end of the site includes ferns such as shining spleenwort, hounds tongue fern and common maidenhair which tend to prefer lighter overhead conditions.

Shrubs encountered on the edge of this stand and across much of the site include koromiko, rangiora, karamu and five finger which grow in association with numerous flax bushes and cabbage trees that are scattered across the site.

The vine puawhananga is encountered, particularly around the edges of the shrubland zone entwined amongst the lower branches of mahoe and karamu.

Of particular botanical interest is the existence of one specimen of golden akeake and one specimen of purple akeake just above the shrub belt. However given their proximity to a nearby residential dwelling, there is some uncertainty as to whether these are naturally occurring or planted specimens.

Overall this small stand of trees and surrounding shrubland vegetation is considered to contain the greatest degree of indigenous biodiversity of all the riparian sites investigated along both side of the Ngaruroro River between Fernhill and Matapiro.



**Figure 1-64 : *Clematis paniculata* climbing on mahoe (lime green seed heads visible, white flowers shown in inset).**

#### 1.9.2.5 Kommeren 1

Kommeren 1 features an area of willow treeland and exotic grassland representative of the vegetation cover across much of the broad terrace bordering this reach of the Ngaruroro River. The vegetation can be best described as a willow-poplar treeland. Crack willow is the predominant tree along with localised plantings of a willow hybrid and black poplar hybrids and the occasional cabbage tree. The intervening grassland areas are dominated by swards of grasses such as rip-gut brome. Tree lupin, blackberry, fennel, wild turnip and prickly sow thistle are conspicuous elements of the grasslands.

#### 1.9.2.6 Kommeren 2

Kommeren 2 is associated with an ephemeral wetland that crosses the terrace and intersects with the HBRC access tracks at various locations.

The wetland features a range of riparian and aquatic vegetation types. Submerged plants include curled pondweed, *Myriophyllum* sp., and green algae. Floating and emergent plant species include duckweed, pacific azolla, red pondweed, winter cress, water celery and water speedwell. Riparian species include crack and grey willow trees, sedges such as purei and *Carex virgata*, and swards of tall rank grasses such as tall fescue.

Water quality and clarity in the stream is apparently very good, suggesting the stream flow is derived from sub-surface recharge within the dry riverbed as opposed to surface water drainage from the landward agricultural catchment.





**Figure 1-65 : Pool habitat with diversity of aquatic and riparian vegetation.**



**Figure 1-66 : Pool habitat with abundant woody debris.**

#### 1.9.2.7 *Kommeren 3 and 4*

Kommeren 3 and 4 encompasses two small stands of kanuka trees on the river terrace near the boundary fence. The first stand (Kommeren 3) features around eighty trees in total and the second stand six trees. The trees are in good condition and vary in height from 8 to 10m. The diameter (dbh) of the trees in the Kommeren 3 stands varies from 15 to 34cm.

No kanuka regeneration is evident due to competition from the tall and dense swards to tall fescue and cocksfoot that prevail beneath the canopy.



**Figure 1-67 : Larger of the two kanuka groves abutting edge protection planting (November 2009).**



**Figure 1-68 : View inside kanuka grove shown above.**

#### 1.9.2.8 Alexander's 1

Alexander's 1 represents an area of shrubland vegetation, the majority of which lies within or immediately downslope of a mature pine plantation covering a steep to very steep west to south-west facing slope in proximity to the Kikowhero Stream. The pine plantation appears to have been progressively thinned to a lower stem density in the past.

The increased amount of light reaching the forest floor as a result of thinning and pruning operations is likely to have contributed to the increased density and stature of the indigenous shrubland vegetation, particularly towards the northern end of the plantation where kohuhu and mahoe shrubs and small trees occur along with clumps of flax. Several small localised stands of manuka and several small red matipo trees are also present.

The light conditions within the forest interior appear to maintain the grassland cover at a low enough density and stature that allows for the regeneration of kohuhu, as evidenced by the number of saplings encountered across the steep slopes. The stature and density of kohuhu shrubs is greatest along the toe of the hill slope. Other notable plant species observed include native broom (*Carmichaelia* sp.) which appears to favour the steeper drier sites where there tends to be a lack of grass cover; along with several toetoe (*Cortaderia fulvida*) which are growing on flat ground at the base of the toe slope. A solitary young lowland ribbonwood exists on the narrow river terrace next to Kikowhero Stream amongst extensive mats of wandering jew that cover much of the terrace.





**Figure 1-69 : Native broom and flax on steep facing slope.**



**Figure 1-70 : Kohuhu seedling indicating the natural regeneration capability of this slope.**

Towards the southern end of Alexander's 1, the stature and diversity of the shrubland cover increases despite much of this part of the shrubland being badly 'overrun' by old man's beard and to a lesser extent wandering jew. Much of the shrubland vegetation covers the steeper slopes downslope of the pine plantation and features a number of mature mahoe trees along with a small number of karaka, titoki and kowhai trees of varying ages.

The taller expansive canopy vegetation affords a degree of shading which in combination with a southerly aspect provides suitable conditions at ground level for a variety of ferns such as tender brake and common shield fern, as well as shade tolerant woody species such as kawakawa. Kawakawa growth is especially vigorous across parts of the forest floor despite the presence of old man's beard. Other sub-canopy plants present in this area include rangiora and the attractive drooping vines of the native jasmine.



**Figure 1-71 : Mahoe canopy with kawakawa, rangiora and native ferns present within the understorey.**

In addition to old man's beard and wandering jew, there is a noticeable presence of young hawthorn and boxthorn bushes within the forest interior. Seed sources appear to be several large specimens above the pine plantation within adjacent farmland.

#### 1.9.2.9 Alexander's 2

Alexander's 2 encompasses a large grove of broadleaved trees and shrubs situated to the north of Alexander's 1. These border the Kikowhero Stream and occupy adjacent steep grassy hillslope. A fenceline bisects the area.

The broadleaved trees include mature karaka, titoki, mahoe, kowhai and ngaio as well as cabbage trees that are scattered in small groups or as individual trees along the stream bank and hillside. Kohuhu and red matipo exist along the riparian margins in association with these trees.



**Figure 1-72 : Mahoe, titoki and karaka trees over grazed pasture. Note the limestone blocks in foreground.**

The entire area lies within farmland. Rank grassland exists around the bases of these trees. Prominent outcrops of limestone add to the distinctiveness of this area.

The canopies of the woody vegetation are sufficiently compact along sections of the stream bank providing suitable understorey conditions for the natural establishment of kawakawa, native broom and ferns such as nini, common maidenhair and button fern. It is noted that these plants are able to persist here despite the obvious browsing and trampling effects of cattle.

A number of the trees and shrubs along the riparian margins are festooned with pohuehue. Wandering jew and bindweed is locally common, particularly at ground level.

#### 1.9.2.10 Matapiro 1

The stabilised floodplain in this area is vegetated predominantly with crack and grey willow forest. Forest clearings and edge areas nearer the river feature naturalised plant species such as tree lupin, pampas, buddleia, blackberry and other exotic grass, herbaceous and woody species commonly found within the river corridor.



The upper areas of the escarpment which rise to the Matapiro plain proper is vegetated with plantation pine forest.

A riverine wetland feature, connected directly from the main river channel, flows along the base of the escarpment. The wetland features the floating aquatic plants, pacific azolla and duckweed. Other than the willow canopy, riparian plants associated with this wetland include mahoe, coprosma, purei, toetoe (*Cortideria fulvida*), and flax.



**Figure 1-73 : Typical character of the riverine wetland at Matapiro 1.**



**Figure 1-74 : Purei at wetland margin.**



**Figure 1-75 : Compact panicle of *C. fulvida* with characteristic pendent branchlets.**

Setback from the wetland, under tall willow canopy and sparse exotic herbaceous ground cover, a relatively diverse collection of native plant species are present. These include the fern species: shore spleenwort, shaking brake, lance fern, sweet fern and gully fern. Saplings of karo, kowhai, kanono are present, indicating that the canopy conditions and sparse ground cover are amenable to natural regeneration of these species. The native climber, pohuehue, is encountered growing over the lower limbs of crack willow.

The willow forest nearer the escarpment obviously benefits from cool, moist microclimate conditions afforded by the sheltered conditions of the bounding escarpment along with the wetland feature and associated moist soils. In a large part of this area, particularly to the east, mahoe is prolific under willow canopy, typically with a high density of small diameter stems. Lance fern and gully fern which are two ferns characteristic of damp conditions, commonly co-exist under this willow / mahoe forest cover.



**Figure 1-76 : Coprosma and several fern species occurring under mahoe sub-canopy and tall willow canopy cover.**



**Figure 1-77 : Dense mahoe shrubland under tall willow canopy.**

#### 1.9.2.11 Matapiro 2

Near the Matapiro Hall and adjacent to the Matapiro Road there is a prominent escarpment separating the lower and upper river terraces. Extending along and out from the base of the escarpment is a wetland associated with a small watercourse which appears to occupy a former channel of the Ngaruroro River or ox-bow.

Although the wetland was viewed only from a distance, it was apparent that it contains a range of wetland habitats and indigenous vegetation. While there are extensive patches of blackberry and gorse within this area, there are numerous sedges (*Carex* spp.) bordering the stream and across areas of unimproved pasture between the blackberry and gorse patches. Numerous clumps of rushes (*Juncus* spp.) are also apparent within these open areas. A large part of this area appears to be fenced from surrounding improved pasture. Towards the upstream end of the wetland there appears to be an extensive area of raupo. Cabbage trees are numerous particularly on the toe slopes bordering the wetland and across a large part of the embankment.

Several stands of indigenous trees exist on the embankment to the north of the wetland. The canopy trees of these stands appear to comprise of mahoe, titoki and ngaio, although identification at a distance was hampered by a rampant climber that festoons most of the canopies.

The spotlight fish survey carried out at Matapiro 1 (which is part of the same wetland only downstream of Matapiro 2) returned a diverse native freshwater fish fauna, including the presents of two threatened species.





**Figure 1-78 : The remnant meander of the Ngaruroro River at Matapiro 2 still features a flowing wetland and remnant native vegetation (Top); *Carex* spp. at the wetland margin (bottom left) and remnant forest festooned with climbing vegetation on terrace riser (right).**



## 2 Cultural values

### 2.1 Cultural setting

Water bodies in many cultures hold a special significance. In the past they provided many resources which allowed survival, and continue to be a focal point in modern society. This is no different for the Ngaruroro River.

To enable a local understanding of cultural significance associated with the Ngaruroro River an oral history was undertaken. This involved an interview on the 16<sup>th</sup> of February 2010 with Mathew Love who moved to Fernhill in the 1960's; and an interview on the morning of the 23<sup>rd</sup> of February 2010 with Riordan Kemp who grew up and still lives in the Fernhill area. A field trip was then undertaken on the 23<sup>rd</sup> of February 2010 with Mathew Love, Riordan Kemp, Jenny Mauger, Adam Forbes and Andrea Sinclair. The purpose of the outing was to visit and investigate sites which had been highlighted through the oral history as being of cultural significance.

The sites that were identified as having cultural significance are concentrated around the Fernhill area including lakes Oingo and Runanga, and Pa sites at Ohiti. The map and table below show the sites of significance that were visited. Some sites visited, such as Oingo Lake, are outside the scope of this plan; yet their values are linked to the Ngaruroro River and are somewhat difficult to separate. For that reason all sites identified through the oral history are presented in the following section.

In addition to the oral history records, minutes from a Hui at Kohupatiki Marae regarding a Tangata Whenua perspective on Hawke's Bay riverbed gravel management were also drawn upon in describing cultural values. These complimented the findings from the cultural field trip.

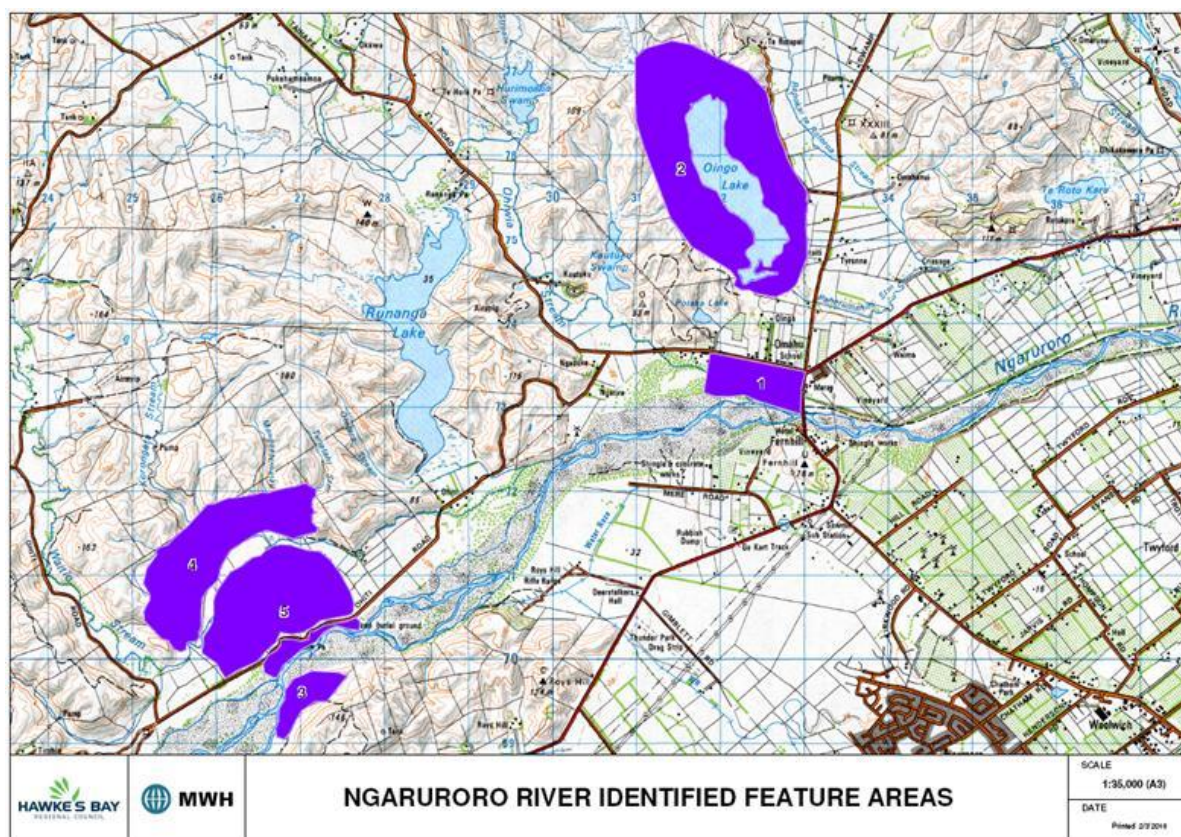


Figure 2-1 : Cultural sites location map.



**Table 2-1 : Cultural sites table.**

Site No.	Site Name	Feature	Description	Threats	Opportunities for Ngaruroro EMEP
1	Taihape Road	<ul style="list-style-type: none"> <li>- Eel factory.</li> <li>- Relocated cemetery.</li> </ul>	Old 'poultry' factory building that was used to farm eels (outside of existing stop bank); Small plaque where cemetery was relocated from due to repeated flooding (landward side of stop bank).	<ul style="list-style-type: none"> <li>- Access to site is through private owner permission.</li> <li>- Land used for cattle grazing.</li> </ul>	Low. Land appears to be owned by members of local hapu who use the land for dairy farming.
2	Oingo Lake	<ul style="list-style-type: none"> <li>- Eight archaeological sites including pa, settlements, terraces, pits, middens and a grave.</li> <li>- Raupo harvesting.</li> <li>- Flax harvesting.</li> <li>- Eeling.</li> </ul>	120 hectare fresh water lake which is spring fed and is connected to the Ngaruroro River. Tangata Whenua occupation dates back approximately 600 years and as recent as the mid 1800 'land wars'	Access to site is through private owner permission.	Nil. Outside EMEP scope.
3	Ohiti Pa	Main pa with approximately two other Pa adjacent (across river).	Hill with characteristic pa terraces and limestone boulders; Native forest fragment on southern side.	<ul style="list-style-type: none"> <li>- Access to site is through private owner permission.</li> <li>- Invasion of pest plants.</li> </ul>	High. Legal protection of native forest fragment (overlap of ecological value)
4	Hills behind Ohiti Road	Watercress gathering.	Water springs running through the hills providing watercress at the top and along the side of the hills;	<ul style="list-style-type: none"> <li>- Access to site is through private owner permission.</li> <li>- Reduction in water quantity in springs.</li> </ul>	Nil. Outside EMEP scope.
5	Former flood plains between river and hills behind Ohiti Road	Alternative food source and transport routes during times of flood.	The Ngaruroro River would previously flow over the flood plains, increasing the area that could be used to gather food as well as use waka.	Modification of tributary streams.	Nil. Outside EMEP scope.

## 2.2 Cultural values

Although the field trip findings used to make an assessment are considered fairly localised to part of the Scheme, they provide a general understanding of what is valued by Tangata Whenua. The Hui minutes agree with the oral history results. The understanding on cultural values obtained can be applied at other sites on the river. The following cultural values have been summarised from the oral history and site visits as well as Hui notes. These values are:

- The ability to access places of significance;
- The good health of the riparian area including the riverbed and the river itself; and
- The flow of the water, including the quantity and its behaviour.

### 2.2.1 Access

Due to the sale of land in the past, it is now only possible to access specific sites of significance with landowner permission. If this permission was to cease, many sites of cultural value would be inaccessible to those people who recognise special value in them. Maintaining access is considered an important cultural value along the Ngaruroro River.

This does not imply that all land along the river should be accessible to all members of the public, but that Tangata Whenua should have the ability to access areas of significance in recognition of their ties to the land. This could also be extended to consulting local hapu on projects which would increase public access to sites considered culturally significant.

### 2.2.2 Riparian health

Edge protection plantings have resulted in relatively uniform riparian vegetation along the river, consisting largely of willows. These species have created a different habitat from as little as 30 years ago, and in some places, have spread into adjacent land. There has also been a loss of quality riparian cover along the tributaries, an example being the Waitio Stream located in the former flood plains at Ohiti, which has been modified into a man-made channel to fit around vineyard blocks.

Raking and gravel extraction has also led to rivers appearing uniform, where the riverbed is 'groomed' rather than allowing flooding as a dynamic cleansing process.

The changing landscape is said to have contributed to a decline in key food species, such as eel, freshwater crayfish, and black flounder, which were said to be abundant and provided a consistent source of food. The concentration of pa sites along the river in Ohiti shows that this area traditionally had resources to support hapu. It is reasonable to assume that riparian health is culturally important, as it ensures that traditional food sources remain available to present and future generations.

### 2.2.3 Water flow

Before the use of stop banks, the Ngaruroro River meandered across the landscape and people of the land followed it over a period of 500 or 600 years. Even until relatively recently, tributary streams would swell and create new areas for resources gathering. This water flow also provided pathways for transport; the waka.

Confining the river through flood management has changed the behaviour of the water flow, such as extracting gravel and beach raking to allow the free flow of flood waters and maintain flood capacity of the riverbed. The use of the water for things such as irrigation, and land draining for pastoral development have also contributed to the modification of water flow.

Water flow into the tributaries was said to have reduced greatly, the same was said for water quantity, changing available resources. In addition, reducing the water flow was said to affect aquatic habitat. Ensuring local hapu are consulted on plans which would reduce the flow of the Ngaruroro River is considered extremely important, as well as using water efficiently.

### 2.2.4 Relevant Maori heritage sites

The Hastings District Council Planning Maps were used to locate land designated as Waahi Tapu sites within the vicinity of the Ngaruroro River. There are three Maori heritage sites identified along the river which the EMEP would have a direct influence over. These sites are listed below:

- Directly upstream of the Chesterhope Bridge on Pakowhai Road: "W13 Battlefield – Urupa".
- Fernhill Hotel Road on the river bed: "W57 Puketapu – Battlefields, Old Pa Sites, Burial Caves".
- Ohiti, Ohiti Road along the riverbank – Ohiti Pa site and Maori burial ground (not designated on private land).



The District Plan Map which relates to these sites are shown below.

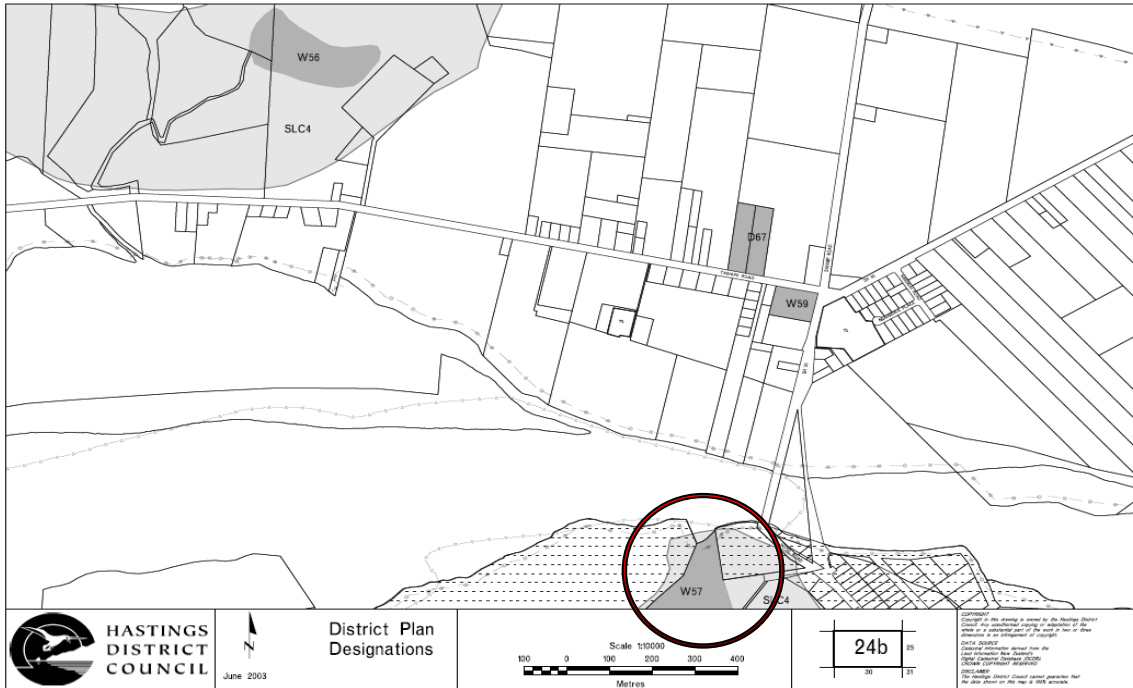


Figure 2-2 : Designation “W57” at Fernhill.

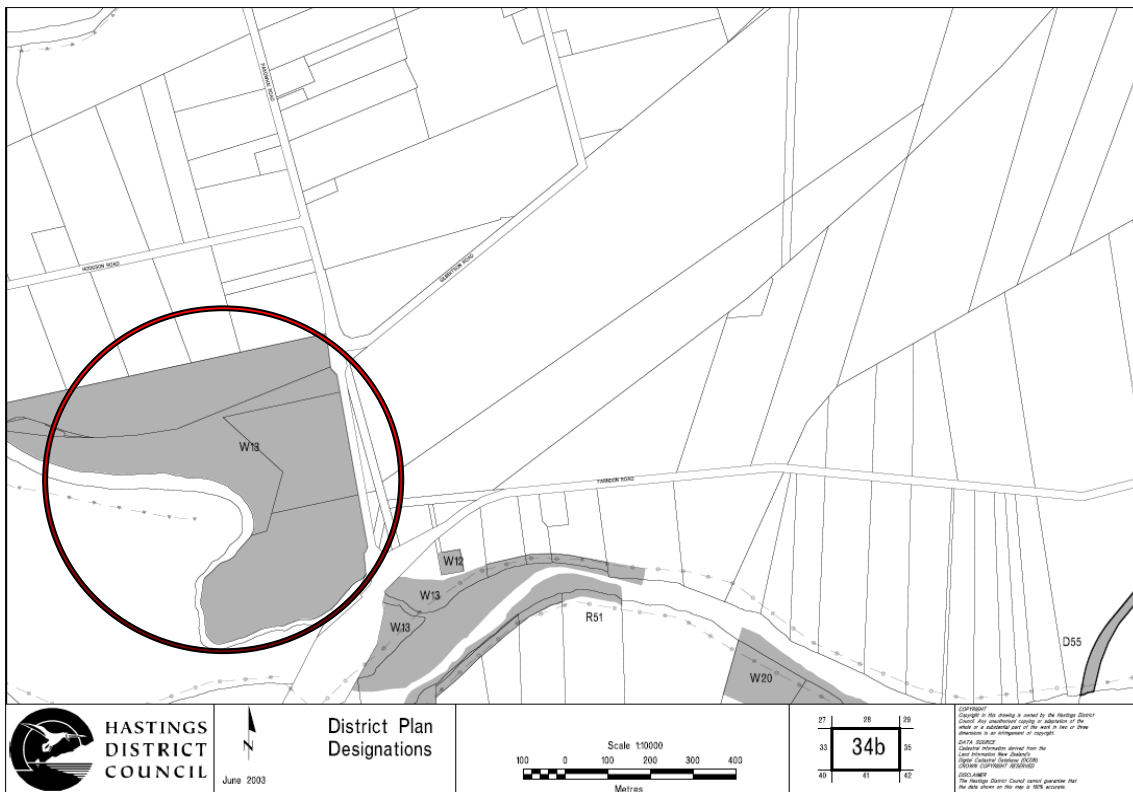


Figure 2-3 : Designation “W13” at Chesterhope Bridge.

The cultural values identified as part of the assessment can be directly applied to these Maori heritage sites when producing a management and enhancement plan.

## **2.3 Management and enhancement opportunities**

### **2.3.1 Opportunity to have cultural management zones**

The sites identified as Maori Heritage Sites can be used to form cultural management zones within the river system. This would ensure a level of consideration to these important sites when developing a management and enhancement plan and would involve specific provisions for these zones which take into account the cultural values.

### **2.3.2 Opportunity to assess level of access to the river**

The issue of access to important sites has been identified as a cultural value. Looking specifically at the three Maori heritage sites, access for Tangata Whenua to the land is currently provided. At Chesterhope Bridge and Fernhill, access is extended to all members of the public. The Ohiti site is on private Maori-owned land. Access as a value however, does not imply that all access should be maintained to all members of the public as the exclusion of the public from freely accessing the land could result in the enhancement of the integrity of the cultural management zone. Outside the three Maori heritage sites, variation in access may have implications for Tangata Whenua's relationship with the land. This should be considered if access to points of cultural interest is to change.

### **2.3.3 Opportunity to improve riparian diversification**

Riparian health along the river is partly a product of the current management regime. An example is to compare Chesterhope Bridge and Ohiti. Considering the importance of riparian health as a cultural value, riparian diversification could be improved through the implementation of this management and enhancement plan.

### **2.3.4 Opportunity to have dual outcomes from ecological management/enhancement**

In some sites along the river there is a direct overlap between enhancing ecological values and enhancing cultural values. An example of this is at Ohiti where a rare pocket of native forest is present at a pa site and Maori burial grounds. Protecting the native vegetation will have a dual outcome of protecting the integrity of these Maori heritage sites. Where there is overlap with ecological values and potential to enhance these values, there is potential to enhance cultural values.



## 3 Recreational values

### 3.1 Recreational assessment

The disturbance to ecological values from recreational activities carried out on the Ngaruroro River are an important consideration when planning ecological management and enhancement.

The Ngaruroro River has been assessed in terms of its use for recreation. This was achieved by characterising recreational use 'type' and 'intensity' at different points along the river from its mouth to Whanawhana (refer sites 1 to 21 in the following plans). Information was derived from visiting the site, speaking to key people involved in specific recreation activities, Fish and Game publications and Regional Council recreation information. In the following assessment recreational use intensities are rated from "very low" to "very high".

### 3.2 Findings

Waitangi Estuary and Chesterhope Bridge had the greatest range and intensity of recreational activities, both being scored "very high". Disturbance from recreational use in this area is significant, and coincides with highly significant ecological values.

The reach of the river between Chesterhope and State Highway 2, the river at Fernhill, and at Whanawhana have a "high" intensity rating with activities ranging from 4WD access, offroad motorbiking, jet boating/jetsports, trout fishing, dog walking and free camping. Disturbance from these activities could be expected to include noise and physical disturbance including longer duration disturbance from free camping. This is of some concern to bird populations of the riverbed.

Outside of those areas mentioned above, recreational use of the river is of a "medium" to "low" intensity. "Medium" intensity relates to sites where there is public access to the river, and "low" intensity relates to places where fishers can walk along the riverbed or jet boats can negotiate the river. The recreational uses are largely restricted to fishing and jet boating, however some of these sites conflict with known bird breeding sites and therefore could have a significant effect on bird populations of river.

The final section of river assessed is at McIndoe Flat, which has a "very low" intensity rating as jet boats are rarely able to access the area, restricting recreational access to foot traffic only.

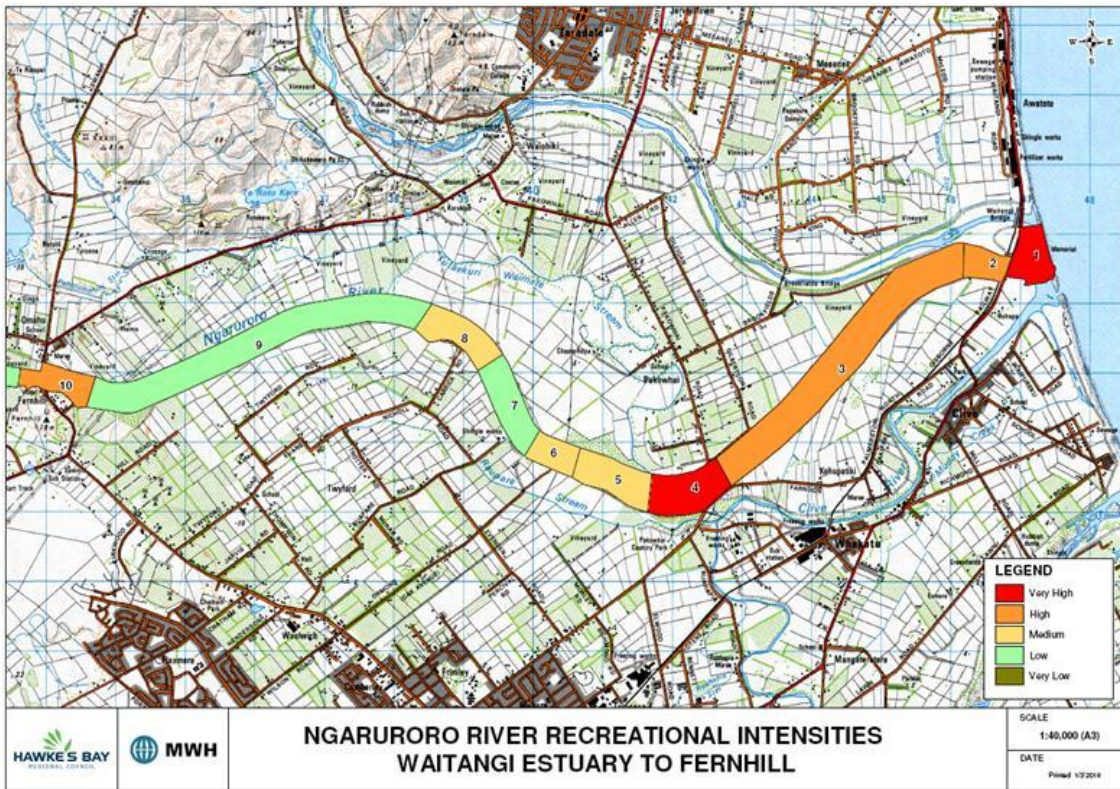


Figure 3-1 : Recreational intensities – Waitangi Estuary to Fernhill.

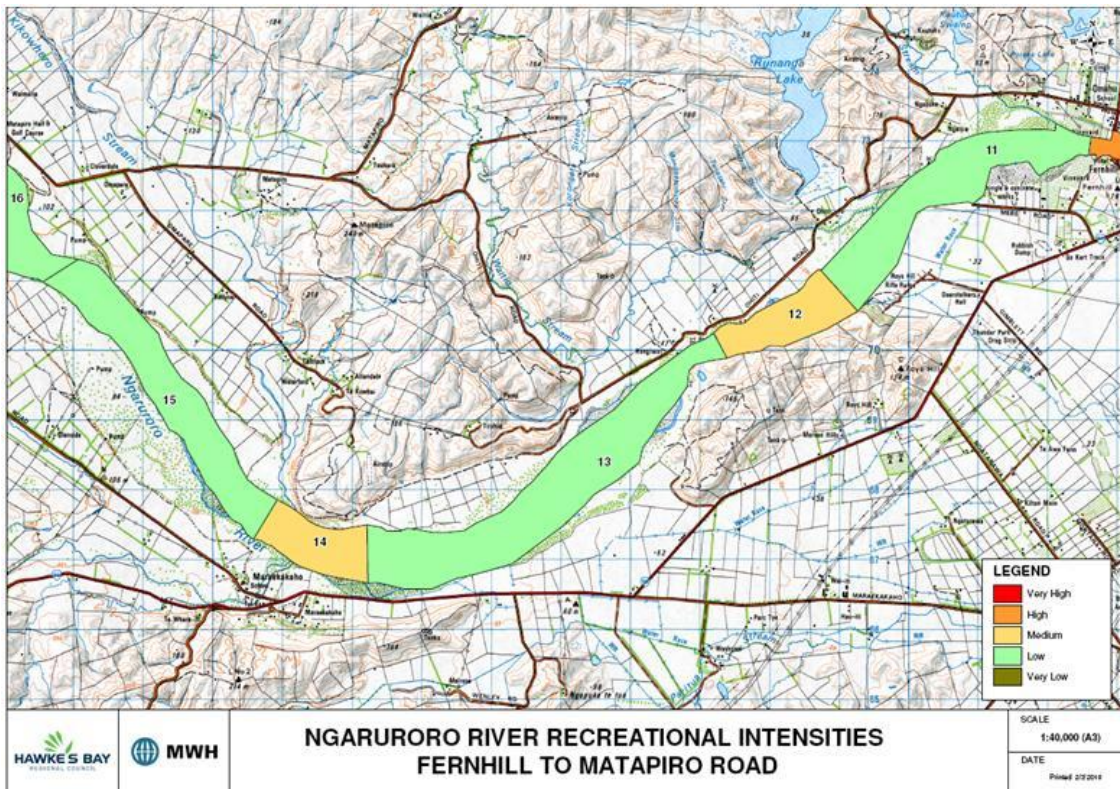
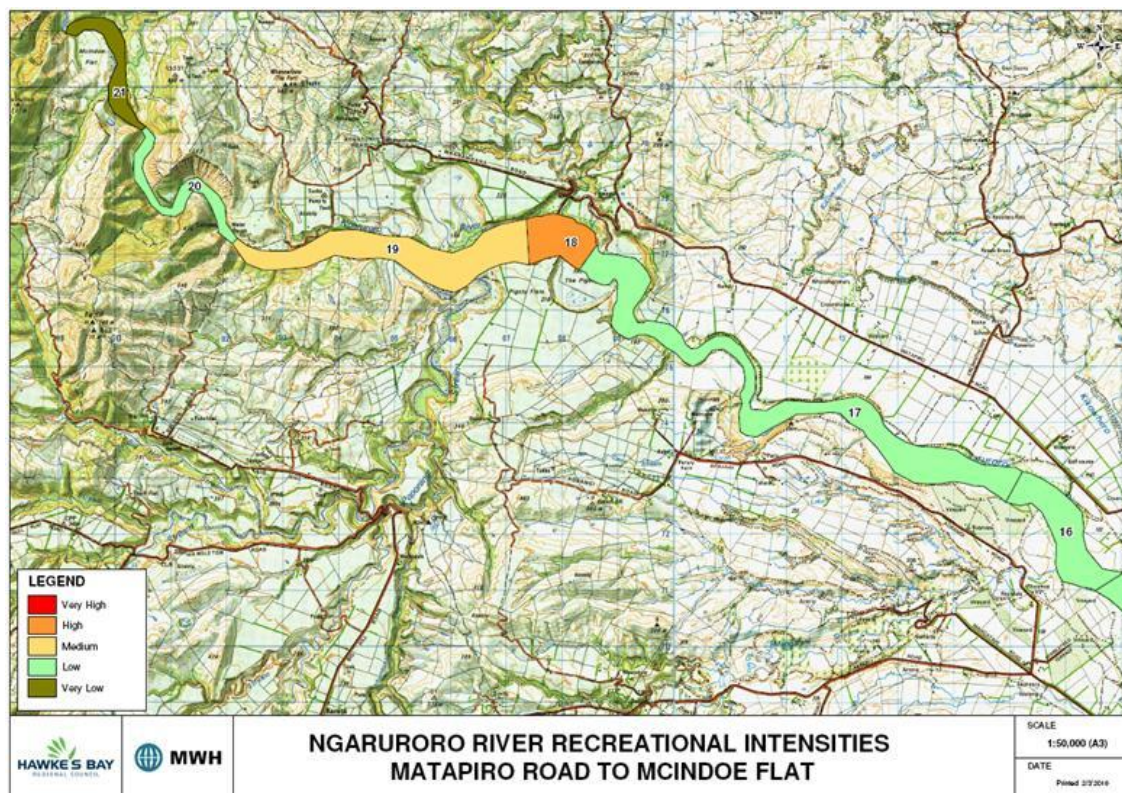


Figure 3-2 : Recreational intensities – Fernhill to Matapiro Road.





**Figure 3-3 : Recreational intensities – Matapiro Road to McIndoe Flat.**

**Table 3-1 : Recreational intensities table.**

Site No.	Name	Activities	Intensity	Description in Relation to Ecology (Disturbance)
1	Waitangi Estuary up to railway bridge (Public Access point)	<ul style="list-style-type: none"> <li>- 4WD</li> <li>- Quad biking</li> <li>- Picnics</li> <li>- Dog walking</li> <li>- Driftwood collection</li> <li>- Motorbiking</li> </ul>	Very High	Reduced habitat for terrestrial invertebrates and lizards due to driftwood removal; A high level of disturbance of habitat on land and in water from intense recreational activities; Introduction of waste into environment rubbish, burnt out cars, loitering, free camping, etc; Pressure on fish populations through various forms of fishing.
2	Above railway bridge to Tutaekuri River confluence	<ul style="list-style-type: none"> <li>- Jetskiing</li> <li>- Jet Boating</li> </ul>	High	A high level of disturbance of habitat in water from intense recreational activities; Introduction of waste into environment rubbish, burnt out cars, loitering, free camping, etc.

Site No.	Name	Activities		Intensity	Description in Relation to Ecology (Disturbance)
3	Tutaekuri River confluence to upper Chesterhope bridge	- Whitebaiting	- Dog walking	High	Pressure on fish populations through various forms of fishing; Vehicle access to river berms; Introduction of waste into environment rubbish, burnt out cars, loitering, free camping, etc.
4	Chesterhope Bridge (Public Access point)	- Motorbike track - 4WD - Un-restricted	- Free camping (motor homes/cars/vans) - Jetboat launching - Dog walking	Very High	Introduction of waste into environment: rubbish, burnt out cars, loitering, free camping, etc; Motorcycling track; Recreational use of riverbed.
5	Chesterhope Bridge to Ormond Road	- Jetboating	- Fishing	Medium	Disturbance to riverbed from recreational use.
6	Ormond Road (Public Access point)	- Quad biking - Jetboating	- Fishing - Picnic/BBQ	Medium	Disturbance to riverbed from recreational use.
7	Ormond Road to Carrick Road (Private access)	- Jetboating	- Fishing	Low	Disturbance to riverbed from recreational use.
8	Carrick Road (Public Access point)	- Quad biking - Jetboating - Fishing	- Picnic/BBQ - 4WD - Free Camping	Medium	Disturbance to riverbed from recreational use; Introduction of waste into environment loitering, free camping, etc.
9	Carrick Road to Fernhill (Private access)	- Jetboating	- Fishing	Low	Disturbance to riverbed from recreational use.
10	Fernhill (Public Access point)	- Quad biking - Jetboating - Fishing - Picnic/BBQ	- 4WD - Free Camping - Swimming	High	Disturbance to riverbed from recreational use; Introduction of waste into environment loitering, free camping, etc.
11	Fernhill to Ohiti Road (Private access)	- Jetboating - Fishing	- Swimming	Low	Disturbance to riverbed from recreational use.
12	Ohiti Road (Public Access point)	- Swimming - Fishing	- Rubbish dumping (green waste) - Game bird shooting	Medium	Introduction of potential weed plant species into the environment; Disturbance to riverbed from recreational use; Introduction of waste into environment loitering, free camping, etc.
13	Ohiti Road to Maraekakaho (Private access)	- Jetboating - Fishing	- Swimming	Low	Disturbance to riverbed from recreational use.



Site No.	Name	Activities		Intensity	Description in Relation to Ecology (Disturbance)
14	Maraekakaho (Public Access point)	- Jetboat launching - Fishing	- Swimming - 4WD	Medium	Disturbance to riverbed from recreational use. Introduction of waste into environment rubbish loitering, free camping, etc.
15	Maraekakaho to Matapiro Road (Private access)	- Jetboating	- Fishing	Low	Disturbance to riverbed from recreational use. Introduction of waste into environment rubbish loitering, free camping, etc.
16	Matapiro Road (Private Fish and Games access)	- Jetboating	- Fishing	Low	Disturbance to riverbed breeding birds, including black billed gull breeding colony and South Island pied oyster catcher nests near this site.
17	Matapiro Road to Whanawhana Road (Private access)	- Jetboating	- Fishing	Low	Disturbance to riverbed from recreational use.
18	Whanawhana Road (Public Access point)	- 4WD - Quad biking - Fishing	- Jetboating - Free camping	High	Disturbance to riverbed from recreational use; Introduction of waste into environment rubbish, loitering, free camping, etc.
19	Whanawhana Road to the Cableway	- Jetboating (private and commercial)	- Fishing	Medium	Disturbance to riverbed from recreational use.
20	The Cableway (Ngaruroro gorge)	- Jetboating - Kayaking	- Fishing - Hunting	Low	Disturbance to riverbed from recreational use.
21	McIndoe Flat	- Fishing	- Fishing	Very Low	

### 3.3 Management of conflicts between recreation and ecological values

In Chapter 3, the findings of the recreational use assessment are used to highlight where recreational activities on the Ngaruroro River conflict with ecological values. The management plan uses management zones to reduce conflicts by imposing rules to change the existing behaviour of recreationalists in ecologically sensitive areas so the impact on ecology is minimised and by planning ecological enhancement in less disturbed areas where conflicting use is low – or conversely - planning appropriate ecological enhancement in areas readily accessible to the public to maximise public benefit.

## 4 Climatic characteristics

### 4.1 Land Environments New Zealand

The following climate descriptions for the management area are taken from the Level III & IV Land Environment New Zealand classifications<sup>72</sup>. Table 4-1 below contains descriptions of the management areas 'LENZ environments' which in-turn are mapped in Figure 4-1 below.

<sup>72</sup> LENZ, 2005.

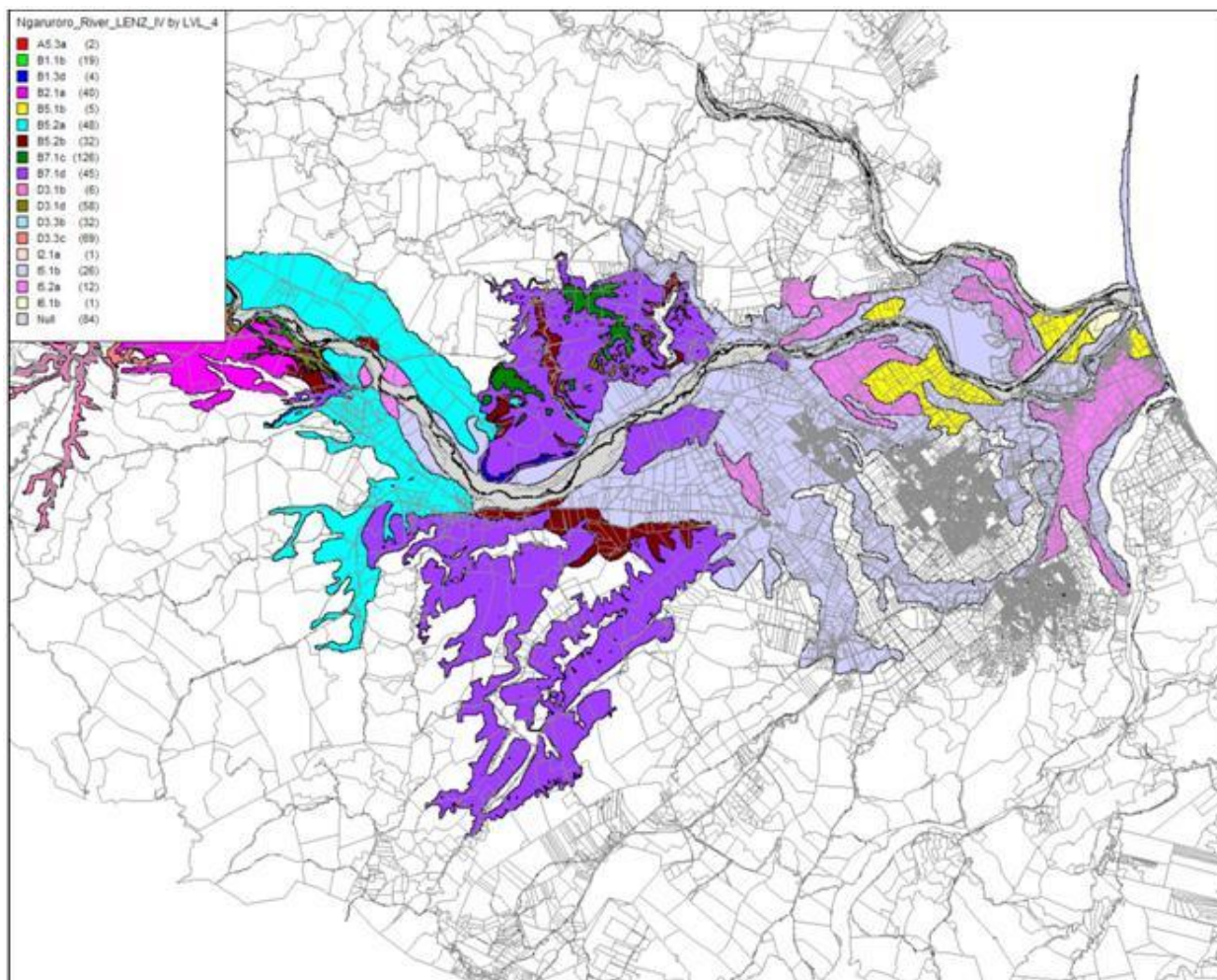
The LENZ data shows that the climate of the management area is characterised by warm air temperatures, high solar radiation and high vapour pressure deficits<sup>73</sup>.

The majority of the Scheme's length experiences moderate annual water deficits.

A relatively short reach of the Scheme near Chesterhope, and discrete areas near the top of the Scheme, around the Mangatahi Stream confluence, experience 'high' annual water deficits.

**Table 4-1 : Climatic characteristics of the Scheme according to LENZ.**

LENZ 'Environment'	I5.1b & B5.1b & B7.1d	I5.2	B5.1b & B5.2a & B5.2b
Climate description	Warm temperatures, high solar radiation, high vapour pressure deficits, <i>moderate</i> annual water deficits.	Warm temperatures, high solar radiation, high vapour pressure deficits, <i>high</i> annual water deficits.	Warm temperatures, high solar radiation, high vapour pressure deficits, very low monthly water balance ratios and moderate annual water deficits.



**Figure 4-1 : LENZ environments of the management area.**

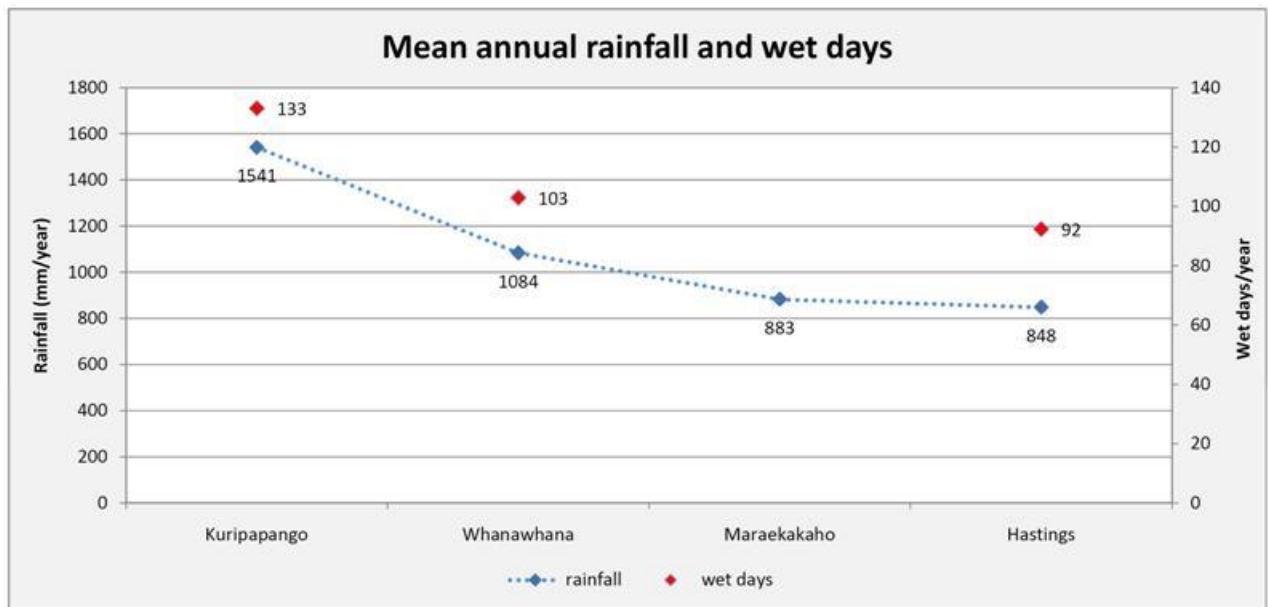
<sup>73</sup> Vapour pressure is the difference (deficit) between the amount of moisture in the air and how much moisture the air can hold when it is saturated. High vapour pressure deficit means low water vapour content, and literally dry air - which can place additional stress on plant life.



## 4.2 Climate station data

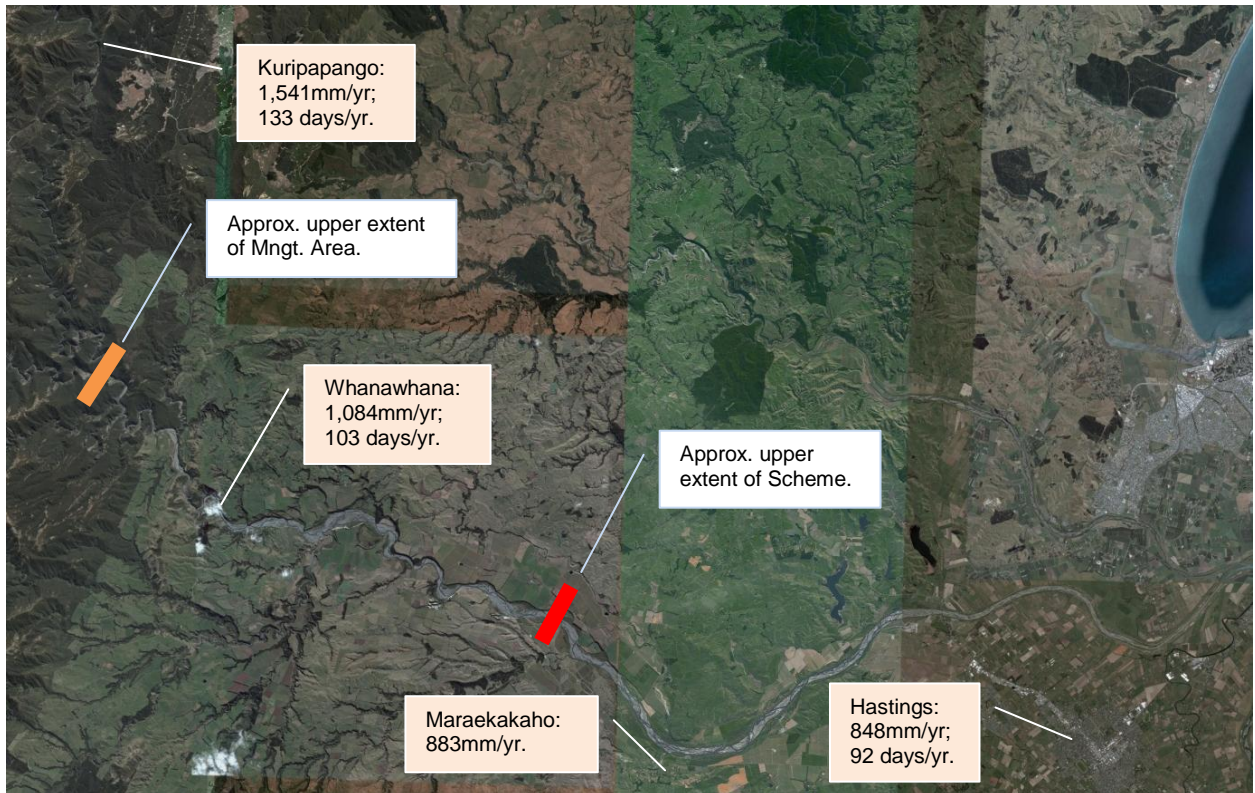
Climate data sourced from the NIWA Cliflo database (accessed July 2010) provides rainfall records at four locations adjacent to the Ngaruroro River (see Figure 4-2 and Figure 4-3 below). A west to east gradient of reducing mean annual rainfall, and reducing rainfall frequency is clear from the data. The river's upper reaches within the axial ranges receive more rainfall per year, and at a greater frequency when compared with the middle and lower reaches of the river corridor (the management area).

Data from two rainfall stations representative of the central and lower Scheme areas ('Maraekakaho' and 'Hastings') show mean annual rainfall to be around 880mm/yr to 850mm/yr; while rainfall at Whanawhana (the upper end of the management area) is around 1084mm/yr.



Standard Errors (S.E)	Site	Kuripapango	Whanawhana	Maraekakaho	Hastings
	Rainfall (mm)	64	25	30	25
	Wet days	13	57	no 'wet day' data	41

**Figure 4-2 : Mean annual rainfall and 'wet day' data at four points along the rainfall gradient of the Ngaruroro River. A 'wet day' represents the number of days in a year when  $\geq 1$ mm rain fell. Standard Errors for all data points are also presented.**



**Figure 4-3 : Approximate climate station locations plus summary of mean annual rainfall and wet day data, in relation to the management area and Scheme.**



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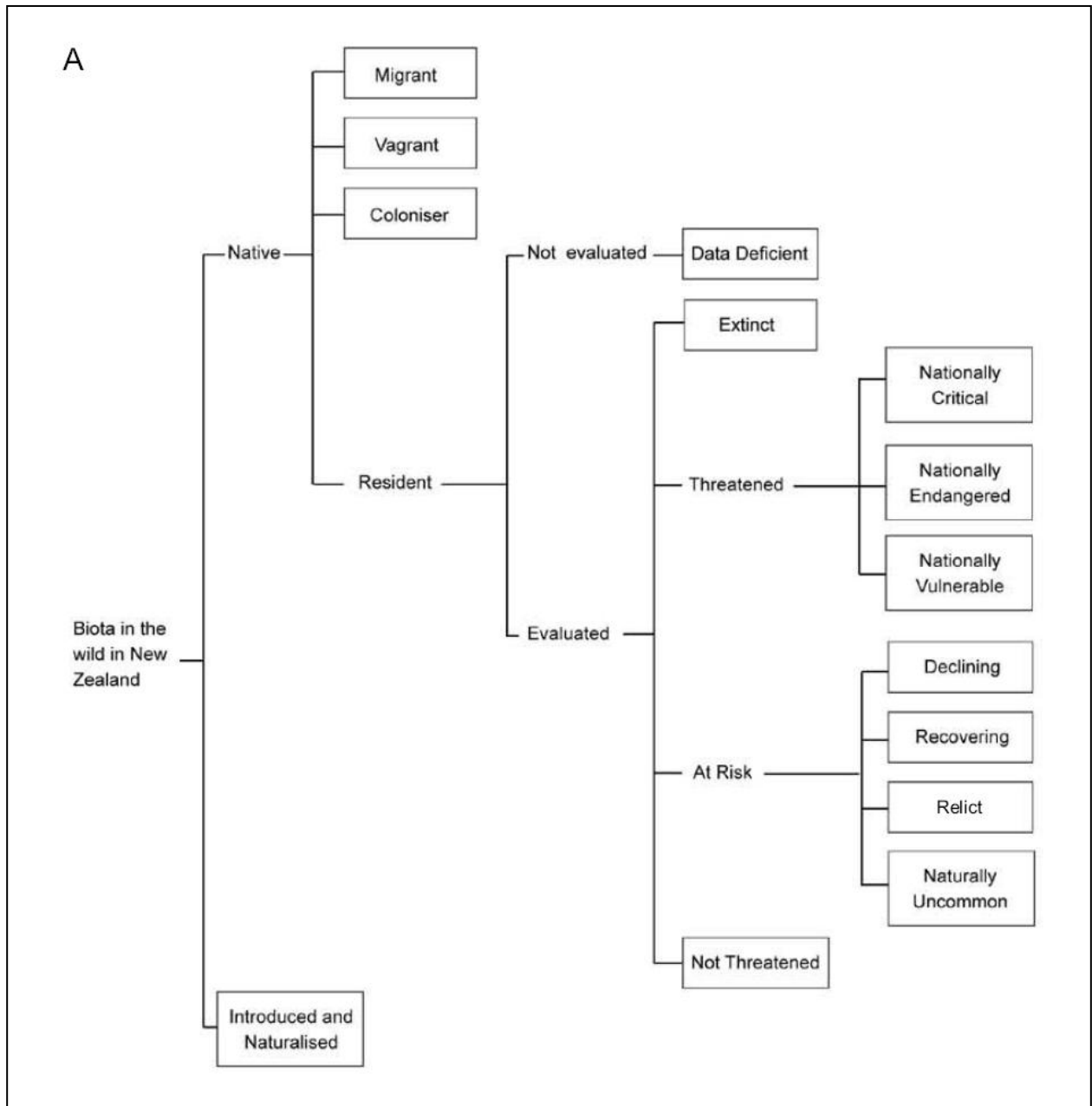
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## Appendix B: Threat Categories of the New Zealand Threat Classification System

New Zealand Threat Classification system structure taken from Townsend *et al*, 2008.



## Appendix C: Full list of flora and fauna referred to in this Chapter

Flora					
Botanical name	Common name	E	N	I	
<b>Trees and shrubs</b>					
<i>Alectryon excelsus</i>	titoki	•			
<i>Aristolelia serrata</i>	makomako	•			
<i>Beilschmiedia tawa</i>	tawa	•			
<i>Brachyglottis repanda</i>	rangiora	•			
<i>Carmichaelia</i> sp.	native broom	•			
<i>Coprosma australis</i>	kanono	•			
<i>Coprosma repens</i>	taupata	•			
<i>Coprosma robusta</i>	karamu	•			
<i>Cordyline australis</i>	cabbage tree	•			
<i>Coriaria arborea</i>	tree tutu	•			
<i>Corynocarpus laevigatus</i>	karaka	•			
<i>Cotoneaster</i> sp.	cotoneaster			•	
<i>Crataegus</i> sp.	hawthorn			•	
<i>Cytisus scoparius</i>	broom			•	
<i>Dodonaea viscosa</i>	golden akeake		•		
<i>Dodonaea viscosa</i> 'Purpurea'	purple akeake		•		
<i>Hebe parviflora</i> var. <i>arborea</i>	tree hebe	•			
<i>Hebe stricta</i>	koromiko	•			
<i>Leptospermum ericoides</i>	kanuka	•			
<i>Leptospermum scoparium</i>	manuka		•		
<i>Lycium ferocissimum</i>	boxthorn			•	
<i>Mahonia</i> sp.	-			•	
<i>Meliccytus ramiflorus</i>	mahoe	•			
<i>Macropiper excelsum</i>	kawakawa	•			
<i>Nestegis</i> spp.	maire	•			
<i>Myoporum laetum</i>	ngaio	•			
<i>Myrsine australis</i>	red matipo	•			
<i>Cassinia leptophylla</i>	tauhinu	•			
<i>Pinus radiata</i>	pine			•	
<i>Pittosporum tenuifolium</i>	kohuhu	•			
<i>Plagianthus divaricatus</i>	saltmarsh ribbonwood	•			
<i>Plagianthus regius</i>	lowland ribbonwood	•			
<i>Podocarpus totara</i>	totara	•			
<i>Populus alba</i>	silver poplar			•	
<i>Populus nigra</i>	black poplar			•	
<i>Populus nigra</i> var. <i>Italica</i>	lombardy poplar			•	
<i>Pseudopanax arboreus</i>	five finger	•			
<i>Quercus robur</i>	English oak			•	
<i>Salix cinerea</i>	grey willow			•	
<i>Salix fragilis</i>	crack willow			•	
<i>Sophora tetraptera</i>	kowhai	•			
<i>Tamarix chinensis</i>	Chinese tamarisk			•	
<i>Ulex europaeus</i>	gorse			•	
<i>Ulmus procera</i>	English elm			•	
<b>Herbs, grasses, sedges, rushes, vines and aquatics</b>					
<i>Alisma lanceolatum</i>	narrow leaved water plantain			•	
<i>Anthoxanthum odoratum</i>	sweet vernal			•	
<i>Aponogeton distachyus</i>	cape pondweed			•	
<i>Asparagus asparagoides</i>	bridal creeper			•	
<i>Azolla filiculoides</i>	pacific azolla		•		
<i>Bolboschoenus fluviatilis</i>	marsh clubrush		•		
<i>Brassica rapa</i>	wild turnip			•	
<i>Bromus diandrus</i>	ripgut brome			•	
<i>Buddleja salviafolia</i>	buddleja			•	
<i>Carex secta</i>	purei	•			
<i>Carex virgata</i>	-	•			
<i>Chrysanthemum leucanthemum</i>	ox-eye daisy			•	
<b>Herbs, grasses, sedges, rushes, vines and aquatics (cont'd)</b>					
<i>Cirsium vulgare</i>	scotch thistle			•	
<i>Clematis paniculata</i>	puawhananga	•			
<i>Clematis vitalba</i>	old man's beard			•	
<i>Conium maculatum</i>	hemlock			•	
<i>Convolvus</i> sp.	bindweed			•	
<i>Conyza floribunda</i>	fleabane			•	
<i>Cortaderia fulvida</i>	toetoe	•			
<i>Cortaderia</i> sp.	pampas grass			•	
<i>Cotula coronopifolia</i>	bachelors button			•	
<i>Dactylis glomerata</i>	cocksfoot			•	
<i>Equisetum arvense</i>	field horsetail			•	
<i>Festuca arundinacea</i>	tall fescue			•	
<i>Foeniculum vulgare</i>	fennel			•	
<i>Fumaria muralis</i>	scrambling fumitory			•	
<i>Galium aparine</i>	cleavers			•	
<i>Hedera helix</i>	English ivy			•	
<i>Juncus effusus</i>	soft rush			•	
<i>Juncus maritimus</i>	sea rush		•		
<i>Lemna minor</i>	duckweed			•	
<i>Lotus corniculatus</i>	birdsfoot trefoil			•	
<i>Lotus pendunculata</i>	lotus			•	
<i>Lupin arboreus</i>	tree lupin			•	
<i>Malva</i> sp.	mallow			•	
<i>Melilotus indica</i>	King Island melilot			•	
<i>Mentha pulegium</i>	pennyroyal			•	
<i>Mimulus repens</i>	Maori musk		•		
<i>Muehlenbeckia australis</i>	pohuehue		•		
<i>Muehlenbeckia complexa</i>	maidenhair vine	•			
<i>Nasturtium officinale</i>	watercress			•	
<i>Oenothera stricta</i>	sand primrose			•	
<i>Parsonsia capsularis</i>	native jasmine	•			
<i>Paspalum distichum</i>	mercer grass			•	
<i>Pastinaca sativa</i>	wild parsnip			•	
<i>Phormium tenax</i>	flax	•			
<i>Picris echioides</i>	oxtongue			•	
<i>Plantago lanceolata</i>	narrow leaved plantain			•	
<i>Potamogeton crispus</i>	curled pondweed			•	
<i>Ranunculus flammula</i>	spearwort			•	
<i>Ranunculus repens</i>	creeping buttercup			•	
<i>Ranunculus trichophyllus</i>	water buttercup			•	
<i>Robinia pseudoacacia</i>	black locust			•	
<i>Rubus fruticosus</i>	blackberry			•	
<i>Rumex conglomeratus</i>	clustered dock			•	
<i>Rumex obtusifolius</i>	broad-leaved dock			•	
<i>Ruppia polycarpa</i>	horse's mane weed			•	
<i>Sisymbrium officinale</i>	hedge mustard			•	
<i>Sonchus</i> spp.	sow thistle			•	
<i>Taraxacum officinale</i>	dandelion			•	
<i>Tradescantia fluminensis</i>	wandering jew			•	
<i>Typha orientalis</i>	raupo		•		
<i>Urtica urens</i>	nettle			•	
<i>Verbascum thapsus</i>	woolly mullein			•	
<i>Veronica anagallis-aquatica</i>	water speedwell			•	
<i>Vicia</i> sp.	vetch			•	
<b>Ferns</b>					
<i>Adiantum cunninghamii</i>	common maidenhair	•			
<i>Asplenium bulbiferum</i>	hen and chicken fern		•		
<i>Asplenium flaccidum</i>	drooping spleenwort		•		
<i>Asplenium oblongifolium</i>	shining spleenwort	•			
<i>Asplenium obtusatum</i>	shore spleenwort		•		
<i>Blechnum chambersii</i>	nini		•		
<i>Blechnum lanceolatum</i>	lance fern			•	
<i>Blechnum minus</i>	swamp kiokio		•		
<i>Blechnum triangularifolium</i>	kiokio	•			
<i>Microsorium pustulatum</i>	hounds tongue fern		•		
<i>Pellaea rotundifolia</i>	button fern	•			
<i>Pneumatopteris pennigera</i>	gully fern		•		
<i>Polystichum richardii</i>	common shield fern	•			
<i>Pteris macilenta</i>	sweet fern	•			
<i>Pteris tremula</i>	tender brake		•		

**Note:** E = Endemic  
 N = Native  
 I = Introduced



**Fauna**

Scientific name	Common name	E	N	I	Scientific name	Common name	E	N	I
<b>Avifauna</b>					<b>Fish</b>				
<i>Anarhynchus frontalis</i>	wrybill	•			<i>Aldrichetta forsteri</i>	yelloweyed mullet		•	
<i>Anas gracilis</i>	grey teal		•		<i>Anguilla australis</i>	shortfin eel		•	
<i>Anas rhynchotis</i>	Australasian shoveler		•		<i>Anguilla dieffenbachii</i>	longfin eel	•		
<i>Anas superciliosa</i>	Pacific black (grey) duck		•		<i>Cheimarrichthys fosteri</i>	torrentfish	•		
<i>Anthonis melanura</i>	bellbird	•			<i>Galaxias brevipinnis</i>	koaro	•		
<i>Anthus novaeseelandiae</i>	New Zealand pipit	•			<i>Galaxias divergens</i>	dwarf galaxias	•		
<i>Ardea alba</i>	great egret (white heron)		•		<i>Galaxias maculatus</i>	inanga	•		
<i>Botaurus poiciloptilus</i>	Australian bittern		•		<i>Gambusia affinis</i>	gambusia			•
<i>Callipepla californica</i>	quail			•	<i>Geotria australis</i>	lamprey		•	
<i>Charadrius bicinctus</i>	banded dotterel	•			<i>Gobiomorphus basalis</i>	crans bully	•		
<i>Charadrius melanops</i>	black-fronted dotterel		•		<i>Gobiomorphus cotidianus</i>	common bully	•		
<i>Charadrius obscurus</i>	New Zealand plover (dotterel)	•			<i>Gobiomorphus gobioides</i>	giant bully	•		
<i>Chrysococcyx lucidus</i>	shining (bronze)-cuckoo		•		<i>Gobiomorphus hubbsi</i>	bluegill bully	•		
<i>Columba livia</i>	rock pigeon			•	<i>Gobiomorphus huttoni</i>	redfin bully	•		
<i>Egretta novaehollandiae</i>	white faced heron		•		<i>Grahamina sp.</i>	estuarine triplefin		•	
<i>Egretta sacra</i>	eastern reef egret (heron)		•		<i>Oncorhynchus mykiss</i>	rainbow trout			•
<i>Falco novaeseelandiae</i>	New Zealand falcon	•			<i>Retropinna retropinna</i>	common smelt	•		
<i>Gerygone igata</i>	grey gerygone (warbler)	•			<i>Rhombosolea retiaria</i>	black flounder	•		
<i>Haematopus finschi</i>	South Island oystercatcher	•			<i>Salmo trutta</i>	brown trout			•
<i>Haematopus unicolor</i>	variable oystercatcher	•			<b>Invertebrates</b>				
<i>Hemiphaga novaeseelandiae</i>	kereru	•			<i>Maaminga marrisii</i>	endemic wasp	•		
<i>Himantopus himantopus</i>	piebald stilt		•		<i>Paranephrops planifrons</i>	freshwater crayfish	•		
<i>Hirundo neoxena</i>	welcome swallow		•		<b>Introduced Mammals</b>				
<i>Larus bulleri</i>	black-billed gull	•			<i>Erinaceus europaeus</i>	European hedgehog			•
<i>Larus dominicanus</i>	black-backed gull		•		<i>Felis catus</i>	feral cat			•
<i>Larus scopulinus</i>	red-billed gull		•		<i>Mus musculus</i>	house mouse			•
<i>Megalurus punctata</i>	New Zealand fernbird	•			<i>Mustela erminea</i>	stoat			•
<i>Morus serrator</i>	gannet		•		<i>Mustela furo</i>	ferret			•
<i>Ninox novaeseelandiae</i>	morepork	•			<i>Mustela nivalisvulgaris</i>	weasel			•
<i>Phasianus colchicus</i>	pheasant			•	<i>Rattus norvegicus</i>	Norway rat			•
<i>Polioccephalus rufopectus</i>	dabchick	•			<i>Rattus rattus</i>	ship rat			•
<i>Porzana pusilla</i>	baillon's (marsh) crake		•						
<i>Porzana tabuensis</i>	spotless crake		•						
<i>Prothemadera novaeseelandiae</i>	tui	•							
<i>Rhipidura fuliginosa</i>	grey fantail		•						
<i>Sterna albobriata</i>	black-fronted tern	•							
<i>Sterna caspia</i>	caspian tern		•						
<i>Sterna striata</i>	white-fronted tern		•						
<i>Tadorna variegata</i>	paradise shelduck		•						
<i>Thinornis novaeseelandiae</i>	shore plover	•							
<i>Todiramphus sanctus</i>	sacred kingfisher		•						
<i>Vanellus miles</i>	spur-winged plover		•						
<i>Zosterops lateralis</i>	silveryeye		•						
<b>Lizards</b>									
<i>Hoplodactylus granulatus</i>	forest gecko	•							
<i>Hoplodactylus maculatus</i>	common gecko	•							
<i>Hoplodactylus pacificus</i>	pacific gecko	•							
<i>Oligosoma lineocellatum</i>	spotted skink	•							
<i>Oligosoma nigriplantare polychroma</i>	common skink	•							



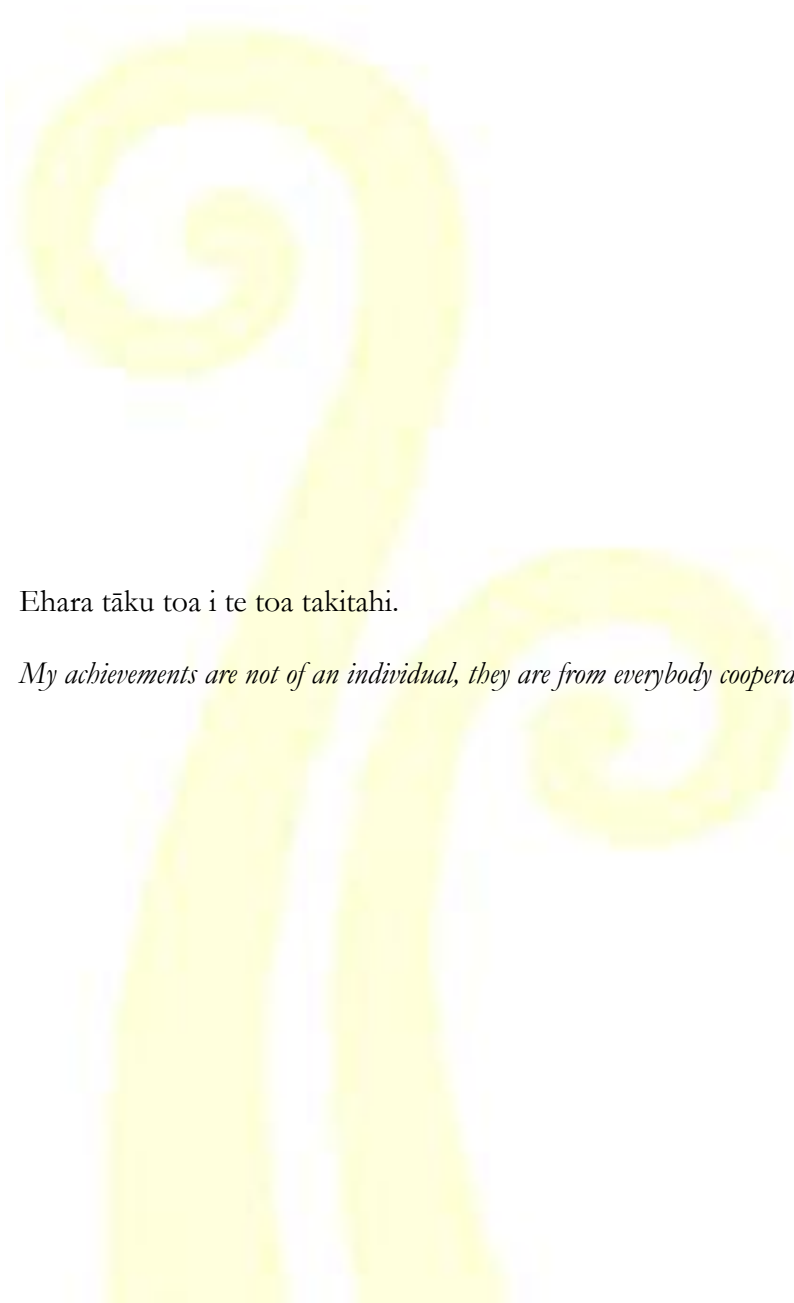
**MWH**

*BUILDING A BETTER WORLD*

## CHAPTER 3 : ECOLOGICAL MANAGEMENT PLAN







Ehara tāku toa i te toa takitahi.

*My achievements are not of an individual, they are from everybody cooperating.*

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# 1 Overview assessment of ecological effects

The operation of the Ngaruroro River flood control and drainage Scheme involves a range of physical activities.

A number of those activities can present actual or potential effects<sup>1</sup> to the ecological values of the Ngaruroro River.

A range of other important influences (e.g. predation by introduced mammals and recreational use of the Scheme area (etc)) affect the ecological values of the Scheme and the wider management area, and are important to the effective ecological management of the river.

As those other influences are unrelated to Council's Scheme, they are highlighted and incorporated in Section 4 of this Chapter, "Ecological Management Issues".

It is important to note that the foremost management priority for the Scheme is 'flood management', that is the protection of human life and property through the design and efficient operation of river and flood control works, and drainage systems. This management plan acknowledges that flood management is of primary importance. However where the demands of flood management allow, the management plan aims to maximise benefits to ecology from Scheme management.

In some cases (see Table 1-1), essential flood management activities have a positive effect on ecological values of the Scheme area. A classic example of this is beach raking, which reduces encroachment of the gravel riverbed by herbaceous plants, thereby assisting in the maintenance of the very important open gravel habitat for river birds. This is an example of how flood control activities and ecological enhancement goals can at times align.

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<sup>1</sup> Both adverse and positive effects are included in the term 'ecological effect'.

Table 1-1 : Overview assessment of ecological effects of the Scheme.

Activity	Summary of Activity	Actual/Potential Ecological Effects	Positive or Adverse Effect
<b>Beach raking</b>	<p>Aims to maintain the flood carrying capacity by maintaining the design profile and removing excessive vegetation growth.</p> <p>Disturbance of river beach armoring through raking, bulldozing or other means to allow for gravel transport and sorting during river freshes, and uprooting and drying of plants of the river gravels before extensive seed release takes place.</p> <p>Occurs on gravel river beaches between Chesterhope and the top of the Scheme near Mangatahi.</p>	Disturbance to specialist river birds; of particular concern during the critical nesting season.	Adverse.
		Removal of refugia (islands and cover from debris and vegetation) for lizards, particularly during floods.	Adverse.
		It is unknown what (if any) effect beach raking has on river channel morphology, in particular pool-riffle sequences and pool morphology. Changes in these features could have potential effects on freshwater fish habitat.	Unknown
		Maintenance of open breeding habitat for specialist river birds, thereby maintaining open gravel substrate for nesting and feeding and reducing cover for introduced mammalian predators around nesting areas.	Positive.
<b>Gravel extraction</b>	<p>Aims to maintain the flood carrying capacity.</p> <p>Carried out in locations where mean riverbed level is above the design bed profile.</p> <p>In some instances carried out to assist with other channel improvements, such as realignment.</p>	Repeated disturbance to river birds at extraction sites and at haulage routes across the riverbed. Of particular concern during their critical nesting period.	Adverse.
		Removal of refugia (islands and cover from debris and vegetation) for lizards. Refugia for lizards is particularly important during floods.	Adverse.
		Release of sediment to river water from extraction activities carried-out on the riverbed, principally excavation/loading, and where hauling routes cross river braids.	Adverse.
		Localised maintenance of open breeding habitat for specialist river birds, thereby maintaining open gravel substrate for nesting and feeding and reducing cover for predators around nesting areas.	Positive.
<b>River mouth opening</b>	<p>Aims to open a blocked river mouth, relocate the mouth to a desirable location, improve drainage of the river mouth or relieve poor water quality in the impounded river.</p>	Disturbance to the significant plant and animal communities and habitat (driftwood and gravels) of the beach by machinery accessing the river mouth, and by placement of the stockpiled gravels excavated from the mouth during the opening operation.	Adverse.
		Opening of the river mouth allows for the passage of freshwater and marine wandering fish between the river and the sea, which is a vital life-history requirement of many of New Zealand's native and endemic freshwater fish.	Positive.
<b>Herbicide application</b>	<p>Pretreatment of flood control planting sites (channel narrowing) or plant pest control on the gravel riverbed.</p> <p>Depending of the scale and location of the area to be covered, herbicide application can be by either land based or aerial vehicle (e.g., backpack sprayer, 4WD tanker or helicopter).</p>	Unintended damage to native plants.	Negative.
		Creation of colonisation sites for early successional plant pests.	Negative.
		Disturbance to river birds by land based or aerial vehicles applying herbicide; of particular concern during the critical nesting season.	Negative.
		Clearing river gravels of prolific plant pest encroachment, thereby maintaining open gravel substrate for nesting and feeding and reducing cover for introduced mammalian predators around nesting areas.	Positive.
<b>Edge retreat</b>	<p>Aims to realign or develop the active river channel to its design width.</p> <p>The river bank and adjacent berm area is physically excavated and removed or allowed to erode during flood events, in order to achieve the channel design width.</p>	Potential for release of sediment to river water.	Negative.
		Potential for loss of native plants if remnant native vegetation is present, or native under-planting or natural colonisation has occurred on the affected river bank or adjacent river berm.	Negative.
<b>Major channel diversion</b>	<p>Involves diversion of the river channel through areas of previous berm area.</p> <p>Likely to involve heavy machinery operation within the active river channel and within the berm area.</p> <p>Likely to involve vegetation clearance and disturbance within the berm area.</p>	Release of sediment to river water.	Negative.
		Disturbance to river birds; of particular concern during the critical nesting season.	Negative.
		Potential for loss of native plants if remnant native vegetation is present, or native under-planting or natural colonisation has occurred within the proposed diversion alignment.	Negative.
<b>Minor channel diversion (temporary or permanent)</b>	<p>Diversions and redirection of the flowing river channel where the diversion path is fully contained within the confines of the active river channel.</p>	Release of sediment to river water.	Negative.
		Disturbance to river birds; of particular concern during the critical nesting season.	Negative.
<b>Grazing</b>	<p>Stock grazing of the river berm.</p>	Nutrient release to the environment from stock faeces and urine. Effects to adjacent aquatic environments, particularly from nitrogen leaching / runoff and bacteria laden surface runoff. Extent of effects dependant on stock management and site variables (e.g., soil type, rainfall, groundwater depth).	Neutral to Negative
		Grazing of native vegetation by uncontrolled stock. Bank instability and erosion. Damage or destruction of marginal vegetation used (or potentially used) by whitebait for spawning by stock grazing, particularly prior to the spawning season.	Negative
		Persistent stock grazing can maintain a grassland community, preventing it from progressing to a vegetation community dominated by woody plant pests (e.g., fennel, lupin, gorse etc). This is a plant pest management technique.	Positive

Activity	Summary of Activity	Actual/Potential Ecological Effects	Positive or Adverse Effect
<b>Edge protection (hard engineering)</b>	Permeable or impermeable groynes.	Intermittent disturbance of the riparian margin from installation and maintenance activities. Potential effects to native plants if under-planting or natural colonisation has occurred within the proposed groyne site.	Negative
<b>Edge protection planting and management</b>	<p>Exotic trees (usually willow) planted adjacent to the active river channel to reduce lateral scour and help confine high velocity flood flows to the main river channel.</p> <p>Maintenance activities include pole planting, tree lopping and layering, and removal of 'over mature' trees.</p> <p>Burning of unwanted tree material from edge protection or buffer zone maintenance.</p>	<p>Provision of forest wildlife habitats and corridors through willow and buffer zone planting.</p> <p>Creation of low diversity forest composition which provides only low habitat diversity and limited food resources for animals. The species of the current edge protection planting lack plants that provide birds and lizards with sources of fruit and nectar. Extensive areas of the current edge protection plantings are therefore unlikely to provide habitat for a diverse community of avifauna and skink or gecko species. Low floral diversity supports only a relatively homogenous invertebrate community.</p> <p>Use of willow species and other exotic trees which have the ability to invade surrounding environments, compounding plant pest problems within and adjacent to the Scheme.</p> <p>Older, larger trees have more tree holes and crevices than younger trees, and these provide an important resource for hole-dwelling animals such as bats, some birds and arboreal geckos. If lizards such as forest gecko or Pacific gecko are present within the Scheme, the removal of older trees is likely to further decrease their abundance. The disturbance to the understorey associated with the replacement of older trees with younger trees may destroy or disturb native under-plantings or natural colonisation of the edge protection planting with native plants.</p> <p>With removal of older trees, the higher light conditions at the forest floor created by the thinning canopy of older trees are less likely to be obtained. This could be a limiting factor for native under-planting of edge protection forests, limiting the viability of plant species with higher light requirements within the edge protection plantings.</p> <p>Decomposing tree trunks provide cover for lizards and substrate and food sources for some invertebrates. The removal of tree trunks from the Scheme is a loss of potential habitat for these animals.</p> <p>Removal of felled trees from the Scheme will decrease the availability of refugia for reptiles, both in cavities between the log and the ground, and if the bark is loose, between the bark and the trunk. The carrying capacity for ground-dwelling lizards such as common skink would be reduced.</p> <p>Riparian plantings of willow can provide some seasonal cover and shading of the water column.</p>	<p>Positive</p> <p>Neutral to adverse</p> <p>Adverse</p> <p>Adverse</p> <p>Neutral to adverse</p> <p>Adverse</p> <p>Adverse</p>
<b>Buffer zone planting</b>	<p>Aims to reduce flood velocities within the berm area, protecting the stopbank system from erosion and failure.</p> <p>Constitutes planting mainly of willows, poplars and alders in the area of the berm between the landward edge of the live edge protection and the stopbank.</p> <p>Trees are arranged in a variety of formats, from widely spaced individual trees to small forest groves of continuous canopy cover.</p>	<p>The tall growing trees of the treelands and small forest groves provide some additional structural diversity within the Heretaunga Plains.</p> <p>Makes some contribution to the wildlife corridor values of the live edge protection plantings.</p> <p>Creation of low diversity forest composition which provides a small variety of habitat diversity and food resources. The species of the buffer zone planting lack plants that provide birds and lizards with sources of fruit and nectar.</p> <p>Use of willow species and other exotic trees which have the ability to invade surrounding environments, compounding plant pest problems within and adjacent to the Scheme.</p> <p>Older, larger trees have more tree holes and crevices than younger trees, and these provide an important resource for hole-dwelling animals such as bats, some birds and arboreal geckos. If lizards such as forest gecko or Pacific gecko are present within the Scheme, the removal of older trees is likely to further decrease their abundance.</p> <p>Decomposing tree trunks provide cover for lizards and substrate and food sources for some invertebrates. The removal of tree trunks from the Scheme is a loss of potential habitat for these animals.</p> <p>Removal of felled trees from the Scheme will decrease the availability of refugia for reptiles, both in cavities between the log and the ground, and if the bark is loose, between the bark and the trunk. The carrying capacity for ground-dwelling lizards such as common skink would be reduced.</p>	<p>Positive</p> <p>Positive</p> <p>Adverse</p> <p>Adverse</p> <p>Adverse</p> <p>Adverse</p>
<b>Plant pest control</b>	<p>Control of plant pests which present a threat to the Scheme integrity, and meet the obligations of the HBRC Regional Plant Pest and Animal Pest Management Strategy (RPPAPS) on Council owned land.</p> <p>In addition to the plant pest requirements set out in the RPPAPS, Council controls the following plants:</p> <ul style="list-style-type: none"> <li>• broom;</li> <li>• buddleia;</li> <li>• climbing spindleberry;</li> <li>• fennel;</li> <li>• tree lupin; and</li> <li>• pampas.</li> </ul>	<p>Positive effects derived from control of plant pests.</p> <p>Misguided herbicide application can kill or otherwise damage native plants.</p> <p>Bare earth resulting from herbicide application by spray may create reinvasion sites where propagules from the sprayed species, or another species of plant pest will reestablish.</p> <p>Damage or destruction by herbicide application of marginal vegetation used (or potentially used) by whitebait for spawning, particularly prior to their spawning season.</p>	<p>Positive</p> <p>Adverse</p> <p>Adverse</p> <p>Adverse</p>
<b>Diversification of edge protection plantings with native plant species</b>	Under-planting of live edge protection forests and diversification of buffer zone plantings with native species.	Ecological benefits derived from improved habitat diversity and functional benefits.	Positive



## 2 Ecological management vision

The ecological management vision for the management area is:

*The Ngaruroro River provides habitat as part of a functioning wildlife corridor between the mountains and the sea, and serves as an important biodiversity refuge, where common and threatened native plants and animals thrive.*

## 3 Ecological management goals

This management plan seeks to achieve the following goals. Note that the planning of the enhancement elements of many of these goals is contained within the enhancement plan (Chapter 4) of this document.

### 3.1 Fauna

#### 3.1.1 Birds

1. Protect birds reliant on the gravel riverbed habitat from Scheme operations on the riverbed; particularly during their critical nesting season when their reproductive success can be adversely affected.
2. Minimise impacts to the river bird community by recreationalists using the riverbed within the Scheme area.
3. Specifically protect and enhance known nesting sites used by threatened species such as black-billed gulls and South Island oystercatcher from disturbance associated with Scheme activities, plant pest encroachment, recreational use and predation by introduced mammals.
4. Create additional habitat for threatened specialist wetland birds.
5. Manage Scheme operations within the coastal beach area so that associated important bird values (nesting, brood rearing and roosting) are protected from avoidable disturbance.
6. Protect the important bird populations associated with the coastal beach from avoidable disturbance caused by recreationalists accessing the beach.
7. Further diversify the existing edge protection and buffer plantings, and create additional habitat 'stepping stones' to improve the Scheme's terrestrial bird habitat and its functional value as a wildlife corridor.

#### 3.1.2 Lizards

8. Off-set the loss of lizard habitat caused by riverbed management and edge protection planting through specific management for lizards at the 'Terrace Escarpment' native forest remnant (near Ohiti). This will include protection from stock grazing and intensive predator control and monitoring.
9. Enhance lizard populations and their habitat within the Scheme area of the coastal gravel beach through mammalian predator control and exclusion of unauthorised vehicle access on the gravel beach.

## 3.2 Flora

1. Protect, and where appropriate actively enhance, native forest and shrubland remnants located within the Scheme area.
2. Further diversify the existing edge protection plantings, and buffer zone plantings with native and non-invasive exotic species to achieve a more resilient edge protection composition and improve its ecological functioning.
3. Allow for some natural re-colonisation of native flora on the coastal gravel beach by preventing public vehicle access onto the beach, thereby reducing the existing disturbance of the beach.
4. Develop and implement a comprehensive strategy for the containment of old man's beard, Japanese honeysuckle, blackberry and gorse within the Scheme, in accordance with the Regional Pest Management Strategy requirements<sup>2</sup>.
5. Develop and implement a strategy for the control of tree lupin within the Ngaruroro riverbed and margins between the Whanawhana/McIndoe Flat area (including seed sources on the surrounding hill country) and the coast at Waitangi.
6. In conjunction with 5 above, investigate and address soil stability issues which might be caused by the removal of tree lupin from hill country around the Whanawhana area.

## 3.3 Habitats

1. Through best practice gravel extraction operation and site management, minimise the release of sediments to river water and aquatic habitats from gravel extraction activities.
2. Manage Scheme operations within the coastal beach area so the gravel beach habitat values are protected from avoidable disturbance.
3. Protect and where appropriate actively manage the existing native vegetation communities within the Scheme.
4. Maintain a less vegetated riverbed habitat through planned and strategic control of tree lupin.
5. Establish additional native forest and wetland habitats.
6. Enhance the Scheme's functional performance as a wildlife corridor.

# 4 Ecological management issues

Table 4-1 below presents a summary of ecological management issues as they relate to the Scheme operation. The Table also includes ecological management issues which are only indirectly linked, or are unrelated, to Scheme activities and yet important to the overall ecological management of the Scheme area.

To the right of the table, each management action is shown to be addressed by either the management plan (this Chapter) or the enhancement plan (Chapter 4).

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<sup>2</sup> HBRC, 2006.

**Table 4-1 : Ecological management issues of the Scheme.**

Management Issue	Management Action	Management Plan	Enhancement Plan
<b>Active River Channel</b>			
Reduced gravel riverbed habitat quality due to plant pest infestations.	<b>Targeted plant pest control at high value riverbed sites:</b> plant pest clearance at the black-billed gull nesting site will be carried out prior to and following their nesting season, to provide good quality open riverbed habitat while avoiding disturbance during their nesting and brood-rearing season.	✓	✓
	<b>Tree lupin infestation of the riverbed:</b> undertake a discrete study of the effect of tree lupin on habitat use of river birds to determine the likely long term benefits and specific objectives of tree lupin (or other weed) control.	-	✓
	Develop and implement short and long term strategies for the control of tree lupin within the river corridor.		
Predation of nesting black-billed gulls by introduced mammalian predators.	<b>Mammalian predator control at the high value riverbed site:</b> undertake an ongoing programme of mammalian predator control in conjunction with long term monitoring of the local nesting population size of the black-billed gull colony located near Mangatahi.	-	✓
Disturbance of river bird communities.	<b>Provide level of protection relative to values:</b> ecological management zones will be created to provide a framework to set rules to control the disturbance to river birds from Scheme activities according to the spatial distribution of river bird values.	✓	-
	<b>River user education:</b> an informative leaflet on river birds will be produced and issued to freshwater fishers, jet boaters, gravel extractors and beach rake operators at the time of permit/licensing or will be otherwise circulated. The leaflet will aim to raise awareness of river birds and in particular, issues driving their decline towards extinction. The campaign will include contact with landowners adjacent to critical nesting sites to confirm and raise their awareness of the issues faced.	-	✓
Release of sediment to river water from beach raking, gravel extraction/hauling, and channel diversions.	<b>Communication, monitoring and enforcement of best practice methods:</b> best practice methods to minimise sediment release to river water shall be communicated to extraction operators. Their performance in adhering to those best practice methods shall be monitored and enforced.	✓	-



Management Issue	Management Action	Management Plan	Enhancement Plan
Herbicide use for pretreatment of flood control planting sites (channel narrowing) or plant pest control on the gravel riverbed.	<p><b>Prevention of spray damage and overspray:</b> only suitably certified<sup>3</sup> spray operators shall apply herbicide within the Scheme area.</p> <p><b>Other control methods:</b> non-spray methods of herbicide application, or other methods such as mechanical control, shall be deployed around sensitive sites where spray application presents a likely risk of unintended damage or where it will provide recolonisation sites thereby promoting the reinvasion of plant pests.</p> <p><b>Auditing:</b> spray operations carried out around sensitive sites (e.g., native revegetation sites or native vegetation remnants) shall be periodically audited for competency of application with a particular focus on avoidance of damage to non-target plant specimens.</p> <p><b>River bird disturbance:</b> ecological management zones apply specific rules where river birds may be disturbed by land based or aerial operations applying herbicide; which is of particular concern during the critical nesting season.</p>	✓	-
<b>Coastal Gravel Beach</b>			
Disturbance of the coastal gravel beach habitat and related fauna and flora.	<p><b>Mechanical rivermouth opening:</b> authorised vehicle movements associated with rivermouth opening will be limited to single routes, and will take care to avoid unnecessary disturbance to the gravel beach and its nesting birds.</p> <p><b>Control of vehicle access:</b> unauthorised vehicle access to the gravel beach shall be prevented, this avoiding vehicle disturbance of the gravel beach habitat and its important flora and fauna.</p>	✓	-
Predation of native fauna (lizards, birds and invertebrates) by introduced mammalian predators on the coastal gravel beach.	<b>Introduced mammalian predator control:</b> contribute to and expand on the existing programme of predator control which is underway on the gravel beach and adjacent wetland complex.	✓	✓

<sup>3</sup> GROWSAFE<sup>®</sup> qualification is a suitable level of certification.

Management Issue	Management Action	Management Plan	Enhancement Plan
<b>River Berms</b>			
Sustainability of river berm management.	<b>Actual and perceived effects of stock access to waterways:</b> stock will be prevented from accessing the Ngaruroro River main channel within the Scheme area.	✓	-
	<b>Nutrient leaching from stock urine and faeces deposited on the river berm:</b> for representative areas of all berm reaches currently leased for stock grazing, sustainable stocking rates shall be calculated and made a condition of lease.	-	✓
	<b>Conversion of pasture to wetland:</b> silt extraction downstream of Chesterhope shall be carried out and finished in a manner where shallow water wetlands are created, suitable to provide areas of open water and support rushes, sedges and raupo beds, as detailed in the enhancement plan of Chapter 4.	-	✓
	<b>Protection of existing important native vegetation features:</b> formalised management zones protect important native vegetation from Scheme activities.	✓	-
	Other mechanisms such legal protection, stock proof fencing, plant and/or animal pest control, buffering and diversification by enrichment planting (or other methods) shall be prioritised and undertaken as described in the enhancement plan contained in Chapter 4.	-	✓
	<b>Wetland creation:</b> in addition to creation of wetlands on the floodplain downstream of Chesterhope, other areas of the river berm will be converted into wetland, in particular to provide habitat for the threatened bird species outlined in Chapter 2, and as detailed in the enhancement plan of Chapter 4.	-	✓
	<b>Diversification of vegetation:</b> edge and buffer protection plantings shall continue to be diversified with native and non-invasive exotic species, as detailed in the enhancement plan of Chapter 4.	-	✓
	<b>Establishment of terrestrial 'habitat islands':</b> habitat islands <sup>4</sup> shall be created to improve the Scheme's functioning as a wildlife corridor, as detailed in the enhancement plan of Chapter 4.	-	✓
	<b>Wide scale revegetation of river berms:</b> trialing and eventual application of wide scale indigenous revegetation of berm areas.	-	✓
<b>Woody debris retention:</b> woody debris originating from vegetation maintenance within the buffer zone will be retained where practical and will be incorporated as debris piles in revegetation plantings as appropriate.	-	✓	

<sup>4</sup> In this context, 'habitat islands' are planted areas on the river berm which are specifically designed to provide year-round resources and habitat for a range of animals.

Management Issue	Management Action	Management Plan	Enhancement Plan
Low diversity edge protection and buffer zone plantings.	<b>Susceptibility to pests and diseases:</b> edge protection and flood control plantings of low species diversity will be the subject of a programme of diversification using native plant species as underplantings.	-	✓
	<b>Native edge protection:</b> at low risk sites, and in conjunction with hard engineering treatments, native plantings will be trialed at the live edge, where willows would normally be used.	-	✓
	<b>Improved biodiversity values:</b> native underplanting, habitat islands and wide scale native revegetation techniques will be trialed and deployed to increase the complexity and diversity of vegetation communities and their habitat values of the buffer zone.	-	✓
Edge protection ('hard' and 'live' edge protection).	<b>Edge protection at/near ecologically sensitive sites:</b> ecological management zones will control the physical works associated with the installation and maintenance of hard engineering edge protection works within ecologically sensitive sites.	✓	-
	Where necessary, edge protection will be used to protect ecological sites on the river berm from erosion.	✓	✓
Plant pest control.	<b>HBRC Regional Plant Pest and Animal Pest Management Strategy:</b> the HBRC will meet its obligations under the Regional Plant and Animal Pest Management Strategy (2006).	-	✓
	<b>In addition to the obligations under the Regional Pest Management Strategy (2006):</b> continue to control the spread of the following plant pests: <ul style="list-style-type: none"> <li>• broom;</li> <li>• buddleia;</li> <li>• climbing spindleberry;</li> <li>• fennel;</li> <li>• tree lupin; and</li> <li>• pampas.</li> </ul>	-	✓



## 5 Ecological management objectives, methods and monitoring

### 5.1 Management of the active river channel

#### 5.1.1 River beach raking

##### 5.1.1.1 Objectives

1. Time beach raking to provide open riverbed habitat for river bird breeding while avoiding disturbance to breeding river birds.
2. Use ecological management zones to provide varying levels of protection of riverbed habitat according to the spatial arrangement and level of river bird values along the river.
3. Minimise the release of sediments to river water by beach raking activities.
4. Minimise the risk of introduction and spread of plant pests between beach raking sites.
5. Minimise the potential for contamination of the riverbed by refuelling or fuel storage.
6. Undertake research to investigate the effect of beach raking on river channel morphology.

##### 5.1.1.2 Methods

**Beach raking management zones:** all beach raking shall be carried out in accordance with the following riverbed management zones:

- “*gravel riverbed management zone, beach raking*” (below); and
- “*black-billed gull/South Island oystercatcher management zone*” (see Section 5.4.1).

**Research the effect of beach raking on river channel morphology:** research is needed to determine the effect of beach raking on river channel morphology.

### Gravel riverbed management zone, beach raking.

#### *Riverbird disturbance:*

- a) Between Chesterhope Road Bridge and Fernhill Road Bridge, no beach raking shall be undertaken between the 1<sup>st</sup> of September and the 30<sup>th</sup> of November each year.
- b) Between the Fernhill Road Bridge and the downstream boundary of the black-billed gull/South Island oyster catcher management zone, no beach raking shall be undertaken between the 1<sup>st</sup> of August and the 27<sup>th</sup> of February each year.
- c) Beach raking within the “*black-billed gull/South Island oystercatcher management zone*” shall be planned and carried out in accordance with the restrictions imposed by the rules of that management zone, which are described in Section 5.4.1.

*Continued*

*Timing of beach raking zone rules:*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a)												
b)												

*Note: shading denotes months when rules 'a)' and 'b)' apply.*

*Release of sediments to river water:*

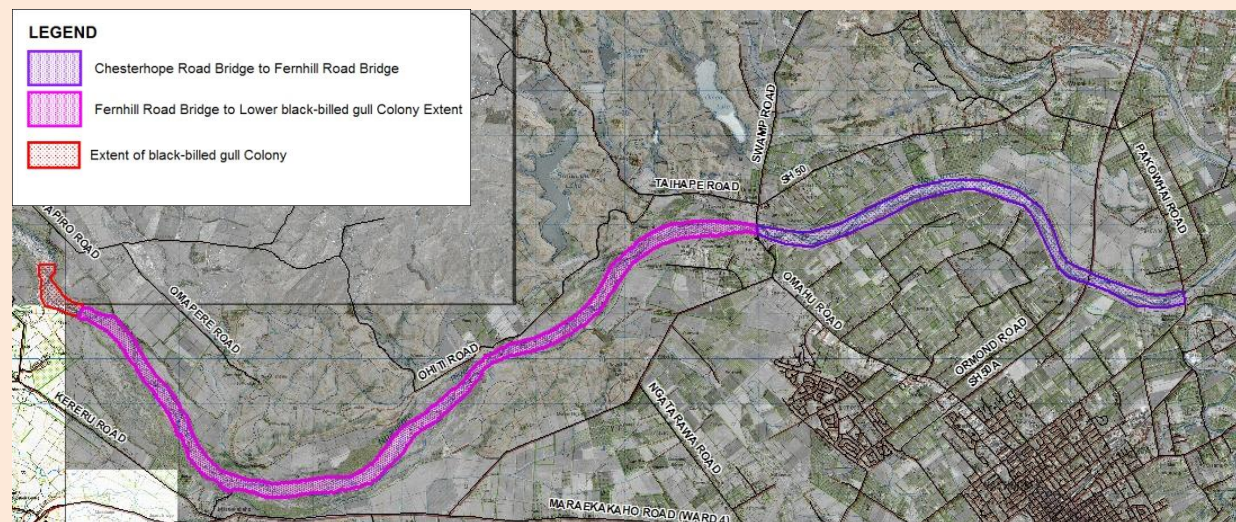
- d) Beach raking shall be no closer than 0.5 metres of actively flowing channels.
- e) Crossing of actively flowing channels shall be avoided when possible, and the number of crossings shall be otherwise minimised.

*Plant pest propagule spread:*

- f) All machinery shall be free of plants and plant seeds prior to use in the riverbed.
- g) Machinery and equipment that has worked in a watercourse shall, prior to entering and leaving that water course, be cleaned with suitable chemicals or agents to kill didymo.
- h) At no time shall machinery be washed within the bed of a watercourse.

*Refuelling outside of the riverbed:*

- i) All practicable measures shall be undertaken to prevent oil and fuel leaks from vehicles and machinery. There shall be no storage of fuel or refuelling of vehicles and machinery within 20 metres of the bed of a river.



## 5.1.2 Gravel extraction

### 5.1.2.1 Objectives

1. Use ecological management zone rules to protect the critical black-billed gull and South Island oystercatcher nesting area from extraction and associated physical activities.
2. Provide protocols for avoiding impacts to nesting birds at new and periodically inactive gravel extraction sites and riverbed haulage routes.
3. Minimise release of sediment to river water during commercial gravel extraction, gravel haulage across the riverbed and other associated activities.
4. Minimise the risk of introduction and spread of plant pests via machinery to and from extraction sites.
5. Minimise the potential for contamination of the riverbed by refuelling or fuel storage.
6. Undertake research to investigate the effect of gravel extraction on river channel morphology.

### 5.1.2.2 Methods

**Gravel extraction in accordance with relevant riverbed ecological management zones:** gravel extraction shall be carried out in accordance with the:

- “*gravel riverbed management zone, commercial gravel extraction*” (below); and
- “*black-billed gull/South Island oystercatcher management zone*” (see Section 5.4.1).

**Research the effect of gravel extraction on river channel morphology:** research is required to determine the effect of gravel extraction on river channel morphology.

### Gravel riverbed management zone, commercial gravel extraction.

*River bird disturbance at new or recently inactive gravel extraction sites:*

- a) Before any mechanical gravel extraction works being carried out in the river reaches during the periods listed and mapped below, the following actions should be undertaken:
  - I. between Chesterhope Road Bridge and Fernhill Road Bridge during the period 1<sup>st</sup> of September to 30<sup>th</sup> of November, or
  - II. between Fernhill Road Bridge and the downstream boundary of the black-billed gull/ South Island oystercatcher management zone during the period 1<sup>st</sup> of August and the 27<sup>th</sup> of February.
    - a. An inspection of the proposed area of works by a suitably qualified ecologist, no earlier than ten working days prior to any works being carried out, to locate any bird breeding sites of the following bird species, and any other river bird species listed in the current DoC threat classification system as “*threatened*” :



banded dotterel



black-billed gull

*Continued*





black-fronted dotterel



South Island oystercatcher

- a. The same person should then prepare a written report that identifies all the located bird breeding or nesting sites and provide copies of that report to the HBRC and the extraction operator.
  - b. Any person carrying out physical works in the area should be informed of any bird breeding or nesting site locations.
  - c. No physical works or machinery movements should be undertaken within 200 metres of birds which are nesting or rearing their young in the bed of the river.
  - d. Where gravel work ceases for more than 10 days, the site will be re-inspected for bird breeding or nesting sites in accordance with 'a.' to 'd.' above.
- b) During the period 1<sup>st</sup> of August to 27<sup>th</sup> of February inclusive, no gravel extraction or associated activities shall be carried out within the “*Black-billed gull/South Island oystercatcher management zone*”. Refer to Section 5.4.1 for the rules of that management zone.

*Timing of gravel extraction zone rules:*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a) I.												
a) II.												

*Note: shading denotes months when rule 'a)' 'I.' and 'II.' apply.*

*Gravel extraction, operation and access management:*

- c) No commercial gravel extraction plant shall be operated in flowing water.
- d) Gravel extraction shall not disturb flowing water.
- e) Where extraction intersects standing water, all reasonable measures shall be undertaken to prevent sediment release to flowing water.
- f) Material rejected from the extraction process shall not be disposed of in wetlands or backwaters.
- g) The gravel extraction operator shall clear vegetation from the extraction site before gravel is extracted.

*Plant pest propagule spread:*

- h) The gravel extraction operator shall take all reasonable steps to ensure all machinery is free of plants and plant seeds prior to use in the riverbed, and again prior to relocation between extraction sites.
- i) Machinery that has been used in South Island waterways within the previous 24 month period shall at no time enter or be used within the riverbed.

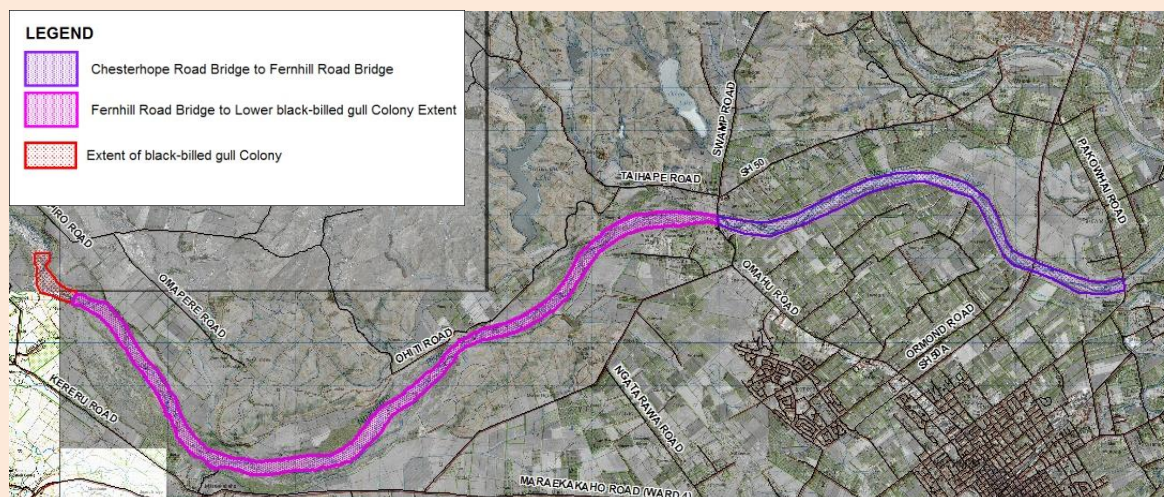
*Continued*

- j) Machinery and equipment that has worked in a watercourse shall, prior to entering and leaving the site, be cleaned with suitable chemicals or agents to kill didymo.
- k) At any one time a single haulage route across the riverbed shall be selected and clearly marked, and all haulage and other vehicle access to/from the extraction area shall be via that single route.
- l) Access routes to extraction points shall be planned so as not to cut-off flow into minor channels or backwaters.
- m) To avoid repeated disturbance and sediment release within the aquatic environment where access routes cross secondary river braids the gravel extraction operator should discuss options for installation of temporary culverts with the HBRC Gravel Management Supervisor.

*Contaminant management:*

- n) All practicable measures shall be undertaken to prevent oil and fuel leaks from vehicles and machinery.
- o) There shall be no storage of fuel or refuelling of vehicles and machinery within 20 metres of the riverbed.
- p) At no time shall machinery be washed within the bed of a watercourse.
- q) In the event of any contamination of the watercourse by fuel or oil the gravel extraction operator shall remove the contaminants immediately from the site and notify, without undue delay, the HBRC (Tel. 0800 108 838).

*Gravel riverbed management zone, distinction between river bird disturbance reaches:*



### 5.1.2.3 Monitoring

A suitably experienced HBRC staff member shall undertake at least one audit per year of all gravel extraction operations which are active within the Scheme area. That audit shall follow the guidance and standard gravel extraction audit form contained in Appendix 'B' of this ecological management plan.

### 5.1.3 Herbicide application on the riverbed

#### 5.1.3.1 Objectives

1. Provide a rationale for deciding when herbicide use on the riverbed is appropriate.
2. Use ecological management zone rules to avoid disturbance to river birds during their critical nesting season from the physical disturbance associated with herbicide application.
3. Monitoring the accuracy and effectiveness of herbicide application to ensure intended benefits are achieved.
4. Use herbicide as a tool for maintaining nesting habitat within the black-billed gull/South Island oystercatcher management zone.

#### 5.1.3.2 Methods

**Use of management zones to control the timing of herbicide application on the riverbed:** all herbicide application within the black-billed gull/South Island oystercatcher management zone shall be carried out in accordance with the rules of that zone (see Section 5.4.1).

Other herbicide application on the riverbed shall be carried out in accordance with the rules of the “*gravel riverbed management zone, herbicide application*” (below).

**Herbicide as a habitat enhancement tool:** the enhancement plan contained in Chapter 4 details the use of herbicide as a tool for enhancing the breeding habitat, in particular for black-billed gull.

#### Gravel riverbed management zone, herbicide application.

*Herbicide vs. non-herbicide plant pest control methods:*

- a) Herbicide use shall be limited to areas where it is not practical, effective or economical to carry out manual or other methods of weed control, or where non-herbicide methods would likely result in unacceptable disturbance to breeding river birds.

*The following protocols shall guide spray application of herbicide:*

- Guidance set out in the New Zealand Novachem Agrichemical Manual, GROWSAFE<sup>®</sup> protocols, rules and best practice guidance provided in the HBRC Regional Resource Management Plan and Environmental Code of Practice for River Control and Drainage Works.
- Spray operators shall hold a current GROWSAFE<sup>®</sup> and approved handlers qualification relevant to the type of application task (e.g., aerial application etc);
- Where possible, drift control additives, spray guards and low-drift foam nozzles are to be used to minimise the possibility of drift.

*Minimise disturbance to riverbed birds from herbicide application, in particular from ground based spraying:*

- b) Between Chesterhope Road Bridge and the Fernhill Road Bridge, ground based spraying should be avoided between the period 1<sup>st</sup> of September and the 30<sup>th</sup> of November each year.
- c) Between the Fernhill Road Bridge and the downstream boundary of the black-billed gull management zone, ground based spraying should be avoided between the period 1<sup>st</sup> of August and the 31<sup>st</sup> December each year.

*Continued*



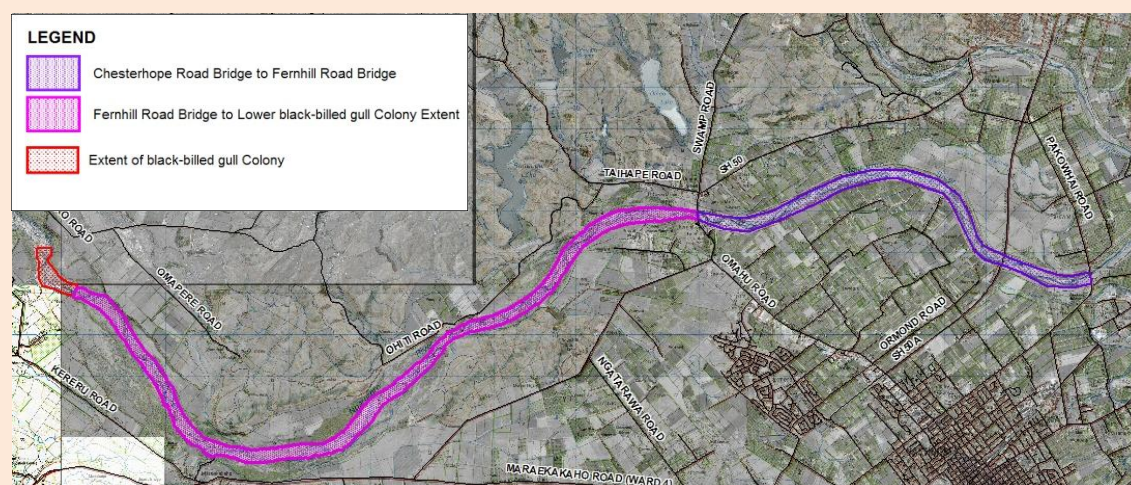
- d) When for drainage and flood control purposes, aerial and/or ground based herbicide application within the black-billed gull/South Island oystercatcher management zone shall be planned and carried out in accordance with the restrictions imposed by the rules of that management zone, which are described in Section 5.4.1.

*Timing of ground based spraying zone rules:*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
b)												
c)												

*Note: shading denotes months when rules 'b)' and 'c)' apply.*

*Gravel riverbed management zone, distinction between river bird disturbance reaches:*



### 5.1.3.3 Monitoring

Where significant areas of herbicide applications are undertaken on the riverbed, the area should be revisited six to ten weeks following application to assess the efficiency of kill against the objective of the spray operation.

### 5.1.4 Edge retreat and channel diversion works

#### 5.1.4.1 Objectives

1. Minimise the release of sediment to river water from edge retreat and channel diversion works.
2. Minimise the disturbance to breeding river birds from edge retreat and channel diversion works.

#### 5.1.4.2 Methods

**Edge retreat and channel diversions in accordance with relevant riverbed ecological management zones:** all edge retreat and channel diversions shall be carried out in accordance with the:

- “*gravel riverbed management zone, edge retreat and channel diversions*” (below); and
- “*black-billed gull/South Island oystercatcher management zone*” (see Section 5.4.1).

### Gravel riverbed management zone, edge retreat and channel diversions.

*River bird disturbance at edge retreat and channel diversion sites:*

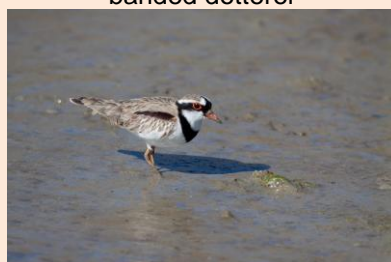
- a) Before any mechanical works being carried out on the riverbed in the river reaches during the periods listed and mapped below, the following actions should be undertaken:
  - I. between Chesterhope Road Bridge and Fernhill Road Bridge during the period 1<sup>st</sup> of September to 30<sup>th</sup> of November, or
  - II. between Fernhill Road Bridge and the downstream boundary of the black-billed gull/South Island oystercatcher management zone during the period 1<sup>st</sup> of August and the 27<sup>th</sup> of February.
    - a. An inspection of the proposed area of works by a suitably qualified ecologist to locate any bird breeding sites of the following bird species, and any other river bird species listed in the current DoC threat classification system as “*threatened*”:



banded dotterel



black-billed gull



black-fronted dotterel



South Island oystercatcher

*Continued*

- b. Any person carrying out physical works in the area should be informed of any bird breeding or nesting site locations.
- c. No physical works should be undertaken within 200 metres of birds which are nesting or rearing their young in the bed of the river.
- d. The physical works shall commence on site no more than 10 days following the time of inspection described in 'a.' above. Where more than 10 days lapse, the site should be re-inspected and 'b.' and 'c.' above reapplied as required.

b) During the period 1<sup>st</sup> of August to 27<sup>th</sup> of February inclusive, no edge retreat or channel diversions shall be carried out within the “*Black-billed gull/South Island oystercatcher management zone*”. Refer to Section 5.4.1 for the rules of that management zone. However, where these works must proceed during the nesting season as a matter of emergency, protocols 'a.', 'b.', 'c.' and 'd.' above shall be adhered to as far as is practicable.

*Timing of edge retreat and channel diversion zone rules:*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a) I.												
a) II.												

*Note: shading denotes months when rules 'a)' 'I' 'II' apply.*

*Edge retreat and channel diversions, operation and access management:*

- c) Wherever possible, machinery shall be operated from dry riverbed, rather than within flowing river water.
- d) Where extraction intersects water, all reasonable measures shall be undertaken to minimise sediment release to flowing water.
- e) Material rejected from the excavations associated with these works shall not be disposed of in wetlands or backwaters.

*Plant pest propagule spread:*

- f) Machinery shall be free of plants and plant seeds prior to use in the riverbed.
- g) Machinery and equipment that has worked in a watercourse shall, prior to entering and leaving the site, be cleaned with suitable chemicals or agents to kill didymo.
- h) At no time shall machinery be washed within the bed of a watercourse.



## 5.2 Management of the coastal gravel beach

### 5.2.1 Disturbance from machinery access for river mouth opening

#### 5.2.1.1 Objective

Avoid unnecessary disturbance to the gravel beach habitat, flora and fauna, in particular to breeding black-billed gulls and white fronted terns, and also banded dotterel by machinery entering the gravel beach for river mouth opening.

#### 5.2.1.2 Methods

**Access to the gravel beach for river mouth opening in accordance with the coastal beach management zone rules:** access to the beach for this purpose shall be carried out in accordance with the coastal beach management zone rules (below).

**Information supplied to key staff and operators:** provide key HBRC staff and contractors with information and any other required training on identification of these birds, their nesting habits and some background information on their current threatened status.

### 5.2.2 Exclusion of vehicle access onto the gravel beach

#### 5.2.2.1 Objective

Reduce disturbance to gravel beach habitat, flora and fauna by preventing public vehicle access onto the gravel beach.

#### 5.2.2.2 Methods

**Access to the gravel beach by private vehicles prevented:** a permanent fence or similar barrier structure shall be erected and maintained on an ongoing basis to prevent public vehicle access to the gravel beach.

### 5.2.3 Introduced mammalian predator control

#### 5.2.3.1 Objective

Control introduced mammalian predators on the gravel beach to reduce predation on breeding birds as well as predation on lizards and invertebrates.

#### 5.2.3.2 Methods

**Ecological enhancement plan (Chapter 4):** the enhancement plan presents details for the control of mammalian predators on the gravel beach.

### Coastal beach management zone.

*Access for river mouth opening:*

- a) Vehicles accessing the gravel beach for river mouth opening purposes shall adhere to a single path for their return trip and will avoid areas which are (at the time of the visit) suspected to be used by the following birds for breeding:

*Continued*



banded dotterel



black-billed gull



white fronted tern

To help with compliance with 'a)' above, breeding occurs during the following periods for each species:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Banded dotterel												
Black-billed gull												
White fronted tern												

*Note: shading denotes months where breeding of the respective bird species is likely to occur.*

*Restricted vehicle access onto the gravel beach:*

- b) HBRC will construct and maintain a permanent fence or similar barrier structure to prevent public vehicle access onto the gravel beach.

*Introduced mammalian predator control:*

- c) Introduced mammalian predator control shall be carried out in accordance with the ecological enhancement plan (see Chapter 4).

*Indicative extent of coastal beach management zone:*



Note that the actual river mouth location varies considerably over time.

## 5.3 Management of the river berm

### 5.3.1 Sustainable river berm management

#### 5.3.1.1 Objectives

1. Prevent stock access to the active river channel from adjacent grazing leases.
2. Use a stock nutrient budget to determine sustainable stocking rates in order to avoid adverse nutrient leaching to groundwater.
3. Plan and coordinate silt extraction downstream of Chesterhope to create sustainable areas of shallow water riverine wetland.
4. Prioritise existing wetlands for enhancement.
5. Create discrete areas of wetland habitat for use by threatened and common bird species.
6. Protect existing significant native vegetation from disturbance from Scheme activities and from other agents of adverse effects.
7. Establish a strategy for mixed native/exotic revegetation of the Scheme's berm areas to enhance the Scheme's functioning as habitat and as a wildlife corridor.
8. Use of woody debris in the revegetation strategy to enhance terrestrial habitat quality.
9. Protection and management of whitebait spawning habitat.

#### 5.3.1.2 Methods

**Prevention of stock access to the active river channel:** stock access to the reach of the Ngaruroro River (mainstem) within the Scheme shall be prevented in accordance with the relevant rule of the river berm management zone (below).

**Sustainable stocking rates and nutrient leaching:** stocking rates for lease areas within the Scheme shall be calculated in accordance with the method described in the enhancement plan (Chapter 4). Stocking rates on all lease areas shall not exceed the calculated stocking rate for that zone.

**Prioritisation of existing wetlands for enhancement:** Chapter 4 provides a priority list of existing wetlands for enhancement, and details the enhancement measures to be undertaken for each wetland. Existing wetland enhancement projects are prioritised along with all other ecological enhancement proposals.

**Creation of new wetland habitat for use by threatened and common bird species:** Chapter 4 provides a description of wetland creation projects which have specific objectives of providing habitat for threatened birds (e.g., Pacific grey duck (nationally critical), Australasian bittern (nationally endangered), dabchick (nationally vulnerable), spotless and marsh crakes (at risk)) as well as common wetland bird species. Wetland creation projects are prioritised along with all other ecological enhancement proposals.

**Protection and/or management of existing native vegetation:** existing native vegetation within the Scheme shall be protected and/or managed in accordance with the rules of the "*native vegetation management zone*" and in accordance with the enhancement activities for those zones as set out in Chapter 4.

**Development and implementation of an ecological revegetation strategy for the Scheme:** the enhancement plan (Chapter 4) sets out the revegetation strategy for the Scheme, and describes each stage of the strategy as discrete projects, which are prioritised against the other ecological enhancement projects. The strategy sets out a plan for three key initiatives, being:



1. diversification of edge protection and buffer zone plantings;
2. establishment of terrestrial 'habitat islands';
3. wide scale revegetation of river berms.

**Incorporation of woody debris into revegetation areas:** terrestrial habitats of the revegetation strategy will be enhanced by incorporation of woody debris into revegetation areas. The specific methods of this enhancement activity are described in Chapter 4.

**Protection and/or management of whitebait spawning habitat:** whitebait spawning habitat shall be managed in accordance with the whitebait spawning habitat management zone rules contained in Section 5.4.3.

### River berm management zone.

*Prevention of stock access from the berm to the active river channel:*

- a) Within areas of the Scheme held under grazing lease, stock shall be prevented from accessing the Ngaruroro River mainstem.

*Sustainable stocking rates and nutrient leaching:*

- b) Maximum stocking rates shall be calculated based on nutrient release and those stocking rates shall then be imposed on each grazing lease. The method for calculating maximum stocking rates is detailed in the enhancement plan (Chapter 4).

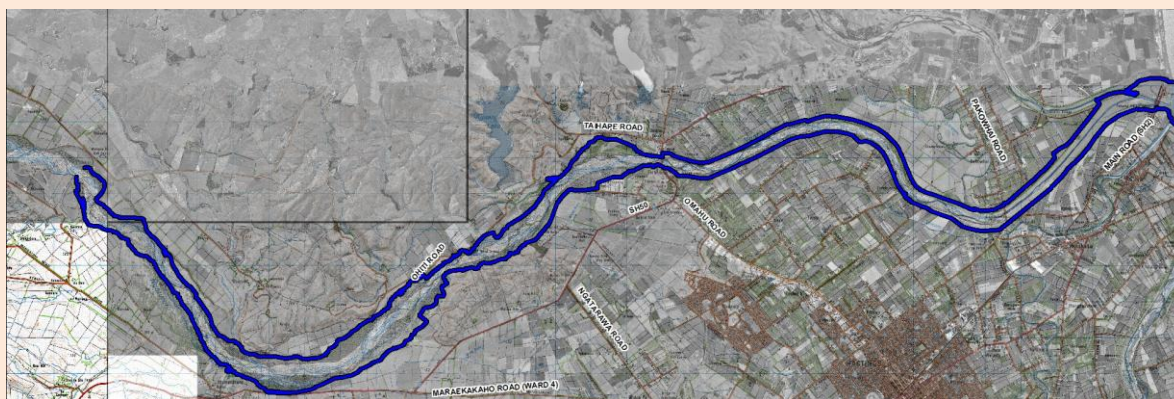
*Shallow water riverine wetland creation:*

- c) Where silt extraction forms part of the wetland creation proposal(s) described in Chapter 4, silt extractors shall be instructed on the pattern (depth, length and width) of silt excavation in order to achieve the majority of the excavation required for wetland creation.

*Protection of native vegetation and whitebait spawning habitat:*

- d) Areas of existing native vegetation covered by the "native vegetation management zone" or the "whitebait spawning habitat management zone" shall be protected and/or managed under the regimes set out by the rules of those zones (see Section 0), and in accordance with any enhancement activities for those features which are set out in Chapter 4.

*Longitudinal extent of river berm management zone:*



#### 5.3.1.3 Monitoring

Grazing leases shall be periodically monitored to ensure stock are prevented from accessing the Ngaruroro mainstem, and that the stocking rates developed for each leased area are not exceeded. HBRC staff shall check the integrity of fencing around whitebait areas throughout the year on an ongoing basis.

### 5.3.2 Edge protection at ecologically sensitive sites

#### 5.3.2.1 Objectives

1. Protect 'ecologically sensitive sites'<sup>5</sup> from disturbance associated with the installation and maintenance of 'live' and/or 'hard' edge protection works.
2. Protect ecologically sensitive sites from disturbance associated with river bank erosion by strategic use of 'live' and/or 'hard' edge protection treatments.

#### 5.3.2.2 Methods

**Carry out edge protection works in accordance with the rules of relevant management zones:** edge protection works around ecologically sensitive sites shall be carried out in accordance with the rules of the corresponding management zone (e.g., "*native vegetation management zones*" or "*whitebait spawning management zones*").

**Edge protection to protect ecologically sensitive sites:** where river erosion presents a threat of damage to an ecologically sensitive site, edge protection treatments will be selected on a site specific-basis to protect the site as far as is practicable.

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<sup>5</sup> In this context "*ecologically sensitive sites*" are those sites located on the river berm which are covered by a 'values specific management zone' (see Section 0) or are existing ecological features which have been prioritised for enhancement in Chapter 4. In addition, as new areas of revegetation or wetland creation are undertaken, those areas shall also be regarded as "*ecologically sensitive sites*".

### 5.3.3 Herbicide application on the river berm

#### 5.3.3.1 Objectives

1. Provide a rationale for deciding when herbicide use on the river berm is appropriate and promote use of 'non-spray' methods of herbicide application where spray application poses a likely risk of unintended damage or where it will provide recolonisation sites for plant pests.
2. Require best practice application methods, and use ecological management zone rules to prevent damage to non-target plants from overspray and spray damage, particularly native revegetation plantings and those areas of native vegetation covered by management zones.
3. Avoid disturbance by aerial herbicide application on the river berms adjacent to the black-billed gull/South Island oystercatcher management zone during their critical nesting season, as described in the rules of that management zone (see Section 5.4.1).
4. Monitor the accuracy and effectiveness of herbicide application to ensure intended benefits are achieved.

#### 5.3.3.2 Methods

**Use of management zones to guide and control herbicide application on the river berms:** herbicide application on the river berm shall be carried out in accordance with the rules of the "*river berm management zone, herbicide application*". In addition, all herbicide application within the following management zones shall comply with the corresponding rules:

- "*native vegetation management zones*" (see Section 5.4.2);
- "*whitebait spawning management zones*" (see Section 5.4.3).

#### River berm management zone, herbicide application.

*Herbicide vs. non-herbicide plant pest control methods:*

- a) Herbicide use shall be limited to areas where it is not practical, effective or economical to carry out manual or other methods of weed control, or where non-herbicide methods would likely result in unacceptable disturbance to breeding river birds on adjacent areas of gravel riverbed.

*Controls on herbicide application within the river berm:*

- b) Herbicide application within the river berm shall be carried out in accordance with the following protocols:
  - Guidance set out in the New Zealand Novachem Agrichemical Manual, GROWSAFE® protocols, rules and best practice guidance provided in the HBRC Regional Resource Management Plan and Environmental Code of Practice for River Control and Drainage Works.
  - Spray operators shall hold a current GROWSAFE® and approved handlers qualification relevant to the type of application task (e.g., aerial application etc);
  - Where possible, drift control additives, spray guards and low-drift foam nozzles are to be used to minimise the possibility of drift;
  - Where plant pests are growing on, or in close proximity to, edge protection or native plant specimens, other herbicide or manual control methods should be considered and adopted as appropriate.

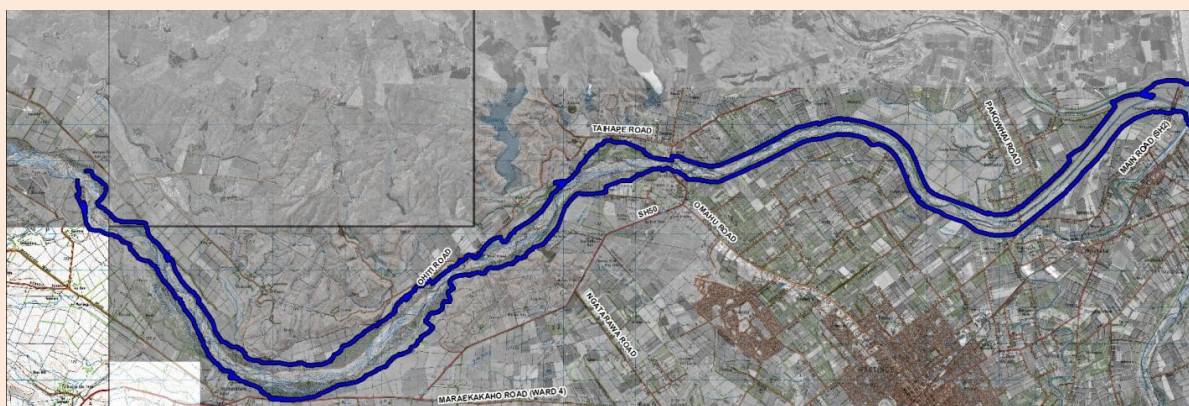
*Continued*



*Avoid disturbance to black-billed gulls from herbicide application on adjacent areas of river berm:*

- c) Any aerial herbicide application on the river berms adjacent to the black-billed gull management zone shall be planned and carried out in accordance with the restrictions imposed by the rules of the black-billed gull/South Island oystercatcher management zone, which are described in Section 5.4.3.
- d) A suitably experienced HBRC staff member shall undertake at least one audit per year of the quality of spray work of all herbicide applicators which are active within the Scheme area during that year.

*Extent of river berm management zone:*



### 5.3.4 Educational material

#### 5.3.4.1 Objectives

1. Inform freshwater fishers, jet boaters, gravel extractors, beach rake operators, river mouth opening contactors/staff, and other relevant staff and contractors of the significance of the gravel riverbed as habitat for specialist river birds, and measures they can take to minimise impacts to birds during their activities on the river.
2. Inform landowners adjacent to the black-billed gull colony of the ecological significance of the area as habitat for the nesting black-billed gull and also South Island oyster catcher, banded dotterel and black-fronted dotterel.

#### 5.3.4.2 Methods

**Information leaflets:** prepare information leaflet(s) suitable for freshwater fishers, jet boaters, gravel extractors, and beach rake operators which can be issued at the time of permit/licensing or otherwise circulated to raise awareness of the following key aspects:

- The gravel riverbed as a scarce and specialist habitat type which is used by specific river bird species.
- The threatened status of many of the birds reliant on river gravels as habitat, in particular for breeding.
- Current threats to the survival of the threatened river bird species.
- The national significance of Hawke's Bay region's braided river habitats for river birds.
- The time/duration and corresponding river reaches when breeding river birds are most sensitive to disturbance.
- What level of disturbance may cause nesting failure.
- Facts on how each of the above river users can minimise impacts to river birds during their activities on the river.

Such information leaflets should be compiled in collaboration between HBRC, DoC and Fish and Game.

**Landowner visits:** visit landowners adjacent to the black-billed gull/South Island oystercatcher management zone and have an informal discussion to confirm their existing level of awareness and where necessary raise awareness of the important bird values of the river corridor adjacent to their properties, and raise the profile of threats posed to river birds by users of the river bed.

## 5.4 Values specific management zones

### 5.4.1 Black-billed gull/South Island oystercatcher management zone

#### 5.4.1.1 *Management zone objective*

Sustainably manage the 49ha of braided riverbed which surrounds the current (i.e., at any given time) breeding colony of the threatened and nationally endemic black-billed gull (nationally endangered). Sustainable management of this area of riverbed also benefits the endemic South Island oyster catcher (at risk), which have a history of nesting on the riverbed in the Mangatahi area.

Management in this area focuses on mitigating threats to breeding success, such as physical disturbance to breeding birds, degraded breeding habitat quality, and impacts of predation by introduced mammalian predators.

#### 5.4.1.2 *Management zone rules*

Note that many of the operational details of the management zone rules are described in detail in the enhancement plan comprising Chapter 4.



## Black-billed gull/South Island oystercatcher management zone (49ha).

### *Black-billed gull and South Island oystercatcher disturbance control:*

- a) No flood control Scheme operations (e.g., beach raking, gravel extraction, herbicide application via aerial or ground based sprayer etc.) shall take place between the 1<sup>st</sup> of August and the 27<sup>th</sup> of February each year.
- b) Where aerial herbicide application on the river berms adjacent to this management zone is required during the period 1<sup>st</sup> August to 27<sup>th</sup> February, aerial operations shall avoid flight passes over this management zone area.
- c) In the event that flood control Scheme operations are required within this management zone during the exclusion periods set out in a) and b) above, a suitability qualified and experienced ecologist should undertake an assessment of effects of the proposed activity on the nesting success of nesting/fledging river birds (in particular black-billed gulls and South Island oystercatchers) within the 49ha management zone area, and provide a written report to HBRC detailing the possible effects to nesting/fledging of those birds.

The activity in question should only proceed if the ecologist's report concludes that there would be no effects on breeding river birds from the proposed activity.

### *Riverbed habitat quality:*

- d) Clearance of plant pests from the riverbed within this management zone shall be carried out twice annually, once during April (beach rake) and a second time in July (herbicide).

### *Introduced mammalian predator control:*

- e) Intensive control of hedgehog, cat, rat and mustelid populations shall take place between 1<sup>st</sup> of May and the 31<sup>st</sup> of January inclusive.

### *Monitoring:*

- f) Monitoring of colony location, population size, breeding success and predator control efficiency shall be undertaken in accordance with the enhancement plan of Chapter 4.

*Continued*

*Timing of black-billed gull/South Island oystercatcher management zone rules:*

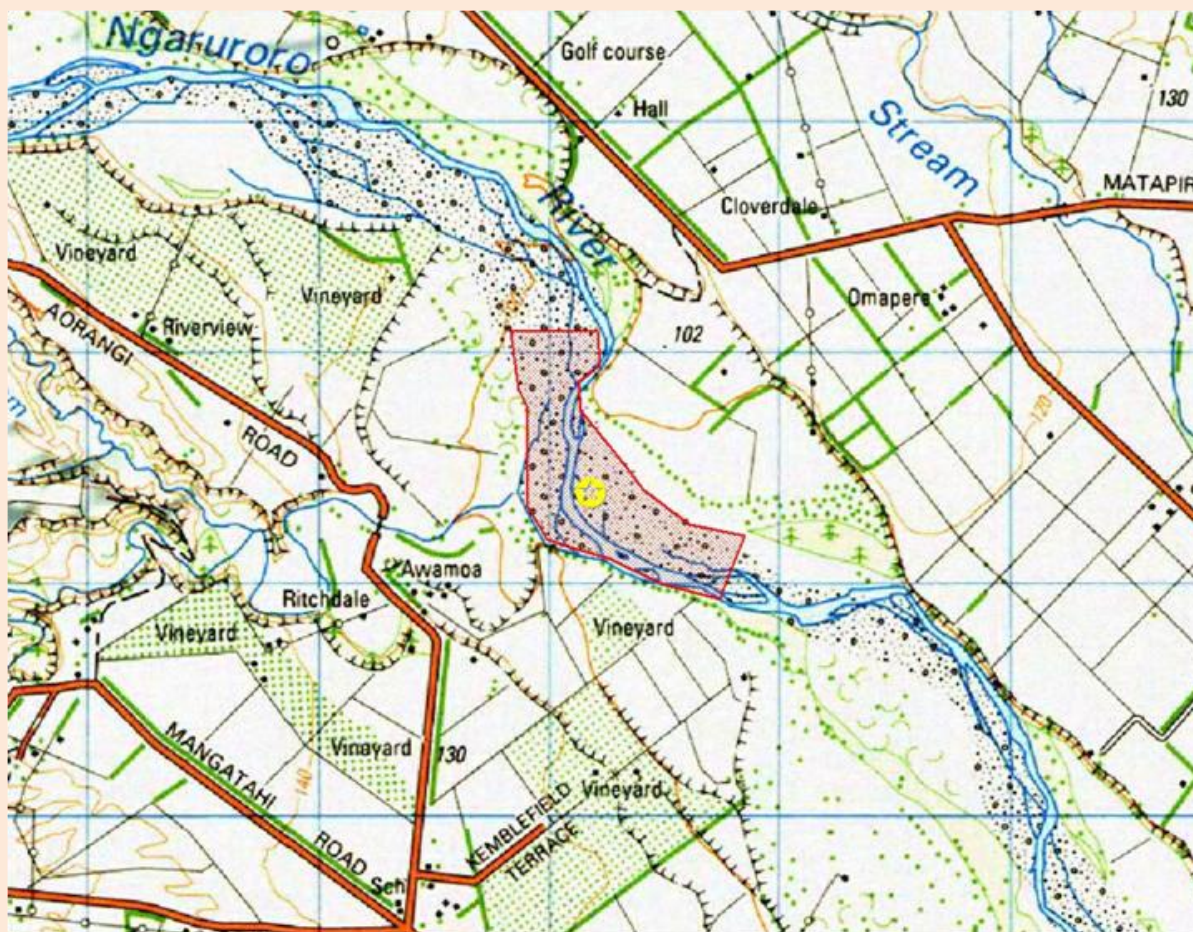
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a), b)												
d)												
e)												

Note: shading denotes months when rules a), b), d) and e) apply.

*Black-billed gull/South Island oystercatcher management zone boundary coordinates (NZTM and NZMG coordinate formats):*

New Zealand Transverse Mercator		
Up-river extent:	1907063.9E	5610444.7N
Down-river extent:	1907787.1E	5609339.5N
2009/2010 colony location:	1907214.2E	5609749.3N
New Zealand Map Grid		
Up-river extent:	2817047.857E	6172087.101N
Down-river extent:	2817770.065E	6170982.477N
2009/2010 colony location:	2817197.836E	6171392.181N

Black-billed gull/South Island oystercatcher management zone extent (red shading) and 2009/2010 breeding colony location (yellow circle/star icon). Note the actual colony location may vary from season to season.



## 5.4.2 Native vegetation management zones

### 5.4.2.1 Management zone objective

Protect and/or manage important native vegetation features within the berm areas and riparian margins of the Scheme.

This objective aims to avoid impacts to native vegetation from Scheme activities. Plans for dealing with other potentially impacting influences, such as stock access and animal pests, along with specific enhancement actions are described in Chapter 4.

### 5.4.2.2 Management zone rules

#### Native vegetation management zones.

*Scheme activities:*

- a) No physical works associated with Scheme activities (e.g., edge protection works, edge retreat, channel diversions) shall be carried out within the native vegetation management zones without consultation with, and approval by, a suitably qualified and experienced ecologist.

*Herbicide application:*

- b) Herbicide use is to be limited to areas where it is not practical, effective or economical to carry out manual or other methods of weed control.
- c) Herbicide application protocols.
  - Guidance set out in the New Zealand Novachem Agrichemical Manual, GROWSAFE® protocols, rules and best practice guidance provided in the HBRC Regional Resource Management Plan and Environmental Code of Practice for River Control and Drainage Works.
  - Spray operators shall hold a current GROWSAFE® and approved handlers qualification relevant to the type of application task (e.g., aerial application etc);
  - Where possible, drift control additives, spray guards and low-drift foam nozzles are to be used to minimise the possibility of drift;
  - Where plant pests are growing on, or in close proximity to, native plant specimens, other herbicide or manual control methods should be considered and adopted as appropriate.
- d) A suitably experienced HBRC staff member shall undertake at least one audit per year of all herbicide applicators which are active within the Scheme area. The accuracy of the spray application with particular regard to avoidance of damage to non-target plant species shall be the key focus of the audit.

*Other protection and enhancement:*

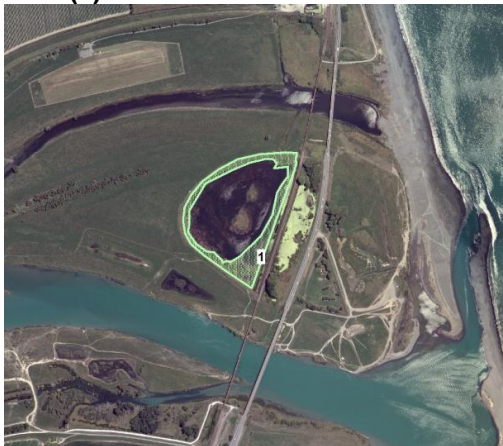
- e) Specific protection and enhancement activities within these management zones are described in full in the enhancement plan, Chapter 4.

Native vegetation management zone areas are shown below.





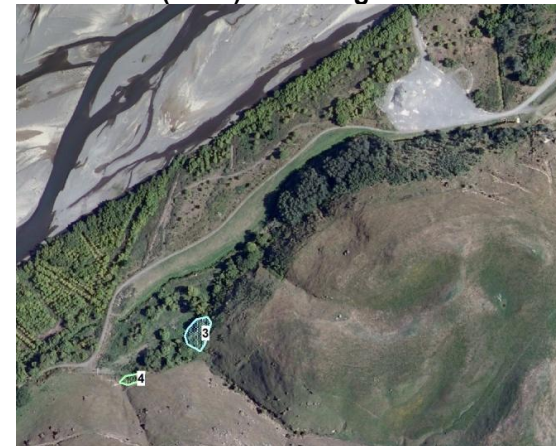
(1) “The Horseshoe Wetland”



(2) “Ohiti Bluff”



(3 & 4) “Recharge 1”





(5) "Recharge 3"



(6) "Turret 1"



(7) "Turret Escarpment", (8) "Higgins Point", (9) Native shrubland, (10) "Higgins 1"





(11 & 12) "Kommeren 3 and 4"



(13) Alexander's native shrubland, (14) "Alexander's 1", (15) "Alexander's 2"





### 5.4.3 Whitebait spawning management zones

#### 5.4.3.1 Management zone objective

Protect and/or manage the critical spawning habitat used by the groups of freshwater fish collectively termed 'whitebait'.

#### 5.4.3.2 Management zone rules

### Whitebait spawning management zones.

*DoC consultation prior to physical Scheme activities:*

- a) Scheme activities within the whitebait management zones shall not be undertaken without prior consultation with staff of the Department of Conservation, Napier.

*Control of grazing animals:*

- b) Known whitebait spawning areas shall be fenced, and that fencing shall be maintained, so as to prevent uncontrolled access by grazing animals.

*Prevention of unplanned disturbance:*

- c) Fences required by b) above shall also be sufficient to prevent damage by people or access by uncontrolled animals to vegetation used by whitebait for spawning.
- d) Signage shall be installed at prominent locations at the boundaries of whitebait spawning areas informing visitors of the importance of vegetation in the area as spawning habitat for whitebait.

*Active management of whitebait spawning habitat:*

- e) Any controlled grazing, spraying, mowing or other weed clearance is to be undertaken during the period July to December. Only light disturbance shall occur during January and February. Spawning areas shall not be disturbed during the period of March to June.

*Timing of whitebait spawning management zone rules:*

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
e)	Main habitat maintenance												
	Light disturbance only												
	No disturbance allowed												

*Note: shading denotes months when rule 'e)' applies.*

*Continued*

*Extent of whitebait management zones:*







## Appendix A: References

HBRC (2006). Hawke's Bay Regional Pest Management Strategy. Napier, Hawke's Bay Regional Council.



## **Appendix B: Gravel extraction audit form**



## HBRC Commercial Gravel Extraction Audit Form

Auditor name:	Date:	Time:
Extraction company name:	Location name:	
Site contact person:	GPS coordinates (NZTM):E	N

Activity for assessment	Compliance	Comments
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### River bird disturbance at new or recently inactive gravel extraction sites

***Check whether the process described in 'a)' below has been complied with.***

- a) Before any mechanical gravel extraction works being carried out in the river reaches during the periods listed below, the following actions should be undertaken:
- I. between Chesterhope Road Bridge and Fernhill Road Bridge during the period 1st of September to 30th of November, or
  - II. between Fernhill Road Bridge and the downstream boundary of the black-billed gull/ South Island oystercatcher management zone during the period 1st of August and the 27th of February.
    - a. An inspection of the proposed area of works by a suitably qualified ecologist, no earlier than ten working days prior to any works being carried out, to locate any bird breeding sites of the following bird species, and any other river bird species listed in the current DoC threat classification system as "threatened" :



**banded dotterel**



**black-billed gull**



**black-fronted dotterel**



**South Island oystercatcher**

- b. The same person should then prepare a written report that identifies all the located bird breeding or nesting sites and provide copies of that report to the HBRC and the extraction operator.
- c. Any person carrying out physical works in the area should be informed of any bird breeding or nesting site locations.
- d. No physical works or machinery movements should be undertaken within 200 metres of birds which are nesting or rearing their young in the bed of the river.
- e. Where gravel work ceases for more than 10 days, the site will be re-inspected for bird breeding or nesting sites in accordance with 'a.' to 'd.' above.

YES

NO

### Describe corrective actions required

Activity for assessment	Compliance		Comments
<b>Extraction within black-billed gull/South Island oystercatcher management zone</b>			
<p><i>Check that any works undertaken within this specific management zone, comply with clause 'b)' below.</i></p> <p>b) During the period 1st of August to 27th of February inclusive, no gravel extraction or associated activities shall be carried out within the <i>"Black-billed gull/South Island oystercatcher management zone"</i>. Refer to Section 5.4.1 of the Ngaruroro River Flood Protection and Drainage Scheme Ecological Management and Enhancement Plan (March, 2011) for the specific parameters of that management zone.</p>	YES	NO	
<b>Describe corrective actions required</b>			

Activity for assessment	Compliance		Comments
<b>Gravel extraction, operation and access management</b>			
<p><i>Check operator's compliance with clauses 'c)' to 'g)' below (inclusive).</i></p> <p>c) No commercial gravel extraction plant shall be operated in flowing water.</p>	YES	NO	
<p>d) Gravel extraction shall not disturb flowing water.</p>			
<p>e) Where extraction intersects standing water, all reasonable measures shall be undertaken to prevent sediment release to flowing water.</p>			
<p>f) Material rejected from the extraction process shall not be disposed of in wetlands or backwaters.</p>			
<p>g) The gravel extraction operator shall clear vegetation from the extraction site before gravel is extracted.</p>			
<b>Describe corrective actions required</b>			

Activity for assessment	Compliance		Comments
<b>Plant pest propagule spread</b>			
<i>Check operator's compliance with clauses 'h) to 'm)' below (inclusive).</i>	YES	NO	
h) The gravel extraction operator shall take all reasonable steps to ensure all machinery is free of plants and plant seeds prior to use in the riverbed, and again prior to relocation between extraction sites.			
i) Machinery that has been used in South Island waterways within the previous 24 month period shall at no time enter or be used within the riverbed.			
j) Machinery and equipment that has worked in a watercourse shall, prior to entering and leaving the site, be cleaned with suitable chemicals or agents to kill didymo.			
k) At any one time a single haulage route across the riverbed shall be selected and clearly marked, and all haulage and other vehicle access to/from the extraction area shall be via that single route.			
l) Access routes to extraction points shall be planned so as not to cut-off flow into minor channels or backwaters.			
m) To avoid repeated disturbance and sediment release within the aquatic environment where access routes cross secondary river braids the gravel extraction operator should discuss options for installation of temporary culverts with the HBRC Gravel Management Supervisor.			
<b>Describe corrective actions required</b>			

Activity for assessment	Compliance		Comments
<b>Contaminant management</b>			
<i>Check operator's compliance with clauses 'n) to 'q)' below (inclusive).</i>	YES	NO	
n) All practicable measures shall be undertaken to prevent oil and fuel leaks from vehicles and machinery.			
o) There shall be no storage of fuel or refuelling of vehicles and machinery within 20 metres of the riverbed.			
p) At no time shall machinery be washed within the bed of a watercourse.			
q) In the event of any contamination of the watercourse by fuel or oil the gravel extraction operator shall remove the contaminants immediately from the site and notify, without undue delay, the HBRC (Tel. 0800 108 838).			
<b>Describe corrective actions required</b>			





**MWH**

*BUILDING A BETTER WORLD*

## CHAPTER 4 : ECOLOGICAL ENHANCEMENT PLAN





Hutia te rito o te pū harakeke, kei whea te kōmako e kō?

*A plea for conservation – if you destroy the flax plant, from where will the bellbird sing?*

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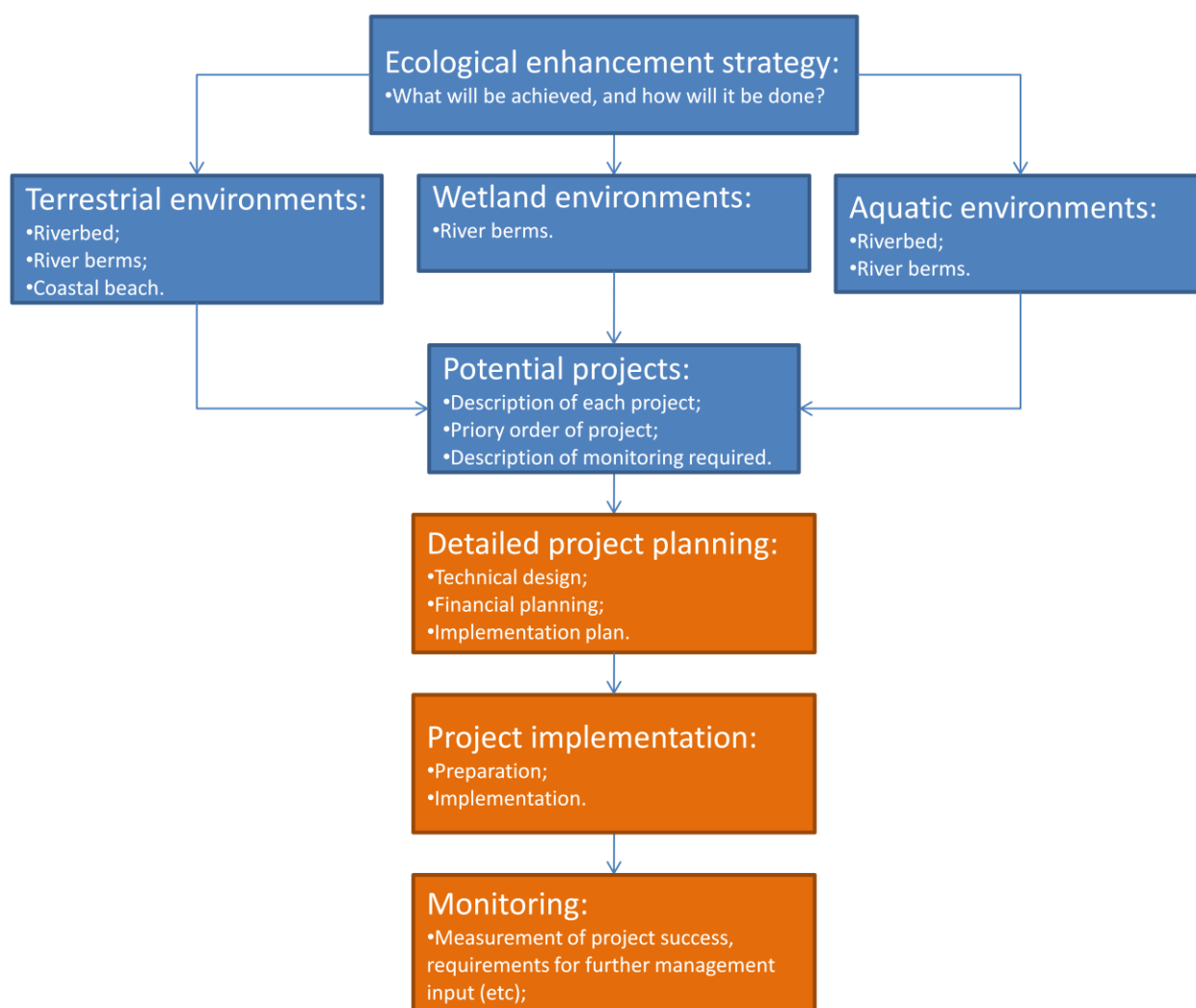
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# 1 Enhancement Plan

This chapter of the EMEP sets out what HBRC aims to achieve through specific enhancement projects and initiatives, and how those aims can be realised.

The projects outlined in this enhancement plan are derived from both the management actions outlined in Chapter 3 (see summary in Table 4-1, Chapter 3) and from 'stand alone' projects which aim to enhance the ecological integrity of the management area.

The enhancement plan structure is shown in Figure 1-1. Boxes coloured blue represent material contained within this document. Orange boxes represent further stages of the enhancement planning process which are needed in order to realise specific projects.



**Figure 1-1 : Broad structure of this enhancement plan relative to the overall project implementation process.**

## 1.1 What is meant by ecological 'enhancement'

Various terms can be used to describe actions which are undertaken to improve the quality or quantity of some characteristics of a site or area (see Appendix B for a list of terms endorsed by the DoC<sup>1</sup>). This document broadly uses the term 'enhancement' to describe the overall range of activities proposed to achieve various improvements in quality or quantity of some characteristics of a site or area. At the project specific level terms from DoC's definitions may be more appropriately used.

## 1.2 Principles leading enhancement

### Principle One: Adoption of 'national priorities'

- Central Government<sup>2</sup> has declared four national priorities for protecting rare and threatened species on private land, namely:

*Priority 1. Protection of indigenous vegetation associated with land environments that have 20% or less remaining in indigenous cover.*

*Priority 2. Protection of indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.*

*Priority 3. Protection of indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by '1' or '2' above.*

*Priority 4. Protection of habitats of acutely and chronically threatened indigenous species.*

The management area is contained almost exclusively within land environments containing <20% indigenous cover (see Appendix C). It contains wetland ecosystems, and the coastal gravel beach at Waitangi meets the criteria of an 'originally rare' ecosystem. The management area also contains habitats of 'Threatened' (and 'At Risk') indigenous species.

On this basis Central Government's four national priorities are extremely relevant to decisions and prioritisation of enhancement actions within the management area. Management actions taken in accordance with those four priorities contribute to, and are consistent with, urgent biodiversity management initiatives being carried out across New Zealand.

- The New Zealand Biodiversity Strategy<sup>3</sup> sets out four 'goals', the first three of which are directly relevant to the ecological resources of the management area:

*Goal one. Enhance community and individual understanding about biodiversity, and inform, motivate and support widespread and coordinated community action to conserve and sustainably use biodiversity.*

*Goal two. Actively protect iwi and hapu interests in indigenous biodiversity, and build and strengthen partnerships between government agencies and iwi and hapu in conserving and sustainably using indigenous biodiversity.*

*Goal three. Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and do what else is necessary to maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity.*

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<sup>1</sup> Atkinson, 1994.

<sup>2</sup> MfE, 2007.

<sup>3</sup> Biodiversity NZ, 2000.



Many of the ecological features of the management area coincide with recreational, cultural or commercial users. Community understanding will be key to avoiding significant adverse effects to specific ecological values (e.g. the black-billed gull colony on the riverbed at Mangatahi). Ecological enhancement actions are proposed on Maori owned land immediately adjacent to the river at Ohiti (Turret Escarpment), and it is hoped that activities such as this will strengthen partnerships between HBRC and iwi/hapu.

High priority enhancement actions are proposed for remaining degraded natural habitats and ecosystems to restore ecosystem function and enhance critically scarce habitats (e.g. wetlands and native vegetation cover). Actions are proposed to restore viability to populations of indigenous species; this will by default maintain their genetic diversity.

#### **Principle Two: Recognition of ecological context at the local scale**

- Recognition of native biodiversity that should be protected at a regional or local scale because it is locally or regionally rare, threatened or valued by that community.
- Ecosourcing is a local response to the global issue of biodiversity decline<sup>4</sup>, and involves sourcing native plants from wild grown local seed for local use. The Ecological District scale should be the largest scale used when ecosourcing for this project.

#### **Principle Three: Consideration and enhancement of ecological values at varying scales**

- Ecological processes operate at varying scales. For example, the important native seed dispersing birds kereru, tui and bellbird travel on a seasonal basis over considerable distances across the landscape, relying on a wide network of suitable habitat. These mobile species, therefore, benefit from habitat planning at the landscape scale, such as provision of 'wildlife corridors' and habitat 'stepping stones'.
- Site or individual specimen scale. Sites such as a bird colony or a remnant stand of native forest can contain important species and/or genetic diversity values and enhancement actions operating at this scale can safeguard those values and improve the ecological viability of the ecological resource.

#### **Principle Four: A functional ecology approach**

- The default enhancement goal will be to create healthy functioning ecological systems. Healthy functioning ecological systems will become self-sustaining over time, with the demand for management inputs also reducing.
- Not just native! In today's environment many introduced species fulfil important ecological functions (e.g. Australian and South African winter flowering trees providing a winter nectar source for nectarivorous and insectivorous birds). Enhancement plans will embrace and utilise non-native (non-invasive) species where they provide a valued ecological function.

#### **Principle Five: Multiple-value outcomes**

- Enhancement actions will be planned and implemented with the view to achieve, where appropriate, outcomes which improve not just ecological values but also cultural, recreational, heritage and landscape values.

#### **Principle Six: Effective prioritisation of enhancement projects**

- This plan ranks enhancement projects in priority order. Factors informing the priority ranking are largely derived from the above 'Principles', and include:

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<sup>4</sup> Ferkins, 2005.

- Protection and enhancement of existing sites over creation of new sites.
- Ability to achieve outcomes consistent with 'Principle One – national priorities' and 'Principle Two – ecological context at the local scale'.
- Ability to achieve outcomes at multiple ecological scales (Principle Three).
- The ability to create or restore healthy functioning ecosystems which will overtime become self-sustaining and require little ongoing management inputs (Principle Four).
- The ability to achieve multiple value outcomes from enhancement efforts (Principle Five).

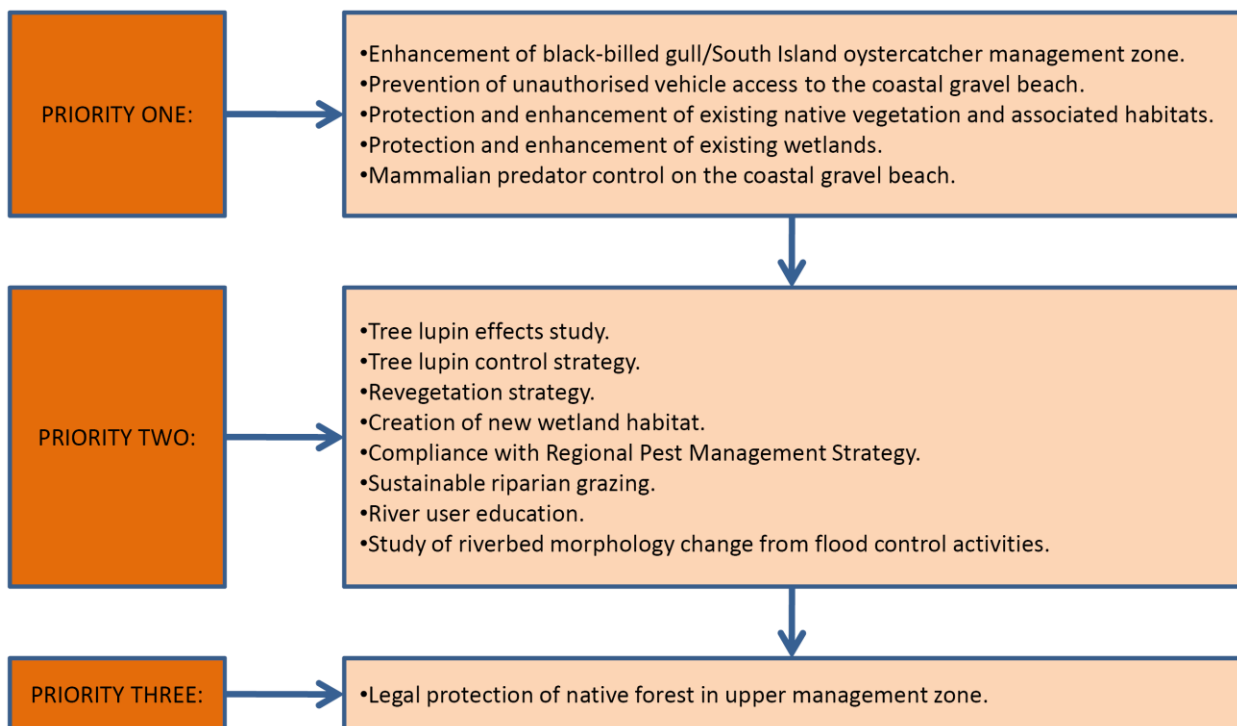
**Principle Seven: Effective monitoring and adaptive management.**

- Use of standard monitoring protocols to measure the success of trials and long term enhancement projects.
- Feedback from monitoring results to management inputs.

### 1.3 Enhancement projects listed in priority order

All projects specified within Chapter 4 are presented in priority order below in Figure 1-2. It should be noted that implementation of the revegetation strategy has multiple components, such as habitat patch creation, groves, native under-planting and native vegetation as edge protection planting. All those activities are grouped under one heading "revegetation strategy" in the priority ranking.

Also, enhancement activities for aquatic ecosystems include riparian enhancement of tributary streams and the main stem margins. However these actions do not feature specifically in the priority ranking, as they are 'by-products' of implementation of the revegetation strategy.



**Figure 1-2 : Enhancement projects presented in priority order.**

## 2 Terrestrial Ecosystems

### 2.1 Riverbed

#### 2.1.1 Enhancement of black-billed gull/South Island oystercatcher management zone

Site details			
<i>Site reference:</i>	Mangatahi black-billed gull/South Island oystercatcher colony.		
<i>Site description:</i>	Braided riverbed ranging in width from 230m to 470m.		
<i>Special ecological features:</i>	<ul style="list-style-type: none"> <li>• Black-billed gull breeding colony.</li> <li>• Black-billed gull is a 'Nationally Endangered' endemic gull with a seriously declining population.</li> <li>• One of only three<sup>5</sup> known North Island breeding sites for South Island oystercatcher.</li> </ul>		
<i>Landform:</i>	Braided riverbed.	<i>Grid reference (NZTM):</i>	
<i>Management zone area (ha):</i>	49	Up-river extent:	1907063.9E 5610444.7N
<i>Altitude (m.a.s.l.):</i>	c. 95	Down-river extent:	1907787.1E 5609339.5N
<i>Aspect:</i>	SE	2009/2010 colony location:	1907214.2E 5609749.3N

Enhancement project details	
<i>Type of enhancement:</i>	Protection and recovery.
<i>Primary long term aim:</i>	Reverse the population decline of this colony of black-billed gulls. A realistic population growth target/breeding success is to be determined following first survey of colony.
<i>Objectives:</i>	<ul style="list-style-type: none"> <li>• Control plant pest growth within the 49ha management zone on the braided riverbed so as to maintain optimum river bird breeding habitat quality, in particular for breeding black-billed gulls and South Island oystercatchers.</li> <li>• Control mammalian predators leading up to and during the black-billed gull and South Island oystercatcher breeding season.</li> <li>• Inform/educate adjacent landowners and recreationalists of the values and sensitivities of the management zone with the aim of reducing disturbance of these bird species during the critical nesting season.</li> </ul>

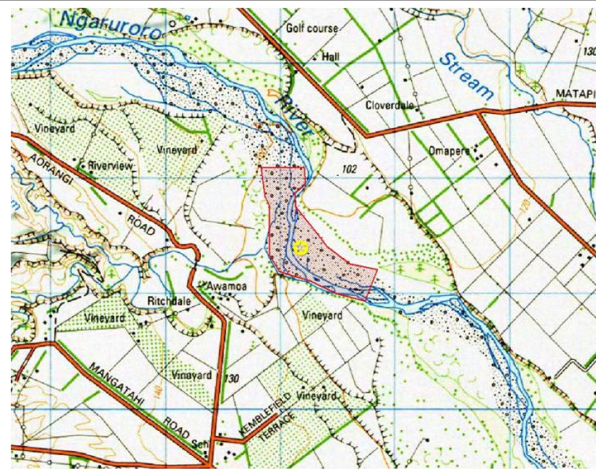
<sup>5</sup> The two other breeding sites are (1) Lake Onoke, in the Wairarapa, although it is currently unknown whether South Island oystercatchers still breed in the Wairarapa (2) Tutaekuri Riverbed (pers. comm. Brent Stephenson 2010).



<p><i>Key enhancement actions:</i></p>	<p><i>Plant pest management:</i></p> <ol style="list-style-type: none"> <li>1. Within the management zone, assess weed growth on the riverbed during late March/early April, to determine the extent of beach raking needed (do this annually).</li> <li>2. If beach raking is needed, rake the gravel beaches of the management zone during April.</li> <li>3. Assess weed growth on the riverbed during late June/early July to determine the extent of herbicide application needed (do this annually).</li> <li>4. If herbicide application is needed, spray the plant pest growth on river gravels of the management zone no later than 31<sup>st</sup> July.</li> </ol> <p><i>Predator control and monitoring:</i></p> <ol style="list-style-type: none"> <li>5. Design and implement an introduced mammalian predator control and monitoring programme to defend the black-bill gull nesting colony from predation. The programme should be designed to control hedgehog, cat, rat and mustelid populations. Intensive control should take place between the 1<sup>st</sup> of May and the 31<sup>st</sup> of January inclusive.</li> </ol> <p><i>Education:</i></p> <ol style="list-style-type: none"> <li>6. Visit owners/occupiers of land adjacent to the management zone and have an informal discussion to confirm their existing level of awareness and where necessary raise awareness of the important bird values of the river corridor adjacent to their properties, and raise the profile of threats posed to river birds by users of the riverbed.</li> </ol> <p><i>Black-billed gull population monitoring:</i></p> <ol style="list-style-type: none"> <li>7. Design and implement a programme of monitoring to investigate the size and reproductive success of the Mangatahi black-billed gull population. The programme should establish the current population size, and identify any population trends. The data should be assessed in conjunction with the predator and weed control work to confirm factors contributing to the observed population dynamics. Findings from this work should inform future management actions in relation to the management zone.</li> </ol>
<p><i>Specific methods and/or materials:</i></p>	<p><i>Plant pest control:</i></p> <ul style="list-style-type: none"> <li>• In years where only small areas of plant growth requires spraying herbicide application should be via backpack or other ground based sprayer application. Larger areas will require spray application via helicopter.</li> <li>• The highest priority riverbed sites for plant pest clearance are areas of highest ground on river islands. It is these sites which, when cleared of plant pests, will provide nesting sites which are least vulnerable to predation by introduced mammals and nest loss during spring/summer river freshes.</li> </ul> <p><i>Animal pest control:</i></p> <ul style="list-style-type: none"> <li>• An effective predator control programme should be developed and carried out by a suitably experienced biosecurity specialist(s).</li> <li>• The predator control programme should utilise a combination of poison bait stations and traps positioned at suitable intervals along the river margins.</li> <li>• Monitoring should comprise a combination of trap counts, tracking tunnel surveys and night spotlighting observations, or other methods as appropriate.</li> </ul>

	<p><i>Black-billed gull population monitoring:</i></p> <ul style="list-style-type: none"> <li>• The monitoring should be designed and led by a suitably qualified and experienced ecologist.</li> <li>• To add value to the gull monitoring, the monitoring programme should aim to include observations of the nesting occurrence and success of any South Island oystercatcher nesting activity within the management zone.</li> </ul>
Value areas to which outcomes relate:	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>
Timeframe:	Initiate immediately; ongoing.
Monitoring required:	Ground monitoring of population size and reproductive success. Monitoring effectiveness of predator control.

**Images characterising enhancement site**



**Aerial view of braided river within management zone (left); management zone boundaries relative to the surrounding features (centre); view across braided riverbed (right).**

### 2.1.2 Tree lupin effects study

The invasive semi-woody exotic herbaceous plant species, tree lupin (*Lupinus arboreus*), is an obvious invader of the river gravels and buffer zones. While it is only one of many introduced herbaceous plants which rapidly colonise recently disturbed river gravels, it appears to be dominant in many areas of the river bed and berms.

Nationally, colonisation of recently disturbed river gravels by introduced herbaceous plants is a common and widespread problem for the river bird species using these habitats. Endemic river birds have evolved to rely on open gravels for nesting and brood rearing. In evolutionary timeframes, the arrival of introduced herbs to New Zealand within the last 150-200 years is a remarkably sudden event. Encroachment of river gravels by introduced herbs is only one part in a complex set of interacting factors which can adversely affect the success of breeding river birds. The diagramme contained in Appendix D<sup>6</sup> illustrates some of the interrelationships and dependencies of factors affecting river bird survival.

It is recommended that a controlled set of observations be undertaken to establish locally what effect tree lupin encroachment on the river bed is having on river bird behaviour.

Key questions to help frame the investigations are:

- Is there a significant difference in gravel habitat use by river birds between colonised and non-colonised river gravels?
- Is there a significant difference in habitat use between river gravels dominated by different herbaceous species (i.e. does one herbaceous species make river bird habitat less usable than any other herbaceous species - which species should be targeted for control)?

The study should aim to inform whether, and to what extent, plant pest control on the river bed should be undertaken to improve habitat for river birds. The findings of this study should also inform and help prioritise actions of the proposed plant pest control strategy (see Section 2.1.3 below).

### 2.1.3 Tree lupin control strategy

Depending on the results of the investigation outlined in Section 2.1.2, a strategy may need to be developed to enhance river bed habitat from tree lupin encroachment. The strategy should set the scope for management actions, including the necessary extent and priority areas of control.

## 2.2 River berms

### 2.2.1 Revegetation strategy

The Ngaruroro River corridor provides a substantial and important opportunity to recreate habitat for native flora and fauna within a landscape which was once dominated by native lowland forest ecosystems - and has today very nearly been denuded of all (forest or otherwise) naturally occurring native vegetation. The existing forest/shrub communities of the landscape surrounding the management area are presented in Appendix E.

Figure 2-1 below presents examples of some remnant native trees of the Scheme area. These specimens are examples of the more resilient species of these floodplain forest communities. Figure 2-2 presents the zonation typical of the native vegetation units existing today in the river's upper management area.

Native vegetation communities of the upper management area are typically shrublands and low forest of tauhinu, kanuka and kowhai on the shallow alluvial soils of the stabilised floodplain, merging up-gradient into mixed broadleaved forest on the river terrace escarpment, with a forest canopy typically comprising

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<sup>6</sup> O'Donnell in Harding et al (2004).



titoki, kowhai, mahoe and ngaio. The forests of the upper management area have only been viewed from the air; however it is quite clear that these forest units also support a diverse floral understorey composition.



**Figure 2-1 : A lone tall kanuka, remnant of former floodplain forests at Kommerens (top left); a lone ngaio with bark cloaked in orange lichen and canopy in serious decline at Kommerens (top right); a small grove of cabbage trees persisting within grazed paddocks near Higgins 1 (bottom left); kowhai (left of frame) and ngaio with mahoe (right of frame) persisting on the steep bank of a Maori Pa site (see Higgins 1) (bottom right).**





**Figure 2-2 : Sapling kowhai (*S. tetraptera*) (top left) tauhinu (top centre) and tauhinu with kanuka (bottom left) on shallow alluvial soils of the stabilised river floodplain. Typical vegetation zonation of upper management area, with vegetation units grading upslope from exotic herbaceous vegetation on the active riverbed to kanuka (in this view with gorse and exotic grassland/herbfield) on the stabilised river floodplain then broadleaved forest on the terrace riser (in this view north facing treeland comprising kowhai, mahoe and kanuka) (bottom centre). Dense south facing native broadleaf canopy on steep escarpment (top right) and a view of a mature example of floodplain kanuka and native broadleaf vegetation on escarpment (bottom right).**

### 2.2.1.1 *Revegetation strategy objectives*

The revegetation strategy for the management area aims to achieve the following objectives:

1. Over time, enhance the wildlife habitat and wildlife corridor values of the management area, with a particular focus on facilitating dispersal of species from the inland hill country out across the Heretaunga Plains providing a linkage with the production and urban landscapes.
2. Design revegetation to promote healthy functioning ecosystems, through use of native and exotic (non-invasive) plants and best practice ecological restoration techniques.
3. Where necessary trial specific revegetation treatments to gauge likely success prior to full implementation.

### 2.2.1.2 *Revegetation strategy components*

The revegetation strategy is made-up of the following physical components:

- 5ha habitat islands.
- 1ha habitat islands.
- Native and exotic tree groves as habitat stepping stones (c.0.02ha each).
- Widescale native revegetation (establishment of nursery conditions for native plants).
- Native under-planting (diversification) of live edge protection forests.
- Replacement of discrete areas of exotic edge protection planting with native plantings (at low erosion risk sites only).

The location of the 5ha and 1ha habitat islands are important. These areas form the 'functional backbone' of the strategy. The longitudinal continuity of the habitat stepping stones is also important. Therefore, the locations/extent and specific design criteria of these features are included in this plan (see following sub-sections).

The actual location of each tree grove, and the locations of native under-planting of edge protection forests and the replacement of discrete areas of edge protection plantings with native plants is less important to the spatial arrangement of the overall strategy. On that basis, the actual sites for those activities are not specified within this plan, and will need to be determined at a later project planning stage.

### 2.2.1.3 *Design considerations important to the strategy*

#### 2.2.1.3.1 *Spatial design and landscape connectivity*

The most recent landscape ecology research<sup>7</sup> on ecological connectivity of New Zealand forest landscapes provides the following spatial parameters for terrestrial habitat patch design. These spatial parameters have been derived from ecological modelling backed by field observations, and are said to provide a sufficient level of connectivity to underpin a restoration strategy at 'patch' to 'landscape' scales<sup>8</sup>.

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<sup>7</sup> Meurk, Hall, 2006.

<sup>8</sup> Meurk, Hall, 2006.



**Table 2-1 : Design parameters to achieve sustainable ecological connectivity in New Zealand urban and rural landscapes.**

Patch component	Minimum area (ha)	Maximum dispersal distance (km)	Spacing* (km)	Design function
Large patch	>5	2.5km	5	Core sanctuary – provides buffered 'interior' microclimate conditions.
Small patch	>1	0.5	1 – 2	Provides habitat for most plants, lizards, insectivorous birds and invertebrates. Provides resource rich stepping stones for larger frugivorous nectar-eating birds.
Forest grove	0.02	0.1	0.2	Provides groves of resource trees, finer grained stepping stones and feeding stations.

Notes: \* Spacing from similar sized patch.  
 (Information source: Meurk, Hall 2006).

These minimum connectivity parameters have been found to represent an important local extinction threshold for many species within urban and rural landscapes. They provide minimum security for a range of plants, including those that are frost or wind sensitive. They also provide security at a landscape scale for at least the more common iconic terrestrial wildlife, such as fantail, bellbird, tui, kereru, tomtit, brown-creeper, as well as lizards and invertebrates.

Within the upper management area these spatial connectivity requirements are largely met, with dispersal/pollination ranges of patches located on the river margin and within the surrounding landscape overlapping (see Figure 2-3). In this regime, the strategy emphasis is on protection of existing vegetation cover.

In the Scheme area however, the connectivity design parameters are currently not provided for. In fact, the Scheme's current native woody vegetation cover (0.3% of the Scheme area) provides very poor ability to contribute to seed dispersal and pollination at the landscape scale (see Figure 2-4). In this context, both protection of existing native vegetation and creation of new habitat to enhance landscape connectivity become a high biodiversity management priority.

An existing characteristic of the Scheme area is the exotic edge protection and buffer zone plantings which present some wildlife corridor/stepping stone function. Further they provide structural elements (Spring/Summer/Autumn canopy cover) which provide nursery conditions for native under-planting. The revegetation strategy of the Scheme therefore aims to build on the existing connectivity and structural values by strategically placing habitat patches (comprising both native and non-invasive exotic plant species) to improve landscape connectivity across the Heretaunga Plains.

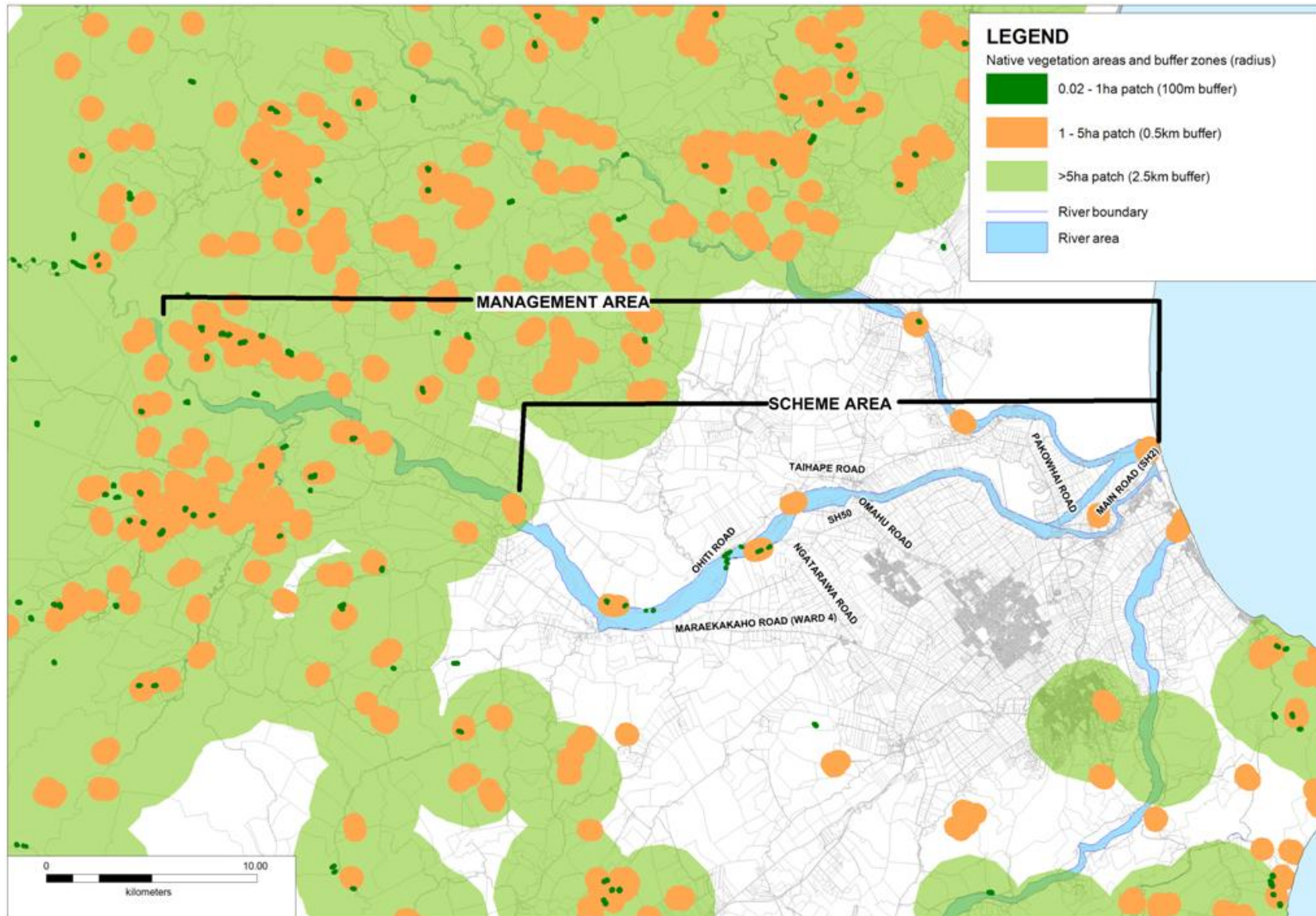


Figure 2-3 : Dispersal/pollination pattern based on current native vegetation cover (LCD2 data).

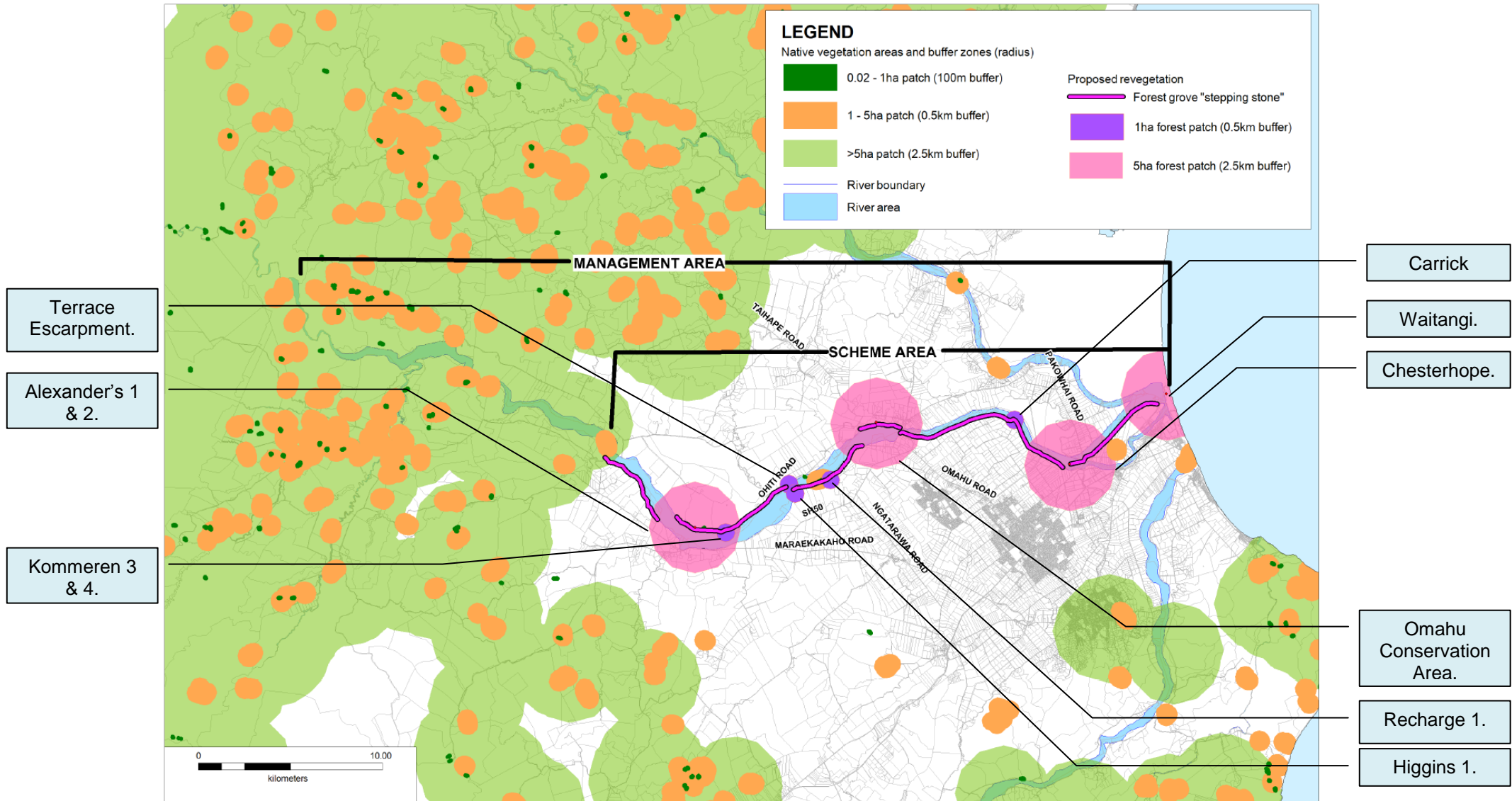


Figure 2-4 : Dispersal/pollination pattern based on current native vegetation cover and fully implemented revegetation strategy (LCD2 data).



## 2.2.1.3.2 Proposed 5ha revegetation sites

**5ha revegetation sites (x4)**
**Waitangi coastal forest and shrubland**

Potential features:

- Opportunity to establish native coastal forest and shrubland.
- High profile site.
- Readily accessible to public.
- Site has high recreational values.
- Already featuring public access facilities.
- Riparian benefits.
- Predator control underway on adjacent sites.
- Some revegetation already underway at site.
- Close to vegetation of horseshoe wetland.

**Chesterhope native forest**

Potential features:

- Site is near Hastings City (dispersal to NE urban boarder) and between Hastings and Napier urban areas.
- Site is adjacent to the HBRC managed Pakowhai Country Park – potential recreational and biodiversity linkages.
- Site adjacent to Waahi Tapu site (“W13”)<sup>9</sup> which is significant as “Battlefield and Urupa”.
- Adjacent to site with existing high recreational values.
- Opportunity to abut the exotic edge protection planting (wildlife corridor).

<sup>9</sup> See Hastings District Council District Planning Map 34b and Chapter 2, pages 69 and 70.

**5ha revegetation sites (cont.)**

Omahu Conservation Area



Potential features:

- Near Omahu/Fernhill community and other rural homes.
- Good opportunities for recreational use.
- Potential for riparian benefits to Ohiwia Stream.
- Approximately 1.5km and 2.0km to Lakes Oinga (RAP 9) and Runanga (RAP 8) (respectively).
- Potential for wetland creation.

Alexander's 1 & 2



Potential features:

- Potential to build-upon and buffer existing native vegetation values.
- Opportunity to revegetate escarpment and stabilised floodplain landforms.
- Potential for riparian benefits to Kikowhero Stream.
- Potential for wetland creation.



2.2.1.3.3 Proposed 1ha revegetation sites

**1ha revegetation sites**

**Carrick Road**



Potential features:

- Public access point with medium recreational values.
- Ready public access.
- Good connectivity with live edge protection (wildlife corridor).




**Recharge 1**



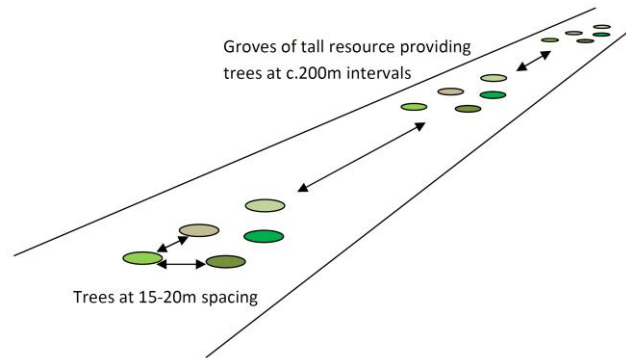
Potential features:

- Opportunity to build on and buffer existing native vegetation.
- Potential for riparian benefits to water race.
- Potential for wetland creation.



1ha revegetation sites (cont.)		
Higgins 1	Terrace Escarpment	Kommeren 3 & 4
 <p><u>Potential features:</u></p> <ul style="list-style-type: none"> <li>• Opportunity to build-on and buffer existing native vegetation.</li> <li>• Close proximity to other existing native vegetation sites.</li> <li>• Located in close proximity to willow edge protection planting (additional climatic buffering).</li> <li>• Located adjacent to site of cultural significance (Pa site).</li> </ul>	 <p><u>Potential features:</u></p> <ul style="list-style-type: none"> <li>• Opportunity to build-on and buffer high value (largest and most diverse native vegetation remnant of the Scheme area) existing native vegetation.</li> <li>• Located on site with high cultural values (i.e. Maori land and adjacent Pa site(s)).</li> <li>• Close proximity to other existing native vegetation sites.</li> </ul>	 <p><u>Potential features:</u></p> <ul style="list-style-type: none"> <li>• Two kanuka groves.</li> <li>• Potential to use edge protection planting as climate buffer.</li> <li>• Seed source for ecosourcing.</li> </ul>

### Forest grove habitat stepping stones



- Multiple small groves to provide habitat 'stepping stones' within the buffer zone(s) along the length of the Scheme area (see recommended layout in Figure 2-4).
- Each grove would only need to contain 4 or 5 individual trees.
- Groves would be composed of a mix of the following native and exotic tree species (see list below) to provide a succession of fruit, nectar/flower resources throughout the four seasons.
- Initially, simple fencing/barriers around trees/groves to prevent stock damage to young trees (within grazed areas of the buffer zone).

Plant species		Season/month											
Botanical name	Common name	J	F	M	A	M	J	J	A	S	O	N	D
<b>Native trees</b>		J	F	M	A	M	J	J	A	S	O	N	D
<i>Alectryon excelsus</i> *	titoki	■	■								■	■	■
<i>Hoheria angustifolia</i>	narrow-leaved lacebark	◆	◆	◆									
<i>Knightia excelsa</i>	rewarewa										◆	◆	◆
<i>Kunzea ericoides</i>	kanuka									◆	◆	◆	◆
<i>Myoporum laetum</i>	ngaio										◆	◆	◆
<i>Podocarpus totara</i>	totara		■	■	■	■							
<i>Sophora tetraptera</i>	kowhai								◆	◆	◆	◆	
<b>Exotic trees</b>		J	F	M	A	M	J	J	A	S	O	N	D
<i>Callistemon</i> spp.	bottlebrush	◆	◆	◆	◆	◆					◆	◆	◆
<i>Eucalyptus camaldulensis</i>	river red gum						◆	◆	◆	◆	◆		
<i>Eucalyptus cordata</i>	heart-leaved silver gum								◆	◆			
<i>Eucalyptus ficifolia</i> *	red-flowering gum	◆	◆	◆									◆
<i>Eucalyptus lansdowneana</i> spp <i>albopurpurea</i> *	crimson mallee gum				◆	◆	◆	◆					
<i>Eucalyptus leucoxylo</i> 'Rosea'	yellow gum					◆	◆	◆	◆	◆			
<i>Eucalyptus sideroxylo</i> *	red ironbark gum					◆	◆	◆	◆	◆	◆		
<i>Eucalyptus stellulata</i>	black sally gum				◆	◆	◆	◆	◆	◆	◆		

Notes: ■ native fruit and seeds; ◆ native nectar; ◆ exotic nectar (◆ & ◆ can also denote flowers which attract insects, serving insectivorous animal guilds).

\* denotes plant species which are susceptible to frost damage when young.

#### 2.2.1.4 Broad scale revegetation - nurse crop establishment

The methods outlined below provide lower cost methods of establishing nursery conditions for natural successional processes to build-upon. The success of these methods depends on a range of variables and it is recommended that methods are trialed before attempting large scale projects.

**Table 2-2 : Broad scale revegetation: trials of nurse crop establishment.**

Techniques	Method overview	Potential sites
<i>Utilise existing areas of tree lupin growth</i>	<ul style="list-style-type: none"> <li>Thin tree lupin cover.</li> <li>Plant nurse crop species in canopy gaps. Suitable species include, primarily kanuka but also cabbage tree, karamu, koromiko, poroporo, and tree tutu.</li> </ul>	<ul style="list-style-type: none"> <li>Sites with suitable cover of tree lupin.</li> <li>Suitable for many areas of the river margins within the Scheme upstream of Chesterhope Road Bridge.</li> </ul>
<i>kanuka brush laying<sup>10</sup></i>	<ul style="list-style-type: none"> <li>Stock-proof trial areas. Assess need for browser control.</li> <li>Thoroughly clear<sup>11</sup> trial sites of sward grasses and other invasive plants to expose bare ground.</li> <li>Lay cut<sup>12</sup> kanuka branches baring ripe seed capsules over the bare ground. Lay in several layers in a criss-cross fashion; not too densely to avoid shading out of germinating kanuka seedlings.</li> <li>On sloping sites, peg branches.</li> </ul>	<ul style="list-style-type: none"> <li>Dry alluvial soils and sloping sites.</li> <li>Suitable for many areas of the river margins within the Scheme upstream of Chesterhope Road Bridge.</li> </ul>
<i>Direct seeding<sup>13</sup></i>	<ul style="list-style-type: none"> <li>Stock-proof trial areas. Assess need for browser control.</li> <li>Collect seed mix: suitable species include cabbage tree, kanuka, karamu, koromiko, poroporo, tree tutu.</li> <li>Thoroughly clear<sup>14</sup> trial sites of sward grasses and other invasive plants to expose bare ground.</li> <li>Consider topsoil scraping/flipping to remove shallow seedbed and create microsites.</li> <li>Roughen ground manually with thorough heavy grazing.</li> <li>Sow seed.</li> <li>Tread in seed (with mob-stock sheep if site allows).</li> <li>Manage initial plant pest growth as required.</li> </ul>	<ul style="list-style-type: none"> <li>Particularly suitable for sites with well developed soils.</li> <li>Suitable for many areas of the river margins within the Scheme upstream of Chesterhope Road Bridge.</li> </ul>
<i>Planting nurse crop</i>	<ul style="list-style-type: none"> <li>Thoroughly clear trial sites of sward grasses and other invasive plants to expose bare ground at planting sites (1m<sup>2</sup>).</li> <li>Plant tree lucerne at 1.5m spacings.</li> </ul>	Very versatile technique suitable for most areas of the river's buffer zone.

<sup>10</sup> See Evans, 1983.

<sup>11</sup> If using herbicides with residual properties, instructions relating to pre-sowing use must be strictly followed.

<sup>12</sup> Note that kanuka should only be harvested from areas where it is locally abundant, and ecosourcing principles should apply.

<sup>13</sup> See Douglas *et al*, 2007.

<sup>14</sup> If using herbicides with residual properties, instructions relating to pre-sowing use must be strictly followed.



**2.2.1.4.1 Promotion of important ecosystem functions**

Year round animal food resources

Plant species for the habitat patches and groves as well as the edge protection diversification plantings should be selected to promote a year-round succession of resources for a range of birds, invertebrates and lizards. The year-round provision of resources in such a denuded landscape is somewhat difficult to achieve if only native plant species were to be used. The resource calendar, contained in Appendix F illustrates the shortage of native fruit/seed resources from June to July/August and the longer duration shortage of native flower/nectar resources from April to August/September.

Exotic flora, in particular the winter flowering nectar producing trees from South Africa and Australia can be used to fill these seasonal resource gaps.

Seed dispersal and pollination

Failure to effectively disperse seeds and failure to successfully pollinate wild native flora are both important ecological functions which are commonly impaired in the native vegetation ecosystems<sup>15</sup> of today. Apart from one nectarivorous bat and several lizards, birds are the only vertebrates filling both seed disperser and pollinator roles<sup>16</sup>. Although, on the New Zealand mainland only a small number of bird species actually fulfil these roles<sup>17</sup> (see Table 2-3 below).

**Table 2-3 : Birds of the lowlands fulfilling pollination and seed dispersal functions.**

Seed dispersing species	Pollinators
bellbird	bellbird
common myna	European starling
Eurasian blackbird	silveryeye
European starling	tui
kereru	
silveryeye	
song thrush	
tui	
whitehead	

Anderson and others<sup>18</sup> suggest that both pollination and dispersal are continuing to function on the mainland largely because of the three surviving endemic bird species: tui, bellbird and kereru. Also, in general terms exotic birds are more significant dispersers of exotic plants than endemic birds<sup>19</sup>. Tui and bellbird fill pollination and disperser roles and therefore their presence is critical for continued ecosystem function in lowland forests. These birds could justifiably be called 'keystone species' and their continued protection is said by Anderson and others to be necessary to prevent large-scale, long-term changes in the surviving native forests of New Zealand.

Mammalian predator control

Mammalian predators will be controlled at the 1ha and 5ha revegetation sites to minimise predation of lizard fauna.

<sup>15</sup> Clout, Hay, 1989; Anderson *et al*, 2006.

<sup>16</sup> Anderson *et al*, 2006.

<sup>17</sup> Introduced birds can fulfil these roles, however this is often of poorer quality than that provided by native birds with which plants have co-evolved. For example, blackbirds are important frugivores but are much more sedentary than kereru and tui and therefore offer only shorter distance dispersal within a habitat patch and none between very isolated patches (Clout, Craig, undated).

<sup>18</sup> Anderson *et al*, 2006.

<sup>19</sup> Clout, Craig, undated.

### Promoting early successional processes

Plant spacing is a key method of natural weed suppression and early promotion of successional processes. Early shading by canopy closure reduces weed growth, and provides perching opportunities for birds (seed dispersal) reduces soil temperatures and moderates topsoil moisture regimes – all aiding regenerative success and natural successional processes. The following planting spaces are recommended to maximise these processes.

**Table 2-4 : Recommended plant spacing to maximise canopy cover and natural weed suppression.**

<b>Vegetation type</b>	<b>Lineal spacing (m)</b>	<b>Specimens per unit area (ha)</b>
Large canopy and podocarp trees	3 – 10	100 – 1,000
Small trees (e.g. kohuhu)	1 – 2	5,000 – 10,000
Shrubs and large tussocks (e.g. toetoe)	1	10,000

#### **2.2.1.4.2 Incorporation of existing features and creation of new features**

Naturally occurring native vegetation within the Scheme area is of prime ecological importance and forms an important part of the revegetation strategy. All remaining vegetation occurs in, at best, small patches which are vulnerable to further degradation. Wherever possible the revegetation strategy aims to incorporate and buffer existing native vegetation.

#### **2.2.1.4.3 Patch design**

Patch size and shape are important design considerations for revegetation areas. Larger patches (1ha to 6ha) require substantial financial investment and should be designed to maximise ecological value, especially to minimise 'edge zones' and maximise 'interior' conditions.

Patches should be designed to minimise the edge to interior ratio. Compact (circular or square) patch shapes should be used, and narrow or protracted areas of revegetation avoided.

Patches should be located to maximise the complexity of microhabitats. For example, tributary waterways, relict braids or river terrace landforms and other variation in landform and topography should be incorporated as far as sound design principles allow.

#### **2.2.1.4.4 Use of trials**

Where the success of revegetation techniques or the success of specific species within the strategy is uncertain, small scale trials will be used to determine the appropriateness of the technique/species.

Specific trials should be undertaken for the following components of the revegetation strategy:

- Trial of survival and vigour of the exotic tree species for habitat stepping stone groves (see exotic species list on page 19).
- Native revegetation treatments described in Table 2-2 should be trailed prior to their wide scale application.

#### **2.2.1.4.5 Site preparation**

Standard 'pre-planting' plant and animal pest control protocols<sup>20</sup> should be adopted. On a site specific basis, mechanical 'ripping' of soils prior to planting may be beneficial to revegetation vigour and overall success, particularly in shallow stony soils of the stabilised riverbed.

<sup>20</sup> See: Davis, Meurk, (2001) and "HBRC, DoC. Planting Native Plants in Hawke's Bay" for standard protocols.

**2.2.1.4.6 Participation**

Many sites of the revegetation strategy are located near settlements or are popular recreational sites which the public are familiar with and value. These attributes present the foundation for participation in the implementation of the strategy.

**2.2.1.4.7 Monitoring**

Measuring the effectiveness of components of the strategy is important, both for management of the existing strategy and for consideration of similar strategies in other areas of the region. Examples of simple yet effective monitoring techniques for the strategy components are provided below. The actual monitoring requirements, including duration and frequency will need to be determined at the time of detailed design of the strategy.

<b>Revegetation strategy - monitoring requirements</b>	
Focus of monitoring	Potential methods
<b>5ha and 1ha revegetation sites</b>	
Vegetation	<ul style="list-style-type: none"> <li>• Monitoring of plant survival during 3 year establishment period</li> <li>• Photopoint monitoring</li> </ul>
Plant pests	<ul style="list-style-type: none"> <li>• Weed monitoring</li> </ul>
Birds	<ul style="list-style-type: none"> <li>• Five minute bird counts</li> <li>• Slow walk transects</li> </ul>
Mammalian predators	<ul style="list-style-type: none"> <li>• 'Trap night' counts</li> <li>• Bait volume/weight taken</li> <li>• Night spotlight surveys</li> </ul>
<b>Habitat 'stepping stones'</b>	
Plant survival	<ul style="list-style-type: none"> <li>• Monitoring of plant survival during 3 year establishment period.</li> </ul>
Birds	<ul style="list-style-type: none"> <li>• Five minute bird counts</li> <li>• Slow walk transects</li> </ul>

**2.2.1.4.8 Expected timescale of strategy implementation**

The revegetation strategy is a long term project. It should be approached with ecological timeframes in mind (multiple decades), rather than using typical financial timeframes (annual and up to 10 years periods) as a time scale reference.

The strategy proposes a substantial amount of physical works which require careful planning, and in some cases, monitoring. It is envisaged that full implementation of the strategy will span multiple decades.

**2.2.2 Native vegetation as live edge protection**

Specific sites at the live river edge which are of low erosion/flood risk should be identified and assessed for suitability for native riparian planting. That assessment should consider soil conditions and suitable revegetation techniques (e.g. direct planting or use of the 'broad-scale revegetation techniques' outlined in Table 2-2).

Actual plant species selected for revegetation in this zone will vary depending on site conditions and the revegetation technique adopted, however the following species have qualities which present themselves as species well suited for revegetation at the live edge:



- cabbage tree
- *Carex* spp.
- kanuka
- karamu
- karo
- kohuhu
- koromiko
- kowhai (*S. tetraptera*)
- mahoe
- New Zealand flax
- ngaio
- *Pittosporium ralphii*
- tree tutu

### 2.2.3 Native under-planting of the live edge protection/buffer zone forests

The following species have characteristics which would favour enrichment planting under the live edge protection/buffer zone plantings:

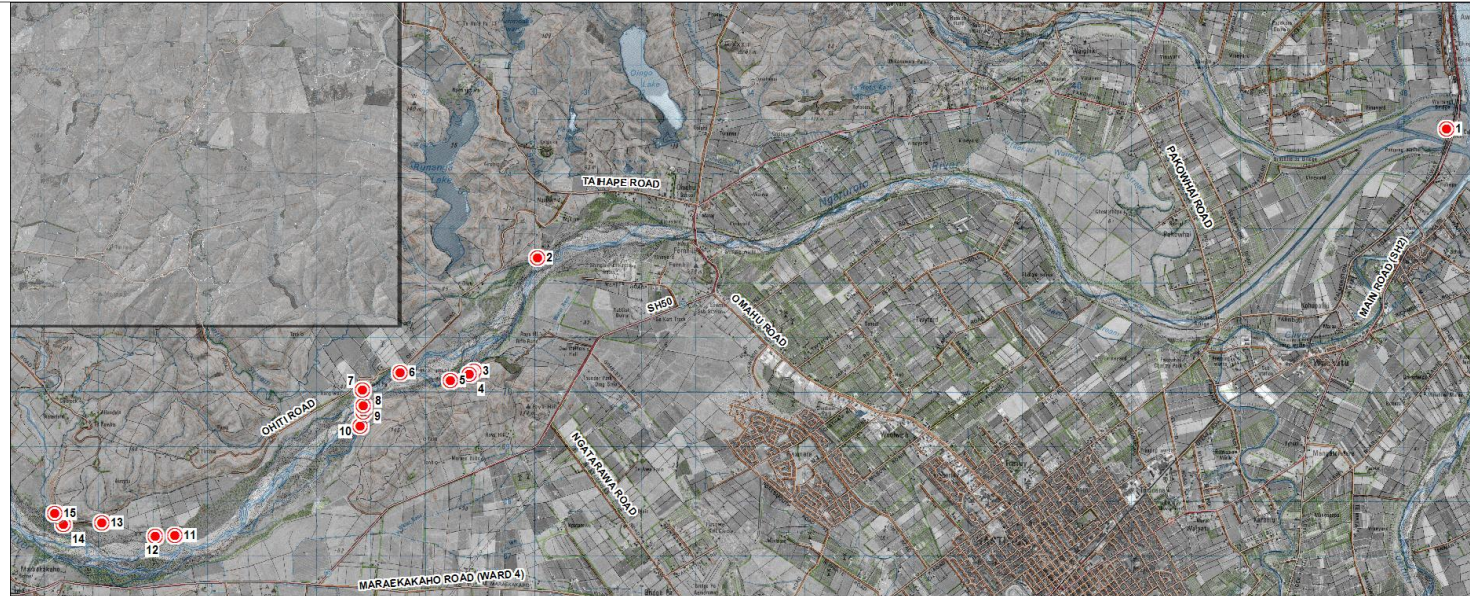
- cabbage tree
- *Carex* spp.
- five finger
- kanuka
- karamu
- karo
- koromiko
- kohuhu
- kowhai (*S. tetraptera*)
- lemonwood
- lowland ribbonwood
- mahoe
- mapou
- narrow-leaved lacebark
- New Zealand flax
- ngaio
- *Pittosporium ralphii*
- tawa
- totara

### 2.2.4 Protection and enhancement of existing native vegetation and associated habitats

This section describes the recommended 'minimum' actions which should be undertaken at existing native vegetation sites. Many of the existing native vegetation features form part of the revegetation strategy which is set-out in Section 2.2.1 and actions required to implement the strategy go beyond the minimum measures recommended below.

**All existing vegetation sites covered under this section**

<i>All site references:</i>	(1) The horseshoe wetland	(2) Ohiti Bluff	(3 & 4) Recharge 1	(5) Recharge 3
	(6) Turret 1.	(7) Turret Escarpment	(8) Higgins Point	(9) Native shrubland
	(10) Higgins 1	(11 & 12) Kommeren 3 and 4	(13) Alexander's native shrubland	(14) Alexander's 1
	(15) Alexander's 2			



#### 2.2.4.1 'Status quo management' vs. management intervention

Status quo management<sup>21</sup> is appropriate at sites which already receive sufficient management inputs, or where natural processes (and basic weed control, protection of stock) will be sufficient to protect and enhance those values the site possesses. At other sites, given the ecological importance of native vegetation remnants, management intervention to effect protection and/or enhancement is appropriate. Status quo management is recommended for the following existing vegetation sites:

- (1) The Horseshoe Wetland
- (2) Ohiti Bluff
- (5) Recharge 3
- (8) Higgins Point
- (10) Higgins 1

#### 2.2.4.2 Active enhancement

The following sites require some form of management intervention to protect or enhance their existing values:

- (3 & 4) Recharge 1
- (6) Turret 1
- (7) Turret Escarpment
- (9) Native shrubland
- (11 & 12) Kommeren 3 and 4
- (13) Alexander's native shrubland
- (14) Alexander's 1
- (15) Alexander's 2

An outline of protection and/or enhancement actions for each site is described below.

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<sup>21</sup> In this context "status quo management" is used to describe sites where no more than the current level and type of management is needed.



### Recharge 1



#### Active enhancement project outline

<i>Site reference:</i>	(3 & 4) Recharge 1	<i>Altitude (m.a.s.l.):</i>	60
<i>Site description:</i>	Native tree groves on flat terrain and toe slopes adjacent to man-made irrigation channel.	<i>Aspect:</i>	Various, generally to northern quarters.
<i>Special ecological features:</i>	A small diversity of native trees, some mature and in small groves. Ungrazed banks feature several native fern species.		
<i>Landform:</i>	Stabilised floodplain, low escarpments and toe of steep hill slope.		
<i>Primary long term aim:</i>	Enlarge area of native vegetation cover and reinstate natural regenerative processes.		
<i>Key enhancement actions:</i>	<ul style="list-style-type: none"> <li>• Legal protection in perpetuity for conservation purposes.</li> <li>• Effective plant pest control.</li> <li>• Effective animal (mammalian predators and domestic stock) control.</li> <li>• Creation of nursery conditions for self-sustaining native regeneration.</li> </ul>		
<i>Specific methods and/or materials:</i>	<ul style="list-style-type: none"> <li>• Plant pest management: Use of non-spray herbicide methods as far as practical. A particular focus on local eradication of old man's beard and other environmental weeds present.</li> <li>• Pest and domestic animal control:               <ul style="list-style-type: none"> <li>– Stock proof fencing of native vegetation, also allowing sufficient fenced area to expand native cover.</li> <li>– Control of mammalian predators (i.e. rats, mustelids, hedgehogs, cats) using kill traps and/or poison.</li> </ul> </li> <li>• Creation of nursery conditions suitable for natural regeneration: Direct planting or other suitable revegetation treatment (see Table 2-2 for alternatives to direct planting) to buffer and link existing native vegetation.</li> </ul>		
<i>Value areas to which outcomes relate:</i>	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>		
<i>Monitoring required:</i>	<ul style="list-style-type: none"> <li>• Surveillance to ensure proposed fences remain stock proof.</li> <li>• Standard monitoring in conjunction with revegetation treatments.</li> </ul>		

**Turret 1**

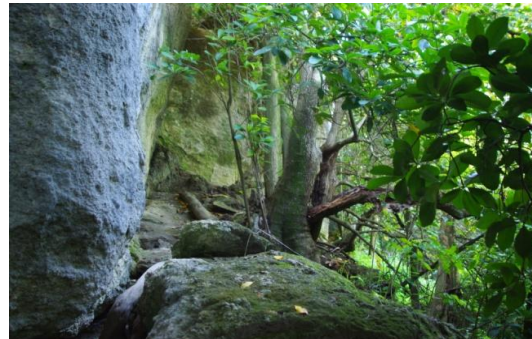


**Active enhancement project outline**

<i>Site reference:</i>	(6) Turret 1	<i>Altitude (m.a.s.l):</i>	70
<i>Site description:</i>	Individual specimens and small clusters of native ferns, shrubs and trees on very steep escarpment and on stabilised riverbed at escarpment base. Currently grazed, although very steep ground allowing some regeneration. Pa site.	<i>Aspect:</i>	Generally to southern quarters.
<i>Special ecological features:</i>	A small collection of native plant specimens, of moderate diversity. Several large kowhai trees present. Microclimate conditions likely due to the sites southerly aspect, close proximity to river water and buffering of climatic extremes by adjacent dense willow edge protection forest.		
<i>Landform:</i>	Steep tall escarpment and stabilised riverbed at foot of escarpment.		
<i>Primary long term aim:</i>	Enable natural regenerative processes.		
<i>Key enhancement actions:</i>	<ul style="list-style-type: none"> <li>• Prevent stock access to southern faces featuring native vegetation.</li> <li>• Install and maintain mammalian predator control devices (traps/bait stations).</li> </ul>		
<i>Specific methods and/or materials:</i>	<ul style="list-style-type: none"> <li>• Prevention of stock access: Install stock proof fencing.</li> <li>• Animal pest control: Control of mammalian predators (i.e. rats, mustelids, hedgehogs, cats) using kill traps and/or poison.</li> </ul>		
<i>Value areas to which outcomes relate:</i>	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>		
<i>Monitoring required:</i>	Surveillance to ensure proposed fences remain stock proof.		



### Turret Escarpment



#### Active enhancement project outline

<i>Site reference:</i>	(7) Turret Escarpment	<i>Altitude (m.a.s.l.):</i>	70
<i>Site description:</i>	The largest and most florally diverse area of native vegetation within the Scheme area. A steep escarpment featuring a number of prominent lime stone bluffs and outcrops.	<i>Aspect:</i>	Generally to southern quarters.
<i>Special ecological features:</i>	Relatively diverse native floral composition. Diverse native terrestrial invertebrate fauna. Good potential habitat for lizards, particularly provided by crevices in limestone outcrops/blocks and by native shrub and forest canopies. Important bird feeding and for some species nesting habitat.		
<i>Landform:</i>	Steep tall escarpment with hill-slope above, and small functioning flood plain at the escarpment base. Obvious karst elements.		
<i>Primary long term aim:</i>	<ul style="list-style-type: none"> <li>• Legally protect ecological values.</li> <li>• Establish and continue mammalian predator control to maximise habitat values for birds, invertebrates and lizards.</li> <li>• Control plant pest invasions to enable natural regenerative processes of native flora.</li> </ul>		
<i>Key enhancement actions:</i>	<ul style="list-style-type: none"> <li>• Legal protection in perpetuity for conservation purposes.</li> <li>• Habitat management for lizards.</li> <li>• Install and maintain mammalian predator control devices (traps/bait stations) with a particular focus on reducing rat numbers for the benefit of lizard populations.</li> <li>• Control plant pests, in particular gorse, English ivy, wandering dew.</li> <li>• Evaluate the areas current protection of wandering stock, ensure area becomes effectively protected from stock.</li> </ul>		
<i>Specific methods and/or materials:</i>	<ul style="list-style-type: none"> <li>• Work with landowner to secure a conservation covenant over the site.</li> <li>• Install permanent cover objects for arboreal and terrestrial lizards.</li> <li>• Animal pest control: Control of mammalian predators (i.e. rats, mustelids, hedgehogs, cats) using kill traps and/or poison.</li> <li>• Plant pest control: Control current plant infestation, ongoing surveillance and maintenance. Use non-spray herbicide methods whenever practical.</li> </ul>		
<i>Value areas to which outcomes relate:</i>	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>		
<i>Monitoring required:</i>	<ul style="list-style-type: none"> <li>• Lizard monitoring.</li> <li>• Predator monitoring or use of surrogates such as amount of bait taken or trap catch.</li> <li>• Plant pest surveillance.</li> <li>• Surveillance to ensure proposed fences remain stock proof.</li> </ul>		



**Native shrubland (near 'Higgins' sites)**



**Active enhancement project outline**

<i>Site reference:</i>	(9) Native shrubland	<i>Altitude (m.a.s.l.):</i>	70
<i>Site description:</i>	A compact shrubland, with some low mahoe forest on a gently sloping escarpment.	<i>Aspect:</i>	Western.
<i>Special ecological features:</i>	Advanced stages of early successional vegetation communities, transition from shrubland to low forest. Adjoins exotic edge protection planting along western side.		
<i>Landform:</i>	Gently sloping escarpment.		
<i>Primary long term aim:</i>	<ul style="list-style-type: none"> <li>• Legally protect ecological values.</li> <li>• Diversify vegetation to enhance this sites role as a habitat stepping stone at the landscape scale.</li> </ul>		
<i>Key enhancement actions:</i>	<ul style="list-style-type: none"> <li>• Legal protection in perpetuity for conservation purposes.</li> <li>• Enrichment planting with resource providing tree species,</li> <li>• Evaluate the areas current protection from wandering stock, ensure area becomes effectively protected from stock.</li> </ul>		
<i>Specific methods and/or materials:</i>	<ul style="list-style-type: none"> <li>• Secure a conservation covenant over the site.</li> <li>• Install permanent cover objects for arboreal and terrestrial lizards.</li> <li>• Enrichment planting: Plan and implement enrichment planting to enhance the ecological performance of this site, in particular rewarewa.</li> <li>• kowhai, and totara (refer species lists enclosed as Appendices to this chapter).</li> </ul>		
<i>Value areas to which outcomes relate:</i>	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>		
<i>Monitoring required:</i>	<ul style="list-style-type: none"> <li>• Monitoring of enrichment planting.</li> </ul>	<ul style="list-style-type: none"> <li>• Surveillance to ensure proposed fences remain stock proof.</li> </ul>	

### Kommeren 3 & 4



#### Active enhancement project outline

<i>Site reference:</i>	(11 & 12) Kommeren 3 & 4	<i>Altitude (m.a.s.l.):</i>	70
<i>Site description:</i>	Two groves of mature kanuka on stabilised floodplain. Rank grass understorey. The easternmost grove is buffered by surrounding edge protection forest. A 4WD vehicle track passes through and adjacent to these groves.	<i>Aspect:</i>	Nil.
<i>Special ecological features:</i>	These two groves are some of the most eastward stands of kanuka on the Ngaruroro River floodplain. Kanuka groves have become rare within the Scheme area. These sites provide an important seed source for ecosourcing.		
<i>Landform:</i>	Stabilised riverbed/floodplain.		
<i>Primary long term aim:</i>	<ul style="list-style-type: none"> <li>• Legally protect ecological values.</li> <li>• Buffer existing groves and initiate natural regenerative processes.</li> <li>• Diversify vegetation to enhance this sites role as a habitat stepping stone at the landscape scale.</li> </ul>		
<i>Key enhancement actions:</i>	<ul style="list-style-type: none"> <li>• Legal protection in perpetuity for conservation purposes.</li> <li>• Revegetation treatments to enable natural regeneration (overcome suppressing effect on natural regeneration by rank grass), incorporating enrichment planting (see species lists in Appendix G).</li> <li>• Consider realignment of existing 4WD track to maximize physical space for enhancement planting.</li> <li>• Evaluate the areas current protection of wandering stock, ensure area becomes effectively protected from stock.</li> </ul>		
<i>Specific methods and/or materials:</i>	<ul style="list-style-type: none"> <li>• Secure a conservation covenant over the site.</li> <li>• Fence revegetation area to exclude stock grazing.</li> <li>• Revegetation by either direct planting or methods outlined in Table 2-2 above.</li> </ul>		
<i>Value areas to which outcomes relate:</i>	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>		
<i>Monitoring required:</i>	<ul style="list-style-type: none"> <li>• Monitoring of revegetation/enrichment planting.</li> <li>• Surveillance to ensure proposed fences remain stock proof.</li> </ul>		



**Alexander's native shrubland, Alexander's 1, Alexander's 2**

**Active enhancement project outline**

<i>Site reference:</i>	(13, 14, 15) Alexander's native shrubland, Alexander's 1, Alexander's 2	<i>Altitude (m.a.s.l.):</i>	100
<i>Site description:</i>	Native vegetation persisting and regenerating on the escarpment slopes of the major headland (true left), at Alexander's, roughly opposite Maraekakaho township. Native shrubland, treeland and forest. Pine forest canopy in middle section of this escarpment. Substantial areas of old man's beard smother native vegetation on the escarpment. Expansive areas of the floodplain of the Kikowhero Stream adjacent to the escarpment are smothered with dense growth of wandering dew. Note that kowhai is regenerating through wandering dew in the vicinity of seed producing trees.	<i>Aspect:</i>	Southwest through southeast.
<i>Special ecological features:</i>	Where stock access is prevented, native shrubland and forest species are naturally regenerating on the escarpment face. Collectively this site contains the second largest concentration of native vegetation cover within the Scheme area.		
<i>Landform:</i>	Escarpment face of major headland. Stabilised floodplain of the Kikowhero Stream/Ngaruroro River.		
<i>Primary long term aim:</i>	<ul style="list-style-type: none"> <li>• Legally protect ecological values.</li> <li>• Enhance natural regeneration through plant pest control.</li> </ul>		
<i>Key enhancement actions:</i>	<ul style="list-style-type: none"> <li>• Legal protection in perpetuity for conservation purposes.</li> <li>• Control old man's beard growing amongst native vegetation on the escarpment slopes.</li> <li>• Evaluate the areas current protection from wandering stock, ensure area becomes effectively protected from stock.</li> <li>• Prevent destruction of this important native vegetation site from future felling of the pine forest which stands on the site. Either seek for the pine forest not to be harvested, or ensure careful felling to avoid damage to underlying native vegetation.</li> </ul>		
<i>Specific methods and/or materials:</i>	<ul style="list-style-type: none"> <li>• Secure a conservation covenant over the site.</li> <li>• Control plant pests using non-spray herbicide or physical control methods as far as practical, especially when working around existing native vegetation.</li> </ul>		
<i>Value areas to which outcomes relate:</i>	<ul style="list-style-type: none"> <li>• Terrestrial ecology.</li> <li>• Maori culture.</li> </ul>		
<i>Monitoring required:</i>	<ul style="list-style-type: none"> <li>• Plant pest surveillance/monitoring.</li> <li>• Monitoring of natural regeneration on escarpment slope.</li> </ul>		



### 2.2.5 Legal protection of native forest in upper management zone

The upper management area contains relatively expansive areas of regenerating native forest. These areas are largely restricted to sloping escarpments and/or adjoining stabilised river floodplains. In most cases native forest has been able to regenerate because stock access has been prevented. Therefore, these sites tend to be either inherently less suitable for stock grazing (i.e. steeply sloping ground), and/or inappropriate grazing sites (i.e. on the riverbed).

It is recommended that a full review of the landownership of regenerating sites be undertaken with a view to identifying land parcels which could be legally protected for conservation purposes. This process could be initially desk-top, and followed up with landowner liaison, 'ground truthing' and ecological values investigations.

Some examples of regenerating forest of the upper management zone are illustrated in the following photographs (Figure 2-5 below).



**Substantial area of native forest (kowhai-kanuka with broadleaf species) on steep and poorly assessable escarpment face.**





**Above: native broadleaf forest on true left escarpment face (left of frame). Native forest at right of frame is the same area as presented on the previous page.**



**Above: native broadleaf forest adjoining plantation pine forest on true left escarpment face.**





**Above: mahoe (bright green canopy) and kowhai (dull green canopy) at left and centre of frame.**



**Above: mature kanuka (characteristic white flowers) with mahoe, kowhai and other broadleaved species.**





Above: kanuka on stabilised riverbed and on adjoining terrace/escarpment.



Above: substantial areas of kanuka on steeply sloping faces.

Figure 2-5 : Examples of regenerating native forest in the upper management zone.

### 2.2.6 Compliance with Regional Pest Management Strategy (2006)

The Regional Pest Management Strategy<sup>22</sup> sets out responsibilities for land owners and/or occupiers for the control of specific animal and plant pests within the region.

From the inventory work undertaken as part of this project, the following plant pests clearly require specific management:

- Japanese honeysuckle 'Total control'
- old man's beard 'Total control'
- blackberry 'Boundary control'
- gorse 'Boundary control'

In addition to the specific requirements of the Regional Pest Management Strategy for plants, HBRC should include in their pest control plan for the management area (discussed below) provision for the continued control of the following environmental pest plants:

- broom (*C. scoparius*)
- buddleia
- climbing spindleberry
- fennel
- tree lupin
- pampus

It is recommended that HBRC develop and implement a comprehensive pest control plan for the management of plant pests within the management area. In some locations effective implementation of the pest control plan is likely to require collaboration with landowners which adjoin the management area (cross land-boundary management).

HBRC should also ensure all measures are taken to achieve compliance with any provisions of the Regional Pest Management Strategy relating to the control of animal pests within the management area.

### 2.2.7 Sustainable riparian grazing

The key opportunity to avoid adverse effects to river water quality from riparian grazing is preventing stock access to the wetted river channel. It is recommended that all areas of the management area held under grazing lease are fenced to prevent stock directly accessing the wetted river channel.

Overland flow from grazed areas to surface water is another potential pathway of contaminant transport to river water from riparian grazing<sup>23</sup>. It is recommended that areas held under grazing leases be reviewed for their connectiveness to the surface water network, and drainage be minimised as far as practical.

It is recommended that nutrient budgets be developed for grazed areas of the buffer zone to ensure stocking rates are limited to avoid excessive leaching of nitrogen to the Ngaruroro River. Such a nutrient budget should take into account specific site characteristics, such as rainfall, soil type and depth to groundwater.

A suitable model for nutrient calculations is "Overseer"<sup>24</sup> which is freely available and endorsed by MAF, FertResearch and AgResearch.

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<sup>22</sup> HBRC, 2006.

<sup>23</sup> McDowell, 2005.

<sup>24</sup> See: [www.overseer.org.nz](http://www.overseer.org.nz).

The outcome of these budgets should be made a condition of the corresponding grazing lease within the management area.

## **2.3 Coastal beach**

### **2.3.1 Prevention of unauthorised vehicle access onto the beach**

The gravel substrates of the coastal beach make the beach an “originally rare” ecosystem<sup>25</sup>. The beach provides nesting habitat for black-billed gulls, white-fronted terns and dotterel. It is also an important overwintering site for black-fronted terns and banded dotterel. The beach also provides habitat for various lizard and invertebrate species, although further inventory work is required to fully understand these values.

The coastal beach is perhaps the most popular recreational site of the entire management area. Vehicle access onto the gravel beach is currently unrestricted. Four wheel drive vehicles are commonly driven across the beach by recreationalists, to access the river mouth and coastline.

Vehicle movements across the beach potentially disturb birds, which is of a particular concern during their critical nesting season. Vehicle use on the gravel beach also presents disturbance to driftwood, beach substrates and native flora, all of which are important components of this rare ecosystem type. With ready vehicle access onto the beach comes more intense use, and of particular concern is burning of driftwood in beach fires (i.e. and therefore reduction/loss of an important habitat within this ecosystem).

The benefits of preventing unauthorised vehicle access to the gravel beach system are clear along the stretch of the beach between Ngaruroro River and Tukituki River mouths.

It is recommended that barriers be installed in a practical alignment along the back of the gravel beach to effectively prevent unauthorised vehicle access onto the gravel beach.

### **2.3.2 Introduced mammalian predator control**

Introduced mammalian predators are well known predators of gravel beach and wetland fauna. Mustelids, rodents, feral cats, hedgehogs are all animals which would predate on the native fauna values of the coastal beach and Muddy Creek wetlands. A programme of mammalian predator control is currently underway along the Muddy Creek wetlands. This enhancement plan presents an opportunity to booster that programme through greater spatial coverage, wider scope of target species, and if necessary more intense control efforts.

In particular, rats are a major predator of New Zealand's lizard fauna, and it is recommended that a programme of rat control along the gravel beach and associated wetlands be designed and implemented.

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<sup>25</sup> See Chapter 2, Section 1.1.4 for definition of ‘originally rare’ ecosystems.



## 3 Wetland Ecosystems

### 3.1 Approach to enhancement of wetland habitats

The management area contains a number of wetland sites and types. Further, there is considerable potential to create new wetland habitat in areas which complement Scheme activities and recreational use of the river corridor.

The following sites are existing wetland features which are particularly deserving of management intervention to protect or enhance their existing values.

- “Matapiro 2” wetland
- Pigsty wetland (RAP18)

The following sites present good potential for creation of new wetland values. These sites would still require detailed investigation into the feasibility of wetland creation.

- Floodplain to the east of horseshoe wetland
- Silt extraction wetlands on floodplains downstream of Chesterhope Road Bridge
- Omaha Conservation Area
- “Recharge 1”
- “Alexander’s 1 & 2”

When planning wetland enhancement, or creation of new wetland sites, a key consideration should be provision of habitat for threatened wetland fauna. The habitat requirements of the following bird species<sup>26</sup> should be considered and incorporated as far as practical in wetland enhancement and design. The philosophy with this approach is that if suitable habitat is provided for these threatened/at risk species, the habitat requirements of many common and widespread species will also be provided for.

Common name:

Threat classification:

- |                             |                       |
|-----------------------------|-----------------------|
| • Pacific black (grey) duck | Nationally critical   |
| • Australasian bittern      | Nationally endangered |
| • dabchick                  | Nationally vulnerable |
| • marsh crake               | At risk, relict       |
| • spotless crake            | At risk, relict       |

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<sup>26</sup> See Chapter 2, Figure 1-15 for illustrations of these bird species.

### 3.2 Protection and enhancement of existing wetlands

The following wetlands are within the management area and require specific protection and/or enhancement actions.

#### Existing wetland sites

Matapiro 2 wetland



**Aim: protect wetland values and enhance ecosystem values through retirement and planting.**

Key opportunities:

- Opportunity to legally and physically protect an example of a riverine wetland on remnant floodplain at the toe of river escarpment;
- *Carex* spp. and raupo patches remaining;
- Opportunity to retire wetland margins from grazing and revegetate the margins with appropriate wetland flora;
- The wetland provides habitat for diverse native freshwater fish fauna;
- The adjacent escarpment face feature stands of native trees.

Pigsty wetland



**Aim: protect and enhance existing wetland values.**



Key opportunities:

- High quality wetland within oxbow formation;
- Fernbird, Australasian bittern, spotless crane present;
- Woody native vegetation on surrounding escarpment face;
- Enhance habitat values through willow control;
- Opportunity to legally protect ecological values for conservation purposes.

*Note: need for full evaluation of enhancement opportunities required.*

### 3.3 Creation of new wetland habitats

The following sites within the management zone present good potential for creation of wetland habitats, often with outcomes over multiple values (e.g. combinations of improvement to ecological, cultural, recreational, educational values).

Proposed wetland sites	
Extension to horseshoe wetland complex	Riverine floodplain wetlands
 <p><b>Aim: enhance existing wetland values through creation of new wetland habitat.</b></p> <p><u>Key opportunities:</u></p> <ul style="list-style-type: none"> <li>• Opportunity to establish whitebait spawning habitat on the saltwater wedge;</li> <li>• Australasian bittern present in adjacent horseshoe wetland;</li> <li>• High profile site;</li> <li>• Readily accessible to public;</li> <li>• Already featuring public access facilities;</li> <li>• Mammalian predator control underway on adjacent sites.</li> </ul>	 <p><b>Aim: create new wetland habitats in association with silt extraction activities.</b></p> <p><u>Key opportunities:</u></p> <ul style="list-style-type: none"> <li>• Opportunity to create low maintenance raupo dominated riverine wetlands on the river floodplain;</li> <li>• Wetlands potentially assessable to public;</li> <li>• Recreational and educational opportunities, in particular if wetlands located near rotary pathway;</li> <li>• Potential to create habitat (or habitat stepping stones) for swamp birds, such as bittern and crane.</li> </ul>



**Proposed wetland sites (cont.)**

**Omahu Conservation Area**

**“Recharge 1”**

**Wetland creation at “Alexander’s 1 & 2”.**



**Aim: to create new wetland habitat with good recreational and educational opportunities.**

Key opportunities:

- Use of water from the adjacent Ohiwia Stream and/or Ngaruroro River to support new wetland habitat;
- Important revegetation site for revegetation strategy, wetland could be designed to incorporate those revegetation plans, and contribute to the revegetation strategy (dual outcomes);
- Site near community and rural houses;
- Potential to incorporate and realise water quality treatment of the Ohiwia Stream prior to its convergence with the Ngaruroro River.

**Aim: create new wetland habitat.**

Key opportunities:

- Use of water from the adjacent irrigation race to support new wetland habitat;
- Native vegetation existing at site, wetland could be designed to build upon those existing values, and contribute to the revegetation strategy (dual outcomes);
- Good access to site.

**Aim: create new wetland habitat with high wildlife values.**

Key opportunities:

- Use of water from the adjacent Kikowhero Stream and/or Ngaruroro River to support new wetland habitat;
- Native vegetation existing on escarpment adjacent to site, wetland could be designed to build upon those existing values;
- Important revegetation site for revegetation strategy, wetland could be designed to incorporate those revegetation plans, and contribute to the revegetation strategy (dual outcomes);
- Potential to incorporate and realise water quality treatment of the Kikowhero Stream prior to its convergence with the Ngaruroro River.

## **4 Aquatic Ecosystems**

Enhancement of aquatic ecosystems is largely achieved in tandem with other outcomes, largely via terrestrial actions undertaken in the riparian zone, or by projects relating to terrestrial and wetland areas. Details of enhancement actions which would benefit the aquatic ecosystems are contained elsewhere in this EMEP. To avoid unnecessary duplication this section is kept relatively short.

### **4.1 Riparian enhancement**

#### **4.1.1 Tributary waterways**

The revegetation strategy discussed above proposes revegetation at two tributary streams, the Ohiwia and the Kikowhero Streams.

Revegetation at these sites should be designed to maximise riparian benefits to these waterways. Planting of appropriate native riparian species to maximise shading of the stream water column is a key goal of these riparian treatments.

#### **4.1.2 Ngaruroro main stem**

Key opportunities for enhancement of the main stem riparian zones are the replacement of exotic live edge protection with native species (at low flood risk sites); and native enrichment planting of live edge protection forests.

These activities are discussed in previous sections, and therefore are not discussed further here.

### **4.2 Water quality improvements where wetland creation is proposed**

Where wetland creation is proposed in association with tributary streams, wetland design should as far as technically feasible be designed to effect water quality treatment.

### **4.3 Study of riverbed morphology change**

As stated earlier in this EMEP, it remains uncertain what effect beach raking and gravel extraction activities have on river bed morphology, and therefore in-stream habitat. This is a research question raised by Fish and Game in relation to trout during consultation, but is also of potential relevance to native fish habitat of the Ngaruroro River.

It is recommended that a study be undertaken to investigate geomorphologic and aquatic habitat effects from flood control activities within the Scheme area.

## 5 Other Enhancement Projects

### 5.1 River user education

The influence users of the river have on the river's ecology is likely to be quite significant. It is recommended that actions are undertaken to inform freshwater fishers, jet boaters, gravel extractors, beach rake operators, river mouth opening contactors/staff, and other relevant staff and contractors of the significance of the gravel riverbed as habitat for specialist river birds, and measures they can take to minimise impacts to birds during their activities on the river.

River users can be educated through use of information leaflet(s) suitable for freshwater fishers, jet boaters, gravel extractors, and beach rake operators. Such leaflets can be issued at the time of permit/licensing or otherwise circulated to raise awareness of the following key aspects:

- The gravel riverbed as a scarce and specialist habitat type which is used by specific river bird species.
- The threatened status of many of the birds reliant on river gravels as habitat, in particular for breeding.
- Current threats to the survival of the threatened river bird species.
- The national significance of Hawke's Bay region's braided river habitats for river birds.
- The time/duration and corresponding river reaches when breeding river birds are most sensitive to disturbance.
- What level of disturbance may cause nesting failure.
- Facts on how each of the above river users can minimise impacts to river birds during their activities on the river.

Such information leaflets should be compiled in collaboration between HBRC, DoC and Fish and Game.

It is also important to inform landowners adjacent to the black-billed gull colony of the ecological significance of the area as habitat for the nesting black-billed gull and also South Island oystercatcher, banded dotterel and black-fronted dotterel.

It is recommended that visits to landowners adjacent to the black-billed gull/South Island oystercatcher management zone be undertaken to have an informal discussion to confirm their existing level of awareness and where necessary raise awareness of the important bird values of the river corridor adjacent to their properties, and raise the profile of threats posed to river birds by users of the river bed.



## Appendix A: References

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## Appendix B: What is meant by ecological 'enhancement'?

Various terms can be used to describe actions which are undertaken to improve the quality or quantity of some characteristic of a site or area. For example, DoC's<sup>27</sup> definitions are presented below:

**Restoration:** *Management that aims to restore particular biotic communities to a condition more like that of a selected time period in the past. It is concerned with both animals and plants as parts of self-maintaining communities and is therefore system-orientated rather than species-oriented.*

*Restoration aims to re-activate the major successional processes likely to have operated during the selected time periods and within the physical conditions (site factors and climate) specified for each restoration programme.*

*However, attention to the ecological requirements of individual species, both the dominant plants and animals, and other less common species, is essential for success with restoration.*

*Furthermore, improving the chances of survival for some threatened species often requires re-establishment of suitable habitats. Here, the goals of community and species management coincide.*

**Rehabilitation:** *The emphasis in rehabilitation work has been to replace lost vegetation, often with something generally similar, but with no particular aim of re-instating a system from a former time period. Where eradication of a pest species is possible, such as on an island or fenced-off mainland peninsula, natural regeneration of plants may be sufficient to rehabilitate the area without further intervention.*

**Revegetation:** *Ecological restoration sometimes requires planting, and therefore there can be confusion between revegetation and restoration. Revegetation involves re-establishing a plant cover of some kind: indigenous, exotic, or mixed. It may be done for a variety of purposes, such as erosion control, stabilising batters along roadsides or canals, re-establishing plants on mining sites, or beautifying an unattractive area. There may be no particular need to restore the plant cover to a former state.*

**Recovery:** *The term has in recent years become particularly associated with species recovery plans. A recovery programme for a threatened species is something that can stand on its own, but it may often involve restoration of a biotic community as habitat essential for the species.*

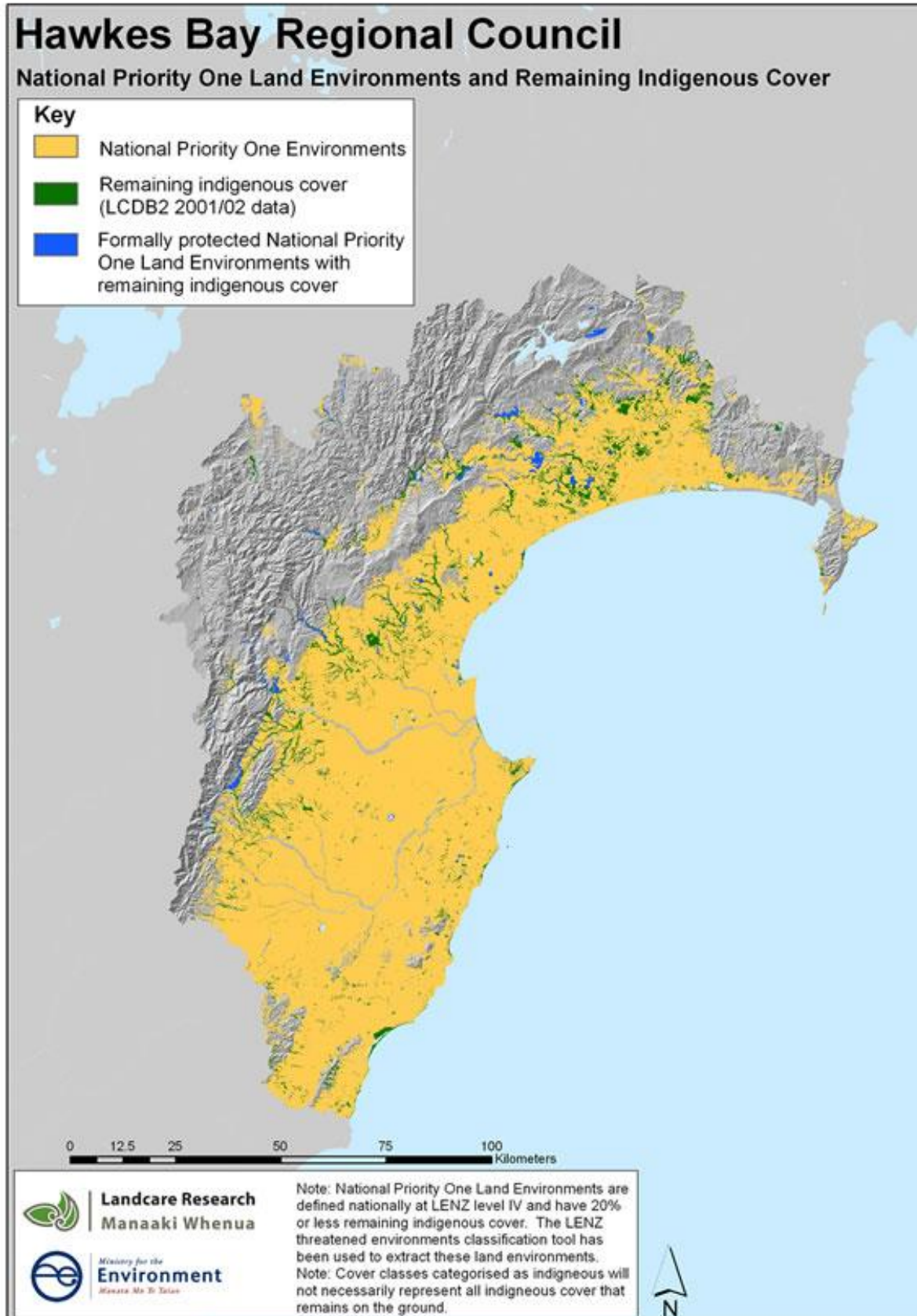
**Enhancement:** *The term enhancement is often used loosely, but in an ecological context it refers to an increase in the quality or quantity of some characteristic of a site or area. Whether this results in an improvement on the previous condition can be a subjective judgement.*

**Ecological engineering:** *It is possible to establish new combinations of plants and animals, both native and exotic, as biotic communities for conservation purposes; for example, as habitat for a threatened species. The extent to which some pine forests have been used by kiwi highlights the potential of this kind of management which is elsewhere called ecological engineering.*

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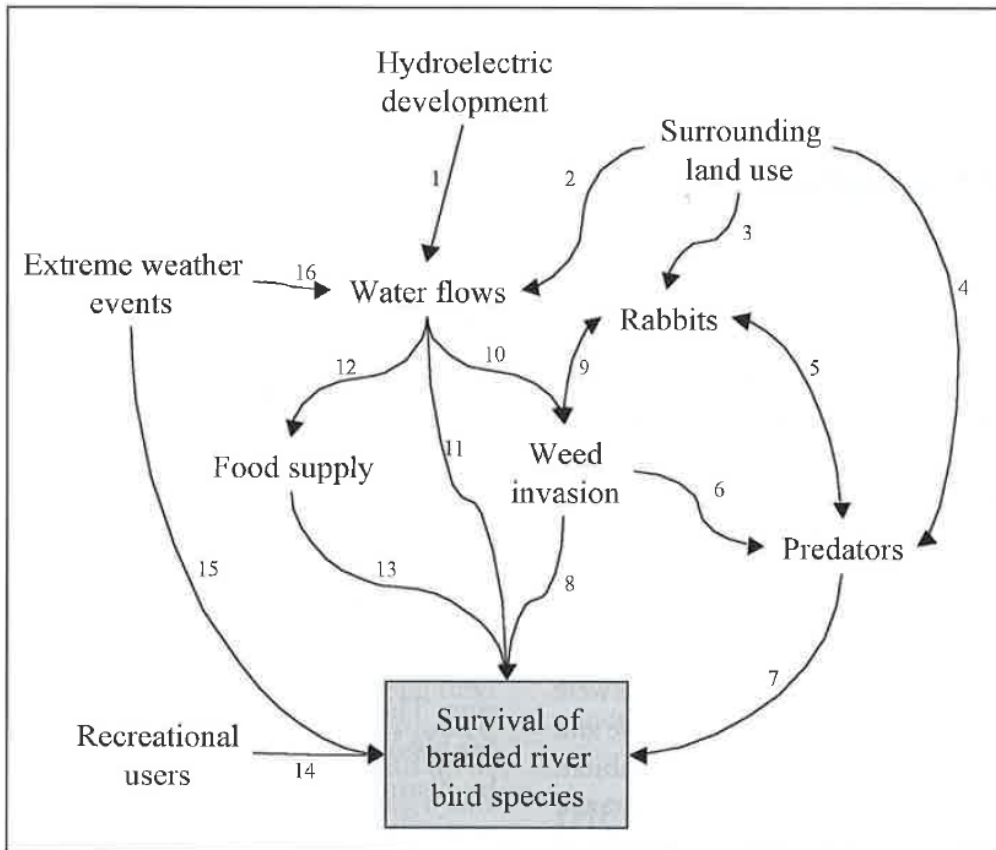
<sup>27</sup> See Atkinson, 1994.

## Appendix C: National Priority One Land Environments and remaining indigenous cover





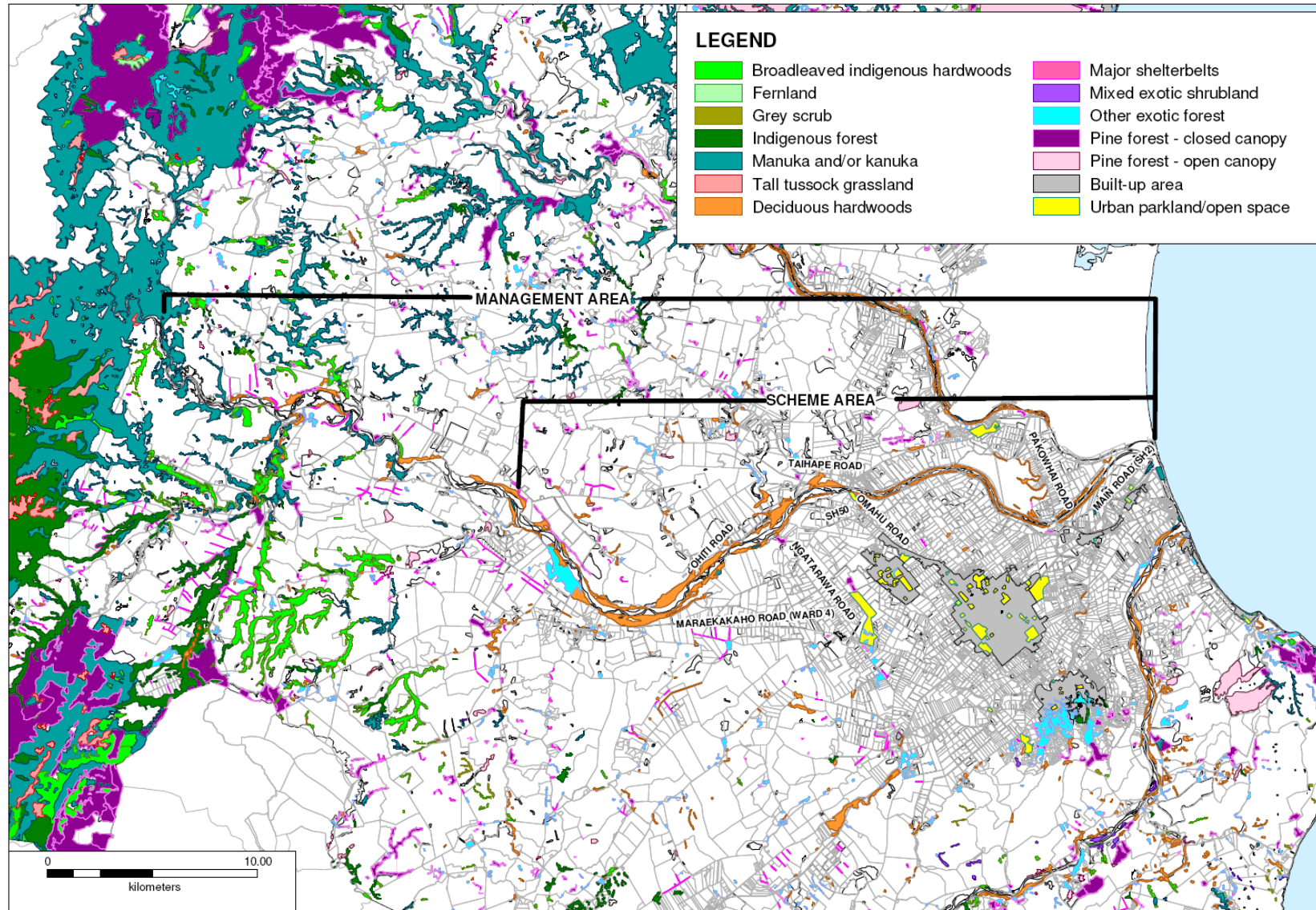
## Appendix D: River bird habitat interactions on braided riverbeds



**Figure 18.13** Interrelationships of some factors influencing the survival of braided-river birds. Examples of hypothesised interactions between the different factors include: 1 – water is redirected into canals for power generation, lowering river flows and flood frequencies; 2 – water is abstracted for irrigation of farmland, lowering river flows; 3 – rabbit control on farmland lowers rabbit abundance; 4 – differing land-use practices changes habitat availability for predators; 5 – predator abundance is altered by changes to rabbit abundance but also helps control rabbit abundance; 6 – vegetation on riverbeds provide cover for predators; 7 – predators prey on eggs, chicks and adults; 8 – weeds clog up breeding habitat and alter feeding habitat; 9 – vegetation provides cover and food for rabbits, but some weed species are controlled by rabbit grazing; 10 – lowered water flows and floods allow vegetation to establish on riverbed; 11 – floods destroy nests; 12 – lowered water flows can alter abundance of aquatic insects; 13 – food abundance can influence survival of young or condition of breeding adults; 14 – fishers, campers and four-wheel drivers can destroy nests or disturb breeding birds; 15 – extreme cold spells can kill eggs and chicks; 16 – high rainfalls can cause floods.

Source: R. Keedwell, Science & Research Unit, Department of Conservation, Christchurch.

## Appendix E: Existing forest/shrub communities of the landscape surrounding the management area



## Appendix F: Plant species which provide resources for birds and lizards

Plant species	Month of year	J	F	M	A	M	J	J	A	S	O	N	D
Botanical name	Common name												
<i>Alectryon excelsus</i> *	titoki	■	■								■	■	■
<i>Aristotelia serrata</i>	wineberry	■								■	■	■	■
<i>Callistemon</i> spp.	bottlebrush	▲	▲	▲	▲	▲					▲	▲	▲
<i>Beilschmiedia tawa</i>	tawa			■	■	■							
<i>Carpodetus serratus</i>	putaputaweta			■	■	■							
<i>Coprosma robusta</i>	karamu		■	■	■	■							
<i>Cordyline australis</i>	cabbage tree	■	■	■	■						▲	▲	▲
<i>Coriaria arborea</i>	tree tutu	▲	▲	■	■	■	■						▲
<i>Eucalyptus ficifolia</i> *	red-flowering gum	▲	▲	▲									▲
<i>Corynocarpus laevigatus</i>	karaka	■	■	■	■								
<i>Eucalyptus camaldulensis</i>	river red gum						▲	▲	▲	▲	▲		
<i>Eucalyptus cordata</i>	heart-leaved silver gum								▲	▲			
<i>Eucalyptus lansdowneana</i> spp <i>albopurpurea</i> *	crimson mallee gum				▲	▲	▲	▲					
<i>Eucalyptus leucoxyton 'Rosea'</i> *	yellow gum					▲	▲	▲	▲	▲			
<i>Eucalyptus sideroxyton</i> *	red ironbark gum					▲	▲	▲	▲	▲	▲		
<i>Eucalyptus stellulata</i>	black sally gum				▲	▲	▲	▲	▲	▲	▲		
<i>Hebe parviflora</i> var. <i>arborea</i>	tree hebe	▲	▲	▲									
<i>Hebe stricta</i>	koromiko	▲	▲	▲									
<i>Hoheria angustifolia</i>	narrow-leaved lacebark	▲	▲	▲									
<i>Knightia excelsa</i>	rewarewa										▲	▲	▲
<i>Kunzea ericoides</i>	kanuka									▲	▲	▲	
<i>Macropiper excelsum</i> *	kawakawa		■	■									
<i>Melicytus ramiflorus</i> *	mahoe		■	■	■								
<i>Muehlenbeckia complexa</i>	pohuehue	■	■	■	■	■			■	■	■	■	■
<i>Myoporum laetum</i>	ngaio										▲	▲	▲
<i>Myrsine australis</i>	mapou			■	■	■							
<i>Phormium cookianum</i>	mountain flax	▲									▲	▲	▲
<i>Phormium tenax</i>	New Zealand flax	▲										▲	▲
<i>Pittosporum tenuifolium</i>	kohuhu									▲	▲	▲	
<i>Podocarpus totara</i>	totara		■	■	■	■							
<i>Prumnopitys taxifolia</i>	matai			■	■	■							
<i>Pseudopanax arboreus</i>	five finger	■	■	■	■	■			■	■	■	■	■
<i>Schefflera digitata</i>	pate			■	■	■							
<i>Solanum aviculare</i>	poroporo			■	■	■	■	■	■	■	■	■	
<i>Sophora tetraptera</i>	kowhai								▲	▲	▲	▲	

Notes: ■ native fruit and seeds; ▲ native nectar; ▲ exotic nectar (▲ & ▲ can also denote flowers which attract insects, serving insectivorous animal guilds).

\* denotes plant species which are susceptible to frost damage when young.



## Appendix G: Plant species lists for revegetation of 5ha and 1ha revegetation patches

Below is a list of plant species suitable for revegetation in the 5ha and 1ha patches. The species composition and species proportion needs to be confirmed at the time of detailed project planning.

Species name					
Botanical name	Common name	E	N	Inland	Coastal
<b>Trees and shrubs</b>					
<i>Alectryon excelsus</i>	titoki	•		✓	✓
<i>Beilschmiedia tawa</i>	tawa	•		✓	
<i>Aristotelia serrata</i>	wineberry				
<i>Callistemon</i> spp.	bottlebrush		•	✓	✓
<i>Cassinia leptophylla</i>	tauhinu	•		✓	✓
<i>Chaemaecytisus palmensis</i>	tree lucerne		•	✓	✓
<i>Coprosma australis</i>	kanono	•		✓	
<i>Coprosma repens</i>	taupata	•			✓
<i>Coprosma robusta</i>	karamu	•		✓	
<i>Cordyline australis</i>	cabbage tree	•		✓	✓
<i>Coriaria arborea</i>	tree tutu	•		✓	
<i>Corynocarpus laevigatus</i>	karaka	•		✓	✓
<i>Eucalyptus camaldulensis</i>	river red gum		•	✓	✓
<i>Eucalyptus cordata</i>	heart-leaved silver gum		•	✓	✓
<i>Eucalyptus ficifolia</i>	red-flowering gum		•	✓	✓
<i>Eucalyptus lansdowneana</i> spp <i>albopurpurea</i>	crimson mallee gum		•	✓	✓
<i>Schefflera digitata</i>	pate	•		✓	
<i>Solanum aviculare</i>	poroporo	•		✓	
<i>Eucalyptus leucoxydon</i> 'Rosea'	yellow gum		•	✓	✓
<i>Eucalyptus sideroxydon</i>	red ironbark gum		•	✓	✓
<i>Eucalyptus stellulata</i>	black sally gum		•	✓	✓
<i>Hebe parviflora</i> var. <i>arborea</i>	tree hebe	•		✓	
<i>Hebe stricta</i>	koromiko	•		✓	
<i>Leptospermum ericoides</i>	kanuka	•		✓	✓
<i>Phormium cookianum</i>	mountain flax	•		✓	
<i>Phormium tenax</i>	New Zealand flax	•		✓	✓
<i>Prumnopitys taxifolia</i>	matai	•		✓	
<i>Meliccytus ramiflorus</i>	mahoe	•		✓	
<i>Myoporum laetum</i>	ngaio	•		✓	✓
<i>Myrsine australis</i>	red matipo	•		✓	
<i>Pittosporum eugenioides</i>	lemonwood	•		✓	
<i>Pittosporum ralphii</i>	-	•		✓	✓
<i>Pittosporum tenuifolium</i>	kohuhu	•		✓	
<i>Plagianthus divaricatus</i>	saltmarsh ribbonwood	•			✓
<i>Plagianthus regius</i>	lowland ribbonwood	•		✓	
<i>Podocarpus totara</i>	totara	•		✓	
<i>Pseudopanax arboreus</i>	five finger	•		✓	
<i>Sophora tetraptera</i>	kowhai	•		✓	✓

Note: species composition, proportions and layout to be determined by a suitably experienced ecologist.