Technical Report 26

# Ecological Impact Assessment

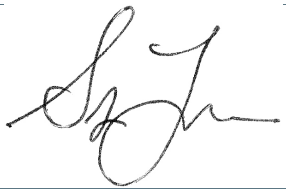
NZ TRANSPORT AGENCY
WAKA KOTAHI

MacKays to Peka Peka Expressway

## Revision History

| Revision Nº | Prepared By | Description | Date |
|---|---|---|---|
| 003 | Matiu Park | Awaiting SEV analysis | 8 Sep 2011 |
| 004 | Matiu Park | Draft for Peer Review | 14 Sep 2011 |
| 005 | Matiu Park | Draft for NZTA review | 26 Sep 2011 |
| 006 | Matiu Park | VE changes and NZTA, KCDC and legal review. | 28 Nov 2011 |
| 007 | Matiu Park | EPA completeness review changes | 16 Feb 2012 |
| 008 | Matiu Park | GWRC review changes | 16 Mar 2012 |

## Document Acceptance

| Action | Name | Signed | Date |
|---|---|---|---|
| Prepared by | Matiu Park |  | 23.03.2012 |
| Reviewed by | Stephen Fuller |  | 23.03.2012 |
| Approved by | Matiu Park |  | 23.03.2012 |
| on behalf of | Boffa Miskell Limited | | |

## Table of Contents


**1 Executive summary ..... 5**

1.1 Introduction ..... 5
1.2 Methodology ..... 5
1.3 Project description ..... 6
1.4 Existing environment ..... 7
1.5 Assessment of ecological value ..... 9
1.6 Project shaping process ..... 9
1.7 Assessment of ecological effects ..... 10
1.8 Recommendations for mitigation ..... 11
1.9 Monitoring ..... 13
1.10 Conclusions ..... 13

**2 Introduction ..... 14**

2.1 Project description ..... 14
2.2 Summary of environmental issues ..... 14
2.3 Study objectives and report structure ..... 15
2.4 Definition of terms ..... 16

**3 Methodology ..... 18**

3.1 Overview ..... 18
3.2 Investigation and assessment process ..... 18
3.3 The study area ..... 19
3.4 Ecological technical reports ..... 19
3.5 Project shaping ..... 25
3.6 Assessing ecological value ..... 25
3.7 Assessing significance of effects ..... 31
3.8 Report limitations ..... 33

**4 Statutory Context ..... 34**

4.1 Legislation ..... 34
4.2 Regional Plans And Strategies ..... 36
4.3 Kāpiti Coast District Plan ..... 37
4.4 Summary of statutory considerations ..... 37
4.5 NZ Transport Agency ..... 38

**5 Description of the existing environment ..... 38**

5.1 Environmental context ..... 38
5.2 Terrestrial flora and vegetation (including wetlands) ..... 42
5.3 Birds/avifauna ..... 46
5.4 Herpetofauna ..... 49
5.5 Terrestrial invertebrates ..... 50
5.6 Freshwater habitats and species ..... 50
5.7 Estuaries and stream mouths ..... 60

**6 Assessment of Ecological Value ..... 64**
6.1 Introduction ..... 64
6.2 Key assessment considerations ..... 64
6.3 Protected Natural Areas (PNAs) ..... 68
6.4 Significant Natural Areas (SNAs) ..... 69
6.5 Terrestrial vegetation & habitat ..... 73
6.6 Freshwater systems ..... 74
6.7 Estuarine systems ..... 75
6.8 Fauna ..... 76
6.9 Summary of sites of ecological value ..... 79
**7 Project Shaping ..... 86**
7.1 Historical context ..... 86
7.2 Route selection process ..... 86
7.3 The preferred Alignment ..... 88
7.4 Consenting team coordination ..... 90
7.5 Construction activities ..... 94
7.6 Ecological issues ..... 95
**8 Assessment of Construction Impacts ..... 96**
8.1 Direct impacts of construction ..... 97
8.2 Indirect impacts of construction ..... 116
**9 Assessment of operational impacts ..... 123**
9.1 Wetland hydrology ..... 123
9.2 Stormwater discharge ..... 127
9.3 Flora and fauna ..... 130
**10 Summary of construction and operation effects ..... 132**
**11 Proposed mitigation ..... 133**
11.1 Loss of terrestrial vegetation & habitats ..... 134
11.2 Loss of wetland vegetation & habitat ..... 135
11.3 Loss and modification of freshwater habitats ..... 141
11.4 Potential changes to wetland hydrology ..... 145
11.5 Sediment discharge to te harakeke/kawakahia wetland ..... 148
11.6 Mortality or displacement of indigenous fauna ..... 149
11.7 Recommended consenting and management requirements ..... 150
**12 Assessment of residual impacts following mitigation ..... 163**
12.1 Summary of residual impacts following mitigation ..... 168
**13 Summary and conclusions ..... 169**
13.1 Potential adverse ecological effects ..... 169
13.2 Summary of mitigation proposed ..... 170
13.3 Potential positive ecological effects ..... 172
13.4 Summary of monitoring proposed ..... 172
13.5 Conclusions ..... 173

**References** ..... 177

## Appendices

Appendix A: Threat Classification ..... 180
Appendix B: Ecological Constraints Desktop Analsysis ..... 183
Appendix C: Description of All Stream Works ..... 184
Appendix D: Stream Works Descriptions for Valued Streams ..... 187
Appendix E: Stream Metrics for Valued Streams (At Stream Works Location) ..... 189
Appendix F: SEV Current and Potential Scores for all Valued Streams ..... 191
Appendix G: SEV Calculations for Culvert, Diversion and Bridging of Valued Streams ..... 192
Appendix H: Ecological Mitigation Ratios for stream works in valued streams ..... 194
Appendix I: Landscape and amenity planting ..... 1

## Figures

Figure 1 Study Area and Territorial Boundaries ..... 17
Figure 2 Geology and Geomorphology of the study area ..... 41
Figure 3: Vegetation of the Study Area (based on LCDBII) ..... 45
Figure 4: Streams and Catchments of the Study Area ..... 59
Figure 5: Estuarine and stream mouth systems of the study area ..... 63
Figure 6: Land Environments of the Study Area and their Threat Classification (Derived from LENZ) ..... 67
Figure 7: PNA and SNA Locations ..... 72
Figure 8: Significant Ecological Areas of the Study Area (Maps a – d) ..... 82
Figure 9 Extent of Wetland Vegetation Affected (Maps a – d) ..... 100
Figure 10 Mitigation Sites (Maps a – d) ..... 158

# 1 Executive summary

## 1.1 Introduction

This Ecological Impact Assessment (EcIA) sets out the findings of the environmental investigations undertaken as to the potential ecological effects of the proposed MacKays to Peka Peka Expressway Project (the Expressway). The ecological investigations included are:

- Terrestrial flora and habitats (including wetlands);
- Herpetofauna;
- Avifauna;
- Freshwater; and
- Marine ecology.

The purpose of this EcIA is to map and describe the values of ecological systems that occur along the proposed Expressway Alignment and to describe the distribution and abundance of native flora and fauna within or in close proximity to the Designation. The potential ecological effects of both the construction phase and ongoing operation of the proposed Expressway are also assessed and options to mitigate potential or actual adverse effects are recommended and discussed, including management and monitoring.

## 1.2 Methodology

### Terrestrial flora and habitats

A desktop review of literature undertaken as part of this assessment focused botanical investigations on those areas of habitat within or adjacent to the proposed Expressway that were most likely to have species or habitats of conservation value (including rare species).

All vegetation within and immediately adjacent to the proposed Expressway Designation was mapped using high resolution aerial photographs and field verification. Wetland vegetation and condition plots were undertaken in key wetlands to better describe those areas of indigenous vegetation that are potentially affected.

### Terrestrial fauna

Investigations of terrestrial fauna included surveys of lizards and birds and the identification of the habitats in which they occur.

### Freshwater habitats and species

A range of measures of stream condition and of associated aquatic fauna were collected to assist the ecological investigations and to allow regional importance and sensitivities to be assessed. The four areas of investigation were:

- physical habitat data, i.e. stream morphology, substrate type, riparian condition etc;
- water quality (collected primarily by Beca);
- water quantity (collected by Beca); and
- flora and fauna (aquatic macro invertebrates, fish and aquatic macrophyte data).

### Estuarine and stream mouth habitats and species

Intertidal surveys of infaunal and epifaunal invertebrates, sediment grain size, sediment quality, depth of oxygenation of sediment and macroalgal cover were undertaken at the mouths of streams that are likely to receive both construction and operational phase stormwater from the proposed Expressway. These streams included the Waikanae Estuary Scientific Reserve and the Waimeha and Wharemauku Stream mouths.

### Assessment of significance

Assessments of ecological significance were carried out for all areas of indigenous flora and fauna habitats based on a range of criteria, including those contained within national guidelines and policies, Environment Court decisions, and regional plans.

### Project shaping

The Project Shaping phase drew on the technical investigations to develop a design philosophy and inform a range of design changes. Consultation with a range of stakeholders also influenced some design changes. The goal through this process was to avoid or minimise effects. The scale of potential effects on terrestrial and aquatic habitats that could not be avoided is described in this Report.

### Assessment of effects

The methodology for assessment of ecological effects drew on international guidance. It included the following steps:

- The predicted magnitude of effects of construction and operation of the proposed Expressway;
- The degree of mitigation required to offset these effects, including the methodology and associated monitoring; and
- The significance of any residual effects that remain after mitigation has been applied.

## 1.3 Project description

The MacKays to Peka Peka Designation consists of an approximately 16 km proposed Expressway from just north of MacKays Crossing to just north of Peka Peka Road. The proposed Expressway would have a general width of 100m providing for two lanes of traffic in each direction, connections with local roads at four interchanges, construction of new local roads and access roads to maintain local connectivity and an additional crossing of the Waikanae River. A shared cycleway/walkway is proposed within the Designation along its length.

The potential extent of works within the Project Footprint, including construction access tracks, disposal sites, site accommodation, lay-down areas, and erosion and sediment control devices, is defined by the Designation and is approximately 164 ha in area. Construction of the proposed Expressway will require the excavation of large amounts of material, with large amounts of peat relocated to fill sites and mitigation areas. Construction will require extensive erosion and sediment control to protect streams, wetland systems, estuarine and stream mouth systems.

The proposed Expressway will require the removal of approximately 1.8 ha of indigenous wetland habitat and 3.8 ha of secondary regenerating native forest within the Project Footprint (a total of 5.6 ha).

The proposed Expressway will require approximately 30 intermittent or perennial stream crossings, 8 by bridge and 22 by culvert. This will affect 1,431 m of stream. There will also be approximately 1,525 m of stream diversions and 2,016 m of new streams constructed.

## 1.4 Existing environment

The entire proposed Expressway Alignment is located within the Foxton Ecological District; which is defined by the dune topography and associated vegetation. Wind is a dominating feature of the climate with north-westerly gales common and affecting the dune landscape, vegetation and land uses.

A great part of the Foxton Ecological District would have been swamp forest dominated by kahikatea and pukatea with rimu and swamp maire, with shrubs and trees dominating inland of the coast. These original forests are now reduced to several small remnants, less than 5% of the surface area is predominantly indigenous vegetation.

The Ecological District also contained extensive dune wetlands and lakes, and connecting waterways. Major drainage works for farming have resulted in the loss of most of these natural lakes and wetland systems throughout the area, and many streams have been channelised. Dune lakes and peat swamps now account for only a small part of the Ecological District (Ravine, 1992).

### Vegetation, communities and habitats

The majority of the proposed Designation lies in a highly modified pastoral landscape, with:

- 70% in pasture and grasslands
- 16% plantation forestry or other exotic forest and trees;
- 9% in pioneer shrublands, scrub and low forest; and
- 4% of the Designation is classed as urban.

Indigenous forest makes up less than 0.5% of the vegetation communities potentially affected and indigenous wetlands comprise approximately 1.2% of the Project Footprint.

### Herpetofauna

One species of common lizard (O*ligosoma polychrome)* was observed in high numbers within the proposed Designation. No species of conservation concern were found although they may be present in very low numbers.

### Avifauna

A total of 41 bird species (excluding dabchick) were recorded along the proposed Expressway Alignment. Of the 22 native species recorded, two species are “Threatened” (bittern and pied shag) and three species are “At Risk” (pipit, black shag and fernbird).

The wetlands in the less developed area of the Alignment north of Te Moana Road (comprising Te Harakeke/Kawakahia Wetland, Ti Kouka Wetland, Ngarara Wetland and Nga Manu Nature Reserve) provide the best quality habitat for freshwater bird species due to the extent and diversity of habitat types present. This area is of particular importance to Threatened and At Risk avian species in the district.

The estuary and stream mouths downstream (including the Whareroa, Wharemauku, Waikanae, Waimeha, and Hadfield / Kowhai estuaries) provide habitat for estuarine and coastal bird species.

### Freshwater habitats & species

The proposed Expressway traverses multiple tributaries of four and the main stems of three streams which are listed in the proposed Regional Policy Statement as providing habitat for nationally threatened indigenous fish. The streams are:

- Whareroa Stream (tributary only traversed)
- Wharemauku Stream (tributaries and main stem)
- Waikanae River (tributaries and main stem)
- Waimeha Stream (Tributaries and main stem)

Of the multiple tributaries 15 perennial streams were identified and studied. The remaining waterways were typically drains, or ephemeral.

Freshwater investigations of the 15 streams described the distribution and abundance of native fish species including eight species that are of conservation concern (nationally Threatened or At Risk). Much of the physical stream habitat has been highly modified, and in some cases ecologically compromised by upstream or surrounding land use. Studies of aquatic macro-invertebrate communities were used to understand the stream habitat quality, many of which were identified as having water quality issues indicating that only robust and tolerant species were able to persist and flourish. Many species sensitive to water quality issues were absent from streams studied.

Finally, water quality sampling during both base flows and storm events highlighted issues with heavy metal and nutrient contaminants in a number of these streams, derived from both rural runoff and urban stormwater.

### Marine habitats & species

The marine assessment considered three estuarine and stream mouths:

- Wharemauku Stream
- Waikanae River Estuary
- Waimeha Stream.

Both the Wharemauku and Waimeha Stream mouths have a low diversity and abundance of invertebrates dominated by non-sensitive invertebrate species. Both these stream mouths have a moderate degree of modification of the marine habitat, including channelisation, management of stream/river mouths, and periodic realignment of the Waimeha Stream drainage channel through the sandflats directly out to sea.

The Waikanae River Estuary was similar to the Waimeha and Wharemauku stream mouths in terms of being dominated by the sand grain size, having low concentrations of contaminants and no epifaunal or macroalgae present (but with additional common features). The Waikanae River Estuary had an invertebrate assemblage dominated by a high abundance of amphipods and gastropods, including a number of sensitive invertebrate species. The Waikanae River Estuary was much less modified, comprising largely unmodified estuarine and saltmarsh habitat.

## 1.5 Assessment of ecological value

### Terrestrial flora, fauna and habitats

In total 32 areas of indigenous vegetation, including 25 wetlands, considered to have ecological value were identified within or in close proximity to the proposed Expressway. As part of this assessment, key vegetation communities and habitats within these areas that will be potentially affected were identified.

### Freshwater flora, fauna and habitats

A combination of fish presence, invertebrate indices, and habitat scores were used to assess the ecological value of each stream that is affected.

The aquatic fauna and physical habitat of most streams traversed by the proposed Expressway were generally considered to be degraded. Only the Waikanae River is considered to be of high (regional) value in terms of important fauna species and habitat integrity. Accordingly, the maintenance of water quality and ecological diversity in the lower reaches of the Waikanae system is of high importance.

### Harbours and estuaries

The ecological values of the intertidal marine habitat in the Wharemauku Stream mouth, Waikanae River estuary and Waimeha Stream mouth are considered to be high, despite the modifications to the Wharemauku and Waimeha stream mouths and the generally low diversity of benthic fauna in these two stream mouths.

### Protected and significant natural areas

The proposed Expressway Designation includes the edge of two protected natural areas (reserves, covenants, Regional Parks), although both are outside of the Project Footprint: Queen Elizabeth Park and Ti Kouka Wetland. Four protected natural areas are located downstream of works.

The proposed Expressway Designation also traverses 13 unprotected sites which have been identified by earlier biological surveys and our field assessments as having conservation value.

## 1.6 Project shaping process

Project shaping formed an important component of ecological involvement in the proposed Expressway design. The shaping process succeeded in influencing a number of aspects of the proposed Expressway design to avoid or minimise adverse effects on ecological systems. This commenced with the Scheme Assessment stage where ecological considerations formed key assessment criteria, and continued through to final Project design and Designation.

The most significant changes made during Project shaping were the avoidance of a number of statutorily recognised wetlands along the length of the proposed Expressway, including at Raumati South, El Rancho and north of Te Moana Road (including Te Harakeke/Kawakahia Wetland, Ti Kouka Wetland and Ngarara Wetland). These changes avoided the most significant potential effects to indigenous vegetation.

Ongoing design benefited from the more detailed ecological investigations with continued refinements of the proposed Expressway further reducing effects on indigenous wetlands, habitats and freshwater systems. Ecological involvement also assisted with the design and

location of stormwater treatment and flood storage areas, bridge and culvert locations, groundwater studies, stormwater sampling, contaminant modelling and sediment and erosion control structures.

## 1.7 Assessment of ecological effects

Ecological effects associated with proposed Expressway construction can be separated into "Direct Effects" and "Indirect Effects". These are summarised below.

### Direct impacts of construction

The proposed Expressway Alignment is proposed within a highly modified landscape dominated by a mix of farming and rural lifestyle blocks and residential areas. The long-standing existing WLR designation has resulted in a number of sites of indigenous vegetation and habitat being protected and maintained. However, a number of these sites will be lost or modified by the proposed Expressway.

The key effects of construction of the proposed Expressway are:

- Permanent loss of approximately 5.6 ha of indigenous vegetation and habitat beneath the proposed Expressway (comprising 1.8 ha of wetlands, 3.8 ha of regenerating shrublands, scrub and low forest and 0.01 ha of mature or maturing forest);
- Potential loss or modification to a further 7.4 ha of indigenous vegetation due to earthworks and construction activities within the proposed Expressway Designation;
- Permanent loss and modification of 1,431 lineal metres of freshwater habitat, riparian margins, and resident populations of freshwater flora and fauna, in perennial or intermittent streams due to culverting and bridge construction;
- Loss and modifications to a further 1,525 m of freshwater habitat and riparian margins within perennial and intermittent streams, through diversion and associated stream shortening;
- Potential loss of sedentary species (e.g. lizards) when their habitat is removed;
- Disturbance and displacement of mobile species (e.g. birds) by construction activity; and
- Potential impact on the movement of migratory fish by streambed modifications and culverts.
- With the exception of a population of North Island fernbird near Nga Manu Nature Reserve, effects on terrestrial fauna and avifauna have been assessed to be very low or low, as most key wetland and terrestrial habitat had been avoided.

This ecological assessment concluded that the significance of effects on vegetation and terrestrial habitat would range from very low to moderate depending on the ecological values of the site and the magnitude of effect. Some mitigation is required for adverse effects, and is discussed in detail in this Report.

The direct effects on freshwater systems along the proposed Expressway Alignment also varied from very low to high. Effects on freshwater fauna would be high due to the permanent loss of significant areas of stream habitat and the expected reduction of habitat values within the extensive diversions required. These effects need to be mitigated.

### Indirect impacts of construction

The key indirect effects during construction will be:

- Potential increase of sediment within stream habitats above baseline levels with potential impacts on streams and freshwater fauna; and
- Potential increase of sediment discharging to the Waikanae Estuary, Waimeha and Wharemauku Stream mouths and Te Harakeke/Kawakahia Wetland above baseline levels with potential impacts on habitats, vegetation and species reliant on these waterbodies.

Overall, we conclude that the effects of sedimentation to streams, wetlands and estuarine systems will be low.

### Operational impacts

The key effects during operation of the proposed Expressway will be:

- Potential drawdown of groundwater and raising / damming of groundwater resulting in adverse effects on wetland hydrology, particularly Raumati Manuka Wetland, Otaihanga Wetlands, El Rancho Wetland (Weggery), Ti Kouka Wetland and Ngarara Wetland.
- Potential discharge of contaminated stormwater from the proposed Expressway surface to local streams and estuaries, with potential impacts on water and habitat quality, and effects on sensitive taxa; and
- Potential effects of proposed Expressway operation on North Island fernbird populations in the wider vicinity of Nga Manu Nature Reserve.

Based on the results of contaminant modelling, we conclude that effects of stormwater runoff to streams and estuarine systems will be low to negligible as a result of the re-distribution of traffic from existing SH1 to the proposed Expressway and the increase in stormwater runoff treatment proposed.

## 1.8 Recommendations for mitigation

### Direct impacts of construction

Ecological mitigation ratios were derived, using existing methodologies where available, to determine the value of the habitat being affected and quantity of mitigation that would be required for loss.

For the loss of 1.8 ha of wetland habitat along the proposed Expressway Alignment, we have recommended the restoration and retirement of approximately 5.4 ha of wetlands in three locations: adjacent to the Paraparaumu Wastewater Treatment Plant (1.2 ha in total), within the Central Otaihanga Wetland (0.4 ha) and at the former Waikanae Oxidation Ponds (minimum of 3.8 ha area restored). These three sites were chosen as they have the widest range of ecological restoration potential and because of their proximity to the area of effects. These three locations were discussed with KCDC, GWRC and DoC.

After a review of all potential wetland restoration or enhancement opportunities within the study area, the former Waikanae Oxidation Ponds were chosen as representing the best mitigation opportunity outside of the Designation. These ponds are located in the middle of the larger, nationally recognised, Te Harakeke/Kawakahia Wetland. This area has an existing ecological restoration plan agreed by KCDC and the restoration potential of the scale of mitigation required to mitigate the effects associated with wetland habitat loss of the proposed Expressway. In the absence of another project of this scale, it is considered

unlikely that the ambitions of the existing restoration plan in terms of surplus peat availability, infilling and restoration planting are likely to be met. The wider Te Harakeke/Kawakahia wetland complex surrounding the former Waikanae Oxidation Ponds is identified by numerous reports and inventories as containing some of the most ecologically significant indigenous vegetation and habitats and the highest concentration of species of conservation concern. Accordingly, restoring this area as mitigation for the loss of wetland vegetation along the proposed Expressway will have long-term ecological benefits for the wider wetland and Pharazyn Reserve area.

For the loss of 3.8 ha of terrestrial vegetation (kanuka forest, regenerating mahoe and mature indigenous forest) along the proposed Expressway Alignment, we have recommended a minimum of 7.6 ha of mixed indigenous planting close to areas of vegetation being lost or areas of ecologically valuable habitat within the Designation as part of the wider landscape and amenity planting. This approach has been taken to maintain and overall improve the wider ecological corridor benefits along the length of the proposed Expressway.

Although not taken into account in the mitigation developed for terrestrial vegetation and wetland loss, it is also anticipated that there will be permanent habitat benefits associated with the development and associated wetland planting of stormwater treatment wetlands and flood detention wetland along the proposed Expressway Alignment. Similarly, the 97 ha of specific indigenous landscaping, amenity and noise mitigation planting are anticipated to have wider ecological habitat benefits for indigenous flora and fauna.

As mitigation for the loss and modification of 1,119 m freshwater habitat through culverting, the loss and modification of 312 m of freshwater habitat by bridges and associated armouring and the loss and modification of 1,525 m of freshwater habitat through stream diversions and modifications, we have recommended the retirement and riparian planting of 4,973 m of stream habitat using the Stream Ecological Valuation (SEV) model. This mitigation is based on a combination of 20 m or 10m wide riparian planting upstream and downstream at each of the 22 culvert locations within perennial and intermittent waterbodies culverted by the proposed Expressway, the construction and restoration of new stream channels and the permanent restoration and retirement of specific reaches of the Wharemauku, Waimeha, Kakariki and Paetawa streams and the Waikanae River. This habitat enhancement is anticipated to provide additional refuge for stream faunal communities immediately adjacent to the area of effects. Given the highly modified nature of most of these waterbodies traversed, this restoration and permanent protection will have long-term benefits.

In total, the effects of stream loss and habitat modification (2,956 m) have been calculated to require mitigation of 4,973 m of stream restoration. A total of 4,716 m of stream restoration has been identified and incorporated into the proposed Expressway design, leaving a small shortfall of approximately 257 lineal metres. This shortfall has been addressed through mass indigenous wetland planting within the approximately 13 ha of flood storage areas and where these allow for fish passage.

### Indirect impacts of construction

Indirect effects largely relate to potential downstream impacts of sediment from earthworks on streams, wetlands and the Waikanae Estuary. A range of measures are proposed for the management of erosion, and the capture and treatment of sediment during construction treatment devices have been designed to exceed regional guidelines.

### Operational impacts

The Project design has incorporated a mix of stormwater treatment swales along the length of the Alignment and a number of larger treatment wetlands. These devices are expected to perform so that the levels of contaminants in stormwater discharging to streams and the stream mouths and estuaries will not increase.

An adaptive management process has been developed to monitor and remedy potential adverse effects arising from changes to wetland hydrology as a result of the proposed Expressway.

## 1.9 Monitoring

A number of recommendations are made in Section 11.7 for baseline and construction monitoring and for consent conditions that will provide some certainty of outcome from the mitigation proposed.

## 1.10 Conclusions

The proposed MacKay's to Peka Peka Expressway is a major infrastructure project which traverses a number of sensitive and ecologically significant environments on the Kāpiti Coast. Given the sensitivity of these environments, ecological involvement has formed an important component of the proposed Expressway design to avoid or minimise effects. We are satisfied that every opportunity to avoid and minimise ecological effects has been explored.

Despite ecological involvement, the nature of the study area has meant that some areas of indigenous vegetation and wetland and some significant lengths of stream will be affected. Because some of the areas affected consist of wetlands, this will lead, at least in the short term, to significant and unavoidable ecological effects. There are also some uncertainties as to the extent of potential hydrological effects on wetlands located in close proximity to the proposed Expressway. A number of measures, including a prescribed adaptive management approach, have therefore been recommended to monitor and mitigate these effects. Overall, if the recommended mitigation is undertaken, most ecological effects are considered to be neutral and in some cases will lead to long-term ecological benefits.

The impacts on freshwater systems associated with culverting and diversions have been mitigated through stream restoration. Best practice erosion and sediment control mechanisms during construction will assist in reducing potential sediment-laden run-off reaching the ecologically sensitive downstream receiving environments. As a result of the combination of stormwater treatment mechanisms incorporated into the proposed Expressway design, an overall reduction is predicted in the levels of sediment volumes and stormwater contaminants from the operation of the proposed Expressway.

Overall, the level of stormwater treatment proposed combined with the reduction in traffic from the existing SH1 (from which untreated stormwater discharges directly too many of the same waterbodies traversed), is anticipated to lead to reduced levels of contaminant loading to the waterbodies downstream of the proposed Expressway Alignment in the long-term. This level of treatment appropriately considers the high value wetland, estuarine and stream mouth habitats downstream of the proposed Expressway Alignment.

# 2 Introduction

## 2.1 Project description

A detailed Project description is outlined in Part D, Chapters 7 and 8, Volume 2 of the AEE.

This assessment summarises the ecological investigations undertaken as part of the Project. This assessment is of potential adverse effects of both the construction and ongoing operation of the proposed Expressway; and measures to mitigate potential or actual adverse effects of the Project.

It draws on the findings of five separate technical reports, each exploring and describing a different aspect of the local ecology. Each of these technical reports record desktop and site investigations and provide information about the existing environment together with an evaluation of habitats, species and their interactions, as appropriate to the topic.

The proposed Expressway Alignment has been divided into four geographic sectors. Each of the sectors covers a geographic area that is described in Table 1 below. For a comprehensive description of each Sector, refer to the full Project description in Part D, Chapters 7 and 8, Volume 2 of the AEE.

**Table 1: MacKays to Peka Peka Expressway Sector Description**

| Sector number | Sector name | Description | Chainage (m) | Length (km) |
|---|---|---|---|---|
| 1 | Raumati South | From MacKays Crossing to just north of Raumati Road | 1900 – 4500 | 2.5 |
| 2 | Raumati / Paraparaumu | From north of Raumati Road to north of Mazengarb Road | 4500 – 8300 | 3.8 |
| 3 | Otaihanga / Waikanae | From north of Mazengarb Road to north of Te Moana Road | 8300 – 12400 | 4.1 |
| 4 | Waikanae North | From north of Te Moana Road to Peka Peka | 12400 – 18050 | 5.7 |

## 2.2 Summary of environmental issues

The proposed Expressway Alignment largely follows the existing Western Link Road (WLR) designation (refer Section 7.1 of this report), with a number of variations. Accordingly, the key environmental issues of the proposed Alignment are well understood.

Given the highly developed residential nature of much of the Kāpiti Coast combined with the long-standing existing WLR designation, much of the landscape through which the proposed Expressway is proposed has been highly modified. There is little remnant indigenous vegetation remaining and the ecological areas that currently exist are predominantly highly modified by historical land clearance, swamp drainage and residential development. However, there are a large number of wetlands in close proximity to the proposed Expressway Alignment, many of which have high ecological values.

The Alignment crosses five catchments, all of which discharge to the Tasman Sea. A number of the streams and drains traversed by the proposed Expressway enter estuarine systems. The waterbodies traversed have a range of values, and a number of them are known for their ecological values. Lengths of stream habitat will be lost due to culverting and associated

construction activities. Similar lengths of stream will suffer from temporary or permanent diversion.

None of the areas within close proximity, or downstream, of the Alignment are listed in the Wellington Regional Policy Statement (RPS) as a site of national or regional significance for indigenous vegetation or significant habitats for indigenous fauna. The Te Harakeke/Kawakahia Wetland is the only waterbody downstream of the proposed Expressway listed in the Regional Freshwater Plan as surface water to be managed in its natural state or surface water to be managed for aquatic ecosystem purposes (Appendix 2).

A small portion of Queen Elizabeth Park, a Greater Wellington Regional Council (GWRC)-administered regional park, is traversed by the proposed Expressway Alignment in the south.

## 2.3 Study objectives and report structure

The purpose of this EcIA is to take the findings of the investigations reported in the five technical reports (in terms of ecological values) and assess the potential and actual effects on the ecological values described. From this, the EcIA then sets out the mitigation recommended to address adverse effects and monitoring to ensure that desirable outcomes are achieved.

This report has the following structure:

| | |
|---|---|
| Section 1 | Provides an executive summary of the EcIA. |
| Section 2 | Introduces the Expressway Project and the nature of this assessment. |
| Section 3 | Summarises the methods used in the technical reports to evaluate the ecological components; and the method of ecological impact assessment used in this report. |
| Section 4 | Provides an overview of the planning context in which the assessment is carried out. For the purposes of this report, the statutory planning documents provide the community or society's assessment of "value" of ecological components (for example, through methods associated with indigenousness of vegetation), the sites where they occur (for example, through compilation of list of "sites of significance"), and the levels of adverse effect considered acceptable (for example, through the mitigation hierarchy). |
| Section 5 | Gives a description of the Project scope, activities, quantities and areas and provides a description of the existing environment, by summarising the findings of the technical reports and providing an account of the important interactions and sites at which they occur. |
| Section 6 | Assesses the ecological values and significance of species, habitats. |
| Section 7 | Describes the shaping of the Project that has occurred as a result of ecological involvement, in particular areas where design changes have led to the avoidance or reduction of identified adverse effects, and where design has led to potential positive ecological effects. |
| Sections 8, 0 & 10 | Assesses the potential positive and adverse effects of the Project. This section is divided into "Construction Effects" and "Operational Effects". |
| Section 11 | Sets out the proposed mitigation for potentially significant adverse effects of construction and operation. |
| Section 12 | Addresses the residual impacts following mitigation. |
| Section 13 | Summarises the ecological values, predicted effects and proposed mitigation and provides a final conclusion. |

## 2.4 Definition of terms

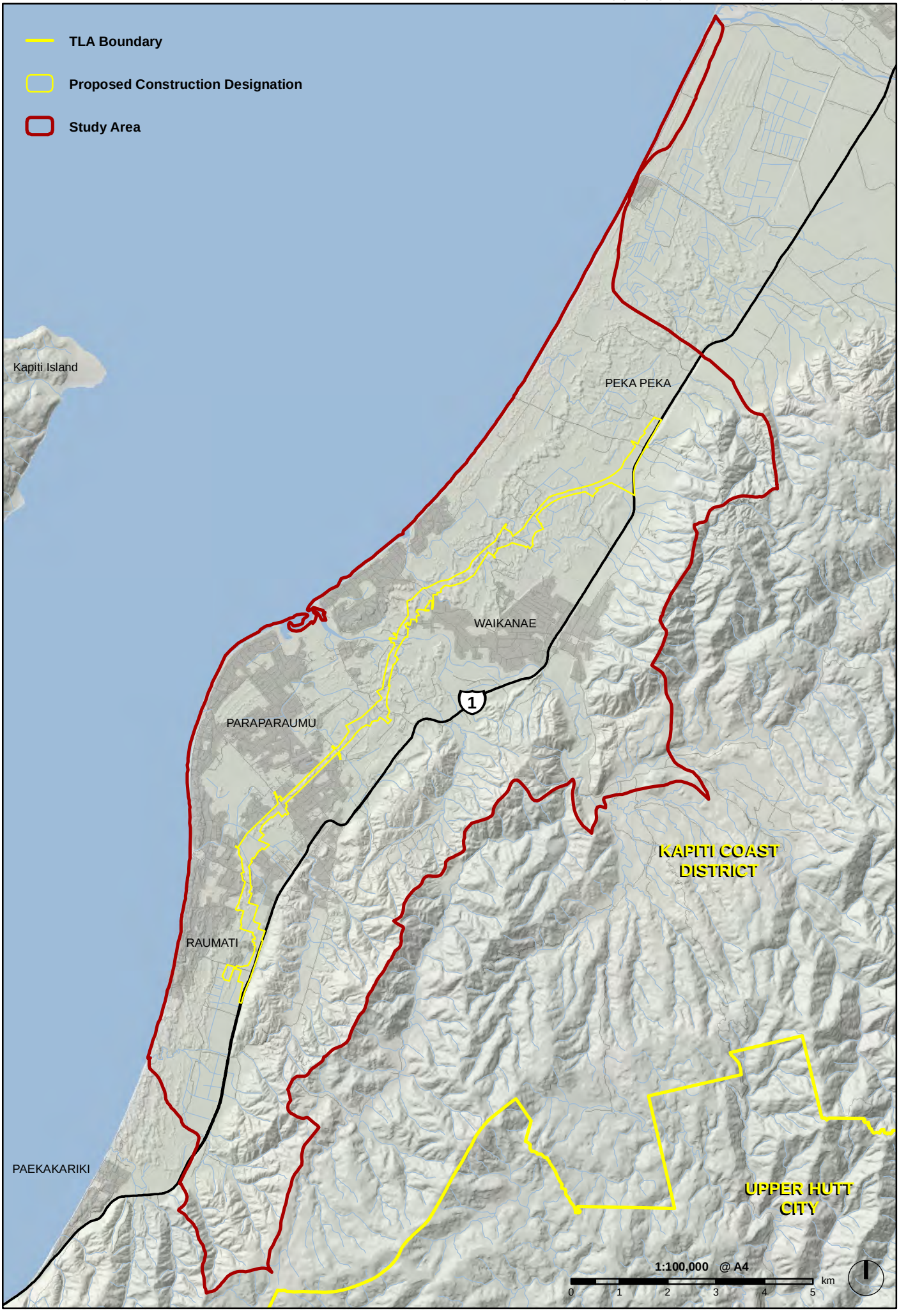
"Project Footprint" refers to the earthworks extent for the proposed Expressway including both the road surface and associated cuts and fills, but does not involve subsidiary works such as fill sites and sediment treatment devices which have not yet been designed. The Project Footprint has an area of 164 ha.

"Designation" refers to the construction Designation. The Designation defines the maximum extent of direct effects on the sites ecology. This is on the understanding that, except where noted, the Designation has been determined to enclose all necessary construction activities, including the proposed Expressway and all subsidiary work such as sediment treatment and fill disposal and mitigation works. The proposed Expressway Designation has an area of 316 ha.

"Study Area" refers to all land, water bodies and receiving environments that could be potentially affected by the Project including all downstream receiving environments. To provide consistency between this and the other ecology technical reports the study area includes all catchments that are crossed by the main Alignment. It has a total area of 10,808 ha. The study area is shown in Figure 1.

"Expressway Alignment" is generally used interchangeably with "Designation" in this report and the other ecological technical reports. However, the proposed Expressway Alignment tends to be a more generic term which includes reference to immediately adjacent environments which may fall outside the Designation.

Descriptions of the route in the EcIA are typically divided into Sectors (see section 2.1).




November 18, 2011 W091181E_ECIA_Statutory_A4.mxd

# 3 Methodology

## 3.1 Overview

This Section comprises:

- A summary of the investigation and assessment process;
- A summary of the scoping process to determine places/sites of potential ecological value and the envelope within which potential effects may occur;
- A summary of the methods used for field investigations and the assessment of ecological value;
- A description of the Project shaping process used to "avoid" some potential adverse effects;
- Methodologies used to ascribe ecological value to places/sites based on species, habitat and ecological processes (drawn from technical reports);
- A method for assessing potential effects; and
- Methods for determining mitigation requirements.

## 3.2 Investigation and assessment process

The process for carrying out an ecological impact assessment is well understood and would normally include the following steps (Treweek, 1999), (IEEM, 2006):

### Scoping

Determine the extent of matters that should be covered in the assessment of effects;

- The statutory context: environmental legislation, plans and policies (see section 4).
- The range and scale of activities that could affect the environment (see section 5).
- Preliminary investigations to determine the ecological resources potentially affected (see section 6).
- Identification of stakeholders that need to be consulted (see section 7).

### Ecological investigations and assessment of ecological value

Carry out appropriate desktop studies and field investigations to accurately describe the presence, distribution and abundance of flora and fauna, and to understand the underlying ecology, habitats, corridors, and natural processes (see section 5).

From the desktop and field investigations assess the values and current condition of the ecological features/biodiversity components including their ecological and conservation importance (see section 6).

### Impact assessment

Once the existing ecological value of an area of vegetation or habitat has been determined, the steps for assessing effects on ecological values are:

- Assess the magnitude of the effects that may occur on those populations.
- Integrate the site or population of ecological value and magnitude of potential impact into an overall assessment of effects.

- Determine the likely effects of each activity on the ecological components, their scale, duration and severity.
- Reach conclusions on the significance and acceptability of the predicted effects (see section 0).

**Impact mitigation**

Refine the Project to avoid or minimise effects, or maximise potential benefits (see section 11).

**Impact evaluation**

Assess the refined Project. Determine the significance and importance of predicted residual effects once Project shaping has been carried out and with the recommended mitigation in effect (see section 12).

**Monitoring and reporting**

Recommendations for additional pre construction monitoring to improve baseline understanding.

Recommendations for construction and post construction monitoring to assess implementation and compliance (see section 13).

## 3.3 The study area

For the purpose of this assessment the "Study Area" has been defined as all land, water bodies and receiving environments that could be potentially affected by the Project.

The study area was defined to encompass all ecological components likely to be directly affected (including through effects associated with water table changes), mobile populations whose ranges may extend some distance beyond the areas directly affected, and any receiving environments that are at some distance from the Project Footprint but which may be indirectly affected (section 3.3).

The study area includes all catchments that are crossed by the proposed Expressway; the study area has a total area of 10,808 ha. The Designation has a total area of 316 ha and the Project Footprint has a total area of 164 ha.

In addition the Avifauna study included information from five 10 km square grids (based on Ornithological Society of NZ field sheets) traversed by the proposed Expressway Alignment.

## 3.4 Ecological technical reports

The ecological values are described and mapped in the separate technical reports and have been summarised and integrated in this report. The five technical reports are:

- Ecological Technical Report 1: Terrestrial Vegetation & Habitats (including wetlands): Description and Values (TR1)
  (Technical Report 27, Volume 3)
- Ecological Technical Report 2: Herpetofauna (TR2)
  (Technical Report 28, Volume 3)
- Ecological Technical Report 3: Avifauna: Description and Values (TR3)
  (Technical Report 29, Volume 3)

- Ecological Technical Report 4: Freshwater Habitat & Species: Description and Values (TR4) (Technical Report 30, Volume 3)
- Ecological Technical Report 5: Marine Habitat & Species: Description and Values (TR5) (Technical Report 31, Volume 3)

This Report makes up the concluding sections of the ecological assessment of the proposed Expressway Alignment.

Each of the technical reports describes their study methodologies in detail, and the technical reports are summarised below.

### 3.4.1 Ecological technical report 1: terrestrial vegetation & habitats

a. Desktop studies

The study commenced with a desktop review of literature relevant to the botanical values. This review included all known published and unpublished reports, papers, species lists, and maps and involved the identification of protected natural areas (PNA) and the identification of other significant natural areas (unprotected) identified by PNA surveys or other biological inventories. It also involved a compilation of GIS mapping resources. Discussions were also had with staff from GWRC, Kāpiti Coast District Council (KCDC), the Department of Conservation (DoC) and the Queen Elizabeth II National Trust to ensure all areas of botanical value in close proximity to the Alignment were considered.

Base maps of the historical vegetation and current vegetation of the study area were produced from national data sets and from our own knowledge of the Kāpiti Coast District. A range of rare plants that could potentially be found along the route was compiled from various sources, and their preferred habitats were identified, to guide field investigations.

b. Field investigations

Following the preparation of base maps and inventories, field investigations were undertaken to map vegetation and confirm the presence or absence of rare plants. Three sampling methods were used:

i. **Vegetation mapping**: A detailed vegetation map was prepared covering a corridor extending a minimum 100 m either side of the centreline of the proposed Expressway. This approach provided a reasonable limit to the area that needed to be studied and mapped. This map was refined to align with the proposed Designation area following the final Alignment being confirmed. Through this work, a number of additional areas of ecological value were located and added to the list of recognised sites.

ii. **Botanical surveys:** Basic species lists were compiled at all sites identified by the desktop studies as potentially affected or thought to provide habitat for plant species of conservation interest. More detailed botanical investigations were carried out in indigenous habitats that were likely to be affected by the Project Footprint.

iii. **Wetland condition monitoring:** Following confirmation of the Designation area, wetland condition assessments were carried out in those wetlands potentially affected (Clarkson et al 2003 method) to refine the vegetation descriptions and assess the composition and condition of potentially affected areas.

c. Assessment of ecological value

The significance of all terrestrial vegetation communities and wetlands within and in close proximity to the Designation was assessed and the areas potentially affected by construction were quantified.

This process identified key vegetation communities and habitats that will be potentially affected, and a number that could be avoided during detail design.

TR1 concludes with several recommendations for assessment of potential effects and mitigation which have been considered in this Report.

a. Ecological technical report 2: herpetofauna

**Desktop studies:**

i. Before fieldwork commenced, the DoC's herpetofauna database was queried for all records of herpetofauna detected within 10 km of the Alignment since 1980.

ii. High resolution aerial imagery and Land Cover Database (LCDBII) were then used to assist in determining where field-based investigations should be focused. Areas considered to represent marginal or better herpetofauna habitat were subsequently targeted with the herpetofauna sampling methodologies.

b. Field investigations:

i. Three sampling methods were used over a period of 5 months between late September 2010 and mid-February 2011.

i. **Manual searches** (diurnal). The manual searching methodology followed that of Whittaker's (1994) 'searching by day' methodology. Search effort was targeted towards scrub and shrubland edges, grasslands and debris such as logs and corrugated iron which could be lifted by hand.

ii. Spotlighting (nocturnal) Nocturnal searches for arboreal geckos were conducted along the all areas identified as providing habitat along and in general proximity of the Alignment using spotlights during the evening (21:00-23:00 hrs) over 8 spring and summer nights. Spotlighting was targeted towards areas where woody vegetation (especially native shrubland or forest) was present. In total, 40 hours of searching time was spent on nocturnal searches.

iii. Artificial refuges (AR's). 220 ARs (500mm x 500mm Onduline roofing tiles) were distributed across the site in 22 groups of 10 in sites that were considered to represent the best of the lizard habitat present within the Alignment (rank grassland, forest/shrubland-grassland interfaces). The ARs were checked for lizard occupancy two or three times over the course of the survey, with a minimum of four weeks left between checks for inhabitants.

c. Results

TR2 describes the results of this investigation, including the species that were found, their relative abundance, and habitat requirements with particular regard to those habitats potentially affected by the Designation. TR2 concludes with several recommendations for

issues for the EcIA to address during consideration of effects which have been considered in this Report.

### 3.4.2 Ecological technical report 3: avifauna

a. Desktop studies

Data from the recent Ornithological Society of New Zealand's (OSNZ) atlas (Robertson *et al.* 2007) was collated from the five 10 km x 10 km grid squares (267,602; 267,603; 268,602; 268,603; 268,604) which encompass the Designation and surrounding area.

Primary habitat for each of the species recorded within these grid squares was obtained from Heather & Robertson (2000), along with each species' New Zealand threat status (Miskelly *et al*. (2008)). Further explanation regarding the threat classification system (Townsend *et al.* 2007) is provided in Appendix 26.A.

The species list obtained from the OSNZ atlas served as a baseline of species potentially present at or near the proposed Expressway recognising that a number of habitats and species may not be represented along the Alignment.

Further literature (published and unpublished) and website searches were undertaken to obtain additional information regarding bird species known to occur at the estuaries along the Kāpiti Coast (including Waikanae) and within the various reserves.

b. Field investigations

The survey sites selected along and adjacent to the proposed Expressway were chosen to provide representative avifauna habitats that occur along the length of the Alignment including: wetlands; streams, rivers and wetlands; pasture; native regenerating shrublands; rural / residential gardens; exotic plantation forest. Species of interest were defined as those having either Threatened or At Risk threat classifications (according to Miskelly *et al.* 2008). These threat classification lists are outlined in more detail in Table 1 below. Four methods were used:

i. Point counts: Five-minute point counts (Dawson & Bull 1975) were undertaken at 23 locations not less than 250 m apart along and adjacent to the proposed Alignment. Counts began no earlier than sunrise, and ended no later than dusk. Each count lasted five minutes and was preceded by a five minute stand down period to allow activity to settle following the observer arrival. During the stand-down period the observer recorded time, visibility, temperature, wind direction, and speed, precipitation, cloud cover, and visibility.

   Two survey sessions were conducted; one in spring (20-23 September 2010) and another in summer (31 January – 3 February 2011). During each session, counts were undertaken twice at each of the 23 count sites; once before midday (morning) and once after midday (afternoon). A total of 92 5-minute point counts were conducted over spring and summer survey periods

ii. Waterbird counts: Given the close proximity of the proposed Expressway to a number of freshwater habitats (e.g. lakes, ponds, wetlands, streams) a survey of waterbird species diversity and abundance was undertaken. At each location, the observer scanned the waterbodies and recorded all waterbirds seen floating on their surface. Consistent with

recent New Zealand research, all counts were conducted from suitably elevated sites in which the observer had the best possible visual coverage of the waterbodies.

Each count took approximately 20 minutes and was preceded by a 5 minute stand-down period, during which the observer recorded the climatic conditions. These counts were undertaken during the spring (20-23 September 2010) and summer (31 January – 3 February 2011) survey sessions. During each session, counts were undertaken twice at each of the nine sites; once before midday (morning) and once after midday (afternoon). Thus, a total of 36 water counts were conducted over the spring and summer survey periods.

iii. Cryptic marshbird counts: Several so-called 'cryptic' marshbird species are rarely recorded by water counts alone, as they are difficult to survey and require rigorous species-specific techniques in order to be adequately sampled. As such, the use of playback calls was adopted at nine sites to survey for these particular cryptic marshbird species, including bittern, fernbird and spotless crake. The playback calls act as "lures" to entice resident birds to appear from cover or vocally respond.

Playback sites were chosen according to the presence of suitable habitat (e.g. raupo or Eleocharis-dominated wetlands and manuka-edged wetlands), and the observer was positioned on the edge of the habitat to entice birds into viewing range. Playback sessions were undertaken twice during each of the spring and summer survey sessions. During each session, a dawn (within four hours of sunrise) and dusk playback was conducted at each of the nine sites. Thus, cryptic marshbird playbacks were conducted on a total of 36 occasions.

iv. Incidental observations: In addition to the above mentioned counts, all incidental observations were recorded while travelling between survey stations. The objective of these observations was to record any significant observations that may have been made outside of the formally defined methods of data collection. They included observation of avifauna within or adjacent to the site, as well as unusually large numbers of a common or exotic species, or any unusual and noteworthy behaviour.

Similar such notes were taken by other Boffa Miskell ecologists undertaking other ecological surveys along and adjacent to the Alignment at the same time as the avifauna surveys.

c. Results

Report TR3 describes the results of the avifauna survey, species presence, distribution and relative abundance, and key habitats. TR3 concludes with several recommendations for issues for the EcIA to address during consideration of effects which have been considered in this Report.

### 3.4.3 Ecological technical report 4: freshwater habitat & species

a. Desktop studies

National datasets and studies were reviewed prior to the commencement of field work. The information obtained informed the study design which focused on sampling of potentially affected reaches of stream, and used methods appropriate for the types of waterway that were encountered.

b. Field investigations

A range of survey methodologies were used, including various national protocols and industry standard practices as well as modified variations of commonly used methods. Each method was tailored to the Project, the site and to the purposes of the data collection.

Sampling and analysis methods were chosen that would:

- Describe the existing aquatic physical habitat (including water parameters);
- Differentiate between the basic aquatic habitat types in the Project area;
- Identify similarities and differences between reaches within streams and across the main waterways in the Project area;
- Supplement the existing data in describing the fish communities in the Project area;
- Describe the existing aquatic macro invertebrate communities;
- Identify rare and threatened species within the waterways;
- Assess the conservation/Regional significance of the species and communities present;
- Allow an evaluation of loss and change of aquatic habitats; and
- Enable identification of potential effects from mitigation proposals that could be developed if the Project were to proceed.

Field investigations were carried out through 2010 and early 2011 and included full Stream Ecological Valuation (SEV) protocol sampling in 15 representative stream reaches traversed by the proposed Expressway Alignment. Investigations of existing culverts and any fish passage issues were also undertaken during the fieldwork. Four broad "sets" of data were collected to describe the aquatic habitats and their assemblages; and to allow regional importance and sensitivities to be assessed as follows:

- physical habitat data, i.e. stream morphology, substrate type, riparian condition etc;
- water quality (collected primarily by Beca and Environmental Laboratories Sampling);
- water quantity (collected primarily by Beca and Environmental Laboratories Sampling); and
- Flora and fauna (primarily aquatic macro-invertebrates, fish and aquatic macrophyte data). Macro-invertebrate data was collected by Boffa Miskell (BML) and was independently analysed by Ryder Consultants Limited.

For the freshwater ecological assessment, we have relied on the following water quantity and quality reports and research undertaken by the Project team[1]:

- Assessment of Hydrology and Stormwater Effects (Technical Report 22, Volume 3);
- Baseline Water and Sediment Quality Investigation Report (Technical Report 24, Volume 3);
- Construction Methodology Report (Technical Report 4, Volume 3);
- Erosion & Sediment Control Plan (CEMP Appendix H, Volume 4);
- Low and Normal Flow Statistics Memorandum (Technical Report 30, Volume 3); and Contaminant Load Assessment (Technical Report 25, Volume 3).

[1] This Report refers to the Project team as carrying out works on behalf of and as contracted by the NZTA. The NZTA is the requiring authority and the consent holder.

c. Results

TR4 provides detailed description of the freshwater ecology, species, habitats and physical environment of the proposed Expressway. It also includes an assessment of ecological value to support the assessment of effects.

### 3.4.4 Ecological technical report 5: marine habitat & species

a. Desktop studies

Data and information on the ecological values (invertebrates, fish, sediment grain size, sediment quality and water quality) of the estuarine environments downstream of the proposed Expressway Alignment was collated from a large number of sources.

Gaps in our current understanding of the ecological values that have the potential to be adversely affected by the proposed Expressway were identified and used to inform the field surveys.

b. Field investigations

i. Intertidal estuarine sampling: Intertidal surveys of infaunal and epifaunal invertebrates, sediment grain size, sediment quality, depth of oxygenation of sediment and macroalgal cover were undertaken at the mouths of streams that are likely to receive both construction and operational phase stormwater from the proposed Expressway. These stream mouths included the Wharemauku, Waikanae and Waimeha Streams. Data was plotted to determine the presence of outliers, and then initially analysed using basic descriptive statistics such as averages and proportions. Invertebrate community composition data was further analysed using multivariate analyses (Primer-v6 software).

ii. Assessment of Ecological Value: Ecological values are described as being low, medium or high based on a number of characteristics which assess the predominant ecological values of parts of the marine environment, based on a weight of evidence approach.

c. Results

TR 5 describes the results of this survey and provides recommendations for matters that the ecological impact assessment needs to consider.

## 3.5 Project shaping

A key component of the ecological assessment was participation in the ongoing “Project shaping” process. This focused on decisions on Alignment and structures to take into account ecological (and a range of other) constraints and opportunities that arose. This process sought to avoid or minimise potentially adverse effects on ecological values.

More detail on the Project shaping process and the route and design changes made as a result of early ecological investigations are summarised in Section 7: Project description and Shaping. Where effects could not be avoided the subsequent assessment considered management, monitoring and mitigation that are needed.

## 3.6 Assessing ecological value

Different methods for assessing value were used for terrestrial habitats and flora, freshwater habitats, and the coastal estuaries, and species of conservation concern as follows:

### 3.6.1 Species of conservation concern

All species are assessed against a standard set of criteria which is described in "Townsend, et.al (2007): New Zealand Threat Classification System Manual. Wellington: Department of Conservation". In summary:

**Table 1: New Zealand Threat Classification System (Summarised from Townsend 2007)**

| | |
|---|---|
| **Criteria for Threatened taxa** | 1. Nationally Critical |
| | 2. Nationally Endangered |
| | 3. Nationally Vulnerable |
| **Criteria for At Risk taxa** | 1. Declining |
| | 2. Recovering |
| | 3. Relict |
| | 4. Naturally Uncommon |
| **Not Threatened** | |

The national threat status for each group of flora and fauna were classified according to the following national assessments.

- PLANTS: de Lange, et al. 2009: Threatened and uncommon plants of New Zealand (2008 revision). New Zealand Journal of Botany 47: 61-96.
- BIRDS: Miskelly, C., Dowding, J., Elliot, G., Hitchmough, R., Powlesland, R., Robertson, H., et al. (2008). Conservation status of New Zealand birds, 2008. Notornis, 55, 117-135.
- HERPETOFAUNA: Hitchmough R., et al, 2009: Conservation status of New Zealand reptiles, 2009. New Zealand Journal of Zoology, 37: 3, 203 — 224.
- TERRESTRIAL INVERTEBRATES: Hitchmough, R., Cromarty, P., and Bull, L. (2007): New Zealand threat classification systems List 2005. Department of Conservation, Wellington
- FRESHWATER FISH: Allibone, et.al. 2010: 'Conservation status of New Zealand freshwater fish, 2009', New Zealand Journal of Marine and Freshwater Research, First published on: 27 September 2010

### 3.6.2 Terrestrial vegetation and habitats

In the absence of a national standard for the assessment of ecological value of vegetation and terrestrial habitats an assessment was carried out using the following inputs (TR1):

- Criteria established by recent Environment Court case law for assessing ecological significance;
- KCDC and GWRC assessments of ecological significance (PNA style surveys);
- National Priorities for Protecting Rare and Threatened Indigenous Biodiversity (Ministry for the Environment and Department of Conservation[2]);

[2] The Minister of Conservation and the Minister for the Environment issued a statement of national priorities for the protection of rare and threatened native biodiversity on private land in April 2007 (http://www.biodiversity.govt.nz/land/guidance/).

- Land Environments of New Zealand (LENZ) threat classes for indigenous vegetation and habitats (Ministry for the Environment and Landcare[3]); and
- Priority habitats described in the DoC Wellington Conservancy Conservation Management Strategy (CMS).

### 3.6.3 Assessment criteria

The criteria used for assessment of "ecological value" of a place/site/area in TR1 are described in Table 2 below:

**Table 2: Assessment criteria for assessing ecological significance**

| Value | Description |
|---|---|
| Representativeness | ▪ Contains indigenous vegetation types or indigenous fauna assemblages that were typical for, and have the attributes of, the relevant class of wetland as it would have existed prior to 1840. |
| Rarity | ▪ Nationally threatened species are present; or<br>▪ Nationally at risk species or uncommon communities or habitats are present and the population at this site has an important contribution to the national population and distribution of a species or number of at risk species or distribution and extent of threatened or uncommon communities or habitats.<br>▪ Regionally uncommon species are present; or<br>▪ Contains a member of a plant community that is now less than 30% of its original extent as assessed at the ecological district and the freshwater bio-geographic unit scales; or<br>▪ Contains ecosystems that are identified as historically rare by Williams et al (2007). |
| Ecological context | ▪ A role in protecting adjacent ecological values, including adjacent and downstream ecological and hydrological processes, indigenous vegetation, habitats or species populations; or<br>▪ A habitat for critical life history stages of indigenous fauna including breeding/spawning, roosting, nesting, resting, feeding, moulting, refugia, migration staging points (as used seasonally, temporarily or permanently); or<br>▪ Contributes to ecological networks (such as connectivity and corridors for movement of indigenous fauna); or<br>▪ Contributes to the ecological functions and processes within the wetland. |
| Distinctiveness | ▪ Has special ecological features of importance at the international, national, freshwater biogeographic unit or ecological district scale including:<br>▪ a. intact ecological sequences such as estuarine wetland systems adjoining tall forest species distribution limit; or<br>▪ b. an unusual characteristic (for example an unusual combination of species, wetland classes, wetland structural forms, or wetland landforms). |

Modified from Policy 22 of the Regional Policy Statement for the Wellington Region (GWRC), the assessment criteria used by the Kāpiti Coast District Council during the district significant ecological area survey (Wildlands, 2003) and *Friends of Shearer Swamp Incorporated v Solid Energy New Zealand Limited* [2010] NZEnvC 345.

[3] LENZ is an environmental classification database intended to underpin a range of conservation and resource management issues (http://www.landcareresearch.co.nz/databases/lenz/about.asp).

For a site each of the four criteria are subjectively scored “high”, “medium”, “low” or “nil”, based on the assessors’ experience and knowledge of the site. The four scores are then combined to provide a single site score which ranges from “Very High” to “Low” based on the following system.

**Table 3: Assessment Scoring for Terrestrial vegetation and habitats**

| Value | Description |
|---|---|
| Very High | ▪ Rates High for all or most of the four assessment criteria. Likely to be nationally important and recognised as such. |
| High | ▪ Rates High for at least one of the assessment criteria and medium for the majority of the others. Likely to be regionally important and recognised as such. |
| Medium | ▪ Rates medium for the majority of assessment criteria. Important at the level of the Ecological District. |
| Low | ▪ Rates Low or Nil for all assessment criteria. Limited ecological value other than as local habitat for a tolerant native species. |

### 3.6.4 Freshwater habitats and species

TR4 assesses the values of freshwater habitats in relation to a number of factors and components:

- Two primary methods have been used to test the regional value of the reaches and streams affected by the proposal. The fish Index of Biological Integrity (IBI) has been calculated for the sites sampled and compared to the general condition of other waterways in the Region.
- A comparison has also been made of how the % EPT (Ephemeroptera, Plecoptera, and Trichoptera - the three insect orders commonly used to test water quality) QMCI (Quantitative Macroinvertebrate Community Index) and MCI (Macroinvertebrate Community Index) values rank relative to the data on these same factors published by GWRC as part of their State of the Environment Reporting (SOE) programme.
- SEV outputs were compared to the hypothetical reference site values, and against each other to give indications of the value of physical habitat.
- Finally, water quality parameters were considered.

Within each sampled stream these factor were considered and subjectively combined to provide a single overall value (Very High, High, Medium or Low).

**Table 4: Assessment Scoring for Freshwater Systems**

| Value | Explanation |
|---|---|
| Very High | A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants for human induced activities. |
| High | A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers etc, and stock access or similar, to the extent it is no longer reference quality. |
| Medium | A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. |
| Low | A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. |

### 3.6.5 Estuarine habitats and species

All the marine ecological values are described in this report as being high. Table 5 lists the characteristics which have been used to assess the predominant ecological values of parts of the marine environment within the Project area, based on a weight of evidence approach. Not all characteristics listed within each ecological value category need to be present in order to assess ecological value. Consideration of low, medium and high benthic invertebrate species richness and diversity is based on expert judgment and experience.

**Table 5: Characteristics of estuarine sites with low, medium and high ecological values**

| ECOLOGICAL VALUE | CHARACTERISTICS |
|---|---|
| Low | ■ Benthic invertebrate community degraded with low species richness and diversity.<br>■ Benthic invertebrate community dominated by organic enrichment tolerant and mud tolerant organisms with few/no sensitive taxa present.<br>■ Marine sediments dominated by smaller grain sizes.<br>■ Shallow depth of oxygenated surface sediment.<br>■ Elevated contaminant concentrations in surface sediment, above ISQG-high or ARC-red effects threshold concentrations[4].<br>■ Invasive, opportunistic and disturbance tolerant species dominant.<br>■ Habitat highly modified. |
| Medium | ■ Benthic invertebrate community typically has moderate species richness and diversity.<br>■ Benthic invertebrate community has both (organic enrichment and mud) tolerant and sensitive taxa present.<br>■ Marine sediments typically comprise approximately 50-70% smaller grain sizes.<br>■ Depth of oxygenated surface sediment typically >0.5 cm.<br>■ Contaminant concentrations in surface sediment generally below ISQG-high or ARC-red effects threshold concentrations.<br>■ Few invasive opportunistic and disturbance tolerant species present.<br>■ Habitat modification limited. |
| High | ■ Benthic invertebrate community typically highly diverse with high species richness.<br>■ Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and mud.<br>■ Marine sediments typically comprise <50% smaller grain sizes.<br>■ Depth of oxygenated surface sediment typically >1.0 cm.<br>■ Contaminant concentrations in surface sediment rarely exceed low effects threshold concentrations.<br>■ Habitat largely unmodified. |

[4] ANZECC (2000) Interim Sediment Quality Guideline (ISQG) High contaminant threshold concentrations or Auckland Regional Council's Environmental Response Criteria Red contaminant threshold concentrations (Auckland Regional Council, 2004).

### 3.6.6 Other assessment resources

a. KCDC and GWRC council assessments

A number of ecological sites have been identified in the Kāpiti Coast District Plan or Greater Wellington Regional Plans or Policy Statement as having ecological value or significance. These have been assessed (TR1) against the criteria described above.

b. Proposed Wellington regional policy statement (2009) (RPS)

Under the proposed RPS, the regionally significant resource management issues for indigenous ecosystems are that the Region's indigenous ecosystems have been significantly reduced in extent, specifically:

- Wetlands
- Lowland forests
- Lowland streams
- Coastal dunes and escarpments
- Estuaries
- Eastern 'dry land' forests.

The proposed RPS notes that the Region's remaining indigenous ecosystems continue to be degraded or lost. These matters are considered in more detail in TR1.

c. National priorities for protecting rare and threatened indigenous biodiversity5

In making the assessment of ecological value of sites or habitats the following have been considered.

- National Priority 1: To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20% or less remaining in indigenous cover.
- National Priority 2: To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.
- National Priority 3: To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.
- National Priority 4: To protect habitats of acutely and chronically threatened indigenous species.

These are considered in more detail in TR1.

d. Wellington conservation management strategy

Within the Wellington Conservancy the highest priority ecosystems and habitats managed by the DoC (DoC 2010) are:

- indigenous forests;
- shrublands;
- freshwater wetlands;

[5] Protecting our Places: A Statement of National Priorities for protecting rare and threatened native biodiversity on private land. Minister of Conservation and Minister for the Environment.

- rivers and lakes;
- estuaries;
- dunes and dune wetlands;
- cliffs;
- herbfields and grasslands; and
- marine environment.

These are considered in more detail in TR1.

## 3.7 Assessing significance of effects

This EcIA was considered in relation to known ecological values determined from investigations and published material (refer TR1) and the relevant statutory plans and policies, including the Conservation Management Strategy, Wellington RPS, Regional Freshwater Plan and the Kāpiti Coast District Plan.

The significance of ecological effects[6] of the proposed Expressway have been considered based upon the following using established international impact assessment criteria (refer

Table 6 and Table 7: below):

- Type of impact (adverse/beneficial);
- Extent and magnitude of the effect;
- Duration of the effect (permanent, long-term, short-term);
- Sensitivity of the receptor / receiving environment; and
- Comparison with legal requirements, policies and standards, significance assessment.

**Table 6: Criteria for describing impact magnitude (Modified from Regini 2002)**

| Magnitude | Description |
|---|---|
| Very High | Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. |
| High | Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. |
| Moderate | Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. |
| Low | Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. |
| Negligible | Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. |

[6] "effects" and "impacts" are used interchangeably in this report. NZ assessment uses the former term, while overseas Environmental Impact Assessment processes usually use "impact".

**Table 7: Matrix combining magnitude and value for determining significance of ecological impacts (from Regina 2002)**

| SIGNIFICANCE | | Ecological &/or Conservation Value | | | |
|---|---|---|---|---|---|
| | | Very High | High | Medium | Low |
| Magnitude | Very High | Very High | Very High | High | Moderate |
| | High | Very High | Very High | Moderate | Low |
| | Moderate | Very High | High | Low | Very Low |
| | Low | Moderate | Moderate | Low | Very low |
| | Negligible | Low | Low | Very Low | Very Low |

This significance is used to determine whether a predicted impact is acceptable or not. For example:

- Very high and high represent a highly significant impact on ecological or conservation values.
- Moderate represents a potentially significant impact that requires careful individual assessment.
- Very low and low should not normally be of concern, though normal design care should be exercised to minimise impacts.

### 3.7.1 Duration

When referring to the duration of an effect, whether positive or negative, the following criteria are used in this assessment.

**Table 8: Scales of temporal magnitude**

| | |
|---|---|
| Permanent | Impacts continuing indefinitely beyond the span of one human generation (taken as approximately 25 years). |
| Long term | 15-25 years or longer – see above |
| Medium Term | 5-15 years |
| Short Term | up to 5 years |

### 3.7.2 Beneficial effects

Beneficial effects on ecological values include a range of outcomes that improve the quantity and quality of indigenous biodiversity and ecological processes within the area affected by the proposed Expressway Designation. Benefits may extend into the wider area over time.

Beneficial effects could include:

- The extension of cover of indigenous vegetation through landscape and ecological planting;
- Improvements to stream morphology and aquatic habitat through habitat creation, meandering channels, riparian planting and permanent protection of riparian areas;
- Permanent protection of existing wetlands and newly created wetlands along the proposed Expressway;
- Buffering of existing wetlands through landscape and ecological planting;
- Contribution to the improvement of water quality through stormwater treatment and removal of contaminants; and

- Improved knowledge of local plant and animal populations and wetland hydrology through site investigations.

## 3.8 Report limitations

Each of the Technical Reports identifies limitations to the ecological data collected and analysed and some of these limitations flow through to this assessment. In particular this assessment is affected by:

- HYDROLOGY & GROUNDWATER: While specialist investigations have been undertaken as part of this Project on the characteristics and hydrological dynamics of the underlying peat along the length of the proposed Expressway Alignment, including groundwater modelling and peat trial excavations, there remains some uncertainty as to the hydrological interconnectedness of peat and thus the nature and scale of any associated effects of construction on wetlands in close proximity to the proposed Expressway.
- SCALE: The large scale of the study area and access restrictions due to invasive weeds (predominantly widespread areas of blackberry and gorse) meant that botanical surveys were restricted to priority sites with safe access. It is possible that plant species that could add to the "ecological value" of a site may have been overlooked.
- TIMEFRAMES: The extended timeframes for confirmation of designation and design, meant that some fieldwork was carried out before design was complete, and a small number of sampling locations that were added following final Alignment confirmation missed optimum sampling times (e.g. winter freshwater fish sampling at the Whareroa Stream tributary).
- SEV REFERENCE SITES: While GWRC has adopted the SEV model for freshwater impact assessments in the Wellington Region, no SEV reference sites have been developed by GWRC for the Kāpiti Coast district. Discussions with GWRC, KCDC and the DoC suggested that the Kakariki Stream, downstream of Nga Manu provided the best possible example of a forested catchment within the Kāpiti Sand Country. However, our research and the results of water quality monitoring proved contrary and a theoretical reference site was instead developed as the basis for this component of the SEV analysis. Overall, we consider that the scale of modification to the historic vegetation, wetlands and waterbodies of the coastal dunes of the Kāpiti and Horowhenua areas has resulted in there being no 'representative' reference streams through sand country.
- TIMING OF FIELDWORK: Timing of terrestrial fauna work. The bird surveys were undertaken in close proximity to the proposed Expressway Alignment and did not take into account estuarine species, particularly seasonal variations. Species that could add to the "ecological value" of a site may have not been recorded. Options for addressing gaps prior to construction are identified in Technical Reports and as part of mitigation proposed here.
- ACCESS: Property access restrictions following the final proposed Expressway Alignment being confirmed have meant that in a small number of locations north of Te Moana Road, detailed site investigations of culverts have not been undertaken and have only been viewed by high resolution aerial photography and our historical knowledge of the site. Similarly, property access restrictions to some areas have meant that groundwater monitoring devices have not been installed and this has limited information and understanding about wetland hydrology in some locations.
- SEDIMENT LOSS CALCULATIONS: Due to the location of the proposed Expressway within sand and peat country, the Universal Soil Loss Equation (USLE) was used to assess likely sediment losses resulting during the construction phase. While we have relied on the comparative outcomes of the USLE calculations to inform our ecological assessments, we

note that these calculations are based on a number of assumptions (slope lengths, open earthworked areas, site stabilisation etc.). More information is discussed on these assumptions and risks in the Construction Environmental Management Plan (CEMP, Appendix 4).

The proposed Expressway Alignment and final design will continue to be reviewed and revised in the light of on-going engineering and environmental investigations and analysis. However, for the purposes of the ecological and other investigations, the Designation envelope has been fixed as described in TR1 and TR2 and is the basis of all technical reports and the Ecological Impact Assessment for the Project.

# 4 Statutory Context

The following section summarises statutory plans and strategies together with any policies, objectives and rules, relevant to this Ecological Assessment.

## 4.1 Legislation

### 4.1.1 Resource Management Act 1991

This report comprises an assessment of the ecological effects of this proposal with particular regard to the ecological matters identified in the Resource Management Act 1991 (RMA) as follows:

- Protect areas of significant indigenous vegetation and significant habitats of indigenous fauna (s. 6(c))
- Recognise the intrinsic values of ecosystems (s.7(d))
- Safeguard the life-supporting capacity of land, water and ecosystems (s.5(2)(b)).

### 4.1.2 Freshwater Fisheries Regulations 1983

The Freshwater Fisheries Regulations require that passage must be provided for indigenous fish. Many indigenous freshwater fish are migratory and must spend part of their lifecycle in the sea (diadromous). They require streams and rivers that are relatively unmodified from their mouth to their headwaters. If passage along a stream is prevented, populations of migratory fish species upstream of the barrier will eventually die out through lack of recruitment.

### 4.1.3 Wildlife Act 1953

While the presence of Threatened and/or At Risk animals is one of the factors taken into consideration when undertaking ecological assessments, it is important to note that all native animals other than those outlined in Schedules 1-5 of the Act are protected under the Wildlife Act 1953. This includes terrestrial or freshwater invertebrate declared to be an animal under Schedule 7 of the Act and Marine species declared to be animals under Schedule 7A of the Act.

### 4.1.4 Conservation Management Strategy (CMS)

The CMS is the key strategic document of the Wellington Conservancy of DoC. In terms of resources managed by the DoC in close proximity to the proposed Expressway, the Paraparaumu Scenic Reserve (R26033), the Hemi Matenga Scenic Reserve (R26023) and the Waikanae Estuary Scientific Reserve (R26019) are identified in the CMS.

The Waikanae Estuary Scientific Reserve is one of the few estuary/wetland areas of any size in the south-western North Island, and is listed in the DoC Wetlands of Ecological and Representative Importance inventory WERI as a nationally significant wetland habitat for waders, seabirds and waterfowl, both local and migratory. The Waikanae Scientific Reserve is also contiguous with Kāpiti Marine Reserve and is one of DoC's priority management areas.

DoC identifies key management issues to the Waikanae Estuary Scientific Reserve and wetland as water quality in the Waikanae River and bridge development.

The relevant objective of the CMS in relation to the Waikanae Estuary Scientific Reserve is:

- (1) Protection for scientific study, education and the benefit of the country, the indigenous ecological associations, soil types and geomorphologic features of the reserve.

Implementation of the CMS includes the following objectives:

- (4) Advocate for improved water quality in the Waikanae River and Mazengarb Drain to enhance the habitat for freshwater fish, birds and indigenous plant communities.
- (5) Advocate for management of land and of land uses adjacent to the estuary [Waikanae] and river and within the river catchment that will not have an adverse effect on natural and historic resources.

### 4.1.5 New Zealand Coastal Policy Statement

Policies 1.1.2, 1.1.4 and 1.1.5 identify the importance of:

- Indigenous flora, fauna or their habitats
- outstanding or rare indigenous communities
- rare species
- ecological corridors
- areas important for migratory species
- natural biodiversity
- Intrinsic values of ecosystems.

### 4.1.6 National Policy Statement for Freshwater Management 2011

The National Policy Statement for Freshwater Management 2011 sets out the objectives and policies for freshwater management under the RMA 1991. We have considered the requirements of the NPS in our assessment of matters relating to freshwater along the proposed Expressway.

### 4.1.7 Proposed National Policy Statement on Indigenous Biodiversity (NPS)

While the NPS has not yet been approved and may change based on consideration of submissions, for completeness we have treated the NPS as an "other matter" having potential relevance. We have accordingly considered each of these criteria in this assessment.

Principles to be applied when considering a biodiversity offset include:

- No net loss
- Additional conservation outcomes
- Adherence to the mitigation hierarchy

- Limits to what can be offset
- Landscape context
- Long-term outcomes
- Transparency.

## 4.2 Regional Plans And Strategies

### 4.2.1 Wellington Regional Policy Statement (Operative)

No areas within close proximity, or located downstream, of the proposed Expressway Alignment are listed in the Wellington Regional Policy Statement as "Sites of National or Regional Significance for Indigenous Vegetation or Significant Habitats for Indigenous Fauna".

### 4.2.2 Wellington Regional Policy Statement 2009 (Proposed)

The proposed RPS 2009 lists the Waikanae River in Appendix 1, Table 15, as "a river with significant amenity and recreational values".

The proposed RPS 2009 also lists the Waimeha Stream, Waikanae River, Wharemauku Stream and Whareroa Stream in Appendix 1 (Rivers and lakes with values requiring protection), Table 16 (Rivers and lakes with significant indigenous ecosystems). In Table 16 the Waikanae Stream is identified as "a catchment with a high percentage of indigenous vegetation cover".

The Waimeha, Waikanae, Wharemauku and Whareroa Streams are all listed in Appendix 1 of the proposed RPS 2009 as "habitat for threatened indigenous fish species" and "habitat for six of more indigenous fish species in the catchment".

The Waimeha Stream, Waikanae River and Whareroa Streams are listed in Appendix 1 of the proposed RPS 2009 as having inanga spawning habitat in the catchment.

Within the proposed RPS 2009 protection of streams listed in Appendix 1 are addressed by policies 17, 23 and 42. These policies cover:

- Policy 17: Protecting significant values of rivers and lakes – regional plans
- Policy 23: Protecting indigenous ecosystems and habitats with significant indigenous biodiversity values – district and regional plans
- Policy 42: Protecting aquatic ecological function of water bodies – consideration

### 4.2.3 Wellington Regional Freshwater Plan

The mouths of the Waikanae River and Waimeha Stream are listed in Appendix 1 of the Regional Freshwater Plan which identifies river mouths and the inland extent of coastal marine area boundaries. The Waikanae River, the Muaupoko Stream (a small tributary of the Waikanae River), the Whareroa Stream and the Wharemauku Stream and its tributaries are listed in Appendix 3 of the RFP as "Waterbodies with Nationally Threatened Indigenous Fish Recorded in the Catchment".

The Waikanae River is listed in Appendix 4, 5 and 6 of the Wellington Regional Freshwater Plan as a waterbody with important trout habitat (including spawning areas); a water body with regionally important amenity and recreational values; and a waterbody with water quality to be managed for water supply purposes.

Both the Mazengarb Drain and the Ngarara Stream and its tributaries are listed in Appendix 7 of the RPS as "Waterbodies with Water Quality Identified as Needing Enhancement for Aquatic Ecosystem Purposes". While not directly affected by the proposed Expressway Alignment, the Te Harakeke/Kawakahia Wetland is located downstream from a number of waterbodies traversed by the proposed Expressway. Te Harakeke/Wetland is identified in Appendix 2 of the Wellington Freshwater Plan as "*Surface Water to be Managed in its Natural State or Surface Water to be Managed for Aquatic Ecosystem Purposes*".

### 4.2.4 Wellington Regional Coastal Plan

The Waikanae Estuary is identified in the Regional Coastal Plan as an "Area of Significant Conservation Value" (Planning Map 2). Its values described as:

- "A range of important habitats and indigenous plant and animal species. A nationally significant wetland for waders, seabirds and waterfowl (local and migratory). An important spawning area and nursery for threatened fish species (including Galaxias spp). The reserve contains significant vegetation of estuaries shrub-rushland.

### 4.2.5 Wellington Regional Riparian Strategy

This strategy, together with a number of information brochures, is seeking to improve water quality, aquatic habitat, and ecological links through urban and rural land. The key methods are retirement and planting to remove the impacts of stock, enhance habitat and buffer the stream and wetlands from overland runoff.

## 4.3 Kāpiti Coast District Plan

The entire proposed Expressway Alignment is located within the Kāpiti Coast District. The Kāpiti Coast District Plan contains a range of objectives and policies that relate to the effects of subdivision, use and development of the ecological processes of the natural environment and the preservation and enhancement of significant ecological sites within the District, including significant indigenous vegetation and habitats.[7]

## 4.4 Summary of statutory considerations

In summary, our ecological assessments have taken into consideration the Wellington Conservation Management Strategy, the Regional Policy Statement, the New Zealand Coastal Policy Statement and Regional Coastal Plan, the Regional Soil Plan, the Regional Freshwater Plan, the Kāpiti Coast District Plan and the Freshwater Fisheries Regulations 1983. In summary these policies, objectives and regulations required us to consider the following:

- Outstanding or rare indigenous plant communities;
- Areas containing nationally vulnerable species;
- Areas and habitats important to the continued survival of indigenous species;
- Areas important for migratory species;
- Areas important to vulnerable life stages of common indigenous species;
- Ecological corridors;

[7] Refer Part C.2 Rural Zone; Part C.7 Subdivision and Development; Part C.7.2 Rural Subdivision and Development; Part C.9 Coastal Environment; Part C.10 Landscape; Part C.11 Ecology Part C.12 Open Spaces and Reserves; Part C.15 Natural Hazards (including flooding); Part C.21 Waikanae North Development Zone; and Part C.22 Ngarara Zone.

- Protection of ecosystems vulnerable to modification, including estuaries and wetlands;
- Areas of scientific value;
- The quality of freshwater entering the coastal marine area;
- The potential for restoration and rehabilitation of natural character; and
- Cumulative effects.

## 4.5 NZ Transport Agency

### 4.5.1 Environmental Plan (June 2008)

This plan sets out the environmental and social responsibilities and objectives that NZTA is committed to as an organisation. Part Two of the Environmental Plan is divided into sections by environmental and social impacts and includes an 'ecological resources' section. The Plan then specifies how the NZTA is to address the key social and environmental impacts. The aim is to select route options that avoid significant ecological resources and maintain the ecological function of an area.

NZTA has the following objectives for the Ecological Resources Section:

- E1 Promote biodiversity on the State highway network;
- E2 No net loss of native vegetation, wetlands, critical habitat or endangered species; and
- E3 Limit the spread of plant pests.

Consistent with NZTA's commitment to promote biodiversity on the SH network and identify and protect significant ecological resources within SH corridors, this report has considered these three objectives of NZTA's Environmental Plan.

Methods and the tools available to NZTA, for activities involving the planning, design, building, and operation and maintenance of a new road are outlined in Appendix 26.I.

### 4.5.2 Stream Ecological Valuation (SEV)

The NZTA recognises the use of Stream Ecological Valuation (SEV) as a method for scoring the ecological performance of streams and for quantifying environmental compensation (Auckland Regional Council, 2008, Technical Publication 302). The freshwater ecological assessment has incorporated SEV as the basis for all stream assessments and the ecologists who undertook the field assessments have been trained in undertaking SEV assessments.

# 5 Description of the existing environment

In this section, the findings of desktop and site ecological surveys carried out as part of the Project, and reported in full in the Technical Reports (Techinical Reports 27-31, Volume 3), are summarised, focusing in particular on the ecological values that are potentially affected by the proposed Expressway and associated construction activities.

## 5.1 Environmental context

### 5.1.1 Foxton ecological district

The study area lies entirely within the Foxton Ecological District (31.02). It is part of the Manawatu Ecological Region. This ecological district is defined by the dune topography and associated vegetation. The long strip of Holocene sand dune country with its associated

wetlands, lagoons and estuaries form the most extensive sand dune system in New Zealand (McEwen, 1987).

Originally, the Foxton Ecological District would have been mostly forested, with shrubs and trees dominating inland of the coast, a great part of the district would have been swamp forest dominated by kahikatea and pukatea with plentiful rimu and swamp maire (Ravine, 1992). There is some evidence that these swamp forests were reduced greatly in extent even before European times by Maori burn-off (Cowie, Fitzgerald and Owens, 1967). These original forests are now reduced to several small remnants.

Because of its mild climate and large range of habitats, the ecological district would have once supported a very diverse indigenous fauna. The impacts of 1000 years of people and introduced animals will have caused many changes to this fauna, though; there is little information on what species would have been lost (Ravine, 1992). According to the Foxton Protected Natural Areas report (Ravine, 1992), less than 5% of the surface area now has predominantly indigenous vegetation (Ravine, 1992) and there were 29 protected natural areas in the district, totalling 2,470ha (or 2.2% of the area of the ecological district).

### 5.1.2 Climate

The climate of the Foxton Ecological District is mild, with warm summers and moderate winters. Typical summer temperatures range between 18 to 28 degrees and between 8 to 18 degrees in the winter. The dominating feature of the climate is the wind. West-north westerly winds predominate, often reaching gale force, and these strong winds have had a major effect on the physical shape of the Ecological District (Ravine, 1992). Rainfall is about 1,100 to 1,200 mm per annum with an increasing gradient in rainfall west to east.

### 5.1.3 Geology and topography

The great majority of the study area lies upon the sand country with strongly rolling to moderately steep sand dunes deposited over the last 6,000 years. The dunes lie parallel to the coast and become progressively older inland. This land class has weakly developed soils with excessive drainage characteristic of the sandy soils (Page, 1995). There are extensive peat and wetland areas along the proposed Expressway Alignment where the sand dunes have impeded natural drainage; peat is a dominant soil type of the isolated dune depressions of this large belt of sand dunes. These wet dune depressions can have a wide variety of sizes, shapes and altitudes.

The New Zealand Land Resource Inventory (NZLRI) identifies seven distinct geological zones within the study area (not including Town/Urban and Unclassified). These zones are summarised in Table 9 which shows both the extent of each zone within the wider study area and the proportion contained within the Construction Designation. Within these seven zones there is a finer gradation of 28 landforms. The zones are:

**Table 9: Geology of the Study Area (Derived from NZLRI, Page 1995)**

| Description | Study Area (ha) | % of Study Area | Designation (ha) | % of Total Designation |
|---|---|---|---|---|
| Sand country | 2,677 | 24.8% | 68.5 | 21.7% |
| Peat bogs, swamps and basins | 1,126 | 10.4% | 218 | 69.0% |
| Low alluvial plains & terraces | 530 | 5.0% | 15.6 | 4.9% |
| Medium height stony alluvial terraces | 347 | 3.2% | 2.4 | 0.8% |
| High dissected loess covered terraceland | 512 | 4.7% | 0 | 0.0% |
| Greywacke hill country | 3,126 | 28.9% | 0 | 0.0% |
| Greywacke mountainlands and associated foothills | 177 | 1.6% | 0 | 0.0% |
| Town / Urban | 1,853 | 17.1% | 11.6 | 3.7% |
| Unclassified | 34 | 0.30% | 0 | 0.0% |
| TOTALS | 10,808 | 100% | 316 | 100% |

In summary, the great majority of the Designation is located on sand country and associated swamp lands (91% or 286 ha). Most of the sand country consists of recent, unconsolidated, excessively drained sand dunes near the coast. In these areas erosion and climate are the two dominant limitations on land use. Figure 2 illustrates the geology of the study area in more detail.

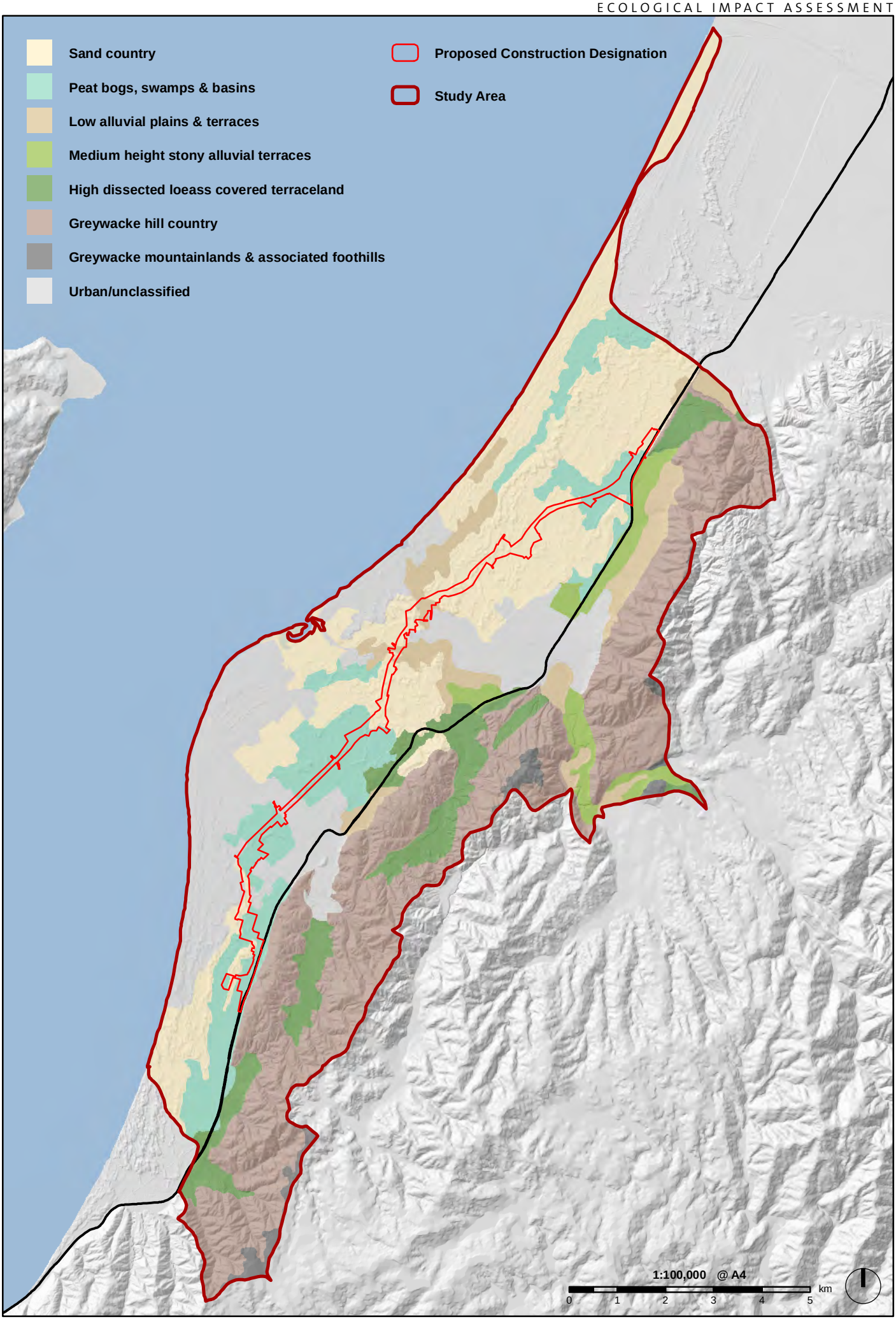
To stabilise the sand, the maintenance of a complete vegetation cover is recommended and strict management guidelines are recommended for road construction, culvert construction, and scrub clearance to minimise soil erosion and maintain water quality and reduce impacts on residential properties. The Assessment of Groundwater Effects (Technical Report 21, Volume 3) outlines the geology of the study area in more detail.

### 5.1.4 Groundwater and hydrology

The coastal dunes typically run perpendicular to the prevailing wind. Sand basins and plains form between them. Dune formation often restricted water runoff and shallow dune lakes with wide wetland margins formed in depressions or dune slacks between dunes. In these wetland areas water levels varied up to 1.5 metres seasonally and following heavy rain. Major drainage works for farming have resulted in the loss of most of these natural lakes and wetland systems throughout the area. Dune lakes and peat swamps now account for only a small part of the area (Ravine, 1992). Water levels also vary considerably (up to 1.5m) from season to season and year to year (Ravine, 1992).

Most of the remaining wetlands of the study area are fen and swamp wetlands with predominantly peat substrates. Based on our ecological investigations, the water table in these wetlands is usually close to or just below the peat surface and is relatively constant for most of the year (with the exception of low water tables in mid-late summer and short-term elevations following heavy winter rains when ground conditions are already saturated). The current plant assemblages within these wetlands have adapted to these conditions, particularly the seasonal adaptations.

Changes in hydrology are considered to be the leading causes of wetland degradation or destruction and maintaining current groundwater flows and providing for the continuation of seasonal fluctuations will be critical to ensuring the ongoing health of these wetlands, particularly in areas where wetlands are located within more extensive and connected areas of peat.




November 18, 2011 W09181E_ECIA_Geomorphology_A4.mxd

NZ TRANSPORT AGENCY

Mackays to Peka Peka

GEOMORPHOLOGY
derived from NZLRI

2

## 5.2 Terrestrial flora and vegetation (including wetlands)

### 5.2.1 Vegetation communities

The following section presents vegetation in two ways, the first is an overview of the study area using the broader scale satellite imagery-based Land Cover Database (LCDBII[8]), followed by a detailed description of the Project Designation based on field observations and mapping.

Table 10 presents a summary of the current vegetation of the study area based on the LCDBII. It compares vegetation within the wider study area, within the Designation, and within the Project Footprint. The LCDBII vegetation categories have been aggregated and sorted to match the vegetation types mapped and presented later in this study. Figure 3 illustrates these vegetation communities in more detail.

**Table 10: Vegetation Communities at different Scales of the Study Area**

| Sort | Description | Study Area (ha) | Designation (ha) |
|---|---|---|---|
| 1 | Grasslands | 5,455 | 237.7 |
| 2 | Wetlands and wet depressions | 218 | 3.7 |
| 3 | Pioneer shrublands, scrub and low forest | 974 | 25.4 |
| 4 | Indigenous forest | 634 | 1.2 |
| 5 | Exotic and planted vegetation | 1,358 | 49.2 |
| 6 | Built-up area | 2,169 | 12.3 |
| | | 10,807 | 330 |

In summary, the great majority of habitat within the study area is grassland, usually rank pasture followed by urban areas and exotic forestry. The vegetation communities along the proposed Expressway Alignment are similar, with grasslands dominating, exotic forest also common, and areas of pioneer shrubland.

Table 11 below provides a more detailed breakdown of the plant communities based on our field work. The current vegetation of the study area is dominated by pasture, exotic and planted vegetation and built-up areas. The following table further refines the vegetation within the proposed Designation with additional plant communities identified by field survey.

[8] Developed by the Ministry for the Environment to reveal information on patterns and trends of land use and land cover.

**Table 11: Vegetation communities within the proposed Expressway Designation**

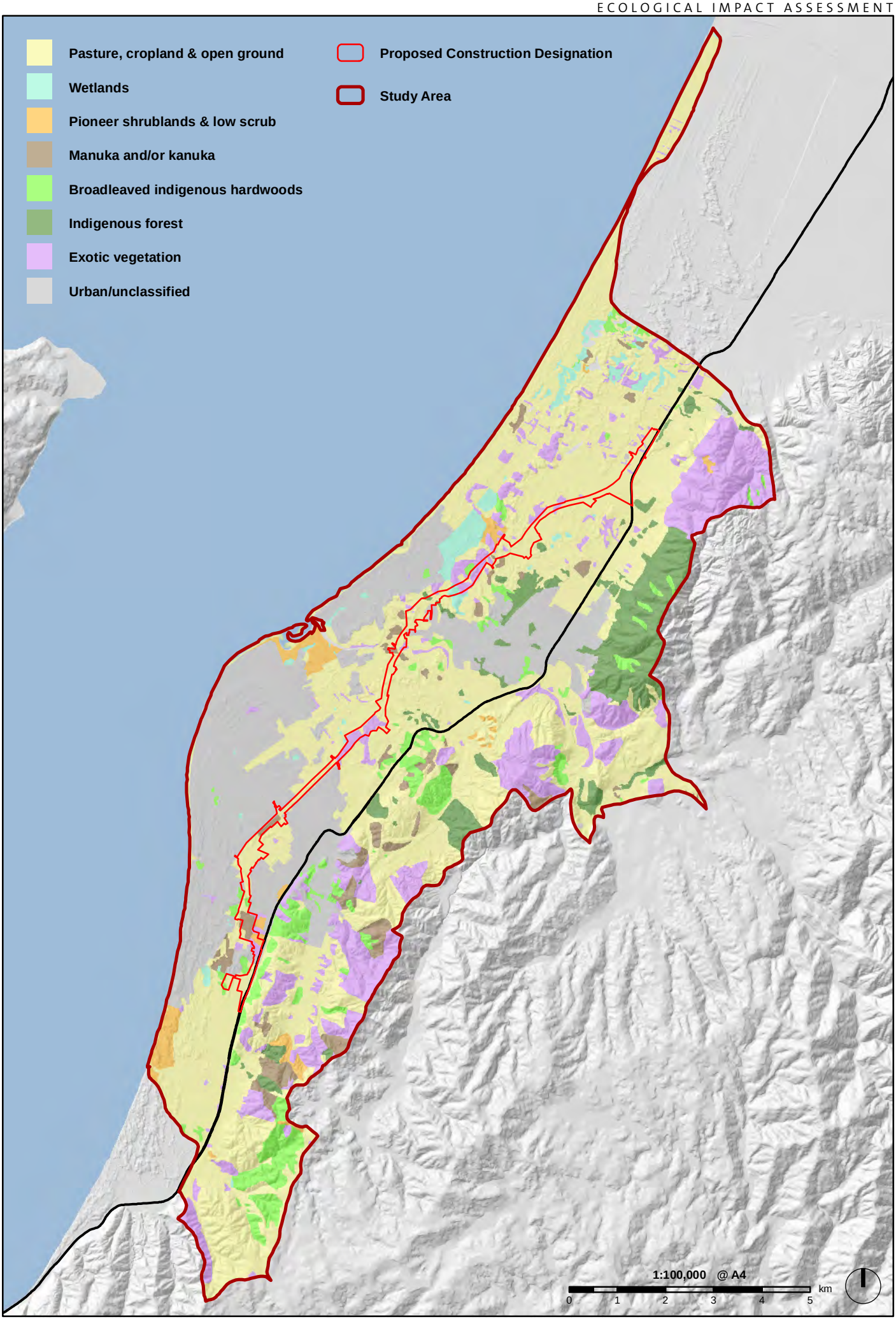
| Description | | Project Footprint | | Designation | |
|---|---|---|---|---|---|
| | | Area (ha) | % of Total Project Footprint | Area (ha) | % of Total Designation |
| **Grasslands** | | | | | |
| 1.01 | Improved pasture | 64.46 | 39.3% | 128.54 | 40.7% |
| 1.02 | Rank pasture | 8.08 | 4.9% | 16.36 | 5.2% |
| 1.03 | Cropland | 2.63 | 1.6% | 2.63 | 0.8% |
| **Wetlands and wet depressions** | | | | | |
| 2.01 | Riparian margins in pasture / rushlands | 1.94 | 1.2% | 3.78 | 1.2% |
| 2.02 | Wet pasture with *Juncus* | 13.90 | 8.5% | 21.37 | 6.8% |
| 2.03 | Sedge-rushland dominated wetlands | 0.78 | 0.5% | 2.04 | 0.6% |
| 2.04 | Cyperus ustulatus dune depressions | 0.25 | 0.2% | 0.49 | 0.2% |
| 2.05 | Manuka wetlands | 0.76 | 0.5% | 1.30 | 0.4% |
| 2.06 | Manuka wetlands with *Sphagnum* | 0.03 | 0.0% | 1.00 | 0.3% |
| 2.07 | Mature and maturing swamp forest with kahikatea | 0.00 | 0.0% | 0.00 | 0.0% |
| 2.08 | Open water / permanent ponds | 0.60 | 0.4% | 2.01 | 0.6% |
| **Pioneer shrublands, scrub and low forest** | | | | | |
| 3.01 | Blackberry dominated weedlands | 16.37 | 10.0% | 30.13 | 9.5% |
| 3.02 | Gorse dominated scrub | 10.56 | 6.4% | 21.89 | 6.9% |
| 3.03 | Regenerating kanuka forest | 0.83 | 0.5% | 1.72 | 0.5% |
| 3.04 | Regenerating broadleaved scrub and low forest | 2.50 | 1.5% | 4.82 | 1.5% |
| 3.05 | Riparian margins in regenerating scrub | 0.48 | 0.3% | 1.71 | 0.5% |
| **Indigenous forest** | | | | | |
| 4.01 | Mature or maturing indigenous forest | 0.01 | 0.0% | 0.06 | 0.0% |
| **Exotic and planted vegetation** | | | | | |
| 5.01 | Plantation pine | 12.00 | 7.3% | 22.32 | 7.1% |
| 5.02 | Plantation pine – harvested | 5.41 | 3.3% | 7.97 | 2.5% |
| 5.03 | Exotic trees | 10.87 | 6.6% | 20.27 | 6.4% |
| 5.04 | Riparian margins with exotic trees | 0.27 | 0.2% | 0.72 | 0.2% |
| **Undefined** | | | | | |
| 6.01 | Built-up area | 11.42 | 7.0% | 25.00 | 7.9% |
| TOTALS | | 164.15 | 100% | 316.12 | 100% |

In summary, the great majority of the Project Footprint lies in a highly modified pastoral landscape. Indigenous forest makes up less than 1% (0.01 ha) of the vegetation communities potentially affected. Excluding the 8.5% of the Project Footprint made up of wet pasture and *Juncus*, indigenous wetlands comprise approximately 1% of the Project Footprint (1.8 ha).

Of the remaining vegetation, 46% is in pasture, 17% is in plantation forestry or other exotic forest and trees, and 19% is in pioneer shrublands, scrub and low forest. The final 7% of the Designation is classed as urban.

Key points from the vegetation survey are:

- Indigenous wetlands are considered to be over-represented within the Designation, reflecting the large-scale transformation of the Kāpiti Coast and the situation whereby the existing WLR Designation has protected these wetlands from the development pressures faced elsewhere on the Kāpiti Coast.
- Excluding areas of wet pasture and *Juncus*, riparian margins and open water, a total of 1.8 ha (or 1%) of indigenous wetland will be lost within the Project Footprint (4.8ha or 1.5% of the Designation). The largest area of indigenous wetland physically affected is within the Otaihanga Wetland complex where 0.55 ha of the 1.39 ha Southern Otaihanga Wetland and 0.53 ha of the 1.0 ha Northern Otaihanga Wetlands will be lost. These wetlands are not scheduled or identified in any statutory planning documents. Approximately 0.38 ha of the southern edge of the 3.9 ha El Rancho Wetland (Weggery) would be lost beneath the Project Footprint. The El Rancho wetland is scheduled by the Kāpiti Coast District Plan. In terms of statutorily listed SNAs or PNAs, approximately 0.38 ha of the Kāpiti Coast District Plan scheduled (KCDC Ecosite (K170)) El Rancho Wetland (Weggery) is located within the Project Footprint. Detailed design is expected to reduce the extent of this loss.
- The largest area of kanuka forest that would be affected is 0.17 ha of the 0.5 ha Otaihanga Kanuka forest. The total area of kanuka forest located within the Project Footprint is 0.8 ha or 0.5% (1.7 ha or 0.5% of the Designation).
- The largest area of regenerating broadleaved forest that would be affected is 0.86 ha of the 4.2 ha Ngarara Mahoe forest. The total area of regenerating broadleaved forest within the Project Footprint is 3.0 ha or 1.8% (6.55 ha or 2.1% of the Designation).
- Large areas of exotic trees and plantation pine are located within the Project Footprint (28.5 ha or 17 %%). These have some value as seasonal habitat for bird movements in the wider Kāpiti area.
- Only a small number of mature or remnant indigenous trees are located within the Designation (0.01 ha of the Project Footprint), consisting of a solitary kohekohe tree and up to half a dozen cabbage trees within blackberry weedlands adjacent to the Tuku Rakau urupa, and a solitary matai, located in regenerating mahoe within the Otaihanga Landfill. Only the cabbage trees are located within the Project Footprint.
- Large areas of blackberry and gorse scrub would be affected, particularly in the southern and central sections of the Designation.




November 18, 2011 W09181E_ECIA_CurrentVegetation_A4.mxd

### 5.2.2 Wetlands

Wetlands are a dominant indigenous habitat along the proposed Expressway Alignment, ranging from remnant lowland swamp forest dominated by kahikatea, manuka shrublands, *Carex* sedgeland through to highly modified wet dune depressions dominated by *Juncus* and exotic wet pasture species.

The majority of the wetlands in the study area are technically fens and swamps, in that they are wetlands with predominantly peat substrate. Fen wetlands generally receive inputs of groundwater and nutrients from adjacent mineral soils. In contrast, swamps receive a relatively rich supply of nutrients and often also sediment via surface runoff and groundwater from adjacent land.

A large number of the wetlands of the Study Area are identified as ecologically significant and are scheduled as Significant Natural Areas in the Kāpiti Coast District Plan.

### 5.2.3 Plants of conservation concern

In the botanical investigations undertaken as part of this assessment, only one plant species that has a national threat classification was found in close proximity to the Designation. *Korthalsella salicornioides* is ranked by de Lange et al (2009) as At Risk[9]. (").

This particular *Korthalsella salicornioides* population is located within a KCDC scheduled SNA, approximately 100 m from the edge of the Designation. This population is considered to be well buffered by the surrounding wetland vegetation. We understand that *Korthalsella salicornioides* is known to be present in a small number of other wetlands in the Kāpiti Coast. However, given its national threat ranking and low ability to successfully introduce into new areas, this particular population elevates the ecological importance of this wetland. We note that the rapid invasion of the Ngarara Wetland by invasive weed species, particularly blackberry, is placing additional pressures on this known population.

A number of other species that are considered to be locally uncommon are located within close proximity to the Designation, the majority of which consist of wetland species within the El Rancho wetlands or Raumati wetlands. The presence of these locally uncommon species contributes to our assessment of significance of these particular wetlands.

## 5.3 Birds/avifauna

### 5.3.1 Distribution and abundance

The avifauna is described in detail in TR3: Avifauna: Ecological valuation. In summary, Table 12 lists the birds recorded during current surveys and gives an indication of their habitat preferences.

[9] Naturally Uncommon, with the qualifier of sparse distribution.

**Table 12: Avifauna species recorded in January, February and March 2010 along and adjacent to the proposed Expressway Alignment and habitat types.**

| SPECIES | CONSERVATION STATUS | | HABITAT | | | | | | | METHOD | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Native forest | Exotic Forest | Scrub \ Shrubland | Farmland \ Open country | Freshwater \ Wetland | Coastal \ Estuary | Urban \Residential | 5 - minute | Waterbird | Cryptic playbacks | Incidental |
| Fantail | Endemic | Not Threatened | | | | | | | | ✓ | | | |
| Kereru | Endemic | Not ThreatenedCD Inc | | | | | | | | ✓ | | | |
| Shining cuckoo | Native | Not ThreatenedDP | | | | | | | | | | | ✓ |
| Tui | Endemic | Not Threatened St | | | | | | | | ✓ | | | |
| Blackbird | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Californian quail | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | ✓ |
| Common pheasant | Introduced | Introduced and NaturalisedSO | | | | | | | | | | | ✓ |
| Crimson rosella | Introduced | Introduced and NaturalisedSO RR | | | | | | | | | | | ✓ |
| Eastern rosella | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | ✓ |
| Grey warbler | Endemic | Not Threatened | | | | | | | | ✓ | | | |
| Silver-eye | Native | Not ThreatenedSO | | | | | | | | ✓ | | | |
| Canada goose | Introduced | Introduced and NaturalisedSO | | | | | | | | ✓ | ✓ | | |
| Chaffinch | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Dunnock | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Gold finch | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Green finch | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| House sparrow | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Magpie | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Pipit | Endemic | Declining | | | | | | | | ✓ | | | |
| Redpoll | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Skylark | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Song thrush | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Spur-winged plover | Naturalised | Not ThreatenedSO | | | | | | | | ✓ | ✓ | | |
| Starling | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Swamp harrier | Native | Not ThreatenedSO | | | | | | | | ✓ | | | |
| Welcome swallow | Native | Not ThreatenedInc SO | | | | | | | | ✓ | | | |
| Yellow hammer | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | | | |
| Australasian bittern | Native | Nationally EndangeredSp TO | | | | | | | | | | ✓ | |
| Black shag | Native | Naturally UncommonSO Sp | | | | | | | | ✓ | ✓ | | ✓ |
| Black swan | Native | Not ThreatenedSO | | | | | | | | ✓ | ✓ | | |
| Grey teal | Native | Not ThreatenedInc SO | | | | | | | | | ✓ | | |
| Kingfisher | Native | Not Threatened | | | | | | | | ✓ | | | |
| Mallard | Introduced | Introduced & NaturalisedSO | | | | | | | | ✓ | ✓ | | |
| North Island fernbird | Endemic | DecliningRR St | | | | | | | | ✓ | | | |
| NZ shoveler | Native | Not Threatened | | | | | | | | | ✓ | | |
| Paradise shelduck | Endemic | Not Threatened | | | | | | | | ✓ | ✓ | | |
| Pied shag | Native | Nationally Vulnerable | | | | | | | | ✓ | | | |
| Pukeko | Native | Not ThreatenedInc SO | | | | | | | | ✓ | ✓ | | |
| Scaup | Native | Not ThreatenedInc | | | | | | | | | ✓ | | |
| Black-backed gull | Native | Not ThreatenedSO | | | | | | | | ✓ | | | |
| Rock pigeon | Introduced | Introduced and NaturalisedSO | | | | | | | | ✓ | | | |

Note: Darker green cells indicate primary habitat.

A total of 41 bird species (excluding dabchick) were recorded in 2010-2011 comprising of 19 introduced (exotic) and 22 native (including seven endemic species).

This represents 76% of the 54 bird species recorded in the OSNZ atlas data (Robertson, Hyvonen, Fraser & Pickard, 2007) over the period 1999-2004 encompassing the proposed Expressway Alignment. Nineteen species recorded in the OSNZ atlas data were not recorded during the current surveys. Conversely, six species were recorded here that were not in the OSNZ list. Of those six species, North Island fernbird, Australasian bittern and pied shag are species of interest with respect to their threat classifications.

Although not observed during the standardised avi-fauna surveys, dabchick were observed in the Osbournes Wetland during wetland surveys being undertaken by BML botanists (i.e. outside of the avi-fauna survey period). Dabchick (*Poliocephalus rufopectus*) are classified as Nationally vulnerable.

### 5.3.2 Species of conservation concern

Overall, introduced species were found to make up the greatest proportion (62.2%) of all birds recorded during the point counts along the Alignment. Of the 22 native species:

- 17 are Not Threatened;
- 3 are At Risk (pipit, black shag and fernbird); and
- 3 are Threatened (bittern, pied shag and dabchick[10]) (Miskelly et al. 2008).

While Threatened and At Risk species were present along the proposed Expressway Alignment, they were recorded in very low numbers (0.8% of all observations).

### 5.3.3 Habitat values

The majority of habitat along the Alignment is comprised of residential development within a rural landscape on a modified coastal dunelands. The greatest diversity was recorded for species associated with farmland/open country, these species were mostly introduced. Only one At Risk species recorded during the avifauna surveys, the New Zealand pipit, utilises farmland as its primary habitat.

In comparison, a high proportion of forest and freshwater bird species recorded were native.

Thus, in terms of ecological values, the forest and freshwater habitats (particularly wetlands) are of greater value in their ability to provide feeding and nesting resources for a range of native species, including Threatened and At Risk species. Freshwater habitats are well represented along and adjacent to the Alignment, as well as in the wider area, though a number of these are constructed ponds.

Specific habitats identified and areas of importance for birds are as follows:

- Te Harakeke/Kawakahia Wetland, Ngarara Wetland and Nga Manu Nature Reserve provide the best quality habitat for freshwater species due to the extent of the wetland and the diversity of habitat types present (i.e. extensive raupo reedlands and flaxlands). This was the area in which both the fernbird and bittern were recorded. Species of note recorded in Wildland's (2002) survey of Te Harakeke wetland included Australasian bittern, North Island fernbird, spotless crake, grey duck, pied stilt, black shag and dabchick. Thus, the wetland sequence around this area is of particular importance to Threatened and At Risk avian species in the district. Although none of these areas of habitat are immediately affected, they are all in close proximity to the proposed Expressway.

[10] Recorded as an incidental observation outside of the standardised avi-fauna surveys.

- Although located outside of the proposed Expressway Alignment, the stream mouths and estuaries downstream (including Whareroa, Wharemauku, Waikanae, Waimeha, and Hadfield / Kowhai) provide habitat for estuarine and coastal bird species. These species favour the coast and are concentrated in areas away from the Alignment (supported by the lack of any recordings in the wider study area during the 2010-2011 avifauna surveys). The concentrations of such species around stream mouths are due to the food supply at these locations. Another record of North Island fernbird was recently confirmed in the Otaihanga oxbow wjthin the Waikanae Estuary.

## 5.4 Herpetofauna

### 5.4.1 Introduction

Desktop studies identified five species of endemic lizard that could potentially occur within the proposed MacKays to Peka Peka Expressway Alignment. They are:

**Table 13: Conservation status and habitat preferences of herpetofauna potentially occurring along the proposed Expressway Alignment.**

| Family | Common Name | Conservation Status[11] | Habitat Preferences |
|---|---|---|---|
| Skink | Copper skink | Not Threatened PD | Open and shaded areas where sufficient cover is available (e.g., rock piles, logs, dense vegetation, etc). |
| | Common skink | Not Threatened | Dry open areas with low vegetation or debris such as logs or stones for cover. |
| | Ornate skink | Declining CD,PD | Open and shaded areas where sufficient cover is available (e.g., rock piles, logs, dense vegetation, etc). |
| Gecko | Common gecko | Not Threatened PD | Forest, scrub, grassland and coastal areas. |
| | Wellington green gecko | Declining | Forest and scrub, especially kanuka / manuka. |

### 5.4.2 Distribution and abundance

In total, the herpetofauna survey found a minimum of 17 common skinks on 68 occasions, and unidentified skinks on 36 occasions. Skinks were observed at virtually all sites where long, thick grass was present, and were not recorded at any other site.

No geckos were found during the survey and there was no record of any gecko skin sloughs.

Native frogs are considered extremely unlikely to occur in the vicinity of the proposed Expressway Alignment due to the absence of suitable habitat. A number of exotic frogs were observed during botanical and freshwater investigations.

### 5.4.3 Species of conservation concern

No species of conservation concern were located during the survey. It is possible that additional lizard species occur along the proposed Expressway Alignment but were not

[11] According to Hitchmough *et al.* (2010) with qualifiers: CD=Conservation Dependent; PD=Partial Decline; Sp=Sparse.

detected. However, given the variety of potential habitats investigated, combined with the intensity of the surveys, if any species were missed they are unlikely to be present in any abundance.

The restriction to only one skink species within close proximity of the proposed Expressway Alignment suggests both a lack of suitable habitat for these other species together with high predation pressure from introduced mammals.

### 5.4.4 Habitat values

The herpetofauna survey demonstrated that common skinks are abundant in most or all dense grasslands across the proposed Alignment. This habitat type was prevalent, particularly in the southern two thirds of the site.

In terms of other potential habitat types, we consider it would be highly unlikely for skinks to occur in the 'pine' or 'trees above sparse grass' habitats unless they were much rarer than in dense grassland. Absence from or rarity in tree-covered habitats probably reflects excessive shade and/or the absence of dense ground tier vegetation. Given the underlying sand dunes and peat swamps along most of the Alignment, there was little potential refugia for other lizards (e.g. rocks, logs or other debris) in the pasture. The close proximity of residential housing to large areas of the Alignment, particularly the southern and central sections, may also be a factor determining herpetofaunal abundance.

## 5.5 Terrestrial invertebrates

A wide variety of common terrestrial invertebrates were detected during various ecological investigations, though none of conservation concern.

One specimen of *Peripatus novae-zelandiae* was located in the compacted sand under a recently fallen pine tree within the Otaihanga Mountain Bike Area. While this species does not currently have a threat status, their taxonomy is under review.

## 5.6 Freshwater habitats and species

### 5.6.1 Hydrology

There are five catchments affected by this proposal[12]. They are:

- The Whareroa catchment discharges to the Kāpiti Coast through Queen Elizabeth Regional Park. This catchment includes the Whareroa Stream and a number of smaller tributaries (consisting of farm drains cut into the larger peatlands of the Regional Park), one of which (Whareroa Drain tributary) would be crossed by this proposal. This watershed has a combined area of 15.4 $km^2$.
- The Wharemauku catchment which discharges to the Kāpiti Coast at Paraparaumu. The main branch of the Wharemauku Stream and a large tributary, Drain 7, is crossed by the proposed Expressway. This watershed has a combined area of 12.7 $km^{2.}$
- The Waikanae catchment, which discharges into the Waikanae Estuary. This watershed includes the Waikanae River and a number of smaller tributaries, including the Mazengarb

[12] We have used figures derived by the Project team from NIWA's WRENZ (http://wrenz.niwa.co.nz/webmodel/) website to estimate the catchment areas at the coast. These WRENZ estimates were then adjusted by the difference between the WRENZ and Project catchment areas at the points where the watercourses cross the Expressway.

Stream, the Wastewater Treatment Plant (WWTP) Drain (the main outlet for the Paraparaumu wastewater treatment plant) and the Muaupoko Stream. All these streams and a number of smaller drains / tributaries are traversed by the proposed Expressway prior to flowing into the Waikanae River upstream of the estuary. This watershed has a combined area of 140.1 $km^2$.

- The Waimeha catchment, which discharges to Waikanae Beach. With the exception of the spring-fed upper Waimeha Stream, the following streams and their associated tributaries (farm drains) all discharge into Te Harakeke/Kawakahia Wetland: Ngarara Creek, Kakariki Stream, Ngarara Stream and Paetawa Drain. There are a large number of associated drains traversed, particularly as part of the Paetawa and Kakariki Streams. This watershed has a combined area of 21.0 $km^2$.
- The Hadfield Drain / Kowhai Stream catchment, which discharges to Peka Peka beach via a small estuary. This watershed has a combined area of 10.2 $km^{2.}$

Within these catchments 15 perennial stream channels were described and sampled. With the exception of the Whareroa Stream tributary, all the remaining watercourses would be crossed by the Alignment.

| Whareroa Stream Catchment |
|---|
| ▪ Whareroa Stream Tributary (Waterfall Road) |
| ▪ Whareroa Drain |
| **Wharemauku Stream Catchment** |
| ▪ Drain 7 Lower |
| ▪ Drain 7 Upper |
| ▪ Wharemauku Stream |
| **Waikanae River Catchment** |
| ▪ Mazengarb Stream |
| ▪ WWTP Drain |
| ▪ Muaupoko Stream |
| ▪ Waikanae River |
| **Waimeha Stream Catchment** |
| ▪ Waimeha Stream |
| ▪ Ngarara Drain |
| ▪ Kakariki Stream |
| ▪ Smithfield Drain |
| ▪ Paetawa Stream |
| |
| ▪ Hadfield Drain / Kowhai Stream |

These watersheds and streams are shown in

Figure 4.

### 5.6.2 Waterway system descriptions

a. Whareroa Stream Tributary

The Whareroa Stream tributary has a catchment of 222 ha and a mean flow of 45 L/sec, with a median flow of 15 L/sec. Approximately 500 metres upstream of the sampling area the channelized drain takes on a natural meandering habitat through a catchment of pine and native forest. The substrate within the reach ranges from thick (30cm) fine silt (close to the SH 1 crossing), to 0.5mm to gravels and cobbles with minimum silt cover. The habitat varies with pools/runs and a small area of riffles, at the shallowest section. The riparian cover consists of a small portion of willows on the true right bank. The left bank has short grazed pasture to the stream edges. The Whareroa Stream tributary is not traversed by the proposed Expressway, but a smaller farm drain tributary of this stream is traversed by the proposed Expressway south of Poplar Ave.

b. The Whareroa Drain

The Whareroa Drain is one of a number of farm drains managed within the Queen Elizabeth Regional Park farm land. At the sampling site, this water body was a deeply incised drain with highly anoxic mud over the fine sand and peat substrate. Partially obstructed culverts currently prevent fish passage. The riparian vegetation consists of a canopy of macrocarpa and pine with an understory of gorse and blackberry over half of the reach (30m), while the remainder is grazed to within 1m of the drain.

c. Upper Drain 7, Wharemauku

Upper Drain 7, a tributary of the Wharemauku Stream, runs through the Raumati Peatlands, and a historical KCDC Council designation which has had varying levels of maintenance over the years. Gorse and blackberry and bare peat dominate riparian edges. The stream substrate was very thick pine needle sludge with anoxic odours. The water colour was dark brown to black in appearance.

d. Lower Drain 7, Wharemauku

Drain 7 is an urban drain of extremely poor quality and low velocity water body within an urban environment, which upstream is used and created as wetland drainage. The catchment is agricultural, urban and industrial. At the sampling site the drain is channelised. The water at this site was still, rusty brown with a highly anoxic odour coming from the deep mud substrate. The riparian vegetation comprises of scrub willow, long ungrazed pasture grasses and water weeds such as willow weed. Fallen branches and a culvert create permanent stream barriers for water and fish passage.

e. Wharemauku Stream

The Wharemauku Stream is a highly modified urban drain, which originates from the combination of many springs in the upper reaches. The catchment of the Wharemauku Stream is 1,007 ha with a mean flow of 158 L/sec. In the location of the sampling, the stream is channelized and influenced by urban (Paraparaumu) and industrial activities, as well as discharge from adjoining drains from peat lands. Riparian vegetation consists of grasses and water weeds with no riparian cover.

The substrate is embedded cobbles and sand with a run/pool habitat with little in-stream debris. Historic records (Fresh Water Fish Database) identified a quite different species composition e.g. koaro (*Galaxias brevipinnis*) short-jaw kokopu (*Galaxias postvectis*) and red fin bully (*Gobiomorphus huttoni*).

f. Mazengarb Stream

The Mazengarb Stream (referred to often as Mazengarb Drain) has a catchment of 378 ha and a mean flow of 51 L/sec. At the sampling location, the stream flows beneath an old stand of macrocarpa and pine providing full shade cover to the entire sampling reach, with a thick mat of *Tradescantia fluminensis* covering the stream banks to the water's edge. The substrate is made up of mud over sand, and contains very little stream debris.

There are a number of potential point source discharges of contamination in the Mazengarb catchment including Otaihanga Landfill and Paraparaumu Waste Water Treatment Plant. Historical water quality sampling showed the Mazengarb to have level of nutrient enrichment with most concentrations above the ANZECC (2000) trigger values. It also had low dissolved oxygen, suspended solids and organic matter.

g. WWTP drain (wastewater treatment plant), Mazengarb

The WWTP Drain originates from drain systems, prior to being mixed with the outflow from the Paraparaumu waste water treatment ponds. This waterbody is highly nutrient enriched from treated waste water outflow. The stream banks are stable, held by long ungrazed pasture grasses, occasional bracken and blackberry. There is significant in-stream debris. Downstream from the sampling site, the long grasses and pines continue, which makes up an exotic functioning riparian cover. This stream is known to have elevated levels above the corresponding guideline value of zinc, acid soluble aluminium, other metals, E coli and faecal coliform, most likely resulting from discharges from the waste water treatment station.

h. Muaupoko Stream

This stream is a large tributary of the Waikanae River, with forested headwaters making up a large component of its 750 ha catchment. Mean flows are 145 L/sec.

At the sampling site, long pasture grasses and exotics (willow and blackberry) dominate the bank side vegetation. This portion of the stream had stable vegetated banks, and in-stream macrophyte provided good fish cover. Near the Waikanae River, the Muaupoko Stream flows through an area of restored riparian vegetation consisting of planted natives amongst occasional willow. This portion of the stream has very unstable sand banks, with no vegetation. The substrate consists of fine gravels, sand with areas of fine mud deposits. The outlet of this stream is proposed to be realigned to accommodate the Waikanae River bridge.

i. Waikanae River

The Waikanae River is one of the most ecologically significant water bodies in the Kāpiti district. The river has a large forested upper catchment with a total catchment of 13,010 ha. Mean flows are 4,766 L/sec at the proposed bridge crossing. The lower reaches of the sampling location consist of a mixture of rough pasture and treeland over pasture with occasional remnants and areas of willow. Substrate is made up of a combination of cobbles, pebbles and gravels, with excellent fish habitat provided by the presence of pool, run, riffle and cascades throughout the channel length. Riparian vegetation within the sampling site is

made up of native forest (much of which is enhancement planting by local community groups) and planted willows for flood protection. A diverse number of fish species are recorded in this river.

j. Waimeha Stream

The Waimeha Stream consists of a large drain surrounded by residential properties and grazing land. The Waimeha Stream is formed by the confluence of two sources (a draining wetland spring and an urban spring), both within the Waikanae township boundaries. The catchment of the Waimeha Stream at the sampling location is 219 ha with mean flows of 169 L/sec.

The urban section of this stream, with decent riparian vegetation buffer, has become a backyard feature for many bordering properties. Downstream riparian vegetation was made up of pasture grasses, *Carex geminata*, blackberry and scattered willows. Historical water quality studies highlight elevated nutrients, bacteriological counts and low toxicant concentrations. The Waimeha Stream is also listed as containing habitat for threatened indigenous fish species. Downstream the stream meanders through the golf course and KCDC reserve to the coast.

k. Ngarara Creek

The headwaters of the Ngarara Creek are formed by a number of smaller farm drains and springs. The catchment for Ngarara Creek is 26 ha and has mean flows of 28 L/sec.

Exotic weeds (blackberry and gorse) are the dominant riparian species, with areas of pine plantation and wetland (Ti Kouka) downstream of the proposed crossing. The low gradient and slow-moving Ngarara Creek has deeply incised banks with sections of still backwater and pool habitat. The stream bed sediments are anoxic and water quality is severely degraded. Ngarara Creek exits into Te Harakeke/Kawakahia Wetland via a small remnant of kahikatea swamp forest.

l. Kakariki Stream

Kakariki Stream (also commonly referred to as the Ngarara Stream) has a catchment of 30.5 ha with mean flows of 126 L/sec. The Kakariki Stream watershed includes some regenerating native forest and shrub land before meandering through grazed agricultural lowlands. At the sampling site, the Kakariki Stream comprises a steeply channelised stream with high quality upstream components as a result of a wide stretch of established riparian planting. At the sampling site riparian vegetation consisted of scrub grasses, willow, flaxes, bracken and blackberry. The deep sided channel, with the overgrown vegetation provides a high level of shading. Macrophytes dominate and the stream substrate consists of fine gravels, and sands with fine sediments.

Downstream of the Alignment, the stream continues before exiting into Te Harakeke/Kawakahia Wetland, which in turn exits via the lower Waimeha Stream by the Waikanae Golf Course. Long term stream monitoring illustrates elevated turbidity, low dissolved oxygen and pH indicative of organic matter and degradation.

m. Smithfield Drain

Smithfield Drain is a deep channelised farm drain created from a network of drained farmland. Surrounding vegetation is dominated by pasture with minimal riparian cover other than rank grass, blackberry and occasional shrubs. Stream habitat consists of slow runs and

pools over a mixed substrate of deep muds and silts. The Smithfield Drain exits into the Kakariki Stream just downstream of Nga Manu Nature Reserve.

n. Paetawa Drain

The Paetawa Drain is a highly channelised waterway through primarily agricultural land. The waterbody has a large catchment of 271 ha and mean flows of 66 L/sec.

At the sampling site the Paetawa Drain is surrounded by pasture with overhanging weeds and occasional *Carex geminata*. Large sections of stream banks are under cut, heavily grazed and with cattle pugging. Stream substrate consists of deep mud over sand. It has high levels of suspended solids. The water is made up of pools with occasional runs. Downstream of the sampling site the Paetawa Drain combines with a number of other lowland farm drains into the Ngarara Stream before entering Te Harakeke/Kawakahia Wetland.

o. Hadfield/Kowhai Stream

The Hadfield/Kowhai Stream is the northern-most waterway traversed by the proposed Expressway. The catchment is 90 ha and mean flows of 17 L/sec. The stream headwaters originate in pine and native forest and pasture, before crossing over farmland and under the existing SH1. Downstream of the sampling site the stream continues via channelised farm drains to the coast more than 2 km downstream.

At the sampling site the waterway was under a shelterbelt pine canopy, stock fenced within 3 meters, with an understory of long pasture grasses, native grasses, ferns and lesser areas of blackberry. The stream has sharply channelised banks with a pebbled sandy substrate, and low deposited sediments.

### 5.6.3 Freshwater fish

Desktop study identified eighteen species of fish that have been previously recorded in the five catchments of the study area (NIWA, 2011 and KCDC et al, 1999[13] ).

Four of these species are tidal and only found in the lowest reaches (smelt, flounder, mullet, triple fin) of the Waikanae River. Because of the distance downstream from the study area, tidal sections of the waterbodies were not targeted by the sampling regime for the Project and these species are assumed to be present permanently or periodically in all of the tidal reaches of the streams of the study area.

Of the remaining fourteen species, the sampling programme for the Project has recorded eight. Those not recorded by electric fishing machine sampling were lamprey, torrent fish, short-jaw kokopu and giant bully. The freshwater fish species recorded in the study area catchments are shown in Table 14 along with their value and threat classification.

[13] Kāpiti Coast District Council, Greater Wellington Regional Council, NZ Dept of Conservation, Ati Awa ki Whakarongotai, Connell Wagner Ltd (2006). Wharemauku Stream Community Freshwater Plan. (Draft).

**Table 14: Fish recorded in the study area (from New Zealand Freshwater Fish Database, NIWA, 2011 and KCDC et al, 1999) and national threat classification.**

| Common Name | Threat Classification | Waimeha Stream | Waikanae River | Wharemauku Stream | Whareroa Stream | Ngarara Stream | Ngarara Stream Tributary |
|---|---|---|---|---|---|---|---|
| Yellow eye mullet | Not threatened | | Y | Y | | | |
| Short fin eel | Not threatened | Y | Y | Y | Y* | Y | Y |
| Long fin eel | Declining | Y | Y* | Y | Y | Y | Y |
| Torrent fish | Declining | | Y* | Y | | | |
| Giant kokopu | Declining | | | Y | Y | Y | |
| Koaro | Declining | | | Y | | | |
| Banded kokopu | Not threatened | | | Y | Y | Y | Y |
| Inanga | Declining | Y | Y | Y | Y* | Y | Y |
| Short-jaw kokopu | Declining | | | Y | | | |
| Lamprey | Declining | | Y | Y | | | |
| Common bully | Not threatened | Y | Y | | Y | Y | |
| Giant bully | Not threatened | Y | | | Y | Y | Y |
| Crans bully | Not threatened | | | | | y | |
| Red fin bully | Declining | Y | Y | Y* | Y* | Y | |
| Estuarine triplefin | Not threatened | | | | | | |
| Smelt | Not threatened | | Y | Y | | | |
| Black flounder | Not threatened | | Y | | | | |
| Brown trout | Introduced | | Y* | | | | |

* Hand fishing and *Fish Observations reported.

Based on the Freshwater Fish Database and sampling undertaken during this study, long-finned and short fin eel are the most common freshwater fish in the waterways of the study area. Lamprey, torrent fish, short-jaw kokopu and giant bully are infrequently found (making up less than 1% of records).

Our survey has confirmed the abundance of eel. It also identified several species that are more widespread in some of the catchments than previous surveys have shown.

### 5.6.4 Aquatic macro-invertebrates

a. Species richness

In total 60 different aquatic invertebrate taxa were sampled from the 15 waterbodies within the five catchments traversed by the proposed Expressway Alignment. These were identified to levels which provide “taxa richness” information. Overall, sampling sites returned a broad range of taxa, between 5 and 33, across all of the sampling sites

The greatest number of individual invertebrates was from the Mullosca family, with *Potomopyrgus* (23,939) found at 10 of the 15 sites (36% of all species). Crustacean were also common in the samples with 20,005 *Paracalliope* identified making up 29% of the total catch. A high scoring MCI Diptera taxa (*Paralimnophila* - MCI 8), was noted in several sites: Muaupoko, Paetawa and Hadfield / Kowhai, but only in very small numbers.

The most diverse family group were the dipteral (flys) (23) followed by the caddisfly (14). All other taxa were generally represented by less than 5 taxa and more commonly by 1 taxa. There was no common species richness but sites generally had between 10 to 15 taxa each which is lower than can be expected for such lowland streams (Quinn & Hickey, 1990).

Four taxa of Ephemeroptera (mayfly) were recognised. In the 15 samples *Deleatidium* were the mostly commonly encountered mayfly (21% of all samples). Deleatidium made up 97% of the Ephemeroptera caught across all samples. The other three taxa, while much less common, were also typical of the streams in general, they are: *Ichthybotus*, *Austroclima* and *Nesameletus*.

Three taxa (10 individuals) of stonefly (Plecoptera) were recognised (*Zelandoperla*, *Zelandobius* and *Megaloptoperla*), all of which were found only in the Waikanae River. Caddisfly (Tricoptera) were the most taxa rich group of the EPT (Ephemeroptera, Plecoptera, and Trichoptera) with 14 taxa recognised. Of the fourteen taxa, *Tripletides* (cased caddis) were most commonly found at 8 sites, within 45 samples.

Overall, the majority of the sampling sites have low representation of sensitive EPT taxa (<10%) and high levels of taxa that are tolerant of water quality issues such as enrichments, contaminants and sedimentation. The Waikanae River and the reference site are the only water bodies to have over 50% of the taxa present belonging to the EPT groups.

b. Sensitivity indices

Stark & Maxted's (2004) Macroinvertebrate Community Index (MCI) scores were calculated. Mean MCI scores in the study area sites were generally low, i.e. less than 100 and typically under 90 (Figure 11). Notably, all but one sampling site scores indicated either "probable mild pollution" or "possible mild pollution". Only the Waikanae River and the Muaupoko Stream scored over 100 (rated as "good' with "possible mild pollution" category).

The QMCI (Quantitative Macroinvertebrate Community Index) which accounts for the abundance of the sensitivity scoring taxa (weighting the score in favour of the most abundant taxa) accounts for the effect of single (or low number of) taxa of very high or low MCI rating on the final score. Those scores are plotted in Figure 12. The range is from 1.5 ("poor" "probably severe pollution") through to 6.9 (excellent).

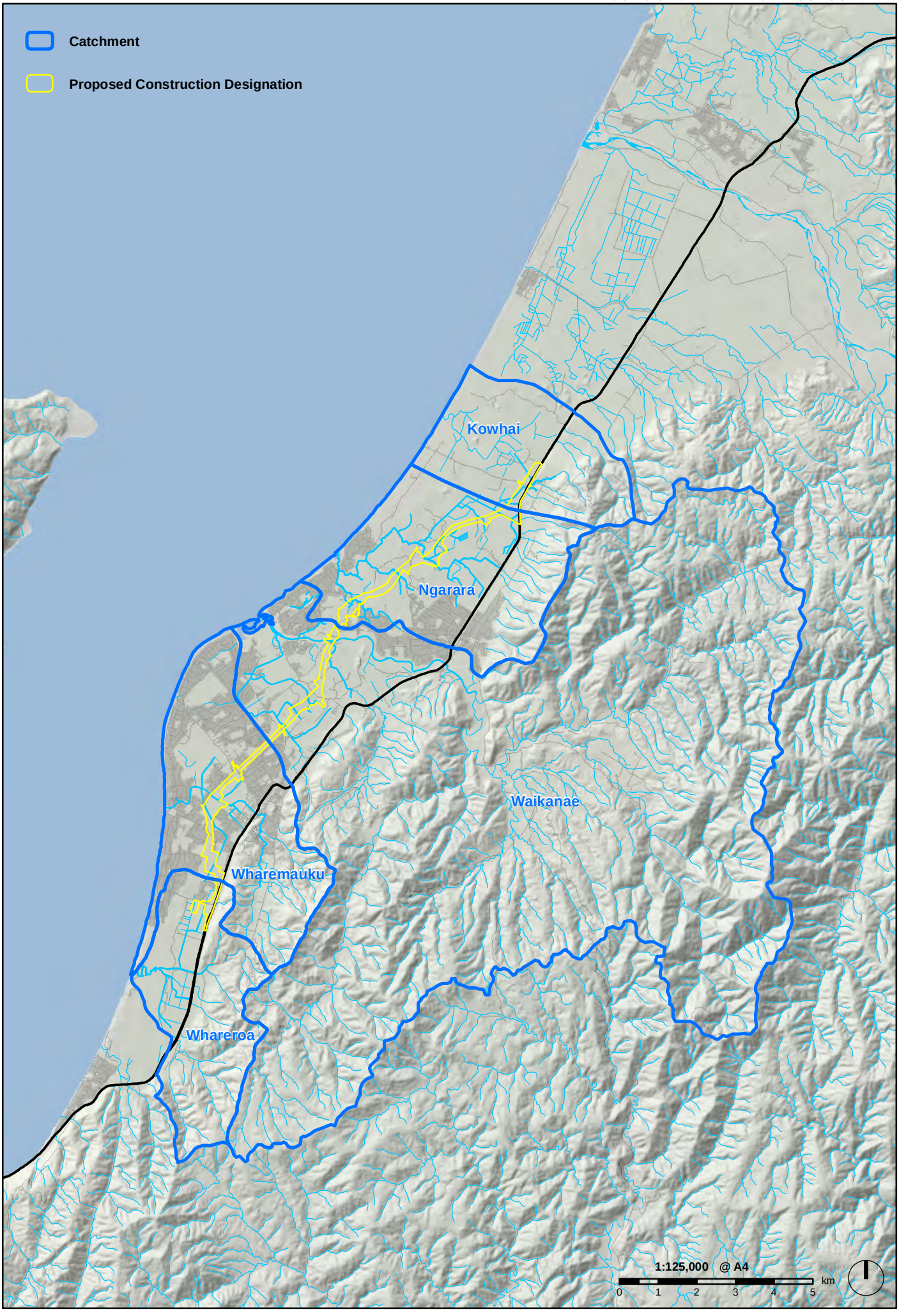
The Waikanae River was notable as being the only site which produced QMCI scores of > 6. Scores > 6 are interpreted as "Excellent" quality, "clean" sites.

### 5.6.5 Freshwater quality

The water quality data gathered by Beca (Technical Report 24, Volume 3) and other sources cited in the Freshwater Values TR4 suggests that most waterbodies sampled have nutrient enrichment above ecological guidelines levels (five of the six sampled waterbodies) and elevated levels of heavy metals. The Ngarara and Mazengarb Stream samples had elevated levels of Aluminium and Boron and stormwater samples from the Wharemauku and the Mazengarb had levels of aluminium, copper and zinc that exceeded (ANZECC 2000) guidelines.

Stormwater sampling undertaken by Beca (Technical Report 24, Volume 3) shows elevated levels of heavy metals, dissolved oxygen, and E Coli in most streams sampled. All streams sampled had high baseline levels of suspended sediments, and many had high levels of turbidity and low associated clarity. Combined these factors suggest that many of the streams along the Alignment already present challenging environments for indigenous flora and fauna, and will favour the presence of species of both plant, invertebrate and fish that are highly tolerant of high contamination levels, poor water quality, and poor clarity.

Nonetheless, benthic macro-invertebrate fauna and fish indicative of good waterway quality persist in most streams sampled. In the absence of data over a prolonged period of time, it is not known whether these conditions and values are trending downwards.




February 2, 2012 W09181E_ECIA_CorridorCatchments_A4.mxd

## 5.7 Estuaries and stream mouths

Five stream mouths and estuaries lie along the Alignment. Of these, three were chosen for survey and analysis based on the potential for adverse effects. They are the Wharemauku stream mouth, the Waikanae Estuary, and the Waimeha stream mouth (refer Figure 5).

The remaining two stream mouths located at the far north and far south of the Alignment, are not considered to be at risk of downstream disturbance, as the Designation only overlays a negligible proportion of their catchments. They are the Whareroa Stream mouth and the Hadfield/Kowhai Stream mouth.

### 5.7.1 Wharemauku Stream mouth

The Wharemauku Stream originates behind Raumati and continues through the Kaitawa Reserve (the outskirts of Paraparaumu); with the stream discharging onto the sandflats along the open coast of Raumati Beach. The catchment area is approximately 1,203 ha.

The lower reaches of the stream are modified through channelisation, wooden walls, and adjacent roading and residential land use.

Wharemauku Stream Mouth is a shallow, small tidal river mouth that is approximately 3-5m wide. The margins of the stream mouth are highly modified with sea walls and houses located on the foredunes (Robertson & Stevens 2007). Estuarine habitat diversity is low given the historic and ongoing modifications and the lack of salt marsh vegetation and tidal flats.

Land-use within the catchment includes pastoral and residential, with some land remaining in scrub and forest. Gravel extraction also occurs within the catchment. These activities and land cover types have resulted in poor stream water quality conditions primarily relating to elevated concentrations of faecal contaminants and nitrogen.

Water quality assessments undertaken by the Project team specifically for the Project determined that the recorded levels of dissolved zinc and aluminium may be exerting a toxic effect on freshwater organisms (Technical Report 24, Volume 3). However, the stream mouth is well flushed and is unlikely to suffer adverse effects from poor stream water quality (Robertson & Stevens 2007).

The Wharemauku Stream differs from the Waikanae and Waimeha streams due to intense urban development and modifications altering the natural stream movement. Hard engineering structures, such as retaining walls and barriers, constrain and alter the natural path of the stream. These structures impede the natural migration paths of several fish species (Todd et al., n.d).

### 5.7.2 Waikanae Estuary

The Waikanae River originates from the western base of the Tararua Ranges where the habitat is largely native bush (Todd et al., n.d). The Waikanae River has good water quality, reflecting the forest and pastoral land use in the catchment (13,400 ha). As the stream migrates towards the coast it passes through the Reikorangi Basin where tributaries feed into the River. As the River nears the coast it runs through the urban areas of Waikanae and Otaihanga, feeding into the estuary and mixing with the tidal seawater. Water quality in the estuary is reduced due to the discharge of treated wastewater via the Mazengarb Drain

(Robertson & Stevens 2007). Occasionally the mouth of the river becomes partially blocked, which may result in reduced water quality until the blockage is cleared.

The estuary is a tidal river mouth estuary and covers approximately 80 ha (Todd et al., n.d) and contains a variety of habitats including tidal mudflats, vegetated sandflats, sand-dunes, two tidal lagoons and saltmarsh (McConkey & Bell, 2005; Robertson & Stevens, 2007). The estuary is approximately 1.5km long, 40-50m wide and average water depth is 1-3 m. The intertidal sand flats (comprising 50% of the estuary) provide important habitat for native fish, as well as a feeding resource for a variety of resident and migratory (national and international) bird species. For these reasons the Waikanae Estuary Scientific Reserve was established in 1978 and is cared for by the DOC (McConkey & Bell, 2005), which considers the significant estuary environment within the reserve as having high ecological value (DOC 2010).

The intertidal area within the Waikanae Estuary below mean high water spring is within the Kāpiti Marine Reserve, which was established in 1992. The Marine Reserve links the Waikanae Estuary Scientific Reserve and the Kāpiti Island Nature Reserve. The reserve incorporates a distribution overlap of species of cool temperature southern waters and warm temperate northern waters resulting in a mixture of northern and southern species. The reserve is also unique as it contacts four distinct habitat zones in close proximity. The habitat zone identified around the Waikanae River mouth is characterised as partly sheltered shallow sand habitat (DOC, 1998).

Pressure is being exerted on the estuary habitats and fauna due to increasing urban development, human recreational activities, introduction of mammalian predators and the spread of exotic plant species (particularly around the estuary margins as a result of urban development). Consequently, an extensive indigenous flora restoration programme is being undertaken by DOC, KCDC, GRWC and Waikanae Estuary Care Group.

### 5.7.3 Waimeha Stream mouth

The Waimeha Stream is a small stream originating from the outskirts of the Waikanae Township. The catchment area (1,574 ha) consists mainly of pastureland. There are two separate subcatchments to the Waimeha Stream mouth – the catchment upstream of the Te Harakeke/Kawakahia Wetland and the spring-fed portion of the Waimeha Stream. Water quality from previous studies showed characteristics of typical lowland rural waterways influenced by agricultural run-off (elevated nutrient levels and low toxicant concentrations). Robertson & Stevens (2007), in their study of Kāpiti Coast marine environments, considered water quality in the stream and estuary to be moderate. However, when the mouth of the stream blocks, estuarine water quality is likely to decline.

The Waimeha Stream exits to a narrow (5-10 m) and shallow (0.5 m) tidal stream mouth. Stream mouth habitat diversity is low due to upstream modifications, regular modification of the beach channel and lagoon (in order to protect coastal residential property), lack of salt marsh vegetation, and high abundance of weeds (Robertson & Stevens 2007).

The stream mouth is modified, with channelisation and construction of an esplanade strip. In 1920 the stream was re-directed to discharge across the beach and provide another white-baiting stream (Todd et al., n.d). .

The sand-flats are a feeding area for coastal and shore birds including black-backed and red-billed gulls, Caspian terns and pied stilts. The relative close proximity to the Waikanae Estuary suggests that a number of other species are likely to visit periodically (Todd et al., n.d).

The Waimeha Stream mouth is a popular site for recreational activities.

### 5.7.4 Sediment

a. Intertidal Sediment Grain Size

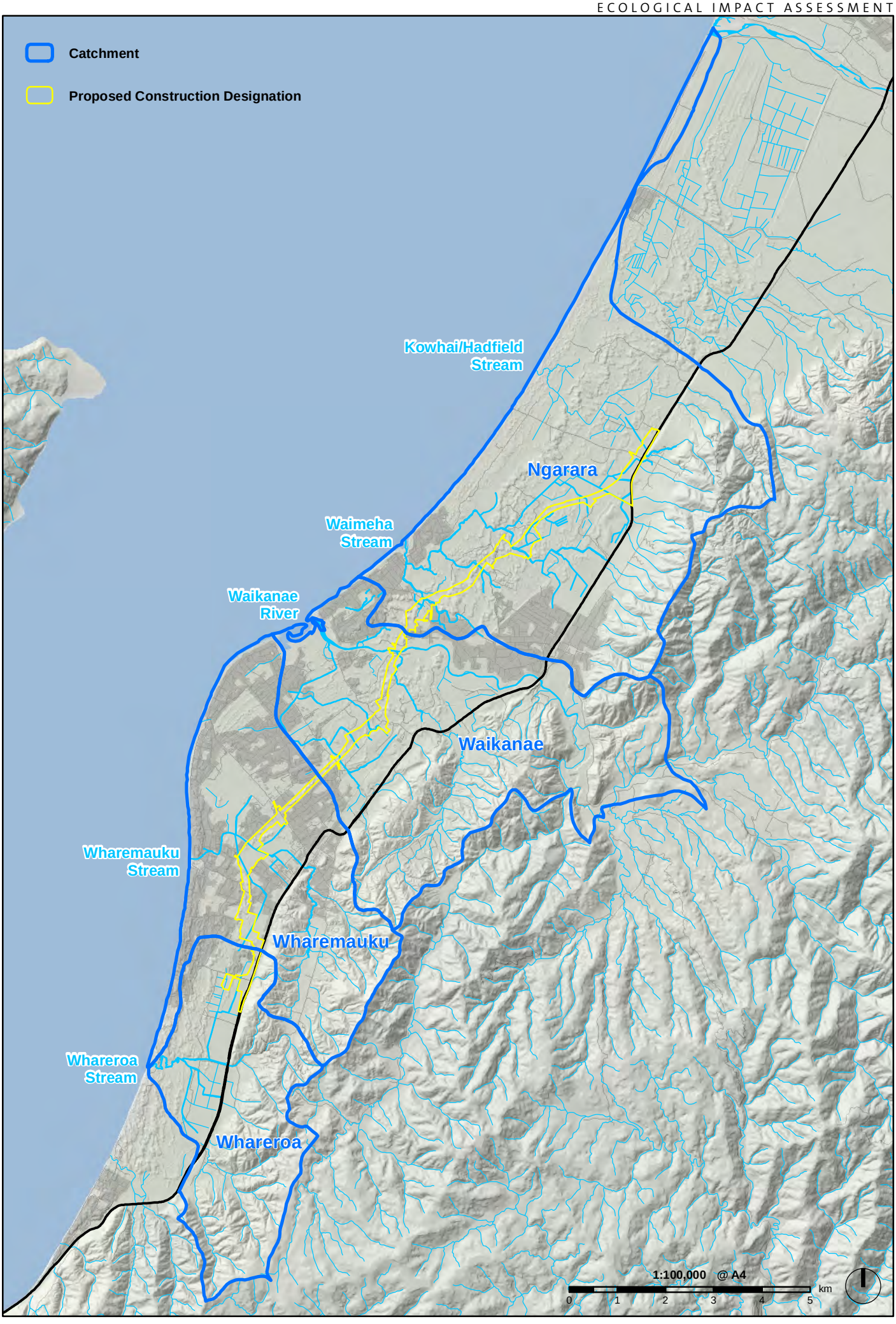
At the Wharemauku, Waimeha and Waikanae estuaries, surface sediment grain size was dominated by fine sand (>70%), with the Waimeha Stream mouth having the highest proportion (84%).

Approximately 95-99% of the sediment at all the sampling sites fell within the medium to very fine sand range. Silt and clay was negligible at all sites (<2%). These results are consistent with those of Cawthron (2006) for the Wharemauku Stream mouth and the Waikanae River mouth.

b. Sediment Quality

The concentration of common stormwater contaminants (copper, lead, zinc and HMW PAHs) taken from each intertidal sampling site was compared against the former Auckland Regional Council (ARC) Environmental Response Criteria (ERC) and the Australian and New Zealand Environment and Conservation Council (ANZECC) Interim Sediment Quality Guidelines (ISQG) (refer to TR 5, Appendix 26.C for trigger levels).

The results indicated that contaminant concentrations at all intertidal sites sampled were significantly below ERC and ISQG low effects thresholds. Of the four sites, sediment collected from the Waikanae North site had the highest concentration of zinc (47 mg/kg dw), lead (9.3 mg/kg dw) and copper levels (7.4 mg/kg dw). The other three sites had similar concentrations of contaminants, all being at very low levels. Thus overall, stormwater contaminant concentrations in surficial sediment are low at all four sites. These results are similar to those reported by Cawthron (2006) for Wharemauku Stream mouth and Waikanae Stream mouth (Waikanae South).




November 18, 2011 W091181E_ECIA_EstuariesStreamMouths_A4.mxd

# 6 Assessment of Ecological Value

## 6.1 Introduction

This section consists of the following:

- Identification of protected natural areas, reserves, and covenants that have been protected, at least in part, due to their ecological values.
- Identification of other natural areas that have been identified by a Protected Natural Areas process as having ecological value, but which do not have formal protection.
- Identification of areas of indigenous vegetation and / or habitat identified as having conservation value.
- A summary of indigenous flora and fauna and habitat potentially affected by the proposed Expressway Alignment.

## 6.2 Key assessment considerations

### 6.2.1 National priorities for protecting rare and threatened indigenous biodiversity[14]

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

A LENZ Level IV analysis was carried out and provides context to the following assessments. The results of this analysis presented in Figure 6. The analysis is based on the following threat classes.

**Table 15: LENZ Threat Classes**

| Category | 1. Acutely threatened | 2. Chronically threatened | 3. At risk | 4. Not at risk | A. Critically under protected | B. Under protected | C. Protected |
|---|---|---|---|---|---|---|---|
| Criteria | <10% indigenous cover remaining | 10–20% indigenous cover remaining | 20–30% indigenous cover remaining | >30% indigenous cover remaining | >30% indigenous cover remaining | | |
| | | | | | <10% legally protected | 10–20% | >20% protected |

- The LENZ map confirms that within the study area the most threatened environments, and the environments that are critically under protected, are the wetlands and sand country of the Kāpiti Coast. These are the areas that were first settled and which are now the most heavily urbanised and the most intensively farmed and drained.
- Nearly all of the Foxton Ecological District is considered to be Acutely Threatened because there is less than 10% of indigenous cover remaining within the Land Environments (LENZ) that occur in these Ecological Districts (Leathwick et al. 2003a; Leathwick et al. 2003b).

[14] Protecting our Places: A Statement of National Priorities for protecting rare and threatened native biodiversity on private land. Minister of Conservation and Minister for the Environment.

- These threat classes are taken into account in the assessment of significance in Section 6.8.4.

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

- All dunelands and associated wetlands are considered in Section 6.8.4.

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

Seventy two "naturally rare ecosystems" have been identified (Williams et al. 2007) and are defined as "ecosystems having a total extent less than 0.5% of New Zealand's total area". Many of these ecosystems rely on specific rock and soil types which are not found in the Kāpiti Coast district. The only naturally rare ecosystems that have been identified within the Designation are:

- Braided riverbeds (raw–recent/sand–boulders/plain/periodically open land)
- The proposed Expressway Alignment traverses the Waikanae River and associated riparian vegetation. The vegetation in this area consists primarily of willows along the immediate river banks and areas of planted native vegetation south of the river edge.
- Ephemeral wetlands (seasonally high water table / depression. Herbfield).
- There are a large number of ephemeral wetlands located within and adjacent to the proposed Alignment. There are also a number of ephemeral wetlands that while retaining some ecological values in terms of indigenous plants and habitat, are not representative of historical communities and have limited botanical value. Their dominance by exotic grasses and weed species also mean they have limited habitat value. These ephemeral wetlands are therefore not recognised unless another value is present (e.g. recognised habitat values or the present of rare flora or fauna).
- Damp sand plains (raw-recent/coastal/sand/depression/plains/permanently high water table. Open land, herbfield)
- There are areas of damp sand plains with manuka and mosses at El Rancho wetland and Ngarara Farm, all of which are historically modified through vegetation clearance and grazing. No original or unmodified sand plains are present.
- Estuaries:
- There are five estuaries of varying size and condition located downstream of the proposed Expressway Alignment, at the outlets of the Whareroa Stream, Wharemauku Stream, Waikanae River, Waimeha Stream and the Kowhai Stream. Three of these are considered to be receiving environments for works along the Alignment.
- Lagoons coastal/lagoon (open land, sedgeland, rushland, reedland, herbfield, shrubland, scrub)
- There is only one coastal lagoon, the Waimanu Lagoon, located just north of the Waikanae Estuary downstream of the proposed Expressway Alignment.

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

- This study did not identify any acutely or chronically threatened indigenous plants. However, it identified one plant, Korthalsella salicornioides (dwarf mistletoe), immediately adjacent to the Designation. This species is ranked by de Lange et al (2009) as "At risk (4. Naturally Uncommon", with the qualifier of "sparse distribution"). The community this is found in is listed in Section 6.8.4.

### 6.2.2 Wellington conservation management strategy

Within the Wellington Conservancy the 10 highest priority ecosystems and habitats managed by DoC in the Wellington CMS area (DoC 2010) are:

**Indigenous forests:**

No indigenous forest remnants are present within the Designation or crossed by the Project Footprint. All remnant forest of the Kāpiti Coast District have been identified and described in earlier PNA surveys and these descriptions have helped to inform the assessment of significance in Section 6.8.4.

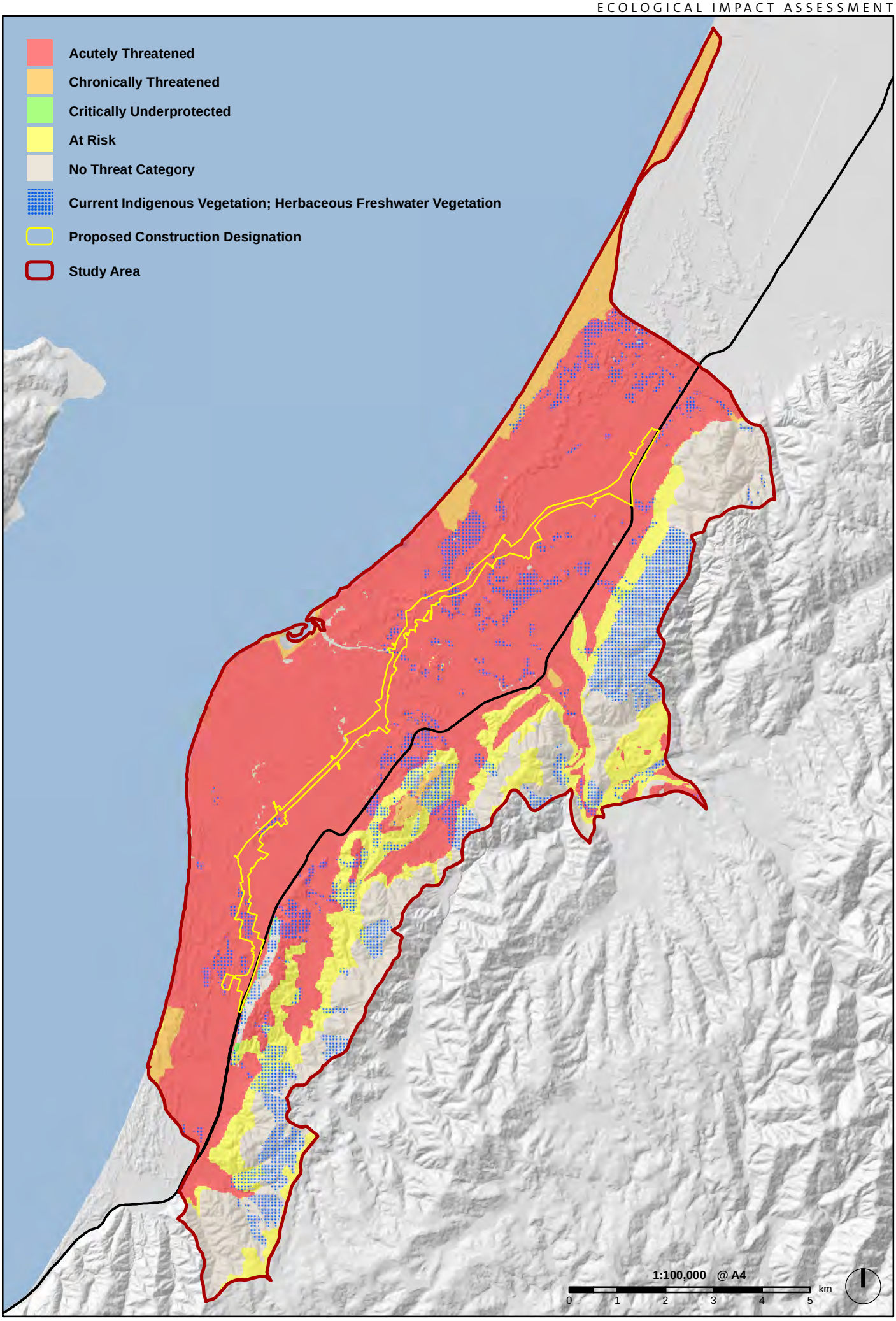
**Shrublands:**

We are satisfied that none of the shrublands contained within the Designation are persistent shrublands representative of historical communities, with the vast majority consisting of blackberry and gorse. They therefore have limited botanical value. However, we have identified areas where regeneration from gorse has advanced to a stage where the shrublands are becoming more valuable as dryland habitat consisting of successional kanuka and mahoe, a habitat type no longer common on the Kāpiti Coast. These are identified in Section 6.8.4.

**Freshwater wetlands:**

There are a number of freshwater wetlands either located within the Designation, crossed by the Project Footprint or considered to be sufficiently close to the Designation that effects may occur through hydrological connections. These are identified in Section 6.8.4.

- Rivers and lakes:
  There are no lakes within the mapped corridor. Listed rivers are identified in Section 6.6 to the extent that riparian vegetation is relevant to the values of these watercourses.
- Estuaries:
  There are five estuaries located downstream of the proposed Expressway Alignment. These are identified in Section 6.8.4.
- Dunes and dune wetlands:
  Refer discussion on dune and wetlands above in relation to National Priority 2. Sites are identified in Section 6.8.4.
- Cliffs:
  No cliff habitat is located within the mapped corridor.
- Herbfields and grasslands:
  All grasslands and herbfields within the study area are considered to be agricultural in origin, and are dominated by exotic grasses and weed species and are therefore not representative of historical communities. Furthermore, they have both limited botanical and habitat value.
- Islands:
  Not relevant to this technical report.
- Marine environment:
  Not relevant to this technical report.




November 18, 2011 W09181E_ECIA_LENZthreat_A4.mxd



**LAND ENVIRONMENTS AND THEIR THREAT CLASSIFICATION (derived from LENZ)**

## 6.3 Protected Natural Areas (PNAs)

### 6.3.1 Terrestrial vegetation (including wetlands)

TR1 lists eleven formally protected natural areas, either through DoC reserve status, QEII covenants or Regional Park status. The majority of these protected natural areas have ecological values, but in some cases these values may not be the primary reason for which the area is protected, e.g. Queen Elizabeth Regional Park. These protected natural areas are listed in Table 16 below.

The protected natural areas listed have been considered in terms of their ecological context or are intersected by the Designation. Of the latter, a number extend beneath the Project Footprint of the proposed Expressway. TR1 has included a number of areas of indigenous vegetation or habitat that are located more than 100m distance from the proposed Expressway where we consider their inclusion is warranted on ecological connectivity grounds.

**Table 16: Protected Natural Areas beneath or in close proximity to the MacKays to Peka Peka proposed Expressway Designation.**

| Name (Sorted by Sector and listed from South to North) | Reln | Description and size | Ecological Value |
|---|---|---|---|
| **Sector 1 Raumati South: From Poplar Ave to just north of Raumati Road (Chainage 1900 – 04500)** | | | |
| Queen Elizabeth Regional Park peatlands | F | The northern edge of a large Regional Park with a range of values, including areas of remnant swamp forest and wetland systems in the south and Poplar Ave wetlands in the north. The actual areas of peatlands have not been determined for this report.<br>Protected by Regional Park, KCDC Ecosite (K184). | Low |
| **Sector 2 Raumati/Paraparaumu: From north of Raumati Road to north of Mazengarb Road (Chainage 04500 – 08300)** | | | |
| Andrews Pond | A | A small manuka wetland located amongst large areas of pasture.<br>Protected as a Scientific Reserve, DoC RAP (Recommended Area for Protection), KCDC Ecosite (K093). | Low |
| Sovereign Way / Crown Hill Eco-site | A | Manuka transitional wetland.<br>Protected by KCDC Recreation Reserve (E183), KCDC Ecosite (E92). | Medium |
| **Sector 3 Otaihanga/Waikanae: From north of Mazengarb Road to north of Te Moana Road (Chainage 08300 – 12400)** | | | |
| Waikanae Estuary Scientific Reserve | DS | Nationally-significant estuarine wetland and river mouth protects a natural mosaic of freshwater lakelets, saltwater lagoons and marshes, tidal sand flats and sandy beach at the mouth of the Waikanae River.<br>Protected as a Scientific Reserve, KCDC Ecosite (K081). | High |
| Waimanu Lagoons | DS | A large saline lagoon system with linkages to Waikanae Estuary Scientific Reserve. Wetland habitat is nationally under-represented.<br>KCDC Ecosite (K175). | Medium |
| Osbournes Swamp | A | A modified flax/toetoe/raupo wetland with *Coprosma propinqua* shrubland. Protected by QEII Covenant, KCDC Ecosite (K068). | Low |

| Sector 4 Waikanae North: From north of Te Moana Road to Peka Peka Road (Chainage 12400 – 18050) | | | |
|---|---|---|---|
| Ngarara Bush | A | An area of contiguous semi-coastal modified primary kohekohe and kahikatea forest.<br>Protected by QE II covenant, KCDC Ecosite (K133). | High |
| Te Harakeke Swamp / Kawakahia Wetland | DS | The largest dune swale wetland remaining in a relatively natural state on the coastal plain of the Foxton Ecological District.<br>Protected by QEII Covenants, KCDC Ecosite (K066), RAP (PNAP). | High |
| Te Kouka Wetland | D | Regenerating kahikatea wetland, with scattered remnant kahikatea.<br>Protected by QEII Covenant, KCDC Ecosite (K066). | Medium |
| Kawakahia Swamp Forest | DS | A small area of kahikatea-dominated semi-coastal remnant swamp forest.<br>Protected by QEII Covenant, KCDC Ecosite (K066). | High |
| Nga Manu Nature Reserve | A | One of the largest and best examples of swamp forest within Foxton Ecological District.<br>Protected by Private Trust, QEII Covenant, KCDC Ecosite (K133). | High |

**A** = adjacent to Designation; **D** = all or part within Designation; **F** = falls beneath road footprint; **DS** = downstream of route; = outside of Designation, but potentially connected via watertable.

## 6.4 Significant Natural Areas (SNAs)

A further 22 sites within, or in close proximity to the Designation have been identified through district wide or regional survey as having ecological value but have not received formal protection. These significant natural areas are derived from a number of sources, but primarily the Wildlands Kāpiti Coast District Council Ecological Sites survey (2003) and the Wildlands Kāpiti Coast District Council potential Ecological Sites survey (2007) as well as our own knowledge of the Kāpiti Coast[15].

The sites listed in Table 17 are either intersected by the Designation, lie in close proximity to the Designation or have been identified through the ecological assessment as being potentially affected through groundwater or hydrological disturbance or habitat disruption to existing habitat corridors. Figure 7 illustrates these areas in more detail.

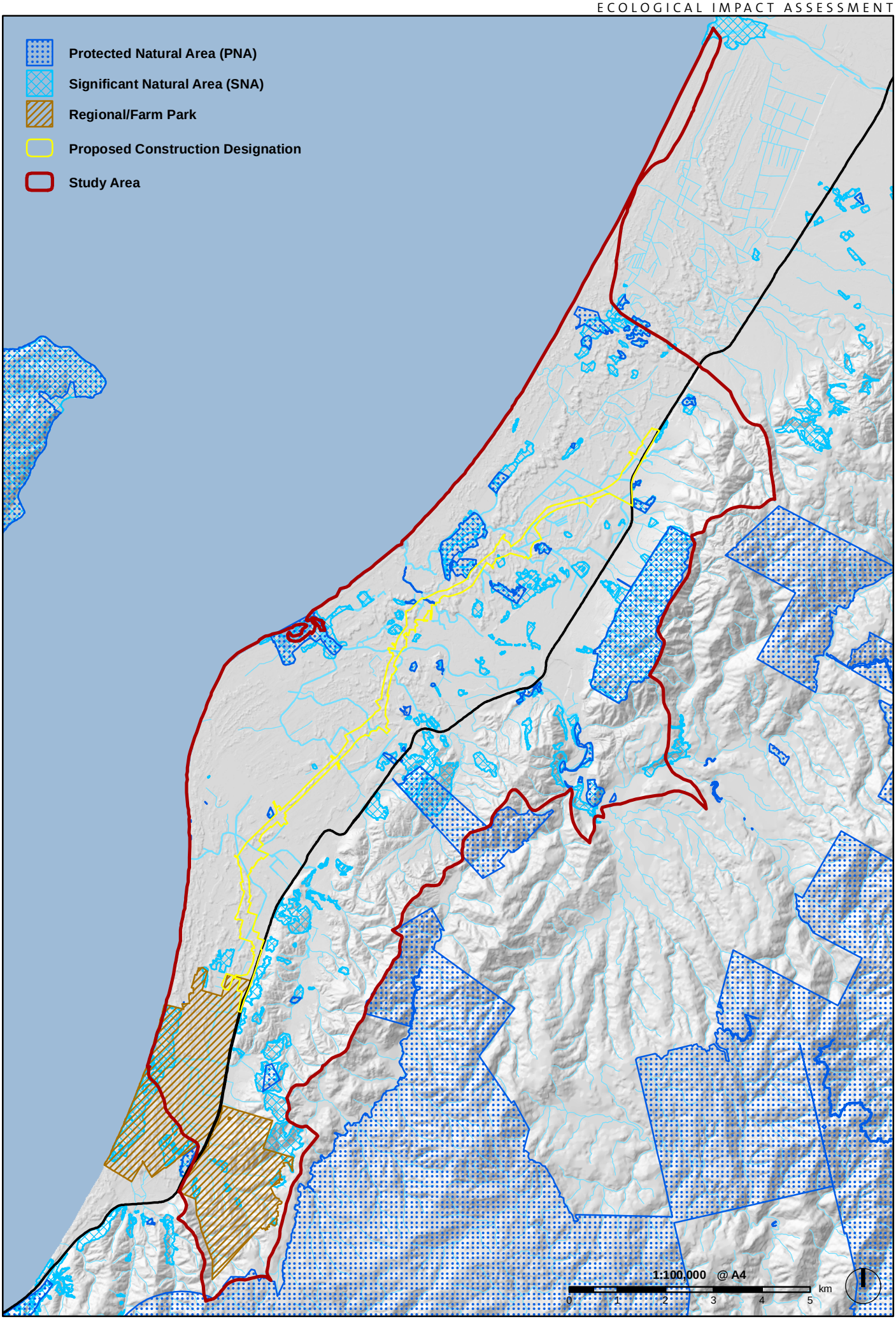
[15] Based on ecological assessments prepared for the following Kāpiti Coast District Council Plan Changes: Ngarara Plan Change, Meadows Trust Plan Change, Andrews Pond, Paraparaumu Airport Plan Change, Tasman Lakes Plan Change, as well as the El Rancho wetland restoration plan and the existing WLR designation.

**Table 17: Significant natural areas (unprotected) beneath or in close proximity to the proposed MacKays to Peka Peka Expressway Designation.**

| Name (Sorted by Sector and listed from South to North) | Reln | Description and size | Ecological Value |
|---|---|---|---|
| **Sector 1 Raumati South: From MacKays Crossing to just north of Raumati Road (Chainage 1900 – 04500)** | | | |
| 131 Raumati South Peatlands | A | Large manuka-dominated wetland with a range of other wetland habitat types.<br>Reference: KCDC; Wildlands, 2007; TR1. | Medium |
| Raumati Manuka Wetland | D / WT | Manuka and Sphagnum wetland, with *Carex* and *Baumea* sedge-rushland and open water.<br>Reference: Wildlands, 2007; OPUS 2007; TR1. | Medium |
| Raumati Road Kanuka | F | A small area of kanuka forest and treeland with scattered mahoe on the raised dunes south of Raumati Road.<br>Reference: TR1. | Medium |
| **Sector 2 Raumati/Paraparaumu: From north of Raumati Road to north of Mazengarb Road (Chainage 04500 – 08300)** | | | |
| Kiwi Pond | F | A large area of seasonally wet pasture that provides occasional wildlife habitat.<br>Reference: Wildlands, 2007; OPUS, 2007; TR1. | Low |
| Meadows Trust Carex Wetland | A | Small area of induced Juncus and Carex wetland.<br>Reference: Wildlands, 2007; BML, 2008; TR1. | Low |
| Southern Otaihanga wetland | F | Large area of purei sedgeland with areas of open water, Baumea rushland and scattered manuka.<br>Reference: Wildlands, 2007; Opus, 2007; TR1. | Medium |
| Middle Otaihanga wetland | F | Modified manuka and Carex wetland dominated by weeds.<br>Reference: Wildlands, 2007; TR1. | Low |
| Northern Otaihanga wetland | F | Manuka and Carex wetland with Sphagnum.<br>Reference: Wildlands, 2007; OPUS, 2007; TR1. | Medium |
| Otaihanga Landfill Mahoe | D | Small stand of indigenous bush with remnant matai tree.<br>Reference: Wildlands, 2007; TR1. | Medium |
| Otaihanga Landfill Kanuka | F | Kanuka forest located on an elevated sand dune.<br>Reference: Wildlands, 2007; TR1. | Medium |
| Open water and Juncus south of Waikanae River. | A | Stock water pond (formed) and large area of Juncus and pasture grasses.<br>Reference: Wildlands, 2007, TR1. | Low |
| Waikanae River Riparian | F | Riparian planting on southern bank of the Waikanae River.<br>Reference: Keesing, 2001; TR1. | Low |
| El Rancho Wetland (Weggery) | F / WT | A large area of manuka dominated wetland with occasional kahikatea. Southern edge includes Baumea and Carex. Some open water and Sphagnum.<br>Reference: KCDC, Cameron, 1995; Kessels, 1998; Keesing, 2001; BML, 2006; Wildlands, 2007; OPUS, 2007; TR1. | Medium |
| El Rancho Wetland (West) | WT | Large area of manuka dominated wetland with some open water to the west.<br>Reference: KCDC; Kessels, 1998; Keesing, 2001; Wildlands, 2007; BML, 2006; OPUS, 2007; TR1. | Medium |
| El Rancho Wetland (Takamore) | WT | Large area of manuka dominated wetland with some open water to the north.<br>Reference: KCDC; Kessels, 1998; Keesing, 2001; Wildlands, 2007; BML, 2006; OPUS, 2007; TR1. | Medium |
| Tuku Rakau Wetland | D | A small wetland with scattered manuka, cabbage tree and rushland.<br>Reference: TR1. | Low |
| Tuku Rakau Forest | F | Regenerating mahoe forest with remnant kohekohe tree. Adjacent to a small modified wetland.<br>Reference: TR1 | Low |

| | | | |
|---|---|---|---|
| Osbournes Swamp West | A | Large area of manuka dominated wetland with some open water.<br>Reference: KCDC; Kessels, 1998; Keesing, 2001; Wildlands, 2007; BML, 2006; OPUS, 2007; TR1. | Medium |
| **Sector 3 Otaihanga/Waikanae: From north of Mazengarb Road to north of Te Moana Road (Chainage 08300 – 12400)**<br>**Sector 4 Waikanae North: From north of Te Moana Road to Peka Peka Road (Chainage 12400 – 18050)** | | | |
| Ngarara Farm Mahoe | F | A large area of advanced mahoe regenerating from gorse on the raised dunes of Ngarara Farm, in close proximity to Ti Kouka wetland.<br>Reference: TR1 | Medium |
| Ngarara Wetland | A | A large area of manuka dominated wetland with areas of Carex sedgeland and regenerating kahikatea forest east of Ngarara Road. Contains *Korthalsella salicornioides*.<br>Reference: KCDC; Wildlands, 2007; BML, 2008; TR1. | Medium |
| Ngarara Dune Depressions | F | Three large wet dune depressions dominated by Juncus (induced from grazing) in the north of Ngarara Farm.<br>Reference: Wildlands, 2007; BML, 2008; TR1. | Low |

A = adjacent to Designation; **D** = all or part within Designation; **F** = falls beneath Project Footprint; **DS** = downstream of route; = outside of Designation, but potentially connected via watertable.




November 18, 2011 W09181E_ECIA_SEAsWaterbodies_A4.mxd

## 6.5 Terrestrial vegetation & habitat

The assessment commenced with the development of a GIS layer that overlaid the mapped vegetation communities in the study area and assigned each one a value (H - High, M - Medium, L - Low, and N - Negligible) as follows.

**Table 18: Value Classification of Plant Communities.**

| Grasslands | | RANK |
|---|---|---|
| 1.01 | Improved pasture | N |
| 1.02 | Rank pasture | L |
| 1.03 | Cropland | N |
| **Wetlands and wet depressions** | | |
| 2.01 | Riparian margins in pasture / rushlands | L |
| 2.02 | Wet pasture with *Juncus* | L |
| 2.03 | Sedge-rushland dominated wetlands | H |
| 2.04 | Cyperus ustulatus dune depressions | M |
| 2.05 | Manuka wetlands | H |
| 2.06 | Manuka wetlands with *Sphagnum* | H |
| 2.07 | Mature and maturing swamp forest with kahikatea | H |
| 2.08 | Open water / permanent ponds | M |
| **Pioneer shrublands, scrub and low forest** | | |
| 3.01 | Blackberry dominated weedlands | L |
| 3.02 | Gorse dominated scrub | L |
| 3.03 | Kanuka forest | H |
| 3.04 | Regenerating broadleaved scrub and low forest | M |
| 3.05 | Riparian margins in regenerating shrublands | M |
| **Mature indigenous forest** | | |
| 4.01 | Mature indigenous forest | H |
| **Exotic and planted vegetation** | | |
| 5.01 | Plantation pine | N |
| 5.02 | Plantation pine – harvested | L |
| 5.03 | Exotic trees | L |
| 5.04 | Riparian margins with exotic trees | L |

Based upon the information contained with the SNA and PNA surveys, the value of each community was reviewed and the status of some were elevated or reduced from this base map. In addition, the presence of rare or locally uncommon indigenous plants was considered as part of this assessment.

## 6.6 Freshwater systems

Project sampling and limited regional and historical data show that overall the streams of the MacKays to Peka Peka area support fauna that are generally tolerant to organic water pollution and contaminants. This is a result of long term nutrient enrichment from farming and other land uses, a background of contamination from residential areas and the existing roading network and land management that did not protect waterways. The absence of systematic data collection over a long time means that it is not possible to identify any trends in fauna communities or condition of the physical environment across the waterbodies sampled.

Maintenance of ecological diversity in the Waikanae River system is considered to be of very high importance at the Regional scale.

Overall, in terms of aquatic habitat values, most waterbodies sampled are not maintaining a "good" condition for aquatic biota.

At a regional scale, the sampling results indicates that the aquatic fauna and physical habitat of the Whareroa, Wharemauku, Waikanae, Waimeha and Hadfield/Kowhai catchments are already degraded.

**Table 19: Assessment of Ecological Value – Streams (south to north)**

| Regionally significant in terms of Ecology | Physical Habitat Assessment (PHA) | (Stream Ecological Valuation (SEV)) | Fish | Threatened Fish Present | Aquatic invertebrates | Compilation result |
|---|---|---|---|---|---|---|
| Whareroa Tributary | M | L | M/L | Y | M | Medium |
| Whareroa Drain | L | L | L | Y | L | Low |
| Upper Drain 7 | L | L | L | Y | L | Low |
| Lower Drain 7 | L | L | L | Y | L | Low |
| Wharemauku Stream | L | L | M | Y | M | Medium |
| Mazengarb Stream | L | L | L | Y | L | Low |
| Waste Water Treatment Plant Stream | L | L | L | Y | L | Low |
| Muaupoko Stream | M | L | L/M | Y | M | Low |
| Waikanae River | H | M | M | Y | H | High |
| Waimeha Stream | L | L | L | Y | L | Low |
| Ngarara Creek | L | L | L | Y | L | Low |
| Kakariki Stream | L | L | L | Y | M | Low |
| Smithfield Drain | L | L | L | Y | L | Low |
| Paetawa Drain | L | L | L | Y | L | Low |
| Hadfield / Kowhai Stream | L | L | L | Y | L | Low |

The results of this study were:

- Only the Waikanae River was considered to be regionally significant, and it is the only waterbody traversed by the proposed Expressway Alignment with high ecological values.
- While all of the streams sampled have high fisheries values, the compilation of results suggest that with the exception of the Waikanae River, Wharemauku Stream, Whareroa

Stream tributary, most waterbodies are low value consistent with their highly modified and drained nature.

## 6.7 Estuarine systems

As outlined in TR5, the marine ecological values are described as being low, medium or high based on the characteristics used to assess the predominant ecological values of parts of the marine environment within the study area. Overall, the patterns in the data collected reflect the environment from which they were collected: open sandy beaches and sheltered estuaries.

The common ecological characteristics of the Waimeha and Wharemauku stream mouths and the two Waikanae Estuary sites are contained in Table 20 below.

**Table 20: Ecological Characteristics Common to Waimeha and Wharemauku Stream Mouths and Waikanae Estuary**

| | Ecological Characteristics of Waimeha and Wharemauku Stream Mouths | Ecological Characteristics of Waikanae River Estuary |
|---|---|---|
| Sediment Grain Size | Dominated by fine sand grain size. | Dominated by fine sand grain size. |
| Sediment Quality | Contaminant concentrations in sediment significantly below guideline values. | Contaminant concentrations in sediment significantly below guideline values |
| Redox Discontinuity Layer | No anoxic sediment discernable. | Depth of anoxic sediment on average 2-4 cm. |
| Surface Macroalgae | No macroalgae present. | No macroalgae present. |
| Epifauna | No epifauna present. | No epifauna present. |
| Infaunal Invertebrates | Low diversity and abundance of invertebrates, which is typical and expected in the mobile sands of an exposed beach and does not reflect a degraded habitat in this case. Shannon Wiener Diversity below 0.4. | Invertebrate assemblage dominated by a high abundance of amphipods and gastropods. Shannon Wiener Diversity just below 1. |
| Sensitive Invertebrates | No known sensitive invertebrate species detected. | Sensitive invertebrate species detected e.g. pipi. |
| Habitat Modification | Modified habitat. | Largely unmodified habitat. |

Overall, the Waimeha and Wharemauku Stream mouths and the marine habitat of the Waikanae Estuary are considered to have high ecological values.

## 6.8 Fauna

### 6.8.1 Avifauna species & habitat

Six species of conservation interest were observed[16] and their habitat identified. Specific habitats and areas of importance for birds are:

- Te Harakeke/Kawakahia Wetland, Ngarara Wetland and Nga Manu Nature Reserve provide the best quality habitat for freshwater species (waterfowl, waders and cryptic wetland species) due to the extent of the wetland and the diversity of habitat types present (i.e. extensive raupo reedlands and flaxlands). The wetland sequence around this wider area is of particular importance to Threatened and At Risk avian species in the district.
- Although located outside of the proposed Expressway Alignment, the estuaries downstream (including the Whareroa, Wharemauku, Waikanae, Waimeha, and Hadfield / Kowhai estuaries) provide habitat for estuarine and coastal bird species.

### 6.8.2 Lizards and habitats

While this study did not detect any uncommon or threatened species of lizard within the proposed Expressway Alignment, the common native lizard species present (common skink) has ecological value. The common skink is most probably representative of the lizard communities now remaining across much of the Kāpiti Coast District, especially in agricultural landscapes with scattered wetlands, shrublands and rank grassland.

The key habitat where this species was found was the dense grasslands across the study area. This habitat type was prevalent along the proposed Expressway Alignment, particularly in Sectors 1 – 3.

The herpetofauna survey revealed no herpetofauna occurring within the regenerating shrubland and forest habitats. Given the small and isolated nature of the areas of shrubland and forest within the Alignment, these areas are considered unlikely to represent significant herpetofauna habitat.

### 6.8.3 Terrestrial invertebrates and habitats

One specimen of Peripatus novae-zelandiae was recorded during this survey. It was located in the compacted sand under a recently fallen pine tree within the Otaihanga Mountain bike Area. While this species does not currently have a threat status, their taxonomy is under review.

### 6.8.4 Flora and habitats

One plant species of conservation interest was located in the Ngarara wetland, adjacent to Ngarara Road. This wetland is not located within the Designation but the wider area provides an opportunity for mitigation, particularly given the known presence of the North Island fernbird.

The following tables summarise the valued ecological components that have been identified and described by this study and detailed in the preceding sections. Figure 8 illustrates the significant natural areas of the study area in more detail.

[16] Including an incidental observation of dabchick outside of the standardised avi-fauna surveys.

**Table 21: Summary of valued ecological components**

| Description | Relationship to Expressway | Ecological Value |
|---|---|---|
| **TERRESTRIAL VEGETATION AND HABITAT** | | |
| **Wetlands** | | |
| Queen Elizabeth Park peatlands[17] | Project Footprint | Low |
| 131 Raumati South Peatlands | Adjacent | Medium |
| Raumati Wetland | Designation | Medium |
| Kiwi Pond | Project Footprint | Low |
| Andrews Pond Scientific Reserve | Adjacent | Low |
| Sovereign Way / Crown Hill Eco-site | Adjacent | Medium |
| Meadows Trust *Carex* Wetland | Adjacent | Low |
| Southern Otaihanga Wetland | Project Footprint | Medium |
| Middle Otaihanga Wetland | Project Footprint | Low |
| Northern Otaihanga Wetland | Project Footprint | Medium |
| Open water and *Juncus* south of Waikanae River. | Adjacent | Low |
| El Rancho Wetland (Weggery) | Project Footprint, Hydrology | Medium |
| El Rancho Wetland (West) | Hydrology | Medium |
| El Rancho Wetland (Takamore) | Hydrology | Medium |
| Tuku Rakau Wetland | Designation | Low |
| Osbournes Swamp West | Adjacent | Medium |
| Osbournes Swamp | Adjacent | Low |
| Te Harakeke/Kawakahia Wetland | Downstream | High |
| Kawakahia Swamp Forest | Downstream | High |
| Te Kouka Wetland | Adjacent | Medium |
| Ngarara Wetland | Adjacent | Medium |
| Nga Manu Nature Reserve | Adjacent | High |
| Ngarara Dune Depressions | Project Footprint | Low |
| **Pioneer shrublands, scrub and low forest** | | |
| Raumati Road Kanuka | Project Footprint | Medium |
| Otaihanga Landfill Mahoe | Designation | Medium |
| Otaihanga Landfill Kanuka | Project Footprint | Medium |
| Waikanae River Riparian | Project Footprint | Low |
| Tuku Rakau Forest | Project Footprint | Low |
| Ngarara Farm Mahoe | Project Footprint | Medium |
| **Mature or maturing indigenous forest** | | |
| Ngarara Bush | Adjacent | High |
| **STREAMS AND AQUATIC HABITAT** | | |
| **High Value Stream Habitat** | | |
| Wharemauku Stream | Project Footprint | High |

[17] Note: the assessment of QE Park took into account the grazed peatlands adjacent to the existing SH1 and Poplar Ave. Poplar Ave wetlands and other identified ecological areas within the Regional Park were not considered as part of this assessment, although they were the site of botanical surveys.

| | | |
|---|---|---|
| Waikanae River | Project Footprint | High |
| Waimeha Stream | Project Footprint | High |
| **Medium Value Stream Habitat** | | |
| Whareroa Stream tributaries | Project Footprint | Medium |
| Upper Drain 7 (tributary of Wharemauku Stream) | Project Footprint | Medium |
| Mazengarb and WWTP Streams | Project Footprint | Medium |
| Kakariki Stream | Project Footprint | Medium |
| Paetawa Drain | Project Footprint | Medium |
| Hadfield / Kowhai Stream | Project Footprint | Medium |
| **Low Value Stream Habitat** | | |
| Whareroa Stream farm drain tributaries | Project Footprint | Low |
| Lower Drain 7 (Tributary of Wharemauku Stream) | Project Footprint | Low |
| Otaihanga Landfill Drain | Project Footprint | Low |
| Waimeha Stream tributaries | Project Footprint | Low |
| Ngarara Creek | Project Footprint | Low |
| Paetawa Drain tributaries | Project Footprint | Low |
| **HARBOUR & STREAM MOUTH HABITAT** | | |
| **Estuaries** | | |
| Whareroa Stream Mouth | Downstream | High[18] |
| Wharemauku Stream Mouth | Downstream | High |
| Waikanae Estuary Scientific Reserve | Downstream | High |
| Waimanu Lagoons | Downstream | Medium |
| Waimeha Stream Mouth | Downstream | High |
| **SPECIES OF CONSERVATION VALUE** | | |
| **Terrestrial Flora** | | |
| Dwarf mistletoe (*Korthalsella salicornioides*) | Ngarara Wetland | At Risk (Naturally Uncommon) |
| **Terrestrial Invertebrates** | | |
| Velvet worm (*Peripatus novae-zelandiae*) | Otaihanga Mountain bike Area | Not Threatened |
| Lizards | | |
| Common skink (*Oligosoma polychrome*) | Rank pasture along the Expressway | Not Threatened |
| **Avifauna** | | |
| Australasian bittern (*Botaurus poiciloptilus*) | Te Harakeke/Kawakahia Wetland | Nationally Endangered |
| Pipit (*Anthus novaeseelandiae*) | Farmland on Ngarara | At Risk |
| North Island fernbird (*Bowdleria punctata vealeae*) | Te Harakeke/Kawakahia, Ngarara wetlands | Declining |
| Black Shag (*Phalacrocorax varius*) | Waikanae River | Naturally Uncommon |
| Pied Shag (*Phalacrocorax novaehollandiae*) | Waikanae River | Nationally Vulnerable |

[18] Refer Assessment of Ecological Impacts Report for Transmission Gully Motorway (Boffa Miskell, 2011)

| | | |
|---|---|---|
| Dabchick (Poliocephalus rufopectus) | Osbournes Wetland | Nationally Vulnerable |
| Freshwater Fauna | | |
| Long fin eel (*Anguilla dieffenbachia*) | Throughout | At Risk (Declining) |
| Torrent fish (*Cheimarrichthys fosteri*) | Waikanae River | Declining |
| Giant kokopu (*Galaxias argenteus*) | Whareroa, Ngarara Streams | At Risk (Declining) |
| Koaro (*Galaxias brevipinnis*) | Wharemauku Stream | At Risk (Declining) |
| Inanga (*Galaxias maculatus*) | Throughout | At Risk (Declining) |
| Short jaw kokopu (*Galaxias postvectis*) | Wharemauku Stream | At Risk (Declining) |
| Red fin bully (*Gobiomorphus huttoni*) | Throughout | At Risk (Declining) |
| Lamprey (*Geotria australis*) | Waikanae River | At Risk (Declining) |

## 6.9 Summary of sites of ecological value

### 6.9.1 Terrestrial vegetation (including wetlands)

Four sites are considered to have high ecological value. All of these high value sites are located outside of the Designation and will not be directly affected by habitat loss as follows:

- Te Harakeke/Kawakahia Wetland (KCDC Ecosite K066) is located approximately 160 metres downstream of the Designation (or 220m from the edge of the physical proposed Expressway). There will be no loss of habitat of this large nationally recognised wetland area.
- Kawakahia Swamp Forest (KCDC Ecosite K066) is located approximately 380 metres from the Designation. There will be no loss of habitat in this wetland.
- Nga Manu Forest Sanctuary (KCDC Ecosite K133) is located 400 m from the proposed Expressway Alignment, and approximately 150m from the new Smithfield Road realignment. There will be no loss of habitat from this protected area of wetland and swamp forest.
- Ngarara Bush (KCDC K133) is located 250 m from the proposed Expressway Alignment, and 90 m from the new Smithfield Road realignment. There will be no loss of habitat from this protected area of forest.

### 6.9.2 Streams

Sections of the Wharemauku and Waimeha Streams and the Waikanae River traversed by the proposed Expressway Alignment are considered to be of high value.

### 6.9.3 Estuaries and stream mouths

No harbours, river mouths, or their habitat will be directly affected by construction of this route. However, three high value estuaries and stream mouths, the Wharemauku, Waimeha and Waikanae, lie downstream of the proposed Expressway Alignment and may be subject to discharge of contaminants, either sediment associated with earthworks, or stormwater during proposed Expressway operation.

### 6.9.4 Fauna

Four species of bird of particular ecological importance; Australasian bittern (Nationally Endangered), North Island fernbird (Declining), pied shag (Nationally Vulnerable) and dabchick (Nationally Vulnerable) have been identified along the proposed Expressway Alignment.

### 6.9.5 Other

Fifteen sites are considered to have medium ecological value. Of these fifteen sites, seven are located with the Designation as follows (south to north):

- The Raumati Manuka Wetland, north-east of Raumati School, is located immediately adjacent to the Project Footprint.
- Approximately 0.35 ha of regenerating kanuka south of Raumati Road will be lost beneath the Project Footprint.
- The southern, central and northern wetlands within the Otaihanga wetland complex are bisected by the proposed Expressway Alignment and there will be some loss of wetland habitat within each of these three wetlands. In the Southern Otaihanga Wetland, approximately 0.55 ha of *Carex* sedgeland and *Baumea* rushland will be lost beneath the Project Footprint. In the Northern Otaihanga Wetland, approximately 0.53 ha of manuka wetland with *Carex* and *Sphagnum* will be lost beneath the Project Footprint. We have not considered the highly modified blackberry dominated weedland vegetation within the Central Otaihanga Wetland. However, pending further testing, some additional consideration of the role the Central Wetland plays in informal treatment of potential leachate from the Landfill may be required.
- Approximately 0.17 ha of the eastern section of the kanuka forest in Otaihanga Landfill will be lost beneath the Project Footprint.
- Approximately 0.38 ha of the El Rancho Wetland (Weggery) (KCDC K170) will be lost beneath the Project Footprint.
- Approximately 0.86 ha of a larger area of regenerating mahoe on the Ngarara property (Ngarara Farm Mahoe) will be lost beneath the Project Footprint.
- At each of these sites of medium value, there is the potential to minimise direct effects through careful management and this is specifically addressed in the Ecological Management Plan (EMP) (CEMP Appendix M, Volume 4).

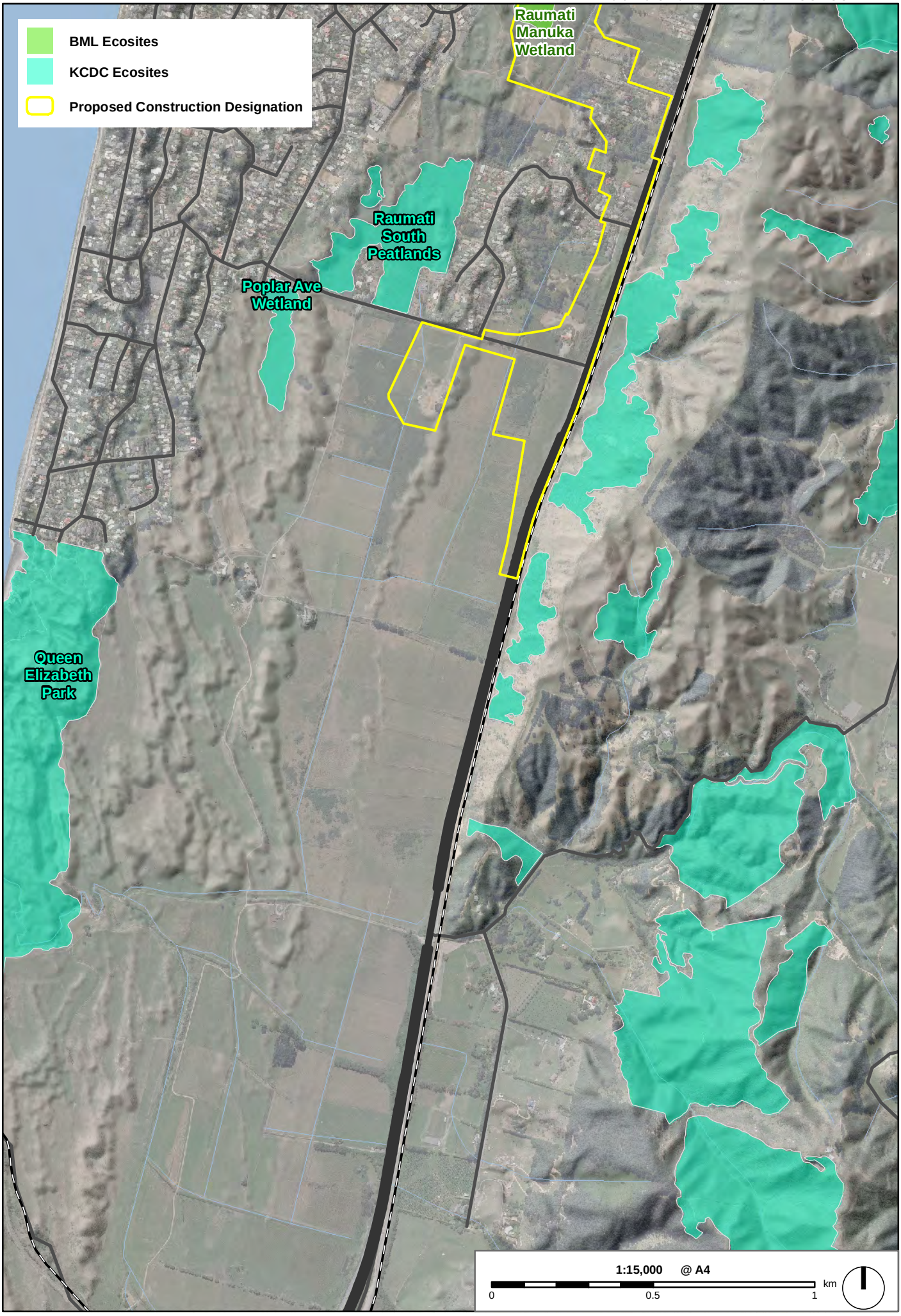
The remaining eight medium value sites are not located within the Designation:

- The Raumati South Peatlands (KCDC K131) are located 500 and 800 metres respectively from the Designation. There will be no loss of habitat.
- The Crown Hill Reserve (KCDC K183) is approximately 120m from the Designation, and is physically separated from the proposed Expressway by a small residential area. There will be no loss of habitat.
- Two of the El Rancho Wetlands (West and Takamore - KCDC K170) are located approximately 250 metres and 180 metres respectively from the Designation. There will be no physical loss of wetland vegetation.
- The QEII covenanted Osbournes Swamp (KCDC K068) and Osbournes Swamp West (KCDC K170) are located 150m and 400m respectively from the Designation and there will be no habitat loss.
- The Ti Kouka wetland, west of Ngarara Road (KCDC K066), is located approximately 35m away from the Project Footprint.
- The Ngarara wetland (KCDC K066) is located approximately 35m from the Designation. However, a small portion of the dryland vegetation buffering this wetland, east of Ngarara Road will be lost beneath the Project Footprint.
- While located within the Designation, the small area of regenerating mahoe within the Otaihanga Landfill is located approximately 15 metres from the Project Footprint and will not be physically affected.

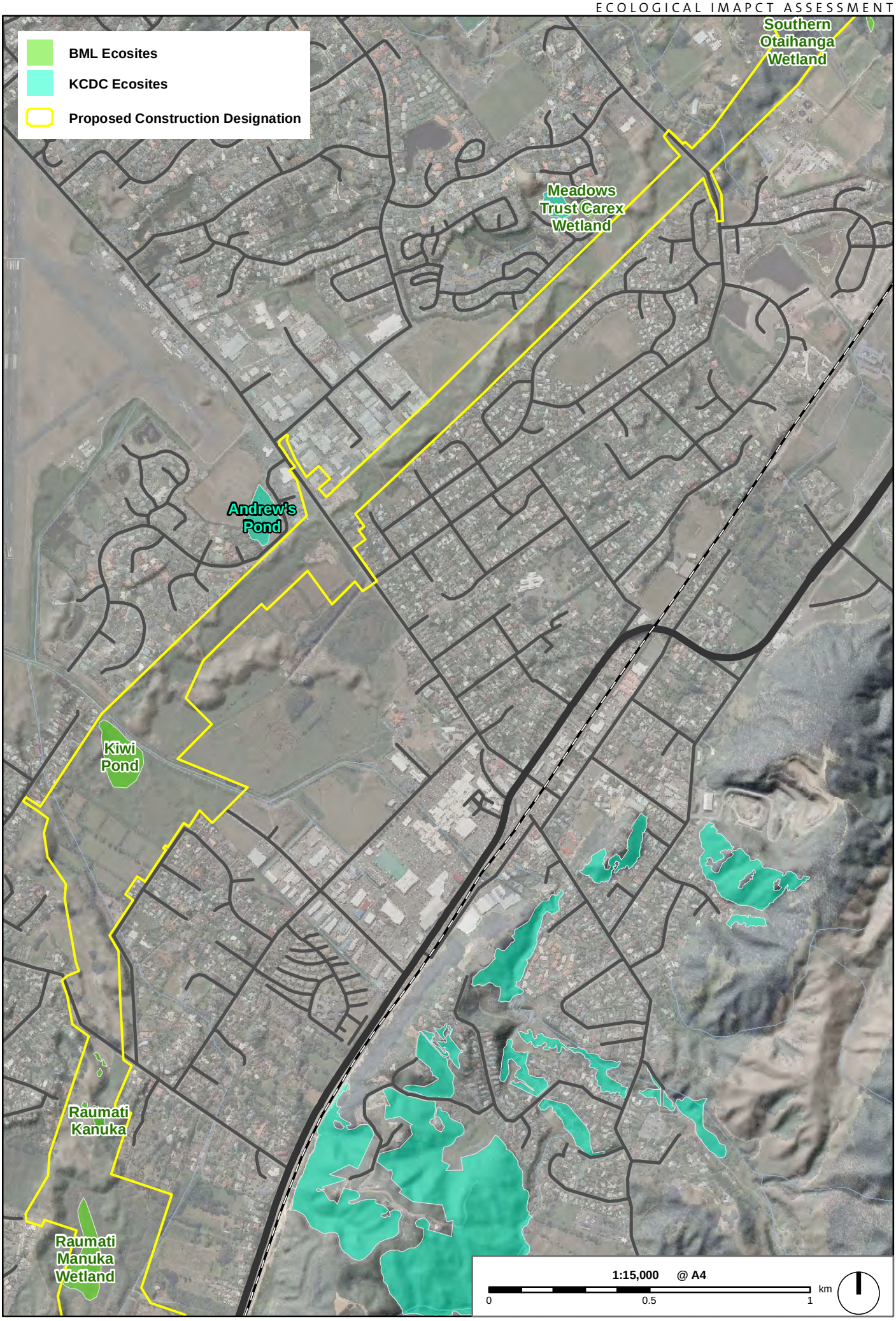
A number of the larger tributaries of the Whareroa and Wharemauku Stream (Drain 7 upper), the Mazengarb and WWTP Drains, the Kakariki Stream, Paetawa Drain and the Hadfield/Kowhai Stream are considered to have medium value. A number of native species of flora and fauna located within the study area, while not nationally threatened, are considered by New Zealand Threat Classification Lists to be At Risk (Declining) including:

- Eight species of native freshwater fish
- Pied shag (Naturally Uncommon) and pipit (At risk)
- A wetland plant species, dwarf mistletoe (*Korthalsella salicornioides*).

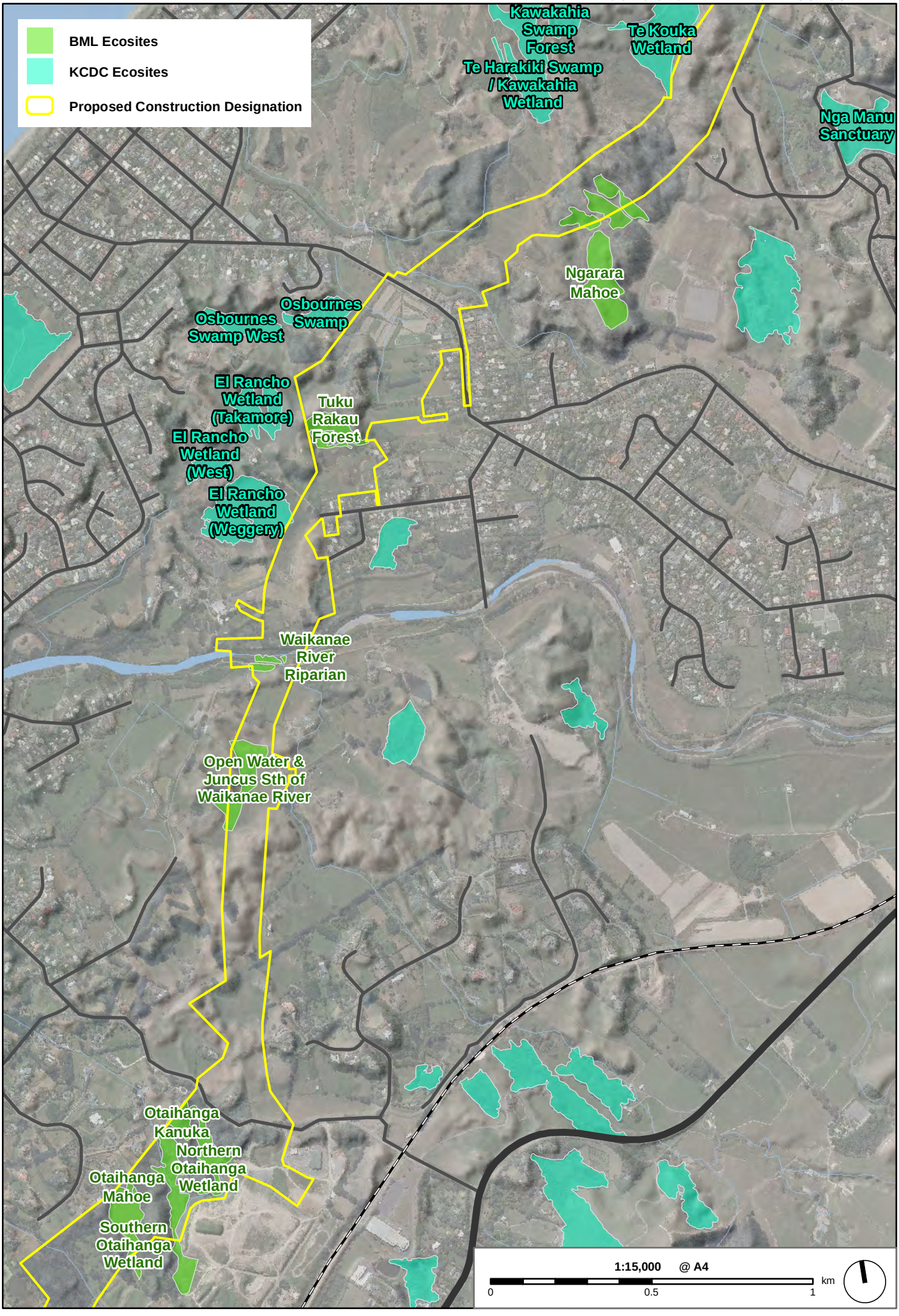
No threatened species of lizard or macro-invertebrate were located during this study. Some may still be present but in very low numbers



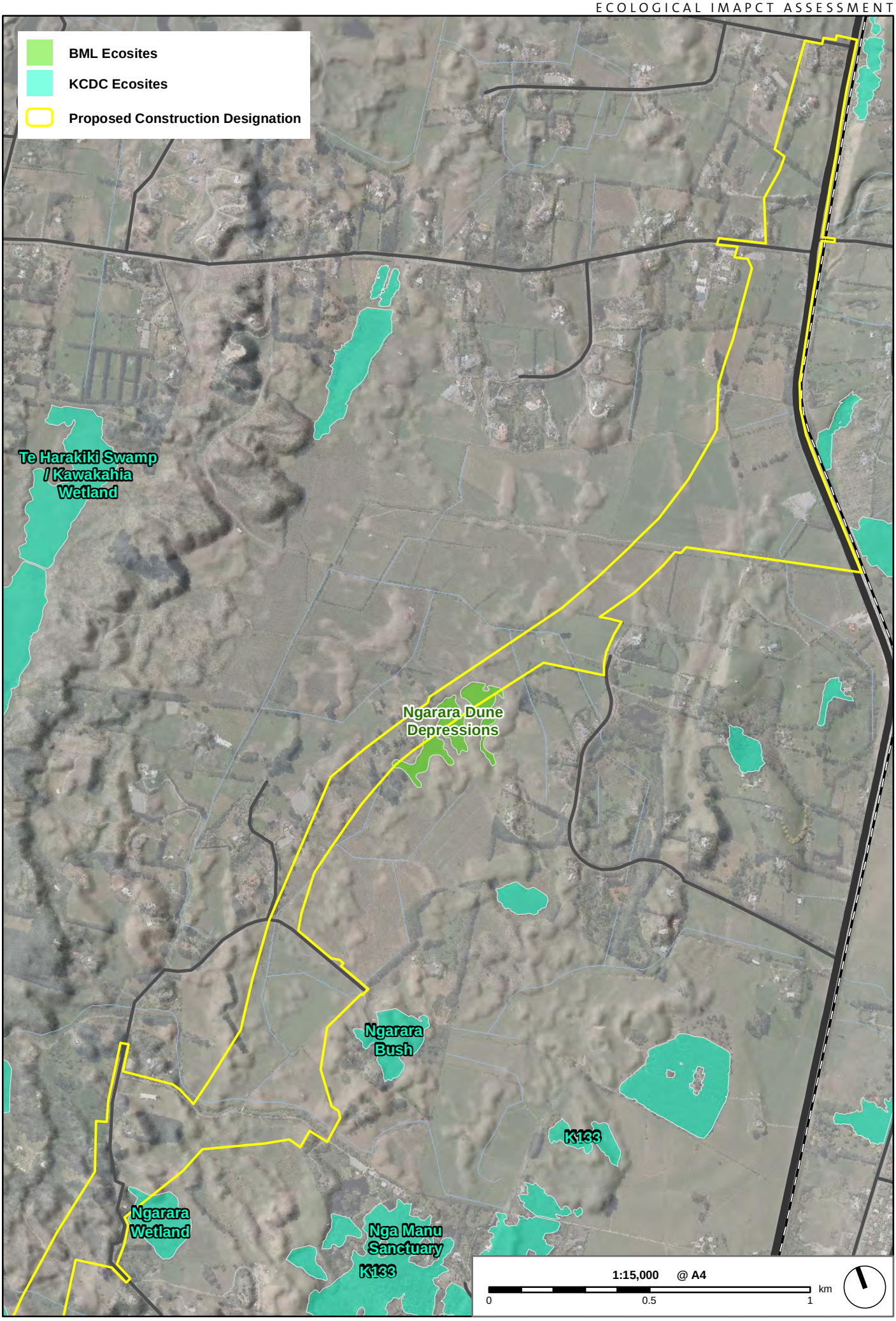

November 18, 2011 W091181E_ECIA_SEAs_A4mb.mxd




November 18, 2011 W09181E_ECIA_SEAs_A4mb.mxd




November 18, 2011 W091181E_ECIA_SEAs_A4mb.mxd




November 18, 2011 W091181E_ECIA_SEAs_A4mb.mxd

# 7 Project Shaping

This section describes the activities that have occurred through the design phase of the proposed MacKays to Peka Peka Expressway Alignment with a focus on decisions that have resulted from recognition of ecological issues and which have sought to as far as practicable avoid or minimise adverse ecological effects.

## 7.1 Historical context

The first designation for a SH1 arterial in the general corridor of the proposed Expressway was in 1954 (The Western Link Road). From an ecological perspective, the existing WLR designation traversed a substantial amount of wetland and terrestrial vegetation habitats, including 11 ecological sites scheduled in the Kāpiti Coast District Plan (Poplar Ave Wetland, Raumati South Peatlands, El Rancho Wetlands (Weggery, West and Takamore), Osbournes Wetlands, Te Harakeke Wetland, Ti Kouka Wetland and Ngarara Wetland) as well as a number of waterbodies and areas of terrestrial habitat.

## 7.2 Route selection process

The main objectives of the route selection process were to:

- Carry out detailed site investigations;
- Refine the existing WLR designation alignment taking into account the findings of investigations;
- Develop a final Project design; and
- Carry out an assessment of effects.

Given the formal existing designation of the WLR within the Kāpiti Coast District Plan and the fact that the majority of the existing WLR designation land requirements had been purchased by either NZTA or KCDC, the design brief was to locate the proposed Expressway within the existing WLR designation as far as practicable (while meeting the NZTA RoNS guidelines for Expressways). This design brief was an important consideration for ecological input, given the existing WLR designation included a number of wetlands identified as PNAs, SNAs or otherwise considered to have ecological value.

In August 2010, shortly following the confirmation of the Alliance Project Team, a desktop ecological report was completed outlining the key ecological considerations for the Project. This report took into account all known biological information within the immediate surroundings of the existing WLR designation, including ecological assessments undertaken by Boffa Miskell ecologists as part of large-scale projects in the vicinity of the existing WLR designation (Ngarara Plan Change, Waikanae North Plan Change, Paraparaumu Airport Plan Change, and Meadows Trust Plan Change). Ecological information from the earlier 2001 existing WLR designation process and more recent iterations was also reviewed as part of this desktop review.

During the development of this desktop report, the ecological team met with the Project Design team to re-align various sections of the route alignment/s where practicable (i.e. in areas with no other constraints, such as houses, cultural values etc.) to avoid a number of areas of recognised high ecological value. This included a number of regionally important wetlands in the northern section of the Alignment north of Te Moana Road. Those wetlands located in close proximity to the proposed Expressway Alignment range from smaller wet

dune depressions of low ecological value (dominated by wet pasture and rush species) through to the nationally important Queen Elizabeth II-covenanted Te Harakeke/Kawakahia Wetland north of Waikanae (consisting of remnant wetland and swamp forest vegetation). Te Harakeke/Kawakahia Wetland is considered to be the largest dune swale wetland remaining in a relatively natural state on the coastal plain of the Foxton Ecological District (McEwen 1987). Accordingly, the ecological significance of each wetland ranges dramatically.

Following development of the desktop ecological constraints report (refer Appendix 26.B) and some realignment to avoid high value ecological areas, a number of route options were assessed through the Multi-Criteria Analysis (MCA) assessment phase.

The key objective of the MCA assessment was to identify the most advantageous route Alignment which could then be further refined and used for assessment and consenting. This MCA phase involved multi-criteria analysis of a number of potential route Alignment options and sub-options. Each option or sub-option was assessed against the current designation which, for the purposes of this assessment, was the baseline. In addition, to the base route Alignment options within close proximity to the existing WLR designation, this MCA assessment also considered a number of alternative options, including the upgrading of the existing SH1 and other related route options (refer Alternative Options Report for more detail and scoring). Ecology was a core discipline throughout the MCA phase and alternative options assessment stages of the route selection process. The development of the Scheme Assessment Report and the MCA assessment process also included extensive consultation with a wide range of statutory bodies and non-government organisations.

The focus of ecological involvement in the MCA phase was the development of a preferred route that would avoid, as far as practicable, the areas of high ecological value currently located within the existing WLR designation. The desktop ecological assessment and developing understanding on the biological values of each of the ecological areas along the route informed this process. Accordingly, the MCA process allowed many areas of even low-medium value ecological sites to be avoided or taken into account in the route selection process.

Overall, the proposed Expressway Alignment has been located to avoid, as far as practical, any physical loss of ecologically significant vegetation (including wetlands) located within the existing WLR designation. However, not all vegetation could be avoided and portions of a small number of sites are located within the Designation and within the Project Footprint. In addition to those areas physically affected within the Project Footprint, there are a small number of other wetlands located close enough to the proposed Expressway Alignment that there may be temporary hydrological effects.

As a result of ecological input into the route selection process and final Project Footprint, ten ecologically significant wetlands located within the existing WLR designation were avoided, including the following:

- Poplar Avenue Wetlands (KCDC Ecosite K184);
- Raumati South Peatlands (KCDC Ecosite K131);
- Raumati Manuka Wetland;
- El Rancho Wetland (West) (KCDC Ecosite K170);
- El Rancho Wetland (Takamore) (KCDC Ecosite K170);
- Osbourne Swamp West wetland (KCDC Ecosite K170);
- Osbourne's Swamp (QEII covenant and KCDC Ecosite K068);
- Kawakahia/Te Harakeke Wetland (QE II covenant and KCDC Ecosite K066);

- Ti Kouka wetland (QEII covenant and KCDC Ecosite K066); and
- Ngarara Wetland east of Ngarara Road (KCDC Ecosite K066).
- The majority of El Rancho Wetland (Weggery) (KCDC Ecosite K170) was also avoided and the Design Footprint was reduced to minimise vegetation loss through the Southern and Northern Otaihanga Wetlands. Large areas of QE Park identified as having ecological restoration potential were also avoided, which ensures that future goals for the restoration of this regional park can be retained.

In addition to seeking to avoid effects on ecologically significant wetlands through the route selection process, the ecological team has worked closely with the geotechnical and groundwater teams to determine any adverse effects of the proposed Expressway construction phase and operational phase on the wetlands near the Designation. This has led to ecological involvement in determining the location of monitoring bores (including piezometers). More information on this process is outlined in TR1.

In addition to the wetlands avoided, the scale of dryland vegetation potentially affected was also minimised in a number of key areas through ecological involvement, including at the following key locations:

- Raumati Road Kanuka.
- Otaihanga Kanuka forest.
- Waikanae River Riparian.
- Tuku Rakau Forest.
- Ngarara Mahoe.
- Kakariki Stream riparian vegetation.

Ecology also played a core role in a number of other technical disciplines, most notably the landscape design, hydrology and stormwater, geotechnical, groundwater, contaminated land and water quality disciplines. Design of stormwater treatment wetlands, flood storage areas and landscape and visual mitigation also involved ecological input.

## 7.3 The preferred Alignment

At the conclusion of the MCA process, a preferred Alignment was confirmed. This final proposed Expressway Alignment option significantly reduced potential ecological effects associated with other route options.

Following confirmation of the preferred proposed Expressway Alignment, more detailed work was undertaken on those areas of ecological value still potentially affected. This included refinements in the vicinity of the El Rancho wetland (in discussion with Takamore Trustees), the Otaihanga Landfill wetlands, Ngarara Wetland and a number of stream crossings. There was also ecological involvement in determining the number, location and design of stormwater treatment wetlands and flood storage areas, particularly where these were located in close proximity to areas of identified ecological value. Groundwater information was gathered to assist with groundwater modelling in a number of wetlands adjacent to the proposed Expressway. Some information was also obtained on water quality in and around the Otaihanga wetlands in the vicinity of the Otaihanga Landfill.

A number of meetings and open days were held with affected residents and interested parties as to some of the finer details, including ecological mitigation, stormwater treatment, planting, environmental effects etc.

The remaining wetlands that will be impacted by the preferred Alignment were largely unavoidable without substantial private property, cultural or other costs as follows:

- The Otaihanga Wetlands (x3) were located in the middle of the existing WLR designation, with rural lifestyle properties to the west and the wastewater treatment plant and old Otaihanga Landfill to the east. The extent of contaminated leachate in the landfill and potentially the adjacent wetlands meant that there were few opportunities to avoid the wetlands in this area, and, we assume this may be part of the reason why these wetlands were not taken into account in earlier council ecological inventories.
- The southern extent of the El Rancho wetland could not be avoided without either impacting on an urupa and culturally important Maketu tree or realigning the proposed Expressway through an established residential area in Puriri Road, Waikanae. The preferred proposed Expressway Alignment in this area was designed to minimise intrusion into this wetland as far as practicable.

In addition to avoiding, as far as possible, the high value wetlands in the vicinity of the proposed Expressway, ecological involvement in the preferred Alignment ensured that the stormwater treatment wetlands and flood storage areas proposed would undertake good ecological design practices to ensure there will be good water treatment and, where appropriate, ecological potential as habitat for indigenous flora and fauna.

Ecological input into the landscape and visual mitigation design has tried to maintain and improve existing ecological areas as far as possible through restoration planting and edge buffering. For example, landscape planting that takes into account areas of high bird movement in the vicinity of Nga Manu Forest Sanctuary and Te Harakeke/Kawakahia Wetland.

Waterbodies traversed by the preferred Alignment were also taken into account in the proposed Expressway design, with reduced culvert lengths along identified waterbodies, bridges replacing larger culverts on some streams and in some areas the proposed Expressway was separated (e.g. Waimeha Stream) to reduce the scale of bridge works above streams and to improve opportunities for ecological enhancement following construction. Given the ecological importance of the Waikanae River, a bridge structure that spanned the entire river corridor was also agreed the best practicable option to reduce potential adverse effects associated with construction on the sensitive estuary and salt marsh of the Waikanae Estuary Scientific Reserve, downstream of the proposed Waikanae River crossing.

Following confirmation of the preferred Alignment, work was undertaken on an ecological mitigation strategy for those areas of ecological value that could not be avoided (residual effects) and areas where there are likely to be indirect impacts as a result of construction and operation.

Key outcomes as a result of ecological involvement in the Project included:

- Avoidance of protected ecological areas (predominantly wetlands);
- Avoidance and reduction in extent of physical loss of ecologically significant wetlands;
- Avoidance of remnant forest;
- Opportunity to restore and rehabilitate a number of wetlands, including the restoration of the former Waikanae Oxidation Ponds as mitigation for the loss of wetlands at El Rancho and the development of a new wetland in the Otaihanga Mountain bike Area as mitigation for the loss of adjacent wetland vegetation in the Southern and Northern Otaihanga Wetlands;
- Design of best practice stormwater treatment wetlands;

- Ecological involvement in design and location of flood storage areas;
- Mitigation planting for loss of dryland species;
- Agreement from KCDC on long-term ownership and management of these ecological areas;
- Greater understanding of wetland, botanical, herpetofauna, avifauna, freshwater and coastal marine ecosystem values on the Kāpiti Coast;
- Permanent protection and restoration of existing ecological areas (e.g. Tuku Rakau Forest);
- Restoration of two statutorily recognised waterbodies, the Whareroa Stream (listed in Appendix 3 of the Wellington RPS) and the Kakariki Stream (listed as Appendix 7 of the Wellington FWP and Appendix 7 of the RPS);
- Additional level of stormwater treatment in the receiving environment of Te Harakeke/Kawakahia wetland;
- A realigned and fully restored stream near Nga Manu Forest Sanctuary (Smithfield Drain);
- Reduction in length of culverts at Hadfield/Kowhai Stream; and
- Improved water treatment from the status quo of the existing SH1.

KCDC biodiversity staff were involved through this MCA scoring process, as well as during discussions on ecological mitigation options.

## 7.4 Consenting team coordination

As part of the development of the preferred proposed Expressway Alignment, the ecological team worked closely with a number of technical disciplines to refine various components of the Final Designation. The objective of this involvement was avoiding, remedying or mitigating ecological impacts of the proposed Expressway.

**Table 22: Summary of technical disciplines and ecological involvement**

| Technical Discipline | Requirement |
|---|---|
| Expressway Design | ■ Agreement on Project Footprint and activities.<br>■ Define Expressway footprint, cut slopes and fill batters.<br>■ Define Designation extent.<br>■ Construction access road location.<br>■ Agree location of peat disposal sites. |
| Structural Design | ■ Agreement on bridge locations.<br>■ Bridge construction methodology.<br>■ Design of retaining walls and associated structures. |
| Hydrology & Stormwater | ■ Agreement on culvert locations.<br>■ Design of new stream and diversion cross-sections.<br>■ Design of culverts to ensure the issue of fish passage is sufficiently addressed.<br>■ Design of stream diversions has a sound ecological basis.<br>■ Stormwater treatment wetland and swale locations and design.<br>■ Flood storage areas location and design. |

| Technical Discipline | Requirement |
|---|---|
| Groundwater and Geo-tech | ▪ Location of piezometers and wetland water table testing.<br>▪ Hydrological modelling of water table effects on wetlands.<br>▪ Construction methodologies in peat and sand country. |
| Water Quality and Contaminated Sites | ▪ Agreement on water quality and sediment sampling locations and parameters.<br>▪ Locations of contaminated land sampling sites.<br>▪ Baseline contaminant loadings of all affected streams and modelling with new Expressway based on treatment design.<br>▪ Contaminant modelling and sediment deposition. |
| Erosion and Sediment Control | ▪ Coordination with BML aquatic habitat sampling.<br>▪ Baseline sediment loadings of all affected streams and modelling of sediment discharges under different scenarios.<br>▪ Contaminant modelling and sediment deposition.<br>▪ The location, design, and sizing of erosion and sediment management systems to the recognised standards. |
| Programme & Cost and CEMP | ▪ Construction duration – staging / locations - % exposed earthworks.<br>▪ Agreement on construction methodology.<br>▪ Co-ordination of Construction Environmental Management Plan (CEMP, Volume 4)<br>▪ Development of the Ecological Management Plan (EMP) (CEMP Appendix M, Volume 4). |
| Landscape & Visual | ▪ Coordination of mitigation planting / habitat restoration (ecology) and mitigation planting (visual & landscape).<br>▪ Coordination of landform shaping / cut batters / fill batters / benching / disposal sites.<br>▪ Agreement on mitigation standards and costs. |
| Cultural and archaeological | ▪ Discussions on wetlands and vegetation removal and historical context. |

In particular, the ecological assessment for freshwater and estuarine environments relied on baseline sampling of water quality carried out by Beca (Technical Report 24, Volume 3). Boffa Miskell (BML) ecologists consulted with Beca to confirm the types and frequency of sampling and the water and sediment sampling locations,

BML reviewed the draft water quality (Technical Report 24, Volume 3), hydraulic modelling (Technical Report 21, Volume 3) and hydrology and stormwater (Technical Report 22, Volume 3) reports to ensure that the analysis provided the information and detail required for the assessment of ecological effects.

The ecology assessment of discharges to streams and estuarine systems relied on modelling of sediment and stormwater generation carried out by Beca. BML worked with SKM to confirm the modelling assumptions.

BML also worked with Beca on culvert and diversion designs to ensure ecological flows and velocities were achieved, and fish passage could be provided.

### 7.4.1 Ecological Management Plan (EMP)

During the process of design development, an Environmental Management Plan (EMP) (CEMP Appendix M, Volume 4) was prepared as part of the Construction Environmental Management Plan (CEMP, Volume 4). The aim of this work was to:

- Ensure that the areas of ecological value along the proposed Expressway Alignment were properly identified and any potential effects on these values were consider and appropriately managed.
- Explore challenging aspects of the proposed Expressway collaboratively and agree appropriate management options.
- Provide indicative details and staging of work areas to show how ecological outcomes are to be achieved.
- Provide greater certainty over the ecological assessment.
- Provide confidence in the ecological mitigation packages.
- Assist with developing resource consent conditions.
- Provide clarity on what the plans required by consent will look like and what they will be responsible for managing.

### 7.4.2 Consultation

During the development of this report, and as part of the ecological investigations, consultation was undertaken with GWRC, DoC and KCDC. As part of this consultation, information was sought on the locations of rare or uncommon flora and fauna in the Kāpiti Coast district, methodologies undertaken and the results of our ecological surveys. Discussions on mitigation opportunities were also held with GWRC, KCDC and DoC.

As part of our involvement, meetings were also held with core affected stakeholders and residents, including the Takamore Trustees, Queen Elizabeth II Trust, Nga Manu Forest Sanctuary and Friends of the Waikanae River.

Ecological attendance at the public expos, Open Days and local affected communities provided good opportunities to discuss any ecological issues with the public and other agencies. A number of visits to private residential properties and established restoration projects were also undertaken. Consultation also extended to providing written information to submitters or responding to interested public or community groups following requests for information.

### 7.4.3 Design changes table

A number of changes to the Project design were made to avoid or minimise concerns in relation to ecological factors. These changes have been summarised in Table 23 below.

**Table 23: Summary of design changes leading to avoidance or minimisation of adverse ecological effects (south to north)**

| Issue | Outcome |
|---|---|
| Loss of ecologically important wetlands | ▪ Avoidance of Poplar Ave Wetland.<br>▪ Avoidance of Raumati South Peatlands.<br>▪ Avoidance of Raumati Manuka Wetland.<br>▪ Avoidance of El Rancho Wetlands (Weggery, West and Takamore).<br>▪ Avoidance of Osbourne and Osbourne's West Wetlands.<br>▪ Avoidance of Te Harakeke/Kawakahia Wetland.<br>▪ Avoidance of Ti Kouka Wetland.<br>▪ Avoidance of Ngarara Wetland. |
| Freshwater | ▪ Bridging of the Wharemauku Stream, Waimeha Stream, Kakariki Stream and Paetawa Streams to reduce ecological effects.<br>▪ Reductions in lengths of culverts and stream diversions across the Project.<br>▪ Restoration of streams upstream and downstream of culvert locations in perennial and intermittent streams.<br>▪ Recommendations for stream restoration in Kakariki Stream and Whareroa Stream.<br>▪ Restoration of new and realigned streams - Smithfield Drain, Whareroa Stream tributaries of Muaupoko Stream.<br>▪ Addition of secondary stormwater treatment wetlands beyond primary swale treatment upstream of Te Harakeke Wetland at Ngarara Creek and Kakariki Stream.<br>▪ Additional wetland planting and freshwater stream connections to large mass planted flood storage areas south of the Wharemauku Stream and north of the Kakariki Stream. |
| Loss of terrestrial vegetation | ▪ Avoidance of kanuka forest north of Poplar Ave.<br>▪ Avoidance of mahoe forest in Otaihanga Landfill.<br>▪ Minimised extent of earthworks in Waikanae River riparian area.<br>▪ Reduced impacts on Tuku Rakau Forest.<br>▪ Reduced loss of regenerating mahoe on Ngarara.<br>▪ Reduction in fill batters in vicinity of El Rancho wetland. |
| Mitigation and restoration | ▪ Restoration of Raumati Manuka Wetland adjacent to the proposed Expressway.<br>▪ Planting and restoration of the Kiwi Pond, south of Wharemauku Stream.<br>▪ Creation of new wetland in Otaihanga Mountain-bike Area.<br>▪ Buffer and screening of proposed Expressway around Ngarara Wetland.<br>▪ Restoration of former Waikanae Oxidation Ponds.<br>▪ Installation of permanent water table monitoring bores within ecologically significant wetlands.<br>▪ Wetland planting in stormwater treatment wetlands.<br>▪ Wetland planting and ecological design of flood storage areas (Wharemauku and Kakariki). |

### 7.4.4 Conclusion

In conclusion we are confident that all opportunities for avoidance of effects through the location of the proposed Expressway Alignment and associated works have been explored.

Significant reductions in potential adverse effects have been achieved through the evolution of the final proposed Expressway Alignment. There will still be some opportunities for further avoidance or reduction of effect during the detailed design stage and these are identified in the following sections and the Ecological Management Plan (CEMP Appendix M, Volume 4) and as part of the mitigation package.

## 7.5 Construction activities

Table 25 sets out a number of "activities" to be carried out as part of the Project which will potentially lead to ecological effects. The scale and duration of these activities is also noted. These are discussed at site level in Section 6 of this Report.

**Table 24: MacKay's to Peka Peka: Summary of activities table**

| CONSTRUCTION STAGE: | |
|---|---|
| **Activity** | **Potential adverse effects** |
| Vegetation clearance along Expressway Alignment | Disruption of ecological values on site and adjacent lands/waters; disruption of ecological processes "downstream"; habitat fragmentation; vegetation/habitat loss; stormwater management requirements for ecological values |
| Importing and depositing fill | Vegetation/habitat loss; stormwater management requirements for ecological values; importation of weeds |
| Construction waterway crossings – building bridges, culverts installation | Erosion, sedimentation, disruption in-stream animal movements, contamination (spills etc); habitat loss |
| Temporary diversions associated with construction of crossings | Erosion, sedimentation, disruption in-stream animal movements, contamination (spills etc); habitat loss |
| Permanent diversions – construction new channel, filling old, diverting water | Vegetation/habitat loss; erosion, sedimentation, disruption in-stream animal movements, contamination (spills etc) |
| Construction of temporary and permanent stormwater management structures | Vegetation/habitat loss; Erosion, sedimentation, disruption in-stream animal movements, contamination (spills etc); vegetation/habitat fragmentation |
| Waste disposal (by contractors) | Soil contamination; importation weeds; toxicity (soil); encouragement of pests |
| Landscape planting | Restoration of ground cover; |
| Restoration planting | Restoration of ground cover; |
| Weed control | Loss of groundcover by annuals. Introduction of new species |
| Dust and dust watering | Contamination of waterways and wetlands if run-off occurs, temporary effects on plants |
| Fire Management | Hot works, smoking, exhausts, during summer have the potential to increase the risk of fires in and adjacent to vegetation within the designation. Fires could lead to vegetation and habitat loss, including potentially rare or threatened species. |

| OPERATIONAL STAGE: Activity | Potential adverse effects |
|---|---|
| Maintenance (surface) | Run-off contaminants |
| Maintenance (berms, planting) | Spray drift into regeneration/ restoration/ retirement areas, removal of invertebrate habitat |
| Traffic noise | Disturbance animals on adjacent land |
| Traffic dust/fumes | Disturbance animals on adjacent land |
| Presence of traffic | Collisions birds/traffic; especially adjacent to wetland areas or habitat corridors (wider Te Harakeke/Kawakahia Wetland - Nga Manu Nature Reserve corridor) |
| Accidental discharge of toxins | Vehicle accident. |
| Severance of habitat | Alignment cutting through a recognised wildlife corridor (Waikanae River and wider Te Harakeke/Kawakahia Wetland - Nga Manu Nature Reserve corridor) |

## 7.6 Ecological issues

Following the Project shaping phase, a number of residual ecological issues remained that required specific ecological consideration in the EcIA. By sector they are:

### Sector 1: RAUMATI SOUTH

Key ecological issues that require consideration in Sector 1 are:

- Lengthening and upgrading an existing culvert on a small tributary of the Whareroa Stream in QE Park off Poplar Avenue.
- Protection and buffering of the Raumati Manuka Wetland and associated stormwater treatment and flood storage ponds.
- The culverting of upper Drain 7, a large tributary of the Wharemauku Stream.
- The loss of secondary kanuka forest south of Raumati Road.

### Sector 2: RAUMATI/PARAPARAUMU

Key ecological issues that require consideration in Sector 2 are:

- The loss of secondary mahoe forest north of Raumati Road.
- The culverting of lower Drain 7, a large tributary of the Wharemauku Stream.
- The ecological functioning of the large flood storage wetlands south of the Wharemauku Stream.
- Potential downstream effects on the Wharemauku Stream and stream mouth associated with construction and operational stormwater contaminants.
- The culverting of the Mazengarb Stream, north of Mazengarb Road.

### Sector 3: OTAIHANGA/WAIKANAE

Key ecological issues that require consideration in Sector 3 are:

- The loss of a portion of the Southern and Northern Otaihanga wetlands and associated hydrological changes.
- The loss of kanuka forest in the Otaihanga Landfill area.

- Exposure and treatment of contaminants and leachate within the Otaihanga Landfill drain and the potential information treatment function of the Otaihanga Central Wetland for leachate from the adjacent Otaihanga Landfill.
- Diversion of the outlet of the Muaupoko Stream.
- Bridge construction and associated flood channel widening of the Waikanae River.
- Potential downstream effects on the Waikanae Estuary associated with construction and operational stormwater contaminants.
- The loss of wetland vegetation within the El Rancho wetlands and associated hydrological changes associated with proposed Expressway construction and associated flood storage areas and stormwater treatment wetlands.
- The loss of wetland vegetation and advanced regenerating mahoe forest around Tuku Rakau.
- Stream diversions and culverting of a tributary of the Waimeha Stream, south of Te Moana Road.
- Potential downstream effects on the Waimeha Stream and stream mouth associated with construction and operational stormwater contaminants.

**Sector 4: WAIKANAE NORTH**

Key ecological issues that require consideration in Sector 4 are:

- The loss of regenerating mahoe forest on Ngarara Farm, north of Te Moana Road.
- Culverting of the Ngarara Creek, west of Ferndale Subdivision.
- Potential downstream effects on the Te Harakeke/Kawakahia Wetland associated with construction and operational stormwater contaminants.
- Ecological buffering of the Ngarara Wetland, north of Ngarara Road.
- Landscape and ecological planting in the vicinity of Nga Manu Forest Sanctuary.
- Culverting/bridging of the Kakariki Stream.
- The development of - and ongoing ecological functioning of the large flood storage areas north of the Kakariki Stream on Ngarara Farm.
- The realignment / diversion and riparian restoration of the Smithfield Drain north of the Kakariki Stream.
- The development of - and ongoing ecological functioning of the large flood storage areas and stormwater treatment wetlands north of the Paetawa Drain.
- The culverting and diversion of a number of smaller tributaries of the Paetawa Drain.
- The culverting and diversion of the Hadfield Drain / Kowhai Stream.

# 8 Assessment of Construction Impacts

For this section of the report, we assess the magnitude of direct and indirect impacts associated with construction using the following criteria and the methodology described in Section 3.7.

| Magnitude | Description |
|---|---|
| Very High | Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. |
| High | Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. |
| Moderate | Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. |
| Low | Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. |
| Negligible | Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. |

Potential direct impacts of construction include:

- Permanent loss of terrestrial habitat, including wetlands and species beneath the Project footprint;
- Temporary disturbance of terrestrial vegetation through related construction activities.
- Loss and modification of aquatic habitat through culverting and diversions of streams; and
- Disturbance and displacement of terrestrial fauna through construction activities.

Potential indirect impacts of construction include:

- Impact on streams, wetlands and estuarine habitats and species through increased turbidity and blanketing of stream bed by sediment generated by construction activities;
- Impact on wetlands through altered hydrological flows associated with proposed Expressway construction and drainage;
- Impact on streams, wetlands and estuarine habitats through discharge of construction contaminants (oil, cement, lubricants) from stores or vehicles; and
- Impact on terrestrial habitat and species loss through dust, fire and weed introduction caused by construction activities.

## 8.1 Direct impacts of construction

### 8.1.1 Terrestrial vegetation and habitat

While the route selection process for the proposed Expressway Alignment successfully avoided a number of high value sites through the Project Shaping process (10 high value wetlands and 6 areas of regenerating native bush), four wetlands of medium value could not be entirely avoided and will face some loss (ranging between 10% to 50% of each site), and six small areas of regenerating bush will also be affected to varying degrees (ranging between 7% to 88% of each site). In total 5.6 ha of vegetation dominated by native species will be lost beneath the Project Footprint as follows.

### Wetlands

Two broad groups of wetland are found within the Designation. The first consists of wet depressions in pasture where a variety of, usually exotic wetlands species such as *Juncus effusus*, and buttercup, or browse tolerant natives such as *Juncus sarophorus* and *Isolepis prolifer*, form simple 'wetland' communities within grazed farmland that are of limited botanical value, and of limited habitat value for indigenous fauna. We have assessed their value as low but note that they have potential for restoration.

The second group consists of wetlands, either remnant or regenerating, where the flora is dominated by more natural communities of indigenous species. These wetlands are of greater botanical and habitat value. Of the total 25 identified indigenous wetlands of ecological value located within or in close proximity to the Project Footprint, all but four have been avoided. These are:

- Raumati Manuka Wetland;
- Southern Otaihanga Wetland;
- Northern Otaihanga Wetland; and
- El Rancho Wetland (Weggery).

These four wetlands have each been assessed to be of medium ecological value.

The total loss of habitat within these four wetlands will be 1.8 ha, the majority within the Otaihanga North (53%) and South (39%) wetlands.

For each of these wetlands we have assumed that all the vegetation within the Project Footprint will be lost as a result of reclamation through formation of pre-load and surcharge embankment construction. Figure 9 outlines the extent of wetland vegetation loss at each of these four wetlands in more detail.

### Mature and regenerating forest

Approximately 3.8 ha of indigenous dryland vegetation is located within the Project Footprint. While all the secondary broadleaved forest within the proposed Expressway Alignment has regenerated in recent years from pasture or been planted as part of council or community restoration projects, there are so few examples of this vegetation type remaining on the sand plains of the Kāpiti Coast that these areas have been assessed as having ecological values that require consideration. The areas affected are as follows:

- 0.8 ha of kanuka forest located at:
  - Otaihanga Kanuka Forest, the largest area affected; and
  - Raumati Road Kanuka;
- 3.0 ha of regenerating broadleaved forest located at:
  - Ngarara mahoe forest; the largest area affected;
  - Waikanae river riparian vegetation (planted);
  - Tuku Rakau Forest; and
  - Kakariki Stream riparian vegetation (planted);

Because of the widespread loss of kanuka forest from the sand country of the Kāpiti Coast, remaining areas of kanuka forest are considered to have high ecological value.

Regenerating broadleaved forest is more widespread. It tends to be of low diversity and habitat value and these areas are considered to have medium ecological value.

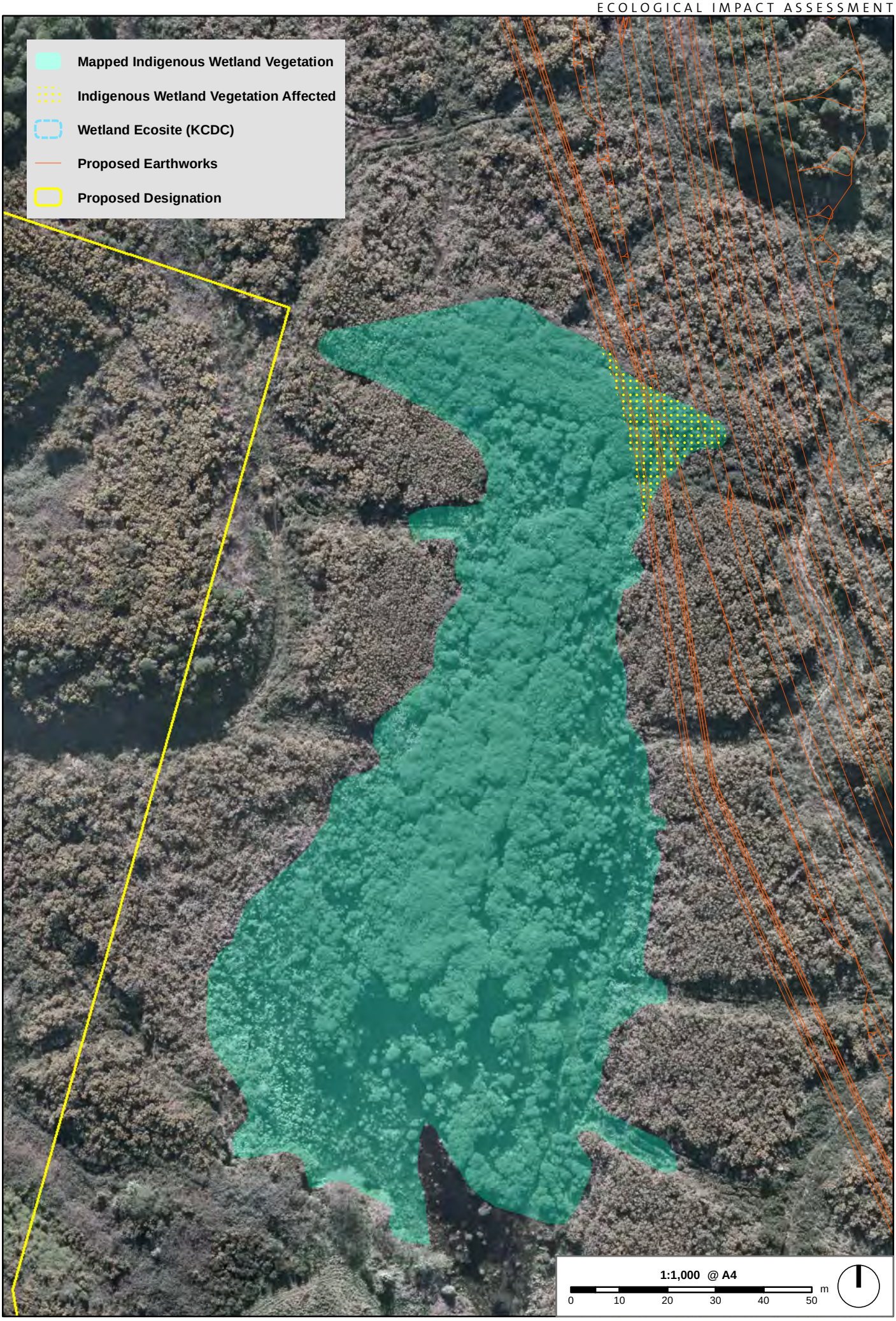
### Pioneer Shrublands

Approximately 22 ha of pioneer shrublands and scrub dominated by blackberry and gorse will be lost within the Project Footprint. These areas have, in all cases, regenerated in recent years through pasture and are of low floristic diversity. They have low botanical and habitat value. They are typically dominated by a gorse monoculture on dry dunes with blackberry intermixed in damp depressions.

Blackberry, in particular, is a pest plant listed in the Wellington Regional Pest Management Strategy as a species requiring site-led management (boundary control). Removal of blackberry within the Designation will improve the success of landscape and visual planting as well as mitigation planting for other ecological effects.

### Assessment of Potential Effects on Terrestrial Vegetation

Table 25presents our assessment of the magnitude of impact to the potentially affected vegetation as a percentage of the total vegetation loss at each site. As a guide we have used the following for this assessment <1%= negligible, 1-5% = low, 5-20% = moderate, 20-50% = high, >50% = very high.




March 23, 2012 W09181E_ ECIA_Wetlands_A4mb.mxd

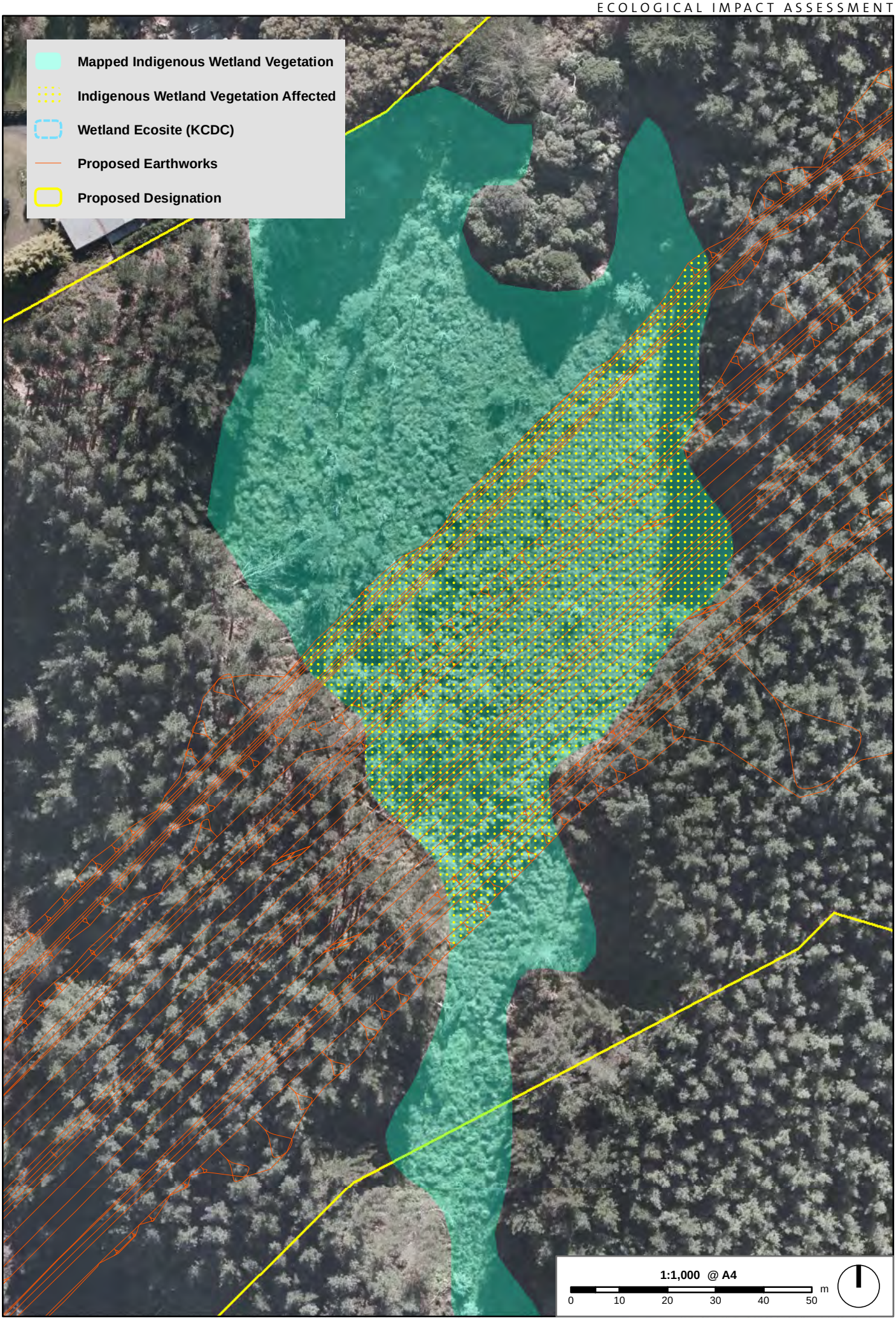
NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

**AFFECTED WETLAND VEGETATION**

***RAUMATI MANUKA WETLAND***

**9a**



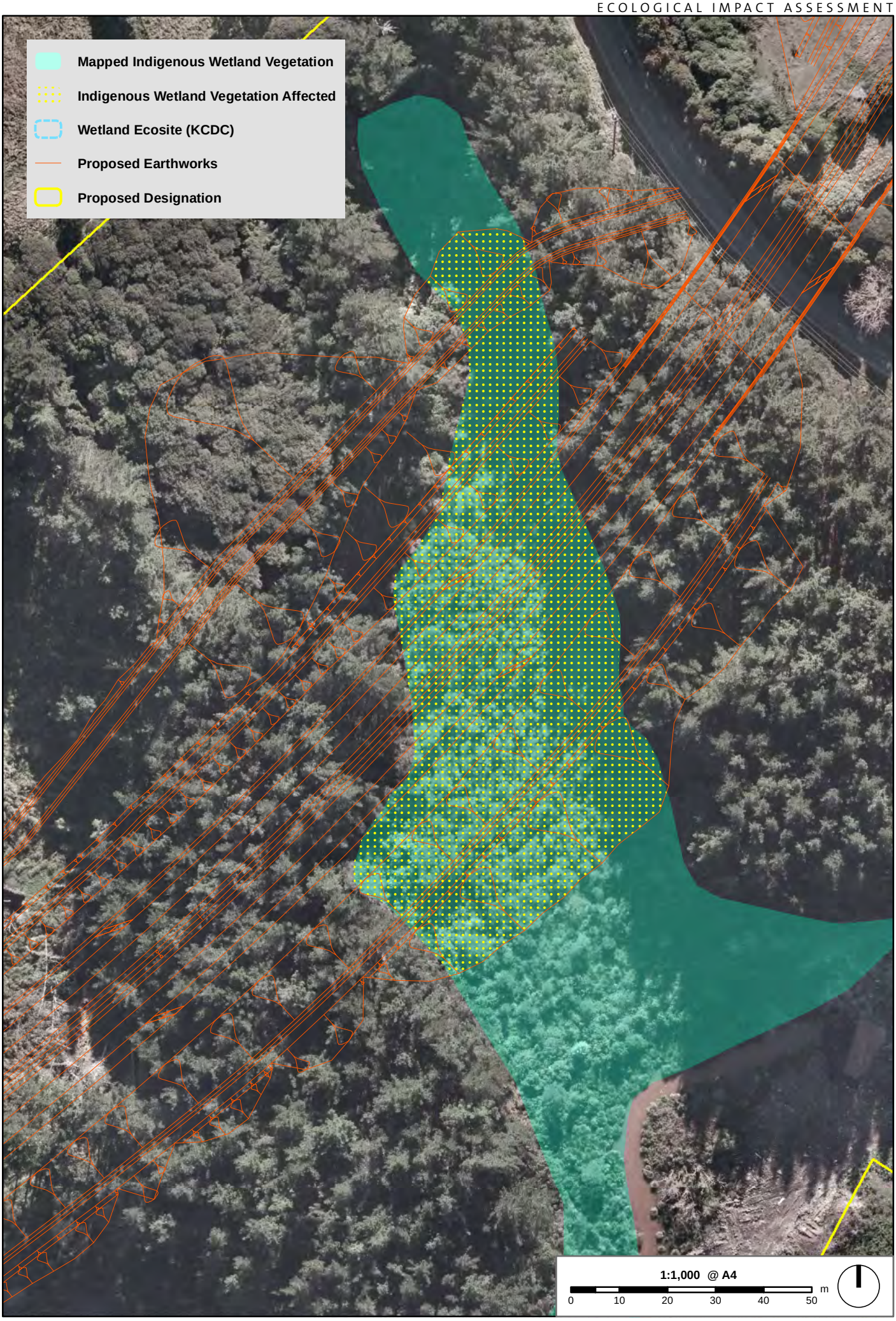

March 23, 2012 W09181E_ ECIA_Wetlands_A4mb.mxd

NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

**AFFECTED WETLAND VEGETATION**
***SOUTHERN OTAIHANGA WETLAND***

**9b**

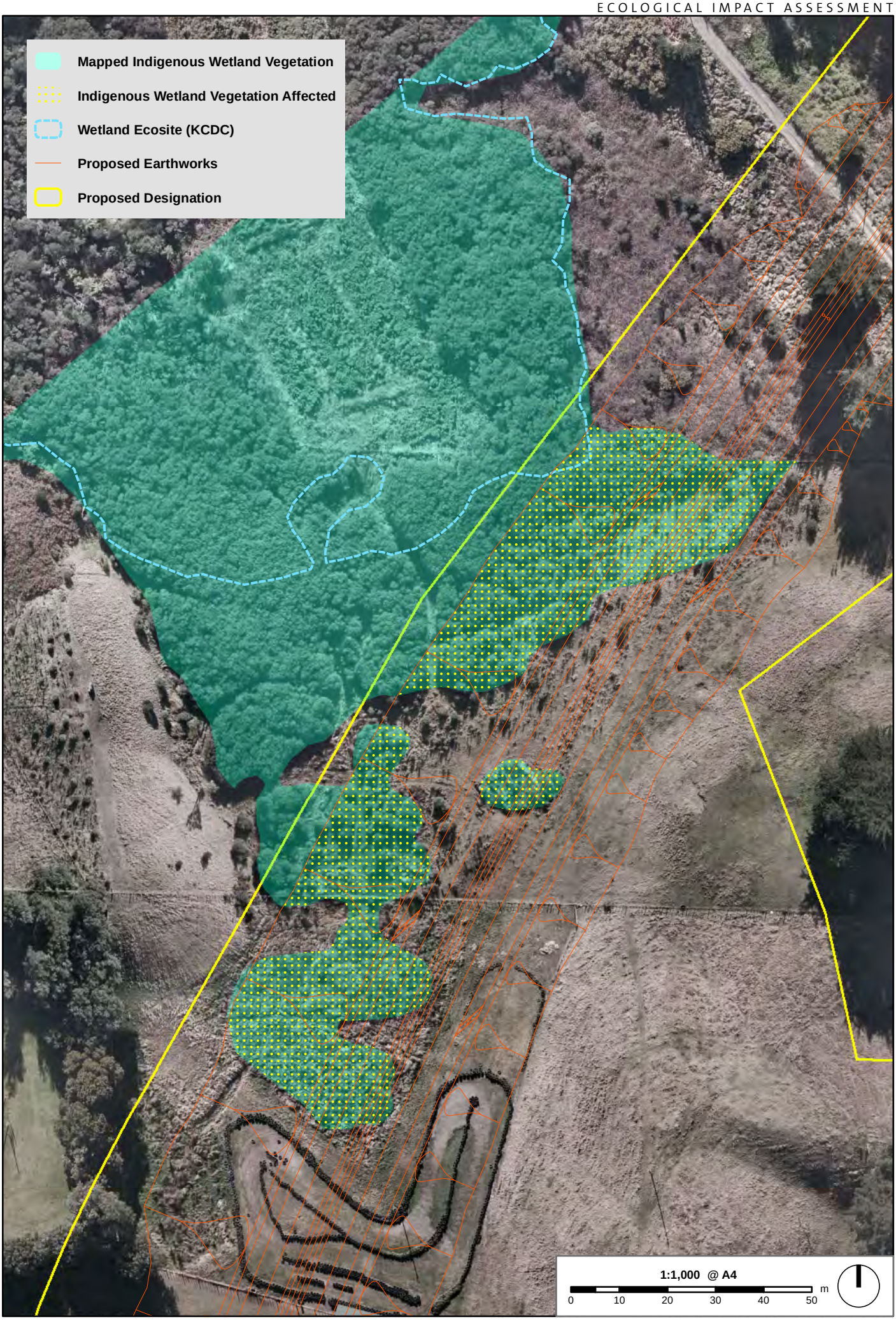



March 23, 2012 W09181E_ ECIA_Wetlands_A4mb.mxd



**AFFECTED WETLAND VEGETATION**
***NORTHERN OTAIHANGA WETLAND***

**9c**




March 23, 2012 W09181E_ ECIA_Wetlands_A4mb.mxd

NZ TRANSPORT AGENCY WAKA KOTAHI

Mackays to Peka Peka

**AFFECTED WETLAND VEGETATION**

***EL RANCHO WETLAND***

**9d**

**Table 25: Magnitude of Terrestrial Vegetation Loss and Modification (without mitigation)**

| DESCRIPTION (listed South to North) | Ecological Value | Area of Loss (Footprint) (ha) | Site Area (ha) | Loss as % of Study Area | Assessment of Impact Magnitude |
|---|---|---|---|---|---|
| **Wetlands** | | | | | |
| Wetlands of low value –(wet pasture and *Juncus*) | Low | 13.90 | n/a | n/a | Negligible |
| Raumati Manuka Wetland | Medium | 0.03 | 2.0 | 15% | Moderate |
| Southern Otaihanga Wetland | Medium | 0.55 | 1.4 | 39% | High |
| Northern Otaihanga Wetland | Medium | 0.53 | 1.0 | 53% | Very High |
| El Rancho Wetland (Weggery) | Medium | 0.38 | 3.9 | 10% | Moderate |
| **Pioneer shrublands and low forest** | | | | | |
| Shrublands of low value (gorse and blackberry) | Low | 21.9 | n/a | n/a | Neutral or minor positive |
| Ngarara mahoe forest | Medium | 0.86 | 4.2 | 20% | High |
| Waikanae river riparian vegetation (planted) | Low | 0.13 | 2.0 | 7% | Moderate |
| Tuku Rakau Forest | Low | 0.25 | 0.9 | 28% | High |
| Kakariki Stream riparian vegetation (planted) | Low | 0.18 | 1.6 | 11% | Low |
| **Kanuka Forest** | | | | | |
| Otaihanga Kanuka Forest | High | 0.17 | 0.5 | 34% | High |
| Raumati Road Kanuka | High | 0.35 | 0.4 | 88% | Very High |
| **Other sites** | | | | | |
| Scattered remnant cabbage trees in weedland | Low | 0.01 | n/a | n/a | Low |

[1]Not mapped in LCDBII

The following table combines our assessment of ecological value with magnitude of effect to assess impact significance.

**Table 26: Assessment of Impact Significance**

| DESCRIPTION | Ecological Value | Assessment of Impact Magnitude | Assessment of Impact Significance |
|---|---|---|---|
| **Wetlands** | | | |
| Wetlands of low value –(wet pasture and *Juncus*) | Low | Negligible | Very Low |
| Raumati Manuka Wetland (2 ha) | Medium | Moderate | Low |
| Southern Otaihanga Wetland (1.4 ha) | Medium | High | Moderate |
| Northern Otaihanga Wetland (1.0 ha) | Medium | Very High | High |
| El Rancho Wetland (Weggery) (3.9 ha) | Medium | Moderate | Low |
| **Pioneer shrublands and low forest** | | | |
| Shrublands of low value (gorse and blackberry) | Low | Neutral or minor positive | Neutral |
| Ngarara mahoe forest | Medium | High | Moderate |

| | | | |
|---|---|---|---|
| Waikanae river riparian vegetation (planted) | Low | Moderate | Very Low |
| Tuku Rakau Forest | Low | High | Low |
| Kakariki Stream riparian vegetation (planted) | Low | Low | Very Low |
| **Kanuka forest** | | | |
| Otaihanga Kanuka Forest | High | High | Very High |
| Raumati Road Kanuka | High | Very High | Very High |
| **Other Sites** | | | |
| Scattered remnant cabbage trees in weedland | Low | Low | Very Low |

### Conclusions

Vegetation clearance on the margins of two kanuka stands will have a very high adverse effect on these stands, in one case leading to loss of a majority of the stand. Mitigation is considered necessary for this loss.

There will be a high effect of earthworks on the Northern Otaihanga Wetland and a moderate effect on Southern Otaihanga Wetland. There will also be a moderate effect of vegetation clearance on Ngarara Mahoe Forest. Effort should be made to minimise effects on any advanced secondary regenerating forest that falls within the Designation.

All other sites or vegetation communities have low, very low or negligible effects. Mitigation is not recommended for the loss of wet pasture, or for loss of pioneer shrubland and scrub communities dominated by exotic weed species (gorse and blackberry).

Our recommendations for mitigation for the proposed vegetation loss are outlined in section 11.5 of this Report.

#### 8.1.2 Freshwater habitat loss

In this section we consider the potential adverse effects of stream works which includes installation of structures such as culverts and headwalls, armouring of banks and beds, diversions and reclamation, and the loss and modification of riparian habitat.

### Proposed stream works

The Project design proposes the installation of:

- 48 culverts with a total length including armouring of 2.35 km,
- 9 diversions totalling 1.53 km in length, with associated reclamation of stream,
- construction of 8 bridges together with the armouring of 312 m of stream bank.

Details of all of these stream works can be found in Appendix 26.C. The number and extent of these structures are summarised in Table 27 and Table 28. The construction methodology for all in-stream works are described in the Erosion and Sediment Control Plan (CEMP Appendix H, Volume 4).

These tables differentiate between all structures (including replacement culverts, flow balancing culverts, and works in ephemeral streams); and those that will be in intermittent and perennial streams (valued waterbodies). The rationale for this differentiation is described it the analysis that follows.

**Table 27: Number of stream works**

| Catchment | All structures (incl flow balancing & ephemeral) | Subset of structures in valued streams |
|---|---|---|
| Culverts (including headwalls & armouring) | 48 | 22 |
| Diversions | 9 | 9 |
| Bridges (abutments and armouring) | 8 | 8 |
| Number of stream works | N=71 | N=45 |

**Table 28: Extent of stream works**

| Catchment | All structures (incl flow balancing & ephemeral) (m) | Subset of structures in valued streams (m) |
|---|---|---|
| Culverts including headwalls & armouring) | 2,346 | 1,119 |
| Diversions | 1,525 | 1,525 |
| Bridge (abutments and armouring) | 312 | 229 |
| Length of stream works | 4,183 | 2,873 |

### Culverting and associated stream loss

Of the 48 culverts proposed, 26 will not affect permanent of intermittent watercourses. These include the following:

- Twenty culverts are located either where there is a risk of ponding upslope of the proposed Expressway formation (to ensure overland flow during rainfall events can continue) or to connect stormwater treatment ponds to neighbouring watercourses. These culverts are not being formed in existing streams.
- Six culverts are located in ephemeral watercourses, typically farm drains and existing roadside depressions or swales that carry water in large rainfall events but are otherwise dry. Based on our site visits these systems have little to no aquatic habitat value and are largely rainwater conveyance systems.

The remaining 22 culverts lie within perennial (permanent) or intermittent (seasonal) streams. Of these, 14 are new culverts and 8 are upgrades or replacements of existing culverts. For replacement culverts only additional culvert length, and any additional armouring or headwalls are considered when determining scale of effect.

The length of stream works in each perennial or intermittent stream, associated with culverting is shown for each stream in Table 29.

**Table 29: Length of culverting and associated works within valued streams (perennial and intermittent.**

| Catchment | Watercourse Name | New Culvert Length (m) | Headwall + Rip Rap (m) | Total Length Modified (m) |
|---|---|---|---|---|
| Whareroa | 2. Whareroa Drain | 30 | 11 | 41 |
| Wharemauku | 3. Drain 7 (Lower) | 60 | 10 | 70 |
| | 4. Drain 7 (Upper) | 100 | 20 | 120 |
| | 5. Wharemauku Stream | | | |
| Waikanae | 6. Mazengarb Stream | 111 | 33 | 144 |
| | 7. Mazengarb Drains (WWTP) | 125 | 22 | 147 |
| | 8. Muaupoko Stream | 10 | 11 | 21 |
| | 9. Waikanae River | | | |
| Waimeha | 10. Waimeha Stream & Drains | 0 | 16 | 16 |
| | 11. Ngarara Creek | 70 | 20 | 90 |
| | 12. Kakariki Stream | | | |
| | 13. Smithfield Stream & Drains | 25 | 11 | 36 |
| | 14. Paetawa Stream & Drains | 195 | 85 | 280 |
| Kowhai | 15. Hadfield Drain | 80 | 78 | 158 |
| **TOTALS** | | **806** | **313** | **1,119** |

**Diversions, reclamation**

Nine diversions of streams totalling 1,525m in length are proposed. In all cases these diversions are in perennial or intermittent streams.

While 1,525 m of stream will be reclaimed as a result of these diversions, the total length of the diversion channels will be 2,016, or 491 m longer than will be lost. This provides an opportunity for mitigation.

With the exception of the Muaupoko Stream outlet, all the diversions proposed consist of replacing straight, channelised farm drains. No natural meanders are being lost. However, the new diversion lengths and new sections of stream being created have incorporated meanders in their design and the lengths provided in the following tables reflect this.. Table 30 summarises the length of stream affected by diversion for each perennial and intermittent stream.

**Table 30: Loss, modification or creation of perennial or intermittent stream channel due to diversion, channel reclamation and new channel construction**

| Catchments | Watercourse Name / Sample Site | Diversion - Current Length (m) | Diversion - New Length (m) | Difference (m) |
|---|---|---|---|---|
| Whareroa | 2. Whareroa Drain | - | - | - |
| Wharemauku | 3. Drain 7 (Lower) | - | - | - |
| | 4. Drain 7 (Upper) | - | - | - |
| | 5. Wharemauku Stream | 50 | 50 | 0 |
| Waikanae | 6. Mazengarb Stream | - | - | - |
| | 7. Mazengarb Drains (WWTP) | - | - | - |
| | 8. Muaupoko Stream | 30 | 30 | 0 |
| | 9. Waikanae River | - | - | - |
| Waimeha | 10. Waimeha Stream & Drains | 360 | 130 | 230 |
| | 11. Ngarara Creek | - | - | - |
| | 12. Kakariki Stream | 125 | 110 | 15 |
| | 13. Smithfield Stream & Drains | 510 | 936 | -426 |
| | 14. Paetawa Stream & Drains | 390 | 570 | -180 |
| Kowhai | 15. Hadfield Drain | 60 | 190 | -130 |
| **TOTALS** | | **1,525** | **2,016** | **- 491** |

These diversions will require the formation of a new stream channel, the transfer of flows to it, and the reclamation of the original streambed. This methodology is described in the Construction methodology Report (Technical Report 4, Volume 3).

Given the highly modified nature of most of the drains and managed channels that are being diverted the diversion channels can, with appropriate design, provide a quality of habitat that is better than that found in the existing watercourses. This potential for increased habitat quality is considered in the mitigation analysis in the following sections.

### Bridges

Eight bridges are proposed along the length of the proposed Expressway. In all cases these bridges cross perennial or intermittent streams.

With the exception of the Waikanae River (see below) all bridge structures will be single span, with no piers or piling within stream or river channels. All bridges will, however, require some armouring of the stream banks and bed to prevent movement of the stream and the risk of undermining the bridge foundations. A total of 312 linear metres of armouring is proposed and this is considered in this assessment.

The Waikanae Bridge will have five spans, one of which crosses the Waikanae River with piers located to either side of the existing channel. Associated with construction of this bridge will be large scale earthworks to widen the existing floodplain, which is being carried out on instruction from GWRC. This widening will involve the following activities:

- Clearance of approximately 0.13 ha of replanted indigenous vegetation, loss of 0.16 ha of flood protection willow on the southern flood plain of the Waikanae River, and loss of 0.62 ha of willows and mixed native and exotic vegetation on the northern floodplain.
- Two temporary diversions away during construction of each of the bridge abutments and excavation of the widened floodplain.

- Approximately 83 $m^2$ of rock riprap and stream embankment armouring, with an additional 30 metres of rock riprap at the point of entry of the Muaupoko Stream diversion.
- Replanting of the new river edge with willow.
- Replanting behind the willow of native riparian vegetation.
- Redevelopment of access tracks and walkways.

Table 30 and Table 31 summarise the lengths of armouring that will occur within each affected stream.

**Table 31: Length of armouring associated with bridge construction by valued stream.**

| Catchment | Watercourse Name | Bridge Count (n) | Rip Rap (m) |
|---|---|---|---|
| Whareroa | 2. Whareroa Drains | | |
| Wharemauku | 3. Drain 7 (Lower) | | |
| | 4. Drain 7 (Upper) | | |
| | 5. Wharemauku Stream | 1 | 32 |
| Waikanae | 6. Mazengarb Stream | | |
| | 7. Mazengarb Drains (WWTP) | | |
| | 8. Muaupoko Stream | | |
| | 9. Waikanae River | 1 | 83 |
| Waimeha | 10. Waimeha Stream & Drains | 3 | 62 |
| | 11. Ngarara Creek | | |
| | 12. Kakariki Stream | 2 | 105 |
| | 13. Smithfield Stream & Drains | | |
| | 14. Paetawa Stream & Drains | 1 | 30 |
| Kowhai | 15. Hadfield Drain | | |
| TOTALS | | 8 | 312 |

### New streams

In addition to diversions and culverting, seven new sections of stream are being created to connect proposed Expressway -related works such as stormwater ponds outlets, to existing watercourses. These total some 2,016 m of new stream habitat, all of which provides opportunities for mitigation. All of this newly created stream will receive riparian planting of some form.

### Summary of stream works

The following table summarises all stream works within valued streams. Of note is that all streams of high or medium value, with the exception of the Whareroa, are bridged meaning that the only adverse affects will be associated with the armouring that is needed to prevent river bank erosion beneath these structures.

With the exception of a short diversion in the Muaupoko Stream, all diversions and culverts are within highly modified streams and drains of low value.

Also of note is that the majority of stream works associated with the proposed Expressway will occur in the low value waterways of the Waimeha Catchment (68%), including the majority of culverts (38%), bridges (63%) and diversions (91%).

**Table 32: Extent of stream works in valued streams**

| Catchments | Watercourse Name / Sample Site | Ecological Value | Culverts (m) | Diversion (m) | Length of Bridges (m) | Combined stream works (m) |
|---|---|---|---|---|---|---|
| Whareroa | 2. Whareroa Drain | Low | 41 | - | - | **41** |
| Wharemauku | 3. Drain 7 (Lower) | Low | 70 | - | - | **70** |
| | 4. Drain 7 (Upper) | Low | 120 | - | - | **120** |
| | 5. Wharemauku Stream | **Medium** | - | 50 | 32 | **82** |
| Waikanae | 6. Mazengarb Stream | Low | 144 | - | - | **144** |
| | 7. Mazengarb Drains (WWTP) | Low | 147 | - | - | **147** |
| | 8. Muaupoko Stream | **Medium** | 21 | 30 | - | **51** |
| | 9. Waikanae River | **High** | - | - | 83 | **83** |
| Waimeha | 10. Waimeha Stream & Drains | Low | 16 | 360 | 62 | **438** |
| | 11. Ngarara Creek | Low | 90 | - | - | **90** |
| | 12. Kakariki Stream | Low | - | 125 | 105 | **230** |
| | 13. Smithfield Stream & Drains | Low | 36 | 510 | - | **546** |
| | 14. Paetawa Stream & Drains | Low | 280 | 390 | 30 | **700** |
| Kowhai | 15. Hadfield Drain | Low | 158 | 60 | - | **218** |
| **TOTALS** | - | | 1,119 | 1,525 | 312 | 2,956 |

### Assessment of potential effects on aquatic habitat

The following table presents our assessment of the magnitude of impact to the potentially affected aquatic habitat as a percentage of the total length of each stream.

**Table 33: Magnitude of Aquatic Habitat Loss and Modification (without mitigation)**

| DESCRIPTION (listed South to North) | Ecological Value | Length of Loss or modification (m) | Perennial Watercourse Length (m) | Loss as % of total Length | Assessment of Impact Magnitude |
|---|---|---|---|---|---|
| **High Value Streams** | | | | | |
| Waikanae River (bridge armouring) | High | 83 | 112,000 | 0.07% | Negligible |
| **Medium Value Streams** | | | | | |
| Muaupoko Stream (bridge armouring & small diversion) | Medium | 51 | 6,800 | 0.75% | Negligible |
| Wharemauku Stream (bridge armouring & small diversion) | Medium | 82 | 10,400 | 0.79% | Negligible |
| **Low Value Streams** | | | | | |
| Whareroa (culverts and diversions) | Low | 41 | 11,500 | 0.36% | Negligible |
| Drain 7 (culverts and diversions) | Low | 190 | 2,500 | 7.60% | Moderate |
| Mazengarb (culvert) | Low | 291 | 6,100 | 4.77% | Low |
| Waimeha (3 bridges and armouring) | Low | 438 | 2,850 | 15.37% | Moderate |
| Ngarara Creek (culvert) | Low | 90 | 1,200 | 7.50% | Moderate |
| Kakariki (2 bridges and diversion) | Low | 230 | 4,700 | 4.89% | Low |
| Smithfield (diversions and culverts) | Low | 546 | 1,200 | 45.50% | High |
| Paetawa (bridge, culvert and diversions) | Low | 700 | 3,900 | 17.95% | Moderate |
| Hadfield / Kowhai (culverts and diversions) | Low | 218 | 9,300 | 2.34% | Low |

The following table combines our assessment of ecological value with magnitude of effect to assess impact significance.

**Table 34: Assessment of Impact Significance (without mitigation)**

| DESCRIPTION | Ecological Value | Assessment of Impact Magnitude | Assessment of Impact Significance |
|---|---|---|---|
| **High Value Streams** | | | |
| Waikanae River | High | Negligible | Low |
| **Medium Value Streams** | | | |
| Muaupoko Stream | Medium | Negligible | Very Low |
| Wharemauku Stream | Medium | Negligible | Very Low |
| **Low Value Streams** | | | |
| Whareroa | Low | Negligible | Very Low |
| Drain 7 | Low | Medium | Very Low |
| Mazengarb | Low | Low | Very Low |
| Waimeha | Low | Medium | Very Low |
| Ngarara Creek | Low | Medium | Very Low |
| Kakariki | Low | Low | Very Low |
| Smithfield | Low | High | Low |
| Paetawa | Low | Medium | Very Low |
| Hadfield / Kowhai | Low | Low | Very Low |

### Conclusion

The total value of 2.9 km of stream loss or modification seems large, however, it is distributed over 12 waterbodies of generally low value, and much of the works proposed, including armouring, diversions and culverts, will, if properly installed, provide opportunities for habitat improvement that will balance this loss. Therefore our assessment is that overall adverse effects will be low to very low.

For example, armouring is an opportunity to put hard substrate and refugia in soft substrate and erodible stream channels. Diversions are opportunities to reset stream banks and substrate and cause riparian enhancement. Culverts become cover for various fish species in narrow open drains subject to correct installation and embedding. These conclusions are supported by the very low ECR ratios that are derived from our SEV analysis for each activity within these streams and associated mitigation sites (see section 11.4). In some locations, these stream modifications proposed replace existing, under-sized structures that may restrict fish passage.

It is therefore our view that with good design, the areas of culvert, armouring and diversions proposed become in and of themselves mitigation for most stream modification that is proposed. Design is therefore a critical component to be addressed by management plans, monitoring and consent conditions.

Irrespective of the low effects score, the functional length of each stream must be maintained and some additional mitigation may be required for effects on the two higher value streams. The SEV calculator, which assesses how well the main ecological functions of a stream reach are being performed, is effectively a 'no net-loss' tool which produces an ecological compensation ratio (ECR) after taking these factors into consideration. This tool is discussed and applied in Section 11.5 of this Report.

### 8.1.3 Flora and fauna

#### Rare and threatened plants

#### Dwarf mistletoe (at risk, naturally uncommon)

Only one rare plant species was recorded during this study. It was the parasitic dwarf mistletoe (*Korthalsella salicornioides*) which was found within manuka scrub in close proximity to the proposed Expressway Alignment.

Up to a dozen trees on the margins of the wetland where mistletoe is located, may be lost during construction of the proposed Expressway, however, the core area where mistletoe is found is considered to be a sufficient distance from construction that adverse effects can, with care, be avoided. This can be achieved by marking the locations to be avoided prior to vegetation clearance, and educating contractors. No additional management or mitigation is required.

It should be noted that substantial landscape and buffering planting is proposed in the vicinity of the wetland habitat of these plants, which should assist with the long-term protection of the trees and habitat upon which this species relies.

#### Herpetofauna

Only one common species of native lizard, the common skink, was found during the herpetofauna survey. This does not preclude the possibility of other cryptic species being present but at levels that prevent observation. Common skink was widespread in areas of dense grass along the proposed Expressway Alignment and is likely to be present at similar densities throughout the district where this type of habitat is present. Large areas of this habitat will be lost beneath the Project Footprint and any individuals that are resident in that habitat are at risk if not removed prior to earthworks.

In the short term this habitat loss will have large effects on populations within the Designation, but is unlikely to impact on populations of this common species within the district generally. However, recovery of habitat will be rapid and in the short to medium term large areas of equivalent or improved habitat will be created on the margins of the proposed Expressway through landscaping and hydro seeding of exposed earthworks.

Construction effects on these residual lizard populations within the Designation could be reduced by trapping and relocation of lizards prior to construction. As outlined in Ecological Technical Report 2 (Technical Report 28, Volume 3), while there are insufficient ecological grounds and some risks associated with capture and relocation of common lizards, it could be explored and is recommended in the EMP. We note that any capture and relocation will require an 'Authority to Disturb Protected Wildlife' permit under the Wildlife Act (1953).

#### Macro- invertebrates

No threatened or at risk species of macro-invertebrates were recorded during this study. One species of scientific interest, a specimen of *Peripatus novae-zelandiae* was observed at one location.

The new habitat created within the Designation through landscaping, combined with increased areas of rank grassland, is expected to provide equivalent areas of suitable habitat for this species in the short to medium term.

Construction effects on this insect within the Designation could be reduced by relocation prior to construction.

**Avifauna**

**a. Fernbird (At risk – Declining)**

Fernbird were seen on two occasions, one during standardised avifauna investigations, the other being an incidental observation on-site, in the vicinity of Ngarara Wetland and the Kakariki Stream in the vicinity of Nga Manu Nature Reserve. It is likely; given the habitat available, that the observed fernbird(s) are resident in the areas they were recorded.

At the time of the avifauna survey, these were presumed to be the most southern observations of fernbird in the North Island, making this population of scientific interest and regionally significant. However, the presence of fernbird has recently (February 2012) been confirmed further south of these sightings in the Otaihanga oxbow within the Waikanae Estuary by Kāpiti Coast District Council staff.

The proposed Expressway will traverse the riparian area where these sightings occurred. It is likely that some habitat may be lost and there may also be some adverse effects relating to disturbance caused by construction activities, noise, movement, and dust, on resident birds.

Consideration of appropriate mitigation for the protection of these birds is therefore considered necessary and this is discussed further in section 13.2.4 of this Report.

b. Bittern (Nationally Endangered)

A solitary Australasian bittern was the only cryptic marshbird recorded during this study. They were recorded in the extensive areas of raupo reedland and flaxlands of Te Harakeke/Kawakahia Wetland, confirming earlier reports of a resident population of this cryptic bird.

No breeding or foraging habitat for bittern will be lost beneath the Project footprint, and it is considered unlikely that construction activity will displace these birds from their habitat, given the distance of Te Harakeke/Kawakahia Wetland from the proposed Expressway Alignment.

No management or mitigation is considered necessary for bittern.

i. Pipit (At Risk – Declining)

NZ Pipit was observed in at a number of locations along the Designation.

It is likely there will be some temporary effects on resident birds associated with construction of the proposed Expressway, however, this will be limited to the construction phase and revegetation is likely to replace lost habitat.

No further management or mitigation for pipit is considered necessary.

ii. Black shag (at risk -naturally uncommon) & pied shag (Nationally vulnerable)

Black shag and pied shag were recorded traversing the proposed Expressway Alignment, although not utilising the waterbodies. Both species are unlikely to utilise habitat along the proposed Expressway Alignment, and the risk of displacement during construction activities associated with waterbodies is considered to be low.

No management or mitigation for black and pied shags is considered necessary.

iii. Dabchick (Nationally Vulnerable)

One incidental observation of dabchick was made during terrestrial flora surveys at a site previously surveyed for this species. Although this species was identified as a key species for the avi-fauna survey methods, this was the only record throughout the course of the study.

The sighting was in an area of open water approximately 300 m from the proposed Expressway. Dabchick are known to utilise freshwater wetlands as well as man-made water features such as farm ponds and sewage oxidation ponds. As such, we consider that there ample habitat is available in the wider area. Further, we consider the stormwater treatment wetlands and flood storage areas associated with the development of the proposed Expressway will provide additional habitat. Heather and Robertson (2000) note that dabchick spend daylight hours on or associated with the waterbody and only fly between waterbodies at night.

No management or mitigation for dabchick is considered necessary.

iv. Other avifauna

Overall, the lack of native forest habitats along the proposed Expressway Alignment limits the range of abundance of native bird species present along the Designation. With the exception of a small number of cabbage trees adjacent to El Rancho Wetland (Weggery) no remnant native forest will be affected by the proposed Expressway. Native avifauna associated primarily with freshwater habitats (i.e. Wetlands and waterways) were recorded in low numbers.

No management or mitigation is considered necessary.

### Freshwater fish

In total eighteen species of native fish have been recorded within the study area. Of these 18 species, 8 have a national threat status[19] (At Risk; Declining). These species are potentially affected by:

- The loss of habitat (culverting) which will potentially reduce local populations;
- Habitat changes associated with new diversion channels and lengths of new stream being created;
- Entrapment and mortality during reclamation of streams, and through prevention of migration (culverts).

Construction will result in 2,956 m of stream works, including culverting and diversion of 2,300 metres. Even though much of the stream that will be affected is highly modified the quantity of habitat that will be affected is large. In the short term we assess the effects as high. In the medium term there will be a degree of recovery aided by oversized and embedded culverts and the maturing of diversions as habitat and the magnitude of effects on freshwater fish without mitigation is considered to be moderate.

[19] Alibone et al 2009.

Some effects can be minimised by trapping and fish relocations as part of stream works (diversions and culverting). However, additional mitigation is recommended for these potential effects and this is discussed in section 11.5.

### Assessment of potential effects on flora and fauna

The following table combines our assessment of ecological value with magnitude of effect to assess impact significance.

**Table 35: Assessment of Impact Significance**

| DESCRIPTION | Ecological Value | Assessment of Impact Magnitude | Assessment of Impact Significance |
|---|---|---|---|
| **FLORA & FAUNA** | | | |
| **Terrestrial Flora** | | | |
| Dwarf Mistletoe | High | Negligible | Low |
| **Terrestrial Fauna** | | | |
| Common Lizards | Low | Moderate | Very Low |
| Peripatus novae-zelandiae | Low | Low | Very Low |
| **Avifauna** | | | |
| Australasian bittern | Very High | Negligible | Low |
| North Island fernbird | High | High | Very High |
| Black Shag | High | Negligible | Low |
| Pied Shag | Very High | Negligible | Low |
| Dabchick | Very high | Negligible | Low |
| Pipit | High | Negligible | Low |
| **FW Fauna** | | | |
| Indigenous Fish | High | Moderate | High |

### Conclusion

Due to the quantity of stream length that will be lost or modified there is a risk without mitigation of major losses of native freshwater fish. In addition there is a risk of very high adverse effects on fernbird without further research or mitigation.

No other species of flora or fauna are considered to be at risk of adverse effects to the extent that mitigation is required, however, attention to the protection of their habitat during detailed design and construction are necessary to ensure this. Conditions of consent and recognition of this in management plans are recommended.

## 8.2 Indirect impacts of construction

This section considers the following potential effects on the local ecology of proposed Expressway operation:

- Effects on terrestrial vegetation and wetlands
- Effects of groundwater take
- Effects of sediment discharge to streams, wetlands and the coast
- Risk of discharge of contaminants to waterways.

### 8.2.1 Terrestrial vegetation

We have considered three potential indirect effects on vegetation communities that might arise during construction.

#### Weeds

Given the propensity of invasive weed growth on the Kāpiti Coast, there is a high risk during construction of the liberation of weed species not currently present, or the spread of weeds which currently have limited distribution on site or locally.

This could occur through the importation of sand, topsoil, clean fill, plant stock, or as seed carried in mud on vehicles and equipment. This risk cannot be quantified but can be mitigated through appropriate management systems.

We recommend that controls be included in the Construction Environmental Management Plan (CEMP, Appendix 4), which includes timely monitoring and a weed response plan.

#### Dust

The issue of adverse ecological effects of airborne dust has been raised. Given the nature of the sand and peat dominated substrates across the study area, we do not consider dust to be a threat to indigenous flora fauna or habitats.

We anticipate that extensive dust management will be carried out to protect residential areas and we believe the levels of suppression needed to meet amenity and public health requirements will also protect indigenous flora and fauna.

We do not believe further mitigation or monitoring is required.

#### Fire

Given the frequent long dry summer periods on the Kāpiti Coast we have considered the risk of fire during the construction period. Fire may be caused by a range of activities including hot works, smoking, and vehicle exhausts.

We assume that this issue will be covered in the Construction Environmental Management Plan (CEMP, Volume 4) which will include appropriate training, rules around hot works, and liaison with local fire services. We do not believe further mitigation or monitoring is required.

### 8.2.2 Groundwater take

During the planned construction period of four years, a total maximum ground water take of less than 900,000 $m^3$ is proposed from bores completed in the deeper Parata aquifer, at various locations along the length of the proposed Expressway.

This level of take was assessed by the Assessment of Groundwater Effects (Technical Report 21, Volume 3) and the report authors concluded that this total is a conservatively high estimate based on the assumption that the supply bores will be pumping continuously. The authors have noted that the actual total will be less as wells will likely be pumping only part of the time. A peak groundwater take rate of 1,580$m^3$ per day is planned, but only for two months of the Project, with a proposed average take rate of about 560 $m^3$/day. Although these withdrawals will be made from bores completed in the deeper Parata aquifer, there is the potential to affect the hydrology of the wetlands near the proposed Expressway.

We therefore do not believe mitigation is required, but that potential changes to wetlands be considered during any monitoring that is carried out during construction of wetland hydrology.

### 8.2.3 Discharge of contaminants to freshwater and wetlands

We have considered the risk of spills of contaminants such as chemicals, fuel, and oil during construction or the release of contaminants by disturbing contaminated soils.

The Construction Methodology Report (Technical Report 4, Volume 3) has addressed this issue, along with the Erosion and Sediment Control Plan (CEMP Appendix H, Volume 4) which has addressed this issue in the Construction Environmental Management Plan. This CEMP describes standard methodologies and management that will avoid or minimise this. It includes management conditions that address spill minimisation, protocols for managing accidental discharges, and planning of bunded storage areas, and refuelling sites etc.

Overall, we are satisfied that with good management this risk can be avoided, or managed so that effects are negligible.

On this basis we conclude that no additional mitigation is required.

### 8.2.4 Sediment discharge

#### Introduction

Sediment discharge into waterways can be an issue during the construction phase, when fine soils from areas of open ground associated with earthworks can be carried into waterways during rain events. Once the earthworks are completed and stabilised, sediment should not reach the waterways except perhaps in extreme rain events or if ground cover is again disturbed. As outlined in the Erosion and Sediment Control Plan ( CEMP Appendix H, Volume 4) it will be important to ensure that through the construction phase maintenance of a complete vegetation cover is achieved and strict management of sediment is adhered to (refer Construction Methodology Report (Technical Report 4, Volume 3) and the Construction Environmental Management Plan (CEMP, Volume 4).

#### Effect threshold for aquatic fauna and flora

In New Zealand some Regional Councils have adopted a base-flow trigger NTU (Nephelometric Turbidity Unit, a measure of the cloudiness of a liquid) of 25 based on levels needed to protect native fish. This is based on research such as Vinyard & Yaun (1996), Dorgeloh (1995), Rowe & Dean (1998) and Richardson et al (2001). These researchers showed that upstream migration of banded kokopu can be disturbed by NTU greater than 20 (22 gm$^3$). Banded kokopu are present in most of the waterbodies traversed by the proposed Expressway. In contrast other native fish (koaro and common bully) do not avoid waters or decrease feeding rates with NTU as high as 300 (340 gm$^3$). The figure of around 20-25 NTU should therefore be considered a “warning” level (dependent on initial stream condition) rather than a “damaging” level.

When considering the effect of higher short term sediment pulses associated with rainfall events, Rowe et al (2002, 2004) tested suspended solid concentrations up to 10,000 NTU on a range of fish and failed to cause mortality. A range of other experiments (Rowe and Graynoth 2002, Barrett et al 1922, Vinyard & Yaun 1996, Dorgeloh 1995, James et al 2002) have explored raised sediment (NTU) effects – in all cases high sediments (>1000 NTU) in suspension are not (in the short term) significantly adverse, but become so if they persist.

In summary the following thresholds, while not scientifically proven, are currently considered to be a sufficient change from a normal situation that indicates the potential for a change in state of habitat or biota:

- A background level of >20-25 will affect migratory banded kokopu.
- Some, species can tolerate background levels of up to 300 NTU.
- All species can tolerate very high levels (>1000 NTU) for short periods.
- For monitoring, a level above 2 standard deviations from the baseline mean is often used as a trigger for potential adverse effects.

### Calculation of sediment volumes for the proposed Expressway

At the beginning of this Project sediment discharge to streams and river mouths was identified as a key issue of concern. The Contaminant Load Assessment (Technical Report 25, Volume 3) in conjunction with the Erosion and Sediment Control Plan (CEMP Appendix H, Volume 4) have considered sediment yield, transport and management during construction and operation of the proposed Expressway, and their reports provide data on existing levels of sediment yield and estimate increases that are likely to occur during construction.

Key assumptions for this modelling were:

- Duration - for the purposes of USLE risk assessment the figures in Table 36 and Table 37 have been based on 2 months total open earthworks areas for each stage. These figures represent 'worst-case' as staging restrictions on open earthworked areas is recommended and and progressive stabilisation will occur.
- Sediment Delivery Ratio – the USLE model has been based on a high infiltration rate and irregular surface capturing flow and sediment - 0.25 assumed figure.
- Efficiency – this has been based on 95% due to control measures exceeding guidelines and chemical treatment - all measures considered of equal efficiency

In summary the authors of the Erosion and Sediment Control Plan (CEMP Appendix H, Volume 4) and the CEMP comment that the site has a flat contour, is predominantly of sand and peat geology, and has high infiltration rates. They comment that each of these factors is critical in concluding that the sediment generation and eventual sediment yields will be low.

The following table (Table 36) outlines each of the catchment areas and the proportion of each traversed by the Project. Catchment areas were calculated using NIWA's WRENZ website[20].

**Table 36: Catchment and Project Footprint Areas**

| | Catchment (ha) | Footprint (ha) | % of catchment |
|---|---|---|---|
| Whareroa | 1,600 | 9.7 | 0.6% |
| Wharemauku | 1,380 | 31.7 | 2.3% |
| Waikanae | 14,200 | 25.5 | 0.2% |
| Waimeha | 120 | 8.4 | 6.9% |
| Ngarara | 1,690 | 65.5 | 3.9% |

[20] The WRENZ estimates were adjusted by the difference between the WRENZ and Project catchment areas at the points where the watercourses cross the Expressway. (http://wrenz.niwa.co.nz/webmodel/)

The 'pre-earthworks' or baseline sediment yields and the additional contribution from the earthworks footprint is presented in Table 37 and are provided in detail in 'Appendix G1 USLE Calculation M2PP Pre Earthworks' & 'Appendix G5 - USLE Calculation M2PP during Earthworks' within the CEMP.

**Table 37: Predicted sediment generation by catchment (pre and during construction)**

| DESCRIPTION | Baseline Sediment Whole Catchment (tonnes) | Total Contribution by Construction (tonnes) * | % Increase over baseline |
|---|---|---|---|
| Whareroa catchment | 18.17 | 0.58 | 2.6% |
| Wharemauku catchment | 38.02 | 4.50 | 9.5% |
| Waikanae catchment | 644.72 | 3.96 | 0.4% |
| Waimeha | 2.37 | 0.77 | 25.3% |
| Ngarara catchment | 50.56 | 6.83 | 9.8% |

* Predicted sediment generated over 2 month construction period

In summary, sediment yields are estimated to increase to a total of 16.6 tonnes of sediment across the five affected catchments over the duration of earthworks. The increased sediment contribution within each catchment varies from 0.6 tonnes to 6.8 tonnes. The differences relate largely to the proportion of each catchment that will carry earthworks, combined with factors such as slope, soil and vegetation cover.

The Erosion and Sediment Control Plan (CEMP Appendix H, Volume 4) and Contaminant Load Assessment (Technical Report 25, Volume 3) recommend standard methodologies to ensure these low discharge levels are achieved - and note the need to focus particularly on the largest areas of open earthworks at Peka Peka interchange and within the ecologically sensitive Ngarara catchment. As outlined above, there is a focus on maintaining a vegetation cover on open earth worked areas through the construction phase of the Project.

We note that the Universal Soil Loss Equation (USLE) was the tool used by the Project team for sediment load generation. The assumptions used and limitations of this tool, are discussed in more detail in the Construction Environmental Management Plan (CEMP, Volume 4).

### Assessment of effects on freshwater ecology

Based on these findings, we conclude that the risk of adverse effects on freshwater ecosystems due to sediment discharge will be low. Overall, we are satisfied that with good management the risk of adverse effects associated with sediment discharge at this site can be avoided, or managed so that effects are low to negligible. The range of management and monitoring tools are described in the Construction Environmental Management Plan (CEMP, Volume 4).

The quantities of sediment potentially entering the Whareroa (0.58 tonnes) are small in quantity and only represent an increase over baseline of 2.6%. More than this amount of sediment is likely to be released into this stream whenever the channel is excavated as part of ongoing maintenance. We conclude that the additional contribution from this Project is unlikely to have an adverse impact on this stream.

In the Wharemauku Stream we consider that the potential sediment discharged during construction (4.5 tonnes) will be mobile - with the majority flowing through this highly channelised and relatively fast-moving stream directly to the coast. If areas of deposition occur, the macro-invertebrate species present are highly tolerant due to the existing modifications, regular maintenance undertaken, stream structure and contaminant loadings within this stream. We conclude the adverse effects will be low.

For the Waikanae River we consider that the potential 0.4% increase above baseline sediment loads during the construction phase will be mobile and will flow down the channel to the coast without major effects on aquatic fauna or habitat. While the freshwater fauna present include a number of sensitive species, we consider they are able to withstand short term perturbations of this scale without suffering noticeable decline.

For the Waimeha Stream the potential 0.77t increase (a 25.3% increase over the baseline) will also be mobile and flow down the channel to the coast without major effects on aquatic fauna or habitat. As outlined in TR 4 this stream is subject to regular flood maintenance and the freshwater species present are able to withstand regular excavation and associated sediment pulses.

The greatest concern is the potentially significant volume entering Te Harakeke/Kawakahia wetland via the Ngarara streams (Kakariki Stream, Paetawa Drain, Smithfield Drain and Ngarara Creek). The length of stream flowing through this wetland is 1,650m. The stream then flows for 1,250m through the golf course to the confluence with Waimeha which is approximately 300m above the river mouth. If this sediment did not flush through the system and out to the coast, infilling of the stream bed could lead to flooding within the flax toetoe tussock grassland to either side of the stream channel. This could have some adverse effects on low wetland vegetation, potentially smothering smaller plants and communities. However, it is unlikely to impact on the taller flax and toetoe canopy. It is not possible to quantify the extent of this effect or its magnitude. Construction monitoring and adaptive management are recommended.

### Assessment of effects on estuarine systems

Adverse effects on marine ecological values from the discharge of sediment via streams to marine environments relate to the concentration of suspended sediment and depth of deposition of sediment, in addition to the duration of exposure. Typically, there is greater risk of adverse effects where discharges occur into sheltered quiescent marine habitats, such as harbours and estuaries, as opposed to exposed high energy habitats.

Three estuaries and stream mouths were surveyed as part of this assessment based on the potential adverse effects. The risk of adverse effects arising from the discharge of sediment, based on Table 37 above, is considered for each of these habitats.

Sediment discharged to the Wharemauku Stream over a two-month period during construction is estimated to increase by 9.5% above baseline (Table 38). The discharge point is close to the mouth of the stream. The stream discharges to the high energy open coast at Raumati Beach, where significant flushing and dilution of discharges occurs. As such, it is anticipated that the predicted increase in sediment discharge to the stream during rainfall events occurring when earthworks is open in this catchment will have negligible effects on the marine ecological values at this site.

Waikanae Estuary is a tidal river mouth estuary that has high ecological values. The predicted increase in sediment discharge to the river/estuary over a two month period during open earthworks in the catchment is 0.4%. The baseline sediment discharge in this

catchment over this period is relatively high at approximately 650 tonnes. Even though the Waikanae Estuary is a more sheltered low energy environment, the adverse effects on estuarine/marine ecological values resulting from the predicted increase of sediment (4.5 tonnes) are considered to be negligible (i.e. not able to be measured) above this baseline.

The Waimeha Stream discharges to the high energy open coast via a relatively narrow and shallow stream mouth. Sediment discharged to the Waimeha Stream is predicted to increase by 25% from 2.37 tonnes to 3.14 tonnes. Whilst the percentage increase is large, the actual volume of sediment is low. The discharge point is approximately 1.5 km upstream of the stream mouth, and sediment is expected to be carried to the open coast during rainfall events. At the open coast sediment will be rapidly diluted and dispersed subtidally with negligible effects on marine ecological values.

Whilst the Whareroa Stream mouth was not assessed as part of this Project due to the low potential for adverse effects, we consider that an increase of 2.5% in sediment discharged to the stream mouth would have negligible effects on marine ecological values due to the rapid dilution and dispersion of sediment provided by the ultimate receiving environment of the Tasman Sea.

### Assessment of indirect construction effects on streams, wetlands and river mouths

The following table presents our assessment of the magnitude of potential impacts to aquatic and marine habitats due to sediment discharge to waterbodies during bulk earthworks.

**Table 38: Magnitude of effects of sediment discharge (without mitigation)**

| DESCRIPTION | Ecological Value | Description of effect | Assessment of Impact Magnitude |
|---|---|---|---|
| **Streams** | | | |
| Whareroa stream | Medium | 2.6% increase over baseline. | Negligible |
| Wharemauku stream | Medium | 9% increase over baseline. | Low |
| Waikanae stream | High | 0.4% increase over baseline. | Negligible |
| Waimeha Stream | Low | 25% increase over baseline. | Moderate |
| Ngarara stream | Low | 9% increase over baseline. | Low |
| **Wetlands** | | | |
| Te Harakeke Wetland (58.2 ha) | High | Potential smothering of wetland vegetation to either side of Ngarara stream | Moderate |
| **Estuaries, stream and river mouths** | | | |
| Whareroa Stream mouth | High | Sediment discharge (0.6 tonnes) to small, unmodified river mouth | Negligible |
| Wharemauku Stream mouth | High | Sediment discharge (4.5 tonnes) to small, highly modified river mouth | Negligible |
| Waikanae Estuary | High | Sediment discharge (3.9 tonnes) to very large, high value estuary | Negligible |
| Waimeha Stream mouth | High | Sediment discharge (6.8 tonnes) to large, somewhat modified river mouth | Negligible |

Table 39 combines our assessment of ecological value with magnitude of effect to assess impact significance.

**Table 39: Assessment of Impact Significance (without mitigation)**

| DESCRIPTION | Ecological Value | Assessment of Impact Magnitude | Assessment of Impact Significance |
|---|---|---|---|
| **Sediment Discharge to Streams** | | | |
| Whareroa stream | Medium | Negligible | Very Low |
| Wharemauku stream | Medium | Low | Low |
| Waikanae stream | High | Negligible | Low |
| Waimeha Stream | Low | Moderate | Very Low |
| Ngarara stream | Low | Low | Very Low |
| **Sediment Discharge to Wetlands** | | | |
| Te Harakeke/Kawakahia Wetland | High | Moderate | High |
| **Sediment Discharge to Estuaries and Stream Mouths** | | | |
| Waikanae Estuary, Waimeha and Wharemauku Stream Mouths | High | Negligible | Low |

**Conclusion**

Only the potential effects of sediment discharge to Te Harakeke/Kawakahia Wetland is assessed as having a High adverse effect. In all other cases the discharge of small amounts of sediment to highly modified and tolerant waterbodies has been assessed as having very low or low adverse effects.

# 9 Assessment of operational impacts

This section considers the following potential effects on the local ecology of proposed Expressway operation:

- Wetland Hydrology / Groundwater Recharge
- Stormwater Discharge and Contamination
- Disturbance of avifauna
- Fish Passage

## 9.1 Wetland hydrology

Project shaping identified the potential for significant adverse effects on wetland hydrology where surface and groundwater flows are impeded by impermeability of road foundations to overland or subsurface flows leading to either a drawdown or damming of groundwater. Also of concern are reduced inflows of water to wetlands through the capture and transport of rainfall away from wetlands by stormwater drains, and the effect of formation of stormwater and flood detention ponds along the Alignment on groundwater levels.

An Assessment of Groundwater Effects (Technical Report 21, Volume 3) was carried out by Beca to assess these risks, focussing specifically on six valued wetlands that lie in close proximity to the proposed Expressway Alignment.

### Drawdown or damming effects in peat layers

2-D and 3-D hydrogeological models were used in an iterative process with designers to predict and minimise any changes to groundwater levels caused by the proposed Expressway and associated storm water devices.

The modelling reported in the Assessment of Groundwater Effects (Technical Report 21, Volume 3) considered the nature of the pre-loading material and the construction methodology which incorporates a starter drainage layer of granular engineered fill to assist in maintaining existing hydraulic gradients and through-flow in the larger areas of peat within which the wetlands occur (refer Drawing CV-EW-121, Earthworks, Volume 5).

The Assessment of Groundwater Effects (Technical Report 21, Volume 3) established that drawdown effects in peat layers will occur on the down gradient side of the proposed Expressway, but this effect will decline significantly with distance from the proposed Expressway and from associated storm water devices. Specifically, 2-D models showed a generic initial drawdown in the peat of 20 cm at a distance of 20 m, and a 5 cm drawdown at a distance of 200 m.

Overall the report concluded that the proposed Expressway embankment (and associated peat treatment) will result in very small long term changes to groundwater levels (typically <0.1 m within 50 m to 70 m of the proposed Expressway) and flow directions, with no discernable changes in aquifer through flow.

The authors of the Assessment of Groundwater Effects (Technical Report 21, Volume 3) note that these peat drawdowns affect the rates of groundwater discharge *to* the overlying wetland (if the wetland is a *discharge wetland*) or the rates of leakage from the wetland to the underlying groundwater system (if the wetland is a *recharge wetland*). They advised that these changes in groundwater flow are relatively small in comparison to other factors such as surface water inflow, direct precipitation and runoff and physical properties of associate stream channels.

The authors of the Assessment of Groundwater Effects (Technical Report 21, Volume 3) concluded that actual effects on water levels in wetlands overlying the peat as a result of these drawdowns would likely be negligible. Of particular importance, they note that the effect will be negligible where a water body is present in wetlands as the effect will be potentially spread evenly over a large area of inter-connected water. In addition, the 2-D and 3-D modelling indicated that proposed Expressway had negligible “damming effects” on underlying groundwater because the much higher permeability of the Holocene sand aquifer underlying the peat is the dominant factor in controlling shallow groundwater flow. The incorporation of the starter drainage layer of granular engineered fill will assist in ensuring hydraulic connections are maintained.

The report concluded that groundwater drawdown, caused by construction of the proposed Expressway and storm water devices, can be expected to result in a negligible reduction in the volume of groundwater discharging to surface water bodies and/or potentially a negligible increase in the amount of water in surface water bodies that is lost through their beds to the groundwater system.

The report assessed the following six wetlands which are, in our opinion, at greatest risk of groundwater changes, due to proximity and value. For these wetlands it determined:

- Drawdown of the water level in the Raumati Manuka wetland is not expected.
- Drawdown of the water level in the Otaihanga Wetlands is not expected.

- Drawdown of the water table beneath the El Rancho wetlands is not expected.
- Effects on water levels in the Ti Kouka Wetland are expected to be negligible.
- Effects on water levels in the Ngarara Wetland are expected to be negligible.
- There are no expected effects on the Te Harakeke/Kawakahia Wetland.

### Groundwater re- charge

According to the Assessment of Groundwater Effects (Technical Report 21, Volume 3), groundwater contribution to rivers and streams may reduce by up to 2% overall (i.e. on a project scale) as a result of long term operation of the proposed Expressway stormwater devices. Locally the effects will be more significant (with larger reductions over discrete lengths of water bodies).

However, Beca concludes that overall river and stream flows will not be significantly affected as the groundwater that would have discharged directly to the water body will still be discharged to that same water body after interception and treatment in stormwater ponds of swales.

Overall, the Assessment of Groundwater Effects (Technical Report 21, Volume 3) has determined that the effects on surface waterbodies are expected to be negligible, except where such bodies are located close to areas of proposed groundwater level lowering.

### Assessment of potential effects on wetland hydrology

While the modelling discussed above provides confidence that there will be minimal effects on wetlands at a broad scale, we remain concerned about localised effects on wetlands that abut, or are severed by the Alignment. In our view localised reductions in groundwater levels of 20cm would have significant adverse effects on a wetland. A reduction of 5cm is less likely to have a measureable effect.

We conclude from this that any wetland that lies immediately adjacent to the proposed Expressway will suffer from groundwater drawdown that will have a measurable adverse effect upon it. This effect diminishes with distance and any wetland areas beyond 200m wetlands will be buffered from this change. The incorporation of the starter drainage layer of granular engineered fill as part of the pre-load and surcharge embankment construction is anticipated to maintain existing hydraulic cross-flows within these wetlands severed by the proposed Expressway.

The following table presents our assessment of the magnitude of impact to each potentially affected wetland as a percentage of each wetland. Where an entire wetland lies within 100 m of the Project Footprint we have assumed adverse effects will be potentially very high. Where a majority of a wetland lies within 100m we have assessed the potential adverse effect to be high. Where the majority of a wetland lies between 100m and 200m we have assessed a moderate potential effect.

**Table 40: Magnitude of Aquatic Habitat Loss and Modification (without mitigation)**

| DESCRIPTION (listed South to North) total area of wetland given | Ecological Value | Proportion of wetland within 100m | Proportion of wetland within 200m | Assessment of Impact Magnitude |
|---|---|---|---|---|
| Raumati Manuka wetland (2.0 ha) | medium | 100% | - | Very High |
| Otaihanga Wetlands (2.4 ha) | medium | 100% | - | Very High |
| El Rancho wetland Weggery (3.9 ha) | medium | 40% | 40% | High |
| Tuku Rakau wetland (0.3 ha) | Low | 100% | - | Very High |
| Osborne's swamp west wetland (1.3 ha) | Low | - | 100% | Low |
| Ti Kouka Wetland (3.7 ha) | medium | 20% | 60% | Low |
| Ngarara Wetland (2.7 ha) | High | 20% | 80% | Moderate |
| Te Harakeke/Kawakahia Wetland (58.2 ha) | High | 0% | 0% | Negligible |

The following table combines our assessment of ecological value with magnitude of effect to assess impact significance.

**Table 41: Magnitude of Direct Construction Effects on Flora and Fauna**

| DESCRIPTION | Ecological Value | Assessment of Impact Magnitude | Assessment of Impact Significance |
|---|---|---|---|
| Raumati Manuka wetland | medium | Very High | High |
| Otaihanga Wetlands | medium | Very High | High |
| El Rancho wetland Weggery | medium | High | Moderate |
| Tuku Rakau wetland | Low | Very High | Moderate |
| Osborne's wetland | Low | Low | Very Low |
| Ti Kouka Wetland | medium | Low | Low |
| Ngarara Wetland | High | Moderate | High |
| Te Harakeke/Kawakahia Wetland | High | Negligible | Low |

Overall, our assessment is that a risk of high adverse effects exists for three wetlands in close proximity to the Alignment. A moderate adverse effect is possible for two additional wetlands. These adverse effects require a response.

Because of the uncertainty over the extent and magnitude of potential hydrological effects, a monitoring and adaptive management approach is required. This is discussed in more detail in Section 11.7.1. This should focus on the Raumati Manuka Wetland, Otaihanga Southern and Northern Wetlands, El Rancho Wetland (Weggery), Tuku Rakau Wetland and Ngarara Wetland – these being the wetlands most closely linked to the proposed Expressway. The Assessment of Groundwater Effects (Technical Report 21, Volume 3), the Groundwater (Level) Management Plan (CEMP Appendix I, Volume 4) and the Ecological Management Plan (CEMP Appendix M, Volume 4) provide more detail on the monitoring process recommended.

## 9.2 Stormwater discharge

### Introduction

Road surfaces contribute considerably larger pollutant loads compared with other land uses. In many studies, correlations have been made between the amount of pollutants generated and the road traffic volume (Wong et al 2000).

Surface water/storm water run-off from roads may contain litter and litter breakdown chemicals (nicotine, plastics etc), heavy metals (cadmium, chromium, copper, nickel, lead and zinc), Polyaromatic Hydrocarbons (PAH), oils, and surfactants. This run-off could also lead to changes to the pH in waterbodies downstream of the proposed Expressway.

In ecological terms, the issue is that the introduction of new contaminants or raised levels of existing contaminants may adversely affect the benthic communities, whether through toxic effects (acute or chronic) with flow-on effects to the food chain, or through reduction in habitat quality (i.e. Changing oxygen availability, changing the pH), or they may result in chemical barriers to fish migration.

The long term, operational consideration is of road run off / storm water contamination.

**Table 42: Urban land use and typical pollutant loads (kg/ha/yr) (Livingston, 1997).**

| Land use | TSS | Pb | Zn | Cu | TP | TKN | NH4-N | NOx-N | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|
| Freeway | 986 | 5 | 2.4 | 0.41 | 1 | 8.8 | 1.7 | 4.7 | N/A | N/A |
| Parking lot | 448 | 0.9 | 0.9 | 0.04 | 0.8 | 5.7 | 2.24 | 3.24 | 53 | 302 |
| High density residential | 470 | 0.9 | 0.8 | 0.03 | 1.1 | 4.7 | 0.9 | 2.2 | 30 | 190 |
| Medium density residential | 213 | 0.2 | 0.2 | 0.15 | 0.5 | 2.8 | 0.5 | 1.6 | 14 | 80 |
| Low density residential | 11 | 0.01 | 0.04 | 0.01 | 0.04 | 0.03 | 0.02 | 0.11 | N/A | N/A |
| Commercial industrial | 1120 | 3.0 | 2.4 | 0.45 | 1.7 | 7.5 | 2.1 | 3.5 | 69 | 470 |
| Park | 3.3 | 0.005 | N/A | N/A | 0.03 | 1.6 | N/A | 0.33 | N/A | 2.2 |
| Construction | 67,200 | N/A | N/A | N/A | 90 | N/A | N/A | N/A | N/A | N/A |

**Table 43: Highway runoff concentrations for various storm water pollutants (Driscoll et al., 1990)**

| Pollutant | EMC* for highways with <30,000 vehicles/day (mg/l) | EMC for highways with >30,000 vehicles/day (mg/l) |
|---|---|---|
| Total suspended solids | 41 | 142 |
| Copper | 0.022 | 0.054 |
| Zinc | 0.08 | 0.329 |
| Lead | 0.08 | 0.4 |
| Nitrite and Nitrate | 0.46 | 0.76 |
| TKN | 0.87 | 1.83 |
| Phosphate | 0.16 | 0.4 |
| Volatile suspended Solids | 12 | 39 |
| Total organic carbon | 8 | 25 |
| Chemical oxygen demand | 49 | 114 |

*EMC: Event Mean Concentration

These examples show that motorways ("freeways") are major sources of TSS, metals volatile suspended solids and even nutrients. These tables do not include the PAH data, also reported in Wong et al (2000) from Smith et al., 1995. These too are greatly exacerbated by roading. As noted above there is a range of references that cite or show adverse effects on aquatic habitat and communities, all generally illustrating a loss in biodiversity, reduction in habitat quality and toxic effects to later food web members (typically fish).

Best practice stormwater treatment design mechanisms have been incorporated into the proposed Expressway design to minimise contaminants from stormwater run-off entering the waterbodies downstream from the proposed Expressway (NZTA Stormwater Treatment Standard for State Highway Infrastructure 2010), including the use of long linear stormwater treatment swales along most of the length, as well as numerous stormwater treatment wetlands at key locations, particularly upstream of recognised high-value streams and wetlands. Siphon sumps are also proposed to trap gross litter and larger sediments. The Assessment of Hydrology and Stormwater Effects (Technical Report 22, Volume 3) outlines these mechanisms and treatment efficiencies in more detail.

### Stormwater discharge to streams and wetlands

The Baseline Water and Sediment Quality Investigation Report (Technical Report 24) reviewed baseline water quality parameters from the main waterbodies traversed by the proposed Expressway, including sediments, ambient water quality and stormwater samples. Sites chosen for freshwater sampling corresponded as far as possible with the freshwater ecology sampling locations discussed in TR 4.

In regard to ambient water quality, sampling was carried out of a range of nutrients, several metals and some physical habitat parameters. This sampling found that the following parameters were elevated in a number of the waterways downstream of the proposed Expressway:

- Turbidity;
- Ammonia Nitrogen, Total Nitrogen & Total Oxidised Nitrogen;
- Nitrate, Total Phosphorus & Dissolved Phosphorus;
- E. coli;
- Dissolved Aluminium & Total Aluminium;
- Dissolved Copper, Dissolved Zinc and Total Zinc.

The sites showing the greatest exceedences were located in the Wharemauku Stream, Mazengarb Stream and Waimeha Stream. These results are shown in Table 15 of Technical Report 24, Volume 3.

In regard to stormwater quality, a number of issues were identified in all of the waterways sampled, but most particularly the Wharemauku and Mazengarb Streams. The Kakariki Stream and Hadfield/Kowhai Stream also had elevated levels of some parameters. Water quality issues included elevated Nitrogen and Phosphorus products, Copper and Zinc products and a TPH (C7- C36) was also found to be present in measurable concentrations in the Wharemauku Stream. These results are shown in Table 17 of Technical Report 24, Volume 3.

The results of sediment sampling (Table 11, Technical Report 24, Volume 3) show that none of the metals tested for reach the ANZEEC guideline[21] levels for protection at any level.

In summary, the results of the ambient water quality monitoring programme demonstrate that the water quality in the watercourses sampled across the Project extent are characteristic of waterways draining predominantly agricultural land use with elevated nutrient concentrations, bacteriological counts and low toxicant concentrations. Urban runoff is a major source of contaminants in streams and rivers with the potential for concentrations to exceed the receiving water quality criteria designed to protect aquatic life.

The Contaminant Load Assessment (Technical Report 25, Volume 3) modelled a number of scenarios to predict the potential contribution of contaminants from the proposed Expressway. The modelling showed that, even without stomrwater treatment, when fully operational, the proposed Expressway in 2031, is likely to lead to an overall improvement over the existing situation in the contaminant loads (sediment, zinc, copper and TPH) discharging to the receiving environments from most catchments modelled (except for the Wharemauku and Waimeha Stream catchments).

The stormwater treatment proposed will lead to further reductions in the contaminant loads generated by the Project including a <2% reduction in sediment load in all catchments relative to the no-stormwater treatment scenario - with corresponding reductions for zinc, copper and TPH range between 1 and 6% for zinc, 2 and 11% for copper and 1 and 14% for TPH.

Stormwater modelling indicates that the contaminant loads within the Wharemauku and Waimeha stream catchments will increase relative to the existing land use scenario. For the Wharemauku Stream catchment, this is most likely due to the redevelopment of the Paraparaumu airport. For the Waimeha Stream catchment, this is most likely due to the

[21] Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) *Guidelines for Fresh and Marine Water Quality*.

redistribution of the traffic network with a larger road area within the higher traffic-count classification.

Increases in contaminant concentrations in stormwater discharges in the Wharemauku and Waimeha streams may lead to an increased accumulation in the ultimate estuarine/marine receiving environments. However, given that these streams discharge to the high energy open coast, deposition and accumulation of contaminants is highly unlikely. This is evidenced by the existing very low concentrations of contaminants in surface sediment at both these stream mouths. We consider the effects of increased contaminants loads in these two catchments to have negligible effects on marine ecological values.

Based on the results of this modelling and the Baseline Water and Sediment Quality Investigation Report (Technical Report 24, Volume 3), we consider that overall any operational impacts on freshwater fauna and habitats associated with stormwater discharge from the proposed Expressway are likely to be negligible. While we have not recommended mitigation for these potential effects, we have recommended a number of monitoring and adaptive management requirements in relation to downstream water quality and sediments across a number of waterbodies downstream of the proposed Expressway.

## 9.3 Flora and fauna

### 9.3.1 Avifauna

a. Australasian bittern

Australasian bittern are present in the Te Harakeke/Kawakahia Wetland, which is located approximately 170 m from the proposed Expressway Alignment.

Playback and observations during this study and historical information suggest that this species is not present in the many smaller fragmented wetlands to the east that lie adjacent to the proposed Expressway Alignment. This suggests that there is unlikely to be regular movement of bittern across the Alignment to these wetlands which would put these birds at risk.

Overall we consider the risk of adverse effects on Australasian bittern from operation of the proposed Expressway to be negligible and do not believe additional mitigation or monitoring is required.

b. North Island fernbird

This species is present in the wider area between Ngarara Wetland, Kakariki Stream and Nga Manu Nature Reserve and has recently been confirmed approximately 1.5 km downstream of the Designation in the Waikanae Estuary. There are two potential effects that could occur to the birds located in the vicinity of the Kakariki Stream; displacement from habitat by proposed Expressway activity and mortality.

Given the apparent rarity of this species locally, a small number of mortalities caused by vehicles could have a disproportionally large effect on the population. Similarly, displacement of birds from current habitat due to traffic noise and activity would potentially diminish the range of this species locally. We believe additional research and mitigation is warranted and this is outlined in section 11.6.1 of this Report.

c. Black and Pied Shag

No habitat required by black and pied shag for roosting and nesting, and feeding will be lost and in the long term the revegetation of the stream margins will provide additional roosting habitat.

Overall we consider the risk of adverse effects on these two shag species from operation of the proposed Expressway to be negligible and do not believe additional mitigation or monitoring is required.

d. Pipit

The extent of habitat modification along the Kāpiti Coast suggests that pipit are present only as a result of their opportunistic ability to adapt to such modified landscapes. All pipit observations were in areas of grazed pasture.

Overall, we consider the effect on pipit from operation of the proposed Expressway to be low and do not believe additional mitigation or monitoring is required.

### 9.3.2 Lizards

The new habitat created within the Designation through landscaping, combined with increased areas of rank pasture, is expected to provide suitable permanent habitat for the relatively high populations of common skinks within the proposed Expressway Alignment.

Overall, we consider the effect on lizards from operation of the proposed Expressway to be negligible.

### 9.3.3 Fish passage

Given the flat, low-lying nature and low velocity of the majority of the waterbodies traversed by the proposed Expressway Alignment, we are confident that fish passage can be provided to all affected streams where native fish are known or likely to be present.

The only operational issue is ensuring the continued maintenance of culverts, their intakes and outlets to ensure that bank erosion, debris deposition, and structural wear and tear, are managed to maintain the conditions necessary for passage past these structures.

With ongoing programmed monitoring and maintenance of culverts, we consider the risk of adverse effects on fish passage from operation is negligible give low gradients.

### 9.3.4 Assessment of operational effects on flora & fauna

Table 44 summarises our assessment of the operation effects for flora and fauna.

**Table 44: Assessment of Impact Significance of Operational Impacts (without mitigation)**

| DESCRIPTION | Ecological Value | Assessment of Impact Magnitude | Assessment of Impact Significance |
|---|---|---|---|
| **FLORA & FAUNA** | | | |
| **Terrestrial Flora** | | | |
| Dwarf Mistletoe | Medium | Negligible | Very Low |
| **Terrestrial Fauna** | | | |
| Common Lizards | Low | Negligible | Very Low |
| Peripatus novae-zelandiae | Low | Negligible | Very Low |
| **Avifauna** | | | |
| Australasian bittern | Very High | Negligible | Low |
| North Island fernbird | Very High | High | Very High |
| Black Shag | Low | Negligible | Very Low |
| Pied Shag | Very High | Negligible | Low |
| Pipit | Medium | Negligible | Very Low |
| **FW Fauna** | | | |
| Indigenous Fish (fish passage) | High | Negligible | Low |

In all cases, with the exception of fernbird, we conclude that any potential adverse effects will be very low or low. There is a risk of very high adverse effects on fernbird due to habitat disturbance and traffic mortality.

## 10 Summary of construction and operation effects

In summary we have identified that the following potential adverse ecological effects resulting from construction and operation of the proposed MacKay's to Peka Peka Expressway which will require monitoring, management and, in some cases, mitigation:

**Very High**

- Loss of kanuka forest and fragments (Raumati & Otaihanga);
- Potential loss of fernbird habitat during construction between Ngarara wetland and Nga Manu Nature Reserve;
- The risk of vehicle mortality, or displacement of fernbird from habitat due to proposed Expressway operation.

**High**

- Fish mortality during construction (diversions and culvert installation);
- Loss of wetland vegetation in Northern Otaihanga Wetland;
- Hydrological effects on Raumati Manuka wetland, Otaihanga Wetlands, and Ngarara wetland;
- Potential sediment impacts on Te Harakeke wetlands (via Ngarara Stream catchment).

**Moderate**

- Vegetation loss in Ngarara mahoe forest;
- Loss of wetland vegetation in South Otaihanga Wetland;
- Loss of stream habitat during construction due to the installation of 1.1km of culverts and 1.5km of diversions in a range of streams along the Alignment;
- Hydrological effects on El Rancho (Weggery) wetland;
- Sediment discharge to Waikanae River.

These assessments assume good site management as per the CEMP (Volume 4), including erosion and sediment management, dust and fire management. They also assume stormwater treatment meets the standards agreed (NZTA Stormwater Treatment Standard for State Highway Infrastructure 2010), and the hydrological effects are as modelled and described.

All other ecological components are assessed to have negligible, low or very low impacts due to either their low value, or the low magnitude of anticipated effects.

## 11 Proposed mitigation

The previous sections identify that mitigation, which may include management and monitoring, is required for the following activities:

**Direct impacts of construction**

- Loss of terrestrial vegetation, in particular kanuka and mahoe forest
- Loss and modification to wetland vegetation and habitat in four wetlands of medium value
- Loss and modification to freshwater habitat associated with culverting, armouring and stream diversions
- Fish mortality during installation of culverts and diversions
- Loss of fernbird habitat during construction.

**Indirect impacts of construction**

- Impact of sediment discharge on Te Harakeke/Kawakahia Wetland.

**Impacts of operation**

- Displacement or mortality of fernbird during construction and operation
- Changes to wetland hydrology

In addition, while potential adverse effects were assessed to be low, management and monitoring is recommended for the following:

- Lizard mortality resulting from vegetation clearance
- Long term effects on fish passage through poor culvert maintenance.

Figure 10 (comprising 4 maps) illustrates the locations of the proposed mitigation sites for terrestrial vegetation loss and modification (incuding wetlands) and for modification and loss of freshwater habitats.

## 11.1 Loss of terrestrial vegetation & habitats

### 11.1.1 Minimising effects through detailed design & site management

We believe that all efforts to avoid or minimise clearance of vegetation have been explored through the Project scoping phase. However, we note further detailed design will occur at which point these decisions need to be considered and possibly refined. We also suggest that during construction careful management of the work sites will be required to delineate areas of ecological value to be avoided and involvement of an ecologist is recommended to provide an overview clearance of indigenous vegetation where it cannot be avoided. This is addressed in the EMP. The key sites for consideration are:

- The various regenerating broadleaved shrublands and low forest north and south of Raumati Road, through minimising the extent of embankments.
- The are of kanuka forest south of Otaihanga road, through separating the shared cycleway/walkway from the proposed Expressway.
- The area of regenerating broadleaved low forest of Tuku Rakau Village, through steeping up the cut faces.
- The area of regenerating broadleaved low forest on Ngarara Farm between Te Moana Road and Smithfield Road, through steeping up the cut faces.

The EMP addresses this objective (sections 2.4, 3.3 & 4.2).

### 11.1.2 Mitigation calculations for loss of terrestrial vegetation

To date there is no national standard or guidance for the calculation of mitigation for vegetation loss, although it is generally recognised that 1 for 1 revegetation is not sufficient where high value plant communities are lost. For the purposes of this assessment, we have therefore used a simple scale-up of revegetation areas as discussed below.

For loss of kanuka forest and regenerating broadleaf scrub and low forest that could not be avoided, a mitigation ratio of 2 to 1 was used which takes into account the relative proportion of these vegetation communities remaining in the Kāpiti District, their condition and speed of recovery to a similar state.

For loss of mature indigenous forest, a mitigation ratio of 3 to 1 was used which takes into account the relative proportion of remnant indigenous vegetation remaining in the Kāpiti District, and the greater time required for recovery of equivalent species assemblages. Use of these ratios results in a requirement for the following mitigation areas:

**Table 45: Mitigation Calculation for Loss of Terrestrial Vegetation**

| Habitat Type | Vegetation Loss (ha) | Mitigation Ratio | Mitigation Area (ha) |
|---|---|---|---|
| Kanuka forest | 0.8 | x 2 | 1.6 |
| Regenerating broadleaf scrub and low forest (including riparian margins) | 3.0 | x 2 | 6.0 |
| Mature indigenous forest | 0.01 | x 3 | 0.03 |
| TOTALS | 3.8 | - | 7.6 |

### 11.1.3 Summary of mitigation requirements

In summary we recommend a minimum of 7.6 ha of mass planting as mitigation for the loss of regenerating broadleaved forest, kanuka forest, and mature forest within the Project Footprint. This recommendation has been incorporated into revegetation at a number of locations along the proposed Expressway as follows:

- Loss of the 3.8 ha of kanuka forest and regenerating broadleaved forest along the Alignment is mitigated in part by the replanting of a minimum of 7.6 ha of broadleaved forest and kanuka within the wider area of mass planting and mass planting with tree enrichment within the Designation (the total area of which is approximately 78 ha).
- The approximately 0.01 ha of loss of scattered mature indigenous forest trees along the Alignment is also mitigated as part of this larger area of mass planting with tree enrichment within the Designation.

For pioneer shrublands, which are typically dominated by gorse, we have not recommended mitigation for their loss or modification. However, we note the potential for these areas to act as nursery crops and this is considered in the EMP. In some locations we have recommended facilitation of this process through interplanting with native trees and ongoing maintenance to control invasive weed pests e.g. blackberry. In these areas this management should speed up the current vegetation succession to more natural indigenous communities than if the gorse was left unattended.

Overall, we are confident that the quantities of revegetation proposed will fully mitigate for the small areas of vegetation that will be lost.

## 11.2 Loss of wetland vegetation & habitat

### 11.2.1 Minimising effects through detailed design & site management

As for terrestrial vegetation, we believe that all efforts to avoid or minimise loss of wetland habitat have been explored through the Project scoping phase. However, we note that these discussions need to be considered during detailed design and as part of management of the sites during construction. The key sites for consideration are:

- El Rancho Wetland (Weggery), through the use of steeper retaining walls in the vicinity of the wetland.
- The Southern and Northern Otaihanga wetlands and the Otaihanga Kanuka forest, through the use of retaining walls, steeper embankments for the cycleway/walkway and the use of a boardwalk through the wetlands for the shared cycleway/walkway.

The EMP addresses these matters.

### 11.2.2 Mitigation calculations for wetland vegetation and habitat

For the loss of indigenous wetland vegetation that could not be avoided, a mitigation ratio of 3 to 1 was settled on taking into account the scale of historical modification of wetlands on the Kāpiti Coast (refer section 5.2.2) and the potential challenges associated with restoring or re-creating wetlands of equivalent form and diversity, including the locally uncommon nature of some wetland species present. Use of these ratios results in a requirement for the following mitigation areas:

**Table 46: Mitigation Calculation for loss of wetlands)**

| Habitat Type | Loss (Project Footprint) (ha) | Mitigation Ratio | Mitigation Area (ha) |
|---|---|---|---|
| Wetlands | 1.8 | x 3 | 5.4 |

### 11.2.3 Summary of mitigation requirements

We have recommended a minimum of 5.4 ha of wetland restoration as mitigation for the loss of 1.8 ha of wetland of moderate value.

Discussions with KCDC and GWRC biodiversity staff and DoC confirmed a preference to focus any mitigation for wetland loss and modification on existing wetlands within the study area that currently lack formal protection. The mitigation for new wetland planting or restoration proposes to incorporate the transplanting of wetland species from affected adjacent wetlands wherever possible. This has resulted in agreement to wetland restoration work at the following selected sites adjacent to the proposed Expressway:

- Raumati Manuka Wetland
- Otaihanga Wetlands
- El Rancho (Weggery) Wetland
- Ngarara Wetland

However, this has not always been possible and additional mitigation is proposed at the decommissioned Waikanae Oxidation Ponds. The various locations and approaches to wetland mitigation are discussed in the following sections.

### 11.2.4 Mitigation treatments for wetlands

#### Raumati Manuka Wetland

A small portion (0.03 ha) of vegetation surrounding this approximately 1 ha wetland is located within the Project Footprint. We consider that the loss of wetland vegetation and the close proximity of the proposed Expressway to this wetland justifies some additional planting of the wetland surrounds to expand and buffer the current wetland.

We have recommended approximately 1.4 ha of mass planting of wetland species within the proposed flood storage areas as well an additional 1.1 ha of wetland buffer planting between the proposed Expressway, cycleway/walkway and the wetland. The large area of gorse and mahoe shrubland surrounding the Raumati Manuka Wetland provide a good opportunity to enhance the existing values of the area and we have recommended that this vegetation be retained as far as practicable and inter-planted to assist with the natural regeneration process. The nature and extent of this planting is outlined in the Assessment of Landscape and Visual Effects (Technical Report 7, Volume 3). To ensure its long-term protection, we have recommended that the Raumati Manuka Wetland be retained within the permanent Designation.

Given the large area of peat within which the Raumati Manuka Wetland is located, we have also recommended long-term hydrological monitoring of water levels to ensure the ongoing ecological health of this wetland.

### Otaihanga Wetlands (Northern and Southern)

While not included in the Kāpiti Coast District Plan schedule of ecological sites, the Northern and Southern Otaihanga wetlands are considered to comprise ecologically significant vegetation. While there are a number of manuka and *Sphagnum* and *Carex* wetlands occurring on the Kāpiti Coast in close proximity to the proposed Alignment, we are not aware of any other areas of similar *Carex* and *Baumea* dominated wetlands of this size and condition in the vicinity of the proposed Expressway.

Both wetlands have been somewhat modified by historic activities, however, they retain high floristic values and are relatively natural. No rare plants were identified during the botanical survey and our freshwater investigations did not confirm the presence of any freshwater fish species, possibly as a result of long-term contamination (refer Technical Report 24, Volume 3). Bird surveys and lizard surveys within the area did not establish any rare or threatened species present. Accordingly, we suggest that the biodiversity losses at the site are predominantly in relation to floristic wetland habitat.

Project shaping sought to minimise effects on these wetlands but several substantial property constraints restricted options for realignment of the proposed Expressway including the KCDC sewerage treatment plant immediately to the east and potential contaminated land and water issues associated with the Otaihanga Landfill adjacent.

As a result approximately 0.55 ha of *Carex* sedgeland and *Baumea* rushland vegetation would be lost from the 1.39 ha Southern Otaihanga Wetland, and approximately 0.53 ha of manuka *sphagnum* bog and *Carex* sedgeland would be lost from the 1.0 ha Northern Otaihanga Wetland.

In calculating loss of habitat, we have assumed the loss of all wetland vegetation within the Project Footprint (including the shared cycleway/walkway path). This assessment also takes into account potential edge effects (edge desiccation and die-back) of wetland vegetation immediately following construction. While there may be some temporary changes to vegetation composition within these residual wetland areas as a result of construction and hydrological effects, we are confident that there is value in trying to retain and protect these residual areas outside of the Project Footprint.

There are a number of factors that have been taken into account in our assessment of mitigation in this area:

- the modified condition of the wetlands or their margins;
- the lack of native fauna (native fish and lizards);
- the remaining size of each wetland following construction;
- the effect of existing culverts, forestry access roads and mountain-bike tracks on the wetland vegetation and hydrology (visible as die-back of older manuka and weed encroachment in the central wetland);
- The absence of larger, more mature wetland trees and predominance of younger, low stature manuka in the canopy;
- Our assumption that prior to land development and vegetation clearance on the Kāpiti Coast, these wetlands would have been vegetated in swamp forest.

We recommend that the remaining area of these wetlands outside of the Footprint be retained and permanently protected as part of the Designation. Maintaining the current hydrological regime and management of construction to limit loss of all wetland vegetation is recommended.

We also recommend the restoration of 0.4 ha of the Otaihanga Central Wetland. Transplanting of the larger wetland plants, particularly *Carex* and *Baumea*, from the wetland areas lost at Otaihanga would be cost-effective and would reduce substantially the 'physical loss' of wetland plants and habitat by re-using them in created wetland habitat. A wetland restoration plan that includes the transplanting of the larger wetland plants should be a condition of consent. Depending on the findings of the contaminated land study currently underway, the restoration of the residual Otaihanga Central Wetland may be able to be designed in conjunction with ecological restoration principles to improve any current informal treatment function for leachate from the adjacent landfill. We also recommend the restoration of a 1.2 ha low-lying dune depression just to the south of the Otaihanga wetlands (adjacent to the WWTP Drain) using the wetland vegetation from the areas of wetland lost beneath the Project Footprint at the adjacent northern and southern Otaihanga wetlands. These areas have been incorporated into the proposed landscape and visual planting drawings.

These areas will provide 1.6 ha of the 3.2 ha of mitigation required, leaving an additional 1.6 ha of mitigation required. As discussed below, we suggest this shortfall can be met through restoration works within the Waikanae Oxidation Ponds.

### El Rancho wetland (weggery)

While effort has been taken to reduce the loss of and potential impacts on this regionally significant wetland, 0.38 ha of the southern edge of the 3.9 ha El Rancho Wetland (Weggery) could not be avoided. The El Rancho Wetland (Weggery) is one of three wetlands in this larger wetland complex.

While the wider El Rancho wetlands complex are recognised as regionally significant, proposed Expressway -related works have been confined to the most modified southern portion of one wetland. In this area the wetland has developed from wet pasture to form cattle-induced mossfield with large areas of regularly grazed manuka *sphagnum* shrubland and scattered areas of *Carex* sedgeland, *Baumea* rushland and open water. In addition the gas pipeline traverses this area and requires regular vegetation clearance and grazing to maintain access to this infrastructure. Finally, vegetation clearance and drainage was recently undertaken in this adjacent area as part of the original existing WLR designation process.

There is little opportunity to mitigate for wetland loss within the El Rancho (Weggery) wetland as it is outside the proposed Designation (and is located within a recognised waahi tapu area). We have therefore had to look to other potential sites and propose restoration of the former Waikanae Oxidation Ponds, part of the Pharazyn Reserve, as mitigation for wetland loss in this location. This option has been discussed with KCDC, DoC and GWRC and is detailed below.

We have also recommended adoption of an adaptive management approach during construction to ensure ecological impacts on the margins of this wetland can be suitably managed. Section 11.4.3 of this Report discusses this approach in more detail.

### Waikanae oxidation ponds

Historically, these ponds were part of the nationally recognised Te Harakeke/Kawakahia wetland downstream of the proposed Expressway but have recently been subject to a range of restoration activities. Surplus peat from the Ontrack Rail Upgrade work has already been disposed of in these ponds and the continuation of this restoration programme would have

long-term benefits for the wider wetland complex. A restoration plan for this work has been prepared by KCDC in 2010 and is recommended to provide the basis for the ongoing restoration of this area[22]. As demonstrated by the shortfall in surplus peat from the Ontract Rail Upgrade project in recent years, it is considered unlikely that the ambitions of the existing restoration plan in terms of surplus peat availability, infilling and restoration planting are unlikely to be met. The scale of peat excavation associated with the proposed Expressway is considered to be consistent with the scale of restoration proposed in the restoration plan.

Restoration at this site is be intended to meet the shortfall of 3.8 ha of mitigation for wetland loss that cannot be met at existing wetland sites within or adjacent to the proposed Expressway.

Restoration involves importing approximately 76,000 $m^3$ and 114,000 $m^3$ of peat from the construction earthworks along the proposed Expressway Alignment to raise the bed of the ponds (currently 2-3m deep) and create islands and shallows which would then be planted as wetland habitat.

### Ngarara wetland

Given the close proximity of the proposed Expressway to the core of the Ngarara Wetland (approximately 25-30 metres distant) and the presence of a nationally threatened bird species (North Island fernbird – refer TR3), we have recommended dense edge planting and landscape treatment to buffer the wetland core. This planting should be undertaken in conjunction with the research and mitigation recommendations outlined for fernbird along the length of the proposed Expressway Alignment in this location (refer section 11.6.1 of this Report).

Attempts should be made to minimise the clearance of, and associated adverse effects on this edge vegetation, which are integral to the values of the wider wetland area.

### Contributions from stormwater treatment wetlands and flood storage areas

Although not included in our calculations for mitigation of vegetation loss or associated habitat effects, we note that the development of a number of stormwater treatment wetlands and flood storage areas along the proposed Expressway Alignment will provide some ecological benefit.

A total of 11 stormwater treatment wetlands (totalling 1.56 ha) and 14 flood storage areas (totalling 33 ha) are proposed (refer to the Assessment of Hydrological and Stormwater Effects - Technical Report 22, Volume 3). While the primary function of these wetlands is hydrology and stormwater treatment, some nonetheless have a dual role outside their primary function in terms of amenity and ecological habitat value. Consistent with these dual values, we have worked with the hydrological and stormwater team to ensure the stormwater treatment wetlands, and several of the larger flood storage areas are designed using best practice ecological principles which will also ensure they develop ecological values.

In most cases, the stormwater treatment wetlands proposed in the proposed Expressway design will have an indigenous wetland plant component of 60% (and 40% open water). In

[22] WILDLANDS CONSULTANTS LTD. 2011. Pharazyn Reserve Landscape and Ecological Restoration Plan. Report prepared for Kāpiti Coast District Council. Contract Report No. 2527.

addition large components of a number of the larger flood storage areas are proposed to be mass planted in indigenous wetland species with fish passage to nearby streams also provided (a total of approximately 13 ha). As outlined in section 11.1 of this Report, these areas will contribute to formation of a vegetated corridor along the proposed Expressway which will enhance existing linkages between forest and wetland habitats, particularly around known habitat corridors (e.g. Nga Manu Nature Reserve to Te Harakeke/Kawakahia Wetland). The provision of fish passage to some of these seasonally wet flood storage areas will also increase freshwater fish habitat which in some cases will allow fish to access historic areas of their former habitat.

The development of these proposed water treatment wetlands and flood storage areas within low-lying dune depressions is consistent with the historical patterns of wetlands on the Kāpiti Coast and would ultimately add to the total quantum of wetlands on the Kāpiti Coast once completed.

### Indigenous vegetation outside of the Project Footprint

In addition to the loss of approximately 5.6 ha of regenerating broadleaved shrubland and kanuka forest within the Project Footprint, we have also considered the *potential* loss or modification to a further 7.4 ha of similar vegetation arising from earthworks and construction activities within the Designation. Because the extent and location of these areas is yet to be determined through more detailed design, some additional mitigation may be required for any additional loss of indigenous vegetation outside of the Project Footprint, but within the Designation.

As noted earlier in this report, much of this additional 7.4 ha of habitat within the Designation is physically very unlikely to be affected and arises only as a result of the Designation relating to property boundaries which may include larger areas of indigenous vegetation e.g. the large area of kanuka forest at Otaihanga.

As outlined earlier in this report and in the EMP, minimising the extent of vegetation clearance or modification through ecological involvement during the construction phase comprises an important part of environmental management proposed. We consider any additional loss of regenerating shrub or forest can be mitigated sufficiently within the wider landscape and amenity plantings, concentrating on those species lost e.g. kanuka forest. In regards to wetland vegetation, we consider that there is sufficient modified wetland within the Designation within the vicinity of the Otaihanga wetlands and the Waikanae oxidation ponds that any additional loss of wetland habitat can be provided for within the scope of the Project.

### Summary of mitigation requirements

In summary we have recommended a minimum of 5.4 ha of wetland restoration as mitigation for the loss of 1.8 ha of wetland of moderate value. This is to be achieved through works along the footprint where existing wetlands provide opportunities for restoration, in combination with restoration work within the decommissioned Waikanae Oxidation Ponds. We also note that stormwater treatment wetlands and flood storage areas that will be formed along the route will provide additional wetland benefits.

Overall we are satisfied that the revegetation and restoration proposed will fully mitigate for the loss of wetlands, and will in the long term provide ecological benefit.

## 11.3 Loss and modification of freshwater habitats

Our assessment has concluded that mitigation is required for loss and modification of stream habitat. The Stream Ecological Valuation System (SEV) was used to generate ecological compensation ratios (ECR) for each stream reach affected. The goal of the SEV method is to achieve at least no net loss. This tool is described in more detail in TR4.

The following tables present the results of the SEV analysis for each of the key activities; culverting, diversion, and bridging for each of the valued streams. Details of these calculations can be found in Appendices 26.F, 26.G and 26.H.

### 11.3.1 Mitigation calculations

Table 47 presents the Environmental Compensation Ratio (ECR) calculations for culverts. It combines both habitat loss due to culvert installation, and habitat modification associated with armouring and headwalls above and below each culvert. The ECR values are generally low (1.6 to 3.5), a reflection of both the poor quality and low SEV scores of the streams being considered, the assumption that some habitat value can be retained within these low gradient and low velocity culverts, and the potential for increased habitat diversity provided by armouring. For the 1,119 m of culvert and riprap proposed, the ECR calculates that 2,575 m of stream restoration is required as mitigation.

**Table 47: Calculation of mitigation requirements for culverts**

| Catchment | Valued Stream | Total Length Modified | ECR for culvert | ECR for Armouring | Combined Mitigation Required |
|---|---|---|---|---|---|
| Whareroa | Whareroa Drain | 41 | 2.31 | 1.88 | 90 |
| Wharemauku | Drain 7 (Lower) | 70 | 1.24 | 0.98 | 84 |
| | Drain 7 (Upper) | 120 | 3.04 | 1.52 | 333 |
| | Wharemauku Stream | - | - | - | - |
| Waikanae | Mazengarb Stream | 144 | 2.08 | 1.23 | 271 |
| | Mazengarb Drains (WWTP) | 147 | 2.61 | 1.64 | 361 |
| | Muaupoko Stream | 21 | 2.61 | 1.64 | 44 |
| | Waikanae River | - | - | - | - |
| Waimeha | Waimeha Stream & Drains | 16 | 3.63 | 1.12 | 17 |
| | Ngarara Creek | 90 | 1.67 | 0.61 | 129 |
| | Kakariki Stream | - | - | - | - |
| | Smithfield Stream & Drains | 36 | 3.26 | 3.18 | 116 |
| | Paetawa Stream & Drains | 280 | 3.32 | 1.66 | 788 |
| Kowhai | Hadfield Drain | 158 | 2.44 | 1.88 | 342 |
| TOTALS | | 1,119 | | | 2,575 |

Table 48 presents the ECR calculations for stream reclamation and diversion. The scores are relatively low (0.92 to 1.37) on the assumption that the new diversion channels are able to improve of the uniform channelised reaches that are being reclaimed, and that the proposed restoration and revegetation will lift the diversion channels close to the reference condition. For the 1,525 m of diversion, the ECR calculates that 1,748 m of stream restoration is required as mitigation.

**Table 48: Calculation of mitigation requirements for diversions**

| Catchment | Valued Stream | Total Length Modified | ECR for Diversion | Combined Mitigation Required |
|---|---|---|---|---|
| Whareroa | Whareroa Drain | - | - | - |
| Wharemauku | Drain 7 (Lower) | - | - | - |
| | Drain 7 (Upper) | - | - | - |
| | Wharemauku Stream | 50 | 1.24 | 62 |
| Waikanae | Mazengarb Stream | - | - | - |
| | Mazengarb Drains (WWTP) | - | - | - |
| | Muaupoko Stream | 30 | 1.37 | 41 |
| | Waikanae River | - | - | - |
| Waimeha | Waimeha Stream & Drains | 360 | 1.16 | 419 |
| | Ngarara Creek | - | - | - |
| | Kakariki Stream | 125 | 1.16 | 146 |
| | Smithfield Stream & Drains | 510 | 0.92 | 467 |
| | Paetawa Stream & Drains | 390 | 1.37 | 535 |
| Kowhai | Hadfield Drain | 60 | 1.31 | 79 |
| TOTALS | | 1,525 | | 1,748 |

Table 49 presents the ECR calculations for bridge construction. This relates to the stream bank armouring required to stabilise the channel beneath the bridge span. The scores are relatively low (1.1 to 3.5) due to the low values of most channels, and on the assumption that in these uniform channels rip rap will provide some additional habitat diversity. For the 312 m of stream armouring associated with bridge crossings, the ECR calculates that 650 m of stream restoration is required as mitigation.

**Table 49: Calculation of mitigation requirements for bridges**

| Catchment | Valued Stream | Total Length Modified | ECR Riprap | Combined Mitigation Required |
|---|---|---|---|---|
| Whareroa | Whareroa Drain | - | - | - |
| Wharemauku | Drain 7 (Lower) | - | - | - |
| | Drain 7 (Upper) | - | - | - |
| | Wharemauku Stream | 32 | 2.03 | 65 |
| Waikanae | Mazengarb Stream | - | - | - |
| | Mazengarb Drains (WWTP) | - | - | - |
| | Muaupoko Stream | - | - | - |
| | Waikanae River | 83 | 3.55 | 295 |
| Waimeha | Waimeha Stream & Drains | 62 | 1.12 | 69 |
| | Ngarara Creek | - | - | - |
| | Kakariki Stream | 105 | 1.63 | 171 |
| | Smithfield Stream & Drains | - | - | - |
| | Paetawa Stream & Drains | 30 | 1.66 | 50 |
| Kowhai | Hadfield Drain | - | - | - |
| TOTALS | | 312 | - | 650 |

Table 50 summarises the results of the previous three tables showing, the types of mitigation required in each stream and a combined total.

**Table 50: Summary of all in- stream mitigation requirements**

| Catchment | Valued Stream | Culvert Mitigation | Diversion Mitigation | Bridge Mitigation | Combined Mitigation Required |
|---|---|---|---|---|---|
| Whareroa | Whareroa Drain | 90 | - | - | 90 |
| Wharemauku | Drain 7 (Lower) | 84 | - | - | 84 |
| | Drain 7 (Upper) | 333 | - | - | 333 |
| | Wharemauku Stream | - | 62 | 65 | 127 |
| Waikanae | Mazengarb Stream | 271 | - | - | 271 |
| | Mazengarb Drains (WWTP) | 361 | - | - | 361 |
| | Muaupoko Stream | 44 | 41 | - | 85 |
| | Waikanae River | - | - | 295 | 295 |
| Waimeha | Waimeha Stream & Drains | 17 | 419 | 69 | 506 |
| | Ngarara Creek | 129 | - | - | 129 |
| | Kakariki Stream | - | 146 | 171 | 317 |
| | Smithfield Stream & Drains | 116 | 467 | - | 583 |
| | Paetawa Stream & Drains | 788 | 535 | 50 | 1,372 |
| Kowhai | Hadfield Drain | 342 | 79 | - | 421 |
| TOTALS | | 2,575 | 1,748 | 650 | 4,973 |

### 11.3.2 Stream mitigation proposal

The proposed mitigation actions have been designed to fall as far as practicable within the waterbodies affected by the proposed Expressway immediately upstream and downstream of the proposed Expressway.

However, this does not provide the full quantity of calculated mitigation and several additional actions are proposed on a number of the higher value waterbodies with good restoration potential within and outside the Designation (Wharemauku Stream, Waikanae River, Waimeha Stream, Kakariki Stream and Paetawa Stream).

Proposed mitigation activities include:

- Culvert Design: All culverts in perennial or intermittent streams will be embedded and sized to allow streambed habitat to pass through them. There are a number of accepted methods for the design of these culverts that will also ensure fish passage.
- Riparian re-vegetation and land retirement upstream and downstream at each of the 22 culverts in perennial or intermittent waterbodies. This would result in a total length of 880 lineal metres based on 20 lineal metres of planting (10m wide on both sides) upstream and downstream of the crossing. Where possible these areas will be fenced and permanently protected within the Designation.
- Construction of a number of new lengths of streams which will connect to existing waterbodies.
- Diversions which total more than the lengths of stream lost.
- Stream diversion guidelines: An indicative stream profile for designing and constructing each of the diversions and new streams proposed has been developed based on the site

visits and information gathered as part of the SEV sampling. Each of the new stream diversions and sections of new stream created will be based on this indicative stream profile and will also be re-vegetated based on a minimum of 10m of riparian planting either side along the entire length. This design will specifically deal with the fundamental characteristics of all stream diversions and formation (i.e. alignment, sinuosity, width, profile, and bank and bed treatment).

- Riparian revegetation of a total of 1,820 lineal metres (based on a minimum of 10-20m wide both sides of the waterbody) within the following specific waterbodies:
  - Wharemauku Stream (160 lineal metres)
  - WWTP Drain (220 lineal metres) to connect into proposed ecological mitigation wetland
  - Waikanae River (380 lineal metres, comprising 300 lineal metres (including flood protection planting) on the northern bank and 80 lineal metres on the southern bank)
  - Waimeha Stream (320 lineal metres)
  - Kakariki Stream (510m lineal metres)
  - Paetawa Stream (230 lineal metres).

Table 51 summarises the total length of mitigation calculated, the forms of mitigation treatment proposed and the potential shortfall.

**Table 51: Mitigation Treatments proposed for Stream Bed and Riparian Habitat Loss**

| ECR Results | Length (m) |
|---|---|
| ■ ECR Mitigation Calculated by SEV analyses | 4,973 |
| **Proposed Mitigation** | |
| ■ New lengths of streams constructed | 1,260 |
| ■ Riparian re-vegetation and land retirement upstream and downstream of the 22 culverts in perennial and intermittent streams | 880 |
| ■ Riparian revegetation of the Wharemauku, WWTP, Waimeha, Kakariki, Paetawa Streams and the Waikanae River | 1,820 |
| **TOTAL** | **4,716** |
| **ECR Shortfall** | **257** |

### 11.3.3 Summary of mitigation requirements

In conclusion, the effects of stream loss and habitat modification (2,956 m) have been calculated to require mitigation of 4,973 m of stream restoration. A range of management and mitigation actions are proposed covering a total of 4,716 m of stream, and this restoration has been identified and incorporated into the proposed Expressway design.

There is a small shortfall of approximately 257 lineal metres. We recommend that this shortfall can be suitably addressed by the additional ecological benefit provided by landscape planting and the development of large mass planted flood storage areas totalling 13 ha in area, which have not been used as ecological mitigation elsewhere (discussed in section 11.2.4 of this Report). The design for these mass planted flood storage areas will have habitat connections to adjacent waterbodies (the Wharemauku Stream and the Kakariki Stream) and this will provide a range of habitat benefits. The extent of indigenous wetland planting proposed within the 105,000 $m^2$ flood storage areas adjacent to the Wharemauku Stream and the 25,500 $m^2$ area north of the Kakariki Stream are substantially greater than the 257 lineal metre shortfall (or 5,140 $m^2$) ECR mitigation required by the SEV analysis.

## 11.4 Potential changes to wetland hydrology

Ecological Technical Report 1 (Technical Report 27, Volume 3) noted that changes in hydrology are one of the leading causes of wetland degradation or destruction on the Kāpiti Coast and nationally. This report recommended that maintaining groundwater flows and providing for the continuation of seasonal fluctuations will be critical to ensuring the ongoing health and functioning of these wetlands, particularly in areas where wetlands are located within more extensive and connected areas of peat.

Although the Assessment of Groundwater Effects (Technical Report 21, Volume 3) has established that any adverse hydrological effects on wetlands will diminish rapidly with distance and will be negligible beyond 100m, we consider there may be some measurable adverse effects on the hydrology of wetlands that abut or are severed by the road formation. Because the scale and extent of these effects cannot be precisely defined we recommend an adaptive management approach. Adaptive management is described generally in section 11.7.1 of this Report and the EMP.

The primary focus of adaptive management is to ensure any potential hydrological changes on these wetlands are adequately monitored to detect any negative changes so that remedial action can be taken, preferably at the earliest opportunity. Accordingly, we have recommended the continuation of water level monitoring (through the use of piezometers) in key wetlands before, during and after construction. Pre-construction monitoring is vital to provide a baseline of data necessary to provide a trigger level for intervention through adaptive management.

The groundwater monitoring planned is outlined in the Groundwater (Level) Management Plan (GWMP) (CEMP Appendix I, Volume 4), which proposes monitoring of potential changes to water levels in wetlands by monitoring groundwater levels between the proposed Expressway and the wetlands. Under this Plan, if groundwater level changes reach Alert or Action levels, then potential effects on wetlands can be avoided by mitigating groundwater level changes before the wetland is deleteriously affected. Where natural wetlands or surface water bodies are within 100 m of the proposed Expressway, this Plan requires specific groundwater level monitoring wells to be installed between the proposed Expressway and the wetlands. This is set out in the GWMP, including specific monitoring of the following wetlands:

- Raumati Manuka Wetlands, CH3700 to CH4100 – 3 piezometers;
- Crown Hill and other small wetlands, CH7400 to CH7700 – 1 piezometer;
- Otaihanga Wetlands, CH8700 to CH9100 – 3 piezometers;
- El Rancho Wetland, CH10900 to CH11600 – 4 piezometers;
- Te Harakeke/Kawakahia Wetland, CH12400 to CH13200 – 2 piezometers; and
- Te Kouka Wetland and Nga Manu Sanctuary, CH13700 to CH14700 – 4 piezometers.

Because the monitoring of potential water level changes to wetlands will be accomplished by monitoring changes in groundwater levels, the methodology, reporting, trigger levels and response management are outlined in Section 5.1 of the GWMP. We recommend these adaptive management 'trigger' levels be developed in conjunction with ecological and groundwater specialists with a knowledge of the Kāpiti Coast wetlands.

In addition to baseline groundwater information, the baseline Wetland Condition Monitoring assessments[23] undertaken as part of the Ecological Technical Report 1 (Technical Report 27, Volume 3) should be repeated at each of these wetlands post construction.

If the baseline ecological and groundwater monitoring trigger levels are exceeded, an ecologist and groundwater specialist should visit the wetland to review wetland health against the established triggers. Notes should be taken on any noticeable changes in the science-based indicators, including changes in hydrology, water pollution, nutrient enrichment, seasonal biodiversity indicators (e.g. presence of summer flowering species), invasion by weeds, animal pests or impaired wetland functioning (e.g. indigenous wetland species die-back). A particular focus should be on ensuring seasonal fluctuations are maintained.

Prior to undertaking any triggered adaptive management interventions the written consent of Greater Wellington Regional Council and Kāpiti Coast District Council will be required.

The four specific locations we have recommended an adaptive management approach are outlined in more detail in the following sections. The adaptive management options are not exclusive and have been suggested to provide guidance at the sort of mechanisms available at each of the specific wetlands.

### 11.4.1 Raumati manuka wetland

A small portion of the Raumati Manuka wetland is located within the Project Footprint and three large areas of stormwater treatment wetland (4,950 $m^2$) and flood storage area (13,700 $m^2$ and 19,853 $m^2$ respectively) are located in close proximity. If ongoing monitoring determines impaired wetland functioning, the following adaptive management options could be considered:

- Establishment of an adjustable weir in Drain 7 just downstream of the wetland to increase groundwater levels within the wider peat complex within which the Raumati Manuka Wetland is located.
- Raising or lowering the water level in Drain 7 in the vicinity of the Raumati Manuka Wetland in response to raised or lowered water levels in the wetland.
- Construction of a new outlet from the southern section of the wetland to Drain 7 with an adjustable weir system to control water height.
- Weed control of invasive weed species that have established as a result of hydrological changes deemed to arise from the proposed Expressway construction.
- Replanting of any areas of die-back with suitable indigenous species.
- Expanded buffer planting in gorse and blackberry areas surrounding wetland as mitigation for hydrological changes (in addition to recommended mitigation planting in this area).
- Undertaking a more comprehensive wetland restoration programme following any significant changes in wetland health, including consideration of large-scale peat removal to retain the original baseline water levels within the wetland and a wetland plant restoration programme.
- Additional mitigation opportunities at other wetlands within the study area.

[23] Refer Clarkson B.R., Sorrell B.K., Reeves P.N., Champion P.D., Partridge T.R., Clarkson B.D. 2003: Handbook for monitoring wetland condition (Revised October 2004). Coordinated Monitoring of New Zealand Wetlands. A Ministry for the Environment Sustainable Management Fund Project (5105).

### 11.4.2 Otaihanga southern and northern wetlands

The proposed Expressway will sever both of these wetlands, potentially damming flows upslope and reducing groundwater levels downslope. If ongoing monitoring determines impaired wetland functioning, the following adaptive management options could be considered:

- Establishment of an adjustable weir at the outlet of both wetlands downstream to increase groundwater levels in both wetlands.
- Construction of an adjustable weir system on the inlet and outlet of Culvert 16 through the Southern Otaihanga Wetland to alter groundwater or hydrological through-flows.
- Weed control of invasive weed species that have established as a result of hydrological changes deemed to arise from the proposed Expressway construction.
- Replanting of any areas of die-back with suitable indigenous species.
- A full wetland restoration programme following any significant changes in wetland health, including, but not limited to, the removal of peat to retain the original baseline water levels within the wetland and a full wetland plant restoration programme.
- Additional mitigation opportunities at other wetlands within the study area, including restoration of the surrounding Otaihanga Central Wetland.

### 11.4.3 EL Rancho wetland (weggery)

The Project Footprint includes a small portion of the southern fringe of this wetland. If ongoing monitoring determines impaired wetland functioning, the following adaptive management options could be considered:.

- Establishment of an adjustable weir to control water within the existing drain through the centre of the wetland.
- Permanent infilling of the existing drain to increase groundwater levels consistent with any lowering of groundwater.
- Reductions in volume or outlet of flood storage area.
- Weed control of invasive weed species that have established as a result of hydrological changes deemed to arise from the proposed Expressway construction.
- Replanting of any areas of die-back with suitable indigenous species.
- Additional mitigation opportunities at other wetlands within the study area, including restoration of the surrounding El Rancho wetlands.

### 11.4.4 Ngarara wetland

An adaptive management framework is recommended to ensure that any construction effects are minimised on the Ngarara Wetland. If ongoing monitoring determines impaired wetland functioning, the following adaptive management options could be considered:

- Weed control of invasive weed species that have established as a result of hydrological changes deemed to arise from the proposed Expressway construction.
- Replanting of any areas of die-back with suitable indigenous species.
- Restoration of existing wetland areas, including control of blackberry, fencing and planting.
- Creation of additional habitat linkages with other areas of wetland habitat to facilitate bird movement.
- Additional mitigation opportunities at other wetlands within the study area.

### 11.4.5 Te Harakeke/Kawakahia wetland and ti kouka wetland

As outlined in section 9.1 of this Report, the Assessment of Groundwater Effects (Technical Report 21, Volume 3) has determined that the Te Harakeke/Kawakahia Wetland and Ti Kouka Wetland are sufficiently distant from the proposed Expressway that potential effects on water levels will be negligible. An adaptive management approach is therefore not considered necessary for potential groundwater effects.

### 11.4.6 Summary of monitoring and adaptive management requirements

In summary, a degree of uncertainty remains over the extent and magnitude of effect on wetlands in immediate proximity to the proposed Expressway embankments. However, for each wetland where we believe there is a risk of moderate to high adverse effects, a range of management options are available that can be implemented if effects are identified through monitoring which trigger an adaptive management response. This is also covered in the adaptive management section of the EMP.

In conclusion, we are confident that potential effects on wetland hydrology that may arise from the proposed Expressway can be managed to moderate to neutral through a range of adaptive management opportunities.

## 11.5 Sediment discharge to te harakeke/kawakahia wetland

Section 8.2.4 of this Report notes the potential for a increase in sediment entering the Te Harakeke/Kawakahia Wetland during the construction phase via the Ngarara catchment (Kakariki Stream, Paetawa Drain, Smithfield Drain and Ngarara Creek).

A total contribution of 6.8 tonnes is predicted, compared to the current USLE baseline of 50.6 tonnes (refer section 8.2.4 of this Report). While this figure represents a 'worst case' based on the USLE open earthworked areas and construction staging etc., this volume of sediment could be significant.

The additional sediment could lead to infilling of the stream bed which could lead to flooding and sediment deposition within the wetlands to either side of these streams. This could potentially lead to effects on wetland vegetation such as smothering of smaller plants and communities. Conversely it could lead to some short-term adverse effects on in-stream fauna. However, small increases to water levels may also have some benefits to the wetland ecology in this area.

As the scale and extent of effects cannot be accurately predicted, we have recommended an adaptive management regime to ensure construction sediment entering Te Harakeke/Kawakahia Wetland is minimised. If the ongoing monitoring recommended determines impaired wetland functioning arising from construction-related sediment, the following options could be considered as adaptive management approaches at the Te Harakeke/Kawakahia Wetland:

- Weed control of invasive weed species that have established as a result of sediment inputs deemed to arise from the proposed Expressway construction.
- Replanting of any areas of die-back with suitable indigenous species.
- Restoration of existing wetland areas, including control of blackberry, fencing and planting.
- Additional mitigation opportunities at other wetlands within the study area.

Like the other adaptive management responses outlined in section 11.7.1 of this Report, any responses should be discussed and agreed with GWRC and KCDC staff prior to implementation.

In conclusion, we are confident that potential sedimentation effects arising from the proposed Expressway on the Te Harakeke/Kawakahia Wetland can be managed to very low or neutral through a range of adaptive management opportunities.

## 11.6 Mortality or displacement of indigenous fauna

### 11.6.1 Fish passage during operation

A scheduled and ongoing programme of maintenance and monitoring is required for all culverts that takes into account continued fish passage requirements.

### 11.6.2 North island fernbird

Given the presence of this high value bird species in close proximity to the proposed Expressway, we propose additional research pre-construction to determine the distribution and utilisation of fernbird under the Project Footprint north of the Waikanae River where the proposed Expressway Aligment intercepts potential fernbird habitat. We have also proposed to undertake a research programme into post-construction habitat utilisation by fernbird adjacent to an existing motorway (Alpurt/Northern Gateway). This example was the subject of pre-construction fernbird translocations. Once obtained, the results of the pre-construction monitoring research will be discussed with the Department of Conservation to determine any requirements for mitigation or ongoing monitoring.

Potential mitigation options may include habitat enhancement (pest control, restoration and protection), translocation (noting that this is potentially a high risk option[24]).

Our recommendations for pre-construction research and potential mitigation options are as follows:

- Undertake a pre-construction research programme to determine distribution and utilisation of fernbird habitat within the proposed Expressway Alignment between the Waikanae River and Kakariki Stream.
- Undertake a research programme at a motorway within known fernbird habitat to determine the operational effects on the ability of a fernbird population to continue to utlise adjacent habitat.
- Pending the research outcomes, the opportunity to allow for potential movement of fernbird through the enhancement of restored Kakariki Stream surrounding the proposed proposed Expressway bridge structure.
- Wetland habitat creation in the vicinity of the proposed Expressway. This could include the new flood storage areas proposed north of the Kakariki Stream and the proposed riparian planting in the Kakariki Stream.
- Pending the research outcomes, investigate the potential to maintain a mown grass buffer along key sections of fernbird habitat adjacent to the proposed Expressway (so as to not encourage birds to the road edge).

[24] A number of fernbird translocations (ranging from 6 to 25 birds) have occurred since the 1970's, with varying levels of success (refer TR3 Avifauna Values). While the exact reasons for unsuccessful translocations are not know, but several have noted some birds appearing stressed.

- Any clearance of vegetation within identified fernbird territories should only occur outside of the breeding season.

### 11.6.3 Lizards

Effects on common lizards, found in some habitats along the route, can be minimised by capture and translocation of animals immediately prior to vegetation clearance/construction. Permits will be required from the Department of Conservation for this work and it must be done by a formally certified ecologist.

Artificial refuges should be set at the key locations outlined in the herpetofauna survey as part of pre-construction site inspection (prior to any vegetation clearance). Any lizards captured should be released in other suitable habitat of sufficient distance from the proposed Expressway Alignment.

Prior to any construction in the vicinity of the El Rancho wetland, a series of tracks should be cut through the scrub within the Project Footprint to allow the area to be searched for arboreal lizards.

We do not believe any further mitigation is required. However, we note that the proposed landscape and amenity planting will result in the creation of habitat suitable for lizards in a number of locations (refer Assessment of Landscape and Visual Effects – Technical Report 7, Volume 3), including a number of open environments with abundant refuges on the edge of plantings and the incorporation of ground tier species appropriate for lizard species. Large areas of rank pasture will also be retained as part of the landscape planting.

## 11.7 Recommended consenting and management requirements

Consistent with our recommendations to avoid, remedy or mitigate any potential adverse ecological effects earlier in this Report, it is our recommendation that a number of conditions should be attached to the Designation and outlined in the Ecological Management Plan (CEMP Appendix M, Volume 4) to provide for the following matters.

### 11.7.1 Adaptive management

In a number of our assessments, for example hydrological effects on wetlands, sufficient uncertainty remains over the magnitude and extent of a potential adverse effects that we believe adaptive management is needed to ensure that these effects are managed and appropriately mitigated. We also note some areas where adverse effects can be avoided or minimised. This will rely on careful site management, and monitoring is necessary to ensure this protection occurs and this monitoring may require a management responses.

Adaptive management is a useful tool when a project may affect complex ecological systems which make it difficult to predict all outcomes with absolute certainty. It is an extension of the precautionary approach inherent in the RMA and it use supports continuous improvement processes that are increasingly best practice for large and complex construction projects.

Adaptive management requires monitoring, research and review. The assessment of monitoring results may lead to ‘adapted’ development and operation, either to anticipate potential problems identified by the monitoring, or to ensure any effects of the existing activity are reduced to acceptable levels. Review conditions provide flexibility to either expand or cut back activity should the research suggest it is necessary.

A key component of adaptive management is the establishment of pre-construction baseline conditions against which to measure change. Monitoring through construction provides continual feedback to the contractor on the effectiveness of environmental management methods. Monitoring post-construction establishes processes for remediation and/or mitigation if effects could not be avoided.

Should a link between the adverse effect and on-site practices be established then alterations to the operational methods (including modifications to environmental devices) can be investigated as a first order response and further monitoring used to assess the effectiveness of any alterations to practice.

### 11.7.2 Terrestrial habitat loss or modification

a. Additional opportunities to avoid

There may be opportunities during detailed design, to minimise effects on a number of high value areas of wetland vegetation, advanced regenerating forest and mature or maturing forest that fall both within the Project Footprint and the Designation. In addition there needs to be a requirement of site management through appropriate environmental management planning to ensure that the areas where effects are to be avoided or minimised are identified and protected during construction.

The identified sites are:

- Raumati Manuka Wetland
- Raumati Road Kanuka
- Otaihanga Landfill Kanuka
- Southern and Northern Otaihanga wetlands
- El Rancho Wetland (Weggery)
- Waikanae River Riparian
- Tuku Rakau Forest
- Ngarara Farm Mahoe
- Kakariki Stream riparian vegetation

b. Mitigation

Mitigation for vegetation loss will require the retirement and revegetation of approximately 13 ha to mitigate for the potential loss of 5.6 ha of indigenous vegetation of varying values. Various treatments are identified for the land proposed for mitigation, ranging from buffer planting, re-vegetation, transplanting of wetland species from affected areas, enrichment planting and permanent land retirement within the Designation through to the ecological restoration of a new wetland at Otaihanga and within the former Waikanae Oxidation Ponds.

c. Other

In the preparation of this assessment, we have identified a number of other risks to terrestrial habitat during construction that will require recognition in appropriate environmental management plans. These are fire and weeds.

d. Planning and consent conditions

The following are recommended:

- Best endeavours to avoid high and medium value vegetation and wetlands (sites specified above). This will require an ecologist involved at an early stage to identify the extent of these sites and contribute to decisions about the nature and extent of vegetation clearance during detailed design and construction.
- Mass planting of indigenous plant species totalling 1.1 ha surrounding the Raumati Manuka Wetland (refer Assessment of Landscape and Visual Effects (Technical Report 7, Volume 3).
- Identified mitigation areas to be legally protected to provide certainty of mitigation prior to commencement of works.
- Transplanting of wetland species from within the Project Footprint to new or restored wetlands where possible.
- Development of a Landscape and Restoration Plan for all restoration and retirement areas including fencing and weed and pest management and plant replacement for standard periods (3 years).
- Monitoring of restoration for standard periods (with 10 year review), and agreed measures of achievement of mitigation.
- A Fire Management Plan including; liaison with rural fire service, restrictions on hot works during drought.
- A requirement for weed management which will include but not be limited to vehicle washing, sourcing of aggregate and topsoil and weed monitoring and control during and following earthworks. A particular focus of weed management will be required for the control of blackberry and other weed species that are likely to hinder plant establishment and natural regeneration within the Project Footprint.

### 11.7.3 Mitigation for effects on terrestrial flora and fauna

a. Avoidance

The Project shaping and route option assessment process has largely avoided the most ecologically important wetlands and fauna habitat south of Raumati Road (131 Raumati Road Peatlands, Poplar Ave Peatlands and Raumati Manuka Wetland) and north of the Waikanae River (including the El Rancho wetland complex, Osbourne's wetlands, Te Harakeke/Kawakahia Wetland, Ti Kouka and Ngarara wetlands).

b. Mitigation

The following are recommended:

#### Terrestrial Flora – kanuka and mahoe forest

- Mass planting of approximately 1.1 ha of indigenous vegetation surrounding the Raumati Manuka Wetland, including interplanting within existing gorse vegetation.
- Restoration of a new (approximately 1.2 ha) wetland north of the WWTP Drain at Otaihanga and the restoration of 0.4 ha of the Otaihanga Central Wetland to provide for the relocation of established wetland plants from the Otaihanga Southern and Northern wetlands, including larger specimens of *Carex secta*, *Carex virgata* and *Baumea teretifolia*.
- Restoration of a minimum of 3.8 ha of the former Waikanae Oxidation Ponds consistent with the approved Pharazyn Reserve Landscape and Ecological Plan (Wildlands, 2011).

**Terrestrial fauna - lizards**

- Capture and transfer of identified lizards prior to works and transfer to nearest safe equivalent habitat.

**Avifauna - fernbird**

Following the completion of the recommended pre-construction fernbird research programmes (along the proposed Expressway Alignment and at the Alpurt/Northern Gateway Motorway), a number of mitigation options are available, pending discussions with the Department of Conservation. These include:

- The enhancement of the Kakariki Stream surrounding the proposed proposed Expressway bridge structure to poterntially assist fernbird movement
- Wetland habitat creation in the vicinity of the proposed Expressway, including the new flood storage areas proposed north of the Kakariki Stream and the proposed riparian planting in the Kakariki Stream.
- Reduction in potential impacts through the removal of the existing Nga Manu Nature Reserve access road within the Kakariki Stream corridor.
- The potential maintenance of a mown grass buffer along key sections of fernbird habitat adjacent to the proposed Expressway (so as to not encourage birds to the road edge).
- Restrictions on vegetation clearance within identified fernbird territories outside of the breeding season.
- Habitat enhancement and increased appropriate planting in the vicinity of any fernbird habitat lost.
- As a last resort, potential translocation of any affected birds.

### 11.7.4 Stream habitat loss or modification

a. Conservative approach

The assessment has applied SEV analysis to the calculation of stream length required for mitigation. The SEV model applies a 1.5x scale up to account for the time it takes for riparian vegetation to establish before environmental benefits occur and this is included in the mitigation ratios recommended.

b. Avoidance

During construction efforts should be made to limit impacts to streams outside the Project Footprint. This includes culverting, temporary construction access tracks and reinstating the stream bed once works are complete. It also includes retention of as much riparian vegetation as possible to retain habitat values, reduce bank erosion and assist with entrapment of sediment from run-off.

c. Mitigation

- Our SEV analysis requires 4,973 m of stream to be enhanced and protected as mitigation for the loss and modification of 2,956 m of perennial or intermittent waterbodies.
- Agreed focus on Wharemauku, WWTP Drain, Waimeha, Kakariki and Paetawa streams and the Waikanae River for mitigation of freshwater habitat they have excellent potential for rapid recovery and long term benefit.
- Diversions and new stream sections - design principles to require improving in-stream habitat types, substrates, velocities.

d. Statutory planning & resource consent conditions

The following are recommended:

- Best endeavours to minimise loss of riparian vegetation outside of the Project Footprint (but within the Designation). This will require an ecologist involved at an early stage to identify the extent of these sites and contribute to decisions about vegetation clearance, both extent and method, during detailed design.
- Identified mitigation areas to be legally protected to provide certainty of mitigation and stock removed prior to commencement of works.
- A Riparian Restoration Plan be developed for all proposed riparian retirement areas including requirements for fencing and weed and pest management and plant replacement for standard periods (3 years).
- Monitoring of riparian and stream restoration for standard periods (with 10 year review), and agreed measures of achievement of mitigation.
- A requirement for weed management during construction which will include but not be limited to: vehicle washing; sourcing of aggregate and topsoil; and weed monitoring and control (as required) during and following earthworks.
- Development of a Stream Diversion Design Guide for inclusion in the EMP, requiring restoration as close as possible to the condition of the original stream bed with supervision by a suitably qualified ecologist.
- Development of a Culvert Design Guide with principles for habitat maintenance, and fish passage for inclusion in the EMP.
- Development of a monitoring plan for in-stream works including successful freshwater habitat establishment in diversion.
- Involve a suitably qualified ecologist to assist in the appropriate installation, following fish passage guidelines.

### 11.7.5 Mitigation for effects on freshwater fauna

a. Construction

- Ecological involvement in detailed design, construction and installation of culverts and associated infrastructure (rip rap and headwalls).
- Ecological involvement in capture, storage and translocation of fish during culvert installation and diversion.
- Restrictions on timing of works in stream beds of perennial and intermittent waterbodies to minimise adverse effects on peak movements (Spring Migration 1 Oct -30 Dec; Autumn Migration 1 April – 30 May) but with flexibility to carry out works for short prescribed periods within these periods.

b. Operation

- Post construction monitoring of fish passage in stream diversions and culverts is required to ensure the designs used are effective and continue to operate to their design standards.

### 11.7.6 Management and monitoring for sediment discharge

a. Freshwater Estuary and Stream Mouths

- Staging of works and establishment of maximum open earth worked area to reduce risk.
- Erosion management and sediment control to exceed regional guidance.

- Risk management plan, including earthworks stabilisation procedures, for significant storm event monitoring and response.
- Monitoring of Te Harakeke/Kawakahia Wetland adjacent to stream channels to capture any effects related to sediment deposition or smothering of wetland vegetation.

b. Planning & Consent Conditions

- Preparation by a suitably qualified ecologist of Stream and Estuarine water quality and aquatic habitat monitoring plans for pre, during and post construction monitoring. This includes the gathering of sufficient baseline (minimum 2 years) on rainfall event size, stream water quality, and aquatic community composition.
- Establishment of appropriate hierarchy of ecological indicators and water quality triggers and design of storm event disaster plan.
- Qualified ecologist to be involved in monitoring of erosion and sediment management programme, and water quality monitoring with a focus on contribution to adaptive management.
- Preconstruction establish site specific "reasonable" mixing zones in each receiving water body, acknowledging difficulties of access and receiving habitat homogeneity.

### 11.7.7 Monitoring of stormwater discharge

a. Freshwater Habitat

- Target treatment levels (NZTA Stormwater Treatment Standard for State Highway Infrastructure 2010) achieved through best practicable option approach and wetland treatment prior to discharge.
- Use of stormwater treatment wetlands (with habitat benefits) to meet target removal rates.

b. Planning and consent conditions

- Water quality monitoring plan, including targeted treatment pond and swale treatments in areas upstream of identified ecologically significant waterbodies during initial years of operation.

### 11.7.8 Monitoring of wetland hydrology

a. Adaptive management

- We recommend continued monitoring using piezometers or similar, of the Raumati Manuka Wetland, Otaihanga Southern and Northern Wetlands and the El Rancho Wetland (Weggery). Monitoring should also include the Wetland Condition Assessments outlined in Ecological Technical Report 1 (Technical Report 27, Volume 3).
- Monitoring is needed to ensure any more than temporary changes in water tables are detected and adaptive management response is initiated (refer section 11.3 of this Report).
- Monitoring needs to occur, pre (baseline), during (impact) and post construction for a period sufficient to determine whether drawdown or damming are occurring and are having adverse effects on wetland ecology.

### 11.7.9 Other

a. Landscape mitigation

It should be noted that the visual and landscape assessment of the proposed Expressway (Assessment of Landscape and Visual Effects - Technical Report 7, Volume 3) has recommended areas of revegetation for landscape and visual effects that are in addition to those recommended above as mitigation for ecological effects. Approximately 78ha of native planting will be carried out as part of landscape and ecological mitigation including terrestrial, riparian and wetland revegetation. We have provided advice on appropriate species, locations and their provenance.

While the primary purpose of much of this landscape and amenity planting is the reduction in visual impacts, the species mix and lineal nature through large parts of the proposed Expressway Alignment has been developed to be complementary to the ecological mitigation and in combination the mitigation proposed is anticipated to have long term biodiversity benefits including the formation of a habitat corridor along much of the Alignment. It will include the following components:

- Retention of the many existing areas of vegetation that has established within or in close proximity to the proposed Expressway (including regenerating broadleaved forest, large areas of gorse, wetlands and associated vegetation and exotic trees).
- Indigenous planting proposed as part of the stormwater treatment wetlands, stormwater treatment swales and the large-scale planted flood storage areas.
- Landscape and amenity planting (including noise walls, earth bunds) and visual screening planting.
- Riparian planting as mitigation for stream habitat loss and mitigation.

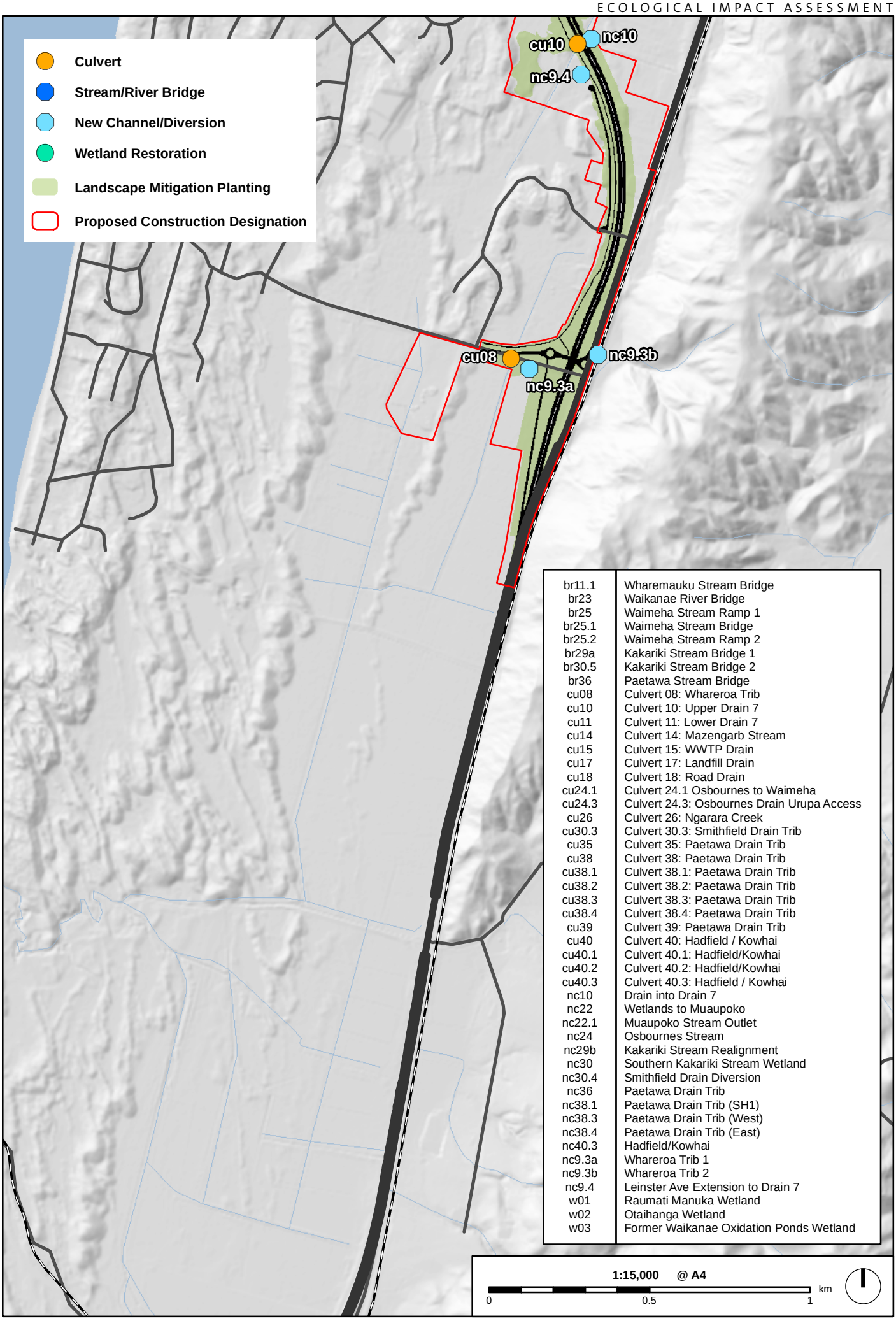
We consider that this corridor will provide additional habitat to bird species which utilise many fragments of vegetation as part of a larger habitat area. Similarly, the large areas of riparian planting proposed as mitigation for the loss and modification of freshwater habitat will provide a range of benefits, including stream shading and cooling, providing litter and habitat for freshwater invertebrates and reducing weed competition. Riparian corridors will also provide for improved habitat for bird species, particularly between forest and wetland remnants along the Kakariki Stream within the noted Nga Manu Forest Sanctuary / Te Harakeke/Kawakahia Wetland corridor.

The Assessment of Landscape and Visual Effects (Technical Report 7, Volume 3) provides more detail on the nature of this vegetated corridor and the extent of each of these broad landscape and revegetation treatments which are summarised in Appendix 26.I.

In total eight planting treatments are proposed, of which six involve mass planting of native species. In combination these planting types will provide the benefits described above. The approximate areas of each are listed below in Table 52 (excluding grass, grassed flood storage areas and dry grass swales):

**Table 52: Mitigation Treatments proposed along the Alignment (indigenous planting italicised)**

| Type of Mitigation | Area Planted (ha) |
|---|---|
| Mass planting | 45.7 |
| Mass planting with tree enrichment | 24.5 |
| Specimen trees under-planted with groundcover species | 4.3 |
| Trees with grass | 25.4 |
| Riparian planting (ecological purpose) | 7 |
| Wetland planting (ecological purpose) | 1.6 |
| Stormwater treatment wetlands | 4.8 |
| Wet swale mass planting | 14 |
| TOTAL | 126.7 ha |

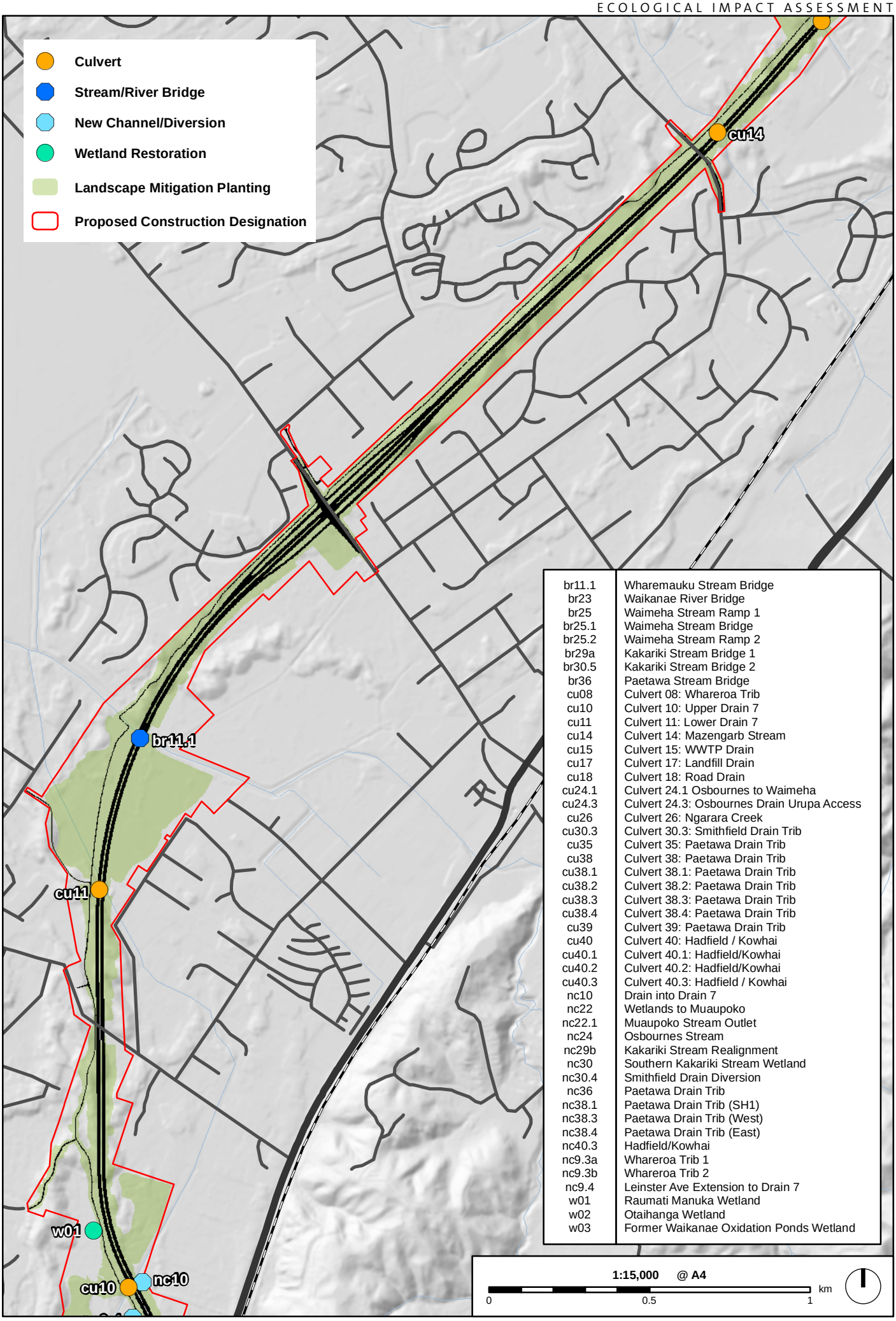



| | |
|---|---|
| br11.1 | Wharemauku Stream Bridge |
| br23 | Waikanae River Bridge |
| br25 | Waimeha Stream Ramp 1 |
| br25.1 | Waimeha Stream Bridge |
| br25.2 | Waimeha Stream Ramp 2 |
| br29a | Kakariki Stream Bridge 1 |
| br30.5 | Kakariki Stream Bridge 2 |
| br36 | Paetawa Stream Bridge |
| cu08 | Culvert 08: Whareroa Trib |
| cu10 | Culvert 10: Upper Drain 7 |
| cu11 | Culvert 11: Lower Drain 7 |
| cu14 | Culvert 14: Mazengarb Stream |
| cu15 | Culvert 15: WWTP Drain |
| cu17 | Culvert 17: Landfill Drain |
| cu18 | Culvert 18: Road Drain |
| cu24.1 | Culvert 24.1 Osbournes to Waimeha |
| cu24.3 | Culvert 24.3: Osbournes Drain Urupa Access |
| cu26 | Culvert 26: Ngarara Creek |
| cu30.3 | Culvert 30.3: Smithfield Drain Trib |
| cu35 | Culvert 35: Paetawa Drain Trib |
| cu38 | Culvert 38: Paetawa Drain Trib |
| cu38.1 | Culvert 38.1: Paetawa Drain Trib |
| cu38.2 | Culvert 38.2: Paetawa Drain Trib |
| cu38.3 | Culvert 38.3: Paetawa Drain Trib |
| cu38.4 | Culvert 38.4: Paetawa Drain Trib |
| cu39 | Culvert 39: Paetawa Drain Trib |
| cu40 | Culvert 40: Hadfield / Kowhai |
| cu40.1 | Culvert 40.1: Hadfield/Kowhai |
| cu40.2 | Culvert 40.2: Hadfield/Kowhai |
| cu40.3 | Culvert 40.3: Hadfield / Kowhai |
| nc10 | Drain into Drain 7 |
| nc22 | Wetlands to Muaupoko |
| nc22.1 | Muaupoko Stream Outlet |
| nc24 | Osbournes Stream |
| nc29b | Kakariki Stream Realignment |
| nc30 | Southern Kakariki Stream Wetland |
| nc30.4 | Smithfield Drain Diversion |
| nc36 | Paetawa Drain Trib |
| nc38.1 | Paetawa Drain Trib (SH1) |
| nc38.3 | Paetawa Drain Trib (West) |
| nc38.4 | Paetawa Drain Trib (East) |
| nc40.3 | Hadfield/Kowhai |
| nc9.3a | Whareroa Trib 1 |
| nc9.3b | Whareroa Trib 2 |
| nc9.4 | Leinster Ave Extension to Drain 7 |
| w01 | Raumati Manuka Wetland |
| w02 | Otaihanga Wetland |
| w03 | Former Waikanae Oxidation Ponds Wetland |

1:15,000 @ A4

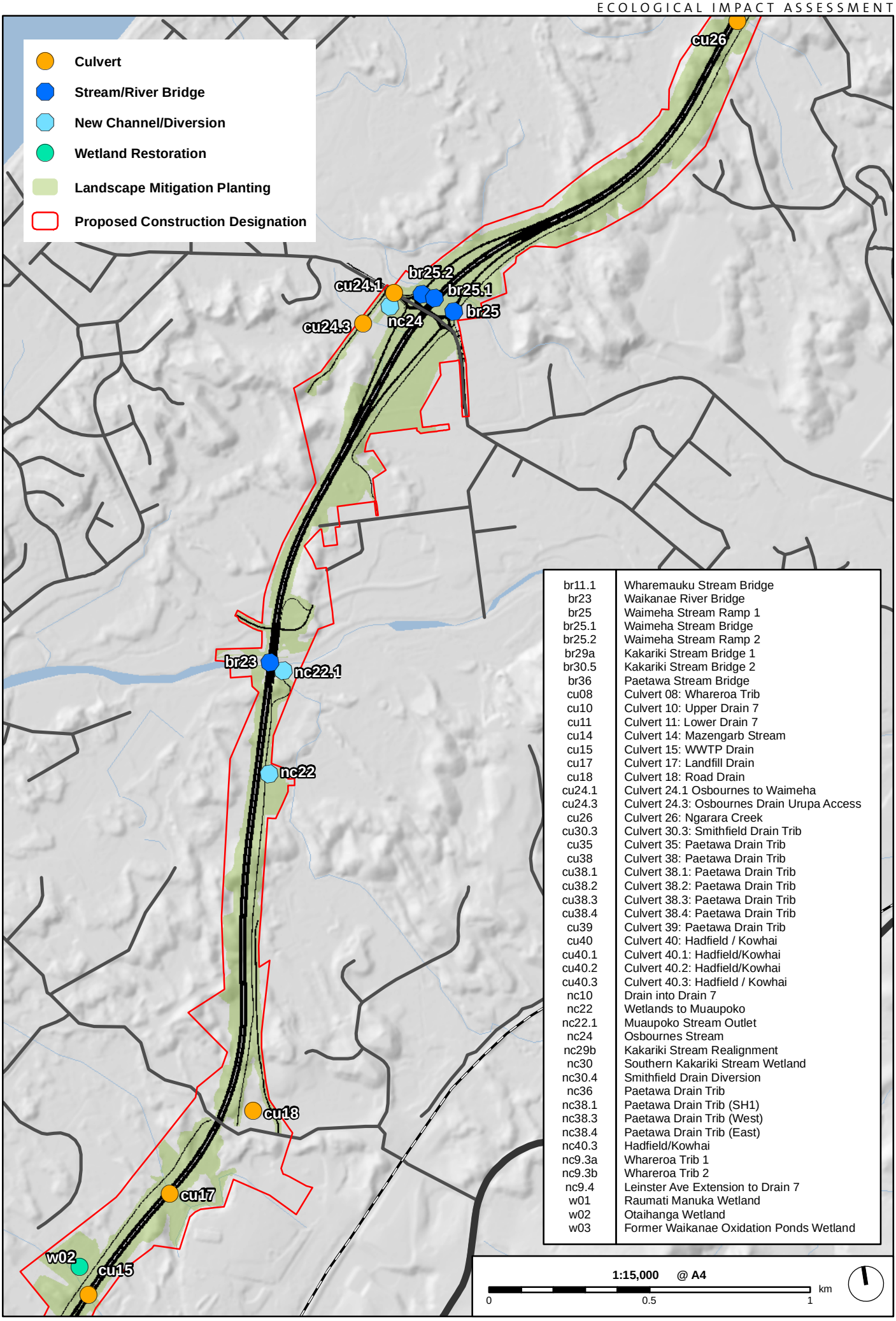
0 0.5 1 km

March 23, 2012 W09181E_ECIA_Mitigation_A4mb.mxd



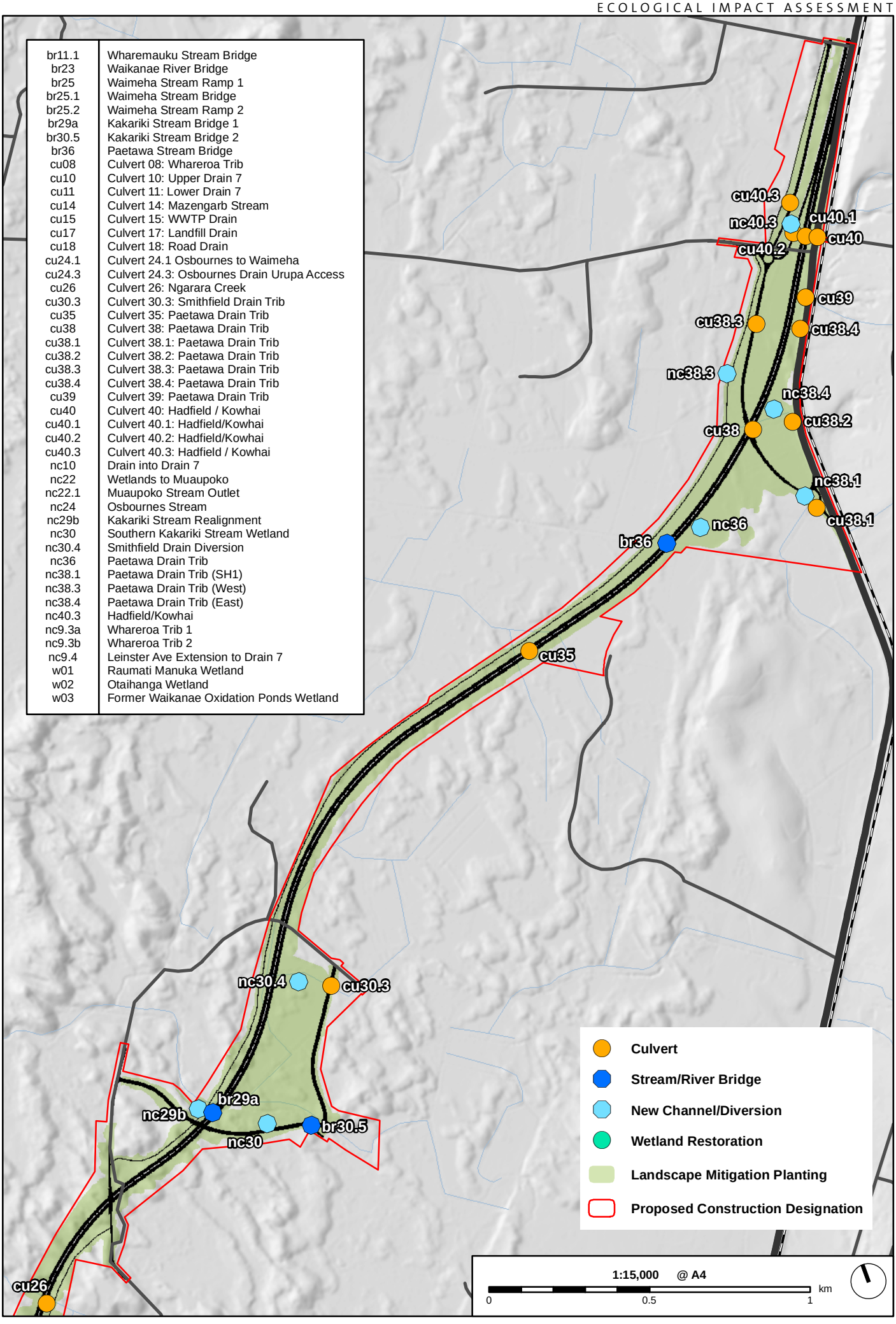

| | |
|---|---|
| br11.1 | Wharemauku Stream Bridge |
| br23 | Waikanae River Bridge |
| br25 | Waimeha Stream Ramp 1 |
| br25.1 | Waimeha Stream Bridge |
| br25.2 | Waimeha Stream Ramp 2 |
| br29a | Kakariki Stream Bridge 1 |
| br30.5 | Kakariki Stream Bridge 2 |
| br36 | Paetawa Stream Bridge |
| cu08 | Culvert 08: Whareroa Trib |
| cu10 | Culvert 10: Upper Drain 7 |
| cu11 | Culvert 11: Lower Drain 7 |
| cu14 | Culvert 14: Mazengarb Stream |
| cu15 | Culvert 15: WWTP Drain |
| cu17 | Culvert 17: Landfill Drain |
| cu18 | Culvert 18: Road Drain |
| cu24.1 | Culvert 24.1 Osbournes to Waimeha |
| cu24.3 | Culvert 24.3: Osbournes Drain Urupa Access |
| cu26 | Culvert 26: Ngarara Creek |
| cu30.3 | Culvert 30.3: Smithfield Drain Trib |
| cu35 | Culvert 35: Paetawa Drain Trib |
| cu38 | Culvert 38: Paetawa Drain Trib |
| cu38.1 | Culvert 38.1: Paetawa Drain Trib |
| cu38.2 | Culvert 38.2: Paetawa Drain Trib |
| cu38.3 | Culvert 38.3: Paetawa Drain Trib |
| cu38.4 | Culvert 38.4: Paetawa Drain Trib |
| cu39 | Culvert 39: Paetawa Drain Trib |
| cu40 | Culvert 40: Hadfield / Kowhai |
| cu40.1 | Culvert 40.1: Hadfield/Kowhai |
| cu40.2 | Culvert 40.2: Hadfield/Kowhai |
| cu40.3 | Culvert 40.3: Hadfield / Kowhai |
| nc10 | Drain into Drain 7 |
| nc22 | Wetlands to Muaupoko |
| nc22.1 | Muaupoko Stream Outlet |
| nc24 | Osbournes Stream |
| nc29b | Kakariki Stream Realignment |
| nc30 | Southern Kakariki Stream Wetland |
| nc30.4 | Smithfield Drain Diversion |
| nc36 | Paetawa Drain Trib |
| nc38.1 | Paetawa Drain Trib (SH1) |
| nc38.3 | Paetawa Drain Trib (West) |
| nc38.4 | Paetawa Drain Trib (East) |
| nc40.3 | Hadfield/Kowhai |
| nc9.3a | Whareroa Trib 1 |
| nc9.3b | Whareroa Trib 2 |
| nc9.4 | Leinster Ave Extension to Drain 7 |
| w01 | Raumati Manuka Wetland |
| w02 | Otaihanga Wetland |
| w03 | Former Waikanae Oxidation Ponds Wetland |

March 23, 2012 W09181E_ECIA_Mitigation_A4mb.mxd




| | |
|---|---|
| br11.1 | Wharemauku Stream Bridge |
| br23 | Waikanae River Bridge |
| br25 | Waimeha Stream Ramp 1 |
| br25.1 | Waimeha Stream Bridge |
| br25.2 | Waimeha Stream Ramp 2 |
| br29a | Kakariki Stream Bridge 1 |
| br30.5 | Kakariki Stream Bridge 2 |
| br36 | Paetawa Stream Bridge |
| cu08 | Culvert 08: Whareroa Trib |
| cu10 | Culvert 10: Upper Drain 7 |
| cu11 | Culvert 11: Lower Drain 7 |
| cu14 | Culvert 14: Mazengarb Stream |
| cu15 | Culvert 15: WWTP Drain |
| cu17 | Culvert 17: Landfill Drain |
| cu18 | Culvert 18: Road Drain |
| cu24.1 | Culvert 24.1 Osbournes to Waimeha |
| cu24.3 | Culvert 24.3: Osbournes Drain Urupa Access |
| cu26 | Culvert 26: Ngarara Creek |
| cu30.3 | Culvert 30.3: Smithfield Drain Trib |
| cu35 | Culvert 35: Paetawa Drain Trib |
| cu38 | Culvert 38: Paetawa Drain Trib |
| cu38.1 | Culvert 38.1: Paetawa Drain Trib |
| cu38.2 | Culvert 38.2: Paetawa Drain Trib |
| cu38.3 | Culvert 38.3: Paetawa Drain Trib |
| cu38.4 | Culvert 38.4: Paetawa Drain Trib |
| cu39 | Culvert 39: Paetawa Drain Trib |
| cu40 | Culvert 40: Hadfield / Kowhai |
| cu40.1 | Culvert 40.1: Hadfield/Kowhai |
| cu40.2 | Culvert 40.2: Hadfield/Kowhai |
| cu40.3 | Culvert 40.3: Hadfield / Kowhai |
| nc10 | Drain into Drain 7 |
| nc22 | Wetlands to Muaupoko |
| nc22.1 | Muaupoko Stream Outlet |
| nc24 | Osbournes Stream |
| nc29b | Kakariki Stream Realignment |
| nc30 | Southern Kakariki Stream Wetland |
| nc30.4 | Smithfield Drain Diversion |
| nc36 | Paetawa Drain Trib |
| nc38.1 | Paetawa Drain Trib (SH1) |
| nc38.3 | Paetawa Drain Trib (West) |
| nc38.4 | Paetawa Drain Trib (East) |
| nc40.3 | Hadfield/Kowhai |
| nc9.3a | Whareroa Trib 1 |
| nc9.3b | Whareroa Trib 2 |
| nc9.4 | Leinster Ave Extension to Drain 7 |
| w01 | Raumati Manuka Wetland |
| w02 | Otaihanga Wetland |
| w03 | Former Waikanae Oxidation Ponds Wetland |

March 23, 2012 W09181E_ECIA_Mitigation_A4mb.mxd




March 23, 2012 W09181E_ECIA_Mitigation_A4mb.mxd

# 12 Assessment of residual impacts following mitigation

The following table summarises the results of this assessment for terrestrial habitats, wetland habitats, freshwater habitats, estuarine habitats, and fauna where the potential adverse effects were assessed as moderate to very high without mitigation. It provides a revised assessed of the residual impact with mitigation on these ecological components.In terms of the significance of residual impact after mitigation, we have used the following scales of temporal magnitude:

- **Permanent**: impacts continuing indefinitely beyond the span of one human generation (taken as approximately 25 years).
- **Long term**: 15 – 25 years
- **Medium term**: 5 – 15 years
- **Short term**: up to 5 years.

Table 53: Summary of Impacts and Residual Impacts after mitigation

| Description | Effect /Predicted Impact | Significance of Impacts without mitigation | Proposed Mitigation | Significance of Residual Impact after mitigation |
|---|---|---|---|---|
| **DIRECT EFFECTS ON TERRESTRIAL HABITAT - LOSS OR MODIFICATION** | | | | |
| **Terrestrial Vegetation** | | | | |
| Tuku Rakau Forest | Loss of up to 0.25 ha from this 0.9 ha area beneath Project Footprint (approx 25%). | Low | Equivalent areas of mahoe are included as part of landscape planting.<br>Aim for 1:1 mitigation planting. | Long term neutral |
| Ngarara Farm Mahoe | Loss of up to 0.86 ha of a larger 4.2 ha area beneath Project Footprint (approx 14%) | Moderate | As above. | Long term neutral |
| Raumati Road Kanuka | Loss of up to 0.35 ha of scattered kanuka trees and forest. | Very High | Equivalent areas of kanuka and mahoe are included as part of landscape planting in this area.<br>Aim for 2:1 mitigation planting. | Short term moderate adverse, long term neutral |
| Kanuka forest in Otaihanga Landfill | Loss of up to 0.17 ha of 0.5 ha beneath footprint (approx 34%) | Very High | Minimise extent of earthworks required to establish the cycleway/walkway path on this vegetation through careful design.<br>Equivalent areas of kanuka are included as part of landscape planting.<br>Aim for 2:1 mitigation planting. | Short term moderate adverse, long term neutral |
| **Freshwater Wetlands** | | | | |
| Raumati Manuka Wetland | Potential edge effects from adjacent Expressway and temporary modification of water table associated with flood storage area. | Low | Minimise effect through careful design.<br>Long term monitoring of wetland hydrology and wetland health.<br>Landscape planting to minimise edge effects and buffer wetland values.<br>Ongoing protection within Designation. | Moderate positive (subject to groundwater changes) |

| | | | | |
|---|---|---|---|---|
| Southern Otaihanga wetland | Loss of up to 0.55 ha of 1.39 ha beneath footprint (approx 40%) | Moderate | Minimise loss through careful design.<br>Mitigate through creation of 1.2 ha new wetland adjacent using transplanted plants.<br>Long term protection of residual areas and new wetland within Designation. | Moderate adverse short-term to long-term neutral |
| Northern Otaihanga wetland | Loss of up to 0.53 ha of the 1.0 ha beneath footprint (approx 53%) | High | Minimise loss through careful design.<br>Mitigate through creation of 1.2 ha new wetland adjacent using transplanted plants.<br>Long term protection of residual areas and new wetland within Designation. | Moderate adverse short-term to long-term neutral |
| El Rancho wetland (Weggery) | Loss of up to 0.38 ha of the 3.9 ha wetland beneath Project Footprint (approx 10%). | Low | Minimise extent of Project Footprint through careful design.<br>Mitigate loss of wetland vegetation and habitat through restoration of 4.2 ha of the former Waikanae Oxidation Ponds.<br>Long term monitoring of wetland hydrology and wetland health.<br>Some uncertainty remains. Assessment assumes hydrology effects are avoided. | Moderate adverse short-term to long-term neutral |
| **DIRECT EFFECTS ON FRESHWATER HABITAT**<br>**LOSS OR MODIFICATION (CULVERTS,)** | | | | |
| Drain 7, Mazengarb Drain, WWTP Drain, Waimeha Stream, Ngarara Creek, Smithfield Drain, Paetawa Drain, Hadfield / Kowhai Stream. | Installation of the following culverts (including headwall and riprap): Culvert 8, Culvert 11; Culvert 14, Culvert 17 Culvert 18.1; Culvert 24.1; Culvert 26; Culvert 30.3; Culvert 35; Culvert 38.2; Culvert 39; Culvert 8; Culvert 15; and Culverts 40, 40.1 and 40.2 and 40.3 | Low to Very low | Design of fish passage during culvert installation and temporary diversions according to ecological principles.<br>Timing of works to avoid peak movements<br>Capture and translocation of fish during culvert installation and diversions.<br>Retirement and revegetation of stream and riparian habitat 20m upstream and 20m downstream of culvert headwall where possible within Designation.<br>Post construction monitoring of fish passage<br>Riparian planting and fencing in key waterbodies. | Short term minor to mid-term neutral |

| LOSS OR MODIFICATION (BRIDGES) | | | | |
|---|---|---|---|---|
| Wharemauku Stream, Waikanae River, Waimeha Stream, Kakariki Stream, Paetawa Stream bridges. | Construction of new bridges and associated bridge abutments, riprap and armouring in these river corridor, including associated river widening at Waikanae River. | Low to Very Low | Minimise extent of earthworks required for widening of river and bridge construction.<br>Erosion management and sediment control to exceed regional guidance.<br>Monitoring of water quality and aquatic habitat (freshwater and estuarine), and adaptive management of erosion and sediment devices.<br>Post construction monitoring of fish passage and habitat re-colonisation.<br>Retirement and revegetation of drain and riparian habitat.<br>Timing of works to avoid peak movements.<br>Erosion management and sediment control to exceed regional guidance. | Moderate adverse short-term to long-term neutral |
| | | | | |
| New diversion of the following waterbodies: Whareroa Stream, Drain 7 (Wharemauku Stream), Muaupoko Stream, Waimeha Tributary, Smithfield Drain, Paetawa Stream and Hadfield/Kowhai Stream | Construction of a new 130 m stream section of a small tributary of the Whareroa Stream in QE Park.<br>A new 170m section of stream created south of Drain 7 and a replacement of 50m of existing drain with 50m of new stream.<br>A 35m diversion of the existing 40m outlet of this stream and a new 80m long new stream section draining the stormwater treatment wetlands into the Muaupoko Stream.<br>A 130m diversion of south of Te Moana Rd, resulting in a loss of 360 m of existing drain.<br>A diversion of an existing 510m of Smithfield Drain and replacing it with a new 936m long section of stream.<br>New streams totalling 790 replacing 270m of smaller perennial tributary drains of | Very low to Low positive | Design of fish passage for diversions according to ecological principles.<br>Incorporation of 10m wide riparian planting and specific meandering stream design.<br>Improve Muaupoko Stream outlet connection with Waikanae River.<br>Improved habitat area through lengths of new stream and associated riparian planting.<br>Removal of market gardens and associated contaminants.<br>Replacing a perched culvert in existing stream outlet to Waimeha. | Neutral to long-term positive |

| | | | | |
|---|---|---|---|---|
| | the Paetawa Drain. A new stream diversion replacing the existing 60 m of stream with a new stream of 190 m of length in Hadfield/Kowhai Stream. | | | |
| **DIRECT IMPACTS ON FAUNA (HABITAT LOSS)** | | | | |
| **Terrestrial fauna** | | | | |
| Common skink | Loss of habitat and loss of animals within habitat. | Very Low | Capture and transfer prior to works.<br>Creation of new habitat through planting and large areas of rank grassland. | Neutral |
| **Avifauna** | | | | |
| North Island fernbird | Loss of habitat and habitat severance for this Declining species. | Very High | Research programmes to determine distribution and habitat utilisation of fernbird within the Project Footprint.<br>Location of Expressway away from Te Harakeke/Kawakahia Wetland and Ngarara Wetland to protect integrity of known habitat.<br>Restoration and enhancement of Kakariki Stream corridor.<br>Removal of existing Nga Manu Nature Reserve access road adjacent to Kakariki Stream.<br>Site utilisation check immediately prior to vegetation removal (outside of nesting).<br>Creation of large areas of flood storage areas as potential future habitat. | Low negative to mid-term neutral. |
| **Freshwater fauna** | | | | |
| Indigenous Fish | Eight species that occur in study area with threat status (Declining).<br>Possible effect on passage of migratory species.<br>Will be habitat reduction through extensive culverting thus reduced local populations.<br>Potentially detrimental habitat changes with diversion.<br>Potential for fish mortality during reclamation of stream channels. | High | Design of fish passage, diversions, culvert installation according to ecological principles.<br>Timing of works to avoid peak movements.<br>Capture and translocation of fish during culvert installation and diversions.<br>Retirement and re-vegetation of stream and riparian habitat (2,700 m).<br>Creation of new lengths of stream and habitat (1,260 m).<br>Post construction monitoring of fish passage. | Long term neutral overall based on existing habitat values. |

| | | | | |
|---|---|---|---|---|
| **INDIRECT EFFECTS ON ESTUARIES, HARBOURS and WETLANDS** | | | | |
| **Construction sedimentation** | | | | |
| All streams | Sediment deposition | Low to Very Low | Effects negligible | Very Low |
| Stream mouths and estuaries | Sediment deposition on high value stream mouth habitat. | Low to Very Low | Erosion control and sediment management as designed to exceed regional guidance.<br>Staging of works and establishment of maximum open earth worked area to reduce risk.<br>Risk management plan for storm event monitoring and response. | Very low or neutral |
| Te Harakeke/ Kawakahia Wetland | Sediment deposition of high value wetland habitat. | High | As above.<br>Focused adaptive management to ensure any potential changes arising from sediment deposition are monitored to detect any negative changes so that remedial action can be taken. | Very low or neutral |
| **POTENTIAL OPERATIONAL IMPACT** | | | | |
| **Wetland Hydrology** | | | | |
| Raumati Manuka wetland | Potential lowering of water levels and loss of wetland values | High | Baseline ecological and groundwater monitoring programme including establishment of trigger levels.<br>Focused adaptive management to ensure any potential hydrological changes are monitored to detect any negative changes so that remedial action can be taken. | Moderate to neutral |
| Otaihanga Wetlands | As above | High | As above | Moderate to neutral |
| El Rancho wetland Weggery | As above | Moderate | As above | Moderate to neutral |
| Tuku Rakau wetland | As above | Moderate | As above | Moderate to neutral |
| Ngarara Wetland | As above | High | As above | Moderate to neutral |
| **Freshwater Habitat (Stormwater)** | | | | |
| All Streams | Contamination from road runoff into stormwater into streams already highly modified by land use. | Negligible | Target treatment levels achieved through proprietary devices and wetland treatment prior to discharge (to NZTA Stormwater Treatment Standards 2010).<br>Retiring grazed land and removing stock contributions.<br>Obtaining a higher level of treatment than existing SH1. | Neutral to low positive |
| Estuaries and stream mouths. | Contamination from road runoff into stormwater to stream mouth with no contamination | Negligible | Target treatment levels achieved through proprietary devices and wetland treatment prior to discharge.<br>Retiring grazed land and removing | Neutral to low positive |

| | | | | |
|---|---|---|---|---|
| | issues. | | stock contributions.<br>Obtaining a higher level of treatment than existing SH1. | |
| **Avifauna** | | | | |
| Fernbird | Cryptic marshbirds flying between wetland fragments being at risk of being struck by vehicles (Te Harakeke to Nga Manu Nature Reserve) | Very high | Research into post-construction utilisation of fernbird habitat adjacent to an operational motorway.<br>Habitat manipulation through planting of a low buffer edge along Expressway Alignment with a higher hedge rows nearby to create safe flight corridors and stream corridors.<br>Enhancing wetlands and habitat adjacent to the Expressway Alignment. | Neutral (subject to adaptive management if required) |
| **Freshwater fauna** | | | | |
| At-risk species of fish | Potential exceedences of ecological thresholds for contaminants in waterways | Low | Target treatment levels achieved through proprietary devices and wetland treatment prior to discharge.<br>Retiring grazed land and removing stock contributions.<br>Obtaining a higher level of treatment than existing SH1. | Neutral to low positive |

## 12.1 Summary of residual impacts following mitigation

In conclusion we are confident that all adverse effects on ecological areas, particularly those areas of significant indigenous vegetation and significant habitat for indigenous fauna that could be avoided have been.

For those adverse ecological effects that could not be avoided, we believe the mitigation recommended can reduce most effects to neutral or long term positive, particularly when considering the wider ecological benefits associated with the landscape and amenity planting proposed along the proposed Expressway which we consider meets the requirements of s5(2)(c) of the RMA. As a consequence we consider that the ecology will be sustained, its life supporting capacity safeguarded, and the intrinsic value of ecosystems protected in accordance with sections 5(2)(a)-(b) and 7(d) RMA. Uncertainty remains in three areas:

- A potential risk of changes to the hydrology of wetlands in close proximity to the proposed Expressway. To ensure the requirements of section 6(c) of the RMA are met, the hydrology of several key wetlands need to be monitored and managed if effects occur;
- There still remains uncertainty as to the potential effects of sedimentation resulting from construction-related earthworks in the wider Ngarara catchment and the downstream effects of this sedimentation on the Te Harakeke/Kawakahia Wetland. In order to protect the natural character of these wetlands and rivers and their margins (section 6(a) RMA) and areas of significant indigenous vegetation and significant habitats of indigenous fauna (section 6(c) RMA), this wetland needs to be monitored and managed if effects occur; and
- There still remains uncertainty over the population size and distribution of the North Island fernbird and the degree to which this species is at risk from the proposed Expressway. Consistent with section 6(c) of the RMA and the Wildlife Act 1953 this population needs to be monitored and adaptive management put in place if required.

Finally, a large quantity of ecological mitigation is proposed, in particular stream and wetland restoration and revegetation. Monitoring is required to confirm that the mitigation that is carried out achieves the degree of mitigation that has been described.

# 13 Summary and conclusions

## 13.1 Potential adverse ecological effects

### 13.1.1 Terrestrial vegetation (including wetlands) and habitats

The proposed Expressway Alignment is predominantly located in improved pasture, blackberry and gorse with limited or no ecological values. In some locations the proposed Expressway Alignment traverses areas of ecologically significant vegetation, predominantly wetlands, and in these locations there will be unavoidable ecological effects. In total 5.6 ha of native vegetation will be permanently lost beneath the Project Footprint (within the Designation). We have calculated that the protection and restoration of approximately 13 ha of land will be required to mitigate for this loss of indigenous vegetation and habitat.

As outlined in Section 8.1, our assessment of indigenous vegetation and habitat loss has been based on the assumption that all indigenous vegetation and habitat within the Project Footprint is at risk. Our calculations of necessary mitigation and biodiversity offsets have been based on this approach. However, we are confident that there are real opportunities during detailed design and construction to reduce the affected areas of vegetation and habitat to further avoid effects on indigenous habitats located within the Project Footprint. These opportunities have been identified in this assessment and form an important component of the Ecological Management Plan (CEMP Appendix M, Volume 4).

Due to the large areas of peats along the proposed Alignment and the lack of information as to the hydrological interrelationships between the raised dunes and these wider peat areas as a result of peat removal and preloading and compaction, there are a number of locations where we have not been able to fully rule out potential adverse effects. While we do not consider these effects will lead to full loss of wetlands, we acknowledge that there may be some effects that require consideration. Based on our knowledge of the species present in these wetlands and their propensity to survive and adapt to seasonal and temporary changes in water levels, we have not considered these potential effects in terms of mitigation – but have recommended a number of adaptive management approaches to ensure any changes can be picked up and addressed. Overall, we consider that should the construction methodologies and adaptive management and monitoring recommendations be followed, any effects on these areas can be suitably managed.

Overall, our conclusion is that there will be a moderate short-term effect on indigenous vegetation and habitat based on these known losses. While the permanent losses to wetland vegetation are considered significant in terms of the general loss of wetlands in the Wellington Region historically, the wetlands affected are not known to provide habitat for any rare or threatened flora or fauna, nor do they consist of remnant vegetation. There is good evidence that all the wetlands present are modified from their former extent by swamp drainage and vegetation clearance, and the vegetation present reflects varying stages of successional vegetation to swamp forest. Ultimately, we consider the ecological mitigation proposed combined with the landscape and visual planting recommended will result in an increase in indigenous vegetation along the proposed Expressway Alignment, large areas of which will be permanently protected.

### 13.1.2 Streams and freshwater habitat

A total of 2,956 m of stream will be permanently lost or significantly modified through culverting or through the shortening of stream length associated with diversion. While most of these effects take place in low value streams, we have calculated that the protection and restoration of 4,973 m of stream is required to mitigate for the loss. A total of 4,716 m of stream restoration has been identified and incorporated into the proposed Expressway design. The shortfall of 257 lineal m can be suitably mitigated by the large areas of mass planted flood storage areas where freshwater fish passage is provided.

Our conclusion is that despite their generally low values, the adverse effects on streams will be ecologically significant. However, we consider that the calculated mitigation is sufficient to ensure that the functional integrity of the stream is maintained, and that no fish species are lost. Overall, the ecological enhancements recommended will mitigate, in the medium to long term, for the loss of habitat by raising the ecological health of historically modified streams through retirement and re-vegetation.

This level of mitigation will require a commitment by the Alliance to ecologically-driven design. In particular, a system for integrating ecological input and review into the design process will be needed.

### 13.1.3 Fauna

This assessment has considered a number of indigenous fauna that require consideration during construction. Generally the species identified are considered unlikely to be significantly affected by construction or operation of the proposed Expressway. Where there will be an effect such as habitat loss, mitigation is readily achievable that takes into account the ecological significance and conservation value of those species.

### 13.1.4 Estuaries, stream mouths and wetlands

This assessment considered the discharge of construction phase sediment and contaminants and operational phase stormwater to estuaries, stream mouths and wetlands. Negligible adverse effects on stream, estuarine and marine ecological values are predicted to occur during both the construction and operational phases of the Project. Therefore, no mitigation is necessary.

An adaptive management approach is recommended in relation to potential effects from construction-phase sediment entering the Te Harakeke/Kawakahia Wetland.

## 13.2 Summary of mitigation proposed

### 13.2.1 Vegetation and habitat loss

In total it has been calculated that 13 ha of land needs to be revegetated and permanently protected to mitigate for the permanent loss or modification of 5.6 ha of terrestrial habitat. Of this 5.6 ha of habitat loss, 1.8 ha consists of wetland habitat, for which we have calculated 5.4 ha of wetland restoration is necessary.

In addition to the mitigation necessary for the terrestrial (and wetland) vegetation loss, to mitigate for the permanent loss or modification of 2,956 m of stream habitat a total of 4,973 m of stream needs to be restored. This relies on:

- Careful design of diversions and new lengths of stream so that they recreate or improve as far as possible the original morphology and hydrology and habitat values.
- Careful design and construction of culverts to provide continuous stream bed habitat along their length and ensure continued fish passage in all streams currently containing native fish.
- Restoration of habitat 20 m upstream and downstream of each culvert location within a perennial or intermittent waterbody (based on best practice riparian re-vegetation 10m either side of the waterbody).
- Best practice riparian revegetation of a minimum 10m wide either side of the waterbody along the Wharemauku, Waimeha, Kakariki and Paetawa Streams and the Waikanae River as mitigation.

In addition to these mitigation areas within the Designation, one mitigation site is proposed outside of the Designation (the former Waikanae Oxidation Ponds). Given the lineal nature of the proposed Expressway Alignment traversing the numerous waterbodies of the study area, these external sites provide a quantity of land and waterway in which the required scale of mitigation of stream effects can be readily achieved without requiring substantial increases to the land take required for the Designation.

Overall, the combination of re-vegetation within the Designation and the restoration planting outside of the Designation provide a quantity of mitigation planting that exceeds our calculated mitigation requirements (when landscape and visual planting is taken into account). This land will be treated in a variety of ways to achieve the riparian enhancements required by the relevant analysis.

We would note that retirement and revegetation of this land will have benefits that extend beyond vegetation loss and stream mitigation, including improved habitat connections in the wider Kāpiti area as well as reduced erosion and sedimentation on downstream aquatic habitat and stream mouths.

### 13.2.2 Sediment

It is proposed to significantly exceed regional guidelines for erosion management and sediment control, with an additional level of control upstream of all waterbodies identified as sensitive receiving environments (including wetlands). Targets of 70% for on-site capture of sediment from erosion on site, and 75% efficiency for stormwater pond treatment have been adopted by NZTA.

### 13.2.3 Stormwater

Best practice stormwater treatment design mechanisms have been incorporated into the proposed Expressway design to minimise contaminants from stormwater run-off entering the waterbodies downstream from the proposed Expressway (NZTA Stormwater Treatment Standard for State Highway Infrastructure 2010). Treatment mechanisms include the use of long linear stormwater treatment swales along most of the length, as well as numerous stormwater treatment wetlands at key locations, particularly upstream of recognised high-value streams and wetlands.

### 13.2.4 Fauna

All mitigation is proposed to occur during and pre-construction and will focus on terrestrial and freshwater fauna that reside in habitats which will be lost beneath the Project Footprint.

Capture and translocation of native lizards prior to earthworks is recommended.

Capture and transfer of freshwater fish from streams prior to reclamation for culverts and diversions is recommended.

Pre-construction monitoring of North Island fernbird populations within the Project Footprint north of the Waikanae River and the Kakariki Stream will be undertaken to determine the most appropriate mitigation required.

A range of other mitigation measures are detailed in the preceding sections.

## 13.3 Potential positive ecological effects

The ecological mitigation recommended for the loss of terrestrial and freshwater habitat, and the methods of stormwater management, will have a number of additional positive environmental outcomes. They are:

- New stormwater treatment wetlands: The proposed Expressway Project design utilises 11 stormwater treatment wetlands, with a total surface area of 1.56 ha, for the capture and removal of contaminants from stormwater. While their primary design is for stormwater treatment, if designed and managed properly these wetlands will also provide additional habitat benefit for native flora and fauna.
- New flood storage areas: The current Project incorporates 14 flood storage areas, with a total area of 33 ha (including a small component of additional treatment wetlands in addition to above) to provide flood storage lost under the proposed Expressway Footprint. A number of these areas that are subject to mass planting of indigenous wetland species will provide additional benefit for native flora and fauna through connections with adjacent waterbodies and the long-term maintenance of wetland values.
- A forested habitat corridor: Through retirement, restoration and revegetation along sections of the proposed Expressway Alignment (as part of a combination of ecological, hydrological, landscape, amenity and acoustic mitigation), there is an opportunity to connect existing vegetation fragments and wetland areas and provide a series or habitat "stepping stones" along the Alignment. This will have long-term ecological benefits for both terrestrial fauna and native birdlife as well as providing landscape and amenity benefits.
- A more naturalised freshwater corridor: Through retirement and revegetation of sections of stream within the Wharemauku, Waimeha, Kakariki and Paetawa streams and the Waikanae River there is an opportunity to create sections of aquatic habitat with greater habitat values than are currently present in these highly modified environments. This will have long term ecological benefits and may potentially improve the distribution and abundance of native fish.
- Research: As was identified with the finding of the North Island fernbird population near Ngarara Wetland, this Project will result in a range of ecological investigations that will provide public good in terms of increasing local and national (in the case of fernbird) conservation knowledge, and will potentially involve new science around stream diversions and rehabilitation and fernbird habitat utilisation. This knowledge and science can be fed directly into management of adjoining areas under control of other agencies.

## 13.4 Summary of monitoring proposed

Construction and post-construction monitoring of sensitive environments (particularly indigenous wetlands), water quality, culvert installation, earthworks, discharges to the

streams, wetlands and estuaries, and mitigation will be critical to achieving the outcome discussed above.

As outlined in section 11.3 of this Report, we strongly recommend a process of adaptive management for dealing with uncertainty around wetland hydrology, erosion and sediment control, and for the design and installation of culverts and diversions. Adaptive management would require detailed monitoring, the results of which feedback into the design and ongoing management.

## 13.5 Conclusions

Ecological involvement has formed an important component of the final proposed Expressway design and location. As a result, the most ecologically significant areas have either been avoided or the potential scale of effects on these areas minimised as far as possible. Most notably, the proposed Expressway Alignment has avoided a large number of statutorily recognised or ecologically significant wetlands and areas of indigenous vegetation and habitat along its length consistent with the intent of section 6(c) RMA (significant indigenous vegetation and significant habitat for indigenous fauna). There have also been a number of smaller scale modifications to the proposed Expressway design to reduce ecological effects and appropriately consider the wider intrinsic values of ecosystems under section 7(d) RMA. Overall, we are satisfied that every practical opportunity to avoid adverse ecological effects through refinement of the proposed Expressway Alignment has been undertaken.

Despite ecological involvement, the nature of the study area has meant that some areas of indigenous vegetation and wetland and some large lengths of stream will be lost beneath the proposed Expressway and affected by other construction activities. These activities will lead, at least in the short term, to significant and unavoidable impacts on terrestrial and freshwater habitats and their associated fauna.

This EcIA has considered the magnitude and significance of these residual impacts and recommended a number of mitigation measures to ensure the life-supporting capacity of land, water and ecosystems is safeguarded consistent with section 5(2)(b) of the RMA. In a number of locations, there are anticipated to be some long-term ecological benefits as a result of the mitigation proposed. A number of areas of significant indigenous vegetation will be enhanced and assured permanent protection through the Designation process. Overall, assuming the recommended mitigation is established, most ecological effects are considered to be neutral.

The impacts of proposed Expressway construction on freshwater systems associated with culverting and stream diversions have been largely mitigated through stream restoration within and outside of the Designation and careful attention to freshwater species during construction. Further, as a result of its location in sand country, the construction of the proposed Expressway is not expected to generate large quantities of sediment during the construction phase. Best practice erosion and sediment control mechanisms through construction, combined with the slow-moving nature of the waterbodies downstream of the Alignment, will assist in reducing potential sediment-laden run-off reaching ecologically sensitive downstream receiving environments. This is consistent with section 5(2)(b) RMA and safeguarding the life-supporting capacity of land, water and ecosystems.

Similarly, these site conditions are expected to minimise potential impacts associated with long-term deposition of sediment and associated stormwater contaminants derived from the operation of the proposed Expressway. Given that a number of the waterbodies traversed by

the proposed Expressway already have elevated nutrient issues as a result of their agricultural and residential location, we consider any potential effects to be negligible (based on information in Technical Report 24, Volume 3). Overall, the level of stormwater treatment proposed combined with the reduction in traffic from the existing SH1 (from which untreated stormwater discharges directly too many of the same waterbodies traversed), is anticipated to lead to reduced levels of contaminant loading to the waterbodies downstream of the Alignment in the long-term. This is consistent with the intent of section 5(2)(b) RMA to safeguard the life-supporting capacity of land, water and ecosystems, section 6(c) to protect areas of significant indigenous vegetation and significant habitats of indigenous fauna, and the numerous statutory provisions seeking the maintenance and improvement of water quality in a number of waterbodies along the Kāpiti Coast.

In conclusion:

- Outstanding or rare indigenous plant communities; There are no outstanding or rare plant communities that will be directly affected by the proposed Expressway.
- Areas containing nationally vulnerable species; There are a number of habitats with vulnerable species present within and adjacent to the proposed Expressway. Potential effects on vulnerable bird species have been taken into account through additional pre-construction research proposals, avoidance of habitat, mitigation planting and permanent protection of areas of habitat. The additional habitat utilisation surveys have been developed in conjunction with the Department of Conservation to better understand the North Island fernbird population in the area traversed by the proposed Expressway and develop an appropriate mitigation package. There is a risk of significant effects on native fish but this can be avoided with good design and installation of culverts and stream diversions.
- Areas and habitats important to the continued survival of indigenous species; With the exception of bird species, there are no areas or habitats within the Designation or the wider watersheds that are important for the continued survival of an indigenous species. As outlined above, areas of known habitat for nationally vulnerable species have been largely avoided and considered in mitigation planting and permanent protection of areas of habitat.
- Areas important for migratory species; The only migratory species that were recorded within the Designation were native diadromous fish. The issues of continued fish passage have been addressed in this assessment. Because of the low-gradient and low velocity of the waterbodies affected, we are confident that the proposed Expressway can proceed without adversely affecting fish migration. A number of migratory bird species utilise the Waikanae Estuary and the other smaller stream mouths of the study area but these are considered unlikely to be adversely affected by the proposed Expressway.
- Areas important to vulnerable life stages of common indigenous species; The Waikanae Estuary, and to a lesser extent the smaller stream mouths of the study area, are important for spawning of a number of fish species. The extent of riparian revegetation proposed and new stream habitat created may improve the quality and quantity of habitat for these fish.
- Ecological corridors; The proposed Expressway has the potential to impact on a number of ecological corridors, most notably the movement of fish within waterbodies traversed and the wider bird corridor made up of the scattered wetland and forest remnants between Nga Manu Nature Reserve, Te Harakeke/Kawakahia Wetland and the Waikanae River. The good design of culverts and stream diversions and the scale of landscape and amenity planting proposed is expected to improve ecological corridors for avifauna, terrestrial fauna, and fish in the long term.

- Protection of ecosystems vulnerable to modification, including estuaries and wetlands; Adverse effects on wetlands and estuaries have been avoided or mitigated as far as possible. However, given the largely unmodified nature of the Waikanae Estuary and Te Harakeke/Kawakahia Wetland, these two ecosystems have been identified as particularly vulnerable to modification. Based on the results of construction and operational contaminant predictions undertaken, our conclusion is that the Waikanae Estuary and Te Harakeke/Kawakahia Wetland can be protected from the adverse effects of sediment discharge and stormwater contaminants from the proposed Expressway. Adaptive management is recommended to ensure potential effects associated with sediment run-off from the construction phase of the proposed Expressway is adequately mitigated. The construction of the proposed Expressway involves the permanent loss of medium value indigenous wetlands at Otaihanga and El Rancho. A number of activities are proposed to mitigate for this loss of wetland habitat, including the restoration of part of the former Waikanae Oxidation Ponds (an area of former wetland within the wider Te Harakeke/Kawakahia Wetland system) and smaller wetlands in this vicinity. Further, the avoidance of a large number of statutorily recognised wetlands in the vicinity of the proposed Expressway has assisted in assuring the long-term survival of these wetlands consistent with section 6(c) of the RMA.
- Areas of scientific value; A number of the measures recommended for the protection and enhancement of the local ecology and for monitoring involves some areas of innovation and research. These studies will continue to contribute to the local knowledge of these significant ecosystems and may assist in their long-term survival.
- The quality of freshwater entering the coastal marine area; This assessment, together with the work carried out by the Project team on behalf of the NZTA indicates that there will not be a significant increase in contaminants from road runoff reaching the estuaries and stream mouths downstream of the proposed Expressway. Treatment of stormwater is proposed to a high standard along the length of the proposed Expressway to ensure that this is the case.
- The potential for restoration and rehabilitation of natural character; This assessment provides for extensive restoration and rehabilitation of terrestrial plant communities and habitats for significant species and freshwater and riparian habitats along the length of the proposed Expressway. While the ecological mitigation recommended is consistent with the ecological value calculated, the total quantum of indigenous vegetation and habitat created or protected along the proposed Expressway is substantial.
- Cumulative effects: The proposed Expressway has the potential to have cumulative effects on the continued fragmentation of indigenous vegetation and wetland habitat and the physical extent and hydrology of wetlands on the Kāpiti Coast. We consider that the mitigation proposed for the loss of terrestrial habitat and potential hydrological effects on wetland satisfactorily addresses these cumulative effects and will result in long term ecological benefits through permanently protecting larger, more connected ecological areas.
- Indigenous biodiversity: While some populations of indigenous flora and fauna will be affected, the level of mitigation proposed will ensure that no species or communities will be lost from either the catchments traversed of the Foxton Ecological District. Overall, we consider there will be a gain in indigenous biodiversity in the long-term when considering the scale of landscape planting and planted flood storage areas along the proposed Expressway.
- Ecological mitigation: While there will be a net loss of stream length and freshwater habitat, we believe that, with the mitigation proposed, the quality of remaining stream habitat in several catchments will be enhanced to a point that this loss is mitigated.

Similarly, while there will be a net loss of wetland habitat, the restoration proposed as mitigation for this loss will have greater conservation outcomes through the long-term enhancement of a nationally significant freshwater wetland complex at Te Harakeke/Kawakahia Wetland. The landscape planting and riparian mitigation proposed along the proposed Expressway will also have long-term conservation benefits in terms of vegetated habitat corridors within the Designation. When taking into account the additional ecological benefits of the landscape and visual planting proposed, the quantum of mitigation proposed are larger than are strictly required by the analysis we have conducted. This will lead to additional conservation benefit in both freshwater and terrestrial habitats in the long term.

- Additional statutory considerations; Protecting habitats with significant indigenous biodiversity values and maintaining or enhancing the functioning of ecosystems and riparian margins has been taken into account consistent with the Regional Policy Statement for the Wellington Region. The level of stormwater treatment and riparian restoration proposed is expected to assist with improving water quality in the Waikanae River, Mazengarb Drain and Ngarara Stream consistent with the Conservation Management Strategy, the Regional Freshwater Plan and the Regional Policy Statement. The design of the proposed Expressway appropriately considered potential effects on the Waikanae Estuary consistent with the Conservation Management Strategy.

While the construction and operation of the proposed MacKays to Peka Peka Expressway will result in a range of adverse ecological effects, the scale of the mitigation proposed and the permanent avoidance of a large number of areas of identified ecological importance along the length of the Alignment will satisfactorily mitigate these effects. Overall, we consider that the indigenous biodiversity and ecological values can be maintained in the long-term consistent with the intention of Part 2 of the RMA which seeks to safeguard the life-supporting capacity of land, water and ecosystems (section 5(2)(b)), recognise the intrinsic values of ecosystems (section 7(d)) and protect areas of significant indigenous vegetation and significant habitat of indigenous fauna (section 6(c)).

## References


ALLIBONE, et.al. 2010: Conservation status of New Zealand freshwater fish, 2009. New Zealand Journal of Marine and Freshwater Research, First published on: 27 September 2010

AUCKLAND REGIONAL COUNCIL (2004). Blueprint for monitoring urban receiving environments. Auckland Regional Council Technical Publication No. 168, Auckland.

AUSTRALIAN AND NEW ZEALAND ENVIRONMENT AND CONSERVATION COUNCIL (ANZECC) (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The Guidelines.

BIBBY, R. (2011). *Baseline Water and Sediment Quality Investigation Report:* Technical Report 24, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

BIBBY, R. & FULLERTON, A. (2011). *Contaminant Load Assessment:* Technical Report 25, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

BULL, L. (2011). *Ecological Technical Report 3: Avifauna Studies – Description and Values:* Technical Report 29, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

DAWSON, D., & BULL, P. (1975). Counting birds in New Zealand forests. *Notornis 22* , 101-109.

*de LANGE, P. J., & et.al. (2009).* Threatened and uncommon plants of New Zealand (2008 revision). *New Zealand Journal of Botany 47: 61-96.*

DE LUCA, S. (2011). *Ecological Technical Report 5: Marine Habitat and Species – Description and Values:* Technical Report 31, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

EVANS, B. & FAULKNER, B. (2011). *Assessment of Landscape and Visual Effects:* Technical Report 7, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

FRANCE, S. & MICHAELSEN, J. (2011). *Assessment of Groundwater Effects:* Technical Report 21, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

FRANCE, M. & UTTING, M. (2011). *Groundwater (Level) Management Plan:* CEMP Appendix I, Volume 4 of the MacKays to Peka Peka Expressway Project AEE.

FULLER, S. (1993). *Wetlands in the Wellington Region.* Wellington Regional Council Policy and Planning Dept report; WRC/PP-G-93/16 32 pp.

FULLER, S., & WASSILIEFF, M. (1993). *An Inventory of Biological and Geological Sites in the Wellington Region. Unpublished report.* Prepared for the Wellington Regional Council. 33 pp. incl. Appendices.

GOLDIE, A. (2011). *Construction Methodology Report:* Technical Report 4, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

HEATHER, B., & ROBERTSON, H. (2000). *The Field Guide to the Birds of New Zealand.* Auckland: Penguin Books.

HEINE, J. C. (1975). *Interim report on soils of Wellington Region, New Zealand.* N.Z. Soil Bureau Record 39. Department of Scientific and Industrial Research.

HITCHMOUGH, R., BULL, L., & CROMERTY, P. (2007). *New Zealand Threat Classification System lists—2005.* Wellington: Department of Conservation.

HITCHMOUGH, R., et al, 2009: Conservation status of New Zealand reptiles, 2009. New Zealand Journal of Zoology, 37: 3, 203 — 224.

IEEM. (2006). *Guidelines for Ecological Impact Assessment in the United Kingdom.* Institute of Ecology and Environmental Management.

LEATHWICK, J., & et.al. (2002). *Land Environments of New Zealand; Technical Guide.* Prepared by Landcare Research for the Ministry for the Environment.

MCEWEN, W. M. (1887). *Ecological Regions and Districts of New Zealand. Third Revised edition in Four 1:500 000 Maps.* Report produced for Department of Conservation, Wellington.

MISKELLY, C, DOWDING, J, ELLIOT, G. HITCHMOUGH, R POWLESLAND, R, ROBERTSON, H, et al. (2008). Conservation status of New Zealand birds, 2008. Notornis , 55, 117-135.

PAGE, M. J. (1995). *Land Use Capability Classification of the Wellington Region.* Landcare Research Science Series No.6.

PARK, M. (2011). *Ecological Management Plan:* CEMP Appendix M, Volume 4 of the MacKays to Peka Peka Expressway Project AEE.

PARK, M. (2011). *Ecological Technical Report 1: Terrestrial Vegetation and Habitats (Including Wetlands):* Technical Report 27, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

RAVINE, D.A. 1992: Foxton Ecological District, Survey report for the Protected Natural Areas Programme. Published by the Department of Conservation, Wanganui

RIDLEY, G. (2011). *Erosion and Sediment Control Plan:* CEMP Appendix H, Volume 4 of the MacKays to Peka Peka Expressway Project AEE.

RISI, B. (2011). *Ecological Report 4: Freshwater habitat and Species – Description and Values*: Technical Report 30, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

RUFFELL, J. (2011). *Ecological Technical Report 2: Herpetofauna*: Technical Report 28, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

RUTLEDGE, D.; PRICE, R.; HEKE, H.; AUSSEIL, A. (2004). *National Analysis of Biodiversity Protection Status: Methods and Summary Results.* Prepared for the Ministry for the Environment. Landcare Research Contract Report: 0405/042.

SMITH, I. (2011). *Assessment of Hydrology and Stormwater Effects:* Technical Report 22, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

TOWNSEND, A., de LANGE, P., DUFFY, C., MISKELLY, C., MOLLOY, J., & NORTON, D. (2008). *New Zealand Threat Classification System Manual.* Wellington: Department of Conservation.

TREWEEK, J. (1999). *Ecological Impact Assessment.* Blackwell Science Ltd.

WILDLAND CONSULTANTS LTD. 2003. *Kāpiti Coast District Council 2002-2003 Ecological Sites Survey.* Prepared for Kāpiti Coast Disstrict Council, Report 662. 57pp.

WILDLANDS CONSULTANTS LTD. 2011. Pharazyn Reserve Landscape and Ecological Restoration Plan. Report prepared for Kāpiti Coast District Council. Contract Report No. 2527

# Appendices

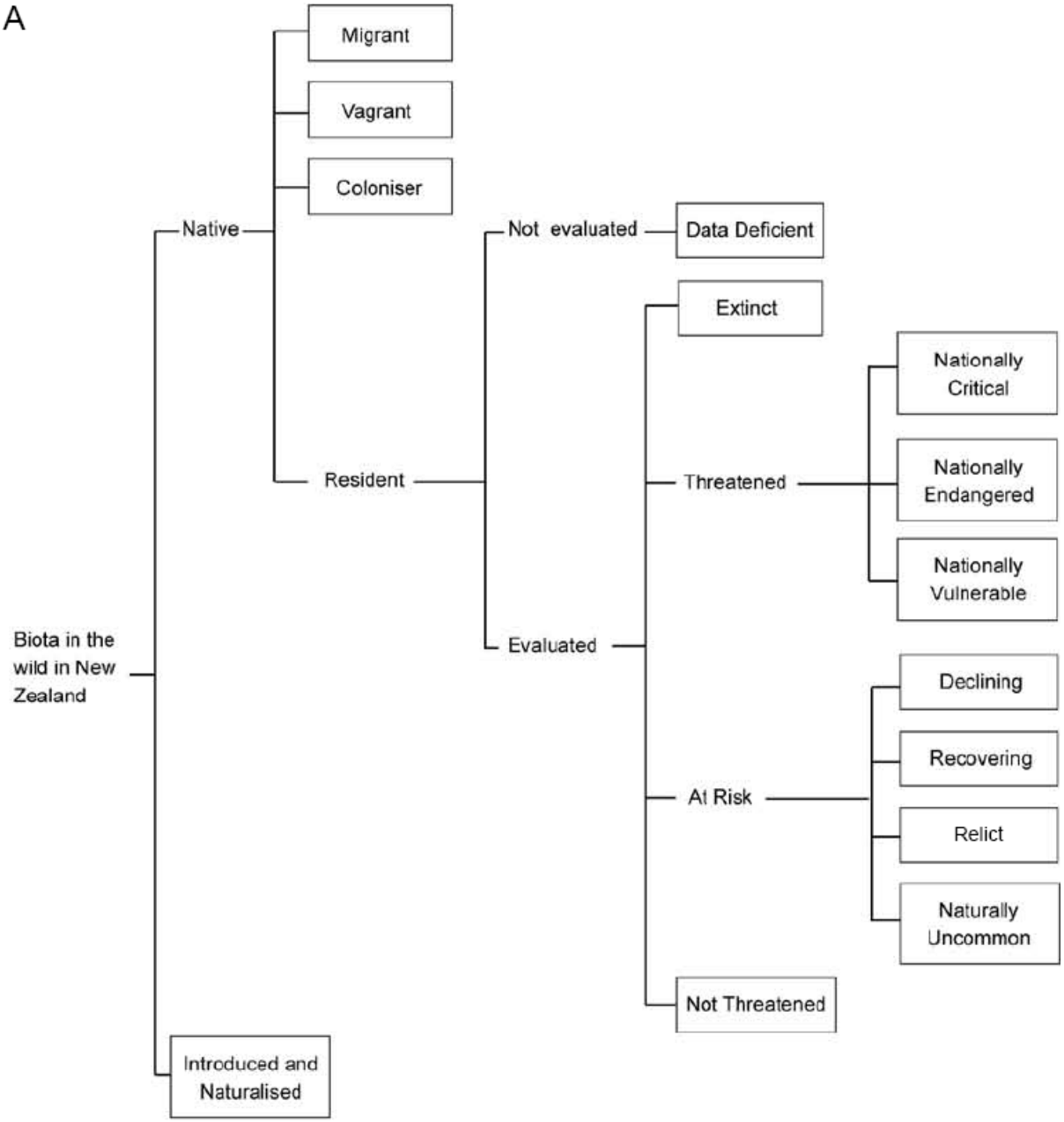

Appendix A: Threat Classification ..... 180
Appendix B: Ecological Constraints Desktop Analsysis ..... 183
Appendix C: Description of All Stream Works ..... 184
Appendix D: Stream Works Descriptions for Valued Streams ..... 187
Appendix E: Stream Metrics for Valued Streams (At Stream Works Location) ..... 189
Appendix F: SEV Current and Potential Scores for all Valued Streams ..... 191
Appendix G: SEV Calculations for Culvert, Diversion and Bridging of Valued Streams ..... 192
Appendix H: Ecological Mitigation Ratios for stream works in valued streams ..... 194
Appendix I: Landscape and amenity planting ..... 1

# Appendix A
# Threat Classification

*Appendix A: Threat Classification*

(From Townsend et.al. 2008)

A



# Appendix B
# Ecological Constraints Desktop Analysis

## Classification Sub Categories

| | | |
|---|---|---|
| Criteria for 'Threatened' taxa | | A. Very small population (natural or unnatural) |
| | | B. Small population (natural or unnatural) with a high ongoing or predicted decline |
| | | C. Population with a very high ongoing or predicted decline (> 70%) |
| | | A. Small population that has a low to high ongoing or predicted decline |
| | | B. Small stable population (unnatural) |
| | | C. Moderate population and high ongoing or predicted decline |
| | | A. Small, increasing population (unnatural) |
| | | B. Moderate, stable population (unnatural) |
| | | C. Moderate population, with population trend that is declining |
| | | D. Moderate to large population and moderate to high ongoing or predicted decline |
| | | E. Large population and high ongoing or predicted decline |
| Criteria for 'At Risk' Taxa | | A. Moderate to large population and low ongoing or predicted Decline |
| | | B. Large population and low to moderate ongoing or predicted decline |
| | | C. Very large population and low to high ongoing or predicted Decline |
| | | A. Moderate population |
| | | B. Moderate to large population |
| | | |
| | | |
| Not Threatened | | |

## Qualifiers used in the classification

| Qualifier | Stands for Status | Explanation |
|---|---|---|
| CD | Conservation Dependent | The taxon is likely to move to a higher threat category if current management ceases. |
| DP | Data Poor | Confidence in the listing is low due to there being only poor data available for assessment. |
| EF | Extreme Fluctuations | The taxon experiences extreme unnatural population fluctuations, or natural fluctuations overlaying human-induced declines, that increase the threat of extinction.<br>When ranking taxa with extreme fluctuations, the lowest number of mature individuals should be used for determining population size, as a precautionary measure. |
| EW | Extinct in the Wild | The taxon is known only in cultivation or captivity. |
| OL | One Location | Found at one location (geographically or ecologically distinct area) of less than 1000 km2 (100 000 ha), in which a single event (e.g. a predator irruption) could |

| | | |
|---|---|---|
| | | easily affect all individuals of the taxon, e.g. L'Esperance Rock groundsel (Senecio lautus var. esperensis) and Open Bay Island leech (Hirudobdella antipodum). Taxa with restricted distributions but where it is unlikely that all sub-populations would be threatened by a single event (e.g. because water gaps within an archipelago are larger than known rodent swimming distances) should be qualified as 'Range Restricted' (RR). 'OL' can apply to all 'Threatened' and 'At Risk' taxa, regardless of whether their restricted distribution is natural or human-induced. |
| RF | Recruitment Failure | The taxon's current population may appear stable but the age structure is such that catastrophic declines are likely in the future. |
| SO | Secure Overseas | The taxon is secure in other parts of its natural range outside New Zealand. |
| TO | Threatened Overseas | The taxon is threatened in those parts of its natural range outside New Zealand. |
| St | Stable | The total population is stable (± 10%), taken over the last 10 years or three generations, whichever is longer. |
| IE | Island Endemic | A taxon whose natural distribution is restricted to one island archipelago (e.g. Auckland Islands) and is not part of the North or South Islands or Stewart Island/Rakiura. |
| Inc | Increasing | There is an ongoing or predicted increase of > 10% in the total population, taken over the next 10 years or three generations, whichever is longer. Note that this qualifier is redundant for taxa ranked as 'Recovering'. |
| PD | Partial Decline | Taxa undergoing decline over the majority of their range, but with one or more secure populations (such as on offshore islands). Partial decline taxa (e.g. North Island kaka Nestor meridionalis septentrionalis and Pacific gecko Hoplodactylus pacificus) are declining towards 'Relict' status rather than towards extinction. |
| RR | Range Restricted | Taxa confined to specific substrates, habitats or geographic areas of less than 1000 km2 (100 000 ha); this is assessed by taking into account the area of occupied habitat of all sub-populations (and summing the areas of habitat if there is more than one sub-population), e.g. Chatham Island forget-me-not (Myosotidium hortensia) and Auckland Island snipe (Coenocorypha aucklandica aucklandica). This qualifier can apply to all 'Threatened' and 'At Risk' taxa regardless of whether their restricted distribution is natural or human-induced, but is redundant if a taxon is confined to 'One Location' (OL). |
| Sp | Sparse | Taxa that occur within typically small and widely scattered populations. |
| De | Designated | A taxon that does not fit within the criteria provided, and which the Expert Panel has designated to the most appropriate listing without full application of the criteria. For example, a commercial fish stock that is being fished down to Biomass Maximum Sustainable Yield (BMSY) may meet criteria for 'Declining'; however, it could be designated as 'Not Threatened' if the Expert Panel believes that this better describes the taxon's risk of extinction. |

# Appendix C
# Description of All Stream Works

## *Appendix C: Description of All Stream Works*

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Origin | Watercourse Form | Catchment Area (ha) | Type of Works | Culvert New / Existing |
|---|---|---|---|---|---|---|---|---|
| 6 | 1950 | 1. Whareroa Stream | Drain off Whareroa (not discharging to water) | Drain | Ephemeral | 4.9 | Culvert | Existing |
| 7.1 | 2220 | 1. Whareroa Stream | Drain off Whareroa (not discharging to water) | Drain | Ephemeral | 5.7 | Culvert | Existing |
| 7.4 | 2675 | 1. Whareroa Stream | Road drain (not in stream) | New | Ephemeral | 1.0 | Culvert | New |
| 7.5 | 2605 | 1. Whareroa Stream | New outlet (no flowing water) | New | Ephemeral | 15.6 | Culvert | New |
| 8 | 2600 | 1. Whareroa Stream | Drain off Whareroa | Drain | Intermittent | 12.5 | Culvert | Existing |
| 9.3a | 2600 | 1. Whareroa Stream | New roadside open channel through QE Park | Stream | Intermittent | 23.3 | New channel | |
| 9.3b | 2600 | 1. Whareroa Stream | New roadside open channel SH1 | Stream | Intermittent | 23.3 | New channel | |
| 9.4 | 3500 | 2. Wharemauku Stream | New outlet off Leinster Ave Area into Drain 7 Upper | Drain | Intermittent | | New channel | |
| 10 | 3685 | 2. Wharemauku Stream | Upper Drain 7 | Drain | Perennial | 44.4 | Culvert | New |
| 10 | 3700 | 2. Wharemauku Stream | Replaces existing drain into Drain 7 upper | Stream | Perennial | | DIVERSION | |
| 11 | 4930 | 2. Wharemauku Stream | Lower Drain 7 | Drain | Perennial | 151.3 | Culvert | New |
| 11.1 | 5400 | 2. Wharemauku Stream | Main Channel of Wharemauku Stm | Stream | Perennial | 1,007.8 | BRIDGE | New |
| 11.2 | 5400 | 2. Wharemauku Stream | FB_Wet depression - flow balancing - wharemauku | New | Watershed | 0.7 | Culvert | New |
| 11.3 | 5400 | 2. Wharemauku Stream | FB_Flow balancing culvert - wet depressions - Wharemauku | New | Watershed | | Culvert | New |
| 13 | 7465 | 3. Waikanae River | SW_Stormwater pond outlet to residential stormwater | New | sw | | Culvert | New |
| 14 | 8040 | 3. Waikanae River | Mazengarb Stream | Stream | Perennial | 378.8 | Culvert | New |
| 15 | 8500 | 3. Waikanae River | WWTP Drain | Drain | Perennial | 17.0 | Culvert | New |
| 16 | 8725 | 3. Waikanae River | FB_Otaihanga South Wetland - Flow balancing - no stream | New | Wetland | 3.7 | Culvert | New |
| 17 | 8930 | 3. Waikanae River | Landfill Drain (middle wetland) - Landfill drain to Waikanae | Stream | Intermittent | 15.2 | Culvert | Existing |
| 18.1 | 9270 | 3. Waikanae River | road drain (not in stream) | Drain | Intermittent | 10.4 | Culvert | New |
| 21 | 10290 | 3. Waikanae River | FB_New outlet in dune depression - flow balancing | New | Watershed | 4.2 | Culvert | New |
| 22 | 10300 | 3. Waikanae River | Muaupoko connection from wetlands | Stream | Intermittent | | New channel | |
| 22.1 | 10465 | 3. Waikanae River | FB_Dune depression south of Waikane River - flow balancing | Drain | Wetland | 1.3 | Culvert | New |
| 22.1 | 10600 | 3. Waikanae River | Muaupoko Diversion - New stream - losing 5m of original stream | Stream | Perennial | | DIVERSION | |
| 22.2 | 10300 | 3. Waikanae River | SW_\New outlet of treatment pond and dune depressions into Muaupoko Stream | Drain | sw | 4.4 | Culvert | New |
| 23 | 10600 | 3. Waikanae River | Main Channel of Waikanae River | River | Perennial | 13,005.2 | BRIDGE | New |
| 23.3 | 11110 | 3. Waikanae River | FB_Tocker to El Rancho wet depressions - flow balancing | New | Wetland | 1.1 | Culvert | New |

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Origin | Watercourse Form | Catchment Area (ha) | Type of Works | Culvert New / Existing |
|---|---|---|---|---|---|---|---|---|
| 23.4 | 11225 | 4. Waimeha Stream | FB_Tocker to Urupa wet depressions - flow balancing | New | Wetland | 1.9 | Culvert | new |
| 24 | 11800 | 4. Waimeha Stream | SW_Swale outlet to stormwater treatment wetland in market garden | Drain | sw | 14.0 | Culvert | New |
| 24 | 11700 | 4. Waimeha Stream | Market gardens trib - new diversion off Te Moana | Stream | Intermittent | | DIVERSION | |
| 24.1 | 11820 | 4. Waimeha Stream | New outlet of Osbournes Drain to Waimeha Stream(was 24A) | Drain | Intermittent | 31.0 | Culvert | Existing |
| 24.2 | 11780 | 4. Waimeha Stream | New outlet in market garden in house location (was 24B) | Drain | Ephemeral | 12.0 | Culvert | New |
| 24.3 | 11700 | 4. Waimeha Stream | Urupa access culvert of Osbournes Drain (23.4 label) | Drain | Intermittent | 12.0 | Culvert | Existing |
| 24.4 | 11650 | 4. Waimeha Stream | FB_Flow balancing catchment | New | Watershed | 2.2 | Culvert | New |
| 25 | 11800 | 4. Waimeha Stream | Waimeha Stream ramp | Stream | Perennial | 218.8 | BRIDGE | New |
| 25.1 | 11800 | 4. Waimeha Stream | Waimeha Stream / floodway | Stream | Perennial | 218.8 | BRIDGE | New |
| 25.2 | 11800 | 4. Waimeha Stream | Waimeha Stream ramp | Stream | Perennial | 218.8 | BRIDGE | New |
| 25.3 | 12200 | 4. Waimeha Stream | FB_Flow balancing at J Smiths | New | Watershed | 9.5 | Culvert | New |
| 26 | 13200 | 4. Waimeha Stream | Ngarara Creek | Stream | Perennial | 164.2 | Culvert | New |
| 27 | 13400 | 4. Waimeha Stream | FB_New outlet in dune depression on Ngarara - flow balancing | New | Watershed | 2.2 | Culvert | New |
| 29a | 14000 | 4. Waimeha Stream | Kakariki Stream 1 bridge | Stream | Perennial | 575.9 | BRIDGE | New |
| 29b | 14000 | 4. Waimeha Stream | Kakariki Stream 1 remove kink. | Stream | Perennial | 575.9 | DIVERSION | New |
| 30 | 14060 | 4. Waimeha Stream | FB_New outlet in dune depression to Kakariki - flow balancing | new | Wetland | 6.3 | Culvert | New |
| 30 | 14000 | 4. Waimeha Stream | southern kakariki | Stream | Intermittent | | New channel | |
| 30.1 | 14270 | 4. Waimeha Stream | SW_Access road culuvert through Farm drain and stormwater treatement to Smithfield Drain | Drain | sw | 1.8 | Culvert | New |
| 30.2 | 14375 | 4. Waimeha Stream | SW_Access road culuvert through Farm drain and stormwater treatement to Smithfield Drain | Drain | sw | 1.0 | Culvert | New |
| 30.3 | 14480 | 4. Waimeha Stream | Smithfield drain trib | Drain | Intermittent | 14.9 | Culvert | New |
| 30.4 | 14340 | 4. Waimeha Stream | New outlet from dune depression to Smithfield drain | Drain | Ephemeral | 5.5 | Culvert | New |
| 30.4 | 14340 | 4. Waimeha Stream | Smithfield Drain | Stream | Perennial | | DIVERSION | |
| 30.5 | 14100 | 4. Waimeha Stream | Kakariki Stream 2 | Stream | Perennial | 618.0 | BRIDGE | New |
| 31 | 15100 | 4. Waimeha Stream | FB_New outlet dune depression peats - flow balancing | New | Watershed | 1.7 | Culvert | New |
| 33 | 15650 | 4. Waimeha Stream | FB_Dune depression peats to Paetawa Drain - flow balancing | New | Watershed | 5.2 | Culvert | New |
| 34 | 15780 | 4. Waimeha Stream | FB_Dune depression peats to Paetawa Drain - flow balancing | New | Watershed | 17.0 | Culvert | New |
| 35 | 15910 | 4. Waimeha Stream | Paetawa Drain trib | Drain | Perennial | 39.8 | Culvert | New |
| 35.1 | 16100 | 4. Waimeha Stream | FB_Flow balancing catchment | New | Watershed | n/a | Culvert | New |
| 36 | 16400 | 4. Waimeha Stream | Paetawa Stream | Stream/Drain | Perennial | 271.2 | BRIDGE | New |
| 36 | 16400 | 4. Waimeha Stream | Paetawa trib | Stream | Intermittent | | DIVERSION | |

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Origin | Watercourse Form | Catchment Area (ha) | Type of Works | Culvert New / Existing |
|---|---|---|---|---|---|---|---|---|
| 38 | 16805 | 4. Waimeha Stream | Paetawa Drain Trib | Drain | Perennial | 83.8 | Culvert | New |
| 38.1 | 16550 | 4. Waimeha Stream | New culvert adjacent to SH1 into Paetawa Drain | Drain | Perennial | 82.5 | Culvert | New |
| 38.1 | 16710 | 4. Waimeha Stream | Paetawa Trib - off SH1 (for roundabout) | Stream | Perennial | | DIVERSION | |
| 38.2 | 16840 | 4. Waimeha Stream | Paetawa Drain trib upgraded under SH1 | Drain | Perennial | n/a | Culvert | Existing |
| 38.3 | 17140 | 4. Waimeha Stream | Paetawa Drain trib | Drain | Perennial | 2.1 | Culvert | New |
| 38.3 | 17100 | 4. Waimeha Stream | Paetawa - west of Expressway | Stream | Perennial | | DIVERSION | |
| 38.4 | 17165 | 4. Waimeha Stream | Paetawa drain trib under SH1 | Drain | Perennial | 53.7 | Culvert | Existing |
| 38.4 | 17200 | 4. Waimeha Stream | Paetawa - east of Expressway | Stream | Perennial | | New channel | |
| 39 | 17170 | 4. Waimeha Stream | Paetawa Drain trib under SH1 | Drain | Perennial | 25.0 | Culvert | Replace |
| 40 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Stream | Perennial | 104.1 | Culvert | Replace |
| 40.1 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Stream | Perennial | 104.6 | Culvert | New |
| 40.2 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Stream | Perennial | 104.6 | Culvert | New |
| 40.3 | 17630 | 5. Hadfield Kowhai | Hadfield/Kohwai | Stream | Perennial | 104.6 | Culvert | New |
| 40.3 | 17500 | 5. Hadfield Kowhai | Hadfield/Kowhai Diversion | Stream | Perennial | | DIVERSION | |

# Appendix D
# Stream Works Descriptions for Valued Streams

## *Appendix D: Stream Works Descriptions for Valued Streams*

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Form | Type of Works | Culvert New / Existing | Culvert Diameter / Dimensions | Culvert Length ALL Total | Headwall + Rip Rap | Total Length Modified | Diversion - Current Length | Diversion - New Length | Difference Stream & Diversion Length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 2600 | 1. Whareroa Stream | Drain off Whareroa | Intermittent | Culvert | Existing | 1050 | 55 | 10.8 | 65.8 | | | |
| 9.3a | 2600 | 1. Whareroa Stream | New roadside open channel through QE Park | Intermittent | New channel | New | | | | | | | |
| 9.3b | 2600 | 1. Whareroa Stream | New roadside open channel SH1 | Intermittent | New channel | New | | | | | | | |
| 9.4 | 3500 | 2. Wharemauku Stream | New outlet off Leinster Ave Area into Drain 7 Upper | Intermittent | New channel | | | | | | | | |
| 10 | 3685 | 2. Wharemauku Stream | Upper Drain 7 | Perennial | Culvert | New | 1500 | 60 | 9.75 | 69.8 | | | |
| 10 | 3700 | 2. Wharemauku Stream | Replaces existing drain into Drain 7 upper | Perennial | DIVERSION | | | | | | 50 | 50 | |
| 11 | 4930 | 2. Wharemauku Stream | Lower Drain 7 | Perennial | Culvert | New | 3x2 | 100 | 19.5 | 119.5 | | | |
| 11.1 | 5400 | 2. Wharemauku Stream | Main Channel of Wharemauku Stm | Perennial | BRIDGE | New | | | 32 | 32.0 | | | |
| 14 | 8040 | 3. Waikanae River | Mazengarb Stream | Perennial | Culvert | New | 5x3 | 111 | 32.5 | 143.5 | | | |
| 15 | 8500 | 3. Waikanae River | WWTP Drain | Perennial | Culvert | New | 1500 | 60 | 13.8 | 73.8 | | | |
| 17 | 8930 | 3. Waikanae River | Landfill Drain (middle wetland) - Landfill drain to Waikanae | Intermittent | Culvert | Existing | 1200 | 75 | 7.8 | 82.8 | | | |
| 18.1 | 9270 | 3. Waikanae River | road drain (not in stream) | Intermittent | Culvert | New | 1050 | 10 | 10.8 | 20.8 | | | |
| 22 | 10300 | 3. Waikanae River | Muaupoko connection from wetlands | Intermittent | New channel | | 80 | | | | | | |
| 22.1 | 10600 | 3. Waikanae River | Muaupoko Diversion - New stream - losing 5m of original stream | Perennial | DIVERSION | | | | | | 30 | 30 | |
| 23 | 10600 | 3. Waikanae River | Main Channel of Waikanae River | Perennial | BRIDGE | New | | | 83 | 83.0 | | | |
| 24 | 11700 | 4. Waimeha Stream | Market gardens trib - new diversion off Te Moana | Intermittent | DIVERSION | | | | | | 360 | 130 | 230 |
| 24.1 | 11820 | 4. Waimeha Stream | New outlet of Osbournes Drain to Waimeha Stream(was 24A) | Intermittent | Culvert | Existing | 1050 | 15 | 8.8 | 23.8 | | | |
| 24.3 | 11700 | 4. Waimeha Stream | Urupa access culvert of Osbournes Drain (23.4 label) | Intermittent | Culvert | Existing | 1050 | 15 | 6.8 | 21.8 | | | |
| 25 | 11800 | 4. Waimeha Stream | Waimeha Stream ramp | Perennial | BRIDGE | New | | | 32 | 32.0 | | | |
| 25.1 | 11800 | 4. Waimeha Stream | Waimeha Stream / floodway | Perennial | BRIDGE | New | | | 15 | 15.0 | | | |
| 25.2 | 11800 | 4. Waimeha Stream | Waimeha Stream ramp | Perennial | BRIDGE | New | | | 15 | 15.0 | | | |

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Form | Type of Works | Culvert New / Existing | Culvert Diameter / Dimensions | Culvert Length ALL Total | Headwall + Rip Rap | Total Length Modified | Diversion - Current Length | Diversion - New Length | Difference Stream & Diversion Length |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 13200 | 4. Waimeha Stream | Ngarara Creek | Perennial | Culvert | New | 3x2 | 70 | 19.5 | 89.5 | | | |
| 29a | 14000 | 4. Waimeha Stream | Kakariki Stream 1 bridge | Perennial | BRIDGE | New | | | 80 | 80.0 | | | |
| 29b | 14000 | 4. Waimeha Stream | Kakariki Stream 1 remove kink. | Perennial | DIVERSION | New | | | | | 125 | 110 | 15 |
| 30 | 14000 | 4. Waimeha Stream | southern kakariki | Intermittent | New channel | | | | | | | | |
| 30.3 | 14480 | 4. Waimeha Stream | Smithfield drain trib | Intermittent | Culvert | New | 1050 | 25 | 10.8 | 35.8 | | | |
| 30.4 | 14340 | 4. Waimeha Stream | Smithfield Drain | Perennial | DIVERSION | | | | | | 510 | 936 | -426 |
| 30.5 | 14100 | 4. Waimeha Stream | Kakariki Stream 2 | Perennial | BRIDGE | New | | | 25 | 25.0 | | | |
| 35 | 15910 | 4. Waimeha Stream | Paetawa Drain trib | Perennial | Culvert | New | 1500 | 48 | 13.8 | 61.8 | | | |
| 36 | 16400 | 4. Waimeha Stream | Paetawa Stream | Perennial | BRIDGE | New | | | 30 | 30.0 | | | |
| 36 | 16400 | 4. Waimeha Stream | Paetawa trib | Intermittent | DIVERSION | | | | | | 70 | 80 | -10 |
| 38 | 16805 | 4. Waimeha Stream | Paetawa Drain Trib | Perennial | Culvert | New | 3x2 | 65 | 19.5 | 84.5 | | | |
| 38.1 | 16550 | 4. Waimeha Stream | New culvert adjacent to SH1 into Paetawa Drain | Perennial | Culvert | New | 3x2 | 30 | 19.5 | 49.5 | | | |
| 38.1 | 16710 | 4. Waimeha Stream | Paetawa Trib - off SH1 (for roundabout) | Perennial | DIVERSION | | | | | | 50 | 90 | -40 |
| 38.2 | 16840 | 4. Waimeha Stream | Paetawa Drain trib upgraded under SH1 | Perennial | Culvert | Existing | 525 | 20 | 3.4 | 23.4 | | | |
| 38.3 | 17140 | 4. Waimeha Stream | Paetawa Drain trib | Perennial | Culvert | New | 1050 | 30 | 6.8 | 36.8 | | | |
| 38.3 | 17100 | 4. Waimeha Stream | Paetawa - west of Expressway | Perennial | DIVERSION | | | | | | 270 | 400 | -130 |
| 38.4 | 17165 | 4. Waimeha Stream | Paetawa drain trib under SH1 | Perennial | Culvert | Existing | 1800 | 25 | 11.7 | 36.7 | | | |
| 38.4 | 17200 | 4. Waimeha Stream | Paetawa - east of Expressway | Perennial | New channel | | | | | | | | |
| 39 | 17170 | 4. Waimeha Stream | Paetawa Drain trib under SH1 | Perennial | Culvert | Replace | 1500 | 25 | 9.8 | 34.8 | | | |
| 40 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | Culvert | Replace | 3x2 | 20 | 19.5 | 39.5 | | | |
| 40.1 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | Culvert | New | 3x2 | 40 | 19.5 | 59.5 | | | |
| 40.2 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | Culvert | New | 3x2 | 20 | 19.5 | 39.5 | | | |
| 40.3 | 17630 | 5. Hadfield Kowhai | Hadfield/Kohwai | Perennial | Culvert | New | 3x2 | 20 | 19.5 | 39.5 | | | |
| 40.3 | 17500 | 5. Hadfield Kowhai | Hadfield/Kowhai Diversion | Perennial | DIVERSION | | | | | | 60 | 190 | -130 |
| 40 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | Culvert | Replace | 3x2 | 20 | 19.5 | 39.5 | | | |
| 40.1 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | Culvert | New | 3x2 | 40 | 19.5 | 59.5 | | | |
| 40.2 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | Culvert | New | 3x2 | 20 | 19.5 | 39.5 | | | |

# Appendix E
# Stream Metrics for Valued Streams (At Stream Works Location)

## *Appendix E: Stream Metrics for Valued Streams (At Stream Works Location)*

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Form | Catchment Area (ha) | MCI Score | QMCI Score | EPT (%) | Fish Taxa | Riparian Veg | Watercourse Substrate | SEV Score (SEVi-C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 2600 | 1. Whareroa Stream | Drain off Whareroa | Intermittent | 12.48 | 78 | 3.7 | 19% | 2 | Nil/Exotics | mud | 0.283 |
| 9.3a | 2600 | 1. Whareroa Stream | New roadside open channel through QE Park | Intermittent | 23.3 | | | | | | | |
| 9.3b | 2600 | 1. Whareroa Stream | New roadside open channel SH1 | Intermittent | 23.3 | | | | | | | |
| 9.4 | 3500 | 2. Wharemauku Stream | New outlet off Leinster Ave Area into Drain 7 Upper | Intermittent | | | | | | | | |
| 10 | 3685 | 2. Wharemauku Stream | Upper Drain 7 | Perennial | 44.41 | 73 | 2.5 | 29% | | pasture/exotics | mud | 0.304 |
| 10 | 3700 | 2. Wharemauku Stream | Replaces existing drain into Drain 7 upper | Perennial | | | | | | | | 0.304 |
| 11 | 4930 | 2. Wharemauku Stream | Lower Drain 7 | Perennial | 151.32 | 60 | 3.1 | 9% | 3 | pasture/exotics | mud | 0.362 |
| 11.1 | 5400 | 2. Wharemauku Stream | Main Channel of Wharemauku Stm | Perennial | 1007.76 | 90 | 3.7 | 25% | 4 | urban/nil | gravel,sand | 0.437 |
| 14 | 8040 | 3. Waikanae River | Mazengarb Stream | Perennial | 378.83 | 69 | 4.8 | 8% | 3 | exotics | sand/mud | 0.373 |
| 15 | 8500 | 3. Waikanae River | WWTP Drain | Perennial | 17.04 | 41 | 1.7 | | 3 | exotics | mud | 0.389 |
| 17 | 8930 | 3. Waikanae River | Landfill Drain (middle wetland) - Landfill drain to Waikanae | Intermittent | 15.22 | | | | | exotics | mud | 0.389 |
| 18.1 | 9270 | 3. Waikanae River | road drain (not in stream) | Intermittent | 10.38 | 78 | 3.7 | 19% | 2 | Nil/Exotics | mud | 0.389 |
| 22 | 10300 | 3. Waikanae River | Muaupoko connection from wetlands | Intermittent | | | | | | | | |
| 22.1 | 10600 | 3. Waikanae River | Muaupoko Diversion - New stream - losing 5m of original stream | Perennial | | | | | | | | 0.48 |
| 23 | 10600 | 3. Waikanae River | Main Channel of Waikanae River | Perennial | 13005.22 | 115 | 6.4 | 55% | 5 | Exotics/native | cobble | 0.644 |
| 24 | 11700 | 4. Waimeha Stream | Market gardens trib - new diversion off Te Moana | Intermittent | | | | | | | | 0.341 |
| 24.1 | 11820 | 4. Waimeha Stream | New outlet of Osbournes Drain to Waimeha Stream(was 24A) | Intermittent | 31 | 77 | 4.7 | 13% | | nil | mud | 0.341 |
| 24.3 | 11700 | 4. Waimeha Stream | Urupa access culvert of Osbournes Drain (23.4 label) | Intermittent | 12 | | | | | nil | mud | 0.341 |
| 25 | 11800 | 4. Waimeha Stream | Waimeha Stream ramp | Perennial | 218.8 | 77 | 4.7 | 13% | 2 | pasture | mud | 0.341 |
| 25.1 | 11800 | 4. Waimeha Stream | Waimeha Stream / floodway | Perennial | 218.8 | 77 | 4.7 | 13% | 2 | pasture | mud | 0.341 |
| 25.2 | 11800 | 4. Waimeha Stream | Waimeha Stream ramp | Perennial | 218.8 | 77 | 4.7 | 13% | 2 | pasture | mud | 0.341 |

| Ref | Chainage | Catchment Name | Waterbody Name / Descriptions | Watercourse Form | Catchment Area (ha) | MCI Score | QMCI Score | EPT (%) | Fish Taxa | Riparian Veg | Watercourse Substrate | SEV Score (SEVi-C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 13200 | 4. Waimeha Stream | Ngarara Creek | Perennial | 164.19 | 75 | 4.3 | 9% | 2 | exotics | mud | 0.291 |
| 29a | 14000 | 4. Waimeha Stream | Kakariki Stream 1 bridge | Perennial | 575.86 | 77 | 4.7 | 13% | 4 | native/pasture | mud | 0.454 |
| 29b | 14000 | 4. Waimeha Stream | Kakariki Stream 1 remove kink. | Perennial | 575.86 | 77 | 4.7 | 13% | 4 | native/pasture | mud | 0.454 |
| 30 | 14000 | 4. Waimeha Stream | southern kakariki | Intermittent | | | | | | | | |
| 30.3 | 14480 | 4. Waimeha Stream | Smithfield drain trib | Intermittent | 14.93 | 70 | 2.7 | 6% | 3 | pasture/nil | mud | 0.381 |
| 30.4 | 14340 | 4. Waimeha Stream | Smithfield Drain | Perennial | | | | | | | | 0.381 |
| 30.5 | 14100 | 4. Waimeha Stream | Kakariki Stream 2 | Perennial | 617.95 | 77 | 4.5 | 21% | 4 | native/pasture | mud | 0.454 |
| 35 | 15910 | 4. Waimeha Stream | Paetawa Drain trib | Perennial | 39.78 | 87 | 4.4 | 20% | 3 | pasture/nil | mud | 0.491 |
| 36 | 16400 | 4. Waimeha Stream | Paetawa Stream | Perennial | 271.22 | 87 | 4.4 | 20% | 3 | pasture/nil | mud | 0.491 |
| 36 | 16400 | 4. Waimeha Stream | Paetawa trib | Intermittent | | | | | | | | 0.491 |
| 38 | 16805 | 4. Waimeha Stream | Paetawa Drain Trib | Perennial | 83.81 | | | | | | | 0.491 |
| 38.1 | 16550 | 4. Waimeha Stream | New culvert adjacent to SH1 into Paetawa Drain | Perennial | 82.52 | | | | | | | 0.491 |
| 38.1 | 16710 | 4. Waimeha Stream | Paetawa Trib - off SH1 (for roundabout) | Perennial | | | | | | | | 0.491 |
| 38.2 | 16840 | 4. Waimeha Stream | Paetawa Drain trib upgraded under SH1 | Perennial | n/a | 87 | 4.4 | 20% | 3 | nil/exotics | mud | 0.491 |
| 38.3 | 17140 | 4. Waimeha Stream | Paetawa Drain trib | Perennial | 2.1 | | | | | | | 0.491 |
| 38.3 | 17100 | 4. Waimeha Stream | Paetawa - west of Expressway | Perennial | | | | | | | | 0.491 |
| 38.4 | 17165 | 4. Waimeha Stream | Paetawa drain trib under SH1 | Perennial | 53.74 | | | | | | | 0.491 |
| 38.4 | 17200 | 4. Waimeha Stream | Paetawa - east of Expressway | Perennial | | | | | | | | |
| 39 | 17170 | 4. Waimeha Stream | Paetawa Drain trib under SH1 | Perennial | 25.02 | 87 | 4.4 | 20% | 3 | pasture/nil | mud | 0.491 |
| 40 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | 104.06 | 77 | 4.7 | 13% | 2 | exotics | sand | 0.395 |
| 40.1 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | 104.6 | 77 | 4.7 | 13% | 2 | exotics | sand | 0.395 |
| 40.2 | 17465 | 5. Hadfield Kowhai | Hadfield/Kowhai | Perennial | 104.6 | 77 | 4.7 | 13% | 2 | exotics | sand | 0.395 |
| 40.3 | 17630 | 5. Hadfield Kowhai | Hadfield/Kohwai | Perennial | 104.6 | 77 | 4.7 | 13% | 2 | exotics | sand | 0.395 |
| 40.3 | 17500 | 5. Hadfield Kowhai | Hadfield/Kowhai Diversion | Perennial | | | | | | | | 0.395 |

# Appendix F
# SEV Current and Potential Scores for all Valued Streams

## *Appendix F: SEV Current and Potential Scores for all Valued Streams*

| Ref | Chainage | Catchment Name | Watercourse Form | Type of Works | SEV Score (SEVi-C) | SEV Score (SEVi-P) |
|---|---|---|---|---|---|---|
| 8 | 2600 | 1. Whareroa Stream | Intermittent | Culvert | 0.283 | 0.390 |
| 10 | 3685 | 2. Wharemauku Stream | Perennial | Culvert | 0.304 | 0.537 |
| 10 | 3700 | 2. Wharemauku Stream | Perennial | DIVERSION | 0.304 | 0.537 |
| 11 | 4930 | 2. Wharemauku Stream | Perennial | Culvert | 0.362 | 0.485 |
| 11.1 | 5400 | 2. Wharemauku Stream | Perennial | BRIDGE | 0.437 | 0.537 |
| 14 | 8040 | 3. Waikanae River | Perennial | Culvert | 0.373 | 0.494 |
| 15 | 8500 | 3. Waikanae River | Perennial | Culvert | 0.389 | 0.500 |
| 17 | 8930 | 3. Waikanae River | Intermittent | Culvert | 0.389 | 0.500 |
| 18.1 | 9270 | 3. Waikanae River | Intermittent | Culvert | 0.389 | 0.500 |
| 22.1 | 10600 | 3. Waikanae River | Perennial | DIVERSION | 0.480 | 0.619 |
| 23 | 10600 | 3. Waikanae River | Perennial | BRIDGE | 0.644 | 0.712 |
| 24 | 11700 | 4. Waimeha Stream | Intermittent | DIVERSION | 0.341 | 0.424 |
| 24.1 | 11820 | 4. Waimeha Stream | Intermittent | Culvert | 0.341 | 0.424 |
| 24.3 | 11700 | 4. Waimeha Stream | Intermittent | Culvert | 0.341 | 0.424 |
| 25 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | 0.341 | 0.424 |
| 25.1 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | 0.341 | 0.424 |
| 25.2 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | 0.341 | 0.424 |
| 26 | 13200 | 4. Waimeha Stream | Perennial | Culvert | 0.291 | 0.441 |
| 29a | 14000 | 4. Waimeha Stream | Perennial | BRIDGE | 0.454 | 0.523 |
| 29b | 14000 | 4. Waimeha Stream | Perennial | DIVERSION | 0.454 | 0.523 |
| 30.3 | 14480 | 4. Waimeha Stream | Intermittent | Culvert | 0.381 | 0.456 |
| 30.4 | 14340 | 4. Waimeha Stream | Perennial | DIVERSION | 0.381 | 0.456 |
| 30.5 | 14100 | 4. Waimeha Stream | Perennial | BRIDGE | 0.454 | 0.523 |
| 35 | 15910 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 36 | 16400 | 4. Waimeha Stream | Perennial | BRIDGE | 0.491 | 0.594 |
| 36 | 16400 | 4. Waimeha Stream | Intermittent | DIVERSION | 0.491 | 0.594 |
| 38 | 16805 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 38.1 | 16550 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 38.1 | 16710 | 4. Waimeha Stream | Perennial | DIVERSION | 0.491 | 0.594 |
| 38.2 | 16840 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 38.3 | 17140 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 38.3 | 17100 | 4. Waimeha Stream | Perennial | DIVERSION | 0.491 | 0.594 |
| 38.4 | 17165 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 39 | 17170 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 |
| 40 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 |
| 40.1 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 |
| 40.2 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 |
| 40.3 | 17630 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 |
| 40.3 | 17500 | 5. Hadfield Kowhai | Perennial | DIVERSION | 0.395 | 0.575 |

# Appendix G
# SEV Calculations for Culvert, Diversion and Bridging of Valued Streams

## *Appendix G: SEV Calculations for Culvert, Diversion and Bridging of Valued Streams*

| | | | | | Culvert | | | | Armour | | | | Diversion | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ref | Chainage | Catchment Name | Watercourse Form | Type of Works | SEVi-P | SEVi-I | SEVm-P | SEVm-C | SEVi-P | SEVi-I | SEVm-P | SEVm-C | SEVi-P | SEVi-I | SEVm-P | SEVm-C |
| 8 | 2600 | 1. Whareroa Stream | Intermittent | Culvert | 0.283 | 0.39 | 0.39 | 0.225 | 0.39 | 0.283 | 0.39 | 0.256 | 0.39 | 0.283 | | |
| 9.3a | 2600 | 1. Whareroa Stream | Intermittent | New channel | - | - | | | | | | | | | | |
| 9.3b | 2600 | 1. Whareroa Stream | Intermittent | New channel | - | - | | | | | | | | | | |
| 9.4 | 3500 | 2. Wharemauku Stream | Intermittent | New channel | - | - | | | | | | | | | | |
| 10 | 3685 | 2. Wharemauku Stream | Perennial | Culvert | 0.304 | 0.537 | 0.537 | 0.345 | 0.537 | 0.304 | 0.537 | 0.384 | 0.537 | 0.304 | | |
| 10 | 3700 | 2. Wharemauku Stream | Perennial | DIVERSION | 0.304 | 0.537 | | | | | | | | | 0.537 | |
| 11 | 4930 | 2. Wharemauku Stream | Perennial | Culvert | 0.362 | 0.485 | 0.485 | 0.236 | 0.485 | 0.362 | 0.485 | 0.36 | 0.485 | 0.362 | | |
| 11.1 | 5400 | 2. Wharemauku Stream | Perennial | BRIDGE | 0.437 | 0.537 | | | | | 0.537 | 0.402 | 0.537 | 0.437 | | |
| 14 | 8040 | 3. Waikanae River | Perennial | Culvert | 0.373 | 0.494 | 0.494 | 0.326 | 0.494 | 0.373 | 0.494 | 0.395 | 0.494 | 0.373 | | |
| 15 | 8500 | 3. Waikanae River | Perennial | Culvert | 0.389 | 0.5 | 0.5 | 0.307 | 0.5 | 0.389 | 0.5 | 0.379 | 0.5 | 0.389 | | |
| 17 | 8930 | 3. Waikanae River | Intermittent | Culvert | 0.389 | 0.5 | 0.5 | 0.307 | 0.5 | 0.389 | 0.5 | 0.379 | 0.5 | 0.389 | | |
| 18.1 | 9270 | 3. Waikanae River | Intermittent | Culvert | 0.389 | 0.5 | 0.5 | 0.307 | 0.5 | 0.389 | 0.5 | 0.379 | 0.5 | 0.389 | | |
| 22 | 10300 | 3. Waikanae River | Intermittent | New channel | - | - | | | | | | | | | | |
| 22.1 | 10600 | 3. Waikanae River | Perennial | DIVERSION | 0.48 | 0.619 | | | | | | | | | 0.619 | |
| 23 | 10600 | 3. Waikanae River | Perennial | BRIDGE | 0.644 | 0.712 | | | | | 0.712 | 0.551 | 0.712 | 0.644 | | |
| 24 | 11700 | 4. Waimeha Stream | Intermittent | DIVERSION | 0.341 | 0.424 | | | | | | | | | 0.5 | |
| 24.1 | 11820 | 4. Waimeha Stream | Intermittent | Culvert | 0.341 | 0.424 | 0.424 | 0.223 | 0.424 | 0.341 | 0.424 | 0.362 | 0.424 | 0.341 | | |
| 24.3 | 11700 | 4. Waimeha Stream | Intermittent | Culvert | 0.341 | 0.424 | 0.424 | 0.223 | 0.424 | 0.341 | 0.424 | 0.362 | 0.424 | 0.341 | | |
| 25 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | 0.341 | 0.424 | | | | | 0.424 | 0.362 | 0.424 | 0.341 | | |
| 25.1 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | 0.341 | 0.424 | | | | | 0.424 | 0.362 | 0.424 | 0.341 | | |
| 25.2 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | 0.341 | 0.424 | | | | | 0.424 | 0.362 | 0.424 | 0.341 | | |
| 26 | 13200 | 4. Waimeha Stream | Perennial | Culvert | 0.291 | 0.441 | 0.441 | 0.274 | 0.441 | 0.291 | 0.441 | 0.38 | 0.441 | 0.291 | | |
| 29a | 14000 | 4. Waimeha Stream | Perennial | BRIDGE | 0.454 | 0.523 | | | | | 0.523 | 0.448 | 0.523 | 0.454 | | |
| 29b | 14000 | 4. Waimeha Stream | Perennial | DIVERSION | 0.454 | 0.523 | | | | | | | | | 0.5 | |
| 30 | 14000 | 4. Waimeha Stream | Intermittent | New channel | - | - | | | | | | | | | | |
| 30.3 | 14480 | 4. Waimeha Stream | Intermittent | Culvert | 0.381 | 0.456 | 0.456 | 0.293 | 0.456 | 0.381 | 0.456 | 0.297 | 0.456 | 0.381 | | |
| 30.4 | 14340 | 4. Waimeha Stream | Perennial | DIVERSION | 0.381 | 0.456 | | | | | | | | | 0.456 | |

| | | | | | Culvert | | | | Armour | | | | Diversion | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ref | Chainage | Catchment Name | Watercourse Form | Type of Works | SEVi-P | SEVi-I | SEVm-P | SEVm-C | SEVi-P | SEVi-I | SEVm-P | SEVm-C | SEVi-P | SEVi-I | SEVm-P | SEVm-C |
| 30.5 | 14100 | 4. Waimeha Stream | Perennial | BRIDGE | 0.454 | 0.523 | | | | | 0.523 | 0.448 | 0.523 | 0.454 | | |
| 35 | 15910 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 36 | 16400 | 4. Waimeha Stream | Perennial | BRIDGE | 0.491 | 0.594 | | | | | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 36 | 16400 | 4. Waimeha Stream | Intermittent | DIVERSION | 0.491 | 0.594 | | | | | | | | | 0.594 | |
| 38 | 16805 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 38.1 | 16550 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 38.1 | 16710 | 4. Waimeha Stream | Perennial | DIVERSION | 0.491 | 0.594 | | | | | | | | | 0.594 | |
| 38.2 | 16840 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 38.3 | 17140 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 38.3 | 17100 | 4. Waimeha Stream | Perennial | DIVERSION | 0.491 | 0.594 | | | | | | | | | 0.594 | |
| 38.4 | 17165 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 38.4 | 17200 | 4. Waimeha Stream | Perennial | New channel | - | - | | | | | | | | | | |
| 39 | 17170 | 4. Waimeha Stream | Perennial | Culvert | 0.491 | 0.594 | 0.594 | 0.366 | 0.594 | 0.491 | 0.594 | 0.48 | 0.594 | 0.491 | | |
| 40 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 | 0.575 | 0.282 | 0.575 | 0.395 | 0.575 | 0.349 | 0.575 | 0.395 | | |
| 40.1 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 | 0.575 | 0.282 | 0.575 | 0.395 | 0.575 | 0.349 | 0.575 | 0.395 | | |
| 40.2 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 | 0.575 | 0.282 | 0.575 | 0.395 | 0.575 | 0.349 | 0.575 | 0.395 | | |
| 40.3 | 17630 | 5. Hadfield Kowhai | Perennial | Culvert | 0.395 | 0.575 | 0.575 | 0.282 | 0.575 | 0.395 | 0.575 | 0.349 | 0.575 | 0.395 | | |
| 40.3 | 17500 | 5. Hadfield Kowhai | Perennial | DIVERSION | 0.395 | 0.575 | | | | | | | | | 0.575 | |
| 8 | 2600 | 1. Whareroa Stream | Intermittent | Culvert | 0.283 | 0.39 | 0.39 | 0.225 | 0.39 | 0.283 | 0.39 | 0.256 | 0.39 | 0.283 | | |
| 9.3a | 2600 | 1. Whareroa Stream | Intermittent | New channel | - | - | | | | | | | | | | |

# Appendix H
# Ecological Mitigation Ratios for stream works in valued streams

## *Appendix H: Ecological Mitigation Ratios for stream works in valued streams*

| BECA Reference | Chainage | Catchment Name | Watercourse Form | Type of Works | ECR culvert | ECR Armour | ECR Diversion | Combined ECR Value |
|---|---|---|---|---|---|---|---|---|
| 8 | 2600 | 1. Whareroa Stream | Intermittent | Culvert | 2.3 | 1.9 | | 90 |
| 10 | 3685 | 2. Wharemauku Stream | Perennial | Culvert | 1.2 | 1.0 | | 84 |
| 10 | 3700 | 2. Wharemauku Stream | Perennial | DIVERSION | | | 1.2 | 62 |
| 11 | 4930 | 2. Wharemauku Stream | Perennial | Culvert | 3.0 | 1.5 | | 333 |
| 11.1 | 5400 | 2. Wharemauku Stream | Perennial | BRIDGE | | 2.0 | | 65 |
| 14 | 8040 | 3. Waikanae River | Perennial | Culvert | 2.1 | 1.2 | | 271 |
| 15 | 8500 | 3. Waikanae River | Perennial | Culvert | 2.6 | 1.6 | | 179 |
| 17 | 8930 | 3. Waikanae River | Intermittent | Culvert | 2.6 | 1.6 | | 182 |
| 18.1 | 9270 | 3. Waikanae River | Intermittent | Culvert | 2.6 | 1.6 | | 44 |
| 22.1 | 10600 | 3. Waikanae River | Perennial | DIVERSION | | | 1.4 | 41 |
| 23 | 10600 | 3. Waikanae River | Perennial | BRIDGE | | 3.6 | | 295 |
| 24 | 11700 | 4. Waimeha Stream | Intermittent | DIVERSION | | | 1.2 | 419 |
| 24.1 | 11820 | 4. Waimeha Stream | Intermittent | Culvert | 3.6 | 1.1 | | 10 |
| 24.3 | 11700 | 4. Waimeha Stream | Intermittent | Culvert | 3.6 | 1.1 | | 8 |
| 25 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | | 1.1 | | 36 |
| 25.1 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | | 1.1 | | 17 |
| 25.2 | 11800 | 4. Waimeha Stream | Perennial | BRIDGE | | 1.1 | | 17 |
| 26 | 13200 | 4. Waimeha Stream | Perennial | Culvert | 1.7 | 0.6 | | 129 |
| 29a | 14000 | 4. Waimeha Stream | Perennial | BRIDGE | | 1.6 | | 130 |
| 29b | 14000 | 4. Waimeha Stream | Perennial | DIVERSION | | | 1.2 | 146 |
| 30.3 | 14480 | 4. Waimeha Stream | Intermittent | Culvert | 3.3 | 3.2 | | 116 |
| 30.4 | 14340 | 4. Waimeha Stream | Perennial | DIVERSION | | | 0.9 | 467 |
| 30.5 | 14100 | 4. Waimeha Stream | Perennial | BRIDGE | | 1.6 | | 41 |
| 35 | 15910 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 182 |
| 36 | 16400 | 4. Waimeha Stream | Perennial | BRIDGE | | 1.7 | | 50 |
| 36 | 16400 | 4. Waimeha Stream | Intermittent | DIVERSION | | | 1.4 | 96 |
| 38 | 16805 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 248 |
| 38.1 | 16550 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 132 |
| 38.1 | 16710 | 4. Waimeha Stream | Perennial | DIVERSION | | | 1.4 | 69 |
| 38.2 | 16840 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 45 |
| 38.3 | 17140 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 111 |
| 38.3 | 17100 | 4. Waimeha Stream | Perennial | DIVERSION | | | 1.4 | 370 |
| 38.4 | 17165 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 53 |
| 39 | 17170 | 4. Waimeha Stream | Perennial | Culvert | 3.3 | 1.7 | | 16 |
| 40 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 2.4 | 1.9 | | 37 |
| 40.1 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 2.4 | 1.9 | | 134 |
| 40.2 | 17465 | 5. Hadfield Kowhai | Perennial | Culvert | 2.4 | 1.9 | | 86 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 40.3 | 17630 | 5. Hadfield Kowhai | Perennial | Culvert | 2.4 | 1.9 | | 86 |
| 40.3 | 17500 | 5. Hadfield Kowhai | Perennial | DIVERSION | | | 1.3 | 79 |
| | | | | | | | | 4,973 |

# Appendix I
# Landscape and amenity planting

## *Appendix I: Landscape and amenity planting*

Planting and revegetation treatments will include the following:

- *Mass planting* – trees and shrubs, typically native species selected from a palette of proven species eco-sourced from the Foxton Ecological District. This planting will be the dominant type for most areas along the route, including both the 'wet' swales and 'dry' swales and planting in the median.
- *Mass planting with tree enrichment* – similar to above but with eco-sourced canopy tree species planted, generally a year or more after the initial planting has been carried out. The mass planting will provide shelter and a better growing environment for the canopy tree species.
- *Specimen trees underplanted with groundcover species* – this planting type is mostly confined to the Kāpiti and Te Moana interchanges and comprises large grade native or exotic tree species with small grade native or exotic groundcover species.
- *Trees with grass* – this is proposed in the open rural areas with the aim of re-establishing pasture close to the road with shelterbelts or groups of rural type tree species in places.
- *Riparian planting* – where the proposed Expressway crosses streams and waterways riparian planting using native species will be planted 10.0m on both sides of the waterway extending approximately 50m upstream and downstream of the proposed Expressway. This planting will be closely-spaced using eco-sourced species from the Foxton Ecological District with the aim to create a dense band of planting that will overhang the stream to provide shade and habitat.
- *Wetland planting* – forming the edges of wetlands and then planting these areas with a range of proven species will be challenging both in terms of plant establishment and ongoing maintenance. Aggressive exotic pest plants are well established and a problem in many of the existing wetlands on the Kāpiti Coast, including those along the proposed Expressway route. Plant establishment will rely on ensuring the overall form and design of wetland areas provide suitable habitat for plant establishment, and good site preparation prior to planting is carried out and then timely maintenance to ensure pest plants and animals are controlled.
- *Wetland areas proposed* – two types are proposed: ecological wetlands and stormwater treatment wetlands. There are several existing wetlands along the route and most of these have been avoided and will be retained as key ecological features. However, control of pest plants will be required and also some additional planting. The margins of existing wetlands that are disturbed will be rehabilitated. In addition, there is one new ecological wetland area proposed near Otaihanga Road.
- *Stormwater treatment wetlands*- will in many instances have a similar appearance to ecological wetlands but their function will be quite different; they will collect and treat stormwater from the proposed Expressway. They will require a totally different kind of maintenance to the ecological wetlands with periodic cleaning with removal of slit and contaminated material from proposed Expressway runoff. A similar range of eco-sourced native plants will be used in both types of wetlands.
- *Flood storage areas* –are extensive in several places along the route. Generally, these areas once formed, will be re-grassed and grazing continued wherever possible. Some will have areas of standing water whereas other flood storage areas will remain damp and periodically they will become inundated with flood waters. In some locations, where there are additional ecological values or amenity requirements, these flood

storage areas will be planted with appropriate local native species (e.g. north of Kakariki Stream).