Hawke's Bay Regional Investment Company Limited

Ruataniwha Water

Storage Scheme

Terrestrial Ecology Study

Assessment of Ecological Effects

FINAL

May 2013.

Volume I

Kessels & Associates Ltd
ECOLOGY AND ENVIRONMENTAL PLANNING

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Glossary of terms and abbreviations used

Term	Definition
ABM	Automatic bat monitoring recorder
ACO	Artificial cover object, used primarily for reptile surveys
BBOP	Biodiversity offsetting principles
BioWeb	Department of Conservation biodiversity database
Concave densitometer	A device for measuring percentage of canopy cover. Consists of a concave mirror with segments for estimating percentages of canopy cover.
Dam	The proposed Ruataniwha Water Storage Scheme dam, also referred to as "the dam".
DOC	New Zealand Department of Conservation
Edge effects	The term "edge effects" describes a broad range of alterations of environmental and biological processes that can occur along boundaries of habitat fragments. Edge effects may vary depending on size and shape of fragment, the distance from fragment boundary, as well as the proximity to other habitat fragments.
Footprint	The area covered by the proposed Ruataniwha Water Storage Scheme reservoir, and / or dam structure (e.g. "the reservoir / dam footprint").
GIS	Geographical information system is a set of digital tools to perform mapping an spatial analysis tasks.
HBRC	Hawke's Bay Regional Council
HBRIC	Hawke's Bay Regional Investment Company Limited
H soil horizon	Organic soil horizon, consists of partly decomposed leaves, twigs etc. Some original structures are hard to discern. In contrast to L horizon where original structures are clearly visible, and leaves, for example, are not or only slightly decomposed.
KAL	Kessels & Associates Limited
LENZ	Land Environments of New Zealand is a dataset of New Zealand's terrestrial environments containing spatial and categorical data, such as location and extent of certain vegetation cover types.
Malaise trap	A large, tent-like structure used for sampling flying insects. Insects fly into the tent wall and are funnelled into a collecting vessel attached to the highest point.
MfE	New Zealand Ministry for the Environment
NPS	National policy statement on biodiversity
NZST	New Zealand Standard Time
OSNZ	Ornithological Society of New Zealand
RAP	Recommended area for protection
RECCE	"RECCE" or "RECCE plot" or "Reconnaissance" refers to standardised quantitative method for surveying vegetation at certain sites.
Reservoir	The proposed Ruataniwha Water Storage Scheme reservoir, also referred to as "the reservoir".
Reservoir area	The area covered by the proposed Ruataniwha Water Storage Scheme reservoir.
RMA	Resource Management Act
RTU	Recognizable taxonomic unit used in rapid biodiversity surveys, provides a way to measure species richness where proper taxonomic identification is not feasible
RWSS	Ruataniwha Water Storage Scheme
SBBG	Southern black-backed gull
The Scheme	Ruataniwha Water Storage Scheme
Tracking tunnel	Device that can be used for monitoring the presence of ground living reptiles, weta, but also introduced rodents for example.

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Executive Summary

This Terrestrial Ecology Study is one of the scientific assessment studies that will provide the information for the resource consenting process for the proposed Ruataniwha Water Storage Scheme in Central Hawke's Bay. Kessels & Associates (KAL) have been engaged by Hawke's Bay Regional Investment Company Limited (HBRIC) to conduct an ecological impact assessment of the Scheme and make recommendations regarding measures to avoid, mitigate or offset potential adverse effects on indigenous terrestrial fauna and flora species and their habitats. The focus of this assessment and report is on the reservoir and dam components of the Scheme, although the assessment extends to the braided river ecosystems downstream of the dam and reservoir.

Potential Ecological Effects

The potential ecological effects of the construction and operation of the Scheme on terrestrial indigenous fauna and flora as assessed in this report are:

- A permanent loss of a variety of indigenous vegetation communities and braided river within the reservoir ,dam and spillway footprint area;
- A permanent loss of a variety of feeding, roosting and breeding habitats (both exotic and indigenous) for birds, lizards, bats and invertebrates;
- Alteration of habitats for indigenous flora and fauna within and adjacent to braided river ecosystems downstream of the dam and upstream water intake structure associated with changes in sediment deposition rates, river flow patterns and changes in landuse; and
- A change of habitat types on the margins of the reservoir due to changes in hydrology and effects of seasonal and irrigation drawdown causing inundation and ebbing of the 'lake' edge; and
- Disturbance of remaining indigenous flora and fauna adjacent to the reservoir due to potential increases in the recreational use of the reservoir and its margins.

Assessments Undertaken

Field assessments have been undertaken over the period of September 2011 to February 2013 within, and over areas potentially affected by, the proposed dam and reservoir components of the Scheme. In addition, literature searches, data analysis, GIS mapping analysis and ecological significance determination have also been undertaken during this period. Specifically, the investigations have focussed on:

- Field Investigations to ground truth and refine vegetation maps and to assess whether any at risk or threatened plants are in the affected areas;
- Avifauna surveys to determine relative abundance of common indigenous and native birds and to assess whether any at risk and/or threatened birds utilise the affected areas;
- Field investigations to confirm the level of importance of affected habitat for long-tailed bats;
- Field investigations to confirm the importance of affected habitat for lizards, in particular to identify the presence or absence of at risk and threatened species;
- Field investigations to confirm the importance of affected habitat for invertebrates, in particular to identify the presence or absence of at risk or threatened species;
- An examination of the impact of habitat loss on functional landscape ecology values;
- Potential effects of river morphology changes on terrestrial linked ecosystem values; and

- Recommendations for appropriate measures to avoid, remedy, mitigate, or offset for any potential adverse effects identified.

Results of the Assessment

- The total area affected by flooding, the dam structure and spoil disposal is approximately 450.18 ha. A total of 185.18 ha of ecologically significant indigenous vegetation and habitats would be flooded by the proposed reservoir, or covered over by associated infrastructure including the dam structure, new access tracks and soil disposal sites. This comprises of: 80.71 ha of mature and secondary indigenous forest (including a number of trees which would be in excess of 300 years old); 2.69 ha of treeland; 22.70 ha of secondary indigenous scrub; 73.97 ha of gravel river bed; and 5.11 ha of wetland or seep zones. One At Risk plant species was found – red mistletoe.
- A total of 38 bird species (11 endemic) were identified at the proposed reservoir locality during formal field surveys. Of all individual birds formally observed 55% were native and 45% introduced. Threatened or At Risk species comprise 2.5% of all observations, including one pair of nesting and Nationally Vulnerable New Zealand bush falcon, and one adult banded dotterel with a chick. Nationally 'At Risk' species detected were pied stilt, New Zealand pipit, black shag and North Island fernbird.
- Long-tailed bats were found throughout the proposed reservoir during an ultrasonic survey completed between November 2011 and February 2012 and again between January and February 2013. Simultaneous surveys of the reservoir area and wider landscape showed that it is likely that bats are resident and roosting within the reservoir area, and then move out into the wider landscape throughout the night. Activity levels are higher within the reservoir zone when compared to the wider landscape demonstrating the importance of this habitat for the bats, albeit evidence of a discrete population within the wider landscape was obtained through the surveys.
- Eleven lizard species are known from the southern Hawke's Bay region or neighbouring areas of the southern North Island. However, only one lizard was found during the field survey. This was a southern North Island forest gecko. It is not classified as being a nationally At Risk or Threatened species.
- Targeted rapid surveys for terrestrial invertebrates were undertaken within the proposed reservoir site in December 2011 and again in January 2012. In addition, passive detection devices have been deployed and checked throughout the site from November 2011 until February 2013. Results showed a rich diversity of insects and land snails. Two individuals of the 'At Risk' Hawke's Bay tree weta, *Hemideina trewicki*, have been discovered within the study area.

Suggested Approach for the Effects Identified

A number of measures are required to avoid or remedy potential adverse effects on terrestrial ecology. These include:

- A bat management plan;
- A pre-construction lizard survey and translocation plan;
- Weed hygiene and surveillance; and
- Post-construction monitoring of key wader bird species within affected braided river habitat and contingency habitat enhancement if adverse effects are shown to occur.

In addition to measures to avoid, remedy or directly mitigate for potentially affected flora and fauna, three key Mitigation and Offset packages are recommended. These are:

A Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone: The objectives of this package are to:

- Recreate 46 ha of riparian margin with indigenous vegetation, which will provide habitats and ecological linkages for a wide range of fauna and flora.
- Restore and enhance at least 100 ha of marginal farmland and existing forest, scrub, treeland, shrubland and wetland remnants within the sub-catchment above the dam to quickly improve existing habitat for flora and fauna, reinforce ecological linkages

within the landscape and provide refuge for species during and after the flooding process.

B Ruataniwha Riparian Enhancement Zone (River Halo Project): The objectives for this package are to:

- Control of willows/lupins and other braided river weeds to maintain and enhance habitat for wading birds, particularly banded dotterel, within the Waipawa and Makaroro Rivers. This may also include fencing and restoring margins of the main stems of the two rivers where required, in consultation with adjoining landowners. The primary target area for these works would be high quality wading bird habitat.
- Assist landowners with fencing, replanting (as required) and legally protecting existing areas of wetlands, bush and scrub within or contiguous with the 1 km buffer (width) enhancement zone.

C Ruataniwha Threatened Species Habitat Enhancement: Its objectives are to -

- Targeted assistance programme to foster research, advocacy and habitat protection/enhancement for bats and their habitats throughout Hawke's Bay.
- Predator trapping programme to enhance the biodiversity values of indigenous forest areas within the upper Makaroro River catchment and downstream of the dam structure to Caldwell Road (principally focusing on blue duck and wader bird habitats, subject to results of pre-construction blue duck survey and wader bird population survey).
- Trap and transfer programme focusing on native fish.

The above programmes would result in a number of significant ecological benefits, including: Intensive, targeted animal pest control over 1,100 ha of habitats within the Makaroro River catchment, 146 ha of habitat recreation and enhancement around the new reservoir and within its sub-catchment; assisting landowners to protect and manage over some 622 ha of bush, scrub and wetland, and approximately 314 ha of braided river habitat for wading birds within a corridor of the mid reaches of the Waipawa and Makaroro Rivers; and contributing towards projects that will enhance the knowledge of Threatened and At Risk species, as well as their habitats within the Hawke's Bay region. In addition, Project E will recreate and restore wetlands in and along the Old Waipawa River / Papanui Stream, providing additional compensation for the wetland ecosystem losses associated with the Scheme.

The mitigation recommendations contained within this report have been integrated into a separate report entitled "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (HBRIC 2013f), which should be read in conjunction with this report.

1 Introduction

1.1 Project Outline

This Terrestrial Ecology Study is one of the scientific assessment studies that will provide the information for the resource consenting process for the proposed Ruataniwha Water Storage Scheme ("the Scheme") in Central Hawke's Bay. The Scheme essentially involves surface water harvesting, storage and distribution for servicing irrigable land principally located on the Ruataniwha Plains.

Kessels & Associates (KAL) have been engaged by Hawke's Bay Regional Investment Company Limited (HBRIC) to conduct an ecological impact assessment of the Scheme and make recommendations regarding measures to avoid, mitigate or offset potential adverse effects on indigenous terrestrial fauna and flora species and their habitats. The focus of this assessment and report is on the reservoir and dam components of the Scheme, although the assessment extends to the braided river ecosystems downstream of the dam and reservoir.

The assessment of ecological effects in this report is based on the Ruataniwha Water Storage Scheme Project Description (Tonkin & Taylor, May 2013a).

The investigations summarised in this report have focussed on:

a) Field Investigations to ground truth and refine vegetation maps and to assess whether any at risk or threatened plants are in the affected areas;

b) Avifauna surveys to determine relative abundance of common indigenous and native birds and to assess whether any at risk and/or threatened birds utilise the affected areas;

c) Field investigations to confirm the level of importance of affected habitat for long-tailed bats;

d) Field investigations to confirm the importance of affected habitat for lizards, in particular to identify the presence or absence of at risk and threatened species;

e) Field investigations to confirm the importance of affected habitat for invertebrates, in particular to identify the presence or absence of at risk or threatened species;

f) An examination of the impact of habitat loss on functional landscape ecology values;

g) Potential effects of river morphology changes on terrestrial linked ecosystem values; and

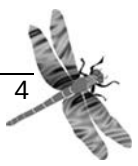
h) Recommendations for appropriate measures to avoid, remedy, mitigate, or offset for any potential adverse effects identified.

1.2 Report Structure

Following this introduction the report is structured as follows:

Section 2 Methodology

While the different biodiversity survey methodologies are described in detail in the respective sections, this section presents an overview of the literature review and biodiversity offsetting methodologies that were applied during creation of this report.



Section 3 The Ecological Landscape Context

The dam and reservoir area is set into context with the wider ecological landscape. Consideration is hereby given to the different ecological districts, ecosystems, soil characteristics, and existing protected natural areas within the region.

Section 4 Threatened and At Risk Species

Background on the assessment of Threatened or At Risk species, as well as a summary of any Threatened and At Risk species discovered during the course of this work is provided. This section also contains additional information from the BioWeb database.

Section 5 Botanical Surveys & Assessment

The botanical survey methodology is described, and findings from RECCE plots and GIS vegetation mapping are presented. Any Threatened or At Risk plant species discovered during the botanical survey are commented on.

Section 6 Avifauna Surveys & Analysis

The avifauna survey methodology is described, and findings from five-minute bird counts and walkthrough surveys, as well as casual observations of birds and BioWeb database queries are presented. Any Threatened or At Risk bird species discovered during the avifauna survey are commented on.

Section 7 Bat Surveys & Analysis

The bat survey methodology is detailed, and its findings are presented. Results from surveying long-tailed bat activity within the reservoir area and among wider landscape are discussed in terms of how long-tailed bats may utilize the available habitat.

Section 8 Herpetofauna Surveys & Assessment

The methodology of the herpetofauna survey is described, and findings from habitat searches, tracking tunnels set-ups, as well as occupancy surveys of artificial cover objects are presented.

Section 9 Terrestrial Invertebrate Surveys & Assessment

The survey methodology for terrestrial invertebrates is described, and findings from the terrestrial Gastropod and Hymenoptera biodiversity assessments are presented and discussed. Threatened and At Risk terrestrial invertebrate species

discovered during this survey are commented on. Results of a terrestrial invertebrate literature study are summarised.

Section 10 Animal Pests and Weeds

A summary of introduced pest animal and plant species within and around the Scheme area is provided. Where applicable existing pest management regimes are outlined.

Section 11 Ecological Significance Assessment

Criteria for assessing the significance of the natural environment within the dam and reservoir area are provided, and a summary of significant vegetation and Threatened and at Risk species within the Scheme area is given.

Section 12 Assessment of Effects on Terrestrial Indigenous Fauna and Flora

This sections deals with the effects on the terrestrial indigenous flora and fauna the Scheme may have during, and after dam construction and reservoir filling are complete. A detailed analysis of significant vegetation loss within the dam and reservoir area, as well as edge and draw down effects are also provided. Amelioration and monitoring recommendations for the different biodiversity components are given.

Section 13 Biodiversity Offsetting Recommendations

Biodiversity offsetting criteria are described, and recommendations made for specific offset mitigation projects.

Section 14 Conclusions & Recommended Amelioration Measures

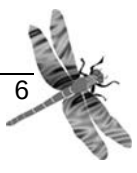
Key findings from biodiversity surveys are reiterated, and a summary of recommended mitigation and monitoring measures is provided.

Volume II of this report contains the following Appendices. Additional explanation to the appendix content is provided where the appendix title is not self-explanatory.

Appendix I Additional Information on Threatened and At Risk Flora and Fauna Species Recorded from within a 10 km Radius around the Scheme Area

Appendix II Plant Species List

List of plant species encountered within the Scheme area.



Appendix III RECCE Plot Data

Supplementary information from RECCE plots as part of the botanical biodiversity survey.

Appendix IV Photos of Vegetation Types Present within the Proposed Reservoir Footprint

Appendix V Maps of Vegetation Communities showing Detailed Classifications

Vegetation community maps showing classification of areas within the Scheme.

Appendix VI List of all Bird Species Observed on Site or Discussed within this Report

Appendix VII Sample Water Bird/Wader Walkthrough Field Data Sheet

A sample of the water bird/wader walkthrough field data sheet.

Appendix VIII Bat Survey Data Summary

Appendix IX Abundance Tables of Hymenoptera and Terrestrial Gastropod Species/RTUs

Appendix X Environmental Information on Invertebrate Sampling Sites

Appendix XI Weed Species Recorded from within a 10 km Radius around the Reservoir Area

Appendix XII Section 3.4 of the Hawke's Bay Regional Policy Statement

HBRC Policy statement on the scarcity of indigenous vegetation and wetlands.

Appendix XIII Central Hawke's Bay District Plan Criteria for Determining 'Areas of Significant Nature Conservation Value'

Appendix XIV Response Letter to Stakeholder Group Feedback

Appendix XV Peer-Review Letter and Response to Peer-Review Letter

Appendix XVI Terrestrial Invertebrate Literature Study

Literature study on beetle, spider, moth and butterfly species potentially found within or near the Scheme area is outlined, and findings for any At Risk, or Threatened species are presented.

2 Methodology

2.1 Method Overview

Following the preparation of a number of background reports, literature reviews (Forbes *et al*., 2011, Kessels *et al*., 2011), and consultation with key stakeholders, field surveys and data analysis were conducted commencing September 2011. The primary outcomes of these investigations include: the mapping of all major vegetation types, fauna habitat communities, and compiling a list of species and their distribution and key habitats within the dam/reservoir footprint as well as an assessment of ecological effects on terrestrial invertebrate, herpetofauna (lizard), avifauna and bat species and their habitats.

The detailed methodologies for the flora and fauna surveys are described in the relevant sections below.

2.2 Review of Existing Literature and Information

All existing databases and reports were reviewed to ascertain the characteristics and locations of key significant natural areas and fauna habitats within the study area. Specifically the following documents and databases were reviewed:

- The pre-feasibility study by MWH (Forbes, 2011);
- MWH wider ecological landscape study (Tukituki Catchment study; Forbes *et al.*, 2011b)
- Tonkin & Taylor Technical Feasibility Study - Initial Project Description (Tonkin & Taylor, 2011);
- Tonkin & Taylor Feasibility Project Description (Tonkin & Taylor, 2012);
- Tonkin & Taylor Project Description (Tonkin & Taylor, May 2013a);
- Protected Natural Areas (PNA) Survey of the Ruahine Lowlands by Fromont (1991);
- Ruahine Forest Park Conservation Management Plan by the Department of Conservation (DOC) (1992);
- Heretaunga Ecological District - Survey report for the Protected Natural Areas Programme by Lee (1994);
- The species list of the Blowhard Reserve Management Plan and Yeoman's Track (Jane & Donaghy, 2006)
- "A checklist of the Arthropoda from Hawke's Bay New Zealand" by T.H. Davies (1986);
- Threatened Environment Classification Maps and Criteria;
- Land Cover Database II (LCDB2);
- DoC Conservation Land and BioWeb data;
- Ornithological Society of New Zealand (OSNZ) national bird-distribution database;
- Operative Central Hawke's Bay District Plan; and
- Operative Hawke's Bay Regional Policy Statement.

2.3 Biodiversity Offsetting

As part of this assessment on the ecological effects of the Scheme, in addition to the requirements of the RMA, the mitigation packages recommended have also been tested in terms of how they meet the principles of "Biodiversity Offsetting".

As the Department of Conservation notes in its factsheet on the matter (DOC, 2011): "*It is essential to note that offsets do not replace the [RMA] mitigation hierarchy, but are a means to*

address the residual adverse biodiversity impacts arising from project development after appropriate avoidance and mitigation measures have been taken."[1] However, while biodiversity offsets can provide a way to transparently quantify environmental compensation, biodiversity offsetting as an approach is *not* explicitly provided for under New Zealand's legislative framework and models associated with quantifying offset requirement are in the very early stages of development for the New Zealand ecosystems.

Biodiversity offsets have been defined as: "*measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and mitigation measures have been implemented. The goal of biodiversity offsets is to achieve no net loss, or preferably a net gain, of biodiversity on the ground with respect to species composition, habitat structure and ecosystem services, including livelihood aspects*"[2].

Internationally, this process is being conducted in a standardised and coordinated manner in conjunction with or using resources developed by the Business and Biodiversity Offsets Programme (BBOP). The key tool developed by BBOP includes a set of guiding principles and associated draft criteria and indicators. It is important to note that the BBOP tools have been designed principally for international projects where government environmental regulation is weak or non-existent. These tools therefore contain many of the key principles that already underlie international best practice environmental impact assessment methods, and which are already reflected in the RMA.

Section 13 of this report provides details for the mitigation objectives, requirements and recommendations for a number of offset mitigation packages in order to compensate for the residual adverse terrestrial ecological effects associated with the Scheme.

3 The Ecological Landscape Context

3.1 Ecological Districts

An Ecological District (ED) is a scientifically determined region which reflects the underlying biophysical characteristics of a locality. Each ED has a number of unique or distinctive natural habitat features (usually botanical) which distinguishes it from neighbouring EDs. In this study two main EDs were investigated – the Ruahine ED, in which the proposed reservoir area is situated, and the Heretaunga ED, which lies approximately 4.0 km downstream of the reservoir where populations of resident shorebirds as well as potential habitats for North Island long-tailed bats were monitored.

The Makaroro River flows into the Waipawa River and is part of the Waipawa catchment (refer to Figure 1 below for the location of the EDs in relation to the Waipawa catchment and the Hawke's Bay regional boundary).

Section 11 provides detailed analysis of the extent of the vegetation clearance under the reservoir footprint in relation to remaining vegetation within the Ruahine Ecological District as a whole.

3.2 Threatened Environments

Land Environments of New Zealand (LENZ) is a national environment-based classification of ecosystems mapped across New Zealand's landscape based on the wider ecological theory as described by Walker *et al*. (2004). Section 11 provides an analysis of LENZ in relation to the reservoir footprint. LENZ uses 15 climate, landform and soil variables likely to influence the distribution of species to classify and map areas that have similar environmental or ecosystem character. LENZ is a surrogate for the likely past (pre-human) pattern of terrestrial ecosystems and their associated biodiversity. When LENZ is combined with an analysis of changes in the Land Cover Database and these data are compared to a national database of the protective status of land, it has become possible to identify broad patterns of change, vulnerability and

[1] http://www.doc.govt.nz/publications/conservation/biodiversity-offsets-programme/biodiversity-offsets-programme/

[2] Business and Biodiversity Offsets Programme (BBOP), 2009. Business, Biodiversity Offsets and BBOP: An Overview. BBOP, Washington, D.C.

protection (Walker *et al*., 2007). The Threatened Environment Classification (TEC) assigns one of six threat categories on the basis of: (a) past loss of indigenous vegetation and braided river habitat (% indigenous vegetation & braided river habitat left), and (b) current legal protection (% protected). The six threat categories are as follows:

Category	Criteria	Category Name
1	< 10 % indigenous vegetation left	Acutely Threatened
2	10-20 % indigenous vegetation left	Chronically Threatened
3	20-30 % indigenous vegetation left	At Risk
4	>30 % left & 10 % protected	Critically Under-protected
5	>30 % left & 10-20 % protected	Under-protected
6	>30 % left & > 20 % protected	Less Reduced & Better Protected

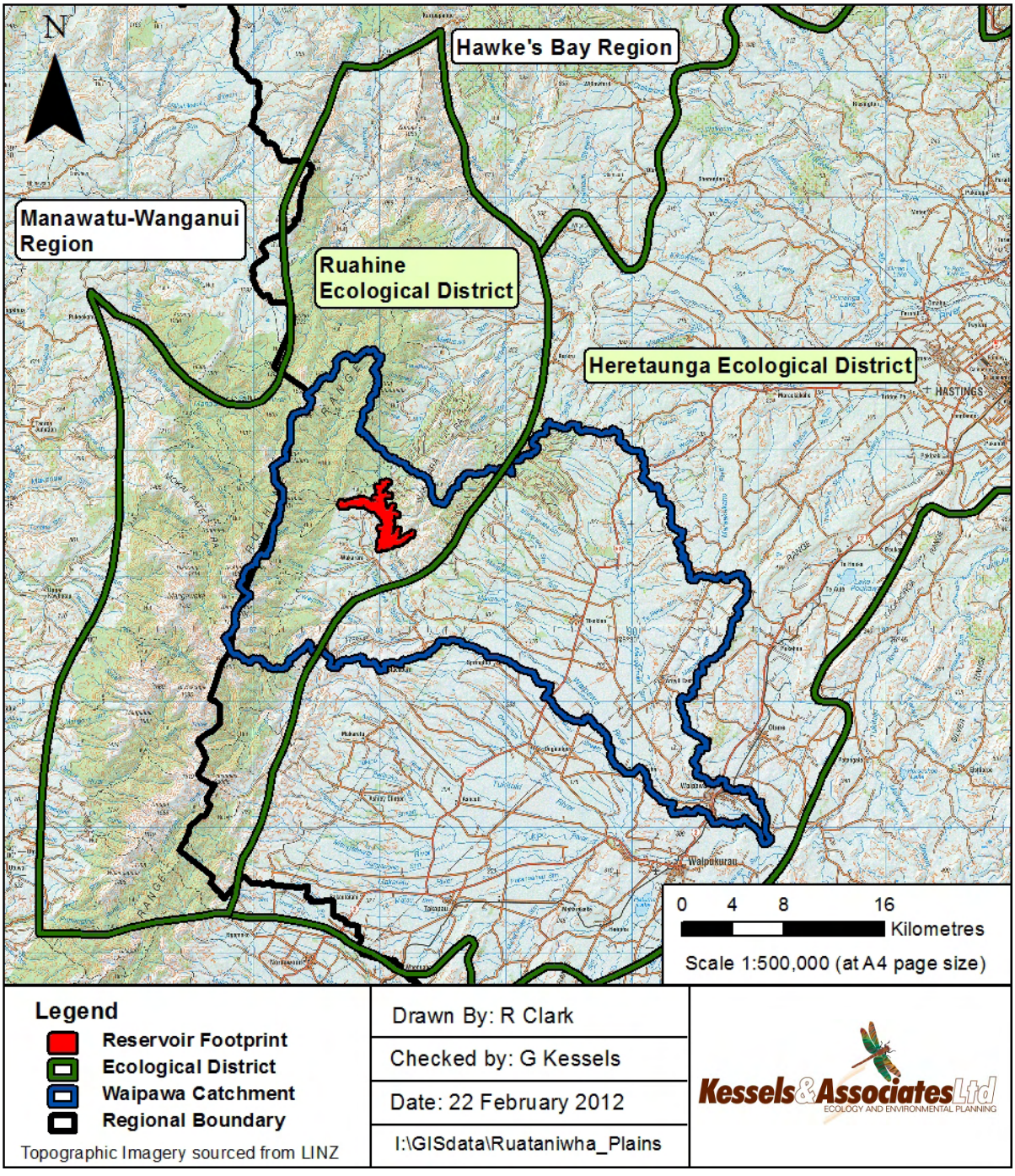


Figure 1 Location of the proposed reservoir site within the wider landscape

3.3 Soil Types

Recent assessments of soil types have only been undertaken with regards to their irrigability in the receiving service area downstream of the study site (Webb, 2011), i.e. reasonably far away from the proposed reservoir.

According to Fromont (1991), the soil types in the proposed reservoir area are derived mostly from the Greywacke material of the nearby mountain ranges, i.e. Ruahine to the west and Wakarara to the north-east, as well as some volcanic ash. Different silt loam soils are present in the riverbed, such as Taihape silt loam (Mudstone), Kopua silt loam (Alluvium from greywacke and volcanic ash), Ruahine silt loam (Greywacke), Matamata silt loam (Pumiceous sandstone and mudstone) and Dannevirke silt loam (Alluvium from greywacke and volcanic ash).

3.4 Existing Protected Natural Areas

Figure 2 outlines the location of the protected natural areas found within and in close vicinity of the proposed reservoir footprint. Protected Areas and Recommended Areas for Protection (RAPs) within a 10 km radius of the proposed reservoir are shown in Figure 3. The reservoir footprint encompasses two areas of the Ruahine Forest Park (22.2 ha in total) that are managed by the Department of Conservation (refer to Table 1). One of these areas is listed as an 'Area of Significant Nature Conservation Value' in Appendix D of the Central Hawke's Bay District Plan (i.e. 'Site 18' – 'Bush margin – Makaroro River', an area of 7.9 ha that is part of the Ruahine Forest Park).

Several privately owned QEII National Trust open space covenants are situated within a 10 km radius around the site, but no covenant is present within the reservoir footprint. There are also no RAPs located within the proposed reservoir area.

Table 1 DOC land within the proposed reservoir footprint

Name of Conservation Area	Total Area (ha)	Area within Reservoir Footprint (ha)	Notes
Ruahine Forest (East) Conservation Area (Stewardship Area)	1,121.83	1.58	Two parts of a multi-part Stewardship Area contiguous with Ruahine Forest Park. Both of these lie within the Dutch Creek arm of the Reservoir Footprint.
Ruahine Forest Park (Conservation Park)	94,829.22	7.90	Separate part of Ruahine Forest Park that is almost entirely within the Reservoir Footprint (total area of this part is 8.26 ha).
Ruahine Forest Park (Conservation Park)	94,829.22	12.76	This is part of the main Ruahine Forest Park that is within the Dutch Creek arm of the Reservoir Footprint.
TOTAL	**95,951.06**	**22.23**	

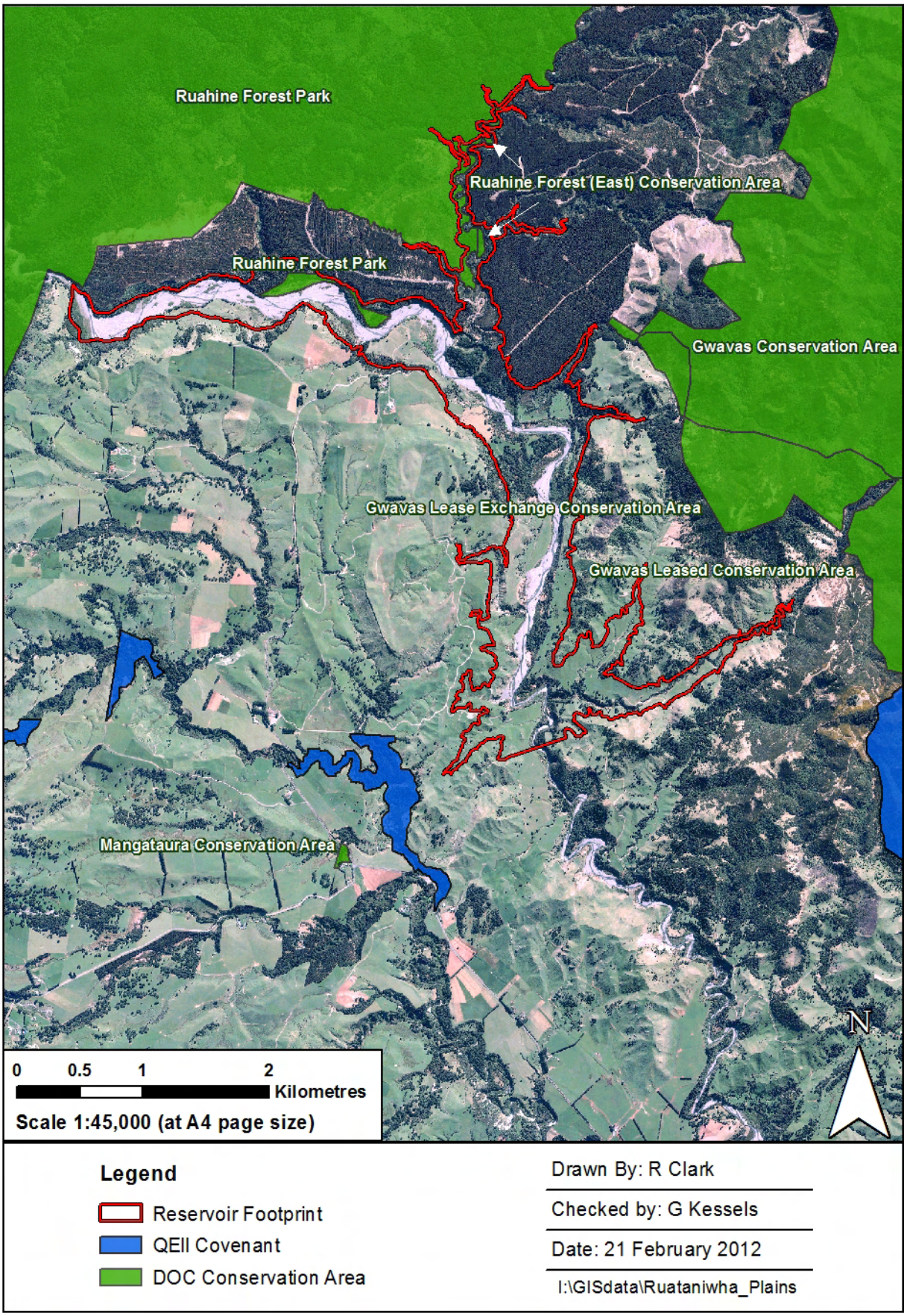


Figure 2 Overview of protected areas within and in the vicinity of the proposed reservoir area

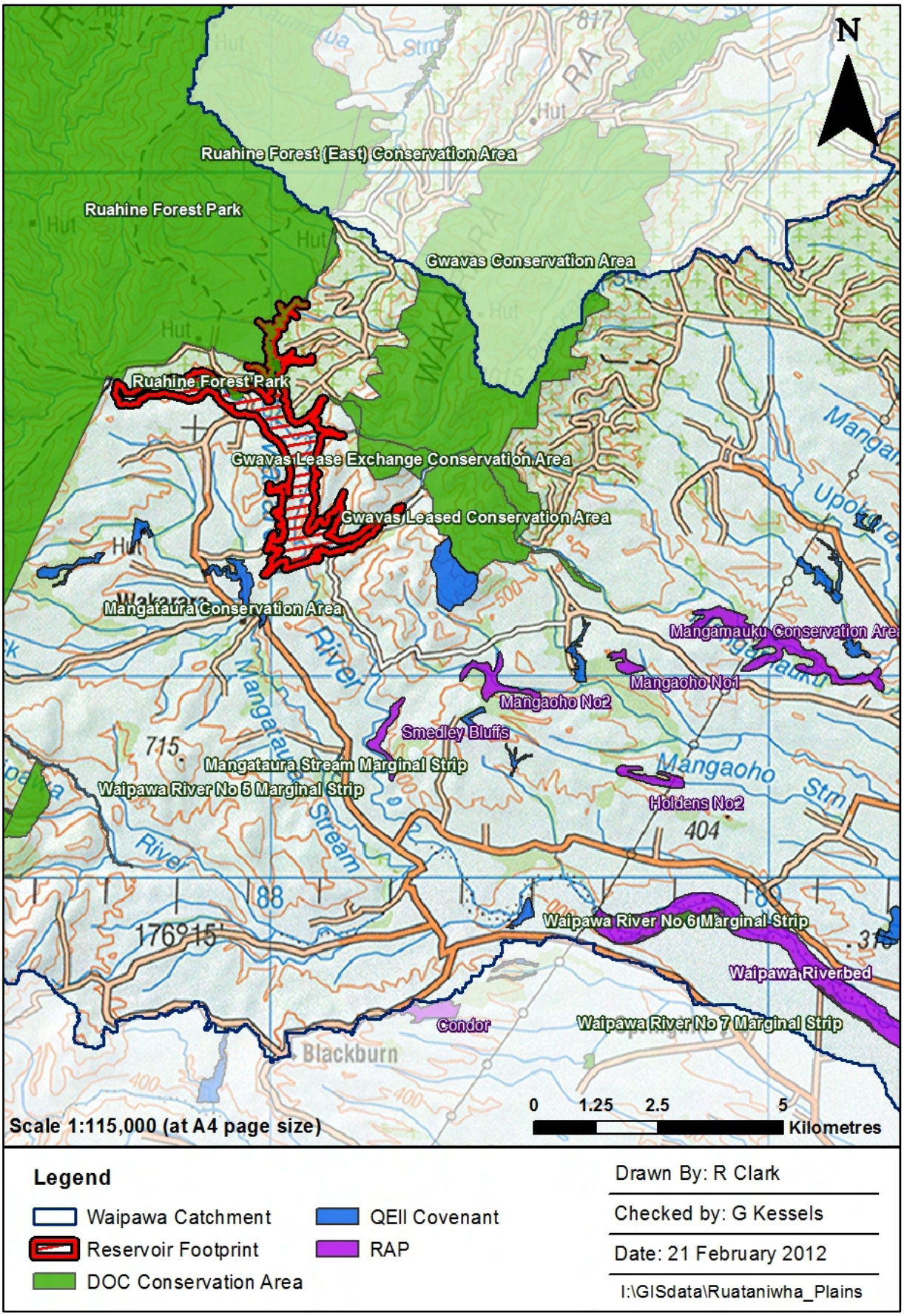


Figure 3 Existing protected areas and Recommended Areas for Protection in the Waipawa catchment within 10 km of the proposed reservoir area

4 Threatened and At Risk Species

4.1 Methodology

Any threatened species found or considered likely to be present due to records found in the Department of Conservation's BioWeb database in the vicinity of the project area were recorded and classified in accordance with Hitchmough, R.; Bull, L; Cromarty, P. (comp.) 2007: "*New Zealand Threat Classification System lists-2005. Science & Technical Publishing, Department of Conservation, Wellington*." and any subsequent published updates to this document (i.e. Allibone *et al.* (2010); de Lange *et al.* (2009); Hitchmough *et al.* (2010); Miskelly *et al.* (2008); Newman *et al.* (2010); and O'Donnell *et al.* (2010)). Over the last four to five years there have been substantial revisions of the threatened species classifications for New Zealand by DOC (Townsend *et al*., 2008). In the Department's 2007 revisions the threatened species classifications were changed to At Risk and Threatened, so in effect there are now two 'super' categories - Threatened and At Risk (Hitchmough *et al*., 2007). Species listed as Threatened can be considered more endangered than At Risk Species. Within of these two 'super' categories there are different sub-levels. In the Threatened category the order, from most endangered to least endangered are: 'Nationally Critical', 'Nationally Endangered', followed by 'Nationally Vulnerable'. In the At Risk category there are four sub-levels which in descending order are: 'Declining'; 'Recovering'; Relict'; and ' Naturally Uncommon'. The plant and animal species list contained within the Blowhard Reserve Management Plan was forwarded on to KAL from the Forest and Bird Protection Society via HBRC. This list was also reviewed to ensure that the proposed survey methods are adequate for the species, which also are likely to be present within the Scheme area.

Implications for threatened species as a consequence of the Scheme were defined in terms of their habitat usage. Habitat usage for any threatened species recorded was broadly defined as transitory, home range, territory or breeding. Risk assessment was undertaken in terms of habitat usage in relation to the dam and reservoir footprint and the extent to which habitat removal/modification would affect populations at a local, regional and national level. Specific assessments for each 'Threatened' and 'At Risk' species found are detailed in Section 5 (flora), Section 6 (avifauna), Section 7 (bats), Section 8 (herpetofauna) and Section 9 (terrestrial invertebrates).

4.2 Summary of Threatened Flora and Fauna found within the Study Area

Eleven nationally classified Threatened and At Risk flora and fauna species have been recorded to be present within the proposed reservoir footprint. Refer to Table 2 and Table 3 overleaf for the species observed and their relevant threat categories. Nine of these species were observed by KAL during the various field surveys and two more (two fish species that were not surveyed for by KAL) are recorded as being present in the Department of Conservation's BioWeb database. The effects of the Scheme on the fish species are covered in the aquatic ecology report provided by Cawthron Institute. Three of these Threatened and At Risk species present within the Scheme area fall within the nationally 'Threatened' species category, and the other eight species are listed in the 'At Risk' category. A further six listed flora species (1 nationally Threatened and 5 At Risk species) and one additional fauna species (nationally Threatened) are recorded in the BioWeb data as being present within a 10 km radius around the reservoir area. These are listed in Table 4 and Table 5 below. These species may all be present within the Scheme area. Apart from one observation of blue duck at the upper Makaroro tributaries, field surveys to date have not found them despite suitable habitat being considered to be present in the Scheme area. More detailed information about each of these further species is included in Appendix I. Banded dotterels (*Charadrius bicinctus bicinctus*; Nationally vulnerable (Miskelly *et al*., 2008)) were not observed within the reservoir area during the KAL site visits during the 2011 and 2012 surveys. Neither have they been recorded within a 10 km radius around the site in the BioWeb database. They were, however, recorded during the wader bird surveys within the Waipawa River approximately 19 km downstream of the site, and one adult and one juvenile were observed in the upper reaches of the proposed reservoir during a visit in November 2012 (refer to Section 6.3.6).

The following references have been used to determine the Threat Classification for the different flora and fauna species that are shown in the tables below: for Mammals: O'Donnell *et a*l. (2009); for Birds: Miskelly *et al*. (2008); for Fish: Allibone *et al*. (2010); for Plants: de Lange *et al*. (2009); and for Invertebrates: Hitchmough *et al*. (2007).

Table 2 Threatened species found within the reservoir footprint; Reference: KAL = Kessels & Associates' observation, BW = BioWeb 2011.

Group	Common name	Scientific name	Threat classification	Reference
Mammals	Long-tailed bat 'North Island'	*Chalinolobus tuberculatus*	Nationally Vulnerable	KAL
Birds	New Zealand bush falcon	*Falco novaeseelandiae*	Nationally Vulnerable	BW, KAL
Birds	Banded dotterel	*Charadrius bicinctus bicinctus*	Nationally Vulnerable	KAL

Table 3 At Risk species found within the reservoir footprint; Reference: KAL = Kessels & Associates' observation, BW = BioWeb 2011.

Group	Common name	Scientific name	Threat classification	Reference
Birds	Black shag	*Phalacrocorax carbo novaehollandiae*	Naturally Uncommon	KAL
Birds	New Zealand pipit	*Anthus novaeseelandiae novaeseelandiae*	Declining	KAL
Birds	North Island fernbird	*Bowdleria punctata vealeae*	Declining	BW, KAL
Birds	Pied stilt	*Himantopus himantopus leucocephalus*	Declining	KAL
Fish	Dwarf galaxias	*Galaxias aff. divergens 'northern'*	Declining	BW
Fish	Longfin eel	*Anguilla dieffenbachii*	Declining	BW
Plants	Red mistletoe	*Peraxilla tetrapetala*	Declining	KAL
Invertebrates	Hawke's Bay tree weta	*Hemideina trewicki*	Sparse	KAL

Table 4 Threatened species found within a 10 km radius around the reservoir area (as recorded in BioWeb data) ; Reference: KAL = Kessels & Associates' observation, BW = BioWeb 2011.

Group	Common name	Scientific name	Threat classification	Reference
Birds	Blue duck, whio	*Hymenolaimus malachorhynchos*	Nationally Vulnerable	BW, KAL
Plants	Annual fern	*Anogramma leptophylla*	Nationally Vulnerable	BW

Table 5 At Risk species found within a 10 km radius around the reservoir area (as recorded in BioWeb data) ; Reference: KAL = Kessels & Associates' observation, BW = BioWeb 2011.

Group	Common name	Scientific name	Threat classification	Reference
Plants	Giant maidenhair	*Adiantum formosum*	Relict	BW
Plants	Yellow mistletoe	*Alepis flavida*	Declining	BW
Plants		*Coprosma pedicellata*	Declining	BW
Plants	Blanket fern	*Pleurosorus rutifolius*	Naturally Uncommon	BW
Plants	Native verbena	*Teucridium parvifolium*	Declining	BW

5 Botanical Surveys & Assessment

5.1 Summary

Field surveys and mapping of vegetation types were conducted from September to December 2011. The fieldwork included semi-quantitative surveys of all major indigenous vegetation community types, opportunistic searches for threatened plant species, as well as detailed surveys using 20 m x 20 m RECCE[3] (Reconnaissance) plots in the three most prominent forest types. Potential risks and threats associated with weed and animal pests were also assessed.

The total area affected by the Scheme (i.e. reservoir area, dam footprint and spoil disposal areas) is 450.18 ha. The mapping process resulted in the classification and description of 17 broad, distinctive vegetation communities (exclusive of open bodies of water, the gravel riverbed and roads and farm tracks). The indigenous vegetation covers an area of 167.57 ha and includes four types of forest, three types of indigenous scrub, four types of shrubland and treeland, and three wetland classes (whereby seep zones are commonly dominated by exotic pasture species). Exotic vegetation covers an area of 204.90 ha with the majority being pasture or rank grasses (i.e. 174.24 ha or 38.7% of the total area). The braided riverbed was mapped out separately and covers an area of 73.97 ha or 16.43% of the total area surveyed.

Surveys to date only found one threatened flora species within the reservoir area - Red mistletoe (*Peraxilla tetrapetala*), which is listed as an At Risk species (Declining) in de Lange *et al.* (2009). However, suitable habitat for six more Threatened and At Risk species that are recorded from the wider area is present (refer to Table 4 and Table 5).

5.2 Methodology

Mapping of vegetation types was undertaken for the maximum flooded area and the footprint of the dam structure using recent aerial photographs supplied by Hawke's Bay Regional Council (HBRC) in ArcGIS (10.0) following HBRC GIS QA procedures. The first step in the vegetation assessment was to redefine the preliminary MWH vegetation type descriptors (Forbes, 2011) and to map broad vegetation and habitat communities, redrawing the MWH GIS polylines where required. Mapping was undertaken on scales as small as 1:500. In addition to the original MWH mapping, further vegetation types, i.e. pasture, treeland, exotic forest and shrublands, as well as tracks and roads and gravel riverbed habitats, were included. Subsequently, areas for each habitat type were calculated in GIS and tabulated in Excel so that a suitable comparison of indigenous versus exotic (and non-ecologically significant) habitats could be made. The mapping process resulted in the classification of 17 broad, distinctive vegetation communities, exclusive of open bodies of water, the gravel riverbed and roads and farm tracks, which were also digitised (refer to Section 5.2.1 for a description of each vegetation type). The proposed reservoir footprint was then visually rechecked and assessed from high vantage points and up to date aerial photography.

Field surveys were conducted in September, October, November and December 2011, by two botanists over a total period of 12 person days within all vegetation types within the reservoir footprint. Attention was also given to the margins of the proposed lake edge and tributary streams to assess the potential for wetland habitat to be recreated around the new lake edge. A vascular plant species list was compiled from the field records and is included as Appendix II.

More detailed surveys were undertaken using four 20 m x 20 m RECCE (Reconnaissance) plots. These were measured and recorded within the three major indigenous forest types in accordance with standard protocols as described by Hurst & Allen (2007a and b). The location of the RECCE plots is shown in Figure 4.

The quantitative RECCE results are shown in Appendix III. They can be used to assess the relative composition and abundance of each vegetation type within the surveyed sites. This interpretation would be based on an assessment of vegetation diversity and abundance, as well as plant and animal pest influences. The RECCE data can provide useful baseline data for biodiversity off-set mitigation monitoring and allow meaningful comparisons with other similar

[3] The Reconnaissance (RECCE) description is a widely used field method for describing vegetation compositions (refer to Allen, 1992).

habitat types in accordance with nationally accepted protocols.

Existing and potential weeds, as well as browsing animal pests, were assessed and characterised in terms of potential risks and threats associated with the creation of a lake in the locality and any associated restoration and recreation of lost habitats.

5.3 Results

5.3.1 Key Vegetation Communities

Common plant names are used in the text. A list of all indigenous and exotic plant species found within the dam footprint is contained within Appendix II. The detailed data of the RECCE plots is provided in Appendix III. A summary of each vegetation type and the percentage cover within the proposed dam footprint is shown in Table 23 in Section 12.2.1. Photos of the various vegetation types described in the following text are provided below (Photo 1-5), and additional photos are included in Appendix IV.

Several distinctive indigenous vegetation types remain within the dam and reservoir footprint. The distribution of these key vegetation types in relation to the dam and reservoir footprint was mapped based on the vegetation types previously mapped and described by MWH (Forbes, 2011). They are shown in broad classes in Figure 4 at the end of this section, and a more detailed classification is shown in Maps 1-9 in Appendix V. The classifications generally follow Atkinson (1985) and are described as structural vegetation classes based on the dominant canopy species. The broad mapping process distinguished between 17 different vegetation types as follows (in addition to these vegetation types, the lower stream channel of Dutch Creek, the gravel riverbed of Makaroro River, as well as farm tracks and Wakarara Road were mapped out separately):

1. **Beech forest (52.03 ha):** This is the most widespread forest type within the proposed reservoir area and two RECCE plots were undertaken to accurately represent the variety of this vegetation type. Apart from one area at the very downstream end of the dam and reservoir footprint, which is dominated by mountain beech, these areas are usually dominated by mature black beech (i.e. >50% canopy cover). However, there are areas, such as at the confluence of Dutch Creek with Makaroro River, where large matai (>25 m in height) and the occasional kahikatea emerge above the black beech canopy and where red beech forms a small canopy component as well (refer to RECCE data for Plot 2 and Photo 1). The average canopy height within these areas can reach 20 m whereas within the black beech dominated RECCE Plot 1 the average canopy height was recorded as 12 m. DBH (diameter at breast height) measurements within the RECCE plots showed that black beeches within Plot 1 were frequently between 53 and 78 cm in size and even larger within Plot 2, reaching up to 95 cm DBH. Matai were measured in Plot 2 between 48 and 70 cm DBH, and red beech and kahikatea were measured at 75 and 95 cm DBH, respectively. The lower tiers of this vegetation type (i.e. between 0.3 and 12 m height) still predominantly consist of black beech (up to 50% coverage), but also contain a fair amount of broadleaf species (up to 25%), such as black matipo, lacebark, mapou, mahoe, lancewood, white maire, hangehange, rangiora, kanono and horopito, as well as small-leaved shrubs, such as *Coprosma* species, New Zealand myrtle, mingimingi and poataniwha. A pokaka sapling was noted, and two mature specimens of this species were encountered at the very southern end of the site near the proposed dam structure. Kowhai and putaputaweta were often noted in areas closer to the river, and the occasional wheki-ponga may be found within this vegetation type. Podocarps such as matai, kahikatea, rimu, totara and miro are also frequently regenerating in the lower tiers of this forest type. Common lianes in this forest type are clematis species, New Zealand jasmine, bush lawyer and pohuehue. The groundcover usually comprises various groundferns (e.g. *Asplenium*, *Blechnum* and *Polystichum* species), a number of indigenous sedges and grasses (e.g. *Uncinia* and *Luzula* species, and bush rice grass), as well as common herbs (e.g. New Zealand blueberry) and seedlings of the tree and shrub species. The threatened (At Risk) red mistletoe was found in this forest type along Dutch Creek (see Photo 6 and description in Section 5.2.2).

2. **Podocarp-broadleaf forest (10.61 ha):** This vegetation type is dominated by a mixture of young podocarp species such as kahikatea, rimu and matai that are starting to emerge over a broadleaf subcanopy, but are commonly still at a similar height. RECCE Plot 3 was measured within this vegetation type on the true right side of Makaroro River. The average canopy height within this plot was estimated at 10 m, with some kahikatea emerging slightly above the main podocarp-broadleaf canopy. The podocarps in this forest type are usually a lot younger than the ones found amongst the old-growth beech forest with the largest kahikatea measured in RECCE Plot 3 being just over 27 cm DBH. Broadleaf species commonly found amongst the canopy of this vegetation type are putaputaweta, five-finger, lancewood, white maire, lacebark, black matipo, pate and kaikomako. Cabbage trees and treeferns (i.e. wheki-ponga and wheki) are also frequently present, and common lianes and climbers in this forest type are rata species, clematis, New Zealand jasmine, bush lawyer and pohuehue. The understorey of this vegetation type typically comprises karamu, kanono, hangehange, young mahoe and koromiko, and the occasional tree fuchsia can be found. Seeps are often present in this vegetation type and support a dense groundcover of fern species (e.g. gully fern, water fern, kiokio, hen and chicken fern and nini), as well as toetoe, bush flax and indigenous sedges. Two reasonably common orchid species were also found within this forest type (i.e. helmet orchid and grass-leaved greenhood).

3. **Broadleaf forest (17.40 ha):** This forest type consists of a pure broadleaf canopy with podocarps (i.e. matai, totara and kahikatea) only present as saplings and seedlings. The most widespread species in this forest type are lacebark, kaikomako, lancewood, putaputaweta, black matipo, mahoe and mapou. The average canopy height in RECCE Plot 4 was estimated as 10 m, with lacebark reaching heights above 12 m and DBHs mainly between 15 to 32 cm. Kaikomako usually had smaller DBH measurements between 4 and 25 cm, and lancewood reached DBHs between 3 and 21 cm. Smaller leaved species such as kowhai, poataniwha, New Zealand myrtle and coprosma species are also present in this vegetation type, but only in reasonably low numbers. The understorey mainly contains young mahoe, as well as poataniwha and wheki-ponga with smaller amounts of horopito (often showing severe deer damage), pate and round-leaved coprosma. The groundcover contains good densities of prickly shield fern, hen and chicken fern and kiwikiwi with smaller amounts of lance fern and round-leaved fern. *Hydrocotyle* sp., two different hook sedges, bush rice grass and various indigenous herbs (e.g. New Zealand bitter cress, wall lettuce and scrub nettle) can also be found in this forest type.

4. **Small-leaved forest/scrub (0.67 ha):** Only a very small area of this vegetation type is present within the subject site. The canopy consists of manuka of approximately 6-8 m height with podocarps and broadleaved species currently only present in the understorey. The canopy is dominated by manuka, but includes patches of bitter willow and very few grey willows. In some areas the canopy is so dense that it shades out any vegetation below and the ground is only covered in leaf litter. Where enough light can penetrate the canopy a diverse understorey of mostly native shrubs, such as cabbage tree, lacebark, black matipo, karamu and other native coprosma species is present. Kiokio is common and some alpine blechnum was observed, as well as a few cabbage trees reaching up to 2 m, few small koromiko seedlings and the occasional kahikatea seedling. Numerous common pasture weed species cover the ground (e.g. blackberry, lotus, selfheal, ragwort, creeping buttercup, white clover and grasses) while cotoneaster very occasionally grows into the understorey. Wetter areas allow rushes and sedges to grow (e.g. rautahi, pukio, slender spike sedge). In some open areas toetoe is the dominating groundcover.

5. **(Podocarp)/broadleaf-small-leaved scrub (10.52 ha):** These areas are regenerating secondary scrub with canopy heights of usually less than 6 m with only the occasional podocarp (usually kahikatea or totara) emerging in some areas. Species common in this vegetation type include broadleaf species such as mahoe, hangehange, koromiko and lancewood, as well as small-leaved species such as manuka, kanuka, poataniwha, New Zealand myrtle and korokio. The groundcover is usually dominated by pasture herbs and common grasses.

6. **(Kowhai)/broadleaf scrub (1.19 ha):** This vegetation type is found on the steep slopes of the Makaroro River banks. These areas are usually dominated by young, low-growing

broadleaved species such as mahoe, lancewood, koromiko and karamu, with a conspicuous percentage of emerging kowhai trees, that reach 3 to 5 m, and some emergent cabbage trees (up to 6 m). Some small-leaved shrub species, as well as monocotyledonous species such as astelia, mountain flax toetoe and machaerina can also be found within these areas. Bracken and kiokio are common groundferns in this habitat. Along the lower and less steep margins of the slopes additional native species are emerging into the canopy (e.g. manuka, wheki-ponga, lacebark, kaikomako, karamu and lancewood).

7. **Small-leaved-broadleaf scrub (10.99 ha):** Vegetation included in this type typically contains a mixture of manuka with a smaller percentage of other small-leaved shrubs (e.g. korokio, poataniwha) and occasional broadleaf species, such as young mahoe, lancewood, koromiko and coprosma species. The occasional young podocarp (i.e. kahikatea or totara) may be present and emerge over the main canopy (refer to Photo 2).
8. **Broadleaf-small-leaved-tussock shrubland (29.92 ha):** This vegetation type covers a reasonably large area within the study site. It occurs on steep cliffs and river banks and contains a various mixture of broadleaved and small-leaved shrub species (e.g. koromiko, hangehange, mahoe, putaputaweta, kaikomako, broadleaf, cabbage tree), as well as monocotyledonous species such as flax, machaerina, astelias and toetoe, which are classified as 'tussocks' in Atkinson (1985, refer to Photo 3). Whip broom was also frequently encountered within this vegetation type in the Dutch Creek area, and tutu is common close to the river/stream banks.
9. **Black beech treeland (9.32 ha):** This vegetation type comprises remnant trees of the original black beech forest canopy mainly situated within grazed pasture with no understorey species remaining. Species present are usually mature black beeches interspersed with only the occasional matai, kahikatea or rimu. Some areas along the downstream tributaries on the true left side of Makaroro River are only occasionally grazed and still contain a thin indigenous shrub layer underneath a narrow line of black beech trees.
10. **(Podocarp)/broadleaf-small-leaved treeland/shrubland (18.80 ha):** This is a variant of (Podocarp)/broadleaf-small-leaved scrub above with less than 80% tree/shrub cover over significant amounts of pasture. This vegetation type covers reasonably large areas (i.e. 18.8 ha or 4.4% of the study are) in the centre of the site on both sides of the river.
11. **Small-leaved treeland and/or shrubland (1.01 ha):** A variant of 'Small-leaved forest' and 'Small-leaved-broadleaf scrub' above with less than 80% tree/shrub cover over significant amounts of pasture. This vegetation type includes groves of trees and shrubs in pasture or on bluffs.
12. **Wetland (0.29 ha):** This vegetation classification was used for an oxbow wetland in the lower reach of Dutch Creek. Small ponds are present in this area, which are largely covered with *Azolla* fern and surrounded by rush/sedgelands grading into woody vegetation. Wetland species present include slender spike sedge, four *Carex* and a *Juncus* species, kiokio and swamp kiokio, toetoe, astelia, mountain flax, *Hydrocotyle*, *Sphagnum* moss and duck weed. Woody species present include three coprosma species, cabbage tree, manuka and koromiko. Some wheki-ponga are also present. The slightly drier margins also have kahikatea, wineberry, broadleaf, kowhai, lancewood, lacebark, black matipo, snowberry, mingimingi, matai and horopito.
13. **Podocarp-broadleaf-small-leaved shrubland/seep zone (0.46 ha):** Three areas were mapped as this vegetation type. They are grazed and consist of a mixed indigenous shrubland containing some large kahikatea, young podocarps (e.g. kahikatea and rimu), as well as various broadleaf and small-leaved species, such as lacebark, kowhai, manuka and cabbage tree, over a seep zone with remnant indigenous sedges and fern species (refer to Photo 4). Blackberry, pasture grasses and common pasture herbs are dominating the margins and becoming less frequent towards the centre of these areas.
14. **Seep zone (4.36 ha):** Areas mapped as seep zones indicate the presence of an elevated water table in association with indigenous and exotic rushes, sedges and mosses, along with only occasional native shrubs in exotic pasture. These areas are dominated by slender spike sedge, *Isolepis* and *Juncus* species, and sometimes include small areas of raupo

wetland. In addition to these typical wetland species other native species present are emerging wheki and astelias. Common exotic herbs and grasses have invaded the seep zones from the surrounding pasture land and impact from stock browse is apparent, where stock has not been fenced off properly. Some of the seep zones include low growth of native shrubs, mostly manuka and also few kahikatea, black beech, *Coprosma* species and their hybrids. Unlike the other vegetation types listed here, this type is based on a combination of hydrology and vegetation.

15. **Exotic forest and/or treeland (16.00 ha):** This descriptor was used for shelterbelts and plantations of pines, eucalypts and larches, as well as scattered mature pine trees in a matrix of pasture.
16. **Willow/lupine forest and/or scrub (14.66 ha):** Areas within the current floodplain that are dominated by bitter willow (*Salix elaeagnos*, called hoary willow in Forbes (2011)), with grey willow and occasionally crack willow. This vegetation type covers islands within the riverbed and larger areas on the banks. It also includes areas dominated by lupine or buddleia (the latter one predominantly occurring towards the upstream end of the site), and sometimes including areas with scattered native shrubs, i.e. willow-manuka shrubland (refer to Photo 5). Some pines are occasionally present as well. The canopies of the willow forest / scrub along the river banks are dominated by bitter willow, but also include grey willow and the occasional crack willow. The canopies reach heights of up to 7 m. Some native species are reaching into the canopy, such as manuka, karamu, koromiko and tutu. The understorey is often dominated by native shrubs, herbs and ferns. While most woody species, such as those mentioned above, as well as kaikomako, lacebark, wineberry, black matipo, rangiora and pohuehue can eventually grow into the canopy, the present coprosma species do not grow above 2 m. Numerous monocotyledonous species, such as astelia, mountain flax, toetoe, hook sedge and the common ferns kiokio and prickly shield fern cover the ground, together with common pasture weeds and exotic grasses and blackberry, wild broom and the occasional cotoneaster.
17. **Pasture or rank grass (174.24 ha):** Areas of grazed pasture and areas that are fenced off or not accessible to stock for various reasons where a cover of rank grasses has become established. This vegetation type covers 38.7% of the reservoir area.
18. **Gravel riverbed (73.97 ha):** The Makaroro riverbed (braided and single channel) including the open stream channel, dynamic gravel areas and stable gravel banks where vascular plants are starting to become established.
19. **Stream channel (0.83 ha):** The open stream channel of the lower Dutch Creek.
20. **Farm track or road (2.91 ha):** Distinct farm tracks and a section of Wakarara Road where it crosses Dutch Creek.

Photo 1 View onto Black beech forest containing large podocarps at the confluence of Dutch Creek (see left margin of the photo) with Makaroro River

Photo 2 Small-leaved-broadleaf scrub along a tributary stream on the true left of Makaroro River towards the downstream end of the proposed reservoir

Photo 3 Broadleaf-small-leaved-tussock shrubland with black beech treeland at the top of the cliff

Photo 4 Podocarp-broadleaf-small-leaved shrubland/seep zone

Photo 5 Willow-manuka shrubland (white) in front of Black beech forest (green) on the true left side of Makaroro River and Exotic lupine scrub (blue) as well as (Kowhai)/broadleaf scrub (yellow) on the true right

5.3.2 Threatened Species

Red mistletoe (*Peraxilla tetrapetala*) is the only threatened flora species found within the reservoir footprint to date (Photo 6). This species is listed as an At Risk species (Declining) in de Lange *et al.* (2009). The following description is derived from the New Zealand Plant Conservation Network: The species occurs on both North and South Island, but is less common in the North Island. It is distributed throughout the coastal to montane climatic zones. The plant is a hemiparasite whose main hosts are mountain beech (*Nothofagus solandri var. cliffortioides*), black beech (*N. solandri var. solandri*), red beech (*N. fusca*), and silver beech (*N. menziesii*). However, it has been recorded as a parasite on a further 17 species (2 exotic). Red mistletoe is a shrub that can grow up to 2 m across. It usually parasitises close to the trunk of its host (a feature that distinguishes it from other mistletoe species) and has bright red flowers that are up to 40 mm long. A variety of threats are considered to cause the national decline of this species and other mistletoes, but browsing by possums is recognised as the primary cause for the loss of the beech mistletoes from large parts of the country's beech forest.

Photo 6 Red mistletoe (*Peraxilla tetrapetala*) growing on a large black beech at Dutch Creek

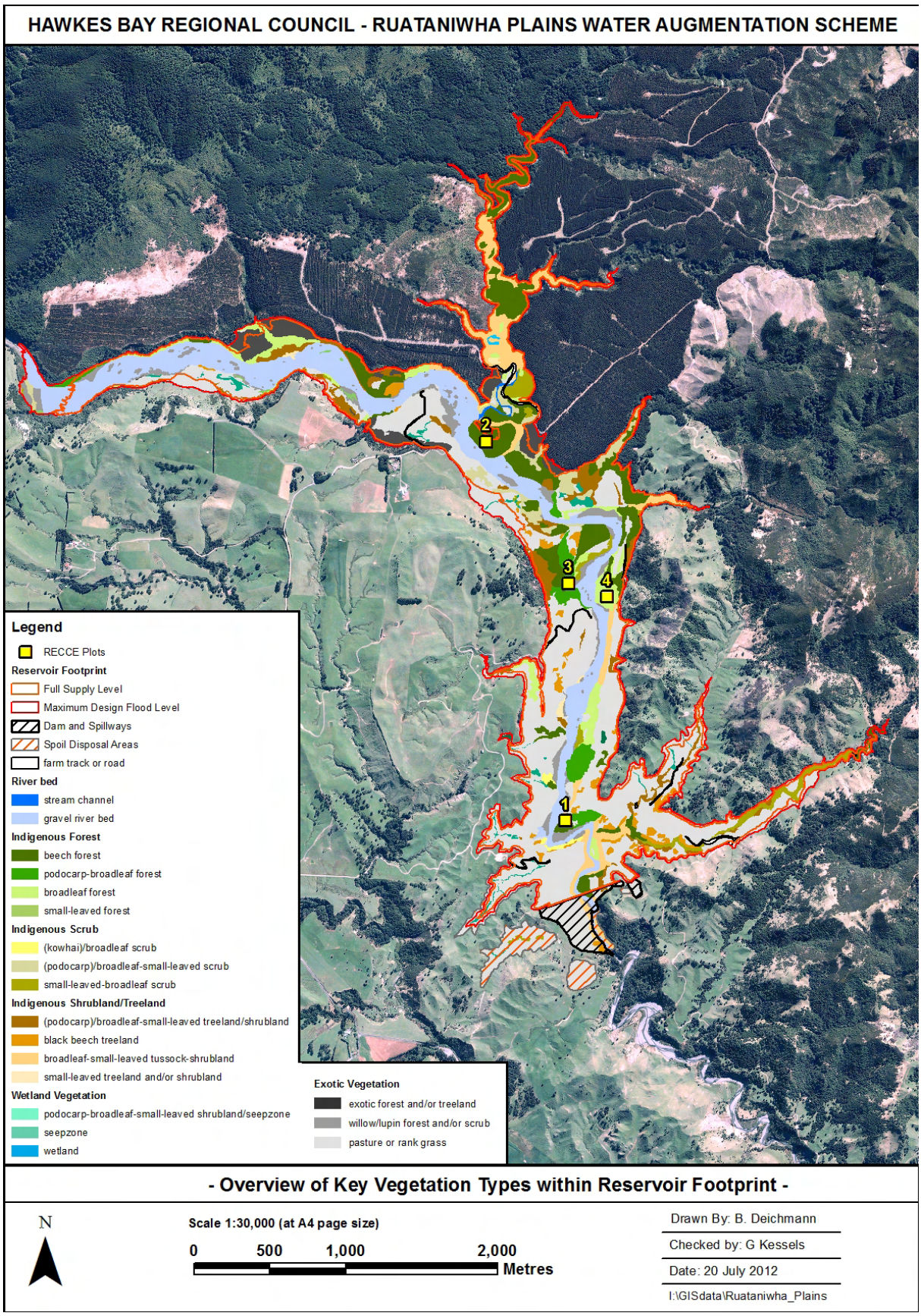


Figure 4 Key vegetation types within the proposed reservoir area (for a more detailed classification refer to Maps 1-9 in Appendix V)

6 Avifauna Surveys & Analysis

6.1 Summary

This section presents the results of bird surveys completed within the proposed reservoir area October 2011 and February 2013, as well as for an area 19 km downstream of the site where additional surveys of waders and water birds were undertaken.

A total of 945[4] birds from 38[5] bird species (11 endemic) were identified within the reservoir area during this fieldwork. Fifty five percent[6] of all individual birds formally observed were native, while 45% belonged to introduced species. Threatened or At Risk species comprise 2.5% (23 birds) of all formal observations, including the Nationally Vulnerable New Zealand bush falcon, which was most likely nesting in the site during spring 2011 and summer 2011/12. This pair was not detected again during further surveys and site visits during 2012 and summer of 2012/13. Banded dotterel were not observed within the reservoir area during the extensive surveys in 2011/12 but one adult with a chick were observed in November 2012 (P Stewart, *pers. comm.*). Other species that were potentially present, such as kiwi and blue duck (whio), were not detected within the reservoir area. However, blue duck were sighted upstream from Upper Makaroro Hut in November 2012 (P Stewart, *pers. comm*.). Nationally 'At Risk' species detected were pied stilt, New Zealand pipit, black shag and North Island fernbird.

Data from the 21 formal five-minute count stations, as well as walkthrough transects, showed tui (11.8% of all birds) to be the most common of the 15 non-threatened native species observed. Counts for this species were highest when kowhai was flowering abundantly in October. Silvereye (9.5%), grey warbler (8.1%), bellbird (4.8%) and fantail (4.5%) were the other relatively abundant species detected.

Walkthrough surveys of waders and water birds were completed 19 km downstream from the reservoir site, along a 4.5 km reach of the Waipawa River, from the State Highway 50 bridge to the proposed upstream water intake at the end of Caldwell Road (refer to Figure 11). The Nationally Vulnerable banded dotterel was commonly detected at densities of up to 3.3 pairs/km along this transect. Nationally At Risk pied stilt and pipit were also recorded and, in addition, two large colonies of southern black-backed gulls were observed. Two banded dotterels[7] were also observed on the riverbed within the reservoir area in November 2012 (P Stewart, *pers. obs.*).

In summary, there are several threatened bird species that may be affected by construction and potential down-river effects of the Scheme, and appropriate mitigation strategies will need to be developed.

A list of all bird species found on site and discussed within this report is provided in Appendix VI.

6.2 Methodology

6.2.1 Desktop Analysis

Historic species distribution records were obtained from the Department of Conservation (DoC) BIOWEB data base. Records of banded dotterels on Hawke's Bay riverbeds were collected from the Classified Summarised Notes scheme of the Ornithological Society of New Zealand (OSNZ) to provide a regional perspective of the population on the Makaroro River. Local knowledge was obtained by talking with DOC staff and local ornithological groups. Further anecdotal information was also gathered from residents of the Upper Makaroro River while completing the fieldwork.

6.2.2 Field Reconnaissance

A field reconnaissance of the Site was completed on 23/09/2011. The aims of this visit were to field truth literature to hand and also develop appropriate field survey techniques based on practical issues such as site access and fragmentation of habitat.

[4] Total of all individuals observed within reservoir/dam footprint during formal avian survey and other fieldwork activities.
[5] This number excludes morepork, which where heard during nighttime observation, but for which only presence has been noted.
[6] These percentages exclude casual observations of birds made during other fieldwork activities.
[7] One adult banded dotterel and one juvenile.

6.2.3 Field Study Objectives

The aim of the field study was to determine the distribution and relative abundance of avifauna within the reservoir area and also the presence/abundance of threatened waders further downriver. The objectives of this study were:

1. To compile a list of avian species present and their distribution/relative abundance at the Site.
2. To establish any seasonal variation in habitat requirements (threatened and non-threatened species).
3. To understand if threatened species are likely to be adversely affected by the actual dam, within the reservoir footprint, and also downriver due to subsequent alteration of natural flood events (Waipawa study site).
4. To determine if there will be any loss of connectivity for water birds above and below the dam reservoir area; and
5. To provide recommendations with reference to any potential mitigation requirements.

6.2.4 Field Methods

The total effort for all formal avifauna surveys conducted between October 2011 and February 2012 was 202 hours and 42 minutes. A breakdown of effort per survey type and the period completed is shown in Table 6.

In addition further informal bird surveys were undertaken during other stages of the terrestrial ecology studies. This included a field trip to the Upper Makaroro Hut on 11 and 12 November 2012, additional whio and kiwi bioacoustic surveys in January and February 2013 and wader bird surveys through the reservoir foot print, including Dutch Creek, again in January and February 2013.

Table 6 Summary of all avifauna survey effort at the Makaroro and Waipawa Sites, October 2011 – February 2013

Survey type	Period	Hours	Minutes
5-minute bird counts	October, November, December and February	6	50
Makaroro River walkthrough	November and December, 2011 and again November 2012 and January/February 2013	17	0
Kiwi listening stations	November 2011, and February 2012	3	0
Whio walkthrough	October, November, December, 2011; February and November 2012; January, February 2013	27	49
Whio/kiwi bioacoustic recorders	November – December, 2011	144	0
Waipawa River wader walkthrough	November and December 2011	4	3
	Total survey effort	202	42

Five-minute bird counts

Five-minute bird counts were considered the most appropriate method to describe species composition due to the fragmented and varied nature of habitat in the survey area. Habitat throughout the area is predominantly:

1. pasture/treeland on low angle slopes and terraces (Photo 7);
2. remnant forest/scrub restricted to steep slopes, cliffs and gullies; and
3. riverbed.

Sampling was spread throughout the survey period in order to establish whether bird activity varied due to changes in seasonal activity (such as availability of food). A total of 20 stations were initially set at vantage points in habitats 1 and 2 (native vegetation and pasture) as per Dawson & Bull (1975) during October; these were at least 200 m apart (Figure 5).

The relative abundance of birds across the study site was assessed by completing counts from each station. These were sampled monthly during October, November, December and February, resulting in a total of 80 counts over the survey period (20 counts x 4 months). Subsequent to the commencement of the bird count survey the reservoir area was increased and so an additional count station was established in the upper reaches of the reservoir in indigenous shrubland habitat. This resulted in an amended total of 82 counts and total observational effort of 6 hours and 50 minutes. Birds could be observed from >200 m in the pasture/treeland stations and so typically these were located 3 – 400 m apart and a range finder used to estimate the 200 m radius about stations. Birds such as harriers and black backed gulls flying across the general landscape were not included in the count station data, but included in the overall data for species diversity purposes.

Photo 7 View downriver towards the dam site showing pasture and associated cliffland scrub-shrubland communities

Makaroro riverbed walkthrough survey

The five-minute count stations did not give adequate coverage of the riverbed and so walkthrough surveys were completed in November (1 fieldworker) and December (2 fieldworkers) 2012 in order to detect any water bird/wading species. Surveys were completed along a 4.5 km transect on overcast days so that sun strike and heat haze were avoided. Total search effort from

these two walkthrough surveys was 12 hours. Additional walkthrough surveys were conducted in November 2012, and January/February 2013, adding a total of five hours to the total Makaroro walkthrough survey effort. Time, Date and GPS location data were recorded for each observation.

Supplementary surveys

There are historic records of North Island brown kiwi (Eastern taxon) and blue duck (whio) in the Upper Dutch Creek and Makaroro catchments. Surveys for blue duck and kiwi were completed throughout the survey period.

Kiwi

BioWeb Queries to the BioWeb database did not reveal any records of kiwi within the dam / reservoir footprint area, or within a 10 kilometres radius around the site.

Kiwi listening stations Thirty minute solicited listening surveys were completed 45 minutes after official sunset and prior to midnight on two occasions from three listening stations (Figure 5). This work was undertaken on 22/11/2011 in fine clear conditions and on 2/02/2012 during damp calm conditions, resulting in a combined total of six survey hours.

Bioacoustic recorder survey In addition to kiwi listening stations, data from three bio acoustic recorders, which were set up at Dutch Creek to monitor for blue duck calls, were also inspected for kiwi calls (see paragraph on Blue duck below).

Blue duck

BioWeb BioWeb data and information from local residents suggested that blue duck was not present within the lower reaches of Dutch Creek, but it was possible that this species was present in side streams, but had not been encountered (by trampers/hunters).

Walk-through surveys The lower reaches of Dutch Creek were walked on six occasions during fine weather on 26/10/2011, 22/11/2011, 24/12/2011, 9/02/2012, 14/01/2013, and 02/02/2013 (see Figure 5 for survey route). First and second order stream/tributaries were walked once on 22/11/2011. This resulted in a total search effort of 15 hours and 49 minutes. Furthermore, on the 11th November 2012 a field team searched two Makaroro tributaries upstream from the Upper Makaroro Hut for whio. The following day the team walked downriver to the reservoir upper limit at the confluence of Gold Stream and Makaroro River (total of 12 search effort hours for 11 -12 November 2012 field work).

Bioacoustic recorder survey Three automated digital recorders were deployed near slow moving sections of Dutch Creek over the 12 night period between 22 November and 2 December 2011. They were set to record data from the first two hours after official sunset and the two prior to sunrise resulting in 144 effective hours of recorded data.

Waipawa River wader walkthrough surveys

Surveys were completed in an upstream direction to avoid sun strike and also on overcast days to avoid heat haze. The 4.5 km section of the Waipawa River between the Highway 50 river bridge and the northern end of Caldwell Road (see map of area in Figure 11) was walked on 23 November and 22 December 2011. Overall survey effort was 4 hours and 3 minutes. Time, Date and GPS location data were recorded for each observation and samples of this data are shown in Appendix VII.

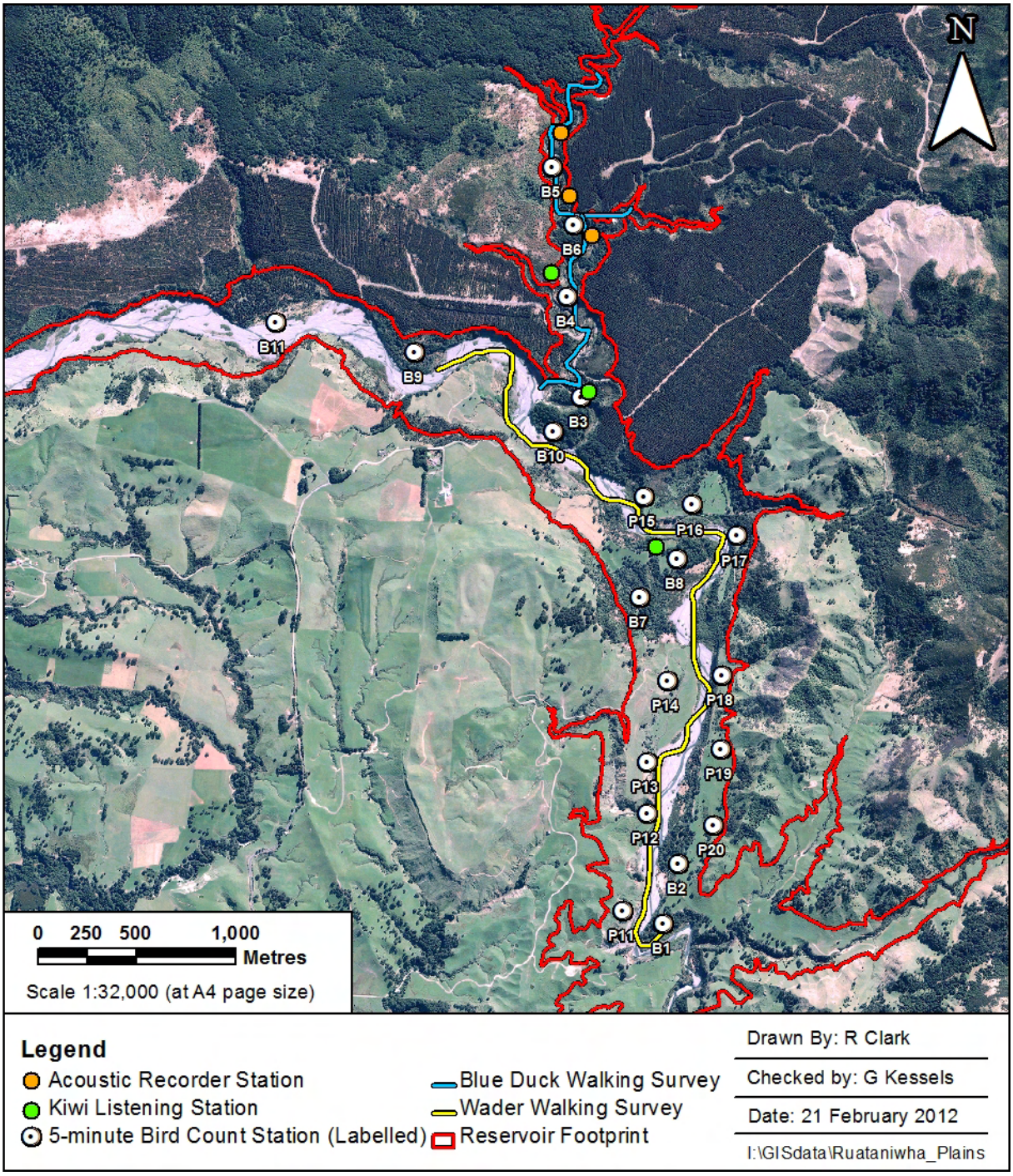


Figure 5 Five-minute bird count stations, wader transect, acoustic recorder locations and kiwi and blue duck walkthrough survey routes within the proposed reservoir, surveyed from October 2011 to February 2012

6.3 Results

6.3.1 Scoping Study

Several Threatened and At Risk species (kiwi, blue duck, NZ pipit, pied stilt, banded rail and North Island fernbird) were recorded on the DOC BIOWEB database as being present within the wider Hawke's Bay region, and so survey methods were put in place to detect these birds. In addition, calls were also played for spotless crake during field surveys as Forbes *et al*. (2011), had suggested that they may be present. NZ bush falcon is shown as being sparsely distributed throughout Hawke's Bay (Bell & Lawrence, 2009). These birds have large home ranges and given the site's proximity to the Ruahine Ranges this species was likely to be present. The following threatened species were observed during the afternoon/evening of 23/09/2011:

- Two falcons were observed pursuing a harrier away from a cliff top at the mouth of Dutch Creek during the afternoon of 23/09/2011.
- North Island fernbird was heard on the lower reaches of Dutch Creek; and
- Banded dotterel were observed at the Waipawa River end of Caldwell Road during the same evening.

6.3.2 Overview

A total of 999 individual birds were observed and of this total 945 birds from 38 bird species[8] were identified within the reservoir area during five-minute bird counts and walkthrough surveys. Thirty five (3.7%) of these sightings were unidentified and have been omitted from further analysis. Twenty of the species encountered during formal surveys[9] were native (11 endemic) and five are presently considered to be threatened (Table 7). Overall 55% of all birds observed during formal surveys were native and belonged to 45% introduced species. A summary of these results is shown in Table 7 and key points are summarised below:

- Nationally Threatened and At Risk species comprise 2.5% (23 birds) of all observations.
- Nationally Vulnerable NZ bush falcon was most likely nesting within the Site during spring.
- Some threatened species that were potentially present, such as kiwi, were not detected.
- Nationally At Risk species were pied stilt, pipit, black shag and North Island fernbird.

The total number of birds for each habitat type and their threat status is shown in Table 7. A grand total of all birds detected from formal surveys within the reservoir area was also calculated and this figure was used to determine the proportion of each species detected at the site over the period of the survey. Casual observations of species not detected during formal sampling, but within the reservoir area, are shown in the right hand column of Table 7. These casual observations were used for species diversity purposes only. Observations of birds made outside the reservoir area, but within the local area are listed in the respective sections, but were omitted from calculations.

6.3.3 Five-minute Bird Counts

Relative abundance is shown as the monthly mean figure for species in forest habitat in Figure 6 and Figure 7, and that of pasture/treeland habitat in Figure 8 and Figure 9.

Data from the 21 formal five-minute count stations and walkthrough transects showed tui (11.8% of all birds) to be the most common of the 15 non-threatened native species observed. Counts for this species were highest when kowhai was flowering in forest remnants about pasture treeland in October 2011 (Figure 8). Silvereye (9.5%), grey warbler (8.1%), bellbird (4.8%) and fantail (4.5%) were the other relatively abundant Non Threatened species. Seventeen introduced adventive species were detected including chaffinch, which was by far the most common (13.6%) of all birds.

Forest/shrubland habitat

In forest/shrubland habitat 52% of the 28 species were native. Over the October – February period there were some notable changes in the number of native birds observed, e.g. there was a 10 fold increase in the numbers of silvereyes detected during late summer compared to early spring (Figure 6). Most of the silvereyes in February 2012 were observed in large flocks. There also appears to have been an increase in the frequency of tui observations during December compared to other months.

[8] This number excludes morepork that were also incidentally observed during nocturnal observer and bio acoustic surveys, but for which only their presence was noted.

[9] These numbers relate to five-minute bird counts and river walkthrough surveys, but exclude casual observations, such as the two banded dotterel individuals.

Table 7 Summary of all birds detected within the reservoir area, October 2011 – February 2012. (E) denotes endemic species. [r] = Individuals were not observed within reservoir area, but within local area.

Common name	Threat Classification Miskelly *et al*. 2008	Number detected from pasture 5 min counts	Number detected from bush 5 min counts	Number detected from walk through river counts	Total number from both methods	% of total number	Number detected from walk through casual observations
Bush falcon (E)	Threatened - Nationally Vulnerable	0	2	0	2	0.22%	0
Pied stilt	At Risk - Declining	5	0	4	9	0.97%	0
NI fernbird (E)	At Risk - Declining	0	5	0	5	0.54%	0
Banded dotterel (E)	Threatened - Nationally Vulnerable	0	0	0	0	0.00%	2
NZ pipit	At Risk - Declining	0	0	5	5	0.54%	0
Black shag	At Risk - Uncommon	1	0	1	2	0.22%	0
Sub-total for native Threatened and At Risk species		6	7	10	23	2.47%	2
Tui (E)	Not Threatened	39	67	4	110	11.83%	0
Silvereye	Not Threatened	20	67	1	88	9.46%	0
Grey warbler (E)	Not Threatened	27	47	1	75	8.06%	0
Bellbird (E)	Not Threatened	16	29	0	45	4.84%	0
NI fantail (E)	Not Threatened	11	31	0	42	4.52%	0
Paradise shelduck (E)	Not Threatened	16	2	8	26	2.80%	0
Shining cuckoo	Not Threatened	9	15	1	25	2.69%	0
Welcome swallow	Not Threatened	5	15	1	21	2.26%	0
Whitehead (E)	Not Threatened	2	14	0	16	1.72%	0
Kereru (E)	Not Threatened	2	9	0	11	1.18%	0
Spur-winged plover	Not Threatened	6	2	0	8	0.86%	1
Sacred kingfisher	Not Threatened	3	3	1	7	0.75%	0
Pied tomtit (E)	Not Threatened	0	2	0	2	0.22%	2
Southern black-backed gull	Not Threatened	1	0	1	2	0.22%	0
Swamp harrier	Not Threatened	6	0	0	6	0.65%	10
Sub-total for native Not Threatened species		163	303	18	484	52.04%	13

*Table 7 continued on next page.

Chaffinch	Introduced and Naturalised	63	57	6	126	13.55%	0
Eurasian blackbird	Introduced and Naturalised	23	29	1	53	5.70%	0
Yellowhammer	Introduced and Naturalised	41	16	1	58	6.24%	0
Common starling	Introduced and Naturalised	22	12	1	35	3.76%	0
European greenfinch	Introduced and Naturalised	25	9	0	34	3.66%	0
Australian magpie	Introduced and Naturalised	24	9	0	33	3.55%	0
European goldfinch	Introduced and Naturalised	15	5	0	20	2.15%	0
Song thrush	Introduced and Naturalised	11	9	0	20	2.15%	0
Eastern rosella	Introduced and Naturalised	3	9	0	12	1.29%	0
House sparrow	Introduced and Naturalised	7	0	0	7	0.75%	0
Eurasian skylark	Introduced and Naturalised	4	0	0	4	0.43%	0
Common redpoll	Introduced and Naturalised	2	1	0	3	0.32%	0
California quail	Introduced and Naturalised	2	0	0	2	0.22%	0
Wild turkey	Introduced and Naturalised	1	0	1	2	0.22%	0
Common myna	Introduced and Naturalised	1	0	0	1	0.11%	0
Mallard duck	Introduced and Naturalised	0	0	12	12	1.29%	0
Common pheasant	Introduced and Naturalised	0	1	0	1	0.11%	0
Sub-total for Introduced and Naturalised species		244	157	22	423	45.48%	0
Grand total		413	467	50	930		15

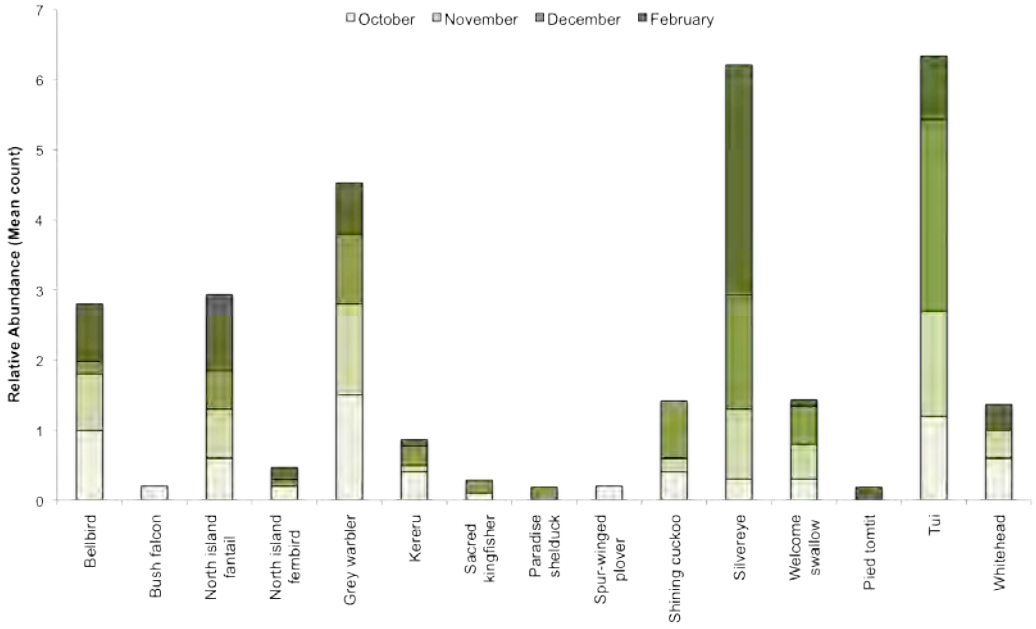


Figure 6 Mean five-minute native bird counts per station from 11 listening stations in forest / shrubland habitat about the Makaroro River, spring/summer/autumn 2011/12

Chaffinch, blackbird and yellowhammer were consistently observed in forested habitat throughout the survey period. Other more mobile species, such as rosella and starling, were observed intermittently. Starlings were observed in small flocks during October, but only as individuals in February.

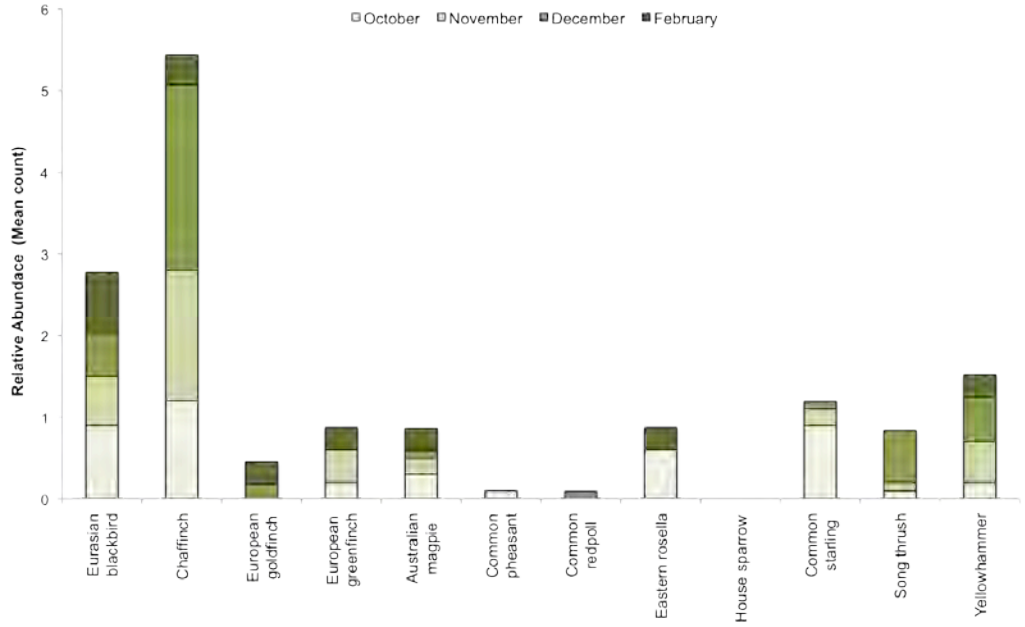


Figure 7 Mean five-minute adventive bird counts per station from 11 listening stations in forest / shrubland habitat about the Makaroro River, spring/summer/autumn 2011/12

Pasture/treeland habitat

In pasture / treeland habitat a total of 29 individual species were identified. Of these 41 % were native. Counts conducted among pasture / treeland habitat observed Tui with noticeable abundance during October 2011 among forest-shrubland fragments containing kowhai (Figure 8).

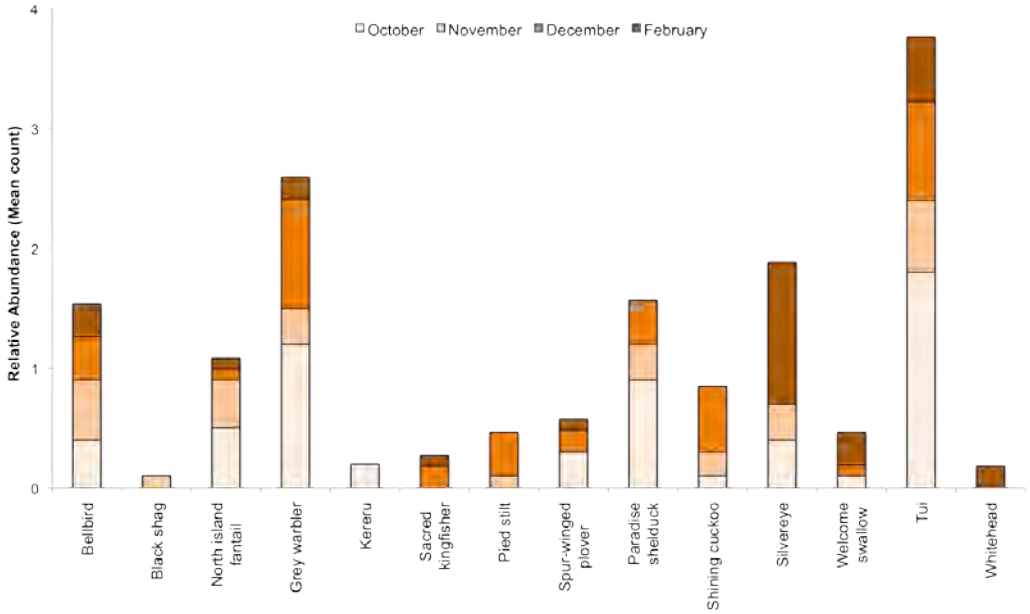


Figure 8 Mean five-minute native bird counts per station from 10 listening stations in pasture/treeland habitat about the Makaroro River, spring/summer/autumn 2011/12

The adventive species most consistently observed in pasture/treeland habitat were chaffinch, greenfinch, magpie and blackbird.

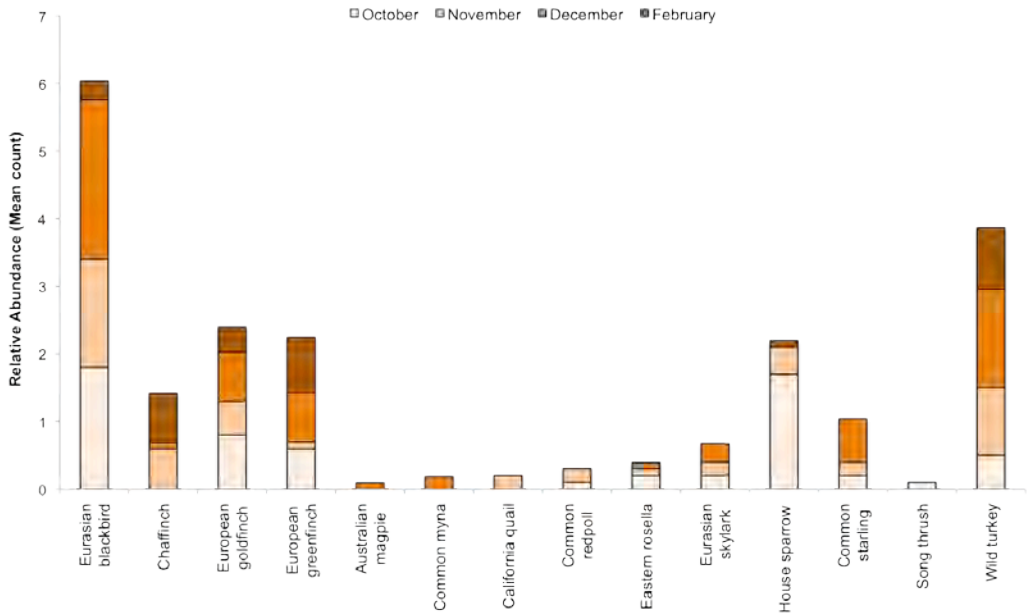


Figure 9 Mean five-minute adventive bird counts per station from 10 listening stations in pasture/treeland habitat about the Makaroro River, spring/summer/autumn 2011/12

6.3.4 Walkthrough Surveys

Table 7 above shows the results of the bird species and numbers recorded during the walkthrough surveys. Species in the Makaroro braided riverbed, such as NZ pipit, paradise shelduck and pied stilt, (Photo 8) were observed during the November and December 2011 walkthrough surveys in spring. Pied stilt had disappeared by late summer and had likely moved to post breeding flock sites. Data for threatened species found during the walkthrough surveys is shown in the threatened species section (below).

Photo 8 Family group of pied stilts feeding in the Upper Makaroro braided riverbed during November 2011

6.3.5 Nationally Threatened and At Risk Species

Threatened and At Risk species comprise 2.5% of all formal observations. One Nationally Vulnerable NZ bush falcon pair was most likely nesting in the site during spring 2011. Other species that were potentially present, such as kiwi and blue duck, were not detected. Nationally At Risk species detected were pied stilt, NZ pipit, black shag and North Island fernbird. . In addition one adult and one chick where observed within the reservoir. The spatial locations of where those species were observed are shown in Figure 10 below. Note that, to improve readability, closed circles may represent the observation location of multiple individuals of the same species.

NZ bush falcon

In addition to the falcon observation on 23/09/2011, birds were observed on several other occasions in the vicinity of the steep forested area shown in Photo 9. It is likely they were the same pair:

- 26/10/2011 at 07:44: Two birds observed (<100 m range) diving off the cliff to gain velocity and then climb. They were subsequently heard hunting above the adjacent pine forest (*Pinus radiata* stand approx. 18 years old). At 09:19 a bird was observed to be hunting the gully about the bird count station B3, and another heard calling from the vicinity of the cliff top where the birds were seen to originally dive from.
- 22/11/2011 at 13:15: one bird observed from the confluence of Dutch Creek and Makaroro River. Observed bird for approximately five minutes. It energetically climbed to high elevation in the direction of the main Ruahine Ranges.

Photo 9 Steep forested area at the confluence of Makaroro River and Dutch Creek where bush falcon were consistently observed during October and November 2011

Pied stilt

These birds were initially detected from a five-minute count at Station P12 on 23/11/2011 at 09:32. Subsequently two were observed by a field worker in the near vicinity of P12 while walking up the river on the same day. One of these birds gave a sustained broken wing display, indicating a nest or chicks nearby. Four pied stilts were observed in the vicinity of this site on three occasions during December 2011. No pied stilts were observed during the February 2012 fieldwork.

New Zealand pipit

Up to five individuals periodically observed in the riverbed during the survey period. One individual is pictured in Photo 10.

Black shag

Observed on two occasions in the river (23/11/2011 and 21/12/2011) and flying overhead on 9/02/2012.

Kiwi

No kiwi were observed in or about the site during formal surveys or while completing surveys throughout the period of the fieldwork.

Blue duck

On the 11th November 2012, a Blue duck pair was observed just above the Upper Makaroro Hut, which is approximately 8 km North of the Gold Stream/Makaroro confluence and upper limit of the reservoir area.

The upper Makaroro River population of blue duck are part of a northern Ruahine blue duck population of about 50 birds. Blue duck use of Dutch Creek may be confined to winter use by the occasional mobile juvenile birds (John Cheyne, *pers comm*[10]). Mr Cheyne states that the northern Ruahine Ranges, including the upper reaches of the Makaroro, Waipawa and Tukituki Rivers, supports a population of blue duck of about 50 – 70 birds. This is the southernmost population of blue duck on the eastern side of the North Island. DOC carried out a banding study in the Apias River (Ikawatea catchment) and Makaroro River between 1960 and 1996 when 41 birds (24 adults, 17 Juveniles, adult pairs increased from 5 to 8 over the study) and 22 birds (18

[10] Blue duck expert, Bay Eco-solutions

adults, 4 juveniles, adult pairs increased from 2 to 5 over the study) were banded respectively over this period (Adams et al, 1997). From these studies and recent reports from trampers and hunters Mr Cheyne considers that blue duck still exist in similar numbers in the Makaroro catchment (upstream of the proposed dam site) and the most recent breeding record was three years ago near the upper Makaroro hut. The DOC banding study focused on the Makaroro catchment upstream of Gold Creek, but the aerial plane monitoring of transmitter marked juvenile birds showed that juveniles from the Apias River dispersed widely with a single bird being recorded moving into Dutch Creek for a period of time (J Cheyne, pers comm). Other records were made of juvenile birds using other small eastern Ruahine streams to the north and also on the western side of the range. Thus the dispersal of juvenile blue ducks appears to be quite wide before they return to their natal river.

Though the present survey may not have detected blue duck within the reservoir area, further winter surveys for blue duck are recommended. If blue duck are found close to or within the reservoir area a mammalian predator trapping programme in the upper Makaroro catchment will be required to offset the modification of the Dutch Creek blue duck habitat. This is discussed further in section 12.3.3.

Banded dotterel

During ACO survey work on the 12th November 2012, a field team observed two banded dotterel (one adult and one chick) within the reservoir area, on the braided riverbed.

North Island fernbird

At least 3 individual birds were heard on the margins of Dutch Creek throughout the survey period. A pair was consistently detected in the shrubland/wetland about five-minute count station B4 (Figure 6 and Photo 11).

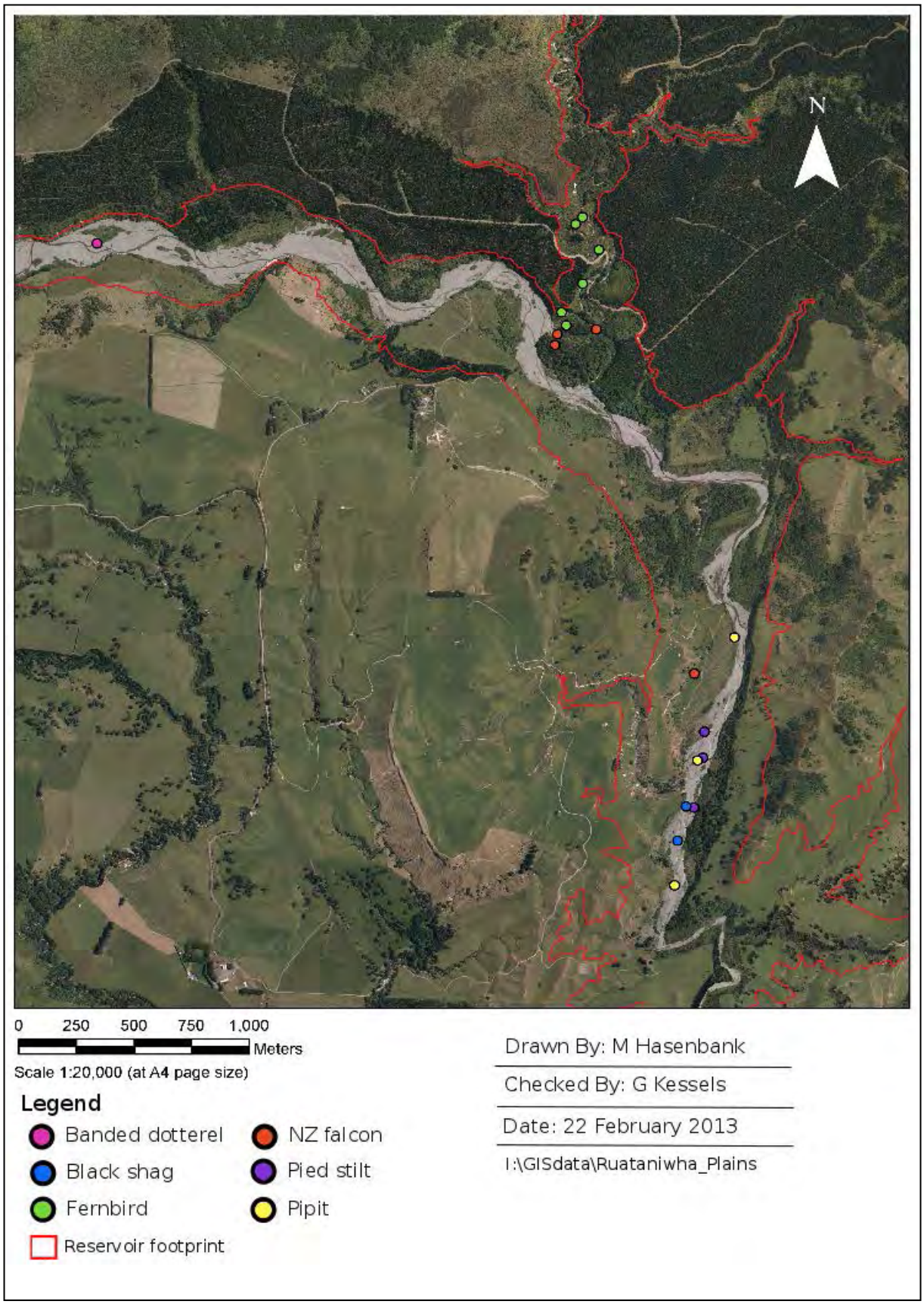


Figure 10 Location of Nationally Threatened and At Risk Species observations, Makaroro October 2011 to February 2013; closed circles may represent observations of multiple individuals

Photo 10 NZ pipit on log in Makaroro braided river habitat, December 2011

Photo 11 Wetland/shrubland habitat where fernbird are located in the vicinity of five-minute bird count station B4, Dutch Creek, November 2011

6.3.6 Waipawa River Walkthrough Surveys

Walkthrough surveys of waders and water birds were completed 19 km downstream from the reservoir along a 4.5 km reach of the Waipawa River. The Nationally Vulnerable banded dotterel was commonly detected at densities of up to 3.3 pairs/km. Nationally At Risk pied stilt and NZ pipit were also recorded, and in addition, two colonies of southern black-backed gulls were observed (Figure 11). A summary of this data is presented in Table 8.

Table 8 Native wader and water bird observations, Waipawa River November 2011 – February 2012, (E) denotes endemic species

Common name	Threat Classification Miskelly *et al*. 2008	Qualifier	Nov-11	Dec-11
Banded dotterel	Threatened - Nationally Vulnerable	RR	17	37
Pied stilt	At Risk - Declining	SO	14	24
NZ Pipit (E)	At Risk - Declining		2	-
Paradise shelduck	Not threatened	-	4	58
White faced-heron	Not threatened	-	-	1
Southern black-backed gull	Not threatened	-	150+	≈250

Banded dotterel

Most birds were observed during the 22 December 2011 survey. A total of 37 birds were detected with 15 territories confirmed and a further 8 birds were counted which were either singletons or could not be confirmed as pairs occupying a territory. Conservatively this equates to 3.3 pairs/km over the 4.5 km reach of river (15/4.5). Braided river habitat is shown in Photo 12, the locations of the bird observations in Figure 11 and observational data in Appendix VII.

Photo 12 View down river towards the Highway 50 bridge across the Waipawa River showing lupine establishing on banded dotterel habitat

New Zealand pied stilt

[11] RR = Range restricted, SO =Secure overseas

Again most birds were observed during the December survey. This is due to a flock of 19 that were roosting approximately 200 m upriver of the upper southern black-backed gull colony.

Other birds

Two New Zealand pipit were observed in the midsections of the survey reach at 07:54 on 23 November. A flock of 58 paradise shelduck were observed in the vicinity of the lower southern black-backed gull colony (SBBG Nest site 1) on 22/12/2011.

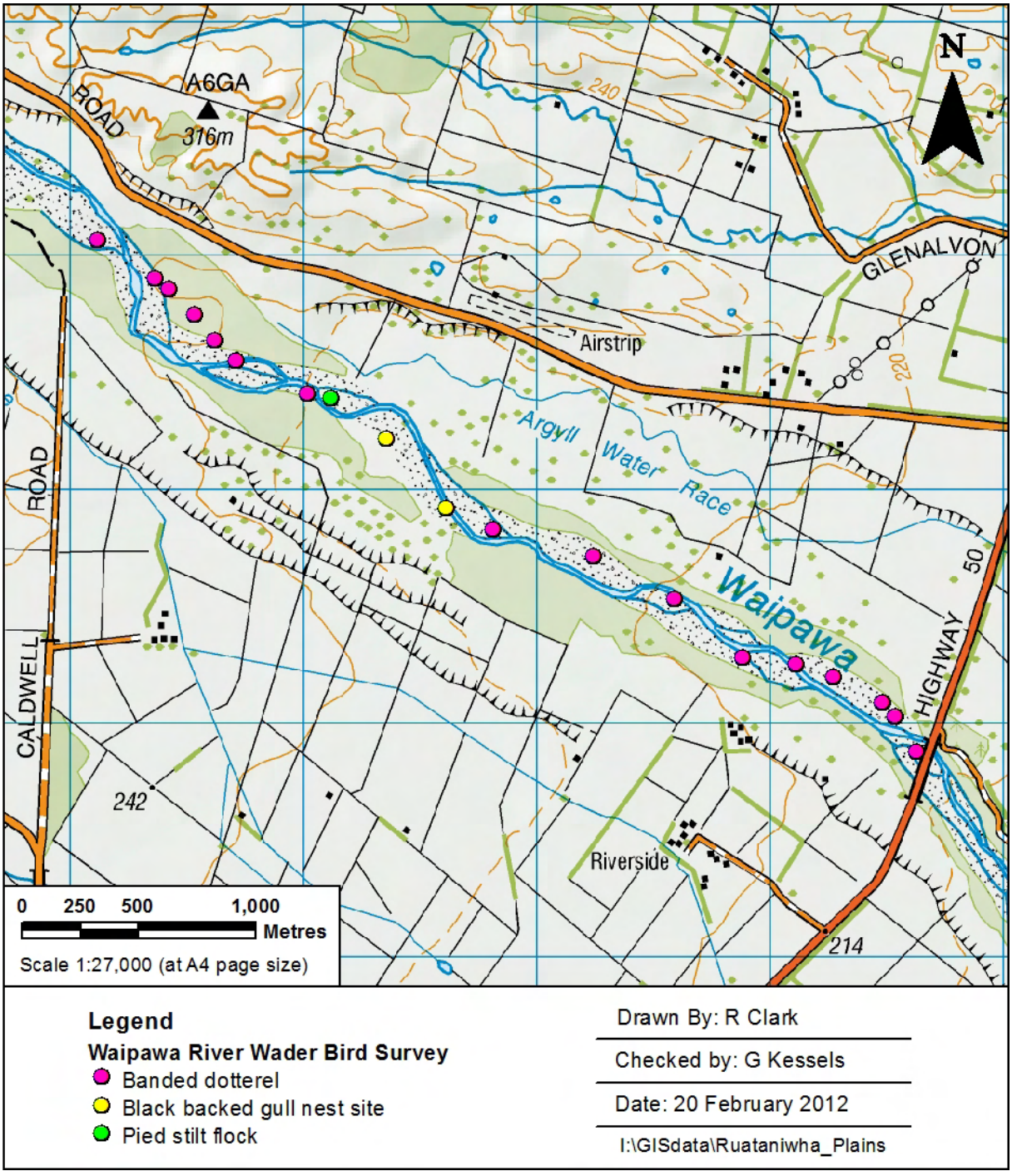


Figure 11 Locations of banded dotterel and pied stilts in relation to black backed gulls on the Waipawa River, 22/12/2011. Waypoints show locations of bird observations as shown in Appendix VII