



Terrestrial ecology
assessment

Benmore Irrigation Scheme

Prepared for
Benmore Irrigation Company Ltd

Prepared by
Tonkin & Taylor Ltd

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Executive summary

Benmore Irrigation Company (BIC) proposes to irrigate approximately 3,564 ha of farmland between Omarama and Twizel.

This report outlines the results of a survey of terrestrial ecology values to support an application being prepared by BIC for resource consents.

Objectives of the survey were to:

- 1 Survey terrestrial fauna and botanical values across the study area,
- 2 Provide an assessment of the values potentially affected by the development, and
- 3 Identify sites, species or communities on which ecologically significant effects may result from the proposed development.

The 39 individual candidate sites across six properties that comprise the initial scheme investigation were surveyed on 24 April 2014, and between 19 May and 22 May 2014.

The site visits recorded:

- Indigenous vegetation cover, plant species composition, exotic vegetation and bare soil to comment on the likely values of vegetation communities,
- Quality of lizard habitat, including presence of lizard sign,
- Samples of terrestrial invertebrate communities in sites where indigenous plant communities were most intact, and
- Observations of birds including site survey and sightings and records from landowners.

Individual ecological values for vegetation, avifauna, terrestrial invertebrates, lizards and Environment types were combined to provide a relative ecological value for each site.

The 39 candidate irrigation sites for consideration of inclusion in the scheme were classified, based on overall indigenous terrestrial ecology values, as:

- High value 2 sites (GB1, BM1a)
- Moderate- High value 2 sites (TD1a, GB2a)
- Moderate value 4 sites
- Moderate-low value 13 sites
- Low value 9 sites
- Very low value 9 sites

Ecological values at most sites were patchy and of a mosaic nature such that further discrete mapping of contiguous units was not possible for this assessment, but which could be undertaken to further resolve potential divisions within sites of higher and lower ecological values.

Of the 39 candidate sites, 36 were chosen to be part of the proposed irrigation scheme.

The Significant Ecological Area criteria of the Canterbury Regional Policy Statement were used to assess the ecological significance of the 36 sites. Nine sites (totalling around 1,593 ha) were considered to support indigenous vegetation and habitats of indigenous fauna that qualify as Significant Ecological Areas. Other sites support primarily or completely modified exotic vegetation for grazing, cropping or irrigation.

Of these nine sites, particular features included:

- Three nationally rare plant species (piripiri *Acaena buchananii*, Coral broom *Carmichaelia crassicaulis* subsp. *crassicaulis*, Cushion pimelea *Pimelea sericeovillosa* subsp. *pulvinaris*; all Nationally At Risk) recorded with the possibility of several others being present,
- Specialised invertebrate faunas, including some naturally uncommon species,
- Native birds including habitat for banded dotterel and pipit on less-modified habitats (and records of threatened black stilt, black-fronted tern, terns, and black-billed gull from sites already converted to intensive grazing, cropping or irrigation),
- Native lizards including at least one species of gecko and one skink throughout sites supporting indigenous habitats (although some farmed and cropped sites also supported habitat for lizards),
- Land Environment types that are nationally acutely or chronically threatened (i.e. there is less than 20 % of their original extent remaining nationally) on 11 of the sites totalling 206 ha.

Overall, the greatest potential effects of the proposed development on terrestrial ecology values will be through the conversion of sites BM1a, GB2a, BM4a and GB1 to irrigation, with a lesser level of loss (although still ecologically significant losses) from conversion of sites TD1b, GB6, BM6, BM11a and LB3.

There are a variety of management options available to landowners to protect, restore or otherwise ameliorate threats on land of similar type to improve ecological values and generate biodiversity gains that can be used to offset unavoidable losses on significant ecological values within the project areas.

1 Introduction

1.1 Background

Benmore Irrigation Company (BIC) proposes to irrigate farmland between Omarama and Twizel as shown in Figure 1.

This assessment of terrestrial ecology values was undertaken to help refine the extent considered for irrigation and to support an assessment of environmental effects (AEE) being prepared by BIC as part of an application for resource consents.

1.2 Scope of work and objectives

The scope of work covered by this report includes an assessment of terrestrial ecology values (including wetlands) within the general areas identified by BIC as candidate sites for irrigation (hereafter 'candidate sites') and to provide an assessment of potential effects for the sites proposed for the resource consent application (hereafter 'proposed sites', which are a sub-set of the candidate sites). Together, the sites comprise the study area.

This survey and assessment also includes only those sites on which irrigation may occur, and does not include any potential effects that may arise from developing infrastructure associated with irrigating the candidate sites.

Objectives of the survey were to:

- 1 Survey terrestrial fauna and botanical values across the study area,
- 2 Provide an assessment of the values potentially affected by the development, and
- 3 Identify sites, species or communities on which ecologically significant effects may result from the proposed development.

The work was carried out in accordance with our letter of engagement with Benmore Irrigation Company dated 07 May 2014 and instruction to undertake further work dated 8 November 2015.

1.3 Benmore Irrigation Project

The candidate irrigation area covers portions of six properties on either side of State Highway 8 between Omarama and Twizel in the southern portion of the Mackenzie Basin. The six properties include Benmore Station, Buscot Station, Glenbrook Station, Willowburn Station, Westside and Twizel Dairy.

Benmore Irrigation is seeking consents to irrigate additional land area, which adds to that already irrigated, or in some places, seeks to irrigate new blocks distant from existing irrigated land.

The candidate irrigation area covers around 4,890 ha of Basin floor.

A breakdown of the number and collective size of the candidate sites (discrete areas of land assessed for ecological values) on each station is provided in Table 1.1.

Table 1.1: Proposed irrigation sites by landowner and total area

Land owner	Irrigation sites	Total Area (ha)
Twizel Dairy	4 sites	704.2
Westside	2 sites	88.9
Glenbrook	8 sites	1,131.1

Benmore	17 sites	1,941.5
Willowburn	2 sites	798.4
Buscot	6 sites	225.8
Total	39 sites	4,890 ha

Figure 2 shows the distribution of proposed sites that were assessed by this study. GIS shapefiles describing the sites were obtained from Benmore Irrigation Company (via Tom Heller, Environmental Associates Ltd).

1.4 Ecological context

1.4.1 Ecological values

Through geological history and climatic isolation, the MacKenzie Basin has developed unusual plants and animals adapted to the often stony and infertile soils and climatic extremes of drought, frost, heat and wind.

Human occupation (Maori, then European) has brought about widespread change to the vegetation through land clearance and conversion to exotic pasture grasses (McGlone 2004), such that many indigenous species and communities supported in the Basin are locally, regionally or nationally rare or threatened (Walker et al. 2003; de Lange et al. 2009). The broad-scale change in vegetation composition, along with the establishment of invasive weeds has led to soil erosion issues (Cuff 1994), and a widespread loss of biodiversity values.

The dry grasslands of the Mackenzie Country have been extensively farmed in large “sheep stations” since the earliest days of European settlement in the South Island interior. Agricultural landholders recognise the opportunities that changed land management offers for improving sustainability of businesses and also for the conservation of the indigenous biodiversity on properties. One of the key challenges acknowledged is the need for information on how changed land management may adversely affect, or alternatively, protect and restore, high indigenous biodiversity values.

Ongoing decline of biodiversity in the MacKenzie Basin is caused not only by land use change such as land intensification, but also through progressive degradation of ecological areas due to weed invasion and the effects of introduced pests. Introduced hawkweeds and wilding pines are two key ongoing threats to indigenous grasslands which will further degrade local ecological values irrespective of whether or not farming practices intensify land use (perversely, land intensification in some areas can be argued to prevent further biodiversity decline elsewhere by removing local infestations of wildling trees and removing introduced hawkweed sources). The issue of wildling pine spread and the need for landscape-level control is recognised by all stakeholders.

Research on the removal of grazing and land improvement practices (e.g. oversowing and top-dressing) shows that degraded ecosystems can recover quickly with native tussock and inter-tussock species recovering along with an associated reduction in invasive weeds such as hawkweeds. The spread of wildling conifers is more problematic. Even without further land development, wildling pines are predicted to spread, progressively cover large areas of the landscape and eliminate indigenous communities (Harding 2001). Thus, in many places, the background rate of change is one of progressive decline in indigenous biodiversity values over time, unless active intervention is applied to control wildling conifers.

Today, the MacKenzie Basin supports some of the more unique and threatened ecological communities and species in New Zealand.

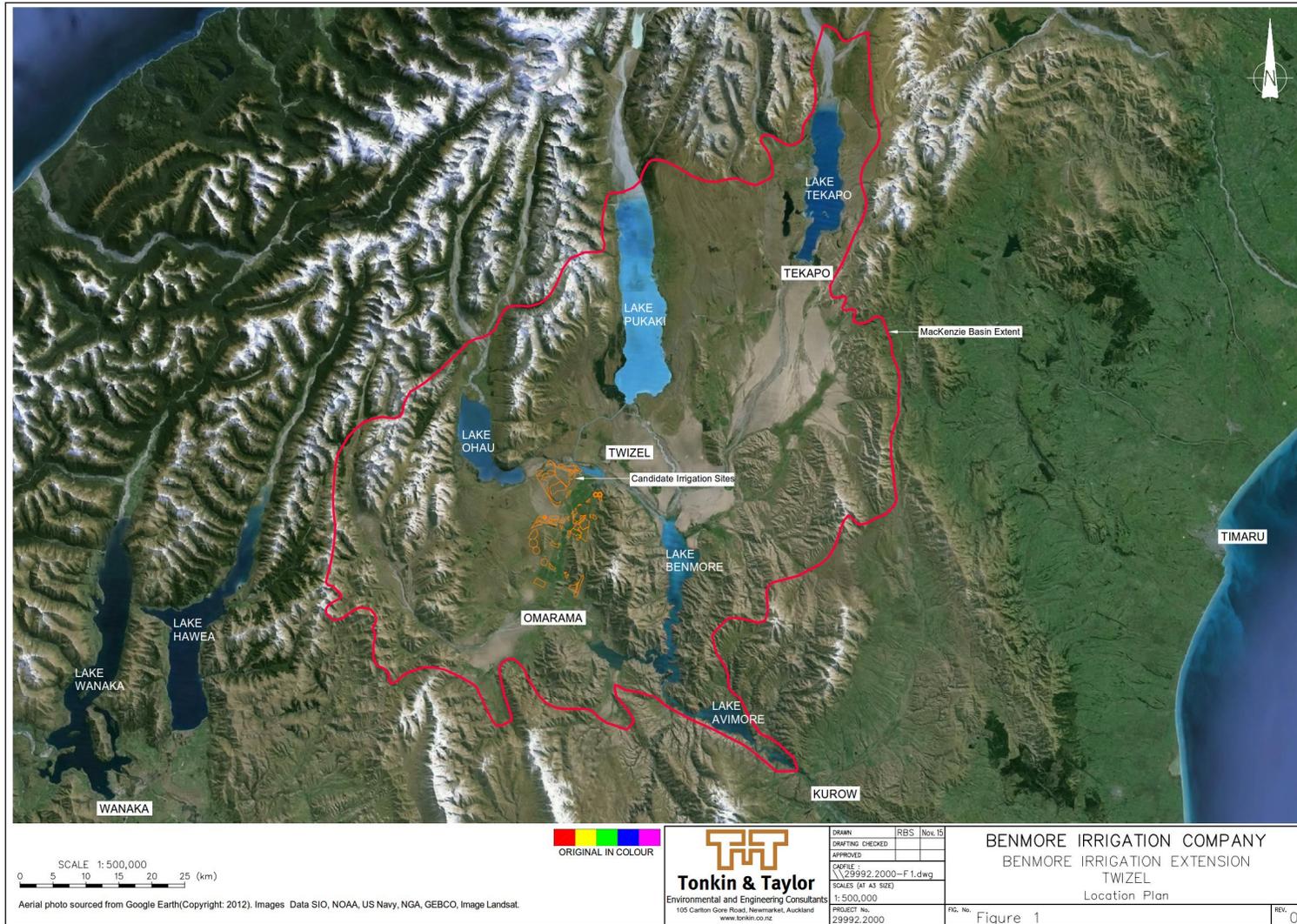


Figure 1. Candidate sites proposed for irrigation by the Benmore Irrigation Company and spatial extent of the Mackenzie Basin area. Mackenzie Basin spatial extent taken from Walker (2009).

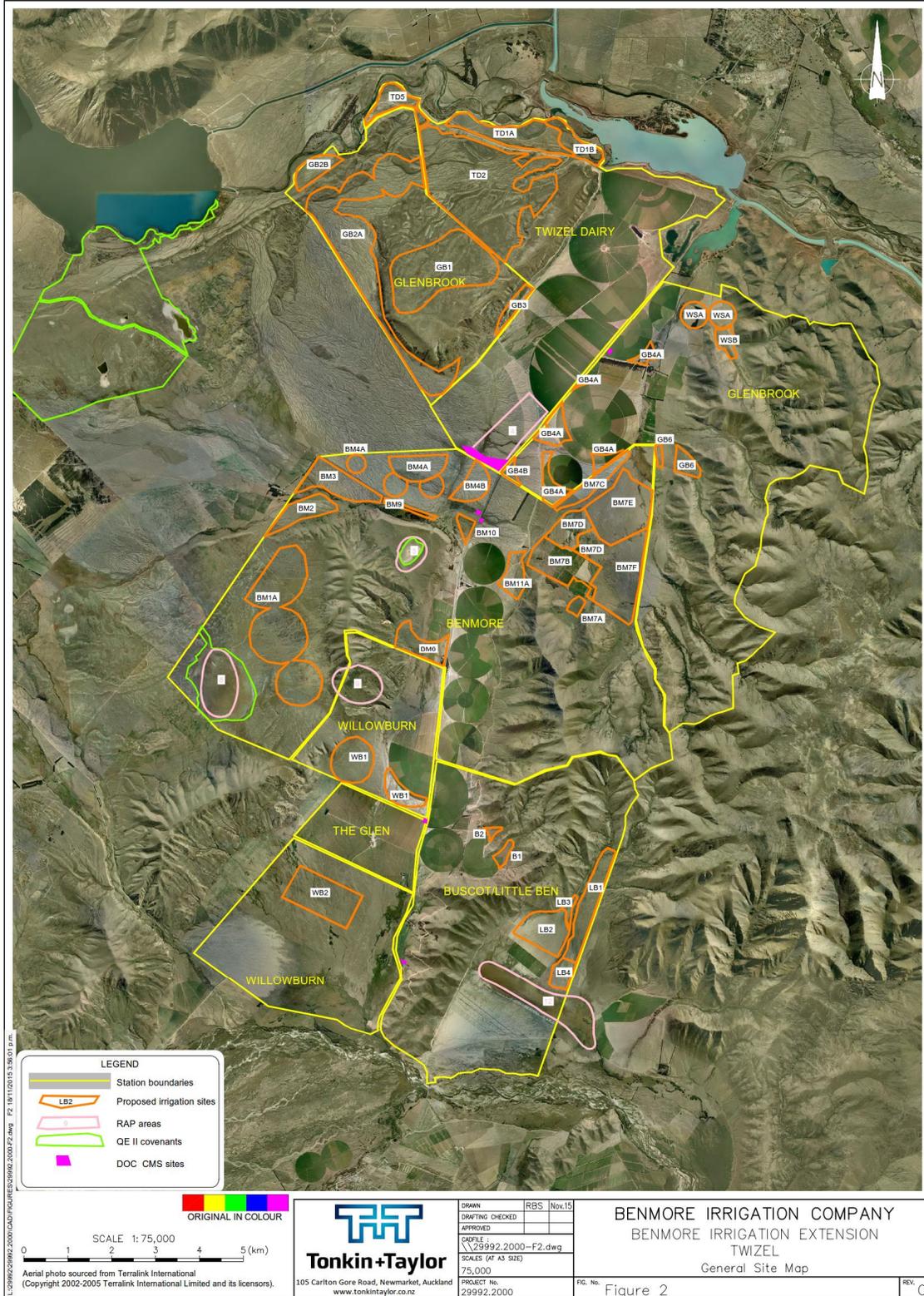


Figure 2. Proposed irrigation areas, property boundaries and sites of high ecological value (DOC Conservancy Management Strategy Canterbury (CMS), DOC Recommended Areas for Protection (RAP), and QE II open space covenant sites (QE II National Trust)).

Land Environments of New Zealand (LENZ) provides a proxy for ecological features across New Zealand based on similar physical environment characteristics. LENZ types originally present throughout the MacKenzie Basin have in some cases been significantly reduced due to past human activities. Most land environments in the Basin are reduced such that remaining portions are classified as being of high threat status, and therefore of high conservation priority to conserve from further degradation.

The diverse and specialised nature of vegetation communities in the MacKenzie Basin has given rise to specialised and diverse invertebrate faunas. A government funded survey of the ecological values of the MacKenzie Ecological Area (a broader area than the Basin) (Espie et al. 1984)¹, made recommendations for permanent protection of sites to protect plant and insect communities.

The MacKenzie Basin supports numerous nationally 'Threatened' or 'At Risk' plant species that are threatened because of declining population size and/or small restricted population distribution. Twenty "Threatened" and 40 "At Risk" (i.e. near threatened) plant species occur in the MacKenzie Basin floor environments, which represent 24 % and 23 % respectively of the total "Threatened" and "At Risk" plant species of the Canterbury region (Walker 2009).

Invertebrate species of interest recorded from the Basin floor environments included native grasshopper species, large ground beetles, ground weta and threatened moths. Further invertebrate surveys by Patrick (1992) emphasised the values of the remaining natural areas of the MacKenzie Basin, particularly for native moths and butterflies. In his report Patrick suggested protection for several natural areas in addition to those identified by Espie et al. (1984), including native grasslands between Twizel and the Ohau Lake road turnoff (which lie partly within recently irrigated sites and partly amongst candidate areas under this proposal).

Alluvial outwash surfaces, wetlands and braided rivers in the MacKenzie Basin support at least 36 species of native birds, of which 10 are classified as "Threatened" species and an additional four are classified at 'At Risk'. The habitats of most of these species are predominantly braided riverbeds, wetlands or woody vegetation. None of these habitats are well represented within or nearby the candidate irrigation areas, however some of these bird species are known to use alluvial plains and irrigated areas for feeding, roosting and, in some cases, breeding.

The MacKenzie Basin also has a disproportionate density and area of naturally rare ecosystems (otherwise known as 'historically rare' ecosystems) compared to most other places in New Zealand. These ecosystems often support highly specialised and diverse plant and animal communities and are characterised by relatively high proportions of either endemic or nationally threatened or rare species (Williams et al. 2007). Six of the 72 naturally rare ecosystems identified throughout New Zealand are present in the Basin area, and include moraines, inland outwash surfaces, inland sand dunes, braided rivers, ephemeral wetlands and tarns. The nature of naturally rare ecosystems is that they are patchy and widely distributed across the landscape in mosaics, making it difficult to accurately map or separate units for management purposes. The interconnectedness of naturally rare ecosystems and the surrounding wetlands, freshwater systems and grasslands is reflected in the distinctive overall biodiversity of the Mackenzie Basin.

A more complete description of the historic background, and the national and regional context of the ecological values of the MacKenzie Basin is provided as a preface to the description of the ecological values of the candidate sites in Appendix A.

1.4.2 Protected areas or areas proposed for protection

We used three information sources to identify sites within the general study location that have been regarded by others as supporting particularly high indigenous biodiversity values or which were

¹ This survey was undertaken as part of a systematic survey of New Zealand's natural areas

considered worthy of conservation and protection. These areas are shown in Figure 2 and the three sources of information included:

- 1 Sites identified as high conservation value sites at a regional level through the Department of Conservation's (DOC) Conservancy Management Planning process. Mapped sites in the vicinity of the proposed irrigation areas include point locations along SH8 (at the north-east boundary of The Glen Station), two point locations at the intersection of SH8 and Lake Ohau Road, Spring Creek Reserve (adjoining site BM4a) and a point location near the private accessway to Glenbrook Station homestead.
- 2 Sites from the national ecological survey programme PNAP in the early 1980s (Espie et al. 1984) which identified recommended areas for protection (RAP) based on high ecological values. Sites in the vicinity of the proposed irrigation sites include Ben Omar Swamp (RAP site 12), Wairepo Lake adjacent to site BM1a (RAP 8), Willowbank Fault Scarp (RAP 9), Benmore Homestead Tarn (RAP 5), and Spring Creek (RAP 4). These sites are reflected in the Waitaki District Plan.
- 3 Sites volunteered by landowners as protection of natural values under the QEII National Trust. Sites in the vicinity of the proposed irrigation scheme include an Open Space covenant encompassing Wairepo Lake, a covenant over the Benmore Homestead Tarn, and several large covenants to the south of Lake Ohau.

None of the CMS, RAP or QEII sites are located within the proposed areas and therefore will not be directly affected by the proposed scheme.

2 Methods

The sites were visited on 24 April 2014, and again between 19 May and 22 May 2014. During the May visit, each site was visited and traversed by vehicle (all sites) and foot (for sites with obvious indigenous values), by a botanist and a fauna ecologist. Two sites were not visited (GB5 and GB2b), however they were observed from nearby sites and showed characteristics in common with other sites that had been modified to the same extent.

The site visits recorded:

- Indigenous vegetation cover, plant species composition, exotic vegetation and bare soil to comment on the likely values of vegetation communities (See Appendix A for a more detailed description),
- Quality of lizard habitat, including presence of lizard sign (particularly for geckos in suitable habitats),
- Samples of terrestrial invertebrate communities (see below) in sites where indigenous plant communities were most intact, and
- Observations of birds including site survey and sightings and records from landowners.

Sources of information for each of the subject sites were:

2.1 Vegetation

- Spot surveys of representative communities within each site
- Broad walkover/ drive-over surveys of the rest of each site
- Visual estimate of indigenous cover and bare ground and weed cover
- Background information obtained from published reports and papers, threatened plant lists and plant distribution databases (e.g. NZ Plant Conservation Network).

2.2 Lizards

- Assessment of habitat availability and suitability at each site
- Observations of animal sign or presence (while undertaking invertebrate searches)
- Background information obtained from the DOC National Herpetofauna Database and site records of land tenure surveys

2.3 Avifauna

- Binocular spotting of sites prior to access
- Habitat availability and records of birds using the site
- Interviews with landowners
- Information supplied by DOC (black stilt programme)
- OSNZ Bird Atlas of New Zealand
- Land tenure review information

2.4 Terrestrial invertebrates

- Pan trap-lines at five sites (sites TD1b, GB1, GB2, BM4a, BM1a)
 - Pan trap-lines consisted of 10 traps, spaced 10m apart for sites GB1, GB2 and BM1a. For sites TD1a and BM4a traps were set so as to target specific habitats with 6 pans set across one vegetated terrace riser in TD1a and 7 traps set within a patch of short tussock grassland in site BM4a.

- Pantraps were plastic dishes 17 cm long x 12 cm wide x 5.5 cm deep.
- Pantraps were painted yellow on the base, half filled with saturated salt solution and set level on top of the ground surface.
- Traps were set for 3 days.
- Site photos are shown in Plate 1.
- Pitfall traplines at three sites (GB1, GB2, BM1a)
 - Each pitfall trap-line had 10 stations spaced 10 m apart, with each station having two pitfalls spaced up to 2 m apart (providing 20 pitfalls per site)
 - Pitfalls were plastic cups 10 cm deep x 7 cm diameter. Cups were buried level with the ground following best practice installation
 - Pitfalls were set with one-third saturated salt solution and left uncovered. Traps were set for 3 days.
- Malaise traps at two sites (GB1, BM1a)
 - One trap was set at each site for 3 days (see Plate 1 for locations)
- Sweep-netting around pan-trap sites (opportunistic)
- Manual searches of vegetation, rock areas and similar habitat
- Background information obtained from published reports and papers
- Invertebrate identification and interpretation of results undertaken by Entecol Ltd (see Appendix B for report).



1a



1b



1c



1d



1e

1f

Plate 1. Habitats and sites sampled for terrestrial invertebrates. 1a: Pantraps were laid within predominantly native scrub and fescue tussock grassland covering an alluvial terrace riser at TD1a; 1b: Watercourse at GB1 where pan-trapping, pitfall and Malaise trapping was undertaken. Vegetation was partly modified fescue tussock grassland with patches of woody native vegetation. 1c: Native scrubland vegetation at GB1 above browntop and fescue tussock grassland amongst which pitfall and pantrap lines were set. 1d: Sparse short tussock grassland at GB2a with bare ground and silty soils. 1e: Mini-Malaise trap set at BM1a to sample from short tussock grasslands and patches of woody vegetation, here dominated by golden Spaniard, porcupine shrub and matagouri. 1f: Predominantly open bare soils and hawkweed typical of site BM4a with patches of short tussock grassland, amongst which pan-traps were set.

In addition, landowners were interviewed about biodiversity in and around the candidate irrigation sites, particularly threatened birds and plants, and past land management practices.

3 Results

3.1 Indigenous Vegetation

We divided the candidate irrigation areas into 39 discrete sites reflective of the general quality of indigenous vegetation cover and degree of modification.

A summary of sites that were classed in each vegetation value category is provided in Table 3.1).

Table 3.1: Vegetation community values of the candidate irrigation sites.

Indigenous vegetation value	Sites
Very Low (14 sites)	WB1, WB2, B1, B2, LB1, LB4, BM7a, BM11b, BM10, BM4b, BM7d, WSa, TD3, TD2
Low (10 sites)	LB2, BM1b, BM2, BM3, BM9, BM7b, GB4a, GB3, TD1a, WSb
Moderately Low (8 sites)	BM11a, BM7f, BM7e, BM7c, GB4b, GB2b, TD5, BM4a
Moderate (4 sites)	GB2a, GB6, BM6, LB3
Moderately High (2 sites)	GB1, TD1b
High (1 site)	BM1a

Rare or threatened plants recorded from the survey included the 'At risk (Declining)' species:

- Piripiri *Acaena buchananii* Site TD1b
- Coral broom (*Carmichaelia crassicaulis*) Site BM1a
- Cushion pimelea *Pimelea sericeovillosa* subsp. *pulvinaris* Sites GB1, BM1a

As discussed in the values report (Appendix A), the survey was conducted at a time of year (late autumn) when many plant species of interest are absent or cryptic. The survey results for plant communities at best provide a general guide to the ecological value of each site relative to other sites. It is very likely that survey of the sites during spring and summer would record plant species not recorded from this survey, including the possibility of additional rare or threatened plant species.

In order to better inform the potential values of each candidate site, and in the absence of a survey during spring and summer, we compiled information about habitat use for some of the rare or threatened plants known to occur within the general habitats represented within the candidate sites. The purpose of the assessment was to provide a means for assessing the likelihood of occurrence of each species within each of the candidate sites. Our desktop assessment seeks to provide a precautionary approach to predicting rare or threatened plant presence, however field survey would provide a more thorough and reliable assessment.

We used information from DOC's BioWeb database for locations of plants of note within the Omarama Ecological District together with a selection of plants that may be expected to occur in habitats similar to those encountered within the candidate irrigation areas, namely low tussock grasslands, grey scrub, gravels, alluvium and the margins of damp sites such as ephemeral wetlands and seepages. We have not included species characteristic of tarns, kettleholes, stream margins or wetlands, as those habitats either do not exist within the candidate irrigation areas or the irrigation areas are intended to avoid these sites (such as stream margins and wetlands).

The assessment (Appendix C) suggests that rare or threatened plants may be present in several of the sites as shown in Table 3.2.

Table 3.2. Threatened or rare plant species for which habitat may be present in specific sites within the candidate irrigation areas, based on existing records and known habitat associations from elsewhere. This table excludes sites which have been oversown and topdressed, ploughed or are in crops such that no native vegetation remains, or it is scarce.

Species and threat status	Sites at which it may be present (i.e. within which habitat that may be suitable is known to occur)
<i>Acaena buchananii</i> At Risk - declining	could be present in sites BM1a, TD5, GB2b, GB6, BM6
<i>Carmichaelia crassicaulis</i> subsp. <i>crassicaulis</i> At Risk - declining	could be present in sites GB1, BM7F, GB2b, TD1b
<i>Pimelea sericeovillosa</i> subsp. <i>pulvinaris</i> At Risk - declining	could be present in sites GB2b, BM1a
<i>Carmichaelia vexillata</i> At Risk - declining	could be present in sites GB1, BM1a
<i>Ceratocephala pungens</i> Nationally critical	could be present in site TDb1
<i>Myosurus minimus</i> subsp. <i>novae-zelandiae</i> Nationally Endangered	could be present in sites GB2a, TD1b, BM4a
<i>Myosotis brevis</i> Nationally vulnerable	could be present in sites GB1, BM1a
<i>Leptinella conjuncta</i> Nationally critical	could be present in sites TD1b, GB2a
<i>Leonohebe cupressoides</i> Nationally endangered	could be present in sites GB1, BM1a
<i>Lepidium solandri</i> Nationally Endangered	could be present in sites GB1, BM1a, GB2a, TD1b
<i>Carmichaelia nana</i> At Risk - declining	could be present in sites GB1, BM1a, GB2a, TD1b
<i>Leucopogon nanum</i> At Risk - Naturally uncommon	could be present in sites GB2a, TD1b
<i>Carmichaelia curta</i> Nationally Critical	could be present in sites GB1, BM7F, GB2b, TD1b
<i>Carmichaelia kirkii</i> Nationally Vulnerable	could be present in sites GB1, BM1a
<i>Raoulia monroi</i> At Risk - Declining	could be present in sites GB1, BM1a, GB2a, TD1b, BM4a, LB3

<i>Senecio dunedinensis</i> Nationally Vulnerable	could be present in sites GB1, BM1a
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While we consider that there is a strong possibility of rare or threatened plants, other than those found during this survey, being present at some of the candidate sites, and species may be present in addition to those shown in Table 3.2, many of the sites candidate sites have been oversown, disced and topdressed, while others have been irrigated to a lesser extent than sought by this proposal.

Those sites that have been oversown and topdressed repeatedly have lost most of their original natural vegetation values and, given the ways in which these practices change local environments, we consider that it is unlikely that substantial remnant rare or threatened plants now exist at those locations. Sites that have also been irrigated stand even less of a chance of retaining significant components of their natural plant communities.

For sites where indigenous plant community modifications have been less intense or less frequent, and where there are still remnants of natural communities, survey during summer and spring may indeed detect additional indigenous plant species, including some of the rare or threatened species predicted to be present from the Appendix C assessment. However, that may not in itself change the assessed ecological significance of the site given that most in these categories of 'moderate' value or greater have been assessed as being of ecological significance by triggering other ecological significance criteria (see next section of this report).

3.2 Avifauna

Twenty-two species of bird were recorded from across the candidate irrigation sites of which 9 were native species. Most were found throughout the study area in their respective habitat types. Interviews with landowners and records in existing literature provided a more extensive list of native birds that use or are likely to use habitats of the candidate irrigation sites, but which were not present or recorded during the field survey.

Table 3.3 provides a checklist of indigenous birds recorded or known from cropland/ open ground and indigenous grassland environments. Appendix D provides checklist of all birds recorded from terrestrial (including forested) and water environments in MacKenzie Basin habitats similar to those within and surrounding the candidate irrigation sites.

Table 3.3: Birds observed or known to use habitats within the candidate irrigation sites and their conservation status

Habitat	Species	Comments
Threat Status		
Threatened – Nationally Critical	Black stilt, Black-billed gull	Use improved pasture and irrigated areas for feeding. See text for further details.
Threatened – Nationally Endangered	Black-fronted tern	Use improved pasture and irrigated areas for feeding.
Threatened – Nationally Vulnerable	Caspian tern	Use improved pasture and irrigated areas for feeding

	Banded dotterel	Uses open ground (e.g. degraded grasslands, outwash plains) and short tussocklands for breeding, feeding
At Risk	Pied stilt NZ pipit and Pied oystercatcher	Use improved pasture and irrigated areas for feeding Use open ground sites (e.g. outwash plains, river terraces) for breeding.
Taxonomically Indeterminate	Southern falcon	Falcon use farmland and indigenous grassland/ shrubland habitats
Not Threatened	Australasian harrier, Pukeko, Southern black-backed gull, Spur-winged plover, Welcome swallow, White-faced heron all use farmland and irrigated areas as part of their range of habitats for feeding, roosting or breeding. Grey warbler, Fantail and Silvereye most likely use shelterbelts and shrubland.	

Overall, the existing vegetation cover at all sites provides habitat for native birds, including rare or threatened species. Notable species include:

Black stilt may occur within candidate irrigation areas since they are attracted to the foraging opportunities provided by irrigation and ploughing. Black stilt were not recorded during this survey, however, survey records from DOC and observations over many years by several of the landowners indicate that black stilts are present on sites that are already irrigated, including:

- Black stilt can nest within farmland areas, with a recent record within the farm building/ service area of Willowburn Station (Dannie McAughtrie, landowner, *pers. comm.*).
- Black stilt (and pied stilt) are regular visitors to the treatment ponds at Twizel Dairy (near the the candidate sites) with up to 6 black stilts recorded in recent years (Dave Gordon, station contact, *pers. comm.*).
- Black stilt (and pied stilt, and gulls and terns) have been observed following the line of pivot irrigators on already irrigated land near to candidate sites.
- DOC's records for black stilt included records of sub-adults or adults within improved farmland sites already pivot irrigated or candidate sites for this project (Dean Nelson, DOC, *pers. comm.* and database information²):
 - at Buscot Station LB sites (5 records in improved pasture),
 - within Willowburn Station W2 (2 records within grazed, improved pasture, separate from nesting record around service area),
 - within irrigated areas at north Willowburn and north Buscot (either side of SH18),
 - in improved pasture/ crops close to Benmore sites BM2 and BM3, and
 - four records within irrigated areas around Twizel Dairy site TD3 and Glenbrook site GB4a

Terns and black-backed gulls feed over farmland, especially where ploughed or irrigated.

Banded dotterel were not recorded during this survey however they have been recorded in outwash plains near to GB2a (Dale 2013). Similar habitat exists at sites BM4a, TD1a, and TD2 at the least.

Wetland birds – (for example, Australasian bittern, shoveller, black shag, crested grebe, dabchick, grey duck, marsh crane, NZ scaup). Wetlands are situated adjacent to the candidate irrigation areas

² Information supplied by DOC Twizel office (Dean Nelson) including locations of recent sightings of black stilt in and around the subject candidate irrigation sites.

at five locations³ and the avifauna there includes a range of species not present within more terrestrial environments. For some of those wetland sites, adjoining land is already irrigated (by K-line for example) and at the rest the surrounding vegetation is improved grazing pasture. Stock have access to some stream and wetland systems at some locations.

Collectively, sites modified by oversowing, grazing and/or some type of irrigation already offer habitat value to a range of indigenous birds, including some threatened or rare riverine and wetland birds. The extent to which these species depend upon these particular modified sites for successful breeding and as critical habitat is unclear, however, strongholds for all of these species for nesting and feeding occur elsewhere in the MacKenzie Basin and these birds are known to travel large distances in search of habitat. In addition, given these species are associated primarily with other key environment types (e.g. fluvio-glacial outwash plains, river flats and margins and tarns) it is likely that farmed environments represent a less important habitat than natural environments.

In the case of natural environments such as the relatively unmodified outwash plains to the north and west of Table Hill (forming the majority of site GB2a), these form potential nesting habitat for banded dotterel, pied oystercatcher, spur-winged plover, Australasian harrier and southern black-backed gull, and probably seasonal feeding habitat for black-fronted tern.

3.3 Lizards

Nine species of lizards have been recorded from the MacKenzie region (Table 3.4; source Herpetofauna Database). Of these, six are known to have habitat preferences that include Basin floor environments such as those found within the candidate irrigation areas. The likelihood of the presence of native lizards decreases considerably in sites that have been extensively grazed, improved or irrigated, as these actions may remove refuges (e.g. rock piles), and reduce natural foods associated with diverse natural vegetation.

Table 3.4: Lizards recorded from the MacKenzie Basin area

Species	Common name	NZ threat classification	Potential presence within study area
<i>Oligosoma chloronoton</i>	Green skink	At Risk - declining	Possible
<i>Oligosoma lineocellatum</i>	Spotted skink	At Risk - relict	Possible
<i>Oligosoma maccanni</i>	McCann's skink	Not threatened	Certain
<i>Oligosoma polychroma</i>	Common skink	Not threatened	Likely
<i>Oligosoma waimatense</i>	Scree skink	Threatened – Nationally Vulnerable	Unlikely
<i>Oligosoma longipes</i>	Long-toed skink	Threatened – Nationally Vulnerable	Unlikely
<i>Oligosoma aff. lineocellatum</i> 'Mackenzie Basin'	MacKenzie Basin skink	Threatened – Nationally Vulnerable	Possible
<i>Naultinus gemmeus</i>	Jewelled gecko	At Risk - declining	Unlikely
<i>Woodworthia sp.</i> 'Southern Alps'	Southern Alps gecko	Not threatened	Certain

³ Wetlands included Ben Omar Swamp (DOC site H39095) downstream of sites LB1 -4; Willowburn Stream wetland which forms the lower catchment for much of Willowburn site WB2; Wairepo wetland (junction of SH8 and Lake Ohau road) downstream of proposed Benmore sites BM9, BM2 and BM3; 'Big Tarn' (Wairepo Lake) located down-contour of site Benmore BM1a a listed RAP and QE II covenant ephemeral wetland site; and Barclays wetland down-stream and down-catchment of Benmore sites BM7a – f, BM11a –b and sites upstream that feed into Spring Creek and Wairepo Creek.

Skink and gecko habitat was scored as high, moderate or low quality as a surrogate for the potential to support lizards, in each of the sites (Table 3.5; Plate 2).

Habitat searching (for invertebrates) and insect trapping detected two McCann's skink: one as an accidental capture in an insect pitfall trap in site GB1 and one observed amongst Spaniards at site BM1a. Southern Alps geckos were at all sites where habitat was judged to be moderate or high quality for geckos (apart from site GB6 where habitat was noted from afar).

Habitat for skinks and geckos exists throughout the candidate irrigation areas and extends throughout the adjacent and surrounding areas. Geckos or their presence was detected at seven sites within the candidate irrigation areas and at sites adjacent to candidate irrigation sites where (usually) slopes were less modified and supported rock outcrops or debris piles. High or moderate quality skink habitat was found at 15 of the candidate sites, and there is abundant habitat in the adjacent and surrounding landscape.



2a



2b



2c



2d



2e



2f

Plate 2. Examples of habitat quality for skinks and geckos. 2a: *Woodworthia* sp. 'Southern Alps'. 2b: high lizard habitat in site GB2a (gecko sightings). 2c: high lizard habitat in site BM4a (gecko sightings). 2d: moderate quality lizard habitat for skinks in site BM7e. 2e: low quality habitat for lizards in site BM1b. 2f: high quality habitat for lizards in site BM1a (McCann's skink seen).

Table 3.5: Quality of habitat for skinks and geckos (assessed separately) within the candidate irrigation sites (does not include vegetation on the boundaries of candidate sites that may support viable habitat, but which are not located within the candidate irrigation areas).

Habitat quality	Skinks	Geckos
High [#]	TD1b, TD1a, TD5 GB1, GB2a LB3 BM1a	TD1b GB1 LB3 BM1a
Moderate ^{##}	GB6 BM2, BM3, BM4a, BM6, BM7a, BM7b, BM7e, BM7f, BM11b WSb WB3	GB2a, GB6 BM4a TD5 WB3
Low ^{###}	TD3, TD2 GB3, GB2b, GB4a, GB4b WSa, WB1, WB2 LB1, LB2, LB4 B1, B2 BM1b, BM4b, BM7c, BM7d, BM9, BM10, BM11a	TD3, TD1a, TD2 GB3, GB2b, GB4a, GB4b WSa, WSb WB1, WB2 LB1, LB2, LB4 B1, B2 BM1b, BM2, BM3, BM4b, BM6, BM7a, BM7b, BM7c, BM7d, BM7e, BM7f, BM9, BM10, BM11a, BM11b

[#] Habitat was judged to be of high quality if it had a diverse cover of indigenous and exotic ground plant species providing thick cover and/or woody vegetation, rock outcrops or stone banks, gravel deposits, and fallen debris (e.g. logs) as potential refuges.

^{##} Habitat was judged to be of moderate quality if it had been improved such that grassland vegetation was grazed short, exotic pasture grasses dominated and woody vegetation was largely absent

^{###} Habitat was judged to be of low quality if the site had predominantly very low stature vegetation (e.g. hawkweeds), or sparse grassland species, or the site comprised pasture or cropland.

Geckos were present wherever there were rock outcrops, rock stacks (naturally or created through land improvement works) or stream bed gravels. Skinks, particularly McCann's skink, are likely to be present throughout most of the sites, either in habitat within the site or in vegetation along fencelines bordering sites.

3.4 Terrestrial invertebrates

We targeted areas and sites that supported a high diversity of indigenous vegetation or a diversity of vegetation structural types, on the reasonable assumption that those areas would also support the highest invertebrate diversity.

Despite the short duration of sampling, and its timing when key parts of the invertebrate fauna are absent or inactive, we found a number of species of conservation interest. None are listed nationally rare or threatened species (Table 3.6).

The presence of these species is indicative of less-disturbed natural habitats and indicates that species of equal or greater conservation significance may be found in these areas at times of the year when their life cycles enable more effective sampling (i.e. spring and summer months).

A more detailed description of the results of the invertebrate survey can be found in the report on terrestrial invertebrate communities in Appendix B.

Table 3.6: Invertebrates of note recorded from candidate irrigation sites dominated by indigenous vegetation.

Species	Conservation classification	Comments
Tekapo ground weta (<i>Hemiandrus 'furovianus'</i>)	Naturally Uncommon	Found in site GB2 (outwash plain) Appears to require sites less modified by farming. Threats to its local persistence include high stock grazing (ground compaction), tilling and irrigation.
<i>Sigaus australis</i> grasshopper	Regionally restricted	Found at sites GB1 and BM1, both elevated sites, sampled within intact indigenous scrubland and short tussock grasslands.
<i>Prodontria matagouriae</i> chafer beetle	Naturally Uncommon	May be dependent on matagouri (i.e. clearance of matagouri may result in it disappearing locally).
<i>Atomotricha</i> sp. (possibly <i>sortida</i>) moth	new record or new species	May be the first time this species has been recorded from the MacKenzie Basin, or if not this species, it is likely a new species.
<i>Cantuarina</i> trapdoor spider	new record or new species	Probable new species for the MacKenzie Basin, but this is not unusual for this group of spiders, given their localised speciation.

3.5 Land Environments

The Land Environments present within the candidate irrigation areas are mostly Land Environment N with smaller amounts of Environments E, K and Q. These equate to original (pre-human) vegetation comprising indigenous tussock grasslands with matagouri shrubland, and vegetation in wet depressions. Currently, indigenous vegetation (where present in sites) is dominated by degraded fescue tussock with varying proportions of exotic weeds and pasture grasses. Matagouri shrubland is scarce and patchy.

Using LENZ at Level IV definition (the highest resolution mapping available), the level of formal protection for these Environment types can be overlaid to provide a relative indication of rarity using the Threatened Environments Classification (TEC) (Walker et al. 2007). The Level IV Land Environments within the proposed irrigation areas are shown in Table 3.7, with their threat status. Land Environments with 20 % or less of their original extent remaining today are considered to be national priorities for protection (MfE, 2007) given their current low level of formal protection and likely vulnerability to future loss.

The result of that analysis once merged with the current underlying land uses and mapped vegetation type provides an indication of the presence of a Threatened Environment that still supports the underlying indigenous ecological system (as opposed to a land environment over which

ploughing or irrigation has occurred, thereby removing the natural values associated with that environment type).

Table 3.7: Level IV Land Environments within the candidate irrigation sites. Shaded cells are Land Environments with less than 20 % remaining nationally that are present within the candidate irrigation sites.

Environment	Threatened Environments Classification	Indigenous vegetation cover remaining (nationally, %)
N5.1a	Acutely threatened	<10% indigenous cover left
N4.1d	Chronically threatened	10-20% left
E3.1a	Chronically threatened	10-20% left
N3.1d	Chronically threatened	10-20% left
N3.1e	Chronically threatened	10-20% left
N4.1a	Chronically threatened	10-20% left
N7.1a	Chronically threatened	10-20% left
E4.1b	At risk	20-30% left
K3.1a	At risk	20-30% left
N4.1e	At risk	20-30% left
N4.1c	Critically underprotected	>30% left and <10% protected
N6.1a	Critically underprotected	>30% left and <10% protected
N6.1b	Critically underprotected	>30% left and <10% protected
Q2.2a	Critically underprotected	>30% left and <10% protected

3.6 Summary of Ecological Values

Individual ecological values for vegetation, potential for rare plant presence, avifauna, terrestrial invertebrates, lizards and Environment types were combined to provide a relative ecological value for each site. This is shown in Table 3.8 and illustrated in Figure 3.

The 39 sites were classified, based on overall indigenous terrestrial ecology values, as:

- High value 2 sites (GB1, BM1a)
- Moderate- High value 2 sites (TD1a, GB2a)
- Moderate value 4 sites
- Moderate-low value 13 sites
- Low value 9 sites
- Very low value 9 sites

The overall ecological value given to a site represents an average value across the site. Ecological values at most sites were patchy and of a mosaic nature such that further discrete mapping of contiguous units was not possible for this assessment. For example, site GB1 supports very good indigenous ecology values in gully areas, good values on spurs and slopes and generally poor (but patchy) values at the highest point to the east.

Where a site is identified as being of particular ecological value and as a priority for irrigation, more detailed mapping of values and technical feasibility for irrigating may assist with helping to better

separate out areas where irrigation can be avoided, from those areas where irrigation may have less adverse effects on the ecological values of the site.

Site ecological value scores do not provide comment on the value of land for current grazing or irrigation. The scores also do not explicitly state threats to ecological values from, particularly, invasive weeds such as wildling pines, although the scores provided for plant community values do reflect the intactness of the botanical communities and their level of degradation, including by colonisation by wildling pines and other non-native plant species.

The ecological values show in Table 3.8 represents that state at the time of survey. We acknowledge that for some sites, ongoing colonisation and spread by, especially, invasive weeds, is likely to reduce indigenous values over time unless active management is applied to, for example, weed control.

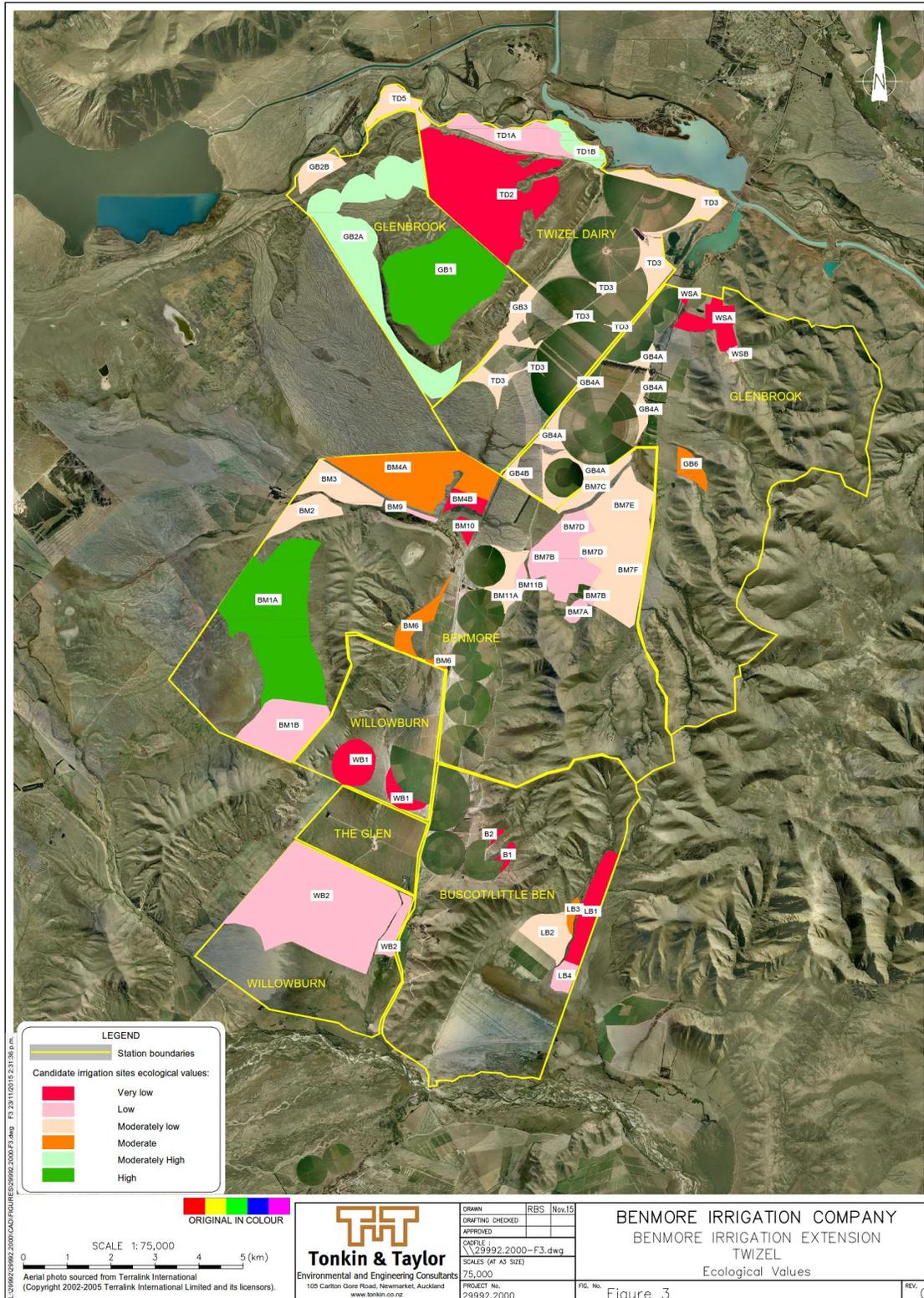


Figure 3. Combined ecological values of the candidate irrigation sites.

Table 3.8: Indigenous ecological values of the candidate irrigation sites.

Site	Plant community values	Likely presence of rare plant(s)	Avifauna values	Invertebrate values	Lizard values	Threatened Environment with indigenous vegetation still present? ¹	Overall Ecological value
WB1	Very Low	Low	Low	Low	Low	No	Very Low
WB2	Very Low	Low	Moderate	Low	Low	No	Low
B1	Very Low	Low	Low	Low	Low	No	Very Low
B2	Very Low	Low	Low	Low	Low	No	Very Low
LB1	Very Low	Low	Low	Low	Low	No	Very Low
LB2	Low	Low	Moderate	Moderate	Low	No	Moderately Low
LB3	Moderate	Moderate	Moderate	Moderate	High	Yes	Moderate
LB4	Very Low	Low	Moderate	Low	Low	No	Low
WSa	Very Low	Low	Low	Low	Low	No	Very Low
WSb	Low	Low	Low	Low	Low	No	Low
TD1a	Low	Low	Low	Low	Moderate	No	Low
TD1b	Moderately High	High	Moderate	Moderate	High	No	Moderately High
TD2	Very Low	Low	Low	Low	Low	No	Very Low
TD3	Very Low	Low	Moderate	Low	Low	No	Moderately Low
TD5	Moderately Low	Moderate	Moderately Low	Moderately Low	Moderate	No	Moderately Low
GB1	Moderately High	High	High	High	High	No	High
GB2a	Moderate	High	Moderate	High	High	No	Moderately High
GB2b	Moderately Low	Moderate	Low	Moderate	Low	No	Moderately Low
GB3	Low	Low	Moderate	Low	Low	No	Moderately Low
GB4a	Low	Low	Moderate	Low	Low	Yes	Moderately Low
GB4b	Moderately Low	Low	Low	Low	Low	No	Moderately Low

Site	Plant community values	Likely presence of rare plant(s)	Avifauna values	Invertebrate values	Lizard values	Threatened Environment with indigenous vegetation still present? ¹	Overall Ecological value
GB6	Moderate	Moderate	Moderate	Moderate	Moderate	No	Moderate
BM1a	High	High	High	High	High	Yes	High
BM1b	Low	Low	Low	Low	Low	Yes	Low
BM2	Low	Low	Moderate	Low	Moderate	No	Moderately Low
BM3	Low	Low	Low	Low	Moderate	No	Moderately Low
BM4a	Moderately Low	Moderate	Moderate	Moderately Low	Moderate	No	Moderate
BM4b	Very Low	Low	Low	Low	Low	No	Very Low
BM6	Moderate	Low	Moderate	Moderate	Moderate	Yes	Moderate
BM7a	Very Low	Low	Low	Low	Moderate	No	Low
BM7b	Low	Low	Low	Low	Moderate	No	Low
BM7c	Moderately Low	Low	Moderate	Low	Low	No	Moderately Low
BM7d	Very Low	Low	Moderate	Low	Low	No	Low
BM7e	Moderately Low	Low	Moderate	Low	Moderate	No	Moderately Low
BM7f	Moderately Low	Moderate	Moderate	Low	Moderate	No	Moderately Low
BM9	Low	Low	Low	Low	Low	No	Low
BM10	Very Low	Low	Low	Low	Low	No	Very Low
BM11a	Moderately Low	Moderate	Moderate	Moderate	Moderate	Yes	Moderate
BM11b	Very Low	Low	Moderate	Low	Moderately Low	No	Low

¹ Acutely or chronically threatened Environment Class i.e. Environment types with 20% or less of their originally extent remaining nationally.

4 Assessment of effects

The candidate sites described in the previous section were included in a prioritisation assessment by BIC in which ecological values were one of the factors considered during a refinement of the proposed scheme.

As a result of the refinement process, several candidate areas were dropped from the proposed scheme and others were reduced in size (some substantially) or re-located to create larger buffers to ecologically sensitive areas, to form the proposed irrigation scheme. This is shown in Figure 4.

Overall, the proposed irrigation scheme includes 3,564 ha of land covering 36 sites. It is the actual and potential adverse ecological effects on those land areas that is discussed in the remainder of this report.

Appendix E provides a list of the proposed irrigation sites and their respective areas. The site descriptions provided in Appendix A are still relevant to these areas, as the proposed irrigation areas comprise a sub-set of the candidate sites.

4.1 Indirect effects

The proposed sites do not include the removal of vegetation or stream bed within waterways that may cross the irrigated parcels. For example, waterways within site GB1 and BM1a will be fenced to exclude stock and standard set-back riparian margin of 10 m average width provided along each waterway (in line with best practice farm management).

Where proposed irrigation areas are adjacent to riparian margins (for example, LB1, GB6, BM3, WB2, BM7E), a 10 wide set-back will be maintained by stock-proof fencing and vegetation within the set-back maintained for indigenous vegetation values (e.g. through weed control and/or replanting).

Five wetlands are adjacent to or downstream of proposed irrigation areas. These wetlands are:

1. Ben Omar Swamp (DOC site H39095) downstream of sites LB1 -4, which is listed as a nationally important site for biodiversity protection;
2. Willowburn Stream wetland which forms the lower catchment for much of Willowburn site WB2;
3. Wairepo wetland (junction of SH8 and Lake Ohau road) downstream of proposed Benmore sites BM9, BM2 and BM3;
4. 'Big Tarn' (Wairepo Lake) located down-contour of site Benmore BM1a, and which is a listed Recommended Area for Protection under DOC's national site prioritisation scheme and is a QE II Trust national covenant ephemeral wetland site; and
5. Barclays wetland down-stream and down-catchment of Benmore sites BM7a – f, BM11a –b and sites upstream that are adjacent to Spring Creek and Wairepo Creek.

A potential effect is adverse changes to water quality arising from irrigation, with accompanying overland flow or groundwater flow into streams and wetlands. Substantial changes to water quality, particularly nutrient enrichment, may affect plant communities with flow-on effects to the availability of species richness, persistence, vegetative cover, habitat, food supply and long-term wetland use by, especially, waterfowl and wetland bird species.

The Water and Nutrient Assessment report by Environmental Associates Ltd (prepared in support of the AEE accompanying this application) assessed the degree to which changes in nutrient levels could be expected in wetlands as a result of the proposed irrigation areas.

In summary, that report and the subsequent section 92 response to Council provided by Environmental Associates Ltd found that (Tom Heller, report author, *pers. comm.*), for:

1. Ben Omar Swamp, there will be no effect upon existing phosphorus (P) concentrations within the Ben Omar Swamp and lower Sutherland's Creek (around which proposed irrigation sites LB 1 – 4 are located). A small (2.7 L/s) increase to groundwater flow input to the Ben Omar Swamp and lower Sutherland's Creek is predicted. There is most likely to be a measureable increase in nitrogen (N) concentrations within the Ben Omar Swamp and lower Sutherland's Creek in the order of 0.15 mg/L, taking the current average measured from 0.63 mg/L to 0.78 mg/L. These calculations are consistent with the methodology utilised within the Water and Nutrient AEE report.

However, the predicted change to nitrogen concentrations would not alter the current state of water quality range in those surface water bodies. Additionally, the majority of increased nitrogen concentration will most likely not incur an impact upon the biological health of the water bodies, as under those circumstances, they would be clearly phosphorus limited. No additional water quality change is predicted to occur as a result of the proposed increase in irrigation area by BIC for the Sutherland's Creek catchment.

2. Willowburn Stream wetland, the Willowburn Stream feeding into the wetland is predicted to reduce in nitrogen and exhibit some increase in phosphorus. The change to N and P concentrations is small and these concentrations are identified in the AEE report.
3. Wairepo Wetland, the wetland is directly associated with the upper Wairepo Stream. The water quality effects have been quantified as part of the upper Wairepo Stream catchment assessment described in the Water and Nutrient Assessment AEE report by Environmental Associates Ltd. Within the AEE report the predicted changes to N and P concentrations as a result of additional irrigated land are relatively small. The predicted changes to nutrient concentrations would be reflected in the Wairepo Wetland. There is no predicted change to the current water quality state for this waterbody.
4. Big Tarn, no effects upon water quality. Big Tarn is not a receiving environment for nitrogen or phosphorus for any increase to irrigated land proposed as part of this project.
5. Barclay's wetland, the effects of additional irrigated land would be lesser than that associated with the Wairepo Stream. Effects of changes to concentrations in N and P for the Wairepo Stream are given in the Water and Nutrient Assessment report by Environmental Associates Ltd. The report indicates some additional N and P loss to the stream, however, the increase in N and P concentrations are small. There is no predicted change to the current water quality state for the waterbody

4.2 Direct effects

The direct effects of irrigation within indigenous grassland ecosystems are well documented from studies elsewhere. Physical effects of ploughing, oversowing and effects of nutrient changes and water availability result in a total loss of habitat for indigenous plant communities, and removal of habitat for geckos and, in most cases, skinks. Loss of indigenous plant communities usually means

the associated loss of much of the native terrestrial invertebrate community which is typically reliant on specific plant hosts and natural environmental conditions.

Some native bird species are likely to benefit from change of land use, particularly those that currently use grazing or cropland, such as black-backed gull, terns and, infrequently, black stilt, as more foraging habitat becomes available under the irrigation scheme. For native birds that use sites that support indigenous vegetation, including land that receives grazing and oversowing, the changes with irrigation are likely to remove habitat.

Therefore, for sites that currently support predominantly indigenous vegetation, the change will be an almost complete loss of indigenous ecological value.

For sites that are currently farmed, cropped or otherwise irrigated, the change will remove most of the remaining indigenous biodiversity. For native bird communities at these sites, the change will possibly be beneficial if irrigated sites contribute to a source of more available insect foods, as appears to be the case with nearby sites that have already been irrigated to the extent proposed.

4.3 Effects on protected areas

The 36 sites proposed for irrigation are not within areas recommended or set aside for protection of biodiversity through QE II Trust covenants. There are no sites within the proposed irrigation areas that are listed in the Department of Conservation's Conservation Management Strategy, or through the national Protected Natural Areas Programme's (PNA) Recommended Areas for Protection (RAP) (Figure 2).

4.4 Adverse effects in context

The loss of indigenous biodiversity from the areas within the 3,564 ha irrigation scheme will be essentially absolute. The significance of that loss in a local and national context is difficult to assess for most elements of biodiversity, simply because the detailed knowledge of distribution and/or population is absent within the wider McKenzie Basin context. In addition, apart from seven or so sites that retain mostly indigenous vegetation cover (i.e. those rated as of 'moderate' vegetation quality or greater), all other sites support degraded indigenous communities. These degraded communities not only relate to vegetation, but also to lizards, birds and most probably (by association with degradation of vegetation in general), rare plants and invertebrates.

However, broad judgements can be made for some species and by using surrogates, the principal of which is the Land Environments classification.

For avifauna, most if not all of the 3,564 ha within the proposed scheme represents habitat for some native bird species. Conversion to irrigated land will likely produce a marginal benefit by creating greater areas of feeding habitat for those species that already seasonally use modified environments such as black stilt, terns, and back-billed gull.

For species such as banded dotterel and pipit that use relatively unmodified outwash plains and sparsely vegetated, open sites, irrigation may represent a total loss of usable habitat in the order of ca. 1,500 ha. However, these sites are not known to be stronghold areas for breeding or foraging for these species and represent a small fraction of the total potential area available in the Mackenzie Basin.

For McCann's skink and the Southern Alps common gecko, these areas of potential habitat within the irrigated sites represent a very small fraction of the species' known distribution over the central South Island and the severity of adverse effects is expected to be no more than minor. The Wildlife Act 1953 classifies all native lizards as 'absolutely protected' species, and a permit is required from the Department of Conservation to destroy habitat or individuals. Salvage and relocation to nearby suitable habitat is usually undertaken to minimise impacts.

For terrestrial invertebrates, the importance of habitat loss within the proposed irrigation sites is best represented by the predicted loss of specific vegetation communities, which themselves are approximated in this survey by the Land Environments classification. Spring Creek Reserve (RAP site 4 on Figure 2) was recommended for protection based on it being a good example of depleted fescue grassland that could be restored (Espie *et al.* 1984). Subsequent survey found that it is a hot-spot for native moths (Patrick 1992) with recommendations for an enlarged area to provide for the conservation of this habitat. In the intervening years, the surrounding habitat on private land has mostly been converted to irrigation, with much of the remainder degraded through successive stock grazing, ploughing, and oversowing. Many of those surrounding areas form part of this application to convert to fully irrigated land.

4.5 Land Environments

A breakdown of the Land Environment types supporting indigenous communities within each irrigation parcel is shown in Appendix E. The status of Land Environment types in relation to the 20 % protection threshold advocated as a national priority (MfE, 2007) is presented in Table 4.1.

Table 4.1 shows that, of the 11 Environment types present, the Benmore Irrigation proposal will result in the loss of 1,593 ha of which 8 of these types will constitute minor reductions (around 2 % each within the Basin region). Predicted reductions within the Basin of the remaining three types will be from 4.4 % to 12.8 %.

Acutely or chronically threatened environment types supporting indigenous vegetation (mostly of low to moderate quality) comprise 206 ha of the 3,564 ha of the overall BIC scheme. Site BM1a contributes to most of this loss (nearly 170 ha; (Table 4.2).

Table 4.1: Extent of Land Environments supporting indigenous vegetation affected by this project in the context of threat status.

Environment	Threatened Environments Classification ¹	Area within proposed irrigation scheme (ha)	% loss from MacKenzie Basin if this project proceeds (area in indigenous vegetation within Basin)
N5.1a	Acutely threatened	166.8	4.4 (3,776 ha)
N3.1d	Chronically threatened	16.5	5.6 (296 ha)
N3.1e	Chronically threatened	6.2	12.8 (48.3 ha)
N4.1a	Chronically threatened	0.6	0.01 (4,693 ha)
N7.1a	Chronically threatened	15.8	1.5 (1,027 ha)
E4.1b	At risk	991.4	2.0 (48,759 ha)
K3.1a	At risk	67.4	1.8 (3,647 ha)
N4.1e	At risk	2.8	0.1 (2,642 ha)
N4.1c	Critically underprotected	1.3	0.005 (24,959 ha)
N6.1a	Critically underprotected	28.3	0.3 (10,873 ha)
N6.1b	Critically underprotected	295.6	0.7 (40,765 ha)
Total area TEC		1,592.7	
Total area < 20 % remaining TEC		205.9	

¹ Acutely and Chronically Threatened Environments have 20 % or less of their original extent remaining.

Table 4.2: Location of acutely or chronically threatened Land Environment types within the proposed irrigation scheme.

Environment type	Area affected (ha)	Distribution across sites that support indigenous vegetation (ha)	Vegetation condition within site (from Appendix A)
N5.1a	166.8	BM1a (146.1 ha); BM6 (19.5 ha), LB3 (0.2 ha);	High – modified grass and shrubland Moderate- exotic with patches matagouri Moderate – grey shrubland/ exotic pasture
N3.1d	16.5	BM1a (16.5 ha);	High – modified grass and shrubland
N3.1e	6.2	BM1a (6.2 ha)	High – modified grass and shrubland
N4.1a	0.6	LB3 (0.6 ha)	Moderate – grey shrubland/ exotic pasture
N7.1a	15.8	BM11a (15.8 ha)	Mod-low – shrubland/ tussock/ pasture spp

4.6 Ecological Significance (plans/ policies)

The Waitaki District Plan outlines controls over the clearance of indigenous vegetation and sets criteria for the identification of significant indigenous vegetation and significant habitats of indigenous fauna.

The District Plan defines 'indigenous vegetation' (Appendix G) as meeting one of the following three criteria:

- The coverage of indigenous species exceeds 30%, where structural dominance is not attained
- The proportion of indigenous species exceeds 30%, where structural dominance is not attained
- The coverage of indigenous species exceeds 20%, where structural dominance is attained

Section 16.9.3.3 of the District Plan also includes criteria to be used in order to identify areas with significant indigenous vegetation or significant habitats of indigenous fauna (Appendix G).

The Canterbury Regional Policy Statement also contains provisions for identifying significant ecological areas and managing adverse effects at those sites (CRPS 2013; Protecting significant natural areas). Under Appendix 3 of the CRPS, a site must meet one or more of 10 criteria as shown in Appendix G to qualify as 'significant indigenous vegetation'.

Applying the definition for indigenous vegetation against the significance criteria from the Regional Plan results in nine sites (Table 4.3; Figure 4 – See Appendix F for full descriptions against the criteria) meeting the definition as ecologically significant sites (on the basis of indigenous vegetation and/or indigenous fauna).

Table 4.3: Significant ecological sites within the proposed irrigation area

Qualifying ecological significance criteria are Canterbury Regional Policy Statement criteria 1) Representativeness, 2) size, 3) less than 20% remaining, 4) Threatened or rare species, 5) distributional limits, 6) distinctiveness including originally rare ecosystems, 7) diversity and pattern, 8) ecological linkage, 9) wetland functional importance, 10) key habitat.

Site	Area (ha)	Ecological value (this report)	Qualifying ecological significance criteria (see Appendix F for descriptions of the criteria)
TD1b	48.7	Moderately High	CRPS 1, 4, 6, 7, 9
GB1	275.5	High	CRPS 1, 2, 4, 7, 8
GB2a	408.9	Moderately - High	CRPS 1, 2, 4, 6, 7, 8

GB6	32.1	Moderate	CRPS 1, 4, 6, 8
BM1a	347.7	High	CRPS 1, 2, 3, 4, 7, 8
BM6	59.3	Moderate	CRPS 1, 3, 4, 6
LB3	9.7	Moderate	CRPS 1, 3, 4, 6, 8
BM4a	116.9	Moderate	CRPS 1, 6
BM11a	40.6	Moderate	CRPS 4, 8
Total	1,339.4		

Nine of the 36 proposed irrigation sites meet criteria for being ecologically significant on a range of criteria under both Plans. Together these sites cover around 1,340 ha of land.

In addition to these sites, sites that are modified, mostly or completely, by farming, cropping and irrigation are used to some degree by threatened (e.g. black stilt, black-billed gull, black-fronted tern) or rare species (possibly Caspian tern). The guidance provided in Wildlands (2013) on the application of the CRPS criteria excludes intensively grazed exotic pasture or ploughed fields that provide temporary sources for threatened or rare bird species. Therefore, we have not included sites in the analysis of ecological significance which are represented only by such bird values.

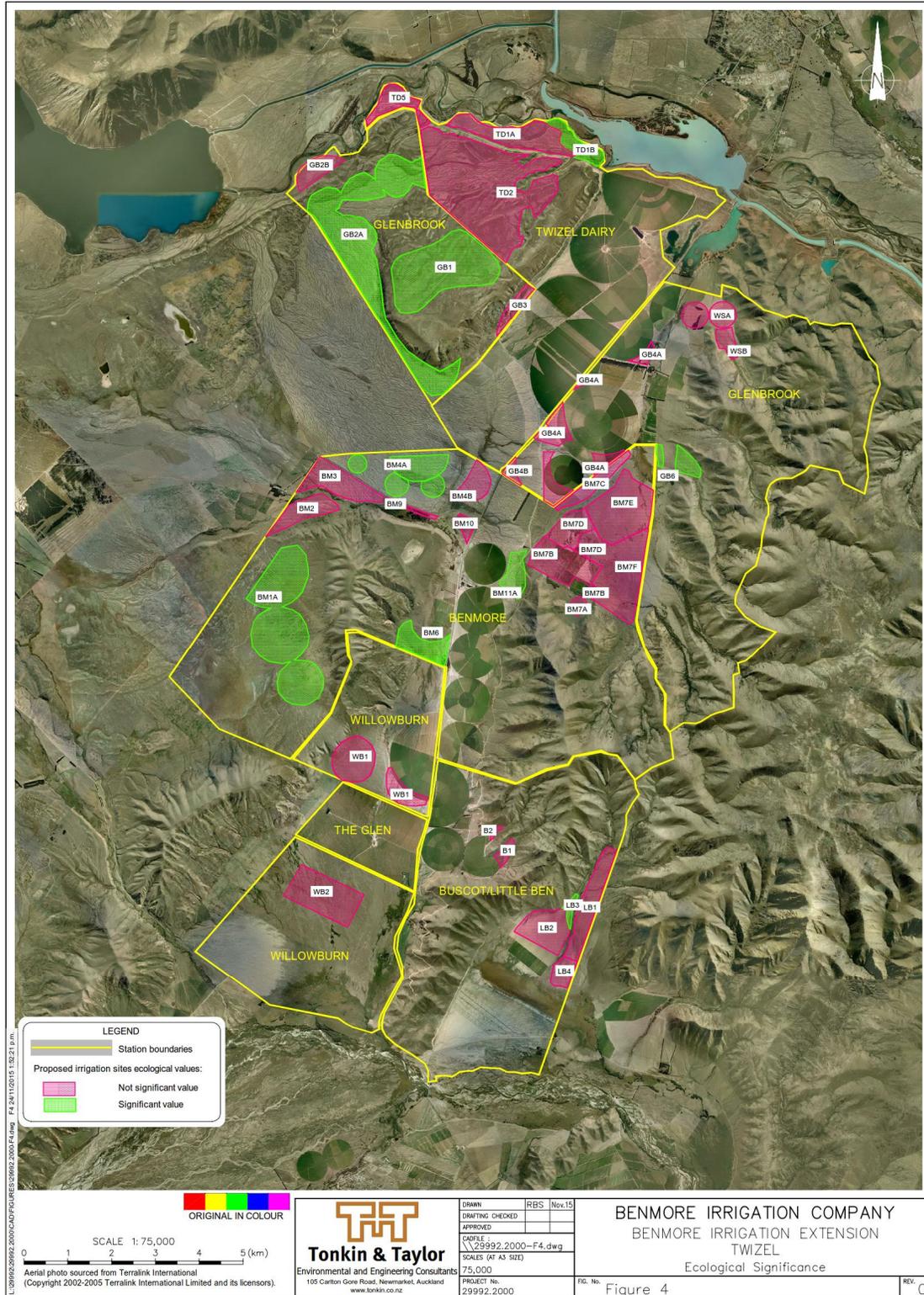


Figure 4. Proposed irrigation sites in relation to ecological significance as assessed under the Waitaki District Plan or Canterbury Regional Policy Statement.

4.7 Residual adverse effects

Of the 39 sites assessed as part of this survey, nine sites (totalling ca. 1,340 ha) support ecological values which, based on plant, animal and Environment Type criteria assessed as part of this survey, support values whose removal would constitute a more than minor ecological loss. Those sites (listed in Table 4.3) also meet the ecological significance criteria of the District and Regional Plan and therefore a loss of indigenous ecological values would presumably constitute a significant adverse effect for overall evaluation under these Plans.

The range of ecological values and the relative value of those is not consistent between the nine sites, however all meet the criteria for qualifying as significant sites on more than one of the criteria under each Plan.

Some of the sites are of small size and comprise small areas of habitat that have less value than other larger sites that adjoin similar habitat but which are not included as part of the proposed irrigation programme. Ranking the relative level of significance of each site using criteria from the District/ Regional Plan and field-based observations of habitat quality, size, connectivity and buffering to adjoining indigenous habitats could provide a means of evaluating candidate sites on their ecological significance. A broad overall judgment on development or any trade-offs is beyond the nature of this ecological evaluation, but it may form an important criterion on alternative options for development or trade-offs.

For the nine sites identified as being of ecological significance, the values within each site are not uniformly distributed. Table 4.4 provides one suggestion which could reduce the magnitude of ecological effects - substantially so if the spatial location of the Environment types corresponds also to where indigenous vegetation and wildlife values at the site are also greatest (this may not be the case and each site may require a site-by-site assessment to locate proposed irrigation areas within the least ecologically valuable part of the site (if feasible)).

Table 4.4: Significant ecological sites within the proposed irrigation area

Priority for protection of part or the whole of sites classified as ecologically significant, based on Threatened Environment types present and overall ecological rating. Note that all other sites proposed for irrigation are assumed to be of less ecological value than these sites and to be not ecologically significant under the CRPS criteria.

Site	Area (ha)	Area of Threatened Environment in native vegetation	Overall ecology value (from Table 3.8)	Priority for protection
TD1b	48.7	none	Moderately High	High
GB1	275.5	none	High	High
GB2a	408.9	none	Moderately - High	High
GB6	32.1	none	Moderate	Low
BM1a	347.7	168.8	High	High
BM6	59.3	19.5	Moderate	Moderate
LB3	9.7	0.8	Moderate	Low
BM4a	116.9	none	Moderate	Low
BM11a	40.6	15.8	Moderate	Low
Total	1,339.4			

The CRPS requires that sites identified as ecologically significant will be protected to ensure no net loss of biodiversity or biodiversity values as a result of land use activities (Policy 9.3.1). Protection of such areas are matters of national importance under Section 6(c) of the RMA.

In seeking to achieve no-net-loss of biodiversity, there are a variety of management options available to landowners to protect, restore or otherwise ameliorate threats on land of similar type to improve ecological values and generate biodiversity gains that can be used to offset unavoidable losses within the project areas.

Management methods include permanent protection through covenanting, removal of stock grazing, control of invasive weeds (e.g. wildling trees), replanting of vegetation communities, enhancing of threatened species populations and reduction of soil erosion. Several of these management are entirely relevant to land within the proposed irrigation parcels and to adjoining areas, where soil erosion and weed spread (including wildling pines) could be reduced or reversed with considerable ecological benefit.

BIL is currently discussing opportunities to develop an ecological offset package. Mitigation put forward by BIL already (and included in the s92 response by BIL in a separate letter), includes a variety of initiatives, some of which include ecological actions that minimise or avoid biodiversity loss as part of good practice farming operations (such as fencing of waterways, having designated stock crossing points of streams, managing riparian zones, and reducing fertiliser inputs and stock rates in some blocks).

5 Conclusions

Benmore Irrigation Company proposes to irrigate around 3,564 ha of land between Omarama and Twizel, over several large landholdings and across a range of existing land uses.

The 39 individual candidate sites were surveyed for terrestrial ecology values as part of an assessment of ecological effects in support of a future resource consent application to develop the irrigation scheme. Three sites were removed and others reduced in size from the scheme as part of refining the candidate sites to those proposed for irrigation.

Of the 36 sites within the proposed irrigation scheme, we regard nine (totalling around 1,340 ha) to support indigenous vegetation and habitats of indigenous fauna that qualify as Significant Ecological Areas under the Waitaki District Plan or Canterbury Regional Policy Statement. Other sites support primarily or completely modified exotic vegetation for grazing, cropping or irrigation.

Of these nine sites, particular features included:

- Three nationally rare plant species recorded with the possibility of several others being present,
- Specialised invertebrate faunas, including some naturally uncommon species,
- Native birds including habitat for banded dotterel and pipit on less-modified habitats (and records of threatened black stilt, black-fronted tern, terns, and black-billed gull from sites already converted to intensive grazing, cropping or irrigation),
- Native lizards including at least one species of gecko and one skink throughout sites supporting indigenous habitats (although some farmed and cropped sites also supported habitat for lizards),
- Land Environment types that are nationally acutely or chronically threatened (i.e. there is less than 20 % of their original extent remaining nationally) on 11 of the sites totalling 206 ha.

Overall, the greatest potential effects on terrestrial ecology values will be through the conversion of sites BM1a, GB2a, BM4a and GB1 to irrigation, with a lesser level of loss (although still ecologically significant losses) from conversion of sites TD1b, GB6, BM6, BM11a and LB3.

There are a variety of management options available to landowners to protect, restore or otherwise ameliorate threats on land of similar type to improve ecological values and generate biodiversity gains that can be used to offset unavoidable losses on significant ecological values within the project areas.

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7 Applicability

This report has been prepared for the benefit of Benmore Irrigation Company Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Report prepared by:

Authorised for Tonkin & Taylor Ltd by:



.....
Graham Ussher
Senior Ecologist

.....
Brett Ogilvie
Project Director

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Appendix A: Ecological values of candidate sites

APPENDIX A:

**A description of the ecological values of the
candidate irrigation sites**

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1. INTRODUCTION

1.1 Background

The candidate irrigation sites cover approximately 4,890 ha as shown in **Figure 1**.

This Appendix provides descriptions of the ecological values of each **candidate site**. It should be noted that the analysis of TEC areas provided in the main report and the assessment of ecological significance are for the **proposed irrigation sites** - which in many cases are a smaller part of the candidate sites.

The methodology used to sample fauna is described in the main report. Below is a brief description of the methodology used to assess botanical values of each site and the categories used to classify the sites.

The sites were visited between the 19 May and 22 May 2014. During the field visit the botanical values were assessed from a vehicle and on foot, which included visiting each property and viewing the candidate areas as well as viewing the surrounding areas, the Spring Creek Reserve area and other sites thought to be potentially affected by the irrigation proposal.

Each of the candidate irrigation areas was assigned to a category reflective of the proportion of indigenous vegetation cover, exotic vegetation and bare soil and hence the likely ecological value of the botanical communities present. The categories were as follows:

- **Very low botanical value.** Areas of very low value were highly modified and comprised almost exclusively exotic species, either as high producing pasture or crops. There were no or very few obvious native species in areas of very low ecological value.
- **Low botanical value.** Areas of low value contained extensive areas of exotic vegetation (low-producing or more improved pasture, hawkweeds, other weeds) or bare soil and included only remnant native species typical of modified environments such as patotara (*Leucopogon fraseri*), common broom (*Carmichaelia australis*), porcupine scrub (*Melicactus alpinus*) and matagouri (*Discaria toumatou*) which were sparsely distributed or concentrated in riparian areas. Very small or isolated areas located between existing irrigated areas were also considered to be of low ecological value.
- **Moderate botanical value.** Areas of moderate ecological value comprised mostly common native species such as fescue tussock (*Festuca novae-zelandiae*), turf Coprosma (*C. petriei*), porcupine scrub, matagouri, common broom, *Ozothamnus vauvilliersii* and the like but included a high proportion of weeds, browntop or bare soil and may have been modified by burning or top-dressing.
- **Moderately high botanical value.** Areas with moderately high ecological value comprised predominantly native species and included some less commonly encountered species such as coral broom (*Carmichaelia crassicaulis*), Spaniard (*Aciphylla* spp.), *Chionochoa flavescens*, mountain daisies (*Celmisia* spp.), *Raoulia* spp., *Pimelea* spp., native grasses (*Deyeuxia* spp., *Rytidosperma* spp.) and the like as well as the commonly encountered

species listed above. These areas were separated from areas of moderate value because of their lower presence of weeds and bare earth; and

- **High botanical value.** Areas of high ecological value comprised a good range of predominantly native vegetation in good overall condition or with a comparatively low incidence of bare earth and weed species.

The timing of the site survey (late autumn) was not ideal for botanical survey due to the lack of seasonal species, and the increased crypticity of small species that would not be flowering at that time. Furthermore the limited time available for the survey likely restricted the ability to comprehensively survey such a large area.

In absence of being able to undertake a comprehensive survey for rare plants at an appropriate time of the year, we undertook an assessment of the likelihood of threatened or rare plants being present at each site, based on the known habitats preferences for each species and, in part, the list of perennial species found during our site visit. The results of the rare plant assessment are contained within **Appendix C**.

2. ECOLOGICAL SETTING

2.1 The Omarama District

2.1.1 Geology and Vegetation

The six properties for which irrigation is proposed are located in the Omarama Ecological District of the Mackenzie Ecological Region. A large part of this district is occupied by a dry outwash plain located below 900 m above sea level (**m asl**) between the Diadem and Benmore Ranges near Omarama (McEwen 1987). The Omarama Ecological District is bordered to the north by drier outwash plains in the Pukaki District, to the west by wetter glaciated mountain ranges in the Ahuriri District, to the south by wetter block mountains (St Bathans and Hawkdun districts) and to the east by a dissected block mountain range (Benmore District), (Espie *et al.* 1984).

The geology of the Omarama Ecological District is mainly Pleistocene tills and fluvioglacial outwash deposits from the Otira glaciation which overlie Pliocene conglomerate with some alluvial gravels dating from the Holocene and some Mesozoic Torlesse Supergroup greywacke and argillite. The overlying soils are shallow to moderately deep, sandy and silty soils from variable thicknesses of loess. The climate is semi-arid to humid inland with cold winters and warm summers (McEwen 1987).

In 1984 the Omarama Ecological District included two protected areas (Lindis Pass tussock grassland and Bendhu Bog Pine Scientific Reserve) totalling 449.7 ha (Espie *et al.* 1984). The small areas of ecological value that remain were recognised in the Protected Natural Areas Programme report (**PNAP report**) for the Mackenzie Ecological Region (Espie *et al.* 1984). These authors identified 14 sites covering 3,747 ha (or 5.9% of the district) as priorities for protection (recommended areas for protection, or **RAPs**). RAPs local to the proposed irrigation scheme considered here are shown in **Figure 2** of the main report.

Parts of five of these areas, covering a small proportion of the land area identified as retaining ecological value, have been formally protected since 1984, two as Department of Conservation reserves, the Wairepo Kettlehole Reserve on Glen Eyrie Downs Station

and the Spring Creek Reserve as shown in pink in **Figure 2**, and the others by Queen Elizabeth II Open Space Covenants on Ohau Downs Station as shown in green in **Figure 2** (the QE II site to the top right of the figure), the site adjacent to site BM1a ('Big Tarn' or Wairepo Lake covenant) and the site to the north of site BM6 (Homestead Tarn covenant).

Wetland habitats and stream channels that meander across this landscape are often dry, reflecting the low rainfall of the area, but are also important habitats. Because of the lack of forest in the ecological district, forest birds are rare, but the braided riverbed of the Ahuriri River and other wetlands provide valuable breeding habitat for wetland birds, including the endangered endemic black stilt (*Himantopus novae-zelandiae*). The upper Waitaki Basin may now provide half of all remaining suitable braided river habitat in New Zealand (Maloney *et al.* 1997).

2.1.2 Land Environments and Vegetation Cover

Land Environments of New Zealand (LENZ) is a national landscape classification that groups together environments with similar physical characteristics. The classification includes four nested levels (Leathwick *et al.* 2002, 2003). LENZ is based on geology, soil and climate data. These variables used in constructing the classification are important drivers of plant growth, and thus whilst not identical, broadly similar physical land environments are expected to have contained similar ecological features.

An analysis of the Land Environments found locally indicates that the environments present are thought to have supported tussock grassland with narrow-leaved snow tussock (*Chionochloa rigida*), red tussock (*Chionochloa rubra*), silver tussock (*Poa cita*), fescue tussock, spear grass (or Spaniard, *Aciphylla* spp.) and matagouri shrubland with red tussock, *Schoenus* spp and *Carex* spp. dominating in wet depressions (Leathwick *et al.* 2002, 2003). The natural vegetation throughout the district currently consists of mainly degraded fescue tussock grasslands with adventive weeds, converted pasture and wetland vegetation associated with tarns and swamps including stands of bog pine (*Halocarpus bidwillii*) and toatoa (*Phyllocladus alpinus*), manuka and *Ozothamnus vauvilliersii* (tauhinu or cottonwood). Matagouri, mikimiki (*Coprosma propinqua*) and *Olearia* spp. are also common (McEwen 1987).

The candidate irrigation footprints comprise mostly Level I Land Environment N, with smaller amounts of environments E, K and Q. Once ecological units have been identified using LENZ, the current level of protection for those units can be defined using the Threatened Environments Classification (TEC) (Walker *et al.* 2007). The TEC classification is only relevant to a significance assessment when the area affected is overlain by vegetation that meets the definition of 'indigenous' (i.e. land use changes that have removed indigenous vegetation cover are also assumed to have removed the values associated with TEC and hence contribute to the increased threat status of the TEC that once represented that environment). The percentage remaining of each of the Level IV Land Environments occurring within the candidate irrigation footprints, along with the percentage formally protected and the classification for each environment within the TEC are shown in **Table A1**.

Table A1: Level IV Land Environments within the candidate irrigation areas in the Omarama Ecological District.

Environment	Percentage Remaining	Percentage Protected	Threatened Environments Classification
E3.1a	10.3	2.5	Chronically threatened
E4.1b	27	5	At risk
K3.1a	27.2	3.5	At risk
N3.1d	13.5	0.3	Chronically threatened
N3.1e	12.7	2.0	Chronically threatened
N4.1a	18	0	Chronically threatened
N4.1c	48.6	1.3	Critically underprotected
N4.1d	18.6	2.3	Chronically threatened
N4.1e	23.7	3.8	At risk
N5.1a	3.3	0.1	Acutely threatened
N6.1a	33	1.3	Critically underprotected
N6.1b	66.4	3.1	Critically underprotected
N7.1a	12.1	3	Chronically threatened
Q2.2a	39.9	5.1	Critically underprotected

Examination of the fourth version of the New Zealand Land Cover Database (**LCDB4**) (Terralink 2014) shows that of the 4, 890 ha included in the current proposal 1, 842 ha (37.7%) comprises predominantly indigenous vegetation including depleted grassland (746 ha), low producing grassland (1, 082 ha) or matagouri and grey shrubland (14 ha). LCDB4 has not been verified by ground survey. The survey described here considers that around 1, 560 ha of predominantly indigenous grassland occurs within the candidate irrigation footprint, which represents a sub-set of the Level IV Environments listed in **Table A1** that still retain indigenous vegetation cover within their footprint (see main Ecology report for further details).

2.1.3 Mackenzie Basin

Walker (2009) defined the Mackenzie Basin as 301,000 ha comprising mostly LENZ Level 1 Land Environments E (which she called “Central Dry Foothills”, 134,900 ha), N (“Eastern South Island Plains” 142,800 ha), K (“Central Upland Recent Soils” 18,600 ha) and J (“Central Well-drained Recent Soils” 4,600 ha).

The Department of Conservation and the Ministry for the Environment (2007) have adopted a minimum threshold of 20% by land area as a target for protection of biodiversity on private land because below this threshold the risk of extinction increases rapidly. This threshold is also promoted as one of the criteria for assessing ecological significance in the Canterbury Regional Policy Statement (CRPS 2013).

In all 19,270 ha (6.4%) of the land within the Mackenzie Basin are managed for conservation¹ including 13, 090 ha within Environment E (11, 130 ha as public conservation land and 1,960 ha within QEII covenants), 280 ha within Environment J (all public conservation land), 2,930 ha within Environment K (2,780 as public conservation land and 150 ha within QEII covenants) and 2, 970 ha within Environment N (2,840 within public conservation land and 130 ha within QEII covenants) (Walker 2009). This

¹ Note that this excludes recreation reserves, local and government purpose reserves and marginal strips and have been rounded to the nearest 10 ha. Furthermore not all QEII covenants are managed for conservation purposes (Walker 2009).

represents between 2% (for Environment N) and 15% (for Environment K) of the total land area formally protected.

Interrogation of LCDB4 reveals that the Mackenzie Basin includes 243,924 ha of predominantly indigenous grassland and shrubland vegetation including 99,922 ha of depleted grassland, 132,956 ha of low producing grassland and 11,046 ha of matagouri or grey shrubland. On that basis the candidate areas represent 0.75% of the depleted grassland which remains in the Mackenzie Basin, 0.81% of the low producing grassland and 0.12% of the matagouri or grey shrubland. None of these habitats can be regarded as having sufficient protection to ensure their persistence in perpetuity.

2.2.4 Historically Rare Ecosystems

Historically or naturally rare ecosystems are those which occupied less than 0.5% of New Zealand's land area (or 134,000 ha) prior to human colonisation (Williams *et al.* 2007). This includes ecosystems that are small in size but geographically widespread and those that are larger, but geographically restricted. Williams *et al.* (2007) identified 72 historically rare ecosystem types in New Zealand, then Holdaway *et al.* (2012) applied the International Union for the Conservation of Nature's (IUCN) ecosystem red-list criteria, which are based on changes in extent of ecosystems and reductions in ecosystem processes to each ecosystem to derive a threat ranking. The Mackenzie Basin Ecological Region contains at least six naturally rare ecosystem types² including:

- **Moraines.** Moraines are an accumulation of detritus from glacial action. They are often linear in nature and include raw, recent, well drained soils with variable particle size. Because of their young age they are sometimes lacking in vegetation. Moraines are considered "vulnerable" in the classification by Holdaway *et al.* (2012).
- **Inland outwash surfaces.** Inland outwash surfaces are formed from alluvium from retreating glaciers, as well as more recent river deposits. They comprise "terrace treads" and "terrace risers". Terrace risers are often stony while terrace treads have a high proportion of wind-blown till. Inland outwash surfaces are considered "critically endangered" in the classification by Holdaway *et al.* (2012).
- **Inland sand dunes.** Nonvolcanic dunes formed of river sand, active, raw or recent soils with no well-developed soil horizons. Inland sand dunes are considered "critically endangered" by Holdaway *et al.* (2012).
- **Braided rivers.** Braided rivers have multiple, mobile channels across gravel flood plain. They are dynamic environments which show recent and historical evidence of channel migration. Braided rivers are considered "endangered" in the classification by Holdaway *et al.* (2012).
- **Ephemeral wetlands/kettleholes.** These are closed depressions fed by groundwater or an adjacent water body, lacking an outlet and only seasonally wet. Ephemeral wetlands/kettleholes are considered to be "critically endangered" in the classification by Holdaway *et al.* (2012).

² The definition of each of the rare ecosystem types described here is taken from <http://www.landcareresearch.co.nz/science/plants-animals-fungi/ecosystems/rare-ecosystems/inland-and-alpine>

- **Tarns.** Tarns are small mountain lakes. Tarns mainly form in association with glacial features such as kettleholes and are considered to be “not threatened” in the classification of Holdaway *et al.* (2012).

These rare ecosystems are patchily and widely distributed across the less developed parts of the district forming an interconnected mosaic of rare ecosystems, associated wetlands and predominantly natural grasslands. This mosaic supports a high proportion of threatened or rare biodiversity including wading birds.

3. VEGETATION DESCRIPTIONS (SEE FIGURE 2 FOR LOCATIONS)

3.1 Twizel Dairy

Twizel Dairy proposes to irrigate approximately 704 ha which we have divided into five parts.

3.1.1 TD 1A

The first Twizel Dairy site (TD 1A) is located on the terraces above the inflow to Lake Ruataniwha. Level IV Land Environments within TD 1A include K3.1a and N6.1b. These environments are regarded as “at risk” and “Critically underprotected” respectively in the TEC.

TD 1A is already irrigated and at the time of our site visit was sown in turnips or exotic pasture as shown in Plates 1 and 2. These areas are of generally of very low to low botanical value, and meet the definition of “improved pasture” within the District Plan. As such they would not meet the criteria for ecological significance on a botanical basis. However the terrace risers (not proposed for irrigation) in particular comprise a higher proportion of native species, including fescue tussock as shown in Plate 3, and as such are of higher botanical value and would not be considered improved pasture.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants anticipated	none on terrace.
Habitat for skinks	good quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential foraging habitat for black stilt, black-billed gull, pied stilt on intensively managed exotic pasture. potential nesting habitat for NZ pipit on less developed risers.
Threatened Land Environments present	none



Plate 1: Vegetation within TD 1A.



Plate 2: Parts of TD 1A are already irrigated.



Plate 3: Looking northeast from a terrace riser across part of TD 1A towards TD 1B.

3.1.2 TD 1B

To the east of TD 1A, within the area referred to here as TD 1B, vegetation is more natural and includes a wetland area as shown in Plate 4. Level IV Land Environments within TD 1B are the same as TD 1A, that is K3.1a and N6.1b, which are regarded as “at risk” and “critically underprotected” respectively within the TEC.

Vegetation on the terrace riser above the area shown in Plate 4 includes native species such as porcupine scrub, matagouri, patotara, *Muehlenbeckia axillaris*, pohuehue (*M. complexa*), *Blechnum penna-marina*, *Bulbinella* sp., bidibid (*Acaena buchananii*), fescue tussock, *Gonocarpus micranthus* and *Raoulia australis*. Exotic species include hawkweed (*Pilosella officinarum*), tussock hawkweed (*Hieracium lepidulum*), sheep sorrel (*Acetosa acetosella*), browntop (*Agrostis capillaris*), Viper’s bugloss (*Echium vulgare*) and brier. On the terrace tread woody species are less common and tussock and grasses (particularly browntop) predominate with hawkweeds and bare ground common. Vegetation within TD1B is of moderately high botanical quality.

The vegetation within TD 1B would be considered significant in terms of the District Plan because it meets the representativeness, rarity and distinctiveness, diversity and pattern and ecological context criteria.

Ecological component	Notes
Threatened or rare plants noted	<i>Acaena buchananii</i> (At risk)

Threatened or rare plants anticipated	<i>Raoulia monroi</i> , <i>Carmichaelia curta</i> , <i>Leucopogon nanum</i> , <i>Carmichaelia nana</i> , <i>Lepidium solandri</i> , <i>Leptinella conjuncta</i> , <i>Myosurus minimus subsp. novae-zelandiae</i> , <i>Ceratocephala pungens</i> , <i>Carmichaelia crassicaulis subsp. crassicaulis</i>
Habitat for skinks	good quality
Habitat for geckos	good quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit and banded dotterel.
Threatened Land Environments present	none



Plate 4: Vegetation within TD 1B. Lake Ruataniwha is in the background.

3.1.3 TD 2

TD 2 is located on the western slopes of Table Hill, furthest from State Highway 8 as shown in **Figure 2**. TD 2 comprises mostly Level IV Land Environment E4.1b with smaller areas of N6.1b. These environments are regarded as “at risk” and “critically underprotected” respectively within the TEC.

Much of the land within TD 2 has been cultivated and at the time of our site visit was planted in a crop of lucerne (*Medicago sativa*) as shown in Plate 5. As such TD 2 is of very low botanical value.

The gully and stream bisecting the site, including the existing set-back of steep exotic grassland vegetation, is not included in the candidate irrigation area.

TD 2 meets the definition of “improved pasture” within the District Plan and as such is not regarded as ecologically significant on a botanical basis.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants anticipated	none

Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential foraging habitat for black stilt, black-billed gull, terns, pied stilt on intensively managed exotic pasture.
Threatened Land Environments present	none



Plate 5: Cultivated land within TD 2.

3.1.4 TD 3

TD 3 includes an area immediately south of Lake Ruataniwha and several small unconnected areas further south which surround existing pivot irrigation command areas as shown in **Figure 2**. Most of TD 3 area comprises Level IV Land Environment N6.1b, which is regarded as “critically underprotected” within the TEC. There is also an area of Environment E4.1b to the south, which is regarded as “at risk” within the TEC. Vegetation within TD 3 comprises exotic pasture which includes red clover (*Trifolium pratense*), white clover (*T. repens*), a variety of high producing exotic pasture species and common pasture weeds such as sheep’s sorrel (*Rumex acetosella*) and woolly mullein (*Verbascum thapsus*) as shown in Plate 6. As such TD3 is also of very low botanical value.

TD 3 meets the definition of “improved pasture” within the District Plan, and as such is not regarded as ecologically significant on a botanical basis.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants anticipated	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential foraging habitat for black stilt, black-billed gull, pied stilt on intensively managed exotic pasture as part of the wider matrix of irrigated pasture surrounding TD3.
Threatened Land Environments present	none



Plate 6: Exotic pasture within TD3.

3.1.5 TD 5

TD 5 is located south of the Ohau River and northeast of GB2 as shown in Figure 2. TD 5 comprises Level IV Land Environment K3.1a, which is regarded as “at risk” within the TEC. Vegetation comprises short tussock grassland with common wilding pine and larch trees and extensive areas of bare ground with abundant hawkweed as shown in Plate 7. The botanical values of TD 5 are moderately low.

Vegetation within TD 5 is considered unlikely to meet the criteria for ecological significance based on botanical values within the District Plan and does not meet the definition of “tall tussock grassland”.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants anticipated	<i>Acaena buchananii</i>
Habitat for skinks	poor quality
Habitat for geckos	moderate quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none



Plate 7: Vegetation within TD 5

3.2 Glenbrook Station

Glenbrook Station proposes to irrigate approximately 1, 131 ha which we have divided into seven parts.

3.2.1 GB 1

GB 1 is located on the western slopes of Table Hill immediately south of TD 2 as shown in Figure 2. GB 1 comprises Level IV Land Environment E4.1b, which is regarded as “at risk” within the TEC.

An example of the vegetation within GB 1 is shown in Plate 8. Vegetation is predominantly indigenous grassland, but includes a significant component of wilding pines (*Pinus radiata* and *P. nigra*) and larch (*Larix decidua*).



Plate 8: Short tussock grassland at GB 1.

Scattered within the grassland, species such as turf Coprosma, patotara, sheep’s sorrel, sweet vernal (*Anthoxanthum odoratum*), blue wheatgrass (*Anthosachne solandri*), hawkweed, browntop, *Austrostipa nodosa*, *Rytidosperma* sp., *Celmisia incana*, *C. argentea*, *C. gracilentia*, blue tussock (*Poa colensoi*), *P. cita*, *Pimelea oreophila*, *P. sericeovillosa* subsp. *pulvinaris*, porcupine scrub, matagouri, golden Spaniard (*Aciphylla aurea*), mountain tauhinu (*Ozothamnus vauvilliersii*), *Muehlenbeckia axillaris*, *Acaena caesiiglauca*, common broom, *Carmichaelia petriei* and mikimiki (*Coprosma propinqua*) occur. In damper areas rushes such as *Schoenus pauciflorus*, *Carex kaloides*, *C. geminata*, *Juncus articulatus* and *J. effusus* are found along with *Epilobium komarovianum*, *Euchiton traversii* and *Ranunculus royi*. Other examples of the vegetation within GB1 are shown in Plates 9 and 10. The vegetation within GB1 is of moderately high botanical quality.

The vegetation within GB 1 meets the criteria for representativeness, rarity, diversity and pattern and ecological context within the District Plan, and as such would be regarded

as significant. It does not meet the definition of tall tussock grassland, because it is not dominated by species of *Chionochloa*, but nonetheless it can be regarded as predominantly natural short tussock grassland.

Ecological component	Notes
Threatened or rare plants noted	cushion pimelea
Threatened or rare plants that may be present	<i>Carmichaelia vexillata</i> , <i>Senecio dunedinensis</i> , <i>Raoulia monroi</i> , <i>Carmichaelia kirkii</i> , <i>Carmichaelia curta</i> , <i>Carmichaelia nana</i> , <i>Lepidium solandri</i> , <i>Leonohebe cupressoides</i> , <i>Myosotis brevis</i> , <i>Carmichaelia crassicaulis subsp. crassicaulis</i>
Habitat for skinks	good quality (McCann's skink recorded)
Habitat for geckos	good quality (Southern Alps gecko recorded)
Threatened or rare birds noted or anticipated	high potential of nesting, resting or foraging habitat for NZ pipit and banded dotterel.
Threatened Land Environments present	none



Plate 9: Matagouri and golden Spaniard within GB 1.



Plate 10: Vegetation within GB 1.

3.2.2 GB 2A

Area GB 2A is located to the north and west of GB1 extending along the outwash gravels to the immediate south of Table Hill. Most of GB 2A comprises Level IV Land Environment E4.1b, with a small amount of N6.1b in the southeastern corner. These environments are regarded as “at risk” and “critically underprotected” respectively within the TEC.

Vegetation within GB 2A is similar to that found within GB 1, with a higher proportion of hawkweeds and more bare ground as shown in Plates 11 and 12. The vegetation within GB 2A is of moderate botanical quality.

The vegetation with GB 2A would likely meet the representativeness, rarity and distinctiveness and ecological context criteria within the District Plan and as such would be regarded as significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Raoulia monroi</i> , <i>Leucopogon nanum</i> , <i>Carmichaelia nana</i> , <i>Lepidium solandri</i> , <i>Leptinella conjuncta</i> , <i>Myosurus minimus subsp. novae-zelandiae</i>
Habitat for skinks	good quality
Habitat for geckos	moderate quality (Southern Alps gecko recorded)

Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit and banded dotterel.
Threatened Land Environments present	none



Plate 11: Vegetation in the northern portion of GB 2A.



Plate 12: Vegetation on the outwash gravels southeast of Lake Ohau (Area GB 2A).

3.2.3 GB 2B

Area GB 2B is located immediately south of the Ohau River as shown in Figure 2. Within GB 2B the Level IV Land Environments include N6.1a and smaller amounts of K3.1A and N6.1a. These environments are regarded as “at risk” and “critically underprotected” within the TEC.

Vegetation within GB 2B comprises a high proportion of bare ground and hawkweed, as well as common wilding pines, with only sparse tussocks and occasional native species as shown in Plate 13. Vegetation within GB 2B is of moderately low botanical value.

Vegetation with GB 2B would not currently be regarded as significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Pimelea sericeovillosa</i> subsp. <i>pulvinaris</i> , <i>Carmichaelia curta</i> , <i>Carmichaelia crassicaulis</i> subsp. <i>crassicaulis</i> , <i>Acaena buchananii</i>
Habitat for skinks	poor quality
Habitat for geckos	poor quality

Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none



Plate 13: GB 2B (in the middle ground) is located immediately south of the Ohau River.

3.2.4 GB 3

The GB 3 area comprises mostly N6.1b with smaller amounts of E4.1b on the foothills of Table Hill. The flat areas of GB 3 have already been developed. These environments are regarded as “critically underprotected” and “at risk” respectively. Less developed vegetation remains on the foothills of Table Hill as shown in Plate 14, but this vegetation comprises mostly exotic species, particularly brier, hawkweed and browntop. As such the botanical values of GB 3 are low.

Vegetation within GB 3 is considered unlikely to meet the significance criteria outlined in the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none

Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	possible nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none



Plate 14: The base of Table Hill (Area GB 3).

3.2.5 GB 4A

GB 4A includes six small areas located on the southern side of State Highway 8 extending south from the Glenbrook Homestead as shown in Figure 2. The GB 4A areas surround the homestead and an existing pivot irrigator further south.

These areas comprise Level IV Land Environments N6.1b with areas of N5.1a closest to Benmore Range. Environment N6.1b is regarded as “critically underprotected” within the TEC, whilst Environment N5.1a is “acutely threatened.” The ecological values of the GB 4A areas are low because of their small size, poor vegetation quality (heavily graze and oversown) and proximity to existing irrigation as shown in Plate 15. The vegetation comprises mostly sweet vernal, brown top, hawkweed and occasional brier, with sparse fescue tussock.

Vegetation within the GB 4A areas are unlikely to meet the significance criteria in the District Plan, and some of them meet the definition of “improved pasture”.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit, although land parcels are small and fragmented by developed, irrigated pasture.
Threatened Land Environments present	none



Plate 15: Part of GB 4A.

3.2.6 GB 4B

GB 4B comprises a small area located immediately adjacent to State Highway 8 which has not been intensively developed as parts of GB 4A as shown in Plate 16. GB 4B comprises Level IV Land Environment N6.1b which is regarded as “critically underprotected” within the TEC. Vegetation there includes sparse fescue tussock with sweet vernal, brown top, hawkweed and occasional brier. The botanical values of GB 4B are moderately low.

GB 4B is considered unlikely to meet the criteria for ecological significance based on botanical values within the District Plan and does not meet the definition of “tall tussock grassland”.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit, although the area is small, adjacent to SH8 and is fragmented by developed, irrigated pasture.
Threatened Land Environments present	none



Plate 16: Vegetation within Area GB 4B.

3.2.8 GB 6

GB 6 is located southeast of the Glenbrook Homestead as shown in Figure 2. GB 6 comprises Level IV Land Environments N4.1c, N6.1b and E4.1B. These environments are regarded as “critically underprotected” (N4.1c and N6.1b) and “at risk” (E4.1b) within the TEC. Vegetation included brown top, sweet vernal, brier and occasional porcupine

scrub, mikimiki, matagouri, pohuehue and fescue tussock. There are only small areas of bare ground and hawkweed. The highest ecological values are located nearest the small stream which flows through the site, including some matagouri which reaches approximately 3 m tall. Further east (upstream) the vegetation forms grey shrubland comprising mostly matagouri, porcupine scrub and brier. Overall botanical values at GB 6 are moderate.

GB 6 meets the representativeness, rarity and distinctiveness and ecological context criteria defined within the District Plan as outlined in Appendix 1.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Acaena buchananii</i>
Habitat for skinks	moderate quality
Habitat for geckos	moderate quality (Southern Alps gecko recorded)
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit
Threatened Land Environments present	none



Plate 17: Vegetation within GB 6.

3.3 Westside

Westside proposes to irrigate around 89 ha which we have divided into two parts.

3.3.1 WS A

WS A is located northeast of the Glenbrook Homestead and south of the Wairepo Arm of Lake Ruataniwha as shown in Figure 2. Level IV Land Environments within WS A include N5.1a, N4.1c, N6.1b and small amounts of E4.1b around the margins of the site. These environments are regarded as “acutely threatened” (N5.1a), “critically underprotected” (N6.1b and N4.1c) and “at risk” (E4.1b) within the TEC.

Vegetation within WS A is almost entirely exotic as shown in Plates 18 and 19 and includes exotic pasture, lucerne and oat crops. Very sparse fescue tussocks remain amongst the lucerne crop, but the botanical values of WS A are very low.

The vegetation with WS A meets the definition of “improved pasture” within the District Plan and as such does not meet the criteria for ecological significance based on botanical values alone.



Plate 18: Exotic pasture within WS A.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality

Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential foraging habitat for pied stilt, black stilt, terns, black-billed gull if managed as pasture (currently is crops)
Threatened Land Environments present	none



Plate 19: Oat (*Avena sativa*) crop within WS A.

3.3.2 WS B

WS B is located east of WS A, closer to Benmore Range as shown in Figure 2. Level IV Land Environments within WS B include N6.1b with E4.1b closer to the foothills. These environments are regarded as “critically underprotected” and “at risk” respectively within the TEC.

Vegetation within WS B is more natural than that found within WS A as shown in Plate 20. Ground cover is extensive, with hardly any bare ground although rocks were common. Pasture weeds such as hawkweed, woolly mullein, oxtongue (*Helminthotheca echioides*) were also commonly encountered. Shrubs such as porcupine scrub, brier, mikimiki and matagouri were sparse across the whole site, although locally common at some locations, whilst fescue tussock was sparse. The botanical values of WS B are moderately low.

WS B is not considered to meet the criteria for ecological significance based on botanical values alone within the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit
Threatened Land Environments present	none



Plate 20: Vegetation within WS B.

3.4 Buscot

Approximately 226 ha is proposed for irrigation within the Buscot and Little Ben properties, which we have divided into six areas.

3.4.1 B 1

Area B 1 is located east of State Highway 8 and north of the Little Ben sites as shown in Figure 2. B 1 comprises almost entirely Level IV Land Environment N6.1b with small

areas of N4.1c on the margins. Both of these land environments are regarded as “critically underprotected” within the TEC.

B 1 appeared to already be irrigated and the vegetation was entirely exotic as shown in Plate 21. Accordingly the botanical values of B 1 are very low and the area meets the definition of “improved pasture” within the District Plan as outlined in Appendix 1.



Plate 21: Exotic pasture at B 1.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	none (narrow, confined by hills and far from lake)
Threatened Land Environments present	none

3.4.2 B 2

B 2 is located north of B 1 as shown in Figure 2. B 2 comprises approximately two-thirds Level IV Land Environment N4.1c and one-third N6.1b. Both of these land environments are regarded as “critically underprotected” within the TEC.

Vegetation within B 2 is also entirely exotic as shown in Plate 22. Accordingly the ecological value of B 2 is very low. B 2 also meets the definition of “improved pasture” within the District Plan, and as such does not meet the criteria for ecological significance based on botanical values alone as outlined in Appendix 1.



Plate 22: Italian rye (*Lolium multiflorum*) and turnip (*Brassica rapa*) crop at B 2.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	none (narrow, confined by hills and far from lake)
Threatened Land Environments present	none

3.4.3 LB 1

LB 1 is located north of Ben Omar Road, in the vicinity of Sutherlands Creek as shown in Figure 2. Level IV Land Environments within LB 1 include N6.1b and N5.1a. These land environments are regarded as “critically underprotected” and “acutely threatened” respectively within the TEC.

All of the vegetation of LB 1 has been cultivated as shown in Plate 23. Closest to the stream (immediately adjacent to the candidate site) the vegetation includes porcupine scrub, mikimiki, matagouri and pohuehue as shown in Plate 24. The streamside vegetation is fenced to the north with an adequate buffer, but not fenced to exclude livestock from the south.

The vegetation meets the definition of “improved pasture” provided in the District Plan, and as such the vegetation would not meet the criteria for ecological significance.



Plate 23: Cultivated land within LB 1.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality

Threatened or rare birds noted or anticipated	none (narrow, confined by hills and far from lake)
Threatened Land Environments present	none



Plate 24: Vegetation adjacent to Sutherlands Creek.

3.4.4 LB 2

LB 2 is located southwest of LB 1 adjacent to the true right bank of Sutherlands Creek as shown in Figure 2. LB 2 comprises mostly Level IV Land Environment N6.1b with small areas of N4.1e and N4.1c. Both environments N4.1c and N6.1b are regarded as “critically underprotected” within the TEC, whilst Environment N4.1e is regarded as being “at risk”.

Vegetation within LB 2 is shown in Plate 25. The vegetation cover includes large areas of bare ground and hawkweed with only very sparse low growing native species such as *Raoulia australis*, *R. hookeri*, porcupine scrub, common broom and fescue tussock. The botanical value of LB 2 is low.

Vegetation within LB 2 is not considered to meet the criteria for ecological significance based on botanical values alone provided in the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none

Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit
Threatened Land Environments present	none



Plate 25: Vegetation within LB 2.

3.4.5 LB 3

LB 3 is located north (upstream) of LB 2 as shown in Figure 2. LB 3 comprises mostly Level IV Land Environment within LB 3 N6.1b with smaller amounts of N4.1a, N4.1e, N4.1c and N5.1a in the north. These environments are regarded as “critically underprotected” (N6.1b and N4.1c), “at risk” (N4.1e), “chronically threatened” (N4.1a) and acutely threatened (N5.1a).

Vegetation within LB 3 comprises grey shrubland with an understory of exotic pasture as shown in Plate 26. The botanical value of LB 3 is moderate and the vegetation meets the definition of “shrubland” provided in the District Plan. The vegetation would also meet the representativeness and rarity and distinctiveness criteria for ecological significance as provided in the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Raoulia monroi</i>
Habitat for skinks	good quality
Habitat for geckos	good quality (Southern Alps gecko recorded)
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit
Threatened Land Environments present	N4.1a chronically threatened N5.1a acutely threatened



Plate 26: Grey shrubland within LB 3.

3.4.6 LB 4

LB 4 is located south of LB 1 on the true left bank of Sutherlands Creek as shown in Figure 2. LB 4 comprises Level IV Land Environment N6.1b which is regarded as “critically underprotected” within the TEC.

An example of the vegetation present within LB 4 is shown in Plate 27. The vegetation is predominantly exotic pasture with extensive areas of hawkweed and bare ground. The botanical value of LB 4 is very low. LB 4’s vegetation would not meet the criteria for

ecological significance provided in the District Plan, but since most of the pasture comprises browntop it would not meet the definition of “improved pasture” either.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit. potential resting habitat for pied stilt
Threatened Land Environments present	none with indigenous vegetation cover



Plate 27: Vegetation within LB 4.

3.5 Benmore Station

Benmore Station proposes to irrigate 1941.5 ha which we have divided into 17 parts.

3.5.1 BM 1A

BM 1A is a large area which extends south from BM 2 as shown in Figure 2. BM 1A includes six Level IV Land Environments, E3.1a E4.1b, N5.1a, N3.1d, N3.1e and Q2.2a.

Environment E4.1b is regarded as being “at risk”, N5.1a is “acutely threatened”, N3.1d, N3.1e and E3.1a are “chronically threatened” and Q2.2a is “critically underprotected” within the TEC.

At the northern end of BM 1A small areas have been burnt recently as shown in Plate 28 and some areas have been disced. This has mainly removed the native shrubs such as matagouri, common broom, golden Spaniard and porcupine scrub locally, but some fescue tussocks have also been affected. Where no burning has occurred, throughout most of BM 1A shown in Plates 29 and 30, ground cover is generally high and native species such as fescue tussock, *Agrostis muelleriana*, broad leaved snow tussock (*Chionochloa flavescens*), blue tussock, patotara, *Brachyglottis haastii*, *Celmisia argentea*, *Pimelea oreophila*, *P. sericeovillosa* subsp. *pulvinaris*, turf Coprosma, golden Spaniard, matagouri, common broom, coral broom (*Carmichaelia crassicaulis*), porcupine scrub predominate. Exotic grasses such as browntop, *Festuca filiformis* and *Austrostipa nodosa* and other exotic species such as white clover, *Orobanche minor*, sheep’s sorrel and hawkweeds are also common, although seldom dominant. Near the wetland area known locally as “Big tarn” the exotic *Carex ovalis* and *Juncus effusus* also occur.

Vegetation within BM 1A would meet the representativeness, rarity and distinctiveness, diversity and pattern and ecological context criteria within the district plan, but does not meet the definition of “tall tussock grassland” because it is not dominated by *Chionochloa* tussocks.

Ecological component	Notes
Threatened or rare plants noted	coral broom <i>Carmichaelia crassicaulis</i> cushion pimelea <i>Pimelea sericeovillosa</i> subsp. <i>pulvinaris</i>
Threatened or rare plants that may be present	<i>Pimelea sericeovillosa</i> subsp. <i>pulvinaris</i> , <i>Carmichaelia vexillata</i> , <i>Senecio dunedinensis</i> , <i>Raoulia monroi</i> , <i>Carmichaelia kirkii</i> , <i>Carmichaelia nana</i> , <i>Lepidium solandri</i> , <i>Leonohebe cupressoides</i> , <i>Myosotis brevis</i> , <i>Acaena buchananii</i>
Habitat for skinks	good quality
Habitat for geckos	good quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	N5.1a acutely threatened N3.1d chronically threatened N3.1e chronically threatened E3.1a chronically threatened



Plate 28: Burning has been locally important in parts of BM 1A.



Plate 29: Short tussock grassland within BM 1A.



Plate 30: Within BM 1A looking west.

Wilding pines are rarely encountered throughout BM 1A, but are most common near the boundary with Ohau Downs Station.

3.5.2 BM 1B

BM 1B is contiguous with and located to the south of BM 1A as shown in Figure 2. Level IV Land Environments within BM 1B include E4.1b, N3.1d and N5.1a. These land environments are regarded as “chronically threatened”, “at risk” and “acutely threatened” respectively within the TEC.

There is a high proportion of bare soil within BM 1B as shown in Plates 31 and 32. Vegetation comprises mostly hawkweed, patotara and moss with sparse brown top, fescue tussock and porcupine scrub. Botanical values within BM 1B are low.

The vegetation within BM 1B is not considered sufficiently high quality to meet the criteria for ecological significance provided in the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality

Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	N5.1a acutely threatened N3.1d chronically threatened E4.1b chronically threatened



Plate 31: Vegetation within BM 1B includes a high proportion of bare soil and rock.



Plate 32: Close view of vegetation within BM 1B.

3.5.3 BM 2

BM 2 is located south of BM 3. Level IV Land Environments within BM 2 include N5.1a, E4.1b and N3.1d. These environments are regarded as “acutely threatened”, “at risk” and “chronically threatened” respectively within the TEC. BM 2 and BM 3 are separated by Wairepo Creek. Vegetation within BM 2 is predominantly exotic on the flat land as shown in Plate 33, with areas of matagouri, brier and porcupine scrub to approximately 2 m tall on the foothill near the proposed irrigation boundary as shown in Plate 34. The botanical value of the vegetation within BM 2 is moderately low.

The shrubs within BM 2 do not meet the definition of “shrubland” provided in the District Plan since they do not have a mostly closed canopy and include scattered outlier individuals, although the vegetation is more intact nearest the small gullies. The vegetation within BM 2 is unlikely to meet the criteria for ecological significance within the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	poor quality

Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	N5.1a acutely threatened, N3.1d chronically threatened E4.1b chronically threatened, all within exotic pasture



Plate 33: Exotic vegetation within BM 2.



Plate 34: Shrubland vegetation within BM 2.

3.5.4 BM 3

BM 3 extends along the south side of Lake Ohau Road, between the road and Wairepo Creek. Level IV Land Environments within BM 3 include N6.1b and E4.1b. These land environments are regarded as “critically underprotected” and “at risk” respectively within the TEC.

BM 3 has been treated with herbicide and parts of it have been cultivated. Exotic species dominate as shown in Plate 35. At the time of our site visit a barley (*Hordeum vulgare*) crop had been grown across part of the site as shown in Plate 36. As such the botanical values of the BM 3 area are very low.

Much of the vegetation within BM 3 meets the definition for “improved pasture” contained within the District Plan. BM 3 is not considered to meet the criteria for ecological significance based on botanical values alone contained within the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.

Threatened Land Environments present	none
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Plate 35: Vegetation within BM 3 near Lake Ohau Road.



Plate 36: Vegetation within BM 3.

3.5.5 BM 4A

BM 4A is located immediately south of the Department of Conservation Spring Creek Reserve and north of Lake Ohau Road. Level IV Land Environments within BM 3 include N6.1b and E4.1b. These land environments are regarded as “critically underprotected” and “at risk” respectively within the TEC.

Vegetation within BM 4A is variable, with small areas of more intact short tussock grassland and extensive areas of predominantly hawkweed and bare soil as shown in Plates 37 to 39. Brier and wilding pines are only occasionally encountered, but European broom is a noticeable component of the vegetation within BM 4A, and at some locations this has been treated with herbicide.



Plate 37: Vegetation within BM 4A west of State Highway 8.



Plate 38: Vegetation within BM 4a near Lake Ohau Road.



Plate 39: Vegetation within BM 4A includes large areas of bare ground.

Within the more natural areas within BM 4A fescue tussock predominates and matagouri, turf Coprosma, patotara, porcupine scrub and common broom intermittently occur, along with other species typical of short tussock grassland. Much of the ground cover is exotic hawkweed, although mountain oat grass (*Deyeuxia avenoides*) is also common. Overall the vegetation within BM 4A is of moderately low quality.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Raoulia monroi</i> , <i>Myosurus minimus subsp. novae-zelandiae</i>
Habitat for skinks	moderate quality
Habitat for geckos	moderate quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit and banded dotterel.
Threatened Land Environments present	none

3.5.6 BM 4B

BM 4B is located immediately adjacent to BM 4A at the intersection of State Highway 8 and Lake Ohau Road, nearest Benmore Stream. BM 4B comprises mostly Level IV Land Environment N6.1b, with a small amount of E4.1b in the west. These land environments are regarded as “critically underprotected” and “at risk” respectively within the TEC.

This small area has been cultivated (including being disced) and more natural vegetation has been replaced with exotic pasture with only occasional fescue tussocks surviving as shown in Plate 40. As such the botanical value of BM 4B is low.

Vegetation with BM 4B meets the definition for “improved pasture” within the District Plan and as such would not be regarded as ecologically significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	moderate quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit. potential foraging habitat for black stilt, black-billed gull, pied stilt on intensively managed exotic pasture
Threatened Land Environments present	none



Plate 40: Vegetation within BM 4B.**3.5.7 BM 6**

BM 6 is located west of State Highway 8 and south of the Benmore Homestead as shown in Figure 2. Level IV Land Environments within BM 6 include N5.1a, E4.1b, N6.1b and N4.1c. These land environments are regarded as “critically underprotected” (N6.1b, N4.1c), “at risk” (E4.1b) and “acutely threatened” (N5.1a) within the TEC.

Vegetation within BM 6 comprises mostly exotic pasture with abundant brier rose and only scattered fescue tussock. Shrubs such as porcupine scrub, mikimiki and matagouri are common, particularly on the steeper parts of the site. As such those parts of BM 6 could be described as grey shrubland, rather than tussock grassland. The botanical value of BM 6 is moderate. Examples of the vegetation present within BM 6 are shown in Plates 41 and 42.

Parts of BM 6 meet the definition of “shrubland” within the District Plan, although those areas are generally small and discontinuous. Vegetation within BM 6 would meet the representativeness, rarity and distinctiveness criteria within the District Plan and as such would be regarded as significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Acaena buchananii</i>
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	N5.1a acutely threatened within degraded short tussock and grey shrubland patches



Plate 41: Vegetation within BM 6.



Plate 42: Remnant grey shrubland within BM 6.

3.5.8 BM 7A

BM 7A is located at the southern end of the Benmore Station sites east of State Highway 8 as shown in Figure 2. BM 7A comprises entirely Level IV Land Environment N4.1c, which is regarded as “critically underprotected” within the TEC.

Vegetation within BM 7A is entirely exotic pasture as shown in Plate 43. As such the botanical value of BM 7A is very low and would meet the definition of “improved pasture” provided in the District Plan. This vegetation would not meet the ecological significance criteria provided in the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none



Plate 43: Exotic pasture within BM 7A.

3.5.9 BM 7B

BM 7B comprises two areas located immediately north of BM 7A as shown in Figure 2. Level IV Land Environments occurring within BM 7B include N4.1c, N5.1a and N7.1a. These environments are regarded as “critically underprotected”, “acutely threatened” and “chronically threatened” respectively within the TEC.

Vegetation within BM 7B comprises mostly exotic pasture with a small area of crack willow (*Salix fragilis*) and occasional native species (*Carex secta*, *C. dissita*, fescue tussock, matagouri, porcupine scrub) nearest the small stream. An example of this vegetation is shown in Plate 44.

The botanical values of BM 7B are low and the vegetation meets the definition of “improved pasture” provided in the District Plan. As such the vegetation is not regarded as ecologically significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential foraging habitat for black stilt, black-billed gull, pied stilt on intensively managed exotic pasture
Threatened Land Environments present	none with native vegetation



Plate 44: Exotic pasture within BM 7B.

3.5.10 BM 7C

BM 7C is a long narrow area of land situated between one of the GB 4A blocks and a small stream which drains to the south as shown in Figure 2. Level IV Land Environments within BM 7C include N6.1b, N5.1a and N7.1a which are regarded as “critically underprotected”, “acutely threatened” and “chronically threatened” respectively within the TEC.

Vegetation within BM 7C includes very sparse tussock with large areas of bare ground and hawkweed as shown in Plates 45 and 46. Overall the ecological value of BM 7C is moderately low.

To the north of BM 7C and BM 7E is a wetland fed by Barclays Creek. The wetland area would be fenced to exclude livestock if the other parts of BM 7c were irrigated.

The vegetation within BM 7C is considered of insufficient botanical value to meet the ecological significance criteria contained within the District Plan and does not meet the definition of “tall tussock grassland”. As such the vegetation would not be regarded as significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none

Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none with native vegetation



Plate 45: Vegetation within BM 7C. GB 4A is visible in the background (across the fence).



Plate 46: BM 7C includes expansive areas of bare ground.

3.5.11 BM 7D

BM 7D is located southeast of BM 7C as shown in Figure 2. Level IV Land Environments within BM 7D include N5.1a and N7.1a. These land environments are regarded as “acutely threatened” and “chronically threatened” respectively within the TEC.

The land within BM 7D has been cultivated and sown in turnips. As such the botanical value of BM 7D is very low and meets the definition of “improved pasture” as provided by the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	none
Threatened Land Environments present	none with native vegetation

3.6.12 BM 7E

BM 7E is located east of BM 7C and north of BM 7D as shown in Figure 2. Level IV Land Environments within BM 7E include N5.1a and N7.1a. These land environments are regarded as “acutely threatened” and “chronically threatened” respectively within the TEC.

The vegetation within BM 7E includes large expanses of exotic pasture with sparse fescue tussock as shown in Plate 47.

Nearest the tributaries of Barclays Creek which cross BM 7E the botanical values are higher with more continuous tussock cover as well as native sedges (*Carex secta*, *C. geminata*) – these margins would not form part of the candidate irrigation areas (they would form riparian set-backs)



Plate 47: Vegetation within BM 7E.

The botanical values of BM 7E are moderately low. Since the vegetation within BM 7E mostly comprises browntop it would meet the definition of “improved pasture” within the District Plan, however it is unlikely to contain sufficient indigenous vegetation to be regarded as ecologically significant.

Ecological component	Notes
Threatened or rare plants noted	none

Threatened or rare plants that may be present	none
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none with native vegetation

3.5.13 BM 7F

BM 7F is located east of BM 7D and south of BM 7E as shown in Figure 2. Level IV Land Environments within BM 7F include N7.1a, N5.1a, N6.1b, E4.1b and N4.1c. These land environments are regarded as “chronically threatened” (N7.1a), “acutely threatened” (N5.1a), “critically underprotected” (N6.1b and N4.1c) and “at risk” (E4.1b).

Vegetation within BM 7F includes areas of scattered, grazed matagouri with porcupine scrub and brier as shown in the mid-ground of Plate 48. Other native species are occasionally encountered, but the pasture has been “improved” (top-dressed and oversown) and the botanical values are moderately low. As such the vegetation is unlikely to meet the criteria for ecological significance provided in the District Plan.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	<i>Carmichaelia curta</i> , <i>Carmichaelia crassicaulis</i> subsp. <i>crassicaulis</i>
Habitat for skinks	moderate quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none with native vegetation



Plate 48: Vegetation within BM 7F.

3.5.14 BM 9

BM 9 comprises a narrow strip of land between Lake Ohau Road and Wairepo Creek located east of BM 3. Level IV Land Environments within BM 9 include E4.1b and N6.1b. These environments are regarded as “at risk” and “critically underprotected” within the TEC.

As shown in Plate 49, BM 9 has been cultivated and contains no natural values except in the very immediate vicinity of Wairepo Creek (which will form a set-back riparian margin).

Vegetation within BM 9 meets the definition of “improved pasture” and as such would not be regarded as ecologically significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	none

Threatened Land Environments present	none
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Plate 49: BM 9 has been cultivated and sown in a crop.

3.5.15 BM 10

BM 10 is located immediately south of the intersection between Lake Ohau Road and State Highway 8 as shown in Figure 2. BM 10 comprises Level IV Land Environment N6.1b, which is regarded as “critically underprotected” within the TEC.

Within BM 10 the land has been irrigated and the tussockland replaced with exotic pasture as shown in Plate 50. The botanical values of BM 10 are very low and the vegetation meets the definition of “improved pasture” within the District Plan. As such the area would not be regarded as ecologically significant on the basis of botanical values alone.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality

Threatened or rare birds noted or anticipated	none
Threatened Land Environments present	none



Plate 50: “Improved pasture” within BM 10.

3.5.16 BM 11A

BM 11A is located east of State Highway 8 and west of BM 7A as shown in Figure 2. Level IV Land Environments within BM 11A include N6.1b and N7.1a. These land environments are regarded as “critically underprotected” and “chronically threatened” respectively.

Vegetation within BM 11A is predominantly natural, including fescue tussock, blue tussock, porcupine scrub, common broom and scattered patches of common mat daisy (*Raoulia australis*). The area has obviously had some intensification, as evidenced by the presence of brown top, sweet vernal and white clover and overall the botanical value is moderately low. An example of the vegetation within BM 11A is shown in Plate 51.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality

Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	N7.1a chronically threatened



Plate 51: Sparse tussock grassland within BM 11A.

3.5.17 BM 11B

BM 11B is located adjacent to BM 11A. Level IV Land Environments within BM 11A include N6.1b and N7.1a. These land environments are regarded as “critically underprotected” and “chronically threatened” respectively.

Vegetation within BM 11A comprises exotic pasture and the remnants of a turnip crop as shown in Plate 52. The botanical value of BM 11B is very low. The area meets the definition of “improved pasture” within the District Plan, and as such the vegetation would not be regarded as ecologically significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality

Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit.
Threatened Land Environments present	none with indigenous vegetation



Plate 52: Exotic pasture within BM 11B.

3.6 Willowburn Station

Willowburn Station proposes to irrigate 798.4 ha which we have divided into three parts.

3.6.1 WB 1

WB 1 comprises two areas located north of WB 2, east of BM 1B and west of State Highway 8 as shown in Figure 2. The circular part of WB 1 comprises mostly Level IV Land Environment N5.1a, with smaller areas of N4.1c, E4.1b and N4.1d around the margins. The crescent shaped portion of WB 1 further east comprises mostly Land Environment N6.1b with smaller amounts of N5.1a in the northeast. Land Environment N5.1a is regarded as “acutely threatened” within the TEC, whilst N4.1c is “critically underprotected”, N4.1d is “chronically threatened” and E4.1b is “at risk”.

At the time of our site visit the circular part of WB 1 had been cultivated and sown in kale (*Brassica oleracea*). The crescent shaped part of WB 1 was also sown in exotic species and part of it formed a race way. As such any native species within WB 1 had been

removed and the botanical value of WB 1 is very low. The area meets the definition of “improved pasture” within the District Plan and the vegetation would not be regarded as ecologically significant.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	none
Threatened Land Environments present	none with indigenous vegetation

3.6.2 WB 2

WB 2 is the southernmost of the proposed irrigation blocks, located immediately west of WB 3. WB 2 comprises mostly Level IV Land Environment N5.1a with smaller areas of N6.1b. These environments are regarded as “acutely threatened” and “critically underprotected” respectively within the TEC.

The vegetation within WB 2 comprises predominantly browntop with very occasional clusters of porcupine scrub or low-growing matagouri and sparse individual fescue tussock plants. WB 2 has low botanical value as shown in Plates 53 and 54. Vegetation within WB 2, whilst mostly improved, would likely not meet the definition of “improved pasture” provided within the District Plan, because that definition specifically excludes browntop and sweet vernal. However, the vegetation of WB 2 is not considered to meet any of the criteria for ecological significance.

Ecological component	Notes
Threatened or rare plants noted	none
Threatened or rare plants that may be present	none
Habitat for skinks	poor quality
Habitat for geckos	poor quality
Threatened or rare birds noted or anticipated	potential nesting, resting or foraging habitat for NZ pipit. potential foraging habitat for black stilt, black-billed gull, pied stilt on intensively managed exotic pasture
Threatened Land Environments present	none with indigenous vegetation



Plate 53: Exotic pasture within WB 2.



Plate 54: Vegetation within WB 2 is dominated by browntop.

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Appendix B: Terrestrial Invertebrate report

Analysis of insect samples from the Benmore-Twizel project area

Richard Toft

Introduction

Terrestrial invertebrates in the proposed Benmore-Twizel irrigation area were surveyed by Graham Ussher, Tonkin & Taylor Ltd, from 19-23 May 2014. Collection methods included pitfall traps, mini-Malaise traps, and yellow pan traps. Five samples were sent to Entecol for analysis.

All sites sampled were of native grassland that has been oversown with exotic grasses and had low-intensity grazing. The photographs supplied indicate the native vegetation remains a dominant feature in the sites. Taller native shrubbery exists within the gullies (G. Ussher pers. comm.).

Findings

The five samples provided contained 270 specimens, which were identified to 32 taxa. In terms of terrestrial invertebrate sampling, these are small numbers, which is due primarily to the time of year in which sampling took place (late autumn) and the short duration of the survey. Despite these limitations, the invertebrate surveys provided a number of species that are of interest and characteristic of the area.

A notable find from site GB2 was 7 specimens of an undescribed ground weta, *Hemiandrus* “furovianus”, which has also been referred to as the Tekapo ground weta. This species is known only from river margins of the Mackenzie Basin, where it has burrows in the silty soils. It usually prefers the terraces above normal flows and small floods, but is susceptible to more severe flooding (Johns, 2001). The conservation status of this species is currently listed as Naturally Uncommon (Trewick *et al.*, 2012). Threats to its survival are primarily in the form of habitat modification, and particularly disturbance to the silty soils (Wyngaarden, 1995).

Several specimens of a regionally restricted grasshopper, *Sigaus australis* complex, were collected at sites GB1 and BM1. This species is highly variable across its range (central Otago and Mackenzie Country) and there is ongoing debate about the delimitations of species within the complex. The various genetic clades do not appear separable on morphological grounds, but the form and location of the specimens collected indicate they would fall within a clade of narrow geographic distribution running from Mt Sutton in the north to Alexandra in the south (clade Sa II in Trewick & Morris 2008). The form in the samples would have previously been considered to be “sp. A” (Morris, 2002) but is now currently considered synonymous with *S. australis* (Trewick *et al.*, 2012).

Other characteristic species identified from the samples included a large ground beetle, *Megadromus alternus*. A pair of these were collected at site BM1. This species is found only

in drier habitats of the Mackenzie Basin from about Tekapo to Omarama (P.M. Johns, pers. comm.). This species is not considered threatened, but the project area is close to the range of similar ground beetles that are potentially of conservation interest, such as *Megadromus omaramae*, which is known only from a 5 ha area of mountain beech forest on the slopes of Quailburn Station (Johns 2007).

Another beetle of interest was a chafer beetle, *Prodontria matagouriae*, which was also collected at site BM1. The conservation status of this species is currently considered Naturally Uncommon (Leschen *et al.*, 2012). The species has only been found in the Mackenzie Basin and Burkes Pass to the north, and always in association with matagouri (*Discaria toumatou*), on which it may be dependent (Barratt, 2007).

The Mackenzie Basin is regarded as an important area for Lepidoptera, with a number of rare and threatened moth species recorded there (Patrick, 1992), but late autumn is not a good time to sample for them. Few moths were collected in the samples, but one species that was collected is an *Atomotricha* sp., that is very similar to *A. sordida*, but is notably smaller than this or any other New Zealand species (J. S. Dugdale pers. comm.), and is a new record for the Mackenzie Basin. This group of *Atomotricha* are notable in that the females are brachypterous (atrophy of the wings rendering them flightless), and all 19 of the specimens collected were males.

The most abundant insect collected (123 individuals) was what appears to be an undescribed species of *Mycetophila* fungus gnat. These were found at all 5 sample sites. Undescribed *Mycetophila* are not uncommon, and this species may have a broad distribution in the region, although it may well be adapted for the short-stature native vegetation types present in the project area.

A number of a small, pale *Cantuaria* trapdoor spiders were collected from sites GB1 and GB2. These could not be matched to any described species, but are similar to *C. toddae*, known only from Cromwell and Alexandra to the south. Most *Cantuaria* are thought to have limited distributions and the existence of numerous undescribed species from isolated geographic areas is suspected (Paquin *et al.*, 2010). Further collections would be required to ascertain the full distribution of the species.

The majority of species collected are natives, but the samples also contained several ubiquitous introduced species, including the eleven-spotted ladybird (*Coccinella undecimpunctata*), European bluebottles (*Calliphora vicina*), Australian golden-haired blowflies (*C. stygia*), and a European harvestman (*Phalangium opilio*). These are all typical of New Zealand farming and human environments and are found also in adjacent native habitats.

Discussion

The terrestrial invertebrate fauna collected contained a range of species that are clearly characteristic of short-stature native and semi-native vegetation in the Mackenzie Basin. Several of these are endemic to the wider area.

The Mackenzie Basin has been well recognised for having rich biodiversity values and being a stronghold for rare ecosystems (e.g. Williams *et al.*, 2007). A number of threatened invertebrate species are known from the Mackenzie Basin, including moths, beetles,

grasshoppers and weta. An area of native grassland and shrubland adjacent to TD3, referred to as Spring Creek, has previously been considered an area of national significance for invertebrates (Patrick, 1992), but has now largely been turned into grazing land. The “kettle-holes” area at the south-east corner of Lake Ohau is another area previously identified as having high values for insect conservation (Patrick, 1992).

The native dryland habitats of the Mackenzie Basin have a long history of human-induced threats, such as fire, rabbits, weed invasion, over-sowing, and sheep grazing. The invertebrate communities endemic to the area seem able to survive these threats reasonably well, and can recover to high-value communities with careful management. However, tilling, irrigation and conversion of these ecosystems to exotic pasture is completely destructive to the ecosystem, including the majority of native invertebrates that live there. The invertebrate community will change dramatically, with a higher prevalence of introduced species, and loss of invertebrate biodiversity values.

Conclusions and Recommendations

The Benmore-Twizel Project is in the heart of an area considered to have high biodiversity values for invertebrates, and even this short survey during late autumn has produced a number of unusual species with limited distributions. The extent of native grasslands in this area has already declined through conversion to pasture, which increases the need to properly understand the remaining communities. Although this late-autumn survey of invertebrates has produced interesting results, it is far from a complete picture and will not have been able to detect species that are only active during warmer months, such as the threatened moth species recorded from nearby sites. It is recommended that:

- Further invertebrate surveys of the project be conducted over spring and summer, and should include nearby comparison areas of similar habitat that will not be affected by development.
- A proper review of existing information on the threatened invertebrates of the wider Mackenzie Basin should be undertaken and used to guide survey protocols and to target particular groups to survey and have formally identified.

Acknowledgements

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Appendix

Table 1: List of invertebrates identified from samples from 5 sites in the Benmore-Twizel project area.

Order	Family	Species	GB1	GB2	TD1	BM1	BM4	
Araneae	Idiopidae	<i>Cantuarina</i> sp.	✓	✓				
	Lycosidae	Indet.	✓	✓		✓		
Coleoptera	Carabidae	<i>Megadromus alternus</i>				✓		
	Coccinellidae	<i>Coccinella undecimpunctata</i>				✓		
	Scarabaeidae	<i>Prodontria matagouriae</i>				✓		
	Staphylinidae	Indet.	✓					
Diptera	Calliphoridae	<i>Calliphora stygia</i>	✓					
		<i>Calliphora vicina</i>	✓			✓		
	Chironomidae	Indet.			✓			
	Muscidae	Indet.	✓			✓	✓	
	Mycetophilidae	<i>Mycetophila fagi</i>	✓					
		<i>Mycetophila minima</i>	✓					
		<i>Mycetophila</i> nov. sp.	✓	✓	✓	✓	✓	
		<i>Mycetophila subspinigera</i>	✓		✓	✓	✓	
		<i>Zygomyia</i> sp. (2-3 spp.)	✓	✓	✓	✓	✓	
	Sarcophagidae	Indet.	✓					
	Sphaeroceridae	<i>Leptocera</i> sp.	✓				✓	
Tachinidae	<i>Calcager</i> sp. cf. <i>apertum</i>	✓						
Tipulidae	<i>Limonia (Dicranomyia)</i> sp. <i>Zealandoglochina</i> sp.	✓	✓					
Hemiptera	Cicadellidae	Indet.			✓			
	Triozidae	Indet.			✓	✓		
Hymenoptera	Formicidae	<i>Huberia striata</i>	✓					
		<i>Prolasius advena</i>		✓		✓		
	Ichneumonidae	Indet.	✓					
Lepidoptera	Noctuidae	<i>Tmetolophota</i> sp. (larvae)	✓					
	Oecophoridae	<i>Anisotricha</i> sp. cf. <i>sordida</i>		✓		✓		
Opiliones	Phalangidae	<i>Phalangium opilio</i>	✓					
Orthoptera	Acrididae	<i>Sigaus australis</i> complex	✓			✓		
	Anostostomatidae	<i>Hemiandrus</i> "furoviarius"		✓				
	Gryllidae	<i>Bobilla</i> sp.	✓	✓		✓		
Trichoptera	Hydroptiliidae	Indet.	✓					

Appendix C: Assessment of threatened or rare
plant occurrence

Appendix C

Threatened or at risk species of plant recorded from the site or recorded in the DOC BioWeb database for Omarama Ecological District, or which may be present within the natural or semi-natural environments recorded within the candidate irrigation areas.

Species highlighted in bold are those recorded from within the candidate survey sites (candidate site locations are noted).

Species	Threat status	Habitat description
piripiri <i>Acaena buchananii</i>	At Risk - declining	<p>Found in short dry tussockland and turf, mainly in inland basins, including montane riverbeds and tussock grassland. Key threats are habitat destruction through land development such as cultivation, oversowing, and irrigation.</p> <p>Recorded within the candidate sites TD1b and GB1</p> <p>Based on gross habitat availability, could be present in sites BM1a, TD5, GB2b, GB6, BM6</p>
Coral broom <i>Carmichaelia crassicaulis</i> <i>subsp. crassicaulis</i>	At Risk - declining	<p>Found in upland and subalpine grassland, scrub and rock.</p> <p>Rigid shrub up to 2m tall. It can grow up to 2 metres tall, but animals browsing on its stems usually prevent it from reaching this height.</p> <p>Recorded within the candidate site BM1a</p> <p>Based on gross habitat availability, could be present in sites GB1, BM7F, GB2b, TD1b</p>
Cushion pimelea <i>Pimelea sericeovillosa</i> subsp. <i>pulvinaris</i>	At Risk - declining	<p>Found in lowland to subalpine zones, in valley and basin floors occupying dry, windswept places, usually with stony substrates and fine-textured, loess-derived matrix, within short vegetation cover. Often on moraine crests, as well as alluvial fans and river terraces. Obvious cushion fields are places that they will be.</p> <p>Recorded within the candidate site GB1</p> <p>Based on gross habitat availability, could be present in sites GB2b, BM1a</p>
dwarf broom <i>Carmichaelia vexillata</i>	At Risk - declining	<p>Found in recent moraines, alluvium, river terraces, terrace risers, disturbed soils, and soils derived from schist parent material. At threat from weeds and browsing animals which inhibit flowering and fruit set, although it may depend upon some level of animal browse to suppress weed regrowth.</p> <p>Based on gross habitat availability, could be present in sites GB1, BM1a</p>

<i>Ceratocephala pungens</i>	Nationally critical	<p>An annual herb found in dry open ground, often amongst scabweed (<i>Raoulia</i> spp.) mats. At serious risk of extinction. The open scabweed habitats this species requires have largely been replaced by taller introduced and indigenous grasses.</p> <p>Based on gross habitat availability, could be present in site TDb1</p>
NZ mousetail <i>Myosurus minimus subsp. novae-zelandiae</i>	Nationally Endangered	<p>This summer-green annual is found in damp and slightly salty depressions in pastures and short tussock grassland, on the margins of tarn and kettle holes, and in damp dune hollows, gravel flats and alluvium. Virtually all of its known habitats are now being invaded by faster growing, taller or turf forming, perennial weeds such as <i>Plantago coronopus</i>.</p> <p>Based on gross habitat availability, could be present in sites GB2a, TD1b, BM4a</p>
<i>Myosotis brevis</i>	Nationally vulnerable	<p>An annual or rarely short-lived perennial herb found in free draining, but seasonally moist habitats. It cannot tolerate over shading and so is very vulnerable to taller weed species invading its habitats. Land development is threatening some populations, and has possibly been responsible for the recent loss of others.</p> <p>Based on gross habitat availability, could be present in sites GB1, BM1a</p>
<i>Leptinella conjuncta</i>	Nationally critical	<p>Creeping perennial herb of inner montane basins and river terraces. Known from dry, semi-arid and rain-shadow areas where it predominantly grows on terraces, terrace edges, and old river channels of gravels and alluvium.</p> <p>Based on gross habitat availability, could be present in sites TD1b, GB2a</p>
Cypress hebe <i>Leonohebe cupressoides</i>	Nationally endangered	<p>Aromatic bushy shrub. <i>Leonohebe cupressoides</i> is a plant of grey scrub communities and occurs across a range of sites. The dominant threats are recruitment failure caused by invasive herbaceous plants that rapidly occupy the disturbed sites this species requires to germinate in. Grazing animals, including domestic stock and wild species such as rabbits and hares can seriously damage or kill plants.</p> <p>Based on gross habitat availability, could be present in sites GB1, BM1a</p>
inland cress <i>Lepidium solandri</i>	Nationally Endangered	<p>Perennial dioecious herb. Found in short and tall tussock grassland, bare hillsides, salt pans, grey scrub and other poorly vegetated ground. All sites are threatened by weed competition, animal browsing, and for most sites changes in land-use management.</p> <p>Based on gross habitat availability, could be present in sites GB1, BM1a, GB2a, TD1b</p>

dwarf broom <i>Carmichaelia nana</i>	At Risk - declining	Lowland to alpine shrub inhabiting stable but unconsolidated alluvial river beds and eyots, river terraces, moraines, shingle slopes, lahar mounds and inland volcanogenic dunes. Based on gross habitat availability, could be present in sites GB1, BM1a, GB2a, TD1b
<i>Leucopogon nanum</i>	At Risk - Naturally uncommon	This dwarf entity is confined to short-tussockland alluvial terraces and inner montane basins of southern Marlborough and Canterbury. Confined to deflation hollows in some places, and also found at more adverse sites, such as the dry, Hieracium- and rabbit-infested sites. Based on gross habitat availability, could be present in sites GB2a, TD1b
Waitaki broom <i>Carmichaelia curta</i>	Nationally Critical	A component of grey scrub usually growing on colluvial aprons and alluvium, particularly on river terraces and also on rock outcrops. As an endemic of the highly modified Waitaki Valley and surrounding catchments, most populations of <i>C. curta</i> occur within habitats accessible to browsing animals, and so are severely damaged, and of those which are reproductive, recruitment is often limiting due to suppression of seedling germination by weeds. DOC's database notes one record from the Tara Hills Research Station south of Omarama. Based on gross habitat availability, could be present in sites GB1, BM7F, GB2b, TD1b
Kirk's broom <i>Carmichaelia kirkii</i>	Nationally Vulnerable	A plant of moderate to high fertility sites. Usually associated with grey scrub communities particularly those along riverbanks and gorges, or on poorly drained river terraces. It is often associated with totara (<i>Podocarpus totara</i> var. <i>totara</i>) forest, and has also been found in carex dominated wetlands, or within kahikatea (<i>Dacrycarpus dacrydioides</i>) dominated forest. The species is highly palatable and so vulnerable throughout its range of all browsing animals. DOC's database notes several records from nearby, including in the scrubby riparian margins of Silver Creek and Totara creek to the east of Little Ben proposed sites, and in dry riverbed of Ohau River between Lake Ohau and Lake Ruataniwha Based on gross habitat availability, could be present in sites GB1, BM1a
Sneezeweed <i>Centipeda minima</i> subsp. <i>minima</i>	Nationally Endangered	This aromatic, usually prostrate, annual is found in wet, or partially dried out lake, pond and stream margins. This species requires open sparsely vegetated ground. It cannot tolerate any competition, so grows in the most open sites it can find (wet or dry). The largest recently discovered populations in New Zealand come from rubbish dumps, poorly draining foot paths, and muddy ground associated with poorly drained airstrips.

		<p>DOC's database notes records within the Ben Omar wetland, downstream of the proposed Little Ben irrigation sites.</p> <p>Based on gross habitat availability, there are not likely to be any sites within the candidate irrigation areas that could support this species.</p>
<i>Chenopodium detestans</i>	Nationally Critical	<p>Recent (post 1980) collections have only been made from Lake Lyndon and the upper Waitaki Valley. In those days this area was extensively farmed for sheep and cattle, and while this was the case <i>C. detestans</i> was common on the shores of Lake Lyndon, in sites frequented by these animals.</p> <p>As far as is known <i>C. detestans</i> has declined mainly because of a loss of suitable open, sparsely-vegetated habitats. This seems to have been the result of the spread of introduced pasture grasses and weeds, and changes in land use, especially stocking levels. The only recent collections have come from well-stocked sheep farms in the upper Waitaki Valley, where it grows on clay and salt pans. Possibly because of its foul smell the species does not seem to be palatable to livestock, so livestock may help reduce competition from other taller, more palatable plants.</p> <p>DOC's database notes one specimen was recorded from the banks of the Ahuriri River south of Omarama in 1967.</p> <p>Based on gross habitat availability, there are not likely to be any sites within the candidate irrigation areas that could support this species.</p>
<i>Crassula multicaulis</i>	Nationally Endangered	<p>Coastal, lowland to alpine (0- 1800 m a.s.l.) in open, seasonally damp ground, such as clay or salt pans or around tarn margins. It has also been collected from braided river beds.</p> <p>DOC's database notes that it has been recorded in wetland margins around Red Lagoon to the south of Lake Ohau</p> <p>Based on gross habitat availability, there are not likely to be any sites within the candidate irrigation areas that could support this species.</p>
<i>Gratiola concinna</i>	Nationally Vulnerable	<p>Muddy hollows in forest clearings, streambanks or in turf at the margins of lakes, rivers or ponds; sometimes aquatic at edge of shallow lakes or rivers.</p> <p>DOC's database notes that it has been recorded in wetland margins around Red Lagoon to the south of Lake Ohau</p>

		Based on gross habitat availability, there are not likely to be any sites within the candidate irrigation areas that could support this species.
<i>Ranunculus brevis</i>	Nationally Endangered	<p>A diminutive tufted, non-rhizomatous perennial herb that is found from montane to subalpine (300-1200 m a.s.l.) altitudes, usually in shallow muddy, sparsely vegetated pools, or in swamps, river, tarn or lake margins. Never common.</p> <p>DOC's database notes a record in the bed of the Ohau River on the south side of Lake Ruataniwha.</p> <p>Based on gross habitat availability, there are not likely to be any sites within the candidate irrigation areas that could support this species.</p>
Fan leaved mat daisy <i>Raoulia monroi</i>	At Risk - Declining	<p>Found in lowland to upland open ground and rocky places, on river terraces and stabilised river gravel. As a lowland to montane species of dry, open ground this species is vulnerable to competition from taller, more aggressive weed species.</p> <p>DOC's database notes records on the margins of Silver Creek (to the East of Sutherland's Creek and proposed irrigation sites LB 1 – 4)</p> <p>Based on gross habitat availability, could be present in sites GB1, BM1a, GB2a, TD1b, BM4a, LB3</p>
Fireweed <i>Senecio dunedinensis</i>	Nationally Vulnerable	<p>Lowland to subalpine (10-1300 m a.s.l.). Frequenting grey scrub where it grows in shaded sites under taller shrubs. Also often seen growing in shaded sites amongst boulders, or near or under rock overhangs. Sometimes it has been gathered from open grassland. Never common with an apparently naturally sporadic distribution</p> <p>Two locations historically known from south of Omarara in 1943</p> <p>Based on gross habitat availability, could be present in sites GB1, BM1a</p>

Appendix D: Checklist of birds in the MacKenzie Basin area

Birds marked with * were recorded during this survey.

Species	Latin name	Threat status
Native/ Endemic		
Australasian bittern	<i>Botaurus pauciloptilus</i>	Threatened – Nationally Endangered
Australasian crested grebe	<i>Podiceps cristatus</i>	Threatened – Nationally Vulnerable
Australasian harrier *	<i>Circus approximans</i>	Not Threatened
Australasian shoveler	<i>Anas rhynchotis</i>	Not Threatened
Banded dotterel	<i>Charadrius bicinctus bicinctus</i>	Threatened – Nationally Vulnerable
Bellbird	<i>Anthornis melanura</i>	Not Threatened
Black-billed gull	<i>Larus bulleri</i>	Threatened – Nationally Critical
Black shag *	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk – Naturally Uncommon
Black stilt	<i>Himantopus novaeseelandiae</i>	Threatened – Nationally Critical
Black-fronted tern	<i>Sterna albobriata</i>	Threatened – Nationally Endangered
Brown creeper	<i>Mohoua novaseelandiae</i>	Not Threatened
Caspian tern	<i>Sterna caspia</i>	Threatened – Nationally Vulnerable
Dabchick	<i>Poliiocephalus rufopectus</i>	Threatened – Nationally Vulnerable
Falcon	<i>Falco novaeseelandiae</i>	Taxonomically Indeterminate – Nationally Vulnerable
Fantail	<i>Rhipidura fuliginosa fuliginosa</i>	Not Threatened
Grey duck	<i>Anas superciliosa</i>	Threatened – Nationally Critical
Grey teal	<i>Anas gracilis</i>	Not Threatened
Grey warbler	<i>Gerygone igata</i>	Not Threatened
Little shag	<i>Phalacrocorax melanoleucos</i>	Not Threatened
Marsh crake	<i>Porzana pusilla</i>	At Risk - Relict

New Zealand pigeon	<i>Hemiphaga novaeseelandiae</i>	Not Threatened
New Zealand pipit	<i>Anthus novaeseelandiae</i>	At Risk - Recovering
NZ scaup *	<i>Aythya novaeseelandiae</i>	Not Threatened
Paradise shelduck *	<i>Tadorna variegata</i>	Not Threatened
Pied oystercatcher	<i>Haematopus ostralegus finschi</i>	At Risk - Declining
Pied stilt	<i>Himantopus himantopus</i>	At Risk - Declining
Pukeko *	<i>Porphyrio porphyria</i>	Not Threatened
Rifleman	<i>Acanthisitta chloris</i>	At Risk - Declining
Silvereye	<i>Zosterops lateralis</i>	Not Threatened
Southern black-backed gull *	<i>Larus dominicanus dominicanus</i>	Not Threatened
Spur-winged plover *	<i>Vanellus miles novaehollandiae</i>	Not Threatened
Tomtit	<i>Petroica macrocephala</i>	Not Threatened
Tui	<i>Porsthemadera novaeseelandiae</i>	Not Threatened
Welcome swallow *	<i>Hirundo tahitica neoxena</i>	Not Threatened
White-faced heron *	<i>Ardea novaehollandiae</i>	Not Threatened
Wrybill	<i>Anarhynchus frontalis</i>	Threatened – Nationally Vulnerable
Introduced		
Australian magpie *	<i>Gymnorhina tibicen</i>	Introduced
Blackbird *	<i>Turdus merula</i>	Introduced
Black swan *	<i>Cygnus atratus</i>	Introduced
California quail *	<i>Callipepla californica brunnescens</i>	Introduced
Canada goose	<i>Branta canadensis</i>	Introduced
Chaffinch *	<i>Fringilla coelebs</i>	Introduced
Chukor	<i>Alectoris chukar</i>	Introduced
Dunnock *	<i>Prunella modularis</i>	Introduced

Feral goose	<i>Anser anser</i>	Introduced
Goldfinch *	<i>Carduelis carduelis</i>	Introduced
Greenfinch	<i>Carduelis chloris</i>	Introduced
House sparrow	<i>Passer domesticus</i>	Introduced
Mallard *	<i>Anas platyrhynchos</i>	Introduced
Redpoll *	<i>Carduelis flammea</i>	Introduced
Rock pigeon	<i>Columba livia</i>	Introduced
Skylark *	<i>Alauda arvensis</i>	Introduced
Song thrush *	<i>Turdus philomelos</i>	Introduced
Starling *	<i>Sturnus vulgaris</i>	Introduced
Yellowhammer *	<i>Emberiza cintrarella</i>	Introduced

Appendix E: Parcels within the proposed Benmore Irrigation Scheme

Site	Site area (ha)	Threatened Environments Classification (TEC)		TEC area (ha) where indigenous vegetation is present
		LENZ ID	Threat category where indigenous vegetation is present	
B1	12.7	Nil		
B2	5.5	Nil		
BM10	14.3			
BM11A	40.6	N6.1b	Critically Underprotected	24.8
		N7.1a	Chronically Threatened	15.8
BM1A	347.7	E4.1b	At Risk	179.0
		N3.1d	Chronically Threatened	16.5
		N3.1e	Chronically Threatened	6.2
		N5.1a	Acutely Threatened	146.1
BM2	58.7	Nil		
BM3	86.7	Nil		
BM4A	116.9	E4.1b	At Risk	19.7
		N6.1b	Critically Underprotected	97.2
BM4B	45.9	Nil		
BM6	59.3	E4.1b	At Risk	17.7
		N5.1a	Acutely Threatened	19.5
		N6.1b	Critically Underprotected	22.1
BM7A	11.1	Nil		
BM7B	109.4	Nil		
BM7C	44.0	Nil		
BM7D	61.7	Nil		
BM7E	160.3	Nil		
BM7F	198.5	Nil		
BM9	11.4	Nil		
GB1	275.5	E4.1b	At Risk	275.5
GB2A	408.9	E4.1b	At Risk	392.3
		N6.1b	Critically Underprotected	16.6

Site	Site area (ha)	Threatened Environments Classification (TEC)		TEC area (ha)
GB2B	42.8	E4.1b	At Risk	40.2
		K3.1a	At Risk	1.8
		N6.1a	Critically Underprotected	0.8
GB3	25.9	Nil		
GB4A	106.1	Nil		
GB4B	11.4	N6.1b	Critically Underprotected	11.4
GB6	32.1	E4.1b	At Risk	18.8
		N4.1c	Critically Underprotected	0.4
		N6.1b	Critically Underprotected	12.9
LB1	90.2	Nil		
LB2	86.3	N4.1c	Critically Underprotected	0.5
		N4.1e	At Risk	2.0
		N6.1b	Critically Underprotected	83.8
LB3	9.7	N4.1a	Chronically Threatened	0.6
		N4.1c	Critically Underprotected	0.4
		N4.1e	At Risk	0.8
		N5.1a	Acutely Threatened	0.2
		N6.1b	Critically Underprotected	7.7
LB4	29.3	Nil		
TD1A	114.3	Nil		
TD1B	48.7	K3.1a	At Risk	21.1
		N4.1c	Critically Underprotected	0.1
		N6.1a	Critically Underprotected	27.5
TD2	513.3	Nil		
TD5	50.8	E4.1b	At Risk	6.3
		K3.1a	At Risk	44.5
WB1	118.2	Nil		
WB2	132.9	Nil		
WSA	60.5	Nil		
WSB	22.1	E4.1b	At Risk	3.1
		N4.1c	Critically Underprotected	0.02
		N6.1b	Critically Underprotected	19.0
	3,563.7	total area (ha)		

Appendix F: Assessment of proposed irrigation sites against the CRPS ecological significance criteria

Sheet 1

Sites are considered by Canterbury Regional Council to be ecologically significant if they meet one or more of the 10 criteria listed in the table below (criteria taken from the Canterbury Regional Policy Statement Appendix 3 and Wildlands 2013 (*Guidelines for the application of ecological significance criteria for indigenous vegetation and habitats of indigenous fauna in Canterbury Region*)).

For threatened or rare plant species recorded or anticipated from sites, refer to Appendix A (site values) and C (rare plants that may be present at sites).

Criterion	Sites TD1A, TD2, GB4B, WSa, WSb, B1, B2, LB1, BM4b, BM7A, BM7b, BM7c, BM7d, BM7e, BM9, BM10, WB1, WB2	Sites TD5, GB2b	Site TD1b	Site GB1
Overall significance rating	Not ecologically significant	Not ecologically significant	Ecologically significant	Ecologically significant
Representativeness – representative of natural diversity	Not significant: These sites have no or almost no natural values left being totally or predominantly exotic pasture	Not significant: These sites support severely degraded short tussock grassland burned and oversown with pasture grasses and with extensive wilding pine and hawkweed	Significant: Indigenous vegetation, particularly on the riser is moderately representative of short tussock grassland and low scrub	Significant: Mostly intact, good quality, short tussock grassland but with a significant component of wilding pine
Representativeness – large example	Not significant: These sites have no or almost no natural values left	Not significant: These sites are small and degraded	Not significant: The site is small in area (48.7 ha)	Significant: The site is large (275.5 ha)
Rarity – less than 20 % of former extent remaining	Not significant: These sites have no or almost no natural values left	Not significant: There are no TEC Environments < 20% remaining	Not significant: There are no TEC Environments < 20% remaining	Not significant: There are no TEC Environments < 20% remaining
Rarity – threatened or at risk species	Not significant: The exotic managed pasture or crops of these sites offers potential foraging habitat for black stilt, black-billed gull, terns, pied stilt on intensively managed exotic pasture. Some areas offer nesting and foraging for pipit. None of the areas support breeding populations or colonies, or constitute important habitat.	Not significant: The sites are likely to support pipit, however it is unlikely to support a significant population of pipit. Several threatened or rare plant species may be present, although the site history of modification suggests a low likelihood.	Significant: <i>Acaena buchananii</i> (<i>At risk</i>) was recorded and there may be other threatened or rare plants present. Pipit is likely present.	Significant: Cushion pimelea was recorded and there are likely to be other threatened or rare plants present. Pipit is likely present.
Rarity – at distributional limit	Not significant: None of these sites represents the distributional limit in Canterbury or	Not significant: None of these sites represents the distributional limit in	Not significant: None of these sites represents the distributional	Not significant: The site does not represent the distributional

Criterion	Sites TD1A, TD2, GB4B, WSa, WSb, B1, B2, LB1, BM4b, BM7A, BM7b, BM7c, BM7d, BM7e, BM9, BM10, WB1, WB2	Sites TD5, GB2b	Site TD1b	Site GB1
	nationally of any native species recorded or which may be present within these sites.	Canterbury or nationally of any native species recorded or which may be present within these sites.	limit in Canterbury or nationally of any native species recorded or which may be present within these sites.	limit in Canterbury or nationally of any native species recorded or which may be present within these sites.
Rarity – distinctive/ originally rare ecosystem	Not significant: None of these sites support originally rare ecosystems - they are all heavily modified to exotic ecosystems.	Not significant: These sites do not support originally rare ecosystems and they are common examples of heavily degraded tussock grassland	Significant: The site is a degraded example of an inland outwash gravel plain	Not significant: The site is not an originally rare ecosystem
Diversity/ pattern – high diversity	Not significant: None of these sites support intact indigenous ecosystems. Diversity of native species, communities and natural gradients within these sites has been removed through pasture improvement and cropping. Some sites have very sparse remnants of short tussock only.	Not significant: Sites are degraded to the extent that they support a low indigenous species richness. Sites are surrounded by similarly degraded tussock grassland and/or exotic pasture and cropland	Significant: Vegetation at the site includes short tussock grassland, indigenous scrub remnants and wetland margin vegetation	Significant: Vegetation at the site includes short tussock grassland, indigenous scrub remnants and riparian margin vegetation
Context – linkage/ buffer	Not significant: None of these sites support indigenous vegetation communities.	Not significant: Sites are degraded, do not buffer good quality indigenous habitat.	Not significant: The site does not buffer good quality indigenous habitat.	Significant: The site buffers and adjoins lower lying outwash plains.
Context – important wetland	Not significant: None of these sites support wetlands	Not significant: None of these sites support wetlands	Significant: The site supports a wetland with predominantly indigenous vegetation	Not significant: The site does not support a wetland
Context – important habitat	Not significant: All of these sites are intensively grazed exotic pasture or ploughed land managed for crops – they do not offer important habitat for indigenous species. At most they provide temporary habitat for black stilt, black-billed gull and pied stilt.	Not significant: The sites are unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species.	Not significant: The site is unlikely to provide important habitat for indigenous species.

Sheet 2

Criterion	Site LB2	Site BM2	Site BM3	Site BM7F
Overall significance rating	Not ecologically significant	Not ecologically significant	Not ecologically significant	Not ecologically significant
Representativeness – representative of natural diversity	Not significant: The site supports mostly bare ground and hawkweed with only sparse scattered, heavily grazed native tussock grassland species. It does not represent natural diversity	Not significant: The site supports mostly exotic pasture with elements of degraded short tussock grassland and several patches of matagouri amongst pasture. It does not represent natural diversity	Not significant: The site supports mostly exotic pasture with elements of degraded short tussock grassland. Part of the site has been cultivated. It does not represent natural diversity.	Not significant: The site supports mostly exotic pasture with patches of short tussock grassland and scattered grazed matagouri. The site has been top-dressed and oversown.
Representativeness – large example	Not significant: The site is small and severely degraded (86.3 ha)	Not significant: The site is small and degraded (58.7 ha)	Not significant: The site is small and degraded (86.7 ha)	Not significant: The site is of moderate area and degraded (198.5 ha)
Rarity – less than 20 % of former extent remaining	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation
Rarity – threatened or at risk species	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. No threatened or at risk plants were recorded or are expected from the site	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. No threatened or at risk plants were recorded or are expected from the site	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. No threatened or at risk plants were recorded or are expected from the site	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. Several threatened or rare plant species may be present, although the site history of modification suggests a low likelihood.
Rarity – at distributional limit	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.

Criterion	Site LB2	Site BM2	Site BM3	Site BM7F
Rarity – distinctive/ originally rare ecosystem	Not significant: The site does not support originally rare ecosystems and it is a common example of heavily degraded tussock grassland	Not significant: The site does not support originally rare ecosystems and it is a common example of heavily degraded tussock grassland	Not significant: The site does not support originally rare ecosystems and it is a common example of heavily degraded tussock grassland	Not significant: The site does not support originally rare ecosystems and it is a common example of heavily degraded tussock grassland/ exotic pasture
Diversity/ pattern – high diversity	Not significant: The site is degraded to the extent that it supports a very low indigenous species richness. The site is surrounded by exotic pasture and cropland	Not significant: The site is degraded to the extent that it supports a low indigenous species richness. The site is surrounded by similarly degraded tussock grassland and/or exotic pasture	Not significant: The site is degraded to the extent that it supports a low indigenous species richness. The site is surrounded by similarly degraded tussock grassland and/or exotic pasture	Not significant: The site is degraded to the extent that it supports a low indigenous species richness. The site is surrounded by similarly degraded tussock grassland and/or exotic pasture
Context – linkage/ buffer	Not significant: Site is degraded, does not buffer good quality indigenous habitat. It is separated from Ben Omar wetland by exotic pasture.	Not significant: Site is degraded, does not buffer good quality indigenous habitat.	Not significant: Site is degraded, does not buffer good quality indigenous habitat.	Not significant: Site is degraded, does not buffer good quality indigenous habitat.
Context – important wetland	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands
Context – important habitat	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.

Sheet 3

Criterion	Site LB4	Site GB3	Site GB4a	Site GB6
Overall significance rating	Not ecologically significant	Not ecologically significant	Not ecologically significant	Ecologically significant
Representativeness – representative of natural diversity	Not significant: The site supports mostly exotic pasture with extensive areas of bare ground and hawkweed. It does not represent natural diversity	Not significant: The site supports mostly irrigated pasture on the flats and severely degraded tussock grassland on the slopes. It does not represent natural diversity	Not significant: The site constitutes several very small fragments of grazed, irrigated and oversown exotic pasture with sparse fescue tussock. It does not represent natural diversity	Significant: The site supports mostly exotic lightly-grazed pasture with patches of grazed matagouri and grey scrub. The vegetation is representative of gully and riparian vegetation.
Representativeness – large example	Not significant: The site is small and severely degraded (29.3 ha)	Not significant: The site is small and severely degraded (25.9 ha)	Not significant: The site is moderate sized and degraded (104 ha)	Not significant: The site is small (32 ha)
Rarity – less than 20 % of former extent remaining	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation
Rarity – threatened or at risk species	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. Due to its proximity to Ben Omar wetland, it may provide roosting areas for pied stilt No threatened or at risk plants were recorded or are expected from the site	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. No threatened or at risk plants were recorded or are expected from the site	Not significant: The site is unlikely to support native birds. No threatened or at risk plants were recorded or are expected from the site	Significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. <i>Acaena buchananii</i> may be present.
Rarity – at distributional limit	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.

Criterion	Site LB4	Site GB3	Site GB4a	Site GB6
Rarity – distinctive/ originally rare ecosystem	Not significant: The site does not support originally rare ecosystems and it is a common example of exotic pasture grassland	Not significant: The site does not support originally rare ecosystems and it is a common example of heavily degraded tussock grassland and exotic pasture	Not significant: The site does not support originally rare ecosystems and it is a common example of heavily degraded tussock grassland	Significant: The site supports grey scrub which is a rare vegetation type in the District.
Diversity/ pattern – high diversity	Not significant: The site is degraded to the extent that it supports a very low indigenous species richness. The site is surrounded by exotic pasture and cropland	Not significant: The site is degraded to the extent that it supports a low indigenous species richness. The site is surrounded by similarly degraded tussock grassland and/or exotic pasture	Not significant: The site is degraded to the extent that it supports a low indigenous species richness. The site is surrounded by exotic pasture and irrigated land	Not significant: The site has riparian elements but it does not represent a diversity of sequences or ecological patterns.
Context – linkage/ buffer	Not significant: Site is degraded, and adjoins Ben Omar wetland. It does not provide buffering to the wetland.	Not significant: Site is degraded, does not buffer good quality indigenous habitat.	Not significant: Site is degraded, does not buffer good quality indigenous habitat.	Significant: The site buffers the adjoining stream.
Context – important wetland	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands
Context – important habitat	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species.

Sheet 4

Criterion	Site BM6	Site LB3	BM4A	BM11A
Overall significance rating	Ecologically significant	Ecologically significant	Ecologically significant	Ecologically significant
Representativeness – representative of natural diversity	Significant: The site supports mostly exotic lightly-grazed pasture with substantial patches of grazed matagouri and grey scrub. The vegetation is representative of hill slope vegetation.	Significant: The site supports mostly exotic lightly-grazed pasture with substantial patches of grazed matagouri and grey scrub. The vegetation is representative of gully and riparian vegetation.	Significant: The site supports mostly bare ground and hawkweed with patches of tussock grassland.	Not significant: The site supports predominantly natural tussock grassland community, albeit with oversowing and grazing. The site is not a great example of short tussock grassland communities.
Representativeness – large example	Not significant: The site is small (59.3 ha)	Not significant: The site is small (9.7 ha)	Not significant: The site is moderate size (116.9 ha)	Not significant: The site is small (40.6 ha)
Rarity – less than 20 % of former extent remaining	Significant: TEC Environment type present that supports indigenous vegetation is: N5.1a acutely threatened within degraded short tussock and grey scrubland patches	Significant: TEC Environment types present that support indigenous vegetation include: N4.1a chronically threatened N5.1a acutely threatened	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Not significant: TEC Environment types present that support indigenous vegetation include: N7.1a chronically threatened
Rarity – threatened or at risk species	Significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. <i>Acaena buchananii</i> may be present.	Significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. <i>Raoulia monroi</i> may be present.	Not significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit. Several threatened or rare plants may be present.	Significant: The site is likely to support pipit, however it is unlikely to support a significant population of pipit.
Rarity – at distributional limit	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.

Criterion	Site BM6	Site LB3	BM4A	BM11A
Rarity – distinctive/ originally rare ecosystem	Significant: The site supports grey scrub which is a significant vegetation type in the District.	Significant: The site supports grey scrub which is a significant vegetation type in the District.	Significant: The site is within a historically rare ecosystem (outwash gravel plain)	Not significant: Not significant: The site does not support originally rare ecosystems. It is a common example of grazed tussock grassland/ exotic pasture
Diversity/ pattern – high diversity	Not significant: The site does not support a diversity of sequences or ecological patterns.	Not significant: The site has riparian elements but it does not support a diversity of sequences or ecological patterns.	Not significant: The site is degraded to the extent that it supports a low indigenous species richness.	Not significant: The site does not support a diversity of sequences or ecological patterns.
Context – linkage/ buffer	Not significant: The site does not buffer indigenous vegetation or habitats – it is surrounded by irrigated and graded exotic pasture	Significant: The site buffers the adjoining Sutherlands stream.	Not significant: Site is degraded, does not buffer good quality indigenous habitat.	Significant: Site is degraded, does not buffer good quality indigenous habitat. Surrounding land is irrigated or grazed
Context – important wetland	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands	Not significant: The site does not support wetlands
Context – important habitat	Not significant: The site is unlikely to provide important habitat for indigenous species.	Not significant: The site is unlikely to provide important habitat for indigenous species.	Not significant: The site is unlikely to provide important habitat for indigenous species given the degraded nature of the vegetation.	Not significant: The site is unlikely to provide important habitat for indigenous species.

Sheet 5

Criterion	Site GB2A	Site BM1A
Overall significance rating	Ecologically significant	Ecologically significant
Representativeness – representative of natural diversity	Significant: The site supports predominantly intact short tussock grassland similar to site GB1, but with more bare ground and hawkweeds. Despite its degraded state, it is representative of outwash gravel vegetation.	Significant: Mostly intact, good quality, short tussock grassland with grey scrub and low incidence of wildling pines and hawkweed. It is a good quality, representative of
Representativeness – large example	Significant: The site is large (408.9 ha)	Significant: The site is large (347.7 ha)
Rarity – less than 20 % of former extent remaining	Not significant: There are no TEC Environments < 20% remaining in indigenous vegetation	Significant: TEC Environment types present that support indigenous vegetation include: N5.1a acutely threatened N3.1d chronically threatened N3.1e chronically threatened E3.1a chronically threatened
Rarity – threatened or at risk species	Significant: The site is likely to support pipit, and banded dotterel. Several threatened or rare plants may be present.	Significant: Cushion pimelea and coral broom were recorded and there are likely to be other threatened or rare plants present. Pipit is likely present.

Criterion	Site GB2A	Site BM1A
Rarity – at distributional limit	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within this site.	Not significant: The site does not represent the distributional limit in Canterbury or nationally of any native species recorded or which may be present within these sites.
Rarity – distinctive/ originally rare ecosystem	Significant: The site is within an outwash gravel plain.	Not significant: The site is not an originally rare ecosystem
Diversity/ pattern – high diversity	Significant: The site supports a diversity of sequences and ecological patterns.	Significant: Vegetation at the site includes short tussock grassland, indigenous scrub remnants across an environmental gradient from hill slope to flats bordering Big Tarn
Context – linkage/ buffer	Significant: The site provides a linkage between the semi-natural vegetation communities of Table Hill and tussock grasslands towards Lake Ohau.	Significant: The site buffers Big Tarn (a regionally significant ecological site), although the proposed irrigation area is set back from this tarn
Context – important wetland	Not significant: The site does not support wetlands	Not significant: The site does not support a wetland
Context – important habitat	Not significant: The site is unlikely to provide important habitat for indigenous species.	Not significant: The site is unlikely to provide important habitat for indigenous species.

Appendix G: Planning provisions relating to
indigenous vegetation and ecological
significance

Waitaki District Plan (August 2010)

Rural Rules

Section 4.4.7 Environmentally and Ecologically Sensitive Areas

3. There shall be no indigenous vegetation clearance, other than for the maintenance of existing tracks, irrigation infrastructure, electricity transmission infrastructure, yards or fence lines, in the following areas:
 - a Areas of significant indigenous vegetation and habitat of significant indigenous fauna identified on the Planning Maps and listed in Appendix C.
 - b Within 20m of any lake, river, stream or wetland or within any wetland.
 - c Within 100m (inland) of the mean high water springs at the coast.
 - d Above 900m in altitude.
 - e An area of Otago skink habitat or Grand skink habitat as shown on Appendix J

Added by Author: Note – Appendix C and Appendix C(1) are not Operative according to header on Appendix C tables

Section 4.4.8 provides rules relating to General Indigenous Bush Vegetation Clearance as follows:

1. On any site there shall be no clearance of indigenous bush.
2. On any site there shall, over any five year continuous period, be no clearance of:
 - a more than 5000 square metres of indigenous vegetation generally, except where the vegetation clearance is carried out within, and for the purposes of, maintaining an area of improved pasture; or:
 - b more than 1000 square metres or more of tall tussock grassland communities of the genus *Chionochloa* except where the vegetation clearance is carried out for the purposes of maintaining improved pasture; or:
 - c more than 500 square metres of generally closed canopy matagouri (*Discaria toumatou*) dominated indigenous shrubland that has a canopy height of greater than 1.5 metres and is associated with river margins, fans, ridges and bluffs; or:
 - d more than 500 square metres of diverse indigenous shrubland, where 'diverse' means three or more shrub species and includes at least one of the following species:
 - *Sophora prostrata*
 - Porcupine scrub (*Melicytus alpinus*)
 - Turpentine scrub (*Dracophyllum longifolium*, *Dracophyllum uniflorum*)
 - Tauhinu (*Ozothamnus leptophyllus*)
 - *Coprosma* sp.
 - *Hebe* sp.
 - *Carmichaelia* sp.
 - *Olearia* sp.
 - Mountain wineberry (*Aristotelia fruticosa*)
 - *Corokia cotoneaster*
3. On any site there shall be no clearance of:
 - a any indigenous coastal duneland, saltmarsh or herbfield vegetation; or:

- b any coastal shrubland containing *Hebe elliptica*, *Carmichaelia* sp. or *Coprosma* sp.; or
 - c any indigenous inland saline vegetation; or:
 - d any indigenous vegetation associated with limestone outcrops; or:
 - e any indigenous shrubland containing:
 - Bog Pine (*Halocarpus bidwillii*)
 - Celery Pine (*Phyllocladus alpinus*)
 - Hall's totara (*Podocarpus hallii*)
 - Mountain totara (*Podocarpus nivalis*); or:
 - any individual specimen of the above over one metre in height; or
 - any indigenous turf communities associated with tarns, glacial moraines or river margins.
4. There shall be no exotic tree planting into an area of indigenous bush, shrubland or tall tussock grassland (*Chionochloa* sp.) that exceeds the thresholds contained in 4.4.8 (1)-(3).

Definitions

- 1 For the purposes of Rule 4.4.8, shrubland is characterised by:
 - a A generally closed canopy (although there will be open patches within the shrubland); and
 - b A difficulty avoiding either standing on, or touching, the shrubs when walking through the majority of the area.
 - c An area that does not include scattered individual outlier plants.
- 2 For the purposes of Rule 4.4.8, tall tussock grassland is characterised by a density of tussock plants in which it would be difficult to avoid either standing on or touching the tussocks when walking through the majority of the area.
- 3 For the purposes of Rule 4.4.8, improved pasture means an area of pasture where species composition and growth has clearly been modified and enhanced for livestock grazing by cultivation with or without associated burning, or by topdressing and over-sowing with or without associated burning, or by direct drilling, and where exotic improved pasture species dominate (i.e. where either the coverage of indigenous species or the number of species present, as estimated on a per hectare basis, does not exceed 30%). Improved pasture includes species such as ryegrass and clovers but excludes sweet vernal and browntop.

Exemption to Rules 4.4.7 and 4.4.8

Rules 4.4.7 and 4.4.8 shall not apply to activities that are provided for under any one of the following mechanisms:

- a Section 76 Reserves Act 1977 Declaration
- b Section 77 Reserves Act 1977 Resources Covenant
- c Section 27 Conservation Act 1987 Management Agreement
- d Queen Elizabeth II National Trust Act 1977

Provided that such above mechanisms:

- a Protect the nature conservation values of an area that is subject to the rules
- b Remain current for the duration of the activity
- c Have not been breached
- d Have been lodged with the Council.

Definition of Indigenous Vegetation is given in the Plan as:

INDIGENOUS VEGETATION

Means a plant community in which species indigenous to that part of New Zealand are important in terms of coverage, structure and/or species diversity. For these purposes, coverage by indigenous species or number of indigenous species shall exceed 30% of the total area or total number of species present, where structural dominance is not attained. Where structural dominance occurs (that is indigenous species are in the tallest stratum and are visually conspicuous) coverage by indigenous species shall exceed 20% of the total area.

Significance criteria

Section 16.9.3.3 of the operative Waitaki District Plan (2010) ("the District Plan") includes the following criteria to be used in order to identify areas with significant indigenous vegetation or significant habitats of indigenous fauna:

i Representativeness

The area supports an example of a particular vegetation type, habitat or ecological process that is typical of the ecological district relative to the pre-European baseline and contributes to maintaining the appropriate proportional representation of that feature;

ii Rarity and Distinctiveness

The area supports an indigenous species, habitat or community, which is rare and vulnerable within the ecological district or threatened nationally; or the area contains unusual features such as:

- Playing an important role in the life-cycle of protected or threatened indigenous fauna.
- The presence of species at their distribution limit.
- Containing an intact a sequence, or a substantial part of an intact sequence, of unusual ecological features or gradients.

iii Diversity and pattern

The area exhibits a high degree of biological diversity in terms of:

- Species (vegetation and fauna)
- Habitat types (i.e. "Seral" or "Climax" types)
- Ecological processes;

iv Ecological Context, Size and Shape

The area:

- Maintains connectivity between other significant areas or maintains the opportunity for better connectivity between existing significant sites.
- Provides a buffer for areas that are of significant value.
- Is of sufficient size to be viable and edge effects are not an important limitation.
- Important feeding/breeding areas for indigenous fauna.

The District Plan also seeks to recognise that indigenous communities other than areas with significant indigenous vegetation or significant habitats of indigenous fauna, may have nature conservation values by maintaining connectivity between other indigenous vegetation and/or providing important habitat for species reliant on a patchwork of indigenous vegetation (e.g. birds, lizards).

a. Canterbury Regional Policy Statement

Chapter 9

Ecosystems and Indigenous Biodiversity

Policy 9.3.1 – Protecting significant natural areas

- 1) Significance, with respect to ecosystems and indigenous biodiversity, will be determined by assessing areas and habitats against the following matters:
 - a Representativeness
 - b Rarity or distinctive features
 - c Diversity and pattern
 - d Ecological context

The assessment of each matter will be made using the criteria listed in Appendix 3.

- 2) Areas or habitats are considered to be significant if they meet one or more of the criteria in Appendix 3.
- 3) Areas identified as significant will be protected to ensure no net loss of indigenous biodiversity or indigenous biodiversity values as a result of land use activities.

Policy 9.3.6 – Limitations on the use of biodiversity offsets

The following criteria will apply to the use of biodiversity offsets:

- 1 the offset will only compensate for residual adverse effects that cannot otherwise be avoided, remedied or mitigated;
- 2 the residual adverse effects on biodiversity are capable of being offset and will be fully compensated by the offset to ensure no net loss of biodiversity;
- 3 where the area to be offset is identified as a national priority for protection under Policy 9.3.2, the offset must deliver a net gain for biodiversity;
- 4 there is a strong likelihood that the offsets will be achieved in perpetuity; and
- 5 where the offset involves the ongoing protection of a separate site, it will deliver no net loss, and preferably a net gain for indigenous biodiversity conservation.

Offsets should re-establish or protect the same type of ecosystem or habitat that is adversely affected, unless an alternative ecosystem or habitat will provide a net gain for indigenous biodiversity.

APPENDIX 3

CRITERIA FOR DETERMINING SIGNIFICANT INDIGENOUS VEGETATION AND SIGNIFICANT HABITAT OF INDIGENOUS BIODIVERSITY

Representativeness

- 1 Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.
- 2 Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.

Rarity/Distinctiveness

- 3 Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.
- 4 Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.
- 5 The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.
- 6 Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.

Diversity and Pattern

- 7 Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.

Ecological Context

- 8 Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.
- 9 A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.
- 10 Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.

