Ecological Assessment and Recommendations for Enhancement

Shotover Country, Stalker Road, Queenstown

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Contract Report: NS 87/07

Prepared for:
Ladies Mile Partnership
Queenstown

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1 Background

1.1 Introduction

Clark Fortune McDonald and Associates (CFMA) are currently undertaking planning works associated with the Ladies Mile Partnership (LMP) proposed development on Stalker Road, Queenstown. To understand the ecological values of the development site and opportunities for ecological protection and enhancement CFMA commissioned Natural Solutions for Nature Limited (NSN) to undertake an ecological assessment of the property. NSN understands the ecological report will be utilised to assist the formulation of a private plan change for the property and to inform landscape design treatments in areas of open space.

This report documents the findings of the ecological assessment and is based on both a desktop review and results of ecological survey work. The report forms the basis for recommendations which will assist in the protection and potentially enhancement of ecological values documented in this report.

1.2 Scope of Work

The scope of work undertaken during the ecological assessment includes:

- A desk top study to review the existing environment and provide an understanding of the pre-settlement ecology;
- An ecological survey to describe the vegetation of the site in addition to recording fauna encountered and fauna habitat;
- Identify areas of ecological significance and provide recommendations for their maintenance, protection and enhancement.

Preparation of an ecological values report suitable for submission with a section 32 report and associated plan change application.

1.3 Site Location

The LMP property is located on a sequence of river terraces adjacent to the east bank of the Shotover River (Figure 1). The overall aspect of the site is toward the west and ranges in elevation from 320 to 360 metres above sea level (m asl).

2 Methods

The ecological values assessment was undertaken in three stages including field preparation, fieldwork and the assessment of data collected in the field.

2.1 Field Preparation

The preparation for the fieldwork included:

- Aerial photograph interpretation to assess the landforms and likely vegetation communities; and

- Review of existing ecological information and reports to familiarise field personnel with the expected vegetation and habitats on the property.

2.2 Field Work

The ecological survey programme was undertaken by Natural Solutions for Nature consultant ecologists Dawn Palmer, Lucy Hardy and Glenn Davis in December 2007, January 2008 and again in January and February 2010. The survey programme is described below.

2.2.1 Wetland Survey

A site walkover through the wetland was undertaken on the 12th of December 2007. During the survey a description of the wetland vegetation was made and avifauna sightings were recorded.

Bird recordings for crake (*Porzana* spp.) were played adjacent to the wetland prior to the walkover to encourage a response from these species (if present) to assist identification.

Avifauna surveys of the wetland were also conducted on the 9th of January 2008 and 13th of January 2008.

The results of the wetland survey are supplemented with information from an unpublished restoration plan prepared for the Stalker Wetland by Wildlands Consultants in 2003.

2.2.2 Vegetation Survey

A vegetation survey was undertaken on the 20 December 2007 with a follow up visit on 28 January and 1 February 2010. The survey targeted areas of the property that were likely to contain ecological values. A review of aerial

photography and a walk over the site confirmed the flat terraces of the property had been cultivated and are generally of low ecological value. Therefore the survey targeted the shrublands on terrace escarpments.

All terrace escarpments were traversed during the initial survey with T3 and T5 (to use the numbering system of the Geoconsulting Ltd report) visited in 2010. During the vegetation surveys a total of 26 locations were selected for the collection of detailed ecological information including the recording of GPS coordinates, vegetation community type, species lists and landform information. GPS coordinates were also collected for sites of specific importance including rare flora and weed infestations.

Where plant species could not be positively identified in the field, specimens were collected and identified with the use of botanical reference books offsite.

Although opportunistic fauna observations were made during the wetland and vegetation surveys, site specific bird counts, skink and lizard trapping and invertebrate sampling was not undertaken. Fauna values have been inferred based on habitats encountered and a review of literature.

2.3 Post Field Work

The plants identified during the survey were checked against the list of threatened and uncommon plants listed by de Lange *et al.* (2004).

Based on the vegetation communities described during the survey and aerial photographic interpretation, a vegetation map of the site was prepared.

An assessment of the ecological significance of the vegetation communities and habitats identified was conducted by undertaking the following steps:

- Establishing the representativeness of the identified vegetation communities through a review of expected pre-disturbance vegetation.

- Review species composition within the identified vegetation communities to assess degree of naturalness.

- Identification of the Land Environment of New Zealand (LENZ) Level IV units.

- Identification of the Landcare Research New Zealand threat category for LENZ Level IV units of the site.

- Based on the ecological values identified, maintenance, enhancement and protection measures were evaluated.

3 Values

The following section provides a description of the abiotic and biotic values of the site and is based on literature review and site survey recordings.

3.1 Geology – Landform – Soil

The property lies immediately to the east of the Shotover River delta and consists of a series of river terraces and terrace escarpments that were formed by periods of aggradation and incision of the Shotover River.

The river terraces consist of quaternary (recent <10,000 years before present) gravels and sand up to 50 metres thick which overlies the regional Haast schist bedrock (Turnbull, 2000).

A wetland (back swamp) has developed upstream of a rouche moutonee (located just outside the plan change area) at the historic confluence of the Shotover and Kawarau Rivers.

Abandoned channels and river braids formed when lake and river levels were higher are still visible on the terrace identified as T5 in the report by Geoconsulting Ltd by a series of undulations. The braided lower Shotover has meandered and incised itself deeper into the Delta to the west of the proposed plan change area.

The terrace labels described in the Geoconsulting Ltd report will be used throughout this report to identify the terraces within the proposed plan change area.

Three soil types have been mapped on the property (Grow Otago website) and include:

- Paerau, Deep Silt Loam of moderate fertility – located in the Stalker Wetland.

- Shotover Deep sandy loam low to moderate fertility – located on the terrace platforms.

- Kilmarnock, Shallow sandy loam, steep (terraces) – located on terrace escarpments.

For a more detailed description of soils on the property, refer to the geotechnical assessment report prepared by Geoconsulting Limited.

3.2 Climate

The climate of the site is typical of the Wakatipu Basin with hot summers, cold winters and a dry climate. The climate of the site can be summarised by the following climate variables obtained from the Grow Otago website:

- Temperature – varies between 5.5^{o}C in winter to 15.5^{o}C and has approximately 25 days per year in excess of 25^{o}C.
- Frost free period – approximately 190 days
- Rainfall – annual mean rainfall is between 701 and 750mm and is spread consistently through the year.
- Evapotranspiration – rates range between 85mm in March/April to 225mm in November/December. Evapotranspiration exceeds rainfall during summer leading to significant soil moisture deficits, particularly on north facing slopes.

3.3 Land Environments of New Zealand

Land Environments of New Zealand (LENZ) is a national environment-based classification of ecosystems mapped across the New Zealand landscape. LENZ units are mapped on the basis of 15 climate, landform and soil parameters that were selected for their roles in driving geographic variation in biological diversity (Leathwick *et. al*., 2003).

Figure 2 presents LENZ mapping over the property with four LENZ units identified. Table 1 below presents a summary of the environmental variables characteristic of each unit.

Because LENZ units are derived from parameters that "drive geographic variation in biological diversity" the LENZ units can be used as a surrogate for the potential full range of terrestrial ecosystems and their associated biodiversity (Walker *et. al*., 2006). LENZ is utilised in section 4 to discuss the significance of vegetation recorded during the vegetation survey.

3.4 Vegetation

The vegetation covering the property (Figure 3) consists of grey shrubland, wetlands and highly modified grassland. Landform (terraces and terrace escarpments) is a key factor in the distribution of vegetation, and vegetation communities are discussed below in this context.

Attachment A presents information recorded during the vegetation survey and includes GPS coordinates, landform, aspect and a description of vegetation.

Table 1: LENZ Unit Environmental Parameters

	LENZ Units			
Parameter	K3.3a	K3.3b[1]	N5.1c	N7.1b
Elevation	365 m	365m	415m	410m
Location	Central Otago	Central Otago	Ranfurly, Wanaka and around the Shotover River and Queenstown surrounds	Central Otago
Climate	Mild temperatures, high solar radiation, moderate annual water deficits	Mild temperatures but cooler than K3.3a, high solar radiation, moderate annual water deficits	Mild temps, moderate solar radiation, high vapour pressure deficits, high annual water deficits	Cool temps, moderate solar radiation, high vapour pressure deficits, high annual water deficits
Landform	Gently undulating floodplains	Easy rolling floodplains	Very gently undulating plains	Flat Plains
Soils	Recent imperfectly drained soils of moderate fertility from schist alluvium and colluviums	Recent imperfectly drained soils of moderate fertility from schist alluvium and colluvium	Imperfectly drained soils of moderate fertility	Recent poorly drained soils of moderate fertility from fine schist and greywacke alluvium

Source: Leathwick *et al.* (2002) Land Environments of New Zealand – Technical Guide

3.4.1 Terrace Platforms

The vegetation on the terrace platforms of the property consists of introduced pasture grasses and wetland communities.

Wetlands

The Stalker Wetland shown in Plate 1 is approximately 20 hectares in area and is located on the lowest alluvial terrace identified in the Geoconsulting Ltd report as T6, at the southern boundary of the plan change area adjacent to the Shotover River. The wetland has been subject to modification with the installation of drains and the creation of ponds in the north-east area of the wetland (see Figure 4).

The vegetation in the wetland is distributed according to patterns of soil drainage and/ or moisture (directly related to gentle topographical undulations). Vegetation communities can be categorised by their association with standing water, permanently saturated and seasonally saturated areas . The wetland vegetation communities are described under these categories.

Standing Water

Aquatic vegetation recorded in the ponds and open drains of the site include the sharp spike sedge (*Eleocharis acuta*), jointed rush (*Juncus articulatus*),

duckweed (*Lemna minor*), pondweed (*Potamogeton cheesemanii*), water buttercup (*Ranunculus trichophyllus*), watercress (*Rorippa nasturcium-aquaticum*), starwort (*Callitriche stagnalis*). This association is also found within some test pits within the adjacent terrace (T5).

Permanently Saturated Wetland – Raupo Reedland – Purei sedgeland

The permanently saturated area of the wetland is located toward the north and north-east margins of the wetland. Vegetation communities within the permanently saturated wetland zone are dominated by Raupo (*Typha orientalis*) reedland-purei (*Carex secta)* sedgeland the later being prominent in shallower water.

Seasonally Saturated Wetland – Carex Sedgeland - rushland

The largest area of the wetland is seasonally saturated and consists of all the areas to the west of the drain along the eastern boundary of the wetland. The vegetation at the margins of the ponds and permanently saturated zones merge into the communities described below.

The vegetation of the seasonally saturated wetland consists of the mosaic of sedgeland, rushland and willows and is described below:

- *Rautahi Sedgeland* – The bright green swards of the native *Carex gaudichaudiana* are common throughout the sedgeland. This community also includes numerous introduced pasture grass species including creeping bent (*Agrostis stolonifera*), white clover (*Trifolium repens*), lotus (*Lotus pedunculatus*) where conditions are comparatively drier. Jointed Rush (*Juncus articulatus)* rush is abundant to the north of the wetland

- *Soft Rush Rushland – Carex sedgeland* - The soft rush (*Juncus effusus*) is a dominant species within this community however rautahi, *Purei (Carex secta)* and *Carex geminata* are also important components. Jointed rush and introduced pasture grass species are abundant throughout. Importantly, the rushland-sedgeland is infested with saplings and shoots of crack willow (*Salix fragilis*) which are only being suppressed by browsing cattle. Other problem plants of note in this area include grey willow (*Salix cinerea*), buddleia (*Buddleja davidii*), and tree lupin (*Lupinus arboreus*).

Abandoned River channels/ damp pasture – Carex Sedgeland

Carex Sedgeland – Found north of the wetland in undulations left by historic (abandoned) river channels on the terrace referred to as T5 in the Geoconsulting Ltd report. This sedgeland community is dominated by *Carex coriacea* and *Carex buchananii* (Plate 2) but also contains exotic buttercups, (*Ranunculus* spp.) and is seriously infested by California thistle and pasture grasses such as brown top (*Agrostis capillaris)*, white clover and sweet vernal(*Anthoxanthum odoratum).*

Plate 1: Wetland shown within the white line. The wetland extends further to the south, or left of the photo.

Plate 2: A thistle infested Carex sedgeland in an abandoned river channel on the lower terrace (T5), north of the main wetland.

Introduced Pasture Grassland

The terraces platforms that are the dominant landforms across the property have been cultivated for pastoral farming activities. The vegetation covering the terraces is dominated by introduced grasses and herbs including sweet vernal, browntop, Vulpia hairgrass (*Vulpia bromoides*), barley grass (*Hordeum*

murinum), harefoot trefoil (*Trifolium arvense),* ryegrass (*Lolium perenne*) and sheep sorrel (*Rumex acetosella*).

3.4.2 Terrace Escarpments

The vegetation of the terrace escarpments consists of grey shrubland and introduced grasses.

The terrace margins are defined by well established, mature shelterbelts primarily comprised of *Pinus radiata* and Douglas fir *Pseudotsuga menziesii* along with small clusters of 'Lombardy' poplar and an unidentified spruce or fir species.

More recently planted shelterbelts comprising cedar and poplar are establishing on the north eastern most terrace (T1).

Grey Shrubland

Grey shrubland is a dominant vegetation community covering terrace escarpments on the site (Plate 3). The grey shrubland community is dominated by the indigenous matagouri (*Discaria toumatou*) and introduced broom (*Cytisus scoparius*), gorse (*Ulex scoparius*) and sweet briar (*Rosa rubiginosa*). Also present in the grey shrubland are small populations of (<20 plants) *Carmichaelia petriei* and *Olearia odorata,* both characteristic native species of grey shrubland communities.

Although matagouri is the dominant grey shrubland species, gorse and broom have totally infested some areas of the terrace escarpments and have become locally dominant.

The understorey of the grey shrubland is dominated by a range of introduced pasture grass species including browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*), cocksfoot (*Dactylis glomerata*), crested dogstail (*Cyanosurus cristatus*), ryegrass (*Lolium perenne*), barley grass (*Hordeum murinum*), meadow grass (*Poa pratensis*), vulpia hairgrass (Vulpia bromoides), timothy (*Phleum pratense*), and ripgut brome (B*romus diandrus*).

Plate 3: Grey Shrubland on Terrace Escarpment

Introduced Grassland

Introduced grassland swards are dominant particularly on the north facing terrace escarpment on the south-eastern boundary of the property (Plate 4). This area is dominated by the introduced grasses *Bromus* spp*.,* sweet vernal, browntop, and cocksfoot and herbaceous plants woolly mullein *Verbascum thapsus*) and thistles (*Cirsium* spp.).

Although dominated by introduced species this area does contain a small population (<20 plants) of the native porcupine shrub (*Melicytus alpinus*) and blue tussock (*Poa colensoi*) at the top of the escarpment (see Plot 14 in Attachment A for precise location).

Plate 4: Introduced Grassland on terrace escarpment with scattered porcupine shrub

3.5 Fauna

3.5.1 Avifauna

Native bird species seen or heard during the survey were limited to the following:

- Australasian Harrier (*Circus approximans*) hunting over grassland near willows
- Two pukeko (*Porphyrio porphyrio*) in a dense purei stand adjacent to the wetland ponds
- One dead pukeko adjacent to the wetland ponds
- Black back gull flying overhead
- Paradise shelduck (*Tadorna variegata*) on the lower terraces (T5) in the grassland near the test pits

A more diverse and abundant avifauna was anticipated and we consider that, based on the habitats identified, other native and naturalised species that may inhabit and or visit the site include spur-wing plover (*Vanellus miles*), New Zealand pipit (*Anthus novaeseelandieae*), silvereyes (*Zosterops lateralis*), black fronted terns (*Sterna albostriata*), New Zealand eastern falcon (*Falco novaeseelandiae*), white faced herons (*Ardea novaehollandiae*), Australasian bittern (*Botaurus poiciloptus*), crake (*Porzana* sp.) and the waterfowl New Zealand scaup (*Aythya novaeseelandiae*), New Zealand shoveler (*Anus*

rhyncotis) and grey duck (*Anus superciliosa*). All of these species, with the exception of crake and bittern, are known to inhabitat (at least seasonally) the adjacent lower Shotover River and ponds of the surrounding Wakatipu Basin. Crake and bittern have been recently recorded at Lake Hayes, only 3km to the north-east of the site and could be expected at this site given the size of the sedgeland

Introduced bird species seen during the survey included the following:

- Skylark (*Alauda arvensis*) overhead
- Californian quail (*Callipepla california*) heard in willows on riverbank
- Goldfinch (*Carduelis carduelis*)
- Redpoll (*Carduelis flammea*)
- Greenfinch (*Carduelis chloris*) sighted in willows adjacent to the wetland ponds
- Chaffinch (*Fringilla coelebs*)
- Blackbird (*Turdus merula*) sighted in willows adjacent to the wetland ponds

Other species likely to inhabit the site include mallard (*Anas platyrhynchos*), yellowhammer (*Emberiza citronella*), redpoll (*Carduelis flammea*) and house sparrow (*Passer domesticus*).

3.5.2 Lizards/ Amphibians

Lizards

No lizards were seen during the site survey.

The McCanns skink (*Oligosoma maccanni*) and common skink (*Oligosoma nigriplantare polychroma*) are the most likely lizard species present on the property. Both species are abundant throughout the Department of Conservation (DOC) Otago Conservancy and are not listed as a conservation priority by the DOC (Whitaker *et. al.* 2002).

The McCanns skink only occurs in open habitats and is especially abundant in montane grasslands. McCanns skink is likely to be found in roadside verges and in rank grass on terrace escarpments.

The common skink is found throughout Central Otago although is less common than the McCanns skink. The common skink favours areas of dense grassland and moist sites (Jewel, 2006) and if present is likely to occupy areas of long grass near wet pasture, seasonally saturated areas of the wetland and dense grassland where it persists. It is noted that the common skink will also readily adapt to urban environments (Whitaker *et. al.* 2002).

Although three geckos in the *Hoplodactylus maculatus* complex are known within the Wakatipu area they prefer rocky habitats that do not occur on the property.

Frogs
No frogs or tadpoles were seen during the wetland survey.

No native frogs are known from the Wakatipu Basin; however, the introduced bell frogs (*Litoria raniformis* and *Litoria aurea*) and whistling frog (*Litoria ewingi*) are found in the Wakatipu Basin and ponds within the surrounding mountain areas.

3.5.3 Invertebrates

Central Otago contains a highly diverse invertebrate community. Patrick (1994) listed 384 species of moth alone in a report on the valley floor Lepidoptera. Whilst the Patrick study area did not extend into the Wakatipu Basin, a number of LENZ environments are consistent with the Central Otago area and as such a similar invertebrate fauna is expected.

Patrick (1994) identifies a range of plant species that are known to host moth species. Plant species identified on the property that are important moth host species include:

- Grey Shrubland Species – *Olearia odorata, Carmichaelia petriei,* matagouri and porcupine shrub
- Wetland species – *Carex secta* and raupo.

Given the restricted distribution of the above species in the Wakatipu Basin, populations on the property are expected to provide important habitat for invertebrates in the district.

3.5.4 Freshwater Fish

The open water on the property is confined to the ponds and main drain in the wetland and is connected to the Kawarau River via the main drain.

Freshwater fish that may inhabit the drain and ponds include the long finned eel (*Anguilla dieffenbachia*), koaro (*Galaxias brevipinnis*) and juvenile brown trout (*Oncorhynchus trutta*).

4 Significance

The ecological significance of existing vegetation communities and fauna habitat can be assessed through a comparison with the following variables:

- Rarity and distinctiveness - i.e. Is the vegetation community rare or distinct and/or does the site contain threatened flora and fauna?
- Representativeness - i.e. are existing vegetation communities representative of pre-settlement communities?
- Ecological context - i.e. does the existing vegetation/ faunal habitat assist with connectivity between other patches on the property or district, or, does the site provide a buffer for adjacent communities

The ecological values discussed in section 3 are compared against the above criteria to provide an assessment of ecological significance. In this report, existing vegetation communities and faunal habitats are considered significant if they retain any one of the above attributes.

4.1 Historical Vegetation and Communities

The vegetation of the property has been subject to a long history of disturbance (fire, pastoral activities, plant and animal pest infestation) resulting in a significant change to the pre-settlement vegetation communities.

The following presents a description of historical vegetation based on ecological literature and the author's understanding of the vegetation of the Wakatipu.

4.1.1 Terrace Platforms

Leathwick *et. al.*, (2003) indicates the historical vegetation on the terraces of the site is likely to have consisted of the following:

- LENZ Unit K3.3 - Fescue tussock grassland with speargrass (*Aciphylla aurea* or *Aciphylla subflabellata*), groves of matagouri on stony land and shallow Carex swamps.
- LENZ Unit N5.1c - Supported continuous areas of grassland with some areas of kanuka.
- LENZ Unit N7.1b - Large swamps with dominant species according to drainage - silver tussock on rises, red tussock on damp ground, *Carex sinclarii* and *Carex coriacea* in wet hollows and *Carex secta* in deeper water.

Lucas Associates (1995) indicates that native vegetation on terraces would also have consisted of a mosaic of woodlands and tussock grassland

communities including kowhai (*Sophora microphylla*)/ matagouri/ *Olearia lineata* woodlands with *Myrsine divaricata*, Corokia (*Corokia cotoneaster*), native broom (*Carmichaelia* spp.), *Coprosma* spp., *Cyathodes juniperina*, and short and tall tussock grassland communities.

Lucas Associates (1995) also indicates early vegetation of the backswamp associated with the lower terrace would have and still does consist of sedges, reeds, red tussock and raupo. Wetland composition would have as it does today, varied depending on the depth of the water table, saturation of soils and soil types.

Based on the author's local wetland knowledge, the wetland in its current condition on the lowest terrace (T6) retains diversity that sustains it as a representative example of the range of historical communities likely to have been present at the time of early settlement. The size of the wetland contributes to this finding. The wetland communities that formerly occupied the lower terrace – T5 has been substantially cleared following European settlement and about 150 years of farming with the exception of pockets containing *Eleocharis acuta* and *Juncus* species in the wettest areas and *Carex coriacea, Carex buchananii*, on rising, drier ground.

4.1.2 Terrace Escarpments

The LENZ mapping groups the terrace escarpments with LENZ units K3.3 and N5.1c (see above). The K3.3 environments are present on the flat which runs along the toe of the escarpment between T5 and T3 and extending along the north-western boundary of the plan change area. An area of K3.3 is also present outside the plan change area south-east of the wetland on T6 where the land rises towards the schist outcrop.

Due to the scale of LENZ mapping (>25 square metre pixels), the terrace escarpments have not been mapped. The steep terrace escarpments would be consistent with a LENZ unit mapped adjacent to the property N4.1d. This LENZ unit is characterised by having a climate similar to N5.1c but lies on steep hills of lower hill slopes and in well drained soils derived from schist. Historical vegetation associated with LENZ unit N4.1d includes woodland of kanuka (*Kunzea ericoides*), matagouri, small leaved coprosmas and olearias, native brooms and kowhai with abundant lianes including *Rubus* and *Muehlenbeckia* spp. Finer textured soils supported grassland of silver tussock and *Elymus* spp. (Leathwick *et. al*., 2003).

Lucas Associates (1995) description of the remnant and potential vegetation of the terrace escarpments is consistent with the above and includes Kowhai/ matagouri/ *Olearia lineata* woodlands with *Myrsine divaricata*, Corokia (*Corokia cotoneaster*), *Coprosma* spp, and prickly mingimingi (*Cyathodes juniperina*).

Similar habitats on terrace escarpments near the site and adjacent to the Kawarau River contain matagouri, *Coprosma* spp. *Carmichaelia petriei*, and at

least two species of *Olearia*. Cabbage trees (*Cordyline australis*) are found on moist free draining sites on the northern flanks of Queenstown Hill and lakeside environments, it is likely that they formed a component of the historical vegetation at the LMP site.

It is additionally noted that there is some inconsistency in the literature regarding the historical presence of kanuka in the area. Both Leathwick *et. al.* (2003) and Lucas *et. al.* (1995) list kanuka to be present on the terraces and terrace escarpments, however, Burrell (1965) states that kanuka was not present in the catchment of the Kawarau River. Burrell states that the absence of kanuka is surprising and suggests that this discontinuity is most likely explained by "accidents of survival and dispersal". The conclusion by Burrell is supported by Wardle (2001) who also noted that "kanuka does not extent south of Hokitika in the west nor west of the Clutha Valley in the south". This ecological report adopts the view of Burrell (1965) and Wardle (2001) that kanuka is unlikely to have been a floristic component of pre-settlement vegetation on the site.

The diversity of the grey shrubland currently present is very low by comparison to the likely historical diversity of the site.

4.2 Significance of Present Values

4.2.1 Threat Status

Attachment B presents a full list of plants identified on the site during surveys undertaken by NSN and Wildlands Consulting. A total of 71 plant species were identified during the surveys, 21 of which are native species.

To assess the conservation needs of particular New Zealand plants a threat classification system was developed by Townsend, *et.al.* (2008). The system was utilised by de Lange *et. al.* (2009) to prepare a list of New Zealand's threatened and uncommon plants. Of the 21 native species identified during the field surveys only one, *Olearia lineata,* is listed as being at risk (see Table 2) .

Table 2: Threatened Species Identified

Species	Threat Category	Threat Division	Location	Vegetation Community
Olearia lineata	At Risk	Declining	Wetland (identified by Wildlands Consultants)[1]	Wetland

Olearia lineata identified by Wildlands Consultants in 2003 consisted of two living shrubs adjacent to the willow stands on the southern margin of the property. NSN checked to confirm the presence of the *Olearia lineata* but these plants could either not be located or may have been lost since the 2003 report by Wildlands Consultants. A population of *O lineata* was however

located east of and outside the plan change area, downstream on an escarpment on the true left of the Kawarau River.

4.2.2 Vegetation Communities

To assess the significance of vegetation communities present an assessment of representativeness is required. This can be undertaken by utilising the LENZ Level IV threat classification database compiled by Landcare Research. The database was developed by reviewing the percentage of vegetation remaining within each LENZ unit and overlaying legally protected areas (DOC reserves and QEII covenants) to assess the existing level of protection. Based on these criteria six national scale threat categories have been established and include:

- Acutely threatened - <10% indigenous vegetation cover remaining
- Chronically threatened – 10-20% indigenous vegetation cover remaining
- At risk – 20-30% indigenous vegetation cover remaining
- Critically under-protected - >30% indigenous vegetation cover remaining and less than 10% protected
- Under-protected >30% indigenous vegetation cover remaining and 10-20% protected
- No threat - >30% indigenous vegetation cover remaining and >20% protected

Figure 2 shows the LENZ Level IV environments mapped within the property. The LENZ environments are listed in Table 3 below together with historical vegetation communities, percentage indigenous vegetation cover remaining (estimated at the national scale) and threat category. The summary provided by Table 3 illustrates that the site consists of three acutely threatened environments (K3.3a, K3.3b and N5.1c) and two chronically threatened environments (N7.1b and N4.1d). It is important to note that whilst these units are mapped on-site, much of the vegetation representative of these environments has been modified through pastoral activities and are now of low ecological significance.

Table 3: LENZ Level IV Environments and Threat Status

LENZ Unit	% Indigenous Veg Cover Remaining	% Protected	Threat Category	LENZ Historical Vegetation Description
K3.3a	8.35	5.24	Acutely Threatened	Fescue tussock grassland with speargrass (*Aciphylla aurea* or *Aciphylla subflabellata*), groves of matagouri on stony land and shallow Carex swamps.
K3.3b	7.3	4.58	Acutely Threatened	Fescue tussock grassland with speargrass (*Aciphylla aurea* or *Aciphylla subflabellata*), groves of matagouri on stony land and shallow Carex swamps.
N5.1c	2.72	2.23	Acutely Threatened	Supported continuous areas of grassland with some areas of kanuka.
N7.1b	15.61	4.4	Chronically Threatened	Wetland - Large swamps with dominant species according to drainage - silver tussock on rises, red tussock on damp ground, Carex sinclarii and Carex coriacea in wet hollows and Carex secta in deeper water.
N4.1d[1]	18.59	3.04	Chronically Threatened	Woodland of kanuka, matagouri, small leaved coprosmas and olearias, native brooms and kowhai with abundant lianes including Rubus and Muehlenbeckia spp.. Finer textured soils supported grassland of silver tussock and Elymus spp.

Notes: [1]LENZ Unit N4.1d has not been mapped on the property as discussed in section 4.4.2 above

The vegetation communities described on the property that are representative of the above LENZ units are discussed below.

Fescue tussock grassland

The vegetation associated with K environments present along the boundary of the proposed plan change area and toe of the escarpment between terraces T3 and 5, have been lost to the effects of farming. Potential remnants of this community are represented by an occasional matagouri on the toe of the escarpment.

Grey Shrubland

Although the matagouri dominated grey shrubland on the terrace escarpments is depleted of species diversity it does contain specimens of mature *Olearia odorata*, *Carmichaelia petriei and* porcupine shrub indicating that this community has floristic components that are consistent with being remnants representative of LENZ unit L4.1d.

The review of predicted historical vegetation indicates that grey shrublands were an important component of the terrace escarpment vegetation. Grey shrublands have become restricted in range, particularly in the lowlands where farming has been the most intensive and this is reflected in the chronically threatened status of the LENZ environment associated with the grey shrubland community.

Wetland
The wetland described herein on the lowest terrace (T6) and small pockets within T5 has floral components representative of LENZ unit N7.1b. The distribution of representative wetlands has restricted considerably since settlement and is reflected in the chronically threatened status of the LENZ environment.

4.2.3 Summary of Significance

The indigenous vegetation communities described onsite have been subjected to a long history of disturbance predominantly from pastoral activities. This disturbance has affected the naturalness of the vegetation through the loss of indigenous flora and fauna and promoted the establishment of introduced plant species.

Notwithstanding the above, the vegetation present on the lowest terrace (T6) and escarpments is considered representative of pre-settlement communities and provides a good foundation for recovery of local examples of historical vegetation diversity.

The wetlands are ecologically significant based on the following:

- Existing floristic diversity;
- Potential to provide habitat for avifauna and invertebrates; and
- Is representative of the LENZ unit that is listed as chronically threatened i.e. the main wetland (N.7.1.b)

The grey shrublands are ecologically significant based on the following:

- Floral components representative of a range of the pre-settlement vegetation
- Potential to provide habitat for avifauna and invertebrates; and
- Is representative of LENZ unit N4.1d that is listed as chronically threatened

In addition, the juxtaposition of the terrace escarpment shrublands and lower terrace wetlands with the north face of the Remarkables and braided river delta ecosystems provides a good example of the ecological diversity in the area and further supports the significance of the remnant vegetation described herein.

5 Risks and Recommendations to maintain, protect and enhance ecological values

The key ecological values of significance identified on the property include the grey shrublands on terrace escarpments, and the Stalkers wetland on the lowest terrace (T6) These areas require protection and management to ensure ecological values of the site are maintained and are also the areas that will benefit the most from ecological enhancement efforts. The recommendations detailed below are designed to ensure ecological values documented in this report are maintained and enhanced as part of any development of the plan change area.

5.1 Grey Shrubland

5.1.1 Maintenance and Protection

The risks to the grey shrubland community include:

- Infestation with weed species;
- Grazing pressure from stock, rabbits and possums;
- Clearing associated with proposed development activities; and
- Increased fire risk associated with an increase in the human population.

Weeds
In the absence of management to prevent this, weed species are likely to increase in abundance within the shrubland which may inhibit the establishment of regenerating native species NSN recommends the control of gorse, broom, briar, hawthorn and elderberry to assist with the maintenance of the existing shrubland and support natural regeneration.

Exclusion of Stock and Animal Pest Control
Shrubland plants, especially and new planting to reinstate diversity (see below) are susceptible to trampling and grazing from stock and grazing from rabbits and possums. It is recommended that stock is excluded from the shrubland (particularly recently planted areas) and rabbit and possum populations are controlled.

Clearing
Clearing of shrubland may be required to establish road access as part of the proposed residential development. However roads have been proposed within existing gaps therefore clearance of additional vegetation will be minor. It is recommended that areas of native shrubland are not disturbed but where this can not be avoided the impact and mitigation of any proposed clearing activities is assessed by a suitably qualified ecologist prior to the commencement of clearing activities.

Fire
The development of residential properties in the area may increase the risk of inadvertent fire, but this risk would be balanced by an increase in probability of early detection, response and availability of water. The risk is no greater than that experienced to other subdivisions in the Basin surrounded by grassland and remnant shrublands. The risk can be managed through adherence to local by-laws.

5.1.2 Enhancement

Support and enhancement of grey shrublands identified in the Structure Plan as area 5 is recommended. This can be achieved by the control of pest plants (discussed above), and inter-planting within gaps in the existing shrublands to increase diversity (seed sources for natural regeneration) and site cover. Increasing the diversity will also improve the habitat for invertebrates, and birds and enhance these remnants as local examples of grey shrubland within the Wakatipu Basin.

A list of shrubland species suitable for planting and their ecological values is provided in Table 4 below.

Table 4 – Species proposed for reinstatement into Grey Shrubland and ecological benefits

Species	# per cluster	Height at maturity	Spacing (m)	Ecological Benefits
Cluster group A – 15 plants per cluster				
Aristotelia fruticosa	3	2	1.5	Increase diversity, flowers and fruit provide food native birds
Carmichaelia petriei	3	2	1.5	Currently established on site, host plant for native moths
Coprosma propinqua	3	3	2	Increase diversity, host plant of native moths and provides food for lizards and native birds
Coprosma rigida	3	2	1.5	Increase diversity, provide food for lizards and native birds
Olearia odorata	3	4	2	Increase diversity, important host plant for native moths
Cluster group B – 16 plants per cluster				

Coprosma propinqua	3	3	2	Increase diversity, host plant of native moths and provides food for lizards and native birds
Corokia cotoneaster	3	2.5	1.5	Increase diversity, provide food for lizards and native birds
Myrsine divaricata	3	3	1.5	Increase diversity
Olearia avicenniaefolia	3	4	2	Increase diversity, invertebrates
Plagianthus regius	3	15	3	Increase diversity
Sophora microphylla	1	8	3	Increase diversity, important food for invertebrates and birds
Cluster group C – 15 plants per cluster				
Melicytus alpinus	3	1	1.5	Increase diversity, food source for lizards
Carmichaelia petriei	3	2	1.5	Currently established on site, host plant for native moths
Olearia odorata	3	3	2	Increase diversity, important host plant for native moths
Olearia lineata	3	4	2	Increase diversity, host plant for native moths
Ozothamnus vauvilliersii	3	2	1.5	Increase diversity, invertebrates

Notes: The above species list is subject to availability

5.2 Wetland

5.2.1 Maintenance and Protection

The risks that the wetland requires protection from include:

- Infestation with weed species;
- Grazing from stock and possums;
- Predators including stoats, ferrets and cats;
- Changes to the hydrological regime i.e. groundwater levels; and

- Effects on water quality resulting from discharges from development activities;
- Physical works associated with stormwater attenuation works.

Weeds
The wetland contains a number of invasive weed species including crack willow, grey willow, buddleia, tree lupin, gorse and Californian thistle.

Both willow species are of particular concern and have the ability to suppress and displace indigenous diversity. Control of willow is critical to the maintenance and protection of the existing wetland. The removal of buddleia and control of tree lupin, gorse and Californian thistle will also improve the naturalness of the wetland but the threat posed by these species is not as great as that associated with the willows.

Exclusion of Stock and Animal Pest Control
Wetland plants are susceptible to trampling and grazing from stock and grazing from possums (where enhancement planting occurs). It is recommended that stock is excluded from the wetland and possum populations controlled. Removal of stock and control of animal pests will be particularly important following the commencement of an enhancement program (see below).

Cats, ferrets and stoats should also be controlled to protect avifauna utilising the wetland. Dogs should not present a problem if applicable legislation and by-laws are adhered to. It is anticipated that populations of ferrets and stoats are likely to decrease as a result of the proposed development.

Hydrological Regime
Changes to the hydrological regime through draining or damning the wetland or groundwater abstraction up gradient of the wetland may affect groundwater levels and therefore soil moisture across the wetland. Hydrological changes may lead to inundation or drying out of areas of the wetland and may lead to the loss of some native communities e.g. a sustained increase in groundwater levels could lead to the loss of sedgeland adjacent to permanently saturated sites. Should development activities require the pumping of groundwater or diversion of water through the wetland, this should occur in a manner that does not adversely impact on the sedgeland.

Conversely, storm water attenuation may periodically increase water levels. Given the proximity of the Shotover and Kawarau Rivers and the drainage characteristics of T5 and T6, this is unlikely to result in an adverse effect as water will either percolate or pass through the wetland environments rapidly.

Water Quality
The change in land use resulting from land development activities can impact water quality through the disposal of stormwater and the input of nutrients for the establishment of public open space and residential gardens.

Although wetlands have the capacity to take up nutrients, measures to avoid pollution should be implemented.

Stormwater attenuation works
The wetland may be required as a receiving environment for stormwater as part of development of the plan change area. Where earth works or physical works associated with the areas of open water or drains are required, the potential for weeds to be introduced and the established sedgeland disturbed exists.

In this event, measures should be taken to ensure machinery working on the site is cleaned prior to site works to reduce the potential for weeds to be carried from another site. Disturbed areas should be reinstated using species from Table 5 below immediately following the completion of infrastructural works.

5.2.2 Enhancement

Enhancement of the wetland can be achieved through the control of pest plants and animal pests (discussed above), and the planting of native species, to provide seed sources to boost diversity around the wetland margins, particularly following weed control in these areas.

Additionally, it is recommended that a 50 metre setback between the wetland and Activity Area 1 within an area identified as Area B of the Riverside Protection Area (refer to the structural landscape plan) be established. Buffer planting a 20 metre strip inside this set back will improve the filtering of any surface runoff from developed areas and improve the cover between areas of elevated human activity and the wetland proper as well as enhancing the transition area to the wetland.

This will benefit wildlife in the areas of open water in the north eastern portion of the wetland by improving riparian cover.

Riparian planting should also replace willows where removed from the northern boundary of the wetland to reduce the potential for sediment to wash into the wetland from the adjacent gravel quarry and haul road to the river.

Wetland species recommended for enhancement planting are listed in Table 5 below.

Table 5: Wetland Species List

Species	Height at maturity (m)	Ecological Benefits
Carex buchananii	0.5	Provide cover for invertebrates
Carex gaudichaudiana	0.15	Maintain existing diversity in wetter areas
Carex secta	1.5	Provide cover for invertebrates and wetland birds (e.g. crakes and bittern)
Carex sinclairii	0.4	Increase and/ sustain diversity
Chionochloa rubra	1.5	Increase diversity and provide cover for invertebrates
Coprosma propinqua	3	Increase diversity, provide food for lizards and native birds
Cordyline australis	6	Increase diversity and provide food for native birds
Cortaderia richardii	2	Increase diversity, provide cover for invertebrates and birds
Hoheria glabrata	10	Increase and support diversity
Juncus edgariae	1	Increase and support diversity
Juncus pallidus	1-2	Increase and support diversity
Myrsine divaricata	3	Increase and support diversity
Olearia hectorii	6	Increase diversity, host plant for native moths – a willow replacement
Olearia lineata	6	Increase diversity, host plant for native moths – plant as a minor component
Olearia odorata	3	Increase diversity, host plant for native moths
Plagianthus regius	8	Reinstate diversity – plant on raised ground
Phormium tenax	2	Increase diversity, food source for native birds
Podocarpus hallii	15	Increase diversity
Sophora microphylla	8	Increase diversity, important host plant for native moths

Notes: The above species list is subject to availability

5.3 Shelterbelts

5.3.1 Management

The established shelterbelts are providing substantial relief to the current farm operations and established residences from south westerly winds.

Under the current land management (grazing and cropping), the key risks posed by the presence of exotic shelter belts are:

- the potential for undesirable spread, of Douglas fir (high risk) and to a lesser extent, *Pinus radiata*, (low risk) within and/ or beyond the site (Ledgard and Langer, 1999),

Potential for spread
The mature shelterbelts appear to have been well contained by the existing grazing and cultivation regimes.

There is however a stand of what appears to be *Pinus radiata* on the true right of the Shotover River about 820 metres south east from one of the mature Radiata shelterbelts. The origin of the infestation across the river is unknown but provides a caution regarding the potential for distant spread from such shelterbelts – a north westerly wind could have deposited seed from the shelterbelts[1].

Cedar and poplar shelterbelts have a negligible risk of spreading.

5.3.2 Recommendations

In order to limit the potential for spread from the mature conifer shelterbelts, NSN recommends their removal and replacement with either a multi-species indigenous shelterbelt and/ or an extension of the cedar/ poplar shelterbelts already established on the upper most terraces.

Removal could occur as a one off exercise or be staged with progressive replacement coinciding with the natural life of the shelterbelt.

Table 4 provides an indicative list of species recommended for planting on the terrace escarpments identified within Activity Area 5 in the structural plan where many of the existing shelterbelts are located. Where development of the plan change area makes shelterbelts redundant, it is recommended that the escarpments be planted as recommended in section 5.1.2 above.

[1] Strong wind events in the late 1980s resulted in several outlier infestations around the District.

6 References

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Attachments

A Vegetation Survey Data
B Plant Species List

FIGURES

ATTACHMENT A – Vegetation Survey Data

ATTACHMENT B – Plant Species List