Toitu te whenua
Land Information
New Zealand

Crown Pastoral Land Tenure Review

Lease name :

ALLANDALE / GREENVALE

Lease number : PS 068 / PS 067

Conservation Resources Report - Part 1

As part of the process of Tenure Review, advice on significant inherent values within the pastoral lease is provided by Department of Conservation officials in the form of a Conservation Resources Report. This report is the result of outdoor survey and inspection. It is a key piece of information for the development of a preliminary consultation document.

Note: Plans which form part of the Conservation Resources Report are published separately.

These documents are all released under the Official information Act 1982.

April 07

DOC CONSERVATION RESOURCES REPORT ON TENURE REVIEW OF GREENVALE AND ALLANDALE PASTORAL LEASES

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PART 1

1.1 INTRODUCTION

The lessee of Allandale and Greenvale pastoral leases has applied to the Commissioner of Crown Lands for a review of tenure. The pastoral leases are run as one farming unit. The lessee also owns another pastoral lease, Halfway Bay, which is adjacent to Allandale. This lease is also undergoing tenure review. Due to its remoteness, it is run as a separate farming unit and will be reported separately on by DOC.

Greenvale and Allandale were inspected in late January and early February 1999. Part of the property, namely the Robert Creek catchment, had been previously assessed for some of its conservation values during the Protected Natural Area Programme survey of the central part of the Eyre Ecological District in 1987.

The PNAP survey identified a very large recommended area for protection (RAP) covering the upper Eyre Creek catchment and the southern slopes of the Eyre Mountains as far eastwards as Robert Creek. A strip of the RAP extends onto the leases to include the eastern portion of the Robert Creek beech forests and associated plant communities.

Allandale pastoral lease is 4544 hectares and Greenvale pastoral lease is 4164 hectares. These medium sized leases are located south of Kingston and north of the Mataura Valley. Allandale is situated in the Otago Conservancy and Greenvale is in the Southland Conservancy of DOC.

The properties form part of the South Eastern Eyre Mountains and drain into the Mataura River.

PART 2

INHERENT VALUES : DESCRIPTION OF CONSERVATION RESOURCES AND ASSESSMENT OF SIGNIFICANCE

2.1 LANDSCAPE

METHODOLOGY

For this assessment Allandale has been divided into three landscape units with the boundaries being defined principally by the changes in physical features, ground cover, and land use. After defining the landscape units (LUs) the following landscape criteria was applied to each unit to help determine each unit's distinctive and high inherent values.

1. CHARACTER DESCRIPTION:
   This section of the assessment explains the overall appearance of the LU using common descriptive terms to help create a "mental picture" of the primary elements which include landform, landcover, and where appropriate, land use.

QUALITY ATTRIBUTES:
The following are the attributes which contribute to the overall quality of each landscape unit:

(a) Intactness: Which is the condition of the natural vegetation and the degree of modifications to natural processes. In a landscape context intactness can be looked upon within a continuum of areas being completely pristine to being heavily modified.

(b) Coherence This is the level of harmony visually evident between natural elements, in other words coherence refers to the way a landscape "hangs together".

(c) Distinctiveness: This is the special elusive quality which makes a particular landscape visually striking, frequently this occurs when contrasting natural elements combine to form a distinctive and memorable visual pattern.

(d) Visibility: Although this is not a quality attribute, it is an important factor to consider for future management decisions to understand what type of audience each landscape is viewed by.

3. VULNERABILITY:
This is a measure of each landscape unit's susceptibility to further ecological deterioration based primarily on the intactness and coherence attributes. In general terms, the less modified a LU is, the more vulnerable to further change as a result of human activities that unit is likely to be.

2.1.1 ALLANDALE

Landscape Unit 1
The unit envelopes all of the steep faces overlooking the southern end of Lake Wakatipu. It extends from Southwest Bay in the north, where the property boundaries on to the Halfway Bay pastoral lease, while to the south the run boundaries on to the Glen Allen Scenic Reserve. Within the pastoral lease there is already an enclave of protected land, the Te Kere Haka Scenic Reserve, which forms the physical backdrop to the township of Kingston. The unit's highest point is the summit of Mount Dick, 1805 m from which point the terrain drops down to 400 m close to the lake's edge.

In a wider context LU1 forms the gateway to the Southern Lakes district. The first glimpse of the lake makes a memorable impression on visitors to the district after having travelled across the Northern Southland Plains.

The landform is dominated by glacial features which include the serrated skyline (the cragginess is not so pronounced as that on Halfway Bay), impressive headwalls, tallus slips and cirques. The largest of these cirques is found just east of Mount Dick and contains a large tarn which forms the source of a major stream that drains directly into the lake. Like many of the other water courses that flow off these steep faces it is entrenched in a narrow gully and contains several waterfalls. The short ridges that extend out from the main north-south axis of the mountains contain a band of rocky bluffs that change to smoother rocky ledges close to the edge of the lake.

ke all of the steep faces overlooking the lake, the vegetation pattern has been greatly affected by previous pastoralism. Human intervention is most conspicuous at a lower level where there is now a distinctive green band of bracken fernland that extends up as far as the rocky bluffs. These bracken fernlands are the primary successional stage back to a woody community. In the darker gullies which have been sheltered from past fires the natural succession is more advanced with pockets of beech starting to spread out over the ridgelines.

The most advanced regeneration is close to the boundary of the Te Kere Haka Scenic Reserve where a diversity of mixed shrublands is well established. The most dominant species include lemonwood, tree fuchsia, mahoe, broadleaf, Coprosma, native broom, and a wide distribution of silver beech seedlings. Close to the margins of the lake there are numerous groves of kowhai and frequent clumps of cabbage trees. the rock formations within the scenic reserve are spectacular with the largest outcrop being locally known as Piano Rock.

Along the lake faces, above the rocky bluffs, the vegetation changes rapidly into tussocklands dominated by fescue tussock which grades into healthy snow tussock above 1000 m. Across the faces there is a scattering of wilding pines that are becoming increasingly noticeable from viewing points, as these individual trees contrast markedly with the finely textured tussocklands.

The human modifications within LU1 are confined to a track that runs parallel with the lake edge. The visual impact of this track has been lessened by the recent growth of surrounding shrublands, and also due to its low elevation. The unit's vulnerability to further change would come from the existing natural regeneration being restricted by fire, and development of subdivisional grazing blocks. The skyline would be highly sensitive to the placement of any communication installations.

From a broad landscape perspective the whole of the lake faces need to be looked at as a total entity with the only difference between the two pastoral leases (Halfway Bay and Allandale) being the various stages of succession of the native vegetation. An integrated approach to the management of the lake faces would allow plant communities to expand and eventually occupy their natural ecological range. Although the Te Kere Haka Scenic Reserve forms an impressive setting to Kingston, in a wider landscape context the existing boundaries of the reserve are inappropriate as they fragment the natural landform and sever the successional processes.

Landscape quality:	Intactness	moderate
	Coherence	moderately high
	Distinctiveness	high
	Visibility	high

In a wider context LU1 forms the physical backdrop to the southern end of Lake Wakatipu and its environs. This unit could be described as containing high scenic values, which are produced by the vivid contrasts between the craggy glaciated landform and the strong horizontal lines of the outwashed moraine, and the lake itself. This unit is not only highly visible from SH 6, which is a part of one of New Zealand's most important tourist routes, but also forms the immediate backdrop for boating, which is a popular local recreational activity.

Landscape Unit 2

This unit incorporates the upper section of the Allen Creek catchment and the western slopes overlooking the Glen Allen Scenic Reserve. It has an altitudinal range from 1800 m close to the southern face of Mount Dick down to 500 m close to the moraine outwash. The physical features that surround the backwalls of Mount Dick are impressive and contain a tarn which is

e origin of Allen Creek. Like the adjoining Robert Creek the relief within this catchment is asymmetrical with the eastern faces being a gentle back slope, while the western faces are characterised by steep rocky outcrops that continue down into the reserve.

The vegetation composition is dominated by montane fescue tussock with snow tussock grading in at a higher altitude, while just below Mount Dick there is a sparsely vegetated fellfield. Within the high altitude zone the vegetation conveys an overall impression of being intact with little sign of the plant communities being manipulated by grazing. In contrast, the lower section of this unit would appear to be relatively modified with the dominant grass now being the introduced browntop. Further down the southern ridge there is an infestation of broom which in some places has started to infest the more open areas of the adjoining forest.

The mixed beech forest occupies the margins of Allen Creek up to above 1020 m and although the main forested areas look ecologically healthy, it would appear that regeneration around the fringes is impeded due to direct stock access, while the hard edge between the grasslands and the beech forest creates a vivid landscape due to the contrasts in colour and texture of the different vegetational types.

This unit's vulnerability to further change would come from more farming intensification of the headwaters of Allen Creek. It would be detrimental to the existing high landscape values for any fragmentation of the existing grassland mosaic to occur.

Landscape quality:	Intactness	moderately high
	Coherence	high (except for lower sunny faces)
	Distinctiveness	moderately high
	Visibility	high

The tenure review process may provide the opportunity to protect and maintain the original integrity of a large high country landscape. Although within this assessment, each main catchment has been described individually, there are situations where contiguous areas of similar physical relief, aspect, vegetation and landuse should be viewed as a single entity. It is considered that both the Allen Creek and the Robert Creek catchments should be looked upon as a fully integrated high country landscape.

Landscape Unit 3

This unit comprises the eastern side of the upper catchment of the Robert Creek. The western faces were part of the Cainard Farm property and which is now managed by the Department of Conservation. The upper boundary of the unit is the large cirque to the west of Mount Dick. This alpine basin is characterised by over-steepened rock walls, talus slips, and a permanent lake which forms the origins of the Robert Creek. The mid section of the unit is a long backslope which is characterised by hummocky terrain and wet flushes.

This unit includes the upper limits of the beech forest which has an irregular and convoluted edge due to the influence of previous fires. There would appear to be continual infilling of beech into the larger gaps which will assist with the sustainability of the forest. The balance of the unit is clad in vigorous tussock grasslands which link up with the extensive grasslands within the neighbouring Allen Creek catchment.

Human impacts and vulnerability to change are both similar to those outlined in landscape unit 2.

andscape quality:	Intactness	high
	Coherence	high
	Distinctiveness	moderate
	Visibility	low

SIGNIFICANCE

This property in many respects contains the key pieces to the district's landscape jigsaw. It interlocks with two existing scenic reserves, both of which are substantial in area but presently do not fully represent the full altitudinal sequences of vegetational types within the district.

Additionally the reserves' existing boundaries are illogical in a landscape context. Most inherent values are still intact within the mid and alpine section of the property (LU2 and LU3).

The whole of the lake faces (both LU1 in Allandale and Halfway Bay) are of regional significance, and must be considered as one physical entity due to the strong similarities in the glaciated natural features and the vegetation patterns so strongly influenced by pastoralism.

In totality these highly visible slopes form the edge of one of New Zealand's most distinctive and well known districts, with the Southern Lakes now being marketed at an international level for tourism. In accordance with this the lake faces must be managed as an outstanding landscape area.

2.1.2 GREENVALE

Landscape Unit 1

In a broader landscape context, this unit forms a part of the edge of the high hills and low mountainlands that surround the Northern Southland plains. This chain of uplands frequently forms the physical border between the neighbouring provinces of Otago and Southland.

This unit encompasses the southern section of the rocky escarpment that overlooks Trotters Plain near the township of Kingston. The northern boundary of the unit generally follows the rugged spur that leads off the ridgeline adjacent to Bushy Creek catchment. The vertical relief of the escarpment extends from 1220 m along the crest of the ridgeline down to 375 m at its base. The slope of the scarp varies considerably with the top section being precipitous with bedrock ramparts being a common feature. There is a break in the slope in the mid section with the angle of the terrain becoming more moderate. Near the northern boundary of this unit, the distinctive profile of the scarp is indented by a large gully that includes a remnant of beech forest and terminates in an outwashed gravel fan.

The vegetative pattern is strongly influenced by physical constraints, with rocky bluffs, which have acted as a natural firebreak, determining the existing mosaic of vegetation. Above the rocky formations, fescue tussocklands are the dominant plant community with a good representation of snow tussock within the sub-alpine zone. Amongst and below the rocky formations there is a continual band of bracken fernlands which is a natural indicator that the land is being allowed to go through a primary successional stage back to shrublands. At the base of the scarp there is a mixture of introduced grasslands that are now being colonised by matagouri. From general observations it would appear that stock prefer to graze on these lower slopes, rather than attempting to penetrate the bracken fern.

Although the vegetation over the scarp has been considerably modified by previous land management regimes the present groundcover pattern does convey a strong impression of being natural, with no hard edges being visible in landuse.

In a visual context the high scarp overlooking the plains is a distinctive physical feature that is highly visible from SH 6 which is a part of one of the South Island's main tourist routes - the Queenstown/Milford tourist circuit, as well as forming the backdrop to a local tourist venture, this being the Kingston Flyer tourist train.

Landscape Quality:		
	Intactness	moderate
	Coherence	moderately high
	Distinctiveness	high
	Visibility	high

Although the intactness of the natural ground cover is moderate in quality, from a landscape perspective the most dominant element is the spectacular landform which is frequently accentuated by the effects of light on the over steepened and jutting rock formations. This is a landscape of marked differences such as the contrasts between the coarsely textured elements contained on the scarp and the finely grained short grasses that occupy Trotters Plain, also the angulated landform contrasts sharply with the strong horizontal lines of the plain.

This unit's vulnerability to further change would come from any further measures to impede the natural repatriation of the ground cover, e.g. fire, as well any earth disturbances such as tracking would have a high visual impact due to the acute angle of the viewing plane.

Landscape Unit 2

In a broader context this unit again forms the edge of the inland mountains that surround the Northern Southland plains and also could be described as the gateway to the Southern Lakes.

The unit embraces the northern portion of the escarpment overlooking Trotters Plain, as well it incorporates the catchment of Bushy Creek. Near Kingston it adjoins the Allen Creek catchment which is partly protected as a scenic reserve. Compared with LU1 where the over steepened rocky faces provide that unit with a distinctive character, within this unit the escarpment profile is less obvious with small rocky outcrops protruding out from the main surface from the ridgeline down to the base.

The Bushy Creek catchment drains a relatively large area with a feature of this creek being a series of small rocky waterfalls that are located where the catchment becomes more enclosed.

The overall vegetation mix is relatively different to LU1 with the regeneration of woody species being much more advanced. The slopes are clad in a diverse mixture of shrubs that include Pittosporum, native broom, Hebe, mountain wineberry, Coprosma, matagouri, and tree fuchsia. Beech seedlings have established along the upper ridgelines, along with the occasional wilding pine, that, in the future, will be difficult to control due to the precipitous nature of the terrain. A distinctive feature of the species composition is the presence of both the swamp and the mountain flax, the latter is usually growing in close proximity to clumps of cabbage trees. At the base of the scarp there are extensive seepage areas that contain a number of Carex species.

From an overall ecological perspective the altitudinal sequence from montane tussocklands descending down to regenerating shrublands and wet flushes must be a rarity within this region.

. healthy remnant of both mountain and mountain-red hybrid beech occupy the lower section of the Bushy Creek catchment, this extensive beech forest is surrounded by the slopes being extensively repatriated by broadleaved shrublands, a feature within this catchment is the number of semi mature totara. Landscape unit 2 is contiguous with the Glen Allen Scenic Reserve which like the Bushy Creek catchment contains a substantial area of beech, regenerating shrublands, and tussocklands.

Landscape quality:		
	Intactness	moderately high
	Coherence	moderately high
	Distinctiveness	high
	Visibility	high

Even though the regeneration of the shrublands is more advanced than further south it is still the scale of the landform which is the dominant landscape feature. The overall landscape quality of this unit will be further enhanced by the continual repatriation of the broadleaved shrublands so that they will finally cover their natural ecological niche (similar to what is now occurring within the neighbouring Te Kere Haka Scenic Reserve).

The vulnerability to change comes primarily from any further measures to impede the natural restoration of the broadleaved shrublands.

Landscape Unit 3

This unit comprises all of the western facing slopes overlooking the mid section of Robert Creek which drains out of the southern end of the high glaciated mountains to the west of Lake Wakatipu. The landform primarily consists of long colluvial slopes which in some areas are extensively hummocky and periodically contain wet flushes. This wide V-shaped valley is asymmetrical in profile with the opposite slopes being steeper and containing deep gullies (the corresponding slopes opposite are managed by the department).

The vegetation follows a gradual change with the subalpine area being covered in a dense sward of tall tussocks while most of the upper grazing block is dominated by fescue tussocklands. Introduced grasses, particularly browntop, become more prevalent in the lower altitude grazing blocks. In these lower, more intensively farmed areas, the inherent values are relatively low. Built elements include access tracks and isolated huts which are attributes that are associated within a pastoral farming context.

From opposite Round Hill there is continuous beech forest following Robert Creek and its main tributaries, the overall configuration of this beech forest reflects previous burn-offs. Although the present hard edges between the beech and the surrounding grasslands form a vivid landscape pattern, it would appear that the beech is recovering with further spread of shrublands and beech outliers starting to establish around the fringes of the forested area.

Landscape Quality:		
	Intactness	moderately high
	Coherence	moderately high
	Distinctiveness	moderately high
	Visibility	low

In landscape terms this unit, more specifically the upper grazing block, forms the middle ground of a relatively large back country valley, that both visually and physically links the more spectacular headwaters of Robert Creek with the lower country. This linkage is primarily in the form of the continuous beech forest which spreads over a large surrounding area, and is

anaged under four separate titles, i.e. Landcorp, DOC, and two pastoral leases. Until now this fragmented management has not severely affected the forest, but it would seem logical for it to be managed as a single entity. The beech forest on Greenvale helps to provide an interrupted ecological sequence which helps to create an overall coherent natural landscape.

This unit's vulnerability to further change would come from further farming intensification of the upper grazing block.

SIGNIFICANCE

Similar to the adjoining Allandale pastoral lease, this property is strategically important both from a landscape and a nature conservation perspective. The rocky escarpment being a prominent natural feature helps to form the physical edge to the Northern Southland Plains and provides a local tourist venture with a natural setting.

The existing Glen Allen Scenic Reserve, like most early designated protected areas, put a lot of emphasis on the protection of forest. The boundaries of the reserve reflect this previous approach and ignore landscape and the connectivity of ecological sequences of plant communities between the wet flushes of the Trotters Plain through beech forests to upland tussocklands. This sequence is essentially rare in the region.

The Robert Creek, with its general open character, strong contrasting vegetation types, presence of water, and long views of glaciated landforms, all combine to give this valley a relatively high landscape value which in the future could be developed as a backdrop for back country recreational pursuits. This statement is reinforced by the Department of Conservation Southland Conservation Management Strategy which suggests that in the Eyre Mountains an important opportunity exists to maintain easily accessible but lowland areas free of marked routes. An opportunity rarely duplicated in New Zealand.

2.2 LANDFORMS AND GEOLOGY

OVERVIEW OF GEOLOGY

The Eyre Mountains form a distinctive topographic block southwest of Lake Wakatipu, rising to 2000 m at Jane Peak. The area is mountainous and rugged, bush-clad in the southwest but tussock-covered elsewhere, with rocky bluffs and fell fields at higher altitudes. Geologically the Eyre Mountains are underlain by greywacke and semischist of the Caples terrane of Permian age, and are separated from other Caples rocks of northern Southland by the major valley systems of the Mataura and Von-Oreti catchments which are infilled by extensive glacial and fluvioglacial deposits of Quaternary age. The Eyre Mountains block is cut by several faults, the most significant being the South Von Fault (Turnbull 1980). The regionally significant and much larger Moonlight Fault follows the Von–Oreti valley, where it is almost entirely concealed by glacial gravels. The Eyre Mountains have been heavily glaciated, and glacial erosional features dominate most of the modern landscape. The inferred down-valley limits of the major advances of the Wakatipu glacier are summarised in Figure 1.

Schistosity

The Eyre Mountains rocks show a very well-developed transition from greywacke into semischist. Schistosity in the Eyre Mountains is folded into a major synform (downfold), named the Taieri-Wakatipu Synform (Mortimer and Johnston 1990) which runs from Walter Peak into the upper Mataura Valley. A secondary warp or upfold has been mapped through Cecil Peak

om the lower Long Burn, and another minor downfold runs beneath Bayonet Peaks. The effect of this folding is to produce flat-lying semischist in the axis of the fold; the landscape reflects this with flat ledges, steep bluffs (controlled by sub-vertical fracturing or jointing), and "mesa-like" ridge crests and minor summits. Symmetry Peaks are a good example of this, as is Walter Peak. Isolated "gendarmes" or pillars and detached bluffs are joint- and schistosity-controlled landscape features.

GLACIAL GEOLOGY

The Eyre Mountains landscape is dominated by the effects of valley glaciation, with spectacular U-shaped valleys and cirques, and terminal moraines and outwash plains in the bounding Mataura and Von-Oreti catchments. The Lake Wakatipu trough, with its tributary and outlet valleys, records a succession of glaciations which date back at least 500 000 years (Fig.). It must be noted however that nowhere within the area shown in this figure is there any absolute age control from radiometric dating, and that the following correlations and discussions are based on ages extrapolated from the adjoining Mararoa-Te Anau and Clutha-Kawarau catchments; an element of mis-correlation is likely. Glacial advances and events are here correlated using the International Oxygen Isotope Scale.

Major Ice Advances and Deposits

Late Otiran glacial advance, Oxygen Isotope (OI) stage Q2, 18-24000 yrs BP
The most recent major glacial event saw Wakatipu ice reach Kingston to form a spectacular terminal moraine. Although an outwash gravel plain formed downstream from the terminal moraine early in this advance, for much of the time the Kingston glacier terminus was static and provided an outlet for meltwater draining from the Wakatipu glacier into the upper Mataura catchment. The glacier front is inferred to have moved relatively little during Late Otiran time, producing a succession of terminal ridges within one major moraine deposit. The major abandoned meanders which cut into the older outwash plains south of Kingston formed at this time, and continued to erode the Otiran outwash as the Wakatipu ice melted. There were two meltwater streams, one east of Kingston and a slightly younger one to the west where the Kingston Flyer now runs.

Later, this situation changed when the Kingston outlets were dammed and the Kawarau River became the major outlet for the Wakatipu system during glacial retreat. The eastern Mataura outlet was blocked by alluvial fan gravels from Lorn Peak; the western outlet was closed off by a small moraine wall (now preserved across the Kingston Flyer track). A major post-glacial lake formed in the Wakatipu basin, with well-developed lake benches eroded into the surrounding slopes at an elevation of ca. 350m asl – including the terrace on which most of Kingston is built. This lake drained via the Kawarau system, not via the Mataura. Features on the Kingston moraine surface inferred to be forest dimples (Brockie 1973a) may also date from this time.

Submerged moraine topography off the Kingston waterfront, together with drowned trees around the western Wakatipu shoreline near Elfin Bay and flooded storm beaches in Frankton Arm, indicate that Lake Wakatipu has been naturally raised several metres. Thomson (1984) has suggested the cause was a landslide at the Kawarau Falls at Frankton, which dammed the lake some 6000 yrs ago.

Most if not all of the minor cirques of the Eyre Mountains were probably ice-occupied in Late Otiran time.

.arly Otiran glacial advance, OI stage Q4, 60-70 000 yrs BP
The preceding ice advance also reached Kingston, but little of its terminal moraine is preserved. Most of it has been degraded, leaving only lag boulders and a subdued surface south of the more prominent Late Otiran moraine ridge. However, the extensive outwash plain draining south from there to the Kingston Flier station at Fairlight has a surface gradient which ties it back up-valley to a terminal moraine level higher than the Late Otiran moraine (and now represented by the deflated moraine and lag boulders), and on this basis it is inferred to be Early Otiran (OI stage 4) in age. The dry meander which cuts this outwash plain was probably formed late in the OI stage 4 advance as the ice began retreating upvalley.

Waimean glacial advance, OI stage Q6, 130-180 000 yrs BP
Identification of glacial deposits of this age is tenuous, because these deposits are outside the range of radiocarbon dating. Mapping and correlations are based on degree of preservation of surfaces, relative heights of moraine and outwash deposits, and tracing of down-valley terrace profiles into the Mararoa - Te Anau catchment.

There are no well-preserved moraine deposits associated with this advance in the Mataura catchment, but a terrace remnant at Greenvale Station is identified as a Q6 deposit. Other terrace remnants on the same profile are preserved at and down-valley from Athol. At this time, it is likely that most of the larger valleys within the Eyre Mountains were ice-filled, and the high ridges supported many small cirque glaciers.

Waimaungan glacial advance, OI stage Q_8, 250-300 000 yrs BP
No moraine or outwash deposits of this age are known from the Mataura catchment, and are presumed to have been stripped out by younger advances and accompanying erosion. The down-valley Q8 ice limit shown in Fig. 1 is thus inferred from the upstream limit of older deposits of Stage Q10 (but note that all these correlations are tentative, due to the lack of absolute dating).

Extensive outwash plains in the Oreti and Mararoa valleys are correlated with this glacial period, but no major Q8 valley moraine is known within the Eyre Mountains region. However, all the high cirques, including those on southern Eyre Mountains ridges, would have been occupied by ice.

Nemonan glacial advance, OI stage Q10, 340-360 000 yrs BP
A high-level degraded terrace on the eastern side of the Oreti Valley at the mouth of the Ashton Burn is the only deposit in that catchment correlated with this advance; the gravels in it are somewhat more weathered than in younger units. In the Mataura catchment, probable Q10 age lateral and possibly terminal moraines are preserved on the high terraces east of Fairlight (on Lorn Peak Station) and Garston, with outwash terraces further downstream toward Parawa.

Ice would have occupied all the central Eyre Mountains valleys, and the headwaters of the upper Mataura, Robert Creek, and Eyre Creek as well as the tributaries of the Oreti such as the Ashton Burn. If the ice limit inferred for Stage 10 shown on Fig. 1 is correct, the upper Mataura valleys would have been the site of a glacially-dammed lake; no evidence has been found to confirm this, and possibly the Q10 ice limit lay upstream around Greenvale, allowing the upper Mataura drainage to run along the hill south of Fairlight. Remnants of outwash gravel are preserved on that hill slope, but their age is unknown.

OI stages 12 and older (=430-500 000 yrs BP)
The only deposits known from these advances are within the Mataura catchment, downstream from Garston. It is possible that the ice level around Fairlight at this time reached the low saddle

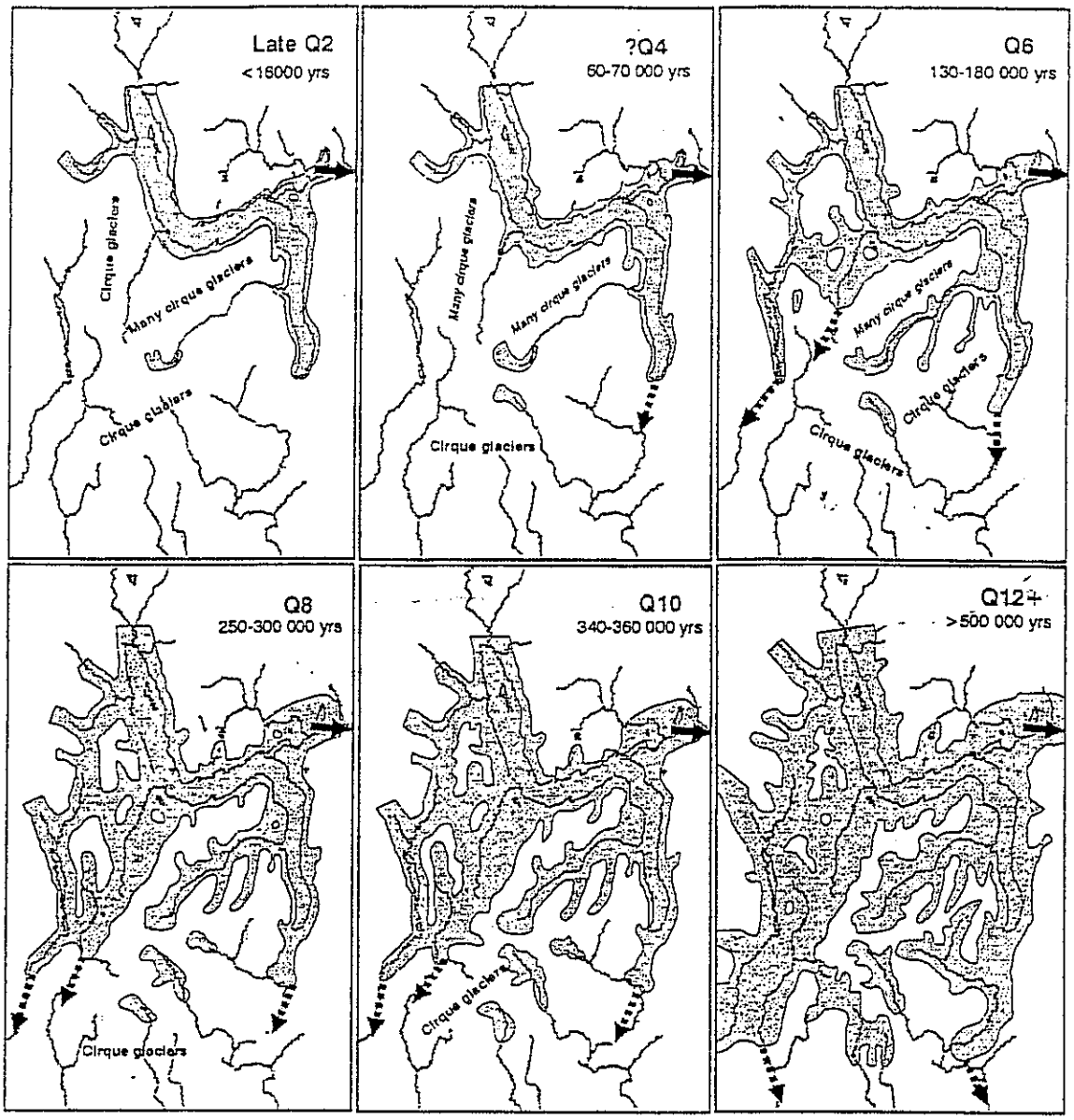

Figure 1: Inferred ice limits for various advances of the Wakatipu Glacier, for Oxygen Isotope stages Q_2 to Q_{12}+. Modified from Fig. 13 *in* Turnbull and Forsyth (1988).

ading to Quoich Creek, with possible Q12 or older outwash gravels preserved in that valley. Weathered glacial debris probably older than OI stage 12 is preserved at heights up to 880m asl. on the Hector Mountains east of Fairlight, and southeast of Athol. However, there is no direct evidence, from topography or preserved gravel deposits, that the proto-Mataura River ever flowed southwest past Mid Dome onto the Five Rivers plain (cf. McIntosh *et al.* 1990). With ice at these levels, glaciers would however have infilled the upper Mataura, Robert Creek, Eyre Creek, and certainly all the central valleys of the Eyre Mountains, and only the highest peaks and ridges would have been ice-free.

Landslides

Large-scale landsliding is a feature of much of the schist terrain of Otago and Southland, and the eastern Eyre Mountains include several major landslides. The slopes east of Robert Creek, east of Allen Creek, and above the Long and Short burns are all major complex landslides. Many other landslides are also present in the eastern Eyres.

These large and complex slope failures are characterised by hummocky topography, a lack of blocky bluffs and steep rocky faces, sometimes actively eroding scarps, and small springs and wet flushes. They are controlled by down-slope failure on schistosity planes within the underlying rock, often released in the head region by pulling apart along joint planes. Gravitational collapse following removal of ice support, especially in deep narrow valleys was probably the major factor inducing initial movement. Subsequently, large earthquakes and/or high groundwater pressures provoked continued movement down the glacially over-steepened slopes. Episodic movement continues to the present time by down-slope creep, rotational slumping, and debris flows.

Other, smaller landslides are mapped in Cascade Creek, in the upper Lochy, and in the serpentinite belt in the southwest. The central Eyres have fewer landslides, as the rocks are less schistose and stronger and foliation is generally flat, a much more stable configuration. Dipping foliation in the upper Lochy makes this area landslide-prone, but the absence of landslide deposits is attributed to more recent ice erosion; the large landslides of the eastern Eyres may date back for several hundred thousand years, as has been demonstrated elsewhere in Central Otago (McSaveney *et al.* 1992).

Smaller landslide deposits are inferred to be block falls, caused by catastrophic collapse of bluffs or oversteepened slopes. They are characterised by fan-shaped or semicircular accumulations of large to small angular boulders spread out over the valley floor and often over-riding older deposits. They are more common in regions where foliation is flat-lying and bluffs are steep and high.

Valley floor alluvium, scree and alluvial fan deposits

All the major and minor valleys of the Eyre Mountains contain deposits of post-glacial stream alluvium. An aggrading alluvial plain in lower Robert Creek is probably related to higher erosion rates in that catchment, in turn related to the large landslide on the east side of the valley. Alluvial fan deposits are widespread, and form at the mouths of side streams of all sizes. These fans grade out and down-valley into terraces with flatter profiles, and the distinction is made on slope angle as much as different gravel properties within them. Both fans and terraces are more fertile, easier to fence and graze than steeper hill slopes, and consequently are the most developed areas within the Eyre Mountains.

Extensive scree deposits are a feature of the central Eyre Mountains, draping the bluffy topography and grading out onto the valley floors. Screes also mantle the slopes of most high cirques. Scree debris ranges from loose fine material in areas of higher schist grade, to coarse, blocky screes in the greywacke-dominated area such as around Eyre Peak. The scree deposits are

inferred to be many thousands of years old, dating from the last glaciation (Q2) or beyond. The ridges on Mataura Valley Station between Eyre Creek and the upper Mataura are also mantled by scree, deeper and finer than elsewhere. This difference is attributed to the area having been ice-free since the early Quaternary, with consequent deeper weathering of the underlying rocks.

SIGNIFICANCE OF THE GEOLOGY AND LANDFORMS

The Kingston moraine has been identified as being geologically and geomorphologically significant. It is listed in the New Zealand Geopreservation Inventory as follows:

> **Kingston terminal moraine and spillway channel**
> SIGNIFICANCE: An accessible good example of terminal moraine, and a well-defined example of an uncommon lake overflow spillway channel
> LOCALITY: 1-3 km inland from Kingston on Lake Wakatipu. F42 740 323
> CLASSIFICATION: Importance = C Vulnerability = 2
> HAZARDS: Further earthworks
> MODIFICATIONS: Channel partly obscured by Kingston railway line route
> INFORMANTS: Brockie, W

Recent geological field work reinforces the importance of this site in terms of its landscape, geomorphological and glacial geology values. The site is readily accessible and visible from roads, has very well-preserved geomorphology, and is a key area for interpreting glacial geology over the wider region.

The critical area for the Kingston moraine and outwash complex extends from the lakeshore south to the Mataura River at Fairlight, and to the hill slopes. The Kingston moraines and outwash plains are vulnerable to the effects of large-scale farm forestry or wilding pine spread, and any modification of the surfaces – by housing, growth of thick vegetation, or roading – will detract from their value.

The basement rocks of the Eyre Mountains contain no known mineral, geological or structural features of particular merit. The area has an unusual appearance by virtue of its synformal structure and associated landscape, and very deeply incised glacial valleys. Although such features can be found individually in many areas (eg, U-shaped valleys in Fiordland; flat-lying semischist in the Garvie Mountains), the combination in the Eyre Mountains is unique.

2.3 CLIMATE

Climatically the Eyre Ecological District is intermediate between the wet Fiordland region to the west and the drier more severe environment of Central Otago to the east. Rainfall records indicate both properties receive 900 mm annually at low altitudes, rising significantly at higher altitudes. Elevation is not sufficient to retain permanent snow. Occasionally, high intensity rain storms can generate large floods which can carry a high sediment loading. Rivers respond rapidly to such events due to the relatively weak vegetative cover on the Eyre Mountains.

The properties are exposed to both NW and SW weather patterns and receive rain from both quarters. Snow can lie for periods of days during winter on the flats and frosts are seasonally common.

2.4 VEGETATION

2.4.1 ALLANDALE

INTRODUCTION

The high ridge running south from Mt. Dick, to near Kingston dominates this property. On the east of this ridge, steep rocky faces, dissected by numerous small streams, drop to Lake Wakatipu while the western slopes form part of the Allen Creek catchment. Further west, slopes rise to another ridge, topped by large bluffs at its northern end, which falls to Robert Creek and the west boundary of the lease. The south end of the lease is squeezed between Glen Allen Scenic Reserve and Te Kere Haka Scenic Reserve. Glen Allen reserve encompasses the beech forest filling the lower Allen valley while Te Kere Haka reserve takes in part of the regenerating beech and broadleaved forest stretching up steep, bluffy slopes above the lakeshore at Kingston.

A 4WD farm access track undulates along and above the lake edge for several kilometres cutting through the lower Te Kere Haka Scenic Reserve, allowing access for numerous weeds. Slopes above the northern end of this track have been periodically burnt, and are grazed annually by both cattle and sheep. Another area burnt in the last ten years is the west face above the Glen Allen Reserve at the south end of the Mt. Dick ridge. Apart from these burnt areas, the native vegetation over the whole Allen Creek catchment and Lake Wakatipu faces has high conservation values with a number of rare, threatened and local plant species present.

The Eyre Mountains are recognised as the most spatially heterogenous and species rich mountains in southern New Zealand. The Eyres and adjoining mountain ranges have a high degree of endemism.

VEGETATION DESCRIPTION

Lakeshore and faces

Northwards along the lakeshore track beyond the Te Kere Haka Reserve, regenerating forest is present both sides of the track. Patches of red beech occur in the gullies and mixed beech forest (red, mountain and occasional silver) spreads up all the steep, incised streamsides. The regeneration is most well developed below the track, towards the lakeshore.

Notable is a threatened tree species *Olearia fragrantissima.* Nine adult plants and three seedlings have been recorded. Since the time of record (Dec. 1994), the largest tree right beside the track has had its track side branches broken by a vehicle and all seedlings have vanished under the feet of cattle which appear to have been wintered over at one time. Trampling and browsing has opened up the whole forest floor in this area. As well as the *Olearia*, the rather local fierce lancewood (*Pseudopanax ferox*) grows here. Other trees and shrubs of this area include *Pittosporum eugenioides, P. tenuifolium, Melicope simplex, Fuchsia excorticata, Pseudopanax crassifolium, Sophora microphylla, Pennantia corymbosa, Griselinia littoralis, Aristotelia serrata, Myrsine divaricata, M. australis, Helichrysum aggregatum, Coprosma linariifolia, C. crassifolius, C. rigida, C. rotundifolia, C. propinqua, Melicytus ramiflorus, Carpodetus serratus* and *Scandia geniculata.*

Apart from the burnt area, regeneration is well advanced along much of the face with shrubland and small patches of beech extending well up slope. In the absence of fire, regeneration to forest will occur up to the natural forest line of about 1150 m.

above about 1100 m is a narrow-leaved snow tussock (*Chionochloa rigida*) grassland which gives way to slim snow tussock (*Chionochloa macra*) at about 1500 m or lower in the colder gullies. Snow tussock extends downhill to the present beech or shrub zone, as low as 800 m, where no burning has occurred in recent times.

The ridge top running south from Mt. Dick has an interesting assemblage of plant communities with a variety of habitats from exposed ridge top with fellfield and cushion plant communities, to wetland and bog, cold cliff with boulderfields and sheltered, snow tussock hollows. These communities are typical of the range and diversity of the plants and communities over all the upper parts of this pastoral lease.

Cushionfield
This occurs on the more exposed ridge tops, summit of Mt. Dick and areas with skeletal soils. *Dracophyllum muscoides* is usually dominant with much rock and bare ground. Mosses and lichens including *Racomitrium* and *Polytrichum* species are important with *Raoulia hectorii, Abrotanella inconspicua, Poa colensoi* and *Luzula pumila.* Other associated plants include *Chionohebe thomsonii, Hectorella caespitosa, Myosotis pulvinaris, Leptinella goyenii, Ourisia glandulosa, Hebe buchananii, Dracophyllum pronum, Raoulia grandiflora, Chionohebe densiflora, Agrostis muelleriana, Kelleria dieffenbachii* and *Colobanthus buchananii.* Large clumps of *Aciphylla lecomtei* are common and occasional plants of the tiny *Aciphylla hectorii* and *Myosotis elderii* are found. Slim snow tussock occurs where the soil is deeper.

Snowbank/snow hollow
Typical plants include the moss *Polytrichum* sp., *Celmisia haastii, Kelleria croizatii, Poa colensoi, Luzula pumila, Plantago lanigera, Phyllachne colensoi, Coprosma perpusilla, Abrotenella inconspicua, Gaultheria nubicola, Gentiana divisa, Ourisia glandulosa, Brachyscome longiscapa, Carex pyrenaica* var. *cephalotes, Rytidosperma pumilum, Anisotome imbricata, Ranunculus pachyrrhizus, Raoulia subulata* and *Phyllachne rubra* with slim snow tussock.

Rock Bluffs/Cliffs
These are home to many of the plants that also grow in the tussockland but a number of plants are confined to these sites. They include the rare Otago endemic *Cheesemania wallii, Grammitis poepiggiana, Anisotome capillifolia, Epilobium glabellum* and *Ourisia caespitosa.* Other plants of interest generally associated with these sites include *Ranunculus buchananii, Celmisia verbascifolia, Celmisia ramulosa, Parahebe planopetiolata, Poa schistacea, Geum parviflorum, Myosotis macrantha, Celmisia angustifolia, Pachycladon novae-zelandiae* and *Coprosma* sp. (a) (of Eagle 1986).

Boulderfields
Debris slopes below the bluffs contain the endemic *Hebe dilatata. Brachyglottis revoluta, Coprosma ciliata, Melicytus alpinus, Aciphylla* sp. "lomond", *Celmisia hectorii, Polystichum cystostegia,* and *Dracophyllum uniflorum* are other species prominent here. *Myrsine nummularia* is uncommon.

Scree and fellfield
On stable scree, *Hebe haastii, Epilobium pychnostachyum* and *Haastia recurva* are present. The endemic *Aciphylla spedenii, A. simplex, Celmisia viscosa, C. brevifolia, C. laricifolia, Craspedia lanata, Acaena saccaticupula,* and *Myosotis drucei* are species found in fellfield together with mosses and lichen species.

Shrubland
As well as shrubs on the boulderfields, shrubs occur scattered throughout the snow tussock grassland with *Dracophyllum uniflorum, Hebe hectorii* and *Ozothamnus vauvilliersii* common.

racophyllum uniflorum forms pure stands on cold, rocky faces and on more exposed ridges *Dracophyllum pronum* forms large patches, often associated with cushion vegetation. Of particular interest is the unusual association of whipchord *Hebes* along the Mt. Dick ridge. Four species can be found growing together in one area, *H. hectorii, H. lycopodioides, H. propinqua* and *H. annulata,* the latter being most uncommon and confined to the Takitimu, Eyre, Hector and Garvie mountains. Further down the ridge, *H. propinqua* is well established either side of the 4WD track.

Wetlands
There are a number of small wetlands along and below the ridge including a small string bog. Mosses, small sedges and rushes are common plants at these sites. Plants here include *Schoenus pauciflorus, Isolepis aucklandica, Luzula leptophylla, Coprosma atropurpurea, Psychrophila obtusa, Plantago uniflora, Celmisia haastii, Gentiana amabilis, Epilobium minutiflorum, Kelleria paludosa, Gnaphalium laterale* and *Oreobolus pectinatus.*

Slim snow tussockland
Above 1500 m on warm north and west facing slopes, and reaching down to about 1300 m on the colder lake faces, slim snow tussock forms the dominant cover. At lower altitudes and in sheltered sites its cover is up to 80% with *Celmisia lyallii* and other herbs. On damp slopes curly tussock (*Chionochloa crassiuscula*) also occurs and on rocky sites *Dracophyllum* species can be prominent. Cold, rocky, colluvial slopes have a mosaic of snow tussock, shrubland, with *Brachyglottis revoluta, Hebe hectorii, Astelia nivicola, Dracophyllum uniflorum* and herbfield with *Celmisia hectorii* prominent. On more exposed sites along the ridge top, slim snow tussock is interspersed with cushion plant, fellfield and boulderfield communities.

Narrow-leaved snow tussockland
This is present below slim snow tussock, to the valley floor of the Allen Creek catchment, to the beech forest margin in Robert Creek, and to the regenerating forest and shrublands along the lake faces. Two exceptions to this are the north end of the lake faces and the south end of the Mt. Dick ridge where the tussockland has been depleted by burning and grazing. Apart from the two burnt areas mentioned, the snow tussock is generally in very good to excellent condition with little bare ground, a good inter-tussock flora and few adventive species present.

Beech forest
The eastern edge of the large 33,000 ha RAP in the central part of the Eyre Ecological District (Mark et al 1987) extends into the true left of upper Robert Creek. It encompasses predominantly mountain beech forest with some silver beech also present. This merges with a shrubland – tussock fringe that soon gives way to narrow-leaved snow tussockland.

PROBLEM PLANTS

From a conservation perspective, the major plant species present include the following:

Broom and Gorse
A large area exists but is being targeted jointly by DOC and the lessee to prevent spread and control scattered patches. DOC's involvement is primarily concerned with protection of the Glen Allen reserve, the historic Trotters homestead ruins and the access to the reserve.

Briar
Only minor infestation occurs on lower hill slopes. No control has been undertaken to date.

'ilding Trees

These problem plants represent the most significant threat to the Eyre Mountains. Wildings of various species are now colonising the Eyre Mountains, particularly the lake faces of Allandale. Some work has been carried out, namely on aerial survey, followed by removal of all wildings on the lake faces from Kingston to Southwest Bay. Follow-up control is planned. Other parts of the property require work to prevent further spread into the tussocklands.

Overall, wilding infestation is still at an early stage of colonisation and the goal of complete removal is considered achievable.

SIGNIFICANCE OF THE VEGETATION

- Except for the relatively small areas previously burnt, the whole of the Allen Creek catchment and Mt. Dick ridge including the lake faces, have high conservation values. Some areas are outstanding. Most of the area is still in its natural state with the forest regenerating well along most of the lake faces. There is high diversity both in the communities represented and in the species present. Several species are threatened or of special note (see below). While some of these are only recorded from the adjacent reserves, they are likely to occur on suitable sites in the adjacent pastoral lease.

- The 4WD track and grazing management along the track threatens the survival of *Olearia fragrantissima* and fierce lancewood as well as acting as a pathway for numerous weeds including broom, hemlock (*Conium maculatum*) and burdock (*Arctium* sp.). It also cuts right through the base of Te Kere Haka Reserve.

- Significant riparian beech forest remnants are present along the true left of Robert Creek. The high botanical values of this area have been recognised through its recommendation as a RAP in the Eyre Ecological District.

- Both the burnt areas, although having a lesser conservation value, still have the potential for regeneration and return to largely natural vegetation with the removal of burning and grazing. Both areas are relatively small in extent.

- **Plants of special distribution and significance**

Species	**Distribution within Allandale**	**Significance** [1]de Lange et al 1999 [2]Molloy & Davis 1994
Aciphylla spedenii	Throughout	Eyre/Thomson mountain endemic
Cheesemania wallii	Throughout	Western Otago endemic
Hebe annulata	Mt Dick	Sparse[1]
Hebe biggarii	Mt Dick	Eyre Mountains endemic
Ischnocarpus novae-zelandiae	Lake faces	Sparse[1], category B[2]
Olearia fragrantissima	Lake faces	Declining[1], category B[2]
Pseudopanax ferox	Lake faces	Sparse[1]
Ranunculus haastii ssp *piliferus*	Throughout	Sparse[1]
Senecio dunedinensis	Lake faces	Sparse[1], category I[2]
Stipa petriei	Lake faces	Range restricted[1]
Uncinia strictissima	Lake faces	Category I[2], Vulnerable[1]

.4.2 GREENVALE

ECOLOGICAL SETTING

Greenvale Station is located near the head of the Mataura River on the east side of the Eyre Mountains within the Eyre Ecological District (ED). The Eyre Mountains are part of an important transition between the dry Central Otago - Northern Southland area to wet Fiordland. The Eyre ED is a large and mountainous ecological district, characterised by steep, highly eroded hill slopes and narrow valleys. The climate is cool and moderately wet, with a rainfall gradient from the wetter south to the drier north (rainfall 800 - 2400 mm) and snow may lie for several weeks on the higher altitudes. The geology is dominated by schist and schistose greywacke. These factors have contributed to the leached, shallow, stony, steepland soils that predominate.

The original (ie pre-Maori) lowland and montane vegetation of the Eyre ED would have been dominated by beech forest. This beech forest was mainly silver beech (*Nothofagus menziesii*) with mountain beech (*N. solandri* var. *cliffortioides*) and localised red beech (*N. fusca*). Non forest communities below treeline were originally localised, but would have included wetlands, tussockland, shrublands, braided riverbeds, screes and rock outcrops. The alpine communities were originally dominated by snow tussocklands. These tussocklands would have been dominated by narrow-leaved snow tussock (*Chionochloa rigida* var. *rigida*), with slim-leaved snow tussockland (*C. macra*) at higher altitude and localised areas of curled snow tussockland (*C. crassiuscula*). Other alpine communities included shrublands, wetlands, scree, rock outcrops and fellfield.

Following the arrival of Maori, fires became a major influence upon the vegetation. The fire frequency further increased with European settlement and the start of pastoral activity. These fires had greatest impact upon the lowland and montane areas. As a result the forest become fragmented, while narrow-leaved snow tussockland and shrublands increased. Stock grazing, over-sowing, topressing and land development have further modified the original vegetation composition and distribution. The natural trend in lowland and montane areas is towards an increase in woody vegetation and a return to forest.

The property occupies both sides of a ridge running southwards from Mt Dick. The east side of the ridge contains the Allen Creek and Bushy Creek catchments. The front faces of Greenvale Station have been steepened by past glaciation. The western faces are more gentle, with slumping following the rock dip slope.

VEGETATION DESCRIPTION

This section of the report is divided into the major catchments of the property. These being:

A	Trotters Plain
B	Front Faces
C	Bushy Creek
D	Head of Allen Creek
E	Robert Creek Faces

A Trotters Plain

Trotters Plain is the large flat area of land south of Kingston. Only a minor portion of Trotters Plain is within Greenvale Station. Trotters Plain is largely composed of fescue tussockland,

though most has been topdressed and oversown. Only limited areas have been cultivated (probably because of the rocky natural of the soils). The area is crossed by ancient river channels from when the outlet of Lake Wakatipu was at Kingston.

Flush Wetland:
This wetland area covering several hectares is fed from the hill slope behind (Grid Ref. centre NZMS 260 695 293). The entire wetland area has some modification, with exotic species (particularly birdsfoot trefoil (*Lotus peduncalata*) being widespread. The southern portion is more modified with an abundance of exotic species, some drains and some stock impacts. Much of the central more intact parts of the wetland are dominated by bryophytes (65% cover), with *Carex diandra* (10%), birdsfoot trefoil (8%), *Carex gaudichaudiana* (5%), spike rush (*Eleocharis acuta*, 5%), *Stellaria alsine* (3%), a variety of native herbs and other species. However the wetland contains a diversity of communities dependent upon water table, drainage, nutrient levels and other site factors. *Carex gaudichaudiana, Carex virgata, C. coriacea* and spike rush were all locally dominant.

River channel wetland:
This wetland lies in an old river channel. The wetland is now fed from water off the faces behind. The wetland was approximately 1 km long and 20+m wide (GR. centre NZMS F43 703 294). The vegetation was dominated by *Carex diandra, C. gaudichaudiana, C. virgata* and spike rush, with *C. sinclairii, C. coriacea* and a variety of herbs. This wetland was relatively intact with few exotic plants.

On either side of this river channel wetland was a modified fescue (*Festuca novae-zelandiae*) grassland containing abundant matagouri (*Discaria toumatou*).

B Front Faces

These front faces are highly visible from the Lumsden-Queenstown Road. The faces express the disturbance regime (particularly burning) of the area. The southern faces having had the most recent disturbance and generally containing communities in an early successional stage. The northern faces have had no burning for several years and have more advanced regeneration, with forest species becoming locally common. The faces within the Glen Allen Scenic Reserve have not been burnt for many years and the succession is even further advanced.

Southern Section:
This area is south of Bushy Creek (GR. centre E43 685 280) and is a very steep face with numerous rock outcrops. The vegetation on the lower slope is dominated by rough pasture - modified fescue tussockland with matagouri - *Coprosma propinqua* shrubland mainly on fans with patches of bracken (*Pteridium esculentum*). The mid slopes are dominated by the rock outcrop systems and bracken, with matagouri - *Coprosma propinqua* shrubland, and localised regenerating forest and shrublands in gullies. The upper slope is dominated by narrow leaved snow tussock (*Chionochloa rigida* spp. *rigida*). The northern most stream is deeply incised and acts as a fire refuge which contains many woody species. Areas of shrubland are regenerating strongly and include the forest species broadleaf (*Griselinia littoralis*), halls totara (*Podocarpus hallii*) black mapou (*Pittosporum tenuifolium*), tree fuchsia (*Fuchsia excorticata*) and lancewood (*Pseudopanax crassifolius*). This catchment also contains a small remnant of beech forest.

Northern Section: -
This area is the face north of Bushy Creek (GR. centre F42 705 303). This area is also a very steep face with numerous rock outcrops. The toe slope is dominated by a mixture of rough

asture and shrubland with some wet areas (including those described in A above). The shrublands are dominated by *Coprosma propinqua* and matagouri with *Coprosma* sp. aff. *parviflora*, *Carmichaelia virgata*, *Olearia lineata*, and lowland flax. The mid slopes are dominated by rock outcropping with *Coprosma propinqua* - matagouri shrubland, manuka shrubland and regeneration forest. The regenerating forest contains abundant *Coprosma propinqua* with some black mapou, broadleaf, marbleleaf (*Carpodetus serratus*), tree fuchsia, wineberry (*Aristotelia serrata*), *Olearia avicenniaefolia* and koromiko (*Hebe salicifolia*). The vegetation on the upper slope is dominated by narrow leaved snow tussock.

C Bushy Creek

Bushy Creek is the stream that flows out of the front faces of Greenvale Station. This area contains the catchment of Bushy Creek.

Forest:
The lower portion of the forest which was examined was dominated by red beech (*Nothofagus fusca*), with some mountain beech (*N. solandri* var. *cliffortioides*), silver beech (*N. menziesii*), halls totara (*Podocarpus hallii*), broadleaf and lancewood (*Pseudopanax crassifolius*) in the canopy. The understory is relatively sparse but contains *Coprosma rhamnoides*, *C. colensoi*, hard fern (*Blechnum procerum*) and prickly shield fern (*Polystichum vestitum*). Along the stream black mapou, marbleleaf, wineberry, tree fuchsia, mountain ribbonwood (*Hoheria lyallii*), *Blechnum vulcanicum* and hounds tongue fern (*Phymatosorus diversifolius*) are common.

Adjacent to the forest is a zone of shrubland, this shrubland is most extensive at lower altitudes, shady faces and in the gullies.

The upper part of the catchment is dominated by narrow leaved snow tussock (this area was not inspected due to low cloud cover on the 28th), however is thought to be very similar to that in the head of Allen Creek.

D Head of Allen Creek

A large portion of this catchment is protected within the Glen Allen Scenic Reserve, however this reserve contains mainly beech forest. The upper-most part of the catchment is within Allandale Pastoral Lease.

The Allen Creek side of ridge has an intact native community with virtually no exotics at higher altitude. There is virtually no bare ground and the vegetation consists of an attractive mosaic of narrow leaved snow tussock, *Dracophyllum pronum*, *Hebe anomala*, *Kelleria diffenbachii*, *Oreobolus pectinatus*, *Phyllachne colensoi*. A lot more cushion plants were found than on the Robert Creek side of ridge. This catchment also includes an extensive area of low fertility montane/alpine wetlands which are less weedy than on the Robert Creek faces. These contain a lot of spaghnum moss and *Psychrophila obtusa*, with scattered *Craspedia spp.*

Upper altitude snow tussockland:
The upper basin examined (GR. E42 687 332) contained a shrub - tussockland. This community was dominated by narrow leaved snow tussock (30 % cover), *Hebe anomala* (18%), bryophytes (10%), *Coprosma cheesemanii* (8%), cottonwood (*Ozothamnus vauvilliersii*, 5%), blue tussock (*Poa colensoi*, 5%), *Brachyglottis revoluta* (2%), *Schoenus pauciflorus* (2%), *Celmisia densiflora* (2%), snowberry (*Gaultheria depressa* var. *novae-zelandiae*, 1%)), *Coprosma perpusilla* (1%), *Anisotome aromatica* var. *flabellifolia* (1%) and other species.

Flush:
There were several flush areas observed. The first one described was found at Grid Ref. NZMS 260 E42 688 332. This flush was dominated by bryophytes (25% cover) and *Schoenus pauciflorus* (18%), with *Hebe pauciramosa* (8%), *Isolepis aucklandica* (8%), narrow-leaved snow tussock (6%), *Ranunculus gracilipes* (6%), *Coprosma perpusilla* (5%), the comb sedge *Oreobolus pectinatus* (4%), *Plantago triandra* (4%), *Dolchoglottis lyallii* (2%), *Bulbinella angustifolia* (2%), *Celmisia* sp. "gracilenta rhizomatous" (2%), *Craspedia* spp. (1%), *Pratia angulata* (1%), *Epilobium brunnescens* (1%) and other species.

A second, different flush community was also examined (GR. E42 686 334). This flush consisted of *Juncus antarcticus* (20%), *Plantago triandra* (15%), bryophyte (10%), sog (10%), *Gnaphalium laterale* (10%), *Epilobium brunnescens* (8%), comb sedge *Oreobolus pectinatus* (5%), *Pratia angulata* (4%), *Ranunculus gracilipes* (3%), *Celmisia* sp. "gracilenta rhizomatous" (3%), *Juncus pusilla* (3%), *Rytidosperma australe* (2%), *Epilobium komarovianum* (2%), *Hydrocotyle microphila* (2%), *Luzula leptophylla* and other species.

Cushionbog:
Some flush communities merged into cushion bog communities. One of the cushionbog communities examined contained comb sedge *Oreobolus pectinatus* (90%), the sundew *Drosera arcturi* (5%), *Gnaphalium laterale* (3%), *Schoenus pauciflorus* (1%), *Rytidosperma australe, Ranunculus gracilipes, Juncus antarcticus, Psychrophila obtusa, Carex gaudichaudiana* and other species.

E Robert Creek Faces

This area includes the faces above Robert Creek. This area includes part of the recommended area for protection (RAP) from the Eyre ED PNAP survey.

The area has a mid altitude contour fence. Below this fence has been oversown and topdressed and is predominately modified with browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*). With increasing altitude an increasing component of native shrubs with cottonwood, inaka, *Hebe pauciramosa* is found. Gullies retain some mountain beech, mountain ribbonwood (*Hoheria lyallii*), koromiko (*Hebe salicifolia*) and manuka.

Forest:
Species noted in the mountain beech forest include *Astelia nervosa*, prickly shield fern, broadleaf seedlings, mountain ribbonwood, *Coprosma parviflora, Cardamine debilis, Pratia angulata, Senecio wairauensis* and *Grammitis billardierii*. Mountain beech forest persists to ~ 1340m in gullies. These gullies all have a margin of regenerating saplings.

Mid altitude snow tussocklands:
One site examined was above the fence at Grid Ref. NZMS 260 D42 675 341 (altitude c. 880 m). This tussockland is dominated by bare/rock (25%), narrow-leaved snow tussock (15%) and *Gaultheria crassa* (12%), with cottonwood (5%), blue tussock (4%), catsear (*Hypochoeris radicata*, 4%), *Raoulia subsericea* (3%), *Leucopogon fraseri* (3%), snowberry (2%), *Gonocarpus montanus* (2%), sweet vernal (2%), bryopytes (1%), harebell (*Wahlenbergia albomarginata*, 1%), inaka, *Hebe anomala* and other species. The narrow-leaved snow tussock becomes taller and denser with increasing altitude, while the amount of bare surface decreases.

A second site examined was across the contour from Mitchell's Hut (TL Robert Creek ~900 m). This site contained a mixed narrow-leaved snow tussock/short tussock grassland. The

ɔmmunity consisted of narrow-leaved snow tussock (~ 30% cover)with bare ground (5%), blue tussock, fescue tussock, *Leucopogon fraserii*, *Luzula rufa*, *Lycopodium fastigiatum*, sweet vernal, snowberry, *Celmisia gracilenta*, *Celmisia densiflora*, tutu (*Coriaria sarmentosa*), *Coriaria plumosa*, *Pimelea oreophila*, *Rytidosperma setifolia*, *Gonocarpus micranthus*, *Viola cunninghamii*, *Ranunculus foliosus*, *Deyeuxia avenoides*, *Gaultheria crassa*, *Acaena caesiiglauca*, *Geranium microphyllum*, *Lachnagrotis lyallii*, *Uncinia rubra*, cottonwood, *Dracophyllum uniflorum*, inaka, prickly shield fern, *Aciphylla* lomond, *Aciphylla glaucescens* and many other species. Old, burnt, mature beech logs were noted within the grasslands. Sidling up valley around the slope contour, ground cover becomes increasingly native although tussock stature decreases. With increasing altitude there is a change in species composition. Additional species at 1100m include *Neopaxia sessiliflora*, *Hebe propinqua* and *Astelia nivicola*. Sweet vernal, browntop and fescue tussock cover phases out and narrow-leaved snow tussock cover increases (~ 55%).

Upper altitude snow tussocklands:
The site examined was at Grid Ref. D42 682 336 (altitude c. 1220 m). This tussockland is composed of narrow-leaved snow tussock (40%), leaf litter (6%), blue tussock (5%), rock (5%), snowberry (4%), cottonwood (3%), fescue tussock (3%), *Raoulia subsericea* (3%), catsear (*Hypochaeris radicata*, 4%), *Leucopogon fraserii* (2%), *Aciphylla* sp. "lomond" (2%), *Dracophyllum uiflorum*, *Celmisia prorepens*, *Lycopodium fastigiatum* and other species.

Another area of snow tussockland studied was on the summit saddle at Grid Ref. E42 686 335. This snow tussockland is composed of narrow-leaved snow tussock (25%), *Hebe anomala* (15%), leaf litter (10%), the moss *Racomitrum lanuginosum* (8%), *Coprosma perpusilla* (8%), blue tussock (5%), snowberry (3%), *Dracophyllum uniflorum* (2%), *Celmisia prorepens* (2%), *Kellaria villosa* (2%) and other species.

Wetlands:
Slump areas generally on lower faces have impeded drainage. One such wetland area was examined at ~920m. These wetland typically contain the comb sedge *Oreobolus pectinatus* (40%), *Gonocarpus micranthus* (20%), *Gnaphalium spp.* (5%), with *Epilobium brunescens*, cutty grass (*Carex coriacea*), *Plantago novae-zelandiae*, *Celmisia gracilenta*, *Anisotome aromatica*, *Drosera arcturi*, *Schoenus pauciflorus*, *Ranunculus glabrifolius*, *Agrostis petriei*, *Carex wakitipu*, *Juncus pusillus* and *Isolepis habra*.

A cushionbog at Grid Ref. NZMS 260 E42 685 335 was examined. This cushionbog was composed of comb sedge *Oreobolus pectinatus* (80%), *Plantago triandra* (8%), bryophyte (5%), *Luzula leptophylla* (2%) and other species.

Fellfield/ridge crest vegetation:
A relatively sheltered area that was examined was dominated by the moss *Racomitrum lanuginosum* (40%), *Phyllachne colensoi* (35%), bryophyte (mainly *Polytrichum juniperina*, 10%), *Dracophyllum uniflorum* (8%), snowberry (2%), comb sedge (1%), *Lycopodium fastigiatum* (1%) and other species.

Another more exposed area consisted of rock (40%), *Dracophyllum uniflorum* (15%), narrow-leaved snow tussock (10%), *Hebe propinqua* (8%), snowberry (4%), *Celmisia prorepens* (4%), comb sedge (2%), *Anisotome flexuosa* (2%), *Coprosma perpusilla* (2%), *Myosotis lyalli* and other species.

An area of summit rock outcrop contained *Hebe biggarii*, *Helichrysum intermedium*, *Gaultheria crassa*, *Pentachondra pumila*, *Cyathodes pumila*, *Dracophyllum prostratum*, *Celmisia prorepens*, *Anisotome flexuosa*, *Racomitrum lanuginosum* and other species.

dditional species noted on ridge north of where the track meets the ridge include *Raoulia grandiflora*, *Leucogenes grandiceps*, *Celmisia verbascifolia*, *Rytidosperma pumila*, *Aciphylla hectorii* and *Brachyglottis cassinioides*.

Flora

A diverse flora of 270 native plant taxa was observed during the survey. Of particular note was the presence of the following species:

Alepis flavida	(national status - declining) This yellow flowered mistletoe was recorded from Bushy Creek. Category B, second priority for conservation (Molloy and Davis, 1994)
Celmisia hookeri	(national status - sparse) This daisy was found on the rock bluffs on the front faces of Greenvale Station (ie, Area B5).
Uncinia purpurata	(national status - sparse) This hook grass was found scattered though the snow tussock grasslands above Robert Creek. Category I, species about which little information exists, but which are considered threatened (Molloy and Davis, 1994)
Uncinia strictissima	(national status - vulnerable) A few plants of this hook grass were found within open shrubland adjacent to rock bluffs on the front faces of Greenvale Station (ie, Area B5). Category I (Molloy and Davis, 1994)
Hebe biggarii	This species is an Eyre and Thomson Mountains endemic. Found on Northern Robert Creek faces.

Other species of note are *Aciphylla kirkii* and *Hebe poppelwellii*. These species are uncommon in the Eyre Ecological District. There are several lowland swamp species that are uncommon in the northern Southland area (ie, Mavora, Waikaia and Central Otago Ecological Regions). These species include *Carex diandra* and *C. virgata*.

DISCUSSION

Natural values are found though much of the property, but particularly on the Robert Creek faces, Allen Creek catchment, Bushy Creek faces, and the front faces of the property and especially at higher altitudes. Some of these values are intact and extensive (eg, the snow tussocklands on the upper parts of these catchments). The low altitude communities are much modified (eg, low altitude tussocklands and wetlands). There are limited lowland areas that retain sufficient values to warrant further consideration on the property.

As well trying to identify the full extent of the vegetation present (including the best examples) the report also includes those of greatest representative value to the ecological district as a whole. The areas which contain sequences and zonations of vegetation and patterns which show the relationships between the vegetation components have been described. This report also seeks to identify areas of sufficient size to allow the successional processes (which are evident) to continue. This will allow nature to sort the patterning of these communities as they recover from disturbance and succession proceeds.

A feature of the property are the shrublands and seral communities of which there is a rich diversity. These communities are found over large portions of the property, particularly on the Roberts Creek faces, Allen Creek catchment, Bushy Creek faces, and the front faces of the property. This indicates a recovery from a period with more regular (and intensive) burning.

urning is thought to be a greater limiting factor to vegetation recovery than grazing on this property.

CONCLUSIONS

Three levels of ecological importance are identified based on the botanical values found. These are considered to be very high (key sites for conservation), high (important sites for conservation), and moderate.

A Very high ecological values

1 Allen Catchment Faces:
This area contains the relatively intact narrow-leaved snow tussocklands and associated shrublands and wetlands above the Glen Allen Scenic Reserve. All of these communities are highly representative of the Eyre ED. This area includes some of the most intact narrow-leaved snow tussocklands on the property. The exclusion of burning would allow succession and the development of communities along an altitudinal sequence to proceed, and ultimately to restore natural treelines and vegetation patterns. The area makes an excellent addition to the Glen Allen Scenic Reserve and when combined with Area 2 (i.e. the northern faces above Robert Creek), serves to link the Glen Allen Scenic Reserve with the extensive Eyre Mountains Conservation Area.

2 Northern Faces above Robert Creek:
This area contains slopes of narrow-leaved snow tussockland, with some forest tongues, wetlands and rock outcropping. The ridge between this area and Allen Creek catchment (Area 1 = Allen Catchment faces) contains a diversity of fellfield, rocky ridge and rock outcrop communities. Therefore the area contains a rich diversity of plant species and communities which are highly representative of the Eyre ED. There is an excellent altitudinal sequence from 340 - 1426m (c. 1100m). The exclusion of burning would allow succession and the development of communities along an altitudinal sequence to proceed, and ultimately to restore natural treelines and vegetation patterns. The area includes an RAP identified from the Eyre ED PNAP survey. This RAP contains beech forest which forms an important buffer to Robert Creek. This area serves to link the Glen Allen Scenic Reserve/Allen Catchment Faces (ie Area 1) with the Eyre Mountains Conservation Area.

3 Bushy Creek catchment: This catchment contains a large remnant of forest with associated regenerating shrublands and narrow-leaved snow tussocklands slopes. The forest contains all three beech species found in Southland and a number of other forest species which are uncommon in forest remnants of northern Southland. The area appears highly natural and to be regenerating strongly, with few problem weed species.

4 Southern Robert Creek Faces: This area is south of (though) adjoining Area 2 (i.e. northern faces of Robert Creek). The ecological values present are very similar to those found in Area 2. This area contains narrow-leaved snow tussockland slopes, with rock outcropping and fellfield and associated ridge crest vegetation along the ridge. The area adjoins the Bushy Creek catchment (ie, Area 3). This area was not examined on ground, however the area was overviewed by helicopter and examined with binoculars from Robert Creek.

High ecological values

5 Greenvale wetlands: This area contains two different wetland systems and some fescue tussockland. The upper or western wetland system is a flat area fed by seepage from the slopes above. This wetland contains a rich diversity of plant species and contains a variety of communities (ie, different parts dominated by different species dependent upon drainage, water table, nutrient content and other site factors). Although the wetland has been modified (it has a drain and exotic plants are common), it has a good ability to improve in condition. The second wetland is a *Carex* swamp in an old river channel.

6 Northern Greenvale faces: This face contains a range of regenerating communities and rock outcrop communities. Parts of the area act as fire refuges and contain a rich diversity of plant taxa, including *Uncinia strictissima.* The area contains the water source for the wetlands identified in Area 6. The vegetation is regenerating strongly.

C Moderate ecological values

7 Southern Greenvale faces: This area includes only the northern most part of the southern faces (ie north of the fence). This face contains a range of regenerating communities and rock outcrop communities.

8 Southern end of Robert Ridge: This area was not examined on the ground and no detailed information is available. It is thought that the values are similar to those in Area 4, however the area is at a lower altitude.

PROBLEM PLANTS

Gorse occurs in the lower Bushy Creek margins and gaps in the forest canopy associated with the water supply access track. The occasional wilding pine occurs on the eastern slopes about Bushy Creek.

All weeds are easily controlled and do not pose a threat to conservation values if control occurs.

SIGNIFICANCE OF THE VEGETATION

Extensive parts of the property contain very high and high botanical values. In particular, the areas described as the Allan Catchment Faces, Northern Faces above Robert Creek, Bushy Creek Catchment, Southern Robert Creek Faces, Greenvale Wetlands and Northern Greenvale Faces are considered to be significant.

Significant flora recorded include:

Alepis flavida	yellow mistletoe; Bushy Creek – status declining
Celmisia hookeri	Northern Greenvale Faces – status sparse
Uncinia purpurata	Northern Robert Creek Faces – status sparse
Uncinia strictissima	Northern Greenvale Faces – status vulnerable
Aciphylla kirkii	) Northern Robert Creek Faces –
Hebe poppelwellii	) status uncommon

Part of the Northern Robert Creek Faces is included in the Eyre Mountains RAP.

..5 FAUNA

2.5.1 ALLANDALE

2.5.1.1 INVERTEBRATE FAUNA

Introduction

During 28th January and 1st February, Mount Dick was surveyed following a light snowfall. This followed a dry summer which reduced the presence of ground dwelling insects but moth fauna was active during warm periods. 107 invertebrate records including 78 species were collected along with observations.

Context

Mount Dick forms part of the eastern extent of the large Eyre Ecological District. This mountain rises from 310 m at Lake Wakatipu to 1805 m asl. at the summit and has a north-south trending ridge over 15 km long. Slopes are moderately steep with alpine cirques and breached basins east of the ridge and some areas of moraine. Western slopes ripple with slumps and have some incised gullies. The lake faces are rugged with rocky knobs and also have gullies with cascading streams. Historical use of fire has substantially reduced flanking beech dominated forests and montane and upper slope shrublands. Alpine communities are diverse and Mount Dick is historically a well known collecting locality for a number of insects and is the type locality for some (eg, nine beetles described by Broun, 1917).

Alpine communities

The alpine flightless shield bug *Hypsithocus hudsonae* was noted from an area of sparse grassland, cushion and rockfell. It has an uncertain conservation status (Molloy and Davis 1994). However, it is known from other mountain tops in the Eyre Mountains and Otago. A diversity of chafers from this site include; manuka beetle *Pyronota* species, *Scythrodes squalidus* and flightless chafer *Prodondria* sp.nr. *capito*. This last species of flightless chafer is recorded for the first time on the Eyre Mountains and forms the western boundary for a species complex known from the Old Man Range. Alpine herbfield and snowbank are characterised by grasshopper *Alpinacris tumidicauda*, cicada *Maoricicada otagensis* and moth *Asaphodes declarata*. Bare rock and herbfield sites have grasshopper *Sigaus obelesci*, ground weta *Hemiandrus species*, Cicada *Maoricicada nigra frigida* and day active moth *Notoreas galaxias*. Large bodied weevils such as *Anagotis latirostrus* and speargrass species *Lyperobius spedeni* (feeding on *Aciphylla spedeni*) and *L. hudsoni* (glossy black and white) are abundant. A particularly rich assemblage of shrubs will be matched by insects such as bugs in the family Miridae and *Pasiphila* species moths (see Mark et al. 1989).

Allen Creek and Robert Creek catchments

Invertebrates widespread in the natural areas of northern Southland and Eyre Mountain were noted. Examples are; moth *Asaphodes sericodes* - wetland tussock, butterflies *Argyrophenga janitae* and *A. antipodum* - snow tussock, moth *Aponotoreas anthracias* - *Dracophyllum* species shrubs and moth *Graphania nullifera*- speargrasses. Carabid beetles *Mecodema lucidum* and velvet worms *Peripatoides* nsp. (D. Gleeson) are a feature of northern Southland and western Otago living in beech forest and alpine snow tussock grassland on schist derived terrains. The carabid beetle *Mecodema chiltoni* has its type locality as Mt Dick. This very large bodied beetle has a threat status of "C" - third priority species for conservation (Molloy and Davis 1994) but such populations (now fragmented and isolated) are in a number of places in the region. It is likely still in the forest patches cloaking the sides of Mt Dick.

.ake faces (slopes from Mt Dick to Lake Wakatipu shoreline)
Not sampled in this survey, however, similar habitats occur on Greenvale Pastoral Lease to the south. Grasslands contain representative insects such as cicada *Kikiha* species, bugs *Nabis maoricus*, *Stenotis binotatus* and *Stenotis norvegicus*. Slopes have areas of rock outcrop and a history of fire followed by regeneration of mixed shrub/grassland. These habitats are extensive with sources of insect colonists from fire refugia among the bluffs and deep gullies. Patches include inaka *Dracophyllum longifolium*, speargrass *Aciphylla glaucescens*, snow tussock *Chionochloa rigida*, bracken *Pteridium esculentum* interspersed with shrublands of kohuhu *Pittosporum tenuifolium*, manuka *Leptospermum scoparium* and *Coprosma propinqua*. Thickets of kowhai and mountain/silver beech provide refuge and carry representative insects such as kowhai moth *Urisophita maorialis* and beech leafroller *Proteodes carnifex* noted nearby.

Lake Wakatipu shoreline (310 m)
Wetlands at the slope toes are likely to have reasonable nutrient status and harbour nymphs of the darning needle dragonfly *Uropetala carovei*. Insect specialists of the wave wash zone will be present but were not surveyed. Adult insects arising from the lake and from stream outlets are likely to provide a significant resource for spiders, carabid beetles and other insect predators in the riparian. While partly modified by fire, these communities (associated with water) have high natural character and functioning.

Streams
A new species of caddis *Hydrobiosella* "species x" (John Ward personal communication) was recorded for the first time in one of many streams that have their origin in alpine cirques and breached basins. At 1400 m and above many basins have tarns with diving beetles *Rhantus* species and mayfly *Nesameletus* "species A" Hitchings. First order stream channels have high stream power and drain directly to the lake or valley floor They are confined to deeply incised gullies and gorges. Water often steps down over bedrock in a series of falls and plunge pools. This habitat is widespread in the Otago Lakes region and is characterised by fishless communities where the dominant predators are large bodied stoneflies.

2.5.1.2 HERPETOFAUNA

Two gecko species (as recognised by Hitchmough 1997), were found on the southern part of the property– *Hoplodactylus* 'Otago 'and *H* 'southern mini'. The former is referred to as H. 'western Otago'. H. 'Otago' is widespread through Otago and parts of Southland and found in a range of habitats (Hitchmough, 1997). H. 'southern mini' has a more restricted range, being found in the Remarkables Range, Hector Mountains, Slate Ra., and Eyre Mountains, in south-western Otago and north-western Southland. Although there was only one site where skinks (O. maccanni) were found the weather conditions were such that they were unlikely to be seen.

2.5.1.3 AVIFAUNA

1 Introduction

Allandale is a south facing property made up of the true left of Robert Creek, the upper part of Allan Creek and the faces above Kingston and Lake Wakatipu.

This report focuses on threatened birds or those that are ranked by Molloy and Davis. It also summarises information for bird species, which while still common have distributional limits, which are relevant to these properties.

Previous Surveys

2.1 Bird Atlas

The Ornithological Society of NZ compiled bird distributional data from 1969 to 1979. (Bull *et al.* 1985).

The properties covered by this report were not covered by the ONSNZ survey so there are no direct records of birds from this time, but the Bird Atlas gives us information on the distance to the nearest record of any given species. From the Bird Atlas data the closest records for NZ falcon are in the Von Valley and Hector Mountains 10-20 kms from these properties. Data for this and other species are summarised in the table below:

SPECIES	LOCATION OF NEAREST RECORD	APPROX. DISTANCE TO NEAREST RECORD
Falcon	Von Valley Hector Mountains	10 kms 20 kms
Kea	Remarkables Greenstone River Mouth Stuart Mountains	20 kms 40 kms 60 kms
Rifleman	Hector Mountains Oreti Valley Queenstown	20 kms 10 kms 30 kms
Brown Creeper	Oreti Valley Queenstown	10 kms 20 kms
Fantail	Von Valley Hector Mountains Garston Mavora Lakes	10 kms 20 kms 10 kms 30 kms
Tomtit	Queenstown Mavora Lakes	20 kms 30 kms
Bellbird	Hector Mountains Athol Oreti Valley Von Valley	20 kms 20 kms 10 kms 10 kms

This analysis shows that based on data from the Bird Atlas populations of the species listed in the tables are isolated from other populations. This particularly applies to kea.

2.2 PNAP Survey

In 1987 a PNAP survey of the Central Eyre Mountains was undertaken (Mark *et al.* 1989).

The key focus of the survey was the headwaters of the Mataura catchment immediately south of this property.

NZ Falcon
Recorded by the PNAP survey in the Eyre Creek, Mataura River and Robert Creek catchment below 1000 m. Considered to be as common as recorded elsewhere.

ea
A small population was recorded in the upper Mataura and birds were recorded in the upper Lochy Valley. They have also been present in Robert Creek (Greenvale Station) in the past.

3 Present Survey

3.2 NZ Falcon

Falcon were recorded in all the main valleys.

Falcon are a wide ranging species and individuals will use extensive areas for feeding and breeding.

Research shows that falcon have a home range of 20 square miles (50 square km).

3.3 Kea

Similarly to NZ Falcon, Kea are a wide ranging species with extensive habitats. Kea are present and breeding on the Remarkables Mountains and have been recorded flying across Lake Wakatipu on a regular basis. In previous relocation work at Arthurs Pass it has been shown that Keas are familiar with an area of about 30 km in diameter.

3.4 Forest Birds
(tomtit, brown creeper, rifleman, bellbird and fantail)

In contrast to kea and falcon, this group of forest species are sedentary and restricted to discreet forest patches. Their distribution on these properties is dictated by the distribution of beech forest.

4 Evaluation

Table 2 summaries the status of the bird species discussed above.

SPECIES	RANKING CATEGORY	STATUS
Kea	B	Endemic
Falcon	B	Endemic
Bellbird	-	Endemic
Tomtit	-	Endemic
Fantail	-	Native
Brown creeper	-	Endemic
Rifleman	-	Endemic

The species listed on Table 2 are all breeding within the property or can be reasonably expected to be breeding.

The kea population in the Eyre Mountains is well away from core habitats.

Populations of bellbird, tomtit, fantail, brown creeper and rifleman in the Northern Eyre Mountains are on the north western edge of distribution. Sparse records for some of these

pecies exist in the Hector Mountains or around Queenstown but the Eyre Mountains contain the last large areas of beech forest habitat when travelling north west.

NZ falcon are present throughout Robert Creek, Allen Creek and the faces about Lake Wakatipu. They are breeding at least on the faces above Lake Wakatipu.

Kea are present sometimes in Robert Creek.

For the forest bird community the five listed species are present throughout beech forest areas and remnants on the property.

2.5.1.4 FRESHWATER FISH

Introduction
At the time of survey, river water levels were slightly elevated with snow melt. The upper reaches of the Robert and Allen Creeks and the outflow of a small tarn near Mt Dick and the mouth of a small stream flowing into Lake Wakatipu at Southwest Bay near the northern boundary of the property were fished.

Methods
All sites were fished using a back pack DC "Kaianga" electric fishing machine. Reaches were sampled with a single pass into a stop net, set down stream. Stream side observations of larval fish and abundance were also noted.

Results

Robert Creek and Allen Creek
No fish were recorded. A diverse freshwater invertebrate fauna was observed.

South West Bay
This stream contained a healthy population of koaro and moderate numbers of bottom fauna. Trout were absent probably due to the shallow rocky precipitous nature of the creek.

Mt Dick tarns
No fish were recorded.

Discussion
The lower section of Robert Creek and its tributaries are known to contain brown trout (*Salmo trutta*), alpine galaxiids (*Galaxias paucispondylus*), roundhead-type galaxiid (*Galaxias* sp.) and a presently indeterminate galaxiid of the "*Galaxias vulgaris* complex" group (*Galaxias* sp.). The absence of fish in the upper reaches fished in this survey is probably a function of the altitude and stream slope/type. No fish were observed above 900 m on neighbouring Greenvale property. Despite the absence of fish in the upper reaches these systems are still significant as land use practices in the upper catchment will affect downstream water quality and the fish communities.

Again the absence in the upper reaches of Allen Creek will be a result of stream slope, and altitude. Despite the absence of fish in the upper reaches, this system is significant as land use practices in the upper catchment will affect downstream water quality and any fish communities present.

is likely that koaro populations exist in most of the small streams on the lake faces, limited in distribution upward only by the incline of the stream beds.

SIGNIFICANCE OF THE FAUNA

Invertebrate Fauna

Allandale contains a variety of insect assemblages from lakeshore to alpine cirque basin which are well represented in the Eyre Mountains and Lake Wakatipu region. Outstanding features include:

- very rich alpine communities
- alpine flightless shield bug *Hypsithocus hudsonae*
- new alpine caddis species *Hydrobiosella* "species x"
- flightless chafer *Prodontria* sp. nr. *capito* at its western limit
- type locality for the large bodied beetle *Mecodema chiltoni*
- low elevation lake shore communities (particularly at stream outlets)

Avifauna

The property contains large intact valley systems with a full complement of rangeland wildlife. Species of note are New Zealand falcon and kea, both Category B species for conservation (Molloy and Davis 1994). Observations suggest falcon and possibly kea breed on the property.

Several forest bird species are at their distributional limits, eg, bellbird, tomtit, rifleman, brown creeper and fantail. These species are poorly represented in Central Otago.

Kea is also at its eastern distributional limit.

Freshwater Fish

Koaro is a Category C threatened species and the presence of a healthy population in the South West Bay stream is noteworthy.

The excellent condition of the upper catchments of Robert Creek and Allen Creek, despite the absence of fish, is important for the retention of any downstream native aquatic values.

2.5.2 GREENVALE

2.5.2.1 INVERTEBRATE FAUNA

Introduction

The lease was inspected in cool conditions and showers during 27th, 28th January 1999. This followed a dry summer which reduced the apparency of ground dwelling insects but moth fauna was active during warm periods. 59 invertebrate records including 43 species were collected along with observations.

Context

Greenvale Pastoral Lease is a part of the eastern edge of an extensive body of mountains (Eyre Mountains). Slightly foliose semi-schist (greywacke) has been uplifted so that it dips to the west. This along with Quaternary glaciation controls the landform and slope soils.- East faces have spectacular rugged steep bluffs and slopes and some small colluvial fans at the base. Western slopes are gentler with very large ripply slumps along the plains of shistosity. Clays formed in the slippage impede drainage and surface wet flush areas are extensive. In addition, Trotters