Toitu te Land whenua Information New Zealand

Crown Pastoral Land Tenure Review

Lease name :
GLENROCK, HOLBROOK, ROLLESBY

Lease number :
PT 084, PT 120, PT 108

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.

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DOC CONSERVATION RESOURCES REPORT ON TENURE REVIEW OF GLENROCK, ROLLESBY AND HOLBROOK PASTORAL LEASES

PART 1

1.1 INTRODUCTION

Holbrook, Rollesby and Glenrock pastoral leases are located on the north-eastern edge of the Mackenzie Basin, on either side of, and to the west of Burkes Pass.

Holbrook (7185 ha) is located at the southern end of the Two Thumb Range and comprises the upper half of the Dead Mans Creek valley, rising to the peak of Mt Edward at its head, and almost all of the 12-13km long Sawdon Stream valley, which drains the southern slopes of Mt Maude. The eastern side of the Mt Burgess ridge from Mt Burgess south and above the 800-900m contour is also within the lease. The boundary descends to SH8 at Burkes Pass, down the east side of Bullock Creek. From Burkes Pass to Sawdon Stream the lease includes the low Corner Hill[1] at Dog Kennel Corner and the Sawdon river flats right up to the highway. Holbrook also includes Sterickers Mound and a large portion of the Sawdon outwash surface and floodplain which forms the Basin floor of this part of the Mackenzie Basin. The homestead area is situated on a raised terrace that has been partly developed. SH8 forms the north boundary for about 2km west of Sawdon Stream.

Rollesby (2619 ha) and *Glen Rock* (3893 ha) pastoral leases comprise most of the Rollesby Range, except some of the eastern and southern slopes which are in other properties in the Rollesby Valley. SH8 from Burkes Pass to Dog Kennel Corner, the Haldon Road as far as a point about 1.5km north of the Mackenzie River and the Mackenzie Pass road form much of the property boundary. The northern 1/3 of the alluvial fans and plain between Haldon Road and Mackenzie Pass road is included (the remainder being part of the Grampians lease). The eastern boundary runs along the foot of the range from Burkes Pass southward for almost half the length of the range before turning 90 degrees and running straight up the slope to the summit.

Holbrook, Rollesby and Glenrock are surrounded by other pastoral leasehold or freehold farmland with the exception of an area of Conservation land that adjoins Holbrook to the north-east at the head of Sawdon Stream valley. Between Holbrook and Rollesby, a narrow strip of land, adjacent to the highway is a Scenic Reserve.

The properties lie in three Ecological Districts – Two Thumb, Pukaki and Grampians. The mountain lands of Holbrook are within the Two Thumb Ecological District in the Heron Ecological Region. It is characterised by a subhumid climate, heavy snow in winter, stony alpine soils and leached steepland soils at lower altitude. The plains of Holbrook, Rollesby and Glenrock on the other hand, are within Pukaki Ecological District (part of Mackenzie Ecological Region). It is characterised by low topography, frost and drought, and is ecologically very distinct from the mountain lands. The mountain lands of Rollesby and Glenrock are at the northern end of Grampians

[1] For the purposes of this assessment the name given to the small hill immediately north of Dog Kennel Corner

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Ecological District, which is described as dissected greywacke block mountains having a semi-arid to subhumid climate and stony steepland soils. All three ecological districts have been surveyed as part of the Protected Natural Areas Programme and three RAPs (known in the Mackenzie report as priority natural areas) were identified on the property – Grampians 1 (Rollesby Range above Rollesby Station), Grampians 2 (Rollesby Range above Bauchops Hill) and Pukaki 18 (Sterickers Mound). The boundaries of these recommended sites have been changed in subsequent documents as a result of reassessments by PASAC, consultants and DOC staff. More information on this is supplied in section 3.3.

PART 2

INHERENT VALUES: DESCRIPTION OF CONSERVATION RESOURCES AND ASSESSMENT OF SIGNIFICANCE

2.1 LANDSCAPE

2.1.1 Landscape context

Holbrook, Rollesby and Glenrock are situated at the north-east edge of the Mackenzie Basin, one of the most extensive outstanding natural landscapes in the Canterbury Region and "one of the most investigated, painted, written about, visited, eulogised and argued over landscapes in New Zealand" (BMP and LA 1993[2])

This 1993 study and a 1992 study by Boffa Miskell Partners[3] on landscape change in the Mackenzie Basin looked at its landscape values (primarily visual values) in some detail (BMP 1992).

These studies identified a range of key attributes to support the significance of the basin making particular note of the variety, the huge scale and clear expression of landforms as well as the basin's visual character particularly its openness, vastness, and strong horizontal emphasis. Other notable characteristics were general absence of trees, overwhelming dominance of landform, high apparent naturalness, tussockland character, and overall unity, simplicity and coherence of the landscape. Other attributes described in the study include the way the Basin is so clearly recognisable as a large basin, due to the strongly defined enclosing ranges, and the ability to see right across the basin floor, particularly in clear light conditions. The absence of features across the plains gives the impression of vast open space and distance.

Most of the Basin is seen as a highly "natural" landscape. From an ecological perspective, much of it is in fact considerably modified, with hieracium and exotic grasses widespread throughout the basin. However, the Basin retains very high "natural" qualities because of its overwhelming dominance of natural landform and extensive presence of short grassland which still retains a component of native species and continues to support a diversity of indigenous insects, lizards and birds. It is still regarded overall as one of the region's, and arguably, the nation's, largest outstanding natural landscapes.

It is also a highly visible landscape. A major tourist highway (SH8) passes through the

[2] Boffa Miskell and Lucas Associates – Canterbury Regional Landscape study, vol. 1 & 2
[3] Boffa Miskell Partners Ltd – Landscape Change in the Mackenzie/Waitaki Basins

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middle of the basin and much of the it is able to be viewed from the highway, along with views from the Canal roads which are popular for recreational driving. Several minor shingle roads afford "back-country" experiences of other parts of the Basin, such as Mackenzie and Hakataramea Pass.

2.1.2 Landscape significance

Holbrook, Rollesby and Glenrock are of significance to the wider Mackenzie Basin in several ways:

- Firstly, the north end of the Rollesby Range and the eastern side of the Mt Burgess ridge frame Burkes Pass on SH8 - the gateway to the Mackenzie Basin and the eastern high country. Two memorials commemorate the history of this area - Burke Memorial, at the top of the pass named after Michael John Burke, and a memorial to the boundary sheepdogs at Dog Kennel Corner who were kennelled here in the days before fences. Whilst the memorial areas themselves sorely lack an appropriate immediate setting, the surrounding hill and valley floor landscape of Holbrook, Rollesby and Glenrock is important as the broader setting for these memorials.
- Burkes Pass is a visually impressive and distinctive landscape of high aesthetic quality especially on the north side of the road - the high, steep, tall tussock-covered east side of the Mt Burgess ridge with its distinctive, sculpted, "slab and ledge" micro-topography more like central-west Otago country. The extension of tall tussock right down around the highway is special. It continues around the east side of Corner Hill where it is probably the lowest tall tussock in the Basin at 660-700m above sea level above sea level (asl). This is the only place along the highway in the Basin where this is experienced, and it is a rare road corridor experience in the South Island.
- The area is also special because of its contrast with the Mackenzie Basin proper, related to the Pass's particular climate. There is an abrupt transition from dense tall tussock at low altitudes on the east and south side of the Mt Burgess ridge to sparse, dry short tussock/sweet vernal and browntop grassland, bare ground and hieracium on its west side and on the other hills and plains around. This is most obvious on Corner Hill. This effect occurs over the lower Two Thumb Range and on the Rollesby Range - on the latter there is a real difference between the east/south side and the west side. This is due to a cool, moist easterly that often hangs all day over the eastern Basin ranges, spilling over the summits and remaining in Burkes and Mackenzie Pass but completely disappearing over Mt Edward and Sterickers Mound. In the Basin it can be a fine, warm, cloudless day but a cottonwool cloud can be seen rolling over the eastern ranges from all around the Basin.
    - The first glimpse of the Mackenzie Basin and a "taste" of the long-distance views so characteristic of the Basin is gained from SH8 in Burkes Pass, looking southwest through the gap between Sterickers Mound and the northwest side of the Rollesby Range to the distant Grays Hills. A pine shelterbelt along the east edge of the Scenic Reserve however is increasingly screening this view and it will soon disappear altogether unless the trees are topped.
    - The hills to the south of the highway lack the strength of landscape character of the Mt Burgess ridge. Much of the pre-European tall tussock has been displaced by scant short tussock/sweet vernal and browntop grassland, "grey scrub"[4] and hieracium. Nevertheless they do have significance in that they form the south side of the Pass

4 [5] Refers to a mix of matagouri, olearia and coprosma shrub species which overall have a grey appearance with the different species indistinguishable at a distance except to the trained eye.

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area. The hills above Grays River and Dog Kennel Corner are also directly in view at close range travelling east towards Burkes Pass, and in certain light conditions they have their own special visual quality based on clearly defined landform and a rhythm of spurs and valleys .

- As you drive from Burkes Pass and past Dog Kennel Corner, the first impressions of the Mackenzie Basin proper are gained. The grassy flats by Sterickers Mound provide a simple, low horizontal foreground to extensive views right across the Basin to the Ben Ohau Range. Many people stop here for a photo. The absence of trees, fences, cultivated areas, and buildings is a special feature of these areas. Further up the road, a similar view is gained across the vast Sawdon outwash plain, south to Grays Hills and the distant Benmore Range. These surfaces are one of the key physical elements of the Basin and underlie the fundamental character of vast, flat, open short grassland that allows the distinctive panoramic views across the Basin. The outwash plain itself whilst to some appearing barren and lifeless and not worthy of a photo stop, has an intriguing visual pattern created by repeated sinuous swales and low dune-like mounds all flowing in the same direction, created by wind and water. Its sheer size is very impressive and somewhat overwhelming. These vast outwash surfaces with their own special vegetation cover are unique to the Basin and very special features. Holbrook includes a substantial portion of this outwash surface.
- The elevated short tussock-covered terrace to the west of Holbrook homestead offered a similar open grassland plain experience until recently, as it has been divided up into large rectangular paddocks with coniferous shelterbelts which when fully mature will prevent views beyond about 500m from the highway.
- The isolated low hill of Sterickers Mound, whilst not visually spectacular in any way, is nevertheless locally a focal feature and a familiar landmark because of its proximity to the highway and its setting in an open plain. It also has several private memorials on its rocky, windswept summit.
- The peak of Mt Edward is a significant skyline peak in the eastern part of the Basin because it is the highest and because of its eye-catching shape and the ridges descending from it, like the arms of a sphinx. It can be seen from many sections of SH8 as you pass through the Basin between Simons Pass and Edwards Stream. Much closer and vivid views of the valley and its central peak are gained from SH8 east of Whisky Cutting. This is the only close up view of a mountain valley and peak possible from SH8 within the Basin.
- The Rollesby Range is significant as one of the ranges clearly seen to be enclosing the east side of the Basin along with the Dalgety and Grampian Ranges. It is part of the backdrop to the extensive views across the Basin from SH8 between the Wolds and Simons Pass and also around Balmoral. These views are in my opinion amongst the best in the Basin and give one of the key Basin experiences. In clear light conditions on a still day, the experience of looking across the Basin to the sharply detailed ranges, rich in shadow and light playing over the valleys and spurs, set beyond a seemingly endless grey-brown or golden grassland plain and under a vast blue sky is very special and forms a vivid image.
- The south end of the Rollesby Range towers over Mackenzie Pass - a pass of equal historic significance to Burkes Pass with the Mackenzie Memorial, a tribute to the legendary sheep rustler James Mackenzie, and one of the first Europeans to enter the Mackenzie Basin. The Dalgety Range encloses the south side of the pass. The high steep mountainsides with tall tussock and speargrass descending right to the valley floor on the Rollesby Range and the dense, native riparian shrub communities create a special atmosphere of relatively remote and extreme high country pass environment, coupled with the fact the road is only a minor shingle road. The change in

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environmental conditions described earlier is readily apparent on travelling west through the Pass and contributes to the special character and natural landscape diversity of the area.

The remaining parts of the Holbrook, Rollesby and Glenrock lease are considered much less significant with respect to the qualities of the wider Basin landscape. They are more modified, of smaller scale and much less dramatic appearance. This includes the lower slopes of the Rollesby Range (from closer range), the Holbrook homestead area, the Glen Rock homestead area and the low hills to the south of it, and the alluvial plain on Glen Rock east of the Haldon Road.

The eastern side of the Rollesby Range is not part of the Basin landscape. It is part of the Rollesby Valley landscape, enclosing its western side. The road through here is a minor shingle road primarily servicing the farms in the valley and the valley sides could not be described as spectacular in any way. They are highly visible however and the summit areas with tall tussock and rock outcrop contribute to the character of the valley and have significant aesthetic value. The Rollesby Valley Road links with Mackenzie Pass Road and provides an alternative "back road" route into the Mackenzie Basin.

2.1.2 Landscape Description

For descriptive purposes Holbrook, Rollesby and Glenrock have been divided into six landscape units – (1) Sawdon outwash surface, (2) undeveloped basin floors, terraces and fans, (3) developed fans and flats, (4) Low hills, (5) High hills and (6) Mountain range. A map and description of the landform, vegetation and human features of these major landscape units and their parts appears in Appendix 1 of this report.

2.1.3 Visual Values

Much of the Holbrook/ Rollesby/ Glen Rock station is publicly visible. The north end and west slopes of the Rollesby Range, Sterickers Mound and the flats of Holbrook, Corner Hill, the east side of the Mt Burgess ridge, the first part of the Mt Maude valley, and most of the Mt Edward valley are clearly visible from many sections of SH8 and the Canal roads, at varying distances. The eastern side and southern end of the Rollesby Range and closer views of the west side of the range are gained from the Rollesby Valley road, Mackenzie Pass road and the Haldon Road. However these are minor shingle roads primarily used for access to farming properties although Mackenzie Pass has historic significance. The Burkes Pass area and Mackenzie Pass are also the settings for monuments commemorating aspects of European cultural history.

A description and analysis of the views from State Highway 8 and other visual values appear in Appendix 2.

2.1.3.1 Visual Vulnerability

The 1992 study assesses visual vulnerability[5] of different areas of the Basin. All of the Holbrook part north of the highway, the Sawdon outwash and area around Sterickers

[5] Visual vulnerability is a measure of the degree to which a defined landscape can accommodate change in a visual sense. High Visual Vulnerability (HVV) indicates very little change could occur without changing the qualities of the landscape and being highly noticeable. Low Visual Vulnerability (LVV) means substantial landscape change could occur without changing the basic character or qualities of the

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Mound, and the mid and higher slopes of the Rollesby Range are identified as being areas of High Visual Vulnerability.

These areas are highly sensitive to visual change - the hills because they are so clearly visible, the flats because of the notable absence of vertical elements, such as trees, and development to fragment them and reduce their scale and simplicity, and also because of their role in allowing extensive views across them.

The valley floors on Glen Rock were attributed Medium Vulnerability status although this is questionable. Although they appear relatively natural with no development yet, they are well-hidden from view and do not have any special visual qualities or natural features except perhaps the dense patches of scrub. The Holbrook terrace was also given Medium status.

The Glen Rock flats by the Haldon Road are accorded Low Visual Vulnerability as they are a very oblique, very distant "floor" to a hill backdrop when seen from major viewpoints. Although development would be a very noticeable change this would not be so apparent in the context of the wider Basin.

The study does state however that visual vulnerability is largely in respect of views from the highways and there may be localised areas with different ratings. The boundaries are also very "coarse". A feeling can be gained however of the relative vulnerability of different areas.

2.1.2 Landforms and Geology

There are three main landform groups represented on Glenrock, Rollesby and Holbrook.

(i) *Rollesby Range* This mountain range comprises a steep, dissected mountain range with semi-arid lower slopes and subhumid summits. The basement rocks are composed of greywackes and argillite of the Torlesse supergroup, the dominant rock type of much of the mountain lands of Canterbury. They have not been glaciated but show peri-glacial effects, with extensive rock outcrop on rolling summits. Lower slopes are often more moderate with some broad rolling spurs. In the valleys are minor river-beds with associated plains and terraces.

The Rollesby Range has a shorter, steeper east side overlooking Rollesby valley, and longer, gentler sloping west side, deeply dissected into five valleys with long spurs running out into the Mackenzie Basin in a southwest direction. The summit of the range is rounded with many knobs and rock tors. Slopes are planar, covered in colluvium, to broadly convex or concave with moderate to large basins at the gully heads. Valleys are winding with overlapping spurs. Rock outcrop is common throughout, some with associated talus. Secondary ridges have "roller coaster" profiles with many small knobs and saddles.

(ii) The mountain lands of Holbrook are part of the *Two Thumb Range*. This range consists of steep to very steep, dissected mountain slopes. On Holbrook this area comprises the head catchments of two streams - Sawdon Stream and Dead Mans Creek. Its upper

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landscape. Medium vulnerability indicates some change can occur but has to be sited and designed carefully (BMP 1992, p.45)

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boundaries are defined by major ridges that include three prominent peaks: Mt Edward (1916m) and Mt Maude (1797m) on the western side, and Mt Burgess (1430m) on the east.

The western side of the upper Sawdons Stream valley (the ridge along to Mt Edward and Mt Maude) is mostly over 1600m high. This ridge is very steep, rugged and narrow with much scree, exposed Torlesse Group greywacke/argillite bedrock and rock outcrop. The rock type is the same as the Rollesby Range but is probably not as hard and more bedded, meaning it erodes more easily especially through frost shatter. Side slopes are large and planar to broadly rounded, well dissected by gullies. Small cirque basins exist along the ridge top and a larger one at the head of the valley with associated small plateau areas and lumpy morainic deposits.

The Mt Burgess ridge on the east of Sawdon Stream is more like the Rollesby Range with its rolling summit, numerous rounded knobs and rocky outcrops. Side slopes are mostly steep and planar to broadly rounded, and well-dissected by streams. These mostly flow straight down with the exception of the deep, hook-shaped Bullock Creek at the southeast end of the ridge. Rock outcrops in this area are made of conglomerate, a softer sedimentary rock possibly explaining the shape of the gully and giving a knobbly appearance to the rock outcrops rather than angular. The ridge overall however is probably comprised of harder rock than the Mt Edward ridge. It grades into weakly schistose, non-foliated, greywacke/argillite (a metamorphic rock, Chlorite Subzone 2 of the Haast Schist Group) at the head of the valley and on the east side, explaining the distinctive sculpted, angular micro-topography of the surface of the eastern slopes with numerous little criss-crossing ledges, slabby appearance and the absence of scree. The ridge summit itself has large areas of mostly stable scree with peri-glacial patterns evident (such as frost stripes), extending down-slope into the valley. Colluvium mantles the lower slopes and numerous alluvial fans spread out on to the valley floor, some incised streams. Fans are often truncated with a short scarp face, by Sawdon Stream. A large lumpy rock slide/debris flow exists on the true right, with a truncated toe.

(iii) The *Basin floor areas of outwash and alluvial plains* The outwash plains are made up of deposits of glacial till and fluvio-glacial outwash, as well as alluvium derived from these deposits. The outwash gravels and alluvium are associated with a series of late Pleistocene ice advances and recessions that occurred during three main ice advances named from oldest to youngest as Balmoral, Mt John and Tekapo formations. The gravels and alluvium deposited downstream of the ice fronts have formed a series of fan and terrace surfaces – older fans and terraces can be correlated with the Balmoral Formation and intermediate fans and terraces with Mount John and Tekapo formations. Young fans and terraces are of post-glacial age and their deposits either overlie glacial outwash or have cut into these deposits.

On Holbrook, the flats and terraces are made up of all three different aged surfaces. The higher terrace on which the Holbrook homestead sits is an older terrace correlated with the Balmoral formation, and the lower outwash surface is correlated with the Mt John formation with a 2-3m terrace scarp separating the two. Sawdon Stream and its immediate terraces and Greys River and its tributaries are on gently sloping terraces, fans and floodplains of more recent (post-glacial) alluvial material. Sterickers Mound (769m) is a greywacke hill that rises out from the plain in the east like an island. The older terraces are well drained soils formed from shallow to moderately deep deposits of loess with a high content of fine sand. The slightly younger and lower outwash surface

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are excessively drained and uneven with much shallower and sandy soils made into a series of shallow swales and low dune-like mounds.

Between the basin floor and the mountain ranges in areas such as the sides of the upper Sawdon Stream catchment, upper Greys River and its side tributaries are gently sloping terraces, fans and floodplains of intermediate age.

2.1.3 Climate

These three properties sit on the very edge of the Mackenzie Basin and share the basin's continental like climate of hot summers and cold winters with a more wetter and cloudier climate on the Rollesby Range, Two Thumbs and around Burkes Pass.

According to climate records from Tekapo, rainfall averages 600mm per year and is normally evenly spread throughout the year, although there is a wide seasonal and annual variability from year to year. Fairlie averages 730 mm of rain and 1880 hours of sunshine per year with less rainfall falling in the winter months. These properties are however, on the edge of the basin and rainfall at Burkes Pass and on the tops of the ranges would be higher due to the strong moist easterly and southerly winds which predominate and the normal increase of precipitation with altitude. A South Canterbury Catchment Board publication on the Opihi River shows rainfall isohytes of 900 mm on the slopes immediately above Burkes Pass and up to 1400mm on that part of the Two Thumb Range around Mt Burgess.

In the basin, snow falls on average on 6-12 days each year, the months May through to September having more than one day of snow per month. However, snow may fall during any month (NZ Met. Service, 1983).

The continental character of the Basin is reflected in annual, diurnal and extreme ranges in temperature. The nocturnal radiation-cooling characteristic of intermontane basins and the influx of cold air by downslope drainage at night from neighbouring mountains leads to the likelihood of low night temperatures at any time of the year and accounts for the large mean daily range in temperature. In addition to the marked diurnal range in temperature, there is clearly defined contrast between summer and lower winter temperatures.

The basin enjoys high sunshine hours, averaging 2000-2300 per year (cf. Christchurch which averages 1970 hours). There is no season which may be called frost free, and the months of April to November have, on average, more than 10 days with frost.

2.1.4 Vegetation

This section of the report describes the main vegetation communities in 5 main parts – the mountainlands of Holbrook, the lowlands of Holbrook, the northern valley system of Rollesby, the lower hill country of Rollesby and Glenrock, and the uplands of Rollesby and Glenrock.

1. Mountain lands of Holbrook

These are the parts of the lease north of State Highway 8, with the exception of the broad valley bottom of Sawdon Stream where it emerges onto the lowland plain. The vegetation description is divided into four parts, to reflect the main ecological patterns:

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a) Land below 900m asl.

On hillslopes with a sunny northerly aspect, most of the original tussock grassland and shrubland has been replaced with fairly sparse exotic pasture dominated by sweet vernal and browntop. Fescue tussock is common, silver tussock (*Poa cita*) and narrow-leaved snow tussock (*Chionochloa rigida*) are present, mouse-ear hawkweed (*Hieracium pilosella*) is abundant and golden speargrass (*Aciphylla aurea*) is scattered. Some rocky faces have patches of shrubland containing matagouri (*Discaria toumatou*), mingimingi (*Coprosma propinqua*), porcupine bush (*Melicytus alpinus*) and *Olearia odorata*. Prostrate kowhai (*Sophora prostrata*) is present in one dry site.

On hillslopes with a shaded southerly aspect, snow tussock grasslands are the predominant vegetation cover down to about 800m. They are dominated by narrow-leaved snow tussock, but also have sweet vernal, browntop, fescue tussock, mouse-ear hawkweed and golden speargrass throughout. Shrubs, mainly matagouri, are common in places. Woody weeds, including exotic conifers, rowan (*Sorbus aucuparia*) and broom (*Cytisus scoparius*) are present. In seepages, *Carex coriacea* is dominant.

b) Land 900-1400m asl.

Snow tussock grasslands are the predominant vegetation cover. Narrow-leaved snow tussock (*Chionochloa rigida*) is generally dominant up to 1100m asl., above which slim snow tussock (*Chionochloa macra*) assumes dominance. The tussocks form more continuous cover on shady (southerly) slopes, where they are often accompanied by turpentine scrub (*Dracophyllum uniflorum*), other shrubs, subalpine herbs and giant speargrass (*Aciphylla scott-thomsonii*). The cirque NE of Mt Edward is cloaked in a dense cover of tussock, in which are dotted a few wilding exotic pines.

On drier sunny (northerly) slopes, especially below 1100m asl., the tussock cover is generally less dense and is interrupted by bare areas, pasture of sweet vernal and browntop (with mouse-ear hawkweed) and scatterings of matagouri. Golden speargrass is common throughout.

Ridge crests are usually stony and fairly depleted of vegetation cover. On them are growing scattered tussocks, mouse-ear hawkweed and a range of native alpine and subalpine herbs including mountain daisies (*Celmisia* spp.), scabweeds (*Raoulia* spp.) and gentians (*Gentiana corymbifera*).

Rock outcrops are common and support native alpine and subalpine shrubs and herbs. These include *Helichrysum plumeum*, a local endemic yellow-flowered compact shrub daisy. Also present are the mountain daisies *Celmisia lyallii, C. gracilenta, C. angustifolia* and *Brachyglottis haastii*, coral broom (*Carmichaelia crassicaule*), dwarf broom (*C. monroi*), snowberry (*Gaultheria depressa*), tauhinu (*Ozothamnus leptophyllus*), native daphnes (*Pimelea oreophila* and *P. traversii*), dwarf heath (*Pentachondra pumila*) and the shrub daisy *Brachyglottis cassinioides.*

c) Land above 1400m asl.

The land at high altitude is predominantly rocky and has numerous rugged outcrops and screes. It encounters the most extreme climate of the lease land. As a result, the

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vegetation cover is composed mainly of alpine plants adapted to such conditions and is increasingly sparse the higher the altitude. The only exotic plant occurring frequently is mouse-ear hawkweed. The tussock grassland is dominated by slim snow tussock, often lush and dense. It is often accompanied by turpentine scrub, particularly on shady slopes.

On ridge crests are extensive herbfields, cushion fields and dwarf shrublands, accompanied by tussocks. The dominant herbs are mountain daisies (*Celmisia lyallii, C. angustifolia, C. semicordata, C. sessiliflora* and *C. viscosa*). Cushion plants include *Chionohebe pulvinaris*, vegetable sheep (*Raoulia eximia*), *Raoulia grandifolia, R. hookeri, Phyllachne colensoi, Oreobolus strictus* and woolly moss (*Racomitrium* sp.). There are mini heathlands formed of *Dracophyllum prostrum* and *D. muscoides*. Other dwarf shrubs include whipcord hebes (*Hebe lycopodioides* and *H. tetrasticha*). Other plants of note are the alpine buttercups *Ranunculus crithmifolius* and *R. haastii*, both growing in stonefields, South Island edelweiss (*Leucogenes grandiceps*) and *Helichrysum plumeum*, growing on rock outcrops.

Screes have some distinctive plants. These include vegetable sheep, *Haastia sinclairii*, *Myosotis* aff. *australis*, *Aciphylla monroi* and *A. dobsonii*. *A. dobsonii* is near the northern end of its range.

d) Valleys

There are two main valleys, Sawdon Stream and Dead Mans Creek. Sawdon Stream is much the larger, and has extensive flats and fans, whilst Dead Mans Creek has smaller versions of the same features. In the flood-prone channels of gravels and boulders are scattered grasses (sweet vernal, browntop, fescue tussock and silver tussock). Willow herb (*Epilobium melanocaulon*), *Muehlenbeckia axillaris* and scabweeds (*Raoulia* spp.) are common among the gravel, and monkey musk (*Mimulus guttatus*) is prevalent in permanently wet places.

In places not prone to flooding, the main vegetation is pasture containing sweet vernal, browntop, fescue tussock and silver tussock. Shrubland is common. It is dominated by matagouri, but also contains *Olearia bullata, O. odorata, O. cymbifolia, Bradyglottis cassinioides*, tauhinu (*Ozothamnus leptophyllus*), native brooms (*Carmichaelia australis* and *C. crassicaule*), mingimingi (*Coprosma propinqua*), *C. intertexta*, porcupine bush (*Melicytus alpinus*) and lacebark (*Hoheria lyallii*). Bracken, shield fern (*Polystichum vestitum*) and large speargrasses (*Aciphylla aurea* and *A. scott-thomsonii*) are present on some banks. Scabweeds are common on dry heavily-grazed fans.

2. Lowlands of Holbrook

a) Sawdon Flats

North of State Highway 8, where Sawdon Stream emerges onto the lowland plain is a very gently sloping fan and terrace. It is clad in pasture of sweet vernal and browntop, with fescue tussock. Rushes and sedges, especially *Carex coriacea*, are dominant in damp sites. Willows grow along the stream sides in places.

South of the highway is similar vegetation on a high terrace, on the upper flats and on the stable surfaces flanking Sawdon Stream. The majority of the area south of the road though is a broad arid plain of stones and loess soils with much more sparse vegetation cover. Plants make up about half the ground cover, and are small and low-growing. Small bushes of matagouri and fescue tussocks are scattered along the crests of mounds.

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Otherwise, the vegetation is composed of small grasses (browntop, *Poa cdensoi* and *Poa maniototo* mainly), mouse-ear hawkweed, scabweeds (*Raoulia australis, R. subsericea* and *R. hookeri*), *Muehlenbeckia axillaris*, *Leucopogon fraseri*, sheep's sorrel (*Rumex acetosella*), mosses, lichens (including tumble lichen, *Chondropsis semiviridis*), *Coprosma petriei* and *Scleranthus uniflorus*. Less common are *Carmichaelia nana*, *Hebe pimelioides* and *Pimelea pulvinaris*, and in the NW corner is a small population of the rare native cress *Lepidium sisymbrioides* subsp. *sisymbrioides*. A small native convolvulus, *Convolulus verecundus*, seasonally appears in spring, before dying away in summer. This habitat has virtual desert conditions and the vegetation is distinctive.

b) Sterickers Mound

Most of Sterickers Mound is clothed in fairly sparse pasture of sweet vernal and browntop, with fescue tussock, silver tussock and much mouse-ear hawkweed. There are small areas of matagouri scrub, and on the eastern flank are also scaattered shrubs of *Olearia odorata*, prostrate kowhai, shrub broom (*Carmichaelia australis*), coral broom (*C. crassicaule*), porcupine shrub and *Muehlenbeckia complexa*. Also there are golden speargrass (*Aciphylla aurea*) and swamp speargrass (*A. subflabellata*) in damper sites.

3. Northern valley system of Rollesby

The upper part of the Grays River catchment, south and west of Burkes Pass is clad in tussock grassland dominated by narrow-leaved snow tussock. There are patches and strips of exotic pasture, expanses of matagouri, scattered golden speargrass (*Aciphylla aurea*) and patches of bracken (*Pteridium esculentum*). Fescue tussock (*Festuca novae-zelandiae*) is fairly common. The area has been fertilised, and some parts cultivated, but overall still retains natural integrity.

The lower valley system has more modified vegetation. There is much more exotic pasture (sweet vernal and browntop, with some fescue tussock). In moist channels, rushes and sedges, particularly *Carex coriacea*, are dominant. They are flanked by silver tussock (*Poa cita*), narrow-leaved snow tussock and occasional swamp speargrass (*Aciphylla subflabellata*), golden speargrass and shrubs of matagouri, *Coprosma intertexta* and *Olearia bullata*. Watercress (*Rorippa nasturtium-aquaticum*) and monkey musk (*Mimulus guttatus*) are abundant in very wet sites.

Where Grays River flows at the base of the hills at the north-western extremity of Glenrock pastoral lease (just SE of Sterickers Mound) is a substantial wetland. It has areas of tussock sedge (*Carex secta*) and other sedges (especially *Carex flagellifera, C. coriacea* and *Eleocharis acuta*), stands of crack willows (*Salix fragilis*) and some open water ponds fringed with rushes, sedges, watercress and monkey musk. Wetlands are rare in this arid country, particularly those like this one that have not been physically modified.

4. Lower hill country of Rollesby and Glenrock

On the lower hill country (below about 900m asl.), the former tussock grasslands and shrublands have largely been replaced. Now, arid exotic pasture is generally predominant. Sweet vernal and browntop are the main grasses, and mouse-ear hawkweed is abundant. Fescue tussock and narrow-leaved snow tussock are scattered throughout, but denser on shaded (southerly) faces. Golden speargrass and matagouri are also common. There is a considerable amount of bare ground, particularly on sunny (northerly) faces. In some such places, especially where there are loess soils, heavy

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grazing and much rabbit activity, scabweeds (*Raoulia australis* in particular) are abundant and cushion plants such as the dwarf broom *Carmichaelia nana* are present.

There are extensive shrublands in some of the valleys and on some southern and eastern slopes. These are dominated by matagouri and also contain, to varying degrees, fescue tussock, narrow-leaved snow tussock, silver tussock, golden speargrass, native shrub broom (*Carmichaelia australis*), shrub daisy (*Olearia odorata*), mingimingi (*Coprosma propinqua*), tauhinu (*Ozothamnus leptophylla*), porcupine shrub (*Melicytus alpinus*) and pohuehue (*Muehlenbeckia complexa*). Giant speargrass (*Aciphylla scott-thomsonii*) is present in some shaded sites. *Carex coriacea* is dominant in seepages and boggy places, sometimes accompanied by tussock sedge (*C. secta*) and swamp speargrass (*Aciphylla subflabellata*). These communities are modified by grazing, burning, oversowing, fertiliser application and clearance using physical and chemical means, but still retain strong natural character.

In the lower portion of the valley that flows south into the Mackenzie River near Mackenzie Pass is a distinctive rocky gorge. The locally endemic compact shrub daisy *Helichrysum plumeum* is common on the rocks. Also present are *Hebe odora*, turpentine scrub (*Dracophyllum uniflorum*), *Olearia cymbifolia*, *O. bullata*, coral broom (*Carmichaelia crassicaule*), *Astelia nervosa*, shield fern (*Polystichum vestitum*) and whahariki (mountain flax, *Phormium cookianum*). Giant speargrass is abundant. This combination reflects the more shaded and moist microclimate there, compared with that elsewhere on the lease.

At the western end of Mackenzie Pass, where the river emerges onto a gentle fan on the edge of the plain, is a flight of river terraces surmounted by hill scarps with occasional rock banks (stable talus). There is much riparian shrubland of matagouri, native shrub broom, shrub daisy (*Olearia odorata*), mingimingi (*Coprosma propinqua*), *Coprosma intertexta*, tauhinu (*Ozothamnus leptophylla*), porcupine shrub (*Melicytus alpinus*) and pohuehue (*Muehlenbeckia complexa*). Blue wheat grass (*Elymus solandri*) and the native climber *Clematis marata* are present. Golden speargrass is common. Dwarf brooms (*Carmichaelia monoi* and possibly also *C. corrugata*), cushion daphne (*Pimelea pulvinaris*) and scabweeds (*Raoulia* spp.) are growing on the terrace flats.

On the dry steep rocky slope above the wetland described in 3. above, is an area of shrubland that is more botanically significant. Prostrate kowhai (*Sophora prostrata*) is common there, mingled with matagouri, mingimingi (*Coprosma propinqua*), *Coprosma virescens*, pohuehue and porcupine shrub (*Melicytus alpinus*). Native blue wheat grass (*Elymus solandri*) is present, protected from grazing by shrub entanglements, and scabweed (*Raoulia australis*) is present in open ground. Shrubland like this, especially with prostrate kowhai and *Coprosma virescens*, is rare in the region.

3. Uplands of Glenrock and Rollesby

Above about 900m asl., snow tussock grasslands are the predominant vegetation cover. Narrow-leaved snow tussock (*Chionochloa rigida*) is generally dominant up to 1100m asl., above which slim snow tussock (*Chionochloa macra*) assumes dominance. The tussocks form more continuous cover on shady (southerly) slopes, where they are often accompanied by turpentine scrub (*Dracophyllum uniflorum*) and giant speargrass. On drier sunny (northerly) slopes, especially below 1100m asl., the tussock cover is generally less dense and is interrupted by bare areas, pasture of sweet vernal and browntop (with mouse-ear hawkweed) and scatterings of matagouri. Golden speargrass is common throughout.

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Shrublands containing matagouri, turpentine scrub, native shrub broom (*Carmichaelia australis*), shrub daisy (*Olearia odorata*) and mingimingi (*Coprosma propinqua*) occur in gullies, but are not extensive on Rollesby. They are more extensive on Glenrock where in addition to *Olearia odorata*, shrublands also contain *Olearia cymbifolia* and *Olearia bullata*, as well as hebes (*H. subalpina* and *H. odora*). They are accompanied by speargrasses and snow tussocks. Seepages usually contain *Carex coriacea* and bog-rush (*Schoenus pauciflorus*).

Rock outcrops, particularly on Glenrock are numerous and support a different kind of vegetation, made of subalpine shrubs and herbs. These include *Helichrysum plumeum*, a local endemic yellow-flowered compact shrub daisy. Also present are the mountain daisies *Celmisia lyallii, C. gracilenta* and *Brachyglottis haastii*, coral broom (*Carmichaelia crassicaule*), dwarf brooms (*C. monroi* and *C. nana*), snowberry (*Gaultheria depressa*), tauhinu (*Ozothamnus leptophyllus*), native daphne *Pimelea oreophila*, dwarf heath (*Pentachondra pumila*) and the whipcord hebes *Hebe lycopodioides* and *H. tetrasticha*. Scabweeds (*Raoulia hookeri* and *R. subsericea*) and the shrub daisy *Brachyglottis cassinioides* are also associated with rocky areas.

Discussion – Previous assessments for conservation

Parts of Holbrook, Rollesby and Glenrock have been identified in the past as worthy of protection for conservation in the Mackenzie PNAP Survey report. Pukaki RAP 18 - Sterickers Mound was recommended as a site representing a diverse, dryland scrub community and a small *Carex secta* wetland as well as habitat for the robust grasshopper. Subsequently PASAC recommended that Sterickers Mound itself, the oversown area to the south and other areas to the east of the powerlines (immediately west of Haldon Road) be withdrawn from the recommendation and an investigation into the status of the robust grasshopper be initiated. This meant the wetland, and the dry shrubland were removed. This boundary was changed again in the mid-1990's in District Plan submissions as a reflection of detailed grasshopper distribution data obtained from a subsequent survey. The site put forward for inclusion in the District plan focussed on a piece of land around Sawdon Stream – reduced from PASAC recommendation, but with a slightly extended boundary west and south.

The other priority natural areas identified in the PNA survey were in the Grampians District Grampians RAP 1 and 2. Grampians 1 was recommended as it represented an excellent example of alpine *Dracophyllum/Chionochloa macra* association on shady southern aspects, and Grampians 2 was a good example of the tors on the Rollesby Range. As part of DOC's submission on proposed plan change 21 by the Mackenzie District Council in the early 1990's these two were combined and extended to better reflect the extent of the vegetation communities on the ground. Dr Bill Lee from Landcare looked at the area in 1996 as part of further submissions on the new Mackenzie District plan and justified these extensions saying that the communities included – the best developed fellfield and associated rock outcrops and boulderfields in the headwaters of the Mackenzie River, and included the best concentration of *Raoulia eximia* in the District, and the locally endemic shrub daisy *Helichrysum plumeum*. Other vegetation communities represented were impressive swards of slim tussock grassland at relatively lower elevations, widespread *Dracophyllum uniflorum* shrubland amongst tussockland, and extensive, vigorous *Chionochloa rigida* grassland, over a broad elevation range. The vegetation is in excellent condition apart from some small areas of modified tussockland or oversown areas of *Lotus pedunculatus* and pasture species. In addition these new extended boundaries made the area large enough to sustain a full range of successional processes and plant communities.

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2.5 Fauna

2.5.1 Birds

As a result of a faunal survey undertaken in February 2001 and from previous visits a total of thirty-three species of birds have been recorded on this property. This comprises six endemic, eleven native and sixteen introduced species. Appendix 2 has a list of these species which include 3 threatened species - black fronted tern, banded dotterel, and New Zealand falcon. The two main habitats for these birds are Sawdon Stream and adjacent flats, as well as the uplands of all three properties. Sawdon Stream and adjacent flats are important for banded dotterel, black fronted tern, black billed gull, white-faced heron and pied oystercatcher who feed and sometimes nest along this stream habitat.

2.5.2 Freshwater Fish

Sampling of freshwater fish was carried out by using an electric fishing machine in the Mackenzie River, Red Hut Stream (a tributary of the Grays River) and on Sawdon Stream upstream of SH8 bridge. A total of five species of freshwater fish were found on these properties including alpine galaxiid, Canterbury galaxiid, upland bully, and in the Mackenzie River brown and rainbow trout. Because of the lack of trout the upper Sawdon Stream turns out to be a very important river for indigenous freshwater fish. Large numbers of invertebrates and freshwater fish were recovered and if trout are kept out of the stream galaxids and bullies have a good chance of continued survival without competition from introduced salmonids.

2.5.3 Reptiles

The sampling of reptiles was carried out by visual searching of likely habitats on all three properties. This information was supplemented from existing data collected over a number of years by various people. A total of seven species of reptiles were recorded from these pastoral leases. The endemic skinks recorded included scree skink which inhabits screes, and dry streambeds in the Two Thumb Range and in the Mackenzie Range. This species is rare and has a category B ranking. Also known from Holbrook, and with a category B ranking is the long toed skink which was found in the rocky scree areas of Mt Edwards during the 1980s. Other reptiles known from these properties are the spotted skink, common skink, Maccans skin and the common grey gecko.

2.5.4 Invertebrates

2.5.4.1 Holbrook

Holbrook Pastoral Lease was surveyed for invertebrates during mild but cool overcast weather between 20-24th February 2001. 84 species of insect were curated and identified from the survey. This included 10 orthoptera (crickets, grasshoppers and weta), 4 cicada species, 10 beetles, 14 caddis and 48 moths and butterflies. The lease is rich for day flying moths in the family crambidae, with 17 species. Seven insects of conservation concern were found. Threatened species included three category A species, two category B and two species of conservation concern - category I.

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Setting - Holbrook spans from 580 m on an extensive ancient outwash area of the McKenzie Basin floor to over 1900 m at Mt Edward in the extensive Two Thumb Range. Mountainous landforms provide a variety of habitat classes for invertebrates. Broadly these include; (1) subnival and alpine habitat, (2) moderately steep grasslands dissected by gullies and intruded by screes, (3) narrow cascading streams that become braided, (4) valley floor fan and terrace lands with rock, grass and shrub.

Inter-montane basin landforms are linked to the above systems and are themselves diverse. These include: (1) old toeslope fans cut by outwash erosion, (2) a broadly planer area of old exposed outwash channels overlaid by dunes and (3) braided channels with ephemeral water. Significant rainshadow-droughty conditions, wind erosion and frost action, are important to interpreting the communities now present.

Habitats

1. *Subnival and alpine habitat*

Sub-nival habitats (above the limit of continuous grassland) were not sampled for invertebrates and thus questions remain about the biogeography of the fauna above 1600 m asl. on Mt. Edward. However it is an outpost of the ranges stretching northward to the Main Divide beyond Lake Tekapo. The fauna may therefore represent an eastern extension of South Island Main Divide communities.

Extensive and also diverse alpine communities are largely natural (Figures 1,2,3,4). Three large bodied flightless insects were found sheltering in rock outcrops at 1600 m (Figure 1). The tor weta *Hemideina maori*, (characteristic of such sites) and the weevil *Anagotis latirostrus*. Both insects feed in prostrate shrubs and herbs as adults. The third species is the giant speargrass weevil *Lyperobius carinatus* (Category I, uncertain conservation status in Molloy and Davis 1994 and Category A, threatened, in Pawson and Emberson 2000) which was feeding on *Aciphylla monoi*.

Alpine scree and stable talus grasshopper *Brachaspis nivalis* is common and two black cicada *Maoricicada clamitans* and *M. phaeroptera* are also characteristic of the habitat (Figure 2), each giving their distinctive calls when sun and reflected heat from stones permit. Extensive low heaths of *Drachophylum muscoides* and *D. pronum* (Figure 2) harbour the day flying moth *Aponotoreas anthracias*. Other day active moths found near Mount Burgess include *Dasyuris partheniata* (larvae on speargrasses), *Notoreas chioneres* (larvae on *Kellaria* spp. heaths) and *Notoreas* sp. larvae on *Pimelea* spp. heaths). The strikingly patterned species *Aponotoreas insignis* also lives below 1400 m with larvae in *Chionocloa* spp. grasses. *Dasyuris erysii* (Category B, Pawson and Emberson 2000) was common between 1200-1400 m asl.

Two predatory carabid ground beetles, *Megadromus* sp. nr. *fultoni* (Category I, Molloy and Davis 1994) and *Mecodema sculpturatum*, were found at 1450 m near Mount Maude. There was no evidence of these at lower elevation.

The faunal assemblage is indicative of species rich alpine prostrate shrub and herbfield communities of eastern Canterbury mountains.

2. *Moderately steep grasslands dissected by gullies and intruded by screes*

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These communities retain native invertebrate elements despite a history of severe fire disturbance. Species recorded that reflect a range of habitats are briefly noted as follows. Moth *Orocrambus crenaeus* and longjawed spider *Tetragnatha* sp. from wet flushes. Moth *Eudonia philerga* from rock faces. *Austrocidaria gobiata* from *Coprosma* spp. shrubs and darkling beetle *Artystona* species from shrub bark. Herb and grassland insects were also abundant. However, scree communities were not sampled. They are extensive and specialist insects including scree weta *Deinacrida crassidens* are likely to be present.

These communities are likely well represented in the Two Thumb Ecological District with some in protected areas.

3. *Narrow cascading streams that become braided - Upper Dead Mans Creek, Sawdon Stream and Bullock Creek*

Above 1100 m, caddis, stoneflies and mayflies will be alpine specialists including some species limited to mid Canterbury-north Otago mountains. The aquatic fauna below 1100 m was shown to have a fauna typical of stony streams of high water quality found anywhere in the South Island. Stream bank habitats may be of more regional significance for invertebrates dependant on moist habitats and remnant vegetation that has survived fire. These habitats remain important for the adults of aquatic insects. However, insects of surrounding depleted open grasslands were more evident.

Braided stream channels provide a significantly different habitat. This fauna is un-surveyed but the species of aquatic insects represented will be similar to those upstream. However, additional species will be present including species harboured in the deeper gravels. Community structure is influenced by additional fish species and by bed movement in floods followed by periods of stable flow. Back channel pools fed by small tributary waters or springs in the gravels are sites for dispersing pond insects. And some caddis and stonefly species are specialists of permanent seepage in the adjacent slopes.

Aquatic communities are perhaps the most natural communities in the valley floor. They will be representative of communities found widely in mountain lands of the Two Thumb Ecological Region. Seepage faunas are vulnerable to stock and to vegetation change and the stream faunas will be sensitive to potential nutrient enrichment or water harvesting activities in the catchment.

4. *Valley floor fan and terrace lands with rock, grass and shrub*

Seven crambid moth species were found here including *Orocrambus sophistes* a rare grassland moth (Category B. Pawson and Emberson 2000). These and other insects such as grasshoppper *Phaulacridium marginale*, small black cicada *Maoricicada campbelli* and boulder butterfly characterised the depleted dry grasslands, native herb associations and bare soils found here. Where there are damper soils, porina moth *Wiseana umbraculata* and longhorn grasshopper *Conocephalus bilineatus* were recorded. During the survey, shrubland was not effectively sampled. But a noteable mixed shrubland of several hectares in extent is present on the true left of Sawdon Stream where the valley ends. It includes a population of *Olearia odorata* shrubs. *O. odorata* is rich in insect species, many of which only feed on these shrubs. Twenty moth species (15 specialist feeders) are known from *O. Odorata* (Patrick 2000). Insects were not effectively sampled from *Olearia* on the leases, however, specialist insects are likely to be present and worthy of protection.

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These valley floor communities have lost some important elements but are still dominated by native invertebrates. The floodplain herb communities, terrace short grass communities and shrublands of the lower Sawdon Valley may well be the most intact of those found in drought prone valleys of the Two Thumb Ecological District.

6. *Basin floor – Sawdon Flats*

Over much of this area, bare ground is the dominant ground cover. Bare ground and low- growing communities such as native grasses and prostrate plants have probably always been a significant part of this habitat. The integrity of the dune forms and low fertility of the soils is characteristic of this type of soil developed on fluvio-glacial gravels overlain by varying depths of sandy alluvium. The survey indicates very high intrinsic value for ground dwelling invertebrates and insects that bask in reflected heat.

The threatened grasshopper *Brachaspis robustus* (Category A, Molloy and Davis 1994) is a specialist of such lowland sites and is joined by grasshopper *Sigaus minutus* as mid Canterbury endemics. These appear to be patchily distributed over the entire area. The rare moths *Orocrambus* "McKenzie Basin" and *Orocrambus sophistes* (Category A & B respectively, Pawson and Emberson 2000), were recorded. These are day flying species of lowland open grassland however there are few sites known and records are occasional. These moths along with ten other crambid moth species indicate a distinctive habitat character for the Sawdon Flats. A number of other insects representative of lowland terraces were noted. Burrowing in sandy soil are larvae of two species of stilleto fly *Anabarhynchus* spp., the specialist carabid beetle *Metaglyma aberans* and Tekapo ground weta *Hemiandrus* sp. "Tekapo". These flies, beetle and weta all have fragmented and local distributions. The moth *Dichromodes sphaeriata* basks on stones, while the larvae feed on lichens. It was common during sampling and indicates the unusual nature of the site since such species are usually known from rock outcrop or bouldery floodplain.

7. *Reaches of Deadmans Stream and Sawdon Stream that cross Sawdon Flats*

Where streams emerge out onto fans and terraces at the western toe of the range and the McKenzie Basin, stream flows are often seasonal. Daily variations in water temperatures are probably extreme. And shallow unconfined channel forms, subsurface flows and storm-flow ponding add extra dimensions to habitat diversity. This is a feature inherent to the McKenzie Ecological region. However, little protection has been afforded such systems.

Both permanent and ephemeral stream channels draining the Two Thumb Range are linkages between mountain streams and the Grays River channel out on the basin floor. Such seasonal streams also link to seasonal wetlands.

2.5.4.2 Invertebrates on Glenrock and Rollesby

These two leases were inspected during mild dry late summer conditions (21 - 24th February 2001). 84 species of native insect and two spiders were curated and identified from the survey. These include 5 grasshopper species, four cicadas, 11 beetles, 7 caddis and 37 moths and butterflies. The crambid day flying moth fauna is particularly rich with 15 species found in the survey. Five insects of conservation concern were found including one status A and three status B (Pawson and Emberson 2000, Molloy and

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Davis 1994). Overall, the fauna surveyed on the Rollesby Range was distinct from the fauna also surveyed on the adjacent Two Thumb Range.

Setting: Glenrock and Rollesby Pastoral Leases together span the length of the Rollesby Range. The range is of modest height (up to 1377 m asl.) and strongly influenced by the dry continental climate of the eastern McKenzie Basin. Relief is subdued and rounded having escaped severe glaciation of the neighbouring mountains. The drainage pattern reflects this and the effect of the low annual rainfall. Most water courses are impermanent and shallowly incised. South of the range, the headwaters of the McKenzie River are an exception, being cut into bedrock and perhaps being much older in origin.

Habitats include; extensive grasslands and herbfield, rock outcrop, stable talus, shrubland, wetland, stream and shallow pan. These are discussed below.

Grasslands and herbfield

On the flats these are very depleted from rabbits and pastoralism, but are recovering at higher elevation and responding to fertiliser on the McKenzie River faces. At higher and lower elevations aspect is important. Southern and eastern aspects of valleys frequently retain native grass, speargrass and shrub elements.

Above 900 m the rare Speargrass weevil *Lyperobius huttoni* (Category B Molloy and Davis 1994;) is common on golden speargrasss *Aciphylla aurea*. This weevil was not found on the adjacent Two Thumb Range during the survey and has several isolated disjunct populations. The brightly coloured moth *Dasyuris enysii* (Category B Pawson and Emberson 2000) was locally common basking on stones among speargrass (its possible host) and along the road. Several insects represented in native grasslands of Canterbury include the weevil *Anagotis latirostris*, cicada *Kikihia angusta* and bag moth *Oiophora unicolor*. Representative day flying moths of alpine snow tussock grassland included the colourful *Asaphodes clarata* and moths *A. insignis*, *A. chionogramma* and *Orocrambus crenaeus*.

A very rich day flying moth fauna is found basking and flying low over alpine herb, rock and lichen sites (Figure 1). These include; *Eudonia ?aspidota*, *Notoreas galaxias* (larvae on *Kellaria dieffenbachii*) and *Paranotoreas brephosata* (larvae on *Epilobium* spp.). Also above 900 m in such open sites were black cicada *Maoricicada darnitans* and tiger beetle *Neocicindella dunedensis*.

On sunny dry slopes and terraces below 900 m (Figure 8), grasses are scarce, bare earth dominates and *Raoulia* spp. plus other herbs are the substrates for insect activity. Grasshoppers *Sigaus australis*, *S. campestris* and *Phaulacridium marginale* are numerous. The singing of *Maoricicada campbelli* and *M. oromelaena* is striking in the hottest parts of the day. All these insects are intrinsic to drought prone grasslands east of The Divide which are depleted but have retained natural character. The boulder butterfly *Boldenaria* species (figure 12) is common on *Muehlenbeckia axillaris* on slopes and also on terraces and fans.

Rock outcrop and stable talus

Lichen feeding moths in the genus *Dichromodes* will be common (not sampled). However these sites (Figure 5, 6) are most important for ground dwelling invertebrates finding refuge among rocks and for insects feeding on plants associated with rock refugia. Insects of the former class include larger carabid beetles *Megadromus antarcticus*

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and *Megadromus* sp.nr. *fultoni*. Insects of the latter include stick insects (not sampled) and copper butterflies *Antipodolycaena* species both feeding on *Muehlenbeckia australis*. Male black cicada *Maoricicada oromelaena* use large rocks for calling but live the rest of the life cycle in adjacent grassland. Many other insects are also associated in this way with rock outcrop. The fauna sampled indicate that a range of native plant elements associated with outcrops persist and maintain the integrity and representativeness of outcrop and talus communities.

Shrublands

Communities of importance are comprised of remnant elements redeveloping after extensive historical use of fire. They are associated with shaded south-eastern slopes, wet seepages, wetland and rocky refugia (see figures 3, 5 & 6). There is also widespread open matagouri/grassland that is at its best on outwash at the toe of the Rollesby Range. Generally, however, shrubland is a scarce and skeletal community.

Shrubs of *Olearia odorata* and *O. bullata* are rich in insect species, many of which only feed on these shrubs. Twenty moth species (15 specialist feeders) are known from *O. Odorata* and 10 are known from *O. bullata* (Patrick 2000). Insects were not effectively sampled from *Olearia* on the leases, however, specialist insects are likely to be present and worthy of protection. Also of note is the bluff and shrubland on the eastern side of Grays River opposite Sterickers Mound. The moth *Hieroderis frigida* was common hovering in *Sophora prostrata*. It is a detritus feeder that specialises in dry shrubland sites. Kowhai species are also rich hosts for moths and other insects.

The headwaters of the McKenzie River includes a south facing gully with the snow tussock *Chionochloa rigida* of tall stature and areas of shrubland (Figure 3). Diverse vegetation elements include the turpentine shrub *Dracophyllum longifolium*, the prickly shield fern *Polystichum vestitum*, mountain flax *Phormium cookianum* and the spear-grass *Aciphylla scott-thompsoni*. The assemblage of invertebrates will match this complexity. However, of importance for this valley is the build up of litter layers following a long period since fire and perhaps lighter grazing. Litter dwelling communities in the range will be best represented here.

Wetlands and Streams
Mackenzie River, Grays River and tributaries

These flowing waters (eg. figures 3,4) have a diverse fauna that is very typical of stony streams of high water quality found anywhere in the South Island. The diversity sampled includes 18 species of caddis, two stoneflies, scorpionfly *Nannochorista philpotti* and toebiter, *Archicaulioides diversus*. In the valleys, the stream bank habitats are of more regional significance for invertebrates dependant on moist habitats and vegetation. As well the rock surfaces (particularly Mackenzie River) are basking sites for tiger beetles *Neocicindela latecincta*, shore bugs *Saldula* species and some cicadas, moths and butterflies.

Permanent wetlands

Wetlands found in the head of the Grays River on Rollesby and Glenrock near Sterickers Mound and Dog Kennel Corner are extremely productive habitats for insects which is in marked contrast to the surrounding environment and indicates the importance of water in the region. The insect fauna is characteristic of fertile wetland sites found in eastern South Island. A range of fly species in the families; chironomidae

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midges, empididae marchflies and syrphidae hoverflies are abundant and plant hoppers (cicadellidae and cercopidae) are swept in large numbers from rushes, sedges and grasses. The cryptic long stem shaped spider *Tetragnatha* species is also abundant. Aquatic insects include moth *Hygraula nitens*, blue damselfly *Austrolesthes colensonis*, redcoat damselfly *Xanthocnemis zealandica* and caddis *Psilichorema tautoru*. Crickets *Pteronemobius nigrovus* and longhorn grasshopper *Coenocephalus bilineatus* inhabits wet flush grasses and numerous flower feeding insects including copper butterflies *Antipodolycaena* sp. and flower beetles *Dasytes ?subcyaneus* are thriving on marginal vegetation. *Olearia bullata*, is a shrub associated with wetland margins and wet flush sites. It is host to a rich moth fauna of which some elements are rare (Patrick 2000).

A range of predatory insects, fish and birds will be dependant on the insects (secondary production) just described. There will also be a refuge and dispersal role of wetlands for a fauna that can make seasonal use of surrounding lands. The ecosystem importance and value are increased by the aridity of the settings for the wetland and flush sites.

Seasonal wetlands and streams

Where streams emerge out onto fans and terraces at the western toe of the range and the Mackenzie Basin, stream flows are often seasonal. Daily variations in water temperatures are probably extreme. And shallow unconfined channel forms, subsurface flows and storm-flow ponding add extra dimensions to habitat diversity. This is a feature inherent to the Mackenzie Ecological region. However, little protection has been afforded such systems.

An ephemeral wetland system located at the southern end of Glenrock at Haldon Road is the only known locality for the threatened moth *Orocrambus fugitivellus* (Category A; Pawson and Emberson 2000). The site has seasonally damp areas of grasses and sedges where moth larvae will be feeding. The community includes *Carex ovalis, Baumea sp., Juncus gregifolius, Poa cita, Agrostis capillaris, Potentilla anserinoides, Phleum pratense and Crassula multicaulis*. Vegetation is dominated by exotics. However, invertebrates including the moth *O. fugitivellus* are more dependant on the seasonal physical processes in the environment than on a specific host plant.
Both permanent and ephemeral stream channels draining the Rollesby Range are linkages between mountain streams and the Grays River channel out on the basin floor. Such seasonal streams also link to wetlands.

Shallow pan

The dry climate which prevails over the western parts of the two leases (on the edge of the Mackenzie Basin) means that annual water evaporation potential far exceeds rainfall. Thus a variety of shallow tarn and pan sites can be found adjacent to Grays River and on Sterickers Mound for example. Map area D on Glenrock PL encloses an arid pan flat and toe slope at the western limit of the Rollesby Range (figure 9,10). The site was very dry at the time of sampling. Soils are exposed and during dry periods, bare ground is the dominant cover in much of the area. Soils included bare gravels and exposed loess. Exotic and introduced dryland herbs are present and also diminutive native grasses (*Poa* spp.), prostrate and cushion forming plants and drifts of tumble lichen *Chondropsis semiviridis*. Patches of soft sand and loess are burrowed by rabbits and also by Tekapo ground weta *Hemiandrus* sp. "Tekapo" and tunnelweb spider *Hexathele petrei* (Figure 11). Both species are large bodied dryland specialists able to survive by remaining in deep burrows (about 300 mm deep) during the day and emerging at night.

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The weta is endemic to the Mackenzie Basin where only a few sites are protected. The spider *H. petrei* is only documented from similar pan areas in Central Otago. Thus the record is either a significant new range extension or an undescribed but related species. The site features many other specialist insects of dry herbfield, short tussock and bare ground. For example, stilleto fly *Anabarhynchus* sp. and black cicada *Maoricicada campbelli*. Three regionally endemic moths are; *Kiwaia* species (on *Raoulia* cushion), *Orocrambus* "Mackenzie Basin" (category A, Pawson and Emberson 2000) and *Orocrambus sophistes* (category B, Pawson and Emberson 2000). The grasshopper *Sigaus minutus* was only on fine gravels while the grasshopper *Phaulacridium marginale* was also found on the adjacent toe slope.

This assemblage of insects and spider, which includes rare species, will be unique to bare herbfield sites and pans of the Mackenzie Basin.

2.5.5 Problem animals

Rabbits are known to be present on some of the lower altitude blocks on Glenrock and Holbrook. Due to RHD, populations are currently very low. This could change, however, should RHD cease to function. Pest proneness figures from the RLMP report written in the early 1990's showed a considerable number of blocks that have a high proneness (95-100% on Kerr scale).

Thar are known to be present within the mountain area of Holbrook at the far south-eastern extent of feral range, and were seen during the field survey. Occasional chamois are known to move through the higher altitude areas, although due to their limited numbers, do not pose any significant threat. There have been unconfirmed reports of fallow deer being present along the Rollesby Range.

Wallabies are known to exist in the basins at the head of Sawdon Stream although in very low densities. This area is contained within the official Wallaby Containment Area as identified within Environment Canterbury's regional pest management strategy (RPMS).

2.6 Historic

Rollesby (including what is now Glenrock), was taken up by the Kennaway brothers in about 1857. At that time it included part of Opawa and part of Clayton so the boundaries were - to the north - from the Sawdon boundary at the Opihi River, just east of a branch of the Tengawai River which divided it from Albury; another branch of the Tengawai River bounded it from Opawa in the south; and the Rollesby Range on the west divided it from Grays Hills Station. Glenrock was a subdivision of Rollesby taken for soldier settlement in 1917. Holbrook on the other hand was subdivided from Sawdon in about 1912.

Historic sites

Most of the known historic sites in the area are on land immediately adjacent to the property. These include the Burke memorial, Dog Kennel Corner, and Mackenzie monument. These are all memorials to early European exploration and settlement of the Mackenzie Basin. The other main feature of historic interest on the property is the old "bullock" track that cuts across the south-eastern corner of Holbrook flats from the Haldon Road south of Sterickers Mound. It then heads south-west across Greys Hills

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to the Tekapo River and onto Maryburn, Simons Hill, and Simons Pass to the Pukaki River. Used in the very early settlement of the basin as the "road" from Burkes Pass to the Pukaki River and beyond, little evidence remains on the ground, but the line can be seen from the air and is marked on maps as legal road as far as the Pukaki River.

2.7 Public recreation

2.7.1 Physical characteristics

According to the FMC guidelines Holbrook, Rollesby and Glenrock would be mainly within an "open space" recreational experience zoning. For open space the descriptors are semi-natural grasslands under extensive grazing, accessible by roads, off-road vehicles and foot tracks.

According to DOC's recreation opportunity descriptors Simons Hill has the primary characteristics of a back-country environment – primarily "4 x 4 drive in". This means that the property is a modified environment but one that is generally dominated by natural vegetation or landscapes and is natural looking. It is accessible to all terrain vehicles and is traversed mainly by ungravelled roads, or 4 x 4 access. Obvious elements of modification include roads and areas of farming or forestry.

2.7.2 Legal access

There are at least 6 legal access ways into Holbrook, Rollesby and Glenrock (i) State Highway 8 which cuts through the middle of Holbrook and separates Holbrook from Rollesby (ii) Haldon Road which provides legal access to parts of all three properties (iii) a legal road which comes off the Haldon Road and cuts through the far south-eastern corner of Holbrook (on what looks to be the same line as the old bullock track) and (iv) the Mackenzie Pass Road which follows part of the southern boundary of Glenrock. There are also legal roads from the Rollesby Road to the Rollesby boundary in two places, only one of which follows a formed track (into Rollesby Station (freehold)).

2.7.3 Activities

The main activities that occur on Glenrock, Rollesby and Holbrook are occasional mountain-biking, 4 wheel drive, tramping, hunting and ski-touring. Mt Edwards is a reasonably popular tramping venue, with access along the ridge between Edwards Stream and Dead Mans Creek on Sawdon the normal route for parties to gain access to the mountain. Mt Maude and the Two Thumb Range are sometimes climbed from the Mt Dobson ski-area and are used occasionally in winter as a traverse from Mt Dobson. There is some hunting activity on the lease with thar and chamois found along the Two Thumb Range – associated with the Mt Dobson/Firewood Creek Conservation Area and probably migratory. A permit system operates and permits can be obtained from any DOC office. Wallabies have also spread into the area from the Hunter Hills and are sometimes sought by hunters. There are a number of good 4 w.d. tracks on the tops of these properties which provide access for mountain-bikes, 4 wheel drive vehicles and horse trekkers.

PART 3

CONSULTATION AND OTHER PLANS

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3.1 Consultation

Two meetings were held with representatives from Canterbury Landrover Club, NZ Deerstalkers Association, Federated Mountain Clubs, Peninsula Tramping Club, NZ Mountain Bike Association, Friends of the Lewis, Forest and Bird, Canterbury Botanical Society and Over 40s Tramping Club, Geraldine Tramping Club, South Canterbury Fish and Game, New Zealand Alpine Club and Public Access New Zealand (PANZ) on 12 December 2000 in Christchurch and 13 December in Timaru to discuss a number of pastoral leases under tenure review including Holbrook, Rollesby and Glenrock. Issues raised on these properties were ones of access, landscape and tussockland protection.

In particular the areas mentioned were the high landscape values around Burkes Pass and the need to manage the tussock grasslands in a representative reserve. The main recreation areas mentioned were to gain access from the State Highway to the Two Thumb Range and from Mt Maude/Mt Burgess back down Sawdon Stream, as well as along the tops of the Rollesby Range from Burkes Pass to Mackenzie Pass for horses, mountain bikes and 4 wheel drives. The need for off-road parking at the Mackenzie Pass was also mentioned, as well as the magnificent views and the potential for hang-gliding off the tops.

Subsequent to the meeting Alan Evans, representing FMC, submitted a letter and a map re-emphasising the points on access and noting the need for signage and off-road parking, as well as proposing Conservation Area at the head of Sawdon Stream and a small tussock reserve near the Haldon corner.

3.2 District Plans (Matters of National Importance)

Holbrook, Glenrock and Rollesby pastoral leases lie within the Mackenzie District. The Proposed District Plan, as amended by Council decisions, was notified in September 1999.

Under this plan Holbrook, Glenrock and Rollesby pastoral leases are zoned Rural. The schedule of Sites of Natural Significance in the Proposed Plan identifies three sites located within these three pastoral leases:

- Site 51(c) (Haldon Road Wetland) which extends onto the south-western corner of Glenrock and is recognised for its invertebrate values (see s. 2.5.4 of this report on the area containing *Orocrambus fugitivellus*);
- Site 51(a) (Sawdon Stream), located on Holbrook Station, includes part of RAP Tekapo 18 and is habitat for the robust grasshopper (*Brachaspis robustus*); and
- Site 51 (Rollesby/Dalgety Ranges) covers part of Glenrock and Rollesby Stations and includes two RAPs with an extended area between.

The Proposed District Plan contains a number of rules relating to land use activities within sites of natural significance, within riparian areas[10] and in the high altitude areas (i.e., areas above 900m):

[10] within 75m of certain specified lakes in the Mackenzie Basin or 50m of any other lake, 20m of a bank of specified rivers in the Mackenzie Basin or 10 m of a bank of any other river, and within 50m of a wetland.

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- No clearance of indigenous vegetation (in the case of riparian areas – no vegetation) to exceed 100m^2 per hectare in any continuous period of 5 years, except for declared weed pests or for the purpose of track maintenance or habitat enhancement;
- No earthworks to exceed 20m^3 (volume) or 50m^2 (area) per hectare in any continuous period of 5 years, except for the purpose of track maintenance (applies to earthworks in sites of natural significance, riparian areas and over 900m);
- No pastoral intensification to exceed 5% of any site of natural significance, except where that activity is provided for under a consent under the Crown Pastoral Land Act, or other management plan or covenant ratified by the District Council;
- No tree planting in sites of natural significance or above 900m, but forestry up to a maximum of 2 hectares per Certificate of Title is a controlled activity within a wetland and riparian areas;

Site 51 (Rollesby/Dalgety Ranges) was re-assessed in 1996 as part of the District Plan process. The original site 51 was subsequently split into four different Sites (51, 51a, 51b and 51c). At the same time, the boundaries of the new Site 51 (Rollesby/Dalgety Ranges) were altered to exclude an area of low natural value and to avoid unnecessary duplication.

As part of the District Plan process, the Mackenzie District Council held Site hearings. Subsequent to the hearings, Council amended and reduced the boundaries of Site 51. The Council felt the redefined area included the bulk of the significant values of the Site while also recognising development plans of the land occupiers. Council also considered that because of the large area involved in the extended Site as proposed by the Department, the Crown Pastoral Land Act and the high altitude provisions of the Proposed District Plan were the most appropriate mechanisms to protect the values of the extended Site.

The Department lodged a reference with the Environment Court seeking to have the boundaries of Site 51 re-instated. However, following discussions with various people from within the Department, it was decided that while the whole Site still contained the values for which it was originally identified, the Department would withdraw the reference in favour of other mechanisms to secure the long-term protection of this Site. It was recognised the majority of the Site being sought was over 900m in altitude and there would be some measure of protection through the 900m rules in the District Plan. In addition, it was also known that some of the properties bordered by Site 51 were due to enter tenure review and that the tenure review process could be relied upon to identify those areas within Site 51 that had the highest conservation value.

3.3 Conservation Management Strategies (CMS)

Holbrook, Glenrock and Rollesby pastoral leases lie in the CMS unit known as Waitaki. The key priorities for this unit are:

- to identify, maintain and seek to enhance the natural landscapes and natural landscape values of the unit – through appropriate methods such as tenure review and district plans
- to identify the significant native vegetation and threatened species of the unit and to use a range of effect methods to protect a representative range of indigenous biodiversity of the unit as well as protecting and enhancing the viability of priority threatened species populations and their habitats in the unit.

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- *For recreation and access the Conservancy's objectives are to provide new recreational facilities and opportunities by the Department and other organisations and concessionaires where natural and historic resources and cultural values are not compromised, and to liase with adjacent landholders to resolve conflicts over access for recreation to land managed by the Department.*
- *To reduce and maintain rabbit and thar densities to levels that ensure their adverse effects on natural values are minimised*

Other priorities identified in the CMS that are Conservancy wide and relevant to tenure review on these properties are – to undertake necessary actions to secure the conservation of Category A and B species, including predator control, fencing and habitat protection. The species listed as priority include Carmichaelia curta, the robust grasshopper, scree skink, long-toed skink, black-fronted tern and banded dotterel.

PART 4

MAPS

4.1 Topo/cadastral
4.2 Landscape units
4.2 Values

Appendix 1 *Property Level Landscape Description*

At the property level, 6 different landscape units can be recognised (refer Maps Two A&B):

1. Sawdon Outwash Surface

- *This is a large part of the very extensive fluvio-glacial outwash surface of greywacke gravels between Edward Stream and Sawdon Stream. It covers an area of around 9 sq. km, that piece on Holbrook representing about half of the total outwash surface in a roughly square shape unrelated to the topography. The surface slopes evenly north to south, ranging in altitude from 550m to 500m asl. The surface topography is made up of a consistent series of sinuous shallow swales and low dune-like mounds all flowing in a southerly direction, created by streams and wind over hundreds of years.*

- *The vegetation cover is also consistent, emphasising the topography and reflecting the well-drained and shallow soils. Hieracium, native mat plants and mosses are the dominant cover overall, with locally dominant sweet vernal and browntop grassland and sparse short tussock. The overall appearance is grey/brown, which at a distance suggests a bleak lifeless plain. However, closer inspection reveals a surprising variety of plant cover. Dark tan/olive coloured native mat plants cover most of the mound areas, with a mosaic of bare ground and hieracium dominating in the swales which appear paler in colour and more hummocky. Pale lime/grey mosses and Raoulia spp. (scabweeds), sweet vernal and browntop grasses appear throughout, the latter often concentrated in moister areas. Some patches of short tussock appear on the mounds close to the Holbrook terrace at the north-western end. There are occasional patches of stunted matagouri scrub. The surface has a very hummocky to pock-marked appearance due to depletion of vegetation cover in a mosaic pattern and to extensive rabbit burrowing which is particularly noticeable around the mounds which are highly amenable to the creation of warrens.*
- *Apart from the severe depletion of vegetation and dry conditions, the area retains a highly natural appearance and the remarkable consistency which characterises the outwash plain. The boundary fence parallelled by vehicle tracks is the only notable human feature. At present the fence is almost invisible from a distance.*

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2. Undeveloped Basin Floors, Terraces and Fans:

(a) *Rollesby Basin*

- a broad, shallowly concave basin between two hill areas at the north end of the Rollesby Range ranging from 700m to 750m asl . Contains part of the headwaters of Grays River. Up to 1km across but merges imperceptibly with low-angle fans and colluvium coming off the steep hillslopes around.
- a mosaic of dense vegetation comprising tall tussock, spear grass, matagouri and sweet vernal and browntop grassland, with Carex spp. in wet areas. Matagouri forms dense thickets in places, extending up the side slope gullies. Vegetation thins out and is dominated by sweet vernal and browntop and short tussock on the drier sloping ground about the basin. Drains into swamp areas at the bottom end.
- Fenced into large paddock areas for extensive grazing with 4WD tracking across it. Differential grazing highlights the fencelines as unnatural lines.

(b) *Upper Grays River Swamp*

- a 3-4km long tussock swamp area sandwiched between the north end of the Rollesby Range and SH8 and Haldon road. The main water sources are a branch of the Grays River and Bullock Creek.
- Comprises series of low terraces and floodplain densely vegetated in short and tall tussock and sedges, spear grass, exotic grasses and matagouri. The stream follows a meandering course with small ox-bows. A clump of mature willows lines the watercourse at the "gap" between Sterickers Mound and the Rollesby Range which forms a dry steep-sided rocky knob with extensive native shrub cover (mostly "grey" scrub and prostrate kowhai). A pine shelterbelt borders the northern and western margin. No wildings were apparent in the swamp.
- Extensively grazed as part of a small grazing block in combination with the Rollesby Fans (below) with one fenceline crossing it just upstream of the willows. Overall it appears as a highly natural swamp area with only its upper end unnaturally severed from the Rollesby Basin by cultivated paddock, shelter belt and 4WD track. A small section of swamp exists on the basin side of the developed area.

(c) *Rollesby Fans*

- broad gently sloping alluvial fans of greywacke gravels draining three gullies at the north-west end of the Rollesby Range forming a roughly triangular area around 1 x 1.5km. Altitude ranges from 660m to 700 m asl. Toe of fan truncated by Grays River and the swamp described above forming a short scarp.
- Has a uniform short tussock/sweet vernal and browntop grassland cover with dense thickets of matagouri at the east end.
- Fenced off from hill slopes above, and in association with the swamp area forms a small extensive grazing block.

(d) *Middle Sawdon Flats* –

- a wide, roughly rectangular expanse of greywacke gravel alluvial plain built by Sawdon Stream, lying between Sterickers Mound and the Mt Burgess ridge and Corner Hill. Approximately 1.5km by 2km, ranging from 640m to 680 m asl and draining both towards Sawdon Stream and to Grays River. A few ephemeral channels are visible winding down the plain marked by denser grass growth. A shelter belt and the Haldon Road separates it from Grays Swamp. SH8 bisects the area. Small pond, well used by stock, exists by Sterickers Mound.
- The whole area is well to excessively drained, supporting a sparse short tussock/sweet vernal and browntop/stunted matagouri grassland with areas of bare ground and hieracium. It is not as "grey" and depleted as the outwash surface but retains a golden grassland appearance.