

Crown Pastoral Land Tenure Review

Lease name : HAPPY VALLEY

Lease number : PO 361

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.

August 06

**DOC CONSERVATION RESOURCES REPORT ON
TENURE REVIEW OF**

HAPPY VALLEY PASTORAL LEASE

PAL 14-04-361

**UNDER PART 2 OF THE CROWN PASTORAL LAND
ACT 1998**

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PART 1**INTRODUCTION****1.1 Background**

Happy Valley Pastoral Lease (PL) was inspected between 5-7 December 2005 as part of a pastoral lease tenure review. The review was requested by the lessees of the PL (Duncan and Rae Henderson) and is being undertaken under the provisions of the Crown Pastoral Land Act 1998. As part of the tenure review process, a range of specialists visited the PL and their reports, identifying the inherent values on the PL, have been incorporated in this Conservation Resources Report.

Happy Valley PL comprises approximately 3277ha and is situated on the eastern face of the Carrick Range at the southern end of the Bannockburn Valley. The PL is entirely within the Bannockburn catchment, with the mainstem draining the southern boundary and Duffers Gully draining the northern boundary. Cromwell is the nearest town to the PL.

The PL is situated within the Old Man Ecological District (ED) and is one of 8 districts in the Central Otago Ecological Region. A Protected Natural Areas Programme survey has been undertaken for the Old Man ED. The report noted that part of one recommended area for protection (RAP) is within the PL, this being RAP 1/5: Bannock Burn – Old Woman Range. The relevant extract from the Old Man ED survey is attached (Appendix 1).

Happy Valley PL adjoins conservation unit F42040, being the 3492ha Old Woman Range Conservation Area.

PART 2**INHERENT VALUES: DESCRIPTION OF CONSERVATION RESOURCES AND ASSESSMENT OF SIGNIFICANCE****2.1 Landscape**

The PL is compact in shape taking in several catchments that include the mid and lower sections of the Bannock Burn and one of its main tributaries that drains through Duffers Gully. The PL spans a wide altitudinal range, with its highest point being 1473 situated along the track that leads to the Old Woman Range and descending to near 400 close to the PL's homestead, which is to be found adjacent to the Hawksburn Road.

The PL possesses a strong cultural overlay, with evidence relating to early gold mining, the major sites being located in the lower Duffers Gully and the margins of the Bannock Burn opposite Round Hill.

METHODOLOGY

The PL was inspected from various vantage points along the Nevis-Cromwell Road as well as from the PL's access tracks.

The fundamental components of the landscape assessment included dividing the PL into three landscape units (LU) principally based on drainage pattern and changes in physical relief. Owing to distinct changes in the cross profile and landscape elements; LU2 has been divided into two subunits. The criteria to assess and evaluate each unit's landscape value is based on the following attributes:

- Naturalness – an expression of the indigenous content of the vegetative cover, and the extent of human intervention.
- Legibility – an expression of the clarity of the formative processes and how striking these physical processes are.
- Aesthetic values – The memorability and naturalness of the area including factors, which can make a particular landscape vivid, such as simplicity in landform, muted colours and fine-textured ground cover.
- Visual values – a subset of landscape values and relates to the visibility of a particular landscape or natural feature seen from public vantage points such as along district highways.

LANDSCAPE UNIT 1 (LU1)**Description**

This unit comprises the northeast facing side slopes that descend from Duffers Saddle ridgeline towards the lower Duffers Gully. The saddle at 1173, forms a natural dip in the terrain between the Carrick Range to the north and the higher Old Woman Range

to the south. The saddle forms the divide between watercourses that drain into the Bannock Burn in the north and the Nevis River towards the south. Cutting across the saddle is the historic Carrick Water Race that has its origins in Coal Creek within the Nevis Valley. The Nevis Road is also located here.

Physical features include the uplands that form the edge to the Old Woman Range and Duffers Saddle where smooth, rounded topography is occasionally broken by uplifted terrain created by the uneven thawing of surface ice. Also present are fell fields and alpine flushes. The drainage pattern is an intricate network of permanent and ephemeral watercourses linking to form a stream that drains into the Bannock Burn via the lower Duffers Gully. Periodically, distinctive tors stud the ground surface. Disjointed gullies, separated by narrow spur lines that contain rock outcropping typifies the mid and lower slopes. One gully features substantial rock bluffs. Patches of wind erosion are evident on the drier and sunnier slopes.

The lower and toe slopes are characterised by gently rolling ridgelines divided by gullies. Across this lower country there is an absence of rocky outcrops, principally due to the deep mantle of colluvium that covers the ground surface. The Duffers Gully Valley floor is bowl-like and merges with the adjoining toe slopes. During the early 1860s the valley was mined for alluvial gold and now features a random pattern of stacked rock, tailings, sludge channels and signs of early habitation in the form of stone cottages or solitary chimneys. In places the watercourse has been diverted to the sides of the valley, which gave the gold miners access to the original stream's bed.

The vegetation cover of the upper slopes, is mainly fescue and blue tussock, with occasional remnants of narrow-leaved snow tussock. In Duffers Gully the tussock cover is sparser with an abundance of golden Spaniard. The ground surface of the upper extents is covered in prostrate *Dracophyllum*, cushion plants and grey lichens. Pavement rocks, bare ground and flushes form the origins of the small watercourse. At about 1100 is a belt of short tussock grasslands that includes a high component of introduced grasses. Below about the 1000 contour there are woody shrubs with a band of matagouri/sweet briar shrublands spreading across the mid slopes. In places, the shrublands are extensive while in other areas they are confined solely to the moist gullies. The lower parched slopes, are covered in dryland pasture grasses with a wide scattering of matagouri and sweet briar. Sites of early habitation are signalled by groups of Lombardy poplars, crack willow and gooseberry. Where the Duffers Gully stream has been diverted, the new watercourses are now flanked with *Carex* and sedges.

Landscape Values

Above the 1100m asl contour the unit contains high inherent landscape values attributable to the overall naturalness and intactness of the ground cover, with various plant communities found on the landform. The harsh climate is reflected in natural processes such as the ripply terrain formed by frost heave and the tundra-like vegetation. In aesthetic terms, the upper sections convey an overall sense of coherence attributable to the limited and subtle palette of colours that range from the yellow hues of the tussock to the tawny browns of the tundra country. From a wider perspective, it is important that the upper segment of this unit is not perceived as a single entity, but as an integral component of the district's high country landscape that encompasses the Old Woman Range and the Garvie Mountains further to the south.

The mid and lower sections of the unit possess moderate inherent landscape values due to the disjointed qualities of the ground cover. The induced state of the vegetation, especially the unnatural spread of matagouri and sweet briar, has greatly influenced the landscape characteristics of this area, which is widely known for its semi-arid and grassland traits.

Potential Vulnerability to Change

This unit has the potential to be adversely affected by the following changes in land use and activities:

- Further migration of woody shrubs such as sweet briar into the clean tussocklands.
- Further infiltration of flat weeds such as hawkweed into the tussocklands.
- Stock and four-wheel-drive damage to the fragile tundra and bog areas.
- Introduction of any “built” elements that would severely compromise the existing perception of isolation and semi-wilderness.
- Insensitive boundary fences that would bisect the existing coherent tussock grasslands.
- The loss of heritage/historic elements within Duffers Gully.

SUB LANDSCAPE UNIT 2A (LU2A)

Description

The section of the Bannock Burn catchment that is contained within the PL has been divided into two sub units primarily due to the distinct changes that occur in the cross profile of the catchment.

The limits to LU2A extend from the upper boundary of the PL that cuts across the Bannock Burn catchment generally at 1350m asl to the lower boundary opposite where the Duffers Gully tributary feeds into the main stem of the Bannock Burn at about 600m asl.

The upper section of the sub unit is typified by broad, gently undulating ridgelines with the ground surface being indented by hollows that contain small watercourses that trickle out from alpine flushes. The occasional castellated tor rises abruptly from the ground surface. Within the mid and lower sections of this sub unit the main stem of the Bannock Burn becomes constricted within a well-defined v-shaped valley. The side slopes of the valley are of a constant grade but are irregularly broken by rock formations and straight runnels that drain directly into the Bannock Burn.

The upper section of the sub unit is clad in a patchwork of tall and short tussock grasslands and generally possesses ground covers and natural elements already described within the adjoining LU1. The mid and lower sections of the sub unit are covered in dryland grasses, thickets of matagouri and sweet briar. Along the margins of the Bannock Burn crack willow has become established.

Landscape Values

The upper segment of this sub unit possesses high inherent landscape values and both complements and reinforces the qualities already expressed for LU1. A distinct feature of this sub unit is its sense of uniformity and boundless qualities that merge in with the head of the Bannock Burn, which is Public Conservation Land. Besides its high inherent landscape values, this sub unit would make an ideal setting for backcountry pursuits such as cross-country skiing with these recreational activities being enhanced due to the lack of “built” elements. The mid and lower sections of the sub unit have moderately high inherent landscape values due to the wild and scenic characteristics of the Bannock Burn, which at this point is visually enclosed within a deep rocky valley.

Potential Vulnerability to Change

This sub unit has the potential to be adversely affected by the following changes in land use and activities:

- Further intensification and subdivision of the upper section of this sub unit.
- Introduction of “built” elements that would severely compromise the existing perception of semi-wilderness.
- Stock and four-wheel-drive damage to the fragile tundra and bog areas.

SUB LANDSCAPE UNIT 2B (LU2B)**Description**

LU2B borders onto LU2A opposite the Duffers Gully tributary, while its lower limit is where the Bannock Burn departs from the narrow gorge into the main open Bannockburn Valley. The gorge-like section of the Bannock Burn possesses relatively steep side slopes that are commonly indented by rocky gullies. The Bannock Burn is entrenched within an incised channel that is bordered by cobbles and boulders. Intermittently flanking the stream are alluvial terraces that were extensively “worked” during the early gold mining era. Tangible evidence of the mining includes stacked rocks and gravel tailings. Threading along the mid slopes is a well-maintained water race that provides Bannockburn farmers with a water supply.

The vegetation comprises an assortment of exotic species and remnants of native plant communities. The darker side slopes are clad in large thickets of matagouri and sweet briar while the occasional open clearings are covered in introduced grasses and legumes including browntop, sweet vernal, Yorkshire fog and white clover. Weed species are abundant and include wild gooseberry, sheeps sorrel, blue borage and hemlock. There are random groupings of mature Lombardy poplars growing adjacent to the water race, while crack willow has established itself along the Bannock Burn. The corresponding semi-arid slopes are typically covered in dryland grasses; furthermore, these slopes commonly feature rocky outcrops and rubble-filled gullies.

Landscape Values

This sub unit possesses moderate inherent landscape values principally due to the modified state of the original ground cover. The extensive crack willow has a modifying effect on the wild and scenic characteristics of this gorge-like section of the Bannock Burn.

Potential Vulnerability to Change

This sub unit has the potential to be adversely affected by further spread of invasive exotic species, especially crack willow along the Bannock Burn.

LANDSCAPE UNIT 3 (LU3)**Description**

This unit encompasses the block of high hill country as well as the lower hills that extend out in the north towards the wider Bannockburn Valley. Deep gullies such as Tucker Gully and the lower Duffers Gully physically separate the unit from the balance of the PL.

The unit is dominated by Round Hill, of 809m asl. From this dome-like hill the moderately steep side slopes radiate out towards the gully floors or towards the northern front country.

The side slopes of Round Hill are clad in a pattern of depleted dryland grasses and thickets of matagouri and sweet briar. Sparse scatterings of *Olearia spp.* survive on the darker slopes of the gullies. Occasionally, the moist hollows and gullies are clad in higher quality pasture grasses. The semi-arid ridgelines and front foothills are clothed in drought-tolerant grasses and mats of flat weeds. Where water is accessible the front country has been subdivided into smaller grazing blocks and paddocks and utilized primarily for growing winter supplementary feed. The PL's homestead is situated along the Hawksburn Road. This dwelling, along with auxiliary buildings, nestles amongst a mixture of exotic shade trees.

Landscape Values

This unit contains moderately low inherent landscape values owing to the original ground cover having been converted into dryland pasture, and also due to the wide infestation of woody weeds such as sweet briar.

Potential Vulnerability to Change

This unit has the potential to be adversely affected by the loss of the occasional *Olearia spp.* and further infestation of sweet briar.

VISUAL VALUES

The Happy Valley PL possesses moderately high visual resource values, with the PL bordering the Nevis Road that is becoming increasingly popular as a recreational route between Bannockburn and Garston in Northern Southland. The upper and mid sections of LU1 are visually accessible from the Nevis Road between high points 1209m asl and 1280m asl where views of Duffers Gully dominate the immediate foreground and sweeping views of the Cairnmuir Range form an impressive visual setting.

In visual terms, LU1 is significant as it forms the transition between the more modified low country of the Bannockburn Valley and the high country, with visitors being able to experience tussock grasslands around Duffers Saddle.

Contrasting markedly with the openness and distant vistas that are experienced along the Nevis Road, Duffers Gully and the Bannock Burn convey enclosed qualities and provide the backdrop for the early gold mining era.

Landscape Photographs are attached as Appendix 2

2.1.1 Significance of Landscape

The Happy Valley PL makes a considerable contribution to the landscape character of the broader Bannockburn Valley, which has highly recognisable traits due to its semi-desert-like climate, richness in early gold mining, pastoral farming and more contemporary land uses such as viticulture and lifestyle blocks. Until recently the Bannockburn Valley could have been considered to be a “backwater” of the Cromwell Basin and the Upper Clutha Valley. Descriptive terms that would epitomize the valley include sun-drenched, thirsty country that is rich in nostalgia.

Within this landscape framework both LU1 and LU2A on the PL are significant as they form the northern limits to the expansive upland plateau that encompasses much of the Carrick, Old Woman and Old Man Ranges. Both of these units are contiguous with existing Public Conservation Land that registers similar landscape characteristics. Furthermore, the absence of “built” elements helps to reinforce the backcountry and remoteness qualities of the area. The mid and lower country on the PL is considered to have less inherent landscape values owing to the extent by which the original cover has been altered, although in places these modified areas have a historic and heritage importance as they provide the landscape setting for the extensive gold mining that took place during the early 1860s.

2.2 Landforms & Geology

Geology

The PL comprises a large part of Bannockburn catchment which drains north eastern slopes between the Carrick and Old Woman Ranges below Duffers Saddle. The Old Man ED, is characterised by block faulted mountain ranges and extensive alpine and montane plateau (Brumley et al. 1986). The block faulted landscape is bounded at the eastern and western boundaries by structural depressions (Nevis and Clutha). North eastern parts of the ED including Happy Valley, experience extremes of temperature and dryness.

Basement rock is Haast schist of Caples terrane, textural zone III (well foliated, slightly segregated schist). This is overlain at a stretch of the Bannockburn running southeast below Duffers Gully (where the ford crosses at GR 2205000 5351900) with Tertiary swamp and river sediments, and moderately to strongly weathered alluvium (Turnbull 2000).

In the lower Bannockburn valley on the northeastern part of the PL, Bannockburn and Dunstan formation of Miocene age (lacustrine clay, silt and oil shale with minor lignite seams, basal quartz and conglomerate) and tertiary swamp and river sediments overlie the schist basement rocks (Turnbull 2000). There are many localised sluiced

faces resulting from gold mining activities in the lower Bannockburn. This may cause localised landsliding.

The Dome Burn fault may cross the PL but has not been reported from surface observations (Turnbull 2000). A network of faults (Old Man fault zone) run southeast across the lower altitude (northeastern) corner of the PL.

Sites of geological significance

The Carrick water race is listed as a site of geological importance (Hayward and Kenny 1998). This race was finished in 1876 and was built to carry water from Coal Creek, Nevis Valley over Duffers Saddle to supply goldmines in the Bannockburn area. It is one of the best preserved water races in Otago. Part of it runs across Happy Valley from Duffers Saddle to GR 2203000 5353400. The race is ranked by Hayward and Kenny (1998) as of regional importance, and unlikely to be damaged by humans. However, current and future land uses may have implications beyond the scope of what was considered in setting the original vulnerability ranking. This should be taken into account when activities are proposed at this site in the future. It has been reported that much of the race has now been cleared and its profile modified by mechanical means (Hamel pers com)

Soils

Soils of the Old Man ED are chiefly derived from schist, loess and alluvium. Yellow-brown silt loams including local Obelisk and Carrick soils occur in the high ranges and plateau area, whilst yellow-grey silty-sandy loams dominate the mountain sides, particularly along the Carrick and Old Man Ranges.

New Zealand Geopreservation Inventory

The aim of the New Zealand Geopreservation Inventory (Arand *et al.* 1991) is to identify and document all landforms, geological sites and soil sites of international, national and regional, scientific and educational significance.

2.2.2 Significance of Soils

Happy Valley PL has one soil site of significance, Site 335 – Bannock Burn – Old Woman Range. This soil site is only partially on the Happy Valley PL

- Contains excellent altitudinal sequence of soils under some of the least modified vegetation in Central Otago
- Pedologically interesting soils formed on periglacial landforms
- Lower parts have been burned and oversown.

(Refer Appendix 3 Bannock Burn- Old Woman Range (335) which contains a comprehensive description).

2.3 Land Environments of New Zealand (LENZ)

There are two databases that have been used to assess biodiversity protection (Walker et al 2003).

1. Environmental distinctiveness has been assessed through the Land Environments of New Zealand (LENZ). This is a classification of New Zealand landscapes using a comprehensive set of climate, landform and soil variables chosen for their roles in driving geographic variation in biological patterns (Leathwick et al 2002 & 2003). It is presented at four levels of detail containing 20, 100, 200 or 500 environments nationally. The most detailed is called LENZ Level IV.
2. The area of unprotected indigenous cover in threatened land environments has been identified in the national land cover database (LCDB).

From the above databases, spatial data depicting indigenous cover and legal protection were overlaid on LENZ Level IV environments to identify biodiversity that is most vulnerable (most likely to be lost). This provides a measure for:

- a. percentages legally protected and;
- b. percentages of remaining indigenous cover

The data used for the LENZ environments and LCDB are not refined adequately to provide reliable data at the fine scale of the land examined in this report. However where possible we have field checked the classifications to ensure the technical descriptions match the on the ground situation.

Based on these two criteria, five categories of threatened environments have been used to identify environments containing indigenous biodiversity at most risk of loss. They are classified as follows:

1. **Acutely threatened:** <10% indigenous cover remaining
2. **Chronically threatened:** 10-20% indigenous cover remaining
3. **At risk:** 20-30% indigenous cover remaining
4. **Critically underprotected:** >30% indigenous cover remaining and <10% protected
5. **Underprotected:** >30% indigenous cover remaining and 10-20% protected
6. **No Threat:** >30% indigenous cover remaining and >20% protected

Table 1: Land Environments of New Zealand (LENZ) Units on Happy Valley PL

Level 4 LENZ Unit	% Indigenous cover remaining	%Protected	Indigenous Cover Change 1997-2002	Threat Category	Approximate Area (ha)
K3.3b	7.3	4.58	No Change	Acutely Threatened	24
N4.1b	17.48	0.97	No Change	Chronically Threatened	426
N4.1c	48.58	1.24	No Change	Critically Underprotected	152
N4.1d	18.59	3.04	No Change	Chronically Threatened	123
N4.1e	23.72	2.92	No Change	At Risk	189
N5.2a	0.98	0.42	No Change	Acutely Threatened	37
N6.2a	17.59	6.48	No Change	Chronically Threatened	27
N8.1b	5.18	1.75	Decrease	Acutely Threatened	31
Q1.1a	98.37	24.81	No Change	No Threat Category	127
Q1.1b	77.1	8.43	Decrease	Critically Underprotected	709
Q1.1c	91.23	17.86	No Change	Underprotected	181
Q1.2a	98.99	37.2	No Change	No Threat Category	3
Q2.1b	66.39	4.27	No Change	Critically Underprotected	26
Q2.2a	39.92	3.91	Decrease	Critically Underprotected	893
Q3.1a	66.59	35.8	No Change	No Threat Category	7
Q3.3a	96.91	25.62	No Change	No Threat Category	276
Q3.3b	80.51	0.94	Decrease	Critically Underprotected	46
Total					3277

2.3.1 Significance of LENZ

Happy Valley PL has the following land environments that are nationally significant because the indigenous vegetation has largely been removed, and/or little of the environment is represented in lands protected primarily for conservation purposes.

- ~ 2.82% of the property has Level IV LENZ units that have less than 10% of their land area still in indigenous vegetation cover (whether protected or

unprotected). These include three 'Acutely Threatened' Units (K3.3b, N5.2a and N8.1b).

- ~ 17.64% of the property has Level IV LENZ Units that have 10-20% of indigenous vegetation cover (whether protected or unprotected). These include three 'Chronically Threatened' Units (N4.1b, N4.1d and N6.2a).
- ~ 6% of the property has Level IV LENZ Units that have 20-30% of its land area still in indigenous cover. These include one 'At Risk' Unit (N4.1e).
- ~ 56% of the property has Level IV LENZ Units that have 30% of their land area still in indigenous cover and <10% is protected. These include five 'Critically Underprotected' Units (N4.1c, Q1.1b, Q2.1b, Q2.2a and Q3.3b).
- ~ 5% of the property has Level IV LENZ Units that have >30% of their land area still indigenous cover and 10-20% protected. These include one 'Underprotected' Unit (Q1.1c).
- ~ 13% of the property has Level IV LENZ Units that have >30% of its land area still in indigenous cover and >20% protected. These include four 'No Threat' Units (Q1.1a, Q1.2a, Q3.1a and Q3.3a).

Where indigenous cover remains within these threatened LENZ units, it attains a much greater significance.

LENZ Map and LENZ Units for Happy Valley PL are attached as Appendix 4. Please note the areas on the LENZ map are approximate only.

2.4 Climate

The climate varies with altitude and aspect. Rainfall in the lower country is very low (420mm) and rises to 600-700mm at the range top. Summers are warm and dry, with nor-westerly winds. Winters are cold, with heavy snow falls, snow lies on the tops for 3-4 months. There are high incidences of fog and cloud year round on higher parts of the property.

2.5 Vegetation

Introduction

Prior to this tenure review the botanical significance of the Old Woman Range was known largely from the Protected Natural Areas Survey Programme which surveyed the Old Man ED over two successive summers: 1983-84 and 1984-85 (Brumley et al. 1986). That survey identified 114 ecological units on the basis of 44 major vegetation associations and 16 landform types. Thirteen 1st priority and eight 2nd priority areas were recommended for protection. One of those areas recommended for protection (RAP 1/5 Bannock Burn – Old Woman Range) includes part of Happy Valley PL.

Other field botanists have also surveyed the range and compiled lists of vascular plants e.g. Druce et al. (1993). Their emphasis is likely to have been on less modified and more accessible higher altitude parts of the range.

The present vegetation on the PL is thought to be very different from that in the past. The likely nature and extent of the pre-human vegetation has been assessed as part of a wider study of the woody vegetation of Central Otago (Walker et al. 2003). This suggests that at lowest altitudes (below 440 m) a kanuka-kowhai woodland would have occurred. At higher elevations (up to 1040 m) a beech-Hall's totara-snow totara forest probably prevailed below a bog pine-snow totara-mountain toatoa shrubland rising up to 1340 m. At the very summit of the Old Woman Range, an alpine tussock-shrubland is predicted, with the models predicting dominance by mat-forming and other low-statured woody plants.

Survey Method

Approximately 22 hours were spent on the PL. Survey on foot was carried out across the Old Woman Range summit plateau and down through the middle reaches of the main stem of the Bannock Burn; down and out Duffers Gully from high on the Nevis Road; and with vehicle support, into the Bannock Burn central tributaries. Little time was spent surveying in the most modified north-east corner of the PL although this area was traversed by vehicle on several occasions and observed from a distance. Descriptions were made of the composition of major plant communities and notes taken on the impact of pastoral farming on those communities. Threatened plants were searched for in potentially suitable habitats. Digital photographs were taken of particular species, communities and landscapes to aid in interpretation. Specimens were collected of uncertain taxa for later determination.

Vegetation Description

Round Hill

This block, centred on the prominent Round Hill, occupies the north-eastern corner of the PL, with a southern boundary along the main branches of the Bannock Burn.

Some developed flat land is present around the homestead and associated buildings. Otherwise the vegetation of this mostly hilly, semi-arid block is comprised of exotic grass/mouse-ear hawkweed (*Hieracium pilosella*) communities and mixed matagouri (*Discaria toumatou*)-sweet briar (*Rosa rubiginosa*) shrublands and scrub. Shrublands are best developed on south-facing slopes and reach their greatest extent on the true left of the Bannock Burn.

Duffers Gully

This block covers the northernmost branch of Bannock Burn (named Duffers Gully on topographical map), from Duffers Saddle down to where the gully swings to the south-east.

The highest parts of this block (c. 1200 m) above the water race, on gently rounded ridge crest, have a depleted short tussock- golden speargrass (*Aciphylla aurea*) cover with much bare ground. Inter-tussock ground cover is provided by tussock hawkweed (*Hieracium lepidulum*) and a small number of native species including Maori onion (*Bulbinella angustifolia*), *Poa maniototo*, *Agrostis muscosa*, *Raoulia subsericea*, and *Lycopodium fastigiatum*.

Between c. 900 m – 1150 m the predominant vegetation community is one of scattered hard tussock (*Festuca novae-zelandiae*) with abundant mouse-ear hawkweed and Maori onion. A mix of native and exotic sub-shrubs and herbs are also common in the groundcover. These include *Gaultheria depressa*, *Pimelea oreophila*, *Raoulia subsericea*, *Ranunculus multiscapus*, sweet vernal (*Anthoxanthum odoratum*) and white clover (*Trifolium repens*). Strips of narrow-leaved tussock (*Chionocloa rigida*) occur sporadically along water courses, becoming more common on the steeper slopes immediately flanking the valley floor stream in Duffers Gully.

A highly distinctive snow totara (*Podocarpus nivalis*) shrubland occupies a boulderfield at c. 1100 m on the north side of Duffers Gully. Three discrete patches are present amongst large angular blocks of rock rubble that provide refuge from fire and grazers for a number of otherwise uncommon species in the vicinity. Other shrubs present include *Coprosma dumosa*, *C. cheesemanii*, *Hebe rakaiensis*, *Olearia odorata*, *Myrsine nummularia* and gooseberry (*Ribes uva-crispa*). Ground cover includes *Muehlenbeckia axillaris*, *Celmisia lyallii*, *Acaena anserinifolia*, *Leptinella pectinata* and *Huperzia australiana*.

Below c. 950 m shrubland becomes increasingly prevalent on both sides of the valley, but especially so on the true right. At first they form discrete patches clustered around rocky outcrops but lower in the valley form a more-or-less continuous band extending to the spur crest. These shrublands are dominated by matagouri with other common shrubs being sweet briar, desert broom (*Carmichaelia petriei*), *Olearia odorata* and mountain wineberry. At the bottom of the block, near where the creek takes a turn to the south, are occasional trees of *Olearia lineata*.

One notable cluster of rocks within shrubland, on a hillside bench at 880 m, has two small patches of the rare sedge *Carex inopinata* beneath an overhang. This sheltered site is shared with a range of ferns and herbs including necklace fern (*Asplenium flabellifolium*), *Asplenium richardii*, prickly shield fern (*Polystichum vestitum*), and *Acaena caesiiglauca*. The surrounding stock camp has sweet vernal, barley grass (*Critesion murinum*) and hemlock (*Conium maculatum*).

Bannock Burn central tributaries

This block covers the catchments of numerous small tributaries of Bannock Burn which lie between Duffers Gully to the north and the main stem of Bannock Burn to the south, and rise to the broad crest of the Old Woman Range.

Top of range down to snow line fence at c. 1100 m

Above c.1400 m a low cushion-like shrubland of *Dracophyllum muscoides* and lichen predominates on patterned ground. A wide range of associated sub-shrubs, herbs and grasses include *Raoulia subsericea*, *R. grandiflora*, *Abrotanella inconspicua*, *Hectorella caespitosa*, *Chionohebe densifolia*, *Anisotome imbricata*, *Leptinella goyenii*, *Poa lindsayi*, *Rytidosperma pumilum* and *Craspedia lanata*.

The base of lichen encrusted rock tors provide sheltered, slightly damper sites, which favour little hard fern (*Blechnum penna-marina*), *Ourisia glandulosa*, *Geum leiospermum*, *Myosotis lyallii*, *Pachycladon novae-zelandiae* and *Ranunculus ensysii* ("R. berggrenii" type).

At lower altitude this community continues to occupy small areas on very exposed ridge crests, but elsewhere on colluvial slopes it is replaced by extensive areas of short tussockland and cushionfield. Alpine fescue tussock (*Festuca mathewsii*) and blue tussock (*Poa colensoi*) are very common along with golden speargrass and *Raoulia subsericea*. Other common species include *Leucopogon fraseri*, *Luzula pumilum*, *Scleranthus uniflorus*, *Acaena caesiiglauca*, *Carex wakatipu*, *Gaultheria depressa*, *Raoulia grandiflora*, and *Kelleria villosa*. Small ablation pavements within this community have *Neopaxia sessiliflorum*, *Anisotome flexuosa* and *Brachyscome* sp. Few weed species are present, at least down to c. 1300 . Species encountered include mouse-ear hawkweed, tussock hawkweed and sheep's sorrel (*Rumex acetosella*). Below 1300 m the cover of mouse-ear hawkweed increases sharply towards the snowline fence with a consequent decrease in native short tussock and herbs. Mouse-ear hawkweed is the dominant vegetation cover immediately on the upslope side of the snowline fence.

Narrow-leaved tussock has a patchy distribution and is mostly confined to sheltered gullies and riparian zones, particularly in the northwestern sector. In these areas it often forms a mosaic with short tussocklands and golden speargrass.

Small herb seepages and snowbanks are present where the slopes steepen towards the various Bannock Burn tributaries. These areas of high plant diversity have many recognisable communities separated by subtle changes in micro-topography, hydrology and fertility. Common species include *Psychrophila obtusa*, *Plantago triandra*, *Viola cunninghamii*, *Carex guadichaudiana*, *Gaultheria parvula*, *Abrotanella caespitosa*, *Phyllachne colensoi*, comb sedge (*Oreobolus pectinatus*) and *Euchiton traversii*. Wetter channels are dominated by moss with blinks (*Montia fontana*), *Ranunculus maculatus*, *Colobanthus apetalus* and *Epilobium komarovianum*. Small patches of heavily browsed slim snow tussock (*Chionochloa macra*) occur around the margins. At lower altitude (c. 1200 m) similar herb seepages contain *Pratia angulata*, *Mazus radicans* and *Ranunculus royi*.

Snow line fence down to valley floor

Short tussock cover is greatly improved on the downslope side of the snow line fence. Silver tussock (*Poa cita*) is locally abundant on fertile sites, but the predominant cover is maintained by alpine fescue tussock at highest altitude and hard tussock as altitude decreases. Maori onion is conspicuous throughout. Pasture grasses, especially sweet vernal, and common pasture weeds such as catsear (*Hypochoeris radicata*), also become more common with decreasing altitude.

Two species of native broom are locally abundant on the broad ridge crests between 1000 – 1100 m asl. Coral broom (*Carmichaelia crassicaule*) is present almost entirely as heavily browsed stumps 20-30 cm tall while the dwarf broom (*Carmichaelia vexillata*), although much less affected, also shows browse damage. They occur amongst an open short tussockland with low shrubs of porcupine shrub (*Melicytus alpinus*), golden speargrass and a range of inter-tussock native and exotic herbs including *Acaena buchananii*, *A. caesiiglauca*, *Raoulia subsericea*, *R. parkii*, *R. australis*, mouse-ear hawkweed and catsear. A rare hybrid between coral broom and dwarf broom is also present.

Below c. 1000 m a generally low stature matagouri-dominated shrubland is widespread. Stature, density and diversity improve within riparian zones and on shady aspects. The low statured matagouri is of recent origin but more diverse shrubland patches elsewhere are suggestive of a long period without disturbance. One such area, a dry open shrubland on a north-facing derivative slope, is dominated by *Corokia cotoneaster* inter-mixed with *Coprosma propinqua*, porcupine shrub, mountain wineberry (*Aristotelia fruticosa*) and occasional sweet briar. A range of drought-tolerant herbs and ferns are present including *Senecio quadridentatus*, *Euchiton ruahenicum*, *Raoulia glabra*, *Vittadinia australis*, rock fern (*Cheilanthes sieberi*) and mouse-ear hawkweed. Adjoining shrublands on damper aspects are dominated by matagouri and *Coprosma propinqua*, in association with *Olearia odorata*, *Corokia cotoneaster*, koromiko (*Hebe salicifolia*), porcupine shrub and bush lawyer (*Rubus schmidelioides*).

Within this shrubland matrix are pockets of rough pasture (predominantly sweet vernal and browntop [*Agrostis capillaris*]) and short tussockland with an understorey that includes both exotic and native herbs.

On the lower footslopes of this block, shrublands become restricted to ribbons along gullies and damp channels, and are dominated by sweet briar. Spur crests, and dry north-facing slopes are dominated by mouse-ear hawkweed with occasional short tussock and pasture grasses.

Bannock Burn main stem

This block covers the large deep valley of the main stem of Bannock Burn, down to where it abuts the Round Hill block.

Slim snow tussock on the lip of the periglacial summit area (c. 1300 – 1400 m) soon gives way to dense narrow-leaved tussockland on slumped valley flanks. The tall statured and generally dense tussock cover on the shady faces of the true left, contrasts with the somewhat patchy and discontinuous tall tussock cover on the true right. The generally damp conditions amongst the dense tussock supports a small range of shrubs and herbs including *Ozothamnus vauvilliersii*, *Dracophyllum pronum*, *Olearia bullata*, *Oreomyrrhis ramosa* and *Dolichoglottis lyallii*.

Small stream channels with damp herbaceous margins intersect the tussock slopes. Common wetland plants and those tolerant of periodic inundation include bog rush (*Schoenus pauciflorus*), *Hydrocotyle* “montana”, Maori onion, *Coprosma atropurpurea*, native dock (*Rumex flexuosus*) and cresses (*Cardamine* spp.).

Rubblefield amongst the tussock have a highly diverse flora from tall shrubs to tiny herbs. Taller shrubs are *Coprosma dumosa* and porcupine shrub. Sub-shrubs and herbs include *Leucopogon fraseri*, *Acaena caesiiglauca*, *A. saccaticupula*, *Geranium sessiliflorum*, *Stellaria gracilentia*, *Celmisia brevifolia* and *Helichrysum filicaule*. Ferns are also common and include little hard fern, prickly shield fern, bladder fern (*Cystopteris tasmanica*), alpine shield fern (*Polystichum cystostegia*) and thousand-leaved fern (*Hypolepis millefolium*).

Continuous riparian shrublands begin at c. 1000 m in the valley floor, forming patches of greater areal extent further down the valley. Common shrub species include *Coprosma propinqua*, desert broom, *Olearia odorata*, and *O. bullata* along with the lianes *Clematis marata* and *Muehlenbeckia complexa*. Large riparian shrublands below the dividing valley fence are of similar composition but with the addition of matagouri, mountain wineberry, golden speargrass and sweet briar. The latter becomes increasingly abundant down valley. Damp rock overhangs next to the stream channel have *Carex coriacea*, *Ourisia caespitosa*, prickly shield fern, silver tussock and the exotic Yorkshire fog (*Holcus lanatus*) and tussock hawkweed.

A rock outcrop and overhang on the toe-slope of true right of Bannock Burn has a small population of the rare cress *Pachycladon cheesemanii* in association with *Asplenium richardii*, *Pseudognaphalium luteo-album*, *Epilobium pubens*, *Oxalis exilis* and *Elymus solandri*. This and other similar outcrops are also refuges for uncommon shrubs such as *Coprosma dumosa* and *Olearia cymbifolia*. A derivative slope downstream of the valley fence (true left) has populations of the uncommon herbs *Anisotome cauticola* and *A. brevistylus* on rocky outcrops and cliffs.

Beyond the gorge and riparian zones, hillslope vegetation on both sides of the valley below the dividing fence is considerably modified. Mixed hard tussock/pasture species prevail with considerable Maori onion and a groundcover comprising many native herbs. Pockets of hillslope scrub, mostly matagouri dominated, persist around rocky outcrops and stream channels. In its lowermost reaches within the PL, the Bannock Burn is lined with a dense willow forest.

See Appendix 5 for a full list of plant species

2.5.1 Significance of Vegetation

Happy Valley PL contains representation of the plants and plant communities in the montane, sub-alpine, low-alpine and high alpine bioclimatic zones of the Hawksburn Land System.

RAP 1/5 Bannock Burn – Old Woman encompasses much of the upper half of the Bannock Burn catchment. This part of the RAP is noted in the PNAP report as follows. “*The Bannock Burn catchment covers an extensive altitudinal range incorporating the botanical transition from moist Waikaia alpine communities to dry, northern montane tussock and scrub*” and it contains one of the best tussockland sequences in the District and “*one of the most vigorous and intact stands of narrow-leaved snow tussock, a dense stand of alpine fescue and the most extensive stand of silver tussock in the District.*” The most recent evaluation of the inherent values confirms and endorses the RAP description in Brumley (loc. cit.), but notes reduced values towards the northern extremity of the RAP which may have occurred post PNAP survey. The head of the Bannock Burn outside of, and adjoining the PL, is now protected as part of the Old Woman Range Conservation Area (3492 ha).

At least 190 native vascular species (see Appendix 4) are present representing approximately 52 % of the vascular plant diversity recorded for the much larger (36 183 ha) and ecologically diverse Old Woman and Carrick Ranges (Druce et al. 1993).

Of the native vascular plant species present, at least nine species are listed as threatened and a further one as Data Deficient in the most recent threat classification system (Hitchmough 2002 as amended by de Lange 2004). Species listed as Data Deficient have insufficient information on which to make an assessment as to their appropriate category. A list of these species with their threat of extinction status and distribution within the PL is provided below in (Table 2 and Appendix 6).

Of highest significance is the occurrence of the small sedge *Carex inopinata* (ranking of ‘Nationally Endangered’) in Duffers Gully. Taxa in this category are facing a very high risk of extinction in the wild (Molloy et al. 2002). This is the first record for the ecological district and only the eighth population known nationally. It, and four other species of threatened grassy plants of dry fertile sites, is the subject of a national recovery plan (Jones 2004). This plan urges the physical and legal protection of sites.

Species listed in the category Gradual Decline fall within the division ‘Chronically Threatened’. Species in this division face extinction but are buffered slightly by either a large total population size, or a slow decline rate. Species listed as Sparse and Range Restricted fall under the division “At Risk”. Although they are not currently in decline, their population characteristics mean a new threat could rapidly deplete their populations. Sparse taxa have very small, widely scattered populations

Several other species, although not ranked as nationally threatened, are notable in a regional and local context and include snow totara, *Pimelea aridula*, *Mazus radicans*, and native dock.

Table 2: Threatened and data deficient plant species found on Happy Valley PL

Threat division	Threat category	Species	Location on PL
Acutely threatened	Nationally Endangered	<i>Carex inopinata</i>	One site at base of rock outcrop in Duffers Creek
Chronically threatened	Serious Decline	<i>Carmichaelia vexillata</i>	Bannock Burn central tributaries 1000 -1100 m
		<i>Carmichaelia crassicaule</i>	Bannock Burn central tributaries 1000 -1100 m
	Gradual Decline	<i>Pachycladon cheesemanii</i>	Rock outcrop along main stem of Bannock Burn
		<i>Acaena buchananii</i>	Widespread in areas of short, dry, pasture
At Risk	Sparse	<i>Olearia lineata</i>	Bannock Burn valley floor shrublands
		<i>Ranunculus maculatus</i>	Wetlands near crest of Old Woman Range

		<i>Euchiton paludosus</i>	Alpine streambank herbfield
	Range Restricted	<i>Festuca matthewsii</i> subsp. <i>pisamontis</i>	Base of rock tor on range summit plateau
Data deficient		<i>Vittadinia australis</i>	Several sites including dry open shrubland and short tussockland along Central Bannock Burn tributaries

Low alpine communities (cushionfield on patterned ground, alpine tors, alpine fescue tussocklands, snow banks and herb seepages) are significant as distinctive communities, and for their contribution to contiguous larger areas of these communities. In comparison with the rest of the PL these communities have been least affected by pastoral farming activities.

The impact of past fires, oversowing and subsequent grazing is greatly evident in the subalpine and montane zones. Natural vegetation patterns have been much altered and mouse-ear hawkweed, short tussock, pasture grasses, briar and young matagouri now occupy slopes and terraces that previously supported forest, diverse shrublands and tall tussock grasslands. Highly palatable shrubs such as native brooms are heavily browsed and there is no evidence of recruitment.

Two areas in particular, on the basis of their composition and stature, stand out as having escaped recent disturbance. The first is a dry, open shrubland at c. 800 m dominated by *Corokia cotoneaster*, and surrounded by diverse mixed shrublands. The second area is a shrubland of snow totara at c. 1100 m in Duffers Gully that is likely to be a relict of a formerly more widespread woody community. The importance of woody vegetation, and the desirability of protecting shrublands across a full range of Central Otago environments, has been given prominence by Walker et al. (2003). The recovery of shrublands in the absence of grazing and fire has been demonstrated at several sites in Central Otago (Walker loc. cit.) and is a desirable biodiversity outcome.

Short tussocklands in the montane and subalpine zones, although at least in part induced, are also significant. In their review on the conservation status of New Zealand's indigenous grasslands, Mark & McLennan (2005) noted that of the five major grassland types recognised in their review, the montane to sub-alpine short tussock grassland has fared the worst. Nationally, only 3% of what remains (some 25% of the baseline area) is formally protected with the smallest values in the two South Island sectors where it was most important: the rangeland and eastern regions.

Numerous small seepages and bogs occur within an alpine setting of high natural character. As areas of high species richness, they make a disproportionately high contribution to the biodiversity of the PL. They are favoured as sheep camps and are targeted for grazing. As a consequence, both riparian tussock grasses and diminutive wetland grasses are cropped short. Wetlands nationally have undergone a 90% reduction and remaining examples are a priority for protection. Two threatened

species in Table 2 (*Ranunculus maculatus* and *Euchiton paludosus*) and two regionally uncommon species (*Mazus radicans* and native dock) are found predominantly in wetland habitats.

2.5.2 Problem Plants

At least 26 exotic species of plants are present on the PL but relatively few are of conservation concern. Many are plants of agricultural importance or are common pastoral weeds.

Buddleia (*Buddleja davidii*) is recorded from just one location in Duffers Gully. Elsewhere it is regarded as a serious pest of riverbeds, disrupting normal flow regimes and affecting recreational user access. Its early eradication is recommended.

At least two hawkweeds (*Hieracium pilosella*, and *H. lepidulum*) are widespread in all but the highest altitude communities. The prevalence of mouse-ear hawkweed is concomitant with the loss of taller indigenous cover through grazing. Maintenance and/or restoration of a dense tall tussock cover may reduce the impact and further spread of mouse-ear hawkweed, however the impact and continued spread of tussock hawkweed may be more intractable. Tussock hawkweed presents particular risks to rare species on rock bluff sites (Wardle 1999) which may necessitate site-specific control measures.

2.6 Fauna

2.6.1 Invertebrate Fauna

Introduction

The Old Man, Old Woman and adjacent Carrick Ranges form a nationally important landscape with a significant biological element. Dramatic schist tors are characteristic of the summit ridgelines and numerous insect holotypes or paratypes have been found on these higher elevations, including two grasshopper species (*Alpinacris tumidicauda* and *Sigauss obelisci*), a weevil (*Lyperobius hudsoni*) and moths *Metacrias* and *Notoreas* spp.

An entomological survey was made on an adjoining property by Emberson and Syrett (2004). A number of threatened insect species were found during that survey including parts of the rare, giant southern ground beetle, *Mecodema chiltoni*. During the survey, of the Happy Valley PL a live specimen of *M. chiltoni* was found, suggesting that populations of the beetle still exist on the Old Woman Range.

Survey methods

Invertebrates were collected by hand searching beneath rocks and logs, aspirating, sweeping vegetation, and by pitfall traps and a yellow pan trap. Collecting effort was targeted towards endemic taxa of the following groups; Arachnids (spiders and harvestmen), beetles, Orthopteroids (grasshoppers, weta and cockroaches) and

Myriapoda (millipedes and centipedes). Species within these taxonomic groups often display local endemism and flightlessness.

Invertebrates were collected from spot sites, chosen to maximise altitudinal range, diversity of native vegetation and access to the least (visually) modified areas of the PL. (See Appendix 7, Map 1)

Areas of the PL surveyed, habitat descriptions and invertebrates found:

A) North block: Duffers Gully headwaters and true left slopes (Sites 1,2,3,4,5,6,7 – Appendix 7)

This area was traversed on foot and invertebrates were collected along a descent into Duffers Gully. The tussockland community at site 1 comprises *Chionochloa macra*, *Aciphylla aurea* and *Bulbinella angustifolia*. Invertebrates active or found in this habitat included the ground weta *Zealandosandrus maculifrons* (ex. water race), butterflies (the common Copper), *Eudonia* tussock moths and the native soldier fly (*Odontomyia chloris*), which feeds on nectar and pollen.

At sites 2, 3, 4 and 5 many interesting invertebrates were collected, all associated with the talus slopes which occur below schist tors. These stonefield habitats provide suitable refugia for many cryptic invertebrates. At site 3 for example, an extensive patch of snow totara (*Podocarpus nivalis*) exists and a search beneath the heavy mats of vegetation produced a (data-deficient) alpine spider (*Neoramia alta*), a large native pill millipede (*Procyliosoma* sp.), the smaller, more common coiling millipede (*Icosidesmus olivaceus*) and an abundance of two cockroach species (*Celatoblatta quinque maculata* and *C. anisoptera*). The threatened spider *Neoramia alta*, was first described from Lake Alta on the Remarkables Range by Forster and Wilton (1973) and is an Otago endemic. By threat definition, information is lacking regarding the biology, habitat or range of *N. alta*.

A diverse range of native hunting spiders was collected amongst the talus slopes. Species included a *Miturga* prowling spider, a specimen of *Clubiona* (hopping spiders) and a *Cycloctenus* species, possibly *C. westlandicus*: Cycloctenidae. These fast moving spiders (known as ‘scuttling spiders’), are common in native forests, and only occasionally found above the bushline or in drier country. They are easily distinguished by their eye arrangement (Forster and Forster 1999).

Carabid beetles found within the area included *Mecodema lucidum* (beneath schist slabs at site 5) and a species of *Metaglymma* possibly *M. aberrans*. These species are of conservation interest on account of their taxonomic status and sensitivity to soil changes. Both *Mecodema* and all *Metaglymma* species are soil burrowers and any change to the texture of upper soil layers may cause population decline. Such disturbance is common in oversown, ploughed and/or rabbit infested lands (Johns 2005).

Numerous *Sigaüs australis* grasshoppers and occasional *Phaulacridium marginale* (the common small grasshopper) were active throughout the surrounding tussock country. Within the same environment the robust speargrass weevil *Inophloeus*

sulcifer, was frequently seen feeding on the leaves and flower spikes of *Aciphylla aurea*.

At sites 6 and 7, Duffers Gully creek, an extensive tussock and shrubland habitat is present. Matagouri, *Coprosma* spp. broadleaf, *Muehlenbeckia australis* and exotic briar rose are the dominant species. Beating *Coprosma propinqua* produced an abundance of native crab spiders (*Diaea ambara*), wheat and seed bugs (*Rhyodes* sp. and *Nysius huttoni*:Lygaeidae) and flower beetles (*Dasytes* sp.). The common South Island alpine cicada, *Maoricicada campbelli* was abundant throughout as was a background chirping of *Bobilla* native crickets. A large *Uropetala chiltoni* mountain dragonfly was found perching under a rock outcrop very near Duffers Gully creek. The Old Man Range marks the known southern range of *U. chiltoni* and Happy Valley PL is close to that limit. The dragonfly was likely to be newly emerged as Otago and Canterbury populations fly between between December and January (Rowe 1987).

A single, live, specimen of the giant ground beetle *Mecodema chiltoni* was collected from site 7, beneath a rock on the true left bank of Duffers Gully some metres from the creek (GR: E2203639 N5552321). The habitat was not especially natural, nor high (815m) and no other individuals were found. Live *Mecodema chiltoni* were last collected from the Carrick range in 1979 (Barratt 1993), however Rowan Emberson and Pauline Syrett recorded *M. chiltoni* body parts on the Carrick range (near Watts Rock), during their tenure review survey of an adjoining property in 2004. This present finding is therefore a new location record for the species and highly significant because beetle populations have declined in the Old Woman and Carrick Ranges since collections began in 1965 (Emberson and Syrett 2004; pers. comm. 2006).

Site 7 produced a second threatened species, the water spider *Dolomedes aquaticaus*. The spider is classified as data-deficient and was found beneath river stones.

Area B) South eastern block: Old Woman Range summit (Sites 8,9,10 – Appendix 7)

Schist tors, snow tussock, speargrass and wet-flushes are characteristic of this part of the PL, which reaches 1473m. Cockroaches (*C. quinque maculata*) and darkling beetles (*Artystona vicina*) were common amongst schist slabs of an outcrop at site 8. Both species are able to withstand the severe freeze-thaw cycles at this altitude. Numerous ground weta (*Zealandosandrus maculifrons*) were recovered from two nights of pitfall trapping at site 9. These nocturnally active, sturdy ground weta are found throughout much of the South Island but not commonly seen. The species has been the subject of taxonomic confusion and Johns (2001), has asserted that the genus be synonymised under *Hemiandrus*, despite the characteristic long ovipositor in female *Zealandosandrus* species. The synonymy is largely based on recent specimens with ovipositors of intermediate length between the type specimens of the two genera. Other species found in the pitfall traps included the Carabid beetles; *Neoferonia procerula* an Otago / Southland endemic and a large *Megadromus* species (possibly *M. sandageri*). Both beetles are of general conservation interest on account of their endemism and habitat requirements.

A yellow pan trap placed at site 9, returned an abundance of Muscid and Scirid flies (root gnats), both of which are attracted to yellow flowers. No native bees were found in the trap, an unusual situation given the presence of yellow and white flowering native plants e.g. *Celmisia*, *Aciphylla* and *Bulbinella*. By contrast, numerous drowned ground weta (*Z. maculifrons*) were found in the trap, obviously having climbed the 15cm sidewalls. While walking through the tussock in this sampling area, high numbers of grasshoppers were active including the Otago / Southland endemic *Alpinacris tumidicauda* and the more common *Sigauss australis*.

Site 10 represented a wet-flush habitat, fed by snow-melt and seepage. Abundant were many insects associated with flowers, including the small metallic blue Melyrid beetle *Dasytes* sp., collected from *Myosotis* flowers. Occasional Bhyrrid beetles (*Liochoria* sp.) were also found on the pin cushion Anisotome (*Anisotome imbricata*). These attractive metallic green, spherical beetles are nocturnal feeders of mosses, and can also be found on alpine *Celmisia* flowers. Ants (*Monomorium antarcticum*) were noted either on or in the cushion plants and their florets. It was unclear whether the ants were robbing nectar from the flowers or harvesting aphids. Similarly, seed bugs (*Rhyphodes anceps*) were very active on *Roulia* cushions.

Area C) South branch of Bannock Burn (including RAP 1/5) (Sites 11,12,13 – Appendix 7)

These south east facing slopes of the upper Bannock Burn provide a comparatively shadier environment drained by multiple stream systems. Vegetation cover is consequently denser with woody species in the Bannock Burn gully. Common were two species of day flying Geometrid moth (*Dasyuris transaurea* the golden spotted looper and *D. callicrena* the rusty *Hebe* looper). *Dasyuris transaurea* is a strong flier and the caterpillars feed on speargrass and *Gingidia* (aniseed) species. As the common name suggests, the caterpillars of *D. callicrena* feed on subalpine *Hebe* plants.

Other moth species found included a single Noctuid (*Graphania rubescens*), collected from grasses at site 13. Species of *Graphania* caterpillars feed on grasses and low growing plants. An endemic lichen moth (*Dichromodes gypsotis*), known from the Wakatipu mountains and was also noted as was a snowberry yellow moth (*Orthoclydon* sp. probably *O. chlorias*), whose caterpillars feed on *Gaultheria* berries. The latter was found in vegetation on the flanks of a small creek at site 12. While neither moth species are threatened, their presence indicates a sufficiently intact community of native host plants.

Carabid beetles of interest found in Bannock Burn included the small and common *Taenarthrus capito* (a species preferring damp habitats), and a widespread Otago species, *Neoferonia procerula*. *Neoferonia* is a complex genus with only nine species named so far and at least another 30 awaiting descriptions. *N. procerula* occupies a wide variety of habitats (Johns 2005).

Additional beetle groups of interest were numerous speargrass weevils (*Inophloeus sulcifer*) on the larger *Aciphylla* plants. An Elatrid beetle (Elatridae: Pyrophorinae) was collected at site 11 from sweep netting tussock, grasses and *Bulbinella*. Many Elatrids are pollen feeders. Beating the native broom *Carmichaelia petriei* produced

a leaf beetle (Chrysomelidae), possibly *Eucolaspis* (Eumolpinae). The majority of New Zealand Chrysomelids feed on foliage and as a group they are poorly known and in need of taxonomic revision. A single jumping spider (Salticidae) was also found on *C. petriei* as were numerous *Diaea ambara* crab spiders.

Area D) Front block: Mid elevation slopes (Sites 14,15 – Appendix 7)

The majority of this area comprises dry, grazed slopes with a range of common, but arid-adapted, native invertebrates. Taxa noted or collected include Gnaphosid spiders (nocturnal hunting spiders), Southern Blue butterflies (*Zizina labrus oxleyi*), crickets (*Bobilla* sp.), various blow-flies (Calliphoridae) and parasitic bristle flies (Tachinidae). At site 15, a steep sided shrubby gully, the day flying Geometrid moth *Dasyuris transaurea* was also found. Numerous darkling beetles (*Artystona vicina*), were similarly collected from this site.

A potentially important finding made, was a *Vittadinia* daisy, growing on a spur in the centre of the PL (at approximately E2204800 N5551700, 800m). *Vittadinia* is host to the Central Otago endemic Heliothine moth *Australothis volatilis*. The moth, a desert specialist, was first discovered in 1987, and is known only from the Pisa Flats. The species is threatened with extinction due to lack of suitable habitat (sun-drenched hillsides with sufficient bare ground for courtship, mating and sunbathing) (Peat and Patrick 1999). A single Lepidopteran pupa was noted on a *Vittadinia* plant (Murdoch *pers. Comm.*), however it is unknown if this was *Australothis volatilis*. This finding alone elevates the status of the area to one with significant invertebrate conservation interest.

Area E) East block: Lower Bannock Burn valley (Sites 16,17,18,19 – Appendix 7)

This section of the PL is grazed by cattle and has been ecologically modified through historical mining activities (slucing tailings and water race structures), farming activities and exotic vegetation. However, the mining tailings currently provide a suitable habitat for the threatened grasshopper *Sigaus minutus*, a specimen of which was found at site 16. *Sigaus minutus* is known from the southern Mackenzie basin / Omarama district and from around Alexandra. The species is classified as gradual decline under (DoC Category 5, threatened species list; Hitchmough 2002). Stream life at sites 17 and 18 was reasonably healthy, with numerous aquatic fly larvae present including; *Archichauliodes diversus* (dobsonfly), *Zelandoperla* sp. (stonefly) and *Deleatidium* sp.? *D. lillii* (mayfly).

See Appendix 8 for a full list of invertebrate species.

2.6.2 Significance of Invertebrate Fauna

Happy Valley PL supports a range of significant inherent values and invertebrate habitats. This is broken down into the areas surveyed on the PL.

Area A) North block: Duffers Gully headwaters and true left slopes:

Three threatened species were found in this part of the PL. The species are the giant ground beetle *Mecodema chiltoni* the alpine spider *Neoramia alta* and the water spider *Dolomedes aquaticus*. A number of beetles of conservation interest were also

found above Duffers Gully. The area is a highly significant location for invertebrate conservation.

Area B) South eastern block: Old Woman Range summit:

Sites 8, 9, and 10 (Appendix 6) were host to a fully endemic insect fauna including large flightless species. A range of habitats exist (including tussock, tor and wet-flushes), and these provide significant refugia for invertebrates.

Area C) South branch of Bannock Burn (including RAP 1/5):

The upper west branch of Bannock Burn (including RAP 1/5) supports at least five sub-alpine native moth species, an Otago endemic Carabid beetle (probably *Neoferonia procerula*) and native broom, *Carmichaelia petriei*, from which two native spider species and leaf beetles were collected.

Area D) Front block: Mid elevation slopes:

This widely modified area supports a less diverse invertebrate fauna than the flanking Duffers Gully and Bannock Burn. However, the existence of a host plant and suitable habitat for and a possible pupa of the rare moth *Australothis volatilis*, highlight the importance of the area for invertebrate conservation.

Area E) East block: Lower Bannock Burn valley:

Native habitat in the lower Bannock Burn has been highly modified, yet a population of the threatened grasshopper (*Sigaus minutus*) exists on old mining tailings. Native invertebrate stream life appears to be healthy, demonstrated by three species of aquatic fly.

2.6.3 Herpetofauna

“Site locations of rare and endangered herpetofauna are recorded in the original report. Herpetofauna of this nature is at risk of illegal activities including damage and removal through unlawful interference and disturbance. Accordingly, information regarding the locations of any such herpetofauna has been deleted from this version of the report. The Department of Conservation has put in place mechanisms to ensure that such information can be released for genuine scientific and research purposes. Please contact the Department of Conservation directly to determine whether the information can be released.”

Introduction

Common gecko have been known from the area for some time, with records on the Carrick and Old Woman Ranges (Herpetofauna database, DOC 2003 and Brumley *et al* 1986). During an inspection of the adjoining Carrick PL in 2003, two forms of the common gecko (*Hoplodactylus* aff. *maculatus* sp.) were identified. The Cromwell gecko (*H. aff. maculatus* “Cromwell”) was widespread and abundant on the Carrick Range and the Otago/Southland large gecko (*H. aff. maculatus* “Otago/Southland

Large”) was sparse in the Carrick Range and abundant between 800 and 1000m on the Old Woman Range. The Central Otago gecko (*H. aff. maculatus* “Central Otago”) may also be present in the vicinity although this area is at its north-western limit (Jewell 2005).

Cryptic skink (*O. inconspicuum*) are known from the vicinity, with records in the Nevis Valley, though none have been found on the eastern Old Woman range (Herpetofauna database, DOC 2003; Brumley *et al* 1986). Suitable habitat was present and it is possible although unlikely that cryptic skins are present.

As is common on mainland New Zealand, it is likely that the lizard populations on Happy Valley PL are subject to predation by the full suite of introduced mammalian predators including feral cats, mustelids, rodents and hedgehogs. Predation and habitat modification represent the greatest threats to herpetofaunal values.

Methodology

Searching was predominantly visual with one person walking through an area scanning suitable habitat, looking in rock crevices and lifting rocks. The weather was fickle with the temperature ranging from cool and drizzly to fine and warm on the first and second days, and fine and hot on the third.

Description

McCann's skinks (*O. maccanni*) were common throughout the PL, below approximately 1200m.

Cromwell gecko (*H. aff. maculatus* "Cromwell") were found between 800m and 1200m on the PL. The habitat available indicates they are likely to be common at lower altitudes around suitable habitat. No other geckos within the *H. aff. maculatus* complex were found on the PL.

See Appendix 9 for a full list of lizard sightings.

2.6.4 Significance of Herpetofauna

McCann's skink (*O. maccanni*) and common skink (*O. nigriplantare polychroma*) are common throughout the ED and beyond. Both are listed as "Not Threatened" in Hitchmough (2002) and of "low" conservation status in Otago (Whitaker *et al.* 2002).

Cromwell gecko (*H. aff. maculatus* "Cromwell") are restricted to western Central Otago but are common in the Old Man and six other ED's. They are listed as "Not Threatened" in Hitchmough (2002) and of "moderate" conservation status in Otago (Whitaker *et al.* 2002).

2.6.5 Avifauna

Birds were not formally surveyed in the Old Man ED during the 1984/85 Protected Natural Areas Programme Survey. However, a range of common exotic birds were observed on the PL during the inspection period. This included Californian quail, finch, sparrow, black-backed gull, SI pied oystercatcher, banded dotterel, skylark, Australasian harrier, redpoll, magpie and hedge sparrow. The lessees of the PL have also noted sightings of New Zealand falcon, fantail, waxeye, bellbird on Kowhai trees, tui and wood pigeon.

2.6.6 Significance of Avifauna

The bird species noted during the inspection at Happy Valley PL are typical of the ED. The presence of the New Zealand falcon on the PL is significant as this species has a threat classification of gradual decline.

2.6.7 Aquatic Fauna

Introduction

The Bannock Burn is a medium sized third order stream. It contributes to the greater Clutha/Mata-au River system. This catchment flows into the Kawarau arm of a hydroelectric dam Lake Dunstan, south of the township of Cromwell. The head waters of the Bannock Burn are predominately sourced within the Happy Valley Station boundary. The catchment vegetation is dominated by fescue-tussock grasslands. Shrublands occur as patches in gullies and as riparian edges. A partially functioning historical water race captures a proportion of the flow from the headwaters of three unnamed true right tributaries of the Bannock Burn. This water race crosses a low watershed into Tucker Gully, a tributary of Shepherds Creek, where the water is consequently utilised for irrigation purposes. Intermittent sections of the water race structure have deteriorated with total water loss in some places negating the initial flow capture from two of the three effected tributaries.

Previous freshwater survey observations from the Bannock Burn, documented on the National Institute of Water and Atmospheric Research (NIWA) Freshwater Fish Database, card numbers 12652 (1993), 24851 (1998) and 25273 (2002), have recorded the presence of brown trout (*Salmo trutta*). The non-migratory galaxiid species, *Galaxias* species D, has been recorded in Shepherds Creek, a lower tributary of the Bannock Burn, by the University of Otago (Waters *et al.* 2001). *Galaxias* species D appears to have a scattered distribution throughout the Clutha/Mata-au River system, however current distributional data suggests this particular population is an outlier for this species.

Prescribed Survey Methods

Survey sites were chosen from topographical map series 260, I42, taking into account accessibility and survey ability. Samples at two sites within each tributary was attempted to ascertain any disparity in fish species assemblages due to altitude natural barriers. Accurate survey site locations were obtained using hand held Global Positioning System (GPS).

At each sampling site, survey was carried out with methods in the “Non-migratory Galaxiid Survey Methods” (DOC n.d.). A backpack, battery powered electric fishing machine (Kainga 300) was employed at all survey sites. Instream habitat descriptions (width/depth/substrate composition) and site characteristics (riparian/catchment vegetation and water flow velocity types) were recorded on NIWA freshwater fish database forms. All fish species captured were identified, measured to the nearest millimetre (mm) and then released. The dominant aquatic insect fauna observed were also identified to a genus level and recorded.

Results

The local weather conditions had remained settled throughout the period leading up to this survey and consequently instream flows were considered to be in a stable condition.

A total of 14 sites were surveyed in the catchment of the Bannock Burn, within the Happy Valley PL boundary. The combined total instream area fished for all sites was 900 m². The average width and depth of all survey sites were 1.2m and 0.27m respectively.

Three Bannock Burn first order tributaries were found to contain the endemic non-migratory galaxiid species, *Galaxias sspecies D*. Adult and sub adult galaxiid lengths ranged from 35 – 105 mm (n=28, average length 80 mm). High numbers (>20 individuals per site) of juvenile and post larval galaxiids (7 – 35 mm) were also identified within two of the three tributaries. A cache of approximately twenty galaxiid eggs (diameter 2 mm) were also located amongst instream substrate. A further 7 surveyed sites contained brown trout ranging in size from 28 to 165 mm (n=37, average length 95 mm). The smaller sized fish were observed occupying first order tributaries. Four tributaries surveyed, including the prominent head-water catchment of the Bannock Burn were found to be devoid of fish species. A summary of these results and GPS locations of survey sites are presented in table (Appendix 10).

The mayfly species *Deleatidium* and *Nesameletus* were the most dominant aquatic invertebrates observed, occurring at eight and four sites respectively. Notable aquatic insects also observed were the Dobson Fly (*Archichauloides diversus*), mayfly (*Coloburiscus*), stoneflies (*Stenoperla*, *Zelandoperla*, *Zelandobius* and *Megaleptoperla*) and caddisflies (*Hydrobiosis*, *Neurochorema*, *Olinga* and *Aoteapsyche*). The presence of these invertebrate species suggests a healthy stream environment having a high score in the Macroinvertebrate Community Index (MCI) (Winterbourn *et al.* 2000).

See Appendix 10 for locations of Aquatic Fauna found on PL.

2.6.8 Significance of Aquatic Fauna

Galaxias species D

Galaxias species D has a threatened species ranking of ‘gradual decline’ and ‘data poor qualifier’ (Hitchmough 2002). It is also considered a ‘taxa of uncertain species status’ as it has yet to be taxonomically classified (DOC 2004). The species has been identified solely on the basis of isozyme data and is a component of the 10 non-migratory lineages currently recognised within the *Galaxias vulgaris* ‘complex’ (Waters and Wallis 2001a).

To date *Galaxias species D* has only been recorded from stream reaches inaccessible to introduced salmoniids (DOC 2004). Population fragmentation and displacement of non-migratory galaxiids may occur as result of an inability to co-exist with predatory species (Townsend 1996). The absence of *Galaxias species D* from the lower stream reaches of the Bannock Burn tributaries is likely to be a consequence of this. Restriction of salmoniid dispersal by natural and manmade barriers e.g. waterfalls, ephemeral stream reaches, dams and water races may facilitate the survival of many small populations of non-migratory galaxiids. This appears to be the case with the three populations of *Galaxias species D* found on the PL which are isolated within the mid reaches of the three tributaries of the Bannock Burn.

Galaxiid populations are vulnerable to low water levels, whether from water abstraction or droughts (DOC 2004). The Duffers Gully tributary appears to be significantly reduced due to the installation of a small dam and diversion of the stream into the historical water race. This appears to significantly reduce instream flow and availability of habitat to galaxiids in the lower tributary below the dam. Adult and juvenile galaxiids were present below this impediment albeit in small numbers.

The surveyed site in Duffers Creek contained a series of noteworthy cascades, particularly below the water race, which may constitute a natural barrier to salmoniids. It is possible that the construction of this water race may have facilitated the dispersal of galaxiids, and/or gene flow between galaxiid sub-populations, from Duffers Creek into Shepherds Creek. This has been documented as occurring in historical water races elsewhere in the Otago region (Esa *et al.* 2000).

These populations of *Galaxias* species D are of significant scientific value aiding the analysis of historical biogeographical dispersal and genetic divergence within the *Galaxias vulgaris* 'complex' (Waters and Wallis 2001a). A number of non-migratory galaxiid species have restricted ranges limited by geographical barriers to dispersal (Waters and Wallis 2001b, Burrige *et al.* unpublished).

The New Zealand non-migratory galaxiid fishes recovery plan (DOC 2004), has an objective of identifying, protecting and managing a minimum of 30 habitats with key non-migratory populations, for each species (Objective 9.1). The performance measure for this objective requires by 2006, that "threats are identified and protective measures initiated for 30 water bodies containing key populations of threatened non-migratory galaxiids species. This is done through tenure review, plan or resource consent hearings, physical restoration and protection activities or non-statutory initiatives such as covenanting."

At present only four key populations of *Galaxias* sp D, in the upper Clutha/Mata-au River catchment, are formally protected out of the 41 defined. Currently in process is the potential for approximately 9 other habitats and corresponding populations, excluding these ones however these are far from certain.

2.6.9 Problem Animals

Animal pests present on the property include goats and rabbits. Lizard and invertebrate populations on the PL are subject to predation by animal pests which include possums, rats, mice, stoats, cats and birds. During the inspection possum scats and fur tufts were noted on the PL. Hedgehogs, which are serious invertebrate predator, were observed at night on the Old Woman Range.

2.7 Historic

Introduction

The history of the PL can be divided in three periods. The first visitors to the Bannockburn area were Maori as they travelled through Central Otago to exploit seasonal food sources and on their way to the West Coast to source the valued

Pounamu. The next major influx of people were the early European explorers into Central Otago such as Nathaniel Chalmers in 1853 and Chubbin, Morrison and MacFarlane in 1856, and the early run holders seeking large tracks of land for the grazing of sheep and cattle. Finally the sudden and dramatic influx of gold-miners to the region saw a rapid increase in the Bannockburn population, with the Bannockburn gold fields becoming one of the richest in Otago's history.

This report firstly presents the available historical and archaeological data currently available on the PL, and then presents new data gathered during an archaeological field survey of Happy Valley PL.

Historic Records

Historic records describing the history of people on the land which encompasses the Happy Valley PL describe mainly the pastoral history. A search of historic records regarding gold mining, such as the Wardens reports found in the *Appendix to the Journal of the House of Representatives* from 1863 to 1907, found no mention of gold mining on the PL. Although detailed reports on mining in the gullies to the north of Happy Valley, such as the famous Pipeclay, Smith's and Adam's Gully's are discussed, as well as the gold mining town of Carricktown, gold mining in Tucker and Duffers Gully's is not mentioned. Gold mining was recorded, however, in Tucker Gully (which would have included Duffers Gully) at the time of Thomson and Spreat's 1867 survey report on gold mining in Otago (Appendix 11). Hence, mining did occur early on in Happy Valley, but, as the names of the gullies on the properties suggest, the mining was possibly not as profitable as at Bannockburn proper and so received little if any reporting (see also Parcell 1976:29). One direct reference to gold mining related activity in Duffers Gully is noted by Parcell (1976:32). He notes that Jacob Crow, who became manager of the Carrick Race Company in 1890 and who was charged with extending the Carrick Water Race to the second branch of Coal Creek, lived in the gully.

Considering the pastoral history, Happy Valley was originally part of the massive Kawarau Station which was first taken up by F.G Alderson in 1858 for the Australian and New Zealand Land Company (Parcell 1976:7). Parcell (1976:7) notes that the run ran from the Kawarau River at its northern boundary to Clyde and Gibbston. From Gibbston the run then extended south to take in the Carrick and Cairnmuir Ranges, the Nevis Valley and a section of the Old Man Range.

In 1910 the Liberal government policy on the subdivision of the large runs was imposed and it was in this year that the station was broken up by the auctioning off of the runs which constituted the present lease (Parcell 1976:14-15). It is from this auction that the 8,100 acre Happy Valley PL (Run 339c) was created and purchased by Allan Crombie, W. Crombie and W.R. Parcell, the Deed for the lease held by Allan Crombie. Allan Crombie renewed his licence in 1931 with the transfer of the licence to Colin Irvine Henderson in 1952, when it became a Pastoral Lease under the Land Act 1948. It ran some 825 ewes and 525 wethers plus replacements at this time.

The Happy Valley Homestead is approximately 90 years old, with the original part of the house being built in 1914, this already registered as an historic site, being site 273. Just inside the boundary of the PL on the Duffers Saddle, there are the remains of a

large two roomed stone structure. The lessee thought this might have been a boundary riders hut. Other opinion (M. Sole pers. com.) suggests it is the remains of a way-point hotel for travellers between the Nevis and Bannockburn due to its closeness to the Nevis Valley Road.

Previous Archaeological Surveys

This PL has not been surveyed in the past by an archaeologist and so no Maori or European/Chinese archaeological sites have previously been recorded on the lease.

There are, however, two archaeological sites of interest just within and on the boundary of Happy Valley. Archaeological site F42/9 located just over the northern boundary of the lease was a find-spot of a silcrete flake tool found in 1976 on an airstrip (Appendix 11). The current lessee has also indicated that in the past Maori flake tools have been found on the PL (Whittaker pers comm.). The Airstrip find and reported past finds of flakes by the lessee therefore indicate that pre-contact Maori were active in and around the lease. As the well known Hawksburn moa-hunting site (G42/5) excavated by Anderson in 1979 lies only *ca.* 4km from the south eastern boundary of Happy Valley, this past activity is not surprising.

The Carrick Water Race (F42/79) is a well known and still functioning water race. This race was begun on April 20, 1872 at it's terminus at Pipeclay Gully, and the full length to the second branch of Coal Creek in the Nevis Valley completed in 1890, a total distance of 35km. This race just skirts inside the lease on its way over Duffers Saddle.

Methods

The assessment methods to provide more archaeological/historic data first entailed identifying streams, creeks or gullies on the lease believed to be likely locations to contain archaeological evidence of past gold mining or pastoral activity based on historic records. Secondly, streams, creeks or gullies were chosen which could be surveyed within the timeframe allocated for the Tenure Review field survey. Duffers Gully was surveyed by field archaeologists during the inspection (Appendix 12)

Newly Recorded Archaeological Sites (Appendix 12)

No Maori pre-contact archaeological sites were located, but three 'findspots' (F42/231, F42/232, F42/233) indicating a Maori presence on the property in the past were relocated with the help of the lessee. Fourteen archaeological sites of European/Chinese origin were recorded during the field survey. This included six stone huts (F42/226, F42/227, F42/228, F42/229, F42/234) three extensive areas of gold mining tailings (F42/219, F42/220, F42/221), an isolated area of gold workings (F42/218), four water races (F42/222, F42/223, F42/224, F42/225), a dam and associated tailings (F42/235) and one stone wall (F42/230). It must be noted that NZAA Site Numbers do not illustrate isolated aspects of human behaviour or boundaries on human behaviour. Site numbers are only used to explain where there is obvious evidence of activity where it is quite probable that other subsurface evidence may be present outside of the site describe.

Pre-contact Maori artefact ‘findspots’ (F42/231-F42/233. Appendix 12)

A ‘findspot’ is a location where an artefact has been found on the ground surface and where there is no other apparent evidence of past activity associated with the find. The lessee showed the author on 30 May 2006 the location of three areas where since the late 1960s through to late 1990s pieces of porcellanite were found. Porcellanite is a stone used by Maori for making flake tools which were used for various subsistence tasks such as butchering Moa. At sites F42/231 and F42/232, a flake of porcellanite was reported as being found and at F42/233 what may have been a core of porcellanite. The lessee could not locate the pieces of porcellanite recovered at the time of the visit, but on visiting the findspots it was clear that if these locations had been the site of past Maori occupation, these sites have been destroyed many years ago by 19th century gold mining in the case of sites F42/231 and F42/232, and farming activity at site F42/233. It is more likely these findspots are the result of dropped items or re-deposition. One other possible findspot was not visited.

Water races (F42/222 – F42/225, Appendix 12)

Site F42/222 is a water race recorded running along the 720m contour (Appendix 12 and 13). This water race is shown on the F42 topographical map as seen in (Appendix 12), where it originates in a small gully over the ridge directly south of Duffers Gully (Appendix 13). This race is still used today and a small dam has been maintained in the modern era to capture additional water along its path. F42/222 would have originally provided water to the gold workings at sites F42/219 & 220 in Duffers and mining in Tuckers Gully, the later lying just outside of the lease boundary.

Site F42/223 is a possible water race identified running along the *ca.* 640m contour. This race was also not followed but would have possibly fed the workings of site F42/220 below. Water race F42/224 would have provided water to the sluicings below of site F42/221. This race was not followed to its origins, but may have originated in the nearby gully where the creek runs into the ‘Ford’ as shown on topo map F42. Race F42/225 was recorded above the Hut 5 (F42/229) (Appendix 12 and 13). Near the hut was a stone-lined tailrace and tailings implying that this race may have fed water to these workings. The origin of this race was not determined, but may have originated from the unnamed creek running into the gully immediately to the south of the hut.

Gold mining (F42/218 - F42/221, Appendix 12)

The tailings recorded in Duffers Gully are extensive, large and complex. The tailings have been divided into four areas in which the water catchments have been used for mining (Appendix 12 and 13). The mining at F42/218 lies at *ca.* 1000 and is high above the majority of the gold workings which are located in the gullies below. The tailings resulting from the sluicings are fine with a small area of tailing stackings present where the lessee believed a stone hut used to be located. As the area surrounding these workings was not surveyed it is difficult to ascertain their extent and complexity. A piece of riveted iron piping typical of 19th century gold mining was found in a nearby creek across from the tailings. It is possible the creek was the source of water used for the ground sluicing.

Site F42/219 represents tailings produced from the working of gold bearing deposits along the stream immediately running down Duffers Gully proper (Appendix 12 and 13). The sluice faces and tailings themselves are mainly on the true right of the gully stream. The gold workings have been little disturbed as illustrated by stone pavements for wheel barrows to run on still being present running along the top of various tailings. Huge stacked tailings dominate this gully and illustrate an intense investment in labour. Both the stream margins and ridge line were alluvial mined creating two terraces of mining activity, with water probably supplied by water race F42/222. Lying at the base of these tailings is hut site 2 (site F42/227, see below).

The tailings of site F42/220 stretch *ca.* 500m down a narrow steep tributary which feeds into the main Duffers Gully stream (Appendix 13). Stacked tailings are also common in this gully but are becoming over grown by matagouri. Nineteenth century gold mining artefacts and a prospectors pit are also present amongst the mining remains. Damage has occurred to tailings in this gully from an access track and the recent construction of a fence line.

Site F42/221 covers the length of the lower water catchment originating from the bottom of Duffers Gully and flowing southeast down to the Bannock Burn (Appendix 13). The length of this flat bottomed gully contains the scattered remnants of gold mining such as large stacked tailings and sluice faces, a stone wall (F42/230) and Huts 3, 4 and 5 (F42/228 & 229). The main tailings are concentrated along the western side of F42/221 and are similar in form to those recorded at F42/219. Sluice faces and large stacked walls of tailings are prevalent and well preserved, some stacked walls being over 2m high. Gold mining artefacts are also distributed amongst the tailings. As with F42/219, the mining has occurred on two levels with tailings stretching from the low ridge top down to the stream below. Patches of tailings were observed as far down as the 'Ford' shown on topo map F42 and near Huts 3, 4 and 5 (F42/228 & 229). The northern side of this gully was not surveyed and so the presence or absence of mining on the hillside above was not confirmed.

Stone wall (F42/230, Appendix 12)

At the south east end of the large western section of the F42/221 tailings where the access track continues down the gully is the remains of a dry stone stacked wall (F42/230) (Appendix 12 and 13). Although difficult to age, this 56m long wall was built from stone sourced from the tailings nearby and may date as early as these tailings and nearby Huts 3 and 4 (F42/228).

Huts (F42/226 – F42/229, Appendix 12)

The five stone huts recorded were distributed from near the top of Duffers Gully to the junction of the southeast gully stream with the Bannock Burn (Appendix 12 and 13). The remains of Hut 1 (F42/226) consist of a 0.5m high stone schist stacked chimney. The occupants of the hut probably used a canvas superstructure flush with the chimney for accommodation. There was no obvious evidence of gold mining associated with this hut, but it could have been used for a variety of purposes such as rabbiting, musterers shelter, race-mans or boundary-mans hut. Hut 2 (F42/27) is a schist stone single room structure with an animal enclosure adjoining its western side

and a small unknown function three walled stone structure behind. The hut is large (5.35m x 3.9m), in excellent preservation and was possibly built as early as 1867, when gold mining was first recorded in Duffers Gully. The hut would have had other uses such as for musterers or rabbiters. The hut is still used today and 20th century corrugated iron has been used to replace the original roof. Nineteenth century European artefacts lie next to and near this hut.

Huts 3 and 4 (F42/228) lie side-by-side and are located next to a 40m long 0.45m high stone stacked wall which runs along their east side (Appendix 12 and 13). Tailings are present to the east of this wall. The schist stone remains of Hut 3 constitute a 3.7m high chimney in the southern wall, partially ruined north wall, still with a window opening, and collapsed western wall, the hut originally measuring 4.4m/4m in dimension. Nearby under the vegetation to the southwest of the hut are the remains of two more walls obscured by vegetation. These walls are possibly the remains of another hut. Two meters to the northwest of the hut is another a long three sided stacked stone enclosure 3.7m wide which may be the remains of an animal enclosure. Only 10m southeast of Hut 3 are the remains of Hut 4. The remains of three of the collapsed walls of this hut can be seen with the northern wall hidden under vegetation. This hut measures 4.8m/2.9m with the chimney ruins 2m high. Huts 3 and 4 are most probably related to gold mining in the gully and may date to the 1860s. It is also possible they were occupied at the same time and may represent contemporary gold mining parties or families.

Hut 5 (F42/229) is located on the true right of the stream flowing out of the southeast gully (Appendix 12 and 13). The wall of this hut are collapsed other than a small piece of the back (east) wall. The notable feature of this hut is the substantial chimney which is of colossal width and breadth (1.85m x 1.85m) considering the size of the hut which originally measured *ca.* 5.1m x 3.1m. The height of the chimney would have been similar to other huts of this type and size. A pre-1900 age for this hut and its function as possibly originally being a gold-miners residence, as with the other huts in this gully, can be attributed to these remains.

Archaeological sites recorded by other field teams (F42/234-F42/235. Appendix 12)

As noted above, not all areas where archaeological remains were believed to be present, such as along the Bannock Burn, could be visited during the Tenure Review inspection by the field archaeologists. Other field staff recorded archaeological sites on the Bannock Burn. Site F42/234 was the remains of a hut site with one of the walls in particularly good condition. This hut appears to have been substantial and constructed using dressed stone. Site F42/235 was an area of tailings and a stone-faced dam. The dam in particular appears to be in very good conditions and is a fine example of this structure for the Bannock Burn area (Appendix 12 and 13).

2.7.1 Significance of Historic

The above review of the history of the Happy Valley PL and archaeological sites recorded during the Tenure Review field survey, clearly illustrates the rich history of this property. Whereas the pastoral history is not physically obvious on the PL but is rich in the historic records, written records on the gold mining appears lacking but the evidence of significant and widely distributed gold mining on the lease is evident.

The only direct detailed historic record relating to the Duffers Gully gold-fields is Parcell's (1976:32) record of Jacob Crow who managed the highly significant Carrick Water Race in 1890 and who lived somewhere in the gully.

All the archaeological sites recorded on the PL most probably date from the mid-to late 19th century other than the stacked wall (F42/230) where this is difficult to determine. The clusters of huts in the south east section of the gully as seen in Figure 3 imply a community of gold miners all occupying this area at the same or similar times. One of the huts may well have been the residence of Jacob Crow.

The gold mining recorded on the PL adds substantially to our knowledge of the history of gold mining in the Bannockburn fields in that although the mining was substantial and labour intensive, as shown by the massive stacked tailings, this gully did not warrant detailed reporting by the local Warden who considered the nearby Pipeclay, Adam's and Smiths Gullies workings more important. In addition, it is the preservation of the remains with intact wheel-barrow tracks and gold mining artefacts distributed amongst the mining debris which makes this gold mining site significant. Many large gold mining sites of this type have been stripped of their portable artefacts and so it is probably the limited access by the public through the PL which has meant these items continue to lie in-situ.

2.8 Public Recreation

2.8.1 Physical Characteristics

In 1992 DOC compiled a Recreation Opportunity Spectrum for the Otago conservancy whereby all areas regardless of land tenure, were classified and mapped according to setting, activity and recreational experience characteristics.

2.8.2 Legal Access

Access to the northern boundary of the PL is via the 2WD Hawksburn Road and partially via the Nevis Road which is 2WD in summer and 4WD in winter.

A formed 4WD legal road from the Nevis Road to Duffers Saddle and into the north west corner of the Old Woman Range Conservation Area bounds much of the western boundary of the property. This western boundary is adjacent to a section of the Craigroy PL.

There is currently no legal public access to the eastern boundary of the PL.

2.8.3 Activities

The PL is in a section of Otago that is relatively remote and therefore visitor use is not high. The formation of the Old Woman Range Conservation Area on the boundary to the PL is likely to have meant that recreational users have had an alternative destination.

Cross country skiing, walking, botanising and hunting are activities undertaken in the Old Woman Range Conservation Area and it is likely that the southern end of the PL adjoining the Old Woman Range Conservation Area has potential for similar

activities Limited access has been provided in the past to the historic sites in Duffers Gully.

2.8.4 Significance of Recreation

Happy Valley PL is located within the backcountry 4x4 drive-in ROS class characterised by a feeling of relative remoteness from populated areas, yet has good recreational facilities. The highly natural setting is a valued part of the experience and may be associated with motivations of 'escape from town' and/or sense of being close to nature. In this setting, four wheel drive vehicles are desirable to give access to high country tussock grasslands and block mountains and more rugged remote areas.

Activities such as tramping, hunting, camping, mountain biking, outdoor education and nature appreciated may occur on the PL while horse trekking, plant study and day walks are summer opportunities available on the Old Woman Range with cross country skiing available in winter.

Historic Heritage appreciation is of significance on this PL with the historic sites in Duffers Gully. Limited access has protected these sites from fossickers.

The upper levels of the PL share many of the same characteristics as the Old Woman Conservation Area. If public access was freely available then similar recreation activities could be expected to occur.

Federated Mountain Clubs compiled a recreational plan for the Otago Block mountains in 1988 (Mason 1988). This plan recognises the "upper eastern faces of the Old Woman Range, generally above 950m, are zoned *natural experience*. Climate severity and ecological fragility dictates that recreation is limited to low impact and self sufficient activities". This plan indicates that the "lower eastern flanks of the Old Woman range generally above 450-600m, are zoned *open space*. Active recreation tends to be site-specific within the zone e.g visiting historic sites.

PART 3**OTHER RELEVANT MATTERS & PLANS****3.1 Consultation**

The following comments were made at the meetings with NGO's in Alexandra on 23 August 2005 and 12 April 2006.

General Comments

- Old Woman RAP 1/5 – much of Bannockburn catchment
- Arid, degraded, spear grass
- Good trails and water races linking up
- Access Duffers Gully to Nevis Road
- Carrick race to Duffers would be good access day route
- A loop walk by foot or mountain bike, beginning from parking area on adjacent public road to Nevis Valley, following along the water race through Duffers Gully, with explanatory material on the historic remains, exiting up the ridge to the side road that leads towards the Old Woman Range, and returning downhill again via public road.
- Bannockburn Creek down to RAP boundary on same sort of contour consistent with the RAP to Nevis Road would be appropriate
- Severe environment, difficult to predict potential for recovery
- Goats and deer in the region.
- There is a good ecological argument with PNA over this area of land
- The Bannockburn catchment needs to be considered more
- Would prefer if the lower altitude valley floor is not given away as this will be something worthwhile in 25-30 years if left to re-establish
- Recreation aspect – nice to be able to get from higher altitude to lower areas easily
- Property lends itself to a mountain bike route for enthusiasts, bikers use property already with permission. If the owner was agreeable, designated areas could probably stand this activity
- Duffers Gully historic area be properly preserved and protected

3.2 Regional Policy Statements & PlansRegional Policy Statement

The Regional Policy Statement for Otago provides a policy framework for all of Otago's significant regional resource management issues. It does not contain rules. District Plans shall not be inconsistent with the Regional Policy Statement. In respect of natural values the Regional Policy Statement includes the following policy and method statement:

Policy: To maintain and where practicable enhance the diversity of Otago's significant vegetation and significant habitats of indigenous fauna, trout and salmon.

Method: Identify and protect Otago's significant indigenous vegetation and significant indigenous habitat of indigenous fauna, trout and salmon, in consultation with relevant agencies and with Otago's communities.

In respect of landscape and natural features it includes the following policy and method statement.

Policy: To recognise and provide for the protection of Otago's outstanding natural features and landscapes.

Method: Prepare in conjunction with relevant agencies and in consultation with the community and affected landowners, an inventory of outstanding features and landscapes that are regionally significant.

Regional Plans

The whole PL is subject to the *Otago Regional Plan Water* rule which requires resource consent for suction dredge mining.

3.3 District Plan

The PL is located within the Rural Resource Area of the Central Otago District Plan.

As at 23 February 2005, the proposed Central Otago District Plan (amended to incorporate Council decisions) requires resource consent (with certain exemptions) for the clearance of areas of indigenous vegetation greater than 0.5 hectares or in the case of snow tussock grassland 10ha, or above 1080masl, or areas containing any threatened plants listed in a schedule. This requirement does not apply to land that has been freeholded under the Crown Pastoral Land Act 1998.

Resource consent is required for tree planting using certain tree species with wilding potential, subject to certain criteria. Resource consent is required for excavations or tree planting within specified distances of a water race or irrigation pipeline, and for development work within 10m of any water body. There are no registered historic sites or areas of significant indigenous vegetation and habitats of significant indigenous fauna and wetlands as set out in the schedules of the plan.

The protected landscape provisions of the plan require resource consent for development of land over 900m, with an exclusion for land that has been freeholded under the Crown Pastoral Land Act 1998.

There is one historic site registered in the plan, being site 273, Happy Valley homestead. Resource Consent is required for any activities that may adversely affect this site.

3.4 Conservation Management Strategy & Plans

The Otago Conservancy of DOC has prepared a Conservation Management Strategy (CMS) which was approved by the New Zealand Conservation Authority in August 1998. The CMS identifies 41 special places of conservation interest in Otago

Conservancy. The Happy Valley PL is incorporated in the Old Man – Garvie Special Place.

The CMS objectives for the Old Man – Garvie Special Place relevant to Happy Valley include:

To protect the entire high altitude range crests for their landscape, nature conservation cultural and recreational importance, to improve legal access to them, and to ensure that recreational and commercial uses are managed to sustain resources and ensure quality recreational experiences, including the remote quality of the Old Woman-Garvie area.

The key implementation methods relevant to Happy Valley PL are:

- Allow appropriate commercial use of the area where such uses will not have a significant adverse effect on natural and historic resources and cultural values, subject to appropriate conditions including the preservation of remote qualities.
- PL tenure review on adjacent properties will provide opportunities to negotiate to protect the entire range crest. Overall management of these new areas with the existing areas will confer net conservation and management benefits (eg, rationalise fencing).
- The integrated management of the high altitude areas administered by the department will be promoted through the concept of a “Kopuwai Conservation Park”. If the park proposal proceeds, a management plan will be developed.
- A public education exercise regarding damage to wetlands will be continued.
- Research and monitoring will be encouraged, especially where there is a management need, or conservation gain.
- Continued identification of key natural and historic resources to enable well informed decision making in PL tenure review process.

Priorities for the Old Man – Garvie Special Place are:

Completion of protection negotiations, including tenure reviews, will be a priority in this Special Place.

3.5 New Zealand Biodiversity Strategy

The New Zealand Government is a signatory to the Convention on Biological Diversity. In February 2000, Government released the New Zealand Biodiversity Strategy which is a blueprint for managing the country’s diversity of species and habits and sets a number of goals to achieve this aim. Of particular relevance to tenure review, is goal three which states:

Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments, and do what is necessary to:-

Maintain and restore viable populations of all indigenous species across their natural range and maintain their genetic diversity.

The strategy outlines action plans to achieve this goal covering terrestrial and freshwater habitat and ecosystem protection, sympathetic management, pest management, terrestrial and freshwater habitat restoration, threatened terrestrial and freshwater species management, etc.

PART 4**ATTACHMENTS****4.1 Additional Information****4.1.1 References**

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4.2 Maps

- 4.2.1 Topographic and Cadastral
- 4.2.2 Landscape Units and Significant Landscape Units
- 4.2.3 Values – Ecological, Recreation and Historic

Maps are attached before the appendices.

4.3 Photographs

Attached before appendices.

4.4 NGOs Comments

Written submissions were received from, the Central Otago Recreational Users Forum, Upper Clutha Branches of Forest and Bird, Federated Mountain Clubs of New Zealand, Central Otago and Southern Lakes Deerstalkers Clubs and Professor Alan Mark. A copy of each submission is attached as Appendix 13.

4.5 Appendices

- Appendix 1 Old Man Ecological District PNAP Report – RAP 1/5
- Appendix 2 Landscape Photographs
- Appendix 3 Soil Sites of Significance
- Appendix 4 LENZ Level IV Map and Characteristics of LENZ Table
- Appendix 5 Plant Species List
- Appendix 6 Map 1 – Area of Significant Inherent Botanical Values
- Appendix 7 Map 2 – Location of Significant Invertebrate Species
- Appendix 8 Invertebrate Species List
- Appendix 9 List of Lizard Sightings
- Appendix 10 Table with locations of Aquatic Fauna
- Appendix 11 Gold mining recorded in Tuckers Gully
- Appendix 12 Happy Valley PL showing property boundaries and archaeological sites recorded prior and during the tenure review field survey
- Appendix 13 Close view of archaeological sites in Duffers Gully
- Appendix 14 NGO Reports




MAPS

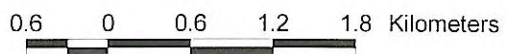
4.2.1 Topographical and Cadastral

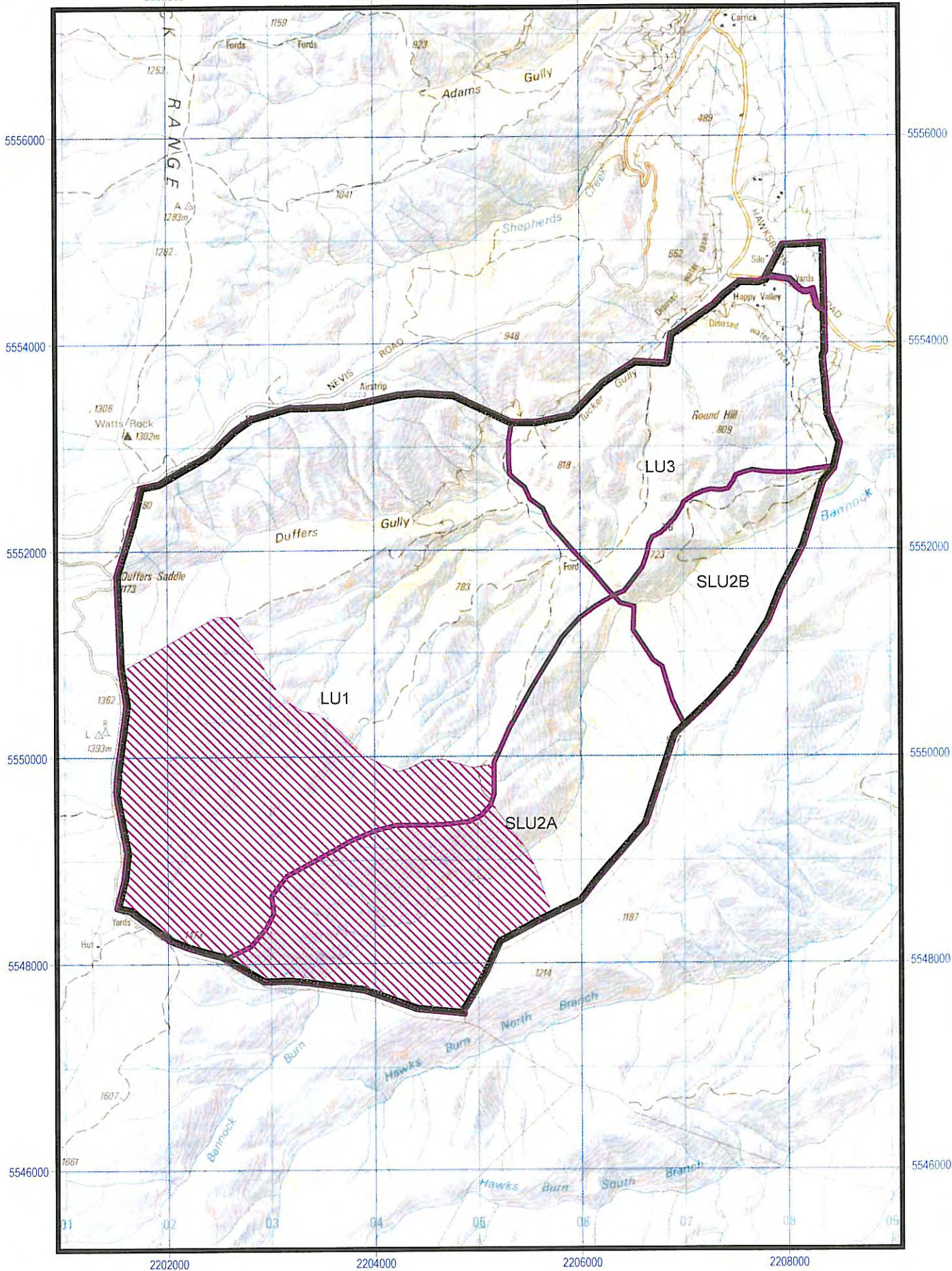
4.2.2 Landscape Values and Significant Landscape Values

4.2.3 Values – Ecological, Recreation and Historic

4.2.1 Topographical and Cadastral Happy Valley

-  Marginal strips
-  Covenants
-  Public Conservation land

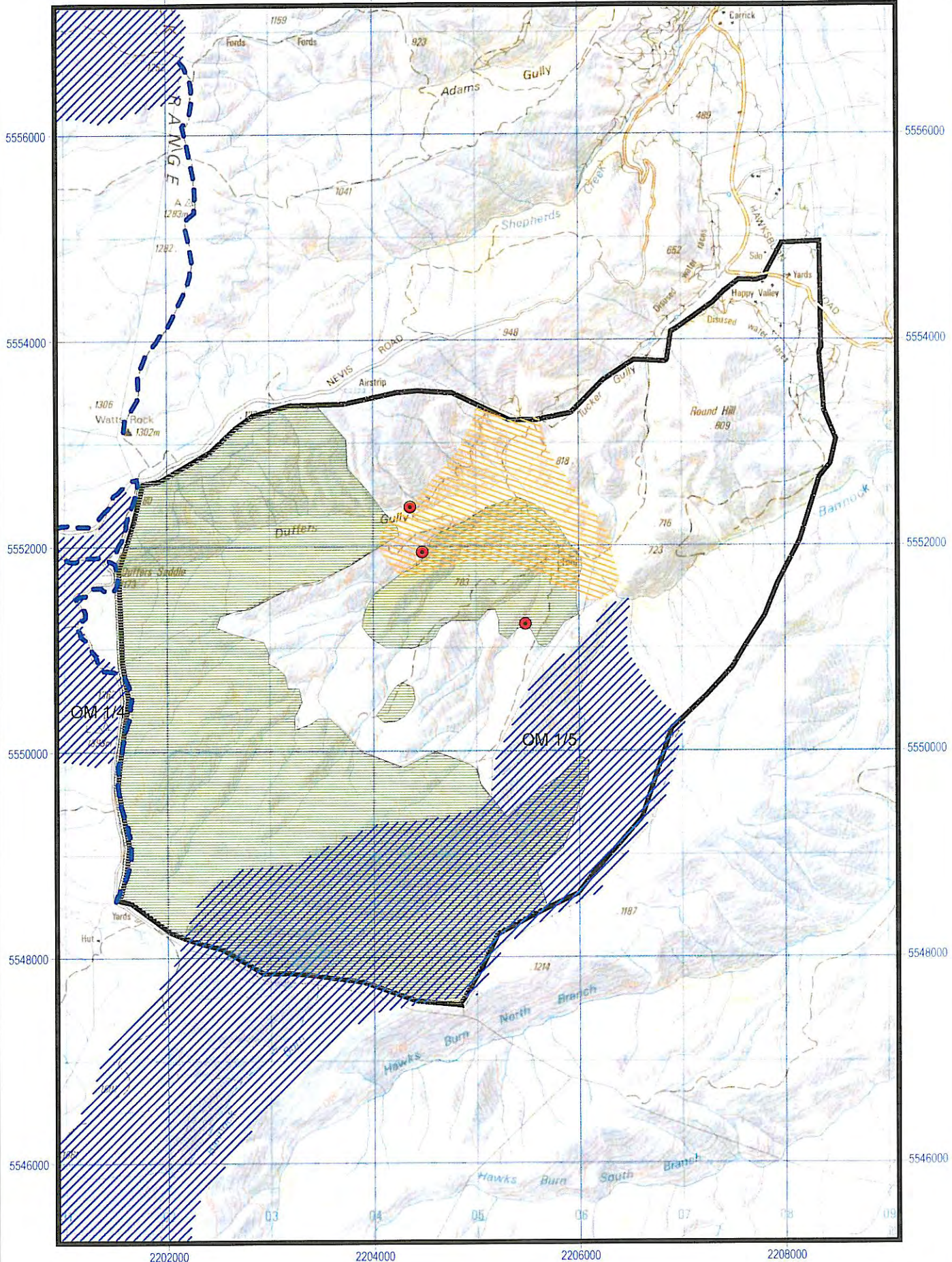




4.2.2 Landscape units and significant landscape values Happy Valley

- Areas of significant landscape value
- Landscape units

0.5 0 0.5 1 1.5 Kilometers



4.2.3 Values - Ecological / Recreation / Historic Happy Valley

- fish records
- Historic values
- RAPs
- Recreational routes
- Ecological significant areas

