Oceana Gold (NZ) Ltd - Macraes Gold Project

Macraes Phase III

Botanical Assessment

prepared by

Ryder Consulting

April 2011

Version: 29/04/2011 3:44 PM

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environment + planning + project management

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Cover photo (M. Dale): Tussock grasslands overlooking the Back Road Rock Stack site.

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1. Executive Summary

Oceana Gold (NZ) Limited (OceanaGold) is proposing an expansion of the consented mine at the Macraes Gold Project, the Macraes Phase III Project, including new pits, waste rock stacks, tailings dam and a freshwater dam. This report presents ecological assessments for each of the proposed developments in relation to terrestrial vegetation, including possible mitigation options for any potential adverse effects identified.

The Macraes Phase III Project is located within an area that contains highly variable levels of significance with regard to intact indigenous vegetation. The plant communities around the active mine areas at Macraes are already highly modified and contain little to no natural values. The larger sites, including the Back Road Waste Rock Stack, Top Tipperary Tailings Storage Facility and Camp Creek, retain higher indigenous diversity, particularly tussock grassland. Rare plant species found within these sites include Hookers mountain daisy, coral broom, sprawling turpentine, *Gingidia grisea* and *Aciphylla subflabellata.*

If the project goes ahead as planned it will have more than minor adverse effects on several rare or threatened species and plant communities. These effects include flooding of diverse gullies, infill from waste rocks of indigenous vegetation and removal of specimens of several threatened plant species.

As avoidance is not feasible for the bulk of the area affected, mitigation is considered appropriate to reduce the adverse effects of the project. Recommended mitigation includes restoration of tussock grassland, fencing off populations of threatened species and artifical enhancement (propagation) of threatened species.

If all mitigation is carried out successfully it will reduce the effects of the project from more than minor adverse effects to minor adverse effects.

2. Introduction

2.1 Background

Oceana Gold (NZ) Limited (OceanaGold) own and operate an open pit and underground gold mine in the Macraes Flat area of East Otago. The company is proposing an expansion and extension to the consented life of the Macraes Gold Project, the Macraes Phase III Project (the Project). Ryder Consulting Limited was engaged by OceanaGold to provide an ecological assessment of the different components of the Project.

The proposed developments included in this report are:

Macraes-Dunback Road realignment
Golden Bar Road realignment
Camp Creek Freshwater Dam
Back Road Waste Rock Stack
Top Tipperary Tailings Storage Facility
Frasers North Waste Rock Stack
Frasers South Waste Rock Stack
Round Hill Extension
Round Hill – Southern Pit Extension
Innes Mills Stage V
Frasers Stage VI

This report presents ecological assessments for each of these proposed developments in relation to vegetation, including possible mitigation options for any potential adverse effects identified. Site-specific assessments are presented in speparate sections followed by a generic section that addresses potential adverse effects and recommended mitigation relating to all developments. Figure 1 outlines the locations of proposed mining extensions.

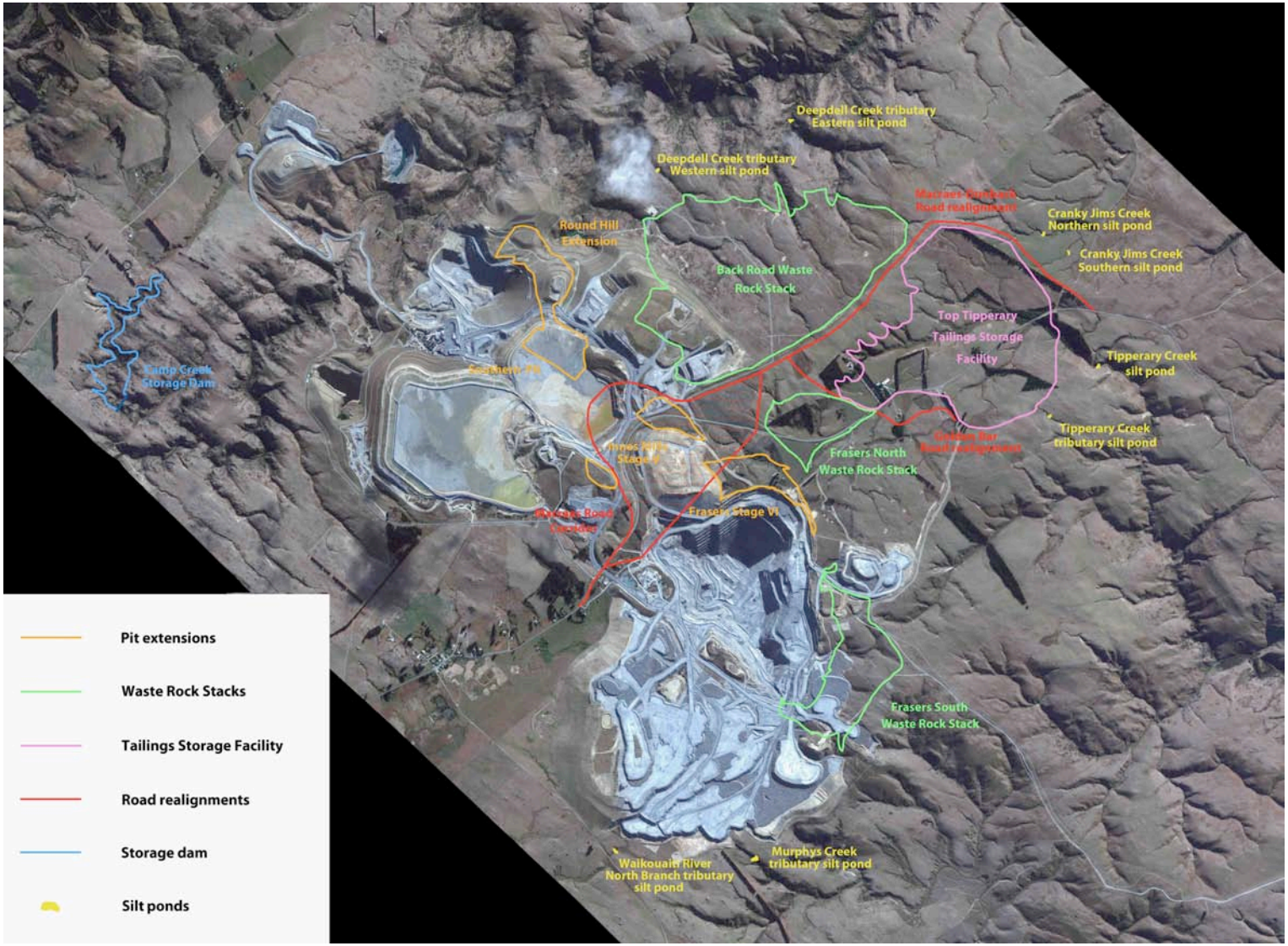

Figure 1 *Map showing locations of proposed mining extensions.*

2.2 Botanical status

The proposed project developments are all situated within the Macraes Ecological District (ED), which is one of two Ecological Districts that make up the Lammerlaw Ecological Region (McEwen 1987). Macraes ED is characterised by gently sloping land (mostly below 600 m), with higher ridges rising over 800 m and is composed of Paleozoic Haasts Schists with areas of Miocene sediments and basaltic cones and flows (McEwen 1987).

Past vegetation cover of the Macraes ED comprised montane short tussockland grading into subalpine tall tussockland, with areas of hardwood forest (including a podocarp element), kanuka forest and Coprosma-flax scrub (McEwen, 1987). Destruction of the forest cover began with natural fires around 2500 years ago and was exacerbated by Polynesian (800 to 400 years ago) and European settlement (1840 AD) (McGlone 1983 and 1989).

The present vegetation of the Macreas ED is of a highly modified nature with approximately 50% of the district dominated by improved pastureland (Bibby 1997). This is because of the long farming history associated with the Macraes ED.

The area locally known as Macraes (i.e., Macraes Flat) has been recommended as an important plant area (IPA) in New Zealand, as it has a high diversity of threatened and uncommon plants and is considered a stronghold for several threatened species (Thorsen 2008). At the time of preparation of this report, the IPAs in New Zealand were not available from the New Zealand Plant Conservation Network as they had not been confirmed, therefore the status of Macraes as an IPA is currently only a recommendation (Sawyer pers. comm.).

2.3 Vegetation surveys

Prior to undertaking field surveys associated with the Project, a thorough literature search of the existing vegetation of Macraes ED was undertaken, specifically focusing on finding areas of biological and conservation significance within proposed development areas.

Various sources of information were reviewed to assess the vegetation communities around Macraes Flat including: the survey report for the Protected Natural Areas (PNA)

Programme of Macraes Ecological District (Bibby 1997), sites of potential biological value in the Home Reef Resource Consent Area (Whitaker 1995), Otago Regional Council (ORC) publications, University of Otago Science library searches and interloan services and wider internet searches.

Threatened and/or uncommon plant species of Macraes ED were identified from previous reports, from a list of threatened and uncommon plants known for Macraes Flat (Thorsen 2008), the New Zealand threatened and uncommon plants species list (de Lange *et al.* 2009), Department of Conservation and the New Zealand Plant Conservation Network database searches.

Aerial photographs were used to generate base maps of proposed development areas. Vegetation types were classified in a similar manner to that used in the Whitaker reports (Whitaker 1986-1996), and mapped onto the aerial photographs (Appendix One). Particular attention was paid to:

- communities such as tussock grassland, flush vegetation, ephemeral wetlands, bluffs, rock outcrops and areas inaccessible by stock;
- the potentially biologically important McCormicks Creek near the confluence of Tipperary Creek (area 10, NZMG 23144 5537 and 23137 55343); and
- the potentially biologically important Macraes Back Road (area 16, NZMG 23113 55354) (Whitaker 1995, Appendix Two).

These areas have been highlighted in previous reports as housing or having the potential to house rare and/or conservation significant plant communities and species (Whitaker 1987, 1991, 1994, 1996a and 1996b).

Any rare and/or conservation significant plant communities or species encountered in the field were transcribed onto hard copies of the photographs/maps with locations accurately marked using a handheld Garmin GPS unit and obvious landmarks. A list of all plant species recorded at every site is included in Appendix Three.

2.4 Glossary

- Ecological District - The definition of an ecological district depends on a thorough consideration of the topography, geology, climate, soils, vegetation and man-induced modifications of the area (Nicholls, 1979). Thus an ecological district is a local part of New Zealand where the topographical, geological, climatic, soil and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities (Park *et al.* 1983).

- Ecological Region - An aggregation of adjacent ecological districts with very closely related characteristics together form an ecological region. In some cases, a single very distinctive ecological district is given the status of ecological region to emphasise its uniqueness (Park *et al.* 1983).

- NZMG – New Zealand Map Grid
- NZTM – New Zealand Transverse Mercator
- IPA - Important plant area
- PNA - protected natural areas
- RAP - recommended area for protection
- BRWRS – Back Road Waste Rock Stack
- TTTSF – Top Tipperary Tailings Storage Facility
- FNWRS – Frasers North Waste Rock Stack
- FSWRS – Frasers South Waste Rock Stack
- FWWRS – Frasers West Waste Rock Stack
- RHE – Round Hill Extension
- IMSV – Innes Mills Stage V
- RHSPE – Round Hill - Southern Pit Extension

3. Statutory Assessment

3.1 The Resource Management Act

The Resource Management Act (RMA) was released in 1991. Part Two of the RMA states that the purpose of the act is to promote the sustainable management of natural and physical resources. Section 6(c) states:

6 Matters of national importance

In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:

(a) the preservation of the natural character of the coastal environment (including the coastal marine area), wet- lands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:

(c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna:

3.2 The New Zealand Biodiversity Strategy

The New Zealand Biodiversity Strategy was released in 2000 as a response to the state of decline in New Zealand's indigenous biodiversity. Four goals were established for conserving and sustainably managing New Zealand's biodiversity. 'Goal Three: Halt the decline in New Zealand's indigenous biodiversity' is relevant to this proposal and is expressed in the following way:

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 else is necessary to maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity. (Department of Conservation and Ministry for the Environment, 2000).

Goal Three recognises that most of New Zealand's habitats have been modified to some extent and that ecosystems in production landscapes are important for maintaining indigenous biodiversity.

3.3 The Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land

The Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land was developed by the Ministry for the Environment in 2007. Four National Priorities were developed with the intention of focusing conservation efforts on the protection of some of our most rare and threatened ecosystems and species found on private land. The National Priorities are used to support and inform councils' biodiversity responsibilities under the Resource Management Act, and provide a framework for determining whether values on private property are significant and require protection. The National Priorities of relevance to the faunal habitat aspects of the Macraes Flat Phase III Project are:

National Priority 2:
To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.

National Priority 4: To protect habitats of acutely and chronically threatened indigenous species.

A proposed National Policy Statement on Indigenous Biodiversity (NPS) is currently being developed by the Government, with public submissions closing on 2nd May 2011. The proposed NPS contains a list of criteria for identifying areas of significant indigenous vegetation and habitats of indigenous animals that are rare or threatened at a national level. The proposed NPS requires district and relevant regional plans to identify these areas of significant biodiversity within five years of the NPS taking effect. Local authorities would be required to manage the effects of activities through district and regional plans and resource consent decisions (or be satisfied that effects are managed by other methods) to ensure there is no net loss of significant biodiversity.

4. Macraes-Dunback Road realignment

4.1 General

Macraes-Dunback Road will be realigned in three stages. The first realignment has been dealt with in a separate application and will not be discussed here. The second and third realignments are predominantly over land previously mined. OceanaGold is proposing to realign 5.12km of the existing road. The proposed new route will be 5.8km long.

Second realignment of Macraes-Dunback Road

The second realignment is to be undertaken where the Macraes-Dunback Road currently traverses the backfilled Innes Mills Pit. Prior to removal of this section of the road, a new section of temporary road will be constructed to the south of the existing road. This temporary road is to allow mining of the northern portion of the proposed Innes Mills Pit. The realignment will be formed using mine waste rock as the base. This second realignment is shown in Figure 2. The second realignment will affect about 0.5km of road and will reduce the road length by a minimal amount (25m). It will be undertaken prior to the removal of the existing road and is provisionally planned for 2016.

Third realignment of Macraes-Dunback Road

The third and final realignment is to be undertaken where the Macraes-Dunback Road currently traverses the backfilled Innes Mills Pit. Once mining has been completed to the north of the road the pit will be backfilled and the final road realignment will be constructed to allow Innes Mills to be mined to completion. Prior to removal of this section of the road a new section of road will be constructed to the north of the existing road. The realignment will be formed using mine waste rock as the base. This third and final realignment is shown in Figure 2. The final realignment will add an additional 0.3km to the road length making the entire road 0.8km longer than the currently existing road. It is provisionally planned for late 2016.

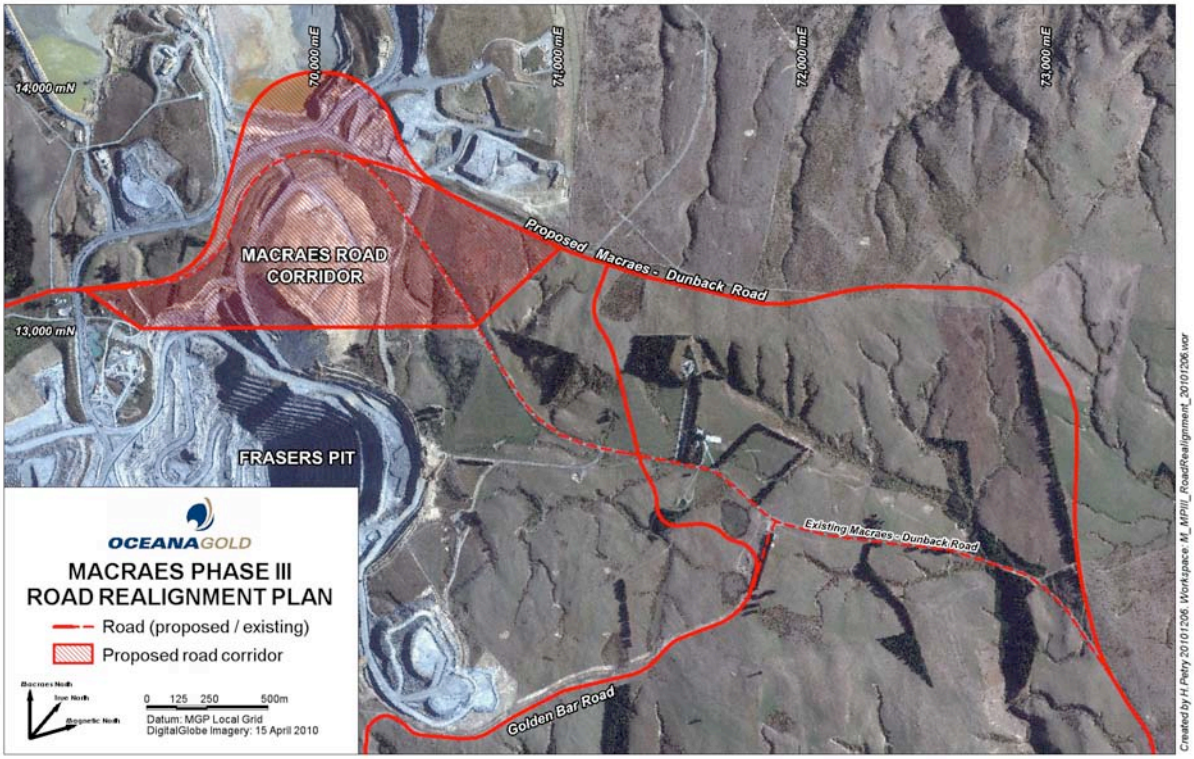

Figure 2 *Map showing location of proposed second and third road realignment stages of the Macraes-Dunback Road and proposed first and second road realignment stages of Golden Bar Road.*

4.2 Current vegetation

The proposed Macraes-Dunback second and third road realignments occur along improved pastureland and already extensively modified mining land. The proposed roading corridor is dominated by improved pasture species, with a small area of tussock grassland to the south of the existing road. The improved pasture is dominated by cocksfoot (*Dactylis glomerata*), browntop (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), red clover (*Trifolium pratense*), sub clover (*Trifolium subterraneum*), white clover (*Trifolium repens*), Onward strawberry clover (*Trifolium fragiferum* cv. 'Grasslands Onward') and alsike clover (*Trifolium hybridum*) and adventive weed species common to improved pastureland at Macraes Flat. The tussockland has higher indigenous diversity with a small area of tussockland dominated by narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) and *Chionochloa* hybrids (*Chionochloa rigida* x *rubra*) and small-leaved pohuehue (*Muehlenbeckia complexa*) interwoven into the base of the tussocks.

4.3 Potential adverse effects and recommended mitigation

The improved pastureland that dominates the proposed road realignment and the already extensively modified areas in the mine site retain no indigenous value and are only valuable in an agricultural sense. Removal of these vegetation types will have a less than minor impact on the Macraes ED. No mitigation is required apart from replanting of exposed construction surfaces with appropriate pasture grass species.

5. Golden Bar Road realignment

5.1 General

Golden Bar Road will be realigned in two stages. 1.65km of Golden Bar Road is being realigned compared to the existing length of 0.24km. Both stages of the realignment are situated predominantly over previously farmed land.

First Realignment of Golden Bar Road

The northern section of the existing Golden Bar Road is planned to be realigned in a north western direction to join with the existing Macraes-Dunback Road. A connection between the existing and realigned Macraes-Dunback Road will be made as shown in Figure 2. This realignment and connection is provisionally planned for 2014. The realigned section of Golden Bar Road will run along the northern face of Frasers East Waste Rock Stack within the current consented footprint before connecting with the existing Macraes-Dunback Road. The connection between the existing and realigned section of Macraes-Dunback Road is over land previously used for farming.

Second Realignment of Golden Bar Road

The second realignment is required for the Frasers North Waste Rock Stack to be constructed to the proposed extent. The realigned section of road would run from the face of the Frasers East Waste Rock Stack up the ridge west of the Top Tipperary Tailings Storage Facility abutment and rejoin the realigned Macraes-Dunback Road. This second realignment is is provisionally planned for 2017.

5.2 Current vegetation

The proposed Golden Bar first and second road realignments occur along improved pastureland and border two medium sized wetlands. The proposed road realignment is dominated by improved pasture species, such as; cocksfoot (*Dactylis glomerata*), browntop (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), red clover (*Trifolium pratense*), sub clover (*Trifolium subterraneum*), white clover (*Trifolium repens*), Onward strawberry clover (*Trifolium fragiferum* cv. 'Grasslands Onward') and alsike clover (*Trifolium hybridum*) and adventive weed species common to improved pastureland at Macraes Flat.

The proposed Golden Bar Road realignment skirts the edge of a pond with associated wetland vegetation (NZTM E1402569 N4973489) (Figure 3) and a ridge top swamp at

NZTM E1401602 N4973760. The swamp is surrounded by red tussock (*Chionochloa rubra* subsp. *cuprea*) and is located in improved pastureland.

Figure 3 *Photo showing wetland at NZTM E1402569 N4973489.*

5.3 Potential adverse effects and recommended mitigation

The improved pastureland that dominates the proposed road realignment and the already extensively modified areas in the mine site retain no indigenous value and are only valuable in an agricultural sense. Removal of these vegetation types will have a less than minor impact on the Macraes ED. No mitigation is required apart from replanting of exposed construction surfaces with appropriate pasture grass species.

The wetlands immediately adjacent to the proposed Golden Bar Road realignment contain plant communities with high values. This is because of the limited extent of these wetland habitats type throughout the Macraes ED and because of the large number of rare and/or uncommon plants species that can be associated with them (Johnson 1993, Whitaker 1995). Mitigation will only be required if the road realignment impinges on the

ephemeral ponds or the bog wetland. Previous studies have identified rare plant species in ephemeral ponds and ridge top bogs around the Macraes ED (Johnson 1993, Whitaker 1995). None of these rare plants were identified by this study, however due to time constraints and lack of distinctive floral characteristics necessary for in-depth classification only a cursory examination was possible. The leaves of freshwater turf plants are typically tiny, and their shape tends to be either linear, pinnatifid, or spathulate (Johnson and Roger 2003), without the aid of inflorescences or a specialist botanist, identification of these plants can be extremely difficult. Therefore the presence of these rare species could not be categorically ruled out by this study. Care should be taken to avoid disturbance of these sites.

6. Camp Creek Storage Dam

6.1 Existing information

No previous botanical surveys have examined Camp Creek. However, several studies have looked at the vegetation in the Deepdell Creek Catchment, to which Camp Creek is a tributary (Whitaker 1986, 1987, 1994 and 1996a). These studies claim no rare or unusual plant communities have been found in the Deepdell Catchment (Whitaker 1986, 1987, 1994 and 1996a). However, two, possibly three, 'At Risk' plant species were identified; the 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*), 'Declining' coral broom (*Carmichaelia crassicaulis* subsp. *Crassicaulis* ex. *Corallospartium crassicaule*) and possibly *Ranunculus brevis*[1] (ex. *Ranunculus depressus*) (Whitaker 1987, 1994 and 1996a; Appendix Four). Other species of note were the increasingly scarce, though non-threatened, *Gingidia montana* and the non-threatened *Scandia geniculata* (Whitaker 1996a). *G.montana* has declined from much of the South Island due to its palability to browsing animals (NZPCN 2010). *S. geniculata* is uncommon in the Macraes area (Thorsen 2008).

6.2 Current vegetation

The vegetation of the proposed Camp Creek Storage Dam is dominated by a mixture of tussock grassland and indigenous scrub, which cover approximately 58% of the area (Table 1). The rounded hill tops and more shallow gullies of Camp Creek have been converted into improved pasture, while the tops of the gully sides have been modified into rough pasture (i.e., not as highly maintained and not as heavily grazed as improve pastureland). Improved and rough pasture are dominated by browntop (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), Italian ryegrass (*Lolium multiflorum*), cocksfoot (*Dactylis glomerata*), white clover (*Trifolium repens*) and adventive weed species including mouse-ear hawkweed (*Pilosella officinarum*), sheep's sorrel (*Rumex acetosella*), Californian thistle (*Cirsium arvense*), shepherd's purse (*Capsella bursa-pastoris*) and dandelion (*Taraxacum officinale*).

Scattered tussocks, including silver tussock (*Poa cita*), hard tussock (*Festuca novae-zelandiae*), narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*), *Chionochloa* hybrids (*Chionochloa rigida* x *rubra*), and wilding pines (generally *Pinus radiata*) are also scattered throughout the rough pasture. Pastureland species occur throughout Camp

[1] *Ranunculus brevis* presence remains equivocal.

Creek as ground cover. Often, the only circumstances where these species are excluded are on rock outcrops, bluffs and cliffs and when the indigenous vegetation forms a dense canopy.

Table 1 *Vegetation/habitat types, areas and percentages within the proposed Camp Creek Storage Dam.*

Vegetation/habitat type	Area (ha)	Percentage
Exotic scrub	2.6	19.9
Rock outcrop	0.7	4.7
Indigenous scrub	1.2	8.5
Carex/Juncus	0.08	0.5
Exotic pasture with scattered tussock	2.2	15.6
Indigenous scrub/Tall tussock grassland	7.3	50.7
Total	14.3	100.0

No pure stands of tussock grassland occur at Camp Creek. The tussock grassland that is present occurs in a complex mosaic with other community types such as scrub, rough pasture and outcrops. Tussock grassland is common on the steeper slopes and bordering improved and rough pastureland.

Tussock grassland is dominated by narrow-leaved snow tussock and *Chionochloa* hybrids, with red tussock (*Chionochloa rubra* subsp. *cuprea*) less abundant and generally found in damper areas such as along the gully floor. Golden spaniard (*Aciphylla aurea*) is common throughout the tussock grassland and around rock outcrops, tors and bluffs. The inter-tussock herbaceous species are frequented by adventive weed species including mouse-ear hawkweed, sheep's sorrel and white clover.

Scrub generally occurs on steeper slopes and towards the gully bottom. It can be divided into three scrub types; matagouri scrub, mixed indigenous scrub and adventive scrub.

Matagouri scrub is dominated almost entirely by the divaricating matagouri (*Discaria toumatou*). It generally occurs on the drier, shallower slopes, and is often found in combination with tussock grassland (*C. rigida* subsp. *rigida* and *C. rigida* x *rubra*) and rough pasture.

Mixed indigenous scrub generally occurs on the steep slopes near the gully floor, along the gully floor and around any rocky slopes. It is dominated by divaricating indigenous

shrub species including matagouri, mingimingi (*Coprosma propinqua*), *Olearia bullata*, porcupine shrub (*Melicytus alpinus*), native broom (*Carmichaelia petriei*) and the occasional adventive shrub species such as gooseberry (*Ribes uva-crispa*), briar rose (*Rosa rubiginosa*) and gorse (*Ulex europaeus*). Lianes commonly interwoven in the shrubs include bush lawyer (*Rubus cissoides* and *R. schmidelioides* var. *subpauperatus*) and *Clematis quadribracteolata*. Common groundcover species below mixed indigenous scrub include cleavers (*Galium aparine*), Californian thistle, Scotch thistle (*Cirsium vulgare*), bidibids (*Acaena* spp.), chickweed (*Cerastium* spp. and *Stellaria media*), willowherb (*Epilobium* spp.), stinging nettle (*Urtica urens*) and fern species such as prickly shield fern (*Polystichum vestitum*), kiokio (*Blechnum novae-zelandiae*) and bracken (*Pteridium esculentum*).

Adventive scrub occurs along the gully floor close to the stream, often mixed in with the mixed indigenous scrub. The adventive scrub is composed almost entirely of gorse.

The riparian vegetation and wetter gully areas are dominated by pukio (*Carex secta*), gorse, *Olearia bullata*, prickly shield fern, rushes (*Juncus* spp.), mint (*Mentha spicata* subsp. *spicata*), musk (*Mimulus moschatus*) and water starwort (*Callitriche* spp.).

There are numerous outcrops, cliffs and bluffs in the Camp Creek catchment. Different species, not seen in the other vegetation types, are often restricted to these niches, either as a result of an adaptation to a certain habitat or due to protection from browsing. The highly palatable 'Naturally Uncommon' Hookers mountain daisy is common on the cliffs and bluffs along Camp Creek (Figure 4). The 'Naturally Uncommon' sprawling turpentine (*Dracophyllum uniflorum* var. *frondosum*) (Figure 4) and the non-threatened *Dracophyllum rosmarinifolium* also occur on the cliffs and bluffs along the true right. The 'Declining' coral broom is located growing on a cliff face at NZTM E1396477 N4974433, E1396472 N4974421 and E1396410 N4974351 (Figure 5). More common widespread outcrop species include porcupine shrub, patotara (*Leucopogon fraseri*), butterfly fern (*Asplenium flabellifolium*), Richards spleenwort (*Asplenium richardii*), creeping or slender everlasting daisy (*Helichrysum filicaule*), golden spaniard, small-leaved pohuehue (*Muehlenbeckia complexa*), blue tussock (*Poa colensoi*) and snowberry species (*Gaultheria* spp.).

Figure 4 *Left: A population of the 'At Risk - Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) growing on a cliff face at Camp Creek.*
*Right: 'At Risk - Naturally Uncommon' sprawling turpentine (*Dracophyllum uniflorum var. frondosum*) on a cliff face at Camp Creek.*

Figure 5 *'At Risk – Declining coral broom (Carmichaelia crassicaulis* subsp. *crassicaulis) growing at NZTM E1396410 N4974351 on a cliff face at Camp Creek.*

6.3 Natural values

Camp Creek has inherent vegetative values due to the presence of substantial rock outcropping surrounded by intact tall tussock grasslands and mixed indigenous scrub. These plant communities are the least modified and are thus most representative of pre-anthropogenic influences, and therefore are of the greatest biological interest. Areas with higher indigenous values are; the gully bottom, rock outcrops, rocky cliffs, bluffs and tors, and the steep inaccessible slopes.

In general, the indigenous plant species within these vegetation types are those that are resilient, common and widespread. However, three rare plant species were observed growing on the rocky cliffs and bluffs along the true right of Camp Creek. These were the 'Declining' coral broom, the 'Naturally Uncommon' sprawling turpentine and 'Naturally Uncommon' Hookers mountain daisy.

Coral broom is classified as an 'At Risk – Declining' species, meaning that it has a moderate to large population with a low to moderate ongoing or predicted decline (Townsend *et al.* 2008, Appendix Four). It is distributed on the east side of the main divide and inhabits a range of environments including upland, sub-alpine grassland, scrub and rock formations (NZPCN 2010). It has previously been found on outcrops and bluffs in the upper reaches of Deepdell Creek (Whitaker 1987), in the proposed Back Road Waste Rock Stack (Ryder Consulting 2009b) and as scattered individuals south of Macraes Flat, where c. 200 individuals are regenerating in the absence of stock (Thorsen 2008). Coral broom is not common throughout Camp Creek, being restricted to a few individuals on the less accessible rock bluffs of the true right.

Hookers mountain daisy has been classified as 'Naturally Uncommon' - by definition a taxon whose distribution is naturally confined to a specific substrate or geographic area, or a taxon that occurs within naturally small and widely scattered populations, and whose distribution is not the result of past or recent human disturbance. (Townsend *et al*. 2008, Appendix Four). It is restricted to the north and east of Otago and to the Mataura River catchment in Southland (Barkla pers. comm., NZPCN 2010). Hookers mountain daisy is relatively abundant in gullies around Macraes Flat (pers. obs.). It has been found previously on bluff outcrops in the Deepdell Catchment, along Maori Tommy gully, in the Northern gully, in the Back Road Waste Rock Stack and on rock faces in Redbank Ridge (Whitaker 1987, Thorsen 2008, Ryder Consulting 2009b). The southern limit for

the species is a site on the Trig J ridge (Thorsen 2008). Hookers mountain daisy was common along the true right of Camp Creek.

Sprawling turpentine is also classified as 'Naturally Uncommon' (Appendix Four). It is distributed throughout south Marlborough, central and eastern districts of Otago and occupies tussock grasslands from 300-900 metres and upland rocky cliffs (Oliver 1951, NZPCN 2010). A nearby population is present on a bluff at the base of Jimmy's Creek and on a large shingle slide at Jimmy's Creek (DOC 2006). Sprawling turpentine was found on cliff faces on the true right of Camp Creek.

6.4 Potential adverse effects and recommended mitigation

If Camp Creek is dammed to a height of approximately 30 metres, rare plant species, mixed indigenous scrub and rock cliffs and bluffs will be inundated. It is recommended that the loss of approximately 8 hectares of mixed indigenous scrub be mitigated by protecting and enhancing an area of indigenous scrub outside of the proposed development area.

6.4.1 Mitigation for Ecologically Significant Plant Species

The loss of the 'Declining' coral broom will require mitigative measures. Recommended mitigation for coral broom includes protecting populations outside of the intended mine expansion from stock and giving consideration to the long-term protection of coral broom by implementing a coral broom enhancement programme, perhaps in conjunction with land recommended for terrestrial fauna mitigation. Coral broom propagation is reported to be easy from fresh seed and relatively difficult from semi-hardwood (NZPCN 2010). It is a very attractive species and would be suitable for restoration or amenity plantings. If such an enhancement programme is undertaken, material must only be collected from plants in the study area to preserve inherent genetic diversity.

It is recommended that some of the larger populations of the 'Naturally Uncommon' sprawling turpentine and Hookers mountain daisy, outside of the proposed mine expansion areas are fenced off from stock and enhanced by propagation.

Any loss of the uncommon *Gingidia montana* and *Scandia geniculata* will need to be mitigated by propagation of specimens within a protected area outside of the proposed mine development.

7. Back Road Waste Rock Stack

7.1 Existing information

Four plant communities with higher indigenous diversity and associated values have been recognised within the BRWRS. These include the wet and dry scrub communities located in the steeper gullies towards Deepdell Creek, the ephemeral wetlands and ridge top swamps along the ridgeline of the proposed BRWRS and the rock outcrops and bluffs (Whitaker 1995, 1996a and Ryder Consulting 2009b). Four 'At Risk' plant species were found in the BRWRS, these included the 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) and *Gingidia grisea* (initially thought to be *G. montana* by Ryder Consulting 2009b) and the 'Declining' *Aciphylla subflabellata* and coral broom (*Carmichaelia crassicaulis* subsp. *crassicaulis*) (Ryder Consulting 2009b, Barkla pers. comm.).

7.2 Current vegetation

The BRWRS is a mixture of exotic pasture, tall tussock and short tussock grasslands and indigenous scrub (Table 2). Improved pastureland occurs along the flat plateau at the tops of the gullies and in the shallower gully sides. It is dominated by agriculturally important grass and clover species and some adventive herb species. The dominant plant species include browntop (*Agrostis capillaris*), cocksfoot (*Dactylis glomerata*), sweet vernal (*Anthoxanthum odoratum*), perennial ryegrass (*Lolium perenne*), white clover (*Trifolium repens*), mouse ear chickweed (*Cerastium fontanum*) and Yorkshire fog (*Holcus lanatus*), with adventive weeds such as Californian thistle (*Cirsium arvense*) and sheep's sorrel (*Rumex acetosella*) common throughout the pastureland. Remnant scattered narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) and hard tussock (*Festuca novae-zelandiae*) occur in some areas of improved pastureland.

Unlike the improved pasture, the rough pasture is not as highly developed. It is the most common vegetation type found throughout the study site and often occurs in combination with the other vegetation types, such as below scrub canopy, merged with tussock grassland along the plateau and ridge tops, or surrounding rock outcrops.

Rough pasture is generally dominated by exotic grass species including browntop, mouse-ear hawkweed (*Pilosella officinarum*), sweet vernal, cocksfoot and creeping bent (*Agrostis stolonifera*). Also present, but at lower densities, are adventive herb species; such as white clover, red clover (*Trifolium pratense*) suckling clover (*Trifolium dubium*),

sheeps bur (*Acaena agnipila*), doves foot cranesbill (*Geranium molle*), catsear (*Hypochaeris radicata*), Californian thistle, Scotch thistle (*Cirsium vulgare*), horehound (*Marrubium vulgare*), woolly mullein (*Verbascum thapsus*), shepherd's purse, mouse-eared chickweed, prostrate knotweed (*Polygonum aviculare*) and dandelion (*Taraxacum officinale*). Also present are some of the less palatable indigenous plant species, including *Pentachondra pumila* and golden spaniard (*Aciphylla aurea*) and patotara (*Leucopogon fraseri*).

Table 2 *Vegetation/habitat types, areas and percentages within the proposed Back Road Waste Rock Stack.*

Vegetation/habitat type	Area (ha)	Percentage
Mine/Road	21.2	10.1
Exotic pasture	70.0	33.3
Indigenous scrub	22.6	10.8
Tall tussock grassland	37.2	17.6
Wetland	0.5	0.2
Exotic scrub	0.1	0.1
Exotic pasture with scattered tussock	26.8	12.7
Rock outcrop	2.5	1.2
Short tussock grassland	29.7	14.1
Total	210.5	100.0

The only locations that exclude rough pasture are the extremely steep outcrops towards Deepdell Creek, especially on the true right. The steep outcrops are commonly dominated by palatable indigenous species such as Hookers mountain daisy (*Celmisia hookeri*), the less palatable narrow-leaved snow tussock, golden spaniard and hounds tongue fern (*Microsorum pustulatum* subsp. *pustulatum*).

The tussock grassland is generally located on the plateau and along the ridgelines of the gullies, often mixed in with rough pastureland and occasionally on rock outcrops. The tussock grassland to the east of the site is more intensively modified than tussock grassland to the west.

Tussock grassland is dominated by the tall narrow-leaved snow tussock, while the short tussock are predominated by hard tussock, scattered individuals of silver tussock (*Poa cita*) and blue tussock (*Poa colensoi*).

The grass and herb species commonly found between the tussocks are similar to those that make up rough pastureland. Additional species scattered through tussock grassland included golden spaniard, matagouri, some gorse (*Ulex europaeus*), bracken (*Pteridium esculetum*) and native broom (*Carmichaelia petriei*).

Scrub in the BRWRS can be divided into three dominant scrub types; matagouri scrub, dry scrub and wet scrub.

Matagouri scrub (*Discaria toumatou*) is more abundant around the shallower gullies close to the ridgeline. Matagouri scrub is frequently found in combination with rough pastureland and tussock grassland.

Dry scrub is more commonly located mid way down the gully slopes to near the gully floors. However, in the less modified gullies (i.e., the gullies to the east), the scrub is less restricted and ranges from the ridge tops to the gully floors. Dry scrub is dominated by matagouri, mingimingi, native broom, *Olearia bullata*, *Coprosma crassifolia*, needle-leaved mountain coprosma (*Coprosma rugosa*), *Coprosma tayloriae*, and porcupine shrub (*Melicytus alpinus*), with scattered areas of briar rose (*Rosa rubiginosa*) and bracken along the gully sides. Lianes such as bush lawyer (*Rubus cissoides* and *R. schmidelioides* var. *subpauperatus*), small-leaved pohuehue (*Muehlenbeckia complexa*), *Clematis quadribracteolata*, New Zealand bindweed (*Calystegia tuguriorum*) and pohuehue (*Muehlenbeckia australis*) are often interwoven in the scrub, especially closer to the gully floors. Beneath the scrub, the predominant vegetation includes bracken, exotic grasses (browntop, cocksfoot, Yorkshire fog, sweet vernal and creeping bent) and herbs including cotton fireweed (*Senecio quadridentatus*), annual mouse-ear chickweed (*Cerastium glomeratum*), Californian thistle, cleavers (*Galium aparine*) and woolly mullein. A small patch of coral broom is found on the true left ridgeline of gully E (Appendix Five).

Wet scrub occurs closer to the gully floors, especially along the steeper, more damp true right sides. Wet scrub contains some dry scrub species such as matagouri, mingimingi, *Olearia bullata*, native broom and bracken. However, additional species include the predominant feathery tutu (*Coriaria plumosa*), scattered koromiko (*Hebe salicifolia*), mountain wineberry (*Aristotelia fruticosa*) and elderberry (*Sambucus nigra*). Beneath the wet scrub are a variety of ferns (bracken, little hard fern (*Blechnum penna-marina*),

kiokio (*Blechnum novae-zelandiae*) and prickly shield fern (*Polystichum vestitum*)), herbaceous species including *Chaerophyllum ramosum*, bidibid (*Acaena anserinifolia*, *A. juvenca* and *A. novae-zelandiae*), chickweed (*Stellaria media*), willowherb (*Epilobium alsinoides, E. ciliatum, E. nummulariifolium* and *E. pubens*), buttercup (*Ranunculus glabrifolius*) and lianes (mainly bushlawyer, scrub pohuehue and *Clematis quadribracteolata*).

Two ephemeral wetlands occur along the ridgeline at NZTM E1401506 N4973964 and E1402039 N4974411. The ponds are bordered by narrow-leaved snow tussock (*C. rigida* subsp. *rigida*), with *Juncus* rushes (*Juncus edgariae, J. effusus* var. *effusus* and *J. pallidus*) around the shallower edges. The 'At Risk – Naturally Uncommon' *Lobelia perpusilla* was found within the first wetland (NZTM E1401506 N4973964).

Two ridge top swamps are located adjacent to the southern egde of the BRWRS at NZTM E1401602 N4973760 and E1402090 N4974208. The swamps are surrounded by red tussock (*Chionochloa rubra* subsp. *cuprea*) and are located within improved pastureland.

Vegetation on the gully floors differs from that found around the ephemeral wetlands. The gully floors are dominated by pukio (*Carex secta*), prickly shield fern, *Juncus* rushes (*Juncus edgariae, J. effusus* var. *effusus* and *J. pallidus*), with an undergrowth of small herbaceous species such as water starwort (*Callitriche* spp.) and willowherb (*Epilobium* spp.). Scattered toetoe (*Austroderia richardii*) occurs along the gully floor, but is not a dominant species.

A few plant species are restricted to the rock outcrops generally on the true right slopes. These are Hookers mountain daisy, *Gingidia grisea* (Figure 6), *Helichrysum lanceolatum*, snowberry (*Gaultheria antipoda* and *G. crassa*) *Pseudognaphalium luteoalbum* and hounds tongue fern. Some species that are common on rock outcrops are also widespread in surrounding vegetation types, including narrow-leaved snow tussock (*C. rigida* subsp. *rigida*), *Coprosma* species (mainly *Coprosma propinqua*), bracken and golden spaniard. A small patch of the 'Naturally Uncommon' *Gingidia grisea* can be found to the north east of Portal Road, at NZTM E1401883 N4975278 and in the general area of NZTM E1401868 N4975162.

'Locally notable' remnant forest species, including kowhai (*Sophora microphylla*) and broadleaf (*Griselinia littoralis*), occur in the deeper less accessible gullies to the north (towards Deepdell Creek) as do cabbage tree (*Cordyline australis*) and mountain flax (*Phormium cookianum* subsp. *cookianum*).

Figure 6 *Photo of the 'At Risk – Naturally Uncommon' Gingidia grisea growing on a rock outcrop within the Back Road Waste Rock Stack.*

7.3 Natural values

The majority of the study site (roughly 75%) is made up of rough pastureland and/or improved pastureland, either by itself or in combination with tussock grassland or scrub. The only areas where pastureland is not abundant are the steeper less accessible gully sides and the rock outcrops. Pastureland is dominated by exotic species, with less palatable native species.

Matagouri scrub is generally found on the shallower more modified ridgelines and plateaus of the shallower gullies. It is the least diverse scrub type and is generally dominated by matagouri, which is a secondary scrub species that has a positive response

to top-dressing (Wardle 1991). Scrub dominated by matagouri is common throughout Macraes Flat. Indeed, an early study found that grassland mixed with matagouri made up a large percent of the South Island (approximately 8%) (Blaschke *et al*. 1981).

Dry scrub has greater indigenous diversity than matagouri scrub. It is more abundant on the steeper gully sides and further downstream (towards Deepdell Creek) of the gullies. This restriction is likely the result of the steeper gully sides not being modified for farming purposes, rather than any range restrictions exhibited by the plants themselves (Whitaker 1996a and 1996b). Dry scrub consists of common and widespread native species that are found throughout the study site and in other deeper less modified gullies (Whitaker 1986, 1987, 1996a and 1996b).

The species composition observed in wet scrub differs from the previous scrub types. Wet scrub is generally restricted to damper areas such as the gully floors and the more damp true right gully sides. This vegetation type is likely due to both a preference for damper habitats and also range restrictions imposed through anthropogenic and stock influences. Wet scrub is represented elsewhere in gullies around Macraes Flat (Whitaker 1986, 1987, 1996a and 1996b).

The rock outcrops around Macraes Flat have been recognised as ecologically important, as they provide natural protection for flora and fauna from stock and introduced predators (Whitaker 1987, 1996a and 1996c). The ecologically significant *Gingidia grisea* and Hookers mountain daisy occurs on the steeper outcrops and gully sides, while coral broom is located on the ridgeline above Gully E (Appendix Five). *G. grisea* is considered an 'At Risk - Naturally Uncommon' species known only from the small geographic area of north-east Otago (Heenan 2004). Although believed to be decreasing in numbers for the last 20 years, strongholds of *G. grisea* remain at Trotters Gorge and Mt Watkin Scenic Reserve (Heenan 2004; Lloyd *et al.* 2008).

The majority of the tussock grassland within the proposed BRWRS is already highly modified. Evidence of this is inferred from the large inter-tussock spacing, the abundance of exotic grass and herb species between the tussocks, the presence of stock and evidence of burning (Bulloch 1973; Connor 1982, Whitaker 1996c). However, tussock grassland towards the Deepdell Creek is comparatively healthy.

The wetlands along the ridgeline and adjacent to the southern egde of the BRWRS are important due to the rarity of this habitat type both locally and nationally.

Overall, the vegetation found in the proposed site is generally representative of common vegetation around the Macraes Flat area (Whitaker 1986, Whitaker 1987, Whitaker 1996a, Whitaker 1996b, Ryder Consulting 2008). Generally the ecologically more diverse vegetation is situated in the steeper gullies.

7.4 Potential adverse effects and recommended mitigation

The removal of the highly altered tussock grassland will have a minimal impact on surrounding tussock grassland due to its already degraded state. However, the removal of the healthy tussock grassland towards the Deepdell Creek will have a significant impact on the natural values present. Tall tussock grassland has been identified as an indigenous cover class that has one of the most extensive areas of 'critically underprotected' (204,206 ha) and 'underprotected' (295,919 ha) indigenous cover in New Zealand (especially inland eastern South Island) according to a recent study on the loss of indigenous cover in New Zealand (Walker *et al.* 2006). An expanse of tussock grassland outside of the proposed project area should be protected to mitigate the removal of the tall tussock grassland.

The steeper gullies with higher biological values to the north northeast are outside of the proposed BRWRS. Placement of silt ponds in the deeper gullies with 'locally notable' remnant species should have a minimal impact on the vegetation as long as the flow of the gully is not drastically altered and an attempt is made to minimise disturbance caused by construction.

The ephemeral wetlands at the southern edge of the BRWRS will be completely eliminated by the proposed development. Between the BRWRS and the consented Frasers East Waste Rock Stack there is potential for the loss of up to forty-five percent of this habitat type in the vicinity. It is recommended that either the footprint of the BRWRS is changed to avoid the wetlands, in particular the wetland containing the 'At Risk' *Lobelia perpusilla* (NZTM E1401506 N4973964). If wetlands cannot be avoided the remaining wetlands in the area that are not designated for development should be protected and enhanced by fencing off from stock and planting with locally sourced vegetation.

It is recommended that the loss of approximately 22.6 hectares of indigenous scrub be mitigated by protecting and enhancing an area of indigenous scrub outside of the proposed development area.

7.5 Mitigation for Ecologically Significant Plant Species

Recommended mitigation for the coral broom includes protecting populations outside of the intended mine expansion from stock and giving consideration to the long-term protection of coral broom by implementing a coral broom enhancement programme. It is a very attractive species both in and out of flower and would be a successful amenity planting that could be incorporated into the revised closure plan. If such an enhancement programme is undertaken, material must only be collected from plants in the study area to preserve inherent genetic diversity and to protect against the introduction of pathogens (Whitaker 1992).

An additional two hour field trip to the BRWRS, undertaken on the 18th of September 2009, identified the 'Declining' *Aciphylla subflabellata* (Barkla pers. comm.). Although searched for in the present (Project) study, it was not re-located, however it was found close by in the proposed Top Tipperary Tailings Storage Facility, and is likely to have been missed due to the large size of the site and difficult terrain. Mitigation for *Aciphylla subflabellata* will be discussed in the section on Top Tipperary Tailings Storage Facility mitigation.

Only a few individuals of *G. grisea* will be lost through the development of the proposed BRWRS. The loss of these individuals can be offset by ensuring the protection of populations outside of the proposed development area.

Any loss of the locally notable kowhai and broadleaf will need to be mitigated by replanting of specimens outside of the proposed development area. This can be incorporated into shelterbelts.

The removal of small populations of Hookers mountain daisy should have a small impact on the localised communities, however, when put into a larger context, it is clear that quite a few populations that occur within the proposed development areas are likely to be destroyed. Therefore, mitigation for this 'Naturally Uncommon' species is needed. It is

recommended that some of the larger populations of the 'Naturally Uncommon' Hookers mountain daisy outside of the proposed mine expansion areas are fenced off from stock and enhanced by propagation.

8. Top Tipperary Tailings Storage Facility

8.1 Existing information

A study of the Home Reef Resource Consent Area (including the Tipperary catchment) recognised that McCormicks Creek near the confluence of Tipperary Creek (between NZMG 23144 5537 and 23137 55343) had the potential to accommodate higher floral values including the 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) and other rare or unusual plants (Whitaker 1995, Appendix Four).

A 1996 vegetation survey focusing specifically on McCormicks Creek and the lower Tipperary Creek (to the south of Macraes Road) found no plant communities or species of conservation or scientific interest (Whitaker 1996b). Nonetheless the 'Naturally Uncommon' Hookers mountain daisy and the increasingly scarce though non-threatened *Gingidia montana* were noted as being abundant on damp and/or south-facing bluffs and outcrops (Whitaker 1996b). Both species were recognised as declining due to their palatability to stock (Whitaker 1996b)

8.2 Current vegetation

The ridge tops and flatter gullies within the proposed TTTSF have been converted into improved pastureland, with tussock grassland in the wetter gullies (Table 3). The shallower gullies in the northern reaches of the upper Tipperary Creek, and to the south of the Macraes-Dunback Road, comprise improved pastureland with matagouri (*Discaria toumatou*) and scattered hard tussock (*Festuca novae-zelandiae*) and silver tussock (*Poa cita*). As the gullies steepen (and in the steep gullies to the east), narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*), golden spaniard (*Aciphylla aurea*), *Olearia bullata*, prickly shield fern (*Polystichum vestitum*) and native broom (*Carmichaelia petriei*) become increasingly abundant. The gullies to the west have additional species including mountain astelia (*Astelia nervosa*), European larch (*Larix decidua*) and *Pinus* species. The 'Declining' spaniard *Aciphylla subflabellata* was observed at the bottom of one of the gullies to the west at NZTM E1402099 N4973887 (Figure 7).

The vegetation along the valley floor to the north of the Macraes-Dunback Road have a wetland-type configuration dominated by red tussock (*Chionochloa rubra* subsp. *cuprea*), pukio (*Carex secta*), prickly shield fern, *Juncus* species and other herbaceous species including *Ranunculus* spp. and *Galium* spp. Broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*) surround the wetland area to the west of the site.

Table 3 *Vegetation/habitat types, areas and percentages within the proposed Top Tipperary Tailings Storage Facility.*

Vegetation/habitat type	Area (ha)	Percentage
Exotic scrub	3.6	2.1
Mine/Road	2.4	1.4
Farm pond	0.6	0.4
Tall tussock grassland	27.9	16.6
Exotic trees	14.3	8.5
Exotic pasture	119.8	71.1
Total	168.6	100.0

Rocky cliffs and bluffs generally occur on the true left of the gullies. These rocky cliffs and bluffs include additional species such as the 'Naturally Uncommon' Hookers mountain daisy, *Gaultheria* spp., *Brachyglottis bellidioides* var. *crassa*, mingimingi (*Coprosma propinqua*) and porcupine shrub (*Melicytus alpinus*), patotara (*Leucopogon fraseri*), Richards spleenwort (*Asplenium richardii*), golden spaniard, small-leaved pohuehue (*Muehlenbeckia complexa*), bush lawyer (*Rubus* spp.) and blue tussock (*Poa colensoi*). No *Gingidia montana* was observed on damp and/or south-facing bluffs and outcrops as was previously found.

Figure 7 *Photo showing the 'At Risk – Declining' spaniard (Aciphylla subflabellata) individual growing in improved pastureland at NZTM E1402099 N4973887.*

8.3 Tipperary Creek silt pond

The proposed Tipperary Creek (TC) silt pond is located in the upstream region of a pine plantation. A small population of the 'Declining' spaniard *Aciphylla subflabellata* is located downstream in improved pastureland at NZTM E1403671 N4973904 (Figure 8).

Figure 8 *Photos showing a community of the 'At Risk – Declining' spaniard (Aciphylla subflabellata) growing at NZTM E1403671 N4973904.*

8.4 Natural values

The areas with higher indigenous diversity and therefore higher values are those that are less accessible to stock (i.e., outcrops and bluffs) and the less modified areas (more damp gully bottoms). Plant communities in these areas are the least modified and therefore are of greater biological interest.

The red tussock grassland along the valley floor has higher ecological values relative to the other plant communities of the TTTSF.

In general, the indigenous plant species growing on the rock cliffs and bluffs were those that were resilient, common and widespread. The only rare species observed on the cliffs and bluffs was the 'Naturally Uncommon' Hookers mountain daisy, which was common along the true left of Tipperary Creek.

The 'Declining' spaniard *Aciphylla subflabellata* was not common throughout the TTTSF, and was observed only at the bottom of a gully to the west of the site (NZTM E1402099 N4973887) and growing in improved pastureland at NZTM E1403671 N4973904 outside of the proposed TTTSF. *Aciphylla subflabellata* is classified as a 'At

Risk – Declining' species, meaning that it has a moderate to large population with a low to moderate ongoing or predicted decline (Townsend *et al*. 2008, Appendix Four). It is distributed in the South Island in the drier eastern districts including Canterbury: Weka Pass, Banks Peninsula, Waiau, Ashley Gorge, Broken River, Mt. Torlesse, Otago: Kirkliston Range, Taieri Plain and Swampy Hill (Oliver 1955). Its northern limit is reportedly the upper Wairau Valley (Dawson and Le Comte 1978). It has previously been found in the proposed BRWRS (Barkla pers. comm.).

8.5 Potential adverse effects and recommended mitigation

Loss of the tussock grassland, especially in the valley to the north of the Macraes-Dunback Road, will require mitigation. Loss of *Aciphylla subflabellata* and the 'Naturally Uncommon' Hookers mountain daisy will also require mitigation measures. In order to mitigate against the loss of the tussock grassland it is recommended that an area of tussock grassland outside the proposed mine expansion is retired and protected from stock. The loss of a small amount of tussock grassland by itself would have a minimal impact on the Macraes ED, but when put into the context of many small areas being lost through the Project, the importance of conserving the tussock grassland increases.

A small population of the 'Declining' spaniard *Aciphylla subflabellata* is located in improved pastureland at NZTM E1403671 N4973904 just outside of the proposed TTTSF. In order to mitigate the removal of the 'Declining' *Aciphylla subflabellata* from the TTTSF, it is recommended that the population outside of the proposed site is fenced off from stock and that thought be given to the artificial enhancement of *Aciphylla subflabellata,* as it is reportedly one of the easier species to cultivate (NZPCN 2010). Flowering occurs from December to February and fruiting (i.e., when seeds can be collected) occurs from February to May (NZPCN 2010). If such an enhancement programme is undertaken, material must only be collected from plants in the study area to preserve inherent genetic diversity and to protect against the introduction of pathogens (Whitaker 1992).

It is recommended that some of the larger populations of the 'Naturally Uncommon' Hookers mountain daisy outside of the proposed mine expansion areas are fenced off from stock and enhanced by propagation. The placement of the Tipparary silt pond within the gully should have a negligible impact on the vegetation as long as the flow of the stream is not drastically altered.

9. Frasers North Waste Rock Stack

9.1 Existing information

Frasers North Waste Rock Stack (FNWRS) was covered by a study identifying sites of potential biological value in the Home Reef Resource Consent Area (Whitaker 1995). Nowhere in the proposed FNWRS was identified as having potentially greater biological values, however a ridge top swamp to the north (NZMG 23113 55354) of the FNWRS was recognised as having the potential for rare and/or unusual wetland plants (Whitaker 1995).

9.2 Current vegetation

The rounded hills and flatter land of the proposed FNWRS have been converted into improved pastureland and are dominated by pasture and adventive weed species common to this vegetation type around Macraes Flat (Table 4). To the north of the Macraes-Dunback Road is a small radiata pine (*Pinus radiata*) plantation.

Table 4 *Vegetation/habitat types, areas and percentages within the proposed Frasers North Waste Rock Stack.*

Vegetation/habitat type	Area (ha)	Percentage
Exotic trees	1.9	8.4
Tall tussock grassland	4.3	18.8
Rock outcrop	0.2	0.7
Exotic scrub	1.1	4.8
Mine/Road	1.4	6.1
Farm pond	0.03	0.1
Exotic pasture	14.0	61.1
Total	22.9	100.0

Again, greater indigenous diversity is restricted to the steeper sides of the gullies and along the gully floors. The steep gully sides consist of a mosaic of rough pasture and tussock grassland. The tussock grassland is dominated by narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) and *Chionochloa* hybrids (*Chionochloa rigida* x *rubra*) with scattered hard tussock (*Festuca novae-zelandiae*), silver tussock (*Poa cita*), golden spaniard (*Aciphylla aurea*), gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*). The wetter gully bottoms are dominated by pukio (*Carex secta*), red tussock (*Chionochloa rubra* subsp. *cuprea*) and prickly shield fern (*Polystichum vestitum*), with scattered toetoe (*Austroderia richardii*), *Olearia bullata* and native broom (*Carmichaelia*

petriei). The 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) was common in the inaccessible cliff faces and rock bluffs around the FNWRS.

9.3 Natural values

The majority of FNWRS is already extensively modified into pastureland. The only areas with any intrinsic value are confined to the steeper gullies. The 'Naturally Uncommon' Hookers mountain daisy occurred on the true left of some of the steeper gullies at FNWRS.

9.4 Potential adverse effects and recommended mitigation

The removal of the 'Naturally Uncommon' Hookers mountain daisy will require mitigation such as fencing off and protecting a population of Hookers mountain daisy population outside of the proposed mine expansion and enhanced by propagation.

10. Frasers South Waste Rock Stack

10.1 Existing information

A 1991 and 1992 study of 'Dead Horse Gully' and 'Golden Ridge', which encompass the Frasers South Waste Rock Stack (FSWRS), concluded that no unusual or unexpected plant communities were present within the study area and that any areas of higher biological value, such as scrub, rock outcrops and tussock grassland were too small and/or too scattered to be significant (Whitaker 1991 and 1992).

However, the ecologically significant (previously classified as 'Nationally Endangered' now classified as 'Declining') climbing broom (*Carmichaelia kirkii*) was observed growing on a low bluff close to the stream at grid reference I 42 231257 55324 on the true left bank of a tributary of Murphys Creek (Whitaker 1991). Additional searches of potential climbing broom habitat within the major tributary of Murphys Creek running south-east from Trig D through to the eastern half of MPA 41 – 026 were unable to identify any additional climbing broom plants (Whitaker 1992). The 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) was also found near the valley floor at the north-east extremity of the FSWRS.

A later Protected Natural Areas survey for the Macraes ED identified twenty Recommended Areas for Protection (RAPs) covering approximately 5% (4733ha) of the ED (Bibby 1997, Appendix Six). No RAPs were located within the proposed project areas, however, the FSWRS extension is within a close proximity of the Golden Bar RAP (Macraes RAP 7, Appendix Six). This area was recognised as requiring protection due to the presence of the 'Declining' climbing broom and the 'Naturally Uncommon' Hookers mountain daisy (Bibby 1997).

10.2 Current vegetation

Currently the proposed FSWRS is dominated by pastureland, with indigenous diversity confined to gullies (Table 5). The rounder hill tops and the sides of the gullies have been converted into improved pastureland with high producing pasture species such as browntop (*Agrostis capillaris*), cocksfoot (*Dactylis glomerata*), perennial ryegrass (*Lolium perenne*), white clover (*Trifolium repens*) and sub clover (*Trifolium subterraneum*).

Table 5 *Vegetation/habitat types, areas and percentages within the proposed Frasers South Waste Rock Stack.*

Vegetation/habitat type	Area (ha)	Percentage
Mine/Road	23.2	44.1
Tall tussock grassland	6.6	12.5
Indigenous scrub	0.3	0.6
Rock outcrop	0.09	0.2
Carex/Juncus	0.6	1.1
Exotic pasture	21.8	41.5
Total	52.5	100.0

The true right of the gullies are generally steeper and dominated by tussock grassland and rocky cliffs. Narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) and golden spaniard (*Aciphylla aurea*) border the rocky cliffs and bluffs. The rocky cliffs have additional species including the 'Naturally Uncommon' Hookers mountain daisy, patotara (*Leucopogon fraseri*), and snowberry (*Gaultheria* spp.). The true left sides of the gullies are generally shallower and have been converted into pastureland, nearly to the gully floor, with areas of matagouri (*Discaria toumatou*). No specimens of climbing broom were found. Mining activities have already commenced towards the north of the proposed FSWRS and to the south of the proposed FSWRS, with roughly a third of the proposed expansion already mined.

10.3 Natural values

The climbing broom to the south of the site has already been fenced off and cuttings and seed pods have been taken from it and planted along the water race between the OceanaGold Management Offices and the Trout Hatchery as part of a planting project. The planting area was also fenced off to keep stock out (Debbie Clarke pers. comm.) in order to protect this ecologically significant plant species.

The majority of FSWRS is already extensively modified into pastureland, the only area with any intrinsic value is the steeper gullies. The higher value in the gullies is a result of the inability to farm the steeper gully sides and rocky cliffs sheltering the more palatable plant species. The 'Naturally Uncommon' Hookers mountain daisy is still present along the true rights of the gullies.

10.4 Potential adverse effects and recommended mitigation

The removal of the 'Naturally Uncommon' Hookers mountain daisy will require mitigation. The mitigative measures for the FSWRS include fencing off and protecting a population of Hookers mountain daisy population outside of the proposed mine expansion and enhanced by propagation.

11. Round Hill Extension

11.1 Existing information

An early vegetation study of Round Hill concluded that no rare or unusual plant communities were present within the Round Hill area (Whitaker 1987). Three 'noteworthy' plant species were identified at Round Hill, including the restricted distribution Hookers mountain daisy (*Celmisia hookeri*) (now recognised as 'Naturally Uncommon'), the localised *Ranunculus brevis* (ex. *Ranunculus depressus*) (although its presence was not confirmed) and the palatable increasingly scarce though non-threatened *Gingidia montana*.

11.2 Current vegetation

Due to extensive modification of the vegetation through mining activities, the Round Hill Extension (RHE) area is now dominated by improved pasture species (from OceanaGold's pasture rehabilitation lists; recommended by AgResearch and local seed firms)(Table 6). These include; Wana cocksfoot (*Dactylis glomerata* cv. 'Grasslands Wana'), browntop (*Agrostis capillaris*), Nui ryegrass (*Lolium perenne* cv. 'Grasslands Nui'), Ruanui ryegrass (*Lolium perenne* cv. 'Grasslands Ruanui'), Turoa red clover (*Trifolium pratense* cv. 'Grasslands Turoa'), Woogenellup sub clover (*Trifolium subterraneum* cv. 'Grasslands Woogenellup'), Huia white clover (*Trifolium repens* cv. 'Grasslands Huia'), Onward strawberry clover (*Trifolium fragiferum* cv. 'Grasslands Onward') and alsike clover (*Trifolium hybridum*). Also present are colonising weed species common around the Macraes area including; yarrow (*Achillea millefolium*), mouse-ear hawkweed (*Pilosella officinarum*), woolly mullein (*Verbascum thapsus*), nodding thistle (*Carduus nutans*), Californian thistle (*Cirsium arvense*), Scotch thistle (*Cirsium vulgare*), mouse ear chickweed (*Cerastium fontanum*), scattered dead gorse (*Ulex europaeus*), shepherd's purse (*Capsella bursa-pastoris*), foxglove (*Digitalis purpurea*), broad-leaved plantain (*Plantago major*), storksbill (*Erodium cicutarium*) and *Brassica* species.

Table 6 *Vegetation/habitat types, areas and percentages within the proposed Round Hill Extension.*

Vegetation/habitat type	Area (ha)	Percentage
Mine/Road	3.4	17.4
Exotic pasture	16.3	82.6
Total	19.8	100.0

11.3 Natural values

The pre-existing rehabilitation of RHE into improved pastureland has meant that the current plant communities of the proposed extension are already highly modified. No plant communities or species of rare and/or conservation significance were found within the proposed RHE.

11.4 Potential adverse effects and recommended mitigation

The proposed RHE area falls within an already highly modified area where any pre-existing biological or conservation significant plant communities or species have already been removed. Therefore the removal of this already highly modified vegetation will have a negligible impact on the vegetation of the Macreas ED. No mitigation is required apart from replanting of exposed construction surfaces with appropriate pasture grass species.

12. Round Hill - Southern Pit Extension

12.1 Existing information

An early vegetation study of Round Hill by Whitaker (1987) covered part of the area proposed for the Round Hill - Southern Pit Extension. This study concluded that no rare or unusual plant communities were present within the Round Hill area (Whitaker 1987). Three 'noteworthy' plant species were identified at Round Hill. These included the restricted distribution Hookers mountain daisy (*Celmisia hookeri*) (now recognised as 'Naturally Uncommon'), the localised *Ranunculus brevis* (ex. *Ranunculus depressus*) (although its presence was not confirmed) and the palatable increasingly scarce though non threatened *Gingidia montana*.

12.2 Current vegetation

There is very little vegetation present at the RHSPE site, due to the substrate consisting of tailings waste (Table 7). Perennial ryegrass (*Lolium perenne*) was patchily distributed throughout the site.

Table 7 *Vegetation/habitat types, areas and percentages within the proposed Round Hill – Southern Pit Extension.*

Vegetation/habitat type	Area (ha)	Percentage
Exotic pasture	0.2	1.5
Mine/Road	14.4	98.5
Total	14.6	100.0

12.3 Natural values

The proposed RHSPE has very low biological values due to its already highly modified state and the lack of indigenous plant species.

12.4 Potential adverse effects and recommended mitigation

The proposed RHSPE area is an already highly modified area. Any pre-existing biological or conservation significant plant communities or species have already been removed. Its removal will have a negligible impact on the vegetation of the Macreas ED. No mitigation will be required for the vegetation removal of the RHSPE.

13. Innes Mills Stage V

13.1 Existing information

No prior vegetation surveys have specifically examined the Innes Mills Stage V pit (IMSV), however it was included in a 1986 Faunal Survey of the Deepdell Catchment (Whitaker 1986). The overall vegetation of the faunal study area was described as; rough pasture (~59%) dominated by exotic pasture plants and weeds, with indigenous species limited to scrub (4.8%), outcrop vegetation (4.6%) and tussock grassland (1.3%) and these were confined to the steeper less accessible gullies and/or to areas too rocky to cultivate (Whitaker 1986). It is likely that prior to mining activities commencing the IMSV was generally dominated by pastureland, with indigenous diversity restricted to the less accessible gullies.

13.2 Current vegetation

The western site of the proposed IMSV comprises a plateau dominated by improved pasture species and colonising weed species (Table 8). The improved pasture is dominated by cocksfoot (*Dactylis glomerata*), browntop (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), Yorkshire fog (*Holcus lanatus*), red clover (*Trifolium pratense*), sub clover (*Trifolium subterraneum*), white clover (*Trifolium repens*), Onward strawberry clover (*Trifolium fragiferum* cv. 'Grasslands Onward') and alsike clover (*Trifolium hybridum*). Also present are colonising weed species including; yarrow (*Achillea millefolium*), sheep's sorrel (*Rumex acetosella*), mouse-ear hawkweed (*Pilosella officinarum*), dandelion (*Taraxacum officinale*), woolly mullein (*Verbascum thapsus*), Californian thistle (*Cirsium arvense*), Scotch thistle (*Cirsium vulgare*), catsear (*Hypochaeris radicata*), mouse ear chickweed (*Cerastium fontanum*), gorse (*Ulex europaeus*), broom (*Cytisus scoparius*), shepherd's purse (*Capsella bursa-pastoris*), foxglove (*Digitalis purpurea*), broad-leaved plantain (*Plantago major*) and storksbill (*Erodium cicutarium*). To the southeast of the proposed extension are a few scattered indigenous tussocks these included narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) and hard tussock (*Festuca novae-zelandiae*). To the south of the extension is a gully with additional indigenous species including matagouri (*Discaria toumatou*) and golden spaniard (*Aciphylla aurea*).

The Macraes - Dunback Road (and associated road verges) bisects the eastern site of the proposed IMSV pit extension. The north and south side of the road are dominated by improved pasture species, with an area of tussock grassland to the south of the road. The

improved pasture is dominated by cocksfoot (*Dactylis glomerata*), browntop (*Agrostis capillaris*), perennial ryegrass (*Lolium perenne*), red clover (*Trifolium pratense*), sub clover (*Trifolium subterraneum*), white clover (*Trifolium repens*), Onward strawberry clover (*Trifolium fragiferum* cv. 'Grasslands Onward') and alsike clover (*Trifolium hybridum*) and adventive weed species common to improved pastureland at Macraes Flat. The tussockland has higher indigenous diversity with a small area of tussockland dominated by narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) and *Chionochloa* hybrids (*Chionochloa rigida* x *rubra*) and small-leaved pohuehue (*Muehlenbeckia complexa*) interwoven into the base of the tussocks.

Table 8 *Vegetation/habitat types, areas and percentages within the proposed Innes Mills Stage VI.*

Vegetation/habitat type	Area (ha)	Percentage
Tall tussock grassland	0.8	7.6
Mine/Road	4.1	39.1
Exotic pasture	5.6	53.3
Total	10.6	100.0

13.3 Natural values

The improved pastureland that dominates the proposed IMSV has already been highly modified and retains little indigenous diversity, and therefore has low ecological significance. The area with higher ecological significance is the tussock grassland to the south of the road. Although of higher significance, the tussock grassland is subjected to farming and mining impacts, and is already highly modified with low indigenous species diversity. No rare plant species were identified in the tussock grassland, although the time of year and the lack of inflorescences (a feature that helps with locating and identifying some of the more inconspicious species) may mean that some of the smaller species were overlooked, however, this is unlikely as the rare and/or uncommon plant species of the Macraes ED are generally found at different habitat types (i.e. ephemeral wetlands, rock outcrops and rocky tors) or in areas inaccessible by stock, while this tussock grassland is flat and easily accessible to stock.

13.4 Potential adverse effects and recommended mitigation

The proposed IMSV area is an already highly modified area. Its removal will have negligible impact on the vegetation of the Macreas ED. No mitigation will be required for the vegetation removal of the IMSV.

14. Frasers Stage VI

14.1 Existing information

No records of past vegetation surveys of the Frasers Stage VI pit have been found, therefore the previous vegetation types and the presence of rare and or unusual plant species is unclear. It is likely that due to the long association of farming and mining at Macraes Flat, the flatter areas had been converted into modified pastureland with higher indigenous diversity restricted to the steeper, less accessible gullies.

14.2 Current Vegetation

Rough pasture makes up the flatter slopes of the Frasers Stage VI site (Table 9). The rough pasture is dominated by cocksfoot (*Dactylis glomerata*), browntop (*Agrostis capillaris*), ryegrass (*Lolium perenne* and *L. multiflorum*), Yorkshire fog (*Holcus lanatus*), red clover (*Trifolium pratense*), sub clover (*Trifolium subterraneum*) and white clover (*Trifolium repens*). Also abundant are the colonising weed species including; Californian thistle (*Cirsium arvense*), sheep's sorrel (*Rumex acetosella*), mouse-ear hawkweed (*Pilosella officinarum*), dandelion (*Taraxacum officinale*), woolly mullein (*Verbascum thapsus*), shepherd's purse (*Capsella bursa-pastoris*), yarrow (*Achillea millefolium*) and storksbill (*Erodium cicutarium*).

Table 9 *Vegetation/habitat types, areas and percentages within the proposed Frasers Stage VI pit.*

Vegetation/habitat type	Area (ha)	Percentage
Exotic trees	0.9	5.6
Tall tussock grassland	0.6	4.0
Carex/Juncus	0.03	0.2
Indigenous scrub	0.6	3.8
Exotic scrub	0.2	1.3
Cleared scrub	0.7	4.2
Mine/Road	5.7	36.2
Exotic pasture	7.0	44.8
Total	15.6	100.0

A small tussock grassland occurs in shallow depressions to the east and west of the haul road. The tussock grassland is dominated by *Chionochloa* hybrids (*Chionochloa rigida* x *rubra*) and narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*). Golden spaniard (*Aciphylla aurea*), matagouri (*Discaria toumatou*) and small-leaved pohuehue (*Muehlenbeckia complexa*) are also predominant in the tussock grassland.

A small stand of exotic mature pine trees (*Pinus* spp.) is situated below the tussock grassland. Another stand of mature trees is situated towards the east of the site, located around an old homestead.

A small gully to the north-east of the site has higher indigenous diversity. The 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) occurs on the cliff face on the true left. Other species that occur in the gully include porcupine shrub (*Melicytus alpinus*), prickly shield fern (*Polystichum vestitum*), patotara (*Leucopogon fraseri*), *Olearia bullata*, butterfly fern (*Asplenium flabellifolium*), golden spaniard, small-leaved pohuehue, blue tussock (*Poa colensoi*) and prostrate snowberry (*Gaultheria macrostigma*). Pukio (*Carex secta*) dominates the gully floor.

14.3 Natural values

The improved pastureland has no ecological value as it is dominated by exotic pasture species and has little remaining indigenous diversity. Its removal will require no mitigation. The tussock grasslands in the depressions have higher values as they contain higher indigenous diversity. The tussock grassland to the east of the haul road is in relatively good condition, while the tussock grassland to the west is heavily grazed and is in poor condition.

The gully to the north, north east of the site has the highest conservation value as the 'Naturally Uncommon' Hookers mountain daisy occurs along its true left.

14.4 Potential adverse effects and recommended mitigation

The removal of the highly modified improved pastureland from the site will have no ecological impact on the surrounding ED, while the removal of the already highly modified small area of tussock grassland and indigenous scrub will have a limited impact. The removal of the 'Naturally Uncommon' Hookers mountain daisy will require mitigation. The mitigative measures for the Frasers Stage VI pit include fencing off and protecting a population of Hookers mountain daisy population outside of the proposed mine expansion and enhanced by propagation.

15. Potential adverse effects and recommended mitigation

15.1 Vegetation

If all proposed developments go ahead as planned it will result in the removal of approximately 155 hectares of indigenous vegetation (Table 10). Although the vegetation survey was completed in a relatively short time frame, it adequately covered the main vegetation types and identified the dominant plant species of the areas. However, due to the size of the survey area, and the fact that it was a single survey, it is possible that some dormant plants, non-flowering plants or some of the more inconspicuous plant species may have been overlooked.

Table 10 *Table showing potential loss (in hectares) of vegetation/habitat types within the proposed Macraes Phase III development area.*

Vegetation/habitat type	Area (ha)
Exotic pasture	262.5
Tall tussock grassland	78.4
Mine/Road	75.8
Indigenous scrub	32.2
Short tussock grassland	29.7
Exotic pasture with scattered tussock	29
Exotic trees	17
Exotic scrub	7.9
Indigenous scrub/Tall tussock grassland	7.2
Rock outcrop	4.1
Carex/Juncus	1.4
Cleared scrub	0.7
Farm pond	0.7
Wetland	0.5
Total	**547**

The proposed pit expansions including Round Hill Pit, Southern Pit, Innes Mills Stage V Pit and Frasers Stage VI Pit occur on already highly modified pastureland, the removal of which will not negatively impact the Macraes ED.

The proposed silt ponds should have minimal impact on the vegetation along the gully sides - it is the vegetation along the gully floor that is most likely to be altered. However, if the downstream flow remain similar to that which currently occurs, these effects should be minimal. Overall, it is the gully sides that have higher biological value (i.e., the presence of 'Naturally Uncommon' Hookers mountain daisy).

15.2 Tussock grassland

Historically, the Macraes ED was dominated by tussock grassland with areas of hardwood forest. Following the introduction of natural and deliberate fires, and farming practices, this ED has been severely modified (McEwen 1987). It is now generally dominated by improved pastureland of low indigenous value. Remaining pockets of tussock grassland, reminiscent of the initial vegetation composition, are therefore of higher endemic value due to their largely depleted distribution. The loss of a small amount of tussock grassland by itself would have a minimal impact on the Macraes ED, but when put into the context that many small areas will be lost because of the proposed development, the importance of conserving the tussock grassland increases. Therefore, the removal of healthy expanses of tussock grassland from BRWRS, TTTSF, Frasers Stage VI and Camp Creek, should be offset by retiring an expanse of tussock grassland. Two options are recommended for establishing a tussock grassland reserve[2];

Option one (preferred)

A site outside of the mining footprint is selected based on three criteria; that it contains a pre-existing representative native tussock grassland, that it is unlikely to be encroached upon by future mining activities and that it is feasible to fence the area off from stock. The minimum size should be at least 108 hectares to compensate for the approximately 108 hectares of tussock grassland that will be lost. The site should be fenced off to allow protection from stock trampling and grazing, and weed species controlled within the site. This is the preferred option because, depending on the site selected, it may be possible to combine the mitigation suggested for other threatened species which are also adversely impacted by this development. For instance, the selected site may also contain Hookers mountain daisy, and other threatened species such as coral broom, sprawling turpentine, *Gingidia grisea,* and *Aciphylla subflabellata* may be planted there. It may prove cost effective to focus mitigation efforts onto one site that can deal with the habitat requirements of various threatened species.

Option two

One or more sites are selected from areas within the mining footprint designated for pasture grass rehabilitation. Tussock is already being planted in selected areas on waste rock stacks, but more information is required on whether or not conditions are conducive to permanent tussock establishment. The site(s) should be fenced off to allow protection

[2] Note that these options are virtually identical to those recommended in the terrestrial fauna report.

from stock trampling and grazing. Establishing a tussock grassland from scratch is likely to prove more costly and labour intensive than protecting a pre-existing tussock grassland, and allows less options for combining mitigation with other threatened species.

Consideration should be given to the following measures when implementing a tussock grassland restoration plan:

- It can be difficult for transplanted tussock to re-establish in different soil (Lowther 2002), therefore it may be beneficial to use large diggers to transplant specimens of tussock from the impact zone to the restoration area, taking care to remove tussock with the surrounding soil and root systems intact.

- Nitrogen should be either applied as fertiliser to the restoration area or built up in the soil by legumes. This has the potential to provide a cost effective means of improving tussock growth (Lowther 2002).

- Rehabilitated tussock grasslands should incorporate all the different species of tussock that will be lost. Red tussock and narrow-leaved snow tussock are of particular note. Red tussock is predominantly found in wetter gully floors.

- Indigenous intertussock vegetation needs to be established along with tussock restoration, which will require weed control of pest plant species.

- The transplantation of tussock should ideally take place outside of pipit breeding season (August to February) to avoid destroying nests and causing disruption to breeding.

- Monitoring of tussock establishment and subsequent pipit colonisation should be carried out to ascertain whether mitigation outcomes have been met.

- Legal protection should be considered for the land that is chosen for tussock rehabilitation.

15.3 Wetlands

A number of small wetland areas will be either removed completely or have the potential to be disturbed by the Macraes Phase III Project. The ephemeral wetlands and ridge top swamps around the district and along the proposed Macraes - Dunback Road realignment, and in the proposed BRWRS, are recognised as having plant communities of higher biological value because of the limited extent of these wetland habitats type throughout the Macraes ED, the large number of rare and/or uncommon plants species that can be associated with them, and because these plant communities are particularly susceptible to damage by livestock and agricultural development (Johnson 1994, Whitaker 1995). Given the Statement of National Priority focus on the retention and enhancement of wetlands it is recommended that wetlands outside of the development area are protected and enhanced. Specific wetlands proposed for protection include, but are not limited to, the following:

- Ridge top swamp at NZTM E1401602 N4973760, described by Whitaker (1995) as a site of potential biological interest, having the potential to harbour rare or unusual wetland plants (Figure 9, number 4).

- Wetland at NZTM E1402569 N4973489 between TTTSF and the proposed Golden Bar Road realignment (Figure 9, number 7).

- Ephemeral wetlands in the area of the proposed Macraes-Dunback Road realignment and the southern edge of the BRWRS (Figure 9, numbers 1, 2, 3, 5 and 6).

- Wetland to the east of the FSWRS between Golden Bar Road and the haul road running adjacent to it at NZTM E1400326 N4972150.

- Wetlands in the headwaters of Cranky Jims Creek shown in Figure 13.

Wetlands should be fenced off to exclude stock and to limit disturbance from vehicles. Where applicable, weed species should be removed and native species planted to enhance the wetland value. Tall exotic species should be controlled so that they cannot overshade the smaller native species. Any rare herbs associated with the wetlands may need specific

management to protect them. The condition and changes within the wetlands should be monitored by an experienced ecologist to determine the effectiveness of the mitigation.

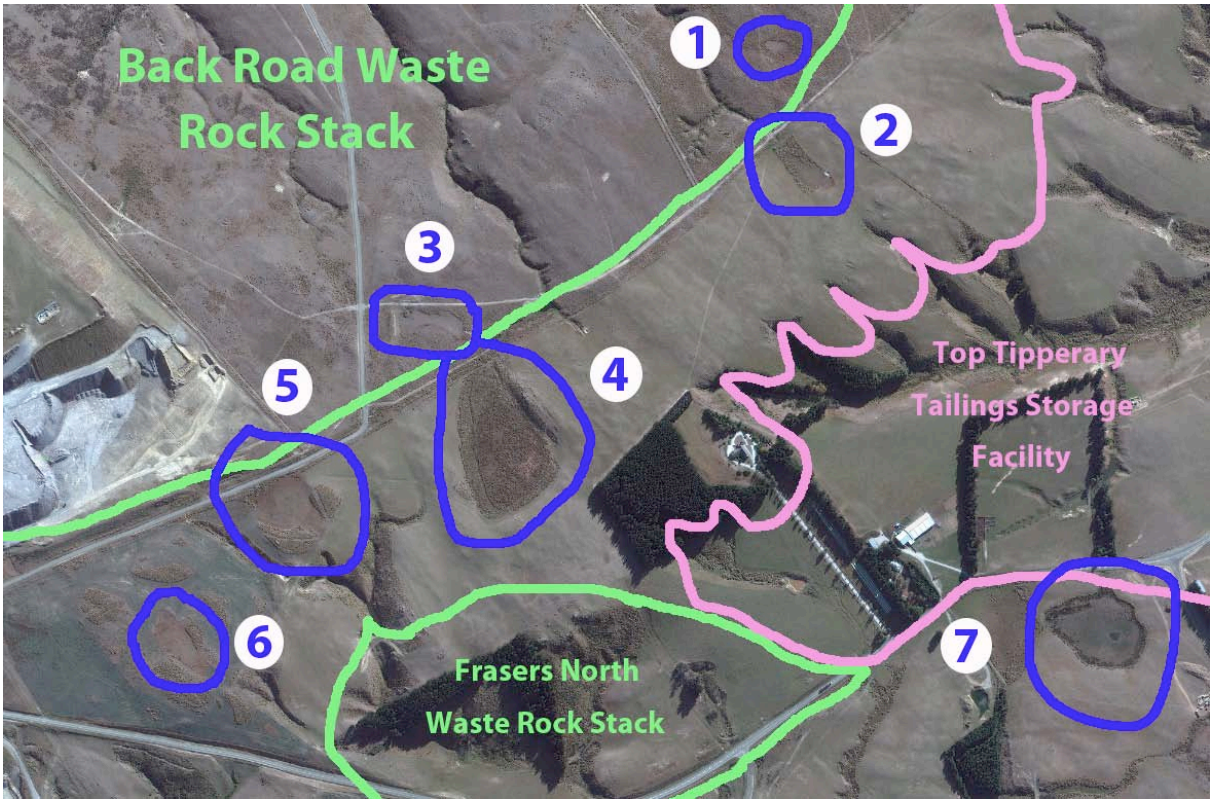

Figure 9 *Wetlands in the area of the proposed Macraes-Dunback Road realignment and the southern edge of the BRWRS.*

15.4 Scrub

There will be a loss of approximately 40 hectares of scrub if all proposals for development go ahead. Scrub habitat is important for providing feeding and nesting habitat for a large variety of bird species, some of which are important prey species for the New Zealand falcon. The Waitaki District Plan states that 'It is the myriad of small and fragmented areas of "common" vegetation types that are under greatest threat and are of the most debated value". It is recommended that as mitigation for the loss of this habitat, an area of indigenous scrub is protected outside of the mining footprint.

15.5 Weed control

If tussock grassland and wetland mitigation are to be successful, it is vital that some weed control is carried out. The wetland-transforming exotic rush *Juncus subnodulosus*, and grass, *Narduus stricta*, have been found with limited distribution in the Macraes area (Thorsen 2008). Early work on the eradication of these two species would be the most

cost efficient way to get rid of them. It is recommended that the Department of Conservation is consulted with on the current locations of these two weeds. Other weed species are gorse, (*Ulex europaeus*), broom, (*Cytisus scoparium*), pine, (*Pinus radiata*), gooseberry, (*Ribes uva-crispa*), and elder, (*Sambucus nigra*). These are all woody species which are easy to identify and must be removed from any areas set aside for protection.

15.6 Plant communities of higher biological value

The plant communities of higher biological value are those that are relatively unmodified and retain a pre-anthropogenic composition. Dry and wetland indigenous scrub also have higher biological values as they contain species that are relatively uncommon throughout the ED, having been removed by mining and agriculture practices (Whitaker 1995). The mixed indigenous scrub in the BRWRS has higher ecological value, with the locally notable broadleaf (*Grisilenia littoralis*) and kowhai (*Sophora microphylla*). The scrub in the TTTSF is of a lower standard due to the intensive farming of this site. The stream sides of Camp Creek are dominated by gorse, but the mixed indigenous scrub higher up the gully sides has higher indigenous values.

Rocky cliffs, bluffs and outcrops also have higher ecological values as they provide protection from browsing and have the potential to house rare and/or uncommon species (Whitaker 1995). These habitat types are not rare in the Macraes ED and were found in BRWRS, TTTSF, FNWRS, FSWRS, and Camp Creek. In general, this habitat type houses the 'Declining' and or 'Naturally Uncommon' plant species found in the most recent survey.

During construction, care should be taken to avoid the introduction of new weed species (e.g., broom and gorse) into areas of higher value through the introduction of soil or machinery. Vegetation should not be affected by the close proximity of machinery, but care must be taken to ensure that, when trenching or drilling, dust, spoil, silt, drilling material or other products of the exploration process do not contaminate valuable sites (Whitaker 1995). A vegetation management plan identifying such issues would help assist in avoiding potential adverse effects.

15.7 Rare and/or uncommon plant species of the Macraes ED

Forty-four rare plant species are known from the Macraes ED (Appendix Four) (Whitaker 1995, Bibby 1997, Thorsen 2008, Townsend *et al*. 2008, Ryder Consulting 2009b, de

Lange *et al*. 2009). Thirteen of these are classified as 'Threatened', twenty five are considered 'At Risk' and six are considered 'Data Deficient' (de Lange *et al.* 2009). Of the forty-four species, six rare plant species were recently found in the proposed mine expansion area (*pers. obs*.) along with two species classified as 'locally notable' by Thorsen (2008).

The 'At Risk – Declining' coral broom (*Carmichaelia crassicaulis* subsp. *crassicaulis*) was found in the BRWRS and at Camp Creek. Suggested mitigative measures for coral broom include protecting populations outside of the intended mine expansion from stock and long-term protection of coral broom by implementing a coral broom enhancement programme. Thorsen (2008) found scattered populations of coral broom (totalling approximately 200 individuals) in the south of the Macraes area. If such an enhancement programme is undertaken, material must only be collected from plants in the study area to preserve inherent genetic diversity. It is a very attractive species both in and out of flower and would be a successful amenity planting that could be incorporated into the revised closure plan. Seed collection could be discussed with the Department of Conservation and a local nursery could be engaged to raise seedlings for planting.

The 'At Risk - Naturally Uncommon' Hookers mountain daisy was found in Camp Creek, Frasers Stage VI, FSWRS, TTTSF, FNWRS, and the BRWRS. The removal of small populations of Hookers mountain daisy should have a small impact only on the localised communities, however, when considered in a wider context, it becomes clear that quite a few populations occur within the proposed development areas and are likely to be destroyed. Therefore, mitigation for this 'Naturally Uncommon' species is needed. It is recommended that some of the larger populations of the Hookers mountain daisy outside of the proposed mine expansion areas are fenced off from stock and enhanced by propagation. It is recommended that a botanist be engaged to find suitable locations.

The 'At Risk - Naturally Uncommon' sprawling turpentine was found along the rocky cliffs of Camp Creek. It is recommended that a botanist be engaged to find any populations outside of the proposed mine expansion. If located, this area could be fenced off from stock and/or seeds collected for replanting within another protected area.

The 'At Risk – Declining' spaniard *Aciphylla subflabellata* was found at the BRWRS (Barkla pers. comm.) and the TTTSF. In order to mitigate the loss of *Aciphylla*

subflabellata, it is recommended that the population outside of the proposed TTTSF (NZTM E1403671 N4973904) is fenced off from stock and that consideration be given to the artificial enhancement of *Aciphylla subflabellata*, as it is reportedly one of the easier species to cultivate (NZPCN 2010).

The 'At Risk - Naturally Uncommon' *Gingidia grisea* was found at the BRWRS. Only a few individuals of *G. grisea* will be lost through the development of the proposed BRWRS. The loss of these individuals can be offset by ensuring the protection of populations outside of the intended development area. It is possible that *G. grisea* may occur in the Deepdell Catchment and may previously have been identified as *G. montana* (Whitaker 1996a).

The 'At Risk - Naturally Uncommon' *Lobelia perpusilla* was found in a wetland at the south of the BRWRS (NZTM E1401506 N4973964, Figure 9, number 3). It is recommended that the BRWRS footprint is adjusted slightly to avoid this wetland. If this cannot be done, it is recommended that other wetlands in the vicinity are protected and planted with *Lobelia perpusilla*. An experienced botanist should be consulted with as to whether specimens can be transplanted from wetlands due for removal to protected wetlands.

As lizards are likely to be important agents of seed dispersal and pollination (Whitaker 1987b), any mitigation involving threatened plant species should be managed in conjunction with ensuring there is suitable lizard habitat at the protected site.

15.8 Potential sites for mitigation

15.8.1 Cranky Jims

A preliminary survey to identify potential sites for mitigation has been completed. This has identified some good examples of vegetation/habitat sites that could potentially be included as mitigation. The areas identified have been described below. OceanaGold has agreed in principle to the mitigation concept proposed but further work is required to confirm these areas and to define final boundaries. In the headwaters of Cranky Jims Creek is an area of high value native bush (Figures 10 and 11). As this is an extremely rare habitat type within the Macraes Ecological District, we recommend that the area is set aside as a mitigation site of at least 28 hectares (Figure 13 and Table 11). We recommend that this area is fenced off from stock and enhanced by weed control, in particular wilding pine control. At risk species found within the bush include *Gingidia grisea* and *Celmisia hookeri*. We recommend that this area be given legal protection in the form of a covenant. Above the Cranky Jims Bush is an area of indigenous tussock grassland (Figure 12). The dominant species is narrow-leaved snow tussock (*Chionochloa rigida* subsp. *rigida*) with areas of red tussock (*Chionochloa rubra* subsp. *cuprea*) and short tussock. We recommend that the area is set aside as a mitigation site of at least 75 hectares (Figure 13 and Table 11).

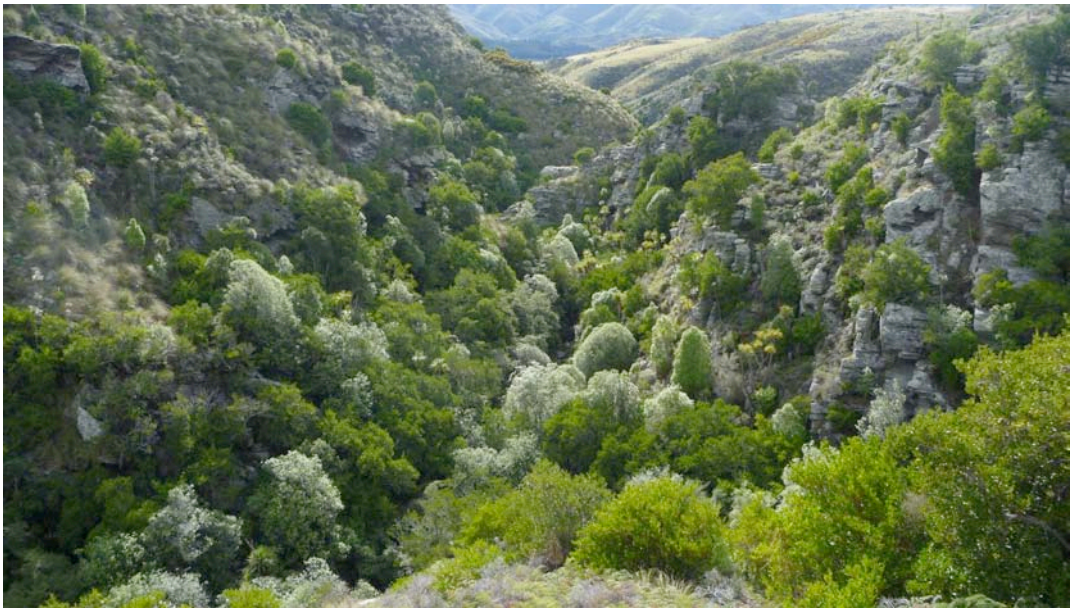

Figure 10 *Photo showing bush habitat in Cranky Jims Creek at property boundary of Oceana Gold Macraes.*

We recommend that this area is fenced off from stock and enhanced by weed control. Various wetlands and ephemeral ponds exist in the vicinity of Cranky Jims Creek headwaters (Figure 13 and Table 11). We recommend these wetlands are examined by an experienced botanist and any areas with high value are set aside as mitigation sites. Wetlands may require fencing off from stock and weed control.

Figure 11 *Photo showing bush habitat understorey in Cranky Jims Creek.*

Figure 12 *Photo showing tussock grassland habitat above Cranky Jims Bush.*

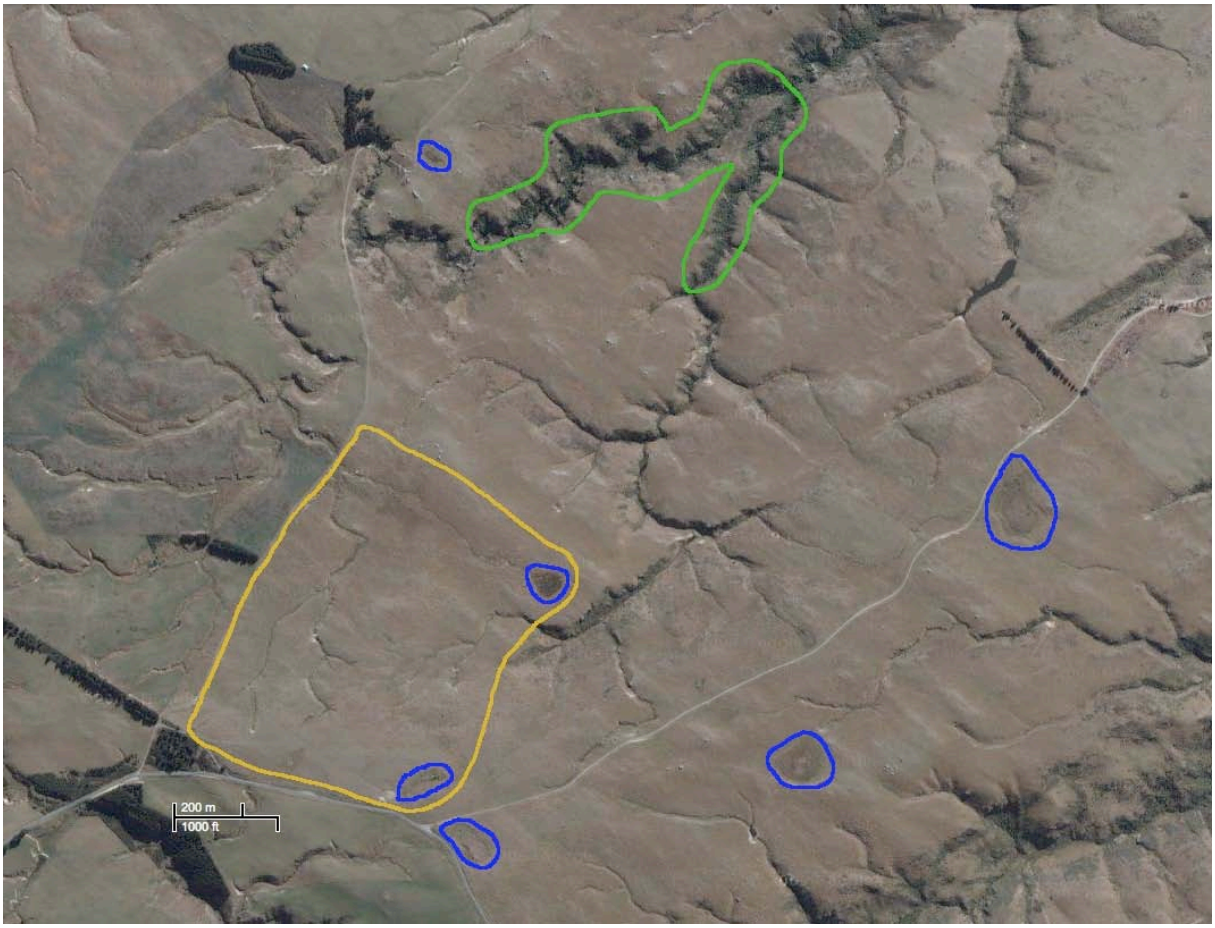

Figure 13 *Aerial photograph showing locations of potential mitigation sites. Core area of bush habitat shown in green, core area of tussock grassland shown in yellow, wetlands shown in blue.*

Table 11 *Area table for Figure 13.*

Colour	Type	Area in hectares
Green	Core area of bush habitat	28
Yellow	Core area of tussock grassland	75
Blue	Wetland	6

15.8.2 Highlay Creek

OceanaGold is considering setting aside an area of Highlay Creek due to the presence of an historical site (Figure 14). As the historical site is within a gully dominated by indigenous scrub (Figure 15), we recommend that the historical mitigation site be tied in with a scrub mitigation site of approximately 10 hectares. We recommend that this area is fenced off from stock and enhanced by weed control and planting of indigenous scrub vegetation. Some small areas of scrub may need to be removed to enhance historical values, this can be offset by new plantings of species such as *Melicytus alpinus, Corokia cotoneaster, Aristotelia fruticosa* and *Dracophyllum* sp.

Figure 14 *Aerial photograph showing location of potential mitigation site in Highlay Creek. Core area of scrub shown in green.*

Figure 15 *Photo showing scrub vegetation in Highlay Creek, immediately upstream of historical site.*

16. Summary and Conclusion

The Macraes Phase III Project is located within an area that contains highly variable levels of significance with regard to intact indigenous vegetation. The plant communities around the active mines areas at Macraes are already highly modified and contain little to no natural values. It is the larger sites, including the Back Road Waste Rock Stack, Top Tipperary Tailings Storage Facility and Camp Creek that retain higher indigenous diversity, including rare plant species. If the project goes ahead as planned it will have more than minor adverse effects on several rare or threatened species and plant communities. These effects include flooding of diverse gullies, infill from waste rocks of indigenous vegetation and removal of specimens of several threatened plant species.

As avoidance is not feasible for the bulk of the area affected, mitigation is considered appropriate to offset the adverse effects of the project. Recommended mitigation includes restoration of tussock grassland, native bush, indigenous scrub and wetlands, weed control, fencing off populations of threatened species and artifical enhancement (propagation) of threatened species.

If all mitigation is carried out successfully it will reduce the effects of the project from more than minor adverse effects to no more than minor adverse effects.

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Appendix One

Vegetation/habitat type mapping of the Macraes Phase III sites

Figure A.1.1 *Key to vegetation/habitat types.*

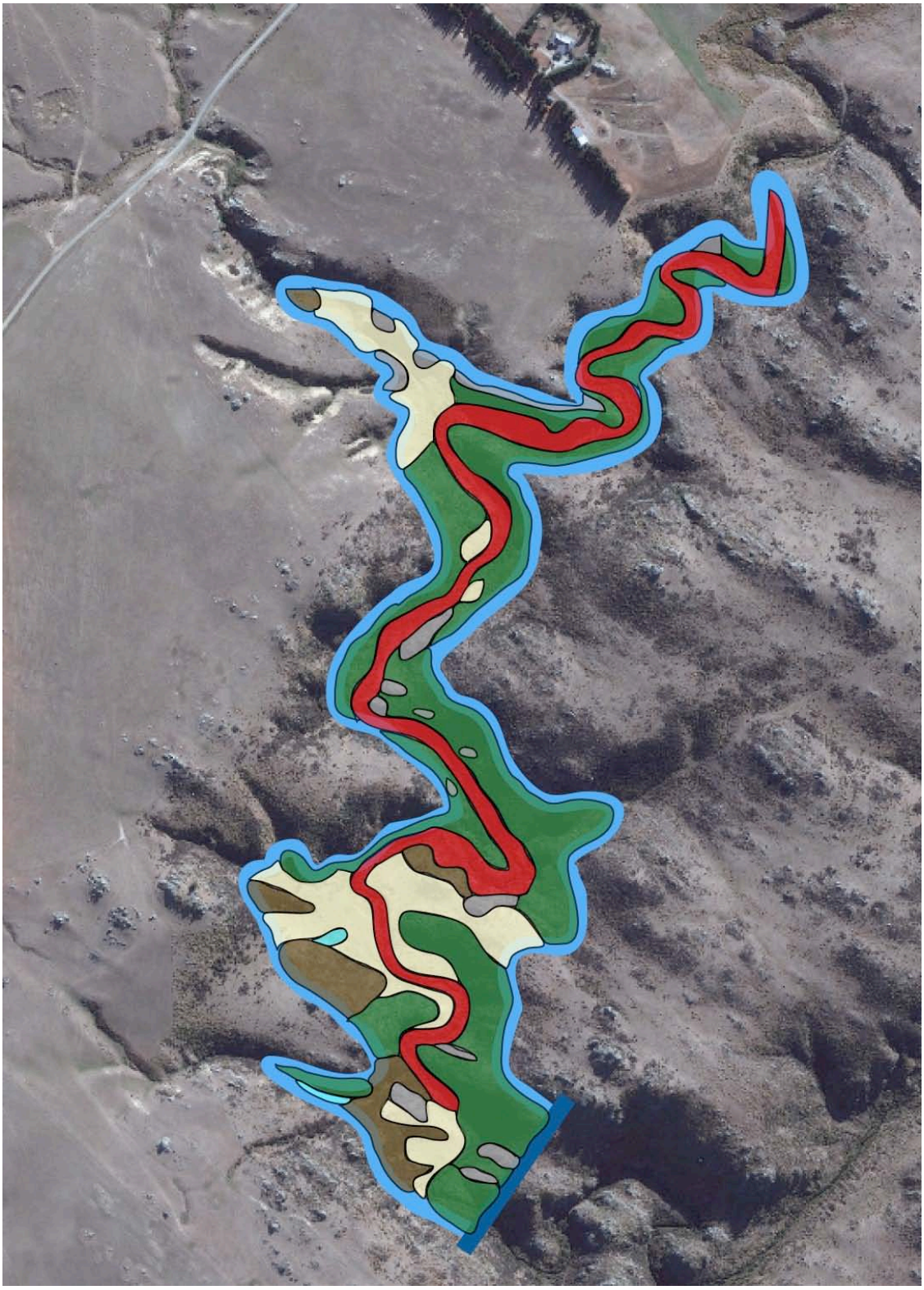

Figure A.1.2 *Vegetation/habitat types within the proposed Camp Creek Storage Dam.*

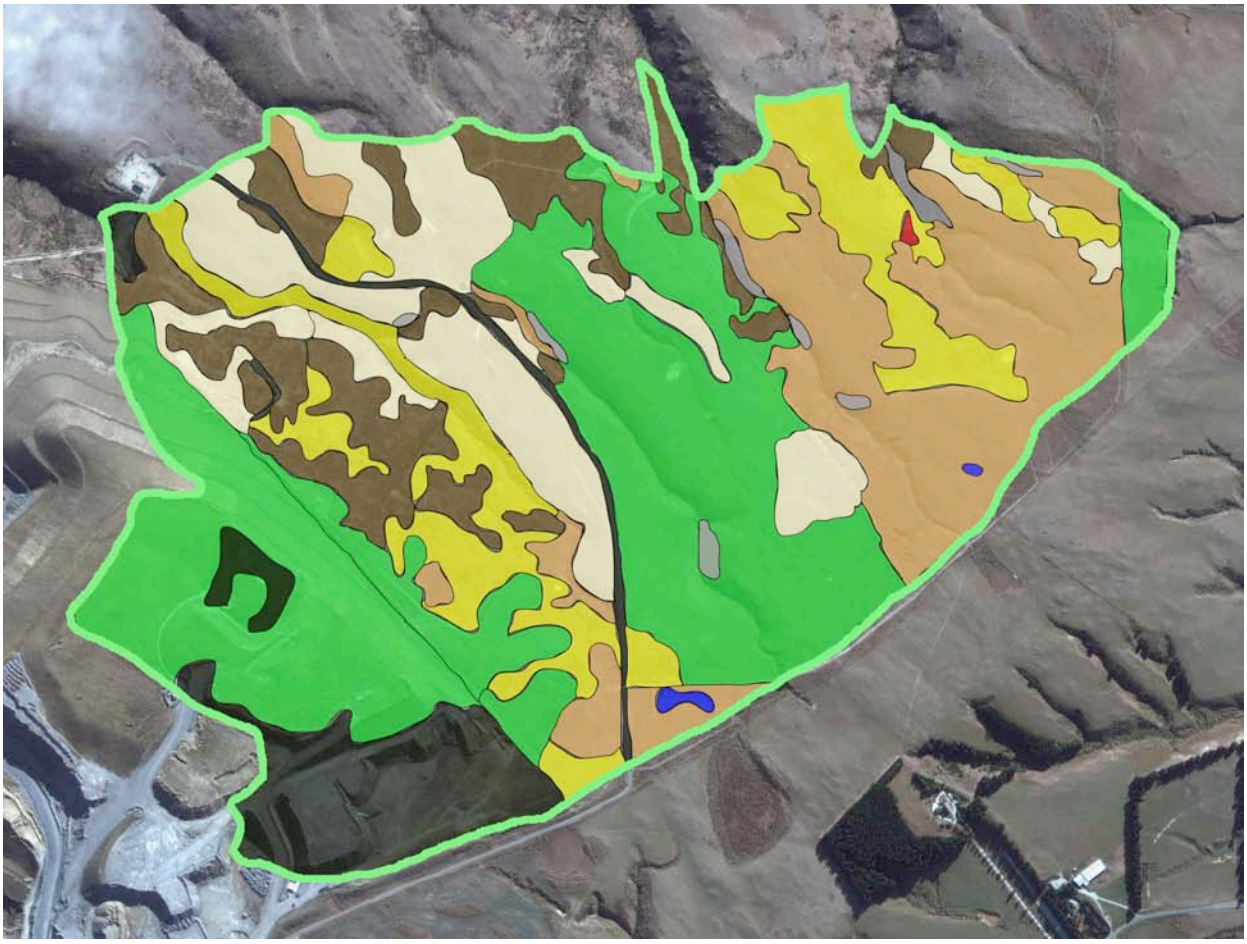

Figure A.1.3 *Vegetation/habitat types within the proposed Back Road Waste Rock Stack.*

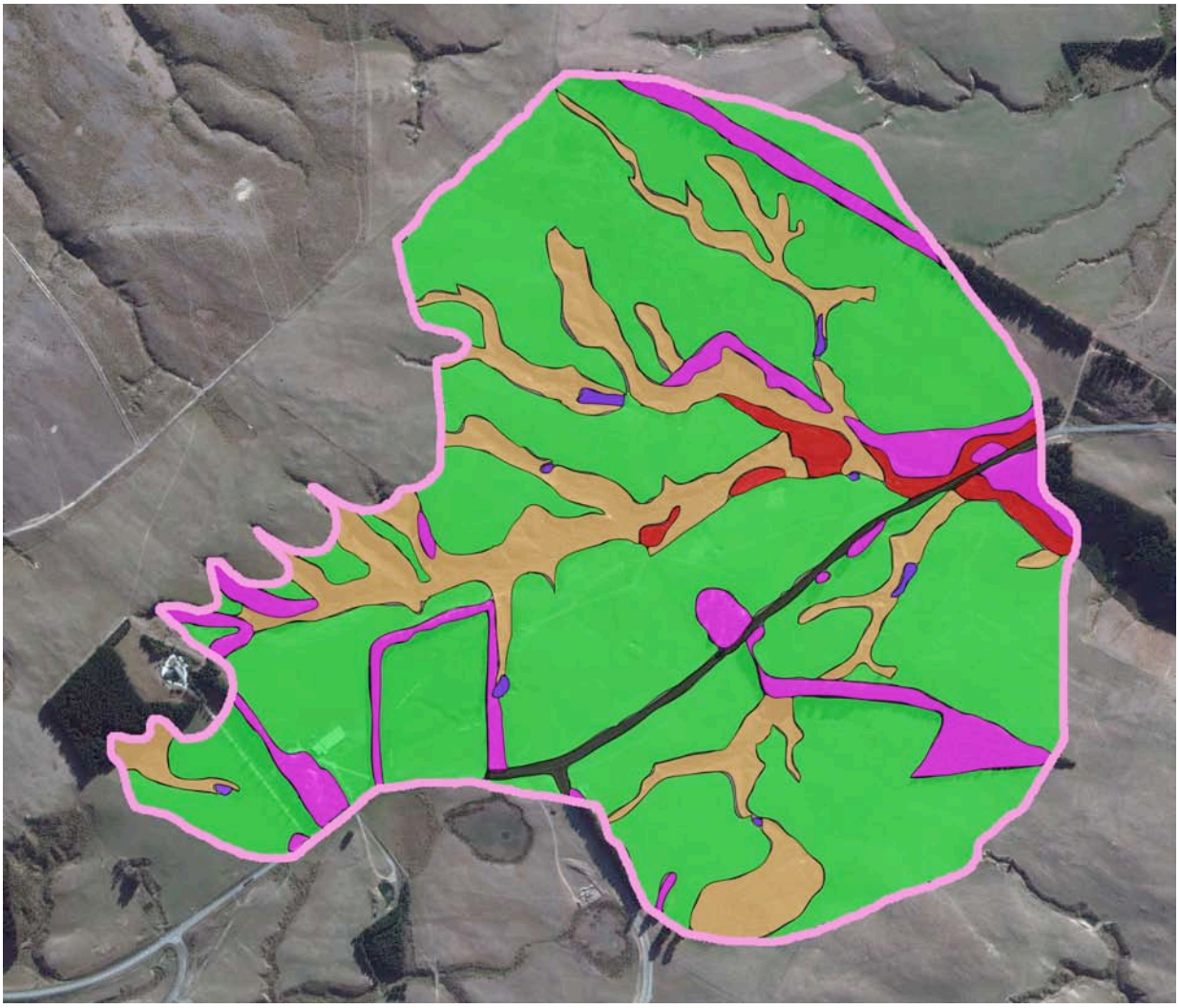

Figure A.1.4 *Vegetation/habitat types within the proposed Top Tipperary Tailings Storage Facility.*

Figure A.1.5 *Vegetation/habitat types within the proposed Frasers North Waste Rock Stack.*

Figure A.1.6 *Vegetation/habitat types within the proposed Frasers South Waste Rock Stack.*

Figure A.1.7 *Vegetation/habitat types within the proposed Round Hill Extension.*

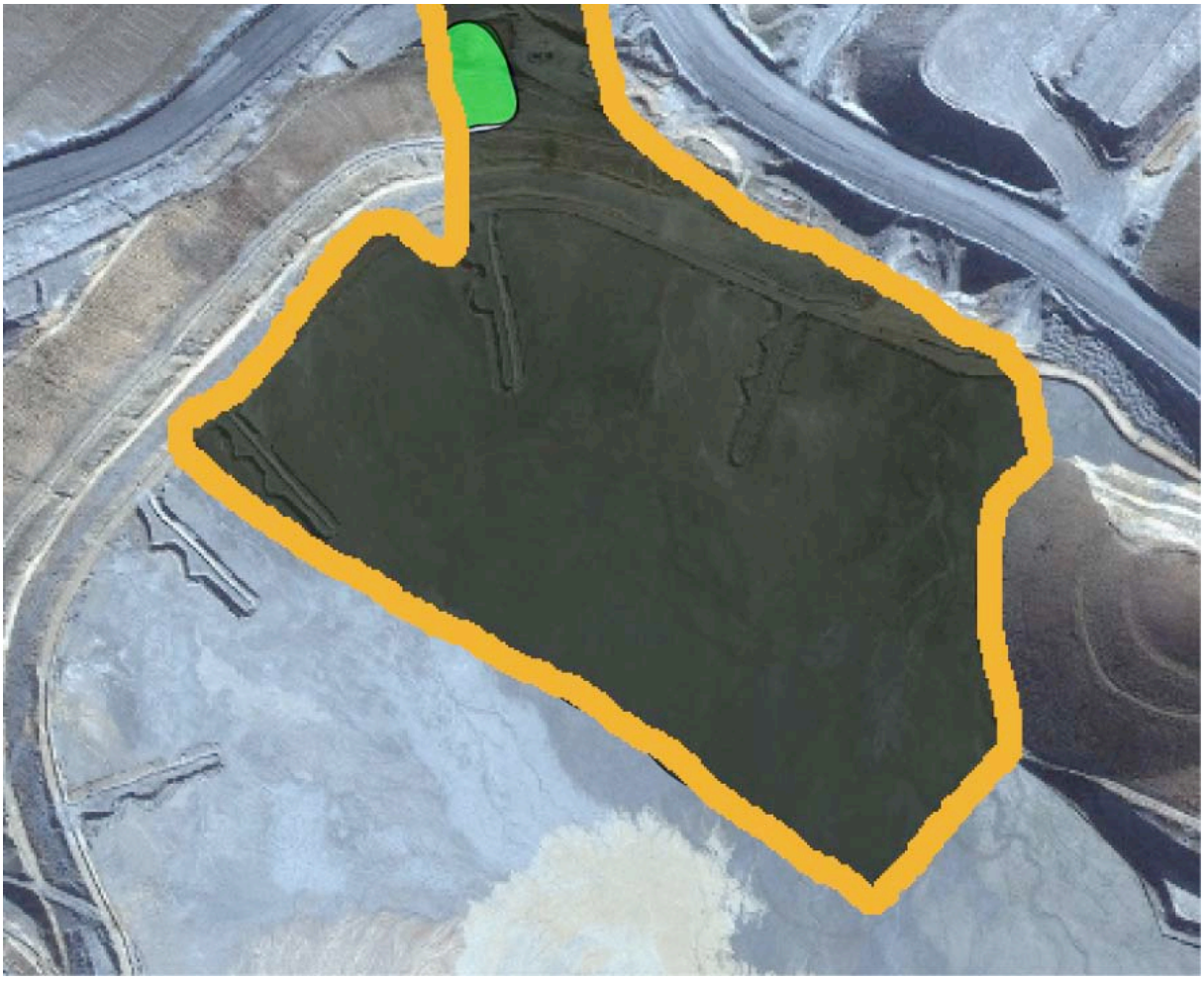

Figure A.1.8 *Vegetation/habitat types within the proposed Round Hill – Southern Pit Extension.*

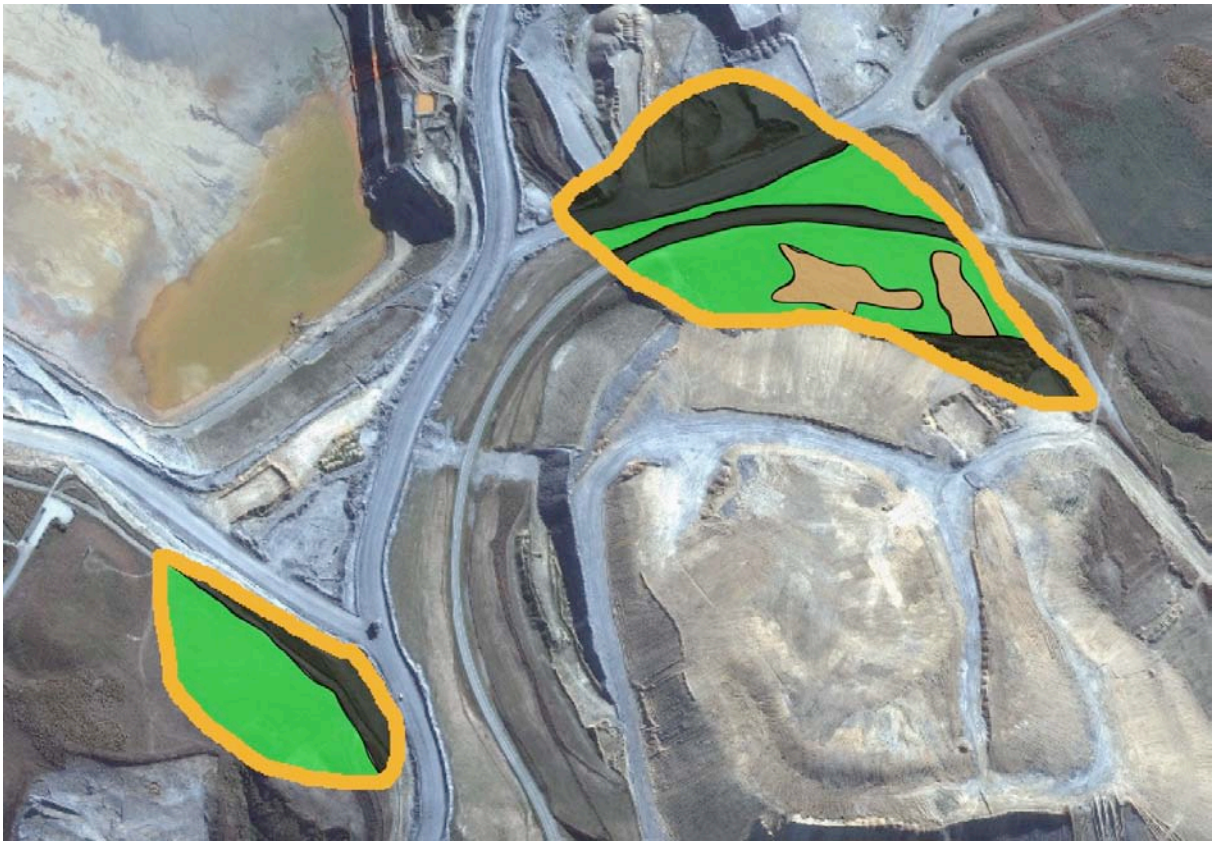

Figure A.1.9 *Vegetation/habitat types within the proposed Innes Mills Stage V.*

Figure A.1.10 *Vegetation/habitat types within the proposed Frasers Stage VI.*

Appendix Two

Sites of potential biological interest in the Home Reef Resource Consent Area

Figure A.2.1 *Topographical map (1:50,000) of Home Reef Resource Consent Area (outline), showing sites of potential biological interest (shaded and numbered). Taken from Whitaker (1995).*

Appendix Three

Plant species identified in the Macraes Flat mining area during the 2010 Ryder Consulting Vegetation Survey.

Table A.3.1 *Plant species identified at Camp Creek, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
*Agrostis stolonifera**	creeping bent
*Anthoxanthum odoratum**	sweet vernal
Austroderia richardii	toetoe
Carex geminata	cutty grass
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Chionochloa rigida x *rubra*	
Chionochloa rubra subsp. *cuprea*	red tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Glyceria fluitans**	floating sweetgrass
*Holcus lanatus**	Yorkshire fog
Juncus edgariae	wiwi, Edgars rush
*Juncus effusus var. effusus**	leafless rush
Juncus spp.	rush
*Lolium multiflorum**	Italian ryegrass
*Lolium perenne**	perennial ryegrass
Poa cita	silver tussock
Poa colensoi	blue tussock
Pteridophytes	
Asplenium flabellifolium	butterfly fern, walking fern, necklace fern
Asplenium richardii	Richards spleenwort
Blechnum novae-zelandiae	kiokio, horokio, palm leaf fern
Microsorum pustulatum subsp. *pustulatum*	hounds tongue fern
Polystichum vestitum	prickly shield fern
Pteridium esculentum	bracken
Gymnosperms	
*Pinus radiata**	radiata pine
Dicotyledons	
Acaena anserinifolia	bidibid
Acaena caesiiglauca	glaucus bidibid, piripiri
Acaena novae-zelandiae	bidibid
*Achillea millefolium**	yarrow
Aciphylla aurea	golden spaniard
Anaphalioides bellidioides	hells bells
Aristotelia fruticosa	mountain wineberry
Callitriche spp.	starwort
*Capsella bursa-pastoris**	shepherd's purse
Carmichaelia crassicaulis subsp. *crassicaulis*	coral broom
Carmichaelia petriei	native broom, desert broom
Celmisia hookeri	Hookers mountain daisy
*Cerastium fontanum**	mouse-ear chickweed
*Cerastium glomeratum**	annual mouse-ear chickweed
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle
Clematis quadribracteolata	
Coprosma crassifolia	
Coprosma propinqua	mingimingi
Coprosma rugosa	needle-leaved mountain coprosma
Coprosma tayloriae	
Crassula sieberiana	
*Cytisus scoparius**	broom
*Digitalis purpurea**	foxglove

Discaria toumatou	matagouri, Wild Irishman
Dracophyllum rosmarinifolium	
Dracophyllum uniflorum var. *frondosum*	sprawling inaka, sprawling turpentine scrub
*Epilobium ciliatum**	willowherb
Epilobium pubens	willowherb
*Erodium cicutarium**	storksbill
*Galium aparine**	cleavers
Gaultheria antipoda	snowberry
Gaultheria crassa	snowberry
Gaultheria macrostigma	prostrate snowberry
*Geranium molle**	doves foot cranesbill
Hebe rakaiensis	hebe
Helichrysum filicaule	creeping or slender everlasting daisy
*Hypochaeris radicata**	catsear
Leucopogon fraseri	patotara, dwarf mingimingi
Melicytus alpinus	porcupine shrub
Mentha spicata subsp. *spicata**	mint
*Mimulus moschatus**	musk
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Olearia bullata	
*Pilosella officinarum**	mouse-ear hawkweed
Pimelea oreophila	
Ranunculus foliosus	grassland buttercup
Ranunculus glabrifolius	buttercup
*Ribes uva-crispa**	gooseberry
*Rosa rubiginosa**	briar rose
Rubus cissoides	tataramoa, bush lawyer
Rubus schmidelioides var. *subpauperatus*	tataramoa, bush lawyer, white-leaved lawyer
*Rumex acetosella**	sheep's sorrel
*Stellaria media**	chickweed
*Taraxacum officinale**	dandelion
*Trifolium pratense**	red clover
*Trifolium repens**	white clover
*Trifolium dubium**	suckling clover
*Ulex europaeus**	gorse
*Urtica urens**	nettle, stinging nettle
*Verbascum thapsus**	woolly mullein, common mullein

Note: *exotic species

Table A.3.2 *Plant species identified at Back Road Waste Rock Stack, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
*Agrostis stolonifera**	creeping bent
*Anthoxanthum odoratum**	sweet vernal
Austroderia richardii	toetoe
Cordyline australis	cabbage tree
Bulbinella angustifolia	
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Holcus lanatus**	Yorkshire fog
Juncus edgariae	wiwi, Edgars rush
*Juncus effusus var. effusus**	leafless rush
Juncus pallidus	giant rush
*Lolium perenne**	perennial ryegrass
Phormium cookianum subsp. *cookianum*	mountain flax

Poa cita	silver tussock
Poa colensoi	blue tussock
Pteridophytes	
Asplenium flabellifolium	butterfly fern, walking fern, necklace fern
Asplenium richardii	Richards spleenwort
Blechnum novae-zelandiae	kiokio, horokio, palm leaf fern
Blechnum penna-marina	little hard fern
Blechnum procerum	small kiokio
Microsorum pustulatum subsp. *pustulatum*	hounds tongue fern
Polystichum vestitum	prickly shield fern
Pteridium esculentum	bracken
Gymnosperms	
*Pinus radiata**	radiata pine
Dicotyledons	
*Acaena agnipila**	sheeps bur
Acaena anserinifolia	bidibid
Acaena juvenca	bidibid
Acaena novae-zelandiae	bidibid
*Achillea millefolium**	yarrow
Aciphylla aurea	golden spaniard
Aciphylla subflabellata	spaniard
Anaphalioides bellidioides	hells bells
Aristotelia fruticosa	mountain wineberry
Callitriche spp.	starwort
Calystegia tuguriorum	climbing convolvulus, NZ bindweed
*Capsella bursa-pastoris**	shepherd's purse
Carmichaelia crassicaulis subsp. *crassicaulis*	coral broom
Carmichaelia petriei	native broom, desert broom
Carmichaelia spp.	broom
Celmisia gracilenta	common mountain daisy, pekapeka
Celmisia hookeri	Hookers mountain daisy
*Cerastium fontanum**	mouse ear chickweed
*Cerastium glomeratum**	annual mouse-ear chickweed
Chaerophyllum ramosum	
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle
Clematis quadribracteolata	
Coprosma crassifolia	
Coprosma propinqua	mingimingi
Coprosma rugosa	needle-leaved mountain coprosma
Coprosma tayloriae	
Coriaria plumosa	feathery tutu, mountain tutu, small-leaved tutu
Corokia cotoneaster	korokio, wire-netting bush
*Cytisus scoparius**	broom
Discaria toumatou	matagouri, Wild Irishman
Epilobium alsinoide	willowherb
*Epilobium ciliatum**	willowherb
Epilobium nummulariifolium	creeping willowherb
Epilobium pubens	willowherb
*Erodium cicutarium**	storksbill
*Galium aparine**	cleavers
Gaultheria antipoda	snowberry
Gaultheria crassa	snowberry
Gaultheria macrostigma	prostrate snowberry
*Geranium molle**	doves foot cranesbill
Gingidia grisea	
Griselinia littoralis	broadleaf
Hebe salicifolia	koromiko
Helichrysum filicaule	creeping or slender everlasting daisy

Helichrysum lanceolatum	
*Hypochaeris radicata**	catsear
Leucopogon fraseri	patotara, dwarf mingimingi
Lobelia perpusilla	
*Marrubium vulgare**	horehound
Melicytus alpinus	porcupine shrub
Muehlenbeckia australis	pohuehue
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Myrsine divaricata	weeping matipo, weeping mapou
Olearia bullata	
Pentachondra pumila	
*Pilosella officinarum**	mouse-ear hawkweed
*Polygonum aviculare**	prostrate knotweed
*Prunella vulgaris**	self-heal
Pseudognaphalium luteoalbum	
Ranunculus glabrifolius	buttercup
*Ribes uva-crispa**	gooseberry
*Rosa rubiginosa**	briar rose
Rubus cissoides	tataramoa, bush lawyer
Rubus schmidelioides	tataramoa, bush lawyer, white-leaved lawyer
*Rumex acetosella**	sheep's sorrel
*Sambucus nigra**	elderberry
Scleranthus uniflorus	
Senecio quadridentatus	cotton fireweed, white fireweed, pahokoraka
Sophora microphylla	kowhai, weeping kowhai, small-leaved kowhai
*Stellaria media**	chickweed
*Taraxacum officinale**	dandelion
*Trifolium pratense**	red clover
*Trifolium dubium**	suckling clover
*Ulex europaeus**	gorse
*Urtica urens**	nettle, stinging nettle
*Verbascum thapsus**	woolly mullein, common mullein
Wahlenbergia albomarginata	NZ harebell

Note: *exotic species

Table A.3.3 *Plant species identified at Top Tipperary Tailings Storage Facility, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
*Anthoxanthum odoratum**	sweet vernal
Astelia nervosa	mountain astelia
Austroderia richardii	toetoe
Bulbinella angustifolia	
Carex petriei	Petries Sedge
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Chionochloa rigida x *rubra*	
Chionochloa rubra subsp. *cuprea*	red tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Glyceria fluitans**	floating sweetgrass
*Holcus lanatus**	Yorkshire fog
Juncus distegus	two storey rush
Juncus edgariae	wiwi, Edgars rush
Juncus pallidus	giant rush
*Lolium multiflorum**	Italian ryegrass
*Lolium perenne**	perennial ryegrass
Phormium cookianum subsp. *cookianum*	mountain flax
Poa cita	silver tussock
Poa colensoi	blue tussock
Schoenus pauciflorus	bog rush, sedge tussock
Pteridophytes	
Asplenium flabellifolium	butterfly fern, walking fern, necklace fern
Asplenium richardii	Richards spleenwort
Blechnum novae-zelandiae	kiokio, horokio, palm leaf fern
Blechnum penna-marina	little hard fern
Blechnum procerum	small kiokio
Microsorum pustulatum subsp. *pustulatum*	hounds tongue fern
Polystichum vestitum	prickly shield fern
Pteridium esculentum	bracken
Gymnosperms	
*Pinus radiata**	radiata pine
Pinus spp.*	pine
Dicotyledons	
Acaena anserinifolia	bidibid
Acaena caesiiglauca	glaucus bidibid, piripiri
Acaena novae-zelandiae	bidibid
*Achillea millefolium**	yarrow
Aciphylla aurea	golden spaniard
Aciphylla subflabellata	spaniard
Anaphalioides bellidioides	hells bells
Anisotome aromatica	aromatic aniseed, kopoti, common aniseed
Aristotelia fruticosa	mountain wineberry
Brachyglottis bellidioides var. *crassa*	
Callitriche spp.	starwort
*Capsella bursa-pastoris**	shepherd's purse
Cardamine debilis	NZ bitter cress
Carmichaelia petriei	native broom, desert broom
Celmisia hookeri	Hookers mountain daisy
*Cerastium fontanum**	mouse ear chickweed
*Cerastium glomeratum**	annual mouse-ear chickweed
Chaerophyllum ramosum	

*Cirsium arvense**	Californian thistle
Coprosma propinqua	mingimingi
Coprosma tayloriae	
Coriaria plumosa	feathery tutu, mountain tutu, small-leaved tutu
*Cytisus scoparius**	broom
*Digitalis purpurea**	foxglove
Discaria toumatou	matagouri, Wild Irishman
Epilobium alsinoide	willowherb
*Epilobium ciliatum**	willowherb
Epilobium nummulariifolium	creeping willowherb
Epilobium pubens	
*Erodium cicutarium**	storksbill
*Galium aparine**	cleavers
Galium perpusillum	dwarf bedstraw
Galium trilobum	native bedstraw
Gaultheria antipoda	snowberry
Gaultheria spp.	snowberry
*Geranium molle**	doves foot cranesbill
Gonocarpus aggregatus	
Hebe odora	hebe
Helichrysum filicaule	creeping or slender everlasting daisy
*Hypochaeris radicata**	catsear
*Larix decidua**	European larch
Lemna minor	common duckweed
Leucopogon fraseri	patotara, dwarf mingimingi
Melicytus alpinus	porcupine shrub
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Olearia bullata	
Oxalis exilis	yellow oxalis
Pentachondra pumila	
*Pilosella officinarum**	mouse-ear hawkweed
Populus spp.*	poplar
*Prunella vulgaris**	self-heal
Ranunculus foliosus	grassland buttercup
Ranunculus glabrifolius	buttercup
*Ribes sanguineum**	flowering currant
*Ribes uva-crispa**	gooseberry
*Rosa rubiginosa**	briar rose
Rubus cissoides	tataramoa, bush lawyer
Rubus schmidelioides	tataramoa, bush lawyer, white-leaved lawyer
*Rumex acetosella**	sheep's sorrel
Salix spp.*	willow
*Sambucus nigra**	elderberry
Senecio quadridentatus	cotton fireweed, white fireweed, pahokoraka
*Stellaria media**	chickweed
*Taraxacum officinale**	dandelion
*Trifolium pratense**	red clover
*Trifolium dubium**	suckling clover
*Ulex europaeus**	gorse
*Urtica urens**	nettle, stinging nettle
*Verbascum thapsus**	woolly mullein, common mullein
Viola cunninghamii	mountain violet, white violet

Note: *exotic species

Table A.3.4 *Plant species identified at Tipperary Creek silt pond, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
*Anthoxanthum odoratum**	sweet vernal
Astelia nervosa	mountain astelia
Austroderia richardii	toetoe
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Chionochloa rigida x *rubra*	
Chionochloa rubra subsp. *cuprea*	red tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Glyceria fluitans**	floating sweetgrass
*Holcus lanatus**	Yorkshire fog
Juncus edgariae	wiwi, Edgars rush
*Juncus effusus var. effusus**	leafless rush
Juncus spp.	rush
*Lolium multiflorum**	Italian ryegrass
*Lolium perenne**	perennial ryegrass
Phormium cookianum subsp. *cookianum*	mountain flax
Poa cita	silver tussock
Poa colensoi	blue tussock
Pteridophytes	
Polystichum vestitum	prickly shield fern
Pteridium esculentum	bracken
Gymnosperms	
*Pinus radiata**	radiata pine
Dicotyledons	
Aciphylla aurea	golden spaniard
Carmichaelia petriei	native broom, desert broom
Celmisia hookeri	Hookers mountain daisy
Melicytus alpinus	porcupine shrub
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Olearia bullata	
*Ulex europaeus**	gorse

Note: *exotic species

Table A.3.5 *Plant species identified at Frasers North Waste Rock Stack, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
Austroderia richardii	toetoe
Carex spp.	sedge
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Chionochloa rigida x *rubra*	
Chionochloa rubra subsp. *cuprea*	red tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Lolium perenne**	perennial ryegrass
Poa cita	silver tussock
Poa colensoi	blue tussock
Pteridophytes	
Asplenium flabellifolium	butterfly fern, walking fern, necklace fern
Asplenium richardii	Richards spleenwort
Blechnum penna-marina	little hard fern
Blechnum procerum	small kiokio
Microsorum pustulatum subsp. *pustulatum*	hounds tongue fern
Polystichum vestitum	prickly shield fern
Gymnosperms	
*Pinus radiata**	radiata pine
Dicotyledons	
Aciphylla aurea	golden spaniard
Carmichaelia petriei	native broom, desert broom
Celmisia hookeri	Hookers mountain daisy
*Cerastium fontanum**	mouse ear chickweed
*Cirsium arvense**	Californian thistle
Coprosma propinqua	mingimingi
Coprosma tayloriae	
*Cytisus scoparius**	broom
Discaria toumatou	matagouri, Wild Irishman
Gaultheria spp.	snowberry
*Geranium molle**	doves foot cranesbill
Hydrocotyle novae-zeelandiae var. *novae-zeelandiae*	pennywort
Melicytus alpinus	porcupine shrub
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Olearia bullata	
*Pilosella officinarum**	mouse-ear hawkweed
*Ribes uva-crispa**	gooseberry
Rubus cissoides	tataramoa, bush lawyer
Rubus schmidelioides	tataramoa, bush lawyer, white-leaved lawyer
*Rumex crispus**	curled dock
*Sambucus nigra**	elderberry
*Trifolium pratense**	red clover
*Trifolium repens**	white clover
*Trifolium subterraneum**	sub clover
*Ulex europaeus**	gorse
*Urtica urens**	nettle, stinging nettle

Note: *exotic species

Table A.3.6 *Plant species identified at Frasers South Waste Rock Stack, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
Austroderia richardii	toetoe
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Chionochloa rubra subsp. *cuprea*	red tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Glyceria fluitans**	floating sweetgrass
Juncus distegus	two storey rush
Juncus effusus var. *effusus**	leafless rush
Juncus spp.	rush
*Lolium perenne**	perennial ryegrass
Poa cita	silver tussock
Poa colensoi	blue tussock
Pteridophytes	
Asplenium flabellifolium	butterfly fern, walking fern, necklace fern
Microsorum pustulatum subsp. *pustulatum*	hounds tongue fern
Polystichum vestitum	prickly shield fern
Pteridium esculentum	bracken
Dicotyledons	
Acaena anserinifolia	bidibid
Acaena caesiiglauca	glaucus bidibid, piripiri
*Achillea millefolium**	yarrow
Aciphylla aurea	golden spaniard
*Capsella bursa-pastoris**	shepherd's purse
Cardamine debilis	NZ bitter cress
Carmichaelia petriei	native broom, desert broom
Celmisia hookeri	Hookers mountain daisy
*Cerastium fontanum**	mouse ear chickweed
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle
Coprosma propinqua	mingimingi
*Cytisus scoparius**	broom
*Digitalis purpurea**	foxglove
Discaria toumatou	matagouri, Wild Irishman
Epilobium pubens	willowherb
*Erodium cicutarium**	storksbill
Gaultheria crassa	snowberry
Gaultheria macrostigma	prostrate snowberry
*Geranium molle**	doves foot cranesbill
Helichrysum filicaule	creeping or slender everlasting daisy
Leucopogon fraseri	patotara, dwarf mingimingi
Melicytus alpinus	porcupine shrub
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Olearia bullata	
*Pilosella officinarum**	mouse-ear hawkweed
*Plantago major**	broad-leaved plantain
Ranunculus foliosus	grassland buttercup
Ranunculus glabrifolius	buttercup
*Rumex acetosella**	sheep's sorrel
*Taraxacum officinale**	dandelion
*Trifolium dubium**	suckling clover
Trifolium fragiferum cv. 'Grasslands Onward'*	Onward strawberry clover
*Trifolium hybridum**	alsike clover

*Trifolium pratense**	Turoa red clover
Trifolium repens cv. 'Grasslands Huia'*	Huia white clover
*Trifolium subterraneum**	sub clover
*Ulex europaeus**	gorse
*Verbascum thapsus**	woolly mullein, common mullein

Note: *exotic species

Table A.3.7 *Plant species identified at Round Hill Extension, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
Dactylis glomerata cv. 'Grasslands Wana'*	Wana cocksfoot
Festuca novae-zelandiae	hard tussock
Lolium perenne cv. 'Grasslands Nui'*	Nui ryegrass
Lolium perenne cv. 'Grasslands Ruanui'*	Ruanui ryegrass
Dicotyledons	
*Achillea millefolium**	yarrow
*Capsella bursa-pastoris**	shepherd's purse
*Carduus nutans**	nodding thistle
*Cerastium fontanum**	mouse ear chickweed
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle
*Digitalis purpurea**	foxglove
*Erodium cicutarium**	storksbill
*Geranium molle**	doves foot cranesbill
*Pilosella officinarum**	mouse-ear hawkweed
*Plantago major**	broad-leaved plantain
*Rumex acetosella**	sheep's sorrel
Trifolium fragiferum cv. 'Grasslands Onward'*	Onward strawberry clover
*Trifolium hybridum**	alsike clover
Trifolium pratense cv. 'Grasslands Turoa'*	Turoa red clover
Trifolium repens cv. 'Grasslands Huia'*	Huia white clover
Trifolium subterraneum cv. 'Grasslands Woogenellup'*	Woogenellup sub clover
*Ulex europaeus**	gorse
*Verbascum thapsus**	woolly mullein, common mullein

Note: *exotic species

Table A.3.8 *Plant species identified at Innes Mills Stage V, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
Chionochloa rigida x *rubra*	
Chionochloa rubra subsp. *cuprea*	red tussock
Dactylis glomerata cv. 'Grasslands Wana'*	Wana cocksfoot
Festuca novae-zelandiae	hard tussock
Juncus effusus var. *effusus**	leafless rush
Lolium perenne cv. 'Grasslands Nui'*	Nui ryegrass
Lolium perenne cv. 'Grasslands Ruanui'*	Ruanui ryegrass
Dicotyledons	
*Achillea millefolium**	yarrow
*Capsella bursa-pastoris**	shepherd's purse
*Cerastium fontanum**	mouse ear chickweed
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle

*Digitalis purpurea**	foxglove
*Erodium cicutarium**	storksbill
*Geranium molle**	doves foot cranesbill
Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
*Pilosella officinarum**	mouse-ear hawkweed
*Plantago major**	broad-leaved plantain
*Rumex acetosella**	sheep's sorrel
Trifolium fragiferum cv. 'Grasslands Onward'*	Onward strawberry clover
*Trifolium hybridum**	alsike clover
Trifolium pratense cv. 'Grasslands Turoa'*	Turoa red clover
Trifolium repens cv. 'Grasslands Huia'*	Huia white clover
Trifolium subterraneum cv. 'Grasslands Woogenellup'*	Woogenellup sub clover
*Ulex europaeus**	gorse
*Verbascum thapsus**	woolly mullein, common mullein

Note: *exotic species

Table A.3.9 *Plant species identified at Southern Pit Extension, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Dactylis glomerata cv. 'Grasslands Wana'*	Wana cocksfoot
Festuca novae-zelandiae	hard tussock
*Holcus lanatus**	Yorkshire fog
Lolium perenne cv. 'Grasslands Nui'*	Nui ryegrass
Lolium perenne cv. 'Grasslands Ruanui'*	Ruanui ryegrass
Dicotyledons	
*Achillea millefolium**	yarrow
*Capsella bursa-pastoris**	shepherd's purse
*Carduus nutans**	nodding thistle
*Cerastium fontanum**	mouse ear chickweed
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle
*Digitalis purpurea**	foxglove
*Erodium cicutarium**	storksbill
*Geranium molle**	doves foot cranesbill
*Pilosella officinarum**	mouse-ear hawkweed
*Plantago major**	broad-leaved plantain
*Rumex acetosella**	sheep's sorrel
Trifolium fragiferum cv. 'Grasslands Onward'*	Onward strawberry clover
*Trifolium hybridum**	alsike clover
Trifolium pratense cv. 'Grasslands Turoa'*	Turoa red clover
Trifolium repens cv. 'Grasslands Huia'*	Huia white clover
Trifolium subterraneum cv. 'Grasslands Woogenellup'*	Woogenellup sub clover
*Ulex europaeus**	gorse
*Verbascum thapsus**	woolly mullein, common mullein

Note: *exotic species

Table A.3.10 *Plant species identified at Frasers Stage VI, October 2010.*

Scientific name	Common name(s)
Monocotyledons	
*Agrostis capillaris**	browntop
*Agrostis stolonifera**	creeping bent
Austroderia richardii	toetoe
Carex secta	pukio, niggerhead
Chionochloa rigida subsp. *rigida*	narrow-leaved snow tussock
Chionochloa rigida x *rubra*	
Chionochloa rubra subsp. *cuprea*	red tussock
*Dactylis glomerata**	cocksfoot
Festuca novae-zelandiae	hard tussock
*Glyceria fluitans**	floating sweetgrass
*Holcus lanatus**	Yorkshire fog
*Juncus effusus var. effusus**	leafless rush
*Lolium multiflorum**	Italian ryegrass
*Lolium perenne**	perennial ryegrass
Poa colensoi	blue tussock
Pteridophytes	
Asplenium flabellifolium	butterfly fern, walking fern, necklace fern
Microsorum pustulatum subsp. *pustulatum*	hounds tongue fern
Polystichum vestitum	prickly shield fern
Pteridium esculentum	bracken
Gymnosperms	
*Cupressus macrocarpa**	macrocarpa
*Pinus radiata**	radiata pine
Dicotyledons	
Acaena anserinifolia	bidibid
*Achillea millefolium**	yarrow
Aciphylla aurea	golden spaniard
Brassica spp.*	
Callitriche spp.	starwort
*Capsella bursa-pastoris**	shepherd's purse
Cardamine debilis	NZ bitter cress
Carmichaelia petriei	native broom, desert broom
Celmisia hookeri	Hookers mountain daisy
*Cerastium fontanum**	mouse ear chickweed
*Cerastium glomeratum**	annual mouse-ear chickweed
*Cirsium arvense**	Californian thistle
*Cirsium vulgare**	Scotch thistle
*Conium maculatum**	hemlock
Coprosma propinqua	mingimingi
Cotula coronopifolia	batchelors button, yellow buttons, waterbuttons
*Cytisus scoparius**	broom
Discaria toumatou	matagouri, Wild Irishman
*Epilobium ciliatum**	willowherb
Epilobium pubens	
*Erodium cicutarium**	storksbill
*Galium aparine**	cleavers
Gaultheria macrostigma	prostrate snowberry
*Geranium molle**	doves foot cranesbill
Hebe rakaiensis	hebe
*Hypochaeris radicata**	catsear
*Jacobaea vulgaris**	ragwort
Leucopogon fraseri	patotara, dwarf mingimingi
Melicytus alpinus	porcupine shrub
*Mimulus moschatus**	musk

Muehlenbeckia complexa	small-leaved pohuehue, scrub pohuehue, wire vine
Olearia bullata	
*Pilosella officinarum**	mouse-ear hawkweed
Ranunculus foliosus	grassland buttercup
Ranunculus glabrifolius	buttercup
*Reseda luteola**	wild mignonette
*Ribes sanguineum**	flowering currant
*Ribes uva-crispa**	gooseberry
*Rosa rubiginosa**	briar rose
Rubus schmidelioides var. *subpauperatus*	tataramoa, bush lawyer, white-leaved lawyer
*Rumex acetosella**	sheep's sorrel
*Rumex crispus**	curled dock
*Salix fragilis**	crack willow
*Solanum dulcamara**	bittersweet
*Stellaria media**	chickweed
*Taraxacum officinale**	dandelion
*Trifolium pratense**	red clover
*Trifolium repens**	white clover
Trifolium subterraneum cv. 'Grasslands Woogenellup'*	Woogenellup sub clover
*Trifolium dubium**	suckling clover
*Ulex europaeus**	gorse
*Verbascum thapsus**	woolly mullein, common mullein

Note: *exotic species

Appendix Four

Threatened plant species of Macraes Ecological District

Table A.4.1 *Threatened plant species of Macraes Ecological District. Identified from previous reports, from a list of threatened and uncommon plants known for Macraes Flat (Thorsen 2008), the New Zealand threatened and uncommon plants species list (de Lange et al. 2009), Department of Conservation and the New Zealand Plant Conservation Network database searches.*

Scientific name	Common name(s)[1]	National threat listing (2008)[2]
Aciphylla subflabellata	Spaniard	Declining[DP SP]
Anemone tenuicaulis	New Zealand anemone	Naturally Uncommon[SP]
Botrychium australe	Parsley fern, patotara	Naturally Uncommon[DP PD SO SP]
Cardamine b (CHR 312947; "Tarn")	Bitter cress, pygmy turf cress	Nationally Critical[CD EF]
Carex allanii	Allen's sedge	Naturally Uncommon[SP DP]
Carex berggrenii	Berggrens Sedge	Naturally Uncommon[SP]
Carex "tenuiculmis"	Slender niggerhead	Declining[DP]
Carmichaelia kirkii	Climbing broom, Kirks broom	Declining[RF]
Carmichaelia crassicaulis subsp. *crassicaulis (*ex. *Corallospartium crassicaule)*	Coral broom	Declining[RF]
Celmisia hookeri	Hookers mountain daisy	Naturally Uncommon[SP]
*Chaerophyllum colensoivar. delicatula (*ex. *Oreomyrrhis colensoi* var. *delicatula)*	Mountain myrrh	Nationally Critical[DP EF RR]
Coprosma intertexta		Relict[DE DP RF SP]
Coprosma rubra		Data Deficient
*Crassula mataikona (*ex. *Tillaea debilis)*		Naturally Uncommon[SP]
Crassula multicaulis		Nationally Critical[DP EF]
Crassula peduncularis		Nationally Critical[EF RR SO]
*Deschampsia cespitosa (*ex. *Deschampsia caespitosa* var. *macrantha)*	Tufted hair-grass, wavy hair-grass	Declining[CD SO]
Dracophyllum uniflorum var. *frondosum*	Sprawling turpentine	Naturally Uncommon[SP]
Epilobium insulare	Willowherb	Declining[DP RR]
Gingidia grisea		Naturally Uncommon[RR]
*Gratiola concinna (*ex. *Gratiola nana)*		Nationally Vulnerable[DE]
*Hymenochilus tristis (*ex. *Pterostylis tristis)*		Naturally Uncommon[DP EF SP]
Iphigenia novae-zelandiae		Nationally Vulnerable[DP RR]
Isolepis basilaris	Pygmy clubrush	Nationally Endangered[DE]
Kirkianella novae-zelandiae	Kirkianella	Nationally Vulnerable[DP]
Lagenifera montana	Papataniwha	Nationally Endangered[DP SO SP]
Leptinella serrulata	Dryland button daisy	Naturally Uncommon[SP]
*Lobelia ionantha (*ex. *Hypsela rivalis)*	Hypsela	Declining[DP]
*Lobelia perpusilla (*ex. *Pratia prepusilla)*		Naturally Uncommon[SP]
Myosotis aff. *australis* (AK 231051; "small white")		Naturally Uncommon[SP]
Myosotis aff. *australis* (CHR 572827; Lammerlaw)		Data Deficient[SP]
*Myosotis glauca (*ex. *Myosotis pygmaea* var. *glauca)*		Nationally Vulnerable[DE DP SP]
Myosurus minimus subsp. *novae-zelandiae*	New Zealand mousetail, bearded mousetail	Nationally Critical[EF SP]
Olearia fimbriata		Nationally Vulnerable[PD RF]
*Olearia lineata (*ex. *Olearia virgata* var. *lineata)*		Declining[PD RF]
Plantago spathulata subsp. *picta*		Naturally Uncommon[RR SP]
*Ranunculus brevis (*ex. *Ranunculus depressus)*[3]		Declining[DP]
Raoulia beauverdii	Beauverds scabweed	Naturally Uncommon[SP]
Rytidosperma thomsonii		Data Deficient
Senecio dunedinensis	Fireweed	Naturally Uncommon[SP]
Simplicia laxa	Simplicia	Nationally Critical[CD SP]

Scientific name	Common name(s)[1]	National threat listing (2008)[2]
Stenostachys gracilis		Data Deficient
Tetrachondra hamiltonii		Declining[DP SP]
Uncinia elegans	Handsome bastard grass, handsome hook sedge	Data Deficient[SO]
Uncinia sinclairii	Sinclairs bastard grass, Sinclairs hook sedge	Data Deficient[SP]

Note: 1. From New Zealand Plant Conservation Network
2. From de Lange *et al.* 2009
3. status equivocal

Appendix Five

Location of ecologically significant species within the proposed Back Road Waste Rock Stack

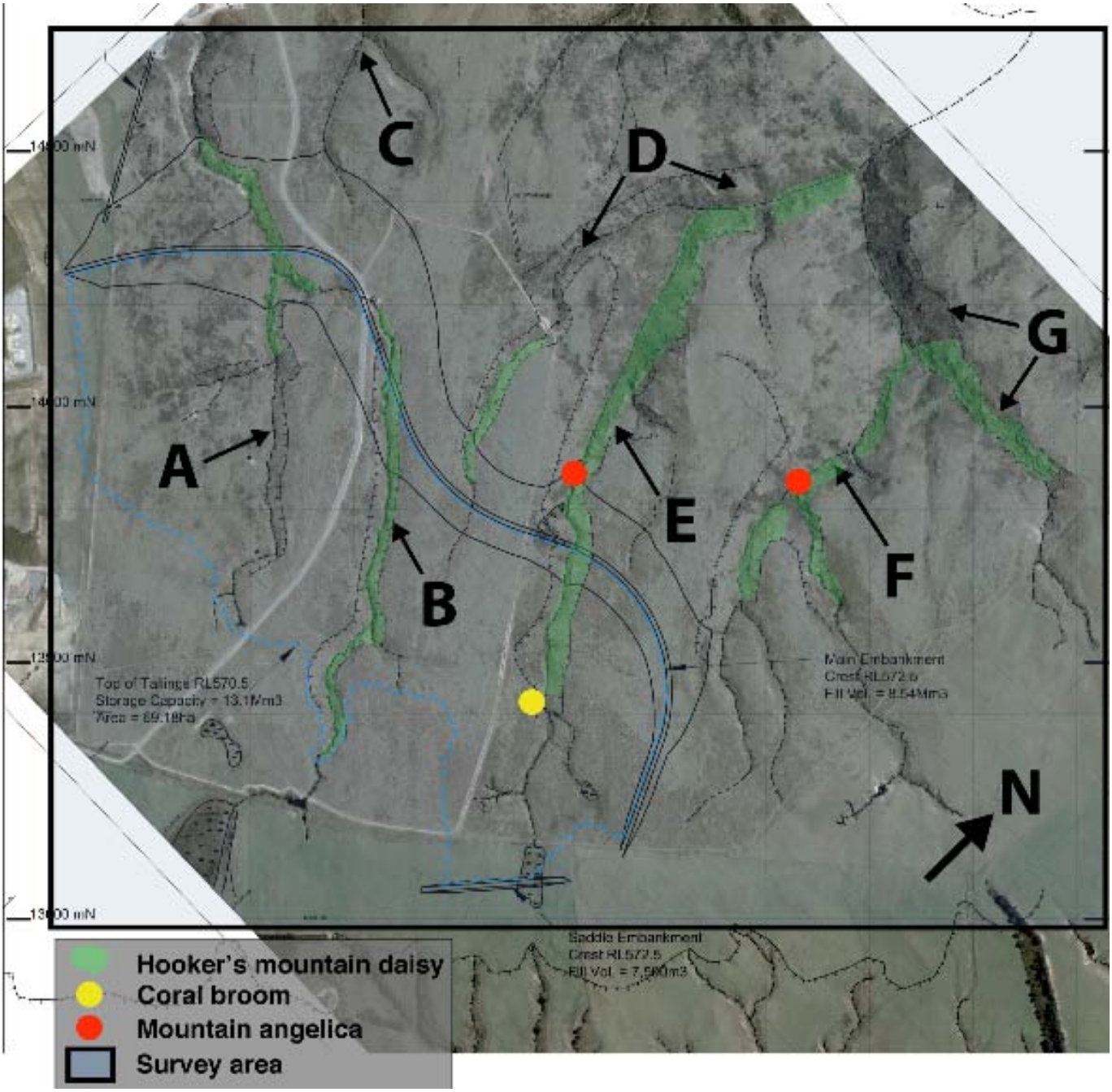

Figure A.5.1 *Aerial photo showing the approximate location of the three ecologically significant plant species found within and adjacent to the proposed Back Road Waste Rock Stack, June 2009. A – F denotes names of gullies. Aerial photo supplied by OceanaGold Ltd. Taken from Ryder Consulting 2009b.*

Appendix Six

Recommended areas for protection (RAPs) within the Macraes Ecological District.

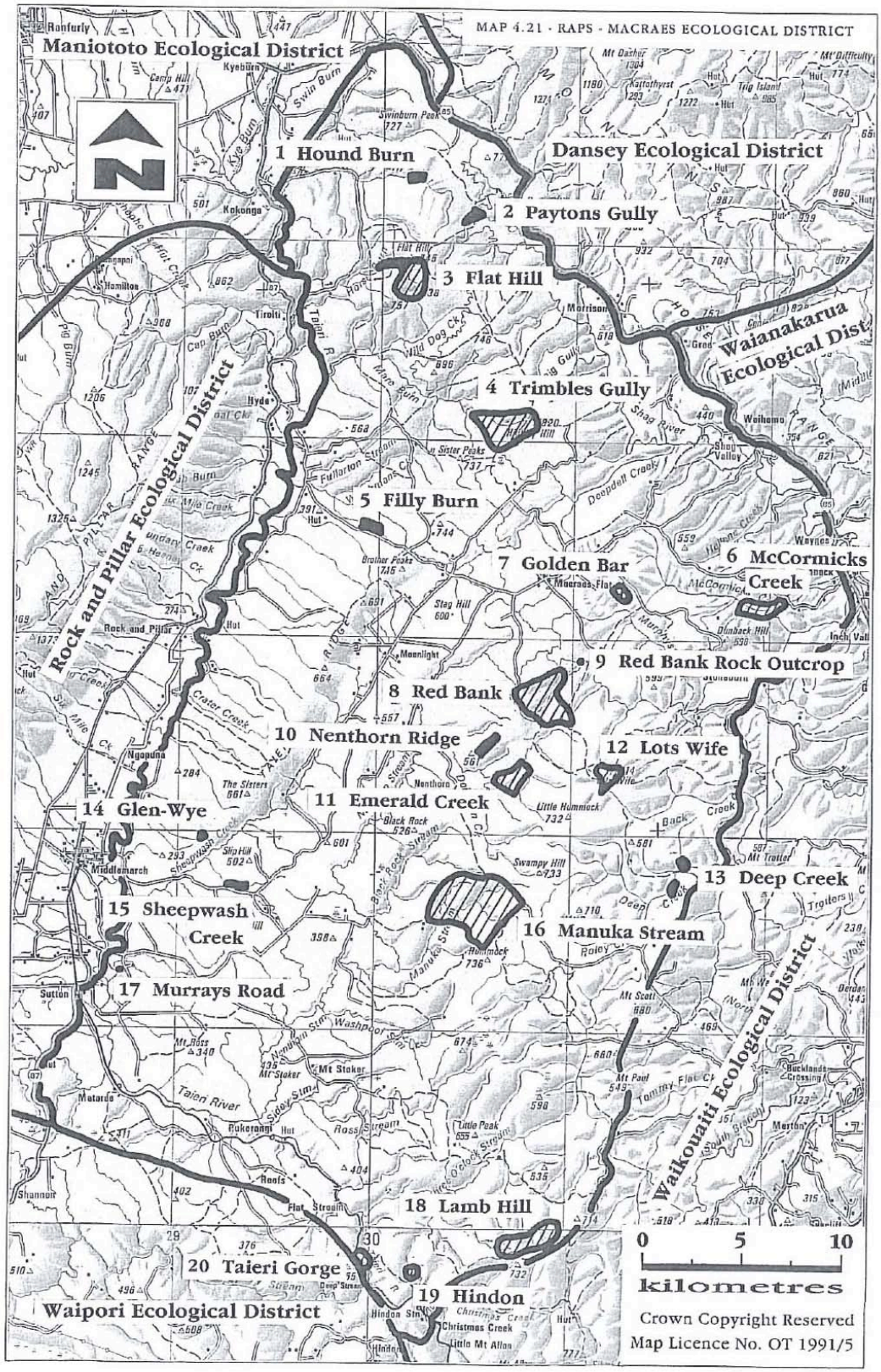

Figure A.6.1 *Recommended areas for protection (RAPs) within the Macraes Ecological District. Taken from Bibby (1997).*