Attachment C

Draft Terrestrial Ecology Report

VEGETATION AND FAUNA OF THE PROPOSED TE KUHA MINE SITE

Prepared for Te Kuha Limited Partnership

mitchell partnerships

October 2013

EXECUTIVE SUMMARY

The Te Kuha mining permit is located predominantly within the Westport Water Conservation Reserve (1,825 ha), which is a local purpose reserve administered by the Buller District Council. The coal deposit is situated outside the water catchment within an area of approximately 490 ha of Brunner Coal Measures vegetation approximately 5 km southwest of Mt Rochfort. Access would be required across conservation land to reach the coal resource.

The Te Kuha site was recommended as an area for protection by the Protected Natural Areas Programme surveys in the 1990s on the basis that in the event it was removed from the local purpose reserve for any reason, addition to the public conservation estate would increase the level of protection of coal measures habitats which, although found elsewhere (principally in the Mt Rochfort Conservation Area), were considered inadequately protected overall.

The proposal to create an access road and an opencast mine at the site would affect twelve different vegetation types to varying degrees. The habitats present at the proposed mine site are overwhelmingly indigenous and have a very high degree of intactness reflecting their lack of human disturbance. Previous surveys have shown that some trees in the area are more than 500 years old. Habitats affected by the proposed access road are less intact and include exotic pasture as well as regenerating shrubland and forest.

Te Kuha is not part of the Department of Conservation's Buller Coal Plateaux priority site and is unlikely to receive management for that reason. The Animal Health Board currently uses toxins to control possums in the area to reduce the risk of bovine tuberculosis and this will be benefiting local flora and fauna.

No threatened plant species were detected during our survey, but the presence of two at risk plant species (*Euphrasia wettsteiniana* and *Dracophyllum densum*) was confirmed along with locally significant species such as *Metrosideros parkinsonii*, *Actinotus novae-zelandiae* and *Celmisia dubia*. Although bryophyte surveys have not been recent or extensive, the area is also known to provide habitat for at least one threatened bryophyte species (*Saccogynidium decurvum*) and four at risk species (*Herzogianthus sanguineus*, *Riccardia multicorporea*, *R*. *furtiva* and *Zoopsis bicruris*) as well as taxonomically isolated species of importance.

The wider habitats have a comparatively intact bird fauna (40 species) with surprisingly few introduced species, but overall bird numbers were low. Two threatened bird species occur at the proposed mine site (Great spotted kiwi and New Zealand falcon) along with five at risk species (Western weka, South Island fernbird, New Zealand pipit, Long-tailed cuckoo and South Island rifleman).

No bats have been detected at Te Kuha, but two species of lizard (forest gecko and speckled skink) have been confirmed at the site and a third (West Coast green gecko) is considered likely to occur there. All three lizard species are regarded "At Risk" nationally.

Invertebrate communities at the site are also predominantly native. No terrestrial invertebrates of conservation concern were found, although surveys detected a previously unknown species of leaf-veined slug (*Pseudaneita*) and a *Rhytida*-like snail that may be of conservation significance, depending on its confirmed identity.

Additional bryophyte surveys, and additional collection of the leaf-veined slug and *Rhytida*-like snail, are recommended both inside and outside the proposed mine footprint to assist in informing resource consent applications.

The vegetation and habitats at Te Kuha are significant in terms of the Resource Management Act (1991). The proposal to construct a mine and access road would remove around 89 ha of these habitats, including around 77 ha of coal measures vegetation, and adversely affect the current high intactness and ecological integrity of the site. Construction of the proposed mine and access road would remove all of the known herbfield vegetation locally (0.04 ha), manuka – Dracophyllum rockland would have around 27% removed but other vegetation types within the local coal measures outcrop would be much less affected. Effective legal protection in perpetuity of the remaining approximately 413 ha (84%) of coal measures vegetation locally would contribute to achieving adequate representation of coal measures vegetation within the reserve network. If combined with weed and pest management, legal protection would provide more certainty about the magnitude and scale of adverse effects due to mining in the vicinity and contribute to a positive rehabilitation outcome in the longer term.

The only practical option to mitigate the effects of vegetation removal on plant species and communities at Te Kuha is to minimise edge effects, reduce the ingress of weeds where possible and rehabilitate to the highest achievable standard. Direct transfer of vegetation, including herbfield and yellow-silver pine – manuka shrubland, is recommended to form part of mitigation efforts.

Rehabilitation techniques developed over last 10 to 20 years for similar coal measures ecosystems at other sites provide the best indication of what is achievable for rehabilitation at Te Kuha. We recommend that as mine planning proceeds consultation with affected parties, particularly the Department of Conservation and Buller District Council peer reviewers, be undertaken to clarify priorities and preferred outcomes for rehabilitation. The most conservative approach to rehabilitation would be to deliver densely vegetated herbfields and bryophyte habitats via direct transfer and buffer this vegetation with other directly transferred vegetation in order to provide resilience against weeds and maintain suitable soil and soil moisture conditions. In other areas, we recommend the establishment of a dense canopy of native species at least 1 to 2 m height, since the most likely weeds are generally herbaceous annuals (exotic grasses and short herbs) and such species are much less competitive in a shaded environment.

In the medium to long term, the vegetation that develops on the backfill is likely to be typical of existing areas with better-drainage and deeper root zones. Vegetation on the upper slopes is likely to have fewer podocarp (native pine) species and more mountain flax. On lower slopes more toetoe and tutu are likely. Herb field, mānuka-dracophyllum rock land and open mānuka – yellow-silver pine shrubland are likely to be reduced in extent, even if these habitats are prioritised for direct transfer.

Provided ecosystem management is undertaken to improve survival and recruitment "Threatened" and "At Risk" species would likely remain in the areas surrounding Te Kuha during and after mining. Such species would then eventually recolonize rehabilitated mine surfaces. Ecosystem management would also contribute to mitigating adverse effects particularly on fauna species which occupy the site currently. If carried out at sufficient scale to connect to managed habitats at Mt Rochfort, ecosystem management could also contribute to the resilience and persistence of the coal measures ecosystem overall.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

APPENDICES

1. INTRODUCTION

1.1 Background

Mining permit 41-289 at Te Kuha is a triangular block of land which covers approximately 860 ha near the township of Westport, on the West Coast of the South Island. The southern boundary of the permit is situated north of the Buller River as shown in Figure 1.

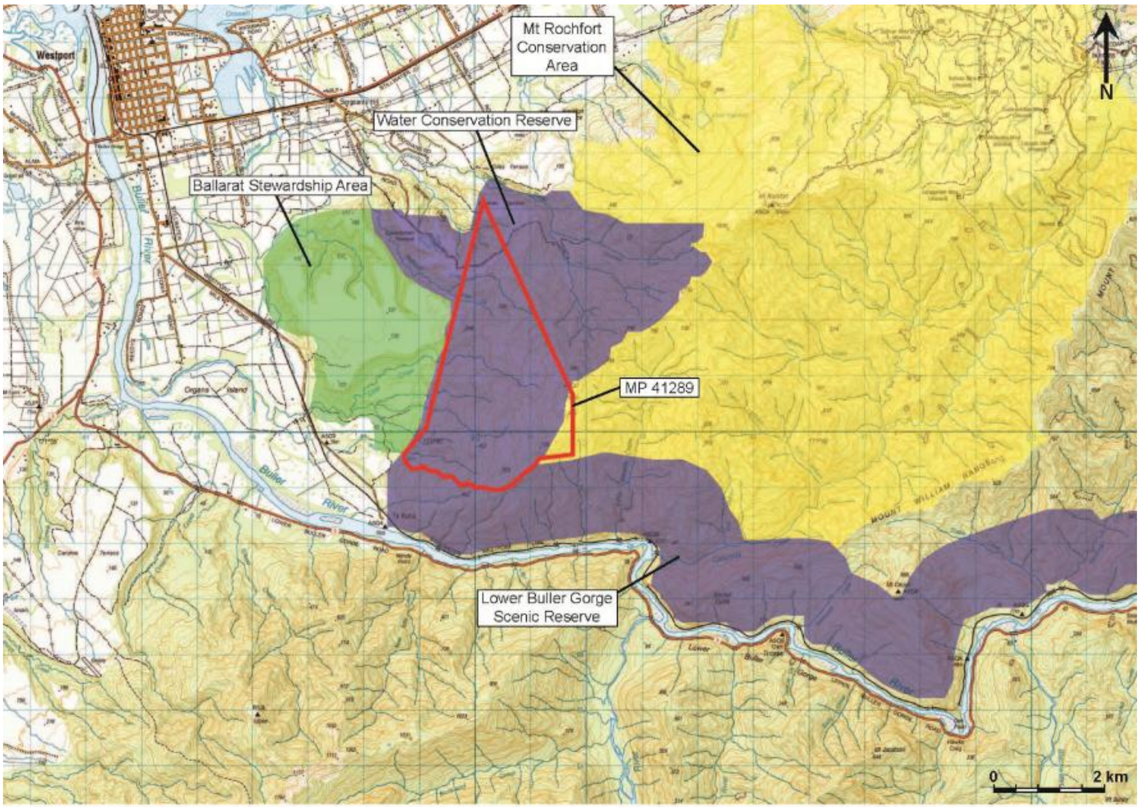

Figure 1: The location of Mining Permit 41-289.

In 1995 Rangitira Developments Ltd[1] (**"RDL"**) purchased this mining permit and commenced the process of obtaining land access agreements and resource consents to mine coal at the site. By 2002 access matters relating to the site remained unresolved and the project was not pursued.

In 2010 Stevenson Group Limited (**"Stevenson"**) and RDL entered into a joint venture to undertake further exploration of the Te Kuha coal deposit, which resulted in an analysis of geology, mine planning, surveying and resource management activities carried out to date in order to identify gaps and suggest a way forward. In 2012 a detailed drilling programme was carried out in conjunction with geological resource modelling to establish and confirm the quality of the coal resources. The results of this additional investigation indicate that the coal deposit comprises around 4 million tonnes of high quality coking coal which could be used in a range of industrial applications including steel production. In general the depth to the main seam is <80 m although there are some small deeper seams.

1 Rangitira Developments Ltd is a wholly owned subsidiary of the Wi Pere Holdings Ltd.

In 2012 Te Kuha Limited Partnership (**"TKLP"**) was formed. TKLP is a joint venture between Stevenson and Wi Pere Holdings Limited, who together are considering all of the options in relation to the Te Kuha Project.

Previous ecological surveys have broadly described vegetation and fauna present in the Te Kuha area (Regnier 1986; Garrick 1986; Mitchell Partnerships & Landcare Research 2001). In addition to describing the vegetation, Mitchell Partnerships and Landcare Research Limited (2001), also undertook a tree age survey at Te Kuha, Mt Rochfort, Deep Creek and Happy Valley. The oldest trees cored at Te Kuha were between 432 and 518 years old. Trees of a similar age were recorded at Deep Creek (505 years), Happy Valley (461 years) and Mt Rochfort (442 years).

While Garrick (1986) surveyed fauna throughout the mining permit and surrounds, Mitchell Partnerships & Landcare Research (2001) focussed on the area then proposed for mining. Garrick (1986) assessed four wildlife habitats present in what he called the Te Kuha Coal Prospect, including riverine, terrace land, dip slope tall forest (divided into dip slope tall forest and Te Kuha dip slope) and Little Cascade habitats. In the current proposal the habitats affected almost entirely comprise what Garrick called "Te Kuha dip slope" in the vicinity of the coal deposit combined with "Dip slope tall forest" along parts of the proposed access road route.

In 2013 Mitchell Partnerships Limited was retained to investigate the site and provide information about the terrestrial ecological values found there and the potential for rehabilitation after mining. Further surveys of flora and fauna were considered necessary because:

- Although the vegetation was mapped by Regnier 1986 and Mitchell Partnerships and Landcare Research Limited (2001), neither map has been digitised, nor has an estimate of extent been derived for the habitats present.

- Neither Regnier (1986) nor Mitchell Partnerships and Landcare Research Limited (2001) provide a plant species list, although both discuss rare species present. The particular threat ranking of many plants has changed since 2001 and the absence of a species list makes it impossible to confirm what threatened species might be present.

- No specialised lizard survey has been undertaken at the site.

- Although faunal habitats are unlikely to have changed significantly since 1999, there may have been changes in species composition or relative abundance of fauna. Furthermore the species which are considered threatened have changed.

- Previous bat surveys have been limited to a single electronic bat detector, at one site for only one night (Mitchell Partnerships & Landcare Research 2001), and visual search for long-tailed bats at dusk (Garrick 1986).

- Prior great spotted kiwi surveillance is also somewhat limited, particularly in 1999, when only two nights listening (one poor because of wind) was undertaken.

- Only 10 five minute bird counts in each of three habitat types were undertaken in 1999: this level of sampling on a one-off survey provides only a very broad indication of common birds present at the time the survey is carried out.

This information is required to supplement and update the existing information as described above and inform future applications for access to the Department of Conservation and Buller District Council.

1.2 Project Description

The coal deposit at Te Kuha is situated at an elevation of between 650 and 800 metres above sea level (**"m asl"**) approximately 2 km north of the Buller River and approximately 12 km south east of Westport.

The mining permit is located predominantly within the Westport Water Conservation Reserve (1,825 ha), which is a local purpose reserve administered by the Buller District Council. The permit also includes approximately 13 ha of public conservation land administered by the Department of Conservation as part of either the Mt Rochfort Conservation Area or the Lower Buller Gorge Scenic Reserve as shown in Figure 1.

TKLP proposes to construct an opencast mine at the Te Kuha site. The pit, overburden stockpiles, Run of Mine (**'ROM'** where newly extracted coal awaits transport for processing), mine buildings and road would cover approximately 89 ha as shown in Table 1 and Figure 2. Other infrastructure associated with the proposed mine, such as a coal handling and processing plant and coal stockpiles, would be located on privately owned land on the lower Buller River terrace and accessed from Nine Mile Road. The mine and the associated infrastructure would be connected by a new haul road to be built between the two locations. The new haul road would be approximately 9 km in length and would cross privately owned land as well as public conservation land which forms part of the Ballarat Stewardship Area.

Table 1: Summary of vegetation affected by mining at Te Kuha.

Year of Mining (Colour in Figure 2)	Area Affected (ha)	Total Affected Area
Year 1		
Pit Year 1 and 2 (Blue)	5.6	
Year 1 Overburden (Brown)	2.9	
Year 1 & 2 Vegetation stockpiles (Brown)	10.5	
Office, Workshops, Infrastructure (White)	2.0	
Access Road (Grey)	15.4	
ROM (Black)	0.8	
Settling Ponds (Dark blue)	0.7	
Vegetation Stockpiles and Passing bays (Blue and Brown)	1.7	
Total for Year 1 Infrastructure		39.6
Year 3 (Yellow)		4.6
Year 4 (Green)		9
Years 5 – 8 (Pink)		30.9
Year 7 and 8 Vegetation stockpiles (Brown)		5.17
Total		**89.2**

The currently proposed mine layout is shown in Figure 2.

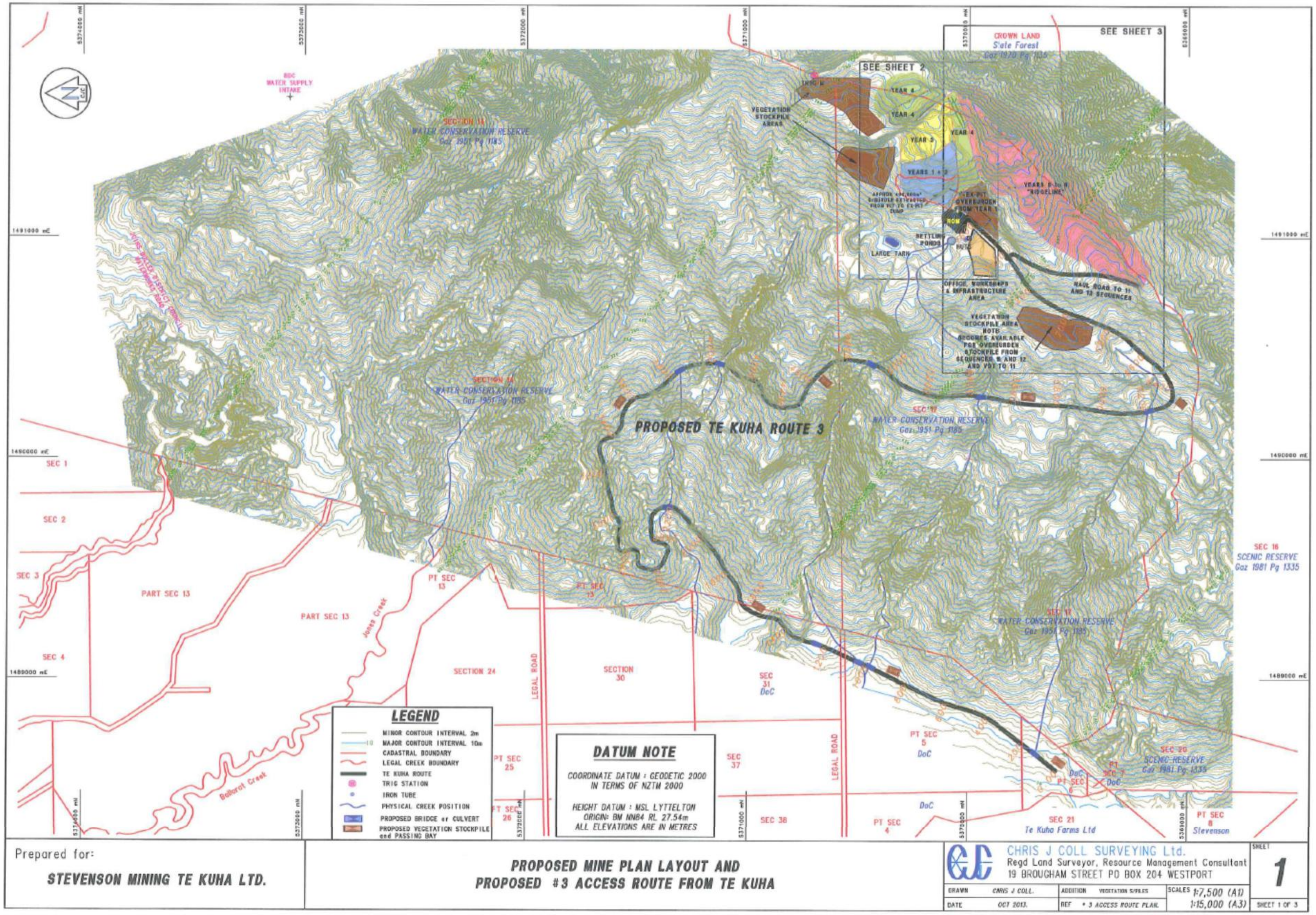

Figure 2: **Layout of the proposed Te Kuha Mine. (Chris Coll Surveyors, October 2013).**

Note that the actual disturbance footprint is likely to be slightly larger than shown once water control infrastructure and buffer zones are applied. Note also that the locations along the access road of passing bays (shown as blue rectangles in Figure 2) and soil stockpiles (shown as brown rectangles in Figure 2) are also subject to change depending on volumes of materials and road rehabilitation treatment.

1.3 Objectives

The purpose of this report is to provide baseline information in relation to the pre-mining vegetation and fauna present at the Te Kuha site and to provide information as to how rehabilitation should be conducted at the site and what the vegetation growing on rehabilitated sites is expected to be like at the completion of mining.

Two earlier assessments of the vegetation and fauna are available (Regnier 1986, Garrick 1986, Mitchell Partnerships & Landcare Research 2001). These earlier reports have been used to inform this report and to provide historical data about the presence and abundance of species in the vicinity of the site. The updated information provided in this report will inform the Environmental Impact Assessment document (**"EIA"**) and the access arrangement applications.

The main objective of this ecological survey was to update and extend the earlier reports with respect to the site in order to include all of the habitats affected by the current proposal, compile a list of species occurring there, document vegetation associations, describe the main habitat types present, identify the presence of any rare or threatened species and develop a plan to rehabilitate the site after the proposed mining is completed. An additional objective was to map the location of established weed populations so that weed management can be implemented as required to protect indigenous communities.

The work described here has been carried out by Dr Gary Bramley of Mitchell Partnerships Limited, who investigated the vegetation matters and compiled this report, Dr Marieke Lettink of Fauna Finders, who investigated the presence of lizards at the site, Mr Rhys Buckingham, assisted by Mr Matt Charteris and Mr Richard Nichol of Wildlife Surveys Ltd, who carried out the bird, bat and *Powelliphanta* snail surveys, Mr Richard Toft of Entecol Limited, assisted by Mr Ian Millar and Mr Richard Nichol who carried out the invertebrate surveys and Dr Robyn Simcock of Landcare Research Limited who assessed the potential for rehabilitation at the site. All of these ecologists have carried out extensive work in the Ngakawau Ecological District over the past five or more years. The results of their surveys are reported together here. This report describes the terrestrial ecological values present at the proposed Te Kuha Mine and addresses the following matters:

- Vegetation – describe and map the vegetation cover and compile a list of species present, including identifying rare or endangered species. This survey was informed by earlier reports discussing the vegetation (Regnier 1986, Mitchell Partnerships & Landcare Research 2001).

- Invertebrates – describe the invertebrate community present based on captures using manual searching, pitfall traps, malaise trapping and ultra-violet light traps. A second aim was to update and supplement the earlier survey described in Mitchell Partnerships & Landcare Research (2001).

- Avifauna – update the earlier bird surveys (Garrick 1986, Mitchell Partnerships & Landcare Research 2001) to include more recent information and cover the areas proposed for mining that were excluded from the earlier surveys. Specifically the objective was to determine the presence and relative abundance of kiwi and other birds.

- Bats – provide additional survey effort for bats in the proposed mine area and surrounds.

- Herpetofauna – confirm the presence of skink and gecko species likely to be present at the mine site.

- Bryophytes – although specialist bryophyte surveys were not undertaken, the earlier survey by Glenny and Fife (2001) is summarised here for completeness. Although no additional surveys were completed, Dr Glenny has reviewed the information provided here.

- Rehabilitation – specifically to identify rehabilitation objectives and the principles that would underpin successful rehabilitation at this site, both during mining and after mining is completed.

- Measures that could be taken to avoid and / or mitigate effects on the ecology of the area caused by the opencast coal mining and construction of a new haul road.

This report consists of ten sections as follows:

Section 1 (this introduction) describes the background and objectives of the survey.

Section 2 describes the ecological setting of the Te Kuha area and the key features of the Ngakawau Ecological District of which it is a part.

Section 3 describes the methods used to survey and map the terrestrial ecological features found there.

Section 4 describes the vegetation and bryophytes present and the fauna values of the site including birds, bats, lizards and invertebrates.

Section 5 describes the significance of the ecological values present at the site.

Section 6 discusses the potential effects of opencast coal mining at the site.

Section 7 discusses rehabilitation of the site after mining is completed and how mine planning will constrain rehabilitation options.

Section 8 discusses ways in which the anticipated potential effects could be mitigated.

Section 9 provides our conclusion with respect to the report findings.

Section 10 is a list of references used in compiling this report.

Appendices 1 - 3 respectively provide lists of the plant species, bird species and invertebrates found at Te Kuha.

2. ECOLOGICAL SETTING

2.1 Ecological Context

The Te Kuha ridgeline forms the southern portion of a coastal escarpment which extends from the Buller River north to the Ngakawau River on the West Coast of the South Island. From Te Kuha, on the true right of the Buller River, the escarpment rises to 805 m asl south of Trig M (also known as Trig A5Q7) in the vicinity of the Te Kuha coal deposit. The ridge then rises to 1,040 m asl at Mt Rochfort, before descending to the Denniston Plateau (mostly 600 – 800 m asl) and the Waimangaroa River gorge. From the Waimangaroa River the ridge rises again to 1,184 at Mt Frederick, west of the Stockton Plateau. Both the Denniston and Stockton plateaux are located to the east of this escarpment, north of Te Kuha.

The Te Kuha coal deposit is located south of the Denniston Plateau approximately 12 km south east of the township of Westport. The proposed Te Kuha development is located near Trig M and the headwaters of West Creek and Coal Creek on the western slopes of the southern part of this coastal escarpment, as shown in Figure 3. Both creeks flow west before merging and then entering the Buller River upstream of Westport.

The Te Kuha survey area is located at the southern end of the Ngakawau Ecological District, within the North Westland Ecological Region (McEwen 1987). The access road and proposed coal handling facility are located within the adjacent Foulwind district. The two districts were separated on the following basis by McEwen (1987):

- Topography – Foulwind District is low lying and rolling or flat whereas Ngakawau District consists of hills and low mountains with deep gorges.
- Geology – Foulwind District comprises terraces of marine gravel and sand whilst Ngakawau District comprises Eocene quartz sandstone, grit and conglomerate with coal seams.
- Vegetation – Foulwind District was originally podocarp-hardwood forest, whilst the Ngakawau District includes the distinctive coal measures vegetation.

Much of the Foulwind District has been cleared for mining, farming or human habitation, whilst much of the Ngakawau District remains in indigenous vegetation with mining the most significant human influence. Little Cascade Creek, west of the escarpment ridgeline, is located within the adjoining Buller Ecological District.

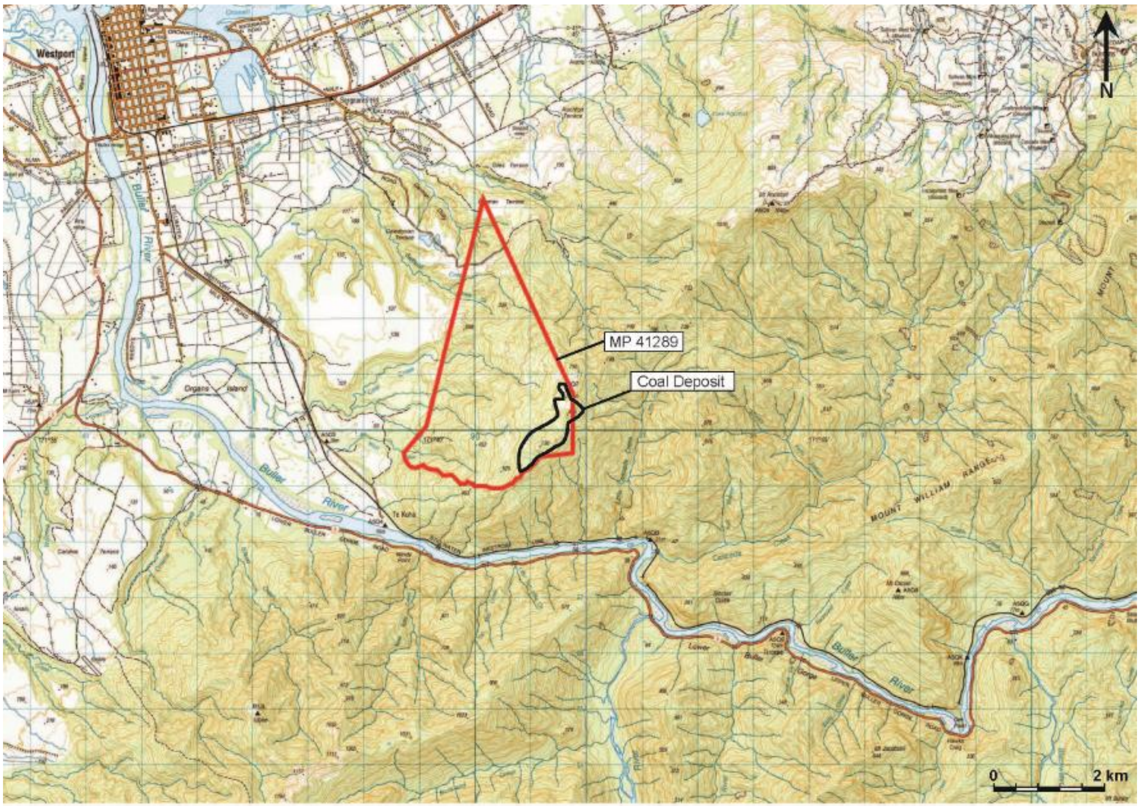

Figure 3: **Location of the Te Kuha coal deposit.**

2.2 Ngakawau Ecological District

The boundaries of the Ngakawau Ecological District are defined by a line connecting Te Kuha to Mount Rochfort, Mount William and a peak west of Mt Lyell in the south, the Glasgow Range in the east and the Mokihinui River in the North. The coastal escarpment marks the boundary of the district to the west, with the coastal plain forming part of the adjacent Foulwind Ecological District. The Ngakawau Ecological District covers approximately 48,750 ha.

The Ngakawau Ecological District is characterised by elevated coal plateaux in the southwest and west trending coastal hills and low mountains up to 1,400 m asl in the north and southeast (McEwen 1987, F. Overmars pers. comm. 2011). The district includes large areas of Eocene (40 – 50 million years old) quartz sandstone, grit and conglomerate with Brunner coal seams forming dissected plateaux with highly distinctive vegetation. At Te Kuha there are also areas of granite and breccia conglomerate composed of varying proportions of granitoid rocks from the Greenland Group and Rahu Suite (McEwen 1987, Nathan *et al.* 2002). The district experiences mild temperatures and high rainfall (2,800 – 6,000 mm per annum) and most of the district remains in indigenous vegetation (McEwen 1987).

The Ngakawau Ecological District is the only ecological district in New Zealand defined by the presence of extensive elevated coal measure geology with its associated landforms, vegetation and flora. The district includes endemic species such as *Chionochloa juncea* (coal measures tussock) and *Celmisia morganii* (McEwen 1987, Overmars *et al.* 1998). The mountain daisy *Celmisia morganii* is "virtually confined" to the Ngakawau Gorge (McEwen 1987). The streamside tree daisy (*Olearia cheesemanii*) is also present in the district, along with *Sticherus tener*, *S. urceolatus* and *Metrosideros parkinsonii*. Both species of *Sticherus* (umbrella fern) and *M. parkinsonii* (Parkinson's rata) have disjunct (discontinuous) distributions which include the Ngakawau Ecological District. The umbrella ferns have the highest possible threat ranking ("nationally critical"), pending confirmation of their distribution and the number of individuals found within New Zealand, but Parkinson's rata is not considered threatened[2] (de Lange *et al.* 2009, Brownsey *et al.* 2013).

Approximately 17 species of lizards have been reported from the West Coast region of the South Island (Whitaker & Lyall 2004; Hitchmough *et al.* 2012), although the exact number of species present is currently unknown because some of the species listed by Whitaker & Lyall (2004) are no longer considered valid and others require further taxonomic revision and formal description (Greaves *et al.* 2008). Currently at least six species are known to occur in the North Westland Ecological Region including West Coast green gecko (*Naultinus tuberculatus*), forest gecko (*Mokopirirakau granulatus*), common gecko (*Woodworthia maculata*), Southern Alps gecko (*Woodworthia* 'Southern Alps'), speckled skink (*Oligosoma infrapunctatum*) and brown skink (*O. zelandicum*) (Department of Conservation Herpetofauna Database, Hitchmough *et al.* 2013). Of those species West Coast green gecko are considered to be "Threatened" ("nationally vulnerable") and forest gecko, speckled skink and brown skink are considered to be "At Risk" ("declining"). Common gecko and Southern Alps gecko are regarded as "Not Threatened" (Hitchmough *et al.* 2012).

Pakihi shrubland of the type found at Te Kuha provides habitat for South Island fernbird (*Bowdleria punctata punctata*), which are also locally common throughout parts of the Stockton Plateau, German and Caledonian terraces and the Tiger and Blackburn pakihi (R. Buckingham pers. obs.). Tall forest vegetation on fertile sites within the ecological district provides habitat for other threatened bird species such as kaka (*Nestor meridionalis meridionalis*), great spotted kiwi (*Apteryx haastii*) and New Zealand falcon (*Falco novaeseelandiae*). Kea (*Nestor notabilis*) are also known from the district (McEwen 1987).

The threatened land snails *Powelliphanta patrickensis*, *P. augusta* and sub-species *of P. lignaria* are also endemic to the Ngakawau district, while *P.* "Buller River" occurs within the Buller Ecological District, south of the Buller River near Ten Mile Creek (Walker 2003).

2.3 Coal Measures Vegetation

2.3.1 Extent of Coal Measures Vegetation

The Ngakawau Ecological District includes the distinctive coal-measures vegetation and exposed sandstone pavement which characterise the Stockton and Denniston Plateaux as well as large areas of pakihi, shrubland and forest and much smaller areas of tussockland, herbfield, boulderfield and wetland. The term "coal measures" refers to

---

2 The current New Zealand species threat classification system for flora and fauna has two broad categories (Townsend *et al*. 2008). "Threatened" taxa are those that are facing imminent extinction; "At Risk" taxa are those that have small populations or have small areas of occupancy. Although they may be "declining", "At Risk" taxa are not facing imminent extinction. Threatened species categories include "nationally critical", "nationally endangered" and "nationally vulnerable". At risk categories include "declining", "recovering", "relict" and "naturally uncommon". For plants, classification includes a provisional conservation status for taxonomically indeterminate species (de Lange *et al*. 2009). Taxa may also be described as "Data deficient" if there is insufficient knowledge to assign them to one of the other categories.

geological sediments laid down in a depositional environment in which coal can form (Overmars *et al.* 1998). Coal measures may, or may not, contain coal.

There are three coal measure formations on the West Coast: Paparoa Coal Measures (present in the Greymouth coalfield), Brunner Coal Measures (at Stockton and Denniston) and Rotokohu Coal Measures (near Reefton). Coal measures parent material develops naturally acidic and infertile soils.

The approximate extent of Brunner Coal Measures near Te Kuha is shown in Figure 4. The Brunner coal measures shown in Figure 3 were retrieved as a GIS map layer from the QMAP series of geological maps produced by GNS Science available at http://www.gnx.cri.nz/static/datadict/

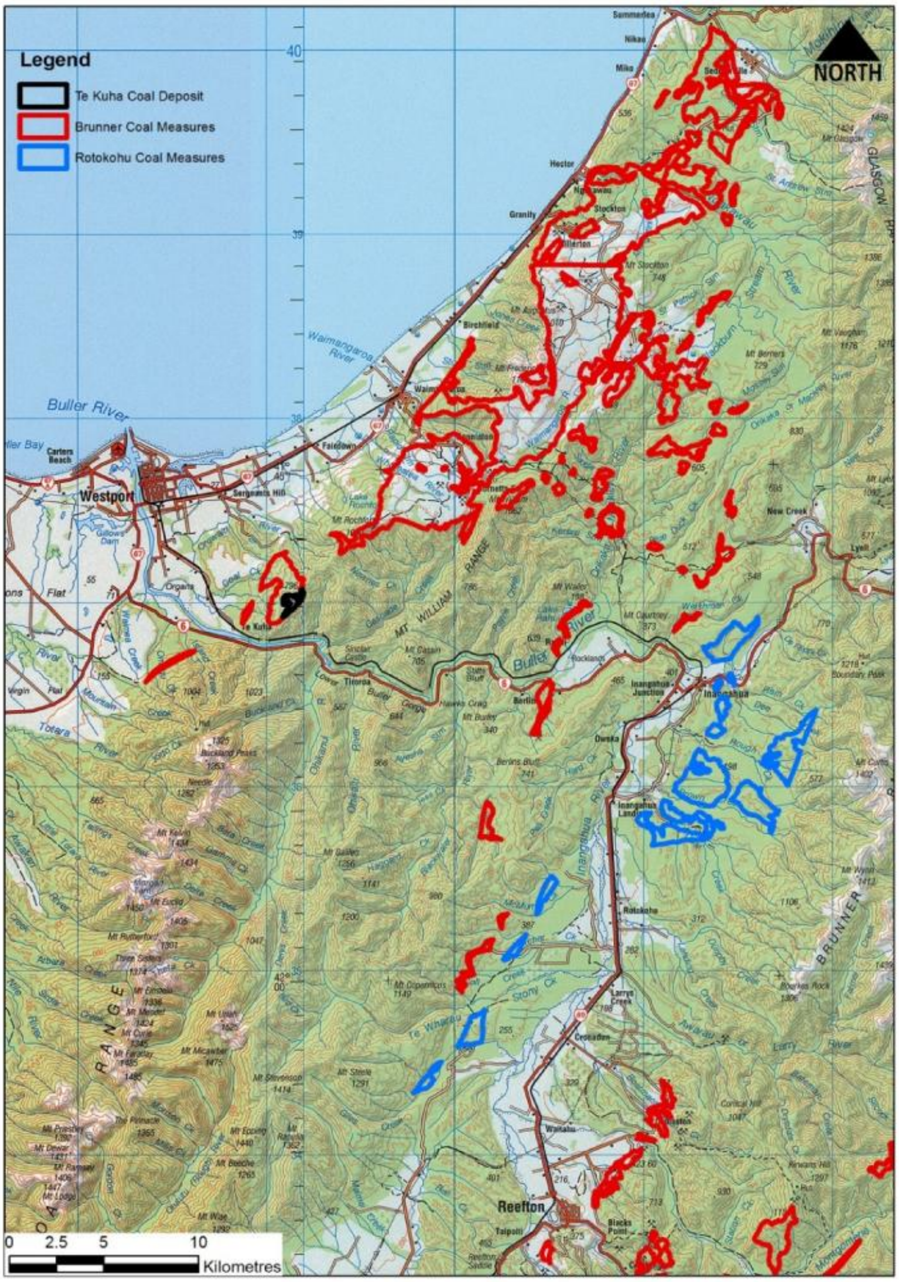

Figure 4: Location of Coal Measures Geology near Westport.

Brunner Coal Measures occupies an area of 26,585 ha on the northern West Coast of the South Island between Golden Bay and Ross and extending as far east as the Gordon Range (north of St Arnaud). The largest concentration of Brunner Coal Measures occurs on the Stockton and Denniston Plateaux, where the acidic geology combines with poor drainage in a cool, wet, and windy environment to create distinctive vegetation communities and exposed gently sloping rock pavements. Brunner Coal Measures cover around 10,311 ha at Stockton and Denniston where the most extensive vegetation communities on the exposed gently sloping rock pavements are dominated by prostrate shrub and tussock communities. Forests and shrublands comprising species adapted to infertile environments develop in more sheltered locations, or those with deeper soils, such as hill slopes and deeply incised gorges. Coal measures at Te Kuha comprise 490 ha in two discrete patches. The larger patch (471 ha) includes around 77.4 ha which would be affected by the current proposal. The coal measures vegetation present at Te Kuha includes low growing shrublands and forest.

2.3.2 Coal Measures Flora

The vascular flora of the coal measures includes locally endemic species such as coal measures tussock (*Chionochloa juncea*) and the alpine daisy *Celmisia dubia*, as well as threatened and at-risk species and species with localised distributions within New Zealand.

Two species of Australian umbrella fern (*Sticherus urceolatus* and *S. tener*) have unusual occurrences on the Denniston and Stockton coal plateaux associated with Brunner Coal Measures vegetation. Both are regarded as "Threatened" ("nationally critical") (Brownsey *et al.* 2013).

Seven "At Risk" plant species have been recorded from the coal plateaux including *Chionochloa juncea* ("declining"), *Dracophyllum densum* ("declining"), *Carex carsei* ("declining"), *Mitrasacme montana* var. *helmsii* ("naturally uncommon"), *Carex dallii* ("naturally uncommon"), eyebright (*Euphrasia wettsteiniana*, "naturally uncommon") and red mistletoe (*Peraxilla tetrapetala*, "declining") (de Lange *et al.* 2009; Overmars *et al.* 1998; Lloyd 2005; Venter 2009; G. Bramley pers. obs.). Eyebright is expected to be listed as "Threatened" when the lists are revised (most likely "nationally vulnerable", F. Overmars pers. comm. 2012).

Eight plant species found on the coal plateaux have localised distributions within New Zealand including *Actinotus novae-zelandiae*, *Astelia subulata*, *Blechnum fraseri*, *Celmisia dallii*, *Celmisia dubia*, *Celmisia similis*, *Metrosideros parkinsonii* and *Pseudowintera traversii* (Williams & Courtney 1998; Overmars *et al.* 1998). The small shrub *Dracophyllum pubsecens* is also endemic to the northern West Coast of the South Island with a patchy distribution including high altitude sites on the coal plateaux.

2.3.3 Vegetation at Te Kuha

At Te Kuha the distinctive coal-measures vegetation includes low growing forests dominated by yellow-silver pine (*Lepidothamnus intermedius*), pink pine (*Halocarpus biformis*), mountain beech (*Nothofagus solandri* var. *cliffortioides*), mountain toatoa (*Phyllocladus alpinus*), *Dracophyllum* spp., mountain cedar (*Libocedrus bidwillii*) and small rimu (*Dacrydium cupressinum*) trees as well as communities dominated by stunted manuka (*Leptospermum scoparium* agg.), wire rush (*Empodisma minus*) and tanglefern (*Gleichenia dicarpa* and *G. microphylla*). Large blocks of fractured sandstone are present, particularly near the ridge top, and the forest vegetation forms a mat over this broken substrate. The coal measures vegetation associations present at Te Kuha are described more fully in Section 4.1.

2.4 Protected Areas of the Ngakawau Ecological District

2.4.1 Formally Protected Areas

In 1987/88 the ecological district was surveyed as part of the Protected Natural Areas Programme ("**PNAP**") to identify recommended areas for protection ("**RAPs**") in order to protect the full range of natural heritage within the ecological district (Overmars *et al.* 1998). The PNAP survey was initiated in response to a recommendation from a former governmental advisory committee (the Protected Areas Scientific Advisory Committee) during its review of recommended ecological areas because of proposals for coal mining in the area and a lack of knowledge regarding the coal plateaux (Overmars *et al.* 1998). The recommendation was to "determine the biological values of the North Buller Coal Plateau with a view to protecting the scientific values in areas where there is no recoverable coal" (Overmars *et al.* 1998). Thus the PNAP survey brief specifically excluded protecting areas known to have coal resources. One of the PNAP survey transects (Transect 8) was located near the Te Kuha area, although that transect was located further north and west than the coal deposit, extending across the upper reaches of the Orowaiti River (Overmars *et al.* 1998).

In 1998 81.7% (or 39,300 ha) of the district was administered by the Department of Conservation and protection of a further 11.2% was recommended in order to achieve a representative reserve network (Overmars *et al.* 1998).

The Ngakawau Ecological District includes the large Ngakawau Ecological Area (13, 871 ha) in the north and part of the contiguous Orikaka Ecological Area (21,189 ha) in the southeast, as well as many smaller protected areas such as Westport Water Conservation Reserve (1,825 ha), Radcliffe Ecological Area (1,523 ha), Plover Stream Conservation Area (1,211 ha), Denniston Scenic Reserve (701 ha), Stockton Conservation Area (346 ha), Ngakawau Scenic Reserve (81 ha), Conns Creek Water Conservation Reserve (34 ha), Stockton Scenic Reserve (7.3 ha), and other small reserves with a variety of designations (Overmars *et al.* 1998, Department of Conservation 2010).

Much of the Ngakawau Ecological District is protected as part of the Ngakawau, Orikaka or Radcliffe Ecological Areas. The Orikaka Ecological Area also extends over parts of the neighbouring Buller and Reefton Ecological Districts. Ecological Areas are primarily established for their scientific, particularly ecological, values to meet one or more of the following objectives (Norton & Roper-Lindsay 1997, Norton & Overmars 2012):

(a) To protect representative portions of natural ecosystems;

(b) To protect rare or unique features including native plants and animals;

(c) As areas available for study aimed at understanding and explaining natural processes;

(d) As benchmarks for assessing changes associated with various forms of development within the region; and

(e) As genetic pools for native plants and animals.

A small part of the Ngakawau Ecological Area was gazetted in 2002 “to protect the range of forest types and wildlife habitat within the Ngakawau catchment including the southern range of land snails *Powelliphanta lignaria johnstoni* and *Powelliphanta lignaria rotella*” (NZ Gazette 2002). This small reserve was substantially added to in 2003 to “protect a large, compact altitudinal sequence of coastal, plateau and mountain land forms and little modified associations from near sea level to the tops of the Glasgow Range, a key site for two species of large native land snails *Powelliphanta lignaria johnstonii* and *P.l. rotella,* the stronghold of a locally endemic daisy *Celmisia morganii* and good populations of forest birds” (NZ Gazette 2003).

The majority of the Orikaka Ecological Area was gazetted in 1998 to “protect landforms, geological and soil features and extensive unmodified forest in an altitudinal sequence from the Buller River to the Glasgow Range” (NZ Gazette 1998). Only the northern part of the Orikaka Ecological Area is within the Ngakawau Ecological District, the remainder is within the Buller and Reefton Ecological Districts. Orikaka Ecological Area features cedar-podocarp-beech forest in the upper basin, pakihi shrubland and dwarf/low forest ecosystems on coal measures, alluvial and swampland forests around Lake Rahui, and extensive mixed beech forests on dissected hill country” (NZ Gazette 1998). In 2001 approximately 6, 500 ha was added to the Orikaka Ecological Area to “protect areas of low-altitude forests poorly represented in the Buller and Reefton Ecological Districts and important roroa/great spotted kiwi and other forest bird habitat” (NZ Gazette 2001).

The Department of Conservation administers approximately 6,175 ha of coal measures vegetation on the Stockton and Denniston Plateaux under a variety of designations. At Te Kuha most of the coal measures vegetation occurs within the Westport Water Conservation Reserve. The only coal measures vegetation with any certainty of protection from mining in perpetuity occurs in the 209 ha Millerton and Plateaux Protection Society Reserve (**“the MAPPS Reserve”**) and a parcel of Department of Conservation, Land Information New Zealand and Solid Energy land that together make up a Recommended Area for Protection agreed during the Cypress Mine hearing process and protected by the Cypress Mine Environment Court decision (commonly referred to as **“the Solid Energy Deed Area”** or **“the Deed Area”**). The Deed Area was modified from the original Upper Waimangaroa Valley RAP proposed by Overmars *et al.* (1998). The Deed Area includes approximately 1,286 ha of land, some of which overlies economic coal reserves, as well as public conservation land. The boundaries of the Deed Area are yet to be legally surveyed, but together these reserves cover approximately 1,495 ha or around 14.5% of the original extent of the 10,300 ha of coal measures vegetation on the plateaux.

2.4.2 Recommended Areas for Protection

The 1998 PNAP report proposed RAPs covering an additional 11.2% of the Ngakawau Ecological District (Overmars *et al.* 1998). These RAPs comprised three large areas (Upper Waimangaroa Valley (2,110 ha), Mt Rochfort (1,335 ha) and Mt Frederick – Mt Augustus 1,050 ha) and four smaller sites. The PNAP process is a two-step one involving identification (survey) followed by formal protection (implementation). The implementation phase will usually involve discussion and consultation with landholders and other parties involved in the use and protection of the land. These discussions are aimed at securing protection of the natural values of the RAPs. Hence changes to RAP boundaries may occur after the consultation process, or after consideration of other values that the RAPs and surrounding areas may possess (Overmars *et al.* 1998). This occurred with the original Upper Waimangaroa RAP which was replaced by the Deed Area as described above.

The PNAP process in the Ngakawau district was concurrent with the process which followed the Blakeley Accord for the allocation of unallocated Crown land. That process took a number of years, so that by the time the PNAP report was published, much of the land within the RAPs had already been allocated to the Department of Conservation. Of the three large areas which totalled 4,483 ha, the following outcomes have been achieved to date:

- The upper Waimangaroa – Mt William RAP was amended from 2,110 ha to 1,286 ha by the agreement between the Department of Conservation and Solid Energy in 2005 as described above.

- The entire Mt Rochfort RAP (1,322.7 ha) was allocated as stewardship land and has been retained by the Department of Conservation.

- At the Mt Frederick – Mt Augustus RAP (1,050 ha), 50 ha is owned by Solid Energy, 80 ha was retained by Land Information New Zealand, but appears to administered by the Department of Conservation as stewardship land and the remainder (920 ha) is administered as stewardship land by the Department of Conservation.

Thus 3,609 ha of the 4,483 ha recommended for protection (81%) is now public conservation land.

Of the four smaller RAPs, three involved minor boundary adjustments or affected only small areas (<100 ha). The seventh ("RAP 7: Part Westport Water Conservation Reserve) was larger, covering approximately 764 ha, and included the Te Kuha site under discussion here as shown in Figure 5.

RAP 7 forms "... a considerable portion of the (Westport) water conservation reserve (which) is entirely beyond the actual water catchment boundaries. Since the area is a mosaic of coal measures vegetations, if this non catchment portion is at any time released from water reserve, it should without doubt be added to the adjoining (Lower Buller Gorge) scenic reserve" (Overmars *et al.* 1998).

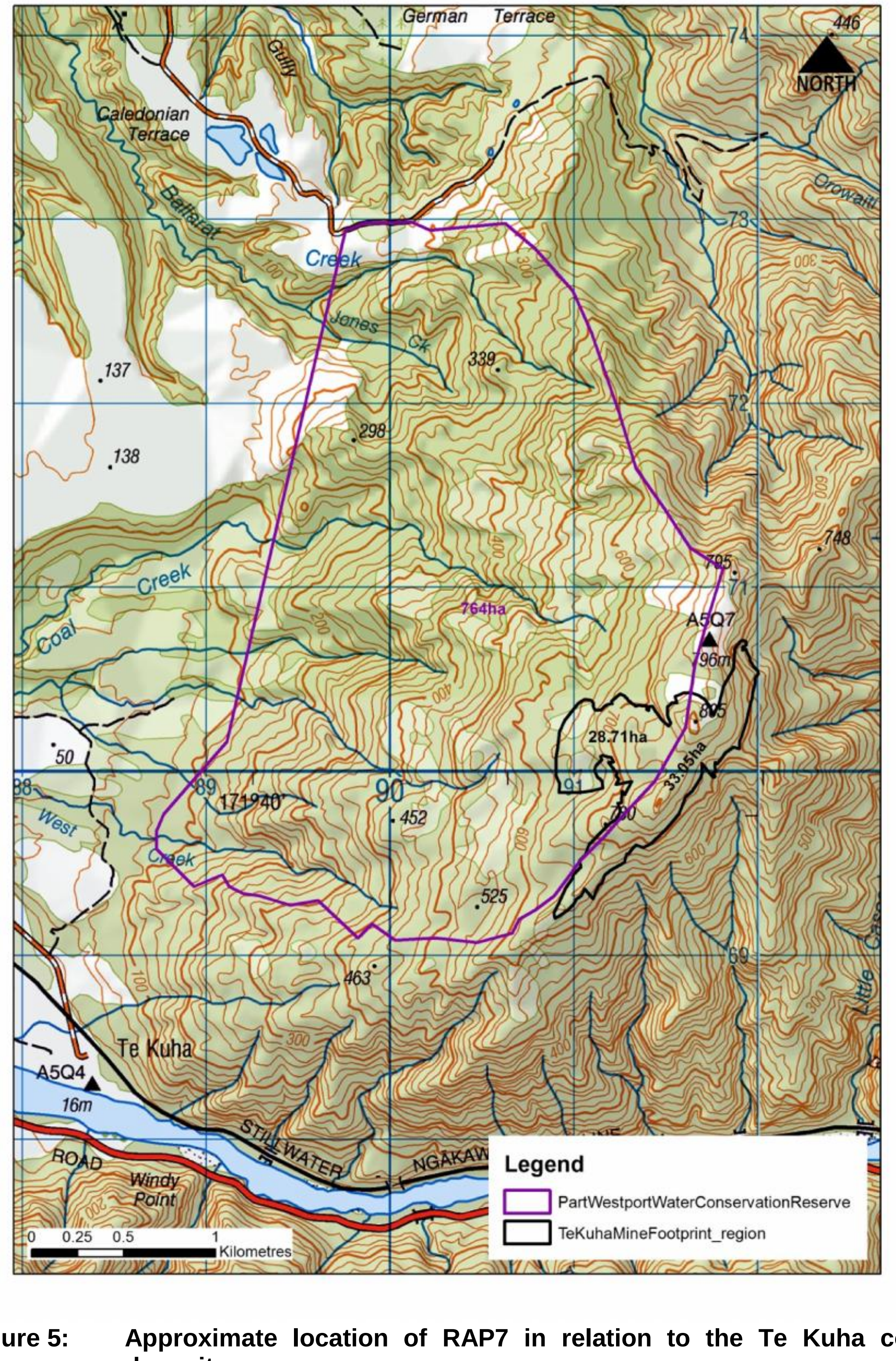

Figure 5: **Approximate location of RAP7 in relation to the Te Kuha coal deposit.**

Mt Rochfort was proposed as the principal representative reserve for coal measures vegetation because it spans a greater altitudinal range than other locations (including RAP 7), but Overmars *et al.* (ibid) considered that RAP 7 was "of particular significance because of the absence of recent fire and the degree of intactness" as well as its location at the southern-most extreme of the coal plateaux. The authors of the PNAP report attributed the relatively natural condition of the site to its isolation, long tenure as a reserve and buffering provided by adjoining natural habitats (Overmars *et al.* 1998). Overmars *et al.* (1998) listed eight ecological units that would be protected by protection of RAP 7 as follows:

- Rimu/Broadleaved forest on coastal hillslopes.
- Mixed beech-southern rata forest (red or silver beech dominant) on coastal hillslopes.
- Hard beech – southern rata – rimu forest on hillslopes.
- Southern rata – mountain beech forest on Brunner Coal Measures.
- Mountain beech/yellow silver pine – pink pine forest on Brunner Coal Measures.
- Mountain beech/yellow silver pine – pink pine forest on Stockton and Denniston Coal Measures Plateau and Kaiata siltstone.
- Mountain beech – silver beech forest and shrubland on Stockton and Denniston Coal Measures Plateau and Kaiata siltstone.
- [Manuka]/wire rush – tangle fern shrub – rushland on Stockton and Denniston Coal Measures Plateau and Kaiata siltstone.

The first seven units were considered to be inadequately protected elsewhere, but the eighth was regarded as sufficiently protected in existing RAPs and reserves.

2.5 Land Environments

Land Environments of New Zealand ("**LENZ**") mapping uses 15 drivers of biological patterns to classify New Zealand into discrete environments so as to provide a spatial context for defining ecological units at a national level (Leathwick *et al.* 2003). According to LENZ the Te Kuha site comprises predominantly land environments P3.1b and P3.2b, with small areas of O2.3b on the eastern side of the ridge (Figure 6). Environments P3.1b and 3.2b are characterised by cool temperatures, moderate to high solar radiation, very low vapour pressure deficits, high monthly water balance ratios and no annual water deficits. The soils are well drained with very low natural fertility (Leathwick *et al.* 2002). Environment O2.3b is very steep mountainous terrain with similar climatic conditions and imperfectly drained soils of moderate fertility.

Once ecological units have been identified using LENZ, the current level of protection for those units can be defined using the Threatened Environment Classification ("**TEC**") (Walker *et al.* 2007). All three of the environments found at Te Kuha are regarded by the TEC as "less reduced and better protected" with 99.9% of Environment P3.1b, 87.59% of Environment P3.2b and 99.63% of Environment O2.3b remaining in indigenous vegetation and 98.52%, 68.24% and 98.11% respectively being formally protected (Landcare Research 2010).

LENZ mapping does have limitations due to accuracy and resolution of the data from which it is derived. In particular the resolution is seldom sufficiently fine scale to detect originally rare ecosystems (Williams *et al.* 2007). Rare ecosystems can be defined as those having a total extent less than 0.5% (i.e. < 134,000 ha) of New Zealand's total area (268,680 km^2) prior to human colonisation and includes ecosystems that are small in size and geographically widespread as well as those that are larger but geographically restricted in distribution (Williams *et al.* 2007).

The coal measures ecosystem was not identified as a "historically rare" by Williams *et al.* (2007) but it does fit Williams *et al.*'s definition. The scale of LENZ mapping is insufficient to separately define coal measures vegetation. The extent of Brunner Coal Measures is discussed in Section 2.3.

Historically rare ecosystems found within the Stockton and Denniston Plateaux and possibly present at Te Kuha include:

- Boulderfields of acidic rocks;
- Seepages; and
- Flushes and tarns.

A fourth historically rare ecosystem (sandstone erosion pavement) also occurs at Stockton and Denniston.

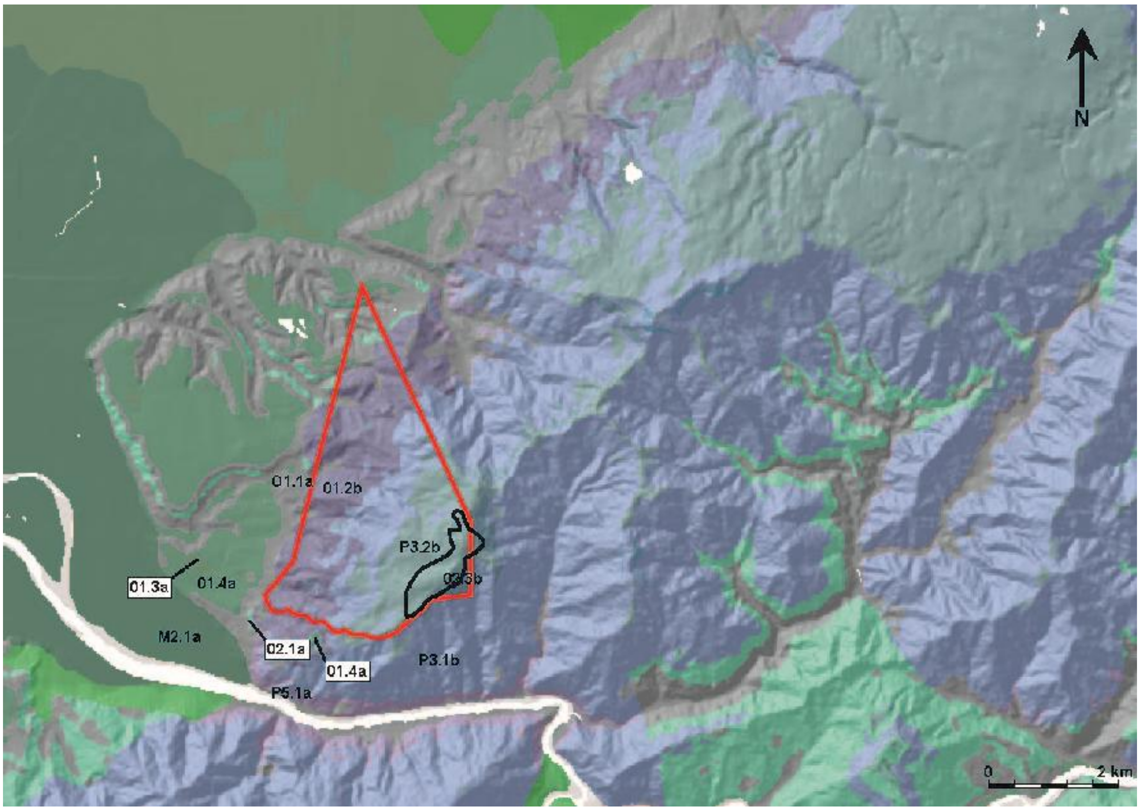

Figure 6: LENZ map of the Te Kuha area with Mining permit 41-289 outlined in red and the coal deposit outlined in black.

3. METHODS

3.1 Vegetation

The vegetation of the Te Kuha area was surveyed 11 – 15 March 2013. On the first day helicopter access to the hut site enabled a fly over of the wider area, followed by walkover surveys of the northern part of the proposed mine, nearest Trig M. Tracks created by the drilling exploration allowed access over subsequent days to the middle portion and southern parts of the proposed mine. On the final day the flagged "direct route" from the hut to Nine Mile Road was traversed.

Vegetation was mapped using aerial photographs and by recording vegetation associations and locations as the surveyor moved throughout the area or from views of the vegetation from local vantage points.

Helicopter transport to the site on the first day provided an opportunity to survey the vegetation patterns from the air. A series of oblique aerial photographs were taken as a record of the broad vegetation types that occur across the ridges and valleys. This method of assessment was particularly useful in assessing the vegetation in areas where access from the ground was difficult. In addition, one observer (Richard Nichol) made brief notes about dominant vegetation at each five minute bird count site where he undertook counts and these descriptions were used to confirm the vegetation type mapped at those locations.

3.2 Bryophytes

A bryophyte expert was unavailable to carry out surveys at Te Kuha within the time constraints imposed for this project, but the Te Kuha area was surveyed by Dr David Glenny and Dr Allan Fife in one day of field work in 2001 as part of an earlier proposal (Mitchell Partnerships and Landcare Research Limited 2001). Drs Glenny and Fife surveyed eight representative plots within the vascular vegetation types present in the area as shown in Figure 7 and their results are summarised here. Two of the plots (Plots 3 and 5) were located within the area defined here as the coal deposit[3]. Plots were 5 x 5 m in size, except the single stream plot (Plot 7) which was 10 m long and included all the stream bed and banks. Bryophyte species of significance, that is those which are rare (known from four sites or less), endemic to New Zealand, taxonomically isolated, outside their known distributional range or a combination of these attributes were highlighted in the earlier report.

3 There is disagreement between the location of grid references provided by Glenny and Fife and the location of the plot sites mapped (Figure 3 in Kingett Mitchell & Landcare Research 2001). Grid references have been used here.

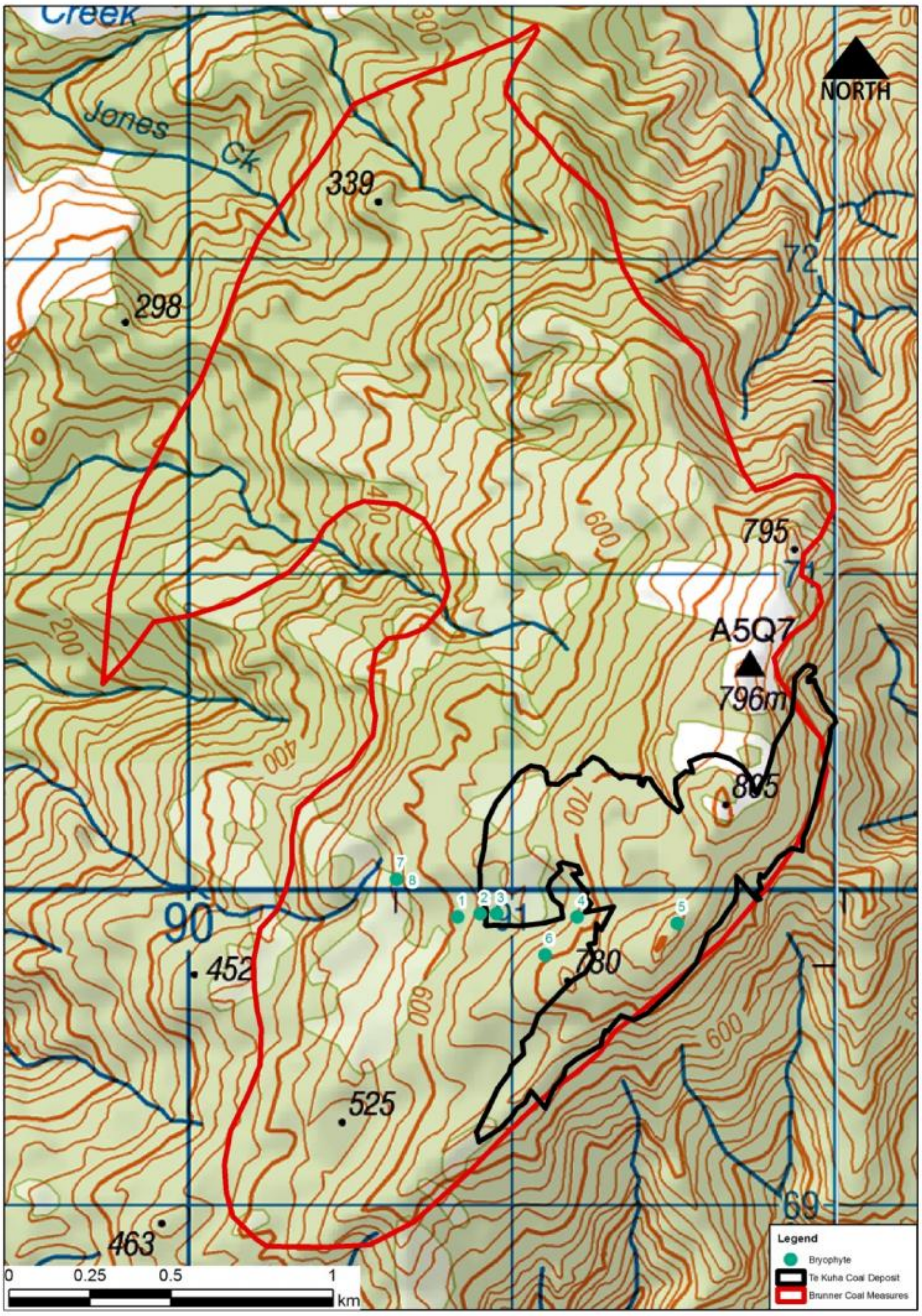

Figure 7: Location of Bryophyte plots at Te Kuha, March 2001.

3.3 Avifauna

3.3.1 Diurnal Birds

The mining permit and surrounds was divided into 53 500 m x 500 m grid cells as shown in Figure 8 and each cell was systematically surveyed for birds between 11 and 15 March 2013 (after O'Donnell & Dilks 1988). In addition to the grid cell counts, five standard five-minute counts were carried out in different habitats on transects 200 m apart (after Dawson & Bull 1975). The location of transects is shown in purple on Figure 8. All tracks and waypoints were recorded using GPS. Sign of rare birds, such as feathers, kiwi probes or footprints, were also searched for during the day and recorded.

3.3.2 Nocturnal Birds

Standard surveys for kiwi (McLennan 1992; Robertson & Colbourne 2003) were carried out during fine settled weather between 11 and 15 March 2013. These surveys involved listening for kiwi and other birds which call during the evening (such as western weka, kaka and long-tailed cuckoo) at strategic sites offering a wide listening coverage. The listening period began at least 45 minutes after sunset and was completed in exactly two hours. Data were recorded separately for each hour. Counts were replicated at least once at key sites such as high points which offered a wide coverage within the area. All species of birds heard during these surveys were noted, and specific details for any kiwi heard (time called, call direction, estimated distance of call, gender) were recorded on standard forms.

3.3.3 Automatic Acoustic Recorders

Six programmable automatic digital acoustic recorders including Songmeter SM2™ and Department of Conservation designed acoustic recorders were established at appropriate sites offering a wide surveillance area within the mining permit. Two of the six recorders malfunctioned and data was only collected from four recorders as shown in Figure 8. Recorders were programmed to record between dusk and dawn with the purpose of recording both nocturnal birds, such as morepork and kiwi, and diurnal birds that tend to be most vocal at dawn and dusk. Data was reviewed using Song Scope™ software.

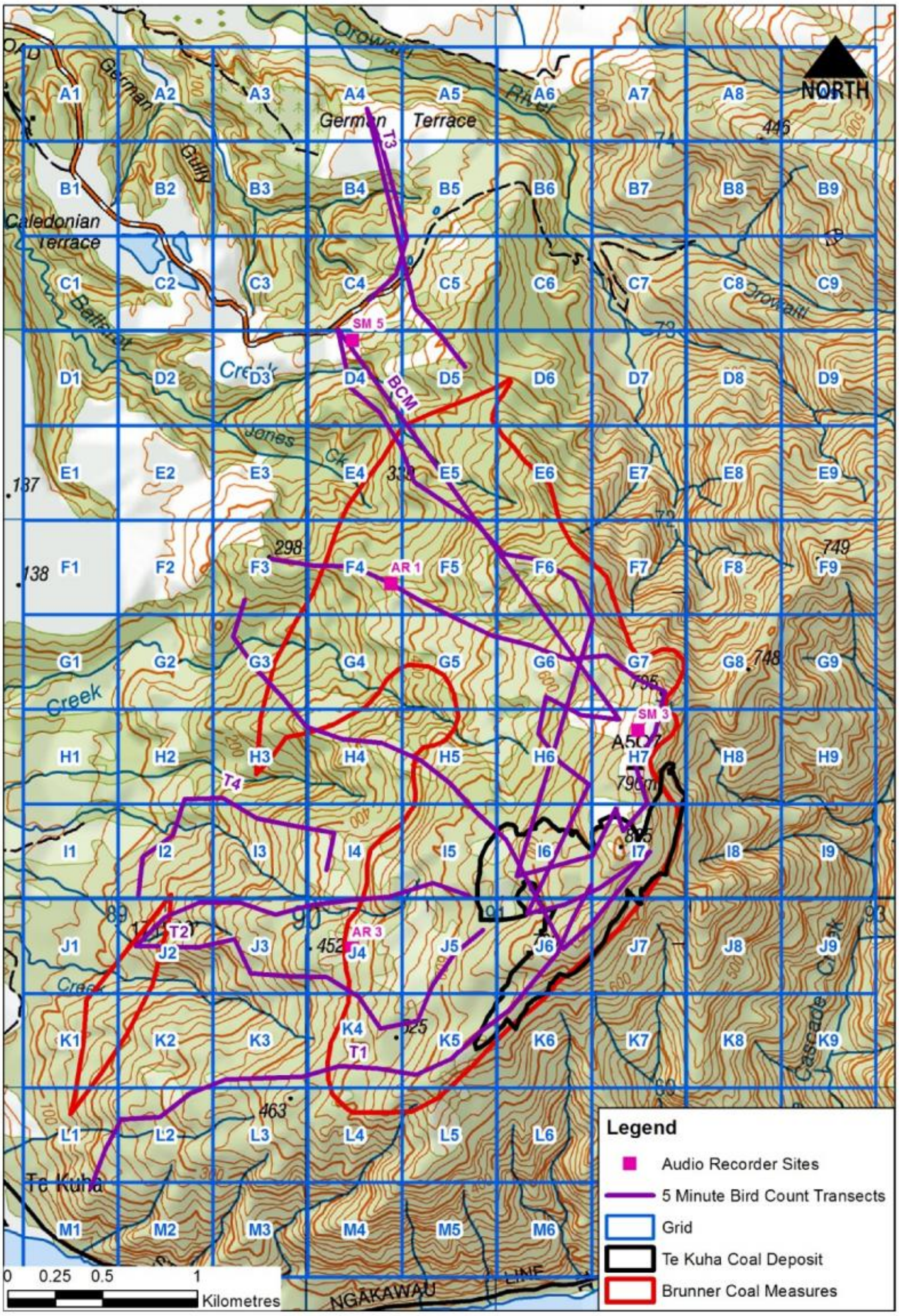

Figure 8: **Grid cells, bird count transects and acoustic recorder sites for surveying birds at Te Kuha.**

3.4 Herpetofauna

The lizard survey was carried out between 11 and 14 March 2013. Lizards were located using a combination of day-time visual searching with the naked eye and/or binoculars, night-time visual searching (‘spotlighting’) using a custom-made binocular-mounted spotlight to detect geckos (Whitaker 1967) and hand-searching of potential retreat sites to check for the presence of inactive lizards or their sign (e.g. sloughed skin and faeces). Searches targeted a range of potential lizard habitats within the proposed mine site including native forest, shrublands and rocky areas (rock outcrops, boulders, and rockland and surrounding vegetation). Hand-searching entailed inspection of rock crevices and tree cavities (by torchlight), peeling bark off trees and careful lifting of rock slabs. All disturbed items were carefully returned to their original positions. Search duration was timed to provide a measure of search effort. Most of the searching was carried out from or near tracks heading north-east and south-west from the hut. These tracks provided access throughout the proposed mine footprint. All captured lizards were measured from snout to vent, sexed, weighed, photographed and released at their capture site. Capture locations were recorded using a hand held Garmin E-Trex GPS. Air temperatures under shade were measured at regular intervals with a Kestrel hand-held weather meter to provide a record of weather conditions experienced during the survey.

3.5 Bats

A survey for bats was undertaken using digital heterodyne ultrasound detectors developed by Stuart Cockburn (Department of Conservation) at the ten locations shown in Figure 9. The recording sites included four within the mining permit (one of which was located within the extent of the coal deposit) and six sites with suitable habitat nearby. These recorders were designed to monitor and record echolocation calls within the optimum ultrasound frequencies (28 and 40 kHz) for detecting both New Zealand bat species simultaneously. Detectors were employed at sites where bats were considered most likely to forage or roost, such as the edge of mature forest, or near streams or ponds for long-tailed bats and within forest for short-tailed bats. The recorders were left in place for varying amounts of time between 10 March and 28 March 2013 in order to continuously monitor overnight bat echolocation calls. Recordings from the recorders were reviewed using the custom made software BatSearch™ to identify bat echolocation calls (Lloyd & Cockburn 2009).

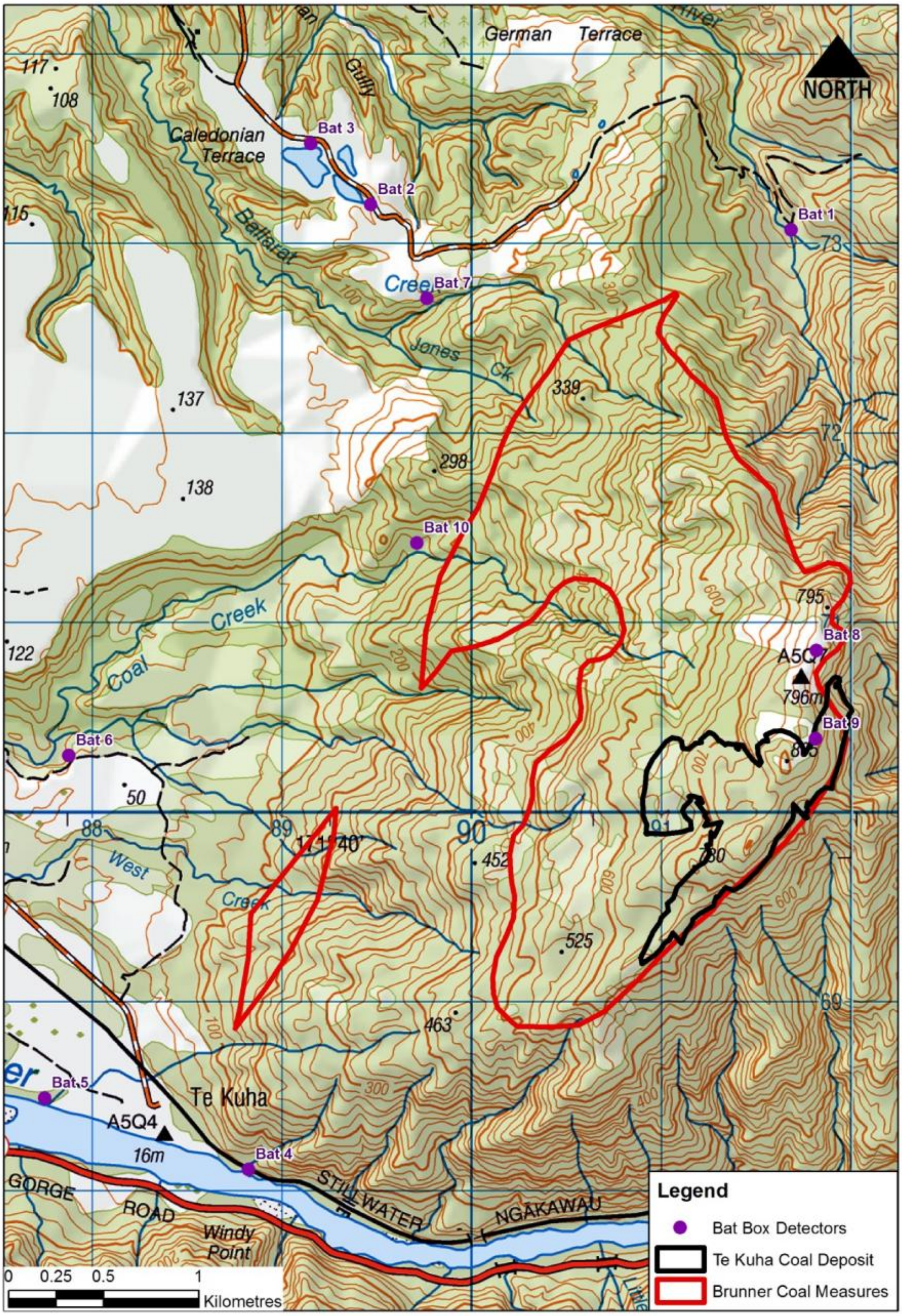

Figure 9: **Location of Bat Box detectors.**

3.6 Invertebrates

A standard baseline survey for *Powelliphanta* snails was undertaken during the day. The method involved searching for empty shells on the ground surface and ground-hugging vegetation (Walker 1997). In addition all field workers were asked to record any *Powelliphanta* snails or shells they encountered.

Targeted invertebrate surveys were undertaken 24–26 April and 30 April–1 May 2013. Weather varied from occasionally sunny to mist, drizzle and rain and temperatures ranged from moderate to cold. Two people visited eleven sites between spot heights 525 m and 805 m in the upper catchment of Coal Creek and set up traps and undertook a range of collecting techniques. The location of invertebrate collection sites is shown in Figure 10. Trapping was also undertaken at one lowland forest site near the base of the proposed road (Site 5).

Manual collecting was undertaken during the day at sites 3, 7, 9, 11 and at the "*Isolepis* wetland[4]" identified by Mitchell Partnerships and Landcare Research (2001). At night manual collections were undertaken at sites 4, 6 and 7. Manual search techniques included lifting rocks, logs and other refuges to search for invertebrates and night searches with head lamps for invertebrates active on tree trunks and elsewhere. Other manual techniques such as sweep netting over ground cover and beating vegetation with a stick to dislodge invertebrates onto a white collecting tray were undertaken only on the second visit. Vegetation was continually wet during the first visit, which did not allow the effective use of these techniques.

At sites 1 – 5 a "mini-Malaise" trap was set up with the base set at ground level. These are primarily flight-intercept traps designed to collect flying insects, but with the base set at ground level, they also collect some crawling invertebrates. At each Malaise trap site two pitfall traps were placed in order to further sample ground invertebrates. The pitfall traps consisted of sections of plastic downpipe set into the ground, into each of which was inserted a disposable plastic drink cup of 75mm internal diameter. Each cup had six small holes drilled into its side about 5cm above the base to allow excess fluid (from rainfall) to leak out. The cups were filled to just below this point with monoethylene glycol as a killing agent and preservative. Each downpipe was placed so that its top (and that of the cup) was flush with the ground surface. Paint tin lids of 165 mm diameter were perched on twigs over the pitfalls to protect them from rain and falling debris, while allowing invertebrates to crawl underneath. The sites chosen for traps covered a range of vegetation types. The traps were set on 24th and 26th April and removed on 1st May.

Ultraviolet (**"UV"**) light traps were also set at five sites (sites 1, 4, and 7 – 9) on three nights. At four sites these were allowed to run overnight, while at the fifth, a trap was run for just two hours on each of two consecutive nights. This latter site was in the exposed heathland adjacent to the hut where wind was considered to be a risk for traps left overnight. The UV traps consisted of a set of clear plastic cross-vanes with a string of UV light emitting diodes around the central crossing point. The vanes were set up over a bucket containing water with a little detergent. The UV light attracts various groups of night-flying insects, especially moths, small flies and small wasps, which encounter the vanes and fall or fly into the bucket. Those that contact the water sink because of reduced surface tension due to the detergent. There was some moonlight present on all nights that the light traps were operated, which may have reduced the

4 Note that Landcare Research has confirmed that the rush species present at the "*Isolepis* wetland" described by Mitchell Partnerships and Landcare Research (2001) is the exotic *Juncus bulbosus*.

catch efficiency of the traps. Also, on two nights there were occasional strong wind gusts and periodic rainfall which reduce invertebrate activity.

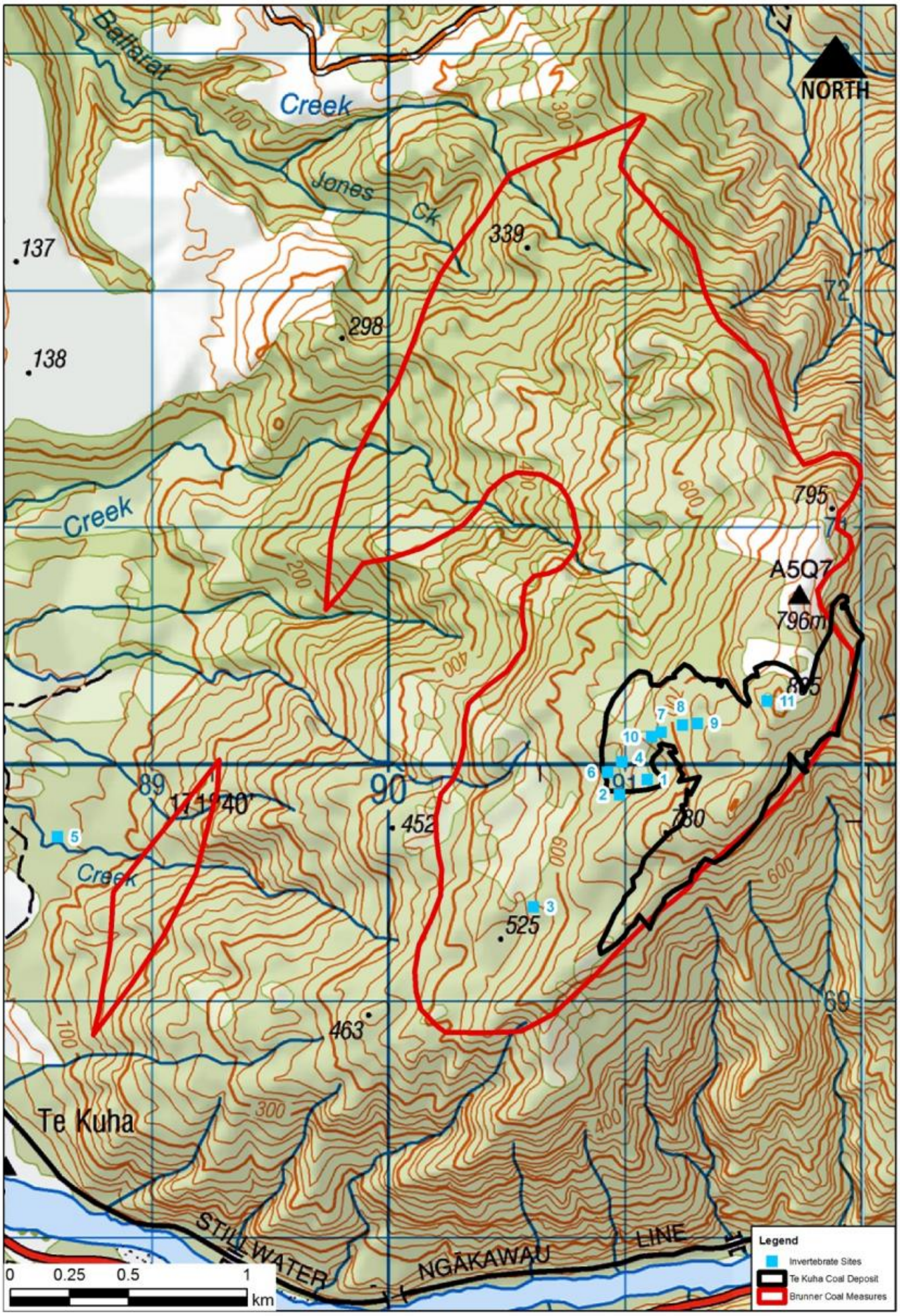

Figure 10: Terrestrial invertebrate collection sites at Te Kuha.

Baited pitfall traps were also operated overnight at three sites (7, 9 and 10). These were baited with honey, peanut butter and shrimp paste.

The specimens collected were sorted to species, family or order depending on available taxonomic resources and expertise, and on the ability of the particular taxonomic group to provide useful comparative information on distribution. Juvenile stages are often difficult to identify to lower levels using morphology and we made no attempt to utilise difficult microscopic taxa, such as mites (Acari), springtails (Collembola) and booklice (Psocoptera), which were present in many pitfall and/or malaise trap catches. Samples were labelled and stored in 75% alcohol except for specimens from which DNA samples may be taken, which were stored in 95% alcohol.

3.7 Other Fauna

All other fauna encountered, including introduced mammals and megainvertebrates were recorded, and photographed where possible. Specialised surveys for introduced mammals were not carried out although the presence or absence of introduced mammal sign was recorded within each of the bird survey grid cells to indicate the distribution and relative abundance of introduced mammals across the mining permit.

3.8 Rehabilitation

An understanding of the proposal and various options to mitigate impacts were discussed during a site visit in July 2013 which was attended by Robyn Simcock, Chris Coll (mine planning) and Peter Rough (landscape architect). During the July visit part of the proposed Te Kuha access road was walked, the proposed infrastructure/ROM area viewed on the ground, and the ridgeline flown. Robyn Simcock had also visited the Te Kuha site from 10 to 12 January 1996 as part of the team assessing a previous proposal. The closed and partly-rehabilitated Sullivan Mine access road, other late 2000s rehabilitation on the Denniston Plateau, and retired sections of the Arthur's Pass highway were also explored in July 2013 to provide context for discussions in relation to the Te Kuha site.

The results of the site visit along with information from the earlier vegetation and animal surveys described here (Sections 3 – 5 above), experience at similar sites, and discussions with the rest of the team were used to assess the similarity of ecosystems and proposed impacts at the Te Kuha site to areas where mining or road construction impacts have been rehabilitated over the last 10 to 25 years. Sites with similar conditions to Te Kuha include Strongman Mine and other Paparoa ridgeline mines to the south, mines and roads on the Stockton and Denniston Plateaux, and retired sections of State Highway 73 from Arthurs Pass to Otira. Similar mines have historically affected broadly equivalent mosaics of vegetation including stunted manuka / wire-rush and podocarps at sites with high rainfall and little drought stress.

4. VEGETATION

4.1 Vegetation Associations

Mitchell Partnerships & Landcare Research (2001) identified 10 vegetation associations in the area between Waterworks Road and the slopes above the Buller River. Eight of those occur within the area affected by the current proposal.

The location of the vegetation types present within the survey area is shown in Figure 11 and the extent of each vegetation type affected and within the larger patch of local coal measures vegetation (471 ha) are provided in Table 2. The vegetation associations encountered are described in more detail below. The species present are listed in Appendix 1.

Table 2: Extent of vegetation types affected at Te Kuha.

Vegetation Type	Extent Affected (ha)	Total Extent Within Local Coal Measures Vegetation
Herbfield	0.04	0.04
Manuka - *Dracophyllum* rockland	4.30	15.7
Manuka shrubland	13.47	104.7
Mountain beech/yellow silver pine - pink forest	50.57	233.2
Rimu - red beech - silver beech forest	1.81	2.9
Slips/bare ground	0.12	0.2
Tarn	0.002	0.07
Yellow silver pine - manuka shrubland	8.31	42.6
Pakihi	0.96	0
Pasture	0.36	0
Regenerating shrubland	0.93	0
Rimu/hard beech forest	8.28	0
Total	89.14*	470.6

*Note that this total includes vegetation which is not coal measures vegetation

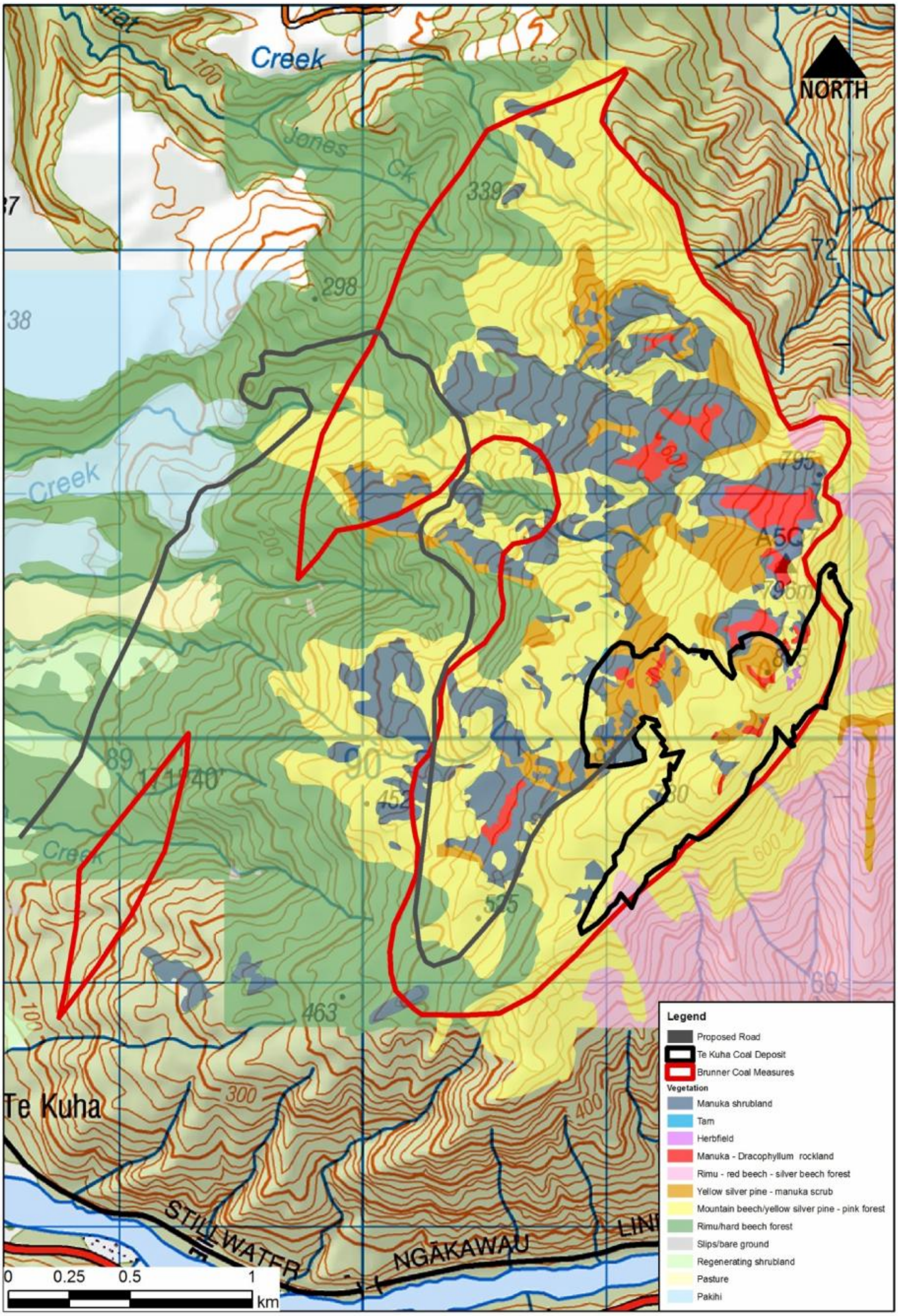

Figure 11: **Vegetation map of the Te Kuha area.**

4.1.1 Mountain Beech/Yellow-Silver Pine – Pink Pine Forest

This vegetation unit corresponds with unit 5 of the same name in Overmars *et al.* (1998) and was called Southern rata – yellow-silver pine – mountain beech by Mitchell Partnerships & Landcare Research (2001). This forest type is variable in stature depending on exposure and location, but is usually between four and eight metres tall, although occasionally taller. An example of this vegetation type is shown in Plate 1. The canopy is dominated by mountain beech with yellow-silver pine, pink pine and southern rata common and locally dominant at some locations. Rata is often emergent above the canopy. Cedar (*Libocedrus bidwillii*) and silver beech (*Nothofagus menziesii*) are occasionally encountered. Canopy cover is variable and the dbh of canopy trees is typically 25 – 60 cm, but occasionally larger. This forest is diverse and multi-layered. The sub-canopy includes saplings of canopy species as well as quintinia (*Quintinia serrata*), mountain toatoa, *Pseudopanax linearis*, Parkinson's rata, kamahi, *Dracophyllum townsonii*, and pokaka (*Elaeocarpus hookerianus*) with occasional rimu (*Dacrydium cupressinum*), Hall's totara (*Podocarpus cunninghamii*), stinkwood (*Coprosma foetidissima*), weeping matipo (*Myrsine divaricata*) and broadleaf (*Griselinia littoralis*). The shrub layer includes the species listed above as well as inaka (*Dracophyllum longifolium), D. oliveri*, *Pseudopanax colensoi*, lancewood (*Pseudopanax crassifolius*), *Pittosporum rigidum*, *Archeria traversii*, *Coprosma colensoi*, *C. linariifolia* and raukawa (*Raukaua edgerleyii)*. Parkinson's rata is locally common in the shrub and ground cover layers at some locations. An example of the understorey vegetation is shown in Plate 2. The ground layer includes seedlings of the above species as well as mountain flax (*Phormium cookianum*), *Gahnia procera*, *Astelia nervosa*, *Luzuriaga parviflora* and *Libertia micrantha*. Fork fern (*Tmesipteris tannensis*) and *Earina* orchids are common epiphytes.

This forest type occurs across large areas of the upper Te Kuha slopes. The substrate beneath this forest, particularly nearest the ridge line, is often very broken with large sandstone boulders covered by a mass of roots and luxuriant bryophytes as shown in Plate 3. Shorter statured examples of this vegetation type merge irregularly with surrounding shrublands, including manuka (as shown in Plate 1) and yellow-silver pine – manuka. East of the ridgeline this vegetation merges with taller mixed beech forest in the Little Cascade Creek catchment.

Plate 1: Mountain beech/yellow-silver pine – pink pine forest with manuka shrubland in the foreground.

Plate 2: Understorey vegetation within tall forest at Te Kuha.

Plate 3: Sandstone boulder substrate with bryophytes and matted roots.

4.1.2 Yellow-Silver Pine – Manuka Shrubland

This vegetation type often forms a margin to the taller forest described above or occurs in patches amongst the forest. A vegetation type of the same name was described by Mitchell Partnerships Ltd & Landcare Research Ltd (2001).

The canopy of this vegetation type is variable in density and typically 3 – 4 m tall. Other species present in the canopy include southern rata, kamahi, quintinia, mountain beech, pink pine, bog pine (*Halocarpus biformis*) and *Dracophyllum* spp. (*D*. *longifolium*, *D*. *rosmarinifolium* and *D*. *oliveri*) as shown in Plate 4.

The understorey of this vegetation type is often very dense and includes species such as *Pseudopanax linearis*, *Pittosporum rigidum*, *Leptecophylla juniperina*, mountain beech, southern rata, pokaka, *Dracophyllum* spp., *Gahnia procera*, mountain flax, *Epacris alpina*, and manuka. An example of the understorey is shown in Plate 5.

Ground cover species include *Celmisia dubia*, wire rush, tangle fern (*Gleichenia dicarpa*), *Gentianella montana* subsp. *montana* and *Lycopodiella diffusa* as well as other herbs and bryophytes. Orchids such as *Prasophyllum colensoi* are also common in this vegetation type.

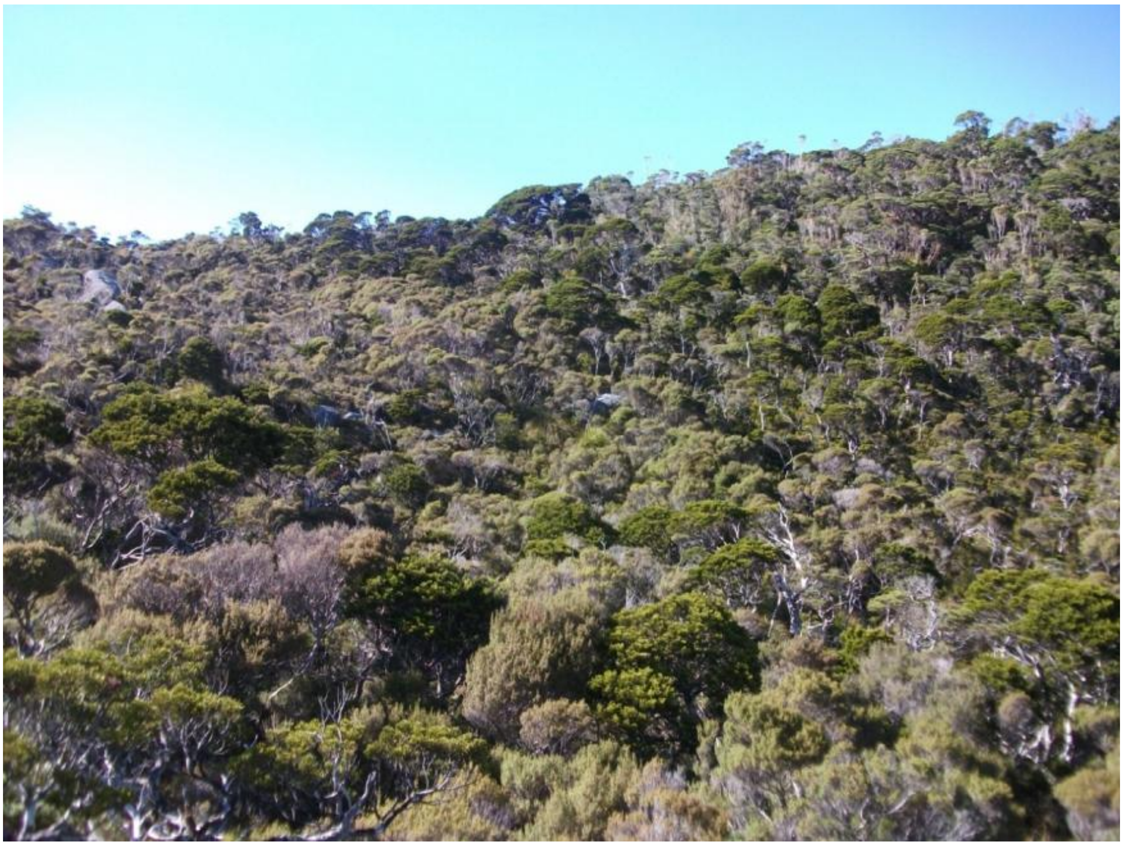

Plate 4: **Yellow-silver pine – manuka shrubland.**

Plate 5: **Understorey of Yellow-silver pine – manuka shrubland.**

4.1.3 Manuka Shrubland

Manuka is widespread at Te Kuha and the species is a common constituent of several vegetation types. Manuka dominated shrubland as a separate vegetation type was also recognised by Mitchell Partnerships and Landcare Research Limited (2001). This vegetation occurs in patches of varying height throughout the area as shown in Plate 6. Some of this vegetation is likely to have resulted from previous disturbance (including a fire approximately 80 years ago and more recent drilling, Mitchell Partnerships & Landcare Research 2001), whilst at higher, more poorly drained or more exposed situations manuka is likely to be the terminal vegetation type. In these situations manuka is usually present as either a prostrate species or as low shrubs. Other common species include wire rush, tangle fern, *Epacris alpina*, *Gahnia procera*, *Celmisia dubia*, *Drosera spatulata*, *Androstoma empetrifolia*, *Gentianella montana* subsp. *montana* and orchids. Elsewhere, such as on the edge of taller forest or in poorly drained hollows, dense manuka is typically 2 – 3 m tall and southern rata, yellow-silver pine, pink pine, bog pine (*Halocarpus bidwillii*) and *Dracophyllum uniflorum* are also scattered in the canopy. Other common species in this taller vegetation type include *Leptecophylla juniperina*, *Baumea teretifolia*, *Lycopodiella diffusa*, *Forstera mackayi*, *Pentachondra pumila*, *Dracophyllum rosmarinifolium* and mountain flax. *Pseudopanax linearis*, kamahi, quintinia, toatoa, mountain beech and *Pittosporum rigidum* are occasionally encountered.

Plate 6: Manuka shrubland.

4.1.4 Herbfield

A relatively large area of herbfield occurs near the Te Kuha ridgeline just south of Trig M as shown in Plate 7. This irregularly shaped herbfield area is surrounded a band of yellow-silver pine – manuka vegetation which merges into taller mountain beech/yellow-silver pine – pink pine as described in Section 4.1.1 above. At the time of the site visit the herbfield was noticeably dry and the species present included carpet grass (*Chionochloa australis*), manuka, *Epacris alpina*, *Carpha alpina*, *Drosera spatulata*, *Brachyglottis bellidioides*, *Donatia novae-zelandiae*, *Gentianella montana* subsp. *montana*, *Euphrasia wettsteiniana*, *E*. *townsonii*, *Lepidothamnus laxifolius* x *intermedius* and *Celmisia laricifolia*.

Plate 7: Herbfield near the Te Kuha ridgeline.

4.1.5 Manuka – *Dracophyllum* Rockland

Areas of exposed sandstone rock are present along the Te Kuha ridgeline and on spurs or ridges coming off the main ridgeline. We have not identified these as sandstone erosion pavements because erosion pavements are defined[5] as areas of "flat to gentle slope that have been cleared of any topsoil through chemical weathering, often from erosion of the topsoil or peat. Erosion pavements mostly have very little sand or gravel (as distinct from gravel fields or sand plains) and may or may not have large cracks and fissures to support gravel or colluvium". Although exposed rock is a characteristic of this community at Te Kuha, the amount of the exposed sandstone is generally less, and the slope is generally higher, than those communities referred to as "sandstone erosion pavement" (Williams *et al.* 2007; Wildland Consultants Ltd 2010). Interspersed amongst the rock outcrops are small patches of low-growing or prostrate

[4] http://www.landcareresearch.co.nz/publications/factsheets/rare-ecosystems/inland-and-alpine/sandstone-erosion-pavements. Accessed 19 June 2013.

species including manuka, *Dracophyllum densum*, *D*. *rosmarinifolium*, pygmy pine, yellow-silver pine, wire rush, *Chionochloa australis*, *Actinotus novae-zelandiae*, *Oreobolus strictus*, *Carpha alpina*, mountain flax, *Drosera spatulata*, *Euphrasia townsonii*, *Forstera mackayii*, *Celmisia dubia*, *Pentachondra pumila* and *Aporostylis bifolia*. *Gahnia procera* and small specimens of southern rata are occasionally encountered. Examples of this vegetation are shown in Plates 8 – 10.

Plate 8: Manuka – *Dracophyllum* rockland near the Te Kuha ridgeline.

Plate 9: **Prostrate and low-growing species with abundant rock.**

Plate 10: **Another example of Manuka – *Dracophyllum* rockland.**

4.1.6 Rimu/Hard Beech Forest

This vegetation is present on the lower slopes of the Te Kuha range (called Dip slope tall forest by Garrick 1986).

Rimu is emergent from this tall forest reaching heights of more than 25 m in some places. The canopy is dominated by hard beech (*Nothofagus truncata*) with silver beech (*N. menziesii*) locally common to occasional and red beech (*N. fusca*) occasionally encountered. The species composition and nature of this forest changes with altitude: at higher elevations the vegetation is shorter, with species typical of coal measures soils (yellow-silver pine, Parkinson's rata, mountain beech) whilst at lower altitudes typical lowland species such as miro (*Prumnopitys ferruginea*), toro (*Myrsine salicina*) and nikau (*Rhopalostylis sapida*) are more common.

Generally speaking within these multi-layered forests, sub-canopy species include toro, kamahi, southern rata, quintinia, rimu, toatoa, hard beech and Hall's totara. The shrub layer includes saplings of the emergent and canopy species, as well as common *Neomyrtus pedunculata*, tree ferns (*Cyathea smithii*, *Dicksonia squarrosa* and others), lancewood (*Pseudopanax crassifolius*), horopito (*Pseudowintera colorata*), hupiro (*Coprosma foetidissima*), *Coprosma areolata* and broadleaf (*Griselinia littoralis*). Climbers such as kiekie (*Freycinettia banksii*), supple jack (*Ripogonum scandens*) and rata (*Metrosideros perforata*, *M. diffusa*) are common, along with a variety of ferns such as crown fern (*Blechnum discolor*), *Lastreopsis hispida*, *Lindsaea trichomanoides*, *Sticherus cunninghamii*, *Asplenium flaccidum* and filmy ferns such as *Cardiomanes reniforme*, *Hymenophyllum demissum* and *H. flabellatum*. Ground cover species include bush rice grass (*Microlaena avenacea*), hook grass (*Uncinia* spp.), *Libertia* spp., mosses and lichens. Epiphytes such as *Earina* orchids, *Asplenium flaccidum* and *Tmesipteris tannensis* are also common.

On the lower river terraces kahikatea (*Dacrydium dacrydioides*) is a common emergent and canopy species as shown in Plate 11. In some places there is evidence of former grazing.

Plate 11: Tall rimu/hard beech forest on lower slopes at Te Kuha (background).

4.1.7 Threatened and At Risk Vascular Flora

Although the vegetation is natural and intact at Te Kuha, only two species identified as being of potential conservation concern were detected in the vegetation survey (*Dracophyllum densum* and *Euphrasia wettsteiniana*) (de Lange *et al.* 2009; F. Overmars pers. comm. 2012). *D. densum* is regarded as "declining", whilst *E. wettsteiniana* is regarded as being "naturally uncommon". The threat ranking of both these species is in part due to the fact their distributions are mostly or entirely restricted to the North Westland Ecological Region (McEwen 1987). Both species are locally common to abundant where they occur.

Several other vascular plant species which have localised distributions are known from the Ngakawau Ecological District, but only three of these (*Actinotus novae-zelandiae*, *Celmisia dubia* and *Metrosideros parkinsonii*) are known to occur at Te Kuha. *A. novae-zelandiae* is a small herb with creeping stems found in montane to subalpine boggy ground and herbfield on the West Coast of the South Island and Stewart Island. *C. dubia* is an alpine daisy endemic to the Northwest Nelson area as far south as the southern Paparoa Range and is locally common on the coal plateaux. *M. parkinsonii* (Parkinson's rata) is a woody shrub which has a disjunct distribution occurring on Great Barrier Island and the North Westland area. Parkinson's rata is also locally common in the shrublands and forests of the Stockton and Denniston Plateaux.

Mitchell Partnerships and Landcare Research Limited (2001) reported another two species which, while not threatened or at-risk, are locally distributed within the Ngakawau Ecological District – *Dracophyllum pubescens* and *Drosera arcturi*.

Dracophyllum pubescens was recorded “within the yellow-silver pine – manuka scrub and herbfield ‘cushion’ vegetation associations at the ridge crest” (Mitchell Partnerships and Landcare Research Ltd 2001). *D. pubescens* is a species of montane to subalpine areas and is endemic to north–west Nelson where it grows in subalpine shrubland, on exposed cliff faces and bluffs, or in herbfield, fellfield or grassland. *D. pubescens* was not noted during this survey but is likely to still be present. It is also known from Mt William, Mt Frederick and Mt Augustus. Some specimens from Mt Augustus were successfully hand transferred to the area known as the “Mt Augustus gardens” at Stockton prior to mining at Mt Augustus.

Mitchell Partnerships & Landcare Research Limited (2001) recorded *Drosera arcturi* growing in manuka – wire rush – tangle fern shrubland which was “restricted to either side of Waterworks Road and in places along the proposed access road (the lower parts only) (but it) was not found at the proposed mine site” (Mitchell Partnerships and Landcare Research Ltd 2001). *D. arcturi* is widely distributed, but within the Ngakawau Ecological District it is restricted to the peaks of Mt Rochfort, Mt Frederick and parts of the upper Waimangaroa valley. It was not recorded during this survey.

4.2 Bryophytes

Seventeen species of significance were recorded in the area in 2001, including three mosses and 14 liverworts (Mitchell Partnerships & Landcare Research Limited 2001). The results of this bryophyte survey are summarised in Table 3.

Table 3: Bryophytes known to be present at Te Kuha in 2001.

Species	Threat Status	Habitat	Notes
Mosses			
Pleurophascum grandiglobum var. *decurrens*	Not threatened		Taxonomically isolated.
Pulchrinodus inflatus	Not threatened	Pakihi. Found near Plot 1 at Te Kuha.	Taxonomically isolated and poorly understood. Found in Northland and southern Nelson/Westland. Scattered elsewhere. Would be affected by hydrological disturbance.
Rhizogonium pennatum	Not threatened	Terrestrial and epiphytic substrates including deeply shaded rotten logs, soil banks, tree trunks and thin humus over shaded boulder faces.	Scattered in New Zealand, Tasmania and Australia.
Liverworts			
Acromastigum cavifolium	Not threatened	Epiphyte of toatoa, yellow-silver pine and silver pine.	Rarely found in Coromandel, Westland and Stewart Island.

Species	Threat Status	Habitat	Notes
Cheilolejeunea novae-zelandiae	Not threatened	Open pakihi.	Known from five sites in Westland and Stewart Island.
Herzogianthus sanguineus	Naturally uncommon		Known from Mt Euclid, Mt Sewell and Te Kuha.
Lepidolaena novae-zelandiae	Not threatened	Epiphyte on rata, manuka and *Dracophyllum*. Found in three plots overlying coal deposit.	Found on Auckland Island, Stewart Island, Westland and Nelson. Locally abundant.
Megalembidium insulanum	Not threatened	Silver and yellow-silver pine forest on infertile soils.	Found between Stockton and Stewart Island.
Nephelolejeunea conchophylla	Not threatened	Epiphytic on manuka. Found in Plot 2 at Te Kuha.	Found at Karikari, Kaimai Ranges and Te Kuha.
Pseudocephalozia lepidozioides	Not threatened (was in 2007 list)		Known from six sites, including two in the North Island
Radula multiamentula	Not threatened		Shared with Tasmania.
Riccardia multicorpora	At risk (naturally uncommon)		Known from Coromandel and three sites in the North Island, including Stockton and Temple Basin.
Riccardia furtiva	At risk (naturally uncommon)	Tall manuka shrubland. Found in Plot 2 at Te Kuha.	Known from Mt Ruapehu and Westland.
Riccardia perspicua	Not threatened	Short yellow-silver pine shrubland. Found in Plot 5 at Te Kuha.	Endemic.
Saccogynidium decurvum	Nationally vulnerable	Pakihi and low yellow-silver pine forest.	Found in Tasmania, Fiordland and at Stockton.
Trichotemnoma corrugatum	Not threatened (was in 2007 list)	Pakihi and associated forest on low fertility soils.	Sole member of its family. Shared with Tasmania.
Zoopsis bicruris	At risk (naturally uncommon)	Low yellow-silver pine forest	Endemic. Known from two sites.

The plots surveyed at Te Kuha in 2001 had a high diversity of species, including rare and threatened species, and those that are taxonomically isolated or otherwise significant. No adventive (exotic) bryophytes were recorded at Te Kuha.

In particular Plot 3 (located within manuka – yellow-silver pine shrubland within the coal deposit, but near the edge) was particularly diverse with 51 species recorded there. In comparison Plot 23 of Glenny (1999) in mountain beech rata and silver pine forest at Stockton had 39 species and Plot 17 of Glenny and Kusabs (2005) on the banks of Mangatini Stream at Stockton had 34 species.

To date there has only been very limited bryophyte survey within the coal deposit boundary (one or perhaps three plots were located there), and outside it (five or perhaps seven plots). With current knowledge it appears that the Te Kuha site is significant for bryophytes, but there is no evidence to suggest that the areas within the proposed pit are any more important than the areas outside the proposed disturbance and it seems likely that the species affected by this proposal will remain in the wider area in habitats outside the mine footprint. If areas adjacent to the Te Kuha mining area are to keep their bryophyte fauna, the hydrology, soils and vegetation surrounding the site need to remain unchanged.

Glenny and Fife (in Mitchell Partnerships & Landcare Research Limited 2001) identified two vegetation types as particularly valuable for bryophytes at Te Kuha. Glenny and Fife (*ibid*.) called those habitats yellow-silver pine forest and pakihi. Here they are called manuka – yellow-silver pine shrubland and manuka shrubland. Both are relatively low growing and open habitats which appear to have resulted from some disturbance either recently (manuka shrubland) or in the distant past (manuka – yellow-silver pine shrubland).

To summarise, the key points made by Glenny and Fife were:

- The area sampled has a very high density of what, to current knowledge (even today), are regarded as rare bryophyte species, or lie outside their main distributional range.

- The habitats with the greatest bryophyte diversity at Te Kuha are the manuka – yellow-silver pine shrubland and the open manuka shrubland.

- Many of the rare bryophytes represented in the area are of special significance because of their taxonomic isolation and unusual features.

- The stream community appears to harbour no bryophytes of special interest.

- The area is remarkable for its lack of adventive and weedy bryophytes, but this will probably change with the construction of road access.

Glenny and Fife recommend that if mining were to proceed at the site, then avoidance of the key bryophyte habitats to the extent possible would protect bryophytes.

Additional bryophyte survey at Te Kuha is recommended before applications for resource consent are lodged. This is likely to result in additional threatened bryophytes being found there because bryophyte knowledge has improved since 2001. For example the threatened liverwort *Telaranea inaequalis* was only described (invalidly) in 2000, shortly before the previous survey, and little was known about its habitat preferences. Subsequent work at Stockton and Denniston has resulted in a valid description and indicated a preference for areas where water seeps over rock faces. That type of habitat at Te Kuha was not extensively surveyed in 2001, hence *T. inaequalis* may be present, but remain undetected.

4.3 Rare Ecosystem Types

Historically rare ecosystems are those that have only ever been present in limited amounts and were rare prior to human colonisation (Williams *et al.* 2007). Historically rare ecosystems may exhibit extremes of biological diversity - some are known to have a diverse flora and fauna, high endemism and / or highly specialised biota, while others are regarded as biologically depauperate (Williams *et al.* 2007).

Williams *et al.* (2007) defined ecosystems as “an ecological system formed by the interaction of co-acting organisms and their environment.” Therefore ecosystem types can be differentiated using one or more biotic or abiotic factor(s). The basis for Williams *et al.*’s classification of rare ecosystems is not directly biologically based, instead it relies on seven abiotic factors which are either known or assumed to be biotic drivers including soil type, parent material or chemical environment, particle size, topography, disturbance regime and climate.

As discussed in Section 4.1.5, the manuka – *Dracophyllum* rockland at Te Kuha is not considered to meet the definition of sandstone erosion pavement. Small tarns are present at Te Kuha, including one approximately 3 m^2 in size that would be affected by the proposal to mine there. A second tarn (identified as “*Isolepis* wetland” in Mitchell Partnerships & Landcare Research Limited 2001, but actually mostly vegetated with *Juncus bulbosus*, an introduced rush) is located outside the project footprint. No acidic boulderfields or seepages were detected, but seepages in particular are very small and may have been missed during our surveys.

4.4 Birds

4.4.1 Species Present

Forty species were recorded within the survey area, including 33 species of birds within the mining permit and 26 species in the area overlying the coal deposit. A list of bird species encountered is provided as Appendix 2. Overall, based on five-minute bird counts, nocturnal counts and recorded dawn/dusk chorus, bird numbers were low.

Of the 33 species found within the mining permit, 23 are indigenous (14 endemic) and 10 introduced.

Two species detected within the mining permit (great spotted kiwi and New Zealand falcon) are considered “Threatened” and five species (western weka, long-tailed cuckoo, rifleman, New Zealand pipit and South Island fernbird) are considered to be “At Risk” (Miskelly *et al.* 2008). “Threatened” and “At Risk” species are considered in more detail below and the results of the surveys are summarised in Table 4.

Table 4: Summarised results of bird surveys undertaken at Te Kuha in March 2013.

Ecological Features	Species Present
Species of particular conservation importance	Great spotted kiwi, New Zealand fernbird, and South Island rifleman (see Section 4.4.5).
Species with a wide distribution within the survey area	Bellbird, silvereye, tomtit, fantail, robin, fernbird, grey warbler and tui (diurnal surveys). Kiwi, weka, and morepork (nocturnal surveys).
Species showing a patchy distribution within the survey area	Kereru, brown creeper, and rifleman.
Localised records	Falcon, long-tailed cuckoo, pipit, shining

Ecological Features	Species Present
	cuckoo, black-backed gull, kakariki, harrier (flying over), kingfisher, and welcome swallow.
Indigenous species recorded in >50% of grid cells (Common species)	Bellbird, silvereye, tomtit, fantail robin, grey warbler and fernbird most common diurnal species. Morepork by far most frequent nocturnal species.
Indigenous species recorded in 20-50% of grid cells (Moderately common species)	Tui, weka, kereru and brown creeper from diurnal counts. Great spotted kiwi and western weka from dusk and nocturnal counts.
Indigenous species recorded in <20% of grid cells (Locally rare species)	Rifleman, harrier, pipit, welcome swallow, falcon, kakariki, long-tailed cuckoo, and kingfisher.
Undetected species which occur elsewhere in the Ngakawau Ecological District	Kaka and kea.

4.4.2 Indigenous Diurnal Birds

The most conspicuous diurnal bird species recorded were bellbirds and silvereyes as shown in Figure 12. Tomtits, fantails and fernbirds were also relatively conspicuous throughout. Introduced birds were less conspicuous than expected. Bellbirds and silvereyes were found in all of the 53 grid cells surveyed and >50% of five-minute bird counts (Table 5). Tomtits and fantails were also relatively conspicuous throughout being found in >90% of grid cells and 60% and 39% of five-minute bird counts respectively (Table 5). Robins and grey warblers were also commonly recorded but appeared to be relatively quiet when the surveys were undertaken.

Table 5: Frequency of indigenous birds recorded in grid cells and five-minute counts.

Species	Grid-cell (n=53)	5-minute count (n=112)
Bellbird	100%	93%
Silvereye	100%	60%
Tomtit	92.5%	60%
Fantail	92.5%	39%
Robin	81.1%	26%
Grey warbler	52.8%	29%
Fernbird	52.8%	25%
Tui	39.6%	20%
Weka	43.4%	5%
Kereru	28.3%	13%
Brown creeper	24.5%	12%
Rifleman	13.2%	5%
Harrier	7.5%	3%
Pipit	1.9%	1%
Welcome swallow	3.8%	0%
Falcon	1.9%	0%
Kakariki	1.9%	0%
Long-tailed cuckoo	1.9%	0%
Kingfisher	1.9%	0%

Of the less commonly recorded species, kereru were mainly recorded in lower-altitude forests, whilst brown creepers were patchily dispersed in scrubby habitat on the western slopes of the mining permit and shrubland on the main ridge. Few records of welcome swallow and kingfisher were obtained, all in the Coal Creek catchment. Shining cuckoo were recorded calling twice during the night by the audio recorders AR1 and AR3 located on the western slopes of the mining permit.

Overall, both the number of species and the number of individuals recorded in each count were relatively low when compared to other areas of contiguous forest in the region such as the Orikaka Valley, Charming Creek and Mokihinui Valley (Buckingham 1999, 2002; Mitchell Partnerships 2007). Of note were the paucity of kakariki records and the notably quiet dawn chorus recorded by audio recorders, even those located at low-altitude sites. Kakariki were not recorded in five-minute bird counts but were heard once by both Gary Bramley and Marieke Lettink on 12 March.

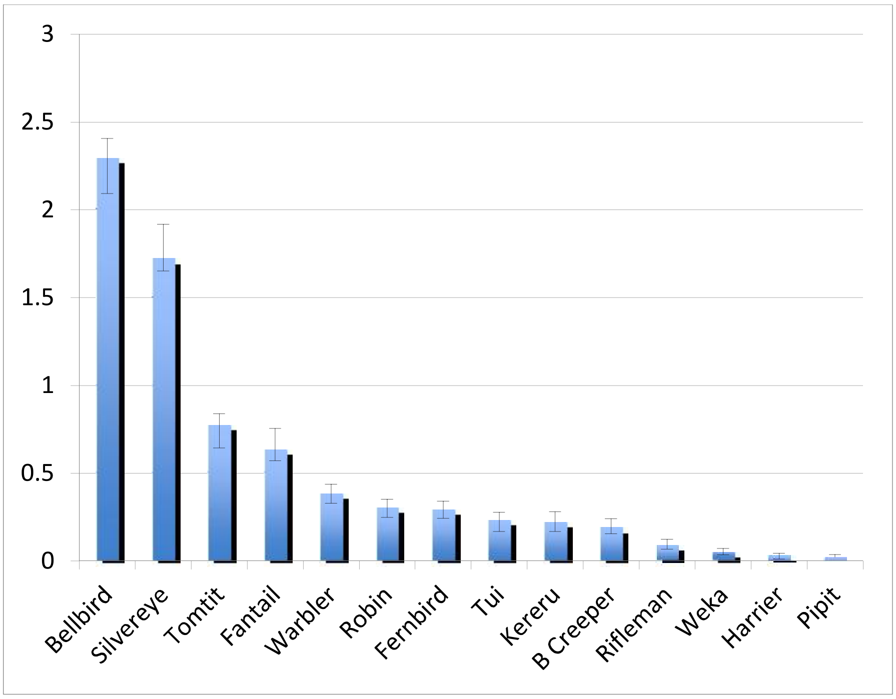

Figure 12: Mean counts of diurnal indigenous birds from five-minute count data (note: vertical axis is the mean number per count, bars show the standard error about the mean).

4.4.3 Nocturnal Birds

Both great spotted kiwi and weka were occasionally recorded throughout the night from all four acoustic recorder sites. These species are considered in more detail below. Moreporks were recorded at all nocturnal listening stations on all surveillance nights and appear to be widespread throughout the survey area. Moreporks were more frequently recorded at lowland sites and only occasionally at upland sites.

Acoustic recorders detected shining cuckoo on two occasions (AR 1 and AR 3) and pukeko at one site relatively near open country (AR 1) on a number of occasions. A single unusual note, which was presumed to be a chaffinch was recorded repeatedly during the night at one recorder site (AR 3). Chaffinches do not normally call at night.

4.4.4 Naturalised Birds

Introduced birds were surprisingly inconspicuous during the survey. The rank abundance of introduced species was similar in both five-minute counts and grid cell counts, except song thrushes ranked higher in grid cell counts (Table 6). Overall, chaffinches were by far the most frequently recorded introduced bird, while blackbirds were also quite conspicuous (Figure 13).

Table 6: Frequency introduced birds recorded in grid cells and five-minute counts.

Species	Grid-Cell	Five-Minute Count
Chaffinch	86.8%	26%
Blackbird	39.6%	8%
Song thrush	20.8%	3%
Redpoll	13.2%	3%
Dunnock	13.2%	2%
Greenfinch	11.3%	4%
Goldfinch	7.5%	1%
Skylark	7.5%	0%

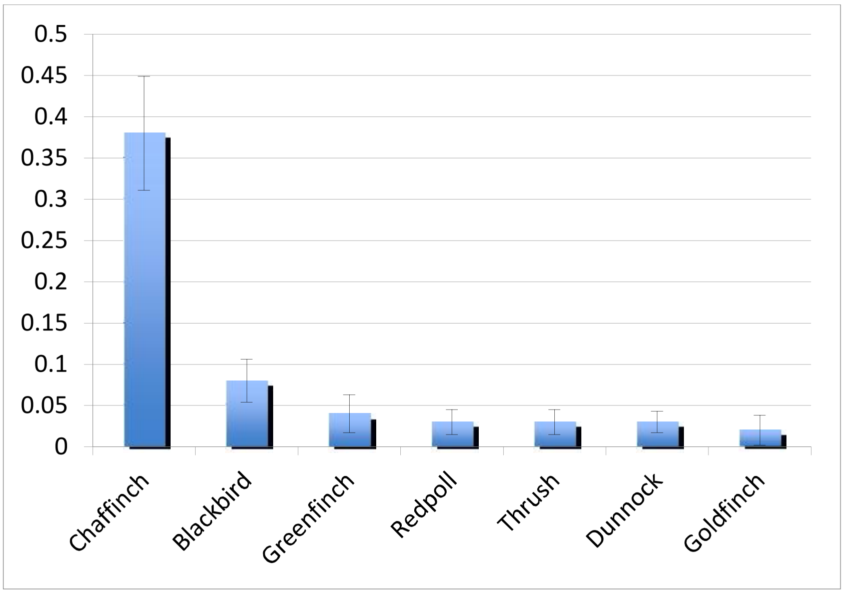

Figure 13: Mean counts of introduced birds from five-minute count data (note: vertical axis is the mean number per count, bars show the standard error about the mean).

4.4.5 Threatened Bird Species

Two “Threatened” species, great spotted kiwi and New Zealand falcon, were recorded within the mining permit.

Great Spotted Kiwi

Great spotted kiwi were recorded throughout the mining permit, from relatively low altitudes (<400m asl) on the western slopes, to the summit ridge. Great spotted kiwi are regarded as “nationally vulnerable” (Miskelly *et al.* 2008).

The overall call rate from listening surveys within the mining permit was relatively low at 1.0 call/hour. Listening counts and acoustic recordings indicated that at least one pair of kiwi reside around the main summit ridge (point height 795 and 796) close to, or just outside, the coal resource boundary. Single male and female kiwi calls (possibly from a pair) were heard at different times northwest from point height 730 (in the direction of the portable hut) on 12 March. A single female was heard on the spur between Coal Creek and Jones Creek on 13 March at an altitude of about 300 m asl.

All functioning acoustic recorders recorded kiwi, confirming that their distribution is widespread within the mining permit. Acoustic recorder SM5 (near Waterworks Road) was the only one that didn’t record both male and female kiwi calls. This recorder detected only a single male calling three times during the evening of 14 March 2013, and no kiwi on the next two consecutive nights. Recorder AR3 (located south of the mining permit) recorded both male and female kiwi but no duets, whereas both the summit ridge recorder (SM3) and the recorder placed between Coal Creek and Jones Creek (AR1) recorded duets between male and female kiwi indicating the presence of paired birds.

Results from the acoustic recorders showed that the mean number of calls per hour increased with altitude, and was highest on the summit ridge within or close to the proposed mine area. Note that call rates from these recorders were averaged over a full surveillance night (20:00-06:00 hours) and differ from the mean call rate reported for formal listening counts. Listening counts also recorded higher call rates of kiwi at higher altitudes.

Acoustic recorders showed that great spotted kiwi called more frequently in the early hours of the evening, though calling was fairly consistent throughout the night. This pattern suggests that listening surveys were appropriate to detect a high proportion of kiwi calling any given night. The survey results for great spotted kiwi are summarised in Table 7.

Table 7: Summary of survey results for Great spotted kiwi.

	Acoustic Recorder Results	Listening Station Results	Conclusion
Distribution	Recorded at all four sites	Recorded at 60% of five listening sites.	Widespread, present at all altitudes within the mining permit
Relative abundance	Recorded on 86.7% of surveillance nights. Mean rate of 0.40/hr. Highest call rate at summit ridge (mean 0.64/hr) and lowest at Waterworks Road (0.1/hr)	Mean 1.0/hr (n=12 hrs; Standard Error = 0.89). Higher call rates with altitude: 1.5 calls/hr above 700m cf 0.17/hr below 700m.	Call rates low compared to stronghold areas to the north (Mt William Range), east (Orikaka River) and south (Paparoa Range).

Other “Threatened” Birds

There was only one sighting of falcon, a bird was seen flying over the northwest slopes of the ridge between Jones Creek and the upper Orowaiti River on 13 March 2013. It is expected that low numbers of falcon are present in the wider area and it is possible that they might nest within the mining permit.

An additional threatened species (grey duck) was recorded when a group of 12 grey ducks were seen on one of the reservoirs near Waterworks Road (i.e. outside the mining permit). These birds may have been grey duck – mallard hybrids. Grey ducks are regarded as “nationally critical” (Miskelly *et al.* 2008). It is possible that grey duck occupy parts of the small creeks within the mining permit in low numbers.

One additional “Threatened” species, South Island kaka, are likely to be occasionally present within the survey area, at least seasonally, but they were not confirmed present during the March 2013 survey (a possible distant kaka was recorded on an automatic recorder on one occasion). South Island kaka are regarded as “nationally endangered” by Miskelly *et al.* (2008). Garrick (1986) also recorded Australasian bittern (“nationally endangered”) just outside the survey area in wetland and at the edge of rough pasture in 1986 (Garrick 1986).

4.4.6 “At Risk” Bird Species

Five “At Risk” species (Miskelly *et al.* 2008) were identified within the mining permit including Western weka, South Island fernbird, South Island rifleman, long-tailed cuckoo and New Zealand pipit. Long-tailed cuckoo are regarded as “naturally uncommon”, whilst the other four species are regarded as “declining” (Miskelly *et al.* 2008). Western weka, fernbirds and rifleman are considered in more detail below.

Long-tailed cuckoo were only encountered once: near the mining permit boundary in forest above the end of Nine Mile Road. Long-tailed cuckoo (along with shining cuckoo) may be more common and widespread in midsummer when migrant cuckoos are more conspicuous in New Zealand forests. New Zealand pipits were only seen twice, on both occasions in a scree area near point height 796 on the main ridge. Relatively little pipit habitat is present within the mining permit.

Western Weka

Western weka were recorded at all nocturnal listening stations and acoustic recording sites, indicating that they are present throughout the mining permit (summarised in Table 8). The mean counts from acoustic recorders were higher at lower altitudes (i.e. the opposite pattern to that observed for kiwi). Weka listening surveys showed a similar trend: only a few weka were heard at sites on the main ridge within or close to the proposed mine site, whereas many weka were heard from a site at point height 298 near lowland forest edge. Weka were rarely recorded in diurnal counts (mean = 0.05/count) and call rates at dusk were not particularly high (mean = 11.67/h at three sites). Although weka are widespread they do not appear to be particularly common at Te Kuha.

Table 8: Summary of survey results for Western weka.

	Audio recorder results	Listen station results	Conclusion
Distribution	Recorded at all four audio sites and all five listening sites.	Recorded at all five nocturnal listening sites.	Widespread distribution.
Relative abundance	Recorded on 86.7% of surveillance nights. Mean rate of 7.07/h. Highest call rate at Waterworks Road (10.67/h) and western face (9.86/h) while lowest at summit ridge (0.83/h).	Mean count 11.67/h at three sites where formal weka counts were undertaken. Notably higher rate of calls at lower altitude. 23/h at 300m cf 7/h at 670m and 5/h at 795m	Overall densities of weka not high compared to stronghold areas on the West Coast (e.g. Hokitika to Reefton). Low densities nearest the coal resource.

South Island Fernbird

South Island fernbird were moderately common throughout the mining permit from the ridgeline to the low-altitude slopes in the west. Fernbird were recorded at all four acoustic recorder sites where they were among the most frequently recorded bird at dusk (a peak vocal time for fernbird). Of the indigenous birds recorded during five-minute counts, fernbird were 7th most common (Table 4). During this survey counts were not carried out on the extensive pakihi between Nine Mile Road and Ballarat (Jones) Creek, but this provides ideal fernbird habitat and even higher counts would be expected there. Fernbird were commonly heard there while crossing the pakihi to reach the survey area. Survey results show that Te Kuha area and surrounds provide particularly good habitat for fernbird.

South Island Rifleman

South Island riflemen were patchily encountered within the mining permit, most often within higher-altitude forest, but also in low-altitude forest near Jones and Coal Creeks. Riflemen are becoming very rare in low-altitude forest on the West Coast and probably the rest of the South Island, so their presence in low altitude forest at Te Kuha was surprising. Overall rifleman counts were very low with a mean of 0.09/count. Rifleman were only found only at 5% of count stations.

Other “At Risk” Species

Two additional “At Risk” species (black shag and South Island pied oystercatcher) were recorded outside the mining permit (at lower Coal Creek near the Buller River and in paddocks nearby respectively).

4.5 Lizards and Frogs

Four adult lizards, including three forest geckos and one speckled skink, as well as one forest gecko skin, were encountered during 29 hours of searching (Table 8). Two forest geckos were found whilst spotlighting and the third forest gecko was found during the day. In addition, the sloughed skin of a forest gecko was found beside a tree cavity in a mountain beech tree approximately 1.5 m off the ground. The speckled skink was found sheltering under a large rock on top of a boulder within manuka shrubland. The altitude where all lizards were found, capture details and their habitats are shown in Table 9.

Table 9: Capture details for lizards at Te Kuha, North Westland.

Species	Altitude (m ASL)	Notes
Forest gecko (skin only)	641	Short forest.
Forest gecko	656	Manuka shrubland. Adult male, 75 mm SVL*, 9.5 g.
Forest gecko	737	Rock slab. Adult female, 88 mm SVL, 16.6 g, two embryos.
Forest gecko	650	Manuka shrubland. Adult male, 84 mm SVL, 13 g.
Speckled skink	563	Open manuka shrubland with boulders. Could not be extracted.

*SVL = snout-vent length

This survey confirmed the presence of two lizard species at Te Kuha: forest gecko and speckled skink. Both species have a conservation status of “declining”. A third lizard species, the West Coast green gecko, was not detected during the survey. West Coast green geckos are notoriously difficult to detect due to their very cryptic behaviour and colouring and weather-sensitive emergence. Surveys conducted in North Westland typically return single (e.g. Adams *et al.* 2000; Lettink 2011, 2012) or no records of this species (e.g. Thomas *et al.* 1997; Thomas & Toft 1997; Bell & Jewell 2007; Waybacks Ltd. & Wildlife Surveys 2008). It can be assumed that West Coast green gecko are present at the site for the following reasons:

(1) Suitable (forest and shrubland) habitats are present throughout the area;

(2) Occasional sightings made by local people of green gecko from forest and shrubland margins on low terraceland at Te Kuha have been reported (Garrick 1986); and

(3) The Denniston Plateau contains similar vegetation and is one of the few known strongholds for the West Coast green gecko (M. Lettink, pers. obs., Department of Conservation Herpetofauna Database).

4.6 Bats

Digital bat detectors were active for between nine and 17 nights per site. Temperature and weather conditions were suitable for bat activity during the survey, but no long- or short-tailed bats were detected in 116 nights of recording.

4.7 Invertebrates

Over 80 invertebrate taxa were identified from the sampling (see Appendix 3). The range of species found during this survey was significantly limited by the time of year in which the survey was undertaken, when invertebrate abundance and activity was less than expected during warmer months. A summer survey undertaken under optimal conditions would have resulted in a much greater range of species being detected, from which more reliable inferences could have been made about the community as a whole. Nonetheless, on the basis of the survey described by Mitchell Partnerships & Landcare Research Limited (2001) and this survey, the terrestrial invertebrate communities found within the proposed Te Kuha mine footprint and throughout the habitats affected by the proposed access road are similar to those known from habitats elsewhere in the Ngakawau Ecological District.

The great majority of species identified were native species. Exceptions include the introduced honeybee (*Apis mellifera*), taken in a malaise trap in low manuka at altitude, and the European common wasp (*Vespula vulgaris*) which was captured in both the lowland forest malaise trap and in the malaise trap set in the low pakihi vegetation adjacent to the hut site. The presence of these species is attributable to the presence in the area of beech trees (*Nothofagus*) and their associated honeydew-producing scale insects.

In general, the dipteran (fly) fauna surveyed indicates a fairly high level of natural integrity and is largely typical of the wider region. Only one introduced fly species was recorded in the samples, this being the common striped dung fly (*Oxysarcodexia varia*) from the open area near the hut. This is commonly found in short stature vegetation throughout the Buller coal fields. Despite the sub-optimal time of year there was a surprisingly high species-richness of *Mycetophila* fungus gnats recorded, indicative of the high levels of diversity common to northern West Coast forests. Amongst the other flies recorded, the picture-winged *Trupanea* species collected near a tarn is also common to wet habitats of the Denniston Plateau.

Three species of weta were collected, the West Coast tree weta (*Hemideina broughi*), Wellington tree weta (*Hemideina crassidens*) and a recently described species (*Hemiandrus electra*). The West Coast tree weta is endemic to the north-west South Island, from about Greymouth and Reefton northward through Kahurangi National Park. It appears not to be as far east as Abel Tasman National Park. The newly described ground weta *Hemiandrus electra* (M. Morgan-Richards and B. Smith, pers. comms.) is also a Northwest Nelson endemic, having a similar distribution but including Abel Tasman National Park (B. Smith, pers. comm.). By contrast, the Wellington tree weta is distributed from the lower North Island, through the Marlborough Sounds, Nelson/Golden Bay and down the West Coast as far as Haast.

Six species of beetles (Coleoptera) were collected, but no specimens of some of the ground beetle (carabid) species known to occur on the Denniston Plateau were recorded. Individuals of the carabid genus *Neoferonia* were collected. This genus is endemic to the South Island, with most species found in the north-west South Island from Hokitika to D'Urville I (P. Johns, pers. comm.). Most *Neoferonia* species remain undescribed.

In general there was higher species richness at sites with more diverse vegetation. This is due both to the greater variety of plants which are potential food sources present and to the more complex habitat architecture provided by taller vegetation. Nonetheless, each habitat has its own specialist species, so that the change from open, heath-like sites to forested sites will be accompanied by changes in the invertebrate species present, as well as an increase in the number of individuals. Key invertebrate groups, such as the moths, reflect the plant species present. Moths collected during the survey include both generalist feeders and specialists on plants such as *Hebe*, *Juncus*, *Phyllocladus* (toatoa), *Dracophyllum* and ferns.

No snails were collected during these surveys, but a *Rhytida*-type land snail was observed and photographed by Marieke Lettink and Richard Nichol. This may well be the same species collected earlier and identified as *Rhytida perampla* (Mitchell Partnerships & Landcare Research 2001), although it is impossible to confirm this without a specimen. *Rhytida perampla* is a small- to medium-sized snail that occurs widely through the North Westland-Nelson area. For some years specialists in this group have suspected that *R. perampla* and some of the other smaller *Rhytida* species actually represent species complexes (e.g. Efford, 1998). Recent and ongoing DNA examination of the *Rhytida* group supports this view, with the entity currently known as *R. perampla* likely to be divided into as many as eight separate species which will be placed in a new genus in future (F. Brook, pers. comm.). At this stage, all that can be said of the specimen photographed in the proposed mine area is that it is likely to be an undescribed species belonging to a new, undescribed genus (F. Brook, pers. comm.). Five undescribed *Rhytida* species are listed in the Department of Conservation's threat-ranking lists; one as Naturally Uncommon and four as Data Deficient (Mahlfeld *et al.* 2012: Supplementary Appendix 1 (Gastropoda)) but it is unclear how these existing taxa relate to the provisional new taxa and how far the current taxonomic research had extended at the time that the conservation status of these species were assessed.

Leaf-veined slugs (family Athoracophoridae) have also been investigated in some detail in recent years. The number of known undescribed species now exceeds the 20 or so described species from the New Zealand mainland (Burton 1963, G. Barker, pers. comm.). The specimen found during night searching in tall forest at site 7 appears to be a new species, aligned to a group of undescribed *Pseudaneita* species known from the northern South Island at Canaan, Stephens Island and Mt Stokes (G. Barker, pers. comm.). At present, therefore, the Te Kuha site appears to be the only site from which this species is known.

Earlier surveys at Te Kuha have failed to detect *Powelliphanta* snails (Garrick 1986, Mitchell Partnerships & Landcare Research 2001). Similarly no sign of *Powelliphanta* snails was found during this survey. *Powelliphanta* snails can be missed by walkthrough surveys that focus on searching for empty shells on the ground surface (Walker 2012; Mark Hamilton pers. comm., Rhys Buckingham pers. obs.). Hence one should not assume an absence of shell records implies an absence of snails. Nonetheless, given the search effort expended to date, their presence is unlikely. *Powelliphanta patrickensis* occurs on the Denniston Plateau but has not been found further south than the northern slopes of Mt Rochfort, 5km to the northeast of the Te Kuha site (Walker, 2003). A population of the land snail *Powelliphanta augusta* was recently introduced into an area near Mt Rochfort, but this population is also distant from the Te Kuha site.

4.8 Other Fauna

Sign of deer, goat, pig and possum was found during the field surveys. Deer sign was found in 100% of grid cells, goat sign in 13% and pig sign was recorded in 4% of grid cells. Occasional possum droppings (generally quite old) were also found. Stoats and rats are also assumed to be present.

5. ECOLOGICAL VALUES

5.1 Significance Assessment

The Te Kuha area is located within the Buller District and West Coast Region. The significant resource management issues, objectives and policies, including criteria for determining significant indigenous vegetation and significant habitats of indigenous fauna in the district are outlined in Section 4 of the Buller District Plan (**"the district plan"**) which became operative 25 May 2009.

Policy 4.8.7.4 of the district plan sets out the criteria to be used as guidelines to identify areas of significant indigenous vegetation and significant habitats of indigenous fauna for the purposes of Section 6(c) of the Resource Management Act 1991. Criteria include:

1. **Representativeness**: The area is one of the best examples of an association of species which is typical of the ecological district.

2. **Distinctiveness**: The area has indigenous species or an association of indigenous species which is unusual or rare in the ecological district, or endemic, or reaches its distribution limit.

3. **Intactness**: The area has a cover of predominantly indigenous vegetation, is little modified by human activity, and is not affected in a major way by weed or pest species.

4. **Size**: The area of indigenous vegetation or habitat is 5 ha or more in size or together with adjacent indigenous habitat is larger than 5 ha; or in the case of natural wetlands is larger than 1 ha in size.

5. **Protected Status**: The area has been set aside by statute or covenant for protection or preservation.

6. **Connectivity**: The area is connected to one or more other significant areas in a way (through ecological processes) which make a major contribution to the overall functioning of those areas.

7. **Threat**: The area supports an indigenous species or community of species which is threatened within the ecological district or ecological region or threatened nationally.

8. **Migratory Habitat**: The area is important as habitat for significant migratory species or for feeding, breeding or other vulnerable stages of indigenous species, including indigenous freshwater fish.

9. **Scientific or Cultural Value**: The area is a scientific reference area, is listed as a geopreservation site, or has significant amenity value.

Under Policy 4.8.7.5, the Buller District Council will compile a schedule of significant natural areas using the significance criteria identified above as a guideline. This schedule has yet to be completed. The significance of the indigenous vegetation and habitat of indigenous fauna in the Te Kuha area is considered using these criteria below.

5.1.1 Representativeness

The concept of representativeness first appeared in the Reserves Act 1977 section 3(1)(b) which has the purpose of: "Ensuring, as far as possible, the survival of all indigenous species of flora and fauna, both rare and commonplace, in their natural communities and habitats, and the preservation of representative samples of all classes of natural ecosystems and landscape which in the aggregate originally gave New Zealand its own recognisable character." Representativeness with respect to plant communities can be interpreted as embodying vegetation types that are typical in plant species composition and structure; and are of a type which would have existed prior to European colonisation (taken as 1840). In practice few communities are of a type that would have existed prior to 1840, and representative vegetation can be regarded as that where:

- Indigenous plant species dominate.
- Most of the expected species and tiers of the vegetation type(s) are present for the relevant vegetation class.
- The vegetation contains indigenous fauna assemblages that are typical of the vegetation class.
- Indigenous fauna species are present in most of the guilds expected for the habitat type.

In terms of the goal of the Reserves Act, the best or only sites of a particular type in an ecological district or region can be regarded as having high representativeness values, and those where there are many better quality sites could be regarded as having lower representativeness value because they would ensure the survival of fewer species of flora and fauna and fewer ecological (functional) connections relative to better quality sites. The district plan uses the phrase "one of the best examples" to define significance in terms of the Resource Management Act (1991).

Overmars *et al.* (1998) considered the issue of representativeness in relation to RAP7 as discussed in Section 2.4.2 above. They concluded that Mt Rochfort was a better representative example, but that Te Kuha was noteworthy because of its lack of recent disturbance. Of the eight ecological units which Overmars *et al.* (*ibid*.) considered would be included by protection of RAP 7 one (unit 12a [Manuka]/wire rush – tangle fern shrub – rushland) was regarded as having adequate protection already, one is not found at Te Kuha (unit 6, mountain beech – silver beech forest and shrubland) and three would only be affected where they are intersected by the proposed access road (specifically units 1, 2 and 3, rimu/broadleaved forest on coastal hillslopes, mixed beech-southern rata forest (red or silver beech dominant) on coastal hillslopes and hard beech – southern rata – rimu forest on hillslopes respectively). The remaining three units were not adequately protected elsewhere (southern rata – mountain beech forest on Brunner Coal Measures, mountain beech/yellow silver pine – pink pine forest on Brunner Coal Measures and mountain beech/yellow silver pine – pink pine forest on Stockton and Denniston Coal Measures Plateau and Kaiata siltstone) and overlie the coal deposit at Te Kuha and thus would be affected by the proposal to mine there.

The fauna at Te Kuha includes the full complement of bird species which could be expected to be present, although members of the parrot family (kakariki, kaka, kea) do not appear to be present in substantial numbers. The same is true of much of the Ngakawau Ecological District and areas with taller forest, or in the case of kea higher altitude sites, are likely to have more resident parrots. The lizard fauna is also likely to be reasonably complete for the area. Invertebrate communities are broadly similar to other coal measures vegetation, with the notable absence of *Powelliphanta* snails.

Southern rata – mountain beech forest and yellow-silver pine – pink pine forests at Te Kuha are high quality examples of their type, which is under represented in the protected natural areas network. These vegetation types could be considered to rank highly for representativeness for that reason. Good quality examples of the other vegetation types present are found elsewhere within the Ngakawau Ecological District and those present at Te Kuha would have only moderate representativeness value.

5.1.2 Distinctiveness

Distinctiveness describes the relative abundance of the individual ecological communities within the ecological district. All other factors being equal, those communities which are uncommon within the district have greater distinctiveness than those communities that are common within a district. It is also relevant to consider how distinctive a community is within the ecological region.

The coal measures vegetation and fauna at Te Kuha is similar to that present on the coal plateaux further north, but the vegetation lacks some species which are considered typical of coal measures (such as coal measures tussock). Some other species, such as Parkinson's rata, are more commonly encountered at Te Kuha than they are on the coal plateaux. Fauna communities are more similar to those further north.

The abundance of the different vegetation types described in this report surrounding the coal deposit is discussed in Section 4.1 above. As noted in Section 2.2, the Ngakawau Ecological District is the only ecological district in the country which comprises (in part) coal measures vegetation. Hence coal measures vegetation is unique in the ecological region and nationally. Tarns are also recognised by Williams *et al.* (2007) as historically rare ecosystems (as identified in Section 2.5). The ecological communities at Te Kuha are ranked moderate – high for distinctiveness on that basis.

5.1.3 Intactness

This value refers to the relative degree of modification and the vulnerability of the communities to modifying forces. Both of these factors may be different for different components of the community of interest.

Apart from the small area immediately around the transportable hut, human induced modification of the vegetation at Te Kuha is noticeably absent. Even former drill sites are dominated by native vegetation and the ingress of weeds is surprisingly low.

Native species of fauna dominate at the site, although bats are apparently absent.

The vegetation and habitats at Te Kuha rank very highly for intactness.

5.1.4 Size

The value and long term sustainability of an area is closely related to its size and shape. The shape of an area affects its relationship to the surrounding land. Shape is of most significance when considering isolated remnant populations because it reflects the ability of external forces such as climate, weeds and pests to influence the area. The Te Kuha site exceeds the 5 ha threshold in the district plan and would therefore trigger this criterion.

5.1.5 Protected Status

The purpose of protecting particular areas varies and the protected status of any individual area may have been conferred primarily by the Conservation Act (1987), the Reserves Act (1977) or the Wildlife Act (1953) depending on how and why it came to be protected.

The Westport Water Conservation Reserve is a local purpose reserve under the Reserves Act (1977). Although parts of the reserve, including the proposed mine site, are outside the water catchment area, their protection was recommended for ecological reasons by Overmars *et al.* (1998).

By virtue of its protected status the site is significant with respect to this criterion.

5.1.6 Connectivity

Connectivity refers to the position of the area under consideration in relation to other areas of habitat and the level of connectedness between areas. Particular areas or habitats may enhance connectivity between patches and / or buffer or similarly enhance the ecological values or processes of a specific site by increasing community resistance or resilience in the face of external forcesor by being seasonally important.

The Te Kuha area is well connected to surrounding habitats, including the forests of the Lower Buller River to the south, the Mt Rochfort Conservation Area to the north and east, and pakihi on German and Caledonian Terraces within the Ballarat Stewardship area to the west. The site ranks highly for connectivity.

5.1.7 Threat

An area scores positively for this criterion if it is known to support a species that is listed as threatened in the current version of the New Zealand Threat Classification System (Miskelly *et al.* 2008 for birds, de Lange *et al.* 2009 for plants, O'Donnell *et al.* 2010 for bats, Allibone *et al.* (2010) for fish, Hitchmough *et al.* 2012 for lizards and Hitchmough *et al.* 2007 for all other species) or supports a species that is at a national distribution limit, is endemic (only occurs in that area) or although common elsewhere is particularly uncommon in the area under consideration.

The Te Kuha area is home to two threatened bird species (great spotted kiwi and New Zealand falcon) and a number of at risk species including plants (*Dracophyllum densum* and *Euphrasia wettsteiniana*), birds (South Island rifleman, South Island fernbird, Western weka) and lizards (forest gecko and speckled skink). It is also home to at least one threatened bryophyte (*Saccogynidium decurvum*) and at least four at risk bryophyte species including *Herzogianthus sanguineus*, *Riccardia multicoporea*, *R. furtiva* and *Zoopsis bicruris*. The site ranks moderately high for threat.

5.1.8 Migratory Habit

Both species of migratory cuckoo (long-tailed cuckoo and shining cuckoo) have been recorded in the Te Kuha area, but it is unlikely that habitats at Te Kuha are any more important to these species than other habitats in the vicinity where their host species (grey warbler and brown creeper respectively) are found. The Te Kuha area is considered of moderate – low significance for this criterion.

5.1.9 Scientific or Cultural Value

No sites of scientific value are known to occur at Te Kuha, but in the event of either the leaf-veined slug or the *Rhytida*-like snail being new species, then Te Kuha would become the type locality which would afford a moderate level of significance. In pre-European times Maori use occurred from the coast to the high plateau of the Waimangaroa and Te Kuha was one of the 'chain' of places used by Poutini Ngäi Tahu when travelling the length of the West Coast (Department of Conservation 2010). The significance of this observation is not assessed here.

5.2 Conservation Management Strategy

The Conservation Act (1987) requires the Department of Conservation to prepare a Conservation Management Strategy (**"CMS"**) for each conservancy. The CMS applies only to conservation land administered by the Department of Conservation, and hence does not apply to the Te Kuha coal resource (which is located within a local purpose reserve administered by Buller District Council), but does apply to the parts of the proposed access road which are located on public conservation land. Because of the large amount of public conservation land in the vicinity, the CMS does set the tone for ecosystem management in the surrounding environs. The CMS relevant to Te Kuha establishes objectives for the integrated management of natural and historic resources, including species managed under a number of different Acts (including the Wildlife Act 1953), and for recreation, tourism and other conservation purposes within the West Coast Tai Poutini Conservancy over a 10 year period between 2010 and 2020 (Department of Conservation 2010).

In the event that the Westport Water Conservation Reserve status were revoked over part or all of the existing reserve, it is most likely that the land would be returned to the Department of Conservation in accordance with the recommendation by Overmars *et al.* (1998). The site is surrounded by public conservation land and could be expected to be managed in a similar way to neighbouring land, even if it remains a water conservation reserve. Hence the CMS for the area is a relevant consideration.

Te Kuha is located within the Kawatiri Place management unit identified by the Department of Conservation (Department of Conservation 2010). Te Kuha is not located within Buller Coal Plateaux priority site (see Map 8 of the CMS) and can be assumed to be a low management priority for that reason.

The goal of the CMS for the Kawatiri Place is for natural heritage values to be maintained and, where practicable, protected and enhanced. Goals relating to coal measures vegetation in 2020 are:

- Rehabilitation is actively pursued on coal measure ecosystems and related freshwater ecosystems that were mined in the past.

- The infertile, acidic often waterlogged soils support distinctive open moorlands of specialist tussock and shrubland communities. These communities are dominated by the endemic coal measure tussock *Chionochloa juncea*, red tussock, and low shrublands of prostrate manuka, yellow-silver pine and pygmy pine.

- A representative sample of viable coal measure ecosystems and landscapes on the Buller Coal Plateaux priority site is legally protected.

- The natural character of previously modified areas is improving as invasive weeds, including gorse, broom and *Juncus squarrosus* are controlled and four-wheel driving is confined to existing formed roads.

- The Buller coal plateaux priority site (which includes part of Denniston Plateau) supports viable populations of locally endemic giant land snails, including *Powelliphanta patrickensis* and *P*. “Augustus[6]”, the great spotted kiwi (roroa) and a high diversity of bryophytes.

In the absence of specific goals for the Te Kuha site in the CMS another goal that could be considered applicable to coal measures vegetation at Te Kuha is that the gently rolling terrain at altitudes of 600-900 m above sea level continue to be dominated by non-forest vegetation communities. The CMS articulates this goal for the Denniston and Stockton plateaux.

The establishment of a coal mine at Te Kuha is not inconsistent with the goals articulated within the CMS provided that some habitats are protected from mining, rehabilitation is completed to a high standard and weeds are prevented from expanding across the site.

5.3 Other Matters

The Department of Conservation and the Ministry for the Environment have published national priorities for protecting biodiversity on land which is not legally protected as public conservation land (Department of Conservation and Ministry for the Environment 2007). The Te Kuha site is legally protected as a water conservation reserve, rather than for protection of biodiversity per se, and hence these priorities have some relevance.

Although these priorities have no statutory weight, they recognise the following as significant indigenous vegetation or significant habitat of indigenous fauna:

i. The naturally uncommon ecosystem types listed in Schedule One of the Department of Conservation and Ministry for the Environment (2007). Schedule One lists 35 naturally uncommon ecosystem types including tarns and sandstone erosion pavements.

ii. Indigenous vegetation or habitats associated with sand dunes.

iii. Indigenous vegetation or habitats associated with wetlands.

---

6 This species has now been described as *P. augusta* (Walker *et al*. 2008).

iv. Land environments, defined by Land Environments of New Zealand at Level IV (2003), that have 20% or less remaining in indigenous vegetation cover. The land environments near the proposed Te Kuha mine site are discussed in Section 2.5.

v. Habitats of threatened and at risk species.

The only rare ecosystem affected by the proposal to construct an opencast mine at Te Kuha is one small tarn. The site also includes a small area of wetland herbfield and habitats of threatened and at risk species. The indigenous vegetation and habitats are considered significant in terms of the Resource Management Act (1991), but have not yet been reduced in area to the extent that they would be regarded as threatened under the Threatened Environment Classification framework.

6. POTENTIAL EFFECTS

6.1 Vegetation

6.1.1 Vegetation Clearance

Effect on Vegetation Types

The extent of each of the vegetation types affected by the proposal is shown in Table 1. Ten of the 12 vegetation types affected are natural, and indeed vegetation across most of the Te Kuha site is predominantly natural and highly intact. The vegetation present is well connected to surrounding natural areas and has a low weed presence.

No threatened species were identified during the surveys. Two species recorded, *Dracophyllum densum* and *Euphrasia wettsteiniana*, are regarded as “At Risk”. *D. densum* is restricted to the manuka – *Dracophyllum* rockland vegetation type (4.30 ha of which would be affected, this represents 27.4% of the local coal measures), and *E. wettsteiniana* is restricted to herbfield (0.04 ha, all of the local herbfield would be affected).

Within the proposed disturbance area the vegetation comprises 47.5 ha of mountain beech/yellow-silver pine – pink pine forest (20.4% of that found with the local coal measures), 10.08 ha of other forest, 22.71 ha of shrubland and 0.96 ha of pakihi vegetation. The remainder of the area proposed for disturbance comprises a small tarn (around 3 m^2), areas of bare ground (0.12 ha) and areas of pasture (0.36 ha). The affected vegetation provides habitat for fauna and the effects of vegetation clearance on fauna are considered in Section 6.4 below.

The amount of clearance proposed at Te Kuha is not sufficient to place any of the vegetation types described and considered here at unacceptably high risk of total removal: more than 20% of all the vegetation types recorded will remain within the Ngakawau Ecological District where large amounts of most vegetation types are protected. Furthermore more than 20% of the vegetation type will remain within the larger (471 ha) patch of coal measures vegetation at Te Kuha. This indicates that for the plant species found there, adverse effects at the population level are unlikely, provided that the effect of exotic weeds can be reduced.

Weeds, particularly gorse (*Ulex europaeus*) and the exotic heath rush (*Juncus squarrosus*), are a common feature of previously mined areas in the Buller District, but are notably absent at Te Kuha. These and other weeds, such as montbretia (*Crocosmia* x *crocosmiiflora*) or broom (*Cytisus scoparius*), are readily introduced on roading material or vehicles and, if allowed to seed, produce a seed bed (or corms in the case of montbretia) which persist in the soil for prolonged periods. The use of soil and other material in rehabilitation means that the potential exists for these weeds to establish and spread across the site when the soils where they establish are re-spread in rehabilitation. This has the potential to compromise mine closure, and to affect surrounding natural habitats, if not properly managed. The risk of weed invasion will be minimised according to the management outlined in Section 8.2 below.

Effect on Locally Important Species

Dracophyllum densum is found from the southern Paparoa Ranges north to Mt Gouland (inland from Kahurangi Point). *D. densum* is locally common at Stockton and

Denniston, including in areas protected from mining. Given the presence of the population at Mt Rochfort, and other examples of the species in similar habitats, removal of around 21% of the *D. densum* habitat at Te Kuha is unlikely to affect the persistence of *D. densum* populations in the wider area. Both *D. densum* and *D. pubescens* survive transplanting well and this method could be used during rehabilitation to ensure these species persist at the site.

E. wettsteiniana is endemic to west Nelson and North Westland and is largely confined to boggy ground. *E. wettsteiniana* is a tiny plant with insignificant leaves which is easily overlooked except when flowering. Its preferred habitat is well represented within the poorly drained rushland sites and pakihi of German Terrace and Caledonian Terrace, but these habitats might be vulnerable to removal due to natural succession. Intact transfer of herbfield vegetation is the method most likely to ensure some individuals survive, since this species is hard to propagate. Direct transfer could help to maintain this species at the site, but the outcome of this method for *E. wettsteiniana* remains unknown. We recommend that the herbfield vegetation be prioritised for direct transfer and *E. wettsteiniana* be monitored to determine its survival.

Celmisia dubia is locally common throughout the shrubland and open habitats at Stockton, Denniston and Te Kuha. *C. dubia* has a light, wind-dispersed seed which does not persist long in the seed bank, but readily colonises rehabilitated areas, including areas of directly transferred vegetation. The removal of large numbers of *C. dubia* has the potential to affect the local population, but this will be mitigated by the large amount of habitat remaining as well as by minimising the amount of active works at any one time and the prompt availability of rehabilitated landforms after mining is completed. This is expected to allow *C. dubia* to colonise newly created landforms without further assistance. No adverse effects at the population level are expected.

Actinotus novae-zelandiae has a localised distribution in New Zealand, confined to montane to subalpine bogs and herbfields throughout the South Island and Stewart Island (Overmars *et al.* 1998). It occurs throughout coal measures vegetation, including at Te Kuha, where it prefers cushion bogs and flush areas in forest and scrub. This species appears to be quite widespread with records from Mt William North, Mt William range, Marshall's Mine and at Denniston (Mitchell Partnerships & Landcare Research 2001, Mitchell Partnerships Ltd 2011, 2012, Overmars 2011). No adverse effects at the population level are expected, particularly if this species survives direct transfer of the herbfield area.

Metrosideros parkinsonii is present and commonly encountered at Te Kuha where it occurs as an element of shrublands and forest vegetation. The removal of vegetation which might include *M. parkinsonii* could affect a significant number of individuals but the abundance of this species at Te Kuha means that seeds will be available to re-colonise the site. Supplementary planting of *M. parkinsonii* will assist in this regard.

6.1.2 Edge Effects

In natural transitions between open habitats and taller vegetation such as forest, a natural edge of smaller shrubs and shorter canopy develops over time which serves to armour the forest to some degree against the climatic variables that prevail within the shorter vegetation outside. Sudden transitions in vegetation brought about by human activity can increase daily fluctuations in climatic variables such as wind speed, temperature and humidity in the exposed forest, the extent of which depends in part on the type of vegetation present and in part and the degree of exposure for the new edge (Norton 2002). These are called edge effects. Edge effects reported in New Zealand include a reduced number of species up to 40 m into forest patches, but any effects are not consistent for all species, since some are adapted to living in edge conditions.

At Te Kuha it could be expected that newly exposed taller forest/scrub edges would be subject to edge effects. This may reduce the suitability of surrounding habitat for moisture-requiring species such as bryophytes or invertebrates like snails and leaf-veined slugs.

The existing vegetation is a complex mosaic with a high proportion of natural edge. The removal of vegetation will create approximately 21.2 km of new cut edge around the site. The new edges created around the perimeter of the pit and along roadsides will be more abrupt and more clearly defined (at least initially) than the existing habitat edges and the vegetation will no longer be buffered from changes in microclimate by surrounding vegetation as it currently is. This will affect vegetation for varying distances from the newly exposed edge depending in part on the height of the edge vegetation. Typical microclimate changes associated with vegetation edges include increased exposure to wind, decreased humidity, increased solar radiation and temperature and increased variability in microclimate. The gradient for these changes may be rapid, as it is for light, or more gradual, as it is for wind speed, and may affect different species differently and for varying distances into the interior (Davies–Colley *et al.* 2000; Norton 2002; Ewers and Didham 2008). A useful rule of thumb is that vegetation within a horizontal distance up to twice the vertical height of the canopy at the edge is likely to be affected. When this is applied to the vegetation types around the pit perimeter at Te Kuha approximately 21 ha of edge vegetation would be created. The worst affected vegetation type would be the tall rimu/hard beech forest (around 16 ha of new edge habitat would be created).

The documented microclimate changes due to the presence of exposed edges vary according to vegetation type, edge orientation and edge age (Norton 2002). The types of abiotic changes described may cause the death of individual plants that cannot cope with such changes, and lead to a change in species composition, species abundance and species interactions at the edge over time (Young and Mitchell 1994; Norton 2002). The effect of edges is not adverse for all species, but edges may also be prone to invasion by exotic species (Lloyd *et al.* 2000; Norton 2002). Sequential mining of small areas will reduce the amount of exposed edge at any one time. Other management actions to minimise any adverse effects due to the creation of new edge habitat are described in Section 8.2 below.

6.1.3 Effect of Dust on Vegetation

The effect of dust on vegetation depends on:

- The deposition rate.
- Meteorological conditions (including the amount of wind and rain).
- Vegetation characters (surface roughness, height, shape, wetness, leaf area).
- Size of dust particles.
- Dust chemistry (including pH and concentration of trace elements).
- Distance from the source of the dust.

The effects of dust could be physical, for example by blocking stomata, shading or abrading leaves or increasing drought stress, or chemical, affecting either the leaf surface or the soil. These effects could lead to changes in species composition over time (Naidoo & Naidoo 2005).

Wetlands may be particularly sensitive to heavy deposition of dust because of their potential to accumulate sediment. Sequential mining of small areas is proposed which will reduce dust effects, but because the haul road will be operational for the life of the mine the habitats surrounding the road coal handling and processing plant are considered those most likely to be affected by dust.

No species at Te Kuha is known to be particularly sensitive to the effects of dust, although we could find no studies investigating effects of dust in the New Zealand situation. The high rainfall at Te Kuha, combined with small working surfaces which are promptly rehabilitated, are expected to minimise any adverse effects due to dust on habitats and vegetation. Dust emissions from activities at Te Kuha are expected to be limited to dry spells because rainfall will settle dust and wash accumulated dust from plant surfaces. We recommend that dust management measures using water tankers and rain guns be made available as necessary. Provided that dust management measures are followed no adverse effects on vegetation or fauna are expected.

6.1.4 Hydrology and Drainage

Existing plants and communities might also be affected by changes in local hydrology or drainage patterns. For example species growing near cut off drains or on road edges might be subject to either increased ponding or more prounounced drying out of the soil substrate or both. Re-creating exact pre-mining hydrological conditions for vegetation that is directly transferred may also prove difficult in which case the community transferred is likely to change over time to adapt to the prevailing hydrological regime. Monitoring of the hydrology at the herbfield wetland prior to mining commencement is recommended to allow a more complete understanding of pre-mining hydrology so that the conditions can be replicated to the extent practicable during rehabilitation.

6.2 Bryophytes

The Te Kuha site is known to provide habitat for significant bryophytes and the area sampled has a high density of significant species (Mitchell Partnerships & Landcare Research Limited 2001). In particular the yellow-silver pine – manuka shrubland typified by Plot 3 exhibited an unusually high diversity of bryophyte species (Mitchell Partnerships & Landcare Research Limited 2001). Approximately 8.3 ha of this vegetation would be affected by the current proposal. This vegetation type is present outside the proposed footprint, and is also amenable to direct transfer. We recommend that this type of vegetation be prioritised for direct transfer in order to maximise the retention of bryophyte species at the site.

6.3 Rare Ecosystem Types

Mining and other activities proposed at Te Kuha would remove approximately 3 m^2 (0.0003 ha) of tarns. The largest tarn in the vicinity would be unaffected. The usually small size of tarns and seepages renders them difficult to distinguish on aerial photos and we may have underestimated the extent of these small features.

No known boulderfields would be affected by the proposed mining project.

It is technically achievable to re-create both boulderfields and tarns during rehabilitation of a mine site and these methods should be employed at Te Kuha. Data on the value of these rehabilitated ecosystems as habitat is lacking however, and monitoring requirements should be discussed with the Department of Conservation prior to rehabilitation commencing.

6.4 Conservation Values in Relation to RAP7

A large part of the Water Conservation Reserve lies beyond the actual water catchment boundaries, and the proposed mine site is situated outside that catchment. The reasons given in the PNAP report for protecting the Te Kuha area are the absence of recent fire, relative lack of access and degree of intactness (Overmars *et al.* 1998). The surveys described here have confirmed the continued intactness of the site.

The ecological units found within RAP7 are widely present elsewhere in the Ngakawau Ecological District and are generally well represented in the Mt Rochfort RAP (Overmars *et al.* 1998). Mt Rochfort clearly contains a greater altitudinal range and a greater range of plant communities, but parts of the Mt Rochfort area, including the Denniston Plateau and lower altitude areas, have been modified to varying degrees. Nonetheless, habitats at Mt Rochfort are well connected to the Mt William Range and the Orikaka area, as well as the plateau vegetation to the north and vegetation to the south. The very much larger areas of the various habitat types at Mt Rochfort, and the greater diversity of habitats and plant species (including tussocks) presents an opportunity to protect a wider range of biodiversity there.

The PNAP report identifies eight ecological units that would be achieve a more secure level of protection by protection of RAP 7. Although these ecological units are not directly comparable with the vegetation types described here, the effect on each ecological unit is as follows:

- Rimu/Broadleaved forest on coastal hillslopes, hard beech – southern rata – rimu forest on hillslopes. There is approximately 87.9 ha of equivalent rimu/hard beech or mixed beech forest within the local coal measures outcrop. 10.08 ha (11.5%) of this would be affected by the proposal.

- Mountain beech/yellow silver pine – pink pine and Southern rata – mountain beech forest on Brunner Coal Measures. There is approximately 233.1 ha of this vegetation within the local coal measures outcrop. Of this 47.5 ha (20.4%) would be affected by the proposal.

- [Manuka]/wire rush – tangle fern shrub – rushland on Stockton and Denniston Coal Measures Plateau and Kaiata siltstone. There is approximately 14.7 ha of manuka – *Dracophyllum* rockland, 104.7 ha of manuka shrubland and 42.6 ha of manuka – yellow silver pine shrubland present within the local coal measures vegetation – a total of 163 ha of manuka dominated vegetation. Of that 25.83 ha (15.9%) would be affected by the proposed mining activities. This unit was regarded by Overmars *et al.* (1998) as having adequate protection elsewhere.

- Mixed beech-southern rata forest (red or silver beech dominant) on coastal hillslopes and Mountain beech – silver beech forest and shrubland on

Stockton and Denniston Coal Measures Plateau and Kaiata siltstone. These vegetation types do not occur within the proposed mine or access road footprints.

The proposal to construct an opencast coal mine at Te Kuha will not remove the only examples of the vegetation types found there, except in the case of herbfield vegetation (Table 10). Rather most vegetation types are well represented within either the Mt Rochfort Conservation Area or the Westport Water Conservation Reserve or both. Small areas of coal measures vegetation also occur within the Lower Buller Gorge Scenic Reserve (Table 10). Of the approximately 490 ha of coal measures vegetation at Te Kuha around 412 ha would continue to be represented within reserves if the project were to proceed.

Table 10: The extent of Brunner Coal Measures vegetation in the vicinity of the Te Kuha project site.

Vegetation Type	Extent Affected By Proposal	Extent Remaining Within Mt Rochfort Conservation Area (Ha)	Extent Remaining Within Westport Water Conservation Reserve (Ha)	Extent Remaining Within Lower Buller Gorge Scenic Reserve (Ha)
Herbfield	0.04	0.25	0	0
Manuka - *Dracophyllum* rockland	4.3	0.92	10.45	0
Manuka shrubland	13.26	1.01	89.85	0.54
Mountain beech/yellow silver pine - pink forest	47.5	14.42	166.45	4.71
Rimu - red beech - silver beech forest	1.44	0.0003	1.44	0
Slips/bare ground	0.12	0.05	0	0
Tarn	0.003	0	0.074	
Yellow silver pine - manuka scrub	8.27	0.03	34.33	
Rimu/hard beech forest	2.44	0	79.3	8.58
Total	77.37	16.68	381.89	13.83

With the exception of herbfields, all of the ecological units affected by mining at Te Kuha are present elsewhere both within the local coal measures outcrop, and elsewhere within the Ngakawau Ecological District. None of the ecological units affected would be reduced in extent by more than 28% if mining were undertaken at Te Kuha. On that basis it would be possible to achieve representative reserves of these vegetation types even if mining at Te Kuha were to proceed.

The Te Kuha site is currently well buffered from surrounding land uses by surrounding conservation land. In the absence of coal mining the likely threats to the vegetation and fauna include accidental fire and the chronic pervasive effects of introduced mammals and weeds.

Protecting the intactness of the area surrounding the site if mining proceeds poses a challenge because construction of an access road and mine will allow weeds access. Some weeds are likely to establish even if strict biosecurity measures are employed and when they do, they would very likely spread to other surrounding habitats, potentially reducing the ecological value of those habitats. The surveys described here have demonstrated that mammal pests are already widespread through the area, although construction of an access road may improve access for pests, and furthermore rehabilitation and planting might provide new habitats (e.g. for hares) and a more easily accessible food source (e.g. for deer). Steps that would reduce the risk of weed and pest invasion are discussed in Section 8 below.

At the scale of the ecological district once rehabilitation is completed at Te Kuha, the representative vegetation types which contribute to defining the ecological district would still remain in localities such as the Upper Waimangaroa RAP (including the Solid Energy Deed Area), parts of the Mt Rochfort Conservation Area and the parts of the Te Kuha coal measures vegetation that remain unaffected by mining. The secondary vegetation regenerating after the mining disturbance would predominantly comprise native species and would be such that natural ecological succession would assist in the long term restoration of community intactness and diversity across the site. Such vegetation would still contribute to maintaining indigenous biodiversity, even though it has been modified.

6.5 Effects on Fauna

6.5.1 General Effects

Mining has both direct and indirect effects on fauna. Direct effects include being killed on access roads or during vegetation stripping or construction of the mine while indirect effects include being displaced or having to compete with neighbouring individuals for a reduced amount of habitat. Indirect effects also include the effects of increased human activity, noise, lighting and the like. The nature and magnitude of these effects varies with the habits of the particular species concerned, but tends to be increased during the breeding season.

The principal adverse effect on fauna within the Te Kuha project area is the removal of habitat caused by stripping vegetation and soils on the mine surface and along the length of the proposed road. Additional loss of habitat will occur with the establishment of other mine infrastructure. Dust, noise, blasting, lighting, edge effects and increased human activity will also affect fauna, but these effects will generally be local in their influence and can be minimised. Because this is a previously undisturbed site there is also increased risk of fire, slope or hydrological (culvert or dam) failure and chemical spills. The invasion of pests and weeds could be facilitated if these risks are not adequately managed. The effects of the proposed activities on the key fauna species known to be present are outlined below.

6.5.2 Great Spotted Kiwi

The effects of the mining activities will include the loss of habitat, and disturbance by noise, lights and the increased presence of people and machinery. The removal of vegetation and soil from the pit and areas associated with the access road will remove kiwi habitat from the area for the life of the mine and until habitat restoration is complete following mine closure (a period of 30-50 years after rehabilitation is completed). These effects could contribute to the death of adult birds, eggs or chicks, or lead to a decrease in survival and / or productivity. It is considered unlikely that mining at Te Kuha would result in the loss of all of the adult birds present, but management of individual birds would reduce this risk even further.

Great spotted kiwi are found in relatively low densities at Te Kuha compared to stronghold areas such as the Orikaka Valley/Mt William Range/Ngakawau Valley and Paparoa National Park. The apparent increase in kiwi densities with altitude observed during this survey is consistent with results of other surveys for great spotted kiwi. Unmanaged kiwi populations are more likely to persist in high-altitude forests where higher rainfall and lower temperatures are less suitable for their predators.

The surveys described here indicate that the Te Kuha area is home to at least one pair of kiwi and perhaps a small number of individual birds as well. The amount of time that each bird spends in the part of its range that would be affected by mining is not known and some birds may be more affected than others by the activities proposed there. Those kiwi whose territories include only a small proportion of the mine habitats or the road would be affected quite differently to those with territories entirely within the mine footprint. The former may adjust naturally to utilise other areas of their home range, whilst those who occupy the proposed mine area may be so affected that their welfare is better ensured through capture and translocation to other suitable habitat.

The re-settlement of displaced kiwi to areas that are already occupied will indirectly affect the resident kiwi through the social disruption associated with competition for territory space. These direct and indirect effects on great spotted kiwi will inflict a cost in terms of energy expenditure and could reduce the survival and reproductive fitness of individuals.

It is expected that mining, rehabilitation and natural development back to an ecosystem that can support kiwi may take up to 50 years. Over that period, assuming productivity consistent with kiwi pairs reported in the literature (McLennan *et al.* 1996), and that adult kiwi at Te Kuha lost to natural mortality are currently being replaced naturally, one pair of kiwi could be expected to produce around 20 chicks (approximately one chick per pair every 2.5 years, McLennan *et al.* 1996). Of those, around 88% (18 individuals) would fail to reach adulthood due to predation (McLennan *et al.* 1996). Thus the lost productivity caused by development at Te Kuha equates to around four adult kiwi. This estimate assumes that the current pair would be killed or have their productivity reduced to zero (two birds, which is unlikely), and accounts for any offspring that could have successfully been reared over the life of the mine in the absence of predator control (another two birds). In practice the resident birds could be managed to protect them (for example by relocation). Individual birds are assumed to be less affected and to re-distribute themselves accordingly.

Once mine rehabilitation is completed and shrublands have been restored to suitable locations around the site, kiwi will begin to use them again, although the habitats will take more than 50 years to achieve a quality equivalent with similar (but unmodified) habitats elsewhere. Whether or not re-occupation of rehabilitated surfaces occurs will depend largely on the availability of dispersing juveniles at the time the habitat is able to support them. Within areas that receive stoat control, approximately half of all chicks produced could be expected to survive to adulthood (J. McLennan pers. comm. 2011).

6.5.3 Other Birds

The abundance and distribution of avifauna varies considerably throughout the Buller District and surrounding areas due to the range of habitats present (e.g. coastal and subalpine forest, regenerating scrubland, pakihi tussockland, rushland, wetland, coal-measures vegetation and sandstone pavement) and the degree of human disturbance due to mining, farming and other activities. Highest concentrations of birds are typically found in forest habitat, while coal-measures scrubland, sandstone pavement areas and pakihi generally support comparatively fewer species. At heavily modified sites introduced species predominate. However, the connectivity of these habitats, both on a geographical and altitudinal scale, may be important for the seasonal movements of many birds.

The relatively high number of native species found at Te Kuha is indicative of the intact nature of the vegetation, the altitudinal sequence of habitats and the extensive connectivity with adjacent habitats. The number of individuals could be expected to be comparatively low because of the amount of non-forested habitat (shrublands and low growing vegetation) and the presence of introduced mammals. The surveys conducted so far indicate that this is the case.

The main effects of mining on native birds include loss of habitat through the removal of soil and vegetation, loss of seasonal food sources (as a result of vegetation and soil removal), direct mortality of individuals (including eggs and chicks in nests, and possibly roosting birds) when areas are being cleared (or when run over by mining vehicles), reduced breeding success and indirect mortality due to stress as a result of enforced emigration and disturbance. Ground dwelling birds like western weka and great spotted kiwi are particularly susceptible to being struck by vehicles on the road. Habitat removal can also cause fragmentation of habitats which can lead to the loss of connectivity between bird populations. Dust, vibrations, noise and the use of bright lights at night during mining operations have similar effects.

In addition to kiwi, one other threatened bird species was detected in the proposed Mt William North mining area (New Zealand falcon). New Zealand falcons were not observed during the 1986 or 1999 field surveys (Garrick 1986; Mitchell Partnerships & Landcare Research 2001), but falcon were known from the area in 1986. Only one record was obtained within the mining in 2013.

Bush falcons are widespread but sparse in the Buller Region, and are infrequently recorded. Falcons use large territories where they hunt live prey, often along forest edges. Juvenile falcons wander widely during autumn and winter (Heather and Robertson 1996). Very few falcons were recorded north of Hokitika on a number of extensive bird surveys for Timberlands West Coast Ltd in the 1990s and early 2000s (Buckingham 1999, 2002; Buckingham & Brown 1996; Buckingham & Nilsson 1994a&b). Falcons were occasionally recorded in the Orikaka Valley where a nest was found in November 1998 (Buckingham 1999) and the Mokihinui Valley in the 2000s (Mitchell Partnerships 2007; Powlesland 2011). Falcons were rarely recorded in the Ohikanui Valley and not recorded in its lower reaches, or at the lower part of the Buller Gorge during Ecology Division bird surveys in the 1970s (Wilson *et al.* 1988). Falcons have only very rarely reported on the Denniston and Stockton Plateau (Buckingham 1998c, 2008b; Powlesland 2012; Thomas *et al.* 1997). An individual or pair of falcon within such a low density population are unlikely to be killed by the removal of around 85 ha of habitat within their territory, but would likely adjust their boundaries accordingly.

Four species present in the proposed mining area are regarded as “At Risk (declining)” by Miskelly *et al.* (2008). These are western weka, South Island fernbird, New Zealand pipit and South Island rifleman.

Western weka are found in moderate to low density at Te Kuha, although they were more common at lower altitudes. Similar moderate to low density has been observed in the habitats on the Stockton Plateau where they favour dense shrubland and forest habitats rather than open sandstone and pakihi. Weka are also widespread elsewhere in the Buller region, where they are most conspicuous in lowland coastal areas near forest, farm or scrubland edges. The proposed mine site would provide habitat for perhaps four pairs of weka, and individuals and pairs would also be affected by the proposed road development in a similar way to kiwi. Weka are birds of shrubland as well as forest and would probably use the rehabilitated mine site more promptly than kiwi. Weka can make up to four breeding attempts per year with up to four eggs per clutch, although predation on chicks and juveniles is high (Bramley and Veltman 2000). Assuming the four resident pairs within the mine footprint are killed and that weka habitat returns within 30 years, the proposal could cause the loss of around 720 adult weka over the life of the mine. As with kiwi, whether or not re-occupation of rehabilitated surfaces occurs will depend largely on the availability of dispersing juveniles at the time the habitat is able to support them.

The distribution of the South Island fernbird is mostly restricted to the western and southern South Island (Farewell Spit to Milford Sound, and in Southland and southern Otago) (Robertson *et al.* 2007). South Island fernbird are particularly common at Te Kuha and in dense shrublands and fernlands in parts of the Blackburn Pakihi, and in the Weka Creek catchment on the Stockton Plateau, but are found infrequently in open habitats or forest (Buckingham 1998a, R. Buckingham pers. obs.). Since the species has a threat status of “At Risk (declining)” (Miskelly *et al.* 2008), their widespread distribution in the Buller District, and their locally high densities in some places, is of note.

Suitable fernbird habitat is low, dense vegetation interspersed with emergent shrubs in swamps, pakihi, rushes, and tussocklands (Heather & Robertson 1996). Around 22 ha (or 24%) of the proposed mine and road footprint is covered by shrubland and pakihi vegetation which is suitable fernbird habitat. No ecological studies have been undertaken of fernbird in subalpine coal-measure habitat like that at Te Kuha, but studies at lower altitude indicate fernbird pairs occupy around 6 ha and lay two clutches of three eggs per year (Powlesland 2012). Thus removal of fernbird habitat at Te Kuha could result in the loss of around 360 fernbird over the life of the mine.

New Zealand pipits are present in low to moderate numbers throughout open and low-scrub areas along the ridgeline at Te Kuha. They also occur at Stockton and Denniston Plateaux and Blackburn Pakihi. Pipits are present throughout the Westland region, typically in high-altitude open habitats and areas of rough pasture. They are absent from densely forested or intensively farmed areas. Beauchamp (1995) reported densities of between 1.0 and 2.5 pipits/km^2 in suitable habitats near Wellington, and up to 6.22 birds/km on transects. Beauchamp (2009) found that habitat use by pipits varied seasonally in Tongariro National Park, but that densities averaged 0.7 birds/km on transects through open grassland in winter and spring and 1.13 birds/km from January to March. Densities in Tongariro National Park were higher in wetland areas (up to 9.7 birds/km in late summer and autumn at Lake Te Whaiau). Because pipits prefer open habitats, mine rehabilitation could create suitable habitat quite quickly (perhaps within 15 years). Assuming similar densities of pipits at Te Kuha to those reported by Beauchamp, the proposal to mine there could result in the loss of perhaps three pairs of pipits and a total of around 180 individuals over the life of the mine.

Other threatened or at risk species which may be present at Te Kuha area include South Island kaka and kea. Kaka are likely to be no more than seasonal visitors to the area since the proposed mine site does not contain a high proportion of preferred habitat for these species. Extensive areas of beech forest habitat with a high proportion of podocarps of the type favoured by kaka are found in the Orikaka valley, and particularly in the South Branch of the Mokihinui. Predators are presumed to be limiting kaka in areas such as the Mokihinui valley where kaka are not as common as expected given the quality of habitat present there (Wildlife Surveys Ltd 2011).

Kea (*Nestor notabilis*), which are regarded as naturally uncommon by Miskelly *et al.* (2008), have been occasionally recorded within the Mt William Range/Stockton Plateau area, though they are thinly spread throughout the mountains of North West Nelson and the northern part of the West Coast.

Neither species of cuckoo are likely to be affected at the population level by habitat removal at Te Kuha since they are dependent on common hosts to rear their young (grey warblers (*Gerygone igata*) in the case of shining cuckoos and brown creepers (*Mohoua novaeseelandiae*) in the case of long-tailed cuckoos).

6.5.4 Lizards

It is possible to make some inferences about the potential distribution of lizards within the Te Kuha area, based on their habitat preferences and the low encounter rates observed in this and other surveys conducted in North Westland. The proposed Te Kuha mining area reaches a maximum elevation of approx. 800 m asl, which is within the altitudinal limits of the three lizard species likely to be found there. The arboreal forest and West Coast green geckos are likely to be present at low densities in forest, shrublands and rocky habitats throughout the area. The speckled skink is terrestrial and requires basking sites on or close to the ground. It is therefore restricted to areas with more open vegetation, such as shrublands, wetlands and rocky areas. Any arboreal geckos living in the forests and shrublands, and the skinks inhabiting the vegetation that falls within the pit area, would be affected by habitat disturbance during the course of the mining operation and are likely to be killed. Other factors such as noise and light are not likely to have significant effects on these species.

Lizards will recolonise suitable habitat in disturbed environments, as indicated by the presence of West Coast green gecko found in short, regenerating vegetation at Marshall Mine in the upper Waimangaroa valley.

6.5.5 Invertebrates

Overall, the invertebrate communities found in the project area are not noticeably different from those found in similar habitats within the Ngakawau Ecological Area. No terrestrial invertebrates were identified during the survey that are known to have a threat status under the Department of Conservation's threat classification system (Townsend *et al.* 2008). However, some undescribed species of uncertain conservation status were found, including the *Rhytida*-like snail and the *Pseudaneita* leaf-veined slug.

Given the present knowledge it is likely that the *Pseudaneita* would be listed as "data deficient" within the threat classification system, since this appears to be the first specimen found. It may be possible to rank the *Rhytida*-like snail, depending on which of the provisional new species it is assigned to, because some undescribed species have been ranked in this system. However, if this is a more recently identified species it will not have been ranked.

It is unlikely that the proposed project presents a specific threat to most of the individual invertebrate species present in the project area as large amounts of similar habitats will remain undisturbed in adjacent areas. Both the *Rhytida*-like snail and the new *Pseudaneita* species were found in taller woody vegetation which is well-represented outside the project footprint. However, since the project area appears on the basis of current knowledge to be the only site where *Pseudaneita* occurs, it would be desirable to survey for this species in similar habitat outside the mine footprint to confirm that it occurs more widely. At the same time, it would also be useful to collect some samples of the *Rhytida*-like snail inside and outside the mine footprint to confirm its identity.

The proposed mining activities would remove habitats within the footprint, and also increase edge effects in adjacent habitats which would otherwise be left undisturbed as discussed above. This is especially likely where taller forest is abruptly exposed against mine workings and ancillary developments and such edges are not buffered by shorter vegetation.

The composition of invertebrate communities is likely to change over time as exotic species are introduced and new habitats are created. For example clearing of vegetation within the mine and road footprints is likely to increase the quantity of dead wood lying on the edges of adjacent habitats. This will lead to an increase in invertebrate species specialising in the use of dead wood in the short to medium term. This effect occurs naturally in indigenous forests after such events as major windfalls and/or snow damage and the invertebrate community will ultimately adjust back to a more normal makeup as the available resource is used up and more natural communities return.

7. REHABILITATION

This section recommends rehabilitation objectives and describes the methods proposed to achieve those objectives, and the constraints which dictate the areas over which the methods could be applied in practice.

Direct transfer as a rehabilitation method is referred to throughout this section because it can be used to achieve multiple objectives at a variety of scales from molecular (such as conservation of genetic resources) to habitats via sediment and erosion control, to landscape level mitigation by achieving prompt vegetation cover which blends in visually with surrounding vegetation. Direct transfer is the movement of intact vegetated sods, or root plates of trees with attached seedlings and underlying soils, their transport in a single layer, and placement on areas requiring rehabilitation (Simcock *et al.* 1999, Ross *et al.* 2000). Internationally vegetation direct transfer (**"DT"** or **"VDT"**) is also known as turf or community translocation (Bullock 1998, Trueman *et al.* 2011). This term has been adapted in New Zealand to include transfer of weathered boulders with attached vegetation (Rodgers *et al.* 2011). The opportunity for direct transfer at Te Kuha will be limited by mine scheduling to between 10 and 20% of the overall footprint.

Rehabilitation of the access road is also considered here. This long, narrow feature would be constructed at the very beginning of the project, but decisions are required regarding the degree of any road removal at different stages after completion of coal extraction. Any changes to road cut and fill batters at the end of active mine life, when large machinery is removed but access is still needed for maintenance activities such as pest plant and animal control, need to be confirmed before the road is constructed. These decisions will influence the road footprint chosen, including the location of associated stockpiles, and the design and rehabilitation of road batters, including water tables.

7.1 Rehabilitation at Similar Sites

The rehabilitated sites discussed in Section 3.8 generally have shallow, naturally strongly acidic soils with low levels of available nitrogen and phosphate. As a result plants growing there typically exhibit relatively slow growth rates. Such soils are often peaty and poorly drained with gley (light-grey) features usually visible where subsoil is present. Nearly all the mine sites considered contain sandstone outcrops and areas with prominent boulders as shown in Plate 12. Elsewhere boulders up to about 3 m diameter have been salvaged and placed on rehabilitated areas with suitable machinery. The feasibility of restoring such habitats has been considered when assessing potential rehabilitation outcomes at Te Kuha. The extensive sandstone pavements with scattered *Chionochloa juncea* and *C. rubra* which occur at Stockton and Denniston are absent from Te Kuha, as are *Powelliphanta* snails.

Plate 12: **Large boulders and rocky outcrops with stunted vegetation present at Te Kuha are found at most comparable sites. (photo: Peter Rough 2013).**

Species of conservation value which are present at Te Kuha and which also occur at most of the previously mined sites considered include great spotted kiwi, lizards, *Celmisia dallii*, prostrate *Dracophyllum densum* and *Metrosideros parkinsonii*. Tarns are also present at many of the sites.

7.2 Impact of the Local Site Environment on Rehabilitation

The Te Kuha site has a relatively mild and wet climate with <10 days ground frost and 3.5 to 4 m rain per annum. Rainfall is recorded on 50% of days and drizzle and cloud are common. The soil pattern is influenced by slope and drainage. Most soils provide very shallow rooting depths, even where the soil profiles are deep. Mew and Ross (1991) mapped the soils of the Te Kuha site and concluded that around 20% has Lithosols or Raw Soils (mostly just topsoil directly on rock or colluvium, V40 and Christmas soil series respectively) and about 60% has Gley Soils (Trent soil series, located mostly around the mine site) with peaty topsoils containing the majority of roots. Very few roots or other soil activities occur in the low-oxygen, low nutrient, strongly acid subsoils.

The existing vegetation pattern described in Section 4 has an altitudinal sequence within which the vegetation mosaic is controlled by drainage (in turn defined by slope and soil type), soil depth, and shelter (wind-shear). Taller beech-podocarp forests occur on the deeper, better-drained, more fertile soils (often on steeper slopes, Koranui soil series) and generally have deeper root systems with the roots exploring the aerated, light brown subsoils. The tilted landform has 10 to 20 degree slopes in general, with about 70% of the site having slopes <18 degrees and about 38% of the site having slopes <12 degrees (Figure 14). These low slopes mean that a high proportion of the site is readily trafficable. This permits high-quality soil /vegetation stripping and formation of geo-technically stable slopes with backfilled rock overburden which can be broadly similar to those present pre-mining.

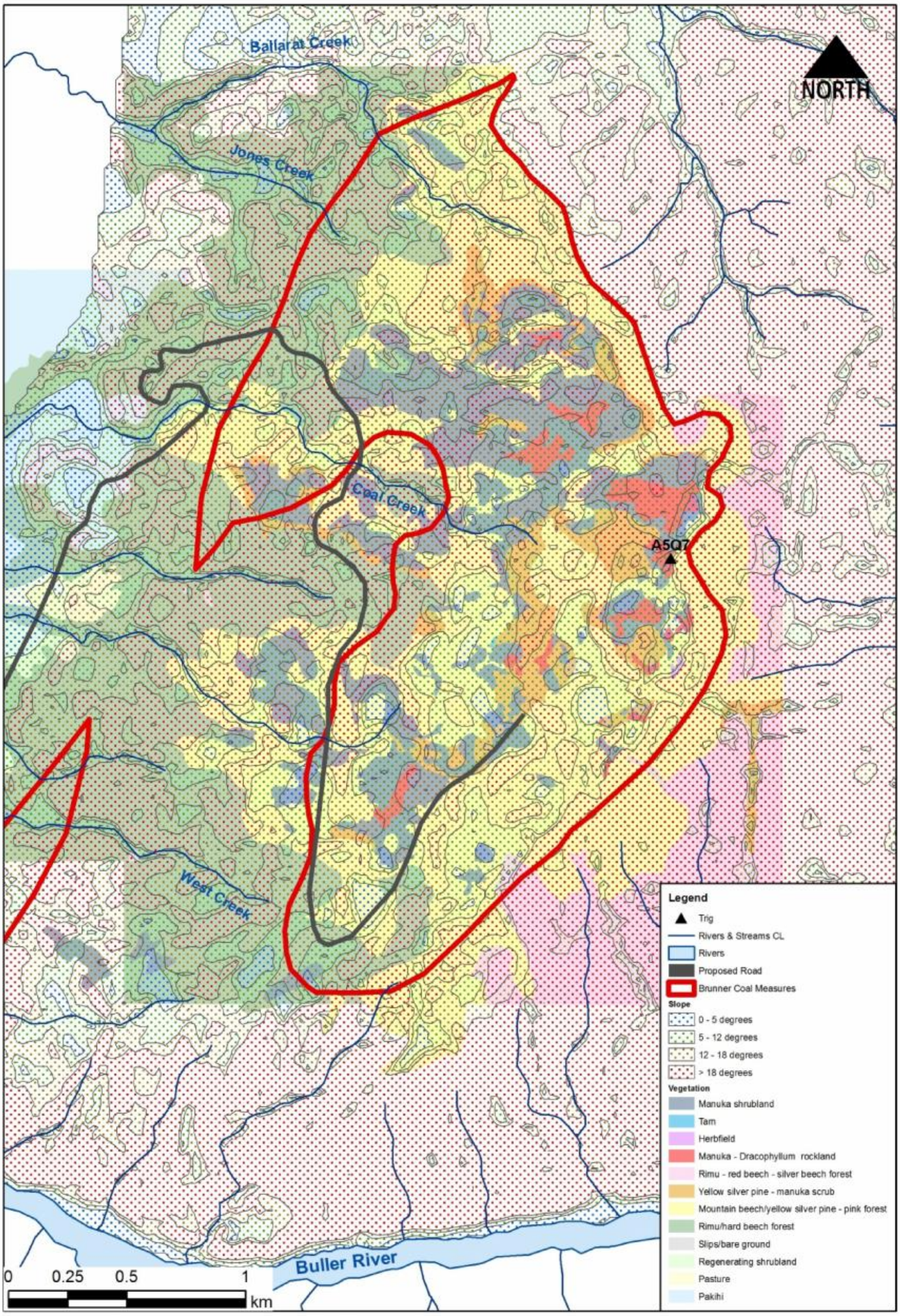

Figure 14: Slopes at Te Kuha overlaid with vegetation association.

Two key factors that determine rehabilitation success at similar sites are soil stability and fertility. A high priority when rehabilitating the site is rapid stabilisation of erodible materials, particularly unvegetated soil, because intense rainfall events are frequent throughout the year and natural water courses naturally have low suspended sediment concentrations. The soils and climate at Te Kuha favour use of the direct transfer rehabilitation technique since transfer of sods of suitable vegetation with underlying soils will reduce sediment mobilisation and should lead to successful outcomes at any time of the year. Very high survival rates should also be expected for nursery-grown seedlings planted into mixed soils, but growth rates are likely to be relatively slow.

7.3 Mine Planning Matters

7.3.1 Vegetation Stripping and Rehabilitation

Figure 15 shows the early stages of vegetation stripping indicating when rehabilitation and direct transfer of vegetation in the coal footprint can begin on a large scale, provided that both shallow and deep coal seams are removed in one operation.

No information is available on the extent of annual stripping or or backfilling beyond year 4, although an area of approximately 31 ha would be mined between years 5 and 8 (around 10 ha per year on average). The area of vegetation to be removed in any one year would be influenced by stripping ratios/coal prices/market considerations amongst other factors. The area and contour of backfill created at rehabilitated sites will largely depend on the volume and types of rock overburden available at the time and the relative cost of haulage, as well as whether all coal seams are excavated at the same time in order to release areas for backfilling. Hence at this stage depictions of backfilled slopes are approximations only.

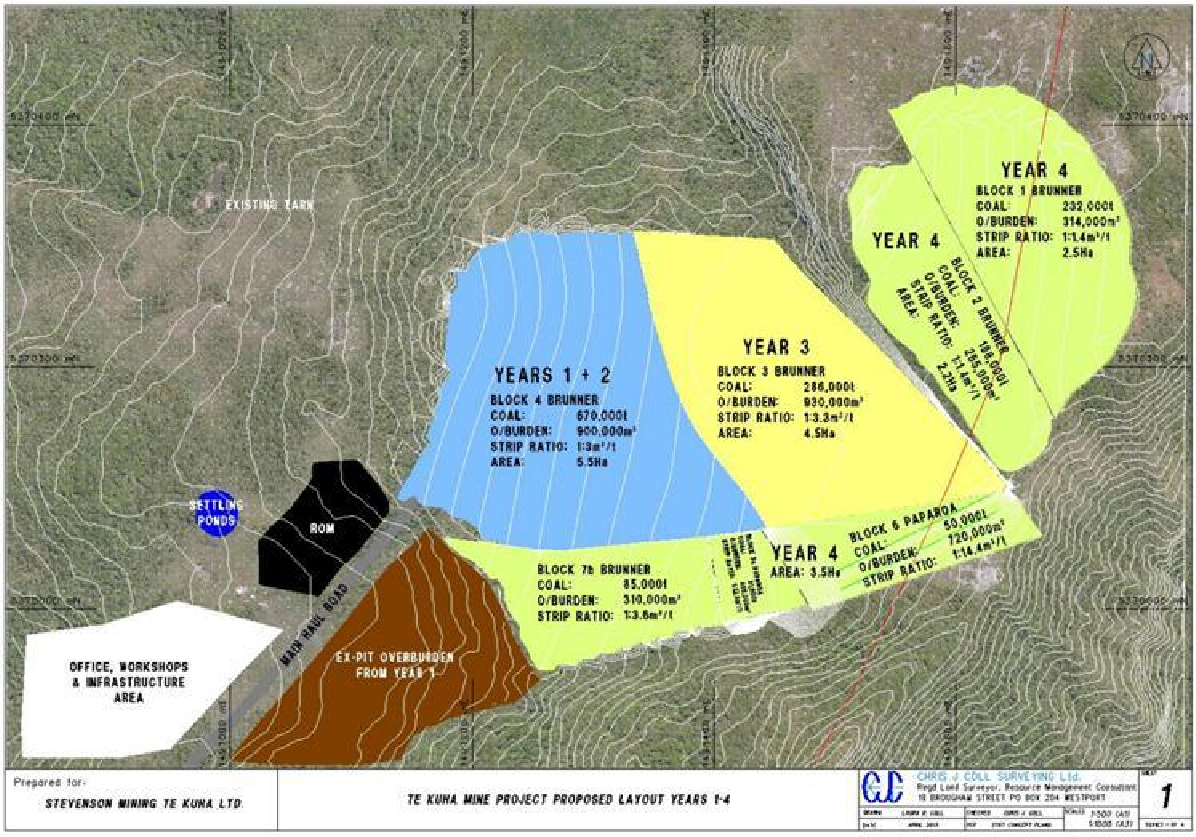

Figure 15: Mine Plan Years 1 – 4 (Chris Coll Surveyors, 19 Sept 2013).

7.3.2 Access Road

The access road has the potential to have a substantial visual impact on the landscape. The road, as a light-vehicle access, will be required for at least 10 years after mining is completed in order to allow monitoring (of water quality and vegetation) and maintenance of rehabilitated surfaces. Management of the road alignment, its footprint size, and its rehabilitation can be used to minimise the duration and degree of any visual impact. In particular, during road planning and construction there is scope to reduce any impacts by altering road realignment, the location and size of stockpiles and passing lanes, and the extent of cut and fill batters. The final road alignment should be informed by geotechnical considerations and stakeholder input.

The road footprint has already been reduced by making it a one way access with passing bays suitable for a fleet of small vehicles (road trucks not dump trucks). This reduces both overall road width and the required height of road bunds. Passing lanes are intended to be located approximately every 1 km (Figure 2), with these likely to be 80 to 100 m long with a road width up to 20 m (Chris Coll pers. comm. 2013).

From a visual perspective an approximately 2 km long section of the proposed road which traverses horizontally between the two uppermost soil stockpiles shown in Figure 2 (immediately before the road turns north and climbs to reach the mine site) will be important because of its visibility and continuity (P. Rough pers. comm.). The visual impact of this section can be reduced by disrupting the clearance of linear features and in the short term by varying the height and colour of batters as shown in Plate 13. In Plate 13 the old road (to the left of the existing road) had soil placed, ripped and seedlings planted in c. 2003. The colour contrast of grassed (fawn) and planted (bright green) areas with adjacent beech forest could have been mitigated by direct transfer or planting of beech and manuka seedlings. Note that retaining walls are used on the right hand side of the road immediately over the bridge shown in Plate 13. Other ways to reduce visual effects include applying direct transfer sods to suitable fill batters during construction and minimising subsequent disturbance to these batters at the end of mining when part or all of the road can be deconstructed. The direct transfer sods can be made available during the road construction phase by 'leap-frogging' that is taking sods from areas of roadside stripping to areas where final batters are available as construction proceeds. There is also the potential to reduce road width in highly visible areas by having just one water-table, but this creates speed restrictions and potentially increases risks for truck operators.

Plate 13: Arthurs Pass National Park Road (August 2013).

A guiding principle for road construction which will help reduce visual effects on the landscape is to limit the cleared footprint by creating steeper cut batters in competent material that is geotechnically stable, but cannot be covered with growing medium (an example of this is shown in Plate 14). Such surfaces will eventually develop a vegetation cover of short plants and mosses. This principle is proposed because visual mitigation of distant views can be achieved without substantial earthworks and backfill (and attendant vegetation damage) being required at road closure. Furthermore, storing soils for the duration of mining would require substantial additional vegetation clearance in order to provide enough soil and fill for later road rehabilitation. Minimising the amount of soil required at the end of road life means soil stockpiles along the road can be reduced, reducing the size of the overall affected area. Alternatively bulk fill to build up buttresses against cut batters could be sourced from non-acid-forming mine overburden, however this would require road water tables to be recreated at closure, creating a risk of increased sedimentation. If substantial amounts of fill were required this might also affect what landforms could be constructed within the former pit.

Plate 14: Steep cut batters on the Lower Buller Gorge reduce the area of native vegetation removed by the road; this is balanced against the reduced ability to establish a dense vegetation cover (photo taken 2011).

7.4 Key Values to be considered in Rehabilitation

7.4.1 Rehabilitation Strategy

Mining at Te Kuha would affect the highly intact altitudinal sequence of vegetation and landscape views of the site. Both of these values should be the subject of rehabilitation efforts to reduce any long term effects. Mitigating the impacts of vegetation clearance and mining on these ecological and landscape values is intended to drive the rehabilitation plan. Ecological values are discussed in Section 4 and a comprehensive description of landscape values is provided separately by Rough and Associates (2013). The landscape associated with the ridgeline forms the boundary of the Lower Buller Gorge Scenic Reserve.

7.4.2 Altitudinal Sequence

Section 4 describes in detail the vegetation assocations present within the proposed Te Kuha mine footprint and identifies the area as part of a relatively undisturbed sequence of vegetation that extends from the Buller Gorge to the ridgeline. This sequence is less diverse than the higher, adjacent Mt Rochfort sequence, however, direct human impact on the vegetation, particularly the higher altitude coal measures vegetation, is naturally very low (Section 4). It appears from the survey described here and earlier surveys of the site that fires may have induced some mānuka-dominated vegetation on mid to lower altitude slopes. Very few non-native plant species are present and these have extremely restricted distributions. Although deer sign was recorded throughout the site, highly palatable species such as broadleaf (*Griselinia littoralis*) continue to be present in the under-storey (Section 4). Construction of road access to the proposed mine would increase the risk of weed invasion and continued human access post mining would increase the risk of anthropogenic fires as well as prolonging the risk of weed invasion which might affect the altitudinal vegetation sequence.

7.4.3 Rehabilitation Outcome

The proposed rehabilitation strategy for the Te Kuha site is to create a backfilled landform that abuts, and is sympathetic with, natural ground levels on the former pit edges. On this backfilled landform root zones and erosion-resistant surfaces can be established in order to underpin a dense native vegetation cover at least 1 m tall which extends over the majority of the site. When combined with effective water management, establishment of fire buffers and plant and animal pest control, this strategy is expected to maximise protection of adjacent undisturbed vegetation from prolonged edge effects.

After mining, a small proportion of the site, including road batters cut into rock and rock-mulched areas will likely have a sparse vegetation cover. In addition to these sparsely vegetated areas it is proposed to establish very small areas of low-growing (<1 m in height) vegetation on soils with a suitably shallow and/or poorly-drained root zone. Such areas would include the high-value herbfield vegetation identified in Section 4 as well as prostrate ridgeline vegetation which includes local manuka and *D. densum*. These habitats would be conserved via DT because they are well suited to the use of direct transfer, have the greatest vulnerability to non-native (weed) plant invasion if bare soil is present and furthermore DT would conserve some of the genetic resources of the key species identified in Section 4.

7.5 Rehabilitation Objectives

7.5.1 Overall Objectives

The three primary objectives of rehabilitation are to:

(1) Rapidly ensure stable, erosion-resistant surfaces that minimise erosion and prevent loss of growth media (soil) from rehabilitated areas into surface waters;

(2) Support the ecological objectives discussed below; and

(3) Support the landscape objective of achieving a high degree of naturalness in short and long term.

TKLP also requested that the rehabilitation achieve a standard that requires minimal maintenance beyond a five- to ten-year establishment period, at the end of which closure standards should be achieved.

7.5.2 Ecological Objectives

The three key ecological objectives of rehabilitation are:

i. Minimise the area affected by mining and associated activities. This includes reducing vegetation clearance within the highest-value ecosystems and buffering adjacent undisturbed areas from adjacent clearance in order to maximise their on-going condition and resilience against weeds, fire and pests.

ii. Establish self-sustaining native vegetation that can develop into a mosaic of native vegetation associations resistant to weeds, fire and pests.

iii. Conserve the genetic resources of vegetation associations and species, particularly those considered at-risk or threatened, both within and outside the disturbed footprint.

Strategies to minimise disturbance are detailed in Sections 7.6 and 8. In some places, minimising the affected footprint will require a trade-off against the ability to establish a vegetation cover and the area required to store material for rehabilitation. An example of such a trade-off is shown in Plate 14 (above).

The access road and initial ex-pit overburden area including soil, wood and vegetation stockpiles are the key places trade-off decisions will need to be made. For example:

- The steeper the road batters, the smaller the footprint (disturbed area). Road batters cut into rock may be stable when very steep, but they are usually difficult to revegetate with woody plants, although herbs, grasses and mosses can be hydro-seeded and naturally establish, especially if surfaces are rough as shown in Plate 15 where the bund of Sullivan Mine access road, which has been narrowed to allow light vehicle access. The road bund has been vegetated with planted seedlings. Bryophytes, ferns, fern allies (*Lycopodium* spp.) and mānuka have colonised the NW-facing cut batter shown in Plate 15 and taller plants have established on roughest parts of batters with higher substrate depth and more moisture.

- Areas with slopes exceeding 25 degrees are more vulnerable to erosion, especially when formed as long or smooth slopes, or with large catchment areas. They are also more difficult to vegetate using direct transfer.

- If the road and its cut/fill batters are to be largely removed at the end of mining, it may be feasible to store topsoil and vegetation immediately adjacent to the road on cut or fill slopes designed to allow this material to be salvaged and used for final road rehabilitation. Re-instating the road to approximate pre-mining contour would probably require significant volumes of in-fill and/or removal of batters before placement of topsoil on the roughened, former road surface. The provision of soil and fill stockpiles needs to be balanced against the increased disturbance footprint such storage would require, and the increased disturbance created at road closure by re-excavation of areas which became vegetated 20 to 30 years earlier during road construction.

Plate 15: Bryophytes, ferns, fern allies and mānuka have colonised the NW-facing cut batter on the Sullivan Mine access road.

7.5.3 Landscape Objectives

Overall the landscape objective of achieving a high degree of naturalness would be enabled by creating excavated and backfilled areas with the following features:

- Non-linear batters, i.e. moving away from benched landforms to concave profiles.
- Non-linear plan footprints.
- Non-linear top (ridge and road cutting) profiles.
- Inclusion of geomorphic features such as gullies and cliffs.
- Inclusion of ridgeline colour and texture variation using vegetation, large boulders and rock mulches.
- Resilient, dense vegetation on stable slopes.

7.6 Achieving Rehabilitation Objectives

7.6.1 Primary Methods

The three primary methods to achieve the rehabilitation objectives outlined above are the creation of stable surfaces, creation of a mosaic of resilient native ecosystems and conservation of genetic resources and the highest-value ecosystems. These methods are described in more detail below.

7.6.2 Creating Stable Surfaces

Achieving stable surfaces in a climate with very intense rainfalls and large soil moisture surpluses (over evapotranspiration) throughout the year, means designing stable slopes, slope lengths, and catchment sizes is critical. Benches provide drainage control and allow efficient vehicle access to the rehabilitated area for initial spreading of topsoil, vegetation establishment and monitoring. Many mine landforms are likely to require benching, at least initially, as shown in Plates 16 and 17, in order to control storm-water runoff. Benches would likely be required until sufficient vegetation cover establishes to bind the substrate and prevent sediment mobilisation.

In Plate 16 slopes between approximately 18 and 24 degrees are shown in the centre and upper parts of the photo. Olive-green strips are direct transfer sods of shrubland bordering areas planted with nursery seedlings and sown exotic grass (fawn areas). In Plate 17 the planted bench and batter landform in the foreground and right mimics the overall natural slope. The ungrassed, gravel substrate has promoted germination of *Hebe* and *Olearia* seedlings in wetter areas. The backfill shown in Plate 17 has a relatively thin soil cover and was seeded with browntop (*Agrostis capillaris*) before planting of nursery-grown seedlings.

Plate 16: Backfilled, benched and vegetated landforms at Stockton Mine.

Plate 17: Rehabilitated site at Strongman Mine (Photographed 2013).

Once stable landforms are formed, surface roughness, substrate material selection and surface cover are key components to minimise erosion and delivery of sediment to water courses. Areas particularly vulnerable to erosion include the lower parts of longer slopes, steeper slopes and slopes adjacent to watercourses. Many erosion-resistant resources are available including rocky, competent materials, mixed soil & woody vegetation, logs and directly transferred vegetation. Identification, conservation and scheduling of these materials for placement on parts of slopes most vulnerable to erosion backfill are important, continuous components of mine planning. The key limitation at Te Kuha is likely to be provision of space to stockpile these resources until surfaces are released for rehabilitation.

High quality direct transfer of vegetation less than 1 to 2 m tall with attached root zone is probably the most erosion-resistant rehabilitation resource available (Weber *et al.* 2011). This provides long-term cover for most slopes and should be used at Te Kuha where possible. Logs and wood salvaged from clearance of vegetation along the access road will be useful to provide surface roughness and protected microsites, particularly on slopes with lower erosion potential, and for placement on reconstructed root zone soils with low organic or rock components. Logs and wood, as well as topsoil, will need to be stockpiled and managed to ensure minimal weed establishment during storage and reuse. Soils stripped from areas with a high rock component can be used to create rough surfaces with the rock 'armouring' the surface as fines are washed into lower pockets.

Browntop and other perennial grasses typically used at other mine sites are not recommended as temporary covers at Te Kuha because they are absent from the site pre-mining. They are also tolerant of low fertility and pH, so likely to persist in open areas after the completion of mining if they are used during rehabilitation. Instead annual species, infertile hybrid grasses or straw could be used to stabilise both overburden and mixed soils both in stockpiles and when spread on rehabilitation surfaces. The use of straw mulches for short-term (3 to 12 months) stabilisation of overburden and soils has been effective at similar sites although straw must be clean and stored in weed-free sites in order to reduce the potential for weed contamination. Elsewhere, the use of wood chip has been limited by the cost of chip and contamination with stones which damages mulching machines. Hence wood chip is not recommended at Te Kuha unless these limitations can be overcome. In addition, large trees are a limited resource at Te Kuha, so those available are likey to be used as logs rather than as wood chip.

7.6.3 Achieving a Mosaic of Weed-Resistant Native Ecosystems

Likely Rehabilitation Outcome

The vegetation that naturally evolves at rehabilitated sites, provided they are stable, will be influenced by four key factors:

- The species first established (especially for species that are slow to disperse such as beech and native pines);
- The drainage status;
- The depth of replaced soils; and
- The degree of exposure/altitude.

Most vegetation associations are likely to be homogenised in the short to medium term, because the mine schedule currently provides limited scope for VDT and the majority of areas below the ridgeline would therefore need to be planted. Temporary storage of VDT resources can only occur within the mine footprint or on the external overburden dump since extending the mine footprint to create additional storage space would degrade, rather than enhance, the rehabilitated site overall because areas underlying stockpiles would need to be revegetated and revegetated areas would have lower values than intact areas for some time.

The rehabilitated landscape is expected to achieve a coarse mosaic of vegetation that will become more distinct over the medium term as local species colonise and adapt to the local micro-sites created. The relatively fine mosaic that is present before mining will be lost, except where small, discrete areas of rock field (as shown in Plate 18) and tarns and herbfields have been created on upper slopes. An approach similar to that shown in Plate 18 is recommended to create rock field on recreated ridgelines at Te Kuha with a variety of boulders interspersed with patches of herbfield, prostrate vegetation and rock-mulch. Boulders can be placed to create the relatively level surface shown in Plate 18 or the rougher surfaces shown in Plate 19. When creating such habitats any un-weathered rocks need to be competent, i.e. not break down upon weathering.

Plate 18: Rehabilitated rock-dominated landscape about 15 months after placement. (Photographed May 2013, from Simcock *et al.* 2013).

Plate 19: Rehabilitated area with a density of 7,500 nursery plants/ha including a high proportion of *Hebe mooreae*, established December 2002 (Photographed November 2011, from Simcock 2012).

Soil drainage is primarily influenced by the organic content and texture of the soils (how much air and water are held by the soil particles) which together detemine how fast water either percolates or runs off. Runoff can largely be controlled by slope and compaction. Very low slope angles, such as those found at the top of waste rock dumps, and landforms that allow water to pond will generally support low growing vegetation. Most backfilled slopes without intact, directly transferred sods would be significantly better drained than equivalent natural slopes, because topsoil is mixed with some rock at deposition and natural finer-textured subsoils are generally absent, replaced by coarse overburden which doesn't impede water escape. In particular, the broad, gently sloping spurs and ridges covered by low shrubland, rush and sedge-land at Te Kuha are likely to be replaced with taller, woody vegetation once they are rehabilitated. The only gentle slopes with low vegetation present in the post-rehabilitation landscape are likely to be those where drainage is manipulated and DT is used, or those on the most exposed and highest-elevation sites where vegetation will suffer from wind-shear. If an appreciable cover of toetoe, tussock, sedges and grasses (native or non-native) are used in rehabilitation or allowed to establish and dominate at the site these elements of the vegetation may appear yellow at closure, rather than olive and bright green as at present. Regeneration suppression, and long term grass dominated vegetation cover can also develop with grazing, fire, and/or inappropriate fertility levels (either very low, or high if it leads to smothering of tree seedlings by grasses).

Rehabilitation Standards

Rehabilitation methods can be specified that will achieve dense vegetation cover on re-spread soils. Experience at other mine sites indicates a mean vegetation cover of 80% and >0.3 m height in exposed areas and >1.0 m height in sheltered, mid to lower altitude areas is achievable in five to ten years at such sites. Rehabilitation is proposed using three methods: planting nursery-raised plants into mixed soil/rock/wood (around 80% of the rehabilitated area), hydro seeding / seeding and VDT (a minimum of 10% of the rehabilitated area each). The tarns and herbfield can only be established using VDT, hence the area and quality of VDT made available by the mine schedule will determine the extent to which re-creation of either is possible (refer to Figure 15). Steep exposed high walls can only be vegetated using hydroseeding, and then only over parts which have appreciable fines to which the seeds can adhere and grow. Rock fields can be rehabilitated using precise rock placement and VDT with smaller areas of hand planting. The extent of rock field creation would be determined by the area required to meet the landscape mitigation plan and by the volume of boulders able to be salvaged. The costs and benefits of rock field creation are also a consideration.

Direct Transfer of Intact Sods

DT is likely to be employed along most road embankments during construction of the access road. DT of forest would target individual root plates and hence a high proportion of bare soil would be present. Within the coal footprint DT would be prioritised for the following high value ecosystems:

- Herbfield.
- 10 ha yellow-silver pine and mānuka shrubland (which contains *M. parkinsonii* and probably the highest bryophyte diversity). An example of similar habitat which has been transferred is shown in Plate 20.
- Rock field with hand transfer of *Celmisias*, *Dracophyllum densum* and *D. pubsecens.*

These ecosystems are amenable to high-quality DT because their low vegetation height enables intact sods to be extracted and replaced with a low proportion of bare ground being exposed or created. In addition, most (approximately 75%) of the yellow-silver pine shrubland and half the manuka shrubland are located on slopes of less than 12 degrees, allowing cost-effective access.

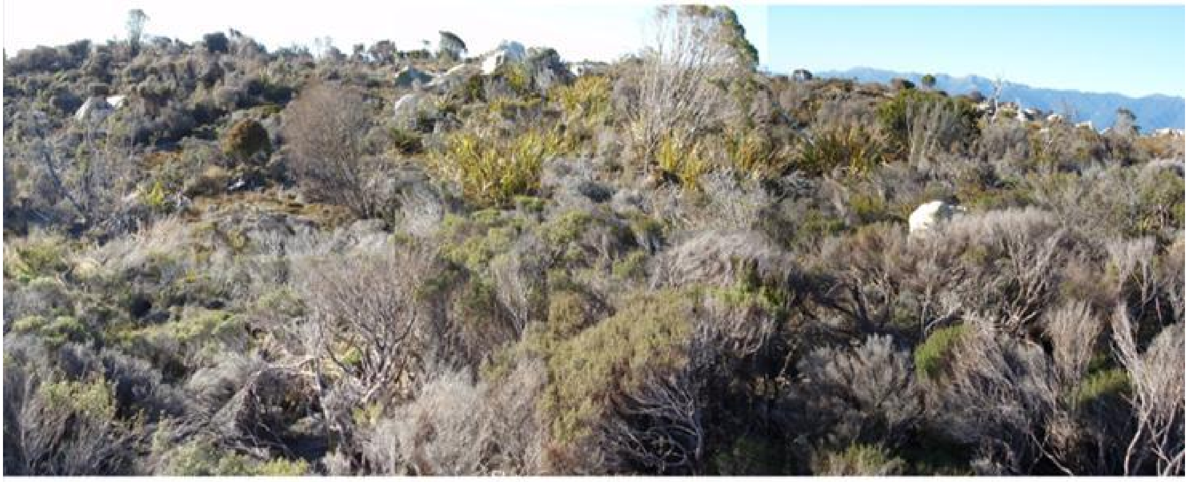

Plate 20: Very high quality rehabilitated manuka shrub land at Stockton Mine ridgeline about 1 year after placement (Photographed May 2013, from Simcock *et al.* 2013).

Creation of both herbfield and rock field require relatively flat to gently sloping topography with shallow rooting depth and poor drainage. Patches of near-saturation can be created by establishing a highly compacted sub-base on which a root zone of direct transfer sods is placed. Such areas can also be very exposed, so would be suitable for locations near the rehabilitated ridgeline. We have summarised the properties which contribute to the potential for successful salvage for VDT in Table 11. Table 12 ranks the vegetation types according to priority for direct transfer given the features described in Table 11 and summarises whether direct transfer is necessary to protect particular ecosystems or not. Tarns are not included in these tables since the largest tarn is located outside the mine footprint.

Table 11: Potential for successful salvage and rehabilitation with dominant canopy species of different of ecosystems at Te Kuha.

Vegetation Association / Ecosystem (high-value plant species)	Area Affected (% of coal measures vegetation in the local area)	Approximate Canopy Height (m)	% cover <1 m height (suitable for VDT)	Main plant species (>20% cover) <1m height	Plant species over 1m height	Rooting depth and soil continuity (together these determine the ease of salvage)
mountain beech/yellow silver pine – pink pine	51 ha (20%)	4-8 m	50 (moderate)	*Empodisma minus*, *Gahnia procera* some ysp & pink pine	Mountain beech; Yellow-silver pine; pink pine	Deep, continuous
Yellow-silver pine – manuka shrubland (bryophytes)	8 ha (19%)	<3 m	50 (moderate to high)	*Empodisma minus*, mānuka	Parkinson's rata, ysp, mānuka	Continuous
hard beech/podocarp forest	8 ha (3%)	<25 m	30 (ow to moderate)	Some places have dense ferns (*Blechnum*, *Sticherus*)	Diverse: quintinia, kamahi, beech, toatoa, rata	Deep, continuous
open manuka shrubland (Parkinsons' rata, bryophytes)	13 ha (12%)	<2 m	60 (high)	*Empodisma minus*, mānuka, tangle fern	Manuka	Variable, continuous
Manuka – dracophyllum rockland	4 ha (27%)	0.5 m	100 (moderate)	Manuka, *Empodisma minus*, *Dracophyllum*, tangle fern	Mānuka	Discontinuous, low savlageability
Herbfield - *Euphrasia wettsteiniana*	0.04 ha (100%)	<0.5	100 (moderate)	*Empodisma minus*, bog pine?	Nil	Discontinuous?
Pakihi	1 ha	0.5	100 (high)	Manuka, *Empodisma minus*, tangle fern	Mānuka	Continuous

Table 12: Potential of ecosystems for rehabilitation by Direct Transfer (DT) and planting of nursery-seedlings.

Vegetation Association / Ecosystem Rehabilitation strategy	**VDT priority**	**Main plant species** tolerant of high exposure and light levels, so can be successfully targeted for DT salvage if <1-2m tall (Bold =>20% cover)	**Canopy and sub-canopy plant species that can be planted as nursery plants**
mountain beech/yellow silver pine – pink pine forest Nursery plantings with small DT areas Changed ecosystem[2]	MODERATE High along access road	***Empodisma minus, Gahnia procera*[1],** quintinia, mountain and silver beech, mountain toatoa, kamahi, yellow-silver pine and pink pine, *Pseudopanex linearis, Myrsine divaricata, Pittoporum rigidum, Pseudopanax colensoi, Astelia nervosa*, mountain flax	Mountain beech, silver beech, southern rata, Pseu linearis, Groundcovers: *Astelia nervosa*, mountain flax
Yellow-silver pine – manuka shrubland DT and planting; reduced area[3]	HIGH	***Empodisma minus*, mānuka,** southern rata, quintinia, mountain beech, pink pine, bog pine, dracophyllum species and most understorey species.	Manuka, southern rata, kamahi, mountain beech, mountain flax, Pseu linearis *Interplant Celmisia dubia*
Herbfeild - *Euphrasia wettsteiniana* DT only; reduce area (genetic salvage)	HIGH	***Empodisma minus***, *Chionochloa australis*, mānuka, *Epacris alpina, Donatia nz, Euphrasia* spp, *Celimisa* spp etc… resilient to DT but vulnerable to weeds	Not applicable (only rehabilitated with DT)
Rimu/ hard beech/podocarp forest Planting; DT stumps	LOW[4]	Emergent rimu over hard beech, silver beech, mountain beech, diverse understorey changes with elevation but most are intolerant of sudden light /exposure changes	Quintinia, kamahi, beech species, toatoa, southern rata, nikau
Open manuka shrubland (Parkinsons' rata, bryophytes) DT & planting	HIGH	***Empodisma minus*, mānuka, tangle fern,** *Epacris alpina, Gahnia procera*, southern rata, pines and dracophyllums, mountain flax	Manuka, southern rata, mountain flax interplant *Celmisa dubia*
Manuka – dracophyllum rockland DT only; reduced	MODERATE	**Manuka, *Empodisma minus*, *Dracophyllum*, tangle fern** Patches favourable to DT if rock exposure allows removal of intact soil sods and ridgeline backfill surfaces available with weed buffer	Mānuka (prostrate) (only rehabilitated with DT)

Vegetation Association / Ecosystem Rehabilitation strategy	**VDT priority**	**Main plant species** tolerant of high exposure and light levels, so can be successfully targeted for DT salvage if <1-2m tall (Bold =>20% cover)	**Canopy and sub-canopy plant species that can be planted as nursery plants**
area (genetic salvage)			

1 Success rate is high with plants <1 m height within intact DT sods 1m by 1 m+ with low root disturbance, but success as small sods (spade width) for individual plants probably relatively low

2 Ecosystem change due to a low proportion of DT for this ecosystem type and much simpler planting regime with high proportion of mānuka and flax and insignificant proportion of pines mean this ecosystem would be greatly reduced in area

3 Reduced extent is anticipated after-rehabilitation because similar ecosystems can only be established through DT; however, nursery planting includes most of the canopy species present so this has the potential to produce a greater area of a simpler, less diverse system in the medium term.

4 Outcome is poor because the trees are large. The canopy structure would be lost for many decades and most understorey species (which aren't tree seedlings) are intolerant of sudden light exposure (e.g. ferns, bryophytes). However, DT is still effective for erosion control, to create protected microsites for seedling establishment, for introducing tree seedlings that are larger than nursery-raised plants and better able to compete against weeds and particularly for conserving topsoil and litter communities (including invertebrates, Boyer *et al.* 2011).

Planting Nursery-Raised Seedlings

It is likely that the majority of Te Kuha mine site would be planted with nursery-raised specimens – this would result in a low diversity of native woody and herbaceous species since achieving an erosion and weed-smothering cover are the highest short-term rehabilitation priorities. Only a relatively small range of easy-to-propagate, fast-growing, native plants that are local to the ecological district are able to achieve these priorities. A high planting density of 12-15,000 plants/ha is recommended. Such a high density is warranted for three reasons: firstly, a relatively short mine life with a closure target of 5 to 10 years post mining is proposed; secondly, relatively slow growth rates are expected at Te Kuha due to the infertility of soils and the moderate altitude, and thirdly; minimal use of non-native grasses for erosion control is preferred in order to avoid weeds establishing. Instead, additional wood or rock and shorter-lived straw mulches are proposed.

Only a narrow range of plant species are recommended to be used at this site for two reasons:

1) Because fire and browse-resistance are necessary and should be the primary focus to ensure vegetation cover targets are achieved.

2) Many of the plant species used successfully at Stockton Mine are not present at Te Kuha currently and it remains unclear how easy to propagate some of the species present might be.

Fire-resistance can be enhanced by incorporating rock, boulders, flax and, at lower altitudes, broadleaf. DT also retards fire as the sods retain high quantities of water effectively. Flammable plants such as long-lived, summer-dry, non-native grasses (browntop, Yorkshire fog (*Holcus lanatus*) and the like) and native grasses *Cortaderia* (toetoe) and large *Chionochloa* should not generally be used except in small areas on lower slopes.

Around half of the species that form, or have traditionally formed, the bulk of plantings successfully used in similar environments at Stockton have not been recorded at Te Kuha. These include plants proven to rapidly stabilise ground and incorporate high biomass such as *Chionochloa flavescens*, *C. conspicua*, *Cortaderia richardii*, and some species that are particularly precocious such as *Hebe mooreae*, *H. salicifolia* (at lower altitudes), *Ozothamnus leptophyllus*, large-leafed *Coprosma* spp. and *Gaultheria* spp. Use of *Chionochloa* and toetoe in particular have landscape-level impacts, because their foliage is pale green to cream and light brown, contrasting with the dominant grey-green vegetation of shrubs and trees already present along the ridgeline and access road. Given the high ecological integrity and low weed presence of the Te Kuha site prior to mining, the potential to use native species which have proven successful at Stockton and Strongman Mines, but are not present at Te Kuha, should be discussed with regulators and the Department of Conservation.

Two commonly-used nursery-grown plant species which should be used in low proportions provided that deer can be controlled for at least 20 years are broadleaf and southern rata. Both are highly palatable, particularly if growth rates are boosted by strategic use of fertilisers (either fast or slow release, or a combination of both), but should reach heights above the level of deer browse within around 20 years.

The use of lime and fertiliser should also be discussed with the Department of Conservation and regulators, but generally we recommend that they be used with caution at the ridgeline/coal deposit areas. The combination of high natural acidity (and soluble aluminium levels) and low available phosphorus increases the resilience of rehabilitated areas to invasion by herbaceous legumes. Strategic placement of fertiliser e.g. below the surface near the root ball at planting, or application of short-lived nitrogen to boost moss growth, may be appropriate. Fertilisers are best utilised in lower altitude areas allowing tall vegetation to establish quickly and supress herbaceous species.

A coarse altitudinal sequence typical of the adjacent areas will be initiated and reinforced through varying the proportion of species of long-lived woody species tolerant of high light intensity that can be planted as part of immediate rehabilitation, and by establishing such species in clusters with appropriate groundcover. The majority of plants established as nursery-grown seedlings should probably comprise the following species: mānuka, mountain flax (together likely to form 50% of planted seedlings), rata, kamahi and beech species. Mountain beech is suited to higher, more exposed areas and silver and red beech to lower altitudes. Species which should be planted in lower proportions include broadleaf, *Pseudopanax*, *Gahnia* and *Astelia* species. Toetoe and tutu (*Coriaria arborea*) could be included in lower-altitude forest plantings because they can rapidly suppress grasses, but do not tolerate shade, so will die out as a canopy of forest trees emerges as part of natural succession. Planting initiates this vegetation succession process.

7.6.4 Conservation of Genetic Resources

The mine footprint contains two vegetation associations that would be vulnerable to weed invasion in the event that mining was undertaken at Te Kuha because the plants are short (≤0.5 m height) and relatively slow growing, meaning that they could be overtopped or pushed aside by both non-native species (should conditions in rehabilitated areas favour taller vegetation) and by weeds (should they establish at any time). These associations are mānuka-*Dracophyllum* rockland and herbfield which are estimated to cover about 3 ha and 0.04 ha of the site respectively. This represents 27% of the existing rockland and 100% of the existing herbfield within the local coal measures vegetation. The herbfield and rockland contain *Celmisia*, *Dracophyllum* and *Euphrasia* species of particular interest, hence the focus on retaining some high quality DT areas of these associations.

The strategy for rehabilitating these two associations is to create small areas that conserve part of the genetic resources by direct transfer of intact sods on compacted, low-slope backfill along the exposed ridgeline. The indicative mine schedule allows this approach in some areas. Only small areas can be rehabilitated this way because it is likely that only parts of these small areas can be salvaged using the direct transfer technique due to the presence of rocks. The rehabilitated areas would then be protected from non-native weed invasion by buffering with taller native DT, salvaged boulders and/or placement on the edge of the mine site adjacent to similar intact vegetation. These sensitive areas should then be isolated from human access by avoiding locating permanent tracks near them.

Yellow-silver pine-mānuka shrubland (about 8.5 ha) is the only other association that would have a significant proportion (19%) of the local coal measures vegetation removed. This vegetation association generally ≥0.5 m tall but <3 m tall. The rehabilitation strategy for this vegetation is to plan the mine schedule to conserve at least 5 ha as DT since about 70% of this association is on slopes <18 degrees and would be easily salvaged for that reason. The value of these DT areas could be enhanced if it is placed so that it buffers areas of herbfield. This association contains *Metrosideros parkinsonii*, a plant of particular local interest which is widespread in the area, but for which nursery propagation and transplanting has been infrequently attempted with erratic results.

Any tarns should be created within the DT *de novo* – the creation of tarns with near-permanent water on compacted, low-slope backfills is not technically difficult and easy to specify. Tarns would enhance the invertebrate diversity of the area, but they do represent a risk in that the establishment of non-native species (in particular *Juncus*) may result. The only large tarn at the site (which would not be disturbed) has a dense, uniform cover of the exotic rush *Juncus bulbosus*. In order to reduce the potential for sediment generation and weed establishment at tarns, each catchment should be small, vegetated using direct transfer, and located near the edges of the site (particularly the ridgeline).

Planning to achieve ecosystem enrichment should start as early as possible. In particular, *Metrosideros parkinsonii* propagation in a nursery would be valuable to provide a backup to DT. A 12 to 36 month lead time is likely to be needed for nursery-grown plants to ensure availability of seedlings of a suitable size when required.

7.6.5 Weed Biosecurity and Management

The virtual absence of non-native plants from the upper parts of the Te Kuha site, the vulnerability of herbfields, tarns and prostrate vegetation to over-topping by non-native plants and the stated objective of re-establishing a mosaic of native ecosystems mean that prevention of weeds would be a vitally important part of the rehabilitation plan for Te Kuha. Such a plan would be supported by closure conditions against which to test the outcomes. This matter is explored further in Section 8.3.

The Department of Conservation has knowledgeable staff with experience of identifying, classifying and managing weeds in regenerating ecosystems, and may ultimately manage the Te Kuha site post-mining, in conjunction with the Buller District Council as land owner. Weed management at the Te Kuha site should be a site-led programme, with most non-native plants, and native species not found in the ecological district, being controlled. Developing and implementing a site weed prevention and management plan will be integral to successful rehabilitation. The plan should consider the following matters:

- Nursery contracts which include specific nursery hygiene standards for supply of plants and seeds. This can include applying a thin layer of sawdust or sand on top of growing medium to trap weed seeds. This layer would be shaken off immediately before transportation. Plants may also be removed from containers immediately prior to delivery.
- Weed controls at any intermediate storage sites where plants are stored off the ground or on coarse gravel floors.
- Weed specifications for suppliers of straw for erosion control and gravel for roading.
- Monitoring of likely areas for weed germination including road sediment detention ponds, straw-mulched areas and gravel storage/quarry areas in spring and autumn.
- Removal/placement of sediment in areas where weeds will not germinate (e.g. within overburden) or can easily be controlled.

- Buffering vegetation that is vulnerable to weeds with weed-resistant vegetation such as high-quality direct transfer.

- Removing weeds and establishing weed-free, native vegetation or rock buffers along the length of the access road, particularly adjacent to the railway line and farmland.

- Removing wind-dispersed weeds from a broad buffer around any quarry located outside the mine footprint. In particular buddleia, broom, gorse, pampas and Spanish heath should be prevented from reaching the mine site.

7.7 Strategies to Minimise the Disturbance Footprint

The following strategies are recommended to reduce the overall ecological footprint. Reduction of the effects should take into account the overall mine footprint, the location of the highest-value, most difficult to rehabilitate ecosystems within the footprint, and the likely resources needed to achieve rehabilitation goals. Many of the strategies are not one-off actions, but need to be carried out whenever coal and overburden scheduling is optimised as part of ongoing mine planning. Hence these strategies should be reflected in any changes to annual mining and rehabilitation plans as mining progresses. The trade-offs between slope and footprint size, and slope and ease of revegetation are discussed earlier in section 7.4.1, particularly with respect to the access road footprint and would also apply here.

In terms of the mine site the greatest effort to reduce disturbance should focus on avoiding and/or minimising impacts outside the coal resource footprint. The greatest opportunity to achieve this is by scheduling mine backfill and creation of areas of final landform suitable for rehabilitation as early as possible. This allows progressive rehabilitation, and would reduce the ex-pit overburden storage footprint required. With two coal seams present at different depths at Te Kuha, both seams must be removed before backfilling and rehabilitation can occur. This increases the potential risk of delayed rehabilitation, requiring an increase in ex-pit stockpile area and reducing the area able to be salvaged and rehabilitated using direct transfer techniques.

Within the mine site the greatest influence on the disturbance footprint is the area required for ex-pit overburden and soil storage and the location of offices and infrastructure. Where there is a choice as to where stockpiles and moveable infrastructure should be located, they should always be located on the lowest-value ecosystems or those which are easiest to rehabilitate quickly. A ‘first cut’ attempt to reduce the footprint has been made by overlaying high-value ecosystems on the initial mine footprint as shown in Figure 16 where high value ecosystems outside the mine footprint are coloured brown. The ex-pit overburden dump shown in Figure 16 does not cover any high-value ecosystems however, the area of high-value ecosystems destroyed by mining can be significantly reduced by relocating the areas shown in black which are the infrastructure area and ROM.

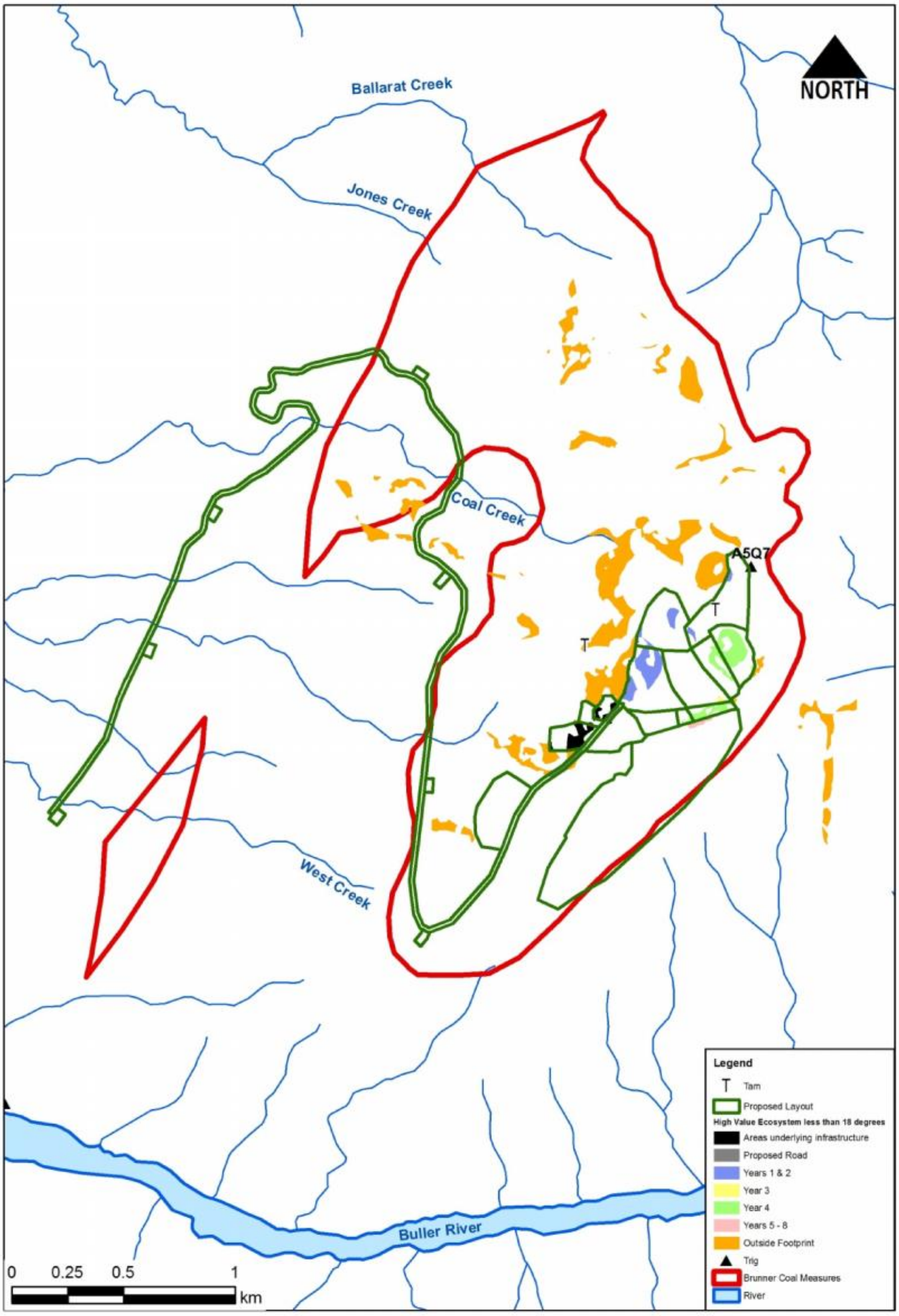

Figure 16: High value ecosystems with a high potential for recovery as direct transfer (i.e. slopes <18 degrees). Green areas are likely to be able to be salvaged as direct transfer.

High-value vegetation may also be avoided at some locations along the access road by using bridges instead of culverts or retaining walls instead of unconfined batters. Another way to reduce the overall ecological footprint is to locate moveable infrastructure on parts of the footprint where vegetation growth rates are highest, so as to achieve the fastest vegetation cover with a similar level of input to poorer sites, or a similar standard of outcome requiring fewer resources when rehabilitation commences. Growth rates should be fastest on low-altitude and more sheltered areas with deepest soils.

The footprint can also be reduced by clustering infrastructure. Reducing the length and width of any roads/spur roads also minimises edge effects. This includes minimising side-casting and other loss of vegetation and implementing weed management and effective run-off controls.

Preventing sedimentation (especially of low-growing vegetation) using sediment fences and rock fences also reduces the disturbance footprint. Sediment fences used to protect vegetation need to be as close to the working edge as possible. Alternatives such as slowly-biodegradable wool mats and bags have been successfully used at other sites to avoid having to remove accumulated sediment or fences when they are no longer required. Another strategy, subject to geotechnical stability, is to place a base of coarse rock under road fill batters to maximise survival of roots from adjacent tree roots under the fill (coarse material can maintain oxygen flow for root survival). In addition there may also be places where undisturbed vegetation and soils can be left within the general footprint to create 'peninsulas' and 'islands' within generally disturbed areas, for example around the sediment pond/s. These generally speed rehabilitation and provide insect and plant propagules. Finally, rehabilitation resources should be salvaged and footprints minimised during any further exploration drilling.

7.8 Backfill and Out-Of-Pit Overburden Profiles

The shape and extent of the ex-pit overburden dump would be influenced by the mine schedule and final size of the ROM, infrastructure pad and any associated roads and water control features. As shown in Figures 2 and 15 the ex-pit overburden area is approximately 3 ha in size. This area is where soil and vegetation removed from approximately 9 ha stripped during the first two years of operation (Years 0 and 1) would be stockpiled for later use in rehabilitation. These soils and vegetation would not be mixed with overburden. This landform will need to be relatively tall and steeply-sloped, so as to maximise the storage volume per hectare of footprint. Stockpiles are also likely to be deep (up to 5 m). If constructed from the maximum extent back towards the pit, with a series of benches, the potential for erosion on the relatively steep slopes can be largely eliminated by using sods of direct transferred scrubland no more than 2 m height. This will also mitigate any visual impacts.

- Backfill should meet and blend with the adjacent natural ground contours in order to reduce edge effects. The backfill contour at the edges of the former pit should be at, or slightly lower than, the adjacent profile. The shorter the vegetation the closer the profile needs to match. This principle means no cut benches will be visible because they will be covered. A backfill surface that is slightly lower than adjacent areas helps contain runoff, reducing potential for sediment or soil entering undisturbed areas. However, the impact on adjacent vegetation will also be minimised if the original hydrology can be re-established by, for example, restoring movement of water back into reinstated catchment after removal /disestablishment of cut off drains.

- Bare (stripped) rock should not be left above any pit edge high wall. Instead, only tall vegetation should be removed. This allows the roots of remaining groundcover and/or planted seedlings to bind the soils and decreases the cost and increases the effectiveness of revegetation later.

- Few slopes are expected to exceed approximately 24 degrees on the backfill because backfill does not have the same angle of repose as competent, un-mined slopes.

Most of the natural slopes are at a relatively shallow angle, so mimicking natural landforms to the extent practicable will include creation of the following:

- Non-linear batters, i.e. moving away from strongly benched landforms to concave profiles on most areas, variable bench widths, and avoiding flat backfill tops.

- A high degree of landscape dissection to disperse flow and create drainage channel geometry (width to depth, relative to slope) and sinuosity that mimics natural channels and also helps minimise erosive flow rates. Dispersing flows may create a tension with the treatment of dirty water, as it is traditionally treated in a few, large devices.

- Non-linear plan footprints.

- Non-linear top profiles and sky-line outlines. Preliminary analysis shows that removing the ridgeline to the base of the coal seam creates a fairly linear form (P. Rough pers. comm.). A more natural, variably ridgeline can be created using three techniques:

  i) Excavation of some areas below the coal seam. The material removed can then be used to create more sheltered areas.

  ii) Building up of some locations with suitable overburden, ideally placed adjacent to excavated areas to accentuate the valley form. Such fill needs to be placed in a way that sediment and runoff is retained within the mine boundary and runoff directed, at least inititally, to areas where sediment can be managed.

  iii) Placement of sandstone boulders to create a long-term colour-contrast with the rehabilitated vegetation, creating a perception of height (if pale coloured). Protruding boulders are a feature of the ridgeline.

The variation in backfilled slopes and topography creates variation in drainage and exposure which help support and drive a vegetation mosaic on the rehabilitated landform. There is no granite available at Te Kuha, since the overburden comprises coal measures sandstones and carbonaceous mudstones. This limits the ability to vary vegetation height/structure by manipulating the location and abundance of the more fertile granitic substrates. However, phosphate availability could be varied by applying rock phosphate in the lower root zone (below topsoil so as to limit its availability to non-native legumes) where taller forest is planned. Under the existing environmental conditions of low pH and high rainfall this phosphate would gradually become available to trees over the medium term.

7.9 Conclusions

7.9.1 Medium to Long Term Rehabilitation Outcomes

The rehabilitation plan provided here is based on backfilled and residual cut landforms that are geotechnically stable to the agreed, specified design events (rainfall and earthquake). The rehabilitation outcomes expected are also predicated on absence of acidity due to acid rock drainage which exceeds background 'natural' levels in the root zone or surface waters. In the medium to long term, the vegetation that develops on the backfill is likely to be typical of existing areas with better-drainage and deeper rooting zones. Vegetation on the upper slopes is likely to have fewer podocarp (native pine) species and more mountain flax. On lower slopes more toetoe and tutu are likely. Herbfield, mānuka – *Dracophyllum* rockland and open yellow-silver pine – mānuka shrubland are likely to be reduced in extent, even if these habitats are prioritised for VDT.

Situations where original vegetation is old and / or tall and topsoils are deep and highly enriched in organic matter will be the slowest to be re-created. This is because tall forest has a complex structure developed over hundreds of years. Likewise, peaty topsoils take decades to hundreds of years to develop in mixed soil/overburden materials, even though humus layers can be developed in several decades under dense vegetation. Invertebrates of topsoil and humus are similarly slow to re-establish, unless intact soils are replaced as high-quality DT. That is the reason why DT is required to establish herbfield and yellow-silver pine – mānuka shrubland – soils in those ecosystems typically have high organic levels, high water-holding capacity and slow lateral drainage (further impeded where slopes are gentle and/or impervious sandstone restricts drainage).

There are also likely to be prolonged impacts to some vegetation communities along the edges of the access road and site boundaries. Susceptible communities may include those affected by diversion of clean water. Influences in this zone may differ somewhat from those created by climatic edge effects because any effects of hydrological change may not be seen until an abnormally dry period occurs. The rehabilitation plan may need to include contingency for remedial action if such effects materialise.

Vegetation along the downslope edge of the proposed mine site and road would likely be sensitive to being covered by sediment and rock generated from exposed areas upslope (i.e. sidecasting). In this largely weed-free site, a key risk of bare sediment is that weeds or non-native plant species will take the opportunity to establish there. Loose sediment can be removed and/or stabilised by adopting standard methods including, but not limited to, prompt planting.

The location of the proposed soil stockpiles to the north of the proposed footprint (near Trig M) should be confirmed in consultation with the Department of Conservation because a better rehabilitation outcome is likely to be achieved if the northern portion overlying rockland is not used. Leaving this habitat intact would better buffer the high value yellow-silver pine – manuka association nearby and reduce edge effects there.

7.9.2 Certainty of Rehabilitation Outcomes

Rehabilitation techniques for similar coal measures ecosystems developed over last 10 to 20 years at similar sites provide the best indication of what is achievable for rehabilitation at Te Kuha. Species to be used, survival rates and expected outcomes for most rehabilitation approaches are known or can be relatively confidently inferred provided that suitable root zones are available (via soil salvage) with no influence of acid rock drainage. It is important to note that at other locations ridge-line herbfields and at-risk or threatened bryophytes have received comparatively little attention to date, hence it remains unknown how they would respond to the types of rehabilitation proposed here. Having said that, there has been extensive research on establishment of common bryophytes (mainly mosses) and herbs using hydroseeding. Furthermore few mining operators in similar environments have intentionally created backfill landforms which mimic natural landforms. Instead, most mines have created obvious benching, which has the advantage of being able to manage the high volumes of runoff, and potentially sediment, whilst at the same time providing access.

Te Kuha is unusual in that it has a very low weed presence. For that reason a low tolerance to weeds is proposed for inclusion in the rehabilitation plan. Higher altitude parts of Stockton Mine (shown in Figures 9 and 11) have remained free of gorse and broom. Strongman Mine (shown in Plate 17) is another example of a mine site that has remained free of gorse and *Juncus squarrosus*. Remaining weed free should also be the goal at Te Kuha.

Rehabilitation success at Te Kuha is predicated on suitable landforms, salvage of adequate soil or weathered competent rock (both in terms of quality and volume), and application of direct transfer for at least 10% of the site overall.

The impact of the proposed road depends on the final extent of the footprint, location of stockpiles and passing bays, and whether suitably sloping road batters created in the first year would be mostly rehabilitated using direct transfer, and whether these areas are closed at the end of mining or not. The most vulnerable habitats at Te Kuha are herbfields, open shrublands containing bryophytes and rockfields. The most conservative approach is to deliver densely vegetated herbfields and bryophyte vegetation via VDT in order to provide resilience against weeds and maintenance of suitable soil and soil moisture conditions. In other areas, we recommend the establishment of a dense canopy of native species at least 1 to 2 m height, because the most likely weeds are generally herbaceous annuals (exotic grasses and short herbs) and such species are much less competitive in a shaded environment.

We recommend that as mine planning proceeds consultation with affected parties, particularly the Department of Conservation and Buller District Council peer reviewers, be undertaken to clarify priorities and preferred outcomes for rehabilitation. In the first year consultation with respect to road construction is likely to be particularly useful. Key matters for consideration include creation of suitable landforms, and the extent of VDT which should be achieved. With two coal seams present, both seams need to be removed before backfilling and rehabilitation can occur. This potentially increases the likelihood of delayed rehabilitation, requiring an increase in ex-pit stockpile area and reducing the area able to be salvaged and rehabilitated using direct transfer technique. Monitoring and reporting will need to confirm the adequacy of salvaged soils and materials needed for high quality rehabilitation, effectiveness of erosion control practices that conserve growth media and mitigation of potential weeds.

8. MITIGATION

8.1 Aims and Rationale

Mitigation at Te Kuha would aim to firstly, reduce invasion by weeds and maintain the integrity of the habitats at the site to the extent practicable, and secondly maintain local species in the vicinity of the disturbed area in order to maximise the potential for re-invasion by local species once rehabilitation commences.

These aims can be achieved in part by attention to weed control and biosecurity of the site and in part by sequential stripping of small areas followed by prompt and comprehensive rehabilitation. Affecting only small areas at a time has the advantage of reducing the spatial and temporal window for invasion and the overall footprint at any one time, as well as reducing the time taken to rehabilitate each small area.

The overall effect of the project on local biodiversity will be reduced by attention to effective rehabilitation. The approach and methods used to rehabilitate the site are also important in reducing adverse effects. The types of rehabilitation proposed at Te Kuha are detailed, evidence based and achievable. No species are expected be lost from the mine area for more than approximately 20 years and the mosaic of rehabilitated habitats will ensure pre-mining habitat types are recreated or encouraged to develop naturally in the longer term. As outlined in Section 7 the three at risk or locally distinctive plant species (*E. wettsteiniana*, *D. densum* and *M. parkinsonii*) should be targeted as part of rehabilitation to ensure they continue to persist in the local area after mine closure.

With respect to fauna the species most at risk should be the subject of species-specific ecosystem management intended to offset any losses. Most fauna species currently found within the proposed footprint, with the exception of rifleman, will be able to occupy the rehabilitated area within a moderate time frame (around 30 years). Although great spotted kiwi will likely use the habitats within that time frame, the habitats will not be able to support kiwi throughout the year for perhaps 50 years or more post-mining.

Reinvasion of native plants and small fauna from surrounding areas, and from directly transferred vegetation, should be promoted. In addition to the species led proposals additional ecosystem management of the wider area would assist in maintaining local species during mine life to ensure they are available to recolonize the site as rehabilitated habitats become suitable.

8.2 Management to Minimise Adverse Effects

The following principles are recommended to minimise effects on flora at Te Kuha:

- Smallest practicable footprint. To minimise the footprint a number of management actions are necessary:

    i. The boundaries of the operational area should be clearly marked during mine life and sediment, silt and sidecast placement should be controlled so that adjacent areas are not affected. Sediment fences should be placed downslope of any workings to prevent damage to vegetation outside the footprint.

ii. By working smaller areas sequentially and rehabilitating promptly, the amount of habitat clearance at any one time will be reduced, maximising the potential for natural re-colonisation from sources nearby, including any small remnants of vegetation within the consent boundary which will not be removed.

iii. Establishing dense, weed-resistant native vegetation along site boundaries and near waterways and avoiding disturbance outside the current mine footprint will reduce edge effects, speed up natural processes of colonisation and maximise the amount of habitat available to wildlife (thereby minimising effects). This can be achieved using planting or direct transfer. Direct transfer would be the preferred method for high value habitats such as tall forest, herbfield and yellow-silver pine – manuka shrubland.

v. Exotic plants should not be used in rehabilitation unless they are sterile annuals which will not spread across the site.

- Salvage of topsoil and forest duff where practicable (including vegetation, topsoil, subsoil, logs, boulders and invertebrates). During any clearance, the identification of salvageable rehabilitation resources in the disturbed areas and then provision of access and time for salvage will maximise the use of these resources. The extent to which salvage is possible and the amount of stockpiling required is determined in part by mine scheduling, and will form part of the detailed rehabilitation plan to be prepared for the site.

- Direct transfer of vegetation in rehabilitation. The potential for VDT during rehabilitation at Te Kuha is limited by the mine schedule, soil depth, topography and type of vegetation amongst other factors. The detailed rehabilitation plan for the site should identify opportunities for direct transfer and ensure that they are maximised as discussed in Section 7.

- Use of local native species and locally sourced genetic material in plantings. Where new seed and plant resources are brought onto the site, these should be sourced from the Ngakawau Ecological District in close proximity to the site. The use of exotic species, or species absent from the site prior to mining, should be absolutely minimised and the site should be managed to minimise the establishment and seeding of weeds.

- Edge effects can be reduced by encouraging dense growth of vegetation along the new edge (Norton 2002). Edge effects may therefore be mitigated by appropriate landscaping and/or planting along any new edges. Vegetating bare edges with native species also reduces the risk of weeds establishing.

- Areas where sediment or silt accumulate (such as near roadsides or in sediment traps) should be monitored regularly and the deposited silt either managed to prevent weed growth or removed from the site.

In order to neutralise the risk of weeds being spread, soil and roading materials likely to be contaminated with either seeds or vegetative material should be prevented from entering the site. When weeds establish at the site, soils known to be contaminated should either be removed from the site altogether and disposed of or deposited in accessible sites that are known to be insensitive to weeds (e.g., distant from waterways), monitored and regularly treated with herbicide until such time as new weeds fail to germinate.

Restoration of herbfield via VDT, and the return of *Dracophyllum densum* and *D. pubescens* to the re-created landform where suitable habitat exists for them, would reduce any long-term effects on that habitat and those species. Planting of *D. densum*, and *M. parkinsonii*, along with direct transfer of some individuals will also assist in maintaining these species locally. VDT of manuka – yellow silver pine shrubland and other low growing habitats is also expected to assist in maintaining invertebrates and bryophytes at the site over the medium to long term. VDT of 10% of the site (between 7 and 10 ha) is proposed.

Recreation of habitats which have the potential to develop into shrublands and forest that could eventually support Parkinson's rata will also assist in retaining this distinctive component of the local flora. Other species with restricted distributions such as *Celmisia dubia* would also benefit from direct transfer of vegetation or reintroduction to suitable sites after rehabilitation is complete, but this is not considered necessary to ensure their persistence.

Although new edges will be created by overburden removal and edge effects might affect approximately 22 ha around the site, the proposal to sequentially mine and rehabilitate at Te Kuha means that these edges should only be exposed for a relatively short time (a few years at most) before the land form is replaced and vegetated. Mine planning can trade-off high value ecosystems and lower value ecosystems to reduce edge effects. For example edge effects are reduced in short open vegetation. Where alternative locations are possible, siting infrastructure within low vegetation or creating shallow slopes were planting can be maximised would be preferred over creation of sharp, tall edges. Where VDT can occur adjacent to existing vegetation this will reduce any microclimatic gradients into original vegetation quickly, but where planting is required the return to a more normal microclimate will take longer. The planted edge vegetation post-mining will be much less natural than pre-mining edge and include a much less diverse range of species, but these attributes will change with time as suitable species colonise from outside the mine footprint, and from adjacent areas of VDT. We recommend a rehabilitation management plan that addresses these matters and ensures that development of a more natural edge is promoted and that no species be lost from the wider area during the life of the mine.

8.3 Site Biosecurity and Weed Control

Even with the best biosecurity some weeds (e.g. those with wind borne seeds) will establish at the site as space is created for them. The management response to minimise the potential for weed establishment can be controlled using suitable conditions of access. Such conditions would identify weeds that should not be tolerated on site because of their aggressiveness or persistence and prescribe how they would be managed. Adequate site biosecurity is required for machinery and materials brought onto the site to ensure that weed propagules do not enter the site. This involves cleaning machinery prior to bringing it on to the site and ensuring that other materials brought on to the site, including gravels and mulch, are free of seeds or pieces of vegetation. Using locally sourced gravel and soils, or other materials where possible, would reduce the potential for the introduction of new weeds to the area. Isolating the mine site and operating vehicles only on site (or between the coal handling plant and the mine) after their initial sanitising will assist in this regard.

Minimising the creation of bare ground and establishing dense, weed-resistant shrubby vegetation along site boundaries, along the road and near waterways will help reduce opportunities for weeds to establish. A plan to rehabilitate road batters and other edges with suitable vegetation should be developed.

Protocols to monitor and manage weeds will be required and these should extend to nurseries and other site contractors as discussed in Section 7.6.5 above. On site management will include monitoring of the existing habitats to detect changes in vegetation or weed abundance (signalling management is required) and monitoring of rehabilitated habitats to determine if further intervention is required. We recommend this be managed using a specific weed management and site biosecurity plan.

8.4 Ecosystem Management

Great spotted kiwi could be managed to protect them the effects of mining at the site (for example by monitoring and removing and affected individuals), but individual management of other species is unlikely to be practically achievable. In order to ensure that local species persist until mine closure is achieved and are available to re-colonise rehabilitated surfaces, ecosystem management will be required to protect flora and fauna for the life of the mine and beyond.

The main agent of decline for many New Zealand forest birds is now recognised as predation by introduced mammals including mustelids (stoats (*Mustela erminea*), ferrets (*M. furo*), weasels (*M. nivalis*)), possums and rats, and removal of these agents is effective at increasing productivity and restoring populations (Innes *et al.* 2010). The same agents have also been shown to adversely affect plant communities either directly, by consuming leaves, seeds and fruit, or by reducing pollinators and seed dispersers (Wilson *et al.* 2003, Kelly *et al.* 2010). Control of these pests, particularly possums and rats, is also thought to benefit *Powelliphanta* populations (Walker 2003).

Since reasonable amounts of similar habitats will remain around the Te Kuha site, and these habitats are currently only managed to reduce brush-tailed possum (*Trichosurus vulpecula*) numbers so as to reduce the spread of bovine tuberculosis, we recommend additional ecosystem management should be focussed on the Te Kuha area and include management of all introduced mammals. The Department of Conservation already manages the Buller Coal Plateaux Priority site further north at Denniston. If it achieves resource consent to construct the Escarpment Mine, Bathurst Resources Ltd will be managing around 4,200 ha of the Denniston Plateau and Solid Energy New Zealand Limited will be managing approximately 8,200 ha of Stockton Plateau as part of its Wider Habitat Enhancement Area as required for the construction of the Cypress Mining Area. Connecting the management of all these habitats north of the Buller River requires an additional approximately 9, 500 ha to be managed and management of all three areas combined has the potential to create a meaningful coal measures reserve and contribute to maintaining coal measures flora and fauna over the longer term.

Another potential site for ecosystem management to mitigate effects of mining at Te Kuha is part or all of the Orikaka Ecological Area.

Translocation of *Powelliphanta* species (either *P. patrickensis* or *P. augusta*) to suitable habitats within managed sites at Te Kuha (but outside the proposed mine footprint) could provide additional security for these species. The details of any translocation proposal would need to be negotiated with the Department of Conservation and relevant experts.

A separate Biodiversity Management plan should be prepared to address the wider ecosystem management requirements.

8.5 Formal Protection to Avert Risk of Future Damage

Brunner Coal Measures and their associated habitats form a distinctive ecological assemblage for which there are a number of existing and proposed mining operations with more likely in the future. The cumulative effects of these projects will mean that coal measures communities like those found at Te Kuha are increasingly at risk from habitat loss, exotic species invasion and fragmentation. Protection of representative and meaningful areas of these habitats and their communities needs to be addressed regionally and is generally beyond the scope of TKLP specifically. Any such reserve proposals are complex and will involve co-operation between a variety of parties including the holders of Mining Permits, the Ministry of Economic Development, Buller District Council, the Department of Conservation and other interested parties. Nonetheless efforts to effectively protect coal measures vegetation outside the proposed footprint are required and will contribute to ensuring such vegetation persists in the longer term and mitigate adverse effects of mining overall.

The current proposal will not exhaust the coal reserves at Te Kuha, but what coal remains is located at greater depth, with currently uneconomic stripping ratios (C. Coll pers. comm.). The economics of coal mining vary with the price of coal, but one way to provide assurance to stakeholders of the scale and magnitude of any effects due to the project proceeding at Te Kuha is to commit to entering discussions with the Ministry of Economic Development and other parties with the aim of formally protecting the remaining coal measures at Te Kuha from future mining and establish that protection in perpetuity, in a similar way to the Solid Energy Deed Area at Stockton. Since neutralisation of any potential coal resource at Te Kuha will require co-operation of the Ministry of Economic Development, Buller District Council and other parties, the outcome of any discussions cannot be guaranteed, but a willingness to forgo some coal and enter meaningful dialogue would indicate recognition by TKLP of the distinctive ecological values at the Te Kuha site and a willingness to collaborate in their future protection. Since ecosystem management of the wider habitats is proposed as one way to mitigate the adverse effects of habitat removal at the site (Section 8.4 above), formal protection has the advantage of ensuring that money spent on pest control is not negated by later habitat removal once ecosystem gains due to this management have been accrued.

9. CONCLUSION

The most striking ecological feature of the proposed Te Kuha mine site is its relatively intact and undisturbed flora and fauna. Although threatened and at risk species are found at Te Kuha it is the undisturbed nature of the communities, rather than their rarity *per se*, that distinguishes the Te Kuha site from other Brunner Coal Measures vegetation at Stockton or Denniston. In addition some obvious components of coal measures vegetation on the coal plateaux are more common at Te Kuha (e.g. Parkinson's rata), while others are less common (e.g. *Dracophyllum densum*) or absent (e.g. coal measures tussock, *Powelliphanta* snails). Furthermore some species, such as the newly discovered leaf-veined slug (*Pseudaneita*), may be unique to that site.

Coal measures vegetation is not recognised as historically rare, but it does meet Williams *et al.*'s (2007) definition. Furthermore coal measures are a habitat type which is known to be declining in extent. Coal measures vegetation has not yet declined to the extent that it fits within the higher categories of the Threatened Environment Classification, rather more than 30% remains and more than 20% is formally protected, resulting in the lowest ranking of "less reduced and better protected" (Walker *et al.* 2007). However, formal protection of coal measures has not resulted in effective protection and the amount of coal measures vegetation even on conservation land continues to decline.

The current proposal involves removal of around 77 ha of the local coal measures vegetation, with a smaller area (22 ha) affected by edge effects. Construction of the road and other human activity would also increase the presence of weeds and possibly pests. This means that in order to leave most of the vegetation unaffected at Te Kuha, effective weed and pest control will be required throughout the site and immediate surrounds. This includes effective biosecurity to prevent weeds reaching the site and effective site management to prevent their establishment and spread. Off site contractors such as nurseries will also require biosecurity protocols.

Some of the species found at Te Kuha, such as bryophytes, invertebrates and *Euphrasia wettsteiniana*, would be best protected from removal due to mining by direct transfer of vegetation during mine rehabilitation, although the benefits of this approach for *E. wettsteiniana* remain unknown. Herbfield and yellow-silver pine – mānuka shrubland should be prioritised for rehabilitation using this method and monitoring is recommended to assist in adaptive management. Hand transfer of individual specimens of *Dracophyllum pubescens* is also recommended since this species is easily identified and locally important. Great spotted kiwi will require individual monitoring to determine to what extent management is required.

In order to achieve landscape level objectives for the ecosystems present at Te Kuha it may be necessary to make trade-offs between habitats by for example increasing the amount of vegetation removal in order to achieve slopes that can be effectively revegetated with direct transfer. Recognising these trade-offs and providing for them is best dealt with in management plans developed in consultation with the Department of Conservation and the Buller District Council as stakeholders.

We recommend that the site footprint be minimised to the extent practicable and that all site infrastructure be located on exotic pasture on the Buller River terraces, rather than requiring additional vegetation removal of low altitude forests. We further recommend that adverse effects due to mining at Te Kuha be minimised by developing the following management plans to address the matters of concern identified in this report:

i. Site Biosecurity and Weed Management.
ii. Pest Control and Ecosystem Management.
iii. Rehabilitation Management.

These plans will require the input of the Department of Conservation and may have their own permitting requirements (e.g. a Wildlife Permit will be required to handle protected wildlife). Other stakeholders could be invited to contribute to developing the management plants as well.

Once coal mining commences at the site changing economic conditions in future could mean that coal that is currently uneconomic to mine becomes feasible and mining expands across the remainder of the coal measures vegetation. In order to prevent this happening and provide some certainty about the scale of likely effects of mining at Te Kuha we recommend that TKLP investigate with affected parties the possibility of permanently protecting the remaining coal measures vegetation at Te Kuha through inclusion in Schedule 4 of the Crown Minerals Act (1991) or similar. There is precedent for this type of approach with the RAP which was negotiated as part of the Cypress Mining Area which became known as the Deed Area.

The rehabilitation plan for the site is based on backfilled and residual cut landforms that are geotechnically stable to the agreed, specified design events (rainfall and earthquake). The rehabilitation outcomes are also predicated on absence of acidity in the form acid rock drainage above background 'natural' levels in the root zone or surface waters. In the medium to long term, the vegetation that develops on the backfill is likely to be typical of existing areas with better-drainage and deeper rooting zones. Vegetation on the upper slopes is likely to have fewer podocarp (native pine) species and more mountain flax. On lower slopes more toetoe and tutu are likely. Herb field, mānuka-dracophyllum rock land and open mānuka, yellow-silver pine shrubland are likely to be reduced, even if these habitats are prioritised for VDT.

As mining proceeds there is likely to be a trade off between the mine footprint (including matters such as the location and size of overburden dumps, the width of the access road, the location of mine infrastructure and the like) and the ease and effectiveness of rehabilitation at those sites. We recommend that as mine planning and development proceeds, consultation with affected parties, particularly the Department of Conservation and Buller District Council peer reviewers, be undertaken in order to clarify priorities and preferred outcomes for rehabilitation and that these matters be considered in future mine planning. In the first year consultation is likely to be particularly helpful with respect to road construction. Key matters for consideration include creation of suitable landforms and the extent of VDT over the rehabilitated site.

If the long term intention for the site is to try and restore the ecological integrity after mining it will be necessary to close the proposed access road and rehabilitate it. This will prevent 4WD and other unrestricted vehicle access which would contribute to introducing and maintaining weeds at the site and further degrade ecological values. As a key stakeholder the Department of Conservation will guide future decisions about the status of the road.

Historic mining on the Denniston Plateau and elsewhere has shown that natural communities can return after mining disturbance. Provided that the recommendations above are followed effectively we consider that the effects of open cast mining at Te Kuha can be managed appropriately to protect the values of the coal measures habitats locally and ensure an acceptable return to a self-sustaining natural community once rehabilitation is completed.

10. REFERENCES

Adams, L., Miller, C., van Mierlo, R., Tocher, M., Affeld, K., van Klink, P. 2000. West Coast lizard surveys. Unpublished Report, Department of Conservation.

Allibone, R., David, B., Hitchmough, R., Jellyman, D., Ling, N., Ravenscroft, P., Waters, J. 2010. Conservation status of New Zealand freshwater fish 2009. New Zealand Journal of Marine and Freshwater Research 44: 1-17.

Beauchamp, A.J. 1995. The status of the New Zealand Pipit (*Anthus novaeseelandiae*) in the Wellington Region. Notornis 42: 117-125.

Beauchamp, A.J. 1999. Weka declines in the north and north west of the South Island, New Zealand. Notornis 46: 461–469.

Beauchamp, A.J. 2009. Distribution and habitat use by New Zealand pipits (*Anthus n. novaeseelandiae*) on the Volcanic Plateau. Notornis 56:183 – 189.

Bell T.P. & Jewell T. 2007. Lizard and invertebrate surveying in the Stockton No. 2 South Block, Stockton Mine, March 2007. Landcare Research Contract Report LC0607/187 prepared for Solid Energy New Zealand Ltd., Christchurch. 26 pp.

Boyer S, Wratten SD, Pizey M, Weber P 2011: Impact of soil stockpiling and mining rehabilitation on earthworm communities. Pedobiologia 54: 99–102.

Bramley, G.N. and Veltman, C.J. 2000. Directions for future management of North Island Weka *Gallirallus australis greyi* to improve survival and productivity in situ. Bird Conservation International 10: 241-253.

Brownsey, P.J., Ewans, R., Rance, B., Walls, S., Perrie, L.R. 2013. A review of the fern genus *Sticherus* (Gleicheniaceae) in New Zealand with confirmation of two new species records. New Zealand Journal of Botany 51(2):104-115.

Buckingham, R. 2008a. A survey for the endemic land snail *Powelliphanta* “patrickensis”, kiwi and other birds along the proposed hydro-power footprint, Whareatea-Lake Rochfort. Contract report for Kawatiri Energy Ltd. 23 pp.

Buckingham, R. 2008b. An investigation of terrestrial ecosystems for the L&M Coal Ltd Escarpment Mine Project: Avifauna and *Powelliphanta snails*. Contract report prepared for Resource and Environmental Management (Nelson) Ltd by Wildlife Surveys Ltd. 60 pp.

Buckingham, R. P. 2002. Survey of the distribution and relative abundance of birds, bats and *Powelliphanta* snails within Timberlands West Coast Ltd exotic forest estate. Contract report prepared for Timberlands West Coast Ltd by Wildlife Surveys. 88 pp plus maps.

Buckingham, R.P. 1998a. Bird and bat survey of Maruia State Forest, Murchison District, New Zealand, 1996–1997. Wildlife Surveys contract report No. 7 for Timberlands West Coast New Zealand Ltd., Greymouth. 106 pp plus maps.

Buckingham, R.P. 1998b. Surveys for endemic bats in the upper Waimangaroa Exploration Permit Area, and surrounding areas, South Island West Coast, New Zealand. Contract report No. 24/2 prepared for Solid Energy International by Wildlife Surveys. 4 pp. Plus maps.

Buckingham, R.P. 1998c. Distribution of birds in the upper Waimangaroa Exploration Permit Area, and surrounding areas, South Island West Coast, New Zealand. Contract report No. 24/3 prepared for Solid Energy International by Wildlife Surveys. 14 pp. Plus maps.

Buckingham, R.P. 1998d. Surveys for *Powelliphanta* land snails in the upper Waimangaroa Valley, Blackburn-Orikaka pakihi, Mount Stockton and Mount Rochfort localities, South Island West Coast, New Zealand. Contract report No. 24/1 prepared for Solid Energy International by Wildlife Surveys. 11 pp. Plus maps.

Buckingham, R.P. 1999. A survey for birds and bats in Inangahua Working Circle (Beech Working Circle 2). Wildlife Surveys contract report No. 25/2 for Timberlands West Coast New Zealand Limited, Greymouth. 146 pp plus maps.

Buckingham, R.P.; Brown, K.P. 1996. Bird and bat survey of Beech Working Circle 2, eastern Paparoa Range, North Westland, New Zealand. Wildlife Surveys contract report No. 2 for Pine Plan New Zealand Ltd., Dunedin. 76 pp.

Bullock JM 1998: Community translocation in Britain: setting objectives and measuring consequences. Biological Conservation 84(3):199–214.

Burton, D.W., 1963. A revision of the New Zealand and subantartic Athoracophoridae. Transactions of the Royal Society of New Zealand, Zoology 3(6): 47-75.

Davies-Colley, R.J., Payne, G.W., and van Elswijk, M. 2000. Microclimate gradients across a forest edge. New Zealand Journal of Ecology 24:111-121.

Dawson, D.G.; Bull, P.C. 1975. Counting birds in New Zealand forests. Notornis 22: 101–109.

De Lange, P.J., Norton, D.A., Courtney, S.P., Heenan, P.B., Barkla, J.W., Cameron, E.K., Hitchmough, R.A. and Townsend,A .J. 2009. Threatened and uncommon plants of New Zealand (2008 revision). New Zealand Journal of Botany 47:61-96.

Department of Conservation 2010. West Coast Conservation Management Strategy 2010 – 2020. West Coast Tai Poutini Conservancy Management Planning Series No. 10. Department of Conservation, Hokitika. 556 pp in two volumes.

Department of Conservation and Ministry for the Environment 2007. Protecting our Places. Introducing the national priorities for protecting rare and threatened native biodiversity on private land. Ministry for the Environment, Wellington. 7 pp.

Department of Conservation Herpetofauna Database (www.doc.govt.nz/nzherpatlas).

Efford, M., 1998. Distribution and status of native carnivorous land snails in the genera *Wainuia* and *Rhytida*. Science for Conservation 101. Department of Conservation, Wellington. 48pp.

Ewers, R.M. and R.K. Didham, 2008. Pervasive impact of large-scale edge effects on a beetle community. Proceedings of the National Academy of Sciences of the United States of America 105(14): 5426-5429.

Garrick D.P. 1986. Te Kuha Coal Prospect Wildlife Assessment February/March 1986. Unpublished Report prepared for Applied Geology Associates Ltd. 36 pp.

Glenny, D. 1999. Bryophyte survey at Stockton Plateau: Happy Valley tussockland and surrounding areas. Unpublished Landcare Research report LC9899/050. Prepared for Solid Energy New Zealand Limited.

Glenny, D. and Kusabs, A. 2005. Bryophyte survey of proposed dam sites at Mangatini Stream, Stockton Plateau. Unpublished Landcare Research report LC0506/038. Prepared for Solid Energy New Zealand Limited. November 2005 40 pp.

Greaves S.N.J., Chapple, D.G., Daugherty, C.H., Gleeson, D.M. & Ritchie, P.A. 2008. Genetic divergences pre-date Pleistocene glacial cycles in the New Zealand speckled skink, Oligosoma infrapunctatum. Journal of Biogeography 35: 853–864.

Heather, B.D. and Robertson, H.A. 1996. The field guide to the birds of New Zealand. Viking Press. Auckland. 432 pp.

Hitchmough R, Anderson P, Barr B, Hoare J, Lettink M, Reardon J, Tocher M & Whitaker T. 2013. Conservation status of New Zealand reptiles, 2012. New Zealand Threat Classification System Series 2, Department of Conservation, Wellington. 9 pp.

Hitchmough, R.; Bull, L.; Cromarty, P. (Compilers) 2007. New Zealand Threat Classification System Lists 2005. Department of Conservation, Wellington. 194 pp.

Innes. J., Kelly, D., Overton, J.McC., Gillies, C. 2010. Predation and other factors currently limiting New Zealand forest birds. New Zealand Journal of Ecology 34(1):86-114.

Kelly, D., Ladley, J.J., Robertson, A.W., Anderson, S.H., Wotton, D.M., and Wiser, S.K. 2010. Mutualisms with the wreckage of an avifauna: the status of bird pollination and fruit-dispersal in New Zealand. New Zealand Journal of Ecology 34(1):66-85.

Landcare Research Limited 2010. LENZ Threatened Environments Classification available at www.landcareresearch.co.nz/databases/LENZ/downloads.asp. Accessed 22 September 2010.

Leathwick, J.R., Morgan, F., Wilson, G., Rutledge, D., McLeod, M., and Johnston, K. 2002. Land Environments of New Zealand: A Technical Guide. Ministry for the Environment and Landcare Research. 237 pp.

Leathwick, J.R., Wilson, G., Rutledge, D., Wardle, P., Morgan, F., Johnston, K., McLeod, M., and Kirkpatrick, R. 2003. Land Environments of New Zealand Nga taio o Aotearoa. David Bateman Ltd. Auckland.

Lettink M. 2011. Lizard survey of Mt William North, West Coast. Unpublished Report prepared for Wildlife Surveys Ltd., Mapua, Nelson. 9 pp. + map.

Lettink M. 2012. Lizard survey of the footprint of the proposed Escarpment Mine, Denniston Plateau, North Westland. Unpublished Report prepared for Royal Forest & Bird Protection Society of New Zealand Inc. 10 pp.

Lloyd, B.; Cockburn, S. 2009. Introduction to the Department of Conservation's Digital Bat Detector and BatSearch software. Unpublished report for the Department of Conservation. 29 pp.

Lloyd, K.M. 2005: Statement of evidence of Kelvin Michael Lloyd on behalf of Buller Conservation Group. In the matter of the Resource Management Act 1991 and in the matter of appeals pursuant to section 120 of the Act between Solid Energy New Zealand Limited, Director-General of Conservation, Ngakawau Riverwatch Incorporated, Royal Forest And Bird Protection Society of New Zealand Incorporated, Te Runanga O Ngati Waewae (Appellants), The West Coast Regional Council and Buller District Council (Respondents). Environment Court, Christchurch.

Lloyd, K.M., McQueen, A.A.M., Lee, B.J., Wilson, R.C.B., Walker, S.M., and Wilson, J.B. 2000. Evidence on ecotone concepts from switch, environmental and anthropogenic ecotones. Journal of Vegetation Science 11:903-910.

Mahlfeld, K., F.J. Brook, D.J. Roscoe, R.A. Hitchmough & I.A.N. Stringer, 2012. The conservation status of New Zealand terrestrial Gastropoda excluding *Powelliphanta*. New Zealand Entomologist 35(2):103-9 + Supplementary appendix.

McEwen, W.M. 1987. Ecological Regions and Districts of New Zealand. Third revised edition in four 1:500 000 Maps. New Zealand Biological Resources Centre, Department of Conservation, Wellington.

McLennan, J.A. 1992. Nationwide monitoring of kiwi populations. DSIR Land Resources. Contract Report No 92/21 for Science & Research, Department of Conservation, Wellington. 16 p.

McLennan, J.A., Potter, M.A., Robertson, H.A., Wake, G.C., Colbourne, R., Dew, L. Joyce, L., McCann, A.J. Miles, J.R.G., Miller P.J. and Reid, J. 1996. Role of predation in the decline of kiwi, Apteryx spp., in New Zealand. New Zealand Journal of Ecology 20(1):27-35.

Mew, G. and Ross C.W. 1991. Soils, agriculture and forestry of the Westport region, West Coast, South Island, New Zealand. DSIR Land Resources Scientific Report No. 1. DSIR Land Resources, Lower Hutt. 68 p.

Miskelly, C.M., Dowding, J.E., Elliott, G.P., Hitchmough, R.A., Powlesland, R.G., Robertson, H.A., Sagar, P.M., Scofield, R.P., and Taylor, G.A. 2008. Conservation status of birds (2008). Notornis 55(3):117-135.

Mitchell Partnerships and Landcare Research Limited. 2001. Vegetation and fauna of the proposed Te Kuha Mine site. Unpublished report prepared for Rangitira Developments Ltd. August 2001. 50 pp + appendices.

Mitchell Partnerships Limited. 2011. Assessment of effects on terrestrial ecology of the proposed operations in the Mt William North mining area. Unpublished report prepared for Solid Energy New Zealand Limited. December 2011. 50 pp.

Mitchell Partnerships Limited. 2007. Mokihinui Hydro Proposal: Baseline terrestrial ecology surveys. Unpublished report prepared for Meridian Energy Ltd. 93 pp. + appendices.

Mitchell Partnerships Limited. 2012. Mt William North Mining Area Offset/ Compensation Proposal. Draft for Consultation. Unpublished report prepared for Solid Energy New Zealand Limited. April 2012. 66 pp + appendices.

Naidoo, G. and Naidoo, Y. 2005. Coal dust pollution effects on wetland tree species at Richards Bay, South Africa. Wetlands Ecology and Management 13(5):509-515.

Nathan, S., Rattenbury, M.S., Suggate, R.P. (compilers) 2002. Geology of the Greymouth area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 12. 1 sheet and 58 p. Lower Hutt. New Zealand: Institute of Geological and Nuclear Sciences Ltd.

New Zealand Gazette 1998. Notice Number: 7238, page 4068. Ecological Area West Coast. Published 8 October 1998.

New Zealand Gazette 2001. Notice Number: 4461, page 1561. Declaring land to be held for conservation purposes, as ecological areas etc. Published 28 June 2001.

New Zealand Gazette 2002. Notice Number: 1483, page 602. Declaring land to be held for conservation purposes as ecological areas, Buller, Grey districts. Published 7 March 2002.

New Zealand Gazette 2003. Notice Number: 4969, page 2483. Declaring Specially Protected Area – Buller. Published 7 August 2003.

Norton, D.A. 2002. Edge effects in a lowland temperate New Zealand rainforest. Department of Conservation Science Internal Series 27. Department of Conservation, Wellington. 33 pp.

Norton, D.A. and Roper-Lindsay, J. 1997. Ngakawau Ecological Area Burma Road – Mangatini Stream Boundary. Report to the Department of Conservation, West Coast Conservancy. Te Wai Pounamu Conservation & Boffa Miskell Christchurch.

Norton, D.A., and Overmars, F.B. 2012. Ecological areas – premier protected areas. New Zealand Journal of Ecology 36(1):108-120.

O'Donnell, C.F.J., Christie, J.E., Hitchmough, R.A., Lloyd, B.D. and Parsons, S.A. 2010. The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology 37(4):297-311.

O'Donnell, C.F.J.; Dilks, P.J. 1988. Mapping the distribution of forest birds. Science & Research series No. 1. 15 pp.

Overmars, F.B. 2011. Evidence in Chief in the matter of an appeal under section 120 of the Resource Management Act 1991 for Buller Coal Limited regarding the Escarpment Mine project. In the Environment Court at Christchurch (ENV-2011-CHC-095 & ENV-2011-CHC-097).

Overmars, F.B., Kilvington, M.J., Gibson, R.S., Newell, C.L., Rhodes, T.J. 1998. Ngakawau Ecological District Survey Report for the Protected Natural Areas Programme. New Zealand Protected Natural Areas Programme Survey Report No. 11. Department of Conservation, Hokitika.

Powlesland, R.G. 2011. Evidence in-chief in the matter of Appeals pursuant to Section 120 of the Resource Management Act 1991 for Meridian Energy Limited regarding the Mokihinui Hydro Project. 81 pp. plus appendices.

Powlesland, R.G. 2012. Statement of evidence in the matter of Appeals pursuant to Section 120 of the Resource Management Act 1991 for Buller Coal Limited regarding the Escarpment Mine Project. 103 pp.

Regnier,C.E. 1986. Vegetation for Te Kuha Study Area. Unpublished Report prepared for Applied Geology Associates Ltd. 9 pp.

Robertson, H.; Colbourne, R. 2003. Kiwi (Apteryx spp.) Best Practice Manual 2003. Department of Conservation, Wellington. 101 pp.

Rodgers D, Simcock R, Bartlett R, Wratten S, Boyer S 2011: Benefits of vegetation direct transfer as an innovative mine rehabilitation tool. In. ‘Workshop on Australian Mine Rehabilitation’, Adelaide, 17–19 August 2011.

Ross C, Simcock R, Williams P, Toft R, Flynn S, Birchfield R, Comeskey P 2000: Salvage and direct transfer for accelerating restoration of native ecosystems on mine sites in New Zealand. NZ Minerals and Mining Conference Proceedings, 29–31 October 2000.

Simcock R, Bramley G, Bartlett R, Roxburgh S. 2013. ‘Contrasting direct transfer rehabilitation for different native ecosystems: vegetation outcomes, mine planning needs and operational requirements.‘Second Workshop on Australian Mine Rehabilitation’, Adelaide, August 2013.

Simcock R, Toft R, Ross C, Flynn S 1999: A case study of the cost and effectiveness of a new technology for accelerating rehabilitation of native ecosystems. In: ‘Minerals Council of Australia 24th Annual Environmental Workshop’, Townsville. _Pp. 234–251.

Thomas B & Toft R. 1997. Surveys for fauna in the upper Waimangaroa Valley. Landcare Research Contract Report LC9697/101 prepared for Mitchell Partnerships and Associates Ltd., Auckland. 37 pp.

Thomas B, Toft R & Mason R. 1997. Fauna of the proposed Northern Opencast Development, Waimangaroa Valley, Buller Coalfield. Landcare Research Contract Report LC9798/41 prepared for Mitchell Partnerships and Associates Ltd., Auckland. 33 pp.

Townsend, A.J., P.J. de Lange, C.A.J. Duffy, C.M. Miskelly, J. Molloy, D.A. Norton, 2008. New Zealand Threat Classification System Manual. Department of Conservation, Wellington. 35 pp.

Trueman I, Mitchell D, Besenyei L 2007: The effects of turf translocation and other environmental variables on the vegetation of a large species-rich mesotrophic grassland. Ecological Engineering 31(2): 79–91.

Venter, S. 2009: A taxonomic revision of the genus Dracophyllum Labill. (Ericaceae). A thesis submitted to the Victoria University of Wellington in fulfilment of the requirements for the degree of Doctor of Philosophy in Botany. Victoria University of Wellington, Wellington.

Walker K. J., Trewick S. A. & Barker G. M. 2008. *Powelliphanta augusta*, a new species of land snail, with a description of its former habitat, Stockton coal plateau, New Zealand. Journal of the Royal Society of New Zealand, 38(3): 163–186.

Walker, K.J. 1997. Techniques for monitoring populations of *Powelliphanta* land snails. Ecological management No. 5: 53-63. Department of Conservation, Wellington.

Walker, K.J., 2003. Recovery Plans for *Powelliphanta* Land Snails. Threatened Species Recovery Plan 49. Department of Conservation, Wellington. X + 208pp. + 68 plates.

Walker, S., Cieraad, E., Grove, P., Lloyd, K., Myers, S., Park, T. and Porteous, T. Guide for Users of the Threatened Environment Classification (Version 1.1, August 2007). Landcare Research Manaaki Whenua.

Waybacks Ltd. & Wildlife Surveys. 2008. Terrestrial fauna survey of the proposed Mangatini hydro-electric power scheme. Contract report prepared for Hydro Development Ltd. 46 pp.

Weber P, Pizey M, Crombie F, Rutter G, Lindsay P, Thomas D, Elder D, Wildy J, Cooper T, Rossiter P 2011: Addressing the environmental effects of mining on the Ngakawau River. Water New Zealand Annual Conference, Rotorua, 9–10 November 2011.

Whitaker A.H. & Lyall J. 2004. Conservation of lizards in West Coast/Tai Poutini Conservancy. Department of Conservation, Wellington. 93 pp.

Whitaker A.H. 1967. Locating nocturnal geckos by spotlight. Herpetologica 23: 310–311.

Wildland Consultants Ltd. 2010. Mapping of vegetation and habitats on the Stockton and Denniston Plateaux, Northern Westland. Unpublished Contract Report 2334 prepared for the Department of Conservation, Hokitika. 18pp.

Wildlife Surveys Ltd. 2011. Solid Energy New Zealand Limited: Survey for Terrestrial fauna at the proposed Mt William North coal resource. Unpublished report prepared for Solid Energy. Wildlife Surveys Ltd, Nelson. 57 pp.

Williams, P.A. and Courtney, S. 1998: The flora endemic to western Nelson. New Zealand Botanical Society Newsletter 53: 9-13.

Williams, P.A., Wiser, S., Clarkson, B. and Stanley, M.C. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Ecology 31(2): 119-128.

Wilson, D.J., Lee, W.G., Webster, R.A., Allen, R.B. 2003. Effects of possums and rats on seedling establishment at two forest sites in New Zealand. New Zealand Journal of Ecology 27(2):147-155.

Wilson, P.R.; Taylor, R.H.; Thomas, B.W. 1988. Effect of topography on seasonal distribution of forest birds in the Ohikanui, lower Buller and Inangahua valleys, North Westland. Notornis 35: 217–243.

Young, A. and Mitchell, N. 1994. Microclimate and vegetation edge effects in a fragmented podocarp-broadleaf forest in New Zealand. Biological Conservation 67:63-72.

APPENDIX 1

Plant Species Recorded at Te Kuha

Scientific Name	Common Name
Trees, Shrubs and Climbers	
Archeria traversii	Archeria
Androstoma empetrifolia	
Coprosma areolata	
C. ciliata	
C. colensoi	
C. dumosa	
C. foetidissima	Hupiro, stinkwood
C. linariifolia	
C. rotundifolia	
C. rhamnoides	
Cordyline indivisa	Mountain cabbage tree
Dacrydium cupressinum	Rimu
D. dacrydioides	Kahikatea
Dracophyllum densum	
D. elegantissimum	Grass tree
D. longifolium	Inaka
D. oliveri	
D. palustre	
D. rosmarinifolium	Inaka
D. townsonii	
D. traversii	
Epacris alpina	
Elaeocarpus hookerianus	Pokaka
Exocarpos bidwillii	
Freycinetia banksii	Kiekie
Griselinia littoralis	broadleaf
Halocarpus biformis	Pink pine
Hedycarya arborea	Porokaiwhiri, pigeonwood
Lepidothamnus intermedius	Yellow-silver pine
L. intermedius x L. laxifolius	
L. laxifolius	Pygmy pine
Leptecophylla juniperina	Prickly mingimingi
Leptospermum scoparium	Manuka
Leucopogon fasciculatus	Tall mingimingi
Libocedrus bidwillii	Pahautea, New Zealand cedar
Lophomyrtus obcordata	Rohutu
Manoao colensoi	Silver pine
Melicope simplex	Poataniwha
Melicytus ramiflorus	Mahoe
Metrosideros diffusa	White rata
M. parkinsonii	Parkinson's rata
M. perforata	White rata
M. umbellata	Southern rata
Manoao colensoi	Manoao, Silver pine
Muehlenbeckia australis	Pohuehue
Myrsine divaricata	Weeping mapou
M. salicina x M. divaricata	
M. salicina	Toro
Neomyrtus pedunculata	Rohutu
Nothofagus menziesii	Silver beech
N. solandri var. *cliffortioides*	Mountain beech

N. truncata	Hard beech
Olearia colensoi	Leatherwood
Parsonsia heterophylla	New Zealand jasmine
Pentachondra pumila	
Phyllocladus alpinus	Toatoa
Pimelea longifolia	Long leaved Pimelea (data deficient)
Pittosporum rigidum	
Podocarpus cunninghamii	Hall's totara
Prumnopitys ferruginea	Miro
Pseuopanax colensoi	Mountain five finger
P. linearis	
P. crassifolius	Lancewood
Pseudowintera colorata	Horopito, pepper tree
Quintinia serrata	Tawheowheo, quintinia
Raukaua edgerleyi	Raukawa
R. simplex	
Rhopalostylis sapida	Nikau palm
Ripogonum scandens	Supplejack
Rubus australis	Bush lawyer
Weinmannia racemosa	Kamahi
Herbaceous Dicotyledons	
Actinotus novae-zelandiae	
Brachyglottis bellidioides	
Celmisia dubia	
C. laricifolia	Needle-leaved mountain daisy
Donatia novae-zelandiae	
Drosera stenopetala	
D. spatulata	
Euphrasia townsonii	Eyebright
E. wettsteiniana	Eyebright, Naturally uncommon
Forstera mackayi	
Gentianella montana subsp. *montana*	Bog gentian
Hydrocotyle heteromeria	Waxweed
Luzuriaga parviflora	
Nertera villosa	Hairy forest nertera
Phyllachne colensoi	
*Plantago major**	Broad-leaved plantain
*Rumex obtusifolius**	Broad-leaved dock
Monocotyledons (grasses, sedges etc)	
*Agrostis capillaris**	Browntop
Astelia nervosa	Mountain astelia
Chionochloa australis	Carpet grass
Carex geminata	
Carpha alpina	
Dianella nigra	Turutu, New Zealand blueberry
Empodisma minus	Wire rush
Gahnia procera	Giant sedge
G. xanthocarpa	
*Holcus lanatus**	Yorkshire fog
Isolepis inundata	
I. subtilissima	

I. prolifer	
*Juncus articulatus**	Jointed rush
*J. bulbosus**	Bulbous rush
J. novae-zealandiae	Dwarf rush
*J. tenuis**	Track rush
Libertia micrantha	Mikoikoi
Machaerina tenax	
M. teretifolia	
Microlaena avenacea	Bush rice grass
Oreobolus strictus	Comb sedge
Phormium cookianum	Wharariki, mountain flax
Rytidosperma nigricans	Bristle grass
Uncinia filiformis	
U. rupestris	Hook sedge
U. uncinata	Hook sedge
Ferns and fern allies	
Asplenium flaccidum	Hanging spleenwort
Blechnum chambersii	Nini
B. discolor	Crown fern
B. procerum	Small kiokio
Cardiomanes reniforme	Kidney fern
Cyathea smithii	Soft tree fern
Dicksonia fibrosa	Wheki-ponga
D. squarrosa	Wheki, rough tree fern
Gleichenia dicarpa	Tanglefern
G. microphylla	Tanglefern
Histiopteris incisa	Water fern
Huperzia varia	Clubmoss
Hymenophyllum demissum	Drooping filmy fern
H. flabellatum	Filmy fern
H. multifidum	
Lastreopsis hispida	Hairy fern
Leptopteris hymenophylloides	Heruheru, crape fern
Lindsaea trichomanoides	
Lycopodiella diffusa	Clubmoss
Lycopodium scariosum	Creeping clubmoss
Notogrammitis billardierei	Common strap fern
Schizaea australis	Southern comb fern
Sticherus cunninghamii	Umbrella fern
Tmesipteris tannensis	Fork fern
Orchids	
Aporostylis bifolia	Odd-leaved orchid
Earina autumnalis	Autumn orchid
E. mucronata	Bamboo orchid
Nematoceras acuminatum	Spider orchid
Prasophyllum colensoi	Leek orchid
Pterostylis sp.	Greenhood orchid

APPENDIX 2

Bird Species Present at Te Kuha

Common Name	Scientific Name	Conservation Ranking
	Native species	
Great spotted kiwi *	*Apteryx haastii*	Nationally vulnerable
Paradise shelduck #	*Tadorna variegata*	Not threatened
Grey duck #	*Anas superciliosa*	Nationally critical
Black shag #	*Phalacrocorax carbo novaehollandiae*	Naturally uncommon
Australasian bittern	*Botaurus poiciloptilus*	Nationally endangered
Swamp harrier *	*Circus approximans*	Not threatened
New Zealand falcon *	*Falco novaeseelandiae*	Nationally vulnerable
Western weka *	*Gallirallus australis australis*	Declining
Pukeko #	*Porphyrio melanotus melanotus*	Not threatened
South Island pied oystercatcher #	*Haematopus finschi*	Declining
Spur-winged plover #	*Vanellus miles novaehollandiae*	Not threatened
Southern black-backed gull *	*Larus dominicanus dominicanus*	Not threatened
New Zealand pigeon (kereru) *	*Hemiphaga novaeseelandiae*	Not threatened
South Island kaka	*Nestor meridionalis meridionalis*	Nationally endangered
Kea	*Nestor notabilis*	Naturally uncommon
Yellow-crowned parakeet (kakariki) *	*Cyanoramphus auriceps*	Not threatened
Shining cuckoo *	*Chrysococcyx lucidus lucidus*	Not threatened
Long-tailed cuckoo *	*Eudynamys taitensis*	Naturally uncommon
Morepork *	*Ninox novaeseelandiae novaeseelandiae*	Not threatened
New Zealand kingfisher *	*Todiramphus sanctus vagans*	Not threatened
South Island rifleman *	*Acanthisitta chloris chloris*	Declining
Grey warbler *	*Gerygone igata*	Not threatened
Bellbird *	*Anthornis melanura melanura*	Not threatened
Tui *	*Prosthemadera n. novaeseelandiae*	Not threatened
Brown creeper *	*Mohoua novaeseelandiae*	Not threatened
South Island fantail *	*Rhipidura fuliginosa fuliginosa*	Not threatened
South Island tomtit *	*Petroica m. macrocephala*	Not threatened
South Island robin *	*Petroica australis australis*	Not threatened
South Island fernbird *	*Bowdleria punctata punctata*	Declining
Silvereye *	*Zosterops lateralis lateralis*	Not threatened
Welcome swallow *	*Hirundo neoxena neoxena*	Not threatened
	Introduced and Naturalised species	
Mallard *	*Anas platyrhynchos platyrhynchos*	
Skylark *	*Alauda arvensis*	
Eurasian blackbird *	*Turdus merula merula*	
Song thrush *	*Turdus philomelos*	
New Zealand pipit *	*Anthus novaeseelandiae*	
Dunnock *	*Prunella modularis*	

Chaffinch *	*Fringilla coelebs*	
European greenfinch *	*Carduelis chloris*	
European goldfinch *	*Carduelis carduelis britannica*	
Common redpoll *	*Carduelis flammea*	
Yellowhammer *	*Emberiza citronella*	

Note: * recorded within MP
recorded outside MP

APPENDIX 3

Terrestrial Invertebrates Collected at Te Kuha

Terrestrial Invertebrates Collected at Te Kuha

		Site:	1	2	3	4	5	6	7	8	9	10	11	12
Mollusca	Athoracophoridae	?*Pseudaneita* nov. sp.							✓					
Diplopoda	Sphaerotheriidae	*Procyliosoma delacyi ?striolatum*						✓						
Opiliones	Triaenonychidae	*Karamea lobata*	✓					✓						
Araneae	Thomisidae	*Diaea* spp. (>1 species assumed)											✓	
		Sidymella sp.						✓						
Orthoptera	Gryllidae	*Metioche* sp.											✓	
	Anostostomatidae	*Hemideina broughi*			✓									
		Hemiandrus maculifrons complex				✓	✓							
		Hemiandrus electra (n. sp., in press)					✓							
	Rhaphidophoridae	undet. sp												
Hemiptera	Psyllidae	*Ctenarytaina clavata*		✓		✓								
	Cicadellidae	?*Novothrymbis* sp. a		✓										
		?*Novothrymbis* sp. b					✓							
Coleoptera	Carabidae	*Neoferonia* sp.	✓	✓				✓						
		Tarastethus ?puncticollis												
	Scarabeidae	*Saphobius setosus*	✓	✓	✓				✓		✓	✓		
		Saphobius sp. (smaller species)					✓							
	Bhyrridae	undet. sp							✓					
	Chrysomelidae	undet. sp							✓					
Diptera	Tipulidae	*Amphineurus fatuus*				✓								
		Atarba eluta							✓		✓			
		Molophilus sp.		✓		✓	✓			✓				
	Chironomidae	undet. spp.	✓	✓	✓	✓	✓		✓	✓	✓		✓	
	Ceratopogonidae	undet. spp.	✓	✓	✓	✓	✓		✓	✓	✓			
	Simuliidae	*Austrosimulium ungulatum*					✓							

	Psychodidae	undet. spp.	✓			✓	✓							
	Cecidomyidae	undet. sp.					✓							
	Sciaridae	undet. spp.	✓	✓	✓	✓	✓		✓					
	Mycetophilidae	*Aneura* cf. *boletinoides*							✓					
		Anomalomyia guttata					✓							
		Austrosynapha cf. *claripennis*							✓					
		Brevicornu spp. indet.	✓	✓		✓	✓		✓					
		Mycetophila conica					✓							
		Mycetophila diffusa					✓							
		Mycetophila dilatata	✓			✓					✓			
		Mycetophila cf. *elongata*				✓								
		Mycetophila fagi	✓			✓	✓		✓	✓	✓			
		Mycetophila filicornis	✓				✓							
		Mycetophila grandis				✓			✓					
		Mycetophila cf. *griseofusca*		✓										
		Mycetophila howletti	✓			✓								
		Mycetophila marginepunctata var. *ruapehuensis*	✓			✓				✓				
		Mycetophila minima		✓					✓					
		Mycetophila cf. *nigripalpis*				✓								
		Mycetophila sp. nr *phyllura*					✓							
		Mycetophila subspinigera					✓							
		Mycetophila sylvatica				✓			✓		✓			
		Mycetophila unispinosa	✓			✓			✓					
		Mycetophila virgata	✓			✓			✓	✓				
		Mycetophila vulgaris grp	✓											
		Mycetophila sp. indet.	✓	✓		✓								
		Neoaphelomera sp. indet.		✓					✓					
		Parvicellula sp. indet.					✓							
		Platurocypta immaculata					✓							
		Tetragoneura sp. indet.		✓		✓								
		Trichoterga monticola				✓								
		Zygomyia nigriventris grp					✓							

		Zygomyia penicillata					✓							
		Zygomyia sp. indet.				✓	✓							
	Empididae	undet. spp.	✓			✓	✓							
	Dolichopodidae	undet. sp.	✓			✓								
	Phoridae	undet. spp.	✓	✓	✓	✓	✓							
	Tephritidae	*Trupanea* sp. indet.											✓	
	Heleomyzidae	*Allophylopsis scutellata*					✓							
	Muscidae	undet. spp.				✓	✓							
	Calliphoridae	*Pollenia* sp.					✓							
	Sarcophagidae	*Oxysarcodexia varia*				✓								
Lepidoptera	Oecophoridae ss	*Phaeosaces compsotypa*				✓					✓			✓
	Depressariidae	*Cryptolechia rhodobapta*							✓		✓			
	Elachistidae	*Elachista gerasmia*	✓											
	Tortricidae	*Ctenopseustis filicis*							✓					
		Ctenopseustis sp., cf *herana*									✓			
		Ericodesma sp. cf ‘gleichenia’	✓											
	Pterophoridae	*Platyptilia falcatalis*				✓								
	Geometridae	*Aponotoreas dissimilis*									✓			
		Cleora scriptaria							✓					
		Declana floccosa								✓	✓			
		Epiphryne charidema autocharis							✓		✓			
		Poecilasthena pulchraria				✓			✓					✓
		Pseudocoremia fenerata							✓	✓				
		Pseudocoremia cf *fenerata*							✓					
		P. monacha									✓			
		P. productata	✓						✓		✓			
		P. suavis				✓								
	Noctuidae	*Agrotis ipsilon*							✓					

Hymenoptera	Ichneumonidae	*Netelia* sp.								✓				
		species ‘a’								✓				
		species ‘b’	✓											
	Braconidae	Alysiinae sp.		✓										
	Scelionidae	undet. sp.	✓											
	Platygasteridae	undet. sp.	✓	✓			✓							
	Mymaridae	undet. sp.	✓	✓										
	Eupelmidae	undet. sp.	✓											
	Vespidae	*Vespula vulgaris*				✓	✓							
	Formicidae	*Huberia brouni*					✓							
		Huberia striata	✓											
		Monomorium smithi	✓											
		M. antarcticum complex											✓	
		Prolasius advenus				✓	✓							
	Apidae	*Apis mellifera*	✓											

Note that B. Thomas lists some species not detected in this survey (Mitchell Partnerships & Landcare Research 2001).

In addition to the species recorded above other invertebrates recorded during ecological work at the proposed mine site in March 2013 are:

Mollusca: '*Rhytida*' sp. A small-medium carnivorous snail, probably an undescribed species (F. Brook, pers. comm.). *Amphikonophora gigantea* (formerly *Pseudaneita gigantea*). A leaf-veined slug, widespread in northwest South Island (G. Barker, pers. comm.)

Orthoptera: *Hemideina crassidens* 'Wellington' tree weta*Hemideina broughi* West Coast tree weta *Hemiandrus* sp. a large ground weta, probably *H. electra* (n. sp.). Rhaphidophoridae sp. a cave weta which might or might not be the species we observed.

Phasmida: *Micrarchus* nov. sp. 2 A brown-grey stick insect; found from the Paparoas and northeast into Kahurangi NP (T. Buckley, pers. comm.) Green stick insect nymph, possibly *Micrarchus* or *Tectarchus* (T. Buckley, pers. comm.)

Coleoptera: *Zeadelium gratiosum*. A bronzy-sheened darkling beetle, widespread through the NW South Island.