REVIEW OF FAUNA COMPONENTS OF AN ACCESS APPLICATION FOR THE TE KUHA OPEN CAST COAL MINE, BULLER

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REVIEW OF FAUNA COMPONENTS OF AN ACCESS APPLICATION FOR THE TE KUHA OPEN CAST COAL MINE, BULLER

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EXECUTIVE SUMMARY

Te Kuha Limited Partnership proposes to create an open cast coal mine on a ridge southwest of Mt Rochfort and the Denniston Plateau. This document provides a review of the effects on fauna that are part of the Mining Access Agreement application and Easement Concession application to the Department of Conservation (BTW South Ltd 2013 and Mitchell Partnerships 2013).

Avifauna and lizard values of the Te Kuha mine site have been generally well documented and interpreted, and potential effects adequately assessed. Insufficient information has been provided to interpret the results of bat surveys. Invertebrate survey work and analysis is inadequate, and needs to be revisited. The long-term ability of the rehabilitated mine site to support existing lizard and invertebrate communities has not been thoroughly addressed.

The assessment of fauna values of conservation land within the mine footprint can only be provided at a very general level as specific information has not been provided for these areas separate from private land and water conservation reserve.

A mitigation package for fauna has not yet been developed. The review has therefore not been able to assess whether effects on fauna resulting from the operation of the Te Kuha mine can be offset. The applicant should work with Department of Conservation staff and other experts as required to develop an adequate mitigation programme that will ensure that potential effects on fauna are addressed.

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Reviewed and approved for release by:

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1. INTRODUCTION

Te Kuha Limited Partnership is proposing to create an open cast coal mine on a ridge southwest of Mt Rochfort. The site is located *c.*12 km southeast of Westport and 2 km north of the Buller River, and lies at an elevation of 600-800 m above sea level (a.s.l.). Rangitira Developments Limited, owned by Te Kuha Limited Partnership, holds Mining Permit 41-289 in which the proposed site is located. The mining permit covers *c.*860 ha.

The proposed mine pit would cover *c.*70 ha near the Te Kuha ridge line. A *c.*9 km haul road would be constructed leading from the near the Buller River up to the pit. Most of the mining permit and the pit site are located within a Water Conservation Reserve, administered by the Buller District Council. Approximately 13 ha of the proposed pit site pit would be located on Department of Conservation stewardship land as well as 1.59 km of the haul road. This length of haul road equates to approximately 8 ha in area.

Rangitira Developments Ltd has lodged a Mining Access Agreement application and an Easement Concession application with the Department of Conservation for the areas of public conservation land affected by the proposal. Wildland Consultants has been asked to provide a review of the fauna aspects of the "Application for Access to Undertake Opencast Coal Mining and Related Activities on Public Conservation Land" (BTW South 2013). This review includes:

- A review of the applicant's ecological reports relating to fauna and an evaluation of the associated assessment of potential effects.
- Identification of information gaps.
- A summary of fauna values present and their ecological significance.
- A summary of potential impacts on those values and their significance.
- Recommendations for further field work and/or information (if necessary).

This review covers all proposed areas of the mine and haul road (i.e. areas within the Water Conservation Reserve), but with specific comment on the Easement Concession and Access Agreement application areas where possible.

2. METHODS

This review was undertaken as a desktop study only, and no field work was undertaken. Information used includes published papers and reports, unpublished data and surveys, evidence produced for Environment Court and council hearings, and expert knowledge.

BTW South Ltd (2013) comprises the first 102 pages of the 468 page document, and is referred to as the 'application document' in this review. Mitchell Partnerships (2013; draft) is the 113 page (plus appendices) terrestrial ecology report, and is referred to as the 'ecology report' in this review.

It is noted that Appendix C: Vegetation and fauna of the proposed Te Kuha mine site (Mitchell Partnerships October 2013) is a draft, and therefore is presumably not final or approved for release.

The authors of this review have each covered the relevant parts of the application document and the ecology report, and have integrated key literature relevant to the site and values present including a previous survey report for the site (Mitchell Partnerships 2011).

3. GENERAL COMMENTS

Sources of threat classifications used within the ecology report have been superseded by more recent published for birds, bats, and lizards. As a result, threat classifications for a number of species are now outdated. These are addressed in the appropriate sections below.

The layout of the application document is difficult to navigate, mainly due to the number of pages, and because the contents page does not include the location of the appendices. The resolution of all figures could have been reduced prior to creating a PDF to help manage the size of the file. Overall, however, most of the application was carefully considered and well-written.

The applicant has not provided a map of the mine footprint (including proposed haul road route) overlaid with the boundaries of public conservation land and vegetation habitats. As such, it is difficult to accurately determine which habitats are present within public conservation land. The specific habitats in which fauna surveys have been undertaken have also not been reported, making extrapolation of results to similar habitats potentially flawed. These two omissions mean that the assessment of fauna values and potential effects on those values within conservation land can only be provided at a very general level.

4. REHABILITATION OF THE MINE

The authors of this review are not experts in vegetation or mine rehabilitation. However, in order to assess the potential effects on the mine on fauna, some assumptions needed to be made regarding the likely outcome of rehabilitation. These are discussed briefly here to aid interpretation of following sections.

The application document states that "*the ability of the site to be reinstated and rehabilitated is clearly addressed in the Rough report* [Landscape Assessment Report] *and outlined in the Landscape section above*". The rehabilitation of the site is actually detailed in the ecology report (Section 7). This report has clear ecological objectives for the rehabilitation, which can be summarised as:

- Minimise the area to be affected by mining.

- Establish self-sustaining indigenous vegetation that can develop into a vegetation mosaic that is resistant to weeds, fire, and pests.

- Conserve the genetic resources of vegetation associations and species, particularly those considered to be At Risk or Threatened.

The report states that "*Most vegetation associations are likely to be homogenised in the short to medium term because the mine schedule currently provides limited scope for VDT [vegetation direct transfer] and the majority of areas below the ridge line would therefore need to be planted*." Also, "*The relatively fine mosaic that is present before mining will be lost, except where small, discrete areas of rock field…and tarns and herbfields have been created on upper slopes*".

The report further states that "*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 in achievable in five to ten years at such sites*". The report notes in regard to medium to long-term outcomes that "*Situations where original vegetation is old and/or tall and top soils are deep and highly enriched in organic matter will be the slowest to be recreated. This is because tall forest and a complex structure developed over hundreds of years*".

From a fauna perspective, the above statements and other information provided in the report indicate that an indigenous, weed-free vegetation cover will develop over the post-mine site that may bear little resemblance to existing habitat types. Mature forest can be expected to develop over centuries that is likely to differ from existing forest types due to changes in landform, substrate, and drainage (Lloyd 2012).

5. ASSESSMENT OF EFFECTS ON AVIFAUNA

5.1 Review of avifauna assessment

5.1.1 Methods

Avifauna surveys covered the entire mining permit area, including the proposed route of the haul road where it lies outside of the permit area, and did not specifically concentrate effort in and around the haul road or the proposed location of the mine pit.

A number of methods have been used to assess the diversity and abundance of avifauna within the mining permit area. Grid cell counts were used in which the mine permit area and surrounds were split into 500 × 500 m squares (or grid cells) and surveyed. The authors have based the method on O'Donnell and Dilks (1988), but do not specify the details. O'Donnell and Dilks (1988) recommend at least 40 minutes of transects to be completed in every square as well as a five-minute bird count. The five-minute bird count has clearly not been carried out in this case, and it is not clear what has been used to survey the birds within each grid cell. The terrestrial report variously describes the method as a 'count' or a 'survey'. O'Donnell and Dilks (1988) acknowledge that the longer an observer spends in a square, the greater the number of species that will be recorded, and that the time spent in any one square will vary greatly due to a number of factors. It is clear, then, that deriving percentage

occupancy estimates using this method may have a number of unknown biases. This issue has not been recognised in the report. Nevertheless, the method ensures systematic coverage of an area.

The number of five-minute bird count transects and the location and number of five-minute bird count stations is unclear from the description of methods and the map provided. The results suggest that there were 112 five-minute bird count stations, that were counted once, and spread throughout the mine permit area with a certain level of concentration within the proposed mine site.

Counts were also carried out after dusk for two hours to survey nocturnally active birds such as great spotted kiwi (*Apteryx haastii*), western weka (*Gallirallus australis australis*), morepork (*Ninox novaeseelandiae novaeseelandiae*), and long-tailed cuckoo (*Eudynamys taitensis*). Best practice methods for monitoring kiwi (Robertson and Colbourne 2003) and weka (Beauchamp *et al.* 1999) are different, and the method adopted here is based on kiwi call count best practice. Weka counts obtained during this time of the night will not be comparable to results using best practice methods.

The fourth method used to survey birds employed automatic acoustic devices. The four devices that functioned were not located in the mine site. The range at which the devices can pick up birds is not described. These devices also have the potential to detect migratory birds passing overhead, although this is not mentioned in the ecology report.

All survey work was undertaken in March. Great spotted kiwi counts are best carried out during summer (December-February), when the species is most vocal and counts have been shown to decrease by March (McLennan and McCann 1991). The Department of Conservation, Westport Office, undertake kiwi monitoring around the Denniston-Orikaka area during December-January. The difference in timing, although relatively minor, means that comparisons between these results and local Department of Conservation counts should be undertaken with caution.

In summary, the methods employed provide a thorough assessment of the avifauna in the mine permit area for that time of the year. The authors have not specifically surveyed the proposed mine location or the haul road. Further surveys at different times of the year may add one or more species to the bird list, but are unlikely to have a significant impact on the conclusions of the ecology report. Comparisons of kiwi and weka call counts with those undertaken by local Department of Conservation staff should be undertaken with caution given the use of different methods and timing.

5.1.2 Assessment of values

The ecology report does not separate bird survey results from the proposed mine site (or haul road) from the results from the mine permit area. Additionally, it does not relate (for example) five-minute bird count results to habitat type. As such, the ecology report does not undertake an assessment of values of the affected area itself. The report does, on one occasion, mention birds found within the proposed mine location, noting that "*26 species [were found] in the area overlying the coal deposit*". However, it does not state what these species were.

The ecology report notes that Appendix 2 contains a list of "*bird species encountered*" (it also provides scientific names and threat classifications). Species marked with an asterisk (*) are those found within the mine permit area, and species marked with a hash (#) are those found outside the mine permit area. A further three species are listed: Australasian bittern (*Botaurus poiciloptilus*), South Island kākā (*Nestor meridionalis meridionalis*), and kea (*Nestor notabilis*). These are presumably species not observed during these surveys (either inside or out of the mine permit area), but that may use the site on occasions; this is not specified.

The threat classifications provided are out of date. Robertson *et al.* (2013) is the most recent listing (the ecology report would have been completed just before its publication). Three species in Appendix 2 have had a change in classification:

- Western weka: was At Risk-Declining, and is now Not Threatened, based on actual improvement (Department of Conservation threat classification spreadsheets).
- South Island rifleman (*Acanthisitta chloris chloris*): was At Risk-Declining, and is now Not Threatened, based on an improvement in knowledge (Department of Conservation threat classification spreadsheets).
- Kea: was At Risk-Naturally Uncommon, and is now Threatened-Nationally Endangered, based on actual observed declines (Department of Conservation threat classification spreadsheets).

New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*) is accidentally listed as an 'Introduced and Naturalised Species' in Appendix 2 (it is correctly identified as indigenous in the text). This species is classified as At Risk-Declining.

Surveys recorded 33 bird species within the mining permit area (and 40 species within the survey area. This is probably more correctly 39, as three species in Appendix 2 appear not to have been observed during surveys). Tables 4 and 5 are useful summaries of results from the bird surveys, but are applicable to the mining permit area only. Graphs of mean five-minute bird counts (Figures 12 and 13) are a more standard method of summarising these results.

The report states (p4): "*Overall, based on five-minute bird counts, nocturnal counts and recorded dawn/dusk chorus, bird numbers were low*". This comment, as written, is related to abundance and not species diversity although it is within a section describing diversity. It also provides no basis for the statement. The authors expand this further (p44) to say "*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*". It is unlikely that bird counts from Orikaka and Mokihinui forests are comparable with results from mid-altitude habitats that include significant areas of coal measure vegetation such as is present in the Te Kuha mining permit area. The authors appear to suggest that the bird community found in the mining permit area is of lower diversity and supports fewer birds than forest habitats on well-draining, more fertile sites. This may be correct, but it does not necessarily lower the avifauna values of the mining permit area. A more useful comparison (habitat and time both being

more comparable) would have been the March 2008 five-minute bird counts undertaken as part of the Escarpment Mine resource consent application, with counts undertaken at Burnetts Face, Coalbrookdale and Escarpment mine. Counts for bellbird (*Anthornis melanura melanura*), silvereye (*Zosterops lateralis lateralis*), grey warbler (*Gerygone igata*), South Island tomtit (*Petroica macrocephala macrocephala*), and fernbird (*Bowdleria punctata punctata*) (the only species estimated separately) are all very similar (Powlesland 2012).

The authors give the greatest attention to great spotted kiwi. Kiwi call counts resulted in a mean call count per hour of 1.00 ± 0.89 (SE; n=12). They note that this is lower than the stronghold areas of the Mt William Range, Orikaka River, and Paparoa Range, but do not provide references (e.g. Kingett Mitchell and Associates Ltd 1997). Standard deviations presented within Kingett Mitchell and Associates Ltd (1997) indicate that the Te Kuha counts are unlikely to be significantly different than these three sites.

5.1.3 Assessment of potential effects

Great spotted kiwi

The authors deal with this species separately from the others. They note that habitat loss, disturbance by mining activities, possible death of adult birds, eggs, or chicks, and possible decrease in survival and/or productivity, as being the immediate potential effects of mining. This is an accurate assessment.

The ecology report (p66) states that "*the Te Kuha area*" - presumably the mining permit area - supports "*at least one pair of kiwi and perhaps a small number of individuals*". Kingett Mitchell and Landcare Research (1997) note that there are few unpaired birds within great spotted kiwi populations. On this basis, given data provided on p46 (second paragraph), it is more accurate to report that the surveys indicate a likely minimum of one pair and three individuals, and a maximum of five pairs within the Te Kuha mining permit area.

The authors attempt to calculate an estimate of the overall number of adult great spotted kiwi 'lost' due to mining development over a period of 50 years (= four individuals). This is a relatively rough calculation based on North Island brown kiwi (*Apteryx mantelli*) chick and juvenile survivorship estimates (from McLennan *et al.* 1996). More recent and robust examinations of appropriate parameter estimates have been undertaken for Mokihinui and Denniston Plateau great spotted kiwi populations (H. Robertson 2011 in O'Donnell 2012, and Lloyd B. 2012 respectively), including a logistic model of possible population trends using a range of λ (annual rate of increase; B. Lloyd 2012). These references should have been used for any population modelling.

Dr Graeme Elliot undertook generalised linear mixed modelling of great spotted kiwi call counts undertaken at four sites in the Orikaka catchment, approximately 17 km to the east of Te Kuha, for the Escarpment Mine case (Elliot 2012). These counts cover 18 years, and count sites vary in altitude from 200 m to 500 m. He found that the population monitored at the highest location (Cedar Creek, 500 m) appeared to be stable. This also appears to be the case for the well-studied, high altitude Saxon Hut

population in Kahurangi National Park (Robertson 2005). The apparent concentration of great spotted kiwi in areas of high rainfall/high altitude due to lower predator numbers was highlighted in Kingett Mitchell and Landcare Research (1997). It should not be assumed that the great spotted kiwi population present in and around the Te Kuha mine site is in decline. As such, the number of adult kiwi 'lost' due to mining developments may be higher than the authors suggest.

The ecology report states that the rehabilitated mine site could be expected to support kiwi within 50 years. It is not unreasonable to expect kiwi to make use of revegetated areas once they develop topsoil and litter layers, but whether they can use replanted areas for daytime roost and nest sites at the same densities as found in mature forest with a more complex physical structure within a 50-year period seems optimistic. Realistically, a return to similar pre-mining densities could take well over a century (see Lloyd K. 2012 for discussion on development of forest on post-mining land formations at Escarpment Mine).

Other Birds

In addition to the four potential effects of mining listed above (for kiwi), this section also notes the possibility of habitat removal causing fragmentation of habitats leading to loss of connectivity within bird populations. This is likely to be a small risk for mobile fauna such as birds, but nevertheless warrants mention. Bush falcon, as the only other threatened species recorded in the mining permit area, are discussed. Their rarity within the Ngakawau Ecological District is not disputed. Falcon nesting within the proposed mine site is a remote possibility (as the authors acknowledge on p47). The report suggests that falcon are unlikely to be affected by clearance of habitat, and this is a reasonable comment. However, while individual adults and juveniles are very unlikely to be killed by clearance (p67), a nest containing eggs and/or chicks could be destroyed. The presence of a nest would be very obvious to mine workers, as adult falcon would be attempting to protect it by dive-bombing intruders. In the unlikely event of a nest being located, work should cease around it until fledglings have left the nest.

The ecology report then lists the four At Risk species found within the mining permit area: western weka, South Island fernbird, New Zealand pipit, and South Island rifleman. The report discusses three of these species, but does not discuss the potential effects of the mine on rifleman.

The report presents some calculations of the estimated numbers of adult weka, fernbird, and pipit to be lost "*over the life of the mine*" (it is not clear what this period is, but possibly 30 years, based on when suitable habitat is predicted to have returned, p68 Paragraph 2). It is difficult to arrive at the same calculations as the authors, but their numbers - 720 weka, 360 fernbird, and 180 pipit - seem generous, particularly considering they have not taken into account the likelihood that the early stages of the mine's rehabilitation may be suitable for all three species to varying degrees. Pipit, in particular, are likely to rapidly adopt the mining area while it remains open, but numbers will decline significantly as the mine achieves full vegetation cover. Fernbird are also likely to inhabit the more shrubby stages of revegetation, disappearing as canopy heights increase, canopy closure is attained, and habitats become more homogenous.

Comments regarding the low impact of the mine on species such as South Island kākā, kea, long-tailed cuckoo, and shining cuckoo are appropriate.

5.1.4 Information gaps

The key information gap is the lack of a specific description of the bird community present within the mine site and haul road. The survey coverage of the entire mining permit area provides a useful context for potential effects within the actual mining site, but does not clearly address the habitats present within the mine site in relation to avifauna. To some extent this is covered in various statements through the report, but it could have been achieved more clearly by combining the vegetation map with bird count stations and transect routes within a GIS. This would have allowed a more accurate assessment of whether survey coverage of the proposed mine site and haul road is sufficient.

Overall, survey of the mining permit area is reasonably thorough, with acceptable limitations due to only one time period being surveyed.

It is not possible to specifically identify the bird community present along the proposed haul road or within the public conservation estate present within the proposed mine site, as that level of detail has not been provided within the report. However, it is expected that great spotted kiwi will use the proposed route of the haul road and all habitats within the proposed mine site itself. The presence of South Island fernbird and New Zealand pipit is less clear, but the former may occasionally occur in the mountain beech/yellow silver pine-pink pine forest vegetation type along the south-eastern boundary of the mine site where vegetation becomes particularly scrubby.

5.2 Avifauna values and significance assessment

Threatened and At Risk species known to be resident within the haul road and proposed mine site are:

- Great spotted kiwi (Nationally Vulnerable). Present throughout affected area, may be higher densities at higher altitudes.
- South Island fernbird (At Risk-Declining). Likely to be limited to *c.*22 ha of shrubland habitat within the mine footprint.
- New Zealand pipit (At Risk-Declining). Likely to be limited to less than 5 ha of open habitat within the mine footprint.

This list does not include western weka and South Island rifleman (included in the ecology report) as they are no longer considered to be in decline.

The Te Kuha populations of these three species are not significant within the Ngakawau Ecological District, all being found in significant numbers elsewhere within the district. However, the Mt William Range-Orikaka great spotted kiwi population, of which the Te Kuha kiwi are part of, has been recognised as being

regionally and nationally important (Kingett Mitchell and Landcare Research 1997). The Mt William Range-Orikaka population is the only population of note between Karamea and the Buller Rivers, and mean call rates have been found to some of the highest in the region, and higher than the national average (Kingett Mitchell and Landcare Research 1997). The Te Kuha mine footprint is only likely to support a very small proportion of this population, which is estimated to comprise 1,800 individuals assuming a density of 2.0-2.5 pairs per 100 ha.

Threatened and At Risk species that may use the proposed haul road and mine site are:

- Bush falcon (Nationally Vulnerable);
- Kea (Nationally Endangered);
- South Island kākā (Nationally Vulnerable);
- Long-tailed cuckoo (At Risk-Naturally Uncommon).

Populations of these species within Te Kuha are unlikely to be significant.

The possible national significance of the coal measures ecosystem with its associated diverse, distinctive and relatively intact community of bird species should be considered. The new ecosystem that will establish on the Te Kuha site will be fundamentally different from the coal measures ecosystem. This association of avifauna and coal measures habitats will be permanently lost, is declining elsewhere on the Stockton and Denniston plateaux, and is under considerable ongoing threat.

5.3 Potential impacts on avifauna values

The authors' general assessment of potential impacts on key bird populations is accurate. Our assessment builds on this, but excludes potential positive effects of mitigation other than revegetation (i.e. pest mammal control).

Loss of Habitat

In the short term (30 years), effects on great spotted kiwi will be major in terms of numbers of individuals, with rehabilitated habitat providing comparatively poor food sources and roosting and nesting habitat. Once forest has developed over most of the site (in over a century), effects are likely to be minor or less than minor.

South Island fernbird will initially be affected, but are likely to recolonise scrub habitats within the 30-year period, assuming that invertebrate supplies are sufficient. Within this timeframe, it is possible that the revegetated mine site could provide more fernbird habitat than presently exists. In the long term (over a century), the effect on the fernbird population will be major as it is assumed forest will eventually develop over most of the mine footprint and become unsuitable for fernbird.

The revegetated mine site will provide a much greater area of habitat in the very short term for New Zealand pipit than exists presently. This will quickly reduce as vegetation cover develops and extends. Very little habitat may be present in the long-term, but could conceivably be similar to present levels. Effects may be minor over this longer period.

Alteration of the ecosystem in the long-term will be a major effect for all three species, as the existing association with coal measures vegetation will be lost.

Habitat fragmentation is not considered to be a significant issue for these three species, which is reasonable.

Disturbance by Mining Activities

Vehicle movements, blasting, general noise, lighting, among other activities, have the potential to affect birds remaining within unaffected parts of the mine footprint, and adjacent areas, during the period that the mine is active. For example, great spotted kiwi are known to be extremely intolerant of disturbance during breeding. McLennan and McCann (1991) caused the abandonment of several nesting attempts simply by walking past the nesting burrow, and Harper *et al.* (2012) suspect that handling of young chicks caused their parents to abandon them. It seems very possible that activities such as blasting and the vibrations caused by excavating and vehicle movements could cause the loss of nesting attempts in adjacent areas, or cause adjacent pairs to move away from the mine. As such, mine works could affect more kiwi, fernbird, and pipit than those present within the mine footprint. The distance at which mine works could have effects on the various bird species is unknown.

Decrease in Survival and/or Productivity

A simple definition of the fitness of an individual is its ability to reproduce. An individual bird of any species which is forced to establish a new territory elsewhere may come into conflict with other territory-holding birds, and some birds may be forced to occupy less favourable habitat. For example, great spotted kiwi that are forced to move into other areas around Te Kuha, or elsewhere in their geographical range (whether by release or moving themselves) are likely to come into conflict with territory-holding birds, particularly if populations in adjacent areas (such as Denniston Plateau) are at or near carrying capacity, or all high quality habitat is occupied. This has the potential to affect the productivity of these displaced birds in the long term.

This loss of fitness is also not restricted to the birds which are attempting to re-establish territories, but can affect existing territory occupants as a result of aggressive interactions and potential changes in existing territory boundaries. Great spotted kiwi are known to sometimes kill other individuals in these conflicts. As such, the potential for decreased survival and productivity is not limited only to birds found within the Te Kuha mine footprint.

Mortality Due to Mining Activities

Eggs and chicks are most likely to be lost to mining activities rather than adult birds, which have a greater ability to move away from machinery as it approaches. It is, however, possible, that some mature individuals could be killed by vehicles and machinery. Although western weka are no longer considered to be in decline, it is worth mentioning the risk of collisions with vehicles; Freeman (2012) calculated a mean road-kill rate of 6.0 weka km^{-1} per year over 25.1 km of local rural roads around

Cape Foulwind. Vehicle movements along the haul road could result in ongoing mortality of weka.

The ecology report authors have produced generous estimates of the numbers of fernbird and pipit lost over "*the lifetime of the mine*" based on the deaths of all adults present at the initiation of mining, and on parameters from populations located in more favourable habitat (e.g. lower altitude, lower rainfall). The estimates for kiwi, however, are much less generous. These estimates could be better modelled; however, they would still be predicated on data that have unknown relevance to coal measures habitats (and in the case of great spotted kiwi, based on the assumption of population decline), and their usefulness is subsequently questionable. Nevertheless, they provide a guideline for ornithological experts to assist with determining what amount of habitat would require intensive management to offset predicted numerical losses.

5.4 Further information required

No further information is required. However, if the applicant proceeds with the resource consent applications, it is suggested that avifauna data are better presented to provide a clearer picture of the bird species present within the mine footprint itself, including their respective habitat associations.

6. ASSESSMENT OF EFFECTS ON HERPETOFAUNA

6.1 Review of herpetofauna assessment

6.1.1 Methods

The objective of the ecological survey (including lizard survey) was clearly noted in Section 1.3 of the ecology report: *"The main objective of this ecological survey was to update and extend the earlier reports… 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"* (p5).

Lizard values would normally include an assessment of the lizard species present and their respective threat rankings, and an assessment of the quantity and quality of lizard habitat within the mining footprint. One paragraph (p22) was used to describe the methods carried out for lizard survey over the proposed mine site designed to meet this objective. The lizard survey was carried out mid-autumn 2013, which was not an ideal season for finding lizard individuals, especially for lizards residing at *c.*600-800 m a.s.l. (the altitudinal span of the mine footprint). However, an inventory of potential lizard habitat can be conducted at any time of year and an experienced lizard searcher within this ecological district, such as the searcher used in this case, could qualify and quantify lizard habitat within the mine footprint irrespective of season.

Overall, the methods used - day-time visual searching, spot-lighting and hand-searching - were appropriate for the species likely to be present, and the habitat present, but not sufficient to determine the presence of rare species given the time of year, and were therefore insufficient to "*provide baseline information in relation to*

the pre-mining…fauna present at the Te Kuha site" (p5). Presumably the anticipated baseline information was envisaged to inform the success of any lizard mitigation initiatives over the post-mine footprint. The success (or otherwise) of lizard mitigation in the absence of baseline data, can be inferred by comparing and contrasting lizard values inside and outside of the footprint post-mining.

On a more minor note, it is considered very useful to include the area subjected to the lizard survey (e.g. a geo-referenced polygon) which includes sites where lizards were found and the location of the tracks mentioned in Section 3.4 of the ecology report. This could have included the area searched previously (Mitchell Partnerships 2011) and location of Marshalls Mine upper Waimangaroa Valley, a site referred to on at least two occasions in terms of the Nationally Vulnerable West Coast green gecko. If needed, this map can later be superimposed on vegetation maps to indicate broad-scale habitat associations. Further, number of hours spent searching in each habitat type (as per Table 2 of the ecology report), time of day, the temperature or prevailing weather during the search, are all important contextual components to the data reported in Table 9.

6.1.2 Assessment of values

As noted above, an assessment of lizard values combines both lizard species values and lizard habitat values, and each will be discussed in turn.

Lizard Species

Two lizard surveys have been carried out over the Te Kuha mining footprint (summer 1999 reported in Mitchell Partnerships 2011; and autumn 2013 reported on in the ecology report). The three species most likely to occur over the mine footprint have been identified as being either highly likely to occur: West Coast green gecko *Naultinus tuberculatus*, Nationally Vulnerable[1]; or were confirmed to be present: speckled skink *Oligosoma infrapunctatum*, At Risk Declining; and forest gecko *Mokopirirakau granulatus*, At Risk-Declining.

Other lizard species were mentioned in the ecology report, but were not included in the assessment of values. It would have been helpful to include all possible species and their habitat preferences in the values section e.g. a summary table indicating common gecko *Woodworthia maculata* and common skink Clade 4 *Oligosoma polychroma* (as per Liggins *et al*. 2008) could occur. These additions are relevant given that the search was undertaken in autumn. Common skink, Clade 4, is currently ranked At Risk-Declining; if present, it should be considered in any mitigation and in the conditions of any Wildlife Act authorities required to implement the proposal.

Lizard Habitat

The lizard habitat of the area broadly comprises a mosaic of forest, scrub, and low-stature shrubland with open areas, as described in Figure 11 and Table 2 of the ecology report. In order to accurately assess the effects of the proposal on lizard

[1] Referred as "At Risk" in the Executive Summary. Lizard threat rankings reported here are from Hitchmough *et al.* 2013.

values, an estimate of potential lizard habitat (in hectares) available over the footprint for each lizard species, the three most likely to be present, but in particular, West Coast green gecko due to its threat ranking, and a description of how it relates to Figure 11 would have also been very useful. This information forms part of "*the baseline information"* (an anticipated outcome of the autumn 2013 survey; p5 of the ecology report) and would be useful to determine whether the rehabilitated landform will provide a similar amount and quality of lizard habitat.

Based on the vegetation mapping (Figure 11 of the ecology report) and the information on vegetation within Mitchell Partnerships (2011), habitat for all of the species mentioned above exists across the footprint, and presumably due to its intactness, the quality of this habitat is high; as noted in the ecology report.

Significance Assessment

Although the report provides an assessment of the significance of the habitat over the footprint against criteria in the Buller District Plan (Section 5 of the ecology report), the assessment could have included more specific reference to the lizard values of the proposed mine footprint. The significance assessment is relevant in determining the level of protection afforded to the site by rules in the Buller District Plan, and therefore the level of mitigation expected by the Council.

Section 4.5 of the ecology report provides a strong case for West Coast green gecko being present, and the presence of this species is unlikely to be a contentious issue. As such, the significance assessment in Section 5 could be re-worked to better address the presence of this species over the mining footprint. A revised significance assessment for this site with more specific reference to the lizard values is provided below in Section 9; in particular the threat criterion has been revised to include the Nationally Vulnerable West Coast green gecko.

6.1.3 Assessment of potential effects

As no recovery of lizards from the footprint is explicitly proposed within the ecology report, the majority of lizard individuals currently residing on the footprint will be killed through implementation of this proposal, and 89 ha lizard habitat will be removed. Mortality of lizards is clearly acknowledged on p69 (Section 6.5.4 of the ecology report) but there is no assessment of significance of these effects for each of the species concerned; that is, how will the loss of individuals and habitat affect the local population of each species? This is a relevant consideration given that the Te Kuha mine is one of various mines proposed and consented over this coal measures ecosystem; under Section 3 of the RMA (1991) the cumulative effects of loss of lizard values over this ecosystem type is a consideration for decision-makers and therefore needs to be addressed.

6.1.4 Information gaps

Although three lizards are acknowledged for the area, the speckled skink that was found within the mining footprint was not captured for identification. Ideally the specimen would have been captured and tail-tipped to confirm the identity; two other clades of *infrapunctatum* (crenulate and Kupe skink; Greaves *et al*. 2008) could also

be present, all of which can be extremely difficult to tell apart. On balance, the lizard was most likely to be a speckled skink given records on the nearby Dennison Plateau are of this species, but if one of the others were to be present it would represent an important new site for the species - one ranked At Risk-Relict (crenulate skink) and the other Nationally Vulnerable (Kupe skink). As with common skink and common gecko, these species would also need to be considered in the mitigation.

In terms of lizard values, it is appropriate to consider alternatives to removing lizard habitat, and particular the habitat for West Coast green gecko. This may or may not be possible, but a section detailing the reasons for or against avoidance would be a welcome addition to the report.

A reference to a West Coast green gecko found in short regenerating vegetation at Marshalls Mine is made on p69; a disturbed site north of the proposed Te Kuha mine. This is a very important record and will help inform the likely suitability of the Te Kuha mine rehabilitated landform for this species. As such it would be very informative to provide more context around this observation, such as: date, time of day, photographs of habitat, information on age of the regenerating habitat. Section 8 of the report (Mitigation section) refers to a 30-year time frame where "*fauna species currently found within the proposed footprint…..will be able to occupy the rehabilitated area"*. More information around West Coast green gecko and their ability to re-colonise rehabilitated landscapes will be a valuable contribution to the report.

No section specifically addresses how the rehabilitated landscape will cater for lizards, and in particular the West Coast green gecko. Section 7 (p79) lists a rehabilitation objective that maybe interpreted as covering the lizard values of the site "*Conserve the genetic resources of vegetation associations and species at risk and threatened, both within and outside the disturbed footprint"* but further reading of Section 7 fails to mention any initiatives to conserve the genetic material of lizards, and especially the Nationally Vulnerable West Coast green gecko even though initiatives are in place for species of lesser concern, e.g. At Risk plant species. The authors mention that boulders will be placed over the rehabilitated landform (p80), which will provide lizard habitat, especially if a mix of boulder fields, tumbles and rock-on-rock configurations are planned for. To this end, the suggestion to consult further on rehabilitation objectives with interested parties (p98) is commended.

6.2 Herpetofauna values and significance assessment

The site is an area of high conservation value as it contains populations and habitats of indigenous lizards, all of which are absolutely protected by the Wildlife Act (1953). Implementation of mining will have a significant effect on this fauna, in particular the Nationally Vulnerable West Coast green gecko. Coal measures habitat is considered a stronghold for the West Coast green gecko (Lettink 2012).

Forest gecko and speckled skink are both ranked as At Risk-Declining. There is no Recovery Plan for any of the species likely to be within the footprint and West Coast green gecko and the forest gecko were ranked as a "low conservation concern" in the now-outdated local lizard conservation report (Whitaker and Lyall 2004). The speckled skink was ranked as "moderate" by Whitaker and Lyall (2004).

6.3 Potential impacts on herpetofauna values

It is agreed, as noted in the application document, that implementation of the proposal, as currently drafted, will result in the death of lizards over the mine footprint and the haul road, in combination with the loss of 89 ha of significant lizard habitat. The implementation of this proposal will also result in minor adverse effects on lizards in areas surrounding the footprint, through noise, dust and disturbance. It is unlikely, however, that the implementation of the proposal will result in the local extinction of any of the lizard fauna.

The most significant effect of implementing the proposal is the contribution that this mine will have on the cumulative degradation of the stronghold population of the West Coast green gecko. The threshold at which impacts on the population cause it to progress towards local extinction may be near or reached by the implementation of the mine, when considered in combination with other mines consented, permitted through mining permits, and those already implemented. Not enough is known about the West Coast green gecko population to accurately determine thresholds for both habitat and population loss over the coal measures ecosystem.

6.4 Further information required

Information gaps identified above should be addressed, including as a matter of importance:

- Options to avoid habitat of the West Coast green gecko are explored.
- More information is provided on the ability of West Coast green gecko to re-colonise post-mine landforms (including detail around the Marshall mine record).
- Information is collated on the likely significance to West Coast green gecko population of killing all individuals within the footprint and removing all habitat. This assessment should include cumulative effects, to take account of other consents being implemented now, in the past, and likely to be implemented in the future.

7. ASSESSMENT OF EFFECTS ON BATS

7.1 Review of bats assessment

7.1.1 Methods

The application document states that "*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*" (p34). The ecology report repeats this, but gives little extra detail. No information is given on the proportion of nights that conditions were satisfactory, and so the value of these bat surveys cannot be established. Current best practice - as used for monitoring long-tailed bats in the Waikato Expressway project

prior to felling trees - recommends that monitoring should take place on nights on which temperatures remain above 10 degrees Celsius for the first two hours after sunset and there is little rain and wind. This information would have been easily gained from the weather stations placed on site by CRL and monitored during the period of the bat surveys.

Likewise, scant detail is provided regarding specific placement of the automatic bat monitoring units (digital heterodyne ultrasound detectors; ABMs); i.e. what the habitat was at each location. With so few sites being monitored this would have been possible.

The lack of detail regarding site characteristics, ABM placement, climatic conditions, and the number of nights that ABMs were active and the climatic conditions were suitable, gives little confidence in the survey design and the results.

In addition, short-tailed bats (*Mystacina tuberculata tuberculata*) are notoriously difficult to detect even in areas where their presence is suspected (Borkin and Parsons 2010) because they mostly use forest interiors and their echolocation calls are emitted at relatively low intensity (O'Donnell *et al.* 2006; S. Parsons unpublished data). Consequently, even if short-tailed bats are present in this area, one limited survey such as this one is very unlikely to confirm their presence.

The ecology report notes that "*Previous bat surveys have been limited to a single electronic bat detector, at one site for only one night (Mitchell Partnerships and Landcare Research 2001), and visual search for long-tailed bats at dusk (Garrick 1986)*" (p2). These prior surveys are very limited and therefore cannot be relied upon to ascertain the presence or absence of long-tailed bats or to adequately support the results of this survey.

Though long-tailed bats (*Chalinolobus tuberculatus*) and short-tailed bats were not detected during these surveys, it is possible that bats may use the area. This is because the surveys outlined in the ecology report give little detail of the weather during which surveys were undertaken and the locations at which surveys took place, consequently it is difficult to determine whether surveys were sufficient to determine the presence of either bat species. In any case, the absence of detection does not indicate absence of bats.

7.1.2 Assessment of values

As no bats were identified in these surveys there have been no values identified within the reviewed report.

Long-tailed bats are present approximately 40 km to the north of the mine footprint at Mokihinui River (O'Donnell 2012), and also within the same Ecological District as much of the mine footprint (Ngakawau Ecological District; O'Donnell 2012). Trees present within the mining permit area are both old enough ("*The oldest trees cored at Te Kuha were between 432 and 518 years old*"; p2) and large enough ("*the dbh of canopy trees is typically 25-60 cm, but occasionally larger*"; p29) to form the cavities, peeling bark, and other crevices that are selected by long-tailed bats as roosts (Borkin and Parsons 2011a; Sedgeley and O'Donnell 1999). The absence of detection does

not indicate absence of bats, and consequently the potential for bats to be present at the site should be addressed.

7.1.3 Assessment of potential effects

As no bats were identified in these surveys there have been no effects identified within the reviewed report.

7.1.4 Information gaps

No specific information is provided about the sites at which ABMs were placed to allow reviewers to determine whether placement was likely to detect long-tailed bats or short-tailed bats. No information has been given about the weather conditions on each night of monitoring, the number of nights that were considered suitable for detecting bats, and what criteria were used to decide whether nights were suitable for detecting bats. This information is required to determine the usefulness of the surveys.

7.2 Bat values and significance assessment

The threat status of South Island long-tailed bats (*Chalinolobus tuberculatus* 'South Island') is Nationally Critical (O'Donnell *et al.* 2013). They are present approximately 40 km to the north of the project footprint at the Mokihinui River (O'Donnell 2012), and also within the same Ecological District as much of this project footprint (Ngakawau Ecological District; O'Donnell 2012). The Mokihinui catchment's long-tailed bat population is considered to be regionally and nationally significant (O'Donnell 2012). Consequently, if additional surveys at Te Kuha confirmed the presence of long-tailed bats, this population would also be both regionally and nationally significant.

Given that long-tailed bat home range widths (the distance from one edge of its home range to the other edge) can be 7-11 km across and home range sizes can be greater than 1,800 ha (median juvenile home range size; Borkin and Parsons 2011b; O'Donnell 2001), the Mokihinui River long-tailed bat population is relatively close to the project footprint. Te Kuha provides suitable long-tailed bat habitat - a combination of foraging habitats (particularly linear landscape features including along the canopy), and roosting habitats (trees that provide potential roosts) - consequently, it is possible that long-tailed bats could use the Te Kuha mine footprint.

If South Island short-tailed bats (*Mystacina tuberculata tuberculata*) were detected in this area, the Te Kuha site would also be both regionally and nationally significant. This is because the species is classified as Threatened-Nationally Endangered (O'Donnell *et al.* 2013), and also because observations of the subspecies are so rare (outside of Eglinton Valley) that any positive identification of individuals would make a new location ecologically significant.

7.3 Potential impacts on bat values

A development such as the Te Kuha mine would be likely to have multiple potential effects on bats should they be within the project footprint. These could include:

- The loss of roosts due to vegetation removal during construction with potential impacts on social structure, loss of genetic diversity, and fragmentation of populations.
- Direct mortality of bats during vegetation removal.
- Potential for noise impacting on bat behaviour.
- Lighting of the site affecting bat emergence from roosts, and foraging behaviour; though the mine is likely to be only operational during the day, it is expected that security lighting will be in place to light the site at night.
- Fragmentation of roosting and foraging areas due to the construction and operation of the road and mine.
- Possible additional long-tailed bat foraging habitat along the haul road, as long-tailed bats are most often detected along linear landscape features (Borkin and Parsons 2009).
- Changes in the invertebrate community resulting in changes in bat diet.
- Changes in hydrology and drainage resulting in changes in water availability, foraging routes, and the invertebrate community with flow-on effects on bats.

Some of the potential effects outlined above would only impact bats during the operation of the mine i.e. noise and lighting; the majority of effects would be long-term. For example, the effect of vegetation removal would be permanent due to its potential direct mortality of individual bats, and consequent loss of genetic diversity, and impacts on social structure. The fragmentation of populations that may result would endure until mature forest, with vegetation suitable as roosts, re-establishes on the site.

7.4 Further information required

Information needs to be provided on the site placement of ABMs, weather conditions on each night of monitoring, and the criteria used by the survey team to determine whether nights were suitable for bat detection. If the weather conditions during the survey mean that the number of nights available for the detection of bats during the survey is reduced (from the 116 nights reported) then additional bat monitoring should be undertaken. This is because any reduction in the number of monitored nights at individual sites would mean that some sites had very little opportunity to detect bats.

8. ASSESSMENT OF EFFECTS ON INVERTEBRATES

8.1 Review of invertebrate assessment

8.1.1 Methods

To fully document the indigenous invertebrate fauna of a largely natural area occupying steep mountain lands is a daunting prospect. It is therefore prudent to select a few invertebrate groups along with the appropriate surveying methods that will characterise the suite of habitats and species likely to be encountered. The invertebrate groups chosen for survey should generally fulfil the following criteria:

- They are generally taxonomically and ecologically well-known so that meaningful statements on identity, distribution, biology and ecology can be made.
- Any new species encountered can therefore be easily inserted into the known taxonomic framework.
- The groups are expected to be relatively species-rich in the habitats likely to be encountered.
- Taxonomic and ecological expertise for those groups is available to the project.
- The groups are able to be sampled within the available timeframe with the available methods.

The invertebrate groups must be chosen prior to the study so that the appropriate sampling regime is matched to them and the required taxonomic expertise is lined up. Three invertebrate groups would be a suitable level of assessment, one of which is expected to be species-rich and taxonomically well-known with available experts and up-to-date literature close at hand (as per the above list). The other two groups could be less well known, but still expected to produce results that will provide useful information about the area in question. These two or more groups can reflect the special characteristics of the invertebrate fauna of the subject area, based on published reports or liaison with local experts. They need not be expected to be species-rich but might perhaps be expected to show local endemism.

The ecology report does not provide a rationale for its selection of invertebrate groups, and likewise the survey methods used to target those groups within the habitats likely to be encountered, and within the timeframe of the survey. The exception was *Powelliphanta* snails. Rather, several generalised rather than targeted collection methods were used to survey terrestrial invertebrates across the proposed mining site at 12 sites. These are adequately outlined in the report and the sites mapped (Section 3.6).

Field work was carried out between 24-26 April and 30 April-1 May 2013. This is not an ideal time of year to be sampling for terrestrial invertebrates given the objectives of a baseline survey are to characterise the area's indigenous invertebrates, and possibly find rare, threatened, or other interesting species. While there is some indigenous invertebrate activity at this time of year, it is at the lower end of the activity spectrum, and any period of cold weather will quickly curtail what little

activity there is. There are some specialist late autumn-early winter emerging species in some invertebrate groups, such as moths, but these were not specifically searched for or found, but are likely to be present in the non-forest habitats at the highest altitudes for the site. This timing in late autumn explains, to a large extent, why only 18 moths were found in the UV light traps at five sites over three nights each. This yield is a poor return for effort and provides little informative data on the characteristic invertebrates of the proposed mining site.

Conflicting information on the weather conditions encountered during the April-May 2013 survey is provided in the report. Section 2.6.5.1 states: "…*the survey was undertaken in a particularly warm weather period when invertebrate activity reduces*." This statement is at odds with Section 3.6 where the report states: "*Weather varied from occasionally sunny to mist, drizzle and rain and temperatures ranged from moderate to cold*." Additionally, the comment that invertebrate activity reduces in warm weather is inaccurate. Any warmer than normal weather encountered in late April-early May will merely extend the autumn activity a little longer, and be positive for the survey results. It is suspected that "cold" should be substituted for "warm" in the first statement to make these statements consistent. This would fit with the generally poor survey results.

8.1.2 Assessment of values

The Te Kuha survey reports on ten invertebrate groups. However, a significant number of families and species was found and listed for only one of these (Diptera; flies). Table 1 lists the taxonomic groups reported on and notes the total number of species, new species and unidentified species found. This table includes a few species found in an earlier survey of the proposed mine site in March 2013. There are several issues with this survey in terms of attempting to characterise the invertebrate fauna of the area in question.

What makes this study less informative is that many of the specimens found have not been identified to species (40%) and, in fact, many of these were only identified to family level. It is clear that the authors made an effort to get moths, fungus gnats, and weta identified by experts in those fields, but did not do so consistently across all taxonomic groups. This expertise is readily available if sufficient planning had been done. Therefore the potential for this study to provide meaningful information is severely curtailed. The surveys probably greatly underestimate the number of indigenous flies caught as the list simply states "*undet. spp*." for many fly families (this presumably means unidentified species - the usual abbreviation is "indet" = indeterminate). How many unidentified species in these fly families was not determined.

Only amongst the Orthoptera (weta and cricket) are the results reasonably informative. Six species are reported, five of which are ground, cave, or tree weta (the report wrongly states that only three weta were collected). But even here two species found are unidentified - one cricket and one cave weta - when, with a little effort, these could have been identified at least to genus (cave weta) and species (cricket). The biogeography of three of the weta species found is discussed accurately in the report but there is no discussion of what their presence here tells us about the quality of habitat in the project area. In particular, the sympatric presence of two

large tree weta species *Hemideina broughi* and *H. crassidens* is not discussed and no comment is made about its significance.

Table 1: List of invertebrate taxa provided in the Draft Terrestrial Ecology Report.

Invertebrate Group	Number of Species	New Species	Unidentified Species
Snails	3	1?	3
Millipedes	1		0
Spiders & relatives	3		2
Bugs	3		2
Beetles	7		4
Flies	48+		19+
Moths	18		0
Wasps, bees and ants	15		8
Weta and cricket	6		2
Stick insects	2		2
Total Species*	**106**	**1?**	**42 (40%)**

* Includes a few additional species collected in an earlier survey of the mine site in March 2013.

Thirteen families within the flies (Diptera) are reported on, but only one family has been thoroughly sorted and identified (fungus gnats; Mycetophilidae). Of the 48+ species found, 34 are fungus gnats and the remaining 14+ species in 12 families are mostly unidentified and probably remain unsorted. Indigenous flies are a species rich and ecologically diverse order in New Zealand, and may be a useful group to report on in a location such as Te Kuha. This would require more work on identifying genera and species across the order, not just one biologically narrow family. Despite the high species richness of fungus gnats found the report only states "*There was also a high species richness of Mycetophila fungus gnats recorded, which are indicative of high levels of diversity common to northern West Coast forests*". This suggests that the authors know that this group of flies is as species-rich in other areas of Northwest Nelson, although such a statement should be referenced.

The 18 species of moth (Lepidoptera) recorded appear to have been collected at the five light-traps employed over three nights. For the equivalent of 15 light-trapping nights this is a particularly poor return and must relate to the time of year and poor weather encountered. In our opinion, around 10-25 moth species would be expected on the best nights at this time of year, at this altitude, per trap, with a total species richness of around 60 species for the sampling programme. Additionally some netting and hand collection by day should add to this total.

In contrast to most of the invertebrate groups reported, the moths are all named to species which allows full analysis. Despite the low number of species found some of them are noteworthy:

- *Aponotoreas dissimilis* (larvae on *Dracophyllum*) is generally uncommon; low alpine western South Island.
- *Ericodesma* new species (larvae on *Gleichenia*) is a local species.
- *Cryptolechia rhodobapta* (larvae on *Phyllocladus*) is found in upland shrublands and is generally rare - found from Arthurs Pass northwards.

Even though the moth survey produced poor results, the presence of this suite of informative species is not discussed. It would also have been useful if the list of moths found was annotated with the ecology/biology of each species to show which vegetation community they are associated with. The list contains a mix of forest, shrubland and open fernland-herbfield species, highlighting the montane nature of the proposed mine site.

This entomological survey found no threatened species (as listed by the Department of Conservation), which is not surprising given the generally poor methods and results and unsatisfactory analysis of the specimens collected. A suite of threatened insect species has been recently found on the Denniston Plateau, adjacent to this site, and in similar vegetation communities.

The ecology report states that "*Overall, the invertebrate communities found in the project area are not noticeably different from those found in similar habitats within the Ngakawau Ecological Area*". This public conservation land is to the northeast of the proposed mine and east and northeast of the Denniston Plateau. No reference is given for this statement and no further discussion or justification is provided. It is surprising that the entomological survey results from the Denniston Plateau, which are relevant, thorough, and recent, are not referenced or discussed.

The ecology report references the Mitchell Partnerships and Landcare Research (2001) invertebrate survey, and it may be that the authors of the ecology report were relying on statements made in this earlier document. However, this earlier survey is inadequate; the report's statements regarding the invertebrate fauna of the Te Kuha area are unsubstantiated as they are based on poor methods, poor results, weak analysis, and generalisations about the invertebrate fauna of the area.

8.1.3 Assessment of potential effects

The ecology report states: "*It is unlikely 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*". Firstly, as the report notes, it is not known if some of the most significant species found, including the possible new species of leaf-veined slug, are found in adjacent areas. Secondly, it is very possible that further significant invertebrate species are present at Te Kuha. Thirdly, the integrity of 'adjacent areas' for invertebrates is compromised by both the access road and the proposed mine site which fragment existing habitats. The road traverses a large area of forest, removing and changing habitat, and allowing weed invasion, which will further change habitats.

The report accurately states that "*The proposed mining activities would remove habitats within the footprint, and also increase edge effects in adjacent habitats which would otherwise be left undisturbed…*", but does not discuss the nature of these habitats in relation to their distribution or extent in adjacent areas. Ideally the report would discuss the importance of the habitats in the mine footprint for invertebrates, particularly the most restricted or characteristic of the area, the extent to which adjacent habitats support this invertebrate community, and how the rehabilitated landforms and new habitats will support these invertebrates in the long-term.

Overall, the report is simplistic in its discussion of effects on indigenous invertebrates and their habitats, and does not address the long-term effects of mining on the invertebrate assemblage present at Te Kuha.

8.1.4 Information gaps

Given the inadequacies of the present invertebrate survey (and earlier 2001 study) in terms of methodology, poor timing, poor weather, and incomplete identification of specimens, its results and conclusions can, at best, be regarded as being provisional. The survey also lacked focus, however, the poor timing and weather would have undermined even a well-organised and focused invertebrate survey of this site.

The outcome of the issues with timing and methodology mean that it is difficult to have confidence that the potential significance of the Te Kuha invertebrate community has been properly assessed.

These surveys contrast markedly with those undertaken on the adjacent Denniston Plateau in recent years. It is surprising that the 2013 survey did not utilise the Denniston Plateau information which is recent, extensive, and ecologically relevant. It is imperative that the results from any further entomological investigations of Te Kuha are compared to what is known of the Denniston Plateau invertebrates.

8.2 Invertebrate values and significance assessment

Essentially, the 2013 study of the invertebrates of Te Kuha coal mine site only presented informative information on the ground and tree weta species of the project area. Other invertebrate groups were inadequately sampled, including flies despite the 48 species identified. For most groups, few species or individuals were found, even fewer identified to species, leaving little in the way of meaningful commentary that can be provided.

Invertebrate biodiversity and significance is potentially high in the project area judging by the results on the adjacent Denniston Plateau, and this needs to be better assessed. On the basis of what has been presented in the ecology report, it is not possible to form an opinion on the significance of the Te Kuha invertebrates.

8.3 Potential impacts on invertebrate values

The potential impacts of the proposed project including the access road are long-term as the vegetation communities that may develop on the new modified landforms are likely to be very different from the present coal measures habitats. How this habitat loss will impact on the invertebrates is difficult to assess as the report does not provide sufficient information on the diversity or distribution of the invertebrates of the Te Kuha mine footprint and adjacent areas. It is possible that given the levels of endemism already known from the Denniston Plateau, that significant invertebrate species may also be present at Te Kuha. Loss of habitat for species with already restricted distributions clearly will have greater impact than effects on widespread species.

The impact of edge effects, fragmentation of existing communities and introduction of exotic plant and invertebrate species is likely to be significant for indigenous invertebrates. This is reasonably well covered in the report and they note that the composition of invertebrate communities is likely to change over time as exotic species are introduced and new habitats created. What exact impact these factors will have on specific invertebrates or invertebrate communities is difficult to assess because of the lack of information on the diversity of invertebrates in the report.

8.4 Further information required

Invertebrate fauna within and adjacent to the Te Kuha mine footprint should be resurveyed. Invertebrates, because of the range of micro-habitats that they occupy and the ecological roles that they play, will provide an important layer of information about the site. It will inform on what special species are present in terms of rarity, threat status, distribution, and specialised relationships with the flora or geology.

Given the altitudinal range, aspect and climate of the proposed mine site, an invertebrate survey should be undertaken that addresses the following criteria:

- Carried out over the summer period - November to March - in a predicted spell of warm weather with low winds.
- Focus on a maximum of three invertebrate groups which are sampled thoroughly at a range of altitudes over the range of vegetation communities mapped by botanists.
- Based on the special invertebrate groups present (as presented in the ecology report), expertise available, and methods already employed, Orthoptera, Lepidoptera, and Mollusca would be three good candidates for survey.
- Utilise appropriate methods to sample these three groups.
- Allow some flexibility to collect other unexpected but potentially interesting invertebrate group(s) that might supply useful insights.
- Two persons should carry out the survey and perform the curation, backed up by the appropriate taxonomic expertise (in the field or providing an identification service).
- Taxonomists should supply an annotated checklist which includes ecological and distributional information, together with significance.

In addition, the two unidentified Orthoptera (one weta and one cricket) found during the present surveys should be identified and reported.

9. ASSESSMENT OF EFFECTS ON PEST ANIMALS

9.1 Review of pest animal assessment

The application document and ecology report are correct in their identification of introduced mammals such as mustelids, possums, and rats as the main agent of decline for many New Zealand forest birds, lizards and invertebrates (McLennan *et al.* 1999, Wilson *et al.* 1998) and that their removal may help restore these populations (Innes *et al.* 2010). They point out that these species can also have negative impacts on plant communities both directly, through consumption of leaves, seeds and fruit (Wilson e*t al.* 2003), and indirectly by preying on seed dispersers (Kelly *et al.* 2010). However, pest animal data was only collected for deer, goats, pigs, and possums, with rats and stoats assumed to be present. Monitoring of rats and stoats in the nearby Denniston Plateau failed to detect rats and stoats were rare (Elliot 2012). The report also ignores the fact that deer, goats, and pigs can also have considerable impacts on plant communities (Wardle *et al.* 2001).

The ecology report makes some incorrect assertions and has descriptions of possible impacts on pest animals that are unclear. For example, the report notes that there are a lot of great spotted kiwi in other parts of the Ngakawau Ecological District, where rainfall is higher and temperatures are lower "*which act as predator controls*" (p85). Wet weather and cold temperatures do not control the main predators of kiwi (stoats and feral cats). Stoats are a Holarctic species that survived the last glaciation and are known to forage during severe Siberian frosts (Yalden 1999, Vaisfeld 1972). In New Zealand, stoats have been observed to inhabit alpine areas of Fiordland National Park in densities similar to adjacent forest (Smith *et al.* 2007, Smith *et al.* 2008). Feral cats are active predators on the slopes of Mt Anglem, Stewart Island (Harper 2007).

An example of an assessment of a likely impact that is unclear is Section 5.2.10 'Effects on Fauna' (p84); "*Due to the fact that this site was previously undisturbed, the site has increased risk of fire, slope or hydrological (culvert and dam) failure and chemical spills which could cause an invasion of pests and weeds if these risks are not adequately managed*." It is not clear what is meant here, and exactly how fire, slope, hydrological failure, and chemical spills might cause an invasion of pests.

9.1.1 Methods

The method used by Mitchell Partnerships Ltd to survey introduced mammals in the mining permit area was to record and photograph them where possible. To give an indication of their distribution and relative abundance across the mining permit, they recorded any sign seen within each of the bird survey grid cells. This resulted in observations of deer in 100% of grid cells, goat sign in 13% of cells, and pig sign in 4% of cells. These values cannot be considered measures of relative abundance as they are inconsistent and therefore not comparable with widely-used methodologies. Also, this methodology will not provide any meaningful measurement of mustelids, rodents, feral cats, or hedgehogs as they cannot be reliably detected using such methods. Statistically, the use of adjacent grid cells will not produce data that is spatially independent for wide ranging species such as deer, goats, and pigs. However, the observation that deer sign was found in 100% of cells, suggests that deer numbers may be high and consequently a threat to vegetation values in the area.

A typical and more robust method of monitoring introduced mammals would be to run tracking tunnel lines for rodents and mustelids following the protocols set out in Gillies and Williams (2013), wax tag lines for possums (NPCA 2008), and faecal pellet counts for deer and goats (Smith 2012). These methods are reasonably cheap and easy to deploy, and would produce data on pest abundances that could be compared with other areas and regions. The need for such comparisons is described in more detail in the following sections.

9.1.2 Assessment of potential effects

There is no serious assessment of the potential effects of the mining activities or the construction and presence of the road on vertebrate pests. In Section 6.5.1 (p65) 'General Effects [Fauna]' they mention that invasion of pests and weeds could be facilitated because this is a previously undisturbed site. This is revisited in Section 9 'Conclusion' (p104) where it is mentioned that "*the construction of the road and other human activity would also increase the presence of weeds and possibly pests*". However, there is no description of which pests may be affected and by what mechanisms.

Throughout the application document there is mention of pest control as mitigation, and it is recommended that a Pest Control and Ecosystem Management Plan is developed (p105). This recommendation is supported, but this plan should not be completed without proper vertebrate pest monitoring establishing the presence and relative abundance of the various pest species. This is particularly important because:

- It has been suggested that the nearby Denniston Plateau has low predator densities and may be a refugia for many threatened species (Elliot 2012). It cannot be ruled out without proper evaluation that the Te Kuha area may be similar, particularly given that it is a high altitude site.
- The proposed mine location is at relatively high altitude (600-800 m a.s.l.) and rats are not always present at high altitude.
- The abundance of rats and mice is highly variable and often strongly associated with vegetation type (Innes 2005, Ruscoe and Murphy 2005).

9.1.3 Information gaps

The information gaps in the application document and ecology report relevant to animal pests are:

- What are the relative densities of animal pests in the area, and consequently the relative risk to native fauna?
- What would be the likely interaction between disturbances from mining and road development, pest animals, and native fauna?
- What risks do browsing mammals pose to the vegetation associations within the mine footprint?

- What risk do browsing mammals pose to the proposed restoration planting?
- What are the known habitat associations between vertebrate pests, particularly rodents, and the various forest types present (e.g. mountain beech/yellow silver pine-pink pine forest, manuka shrubland, rimu/hard beech forest)?
- Are hedgehogs present? The location is within the known range of hedgehogs (Jones and Sanders 2005).
- Are feral cats present?

9.2 Potential impacts on pest animal populations

Road development, disturbance through mining, and habitat restoration all have the potential to impact vertebrate pests.

Road Development

Development of the access road has the potential to impact on mice, stoats, ship rats, and hares. While poorly understood, the effect of roads on the dispersal of alien species is an important consideration in New Zealand (Spellerberg and Morrison 1998). In Pureora Forest Park, mice were found to be more abundant in road edge cut over forest than in unlogged native forest (King *et al.* 1996a, King *et al*. 1996b). Ship rats were also detected in high numbers along the road edge (King *et al.* 1996a), but were also noted to be widespread throughout indigenous forest. In Fiordland National Park, the Eglinton Road affected the behaviour of stoats, with females avoiding it and males showing a preference for it (Murphy and Dowding 1994). Male stoats were observed to scavenge road kill, and may also have been using the road as a linear feature for travel. Hares are not typically found in forest, but will inhabit roads, and road margins. Hares can affect indigenous vegetation through browsing, and also provide an additional food source for stoats (Smith *et al.* 2008).

Mining Disturbance

House mice and ship rats are considered invasive alien species in several regions throughout the world. In New Zealand mice are widespread in indigenous forests, and ship rats are common in podocarp-hardwood forest and in beech forest following mast seedfall events (Ruscoe and Murphy 2005, Innes 2005). While there have been few studies in New Zealand of rodent ecology around disturbances, there have been a number of studies overseas that show they prosper in areas of human disturbance in indigenous forest (e.g. Bennett 1990, Lehtonen *et al.* 2001, Umetsu and Pardini 2007). The development of mining activities and mining infrastructure may produce disturbances that benefit house mice and ship rats. The site will need to be monitored carefully for a rise in these species, and mitigation of such a response to disturbance will need to be a consideration of the Pest Control and Ecosystem Management Plan.

Habitat Restoration

Under Section 7 'Rehabilitation' it is recommended that restorative plantings in the road and mine area achieve dense vegetation cover in order to prevent the spread of weeds. In New Zealand forests mice reach high population densities in areas of dense

ground cover, and therefore may benefit from such dense vegetation plantings. In forest ecosystems mice are important prey for stoats (Smith *et al.* 2008), a predator of kiwi. If the abundance of mice increases in rehabilitated areas it may focus the activity of stoats in these locations.

9.3 Further information required

It is highly desirable that proper monitoring of vertebrate pests using tracking tunnels, wax tags and faecal pellet counts be undertaken in the Te Kuha area and adjacent areas chosen for mitigation, particularly given:

- Te Kuha is a high altitude site and trends in pest abundance, particularly rats, are more difficult to predict at altitude.
- The low number of pests detected in the nearby Denniston Plateau.

If pests are at low abundances, as observed previously on the Denniston Plateau, then pest control may not be of significant benefit to threatened species in the area, and may be outweighed by the disturbance of the species in relatively intact refugia. If pests are at abundances that pose a risk to threatened species then an understanding of pest distribution and abundance will be necessary for planning effective mitigation using pest control.

Further consideration also needs to be given to the impacts of browsing mammals, particularly deer (given they appear to be abundant), on any rare (and threatened) vegetation types in the area, and how they might impact rehabilitation sites.

10. SIGNIFICANCE ASSESSMENT (BULLER DISTRICT PLAN)

The ecology report undertakes an assessment of significance in Section 5 according to significance criteria set out in the Buller District Plan (Policy 4.8.7.4). The plan lists nine criteria, but criteria are only discussed below where we have some disagreement with statements or conclusions of significance.

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

The report notes that the Te Kuha area is almost entirely unmodified, and supports all the fauna species that might be expected to be found in coal measures habitat. However, they appear to only consider parts of it to rank highly for representativeness, and other parts to rank moderately based on the fact that habitats are present elsewhere. In our opinion, this is not the correct usage of the representativeness criterion, and Te Kuha ranks high for significance.

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*".

The criterion does not specifically mention fauna, although the report does in its assessment. It ranks the site highly for intactness, but appears to consider the site less significant for fauna on the basis that bats are not present. The small number of bat surveys, potentially undertaken in poor conditions for bat activity, does not indicate absence. In our opinion, the site ranks highly for intactness for fauna.

Another possibility that has not been investigated through the applicant's surveys is that the Te Kuha site may only support low populations of pest mammals (recent work associated with the Escarpment Mine resource consent applications suggests low rat and stoat populations on the Denniston Plateau; Elliot 2012). If this is the case, and the location provides refugia for vulnerable fauna, then Te Kuha ranks more even highly for intactness.

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

The assessment of ecological values against the Buller District Council "Threat" criterion needs to specifically include the Nationally Vulnerable West Coast green gecko which would alter the ranking to "high" for this criterion.

Overall Significance Assessment: Overall, we agree that Te Kuha is significant in terms of Buller District Plan significance criteria, and the site triggers eight out of nine criteria. As the ecology report notes, the discovery of a new invertebrate species would trigger the ninth criterion, and is a possible outcome of further survey.

In terms of the Buller District Plan, the Te Kuha area is zoned "Rural", and plan provisions are not strongly protective of sites deemed significant in this Zone. The plan is generally permissive of activities in this Zone so long as areas of significant fauna habitat are protected from inappropriate development and the effects are appropriately avoided, remedied or mitigated.

A review of these Buller Council plan provisions (and relevant provisions in the Regional Policy Statement and the West Coast Regional Plan) relating to the protection of areas considered significant under Policy 4.8.7.4 of the Plan would provide a useful planning context, and act as a springboard to determine mitigation requirements should the mine go ahead. We view this as an information gap.

11. MITIGATION AND COMPENSATION FOR FAUNA EFFECTS

The application document is structured in such a way that the rehabilitation section (Section 7) is outside the mitigation section (Section 8), and mitigation also includes off site compensation (consideration of the inclusion of the Orikaka Ecological Area into the ecosystem management initiative). It would be useful to have a section providing details of all activities designed to offset losses in a single section; this way the adverse effects of the proposal on ecological values could be readily assessed against the proposed initiatives to avoid, remedy and mitigate losses, with compensation included to balance the equation by addressing residual effects.

The ecology report states that the aim of a mitigation package for fauna is to "*maintain local species in the vicinity of the disturbed area in order to maximise the potential for reinvasion by local species once rehabilitation commences*". It also states: "*With respect to fauna the species most at risk should be the subject of species-specific ecosystem management intended to offset any losses*". In order to achieve this, the authors recommend management of all introduced mammals in "the Te Kuha area" and that "*wider ecological management requirements*" are contained within a separate Biodiversity Management Plan (p103). The authors also point out that a further 9,500 ha of pest control would join the Solid Energy Ltd and Bathurst Resources Ltd pest management areas (the latter has not yet been implemented), and create a "*coal measures reserve*". Lastly, the authors also suggest all or part of the Orikaka Ecological Area as another potential management area. The ecology report does not go so far as to recommend the size or location of the area(s) that should be managed for pests, or how this should be undertaken, but rather notes that this will be part of separate Pest Control and Ecosystem Management Plan.

The duration of ecological management requires clarification; p99 states the duration as "*during the mine life*" which is apparently inconsistent with p102 "*for the life of the mine and beyond*". Presumably this detail would be provided in the Biodiversity Management Plan. It would also be helpful to include objectives of mitigation/ rehabilitation that are clearly stated for each fauna group.

We are reasonably confident that much of the indigenous fauna detected at Te Kuha, and likely to be lost through mining, can be offset in regards to numbers of individuals. This is correct for birds, bats, and lizards, but possibly not some species and groups of invertebrates. If pest populations such as rats and stoats are very low at Te Kuha, it may not be possible to increase populations of susceptible fauna - such as great spotted kiwi and long-tailed bats - within similar coal measure habitats at similar altitudes. However, it is possible to increase the numbers of such species elsewhere using pest control. Arguably, this is not offsetting, but rather compensation.

Another potential issue is that the impacts of mammalian pests on some species are not well understood, and the response of those species to intensive pest control is not always predictable. For example, South Island fernbird were driven to extinction by the arrival of rats on some offshore islands, but survive in relatively high densities around the South Island in areas receiving no predator control. Whereas, New Zealand pipit nest on the ground so are presumably susceptible to pest mammals. However, it is only recently, with the eradication of rats on Campbell Island where pipit have increased dramatically (Beauchamp 2013), that the possible impacts of pests are being highlighted.

Development of a mammalian pest control programme to mitigate or compensate for the loss of fauna resulting from the mining operation requires some basic but critical decisions to be made; what indigenous species and pest species should be the focus of management, where and how should management take place, and what needs to be controlled. Table 2 provides a list of species or groups of species that the review authors consider would provide appropriate focus for the pest management programme. This list includes long-tailed bats and West Coast green gecko, given their relative proximity to Te Kuha.

Table 2: Fauna species or species groups recommended for mitigation in a pest mammal control programme, assuming that the pest species listed below are present.

Species	Threat Classification	Pest Species
Birds		
Great spotted kiwi	Nationally Vulnerable	Stoats, weasels, cats, possums.
South Island fernbird	At Risk-Declining	Stoats, weasels, cats, possums, rats.
New Zealand pipit	At Risk-Declining	Stoats, weasels, cats, possums, rats, hedgehogs.
Lizards		
West Coast green gecko	Nationally Vulnerable	Rats, weasels, mice, stoats, feral cats.
Speckled skink	At Risk-Declining	Rats, weasels, mice, stoats, feral cats.
Forest gecko	At Risk-Declining	Rats, weasels, mice, stoats, feral cats.
Bats		
Long-tailed bat (southern)	Nationally Critical	Rats, stoats, weasels.
Invertebrates		
Weta spp.?	Not Threatened	Mice, rats, stoats, weasels, feral cats, hedgehogs .

The list in Table 2 is incomplete given the gaps in information identified for invertebrates, and also makes assumptions about the presence and relative abundance of various vertebrate pests. This needs to be addressed before a full list of species and species groups can be completed. Likewise, further bat surveys may need to be undertaken depending on the climatic conditions encountered during the surveys covered in the ecology report.

The decision on what area or areas should be managed would be best undertaken in consultation with Department of Conservation experts before the application proceeds much further. Once this decision is made, and prior to the development of the Pest Control and Ecosystem Management Plan, the applicant must better define the mammalian pest population present in the areas in question. This is because the site is at relatively high altitude (600-800 m asl) and there is typically a negative correlation between rat abundance and altitude. Therefore the presence of rats cannot be assumed, and must be assessed. Stoats can be present at high altitude, but their persistence there will be dependent on a reliable food source. Therefore their presence, or more importantly their relative abundance, should also be established. Threatened species will not provide a reliable food source for stoats. Possible reliable food sources would be one or more of the following: mice, rats, lagomorphs, common indigenous and exotic passerines, and abundant large invertebrates e.g. weta. It would also be important to establish the presence or absence of feral cats and hedgehogs. Feral cats are not controlled by stoat trapping, and their presence and potential impacts on kiwi could jeopardise mitigation through stoat control. While the presence of hedgehogs seems unlikely, they have recently been detected in high altitude beech forest in the Blue Mountains, Western Otago, and in the Hawdon Valley, Arthur's Pass (Department of Conservation, unpubl. data), suggesting they may still be spreading along an invasion front. The presence of hedgehogs could be devastating for endemic invertebrates and smaller species of ground-nesting bird.

If compensation is considered, then the Avatar moth, which is endemic to the Denniston Plateau, is a good candidate given the current knowledge of the species. The Avatar moth (*Arctesthes* new species) was discovered on the Denniston Plateau during the Forest and Bird Society BioBlitz in early March 2012. Despite much

search effort only one male was found flying by day over a wetland. Subsequent genetic analysis at Lincoln University confirmed the species is distinct from its close relatives.

In March 2014, further survey found the species at a second site on the Denniston Plateau, and revealed the larval host plant and pinpointed its exact habitat. This habitat and host plant are rare on the Plateau, and are at risk from increased human disturbance and habitat loss. Based on this new information, the Department of Conservation's specialist Lepidoptera group moved this species to a threat status of Nationally Critical in April 2014.

Habitat of the Avatar moth is closely related to the highest altitude communities of the proposed Te Kuha mine site, therefore a compensation package involving the Avatar moth is relevant. A compensation package for faunal effects of the proposed Te Kuha coal mine project could include a suite of actions that would benefit the Avatar moth on the adjacent Denniston Plateau.

The ecology report raises the possibility of protection of an area of unmodified Te Kuha coal measures habitat in perpetuity, and this suggestion is supported, and should be discussed with the appropriate parties.

12. SUMMARY

12.1 Ecological significance of Te Kuha mine site

Overall Mine Footprint

The "*Te Kuha area*" (this is assumed to mean the mining permit area) has been assessed as triggering eight of the nine significance criteria listed in the Buller District Plan (Section 5, ecology report). We concur with this assessment, and expect that the same can be said for the proposed mine site itself. The possible new species of flatworm found during invertebrate surveys may trigger the ninth significance criterion (Scientific Value; if it is a new species, the site would become a 'scientific reference area' due to it being a type locality). Further invertebrate surveys could potentially make more important discoveries.

The kiwi population within the mining permit area (and mine footprint) is part of a great spotted kiwi population that has been identified as regionally and nationally significant (Kingett Mitchell and Landcare Research 1997). Te Kuha birds will comprise a small proportion of this population. The West Coast green gecko population within the area is part of a stronghold population that is being cumulatively degraded with each consented mining application. There is scant evidence that West Coast green gecko can colonise rehabilitated landforms.

Overall, however, populations of fauna identified to date within the mining permit area (and mine footprint) are not significant within the Ngakawau Ecological District, although the site contains high conservation values. This, however, is in light of limited bat and invertebrate surveys. The observation of southern long-tailed bat, a Nationally Critical species, would make the Te Kuha location ecologically significant

given the paucity of records of this species. Further invertebrate surveys may also identify the site as being ecologically significant.

Public Conservation Land

No fauna surveys have been related back to the areas of public conservation land within the mine site or haul road within the report. Likewise, avifauna surveys within the mine footprint have not been described separately from those undertaken in the mining permit area. As such, the ecological significance of the bird community and bird habitats within the affected area needs to be extrapolated from overall results, and it is difficult to accurately evaluate the fauna within public conservation land located within the affected area. At best, it can be concluded that the public conservation land within the mine site itself is likely to share the same ecological significance as the remainder of the mine site/mining permit area given the similarity of habitat types. However, public conservation land located within the haul road may be less significant given that the habitats present are not coal measure habitats, are generally more modified, and are likely to be more widespread, both in and outside of the Ngakawau Ecological District. Nevertheless, great spotted kiwi are likely to use the public conservation land located within the proposed route of the haul road, and West Coast green gecko, speckled skink and forest gecko are almost certainly present.

12.2 Adequacy of applicant fauna information

Avifauna and lizard information is largely adequate, although presentation and discussion of results could be improved. Further survey work is unnecessary.

The suitability of the weather conditions in which bats were surveyed is unknown. Consequently, it is not possible to assess whether survey effort is sufficient. The ecology report's conclusion that bats are absent is not sound; non-detection does not prove absence.

Invertebrate surveys were too general, were undertaken at a time of the year at which invertebrate activity is decreased, and were poorly analysed. It is not possible, therefore, to assess the significance of the Te Kuha invertebrate community.

A notable omission from the discussion of the results of all fauna surveys is the lack of comparisons, or even acknowledgement, of the recent and largely comparable block of surveys undertaken for the Escarpment Mine resource consent application process.

12.3 Potential impacts

Immediate potential impacts of mining on fauna are generally well described in the ecology report. The long-term potential impacts are not addressed fully for invertebrates and lizards, particularly the likelihood of the existing fauna communities to recolonise the new ecosystem that establishes on the rehabilitated mine surface.

Much of the indigenous fauna within the Te Kuha mine footprint to be lost to mining is likely to be able to be offset in regards to numbers of individuals. This is the case for birds, bats, and lizards, but possibly not some species and groups of invertebrates.

It is unclear whether this can be achieved in similar coal measures habitats as existing pest populations are not well understood, and may be low, resulting in limited opportunities for increasing affected fauna populations.

The overall impact of mining for all fauna that presently use the Te Kuha mine footprint is the permanent loss of the coal measures ecosystem. Associations between species of birds, lizards, bats, and insects and the coal measures habitats that they inhabit will no longer exist at the site. This constitutes an ecologically significant loss that also contributes to the ongoing cumulative loss of these associations on the Stockton and Denniston Plateaux. As the ecology report states (p103), this distinctive ecosystem is at risk from a number of existing mining operations elsewhere on the Denniston and Stockton Plateaux, and will continue to be at risk from operations that are likely to be proposed in the near future. This proposal should not be assessed without regard to the receiving environment.

The figures illustrating the mine layout mining taking place over eight years. However, the access agreement is sought for a period of 10-25 years, and the application document states that this "*includes all stages of the operation, including rehabilitation and closure of the mine*" (p5). However, it also notes that "*The life of the mine is estimated to be between 10 and 25 years*" (p50). It is not entirely clear whether these statements are one and the same thing. If mining for coal continues for up to 25 years, then clearly the impacts (e.g. mortality, disturbance) will continue over a significantly longer timeframe.

12.4 Further information required

The following information should be provided to stakeholders and decision-makers (further detail is provided at the end of each fauna section):

Desktop Information

- GIS map showing vegetation types overlaid on high resolution aerial photography for the mining permit area, and separate maps for the mine site and the haul road. These should also indicate the boundaries of public conservation land. This information is not required if no further desktop review of the application is necessary. However, the applicant should provide this information if the application proceeds further.
- Information on the habitat and characteristics of sites where ABMs were placed and the weather conditions during each night for each ABM.
- Identification of the weta and cricket species collected during the invertebrate surveys.
- A review of these Buller Council plan provisions (and relevant provisions in the Regional Policy Statement, and the West Coast Regional Plan) relating to the protection of areas considered significant under Policy 4.8.7.4 of the Plan would provide a useful planning context, and act as a springboard to determine mitigation requirements should the mine go ahead.

Field Survey Information

- Dependent on the information provided above for bats, further survey may be necessary during suitable weather.

- Further invertebrate survey during an appropriate time of year and using survey and analysis methods, as recommended in Section 7.4.

Rehabilitation, Mitigation, and Compensation

The application has a long way to go to adequately address mitigation with respect to fauna. The application document and ecology report acknowledge this. Basic decisions are yet to be made, for example, on fauna species for which effects need to be mitigated, areas for mitigation, and methods of mitigation.

Development of the "*Pest Control and Ecosystem Management Plan*" is an important component of the application. It should be able to demonstrate that the effects of the mine on key species or groups of fauna can be mitigated and how that can be achieved. In order to develop the management plan, the following is required:

- Discussion/workshop with appropriate Department of Conservation staff and other experts as necessary to make the key decisions on species for mitigation, areas for management, and methods for control.

- The ability of the rehabilitated mine footprint to support populations of lizards and invertebrates needs to be addressed and discussed.

- Formal monitoring of vertebrate pests using tracking tunnels, wax tags and faecal pellet counts is undertaken in the Te Kuha area, and possibly other areas for mitigation, depending on where these are.

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ADDENDUM TO WILDLANDS REPORT R3470
SEPTEMBER 2014 FIELD TRIP

INTRODUCTION

The proposed Te Kuha coal mine site was visited on 9-10 September 2014 by Brian Patrick, Dr Mandy Tocher, and Dr Des Smith. Dr Rachel McClellan also visited the mine site on 9 September, and walked the lower section of the haul road (south of Coal Creek) on 10 September. Dr Kerry Borkin did not visit the mine site.

Visits on both days were very brief; approximately three hours was spent in the mine site on 9 September, and two hours on 10 September, while Rachel McClellan spent two hours walking out along the proposed route of the haul road.

Prior to the visit, the applicant provided further information on avifauna, bat, and reptile surveys undertaken at the site.

This addendum to Wildland Consultants (2014) discusses and summarises changes and additions to the conclusions of that report in light of the field visit and the additional information provided by the applicant.

AVIFAUNA

Wildland Consultants (2014) stated that no extra information on avifauna was required from the applicant, but that the avifauna data should be better presented, should the application proceed further, to more clearly demonstrate the bird species and habitat associations present within the proposed mine footprint. This was because bird counts and bird observations had been undertaken throughout the mine permit area, and no separate summary had been produced for the subset of results of species presence and conspicuousness within the affected area.

Wildland Consultants (2014a) also suggested providing a GIS map showing vegetation types overlaid on high resolution aerial photography for the mining permit area, and separate maps for the mine site and the haul road.

In response, the applicant's experts provided a map of the five-minute bird count stations overlaid on a map of vegetation types for the permit area. The location of the haul road and mine site was not provided on this map, so an assessment of the suitability of the sampling intensity within the mine footprint is still not able to be made. However, the applicant also provided a spreadsheet showing survey effort within the mine site (i.e. hours per each of the eight 500 × 500 m grid squares that cover the mine site), and the absence or presence of bird species within those mine squares. A rapid analysis of these data indicates that twelve indigenous species are present within the mine footprint (excluding the haul road; Table 1). Given that the effort varies significantly between squares (from 0.5-15.5 hours), these data can only be used as indicative of the conspicuousness of these species within the mine site.

However, it can be assumed that at least all the species listed below will be affected by the proposed mine.

Table 1: Presence of indigenous bird species in the eight grid cells covering the proposed Te Kuha mine footprint.

Bird Species	Scientific Name	Presence (Number of Grid Cells)
Australasian harrier	*Circus approximans*	1/8
Western weka	*Gallirallus australis australis*	7/8
South Island rifleman	*Acanthisitta chloris chloris*	2/8
Silvereye	*Zosterops lateralis lateralis*	8/8
Grey warbler	*Gerygone igata*	5/8
New Zealand pipit	*Anthus novaeseelandiae novaeseelandiae*	1/8
South Island fernbird	*Bowdleria punctata punctata*	5/8
Brown creeper	*Mohoua novaeseelandiae*	1/8
Fantail	*Rhipidura fuliginosa fuliginosa*	8/8
South Island tomtit	*Petroica macrocephala macrocephala*	8/8
South Island robin	*Petroica australis australis*	8/8
Bellbird	*Anthornis melanura melanura*	8/8

The applicant's experts also provided two maps of the vegetation types overlaid on to aerial photographs of the mine permit area. One map covered the mine permit area, but only showed the location of the haul road and not the mine site itself; the other map showed the extent of the water conservation reserve, but neither the haul road nor the mine. In addition, the shading of vegetation types did not match between the key and the aerial photograph, and could not be interpreted for several habitat types; Wildland Consultants (2010) mapped the vegetation of the Denniston and Stockton plateaux and numbered vegetation types to avoid this type of potential confusion.

Fourteen bird species were opportunistically observed during the brief site visit; all of which were recorded by Mitchell Partnerships (2013). Birds were much less conspicuous within the proposed mine site than along the lower section of the proposed haul road route, which is to be expected given the habitat types present. South Island fernbird *Bowdleria punctata punctata* were seen at relatively regular intervals along the haul road route in pakihi habitat.

Based on the field visit, and the additional information provided by the applicant, the general avifauna conclusions and discussion given in Wildland Consultants (2014) are unchanged.

INVERTEBRATES

A brief entomological inspection of the proposed Te Kuha mine site showed the site to support a wide range of indigenous invertebrates. The suite of species found indicates that the mine footprint is ecologically significant as it supports sustainable populations of all of the following:

- Species endemic to the northwest South Island, e.g. an unidentified stick insect in the genus *Micrarchus*.
- A number of large-bodied flightless species, e.g. Helm's stag beetle *Geodorcus helmsi*.
- At Risk species, e.g. forest ringlet butterfly *Dodonidia helmsi*, At Risk-Relict.
- Widespread but distinctive Main Divide upland species, e.g. zig-zag moth.

- At least four unnamed species, e.g. the leaf-veined slug and *Rhytida*-like snail described by Mitchell Partnerships 2013, and the large spider and stick insect from this site survey.

Notably, no exotic invertebrate species were found either as adults or larval damage.

The prominence of the group of large-bodied flightless invertebrate species probably indicates the intact character of the site, its remoteness, a relatively low introduced predator population, and an overall high degree of naturalness.

Overall, given the suite of indigenous species present, their relationships and life histories, and the high degree of naturalness of the habitat, this site is significant for indigenous invertebrates in regional and national contexts. A more detailed discussion of the findings of the site visit is provided in Wildland Consultants (2014b).

REPTILES

After visiting the site, including parts of the proposed footprint, we concur with the applicant that threatened West Coast green gecko *Naultinus tuberculatus* is almost certain to occur at the site. Although patchy, large tracts of suitable habitat are present. Given that the presence of West Coast green gecko is acknowledged by the applicant (Mitchell Partnerships 2013), this is not a contentious issue. Should the site be developed, this species will need to be appropriately addressed in proposed mitigation, along with *Mokopirirakau granulatus*, *Oligosoma infrapunctatum*, and any other lizard taxa found at the site.

The proposed mitigation for loss of lizards and lizard habitat (*c*.89 ha), should the proposal proceed, involves predator control for an unspecified period of time, the details of which will be considered in the development of a "Pest Control and Ecosystem Management Plan" (Mitchell Partnerships 2013). The predator control is envisaged to boost lizard populations, including those unaffected by the mine. These populations will then recolonise the rehabilitated landform over the decades following mine closure. The ability of lizard populations to recolonise the rehabilitated landform will be enhanced by the boosted "ready-to-go" populations.

If the proposed predator control mitigation is based on an assumption that West Coast green gecko will and can recolonise the rehabilitated landform (it is not clear whether this is an assumption) then substantial evidence (perhaps by way of research) is required to test this assumption. In response to a query about the ability of the West Coast green gecko to recolonise post-mine landforms - which was illustrated in Mitchell Partnerships (2013) by an unsubstantiated report of a West Coast green gecko on the post-mine landform of Marshalls Mine upper Waimangaroa Valley - the applicant was unable to provide evidence that West Coast green gecko can or would recolonise a rehabilitated landform, and the Marshalls Mine record was actually a forest gecko rather than a West Coast green gecko (M. Lettink, pers. comm., 2014).

If the proposed mitigation does not include in its accounting any recolonisation of the rehabilitated landform (i.e. any recolonisation of the landform by any of the three lizard species present is a bonus) then predator control alone as a mitigation technique will need to continue for many decades following mine closure to fully compensate for the complete loss of all lizards and lizard habitats over the footprint and access routes. Also, and as noted in Wildland Consultants (2014), the most significant effect of implementing the proposal is the

contribution that this mine will make on the cumulative degradation of a stronghold population of the West Coast green gecko. As such, the final mitigation package will also need to appropriately compensate for this cumulative effect on the stronghold for the threatened West Coast green gecko.

BATS

This desktop evaluation is based on the further information provided by the applicant.

The applicant's assertion that it is unlikely that there are large populations of long-tailed bats (*Chalinolobus tuberculatus*) present within the project footprint is supported, and also that it is unlikely that short-tailed bats (*Mystacina tuberculata*) are present in the project footprint. The applicant also suggests that the closest populations of long-tailed bats are likely to be small compared to Fiordland populations. If this is the case then it provides even more reason for them to be well-protected if present, i.e. a more precautionary approach, not a less stringent approach.

It is clear that bat monitoring in the area, prior to that done for this project, was very limited, and as such cannot be relied upon to inform this project.

Despite a specific request for such information, no information has been provided on weather conditions during the surveys undertaken for this project and, as such, confidence in the surveys is relatively low. It is likely that weather conditions were not recorded at the time given their response. However, the applicant attempts to give confidence by saying that the weather was "fine and mild". Temperature, precipitation (and the time of precipitation) should be recorded if any further surveys are undertaken. Such information would give greater confidence in surveys. Bats are less likely to emerge from their roosts on cool, windy, wet nights, and therefore won't be detected.

The applicant's argument that bat detections are rare on the West Coast of the South Island is supported. However this does not indicate that bats are not present within the ecological district or within, or near, the project footprint, given that long-tailed bats were detected approximately 40 km to the north at Mokihinui River (O'Donnell 2012), and also within the same ecological district as much of this project footprint (Ngakawau Ecological District; O'Donnell 2012). Given that long-tailed bat home range spans (the distance from one edge of its home range to the other edge) can be 7-11 km across and home range sizes greater than 1,800 ha (median juvenile home range size; Borkin and Parsons 2011; O'Donnell 2001), the Mokihinui River long-tailed bat population is relatively close to the project footprint. Te Kuha provides suitable long-tailed bat habitat - a combination of foraging (particularly linear landscape features including along the canopy) and roosting habitats (trees that provide potential roosts) - consequently, it is still possible that long-tailed bats could use the Te Kuha project footprint.

PEST ANIMALS

The visit to the Te Kuha coal mine site on 9-10 September 2014 raised further concerns regarding how coal mining activities on the ridge may lead to proliferation of vertebrate pests in the area. These concerns fall into three main areas:

- Lack of browse damage by mammals in the proposed mine area, the amount of short vegetation that could be browed by hares, and the potential for a hare invasion along the proposed road.
- Anecdotal evidence that poor sanitation may have led to the localised proliferation of rodents around the hut.
- The location and distribution of feral goats and feral pigs and how they might affect restorative plantings.

Mitchell Partnerships (2013) identified deer sign in 100% of 53 500 × 500 m grid cells in the mining permit area. This indicates that deer numbers may be high, and vegetation in the area frequently browsed. However, very little deer sign was observed during the field visit to the proposed mining area and its surrounds (some hoof prints were spotted in a dry tarn) and only very small amounts of browse by introduced mammals was observed. This suggests that the location may be relatively free of browsing impacts given that TBFree New Zealand regularly controls possums in the area. Hares do not currently occupy the ridge, but much of the proposed mine site and surrounding areas contains shorter vegetation that could easily be inhabited and browsed by hares (Plate 4). It is likely that that hares would invade the area along the proposed road. Hares are well known along forestry roads, and may have accessed parts of Fiordland National Park along them e.g. Green Lakes via the Borland Road.

Wildland Consultants (2014; Section 9.2, p27) stated that a number of studies overseas have shown that rats and mice prosper in areas of human disturbance in indigenous forest (although this is less well studied in New Zealand). A large amount of rat and mouse activity was found at the hut site. This included seed collection typical of rats on the hut steps (Plate 1) and rat and mouse scats throughout the hut (Plate 3). This activity was likely promoted by (a) the dry shelter provided by the hut, and (b) lack of cleanliness (Plate 2) of the hut which had rubbish, including food remains (e.g. open cans), strewn across the floor. The presence of such rubbish is a recipe for the promotion and proliferation of rats and mice which are predators of introduced birds, lizards and invertebrates. Rats and mice also form part of the prey base of stoats, which are also predators of indigenous birds, lizards, and invertebrates. Rat activity was evident in an approximate 100 m radius of the hut, with conspicuous rat scats and further seed caches observed on the boulders below the hut and beside the stream above the hut. Such rat activity was not observed at any location further away from the hut during the field visit. This suggests that rats may be using the hut as a focal point. Any mining activities - including any further survey work - need to maintain far higher levels of cleanliness and should consider on-site rodent control to prevent rodent proliferation. Invertebrate observations made during this field visit indicate that a number of large-bodied species are present that will be vulnerable to rodent predation.

Mitchell Partnerships (2014) identified feral goat sign in 13% of the aforementioned grid cells and feral pigs in 4% of grid cells. Feral goat sign was concentrated *c.*2 km north of the proposed mine site and feral pig sign was within 1 km of the proposed mine site to the west. Because the survey was 'one-off' and the vegetation in the area is dense, it is unlikely that the full distribution of these species were described for this area. Additionally, their distribution will change seasonally and over time. Feral goats and feral pigs pose a significant threat to the proposed restorative plantings and would need to be managed to prevent this. Their management would also be beneficial to forest health in the areas adjacent to the proposed mine.

Plate 1: Seeds collected by rats on the hut doorstep.

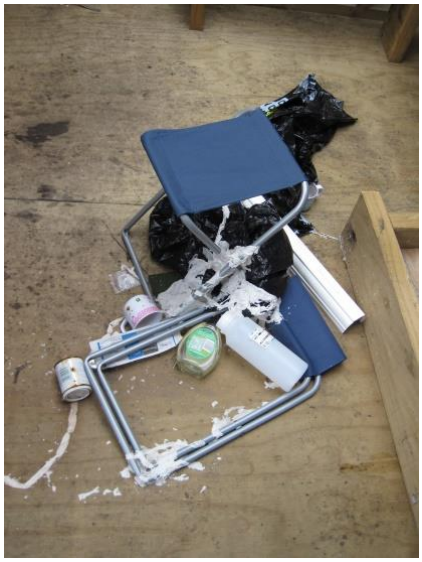

Plate 2: Rubbish strewn around the hut.

Plate 3: Rat scats on the hut bench.

Plate 4: An example of habitat that could be invaded by hares.

ECOLOGICAL SIGNIFICANCE OF THE TE KUHA MINE SITE

Wildland Consultants (2014) concurred with Mitchell Partnerships (2013) that the *Te Kuha area*" (which was assumed to mean the mining permit area) meets eight of the nine significance criteria listed in the Buller District Plan. Our assessment stated that the mine site (which includes the haul road) was likely to also be significant. However, we disagree with some of the interpretations of Mitchell Partnerships; for example, their conclusion that "*Te Kuha*" has "*only moderate representativeness value*". Given the proposed mine site and its surrounds are virtually unmodified and intact, and have a full complement of fauna (birds, invertebrates, and reptiles) that might be expected, the area is clearly "*one of the best examples of an association of species which is typical of the ecological district*" (Buller District Plan).

The ninth criterion - scientific or cultural value - which was noted as potentially being met if either of the unidentified leaf-veined slug or *Rhytida*-like snail were found to be new species,

is now more likely to be met. A further two unnamed species were recorded during this site visit, and an additional species is at its southernmost distributional limit.

Additionally, the site is now considered to be ecologically significant for invertebrates within the Ngakawau Ecological District, and at a national level, given the degree of naturalness and intactness of the site, and the suite of invertebrates associated with the habitats present, including a large number of unnamed species, and large-bodied species that are more susceptible to mammalian predation.

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ADDENDUM TO WILDLANDS REPORT R3470
INVERTEBRATE DISCUSSION

INTRODUCTION

The proposed Te Kuha coal mine site was visited on 9-10 September 2014 by Brian Patrick, entomologist. Although two trips were made to the site over that time, less than half a day of actual sampling was possible. All of the survey work was performed in the daytime with helicopter access to the highest ridge and hut site. Sampling involved observation of characteristic feeding damage on vegetation, hand collection including lifting rocks, and sweep netting of vegetation.

This addendum to Wildland Consultants (2014) discusses and summarises changes and additions to the conclusions of that report in light of the field visit.

ANNOTATED LIST OF KEY INVERTEBRATES FOUND

Forest ringlet butterfly: *Dodonidia helmsi* (Lepidoptera: Nymphalidae: Satyridae)

The elegant forest ringlet butterfly *Dodonidia helmsi* was first found and later described from the Paparoa Range. A significant population of this rare and attractive butterfly species was located from 700-800 m at the Te Kuha site. Larvae were abundant on the larval host plant *Gahnia procera,* and feeding damage was noticeable on all populations of the host plant seen in the understorey of the shrubland and low forest areas. Two size classes of larvae were found (10 and 26 mm) confirming that the life cycle is two years but that some adult butterflies emerge every year (Patrick & Patrick, 2012). This species was not found by Mitchell Partnerships 2013).

The Department of Conservation national threat ranking for this species is At Risk-Relict (Hitchmough *et al.* 2014) reflecting the major decline this species has experienced over the past 70 years. The species is one of our rarest butterflies and has gone from being widespread and locally common from lowland to montane areas from Northland south to Lewis Pass and the south end of Paparoa Range, to now being found only in upland remote sites such as Te Kuha.

Although the exact causes of its decline are unknown, it is believed to be related to the introduction of German wasp, common wasp, and several paper wasp species, all of which prey on the larvae, combined with widespread habitat destruction (Patrick & Patrick, 2012).

Less than 20 populations of this butterfly are known nationwide, and where it has been studied it is still in decline. It has disappeared completely from some sites and regions, several of which are substantial, such as the Waitakere Ranges west of Auckland.

Plates 1 and 2: The larvae of the forest ringlet butterfly *Dodonidia helmsi* (left) found at Te Kuha (700-790m) on the larval host plant *Gahnia procera*, and adult butterfly (right) from Mohikinui (adult image by Melissa Hutchison)

Plate 3: Typical habitat at Te Kuha of the forest ringlet butterfly and its larval food plant.

Helm's stag beetle: *Geodorcus helmsi* (Coleoptera: Lucanidae)

Three individuals of this impressive stag beetle were found under rocks on the summit of Te Kuha. The live male was released but the two dead females retained. Males can be as large as 44 mm long by 20 mm wide and sport impressive "horns". Females are more modest, at 24 mm long. This species was not found by Mitchell Partnerships (2013).

Of our ten endemic stag beetles in this genus, this is the most widespread species, being distributed from Stewart Island and Southland through Fiordland and up the West Coast to the Kohaohai River in Northwest Nelson. This large flightless species is or was found from sea-level to just above treeline, but has gone from many areas, probably due to the presence of rats and other predators. It is a cumbersome species with no natural defense against these introduced predators (see below).

Plate 4: *Geodorcus helmsi.*

Although eight of the ten *Geodorcus* species are classified as Nationally Threatened or At Risk, this one is not. However, in my experience, it should be as it has definitely declined in terms of both relative abundance and distribution over the past 50 or more years.

Holloway (2007), in a recent revision of this beetle family, commented on studies that showed that rats definitely had an effect on this taxon and had possibly eliminated it from islands such as Breaksea in Fiordland.

Large green chafer beetle: *Stethaspis* species probably *suturalis* (Coleoptera: Melolonthininae)

Large larvae of this genus of impressive chafer beetle were found under summit rocks, within the proposed mine footprint. Formerly placed in the genus *Chlorochiton*, these are large beetles (up to 24 mm in length) that have "c" shaped larvae which live in the soil on roots. Adults are "clumsy" fliers. This species was not found by Mitchell Partnerships (2013).

This species is known from the southern North Island south to about Westport, so it is at its southern limit at Te Kuha. In my experience this species is not common across this distribution and its occurrence here is noteworthy and probably indicative of the remoteness and good quality of the habitat at the site.

Stick insect: *Micrarchus* new species (Phasmidea)

Several specimens of a distinctive stick insect were found at 750-800 m on shrubs (see image below). This is an undescribed species that is known from the Paparoa Range north to Kahurangi National Park and east as far as Nelson Lakes (Thomas Buckley, Landcare

Research, Auckland, pers. comm., 2014). This species was not found by Mitchell Partnerships (2013).

Another example of a distinctive indigenous insect fauna inhabiting this upland habitat.

Plate 5: An undescribed species of stick insect found on shrubs (*Exocarpus* shown) at 750-800 m and also within the proposed mine footprint.

Large spider: *Uliodon* new species (Arachnida: Zoropsidae)

This very large spider (41 mm length) was found under rocks on the summit of the proposed mining area at Te Kuha, along with several smaller specimens. Although undescribed it is a known taxon which has a range from the Paparoa Range north to the Denniston Plateau (Cor Vink, Canterbury Museum, pers. comm., 2014*).* As such, it is another large-bodied species restricted to this region. This species was not found by Mitchell Partnerships (2013).

Stonefly: *Omanuperla bruningi* (Plecoptera: Notonemouridae)

A species of stonefly was found, endemic to the northwest sector of the South Island, south to the Paparoa Range. The larvae will inhabit the small streams that originate at Te Kuha. It is another example of a distinctive invertebrate fauna found in this part of New Zealand. This species was not found by Mitchell Partnerships (2013).

Land snail: *Rhytida* species (Mollusca)

A medium-sized (up to 15 mm diameter) snail species was found at 700 m within the proposed mine footprint (see image below). It was photographed and probably equates to the species found by one of the survey groups and recorded in Mitchell Partnerships (2013) as *Rhytida perampla*, a western South Island species.

Plates 6: *Rhytida perampla* landsnail found at 700 m within the mine footprint on a hand for scale.

Zig-zag moth: *Charixena iridoxa* (Lepidoptera: Glyphipterigidae)

Larval damage characteristic of this elegant moth species was commonly seen on *Astelia nervosa* in the forest and shrubland understorey between 700-800 m within the proposed mining footprint at Te Kuha. This species was not found by Mitchell Partnerships (2013).

The white larvae feed within the base of this large *Astelia* and they form an obvious zigzag marking on the elongating growing leaves of the host plant. When the larvae eventually pupate in a cavity of a forming leaf, they are then "transported" about one metre above ground where they later emerge as a purple and yellow day-flying adult.

This moth is widespread in the forests and just above treeline in the mountains of the main divide from Stewart Island to the centre of the North Island, and coastally in a few places along the eastern South Island.

Although widespread in suitable habitat along the Main Divide mountains, it is only found in natural habitat, and only in abundance in high quality natural habitat.

Plate 7: The characteristic mine of the zig-zag moth on *Astelia nervosa* found commonly within forest and shrubland within the mine footprint.

Astelia leaf roller: *Donacostola notabilis* (Lepidoptera: Depressariidae)

This large pale species (wingspan 34 mm) is another specialist feeder on *Astelia nervosa*, where its green larvae bind the leaves together with silk and feed on the leaves from within this protective home. It was found in the upper forested area of the proposed mine site at about 680-750 m. Although sign of the species on *Astelia* is widespread in the montane areas of the main divide from Fiordland to Northwest Nelson the adults are seldom seen. This species was not found by Mitchell Partnerships (2013).

This is another species that, although widespread in the western South Island and not threatened, is typical of high quality indigenous habitat and a distinctive endemic element of such places.

Other moths (Lepidoptera) found:

Two flax moths *Orthoclydon praefectata* (Geometridae) and *Tmetolophota steropastis* (Noctuidae) with larvae on flax are widespread at Te Kuha. Neither species was found by Mitchell Partnerships (2013).

- *Ctenopseustis obliquana* (Tortricidae) was found on a newly recorded host plant. In the mine site, bright green larvae were found feeding on the localised *Exocarpus bidwillii* on the summit of the proposed mine footprint.

- The geometrid *Declana floccosa* was found here as larvae and adults. It is a very widespread species with polyphagous larvae on various trees and shrub species.

An elegant tiny leaf mining moth *Acrocercops panacitorsens* (Gracillariidae) was recorded mining the leaves of *Pseudopanax colensoi* at 700 m. Although it has a widespread distribution, the species is seldom seen. This species was not found by Mitchell Partnerships (2013).

DISCUSSION

This suite of indigenous invertebrate species, the result of a short-duration survey to the proposed mine site, is indicative of a species-rich invertebrate fauna at the site. Only one of the above species appears to have been recorded by Mitchell Partnerships (2013). The fauna assemblage clearly reflects a highly natural and remote site. The invertebrates exhibit many of the characteristics of the New Zealand fauna overall in terms of large body size (*Uliodon* spider), flightlessness in groups that are winged worldwide (*Micrarchus* stick insect), and bizarre life-histories (zig-zag moth). This site and its invertebrate assemblage are typical of ancient New Zealand with elements of the northwestern South Island's endemic species combined with more widespread species. Sites like this are increasingly rare as developments modify, reduce, and eliminate such habitats.

With so many large-bodied flightless species, the invertebrate fauna assemblage is effectively immobile. It 'moves' about the habitable landscape at geological pace, with no ability to recolonise in our timeframes in what we consider to be suitable rehabilitated sites. Each species would need to be reintroduced separately once stable, mature and suitable habitat became available.

At present we know very little about what constitutes "suitable habitat" for these specialised species. Prior to any reintroduction, living collections would have to be made and maintained of each species to ensure that a population was available to reintroduce at a later date. Again our understanding of life histories and ecology are far too limited to attempt this. As can be seen from the invertebrate list above, many of the species are not yet described, let alone having had their life histories and ecologies studied and understood.

The proposed coal mine site at Te Kuha is clearly ecologically significant in terms of its indigenous invertebrate fauna, even based on limited data from a short-duration survey. The character suite of species reflects the remoteness, habitat character, naturalness, and geographical position of the site. It is important from a biodiversity, biogeographic, conservation and scientific perspective for the following reasons:

- Biodiversity: invertebrate richness over many unrelated groups exhibiting a range of different life histories and ecological preferences.
- Biogeography: a suite of species endemic to the northwestern region of the South Island mixed with more widespread species. The mix of species is distinctive in a New Zealand context and probably typical of this region
- Conservation: one At Risk-Relict butterfly and a proposed at risk declining beetle are present here in significant numbers. The site is significant for the conservation of these species being remote, sustainable and with a high degree of naturalness
- Scientific: given the number of undescribed species found here in all the recent surveys it is likely that Te Kuha will become the type locality for several species once they are formally described. The type locality, type populations, and type specimens (Holotype and Paratypes) are hugely important in defining a species and therefore in defining a place also. A type specimen stored in a museum, being dead and often deformed, can only provide limited information about a species. The type population at the type locality with all its individual variation, including the identity of the opposite sex, life history, and ecology, tell so much more. The ongoing conservation of the type population is vital for knowing and understanding the species. Strictly speaking a "species name" can only be confidently associated with the population at the Type Locality, and specimens from other localities need to be compared to that from the Type Locality and an opinion passed on whether they are indeed the same species.

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