Attachment D

Draft Aquatic Ecology Report

August 2013

REPORT

TE KUHA MINE

Assessment of Aquatic Ecosystems for Access Agreement

Submitted to:
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Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

Te Kuha Development Te Kuha Limited Partnership (TKLP) is the owner of Rangitira Developments Limited that in turns owns Mining Permit 41-289. This Mining Permit covers an area of 860 ha approximately 12 km south east of Westport and is known as the Te Kuha Development. TKLP is a limited partnership between Stevenson Group Limited (Stevenson) and Wi Pere Holdings Limited (Wi Pere), who together are considering all of the options in relation to the development of a coal mine within the Mining Permit area

Stevenson, as the project operator is seeking to obtain all necessary project approvals for the Te Kuha Mine Operation, including land access agreements and resource consents.

1.2 Project Background

The Te Kuha Project, and associated Te Kuha coal deposit is located on the top of the Paparoa Ranges, approximately 12 km south east of Westport. The Te Kuha Deposit is predominantly located on an area of Buller District Council (BDC) Water Conservation Reserve with a small area (approximately 13 ha) located on Department of Conservation (DOC) 'stewardship' land.

In 2010 Stevenson and Rangitira entered into a limited partnership to undertake further exploration of the Te Kuha Deposit, which resulted in an analysis of geology, mine planning, surveying and resource management activities. In 2012 a detailed drilling programme and geological resource modelling work was carried out to establish and confirm the quality of the coal resources.

The coal resources on the Mining Permit area have been identify as an upper coal measure of the Brunner Coal measures that is also mined on the Denniston and Stockton mine sites. A lower (deeper) coal measure is also present and has been identified as part of the Paparoa Coal Measure that is currently mined in the Paparoa Ranges near to Greymouth.

1.3 Scope of Report

The purpose of this report is to provide baseline information in relation to the pre-mining aquatic habitat, flora and fauna present at the Te Kuha site. Accordingly, this report[1] details the initial aquatic survey investigation conducted on the proposed coal mine site and for aquatic habitats crossed by the proposed haul road. The data collected is then assessed for the purposes of providing advice for land access agreements with Buller District council and the Department of Conservation (DOC). Later, the information will inform the Environmental Impact Assessment document planned for application for resource consents under the Resource Management Act 1991.

This report describes the aquatic ecological values present at the proposed Te Kuha Mine as follows:

- Habitat – description of the instream habitat, substrate, stream channel, streambanks and riparian vegetation cover).
- Aquatic invertebrates – description of the aquatic invertebrate communities present based on standard stream sampling techniques. Indicators compiled from aquatic invertebrate data were also used to describe instream water quality and stream health.
- Fish – description of the fish communities present based on standard fish sampling techniques. Species present, population structure and conservation status provide information on conservation values.
- Aquatic flora - description of the aquatic flora where there was prominent presence of algae and/or macrophytes.
- Description of measures that could be taken to avoid and/or mitigate effects on the ecology of the area caused by the proposed opencast coal mining and construction of the new haul road.

[1] This report is subject to the limitation in Appendix A.

2.0 METHODS

2.1 Survey Sites

Thirteen aquatic survey sites were visited on the 11-13 March 2013. This sampling period coincided with a significant drought on the West Coast and the survey results below reflect aquatic communities at low or very low flow conditions.

The sites ranged from the water courses and tarn in or close to the Mining Permit area (site 1-5) to sites along the proposed Haul Road (site 6-11) and two sites downstream of all proposed works (Site 12-13) on the two major water courses (Coal Creek and West Creek) draining the proposed mine area (Figure 1).

2.2 Water Quality

Spot measurements of pH, and electrical conductivity (mS/cm) were measured at each site during the 11-13 March 2013 ecological survey using a calibrated hand held YSI Pro Plus multi-meter. Water physicochemistry data collected in the field was supplemented with water quality data supplied by CRL Energy Ltd for the majority of sampling sites on the haul road and on the upper mountain.

2.3 Aquatic and Riparian Habitat

General in-stream and riparian habitat characteristics (stream depth, stream width, streambed substrate composition, type of riparian vegetation, percent shading, bank erosion and macrophyte cover) were recorded at each site using general methods described in the national protocols of Harding et al. (2009). Photographs were taken at each sampling site and included photographs of the streambed where possible.

2.4 Aquatic Flora

Periphyton streambed cover was assessed at each site and compared with recommended New Zealand periphyton guideline values presented in (Biggs 2000). The type (thin film, mat, filamentous) and colour (green, brown, reddish) of the periphyton present was also assessed.

The species and abundance of macrophytes at each sample site was recorded.

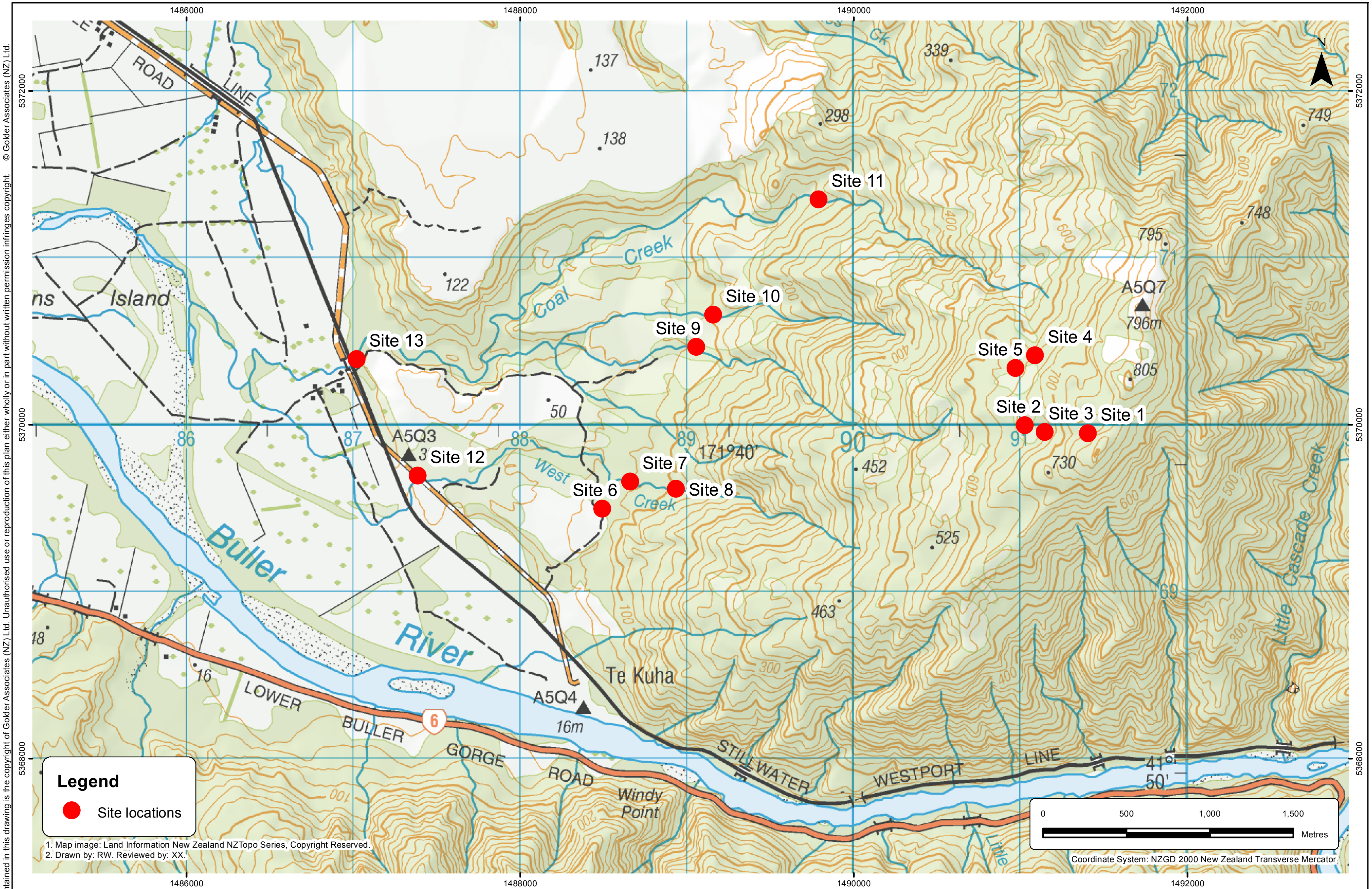
2.5 Benthic Invertebrates

Benthic macroinvertebrate communities were sampled by following the hard-bottomed semi-quantitative Protocol C2 methodology outlined in Stark et al. (2001). A single kick-net sample (0.5 mm mesh and 3 m^2 area) was collected from riffle and run habitat at each sampling site. All samples were preserved in 70 % ethanol and processed using Protocol P2 (200 fixed count plus scan for rare taxa) (Stark et al. 2001) and identified a level suitable for calculating the indices described below using the keys of Winterbourn et al. (2006). With the exception of Site 5 (the dry tarn) macroinvertebrates were sampled from all sites.

The following biological metrics and indices were calculated from invertebrate community data to provide an indication of stream health:

Community composition: – relative abundance of the major macroinvertebrate groups within communities (e.g., Ephemeroptera, Trichoptera, Diptera, Mollusca, Crustacea, and Oligochaeta).

Taxa richness: – a measure of the number of macroinvertebrate taxa recorded from each sample. Streams supporting high numbers of taxa generally indicate healthy communities however interpretation is dependent on the pollution sensitivity or tolerance of the taxa recorded.



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TITLE SITE LOCATION MAP

AUGUST 2013

PROJECT 1378205093

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Total abundance: – a measure of the total number of individuals in a sample. The total number of invertebrates tends to increase in the presence of organic enrichment but declines in the presence of toxic pollution. The number of individuals is a useful measure for comparison between sites but can be highly variable.

EPT taxa richness: – EPT refers to taxa belonging to Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) groups. EPT taxa are generally sensitive to changes in water and habitat quality. The caddisflies *Oxyethira* and *Paroxyethira* are not considered sensitive to pollution and excluded from the calculation of EPT taxa number values. High EPT values suggest high water and habitat quality, while low values are indicative of low water and habitat quality.

MCI and QMCI scores: - The Macroinvertebrate Community Index (MCI) and Quantitative MCI (QMCI) (Stark 1985). For the MCI and QMCI, invertebrate taxa are assigned scores from 1 to 10 based on their tolerance to organic pollution. Higher scoring taxa (e.g., many EPT taxa) are the least tolerant to organic pollution. The MCI is based on presence-absence data whereby scores are summed for each taxon in a sample, divided by the total number of taxa collected, and multiplied by a scaling factor of 20. The QMCI requires either total counts or percentage abundance data whereby MCI indicator scores are multiplied by abundance for each taxon, summed for each sample, then divided by total invertebrate abundance for each sample. The interpretation of MCI and QMCI values is outlined in Table 1.

Table 1: Interpretation of MCI, QMCI, scores for stony streams.

Water quality class	Description	MCI	QMCI
Excellent	Clean water	>120	>6
Good	Doubtful quality or possible mild degradation	100 - 120	5 – 6
Fair	Probable moderate degradation	80 – 100	4 – 5
Poor	Probable severe degradation	<80	<4

Note: Water quality classes after Stark & Maxted (2007) and descriptions after Stark (1998).

2.6 Fish sampling

Fish sampling was undertaken using a NIWA EFM300 electric fishing machine (EFM). Each survey reach was sampled using a single electric fishing pass. Where stream beds were flowing and access allowed then at least 100 m of stream was sampled. All habitat types, pool, runs, riffles and backwater etc were sampled when present.

All fish captured where retained until fishing was complete. Fish that escaped while fishing were noted when these could be identified even when not caught. Fish captured were identified to species level and measured before being released back into the sampling reach.

Additional fisheries data was sourced from the New Zealand Freshwater Fish Database (NZFFD) search for records in Coal Creek and West Creek in April 2013.

3.0 AQUATIC ECOSYSTEMS, FLORA AND FAUNA

3.1 Stream Types

The hilltop sites varied from dry stream areas where drought conditions had led to complete drying of the streams through to 0.5 m wide small streams. All were fully or partially shaded generally by short stature manuaka scrub although Site 3 was in taller mature forest.

The streams all have high gradient reaches where they descend from the flatter mountain top to the terraces at the mountain bottom. These steep sections, when visible from above, show the streams are composed of steep bedrock boulder sections with obvious signs of erosion. It is expected that in the areas with good canopy cover stream erosion is less likely but the steep nature of the streams will continue to provide cascade and plunge pool type habitats.

Below 200 m altitude the stream gradients decrease and the sites along the lower section of the Haul Road are in areas were pool riffle and run habitats are present. Coal Creek (Site 11) was notable in that this site was still steep enough that the stream had step pool structures (Figure 2). Shading was variable with smaller streams (< 1 m wide) well shaded, but wider reaches with wide but not necessarily wet stream beds (> 4 m wide) being partially unshaded (e.g., lower Coal Creek, Site 13, Figure 3). The un-named stream (Site 6) and other small streams draining the mountain front (as opposed to the mountain top) were all small (<1 m wide) and at the time of the survey dry or reduced to remnant pools and/or short intermittent flowing sections (Figure 4).

The lower reaches of Coal Creek appeared fenced from stock at Site 13 and the riparian zone was well protected. Stock access was possible to West Creek at the Nine Mile Road ford and at a farm track crossing between Site 7 and 12.

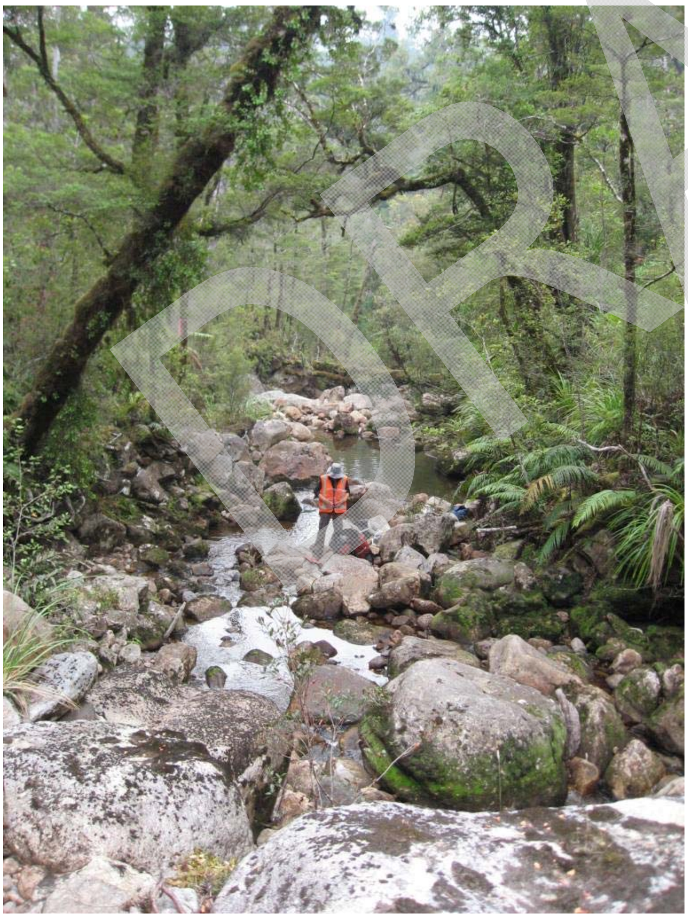

Figure 2: Coal Creek (Site 11) at the lower Haul Road crossing point.

Figure 3: Coal Creek (Site 13) upstream of Nine Mile Road.

Figure 4: The nearly dry stream bed un-named Stream (Site 6), sampling in the background occurring in a remnant pool.

The stream at Site 10 had large accumulations of orange coloured floc on the stream bed (Figure 5). Given the low flow conditions in the months prior to the survey this may have accumulated over some time. However, no other stream had this orange floc so it was considered a stream specific issue. It was also noted that the water at Site 9 was a gray colour that the survey team also noted as unusual.

Figure 5: Coal Creek tributary, Site 10, with orange floc accumulation on stream bed.

3.2 Water Quality

Stream water pH at sites sampled ranged from being acidic (pH 4.6) to 6.4 (Figure 6). The four least acidic sites were all sites in the lower Coal Creek or its tributaries. West Creek and the upper mountain sites had the more acidic water with Site 3 in particular having an acidity that is likely to limit the aquatic fauna and flora present.

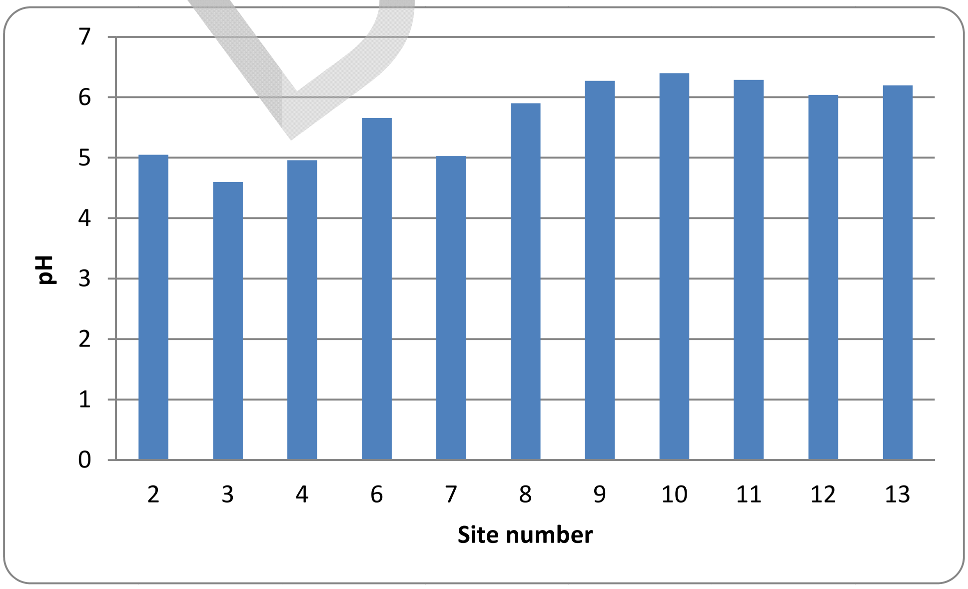

Figure 6: pH at sampling sites at Te Kahu with flowing water.

Conductivity in the flowing streams on the mountain top was low in the order of 10 -25 µS/cm. Conductivity increased downstream with conductivity at the majority of the sites in the lower reaches being between 30-40 µS/cm (Figure 7). Three sites, Sites 9, 10, and 13, had relatively high conductivity and the upper two sites, as noted above, had water colour or stream bed anomalies.

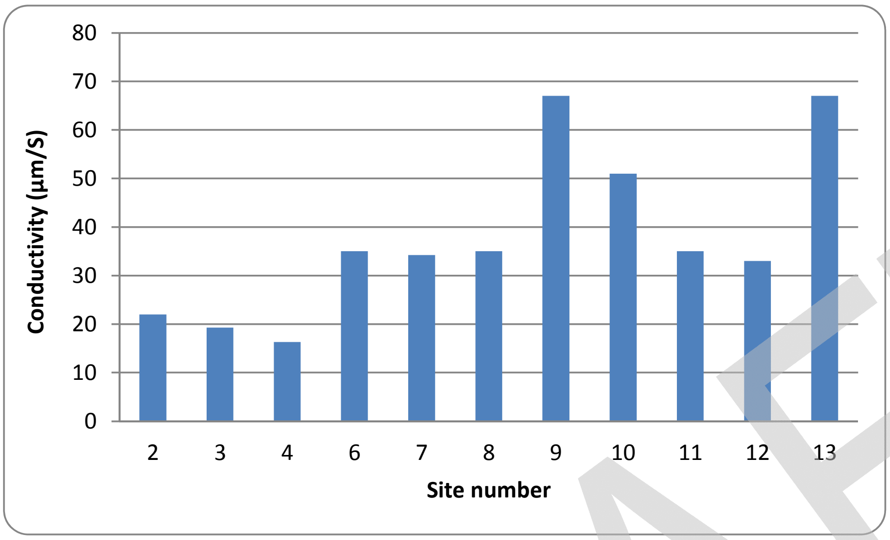

Figure 7: Conductivity at samples sites at Te Kahu with flowing water.

Water quality has been further sampled and analysed (incl. laboratory analysis) by CRL. Results to date confirm the results of the instream water quality meter results above.

3.3 Flora

No macrophytes were observed at any of the stream survey sites. Bryophytes were present at the upper mountain sites (Sites 1-3). Stream bed coverage was low with 2-10 % of the bed covered by bryophytes. At the time of the site visit the dry bed of the tarn was covered in an introduced rush (*Juncus bulbosus*). (Figure 8).

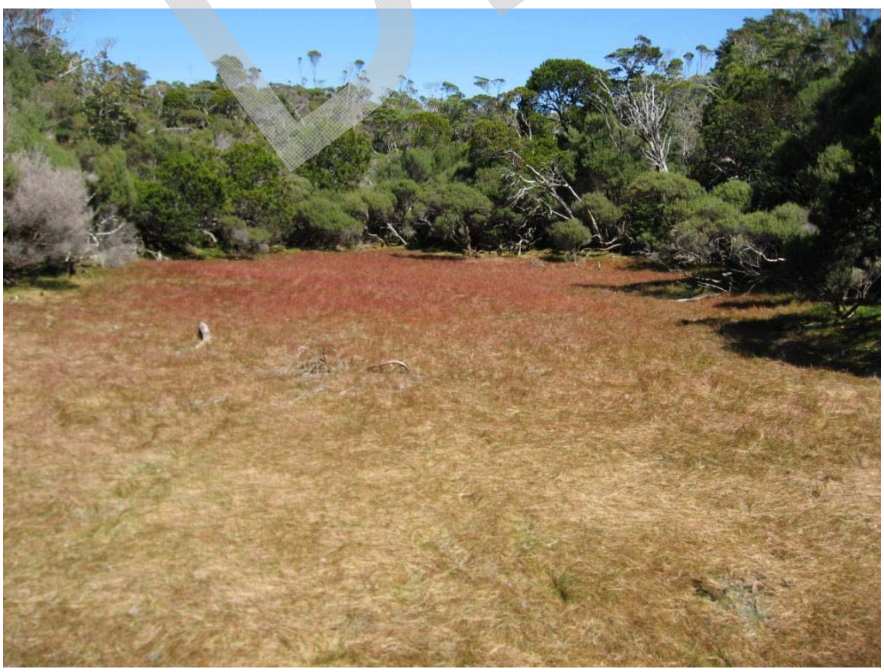

Figure 8: The dry tarn (Site 5) on the upper mountain slopes.

3.4 Macroinvertebrates

3.4.1 Taxa richness and abundance

Taxa richness varied among the sites from 5 (Site 1) to 31 (Site 7) taxa present at a site (Figure 9). Site 1 was remnant pools in an otherwise dry water course on the upper mountain and a full 3 m^2 sample was not collected. This site had few individuals and few taxa and these are likely to be hardy species that could tolerate the still water drought conditions. As such this sample should be treated with caution as it may not represent the community present in more normal flow conditions. Sites 2 to 4 on the upper mountain had flowing sections and supported more diverse invertebrate populations. On the lower mountain slopes along the Haul Road route Site 10 on a Coal Creek tributary was notable for its relatively low invertebrate diversity (10 taxa)..

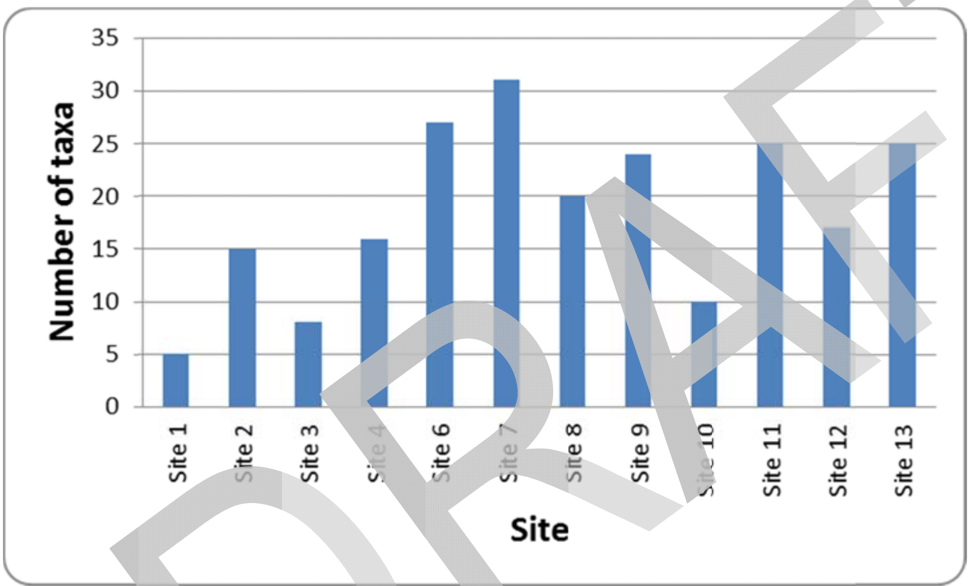

Figure 9: Macroinvertebrate taxa richness (excluding koura) at sample sites at Te Kahu.

Macroinvertebrate abundance was low at all the upper mountain sites with between 17 and 68 individuals present in the samples. There was an increase in invertebrate abundance in a downstream direct with the lower mountain samples (Sites 6-11) having between 132-279 individuals. The two most downstream sites had 248 and 318 individuals (Figure 10). Site 10 with 138 individuals had the lowest macroinvertebrate abundance on the lower mountain.

3.4.2 Biological indicators

Site 1 and Site 10 had lower numbers of EPT taxa than other adjacent sites (Figure 11) whilst %EPT was lowest at sites 1, 12 and 13 (Figure 12).

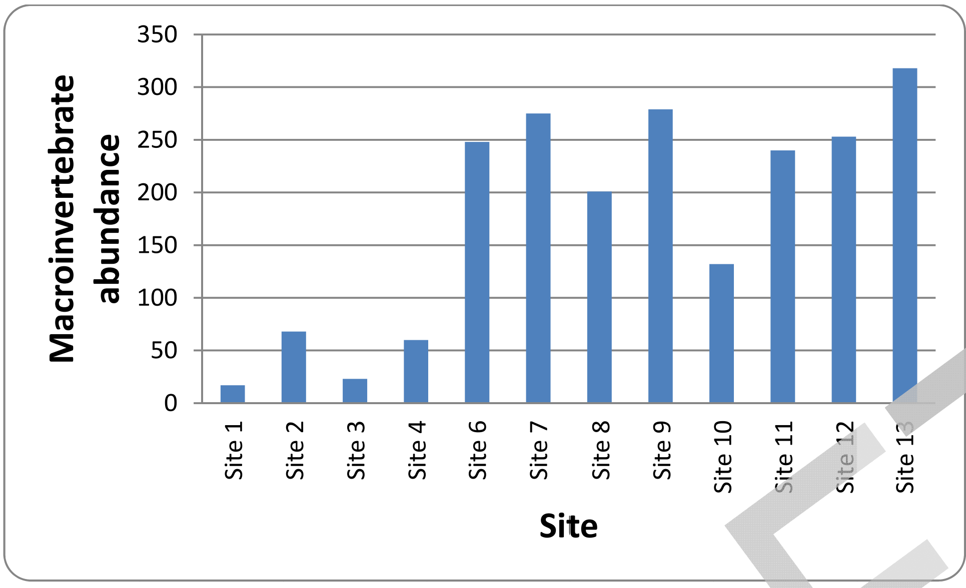

Figure 10: Macroinvertebrate abundance (excluding koura) at sample sites at Te Kahu.

Figure 11: EPT macroinvertebrate taxa richness at sample sites at Te Kahu.

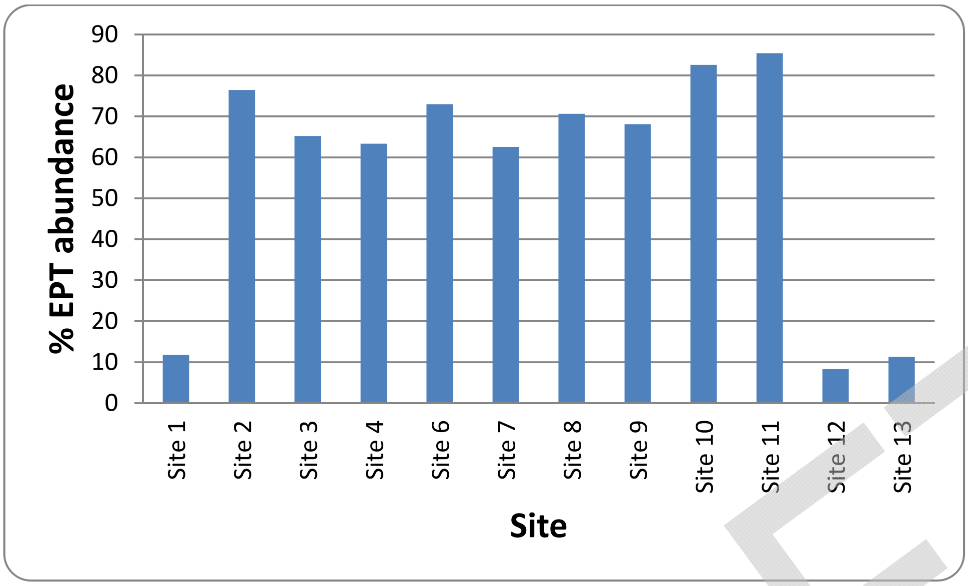

Figure 12: % EPT macroinvertebrate abundance at sample sites at Te Kahu.

The MCI scores for the majority of sites indicate excellent water and/or habitat quality (Figure 13). Site 1 has a low MCI score that is due to the limited number of taxa surviving in the remnant pools. The MCI for Site 10 indicated lowered water quality and Site 12 and 13 are also lower possibly due to the effects of agricultural runoff.

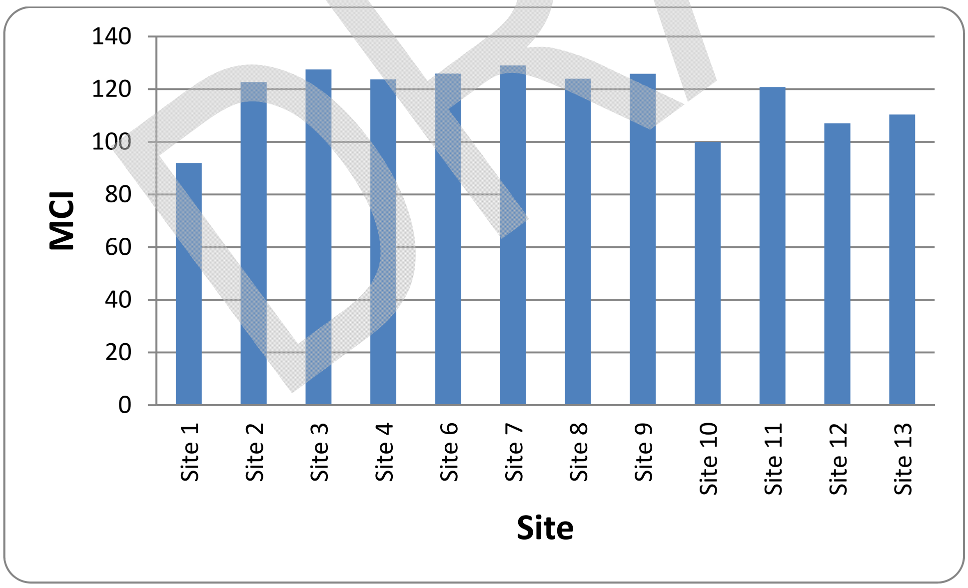

Figure 13: MCI at sample sites at Te Kahu.

The QMCI scores, like the MCI scores indicate lower water and/or habitat quality at Site 1. However, Sites 12 and 13 stand out as the sites with the lowest water quality whereas Site 10 has excellent water quality according to the QMCI score (Figure 14). The difference between the MCI and QMCI scores for Site 10 are due to the high abundance of *Deleatidium* mayflies which increases the QMCI relative to the MCI score.

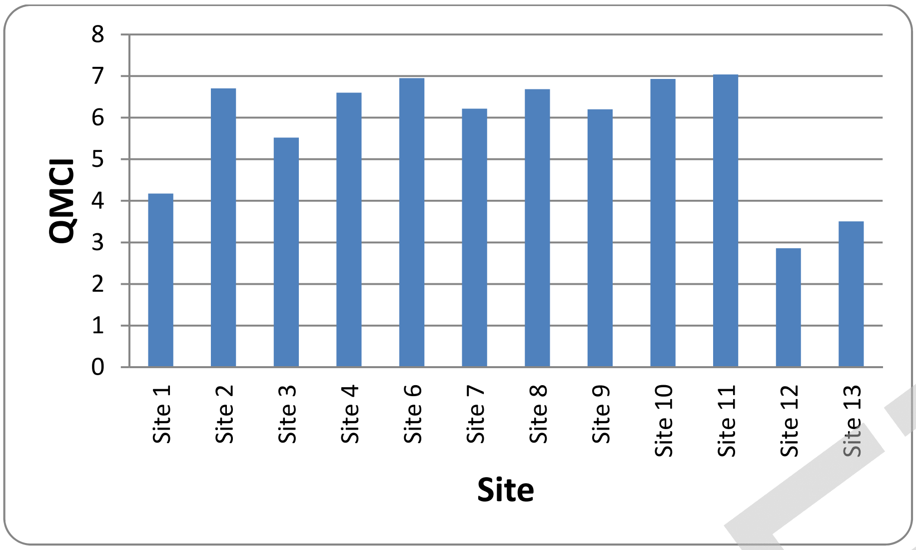

Figure 14: QMCI at sample sites at Te Kahu.

3.4.3 Freshwater crayfish (Koura)

Koura (freshwater crayfish) were located at sites on the upper mountain (Sites 2-5). This macroinvertebrate is of interest as it is classified by DOC as a species in *gradual decline* (Hitchmough et al. 2007).

Smaller streams on the upper mountain where commonly dry. Searches of the stream bed at these sites did locate koura bodies (Figure 15). The tarn on the upper mountain was also dry (Figure 8); however numerous burrows were observed around the margin of the tarn at or about what would most likely be the normal water level (Figure 16). Excavation of the one of these burrows located a live koura (total length 50 mm, Figure 17) at the bottom of the burrow amongst damp sand/fine gravel material. Further burrows were not excavated to avoid promoting more rapid desiccation of koura that had retreated to these damp refuges. The densities of burrows around the tarn edge indicated that a reasonably abundant population of koura was present at the tarn.

Figure 15: Koura remains found in the dry bed of a small stream (Site 4).

Figure 16: Koura found at the bottom of a burrow at the tarn edge.

Figure 17: A burrow at the edge of the dry tarn.

3.5 Fish

Eleven fish species (Table 2) were captured or observed at the 13 sampling sites. No fish were collected at the upper mountain sites (Sites 1-5). Six sites were sampled along the proposed haul road to the site. Fish were present at all six sites and consisted of longfin eel, redfin bully, koaro, banded kokopu, and shortjaw kokopu (Table 3). The maximum sizes of the redfin bully and whitebait species were all well under maximum sizes recorded nationally (McDowall 2000). All the species located were diadromous (migratory) species and juveniles were present at all sites indicating that recruitment is currently present for all these species. The six species present are all noted as capable climbing species and absence of less capable migratory species indicated that partial barriers or steep gradient sections are present downstream.

Two sites were fished in the lower reaches of West and Coal creeks (Site 12, 13). The fish fauna at the Coal Creek site included rare individuals of bluegill bully, torrentfish and common bully together with shortfin eels. All these species aside from the shortfin eel are migratory native fish that have limited ability to ascend steep sections of stream and cannot climb at all. Their presence in lower Coal Creek indicates relatively easy fish passage as far Site 13. NZFFD records also report torrentfish occur upstream of Site 13 in the reach up to Site 10.

Table 2: Fish species and their threat status collected at Te Kuha survey sites.

Fish species	Common name	Sites Occupied	Migratory	Threat status[2]
Anguilla australis	Shortfin eel	Site 13	Yes	Not threatened
Anguilla dieffenbachii	Longfin eel	Sites 7, 9, 10, 12, 13	Yes	Declining
Cheimarrichthys fosteri	Torrentfish	Site 13	Yes	Declining
Galaxias maculatus	Inanga	Site 13	Yes	Declining
Galaxias brevipinnis	Koaro	Sites 7, 8, 10-13	Yes	Declining
Galaxias fasciatus	Banded kokopu	Sites 6, 7, 9, 11, 12	Yes	Not threatened
Galaxias postvectis	Shortjaw kokopu	Sites 7, 8, 11, 12	Yes	Declining
Gobiomorphus cotidianus	Common bully	Site 13	Yes	Not threatened
Gobiomorphus hubbsi	Bluegill bully	Site 13	Yes	Declining
Gobiomorphus huttoni	Redfin bully	Sites 6-9, 12,13	Yes	Declining
Salmo trutta	Brown trout	Site 13	No	Introduced

[2] Allibone et al. (2010)

Table 3: Locations of fish species, number of fish and in brackets length range (mm).

Species	Sites												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
No fish	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-
Koura		✓	✓	✓	✓	-	-	-	-	-	-	-	-
Shortfin eel	-	-	-	-	-	-	-	#	-	-	-	1 (100)	-
Longfin eel	-	-	-	-	-	-	3 (197 -1000)	#	1 (600)	3 (141-400)	-	14 (110 -1000+)	5 (95 -320)
Torrentfish	-	-	-	-	-	-	-	-	-	-	-	-	1 (103)
Koaro	-	-	-	-	-	-	5 (50 -110)	4(55-145)	-	3 (84 -92)	2 (59 -77)	1 (70)	1 (60)
Banded kokopu	-	-	-	-	-	6 (55 -180)	6 (46 -131)	-	1 (110)	-	1 (143)	44(7-145)	-
Inanga*	-	-	-	-	-	-	-	-	-	-	-	-	✓
Shortjaw kokopu	-	-	-	-	-	-	1 (153)	2 (120-165)	-	-	1 (168)	2 (59 -107)	-
Common bully	-	-	-	-	-	-	-	-	-	-	-	-	1 (97)
Bluegill Bully	-	-	-	-	-	-	-	-	-	-	-	-	2 (33 -37)
Redfin bully	-	-	-	-	-	1 (88)	6 (52 -82)	2 (50 -85)	7 (40 -70)	-	-	49 (30-86)	21 (22 -65)
Brown trout	-	-	-	-	-	-	-	-	-	-	-	-	2 (81 -224)

* observed but not caught
# eels present but not caught and identified

A partial fish passage barrier was present in West Creek at Nine Mile Road and most likely further downstream as well. The road crossing is a ford with a vertical fall on the downstream side of the road (Figure 18). Erosion of the road is prevented by the placement of large boulders along the downstream side of the road ford at the base of the drop. When the site was fished juvenile redfin bullies were very common downstream of the road, but noticeable rarer on the upstream side. Furthermore, all of the fish species encountered up and downstream of Nine Mile Road in West Creek are known as climbing species, that can ascend steep slows and vertical surfaces. No poor climbing or swimming only native fish were present at this site indicating that a further barrier exists on West Creek between Nine Mile Road and the Buller River.

Figure 18: Partial fish passage barrier on West Creek at the Nine Mile Road ford.

3.6 Discussion and Summary

At the time of the survey the streams within the mine site where at very low flow or dry and the assessment of the aquatic community on the upper mountain was restricted to only limited reaches of water. The macroinvertebrate communities sampled on the upper mountain indicate that the streams have high water quality and support a range of invertebrate taxa including koura. No fish were located on the upper mountain and the small steep streams are unlikely to provide habitat for fish. The tarn, when water is present, may provide habitat for fish but there was no obvious outflow for migratory fish to enter the tarn. Therefore the tarn is considered to be habitat for invertebrate species only. Koura was the only macroinvertebrate on the upper mountain of conservation interest with a threat ranking of *gradual decline*.

The lower mountain streams along the Haul Road all support moderate density high quality invertebrate faunas and a range of migratory native fish. The fish and invertebrate densities did not appear high but the undisturbed riparian zones and lack of introduced aquatic species indicates these are intact, undisturbed streams of high value. Water quality data indicates that the Coal Creek tributaries are more conductive and that elevated iron and magnesium levels are present.

Downstream of the Haul Road, West Creek has a partial fish passage barrier and stock had access to the stream and stream banks at crossing sites. The impact of this passage barrier is unclear as the extent to which it restricts whitebait and elver passage is unknown and the age of the barrier is also uncertain.

Upstream fish communities are less abundant that that observed in some areas of the West Coast, but the low fish densities may also be the result of flood disturbances as the steep mid-reaches of West Creek have an unstable stream bed and eroding stream banks and riparian zone. In addition, stock access was possible to areas of West Creek from the ford on Nine Mile Road and from a farm track crossing. Storm water runoff from Nine Mile Road (a gravel road) and the farm tracks is also expected to add suspended sediments to the stream reducing the downstream habitat quality. Therefore, the decline in QMCI observed in West Creek at Nine Mile Road is expected to be related to the impacts of agriculture and roading.

The only modification observed to the lower reaches of Coal Creek (above Nine Mile Road) was the presence of brown trout. The macroinvertebrate indices do indicate a decline in water quality or habitat quality at Nine Mile Road when compared to the lower and upper mountain sites. However, on site observation found the stream was well fenced with no ability for stock to access the stream banks and stream. The cause of the decline in the QMCI for the lower section of Coal Creek is not clear. It is possible that stock access and surface water runoff through the riparian zone occurs along some reaches between Sites 11 and 13.

4.0 POTENTIAL EFFECTS ON AQUATIC ECOSYSTEMS

4.1 Background

For the purposes of this assessment we have focused the assessment of effects on the requirements for access agreement to Department of Conservation land. The West Coast/Tai Poutini Conservancy Management Strategy 2010-2010 (Doc Undated) has the following policies with regard to access to Conservation Estate on the West coast for the purposes for mineral extraction.

1. *The Minister will consider each application for an access arrangement on a case-by-case basis, in accordance with the criteria set out in the relevant section (i.e. s61 or s61A and s61B) of the Crown Minerals Act 1991.*
2. *When assessing an application for an access arrangement for prospecting, exploration or mining, consideration should be given to (but not be limited to):*
   a) the significance of the conservation values present and the effect the proposal will have on those values;
   b) the adequacy and achievability of the proposed site rehabilitation work (see also Policy 3 below); and
   c) the adequacy or appropriateness of any compensation offered for access to the area (see also Policy 4 below).
3. *Appropriate site rehabilitation methods should be employed.*
4. *Compensation should be required when damage to, or destruction of, conservation values can not be avoided, remedied or mitigated and will be determined on a case-by-case basis.*
5. *Where ancillary activities such as roads and infrastructure can reasonably be located off public conservation land, this will be expected.*
6. *The term of any access arrangement should be limited to the period reasonably required to carry out the defined work, including site rehabilitation after mining has been completed.*
7. *Low-impact access options will be preferred (e.g. the use of existing formed roads, or helicopters in areas without existing roads).*
8. *Evidence that a valid minerals permit has been obtained from the mineral owner will be required before the Minister of Conservation will make a final decision on an application for an access arrangement or minimum impact activity.*
9. *The granting of an access arrangement for prospecting or exploration does not place any obligation on the Minister of Conservation to grant a subsequent access arrangement for mining, or to grant further variations to a pre-existing access arrangement.*
10. *If monitoring reveals that the effects of mining activities on conservation values and recreational opportunities, including the desired outcomes described in Part 4 of this CMS, are greater than expected, or new effects have been discovered, the Department should review the conditions of the access arrangement.*

11. *Approval of any work plan may be subject to the permit holder obtaining all other necessary authorisations, such as a concession permit for aircraft landings or a Wildlife Act permit.*
12. *Where the Crown Minerals Act 1991 makes provision for mining within national park land, any application for mining these areas will require consultation with the New Zealand Conservation Authority.*

With respect to the above policies and the aquatic ecosystems at the Te Kahu site policies 2, 3, 7 and 10 are considered relevant to the assessment of access.

4.2 Conservation Values

4.2.1 Aquatic communities

With the exception of sites 5 and 13, the freshwater communities sampled at all sites comprised native species with no introduced species. The presence of the introduced rush in the tarn (site 5) and brown trout at Site 13 were the only introduced species noted. The intact surrounding native vegetation at Sites 1-11 also meant the riparian margins of the streams and tarn are in a natural state. Therefore, all the streams in the project area on the upper mountain and along the lower section of the Haul Road can be considered to be in a natural state and are of conservation value. However, the diversity and abundance of fish and macroinvertebrates observed is not considered outstanding but rather within the normal range observed for unmodified streams on the West Coast. The impact of the natural existing acidic pH and metal inputs in some streams may also be limiting the aquatic communities.

Koura, a nationally threatened aquatic species is classified as in *gradual decline* (Hitchmough et al. 2007), was the only threatened aquatic species located on the upper mountain or immediately below the mine site. At the time of the survey the upper limit of koura was set by the dry stream beds and its presence in the mine area was limited to a single water course.

4.2.2 Fish

Four threatened fish (shortjaw kokopu, koaro, redfin bully and longfin eel), that are all classified as *at risk, declining*, (Allibone et al. 2010) were present in streams along the low altitude section of the proposed Haul Road. On the Department of Conservation estate, sampling was conducted along West Creek at two sites, both of which had the four threatened fish. In addition to threatened fish banded kokopu was also present in West Creek. As a general observation the numbers of shortjaw kokopu, banded kokopu, koaro and longfin eels was not high at the sites fished. In addition, no large individuals of the three whitebait species where captured. This would indicate that while the stream support these declining-ranked species the populations appear recruitment limited and large individuals are under-represented or absent from these populations. The presence of a partial fish passage barrier at Nine Mile Road maybe the cause of the recruit limitation but this is considered unlikely for these climbing whitebait species. The limitation maybe caused by periodic flood disturbances of the West Creek stream bed and associated fish mortalities.

Additional fish species, common bully, shortfin eel, bluegill bully and torrentfish were present at the sites along Nine Mile Road. The latter two species are also classified as *declining* (Allibone et al. 2010).

The upstream limit of fish in West and Coal creeks was not determined. The steep mid-reaches of West Creek appeared erosion prone (when observed from the air) and steep unstable stream reaches are likely to represent the upstream limits of fish. Flood related erosion creates disturbances that displace fish and cause mortalities. The steep stream sections also reduce upstream fish migration and provide little stable pool habitat that the majority of fish species present in the lower reaches require for adult habitat. Coal Creek and its tributaries also have steep mid-reach sections and similar limiting factors of erosion, excessive gradient and lack of pool habitat are likely to be present and restricting fish to habitats within the lower reaches. Therefore, given the steep nature of the streams and the lack of fish at the upper mountain Coal Creek sites it is not expected that native fish are present in the upper section of West Creek near the proposed mine footprint.

4.2.3 Stream condition

The two major Coal Creek tributaries, while in a natural state, had high water conductivity and elevated metal levels. This is considered to be a natural condition and the flora and fauna in these streams are therefore considered to be tolerant of these local conditions.

4.2.4 Rare Ecosystem Types

Ecological systems can be differentiated from another by one or more abiotic or biotic factors. Rare ecosystems are generally those that are small in size but maybe geographically restricted. Williams et al. (2007) lists tarns (small mountain lake) typically with a tussockland-sedgeland- cushionfield vegetation type as historically rare ecosystems. Small seepages were not specifically identified in the field survey but are likely to occur throughout the area, especially at times of high water table.

4.3 Potential Effects

4.3.1 Key impacts

The proposed Te Kuha Mine site is dissected by a network of small watercourses. Potential effects of the proposed Te Kuha Mine development on the aquatic environment may occur during the construction and operational phases of the mine. The key activities posing potential impacts to watercourses and associated values are:

- Loss of aquatic habitat.
- Developing stream crossings for the access haul route.
- Earthworks that lead to the addition of sediment to watercourses.
- Contaminant runoff from access roads, vehicle movements and other infrastructure.
- Potential modifications to downstream stream flows.

4.3.2 Effects on stream habitat, flora and fauna

The loss of the waterways within the mine footprint will result in the loss of the aquatic flora and fauna. As koura were widespread within the upper mountain streams, there is potential to lose large numbers of this threatened species in water courses that did not dry during the 2012-2013 summer. A koura rescue programme prior to any construction activity is recommended and an appropriate plan prepared. A koura recipient location(s) will need to be identified and permitted.

Dewatering of the mine site may result in modifications to flow regimes within Coal Creek and West Creek. The potential impact of modified flows and/or any spring or seepage inputs are unknown at the time of writing but the impact of flow modifications to west coast streams include:

- Potential reduction of stream habitat (minimisation in wetted area).
- Potential increase or reduction in baseflow.
- Increase in length of periods of lower flow.

4.3.3 Effects on ecosystem types

Small tarns will be removed by the mining activity, but the largest tarn lies outside of the mine footprint. The smaller tarns were not surveyed but might be expected to be habitat for koura which were evidently abundant in the larger tarn. A koura rescue programme prior to any construction activity is also recommended for any smaller tarns affected by the mine.

4.3.4 Effects of sediment addition

Sediment entering the streams at the mine site is a continuing natural process. The movement of sediment into local watercourses during the proposed mine construction and operational phases could give rise to adverse effects depending on the nature of downstream habitats. This can become suspended in stormwater, so any water discharged from the site can be considerably turbid, especially compared to natural waterways. There is the potential for a decline in water quality and the health of downstream aquatic ecosystems. In particular sediment generation can result in:

- Smothering and infilling of the streambed resulting in a loss of habitat for bottom dwelling organisms including periphyton (the food for grazing invertebrates); and thus the potential loss of food availability for fish and birds in some locations.
- Clogging and covering of the gills of invertebrates and fish reducing efficiency of oxygen uptake.
- Modified fish feeding behaviour.
- Cessation of interstitial flow which provides oxygenated water to fish eggs and larval fish.
- Smothering of aquatic plants resulting in loss of habitat for algae and benthic fauna.
- Reduced light penetration and visibility through the water column.

As the field survey was carried out during extreme low flow conditions, it was not possible to observe the streams at higher flows. However, the high intensity rainfall events typical of the West Coast suggests that the streams will rise and fall rapidly and sediment generation is rapidly mobilised downstream and is unlikely to cause significant impacts in upper mountain streams or the mid-reaches. The impact of sediment intrusion from the access haul route is discussed in section 4.5 below.

Suspended sediment loads in mine-waters can be reduced by the use of settling ponds. Settling ponds effect the removal of suspended sediment by reducing flow velocities, which results in heavier particles settling out of the water. Increased residence times, which are achieved by constructing larger ponds, enhance this removal process.

4.4 Site Rehabilitation

Rehabilitation of the mine sites will require the formation of drainage pathways (streams) on the upper mountain. It is expected that the rehabilitation of the upper reaches will include the construction of drainage pathways that reflect the existing drainage pathways as far as possible. Therefore the majority of rehabilitation will occur in the Coal Creek catchment and the creation of new stream habitat will also occur within this catchment. Accordingly, disturbance and rehabilitation of West Creek is expected to be limited to a small area in the upper reaches.

At the time of the streams survey for this report the natural streams in the proposed mine area were generally dry and the aquatic fauna would have been quite restricted in extent. It can be expected that the aquatic insect fauna will re-establish as winged adults migrate upstream to lay eggs and recolonise the dry reaches when wetted. In a similar fashion it can be expected that new stream courses created during site rehabilitation will be colonised by insects. Streams that are adjacent to the mine area will provide a good source of colonists for the winged insect species. For less mobile fauna, e.g., koura, recolonisation of the dry stream beds and/or new stream courses will be slow. However, it is possible as part of the site rehabilitation that less mobile fauna can be reintroduced to the site streams, perhaps from the koura recipient location. It is expected that site rehabilitation will include riparian planting to restore shade to the stream courses in the mine area and this will provide habitat for adult aquatic insects and promote the establishment of the pre-mine aquatic fauna.

A key aspect of the rehabilitation is the management of any acid mine drainage originating from the mine site. Currently water courses in the upper mountain have an acidic pH and it has been noted that some New Zealand stream invertebrates are well adapted to living acidic environments (Winterbourn 1988) and rehabilitation should seek to retain this habitat. Therefore rehabilitation should seek to maintain the water quality at pHs similar to those currently observed.

4.5 Site Access

Access to the proposed mine site will be via the Haul Road that ascends from Te Kahu to the mine area. The proposed road crosses West Creek, Coal Creek, three Coal Creek tributaries and several smaller unmarked streams. All the streams fished along the haul road route had migratory fish present in them. Therefore, the key aquatic issue for site access is maintaining fish passage at all stream crossings along the lower section of the haul before it ascends the ridge line to the north of Coal Creek. It is expected that bridges will be used for the large water courses along the Haul Road and as such fish passage will not be impeded.

Where culverts occur in permanent waterways the potential effects are:

- Physical disturbance to the waterway during construction and placing of the culvert in the streambed.
- Scour and sediment intrusion downstream of the culvert as water velocities increase at the outlet.
- Prevention of upstream passage for migratory fish and other aquatic organisms between upstream and downstream sections of the waterway.

For smaller streams that may be culverted more care is required in the design; placement and monitoring of fish passage at this crossing. Recent advances in fish passage mitigation at culverts with the placement of mussel spat ropes through the culverts (David et al. 2009, David & Hamer 2012) have provided good methods to managing fish passage at culverts. This method facilitates the passage of climbing species and in non-perch culverts also the passage of swimming fish species (B. David pers com.) therefore, it is expected that fish passage can be maintained to all sites upstream of the Haul Road utilising good designs and passage enhancement techniques such as mussel spat ropes.

It is expected that the Haul Road will create a source of suspended sediment to the lower mountain water courses. Runoff from the majority of the Haul Road can be controlled and channelled to stormwater treatment soak pits. It is likely that small sections of road close to the stream crossings and the bridges themselves will create sources of suspended sediment. The lower reaches of West Creek are already subject to some suspended sediment runoff and the Haul Road will add one additional crossing. For Coal Creek several stream crossings will occur in this catchment and there will be an increase suspended sediments inputs. However, as these sediment inputs will generally occur during rainfall events it is expected that the majority of fine sediment will be flushed downstream and will not accumulate on the stream beds in the areas of high quality habitat. This effect can also be minimised with storm water cut-off drains that direct storm water away from the crossing points

4.6 Monitoring Aquatic Effects

The effects of the proposed mine can be monitored with water quality and aquatic flora and fauna monitoring at sites on the mine boundary and the Haul Road. Key aspects to monitor for are water quality including the presence of acid mine drainage and suspended sediment deposition and additional monitoring on to detect any associated reduction in the stream flora and fauna. Established biomonitoring methods are available to monitor these parameters and data collected for this report provides some initial baseline information. Fisheries and fish passage monitoring is required for stream crossings along the Haul Road to ensure fish passage and the upstream populations are maintained.

5.0 SUMMARY

The streams on the proposed mine site are small clean acidic water streams. Stream acidity declines in a downstream direction to levels below a pH of 6 on the lower slopes. Two tributaries of Coal Creek had relatively high conductivities and water quality analyses indicated high iron and magnesium levels in these streams.

The dry weather condition in autumn 2013 reduced sampling opportunities. However, the assessment found low diversity macroinvertebrate communities were present at or adjacent to the mining area. No fish were found nor are expected to be present on the upper mountain or adjacent to the proposed mine area. The tarn on the upper mountain provides should provide good habitat (when wet) for koura although the current abundance of koura in the tarn is unknown.

The lower mountain streams crossed by the Haul Road are more diverse in size and included small ephemeral streams through to large 10 m wide water courses. All sampled sites had diverse macroinvertebrate faunas and a suite of up to five native fish present. All the native fish were migratory species that require upstream and downstream fish passage. In addition, all but one of the native fish present are classified as *declining*.

All streams on the upper mountain and along the Haul Road had unmodified riparian margins composed predominately of native vegetation. Stream bed substrates were dominated by boulder, cobbles and gravels and provided good habitat for fish and invertebrates.

Therefore, the streams can be considered unmodified, but the instream fauna on the upper mountain maybe limited by the acidic environment. The high conductivity in streams on the lower mountain also indicates there are natural dissolved ion inputs to the streams. The stream in general support good to high quality invertebrate and fish faunas

The proposed mining will remove the headwaters of Coal Creek tributaries and West Creek. These streams at the time of sampling were either dry or in very low condition but from data available supported macroinvertebrate populations only. Other effects associated with access to the site will occur on the haul road but fish passage can be maintained to upstream areas and suspended sediment input managed with appropriate storm water management.

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APPENDIX A

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