September 2014

TE KUHA

Assessment of Aquatic Ecosystems for Access Agreement

Submitted to:
Stevenson Mining Te Kuha Limited
Private Bag 94000
Manukau City
Auckland
New Zealand

Report Number: 1378205208-001-R-RevB

REPORT

Golder Associates

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 of the 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. An assessment of the actual and potential effects of the construction and operation of the proposed coal mine and associated haul road and facilities is then provided along with options for any impact management. Accordingly, the report will support an application for the application for resource consents under the Resource Management Act 1991.

In this report we describe the aquatic ecological values present at the proposed Te Kuha Mine as follows:

- Habitat – description of the instream habitat, substrate, stream channel, stream banks 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.

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

- Aquatic flora - description of the aquatic flora where there was prominent presence of algae and/or macrophytes.

Following the description of the baseline aquatic information the proposed activity (construction and operation of the proposed mine site and the associated facilities and haul road) is outlined. This is followed by:

- A description of the actual and potential effects of the proposed activities associated with the construction and operation of the construction and operation of the proposed mine site and the associated facilities and haul road.
- A description of measures that could be taken to avoid, remedy and/or mitigate effects on the aquatic ecology and the ecological values of the area caused by the proposed opencast coal mining and construction of the new haul road.
- A brief outline of proposed rehabilitation of the site following completion of mining operations at the site.
- Proposed resource consent conditions.

2.0 PROPOSED MINING ACTIVITY AND METHODS

Mining Permit 41289 covers an area of approximately 860 ha, with the total mine footprint expected to be approximately 70 ha in area. The coal resource is mostly located within the BDC Water Conservation Land and the DOC Stewardship Land. Access to the site would be via a proposed access road which would be approximately 9 km in length. The road would be constructed to a standard capable of carrying road trucks and would be irrigated for dust suppression. It is highly likely that a coal washing, processing, stockpiling and rail siding facility would be constructed at the bottom of the hill on land owned by SML. The nature and scale of these facilities is still to be determined. It is expected that the mine will operate as a ‘truck and shovel’ operation.

Opencast mining methods would be utilised, including the stripping and stockpiling of soil and vegetation, with material to be classified for dumping, or capping material depending on its acid producing potential. The mine will operate with a pre-strip, active face and backfill operation. Wherever possible the disturbed land will be kept to a minimum and final rehabilitated landforms will be constructed on a progressive basis. Once the mine is established rehabilitation will advance at the same rate as mining so that the disturbed area is relatively constant throughout the mine life and is kept to a minimum at all times.

It is estimated that annual tonnage of coal extracted from the site would be between 100,000 – 300,000 tonnes per year while overburden would be between 800,000 and 2.4 million BCM per year. The anticipated life of the mine will be 10 - 25 years.

Mined coal will be trucked to a handling and washing facility for optimising coal properties and value. At this site the coal will be blended and loaded onto truck or rail load out facilities. Preliminary washability testing indicates that there could be three products from this mine:

- A premium product for which the specifications will depend on the marked requirements.
- A lower quality (higher ash ~5 - 15 %) product two that still might be exportable.
- And a high ash (>15 %) product that is likely to be a thermal coal.

At the current time it is preferred to construct a rail siding at the base of the hill and transport product via rail to Lyttelton for export, however all transportation options will be considered as part of detailed mine planning.

3.0 METHODS

3.1 Survey Sites

Thirteen aquatic survey sites were visited on the 11 - 13 March 2013 and a selection of sites were re-visited on the 3 December 2013. The March 2013 sampling period coincided with a significant drought on the West Coast and the lack of flowing water in some stream sites necessitated a further visit to confirm some of the findings (i.e., December 2013). In particular, the December 2013 site visit was planned to confirm the conclusions from the earlier fish surveys. For the most part our report refers to the March 2013 visit with confirmatory detail from the December 2013 site visits only applied as relevant.

The sites visited and sampled were water courses and the tarn in or close to the Mining Permit area (site 1 - 5), 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). The additional sites sampled in December 2013 were one site in Coal Creek (CC1) and four sites within West Creek.

3.2 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 has been supplemented by water quality data collected by CRL Energy Ltd. for the majority of sampling sites on the haul road and on the upper mountain ranges.

3.3 Aquatic and Riparian Habitat

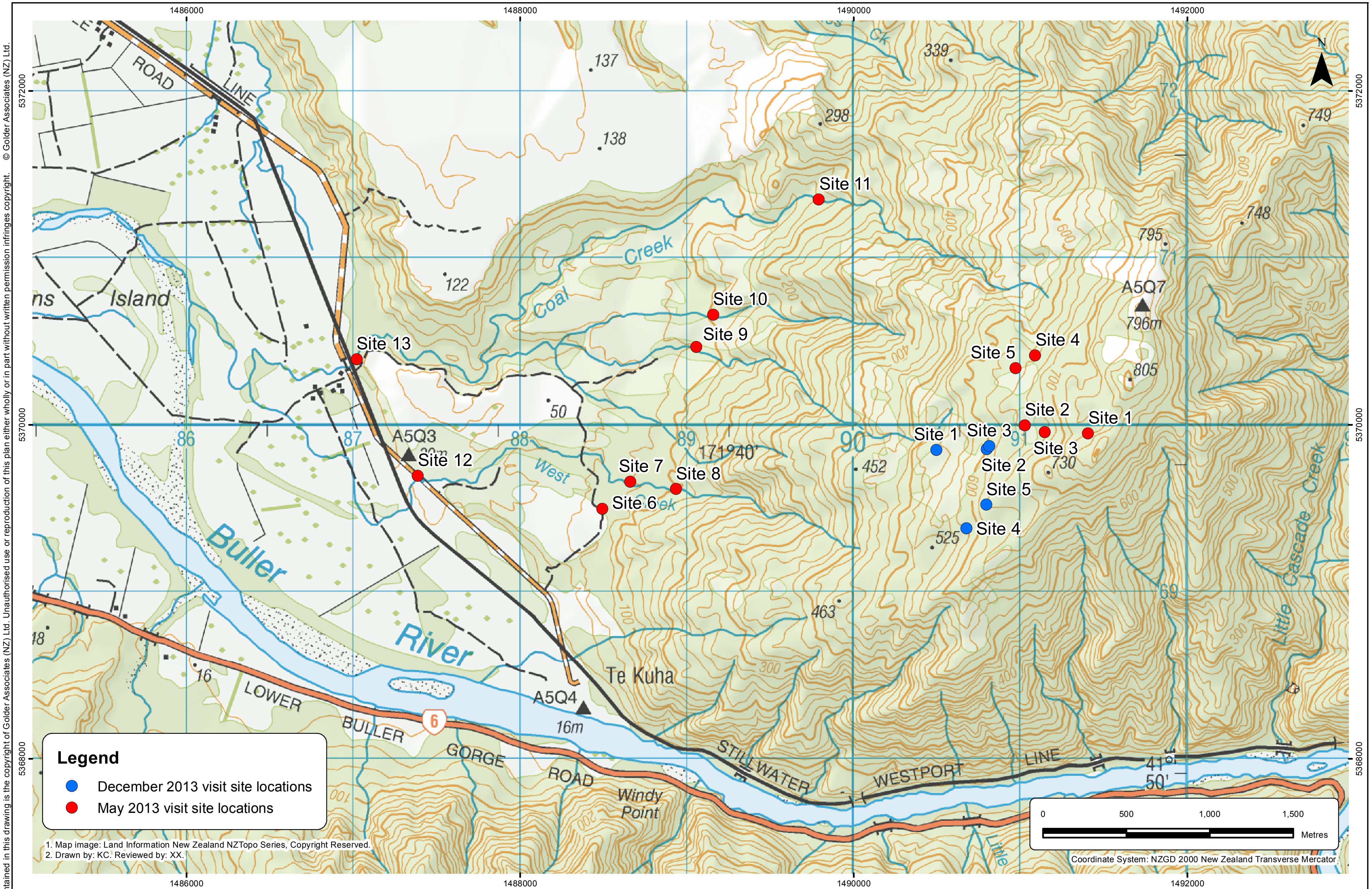
General in-stream and riparian habitat characteristics (stream depth, stream width, streambed substrate composition, type of riparian vegetation, percent shading, bank erosion and macrophyte cover) were recorded at each site using general methods described in the national protocols of Harding et al.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

3.4 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.

3.5 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.



1. Map image: Land Information New Zealand NZTopo Series, Copyright Reserved.
2. Drawn by: KC. Reviewed by: XX.

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TITLE SITE LOCATION MAP

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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.

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).

3.6 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 (i.e., pool, runs, riffles and backwaters) 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.

4.0 AQUATIC ECOSYSTEMS, FLORA AND FAUNA

4.1 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 manuka scrub although Site 3 was in taller mature forest. CRL (2014) confirmed that stream flows demonstrated variable and ephemeral flow.

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.

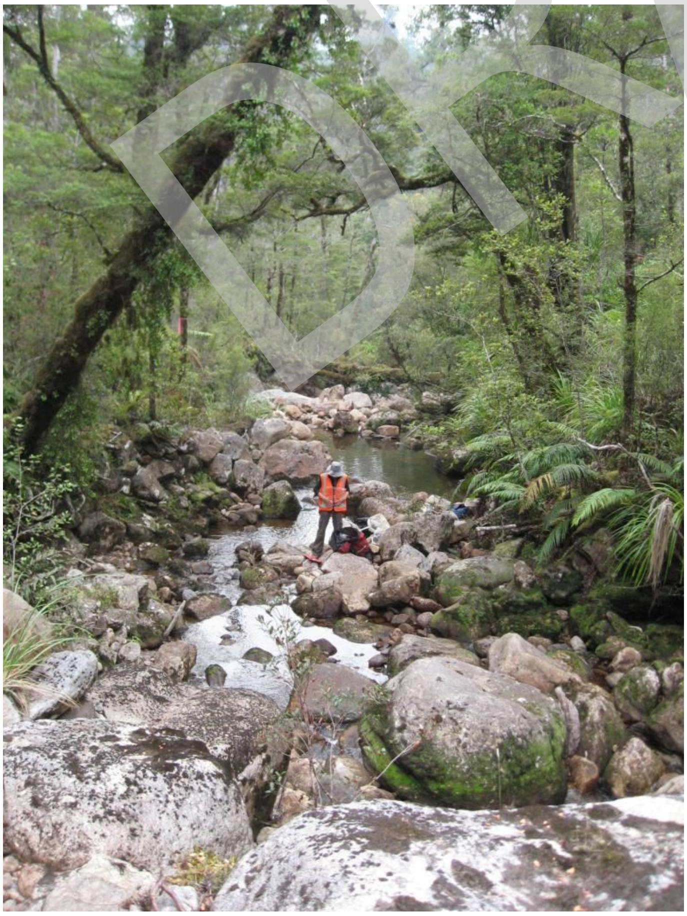

Figure 2: Coal Creek (Site 11) at the lower Haul Road crossing point.

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 grey colour that the survey team also noted as unusual.

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

4.2 Tarns

Several small tarns (small pool-like water bodies) are present on the top of the Paparoa Ranges. Tarns can have specific and often unique aquatic characteristics and biological communities. Small tarns occur at Te Kuha, the most prominent tarn (Site 5) being located outside of the footprint of the project. The tarn at Site 5 was mostly vegetated with *Juncus bulbosus* (an introduced rush). Several small seepages occurred within the gully at the top of the ridge.

4.3 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.

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 these first two sites, as noted above, had water colour or stream bed anomalies

Water quality has been further sampled and analysed by CRL at a suite of sites at the Te Kuha location (Figure 1). A summary of the CRL water quality data collected between March 2013 and February 2014 from sites at or located closely to the aquatic ecology sites are shown in Table 2. The results confirm the results of the instream water quality meter results detailed above.

No spatial trends were evident in the physicochemical data measured from Te Kuha streams between March 2013 and February 2014.

The streams were relatively cool in summer (<=16 °C). Similar conductivity values along the length of the stream suggest the absence of any significant catchment geology or landuse changes or any contaminant flows into the system. The upper reaches (sites TKS-1 to TKS-7) were acidic but the pH of the stream was typically nearer to neutral in the lower reaches. With the exception of a single value recorded at the TKS-6 site, oxygen values along the stream were sufficiently high to support aquatic life (>90 % saturation).

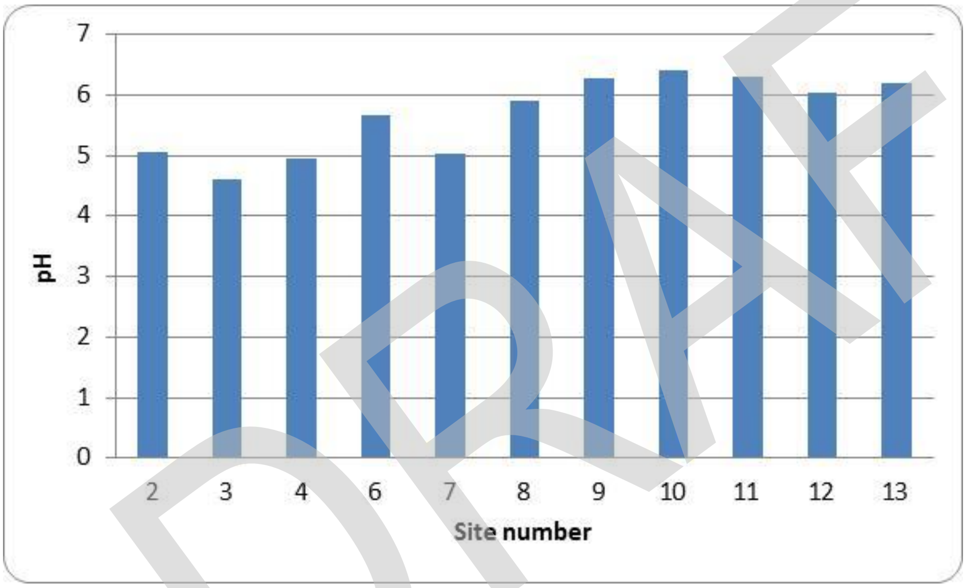

Figure 6: pH at sampling sites at Te Kuha with flowing water, March 2013.

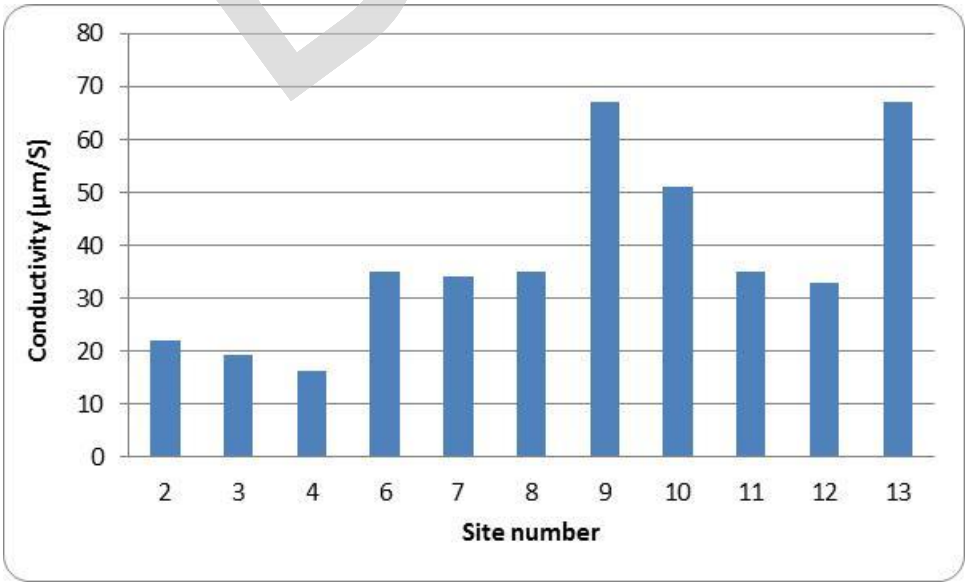

Figure 7: Conductivity at samples sites at Te Kuha with flowing water, March 2013.

Table 2: Summary of physico-chemical water quality collected from selected stream sites at Te Kuha March 2013 to February 2014.

Water quality Site	Proximal ecology Site	Flow (L/m)	Temperature	Conductivity (uS/cm)	pH	DO (g/m^3)	DO (% sat)
TKS-1	-	1 (1 - 1)	8.3 (4.3 - 12.3)	32 (23 - 40)	4.9 (3 - 7.7)	11.3 (11.3 - 11.3)	100 (100 - 100)
TKS-2	2	9.5 (9 - 10.4)	9 (4.8 - 11.1)	23 (17 - 30)	4.8 (2.6 - 7.2)	12.4 (12.4 - 12.4)	97 (97 - 97)
TKS-3	5	0.16 (0.05 - 0.25)	9.4 (4.3 - 12.5)	30 (23 - 39)	4.5 (3.5 - 6.9)	10.8 (10.8 - 10.8)	95 (95 - 95)
TKS-4	3	5.03 (1.6 - 7.9)	8.7 (4.7 - 11.1)	34 (18 - 58)	4.1 (2.7 - 6.1)	11.9 (11.9 - 11.9)	97 (97 - 97)
TKS-5	4	1.85 (0.05 - 5.1)	9.5 (4.4 - 12.2)	29 (20 - 37)	4.7 (3.7 - 6.9)	11.2 (11.2 - 11.2)	92 (92 - 92)
TKS-6	-	0 (0 - 0)	9.4 (4.4 - 12.6)	25 (19 - 32)	4 (3.8 - 4.3)	6 (6 - 6)	93 (93 - 93)
TKS-7	11	29.2 (2 - 50)	8.3 (5.5 - 11.1)	22 (15 - 29)	4.9 (4.3 - 5.8)	13 (13 - 13)	103 (103 - 103)
TKS-8	10	11.53 (0.02 - 80)	11.6 (6 - 15.9)	40 (28 - 62)	6.5 (5.8 - 6.8)	10.6 (8.6 - 11.7)	101 (86 - 125)
TKS-9	9	6.54 (0.02 - 45)	11.3 (5.8 - 15.4)	40 (30 - 62)	6.3 (5.6 - 6.8)	10.7 (8.7 - 12)	100 (85 - 122)
TKS-10	-	0.63 (0 - 5.3)	11.2 (5 - 14.6)	34 (23 - 72)	6 (5.3 - 8.2)	10.3 (8.6 - 11.6)	97 (82 - 118)
TKS-11	8	13.05 (0.03 - 90)	11.2 (5.5 - 14.6)	29 (23 - 44)	6.2 (4.5 - 6.9)	10.8 (8.6 - 13.4)	99 (83 - 125)
TKS-12	6	2.5 (2.5 - 2.5)	14.3 (14.3 - 14.3)	54 (54 - 54)	6.3 (6.2 - 6.4)	10.2 (10.2 - 10.2)	-
TKS-13	-	1.06 (0.04 - 8.8)	10.9 (6 - 16)	37 (27 - 50)	6.7 (6.3 - 7.1)	10.4 (9.1 - 11.7)	95 (86 - 101)

Notes: All data mean values with range in parentheses; n=1-4 for sites TKS-1 through TKS-7 and TKS=12; n=8-12 for sites TKS-8, TKS-9,TKS-10, TKS-11 and TKS-13. *Measured on separate occasions, Data supplied by CRL. Sites TKS-1 to TKS-13 are sites sampled by CRL.

CRL (2014) concluded that water quality in the upper reaches is similar to water quality that drains Brunner coal measures in other places. In these catchments, pH is generally low (~4 to 5.5) and concentrations of dissolved metals including Fe and Al is generally high (0.1 to 0.5 mg/L). These streams are typically low in alkalinity and may have slightly enriched trace element concentrations (especially zinc, nickel and manganese) (CRL 2014).

Samples from lowland river sites indicated a natural neutralisation of the slightly acidic upland river tributaries; with lowland river sites exhibiting lower acidity, higher pH and increased alkalinity compared to upland sites. CRL (2014) also reported on groundwater quality and concluded that groundwater chemistry mostly falls within the variability of the surface water chemistry.

CRL (2014) go on to suggest that in general, the surface water and groundwater systems have stable and therefore predictable chemistry, and that groundwater processes are the dominant control of water chemistry at Te Kuha during baseflow conditions.

4.4 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).

4.5 Macroinvertebrates

4.5.1 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 8: The dry tarn (Site 5) on the upper mountain slopes, Te Kuha, March 2013.

Figure 9: Macroinvertebrate taxa richness (excluding koura) at sample sites at Te Kuha, March 2013.

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.

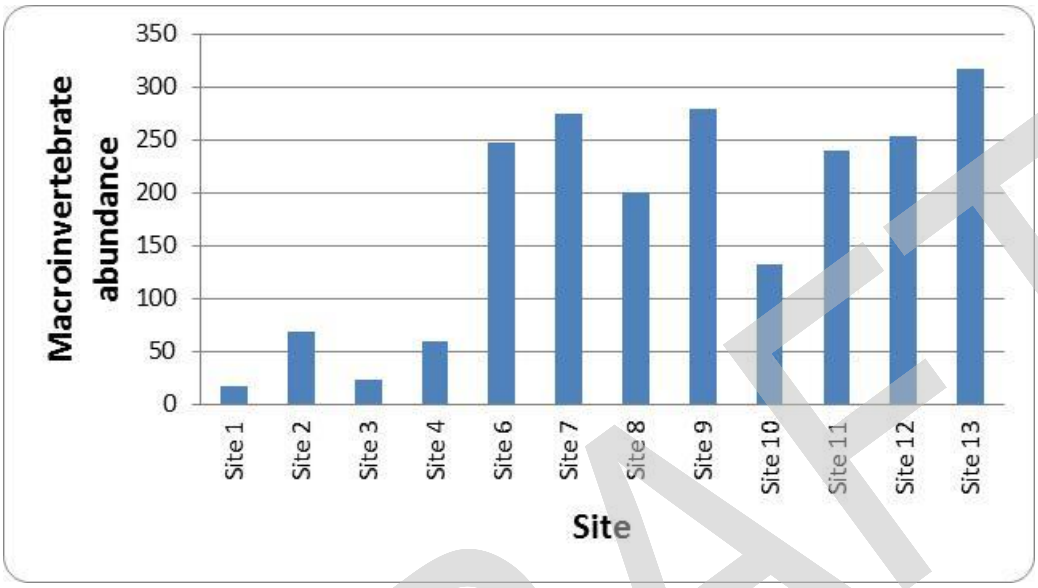

Figure 10: Macroinvertebrate abundance (excluding koura) at sample sites at Te Kuha, March 2013.

4.5.2 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 11: EPT macroinvertebrate taxa richness at sample sites at Te Kuha, March 2013.

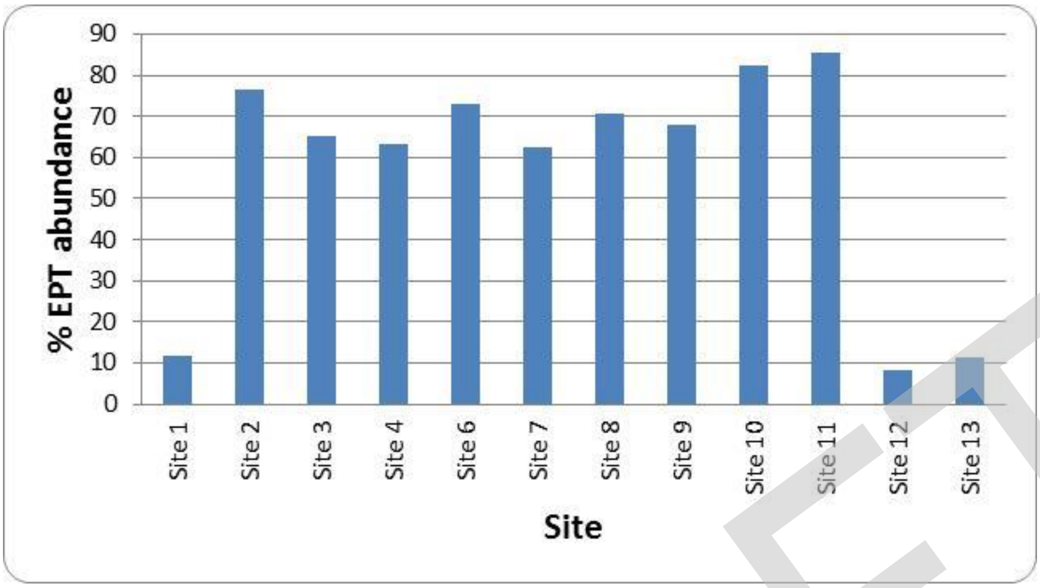

Figure 12: % EPT macroinvertebrate abundance at sample sites at Te Kuha, March 2013.

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.

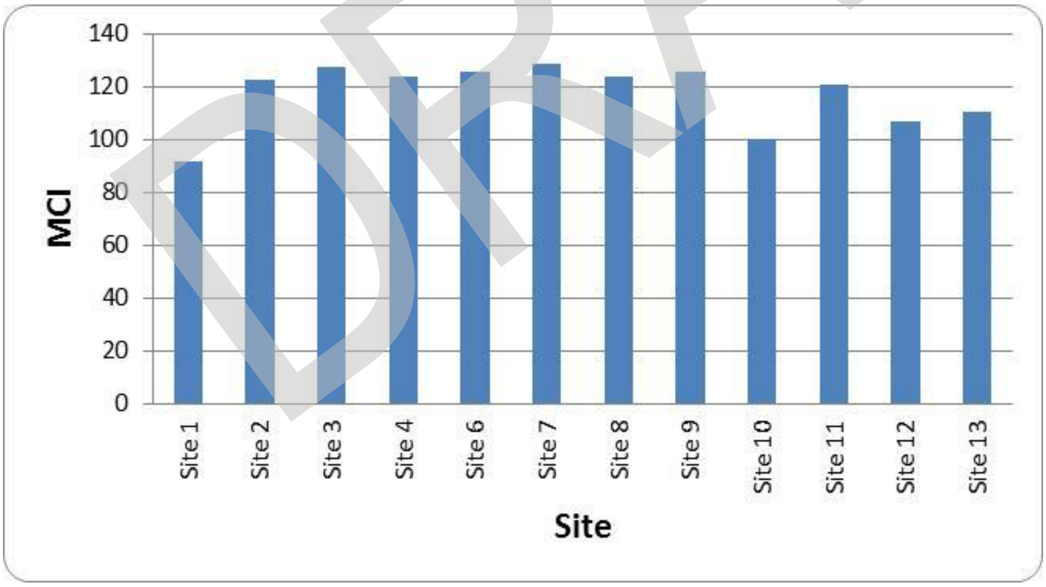

Figure 13: MCI at sample sites at Te Kuha, March 2013.

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.

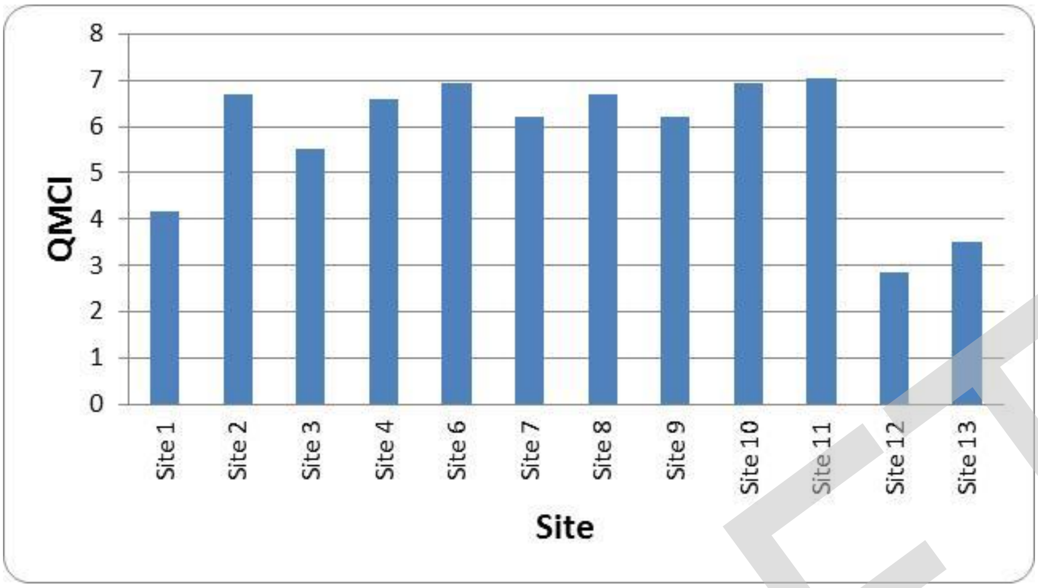

Figure 14: QMCI at sample sites at Te Kuha, March 2013.

4.5.3 Freshwater crayfish (koura)

Koura (freshwater crayfish) were located at sites on the upper mountain (Sites 2 - 5) and was present at all additional sites sampled in December 2013. 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, March 2013).

Figure 16: Koura found at the bottom of a burrow at the tarn edge, March 2013.

Figure 17: A burrow at the edge of the dry tarn, March 2013.

4.6 Fish

Eleven fish species (Table 3) were captured or observed at the 13 sampling sites. No fish were collected at the upper mountain sites (Sites 1 - 5) during the March 2013 survey and the absence of fish at upper mountain sites was confirmed during the additional sampling carried out in December 2013. 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 4). 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.

Table 3: 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

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.

[2] Allibone et al. (2010)

Table 4: Locations of fish species, number of fish (length range (mm) in parentheses) recorded from sites at Te Kuha, March 2013.

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 - 1,000)	#	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 slopes 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.

4.7 Discussion and Summary

At the time of the March 2013 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. These findings were confirmed during the December 2013 survey (when flowing water was present in the upper mountain streams). 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 observations 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.

5.0 ECOLOGICAL VALUES

5.1 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 is the only large invertebrate present at the mine site of is of potential concern due to limitation on recolonisation following mining and site restoration. At the time of the initial survey the upper limit of koura was set by the dry stream beds and its presence in the mine area was limited to larger water courses and/or the lower reaches of small streams.

5.2 Fish

Four threatened fish (shortjaw kokopu, koaro, redfin bully and longfin eel), that are all classified as *at risk, declining,* (Goodman et al. 2014) 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 were 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 at risk - *declining* (Goodman et al. 2014).

The upstream limit of fish in West and Coal creeks was not determined; an attempt was made during December 2013 to sample in a downstream direction along West Creek but no fish were recorded at any of the upper mountain sites fished. The steep mid-reaches of West Creek appeared erosion prone (when observed from the air) and contained several steep unstable stream reaches that 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 any of the upper mountain sites it is not expected that native fish are present in the upper section of West Creek near the proposed mine footprint.

5.3 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.

5.4 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.

6.0 ACTUAL AND POTENTIAL EFFECTS OF MINE CONSTRUCTION AND OPERATION ON AQUATIC ECOSYSTEMS

6.1 Key Impacts

The proposed Te Kuha Mine site is dissected by a network of small watercourses with high ecological values. Actual and 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 ecological values are:

- Loss of aquatic habitat.
- Developing stream crossings for the access haul route and loss of passage for fish and other upstream moving organisms.
- 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.

6.2 Stream Habitat, Flora and Fauna

6.2.1 Effects on stream habitat, flora and fauna

The loss of the waterways within the mine footprint will result in the loss of aquatic habitat and the associated aquatic flora and fauna. In particular, as koura were widespread within the upper mountain streams, there is potential to lose large numbers of this threatened species from water courses during the establishment and operations of the mine.

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.

6.2.2 Avoidance, remediation and mitigation for stream habitat, flora and fauna

It is not possible to avoid loss of the waterways within the mine footprint. As much as possible, loss of waterways outside of the mine footprint will be avoided.

A koura rescue programme prior to any construction activity is recommended with an appropriate plan prepared (components of an indicative koura rescue plan are detailed below). A koura recipient location(s) will need to be identified and permitted.

Rehabilitation of the waterways on the site is discussed in the site rehabilitation section below.

6.3 Rare Ecosystem Types

6.3.1 Effects on rare ecosystem types

Small tarns will be removed by the mining activity, but the largest tarn (cf. section 4.2) 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.

6.3.2 Avoidance, remediation and mitigation of rare ecosystem types

The large tarn at Te Kuha will be avoided by activities associated by the construction and operations of the mine. However, it is recommended that all site personnel receive a briefing on the ecological values of the tarn and both the tarn and its surrounding area (e.g., 30 m) be clearly marked to ensure that no accidental encroachment of equipment or earthworks occurs.

Smaller tarns and depressions within the mine footprint will be removed. It is recommended that small tarns that are affected by the mine construction be included as part of the koura rescue programme as indicated above and outlined below.

6.4 Earthworks

6.4.1 Effects of sediment addition

Sediment entering streams is a naturally occurring process for all streams, including those draining the Paparoa Ranges. The movement of sediment into local watercourses during the proposed mine and road construction and operational phases could give rise to adverse effects depending on the nature of downstream habitats. Sediment can become suspended in stormwater, so any water discharged from the site can be turbid, especially compared to natural waterways.

There is the potential for a decline in water quality and the health of downstream aquatic ecosystems if added suspended solids concentrations are high enough or excessive deposition occurs in stream beds. 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 trout eggs and trout alevins.
- Smothering of periphyton and aquatic plants resulting in loss of habitat for 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 (water quality samples were collected from a range of flows throughout the year CRL 2014). However, the high intensity rainfall events typical of the West Coast suggests that as flows in the streams will rise and fall rapidly, 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 7.1.3 below.

6.4.2 Avoidance, remediation and mitigation of sediment addition

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 treatment residence times, which are achieved by constructing larger ponds, enhance this removal process. The use of chemicals for settlement of sediments is not expected to be required.

6.5 Acid mine drainage

6.5.1 Effects of Acid Mine Drainage

Acid mine drainage (AMD) is a phenomenon that is associated with mining activities and occurs when natural sulphides in rock strata become exposed to water and oxygen. AMD is most often associated with coal, pyrite, Copper, Zinc and iron mining operations. AMD occurs at both active and abandoned mine sites and can affect surface and groundwater systems with contamination that also effects downstream waterways. Most typically AMD is linked to pH and the speciation of various metals; where acidity is reduced metal hydroxides can precipitate out of solution and coat the streambed in a floc (Hogsden & Harding 2012). Precipitation of ferric iron as ferric hydroxide, frequently termed 'yellow boy' is a visible sign of AMD that occurs when pH is ~> 3.5 (Harding and Boothroyd 2004). Furthermore, streams associated with active mine sites may have increased suspended metal precipitates or inorganic material (e.g., coal fines) within waterways.

Coal mine drainage chemistry on the West Coast of the South Island is highly variable (Pope et al. 2010). Factors that influence mine drainage on the West Coast of the South Island include regional geology and paleoenvironmental setting, mine type, hydrogeology, and local geology. West Coast coal mine drainage chemistry is bimodal and controlled by regional geology (Pope et al. 2010). Thus, mines in Paparoa Coal Measures have neutral mine drainage whereas those in Brunner Coal Measures have acid mine drainage (Pope et al. 2010).

The effects of AMD on stream habitats and communities can be highly significant and can lead to highly degraded aquatic ecosystems. AMD can exert chemical and physical stresses on stream biota but separating the multiple and interacting effects of acidity, metal toxicity and habitat degradation can be very difficult, and can be direct or indirect effects (Harding & Boothroyd 2004; Hogsden & Harding 2012). Typically, streams affected by AMD may be completely devoid of macroinvertebrates, or species densities are very low. Some algae are acidophilic and can occur in high densities at sites where stable flows occur. However, the deposition of floc can smother the stream bed preventing organisms from adhering to the substrate of receiving sufficient light and other resources.

The effect of mine drainage on aquatic taxa in West Coast systems is complicated by the fact that many West Coast species are highly endemic tolerate a wide range of pH and metals that suggests an adaptation to naturally acidic streams on the West Coast (Winterbourn et al., 2000; Black et al. 2004).

6.5.2 Potential for AMD at Te Kuha

For Te Kuha, the important feature of the rock geochemistry is that both Paparoa Coal Measures (neutral mine drainage) and Brunner Coal Measures (acid mine drainage) are present at the site. Furthermore, the Brunner Coal Measures of the Te Kuha deposit at the proposed Te Kuha site is less acid forming than the same coal measures at other sites where data is available (CRL 2014).

It is Golder's understanding that the mine plan is to operate two pits overlapping in time, with one pit in the Paparoa Coal Measure and the second in the Brunner Coal Measure (Avery 2014). If this is the case then there is the opportunity to use waste rock management techniques to prevent or significantly reduce the likelihood of acid formation.

The benefit of the lower acid forming coal measures, the potential application of waste rock management methodologies and best practice water management on site should reduce the likelihood of adverse effects resulting from AMD at the Te Kuha site or downstream environments.

6.5.3 Avoidance, remediation and mitigation of AMD

The best methods of managing the potential and actual impacts of AMD is to either prevent or treat mine discharge so that it does not impact on receiving environments. Any treatment will depend on the amount and duration of discharge in combination with the natural background characteristics of the receiving water. It is clear from section 6.5.2 above that the fortunate combination of lower acid forming coal measures and the potential application of waste rock management methodologies will reduce the likelihood of AMD occurring.

Where there is a likelihood of occurrence of AMD an adaptive management plan will be developed that will be based on local aquatic characteristics and using appropriate indicators. An escalation procedure will be developed for established ecological thresholds.

7.0 ACTUAL AND POTENTIAL EFFECTS OF ACCESS ROUTE ON AQUATIC SYSTEMS

7.1 Effects of Stream Crossings for Site Access

7.1.1 Background

Access to the proposed mine site will be via the Haul Road that ascends from Te Kuha 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. Prevention of upstream passage for migratory fish and other aquatic organisms between upstream and downstream sections of the waterway.
- Scour and sediment intrusion downstream of the culvert as water velocities increase at the outlet.

7.1.2 Fish passage

For smaller streams that may be culverted more care is required in the design; placement and monitoring of fish passage at these crossings. 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-perched 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.

7.1.3 Sedimentation

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 any small sections of unsealed 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 and downstream from the crossing points particularly during construction.

7.1.4 Modification to stream flows

CRL (2014) have indicated that during mining operations all site water will be directed to the west (after water treatment) and into the tributaries of West and Coal Creeks. At maximum disturbance during mining operations this is expected to cause a 1.1 % increase in the size of the combined catchments of west and Coal Creeks; and a respective reduction in the Little Cascade Creek and unnamed tributaries of the Buller River. At site closure, it is expected that catchments will be restored as close to original areas as possible (within geotechnical constraints of landform engineering), but it is anticipated that the combined size of the West and Coal Creek catchments will be reduced by 0.2 %, with slight increases in size of the Little Cascade Creek and unnamed tributaries of the Buller River. Flows are expected to fall within the natural variability for headwater streams (CRL 2014). The minor modifications to catchment size are not expected to result in any adverse impacts to streams where the access route crosses these waterways.

7.2 Monitoring Aquatic Effects

The effects of the proposed mine can be assessed through water quality, aquatic flora and fauna monitoring at sites on the mine boundary and the Haul Road. Key aspects to monitor are water quality including the presence of acid mine drainage and suspended sediment deposition as well as additional monitoring to detect any associated reduction in the stream flora and fauna. Established biomonitoring methods are available to monitor these parameters.

Fisheries and fish passage monitoring is required for stream crossings along the Haul Road to ensure fish passage and the upstream populations are maintained.

Suggested conditions of resource consent for aquatic monitoring are provided in section 10 of this report.

8.0 SITE REHABILITATION

Rehabilitation of the mine sites will require the formation of drainage pathways (streams), small tarns and seepages 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. Disturbance and rehabilitation of West Creek is expected to be limited to a small area in the upper reaches.

It can be expected that the aquatic insect fauna will re-establish as winged adults migrate upstream to lay eggs and recolonise the watercourses. In a similar fashion, it can be expected that new stream courses created during site rehabilitation will be colonised by insects. Existing 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 (cf. koura rescue management plan).

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 pH similar to those currently observed.

Site rehabilitation of the Haul Road can also consider the removal of all culverts to remove any maintenance requirements to maintain fish passage. If the road is fully decommissioned these culverts can be removed and the stream revegetated. If the road is to be retain but vehicle use is expected to be rare culvert could be replaced by fords.

9.0 SUMMARY

9.1 Baseline Ecological Values

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.

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 streams in general, support good to high quality invertebrate and fish faunas.

9.2 Actual and Potential Effects

The proposed mining will result in the removal of the small tributary headwaters of Coal Creek and West Creek. These streams supported macroinvertebrate populations only and no fish were present. 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.

Key impacts associated with the construction and operation of the proposed mine are:

- Loss of aquatic habitat.
- Developing stream crossings for the access haul route and loss of passage for fish and other migrating organisms.
- 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.

9.3 Impact Management

Despite the potential for impacts on the aquatic ecological values of the site resulting from the construction and operation of the proposed mine at Te Kuha there are several mechanisms available to avoid, minimise and mitigate these effects.

Loss of aquatic habitat: The aquatic habitat at the mine site will be lost. This amounts to some xx m of permanent and intermittent watercourses. A rescue plan for koura, and a plan to rehabilitate watercourses on site when mining operations have ceased are planned to mitigate for the loss of habitat.

Koura rescue: A koura rescue programme prior to any construction activity is recommended with an appropriate plan prepared. A koura recipient location(s) will need to be identified and permitted.

Sedimentation: Suspended sediment loads in mine-waters can be reduced by the use of settling ponds, and thus impacts on the receiving environment can be minimised. Increased residence times, which are achieved by constructing larger ponds, enhance this removal process and further minimise impacts on the receiving environment. As sediment inputs to waterways generally occur during rainfall events it is expected that the majority of sediment that enters waterways as a result of the mine construction and operations will be flushed downstream and will not accumulate on the stream beds in the areas of high quality habitat.

Culverts: For smaller streams that may be culverted, the passage of migrating fish can be maintained by the careful design and placement of the respective culvert. Technical knowledge of maintaining fish passage mitigation at culverts is well understood and impacts on fish migration at sites along the haul road will be avoided.

Road runoff: Runoff from the majority of the Haul Road will 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. 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.

Acid Mine Drainage: The occurrence of the lower acid forming coal measures, the potential application of waste rock management methodologies and best practice water management on site should reduce the likelihood of adverse effects resulting from AMD at the Te Kuha site or downstream environments. Where there is a likelihood of occurrence of AMD an adaptive management plan will be developed that will be based on local aquatic characteristics and using appropriate indicators. An escalation procedure will be developed for established ecological thresholds.

9.4 Site Rehabilitation

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

Less mobile fauna, particularly koura may need to be reintroduced to the rehabilitated watercourses and tarns. It is preferable if the Koura are reintroduced either from the recipient site (as documented in the Koura Management Plan) or from local sources on the upper mountain.

Rehabilitating as much as possible the hydrological regime and water quality of the site will be an important influence on the success of the rehabilitation of the aquatic ecological values of the site. Replicating the drainage patterns will be important, and management of any acid mine drainage originating from the mine site will be critical. 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.

The rehabilitation of the mine site will need to occur in a manner that sustains the existing downstream aquatic ecosystems and ecological values.

10.0 PROPOSED RESOURCE CONSENT CONDITIONS

10.1 Introduction

The potential and actual effects of the construction and operation of the proposed Te Kuha mine have been identified and discussed in the sections above. In this section, resource consent conditions are proposed to ensure that any effects are managed accordingly to result in no adverse effects; and to ensure that mitigation and rehabilitation of the site is managed according to established expectations. Although not discussed above, for completeness reference is also made to consent conditions that deal with water quality monitoring.

10.2 Proposed Resource Consent Conditions

Personnel supervision and environmental awareness

The Consent Holder shall ensure that personnel responsible for supervising environment and earthwork site staff (i.e., foremen, supervisors and managers) shall undergo environmental awareness training, required by the CEMP. This training shall occur prior to the commencement of Work in any Stage and shall be given by a suitably qualified and experienced person certified by the Manager to deliver practical on-site training. Specifically, training may include (as relevant) but not be limited to:

- Details of any stream diversions or other in-stream work and works in or around tarns or wetlands, briefing on the aquatic ecological values of the streams and tarns, the objectives for stream and culvert design and construction erosion and sediment control measures, the requirements of native fish and koura for fish passage, and the sensitivity of the receiving environment to sediment discharges

Erosion and sediment control

The Consent Holder shall submit a draft Erosion and Sediment Control Management Plan (ESCP) to the Manager at least 30 working days prior to Work commencing. The final ESCP will be submitted to the Manager for certification at least 15 working days prior to commencement of Work. The purpose of the ESCP is to describe the methods and practices to be implemented to ensure the effects of sediment generation and yield on the aquatic receiving environments associated with the Project will be appropriately managed.

Sediment monitoring

The Consent Holder shall undertake monitoring of water quality in permanently and intermittently flowing water bodies upstream and downstream of potential earthwork discharge areas in accordance with the methods, locations, frequency, reporting and all operation and maintenance procedures as outlined in the ESCP.

Monitoring

The Consent Holder shall submit a draft Aquatic Monitoring Plan (AMP) to the Manager at least 30 working days prior to Work commencing. The final AMP will be submitted for certification, and a copy provided to WCRC and DOC, at least 15 working days prior to Work commencing. The AMP shall be prepared by a suitably qualified Practitioner and include (but not limited to):

Water quality monitoring

Surface water turbidity monitoring shall occur at one location upstream and three locations downstream of the stream crossings of identified West Creek and Coal Creek Streams (or their tributaries) associated with the haul road during construction to ensure that construction work does not materially alter overall surface water quality draining from the site; and

Turbidity monitoring shall commence at each of these monitoring locations at least 12 months (where practicable) in advance of construction work commencing that has the potential to affect surface water quality in this area. The purpose of the pre-construction monitoring is to provide a baseline to determine any post-construction effects. Monitoring at each of these locations shall continue for the duration of Works and shall continue for a period of six months following completion of construction Works, unless additional monitoring is required to measure the effectiveness of treatment measures as required in condition XX (**TBC** – sediment treatment).

Samples of surface water shall be collected in each of these monitoring locations every 3 months pre, during and post construction and these shall be analysed for a representative range of cations, anions, nutrients and (dissolved) metals (**TBC**). The results of the monitoring shall be provided in reports to be submitted to the Manager within 30 working days.

The details of the proposed baseline monitoring shall be provided in the AMP as required by condition XX (**TBC**). Details of the pre and post construction monitoring shall also be included in the AMP.

If monitoring indicates any significant departure from the baseline, which is not consistent with the results and trends of the baseline or historical monitoring and which can be attributed to mining construction and operations, the Consent Holder shall undertake one of the following actions, depending on the significance of the departure:

If the concentration of the test parameters as set out in the AMP is confirmed (through repeat sampling) to be at least **THRESHOLD VALUE TBC** value recorded in the pre-construction baseline monitoring (TBC) for the Consent Holder monitoring, the Consent Holder shall increase the frequency of testing to once every month.

If the concentration of the test parameters as set out in the AMP is confirmed (through repeat sampling) to be **THRESHOLD VALUE TBC** value recorded in the pre-construction baseline monitoring (TBC) for the Consent Holder monitoring the Consent Holder shall provide a report to the Manager of WCRC within 30 working days, which will include (but not be limited to):

a) Analysis of the results of the monitoring.

b) Effects (if any) of the exceedance of the water quality parameters.

c) Recommendations regarding the need for additional treatment to surface runoff from the site.

d) Treatment options including a preferred treatment option, and timeframes for implementing this.

e) Further monitoring proposed of this treatment measure and subsequent actions based on the results of this further monitoring.

Aquatic ecological monitoring

Aquatic ecological monitoring shall occur at one location upstream and three locations downstream of the stream crossings of identified West Creek and Coal Creek Streams (or their tributaries) associated with the haul road during construction to ensure that construction work does not materially alter overall aquatic ecological character and health of the streams.

Aquatic ecology shall be sampled at each of these monitoring locations annually during the summer months (Mid - January to mid - March) pre, during and post construction and a range of standard population, community and biological indicators will be established and reported as outlined in the AMP. The results of the monitoring shall be provided in reports to be submitted to the Manager within 90 working days.

The details of the proposed baseline monitoring shall be provided in the AMP as required by condition XX (**TBC**). Details of the pre and post construction monitoring shall also be included in the AMP.

If the aquatic ecological monitoring as set out in the AMP is confirmed (through repeat sampling) to be statistically significantly different than recorded in the pre-construction baseline monitoring (TBC) the Consent Holder shall provide a report to the Manager of WCRC within 30 working days, which will include (but not be limited to):

a) Analysis of the results of the monitoring.

b) Effects (if any) of the significant difference in aquatic ecological parameters.

c) Recommendations regarding the need for additional treatment to surface runoff from the site.

d) Treatment options including a preferred treatment option, and timeframes for implementing this.

e) Any recommended remediation measures to be implemented within the stream(s) affected.

f) Further monitoring proposed of any treatment or remediation measures and subsequent actions based on the results of this further monitoring.

Site rehabilitation

The Consent Holder shall prepare and implement a rehabilitation (including revegetation and mitigation) strategy for the stream modifications and structures authorised by this consent. The strategy shall be submitted to the Manager 15 working days prior to commencement of Work and shall include, but not be limited to:

- Plans of the locations and lengths of riparian planting along water bodies, including along existing and new stream channels, all exposed areas of stream bank, any dewatering channels or diversions and culvert fill slopes.
- The types of streams to be modified.
- Monitoring and maintenance processes and procedures for all areas of riparian planting, including for replacement of dead or diseased plants, for a minimum period of two years from completion of initial planting.

Temporary stream crossings

Temporary stream crossings shall be constructed in accordance with the Construction Plans identified in condition XX (**TBC**). Unless otherwise agreed in writing by the Manager, all temporary stream crossings shall be removed within two years of their installation.

Unless otherwise agreed in writing with the Manager, upon removal of any temporary crossing, the Consent Holder shall reinstate the stream bed to, as far as practicable, a natural state to closely match the upstream and downstream riparian and instream habitats and visual appearance.

The structures installed as part of the Work shall be regularly inspected and maintained by the Consent Holder so that:

- The water body within or over the culverts remains substantively clear of debris.
- Any erosion of the stream banks or bed that is attributable to the stream work authorised by this consent is remedied as soon as practicable by the Consent Holder.
- Where native fish and koura are resident then upstream and downstream fish and koura passage through and past culverts and other structures is not impeded.

Koura rescue and relocation

The Consent Holder shall submit a draft Koura Rescue and Relocation Plan (KRRP) to the Manager at least 30 working days prior to Work commencing. The final KRRP will be submitted for certification, and a copy provided to WCRC and DOC, at least 15 working days prior to Work commencing.

The KRRP shall be prepared by a suitably qualified ecologist. All capture and release of koura shall be undertaken by a suitably qualified ecologist.

The KRRP will include details of koura rescue and relocation techniques to be used, including (but not limited to):

- The Plan shall detail the process and timing for obtaining the relevant permits for the removal and transfer of koura from the mine site to the identified and agreed receptor locations.
- The Plan shall detail the receptor location(s) proposed to receive the captured koura.
- The Plan shall include placement of appropriate screen to stop koura migrating back into the reach to be diverted while the rescue operation is being carried out.
- Detail the use of multiple koura capture methods over multiple nights days/nights (at least 2 days/nights and ceased only when no more koura are caught, or through agreement with the Manager). Koura capture methods may include spotlighting, minnow traps, and electric fishing, suitable to the habitat, post screen installation and prior to any works that may affect the aquatic habitat.
- The methods of transfer proposed for the captured koura.

- The location and use of temporary holding (refuge) pools within the stream or alternative stream or reach to be diverted.
- The method of draining the water body to ensure maximum koura rescue (if relevant).
- The methods of capture (and transfer) from any temporary holding location.
- The methods to record, count and measure all koura caught and transferred.
- The Plan shall guide all works in any permanent or intermittent water body (including tarns and wetlands) that is to be lost, diverted or reclaimed (including temporary diversion for culvert placement).
- The details of the koura rescue and relocation shall be reported to the Manager, WCRC.

11.0 CONCLUSION

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. The total mine footprint expected to be approximately 70 ha in area. Access to the site would be via a proposed access road which would be approximately 9 km in length.

The watercourses on the upper mountain were small headwater streams that were intermittent and were dry during the summer of 2013. The assessment of aquatic ecological found low diversity macroinvertebrate communities were present at or adjacent to the mining area. No fish were recorded on the upper mountain or adjacent to the proposed mine area, but freshwater crayfish (koura) were present at all sites sampled. The tarn on the upper mountain provides 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.

The streams are 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 streams in general support good to high quality invertebrate and fish faunas.

The construction and operation of the Te Kuha mine will result in the loss of headwater tributaries of Coal and West Creek. A koura rescue and relocation operation is proposed and a plan will be prepared accordingly. No further detrimental effects of the construction and operation of the Te Kuha mine on the aquatic values of streams within the footprint and along the access route are expected to occur. Increased sedimentation is a concern during the construction phase of this project and it is recommended that sediment management be a focus of on-site management plans including for the construction of the haul road. Continued passage for indigenous migratory fish at the haul road crossing points is expected to occur as a condition of resource consent. The occurrence of the lower acid forming coal measures and the potential application of waste rock management methodologies as well as best practice water management on site should reduce the likelihood of adverse effects resulting from AMD at the Te Kuha site or downstream environments.

Proposed conditions for resource consent are provided that reflect the management requirements to ensure that any impacts of the construction and operation of the proposed coal mine at Te Kuha are minimal; and that site rehabilitation meets established expectations for the site.

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APPENDIX A

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australia & NZ	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

AUCKLAND

Tel +64 9 486 8068
Fax +64 9 486 8072

Level 2
Nielsen Centre
129 Hurstmere Road
Takapuna
Auckland 0622

PO Box 33-849
Takapuna 0740

WELLINGTON

Tel +64 4 974 6397

Level 1
93 The Terrace
Wellington 6011

PO Box 5234
Wellington 6145

HAMILTON

Tel +64 7 859 2356
Fax +64 9 486 8072

Room 31 in the Homestead
Ruakura Research Centre
10 Bisley Road
Hamilton 3214

PO Box 19-479
Hamilton 3244

NELSON

Tel +64 3 548 1707
Fax +64 3 548 1727

Level 3
295 Trafalgar Street
Nelson 7010

PO Box 1724
Nelson 7040

CHRISTCHURCH

Tel +64 3 377 5696
Fax +64 3 377 9944

Level 1
214 Durham Street
Christchurch 8011

PO Box 2281
Christchurch 8140

DUNEDIN

Tel +64 3 479 0390
Fax +64 3 474 9642

Level 9A
John Wickliffe House
265 Princes Street
Dunedin 9016

PO Box 1087
Dunedin 9054

Golder Associates