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L1 Flora and Fauna Assessment

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L3 Stygofauna Assessment

L3 | Stygofauna Assessment





Kevin's Corner Project

Stygofauna Survey

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LIST OF ABBREVIATIONS

%	-	percent
° C	-	degrees centigrade
µm	-	micrometres
AARC	-	AustralAsian Resource Consultants Pty Ltd
ALS	-	Australian Laboratory Services
DERM	-	Department of Environment and Resource Management
EC	-	Electrical Conductivity
EIS	-	Environmental Impact Statement
EPA	-	Environmental Protection Authority
GDA94	-	Geocentric Datum of Australia 1994
HGPL	-	Hancock Galilee Pty Ltd
km	-	kilometre
m	-	metres
m bgl	-	metres below ground level
mg/l	-	milligrams per litre
mS/cm	-	milli Siemens per centimetre
MLA	-	Mining Lease Applications
Mtpa	-	million tonnes per annum
TOR	-	Terms of Reference
WA	-	Western Australia



EXECUTIVE SUMMARY

The Australian Laboratory Services Water Sciences Group was commissioned by AustralAsian Resource Consultants Pty Ltd to assess the presence, abundance and community composition of Stygofauna in groundwater at the Kevin's Corner Project Site. This work constitutes one of the baseline studies required for the Project's Environmental Impact Statement.

Eleven groundwater samples were collected from bores on and surrounding the Project site as part of a pilot survey that was conducted in March, June and November 2010. Eight individuals of the stygofauna syncarid genus *Notobathynella* were identified in one groundwater sample from outside the Project Mining Lease Application. This sample was collected from groundwater bore 103443 (Surbiton South) in November 2010, which lies approximately 5 kilometres south east of the Kevin's Corner Mining Lease Application and 13 kilometres from the nearest mining area. A separate sample collected from the Project site yielded a single copepod specimen of *Macrocyclus albidus*. This copepod is a widespread surface-dwelling species which is occasionally encountered in groundwater. However, this species does not live in groundwater and is therefore not considered to be stygofaunal.

The discovery of *Notobathynella* sp. represents a significant find, especially considering the limited small sample size of this pilot study. It should be noted that understanding of *Notobathynella* taxonomy within Australia is limited, thereby preventing identification of the recovered individuals to species level. Water quality measurements for the November 2010 groundwater samples were within the known range of tolerance for stygofauna, highlighting the possibility of stygofauna discoveries in future surveys.

This study was conducted in full compliance with the Western Australia Environmental Protection Authority Guidance Statement 54 and 54a. This is a requirement of the Department of Environment and Resource Management, as there are no Queensland-specific stygofauna sampling guidelines.

It should be noted that the number of groundwater sampling locations outside the Mining Lease Application was limited. As such, it is recommended that further stygofauna surveys are conducted in order to increase the number of off-lease sampling locations. Further wells will be installed on site as a result of the ongoing exploration drilling and groundwater investigation programmes. These wells will also provide an opportunity for future on-site stygofauna sampling. It is understood that the main aquifer on the Project site is not in hydraulic continuity with local alluvial aquifers.

The number of stygofauna that were identified at the Surbiton South sampling location (Department of Environment and Resource Management registered bore 103443, which is located approximately five kilometres south east of the Kevin's Corner Mining Lease Application and 13 kilometres from the nearest mining area) also indicates that the initial pilot-scale survey should be converted into a full-scale survey as required by the Western Australia Environmental Protection Authority Guidance Statement 54 and 54a.

Therefore, in conjunction with future drilling and well installation, Hancock Galilee Pty Ltd will conduct a full-scale stygofauna survey both within and outside the Kevin's Corner Mining Lease Application during different seasons, to confirm the presence or absence of stygofauna in the local area



1.0 INTRODUCTION

The Australian Laboratory Services (ALS) Water Sciences Group was commissioned by AustralAsian Resource Consultants Pty Ltd (AARC) to assess the presence, abundance and community composition of stygofauna in groundwater at the Kevin's Corner Project Site (the Project). This work constitutes one of the baseline studies required for the Project's Environmental Impact Statement (EIS).

The proponent for this Project is Hancock Galilee Pty Ltd (HGPL) and AARC has been commissioned to deliver a number of the Project's baseline studies and EIS sections.

This study provides an assessment for the presence of stygofauna both on and off the Project site and whether or not the proposed mining activities (construction, operation and decommissioning) could have an impact upon the local stygofauna community (if present).

1.1 PROJECT DESCRIPTION

Hancock has proposed a new coal mining operation in Central Queensland. The Project site is located in Central Queensland (within Queensland's Galilee Basin) approximately 340 kilometres (km) south-west of Mackay and 110 km west south-west of Clermont. The closest residential area to the Project is the township of Alpha, located approximately 65 km south south-east of the Project site.

The Project is focused on mining thermal coal deposits for which an EIS is being prepared. Hancock currently holds a Mining Lease Applications (MLA) – MLA 70425 which covers the Project site (refer to Figure 2).

The Kevin's Corner Project is adjacent to the Alpha Coal Project and is a 30 million tonnes per annum (Mtpa) open-cut and underground long wall coal mine with a scheduled 30 year mine life. The Kevin's Corner Project will be supported by the Alpha Coal Project's rail and port facility. Coal is proposed to be mined by draglines, excavator and trucks and underground mining, processed on site and then transported by rail to the proposed port site.

As with all baseline studies, the stygofauna survey programme was conducted in accordance with the Project's Terms of Reference (TOR) as defined by the Coordinator General.

1.2 WHAT ARE STYGOFAUNA ?

Stygofauna are microscopic, aquatic animals that live in groundwater. Communities are often dominated by crustacean invertebrates, but also contain oligochaetes, insects, other invertebrate groups and occasionally fish. Stygofauna are known from limestone, calcrete, and fractured rock aquifers, but appear most abundant in alluvial aquifers (Hancock and Boulton, 2008). The main cause of concern for stygofauna in areas where development extends below the water table is that there is a high degree of endemism among species (Western Australia (WA) Environmental Protection Authority (EPA) 2003, 2007). Therefore, with many species restricted to very small geographical areas, development approvals need to be considered carefully to avoid species extinction.



1.3 PROJECT GEOLOGY

The Project deposit lies in the Galilee Basin within a sequence of Late Carboniferous to Middle Triassic sedimentary rocks overlying Late Devonian to Early Carboniferous sedimentary and volcanic rocks of the Drummond Basin. The coal bearing strata sub-crop lies in a linear, north-south trending belt in the central portion of the basin and is essentially flat lying. No major regional scale fold and fault structures have been identified in regional mapping of the Project site.

The stratigraphy of the Galilee Basin in the Kevin's Corner area is described in Table 1 below.

Table 1 Stratigraphy of the Galilee Basin

Period	Unit	Rock Types	Comments	Tectonic Unit
Quaternary		Alluvium	Partly lateritised	
Tertiary		Argillaceous sandstones and clays		Eromanga Basin
Unconformity				
Triassic	Clematis Sandstone	Quartz sandstone, minor siltstone and mudstone		Galilee Basin
	Dunda Beds	Labile sandstone, siltstone and mudstone		
	Rewan Formation	Green-grey mudstone, siltstone and labile sandstones		
Late Permian	Bandanna Formation	5 coal seams (A-E), labile sandstones, siltstone and mudstone	Coal Measures	
Early Permian	Colinlea Sandstone	Labile and quartz sandstone		
Late Carboniferous to Early Permian	Joe Joe Formation	Mudstone, labile sandstone, siltstone, shale, thin carbonaceous beds		
Unconformity				
Early Carboniferous				Drummond Basin

There are six major coal seams within the deposit (A to F), which vary in thickness from 5 m to 8 m. Figure 1 shows a typical east-west cross section across the deposit.

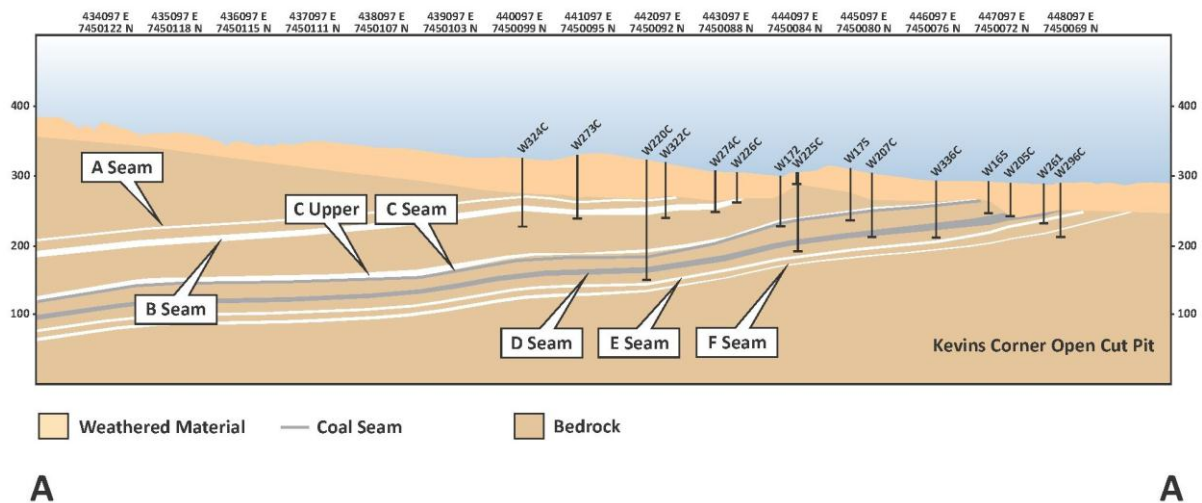


Figure 1 Typical East-West Cross Section Across Deposit

1.4 SCOPE OF WORK

The Scope of Works required for the stygofauna survey is detailed in two Sections of the Kevin's Corner TOR, which have been selected and summarised as follows:

- TOR Section 3.3.4.1:

The description of the fauna and flora present or likely to be present at any time during the year in the project area should include:

- *fish species, mammals, reptiles, amphibians and aquatic invertebrates occurring in waterways*
- *habitat requirements and the sensitivity of aquatic flora species to changes in flow*

- TOR Section 3.3.4.2:

With regard to aquatic flora and fauna, the assessment of potential impacts should consider:

- *measures to minimise wildlife injury and mortality during construction, operation and decommissioning*
- *effects on key rare and threatened or otherwise noteworthy plant and animal species, including listed threatened and listed migratory species and their habitat*

As there are no Queensland-specific stygofauna sampling guidelines, the Department of Environment and Resource Management (DERM) require proponents to follow the sampling protocols of the WA EPA (EPA 2003, 2007).

However, Guidance Statement 54a (EPA 2007) does make allowances for pilot studies that are less intensive as follows:

- *In some cases, proponents may believe there is little likelihood of subterranean fauna occurring in a project area but desktop review does not provide convincing evidence to support this position. A pilot study may be an effective method of determining whether subterranean fauna occur. Much less sampling is required to characterize the type of community present than to document all species. If the area supports significant subterranean fauna, the results of the pilot study can be used to focus the more comprehensive survey that will be required to document all species and assess their conservation.*
- *The design of pilot studies is likely to vary according to situation. The aim will usually be to determine whether a project area has significant subterranean faunal values, which can be achieved with low sampling effort (Culver et al., 2004; Eberhard et al., 2009). It is expected that 6-10 stygofaunal samples or 10-15 troglafaunal samples will be collected in pilot studies. If the pilot study reveals the occurrence of significant subterranean fauna, more intensive investigation is likely to be required.*

Previous stygofauna surveys do not appear to have been conducted for the local area and a limited number of surveys have been conducted in Queensland. It should be noted however, that local groundwater quality is considered suitable for supporting stygofaunal populations). This Project has therefore adopted a 'Pilot Study' approach (as outlined in the preceding paragraphs) in response to the apparent absence of any stygofauna data for the Kevin's Corner area.

2.0 METHODOLOGY

A total of seven groundwater samples were collected for stygofauna assessment by AARC in March and June 2010 (within the Kevin's Corner Project site boundary) and four more samples were collected in November 2010 (outside the Kevin's Corner MLA) (refer to Table 2 and Figure 2 for sample location details) as per WA EPA guidelines for pilot-scale studies. It should be noted that most of the bores sampled were DERM registered bores and the DERM bore number has been used to identify each location where applicable. All samples were sent to the ALS Water Science Group laboratory in Brisbane for processing.

The geographical setting of a number of these stygofauna bores are presented as photographs in Appendix B. Note that not all bores were photographed and in some cases, the bores were connected to livestock watering systems (windmill pumps, pipe work and livestock watering troughs). Bores which incorporated windmill pumps and / or sealed casing covers did not facilitate direct access to the local groundwater. Therefore, groundwater samples were obtained at the outlet of these bores and the water sample passed through a sieve, rather than using the stygofauna sampling net device.

Note that although a total of fifteen off-lease groundwater monitoring bores had been identified as suitable sampling locations before field works commenced, only four of these bores were accessible and sampled in November 2010. The other bores were either destroyed, not correctly geo-referenced, damaged or locked and therefore not available for sampling.

Table 2 Stygofauna Bores Sampled in March, June and November 2010.

Coordinates are in Geocentric Datum of Australia 1994 (GDA94)

DERM / AARC Bore Number	Date sampled	Latitude	Longitude
1230R	21/03/2010	-23.1012	146.42504
1235R	21/03/2010	-23.0876	146.25035
1237R	21/03/2010	-23.0597	146.46480
	29/06/2010		
1240R	21/03/2010	-23.1231	146.41550
	29/06/2010		
1247R	21/03/2010	-23.0619	146.48570
1276D	29/06/2010	-23.1088	146.36356
1368R	29/06/2010	-23.0226	146.52075
12030054	11/11/2010	-23.1127	146.77851
103443	11/11/2010	-23.1520	146.61493
44466 (Monklands)	10/11/2010	-23.3698	146.50648
44456	10/11/2010	-23.0502	146.62767

Stygofauna samples were collected using a weighted net of 50 micrometre (μm) mesh. Stygofauna sampling methods are detailed in Appendix A and are briefly described below. The net was lowered to the bottom of each bore, raised and lowered four times to dislodge any resting animals, then retrieved slowly to the surface. At the top of each haul, the entire contents of the net were emptied into a 50 μm sieve. After six hauls the sample was transferred to a labelled jar, filled with 100 per cent (%) AR



grade ethanol. Samples were then sent to the ALS Water Science Group Laboratory in Brisbane for processing and fauna identification.

Rose Bengal dye, which stains animal tissue pink, was added to each sample before processing to allow stygofauna to be distinguished from sediments and to reduce sorting time. Samples were elutriated to separate the heavier mineral component from the lighter organic component of the sample, and poured through a 50 µm sieve. The sieve contents, consisting of fine sediments, fauna, and other organic material, were spread thinly over the base of a channelled sorting tray. All fauna were identified to the lowest taxonomic level possible under dissecting microscopes and placed in vials containing 100% ethanol.

Stygofauna were examined using Leica MZ 9.5 stereo-dissection microscopes with planachromat objectives and a zoom capability between 6.3x and 60x magnification. A digital camera was attached which allowed for the production of a photographic reference collection when required. Stygofauna were identified to Order / Family level (where possible) using published taxonomic keys, unpublished working keys, and a specimen reference collection maintained by ALS.

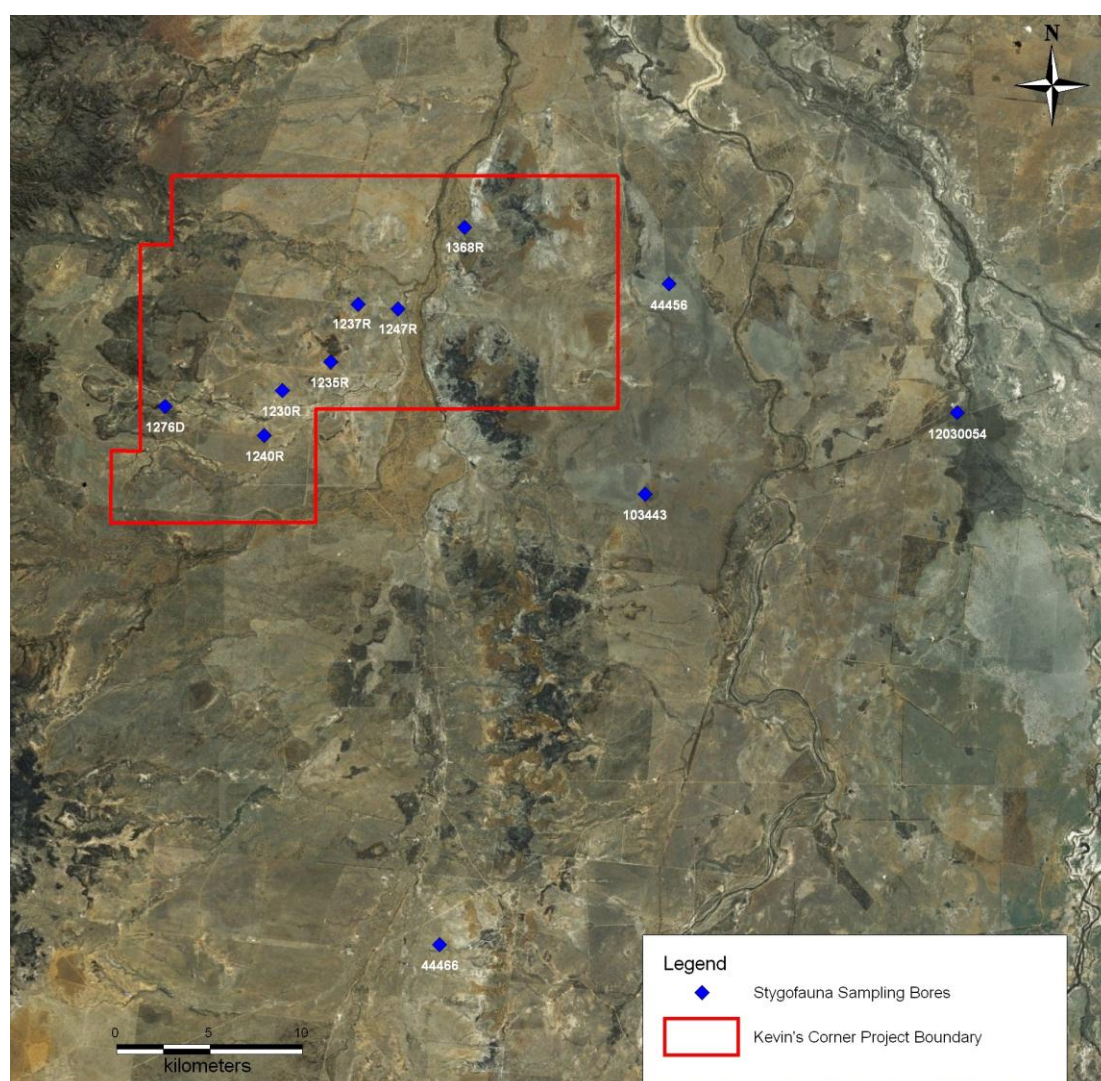


Figure 2 Kevin's Corner on and off MLA Stygofauna Sampling Locations

3.0 RESULTS

Within the Kevin's Corner Project site boundary (MLA 70425), a single cyclopoid copepod was collected from Bore 1237R in March 2010 (refer to Figure 2 for details). This animal was identified as *Macrocylops albidus* (Jurine, 1820), a cosmopolitan surface-dwelling copepod that is occasionally collected from groundwater, but is not stygofaunal.

Four off-lease samples which surround the Kevin's Corner Project MLA were collected in November 2010 (refer to Figure 2 for sample location details). One groundwater sample (from DERM registered bore 103443) produced a total of 8 individuals of the stygofauna *Notobathynella* which is known to inhabit subsurface environments. Stygofauna were not recorded at any of the other on-lease or off-lease groundwater sampling locations (refer to Table 4 for details of these results). However, this limited pilot scale study has indicated that stygofauna are present in the local area, probably associated with particular geological strata.

Water quality was not measured in March 2010 because of a malfunction in the water quality meter. Additionally, the groundwater quality measurements that were recorded in November 2010 were limited, because three of the groundwater sampling bores were connected to livestock watering systems and therefore, had to be sampled at the surface. However, pH, electrical conductivity, and temperature were measured from the groundwater bores that were sampled in June and November 2010, with the exception of temperature at Bore 103443 (refer to Table 3 for groundwater quality details).

It should be noted that bore 103443 is associated with the alluvials of Native Companion Creek and a basalt plug and therefore does not appear to exhibit hydrological connectivity with the Colinlea sandstones which underlie the Kevin's Corner MLA.

The groundwater quality recorded in June within the Project MLA exhibited electrical conductivity values ranging from 1.38 to 6.72 milli Siemens per centimetre (mS/cm), pH ranged from 6.50 to 9.15, whilst groundwater temperatures ranged from 27.6 to 28.4 degrees centigrade (°C). Note that depths to groundwater were measured in terms of metres below ground level (m bgl). Dissolved oxygen readings were not taken, as the probe was found to be faulty.

Off-lease bores that were sampled in November 2010 exhibited pH, EC and temperature groundwater values lower than those within the MLA (refer to Table 3 for details of groundwater quality).

Table 3 Water Quality Measurements from Bore Samples

Bore Number	March -June 2010					November 2010				
	Date Sampled	Water Level (m bgl)	pH	EC (mS/cm)	Temp . (°C)	Date Sampled	Water Level (m bgl)	pH	EC (mS/cm)	Temp. (°C)
1230R	21/03/2010	22.1	-	-	-					
1235R	21/03/2010	44.5	-	-	-					
1237R	21/03/2010	24.1	-	-	-					
	29/06/2010	24.2	8.42	1.38	27.6					
1240R	21/03/2010	28.1	-	-	-					
	29/06/2010	28.1	7.77	6.72	28.2					
1247R	21/03/2010	7.8	-	-	-					
1237R	29/06/2010	24.2	8.42	1.38	27.6					
1276D	29/06/2010	9.2	9.15	3.72	28.4					
1368R	29/06/2010	11.5	6.50	1.73	27.8					
12030054						11/11/2010	16.3	6.8	1.05	24.9
103443						11/11/2010	*	6.96	0.84	-
44466						11/11/2010	*	-	-	-
44456						11/11/2010	*	6.95	0.95	24.5

- = value not recorded due to faulty meter

* = groundwater level not accessible

Note that dissolved oxygen readings are not presented in this table, because the dissolved oxygen probe proved to be faulty

Table 4 Results of Stygofauna Sampling Conducted in November 2010

Bore Code	Subphylum	Family	Genus	Stygofauna	No of animals
12030054	-	-	-	-	-
44466 (Monklands)	-	-	-	-	-
103443 (Surbiton South)	Crustacea	Parabathynellidae	Notobathynella	Yes	8
44456	-	-	-	-	-

- =no Stygofauna recorded



4.0 DISCUSSION

The discovery of *Notobathynella* (a syncarid Crustacea) during the pilot survey confirms the presence of stygofauna within approximately 5 km of the Kevin's Corner Project MLA and 13 km from the nearest mining area, in a tertiary basalt aquifer system. These syncarids uniquely inhabit interstitial groundwater or subsurface environments heavily influenced by groundwater including karstic aquifers and hyporheic zones (Hancock *et al.*, 2005). Previous finds of Australian Bathynellacea have been recorded from a mine site in central Queensland and specimens have been discovered in the Pioneer and Burnett alluvial aquifers (Hancock and Boulton 2008). Additionally, two new species of *Notobathynella* from a related family have been discovered in Queensland (Camancho and Hancock submitted). Therefore, the *Notobathynella* is probably associated with the Native Companion Creek alluvials, rather than the Colinslea sandstone aquifer which underlies the Kevin's Corner MLA.

The taxonomic understanding of *Notobathynella* in Australia is relatively limited and prevented the identification of individuals that were collected during this survey to species level. The DNA sequencing of these individuals may facilitate species identification, providing an indication of the number of species found within the sample (Finston *et al*, 2004) and offer comparisons with future collections.

Only one aquatic animal was recorded in the seven groundwater samples that were collected from within the Project MLA. A single copepod, *Macrocyclops albidus* (Jurine, 1820) was collected from Bore 1237R in March 2010. This species is a widespread surface organism that has been identified in Australia, America and Europe, but it is not stygofaunal. Bore 1237R is located on a large floodplain between two rivers and is approximately 900m from the nearest river so it is likely that the species migrates between aquifer and surface water when the rivers flow.

The fact that the limited stygofauna survey conducted for this Project has identified stygofauna outside, rather than inside the Kevin's Corner MLA, does not preclude the possibility of stygofauna from being identified on the Project site. Further stygofauna surveys are therefore required, in order to confirm the absence of these organisms on the Project site.

It is understood that the aquifer underneath the MLA is not in hydraulic continuity with local alluvial aquifers and therefore, the risk of impactation by the proposed mining activities (such as groundwater abstraction and excavation of the aquifer) upon local stygofaunal populations is considered to be low.

Although the mine is not in an alluvial aquifer, sampling in other parts of Queensland and New South Wales have indicated that alluvial aquifers adjacent to permanently large rivers can support high stygofaunal diversity (Hancock and Boulton, 2008). For example, aquifers along the Peel River and tributaries, near Tamworth in NSW, have 35 known taxa, while the upper Hunter Valley has 28, the Pioneer Valley 19, and the Burnett aquifers 5 (Hancock and Boulton, 2008).

The groundwater quality measurements recorded in Bore 103443 (pH of 6.96 and EC of 0.95 mS/cm) are consistent with known tolerance levels of Australian stygofauna, which have been discovered in regions of New South Wales and Queensland (Hancock and Boulton, 2008).

Repeat sampling of groundwater bores is recommended by WA EPA (2003 and 2007) because stygofauna are not always collected from one sampling event, even when they are present at a location (Eberhard *et al*, 2009), or they may display seasonal trends (EPA 2003). As an example, five bores in the Pilbara region of Western Australia were repeatedly sampled between 2005 and 2007. For the first three sampling occasions no Stygofauna were collected, but for the fourth sampling trip, all five bores contained stygofauna (Biota Environmental Sciences, 2008).



The discovery of stygofauna within Bore 103443 approximately five km from the Kevin's Corner MLA and 13 km from mining areas and the irregularity of their detection at other sites, indicates that further sampling is required, in order to address seasonal fluctuations in stygofaunal populations and confirm that stygofauna are not present within the Kevin's Corner MLA.

5.0 RECOMMENDATIONS

The eight *Notobathynella* stygofauna that were recorded in off-lease groundwater bore 103443, represents a significant discovery, given the small sample size of the pilot survey. Therefore, additional groundwater sampling will be conducted both on and off the MLA, to gain a better understanding of the abundance and distribution of stygofauna locally and confirm whether or not the proposed mining activities will have an impact upon local stygofaunal communities.

Since groundwater sampling is required from bores both within and outside the Project MLA over two seasons (in order to account for any seasonal variations in invertebrate communities) additional and suitable off-lease bores need to be sampled, together with further on site bores that intersect alluvial aquifers. Currently, only two bores have been re-sampled and such sampling has occurred within the same season.

All groundwater bores would need to be sampled within and across seasons, including bore 103443 (where stygofauna were recorded) and 1237R (where a surface water species was recorded).

An assessment of additional off-lease bores which are accessible and suitable for Stygofauna sampling needs to be conducted, before any further Stygofauna surveys are planned. Such an assessment would help to ensure that any additional bores which are visited, produce suitable groundwater samples associated with the activities of the mine.

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Appendix A: Stygofauna Sampling Field Methods

Stygofauna Sampling Field Methods

The following field methodology for stygofauna sampling has been created and provided by Australian Laboratory Service's Environmental Water Sciences Group.

1. Take photos of bore and surroundings.
2. Record depth to water table and bore depth.
3. Use the larger diameter net where possible, however if bore is uncased use the 50 millimetre diameter net.
4. Collect samples of groundwater for determination of water quality only from bores that are cased, remembering to lower the bailer slowly into the groundwater in order to minimise splashing, several metres below water table.
5. Record water level, temperature, Electrical Conductivity pH (if possible), Dissolved Oxygen (%) and Dissolved Oxygen (mg/l) (if possible).
6. Lower net with collecting vial attached to the bottom of the bore and raise and lower it four times to dislodge resisting fauna.
7. Slowly pull the net to the surface in a steady motion taking care not to create a bow wave.
8. Empty net into a 50 micron mesh sieve and wash net with water from squirt bottle.
9. Repeat steps 6 to 8 five more times, rinsing net into sieve between each haul.
10. After six hauls, empty contents of sieve into labelled jar with 100% ethanol and stain with a small amount of Rose Bengal. Ensure ethanol makes up at least half of the jars contents.
11. Rinse nets thoroughly with tap water after each bore to remove animals that may be stuck to it.
12. Wash nets and sieve in DECON 90 solution to sterilise before using again and allow to dry during travel to next site.

Appendix B: Photographs of Selected Stygofauna Sampling Bores



Photo Plate 1: Stygofauna Sampling Bore 12030054



Photo Plate 2: Windmill at Stygofauna Sampling Bore 44466



Photo Plate 3: Stygofauna Sampling Bore 103443



Photo Plate 4: Filtering the groundwater sample from Bore 103443



Photo Plate 5: Stygofauna Sampling Bore 44456