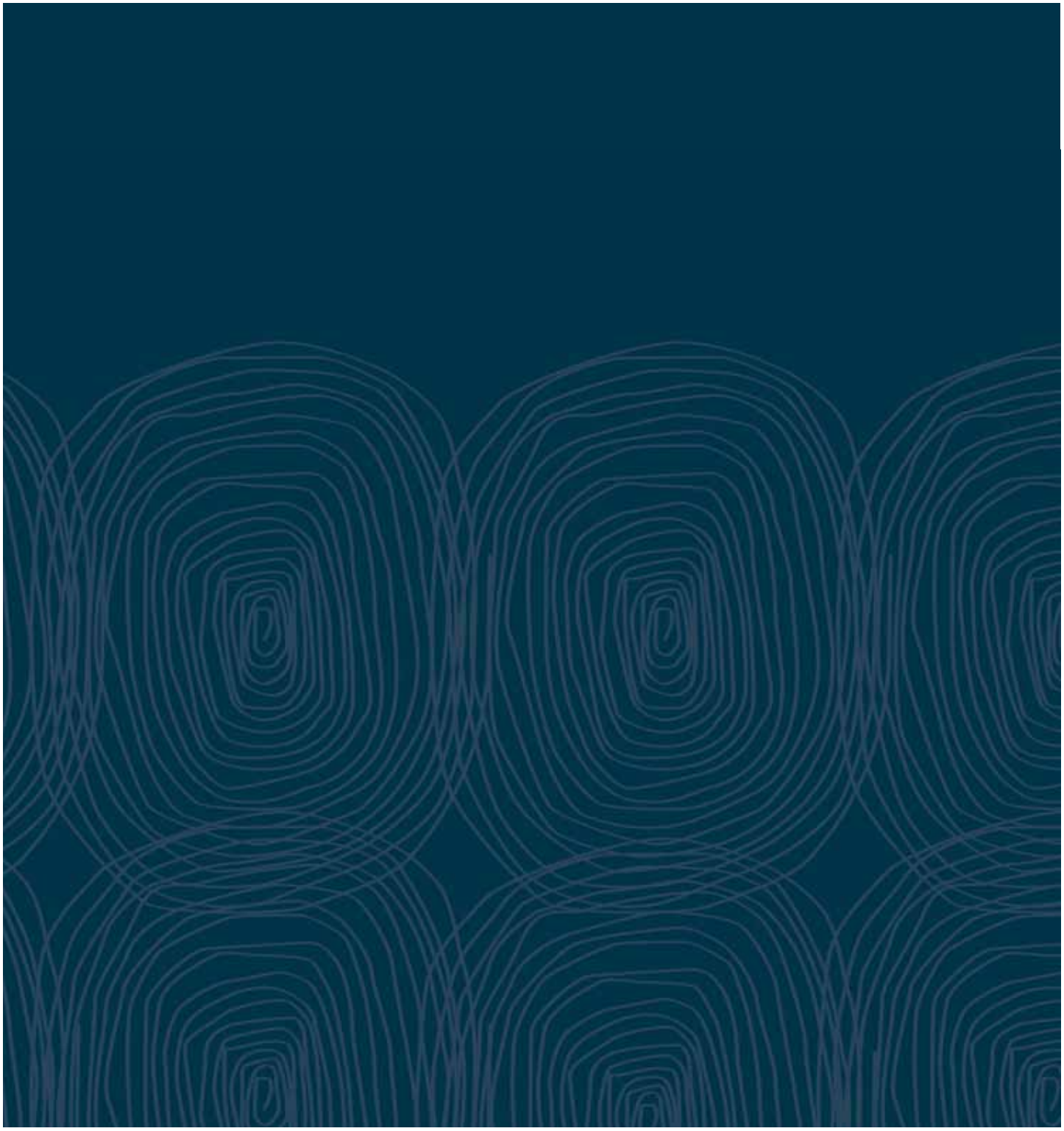
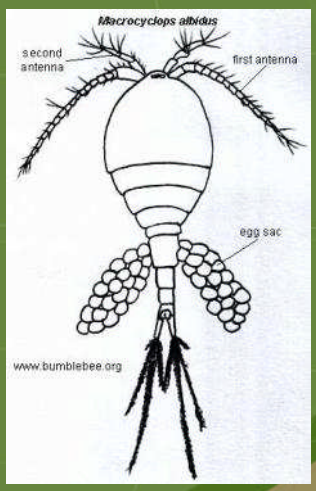
HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

E3 Stygofauna Survey





Alpha Coal Project

Stygofauna Survey

Prepared for:

Hancock Prospecting Pty Ltd

September 2010

AustralAsian Resource Consultants

Document History and Status

Issue	Rev.	Issued To	Qty	Date	Reviewed	Approved
1	0	URS	1	30/07/10	Alison Pearce	Andrew Pearce
2	1	URS	1	07/09/10	Paul Jackson	Andrew Pearce

Author: Paul P Jackson
Project Manager: Andrew Pearce
Name of Client : Hancock Prospecting Pty Ltd
Name of Project: Alpha Coal Project
Title of Document: Stygofauna Survey
Document Version: Final

Opinions and judgments expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions. Information obtained from interviews and contained in the documentation has been assumed to be correct and complete. AustralAsian Resource Consultants Pty Ltd does not accept any liability for misrepresentation of information or for items not visible, accessible, nor able to be inspected at the sites at the time of the site visits.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTO PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

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

EXECUTIVE SUMMARY

The ALS 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 Alpha Coal Project Site (the Project). This work constitutes one of the baseline studies required for the Project's Environmental Impact Statement.

Twenty-eight stygofauna samples were collected from bores on and near the Project site as part of a pilot survey. The only animal found was a single copepod specimen of *Macrocyclops albidus*. This is a widespread surface-dwelling species regularly encountered in groundwater. The occurrence of this species is not significant, and the species is not considered threatened in any way by the Alpha Coal Project operations.

The pilot study was conducted in full compliance with the Western Australia Environmental Protection Authority Guidance Statement 54, and no stygofauna were found. As there are no Queensland-specific stygofauna sampling guidelines, the Department of Environment and Resource Management require proponents to follow the sampling protocols of the Western Australia Environmental Protection Authority. The presence of stygofauna on the Alpha Coal Project site is considered to be unlikely, because the predominant subterranean water bodies on site are coal seam rather than alluvial aquifers.

The presence of *M. albidurus* in Bore 1237R indicated that fauna can occur in the aquifers surrounding the site and although this species is not stygofaunal, it shows that groundwater conditions are suitable for habitation. Therefore, it is possible that stygofauna occur in the alluvial aquifers which were not detected by the pilot study. However, a significant population of stygofauna has not been recorded on the Alpha Coal Project site.

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 Alpha Coal 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 Prospecting Pty Ltd (HPPL) 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 on the Project site and whether or not the proposed mining activities could have an impact upon the local stygofauna community (if present).

1.1 PROJECT DESCRIPTION

HPPL has proposed a new coal mining operation in Central Queensland. The Project is located within Queensland's Galilee Basin approximately 50 km to the north of the township of Alpha, 150km west of Emerald and 420km west of Rockhampton. The Project is focused on mining two thermal coal deposits, identified as Alpha Coal and Kevin's Corner, and an EIS will be prepared for each of these areas. Hancock currently holds two Mining Lease Applications (MLAs), being MLA70425 (Kevin's Corner) and MLA70426 (Alpha Coal), which cover the Project site (refer to Figure 2 for details of the MLA area).

The Alpha Coal Project is a 30 million tonnes per annum (Mtpa) open-cut coal mine with the potential for the future development of significant underground reserves. The operation has an expected mine life of 30 years, and includes the construction and operation of a rail corridor to Abbot Point. The Kevin's Corner Project is adjacent to the Alpha Coal Project and is a 30Mtpa, open-cut and underground long wall coal mine with a 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, processed on site and then transported by rail to the proposed port site.

In concurrence with a range of baseline studies, the stygofauna program has been 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, 2009). 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). With many species restricted to very small geographical areas, therefore, 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 Alpha 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 four major coal seams within the deposit (A to D), which vary in thickness from 5m to 8m. Figure 1 shows a typical east-west cross section across the deposit.

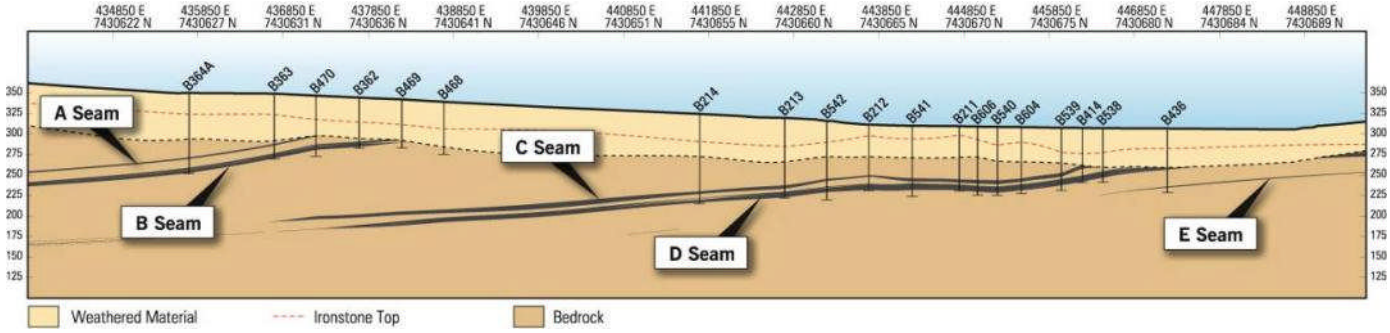


Figure 1 Typical East-West Cross Section Across Deposit

1.4 SCOPE OF WORK

The Scope of Works required for the stygofauna assessment is detailed in two Sections of the Alpha Coal TOR, which have been summarised as follows:

- TOR Section 3.3.4.1:
    - *The EIS should provide a description to Order or Family taxonomic rank of the presence and nature of stygofauna occurring in groundwater likely to be affected by the project. Sampling and survey methods should follow the best practice guideline which is currently that published by the Western Australian Environmental Protection Authority - Guidance for the Assessment of Environmental Factors No.54 (December 2003) and No. 54a (August 2007).*
- TOR Section 3.3.4.2:
    - *In any groundwater aquifers found to contain stygofauna, describe the potential impacts on stygofauna of any changes in the quality and quantity of the groundwater, and describe any mitigation measures that may be applied.*

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. The WA EPA Guidance Statement 54 recommends that for environmental impact assessment, 40 stygofauna samples be collected for each impact area, and an additional 40 be collected from reference bores surrounding the impact area (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 troglofaunal 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.*

There are no known stygofauna from the proposed project area around Alpha, and groundwater has a typically high electrical conductivity, therefore the likelihood of encountering stygofauna on the Project Site is considered to be low. This Project has therefore, adopted the 'Pilot Study' approach outlined in the preceding paragraphs.

2.0 METHODOLOGY

Fourteen samples were collected by AARC in March and April 2010 (refer to Table 2 and Figure 2), and fourteen more were collected in June 2010. A total of fifteen bores fell within the Alpha Coal Project boundary (MLA 70426) and seven occurred outside the Project boundary. Five bores were sampled on two occasions (refer to Table 2 and Table 3). All samples were sent to the ALS Water Science laboratory in Brisbane for processing. The photographic settings of a number of these stygofauna bores are presented in Appendix B. Note that not all bores were photographed.

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

Coordinates are in Geocentric Datum of Australia 1994 (GDA94)

Bore Number	Date sampled	Latitude	Longitude
1122R	28/06/2010	-23.2094	146.47949
1170R	18/03/2010	-23.1639	146.49757
1206R	18/03/2010	-23.1237	146.49905
1215R	18/03/2010	-23.1509	146.49651
1217R	18/03/2010	-23.1597	146.44531
1219R	18/03/2010	-23.1597	146.45530
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		
1242R	15/04/2010	-23.2231	146.41001
	26/06/2010		
1245R	19/04/2010	-23.2608	146.47474
	25/06/2010		
1247R	21/03/2010	-23.0619	146.48570
1250R	15/04/2010	-23.2650	146.45575
	26/06/2010		
1276D	29/06/2010	-23.1088	146.36356
1291R	29/06/2010	-23.2092	146.46367
1325R	24/06/2010	-23.2565	146.52938
1335R	24/06/2010	-23.2892	146.53159
1348D	26/06/2010	-23.2574	146.37317
1350D	15/04/2010	-23.2094	146.46384
1366R	25/06/2010	-23.2368	146.47564
1368R	29/06/2010	-23.0226	146.52075
Stygo 1	29/06/2010	-23.1680	146.53810

Stygofauna samples were collected using a weighted net of 50 micrometre (µm) mesh. Methods are detailed in Appendix A and are briefly described below. The net was lowered to the bottom of each bore, raised and lowered 5 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 50µm sieve. After six hauls the sample was transferred to a labelled jar filled with 100 % AR grade ethanol. Samples were then sent to the ALS Water Science Laboratory in Brisbane for processing and fauna identification.

Rose Bengal, which stains animal tissue pink, was added to each sample before processing to allow stygofauna to be distinguished from sediments and to speed up sorting. Samples were elutriated to separate the heavier mineral component from the lighter organic component of the sample, and poured through a 50µm 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. 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.

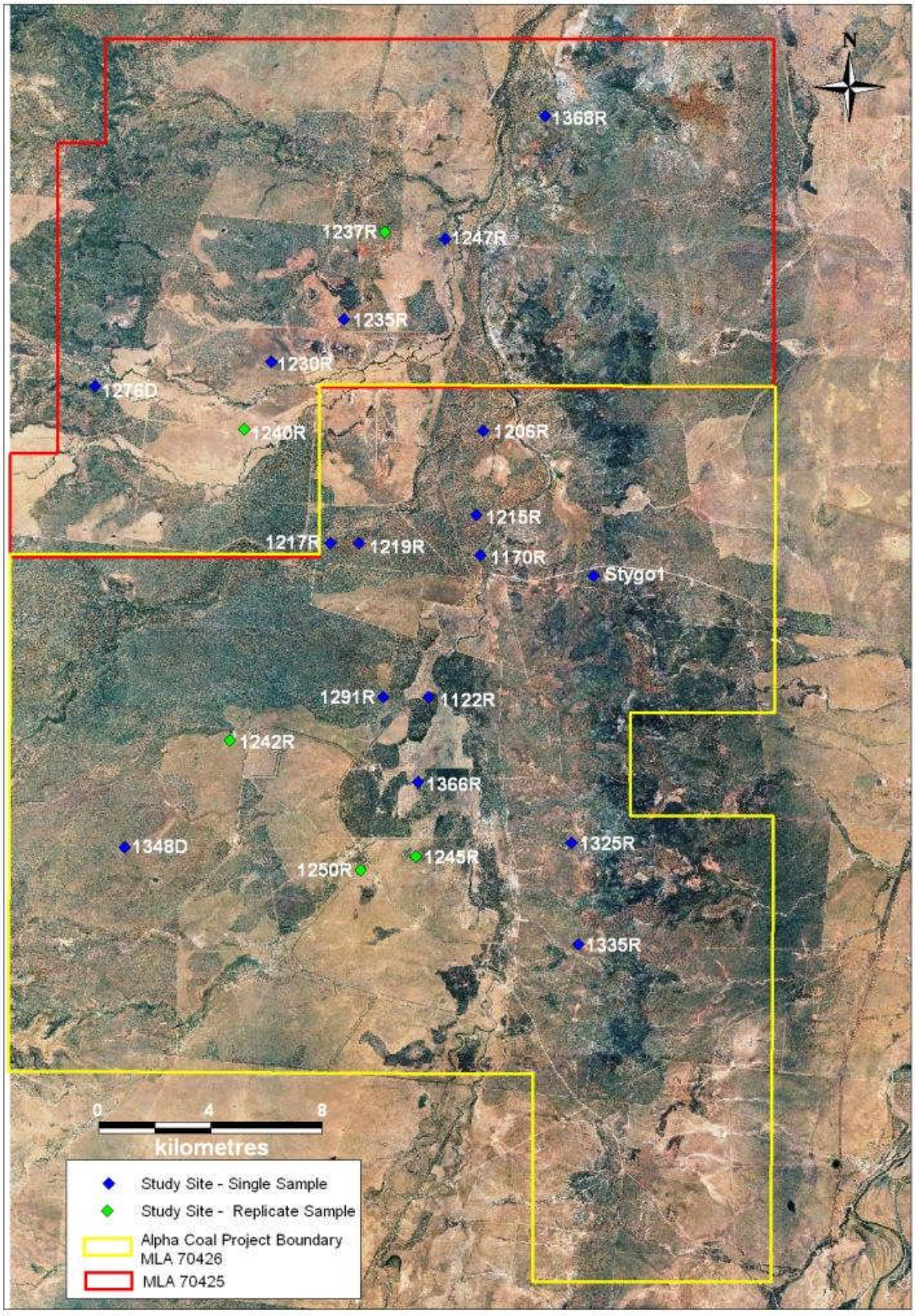


Figure 2 Locations of Groundwater Bores Sampled for Stygofauna

3.0 RESULTS

A single cyclopoid copepod was collected from Bore 1237R in March 2010. This bore occurs outside of the Alpha Coal Project boundary (MLA 70426) but inside the Kevin's Corner Project boundary (MLA 70425) (refer to Figure 2 for details) on a plain between two river branches (refer to Figure 3 for details). This animal was identified as *Macrocyclops albidus* (Jurine, 1820), a cosmopolitan surface-dwelling copepod that is occasionally collected from groundwater.

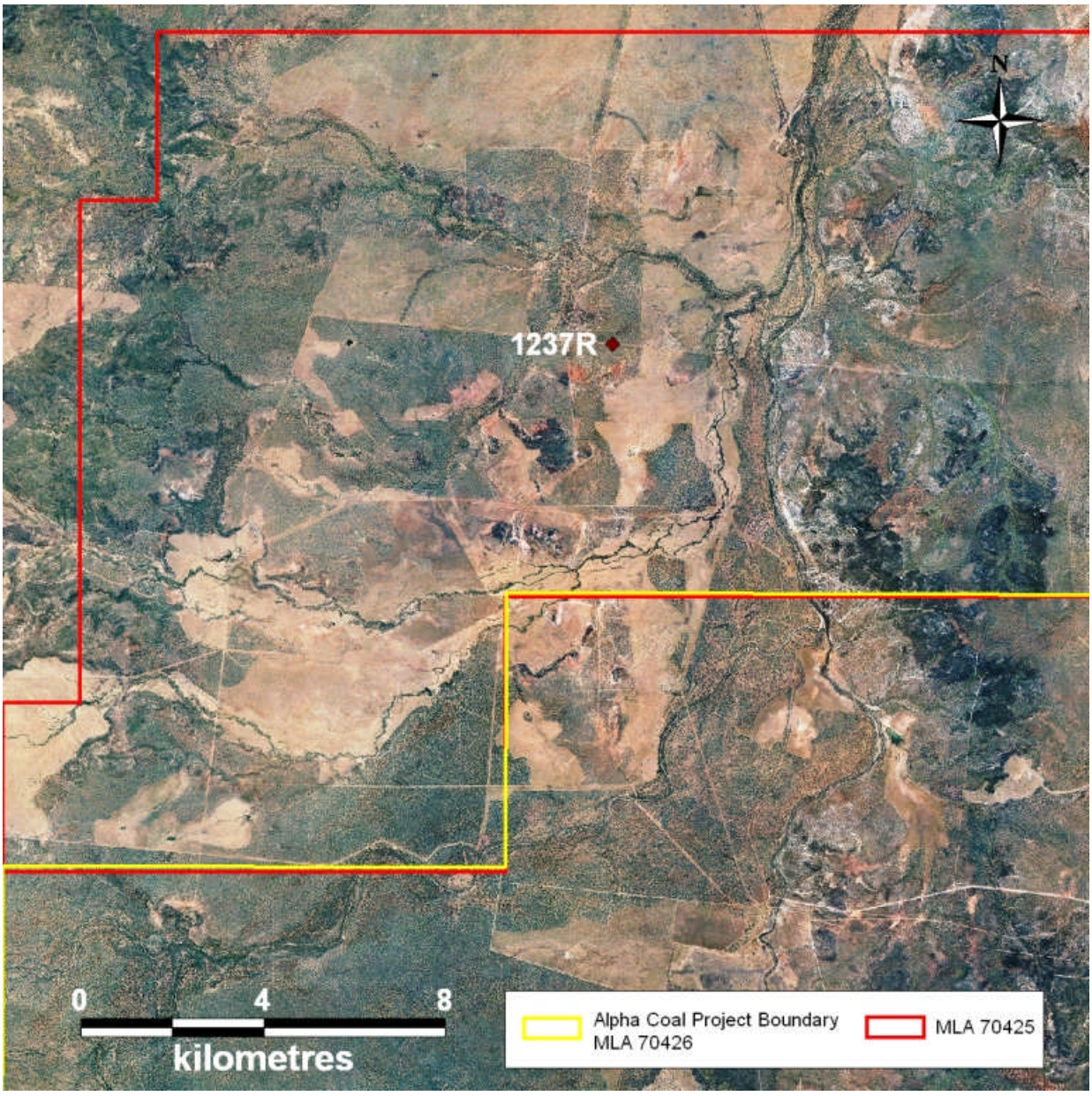


Figure 3 Location of Bore 1237R

Water quality was not measured in March 2010 because of a malfunction in the water quality meter. However, pH, electrical conductivity, and temperature were measured from four bores in April and from all bores in June (refer to Table 3 for water quality details). In the first round of sampling, electrical conductivity ranged between 1.71 and 3.19 milli Siemens per centimetre (mS/cm), pH ranged between 6.57 and 7.16, and the temperature range was between 25.9 and 26.6 degrees centigrade (^{o}C). In June 2010, water level in the bores that were re-sampled was 50-71 cm lower than in April. The Electrical Conductivity (EC) for the re-sampled bores was lower in June and pH was higher (refer to Table 3 for water quality details). Note that depths to groundwater were measured in terms of metres below ground level (m bgl).

Overall, June EC was between 0.6 and 6.72 mS/cm, pH was between 6.5 and 9.15, and temperature was between 26.1 and 30.5^{o}C.

Table 3 Water Quality Measurements from Bore Samples

Bore Number	March/April 2010					July 2010				
	Date sampled	Water level (m bgl)	pH	EC (mScm^{-1})	Temperature (^{o}C)	Date sampled	Water level (m bgl)	pH	EC (mScm^{-1})	Temperature (^{o}C)
1170R	18/03/2010	9	-	-	-					
1206R	18/03/2010	16.7	-	-	-					
1215R	18/03/2010	14.5	-	-	-					
1217R	18/03/2010	21.8	-	-	-					
1219R	18/03/2010	20.1	-	-	-					
1230R	21/03/2010	22.1	-	-	-					
1235R	21/03/2010	44.5	-	-	-					
1237C	21/03/2010	24.1	-	-	-					
1240R	21/03/2010	28.1	-	-	-					
1247R	21/03/2010	7.8	-	-	-					
1242R	15/4/2010	28	7.16	2.16	25.9	26/06/2010	28.55	8.89	1.94	28.3
1250R	15/4/2010	16.8	6.88	2.14	26.3	26/06/2010	17.51	8.26	1.74	30
1350D	15/4/2010	14.7	6.57	3.19	26.6					
1245R	19/4/2010	14.5	6.75	1.71	25.9	25/06/2010	15	8.64	1.53	27.9
1325R						24/06/2010	15.5	8.67	0.6	27.4
1335R						24/06/2010	28.82	6.84	0.46	28.5
1366R						25/06/2010	8.65	7.08	0.22	30.5
1348D						26/06/2010	24.93	6.78	0.65	30.2
1122R						28/06/2010	8.64	7.65	1.25	26.2
1237R						29/06/2010	24.2	8.42	1.38	27.6
1240R						29/06/2010	28.1	7.77	6.72	28.2
1276D						29/06/2010	9.15	9.15	3.72	28.4
1291R						29/06/2010	12.08	7.8	1.33	27.8
1368R						29/06/2010	11.51	6.5	1.73	27.8
Stygo1						29/06/2010	25.51	7.35	1.4	26.1

4.0 DISCUSSION

Only one aquatic animal occurred in the 28 samples collected during the Alpha Coal Project stygofauna pilot survey. A single *Macrocyclops albidus* (Jurine, 1820) was found in Bore 1237R in March 2010. This species is a widespread surface species known from Australia, America, and Europe. 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 bores that were sampled for stygofauna, permeate sectors of groundwater that are likely to be affected by the Alpha Coal Project. No significant stygofauna populations were found in the impact area of the Alpha Coal Project, so mining here is unlikely to significantly threaten stygofauna. Bore 1237R occurs outside the Alpha Coal Project boundary, but inside the adjacent Mining Lease. This area may still be impacted by longwall mining operations or dewatering of the open pit mine if the drawdown cone extends to the bore. However, given the widespread occurrence of *Macrocyclops albidus*, any impact will not place the species at risk from extinction.

It was initially thought that the aquifers around the Alpha Coal MLA would be devoid of fauna. Although no stygofauna were found, the pilot survey did record a surface-dwelling copepod within a bore with the water table 24m below ground. This suggests that the alluvial aquifer, at least, might contain more species. The current study design targeted coal seam aquifers rather than alluvial aquifers due to the nature of the bores available. However, it is possible that stygofauna occur in alluvial aquifers which may not have been identified or sampled by the pilot study.

Sampling in other parts of Queensland and New South Wales indicate that alluvial aquifers adjacent to permanently large rivers can have 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).

Water quality measurements were not collected from Bore 1237R, but the EC of surrounding bores was between 1.71 and 3.19 mS/cm at the time of collection. In Queensland, stygofauna occur in bores of the Burnett region with EC between 0.2 and 11 mS/cm, and in the Pioneer Valley between 0.2 and 18 mS/cm (Hancock and Boulton, 2008), so the groundwater EC in the Alpha Project area is within the range of known tolerance.

Repeat sampling of the same 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). For the purposes of this study, repeat sampling of three bores and sampling of an additional eleven bores in June 2010, also failed to find any stygofauna.

5.0 RECOMMENDATIONS

Twenty-eight groundwater samples collected from two sampling rounds and twenty-two bores did not find any stygofauna at the Alpha Coal Project. Sampling complied with the requirements for a stygofauna pilot study outlined by WA EPA (2003). Therefore, it is not considered that significant stygofauna populations exist at the Alpha Coal Project site.

If the full sampling regime for Guidance Statements 54 and 54a is required, the collection of another 22 samples would bring the total number of samples collected to 40. Guidance Statements 54 and 54a require re-sampling from at least 10 bores over two seasons to account for any seasonal variations in invertebrate communities. Currently, there are only five bores that have been sampled twice and this would need to be increased to 10 (i.e. another five bores should to be re-sampled) if it were necessary to comply with Guidance Statements 54 and 54a. Re-sampling could include bore 1237R, in which the surface water species was found, to determine if this species is a consistent inhabitant of this bore.

6.0 REFERENCES

Biota Environmental Sciences (2008). *BHP Billiton Regional Subterranean Fauna Study (Stygofauna) 2005-2007 Final Report. August 2008*. Prepared for BHP Billiton Iron Ore.

Culver, D.C., Christman, M.C., Sket, B. & Trontelj, P. (2004). *Sampling adequacy in an extreme environment: species richness patterns in Slovenian caves*. Biodiversity and Conservation, 13, 1209-1229.

Eberhard, S.M., Halse, S.A., Williams, M. R., Scanlon, M.D., Cocking, J, Barron, H.J. (2009). *Exploring the relationship between sampling efficiency and short range endemism for groundwater fauna in the Pilbara region, Western Australia*. Freshwater Biology, 54, 885-901.

EPA (2003). *Guidance for the assessment of environmental factors (in accordance with the Environmental Protection Act 1986). Sampling of subterranean fauna in groundwater and caves*. Guidance Statement 54. Environmental Protection Authority, Western Australia.

EPA (2007). *Guidance for the assessment of environmental factors (in accordance with the Environmental Protection Act 1986).Sampling methods and survey considerations for Subterranean Fauna in Western Australia*. Guidance Statement 54a: Technical appendix for Guidance Statement 54. Environmental Protection Authority, Western Australia.

Hancock, P.J. and Boulton, A.J. (2008). *Stygofauna biodiversity and endemism in four alluvial aquifers in eastern Australia*. Invertebrate Systematics 22, 117-126.

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 (for Dissolved Oxygen measurement), several metres below water table.

5. Record temperature, Electrical Conductivity, pH, 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 1170R**

Photo Plate 2: **Stygofauna Sampling Bore 1206R**

Photo Plate 3: **Stygofauna Sampling Bore 1215R**

Photo Plate 4: **Stygofauna Sampling Bore 1217R**

Photo Plate 5: **Stygofauna Sampling Bore 1242R**

Photo Plate 6: **Stygofauna Sampling Bore 1245R**

Photo Plate 7: **Stygofauna Sampling Bore 1250R**

Photo Plate 8: **Stygofauna Sampling Bore 1325R**

Photo Plate 9: **Stygofauna Sampling Bore 1348D**

Photo Plate 10: **Stygofauna Sampling Bore 1348D**

Photo Plate 11: Stygofauna Sampling Bore 1366

Photo Plate 12: Stygofauna Sampling Bore Stygo 1