BHP Billiton Iron Ore

Stygofauna Assessment at OB29/30/35, Mount Whaleback

Final Report

Prepared for BHP Billiton Iron Ore
by Bennelongia Pty Ltd

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Stygofauna Assessment at OB29/30/35, Mount Whaleback

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Cover photo: Paramelitidae sp. B33

Client – BHP Billiton Iron Ore Pty Ltd

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EXECUTIVE SUMMARY

BHP Billiton Iron Ore Pty Ltd is proposing to mine below the watertable at the existing mining operations associated with Orebodies 29 and 30 (OB29 and OB30) and at an approved mine at Orebody 35 (OB35) in the Ophthalmia Range near the town of Newman in the Pilbara (the Proposal).

OB29, OB30 and OB35 are satellite deposits of the existing Mount Whaleback mine at Newman and lie in a syncline approximately 1.5 kilometres (km) to the south of the main Mount Whaleback mining operations. The proposed mining at OB35 will utilise existing infrastructure at Mount Whaleback.

An environmental impact assessment is being prepared as the basis for approval to mine below the watertable at OB29, OB30 and OB35 deposits. The main ground disturbance components and activities proposed to be associated with mining below watertable at OB29, OB30 and OB35 are as follows:

- Progressive open pit mining below the watertable of overburden and ore using similar open pit mining techniques to those currently approved for mining and in use at OB29 and OB30; and
- De-watering of local aquifers to prevent mine pit flooding.

De-watering may cause significant threat to restricted stygofauna species as a result of loss of habitat. For the purpose of assessing threat to stygofauna associated with Proposal development, predicted drawdown >2 m from natural fluctuations was considered to constitute a potentially significant impact.

Field survey of stygofauna in the vicinity of the Proposal was conducted according with the general principles laid out in EPA Guidance Statements Nos 54 and 54A. Altogether 43 samples have been collected within the area where predicted drawdown is >2 m. This survey effort meets EPA recommendations. Furthermore, because an additional 1658 samples have collected elsewhere in the Newman area (mostly to the east), there is a better local context for this assessment than any other conducted to date in the Pilbara.

With only nine species recorded, the Proposal drawdown area is depauperate in stygofauna compared with the wider Newman area, which has at least 53 species. The most likely explanation for fewer stygofauna species in the Proposal area is that it contains poorer quality stygofauna habitat than some other parts of the Newman area. There is only a small area of saturated Tertiary Detritals and, notably, no calcrete within the Proposal drawdown area, whereas significant areas of these habitats occur in the wider Newman area. The main habitat in the Proposal area is banded iron formation, which is less prospective for stygofauna.

All the species collected within the area of predicted groundwater drawdown associated with the Proposal (the impact footprint) are also known, or considered highly likely, to occur in locations not impacted by mining and associated activities. Habitat characterisation and stygofauna sampling results provided a similar picture in terms of suggesting that stygofauna habitat within the Proposal area is connected with stygofauna habitat in the downstream Ophthalmia floodplain. Species such as *Chydaekata* sp. and Paramelitidae sp. B33 occurred in both areas.

None of the stygofauna species collected in the Proposal impact footprint is considered likely to be restricted to, or have a substantial proportion of its population within, the Proposal impact footprint. Therefore, proposed dewatering at OB29, 30 and 35 is unlikely to have significant conservation impact on any stygofaunal species within the Proposal area.

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1. INTRODUCTION

BHP Billiton Iron Ore Pty Ltd is proposing to mine below the watertable at the existing mining operations associated with Orebodies 29 and 30 (OB29 and OB30) and an approved mine at Orebody 35 (OB35) in the Ophthalmia Range near the town of Newman in the Pilbara (the Proposal).

OB29, OB30 and OB35 are satellite deposits of the existing Mount Whaleback mine at Newman and lie in a syncline approximately 1.5 kilometres (km) to the south of the main Mount Whaleback mining operations and 5 km west of Newman town. OB29 and OB30 have been and continue to be mined above the water table. Mining at OB35 is due to commence in 2013 and will utilise existing infrastructure at Mount Whaleback.

An environmental impact assessment is being prepared as the basis for approval to mine below the watertable at OB29, OB30 and OB35 deposits. The main ground disturbance components and activities proposed to be associated with below watertable mining at OB29, OB30 and OB35 deposits are as follows:

- Progressive open pit mining below the watertable of overburden and ore using similar open pit mining techniques to those currently approved for mining and in use at OB29 and OB30; and
- De-watering of local aquifers to prevent mine pit flooding.

The focus of this impact assessment is stygofauna. Stygofauna are aquatic subterranean species, living below the earth's surface in cave lakes and in groundwater. Stygofauna and other subterranean species are a focus of environmental assessment because a high proportion of them have localised distributions (Gibert and Deharveng 2002). According to Eberhard *et al*. (2009), about 70% of Pilbara stygofauna species are likely to be short range endemics (SREs) as defined by Harvey (2002), with many of them having much smaller ranges than Harvey's SRE criterion of 10,000 km^2. Species with restricted ranges are vulnerable to extinction following habitat destruction or environmental changes (Ponder and Colgan 2002; Fontaine *et al*. 2007). In addition to the legal requirement under the *Wildlife Conservation Act 1950* to ensure conservation of all species, there are a variety of other reasons to want to avoid causing extinction of invertebrate species, including their considerable contributions to ecosystem maintenance and their potential scientific and genetic values (Wilson 1987).

Above the watertable mining at OB29 and OB30 has been undertaken since 1974 and 1999, respectively, while mining is planned to commence at OB35 in 2013. The future mining at these three deposits is proposed to extend below the watertable and the potential threat to stygofauna requires investigation (EPA 2003).

Groundwater drawdown of ≥2 m associated with the Proposal is predicted to cover an area of approximately 7059 hectares (ha). Such an area of drawdown may pose a threat to the persistence of any highly restricted species of stygofauna occurring within the impact footprint. This report presents the results of stygofauna survey at the Proposal.

The stygofauna survey formed part of a broader survey program for subterranean fauna in the Pilbara that BHP Billiton Iron Ore began in November 2007 (Regional Subterranean Fauna Sampling Program, RSFSP). It now involves more than 30 Survey Areas (Figure 1). Data from the RSFSP have been used in conjunction with the results of stygofauna survey at the Proposal to better understand the relationships between the local stygofauna community and that in the surrounding subregion.

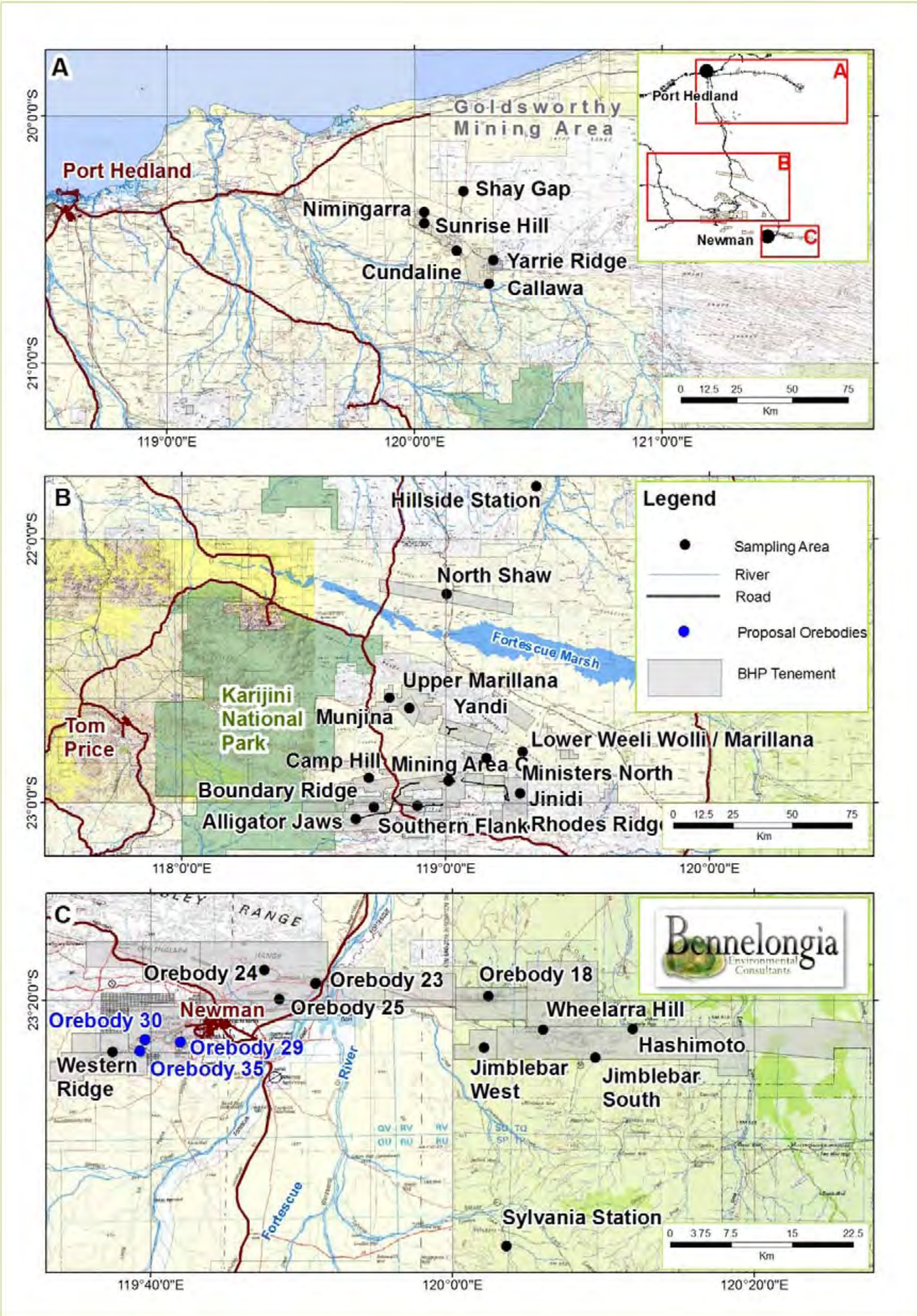

Figure 1. The Proposal Site (Panel C) in Relation to Other Locations Sampled during the BHP Billiton Iron Ore Regional Subterranean Fauna Sampling Program.

The specific objectives of this assessment were:

(1) To describe the stygofauna community present at the Proposal.

(2) To determine the conservation status of the stygofauna species present.

(3) To assess whether the conservation status of any stygofauna species is likely to be affected significantly by development of the Proposal.

2. STYGOFAUNA

Stygofauna are predominantly crustaceans, although stygofaunal worms, snails and water mites also occur. In addition, groundwater contains nematodes, bdelloid rotifers and some other groups with taxonomy that is so poorly resolved that stygal species cannot be reliably distinguished from surface forms. In general, stygofauna are characterised by the loss of eyes and skin pigmentation and development of a vermiform body shape and more elongated appendages than surface relatives, although some species retain reduced eyes and not all species have a vermiform shape.

Studies to date suggest that the Pilbara region contains the richest stygofauna communities in Australia, with 54 species collected from an individual bore and a total of about 350 species known from the region (Halse *et al*. in prep.). New species are constantly being discovered (Finston *et al*. 2008; Karanovic and Hancock 2009) and it has been estimated that 500-550 species of stygofauna will eventually be found (Eberhard *et al*. 2009). Thus, the Pilbara is not only rich in stygofauna at an Australian level; it also has outstanding richness by global standards (Guzik *et al*. 2011).

2.1. Habitat Requirements for Stygofauna

Stygofauna occur in an array of different groundwater habitats including porous, karstic and fractured-rock aquifers, springs and the hyporheos of streams (Eberhard *et al*. 2005). Calcrete and alluvium are typically considered productive habitats for stygofauna, as are mafic volcanics, whereas banded iron formations usually support relatively few species (Halse *et al*. in prep.). Stygofauna inhabit fissures and voids in groundwater aquifers, and there is a correlation between transmissivity and the suitability of the aquifer for stygofauna. Both lateral and vertical connectivity of fissures and voids are important. Lateral connectivity enables animals to move about underground, while vertical connectivity through to the surface enables recharge of carbon and nutrients to the stygofauna community.

Stygofauna have mostly been recorded from fresh to brackish groundwater but may occur in salinities up to 60,000 mg/L TDS (Watts and Humphreys 2006; Reeves *et al*., 2007; Ecologia 2009). Apart from salinity, the physicochemical tolerances of stygofauna to different groundwater parameters have been poorly defined. It should also be noted that in the vast majority of stygofauna studies, physicochemical parameters have been recorded in the upper metre of the aquifer, which may not reflect the conditions experienced by stygofauna in deeper groundwater.

3. PROJECT IMPACTS

Two types of impacts, as a result of mining below the watertable, are recognised in this report: 1) *Primary Impacts* are impacts from proposed mining below the watertable at the Proposal that have the potential to threaten the persistence of stygofauna through direct removal of habitat; and 2) *Secondary Impacts* are impacts that reduce the quality of subterranean fauna habitat and reduce population densities rather than threatening species persistence (Scarsbrook and Fenwick 2003; Masciopinto *et al*. 2006).

Primary impacts at the Proposal are the removal of stygofauna habitat as mine pits are excavated and as dewatering occurs. In practice, the removal of pit habitat occurs within the area of groundwater dewatering and it is sufficient to assess the dewatering impact alone.

Secondary impacts include: 1) percussion from blasting; 2) aquifer recharge with poor quality water; and 3) contamination of groundwater by hydrocarbons.

The assessment in this report is focussed on primary impacts at the Proposal. Secondary impacts are not considered further because they do not threaten species persistence. However, some additional information on secondary impacts is given in Appendix 1.

3.1. Primary Impacts at the Proposal

Dewatering of aquifers to prevent flooding of mine pits is likely to lead to significant risk to restricted stygofauna species through loss of habitat. At the Proposal, predicted drawdown >2 m from natural fluctuations was considered to constitute Primary Impact because annual variation in groundwater levels as a result of variable rainfall is only 1-2 m in the Pilbara (Johnson and Wright 2001). Drawdown of >2 m represents twice natural variability.

The predicted area of >2 m groundwater drawdown will cover approximately 7059 hectares (ha), extending east-west for about 14 km from Western Ridge to Newman and north-south from Mount Whaleback for around 4.5 km (Figure 2). This area is referred to as the 'impact footprint'.

4. HABITAT ASSESSMENT

4.1. Geology

The Pilbara Craton dates back to the Archaean. It is overlain by Proterozoic rocks deposited in the Hamersley and Bangemall Basins. The Hamersley Basin, which occupies most of the southern part of the Pilbara Craton, can be divided into three broad stratigraphic units: the Fortescue, Hamersley and Turee Creek groups (Beard 1975). Of the three groups, the Hamersley Group is the most relevant to this study.

The stratigraphy within the impact footprint and surrounds can be generalized as consisting of the sequence of Tertiary Detritals (mostly alluvium) that occur mostly in association with creeklines and valleys and the underlying Hamersley Group bedrock that includes Mount McRae Shale (mudstone, siltstone, chert), Mount Sylvia Formation (mudstone, siltstone, chert), Wittenoom Formation (Paraburdoo Member [dolomite, chert], West Angela Member [shale, dolomite]) and Mara Mamba Iron Formation (Mount Newman Member, Macleod Member and Nammuldi Member). This is underlain by Jeerinah Formation (shales and cherts) of the Fortescue Group (RPS Aquaterra 2012) (Appendix 2). OB29, OB30 and OB35 are mostly hosted by the upper members of the Marra Mamba Iron Formation (MacLeod and Mount Newman) although mineralisation extends to the lower Nammuldi Member and into the overlying West Angela Member of the Wittenoom Formation (RPS Aquaterra 2012).

Spatially, there is considerable heterogeneity in the stratigraphy within the impact footprint because of folding, faulting and weathering and this is evident in the interpreted cross sections provided in Appendix 2. Western Ridge, in the western portion of the impact footprint, is part of a syncline that extends to and includes OB35. OB30 to the north is part of a lower syncline

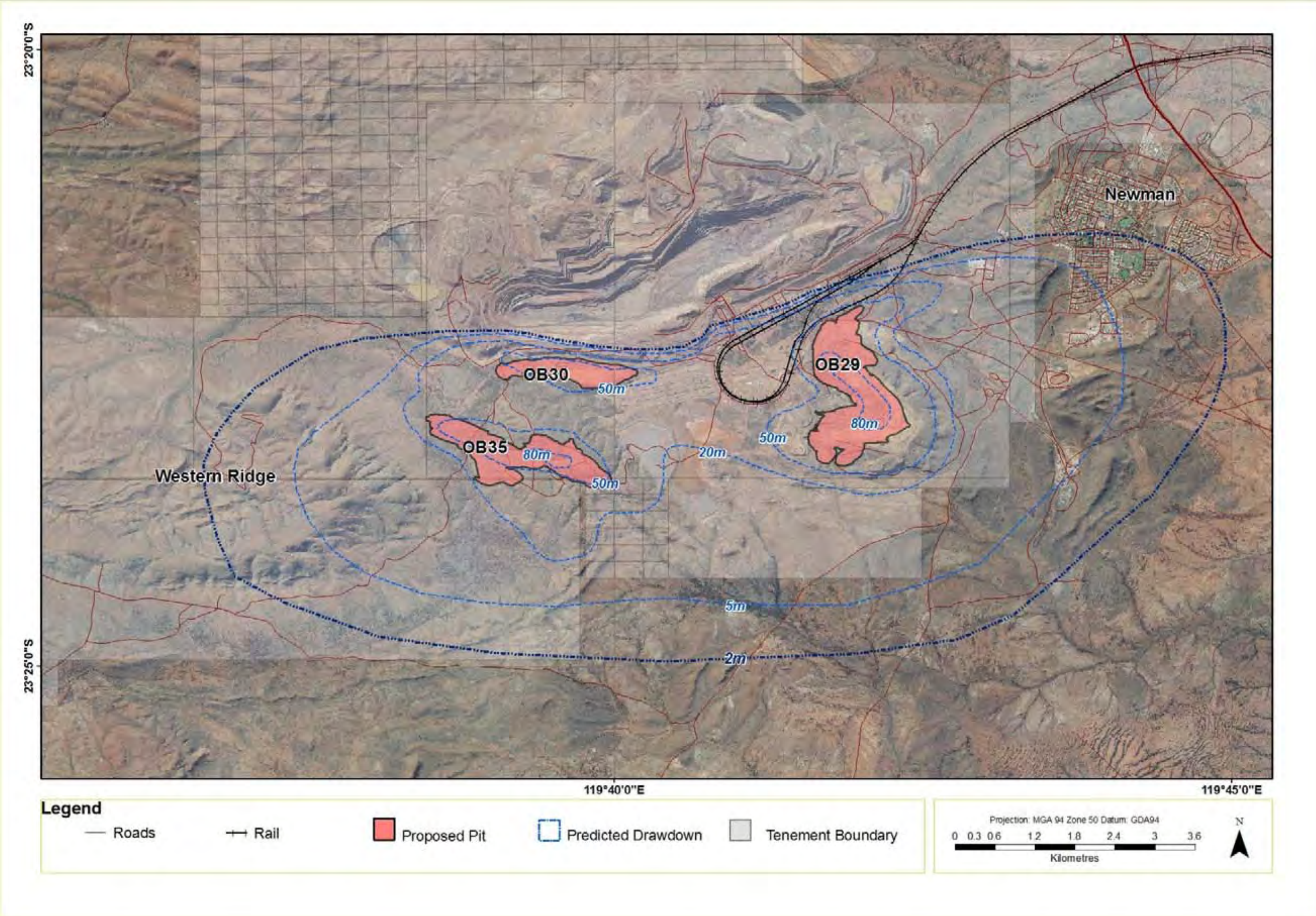

Figure 2. Pit Outlines and Extent of Groundwater Drawdown Associated with the Proposal.

and to the east OB29 lies within a large scale north-west plunging open syncline. The geology to the east and southeast of OB29 is similar to that around OB30 and OB35 but has not been well characterised. To the south of the orebodies, the Tertiary Detrital sequence tends to be deeper but again the geology in this area is not as well understood as that in the vicinity of the orebodies.

4.2. Hydrogeology

Within the impact footprint and broader subregional setting, groundwater occurrence and flow is predominantly influenced by local scale aquifer systems hosted by the Banded Iron Formation and by more superficial, sub-regional scale aquifer systems occurring in Tertiary Detrital valley-fill successions overlying dolomites of the Paraburdoo Member of the Wittenoom Formation.

In the Newman area, there are three main interpreted aquifer systems that occur in:

1. Tertiary Detrital valley-fill successions (where saturated);
2. Paraburdoo Member; and
3. Marra Mamba Formation of the orebodies.

The local aquifers at the Proposal itself are interpreted to occur within the iron ores of the Marra Mamba Formation (RPS Aquaterra 2012). Transmissivity of the aquifer is comparatively high and related to the fractures and vuggy textures remaining from the processes that formed the iron mineralisation. However, vertical permeability is probably highly variable as a result of the occurrence of thin bands containing a higher silt/clay fraction. In the less mineralised Nammuldi Member, transmissivity may be predominantly linked to fracture zones and is interpreted to be significantly less than where there has been iron enrichment. The stratigraphically higher West Angelas and stratigraphically lower Jeerinah Formations typically have a much lower permeability (RPS Aquaterra 2012).

The Marra Mamba aquifer system has potential to be hydraulically connected more widely via the underlying Wittenoom Formation aquifer system and the overlying Tertiary Detritals (RPS Aquaterra 2012, 2013). Groundwater flow is interpreted to be typically aligned with topography and compatible with the surface water divides. Groundwater connectivity is greater to the south, east and west of the proposed mine pits than it is to the north towards Mount Whaleback (RPS Aquaterra 2013) and this variation in connectivity is reflected in the predicted groundwater drawdown contours (Figure 2).

4.3. The Proposal Area as Stygofauna Habitat

All the aquifers occurring in the area of the Proposal are likely to contain voids, cavities or fractures and, therefore, represent prospective stygofauna habitat. However, the Tertiary Detritals and, if it is significantly weathered, the underlying dolomite of the Wittenoom Formation are likely to contain more fauna. Despite fault and fracture systems in the area having considerable hydraulic connectivity (RPS Aquaterra 2013), previous surveys in the region suggest that the Marra Mamba Formation aquifer is likely to contain less fauna (Halse *et al*. in prep.).

5. STYGOFAUNA SURVEYS

5.1.1. Stygofauna Surveys Relevant to the Proposal

Stygofauna have been surveyed in the Newman area on behalf of BHP Billiton Iron Ore by a number of consultants since 1997 and, in total, 1701 stygofauna samples have been collected. Altogether, 1250 samples have collected under the RSFSP and 451 samples were collected prior to that program (Appendix 3). Surveys were conducted for Environmental Impact Assessment for OB23 and OB25

(Eberhard and Humphreys 1999; Biota 2001a,b, 2004), OB18 (Biota 2004) and Jimblebar (Ecowise 2009). Other sampling was undertaken to comply with Ministerial Conditions for OB23 and OB25 (Biota 2008; Subterranean Ecology 2010, 2012). Further baseline survey was undertaken under the RSFSP (ALS 2010). Collectively, the sampling undertaken in these reports and in additional surveys make the Newman area the most extensively studied part of the Pilbara for stygofauna.

5.1.2. Sampling at the Proposal

Stygofauna survey at the Proposal was conducted according to the general principles laid out in EPA Guidance Statements Nos 54 and 54A (EPA 2003, 2007). Altogether 43 stygofauna samples have been collected from 19 bores within the area of predicted groundwater drawdown >2 m (Figure 3). A list of bores sampled is given in Appendix 4.

5.1.3. Sampling Methods

Stygofauna sampling followed the methods outlined in Eberhard *et al*. (2005) and recommended by the EPA (2007). At each bore, six net hauls were collected using a weighted plankton net. After the net was lowered to the bottom of the bore it was jerked up and down briefly to agitate benthic and epibenthic stygofauna into the water column prior to a slow retrieve of the net. Contents of the net were transferred to a 125 ml polycarbonate vial after each haul and were preserved in 100% ethanol. Nets were washed between bores to minimise contamination between sites. Three hauls were taken using a 50 µm mesh net and three with a 150 µm mesh net.

5.1.4. Other Sampling

Records of stygofauna collected as by-catch during troglofauna sampling are included in sampling results. These records provided additional information on species distribution and conservation significance. In total, 35 troglofauna scrapes (using similar netting techniques to those for stygofauna) intersected the watertable (Figure 3).

6. RESULTS

6.1. Stygofauna Occurrence and Abundance

Sampling yielded 181 stygal animals belonging to least nine species of five higher level taxonomic groups, including Oligochaeta (2 species), Ostracoda (1 species), Copepoda (3 species), Amphipoda (2 species) and Nematoda (treated as 1 species but probably more) (Table 1, Appendix 5).

Copepods and oligochaetes were the numerically dominant groups, with *Enchytraeus* Pilbara sp. 2 (PSS) and *Diacyclops humphreysi humphreysi* the only species collected in large numbers (Figure 4). All other species were represented by <20 animals.

The yield of stygofauna in different parts of the Proposal was proportional to the number of holes sampled and hence most stygofauna specimens were recorded at OB35 (Figure 5). The aquifers within the Proposal extend across all orebodies, however, and it is expected that a single stygofauna community occurs in the Proposal. Only a small proportion of the Tertiary Detritals is saturated at OB35 and the stygofauna collected are most likely to have occurred in either the Paraburdoo Member aquifer or the deeper Marra Mamba aquifer (Figure 5, see Section 4.2 and Appendix 3).

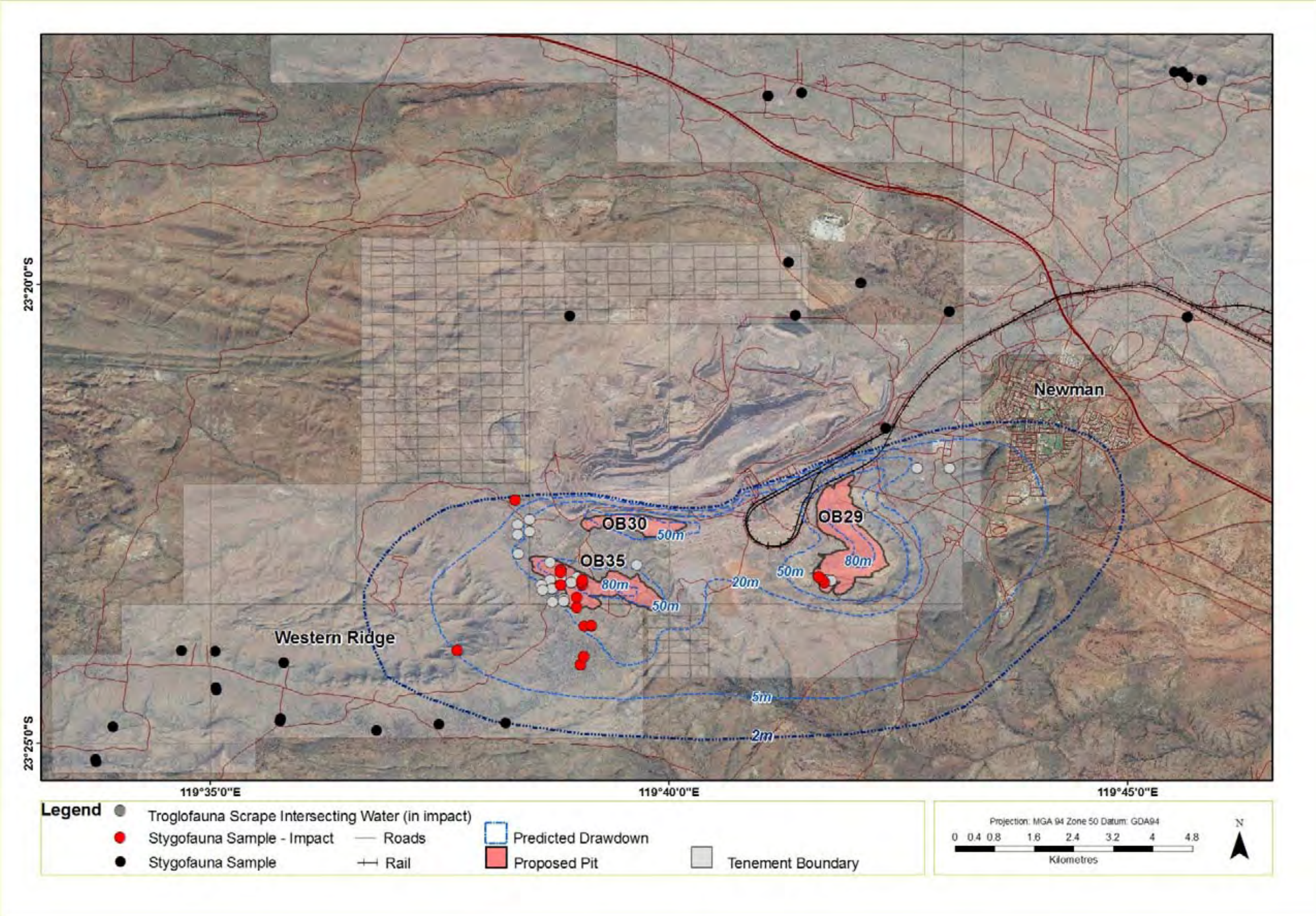

Figure 3. Bores Sampled for Stygofauna within the Impact Area Associated with the Proposal.
Note that locations of troglofauna scrape samples yielding stygofauna are shown, as well as locations of some regional stygofauna samples in the vicinity of the Proposal.

Table 1. Stygofauna Species Recorded at the Proposal.

Higher Groups Species	**Number of Specimens**	**Other Records**
Nematoda		
Nematoda sp.	15	Not assessed in EIAs, but widespread in Pilbara[1,2]
Oligochaeta		
Enchytraeus Pilbara sp. 2 (PSS)	92	Pilbara-wide[2,3]
Phreodrilid with dissimilar ventral chaetae	4	Pilbara-wide[2,3]
Ostracoda		
Origocandona grommike	3	Central Ophthalmia*, Upper Ophthalmia, Newman[3]
Copepoda		
Diacyclops humphreysi humphreysi	50	Pilbara-wide and beyond[3,4]
Fierscyclops sp. B03 (nr *frustratio*)	6	South Flank, Upper Fortescue Catchment*[5]
Parastenocaris sp.	1	Probably one of two *Parastenocaris* species known from the Upper Fortescue, both occur in non-impacted areas [3,5,6]
Amphipoda		
Chydaekata sp.	1	Probably one of two *Chydaekata* species known from the Upper Fortescue, both occur in non-impacted areas[3,5,6]
Paramelitidae sp. B33	3	Lower Ophthalmia, Shovelanna/Sylvania Station, OB24*, Newman*[3,4]

[1]EPA (2007); [2]Halse *et al.* (in prep); [3]Regional Subterranean Fauna Sampling Program; [4]Pesce and De Laurentiis (1996); [5]Bennelongia unpublished data; [6]Subterranean Ecology (2012)
*Recorded in bore/s impacted by groundwater drawdown

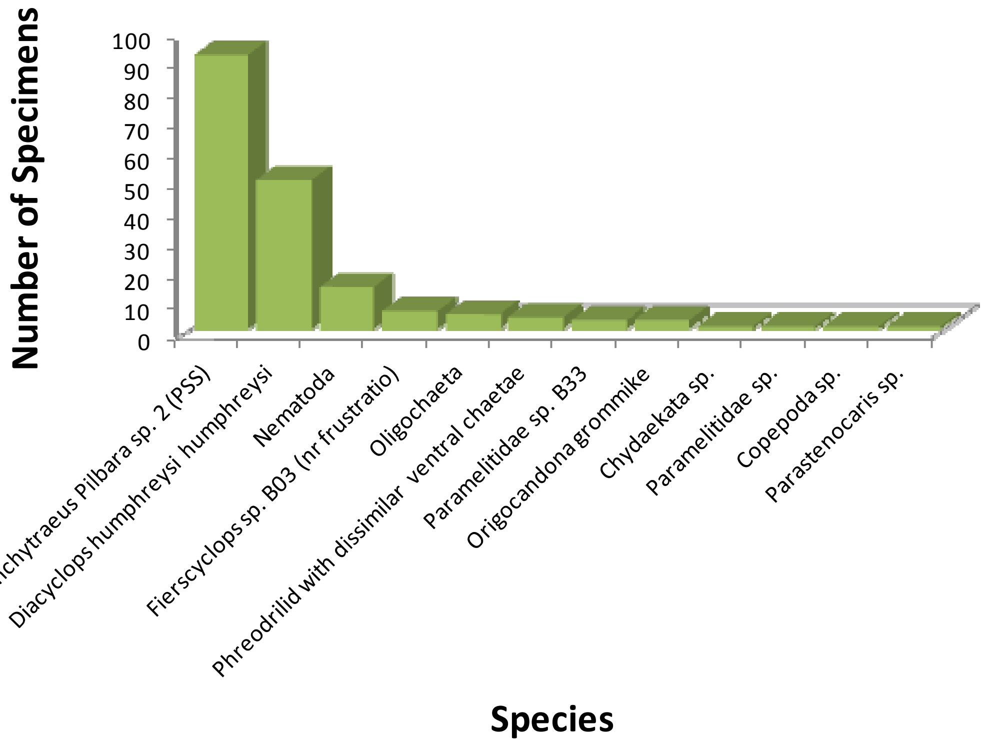

Figure 4. Capture Abundance of each Stygofauna Species Recorded at the Proposal.

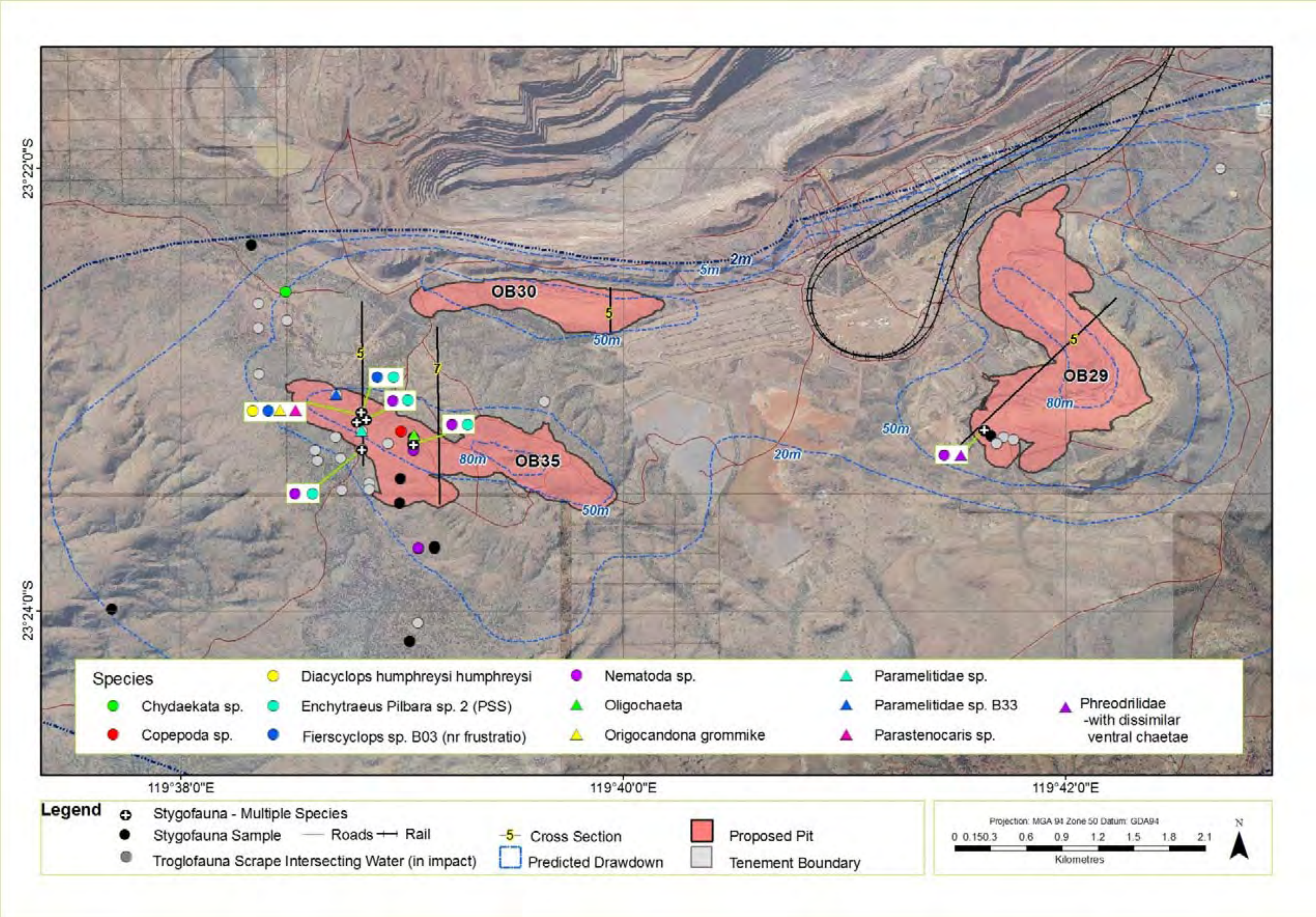

Figure 5. Locations where Stygofauna were Collected at the Proposal.

Stratigraphic cross sections are shown in Appendix 2.

6.2. Species Identification Issues

Some stygofauna could not be identified to species level. When they clearly represented additional species (the copepod *Parastenocaris* sp. and amphipod *Chydaekata* sp.), they were listed in Table 1.

When it was likely the specimens belonged to species listed in Table 1 but could not be identified to species level because of their condition, they are listed in Table 2 at the level of identification achievable.

Table 2. Higher Order Identifications Collected at the Proposal.

Taxa	Number of specimens	Likely Species
Oligochaeta		
Oligochaeta	5	One of the tubificids in Table 1
Copepoda		
Copepoda	1	One of the copepods in Table 1
Amphipoda		
Paramelitidae sp.	1	Paramelitidae sp. B33

6.3. Stygofauna Distributions

All species recorded within the Proposal drawdown cone are known to occur at locations not impacted by mining. In the cases of *Parastenocaris* sp. and *Chydaekata* sp., however, this conclusion is based on an assumption about the species to which they belong (Table 1, Section 6.1).

Four of the nine species are widespread in the Pilbara (Nematoda, *Enchytraeus* Pilbara sp. 2 [PSS], Phreodrilid with dissimilar ventral chaetae and *Diacyclops humphreysi humphreysi*) (Table 1). *Fierscyclops* sp. B03 (nr *frustration*) is known from the Ophthalmia floodplain and also the central Pilbara. The remaining four species (*Origocandona grommike*, *Parastenocaris* sp., *Chydaekata* sp. and Paramelitidae sp. B33) are considered to occur only in the Upper Fortescue/Ophthalmia floodplain.

7. DISCUSSION AND CONCLUSION

7.1.1. Stygofauna Occurrence and Habitat Connectivity

With only nine species recorded, the Proposal drawdown area has a depauperate stygofauna community compared with the wider Ophthalmia area, which has at least 53 species (Bennelongia unpublished data). This most likely is the result of poorer quality stygofauna habitat at the Proposal. The volume of saturated Tertiary Detritals is small and no calcrete is present in the Proposal; both Tertiary Detritals in general, and calcrete in particular, provide better stygofauna habitat than does Banded Iron Formation (Halse *et al*. in prep.).

In addition to a single aquifer system (of three vertically arranged aquifers) existing within the Proposal, it appears likely that this aquifer system extends beyond the Proposal into the Ophthalmia floodplain (RPS Aquaterra 2013). Thus, habitat for the stygofauna community within the Proposal will remain on the Ophthalmia floodplain following groundwater drawdown.

Stygofauna sampling results also provided evidence aquifer connection between the Proposal and the wider Ophthalmia floodplain with both the amphipods *Chydaekata* sp. and Paramelitidae sp. B33 collected within the Proposal and also in the downstream Ophthalmia floodplain.

7.1.2. Conservation Risk for Species

None of the stygofauna species collected in the Proposal impact footprint is considered likely to be restricted to, or have a substantial proportion of its population within, the Proposal impact footprint. Therefore, proposed dewatering at OB29, OB30 and OB35 is unlikely to have significant conservation impact on any stygofaunal species within the Proposal area.

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9. APPENDICES

Appendix 1: Secondary Impacts of Mining on Stygofauna

Secondary impacts on subterranean fauna from mining activities are impacts that reduce habitat quality rather than directly removing habitat. Secondary impacts are more likely to result in reduced population densities than to threaten species persistence. The potential secondary impacts that could reduce the quality of stygofauna habitat from open pit mining below the water table at Orebodies 29, 30 and 35 include: percussion from mine blasting; aquifer recharge with poor quality water; and hydrocarbon contamination of groundwater.

Percussion from Blasting

Impacts on both stygofauna and troglofauna may occur through the physical effect of explosions. Blasting may also have indirect detrimental effects through altering underground structure (usually rock fragmentation and collapse of voids) and transient increases in groundwater turbidity. The effects of blasting are often referred to in grey literature but are poorly quantified and have not been related to ecological impacts. Any effects of blasting are likely to dissipate rapidly with distance from the pit and are not considered to be a significant threats to either stygofauna or troglofauna outside the proposed mine pits.

Aquifer Recharge with Poor Quality Water

Quality of recharge water declines during, and after, mining operations as a result of rock break up and soil disturbance (i.e. Gajowiec 1993; McAuley and Kozar 2006). Impacts can be minimised through management of surface water and installing drainage channels, sumps and pump in pits to prevent of recharge though the pit floor.

Contamination of Groundwater with Hydrocarbons

Any contamination is likely to be localised and may be minimised by engineering and management practices to ensure containment.

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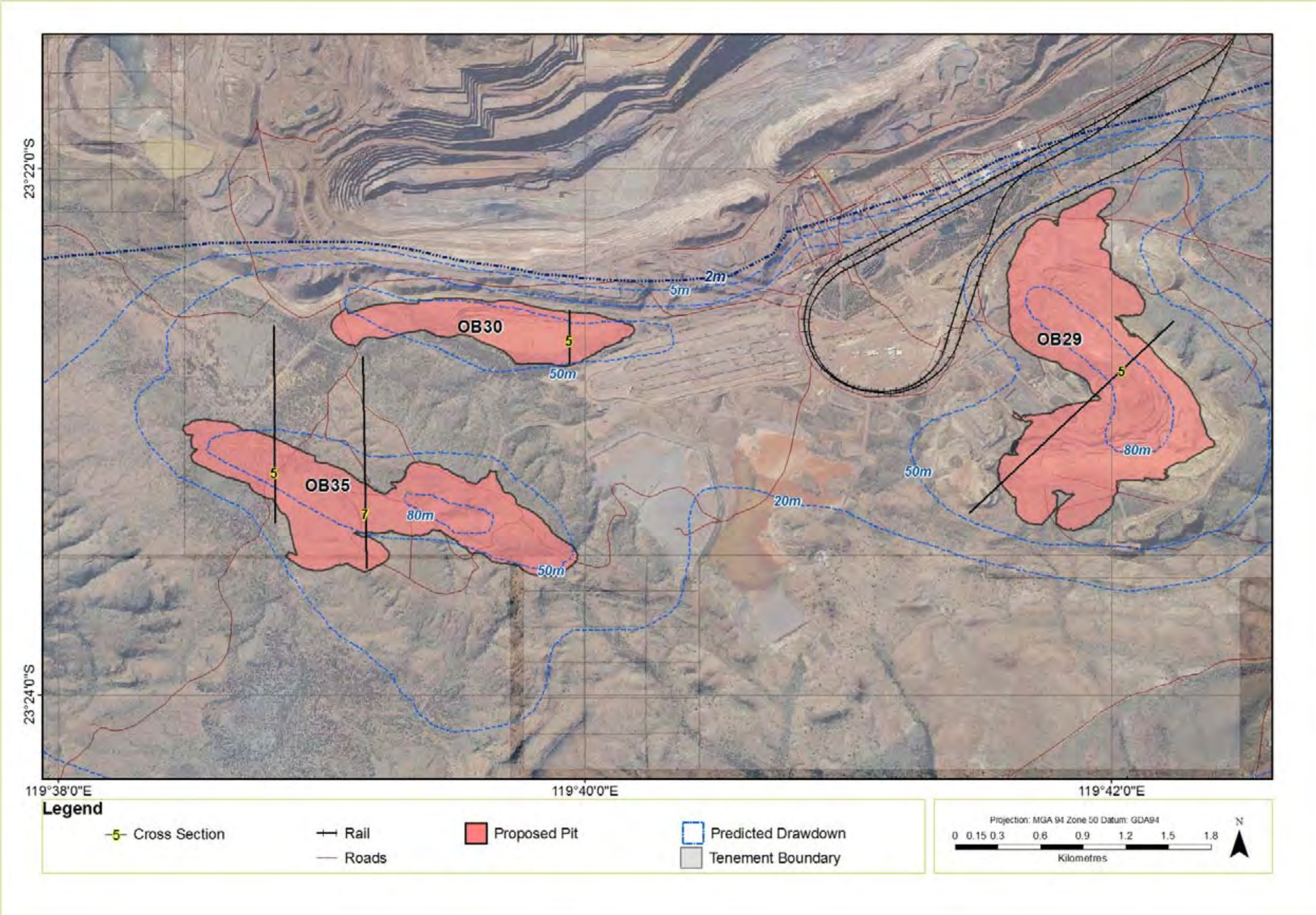
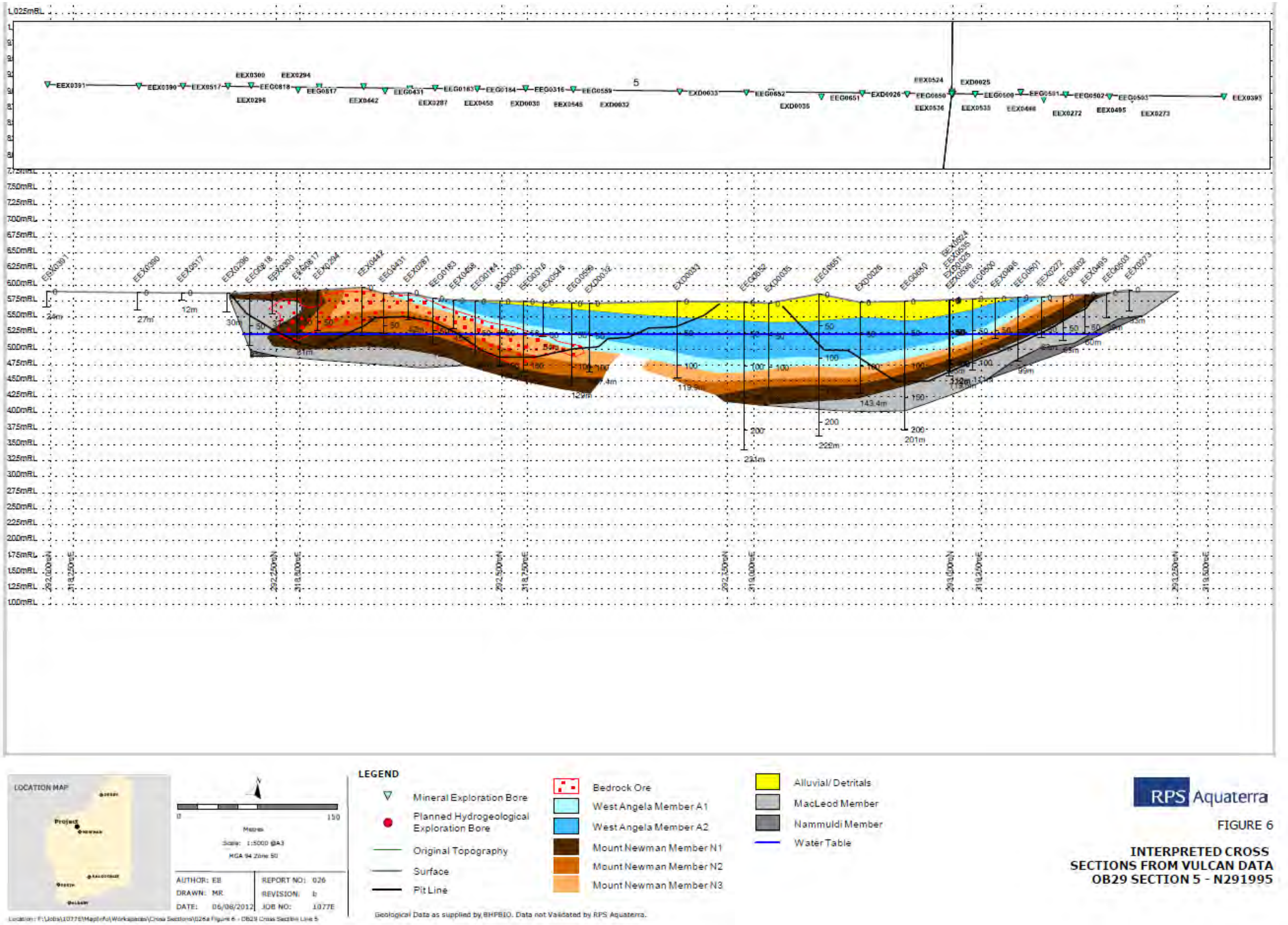
Appendix 2: Examples of the Proposal Area Stratigraphy.

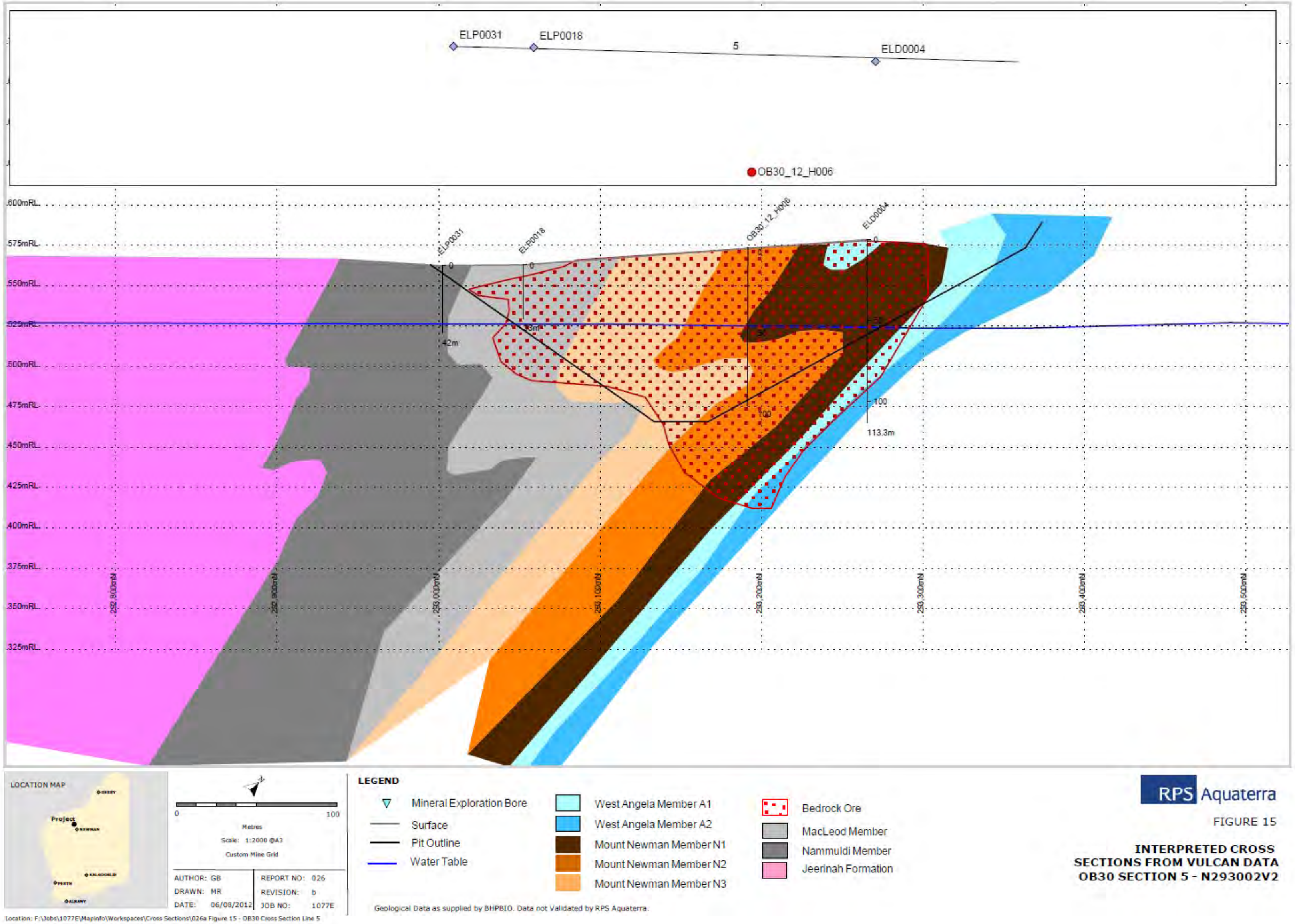
Cross Sections from RPS Aquaterra (2012)



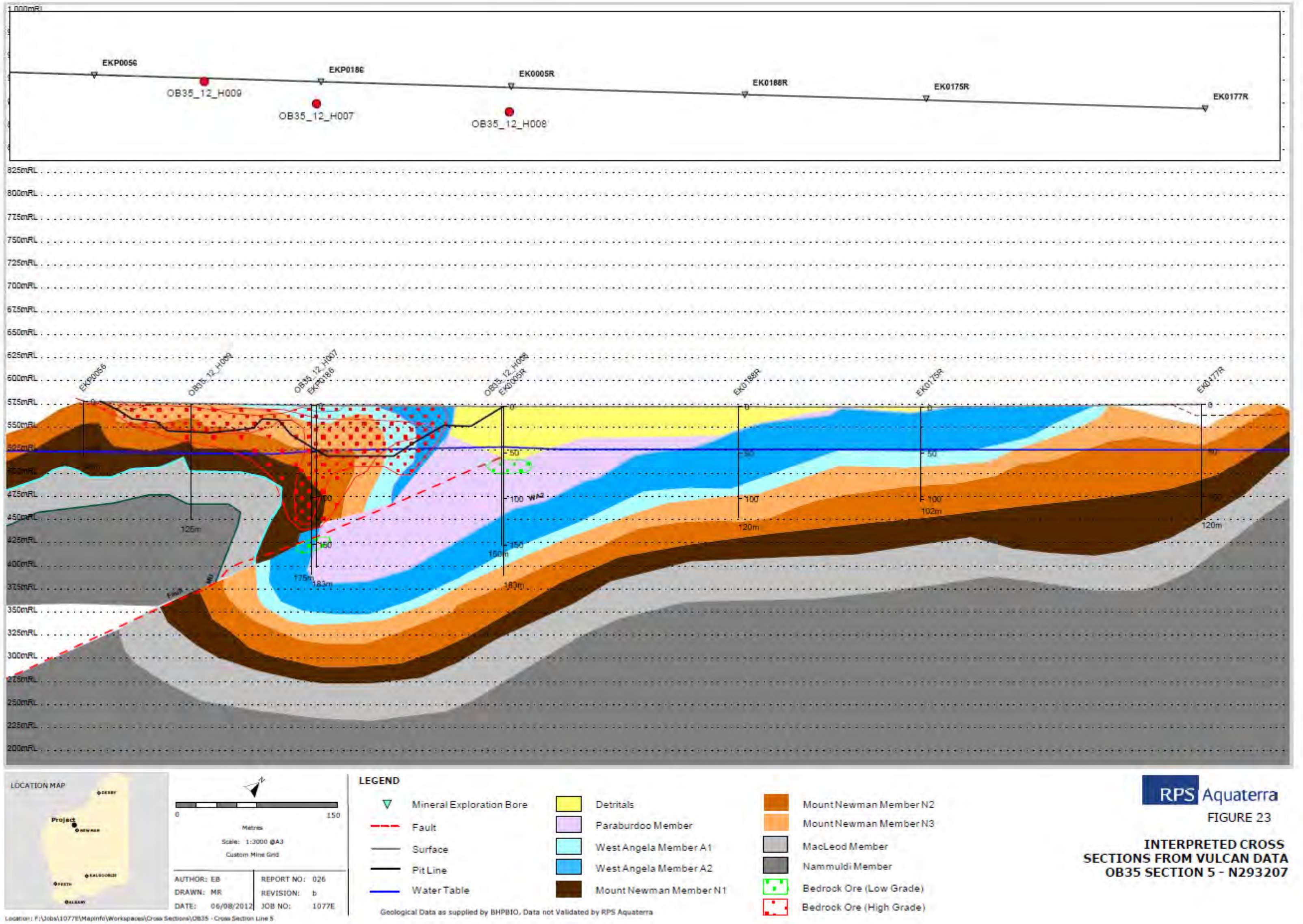
Cross Section 5 OB29



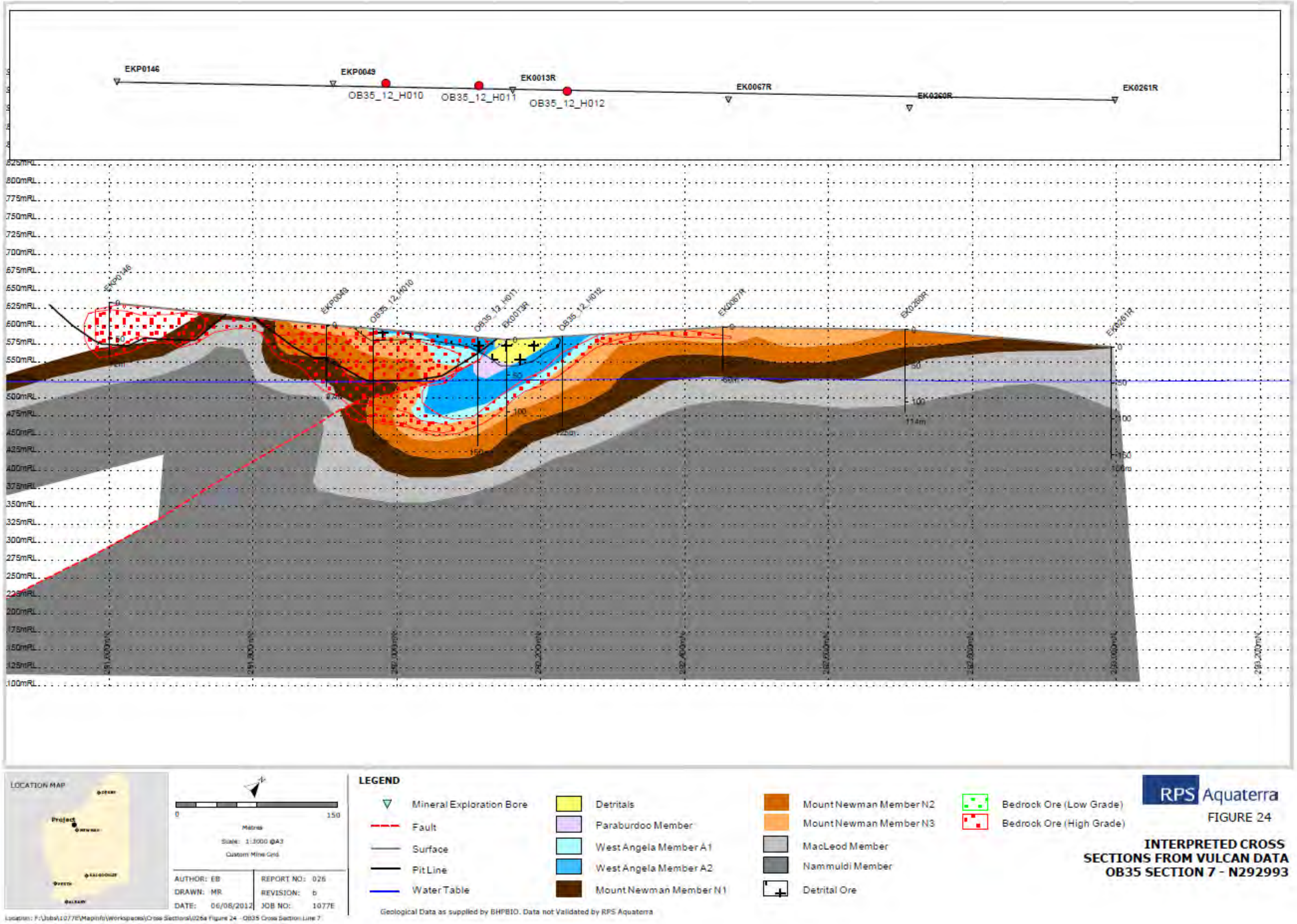
Cross Section 5 OB30



Cross Section 5 OB35

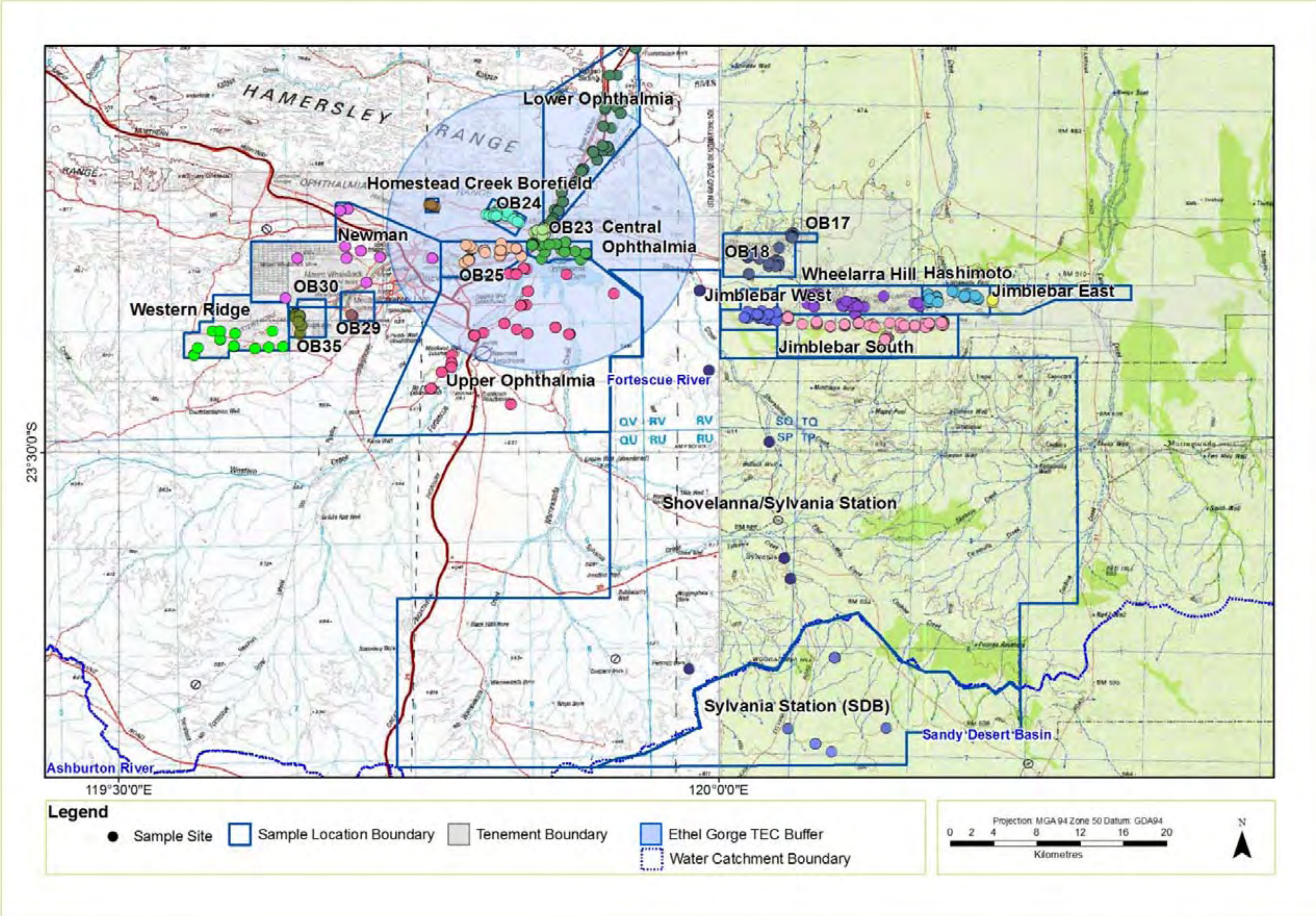


Cross Section 7 OB35



Appendix 3: Stygofauna Sampling in the Newman Area.

Figure: Bores Sampled in the Newman Area. Tables: Samples Taken in the Newman Area.



Samples collected under the RSFSP.

	Bennelongia	Ecowise				Subterranean Ecology				Grand Total
Area/Deposit	**2010**	**2007**	**2008**	**2009**	**2010**	**2009**	**2010**	**2011**	**2012**	
Central Ophthalmia			14	22		26	79	50	90	281
Hashimoto			36							36
Homestead Creek Borefield			4							4
Jimblebar East			3							3
Jimblebar South			58	10						68
Jimblebar West			21	22						43
Lower Ophthalmia			16	29		71	98	69	92	375
Newman			2	8	14	2	6	4	12	48
OB18		11	19	1						31
OB23			28	5		6	11	5	20	75
OB24		9	28							37
OB25			22	9		1	8	2	6	48
OB29				3	3					6
OB35	5			11	21					37
Shovelanna/Sylvania Station				7					5	12
Sylvania Station (SDB)				4					2	5
Upper Ophthalmia			20	28		9	12	3	42	114
Western Ridge	26									26
Grand Total	**31**	**20**	**271**	**159**	**38**	**115**	**214**	**133**	**269**	**1250**

Samples Collected Prior to the RSFSP.

	Consultant		
Area/Deposit	**WAM[1]**	**Biota[2]**	**Grand Total**
OB23		77	
OB23/Ethel Gorge	74	134	
OB25		41	
Ophthalmia		68	
Sylvania Station			
Whaleback area		57	
Sub-total	**74**	**377**	**451**

[1]Eberhard and Humphreys (1999); [2]Biota (2001); Biota (2004); Biota (2008)

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Appendix 4: Coordinates of Bores Sampled for Stygofauna at the Proposal.

Orebody	Bore Code	Sample Date	Latitude	Longitude
Orebody 29	OB29SEPT091	26-Sep-09	-23.3874	119.6947778
	OB29SEPT092	26-Sep-09	-23.3868	119.6943889
		20-Jan-10	-23.3868	119.6943889
	OB29SEPT093	26-Sep-09	-23.3864	119.6938611
		20-Jan-10	-23.3864	119.6938611
		13-Apr-10	-23.3864	119.6938611
Orebody 35	EXR0298	20-Jul-10	-23.3919	119.6498333
	EXR1083	15-Apr-10	-23.4023	119.6505833
		19-Jul-10	-23.4023	119.6505833
	EXR1085	19-Jul-10	-23.4009	119.6511667
	EXR1086	25-Sep-09	-23.3953	119.6512222
		22-Jan-10	-23.3953	119.6512222
		12-Apr-10	-23.3953	119.6512222
	EXR1087	25-Sep-09	-23.3953	119.6524722
		22-Jan-10	-23.3953	119.6524722
		12-Apr-10	-23.3953	119.6524722
	KP271	24-Sep-09	-23.3851	119.6469722
		21-Jan-10	-23.3851	119.6469722
		12-Apr-10	-23.3851	119.6469722
	OB35SEPT091	24-Sep-09	-23.3851	119.6469722
		21-Jan-10	-23.3851	119.6469722
		12-Apr-10	-23.3851	119.6469722
	OB35SEPT092	24-Sep-09	-23.3856	119.6469444
		21-Jan-10	-23.3856	119.6469444
		12-Apr-10	-23.3856	119.6469444
	OB35SEPT093	25-Sep-09	-23.3901	119.6498333
		22-Jan-10	-23.3901	119.6498333
		12-Apr-10	-23.3901	119.6498333
	OB35SEPT094	25-Sep-09	-23.3878	119.6469444
		21-Jan-10	-23.3878	119.6469444
		12-Apr-10	-23.3878	119.6469444
	OB35SEPT095	27-Sep-09	-23.3878	119.6508611
		21-Jan-10	-23.3878	119.6508611
	OB35SEPT096	27-Sep-09	-23.3874	119.6508333
		21-Jan-10	-23.3874	119.6508333
	OB35SEPT097	27-Sep-09	-23.3869	119.6508611
		21-Jan-10	-23.3869	119.6508611
		12-Apr-10	-23.3869	119.6508611
	WP79	22-Sep-09	-23.3724	119.6386667
		21-Jan-10	-23.3724	119.6386667
		12-Apr-10	-23.3724	119.6386667
	WXR0187	19-Jul-10	-23.3952	119.6524444
Western Ridge	EXR1164	21-Jul-10	-23.3999	119.6281389

Appendix 5. Stygofauna Collected at the Proposal.

Orebody	Bore Code	Latitude	Longitude	Taxa	Number of specimens
OB35	EK0145R	-23.37594444	119.6412222	*Chydaekata* sp.	1
OB35	EKP0185	-23.38644444	119.6469444	Paramelitidae sp.	1
OB35	EKP0198	-23.38372222	119.6450278	Paramelitidae sp. B33	3
OB35	EKP0224	-23.38647222	119.6499167	Copepoda sp.	1
OB35	EXP0271	-23.38513889	119.6469722	*Fierscyclops* sp. B03 (nr *frustratio*)	3
OB35	EXR1086	-23.3952908	119.6512285	Nematoda sp.	1
OB35	KP271	-23.385073	119.6469668	*Enchytraeus* Pilbara sp. 2 (PSS)	52
OB29	OB29SEPT093	-23.3864107	119.6938721	Nematoda sp.	5
OB29	OB29SEPT093	-23.3864107	119.6938721	Phreodrilid with dissimilar ventral chaetae	4
OB35	OB35SEPT091	-23.385073	119.6469668	*Diacyclops humphreysi humphreysi*	50
OB35	OB35SEPT091	-23.385073	119.6469668	*Fierscyclops* sp. B03 (nr *frustratio*)	3
OB35	OB35SEPT091	-23.3850730	119.6469668	*Origocandona grommike*	3
OB35	OB35SEPT091	-23.385073	119.6469668	*Parastenocaris* sp.	1
OB35	OB35SEPT092	-23.3855698	119.6469474	*Enchytraeus* Pilbara sp. 2 (PSS)	10
OB35	OB35SEPT092	-23.3855698	119.6469474	*Enchytraeus* Pilbara sp. 2 (PSS)	4
OB35	OB35SEPT092	-23.3855698	119.6469474	Nematoda sp.	1
OB35	OB35SEPT094	-23.3877992	119.6469526	*Enchytraeus* Pilbara sp. 2 (PSS)	12
OB35	OB35SEPT094	-23.3877992	119.6469526	*Enchytraeus* Pilbara sp. 2 (PSS)	2
OB35	OB35SEPT094	-23.3877992	119.6469526	Nematoda sp.	1
OB35	OB35SEPT095	-23.3878414	119.6508552	Nematoda sp.	1
OB35	OB35SEPT096	-23.3873905	119.6508267	*Enchytraeus* Pilbara sp. 2 (PSS)	1
OB35	OB35SEPT096	-23.3873905	119.6508267	*Enchytraeus* Pilbara sp. 2 (PSS)	11
OB35	OB35SEPT096	-23.3873905	119.6508267	Nematoda sp.	5
OB35	OB35SEPT097	-23.3869566	119.6508669	Oligochaeta	5