

Legend

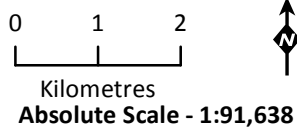
- Thunderbird Proposal Area
- Proposed Disturbance Areas
- SRE Survey Area

SRE Survey 2013 Sampling Sites

- Dry Pitfall Traps and Leaf Litter
- Foraging

SRE Survey 2014 Sampling Sites

- Dry Pitfall Traps and Leaf Litter
- Foraging



SRE Survey Area and Sampling Sites

Figure: 6.15
Project ID: 1645

Drawn: BH
Date: 10.11.15

Coordinate System
Name: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Table 17: Number of Sampling Sites for the Thunderbird Survey Area

Survey	Number of Sites per Sampling Method		
	Dry Pitfall Trapping	Leaf Litter Collection	Foraging
2013 Survey	13	6	6
2014 Survey	10	10	10
Total	23	16	16

Table 18: Summary of potential and confirmed SRE invertebrates recorded at Thunderbird

Species	SRE Status	Number of Records			Comment
		Total	Within Proposal Area	Within Proposed Disturbance Areas	
Arachnida (Mygalomorphae) - Nemesiidae					
<i>Aname</i> 'MYG284'	Potential	20	5	4	
<i>Aname</i> 'MYG285'	Potential	19	2	0	
<i>Aname</i> 'MYG387'	Potential	1	1	0	
<i>Aname</i> 'MYG387?'	Potential	1	1	1	Likely conspecific with <i>Aname</i> 'MYG387' (genetic work required to ascertain this)
<i>Aname</i> 'MYG388'	Potential	4	3	1	
<i>Aname</i> 'sp. indet.'	Potential	1	1	1	Potentially conspecific with other <i>Aname</i> taxon (genetic work required to ascertain this)
<i>Aname</i> 'sp. juv'	Potential	1	1	0	Potentially conspecific with other <i>Aname</i> taxon (genetic work required to ascertain this)
Arachnida (Pseudoscorpiones) – Olpiidae					
Olpiidae 'genus indet. (juvenile)'	Potential	12	12	9	Potentially conspecific with <i>Indolpium</i> 'sp. indet.' (genetic work required to ascertain this)
Arachnida (Scorpiones) – Buthidae					
<i>Lychas</i> 'broome'	Potential	9	2	2	
<i>Lychas</i> 'JPP'	Potential	10	6	1	
<i>Lychas</i> 'JPP2'	Potential	4	4	4	Likely to occur outside of proposed impact area based on habitat suitability.
<i>Lychas</i> 'JPP3'	Potential	7	6	2	
Arachnida (Scorpiones) – Urodacidae					
<i>Urodacus</i> 'kraepelini'	Potential	3	1	0	
<i>Urodacus</i> 'sp. indet.'	Potential	2	2	2	Potentially conspecific with <i>Urodacus</i> 'kraepelini' (genetic work required to ascertain this)
Arachnida (Opiliones) – Assamiidae					
<i>Dampetrus</i> sp.	Potential	2	1	0	
Malacostraca (Isopoda) – Armadillidae					
Armadillidae 'EE1501C'	Potential	1	0	0	
Buddelundiinae 'Gen. indet. NE Broome'	Potential	3	1	0	
<i>Buddelundia</i> 'sp.74'	Potential	8	3	2	
<i>Buddelundia</i> '90'	Potential	1	0	0	
<i>Buddelundia</i> '91'	Potential	6	1	0	
Mollusca (Gastropoda) – Camaenidae					
<i>Quistrachia leptogramma</i>	Potential	5	4	0	
<i>Rhagada bulgana</i>	Confirmed	4	1	0	

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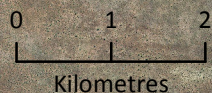
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Legend

- Thunderbird Proposal Area
- Proposed Disturbance Areas

SRE Species

- Aname* 'MYG284'
- Aname* 'MYG285'
- Aname* 'MYG387'
- Aname* 'MYG387?'
- Aname* 'MYG388'
- Aname* 'sp. indet.'
- Aname* 'sp. juv'
- Olpiidae* 'genus indet. (juvenile)'
- Lychas* 'JPP'
- Lychas* 'JPP2'
- Lychas* 'JPP3'
- Lychas* 'broome'
- Urodacus* 'kraepelini'
- Urodacus* 'sp. indet.'
- Dampetrus* sp.
- Armadillidae* 'EE1501C'
- Buddelundiinae* 'Gen. indet. NE Broome'
- Buddelundia* 'sp.74'
- Buddelundia* '90'
- Buddelundia* '91'
- Quistrachia leptogramma*
- Rhagada bulgana* - CONFIRMED



Absolute Scale - 1:80,000



Potential and Confirmed SRE Records in Proposal Area and Surrounds

Figure: 6.16
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Based on the results of both surveys (Ecologia 2014b, Ecologia 2014c), 17 potential and 1 confirmed SRE fauna were recorded during the two surveys, with another three records unable to be identified to species level (Table 18). All but two of these species were recorded within the Proposal Area, however, only 11 potential SRE's are likely to be impacted due to locations within proposed disturbance areas. No confirmed SREs are located within proposed disturbance areas (Figure 6.16).

The female *Aname* 'MYG387?' is the only potential SRE species that was recorded from only one location, of which is located within both the Proposal Area and proposed disturbance area. Conspecificity with the male species (*Aname* 'MYG387') is not certain. It is possible that the female *Aname* 'MYG387?' is conspecific with this taxon, which would indicate that its habitat preference includes both the extensive pindan shrubland and sandstone range habitats, and is therefore widespread in the Thunderbird area.

Based on the results of the surveys, as well as the habitat preferences for the invertebrate taxa recorded within the Thunderbird study area, no potential or confirmed SRE taxa are expected to be restricted to the Proposal Area.

6.2.4 Subterranean Fauna

A subterranean fauna survey was conducted in 2013 to target both stygofauna and troglofauna potentially occurring within the Thunderbird study area (Ecologia, 2014). The stygofauna survey comprised of a single (Level 1) survey conducted in December 2013. Haul nets were used to sample holes by dragging modified plankton nets through the entire water column. Troglofauna was also sampled by a single phase survey using two methods. The trapping method involved lowering custom-designed traps down selected drill holes. Traps were filled with sterilised leaf litter, baited with sweet potato and banana and left in-situ for 45 days to allow for colonisation. The survey area and sampling locations are shown on Figure 6.17.

6.2.4.1 Stygofauna Results

The pH of the groundwater measured showed slight acidic levels (average pH of 5.60), common in igneous and metamorphic sedimentary aquifers, which may not be suitable for all stygofauna. All other measured groundwater parameters (conductivity, dissolved oxygen, salinity and redox) were found to be within the habitable ranges for stygofauna (Ecologia 2014).

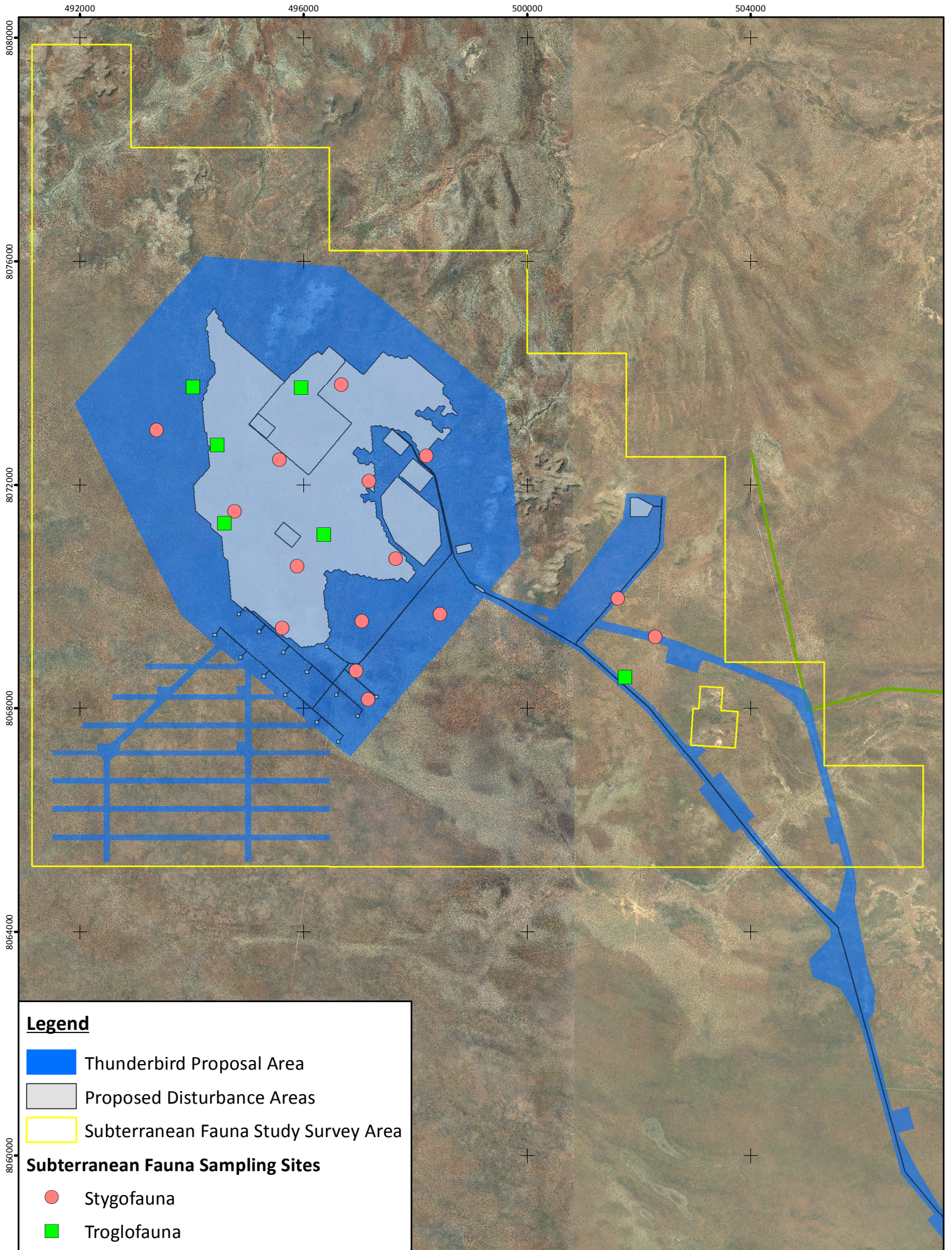
No stygofauna were recorded during the survey. Only ten specimens of worm belonging to the family Naididae (*Naididae* sp. indet) were collected from one sampling site at a depth of 60 m BGL, tapping into the Broome Sandstone aquifer.

Despite widespread sampling within the Thunderbird survey area, no stygofauna were recorded. It is therefore unlikely that a significant or diverse stygofauna assemblage exists within the Proposal Area.

6.2.4.2 Troglofauna Results

Two troglofauna were recorded during the survey, including one specimen of centipede belonging to the family Cryptopidae (*Cryptops* sp.) and a rove beetle belonging to the family Staphylinidae (Figure 6.18).

One specimen of the centipede *Cryptops* sp. was collected during the survey from outside the Proposal Area. Although the geology of this drill hole is unknown, the *Cryptops* was likely inhabiting a sandstone layer up to 36m in depth (water table level). This individual lacked pigmentation, and is therefore likely to be troglobitic. The genus *Cryptops* has not previously been recorded on the Dampier Peninsula, and as it may represent an undescribed species and is considered a potential SRE (WAM 2013b). However, given this taxon was recorded within the sandstone strata, which continues extensively to the east and north, its distribution is unlikely to be confined to the Thunderbird survey area. Additionally, it was recorded outside the Proposal Area and therefore this location will not be impacted by the Proposal.

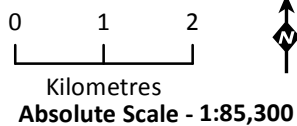


Legend

- Thunderbird Proposal Area
- Proposed Disturbance Areas
- Subterranean Fauna Study Survey Area

Subterranean Fauna Sampling Sites

- Stygofauna
- Troglofauna

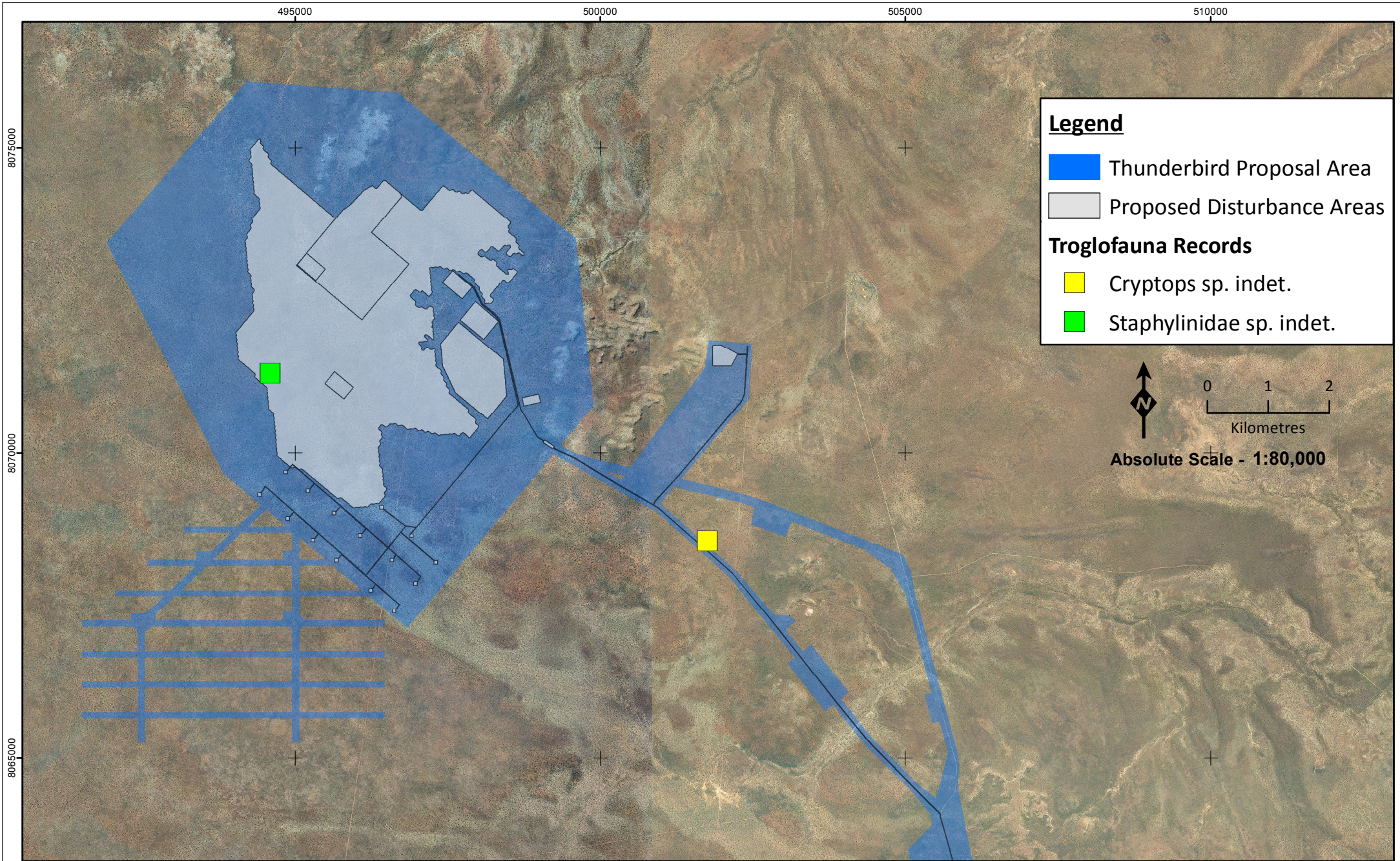


**Subterranean Fauna
Survey Area and
Sampling Sites**

Figure: 6.17
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Legend

- Thunderbird Proposal Area
- Proposed Disturbance Areas

Troglofauna Records

- Cryptops sp. indet.
- Staphylinidae sp. indet.



 Kilometres
Absolute Scale - 1:80,000

One specimen of the rove beetle from the family Staphylinidae was collected during the survey from inside the proposed disturbance area, specifically the planned mine pit, at a relatively shallow depth of 8m. The likely habitat this individual was occupying is a sandstone stratum. Although this individual had eyes present, it is considered to be either a troglophile or troglobite, and not a troglaxene. Due to a lack of geographic context and resolution of taxonomy, this taxon is considered a potential SRE (WAM 2013b). However, given this taxon was recorded within the sandstone strata, which continues extensively to the east and north, its distribution is unlikely to be confined to the Thunderbird survey area.

Generally, the majority of the surveyed area provides minimal for troglofauna, and is comprised solely of sand above the water table. The little habitat that is present, may also occur within the extensive sandstone habitats in the ranges to the east and north. The sampling identified that the Proposal Area is unlikely to contain a diverse or significant troglofauna community.

6.2.5 Hydrological Processes

A Hydrological Assessment was conducted (Pennington Scott, 2015) to assess the local groundwater supplies underlying the Proposal Area and identify any potential impacts to groundwater resources, groundwater dependant ecosystems and users resulting from the implementation of the Proposal.

As part of the assessment, four studies were conducted. Firstly, a pump test was conducted using three test production bores and a combination of 57 water level monitoring bores, stygofauna sampling and piezometers. Secondly, a groundwater model was developed to assess impacts to groundwater levels from different water supply and dewatering scenarios for the Proposal. An airborne survey was used to further inform the geological interpretation of units comprising the Broome aquifer within the Thunderbird area. Lastly, flora and fauna surveys were also reviewed to assess likely impacts to local ecosystems as a result of groundwater use for the Proposal.

The Proposal overlies the Broome aquifer within the Canning Basin. The current water table beneath the Proposal Area is approximately 70 m AHD, leaving a significant portion of the Thunderbird deposit dry with the remainder either partially or fully saturated. As such, the Proposal requires management of water for dewatering of the mine pit and water supply to mine site, processing plants and tailings emplacement. As discussed in Section 2.2.2.7, the Proposal initially requires abstraction of up to 13 GL/annum, reducing to abstraction of approximately 6.5-9 GL/annum during dry mining phases.

Extraction of water for the purposes of the Proposal will require a 5C Licence To Take Water, issued by the Department of Water (DOW) under the *Rights in Water and Irrigation Act 1914*. A 5C application was lodged with DOW on 16 March 2015

6.2.5.1 Groundwater Dependant Ecosystems

During the flora and vegetation surveys conducted (refer to Section 6.2.1.5), a potentially significant vegetation community was identified, vegetation unit *MaMvEtCpCc*. This vegetation community is significant due to the presence of an ephemeral pool (soak) and is highly dependent on the water present and presumably would be highly susceptible to changes in the level of the water table. Regular groundwater monitoring was conducted from temporary bores placed around the soak between August and October of 2015 which showed groundwater levels ranging between 19.7 to 23.9 mBGL. Due to the shallow nature of the water table at the soak, it is likely to be a perched aquifer and is therefore considered unlikely to be connected to the Broome aquifer. Groundwater extraction from the Broome aquifer for the Proposal is considered unlikely to impact on water levels within the soak.

Tributaries associated with the Fraser River North and South, located approximately 5 km to the south-east of the proposed borefield and 5 km east of the proposed mine pit, have been identified as a potential groundwater dependant ecosystem. These rivers drain from the higher terrain north of the resource eastwards toward King Sound. The hydrological assessment concluded that while the

Proposal may result in some gradual changes in water levels over a small portion of the Fraser River South valley of 0.5-1.0m, the vast majority of the valley areas of shallow water table would have impacts significantly lower than 0.5m, which is unlikely to be measurable in the context of natural variability.

6.2.5.2 Subterranean Fauna

As discussed in Section 6.2.4, the Proposal Area does not support a diverse or significant troglofauna community, with only two troglofauna species identified in the surveys. While water level fluctuations may have some impact on humidity in troglofauna habitat, troglofauna are generally thought to be fairly robust to changes in water levels. Groundwater abstraction for the Proposal is therefore not likely to have unacceptable impacts on troglofauna.

Despite the survey effort conducted within the Thunderbird area, no stygofauna was recorded. As such, groundwater use for the Proposal will not impact on any stygofauna communities within the Proposal Area.

6.2.5.3 Other Groundwater Users

Two groundwater users within the vicinity of the Thunderbird Proposal Area were identified as occurring within the predicted groundwater drawdown zone.

A registered heritage site, Nill Bubbaca Well, is a camp and water source located approximately 30 km to the south-east of the Proposal Area. Groundwater modelling predicted this site may experience a decline of less than 0.1 m over a 15 years period and as such, is not expected to be significantly impacted by the Proposal.

Two stock water supply bores located at the Mount Jowlaenga Station, the Homestead Bore and Lanigan's Bore, are approximately 5 km east of the Proposal Area. Groundwater modelling predicted these bores may experience a drawdown of 0.2 m and 0.3 m, respectively, over a period of 15 years. Due to the sensitivity of stock water supply, these bores may be impacted by the Proposal.

6.2.6 Heritage

The Department of Aboriginal Affairs' Aboriginal Heritage Inquiry System was reviewed to identify the presence of any registered heritage places. No registered heritage places listed under the *Aboriginal Heritage Act 1972* are present within the Proposal Area.

A review of the National Native Title Register, managed by the National Native Title Tribunal, was also reviewed to identify whether any native title claims (determined and/or registered) exist over the Proposal Area. One determined native title claim is present within the Proposal Area. The Nyikina Mangala People claim (WC1999/025) was determined on 29 May 2014 and covers the southern portion of the internal haul roads within the Proposal Area. One registered native title claim covers the majority of the Proposal Area, excluding only the accommodation camp and internal haul roads. This claim, Mount Jowlaenga Polygon #2 (WC2014/005), is yet to be determined as to whether native title exists in the area. The northern portion of the internal haul roads within the Proposal Area are not covered by any native title claims and are considered in a 'no claim' area. The Heritage Survey Reference Group was established to consider heritage values within this 'no claim' area.

To determine the presence of any non-registered heritage values within the Proposal Area, the Proponent conducted five heritage surveys. Each survey was conducted by an experienced consultant and included representatives from the Nyikina Mangala Native Title Group. Traditional Owners for the Mt Jowlaenga Polygon #2 Applicant and the Heritage Survey Reference Group were also involved in some of the surveys.

No significant heritage sites were recorded during the surveys, however, some advice has been provided to the Proponent on places/sites to avoid. These places/sites are outside the Proposal Area.