



## 6. Terrestrial Fauna

### 6.1 Receiving Environment

#### 6.1.1 Environmental Studies

Terrestrial fauna studies and reports completed for the Proposal and relevant to the consideration of the Terrestrial Fauna factor generally are summarised in Table 6.1. These studies and reliable, publicly available data (e.g. distribution data from the DBCA-managed Naturemap database) have been used to describe the zoological context for the Proposal in sections 6.1.2, 6.1.3, 0.

**Table 6.1 – Terrestrial Fauna Studies**

Study Title	Survey Timing	Study Purpose and Limitations
<p>Miralga Creek Project: Level 2 Vertebrate Fauna and Short-range Endemic Invertebrate Fauna Assessment (Biologic, 2020a)</p> <p>Appendix E</p>	<p>Level 2 survey</p> <p>9 to 20 May 2019</p> <p>11 to 21 July 2019</p>	<p>Specifically, the key objectives of the assessment were to:</p> <ul style="list-style-type: none"> <li>• Conduct a comprehensive desktop assessment of vertebrate and SRE invertebrate fauna likely to occur within and within the vicinity (40 km) of the Study Area.</li> <li>• Conduct a baseline Level 2 survey for vertebrate fauna to determine vertebrate fauna assemblages occurring within the Study Area.</li> <li>• Conduct a baseline Level 2 SRE invertebrate fauna survey to determine the occurrence and likelihood of occurrence for SRE invertebrates.</li> <li>• Define and delineate broad fauna habitats occurring Within the Study Area, and report on their significance.</li> <li>• Assess the likelihood for vertebrate and SRE invertebrate fauna of conservation significance to occur within the Study Area.</li> <li>• Survey included targeted cave assessments for bats and use of ultrasonic bat detectors.</li> </ul> <p>Biologic (2020a) states that there was no significant limitation to the adequacy of the vertebrate survey with respect to EPA Guidance (Environmental Protection Authority, 2010).</p> <p>In terms of the invertebrate survey carried out concurrently with the vertebrate survey:</p> <ul style="list-style-type: none"> <li>• There are several general limitations with regard to the target fauna living in cryptic habitats, occurring in low numbers and being difficult to detect – this is normal for a survey of this type</li> <li>• Biologic concluded that the 2019 survey is not considered to have suffered from any specific constraints in relation to the number of samples, coverage of SRE habitat types or the sampling and preservation methods used.</li> </ul>



Study Title	Survey Timing	Study Purpose and Limitations
		<ul style="list-style-type: none"> <li>A number of SRE taxa (collected as juvenile or female specimens) were unable to be conclusively identified due to the absence of key diagnostic features only present in male specimens. Again, this is normal for a survey of this type.</li> <li>Taxonomic and ecological knowledge is evolving for this group, therefore SRE-classifications may change over time.</li> </ul>
Miralga Creek Ghost Bat Review – March 2020 (Bat Call WA, 2020)  Appendix F	NA	Provide impact assessment and management recommendations in relation to Ghost Bat habitat.  This memo was revised in December, January and March to provide varying recommendations and expert advice on gaps to be investigated and closed as the LIDAR scanning, geotechnical studies and blast modelling progressed.
LIDAR Scans of Four Caves (Land Surveys 2020)	November 2019	Scan the internal dimensions of caves at Miralga East for use in determining habitat value and assessing impacts the Ghost Bats.  The caves were successfully scanned and accurate three-dimensional models of their interiors developed.
Miralga Creek - Assessment of Potential Mining Activities Impact on the Structural Integrity of the Caves (PSM Consult, 2020)  Appendix G	14-16 November 2019	Assess the potential impact of the proposed mining activities at Miralga East on a series of three caves (CMRC-13, -14, -15).
Assessment of Blasting at Miralga Creek Project: Preservation of Ghost Bat Habitats Post Mining Activities (Blast It Global, 2020)  Appendix H	NA	Model blast parameters to determine how blasting can be undertaken at Miralga East while maintaining the habitat values of nearby caves, in particular CMRC-15.

The following sections are primarily based on information from the studies and impact assessments listed in Table 6.1; the studies covered the study areas shown in Figure 4.1.

### 6.1.2 Fauna Habitat

Six broad fauna habitat types were identified in the Biologic Study Area. These habitat types are described in Table 6.2 and shown on Figure 6.1 (vertebrates) and Figure 6.2 (invertebrates). Although habitat descriptions are broadly the same between vertebrate and invertebrate habitat types, the mapping differs because of the different way that SRE invertebrates (typically with limited dispersal abilities) interact with their habitat. The most common habitats present in the Study Area are of least significance to SRE and conservation significant vertebrates (Biologic, 2020a; 2020b; 2020c).

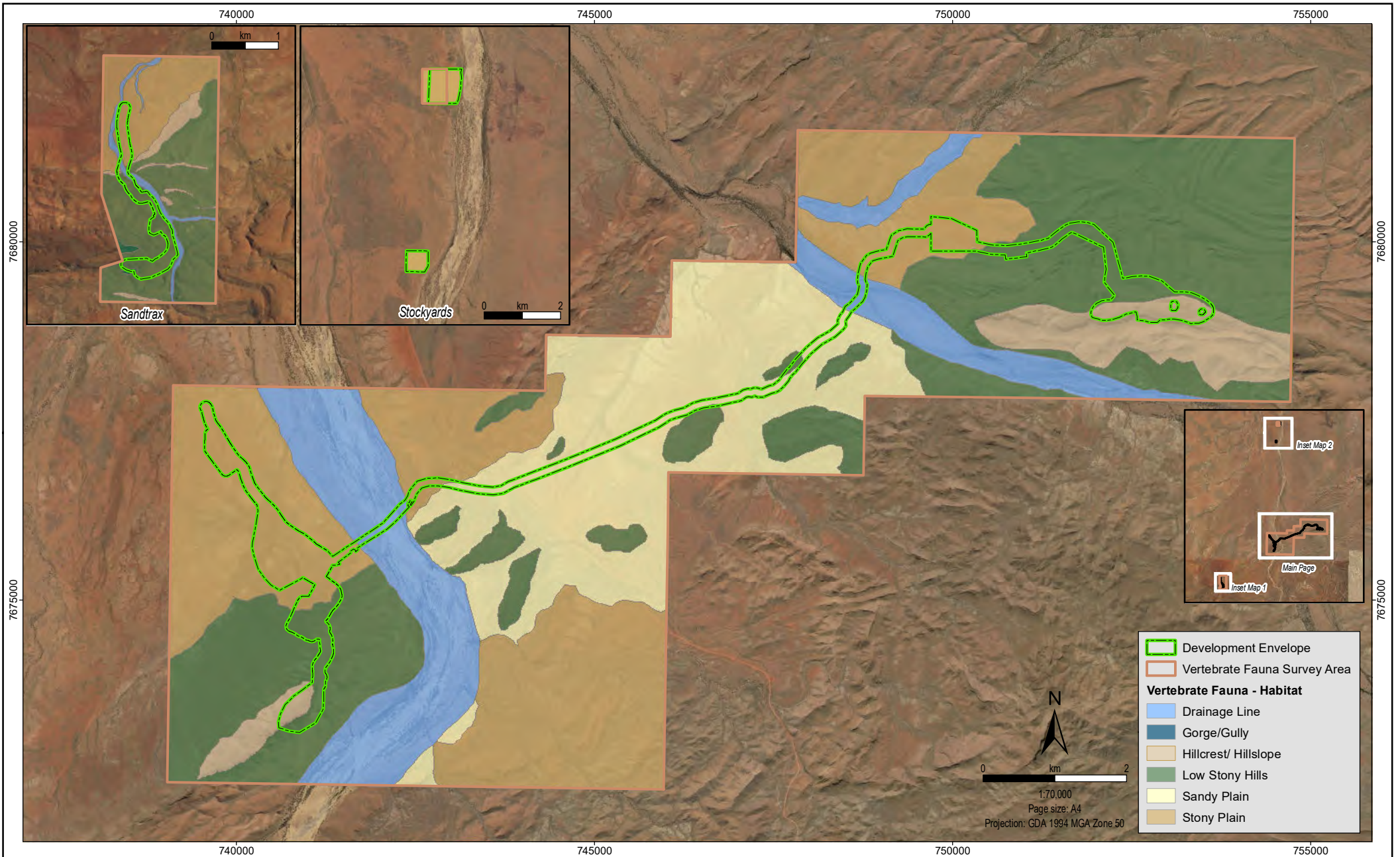



Table 6.2 – Broad Fauna Habitat

Habitat Type	Description	Significance to Vertebrate Fauna and Extent (ha)	Significance to SRE Invertebrate Fauna and Extent (ha)
Low Stony Hills	<p>Low undulating stony hills often dominated by <i>Triodia</i> spp. grassland and/or sparse open shrubland understory with sparsely scattered <i>Corymbia</i> species on gravelly clay loam substrate.</p> <p>Low Stony Hills is broadly distributed across the Pilbara region and is a common habitat throughout the Study Area.</p>	Low 2,586.20	Low 2,213.78
Stony Plain	<p>Stony Plain habitat comprises areas with vegetation dominated by <i>Triodia</i> hummock grasses of various life stages and scattered patches of various small to medium shrub species on gravelly clay loam substrates.</p> <p>This habitat is widespread within the Study Area and more broadly across the Pilbara region.</p>	Low 2,282.43	Low 2,223.98
Sand Plain	<p>Vegetation within Sand Plain habitat is variable, often comprising a mosaic of open <i>Eucalyptus</i> woodland or sparsely scattered individual trees over an understory dominated by small to medium <i>Acacia</i> shrubs and/or <i>Triodia</i> hummock grasses.</p> <p>Sand Plain is regionally common for the Pilbara region and is widespread in parts of the Study Area.</p>	Moderate 1,535.32	Low–moderate 1,640.13
Major Drainage (vertebrate) Drainage Line (invertebrate)	<p>Large permanently or seasonally fed drainage lines with fringing riparian vegetation comprising scattered <i>Eucalyptus</i> species over a patchy understory often dominated by <i>Acacia</i> spp. and small ephemerals grasses and herbs.</p> <p>There are two major drainage lines dissecting parts of the Study Area, the Shaw River and Miralga Creek. These drainage lines are continuous outside of the Study Area and are representative of Major Drainage habitat occurring across the Pilbara.</p>	High 996.28	Moderate 1,000.13



Habitat Type	Description	Significance to Vertebrate Fauna and Extent (ha)	Significance to SRE Invertebrate Fauna and Extent (ha)
Hillcrest/ Hillslope	<p>Hillcrest/Hillslope habitat tends to be more open and structurally simple due to their position in the landscape than other fauna habitats and are dominated by varying species of hummock grasses. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. These are usually dominated by open scattered <i>Eucalyptus</i> woodlands, <i>Acacia</i> and <i>Grevillea</i> scrublands and <i>Triodia</i> low hummock grasslands.</p> <p>Hillcrest/ Hillslope habitat is broadly represented across the Pilbara region. This habitat makes up the majority of the elevated areas within the Study Area.</p>	High 429.79	Moderate–high 791.47
Gorge/ Gully	<p>Gorge/ Gully habitat comprises rugged, steep-sided rocky valleys incised into the surrounding landscape forming shallow gullies and gorges. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Major Drainage Line). Caves and rock waterholes are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.</p> <p>The Gorge/ Gully habitat is commonly associated within the ranges, and occurs in small areas within the Study Area.</p>	High 4.58	High 11.64

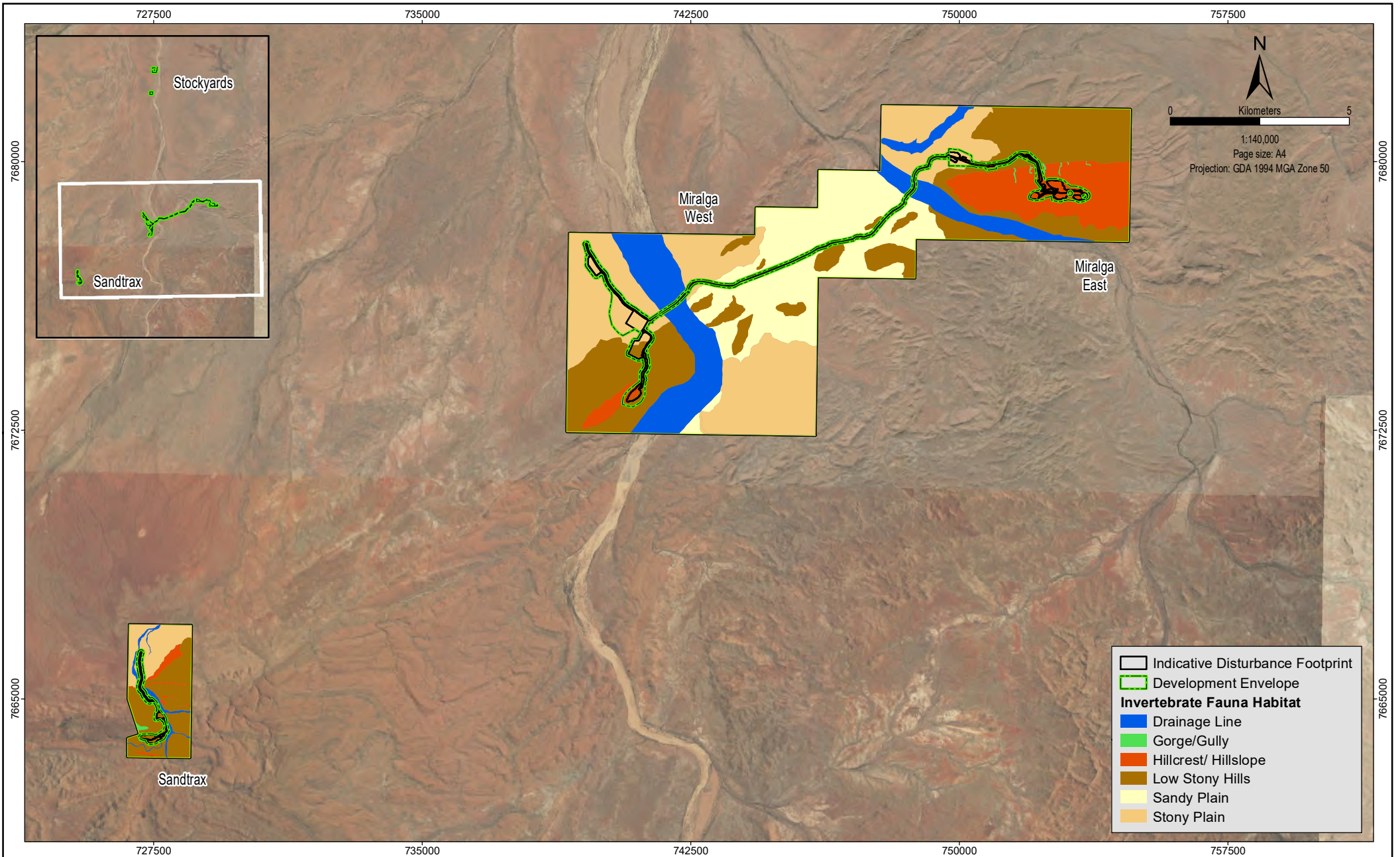



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Source & Notes:

**Vertebrate Fauna Habitats**

Figure No:  
**6-1**



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## Invertebrate Fauna Habitats

Figure No:

6-2



### 6.1.3 Habitat Features

A number of important microhabitat features are present within the Study Area, including caves and water sources. These features provide important sources of shelter, food and water for species of conservation significance. Many of these features were located within the Rocky Ridge and Gorge/ Gully habitat and were not commonly recorded in other broad habitat types of the Study Area.

#### 6.1.3.1 Caves

Caves can be particularly important features within a landscape, particularly in arid zone systems, often providing stable microclimates, shelter and protection (Medellin, 2017).

Sixteen caves were recorded across the Study Area (Figure 6.3). Usage of these caves by Ghost Bats and Pilbara Leaf-nosed Bats is summarised in Table 6.3.

**Table 6.3 – Caves Recorded in the Study Area**

Cave	Habitat Value and Use of Caves	
	Ghost Bats <sup>1</sup>	Pilbara Leaf-nosed Bat <sup>2</sup>
CMRC-01 <sup>3</sup>	Nocturnal roost	Unknown
CMRC-02	Potential nocturnal roost	Unknown
CMRC-03	Nocturnal roost	Nocturnal refuge
CMRC-04	Nocturnal roost	Nocturnal refuge
CMRC-06	Diurnal roost	Nocturnal refuge
CMRC-07	Diurnal roost	Unknown
CMRC-08	Nocturnal roost	Unknown
CMRC-10	Nocturnal roost	Unknown
CMRC-12	No usage	Unknown
CMRC-13	Nocturnal roost	Unknown
CMRC-14	Diurnal roost	Unknown
CMRC-15	Diurnal roost/ possible maternity roost	Nocturnal refuge
CMRC-16	No usage	Unknown
CMRC-17	No usage	Unknown
CMRC-18	Potential diurnal roost	Unknown
CMRC-19	Night roost	Nil
Unsurveyed cave <sup>4</sup>	Potential diurnal roost	Unknown

(1) Bat Call (2020)

(2) Biologic (2020a)



(3) Note that the location of cave CMRC-01 was incorrectly reported in Biologic (2020a) as being on the edge of pit 3 at Miralga East and was assumed to be at risk of direct impact. Its true location was confirmed in the field by Land Surveys (2019). CMRC-01 is actually located midway between pits 2 and 3 at Miralga East, approximately 100 m from the previously reported location. Its coordinates are 20.97131°S, 119.43425°E and its actual location is shown in Figure 6.3.

(4) Identified by field personnel in a subsequent heritage survey.

The 'unsurveyed cave' referred to in Table 6.3 was identified during a heritage survey outside of the Development Envelope. A number of Ghost Bats were flushed from this cave, however it was not inspected by Biologic during their site work due to earthquake activity in the area (Biologic, 2020a). As it is outside the Development Envelope and not in close proximity to the mining areas it is not considered further in this impact assessment.

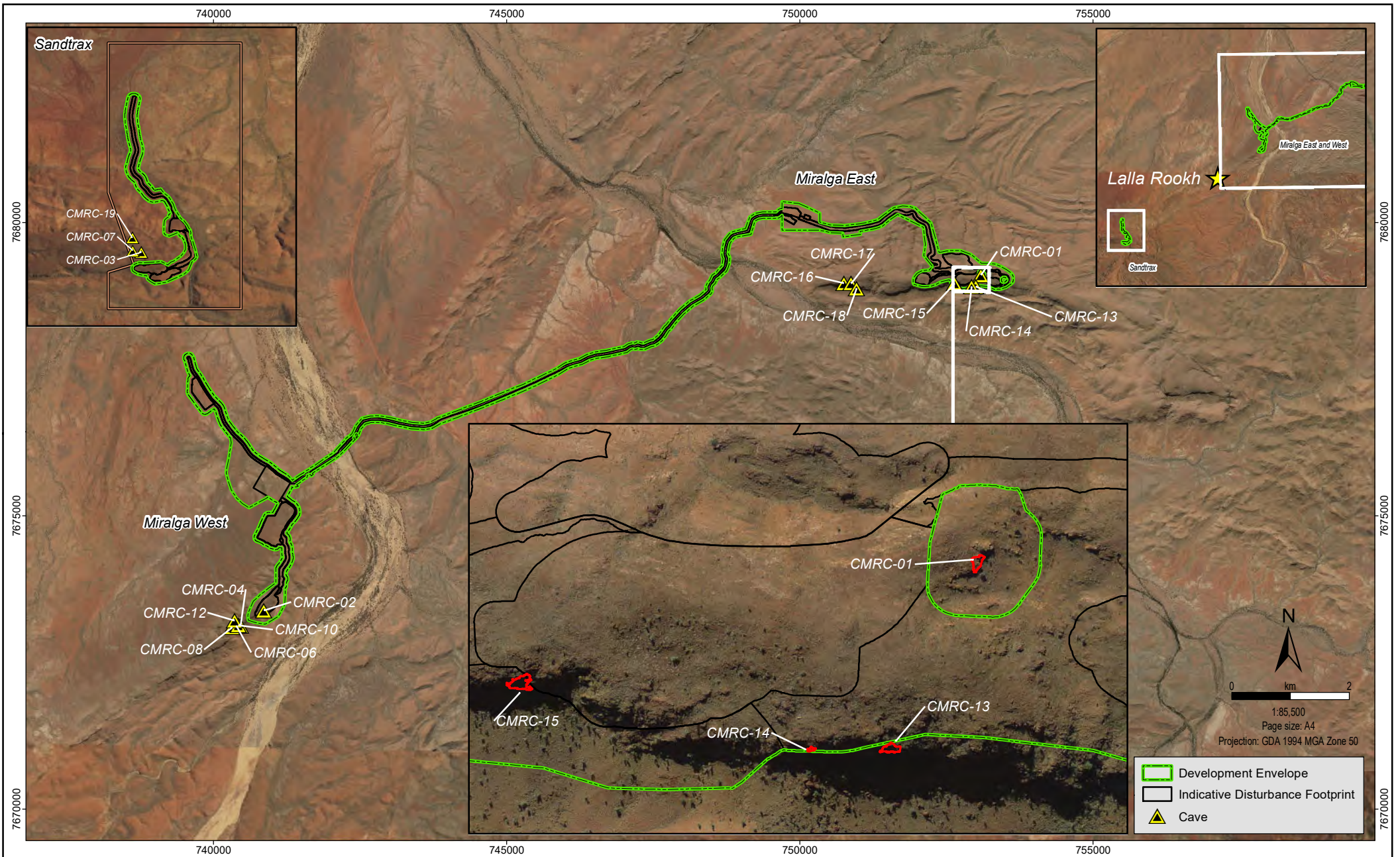
Bat Call WA (2020) has classified Ghost Bat caves into four categories (Bat Call WA, 2020) as follows:


- Category 1 – diurnal roosts with permanent occupancy
- Category 2 – diurnal roosts with regular occupancy
- Category 3 – roosts with occasional occupancy
- Category 4 – nocturnal roosts with opportunistic usage.

Full definitions are provided in Appendix A of Bat Call WA (2020). More details about the classification of Ghost Bat roosts are provided later in the discussion on Ghost Bats (see Section 6.1.5.2). The following discussion relates to the physical features of some of these caves.

A number of caves at Miralga East have internal chambers extending back into the ridge, close to proposed pits. Plate 6.1 shows the conceptual layout of pits and ramps at Miralga East with respect to Ghost Bat roost caves:

- Category 2 roosts:
  - CMRC-15
- Category 3 roosts:
  - CMRC-14
- Category 4 roosts:
  - CMRC-13
  - CMRC-01 (technically an overhang rather than a cave).

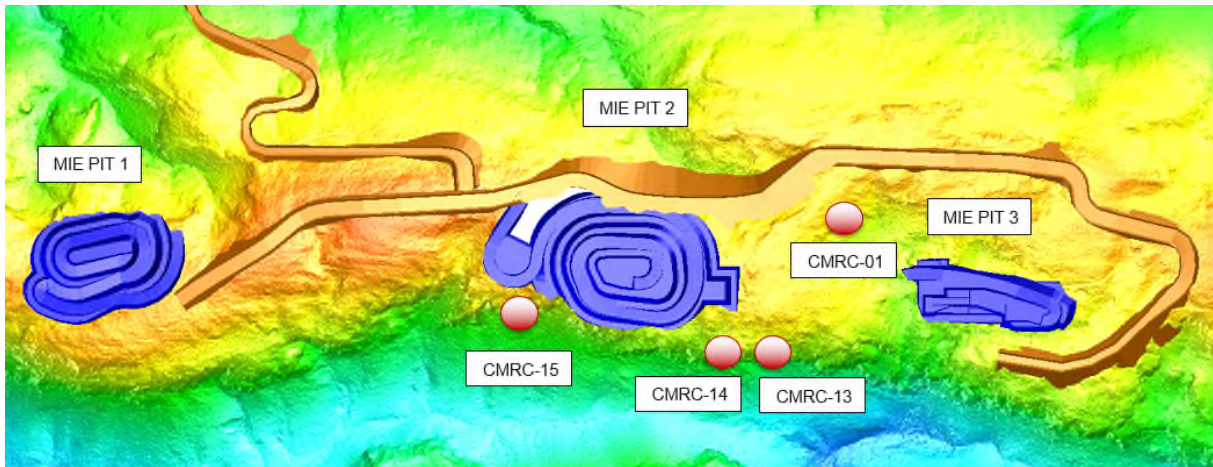



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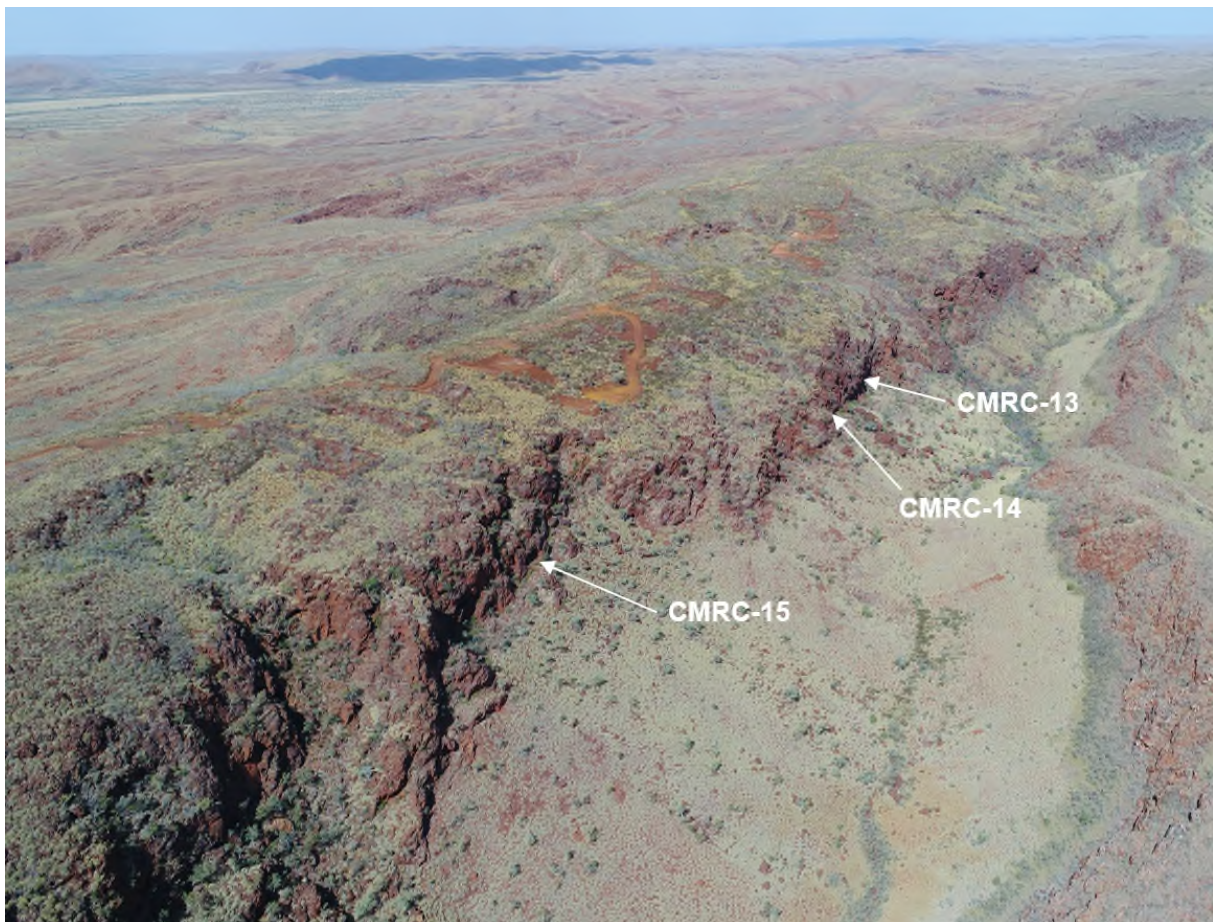
**Caves**

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**6-3**



**Plate 6.1 – Conceptual Layout of Pits, Ramps and Caves at Miralga East**

Plate 6.2 shows an aerial view of the ridge. The locations of three caves of particular interest – caves CMRC-13, -14 and -15 – are indicated along the bottom of the southern side of the ridge.

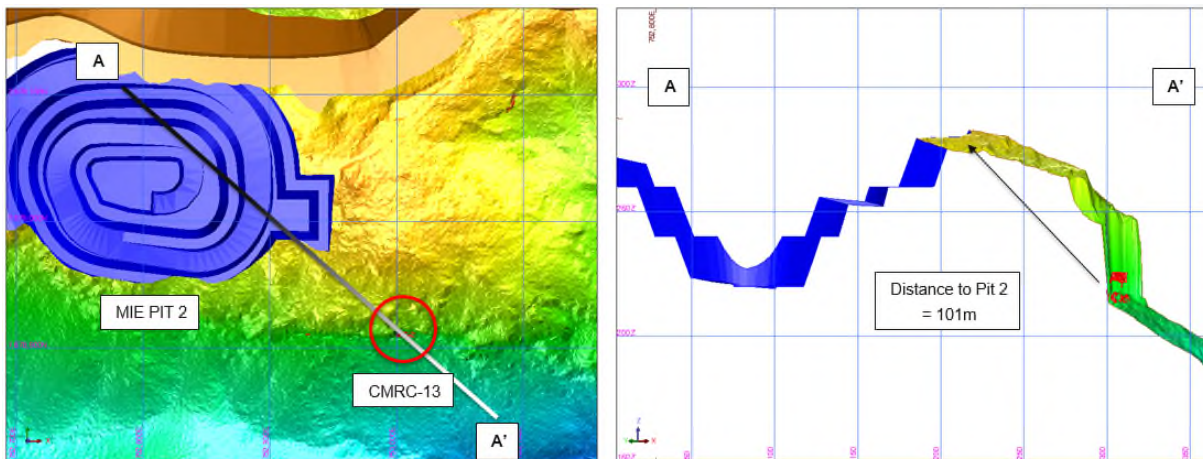


Source: PSM Consult (2019)

**Plate 6.2 – Aerial View Looking East Along the Escarpment Showing Locations of Caves**

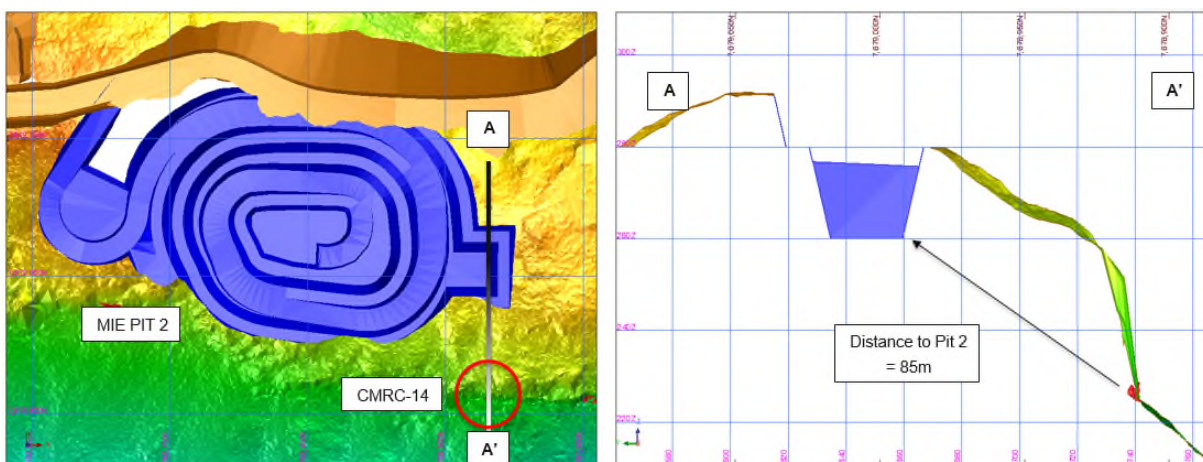
In November 2019, Land Surveys Pty Ltd carried out a LIDAR survey of caves CMRC-01, -13, -14 and -15 (Land Surveys, 2019). The internal dimensions were mapped and a three-dimensional model generated for each cave, accurate to approximately 6 cm. A plan view of the extent of the four mapped caves is shown in Figure 6.3.

Cave CMRC-13 is a category 4 shallow cave located at the bottom of a ridge line on the opposite face of the ridge to Miralga East pit 2 (Plate 6.3). It is approximately 101 m from the edge of pit 2 and approximately level with the base of the pit.



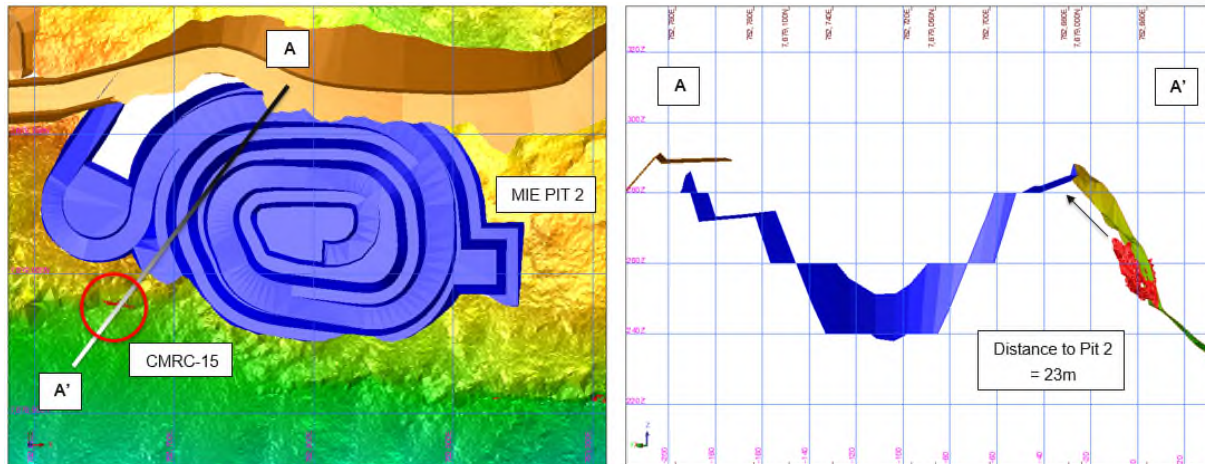
**Plate 6.3 – Cross-section of Cave CMRC-13 (Category 4) and Miralga East Pit 2**

Cave CMRC-14 is a shallow category 3 overhang immediately west of CMRC-13. It is approximately 85 m from the nearest part of the pit shell at Miralga East pit 2 (Plate 6.4).



**Plate 6.4 – Cross-section of Cave CMRC-14 (Category 3) and Miralga East Pit 2**

Cave CMRC-15 is a deep, category 2 cave located southwest of Miralga East pit 2. It is approximately 300 m west of caves CMRC-13 and -14, which are further along the base of the same ridge. The cave extends backwards and upwards into the ridge, its internal chamber measuring approximately 16 m from the entrance to the innermost extremity. The rear of the cave is separated from the closest part of Miralga East pit 2 by 23 m (Plate 6.5).



**Plate 6.5 – Cross-section of Cave CMRC-15 (Category 2) and Miralga East Pit 2**

PSM conducted a geotechnical assessment of caves CMRC-13, -14 and -15 (PSM, 2019; Appendix G), followed by a review of the available geological, geotechnical and cave information to qualitatively assess the potential impact of proposed mining activities (primarily drilling and blasting) on the structural integrity of the three caves. The review concluded that (PSM, 2020):

- Caves CMRC-13 and -14 have a low risk of mine-induced structural instability.
- Cave CMRC-15 has a higher risk of mine-induced structural instability, principally due to the shorter distance to mining activities and the presence of a geological structure (shear zone) at the rear of the cave. While the risk is higher than for caves CMRC-13 and -14, the risk more likely represents the possibility of hanging blocks of rock in the roof or walls falling or collapsing. It is less likely that the cave would collapse (either partially or wholly) or that a new surface entrance would be opened.

As this was a qualitative review, PSM recommended that the effect of blasting be predicted and evaluated to determine a blasting strategy to mitigate any effects on cave CMRC-15. In consultation with Bob Bullen, Atlas Iron commissioned Blast It Global to model blasting impacts which is discussed in more detail in Section 6.3.2.1.

Note that caves are an evolving (albeit over long timescales) feature of the environment. The natural structure of banded iron formations and cherts, being heavily jointed, provide the ideal setting for small localised failures and loose rocks dropping out of the walls and roofs of the caves (Blast It Global, 2020). Evidence of the evolution of caves relevant to the Proposal was observed, particularly at CMRC-15, where naturally accumulated rock debris lie on the floor of the cave. The rock debris are a result of the natural weathering processes (PSM Consultants, 2019; Blast It Global, 2020).

### 6.1.3.2 Water Features

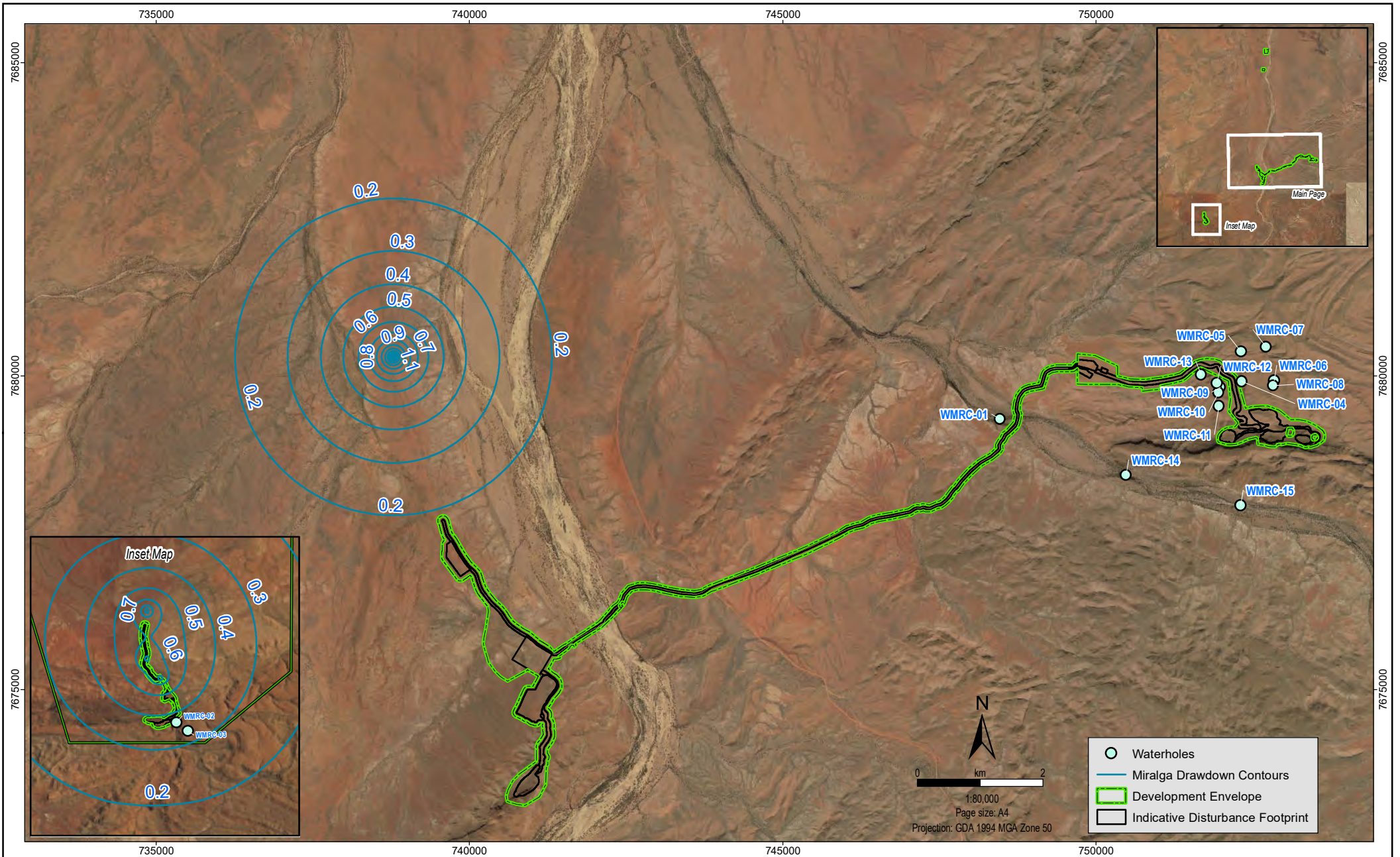
Water sources are a limiting factor for arid-zone ecosystems such as the Pilbara (Burbidge, 2010) (Doughty, 2011); they often represent areas of comparatively high ecological productivity (Murray, 2003). These features are highlighted because they may provide important sources food and water for species of conservation significance.

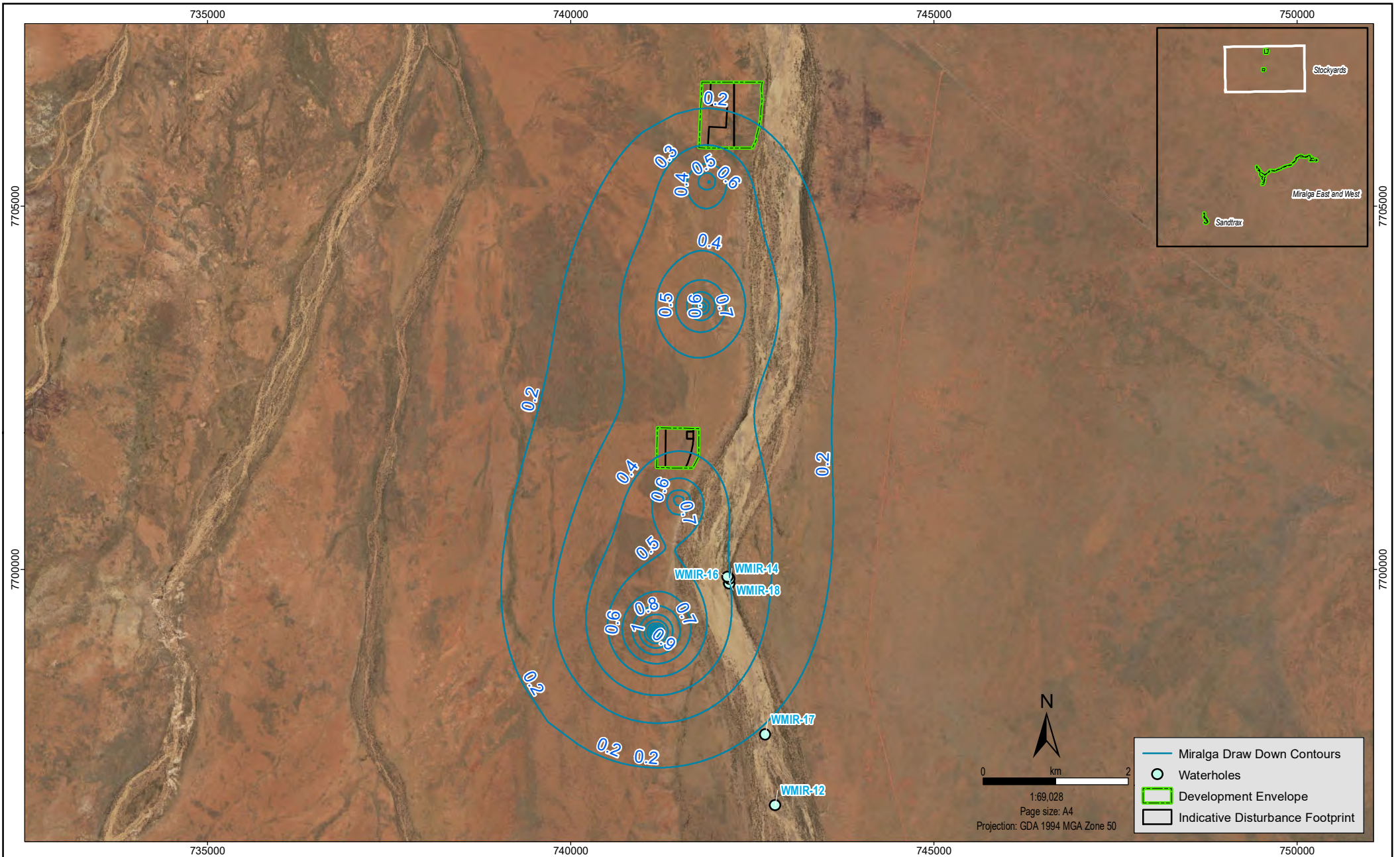
Fifteen natural water features (other than creeks and rivers) were recorded by Biologic during the fauna survey (Figure 6.4), plus a turkey's nest (dam). An additional 17 were mapped



during the GDV field survey. WMRC-02 was investigated in both field surveys (Biologic, 2019). It is important to note that significant rainfall was recorded in March 2019 as a result of Cyclone Veronica (246.2 mm; 324% above the long-term average). This event may have influenced the size of these water features at the time of the first phase of the fauna survey (Biologic, 2020a). Many of the water features were heavily impacted by cattle with algae presence and turbidity high (Biologic, 2019). Biologic (2020a) initially considered four of the natural water features were likely to be semi-permanent to permanent sources of water. However, follow-up site visits observed water to be absent from two of these locations WMRC-01 and -02. Appendix D details observations for each of the waterholes identified during the four field surveys by Biologic and Atlas Iron. The majority of pools have been determined to be non-permanent. WMRC-14 and -15 may be permanent based on site observations to date.

All water sources in the Study Area provide foraging habitat for the Pilbara Leaf-nosed Bat and other fauna (when water is present). Artificial water sources also provide valuable fauna habitat, including a turkey's nest near Sandtrax where Biologic (2019) recorded Pilbara Leaf-nosed Bat and Ghost Bat calls.






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Source & Notes:  
 Disclaimer: Waterholes shown on this figures are a combination of data from the Biologic GDV Study (2020) and Biologic Terrestrial Fauna Study (2020)

**Waterholes**

Figure No:  
**6-4B**

### 6.1.4 Vertebrate Fauna Assemblage

The desktop study and field survey identified that approximately 343 vertebrate species occurred in the study area. A total of 154 vertebrate fauna species comprising 24 native and four introduced mammal species, 84 bird species, 39 reptile species, and three amphibian species were recorded during the survey (Biologic, 2020a). This number of species is comparable with other surveys of equivalent scope and size in the vicinity of the Study Area (Biologic, 2020a). A summary of the vertebrate fauna assemblage recorded within the Study Area is provided in Table 6.4 see Appendix D for further details. No unusual or unexpected species were recorded during the survey; all species had been recorded in the area by at least two previous surveys considered in the literature review.

**Table 6.4 – Native Vertebrate Fauna Assemblage**

Group	Number of Species	Number of Families	Description
Mammals (573 records)	28	12	<p>The most commonly recorded groups were:</p> <ul style="list-style-type: none"> <li>• Bats (244 records)</li> <li>• Rodents (157 records)</li> <li>• Dasyurids (103 records).</li> </ul> <p>The most abundantly recorded species was Common Rock Rat (<i>Zyromys argurus</i>), with 138 records, followed by Northern Quoll with 89 records. This is largely attributed to the targeted sampling (trapping and motion camera trap transects) for Northern Quoll, during which Common Rock Rat was frequently recorded as bycatch.</p> <p>The following conservation significant mammals were recorded within the Study Area during the survey:</p> <ul style="list-style-type: none"> <li>• Northern Quoll (89 records)</li> <li>• Pilbara Leaf-nosed Bat (35 records)</li> <li>• Ghost Bat (11 records)</li> <li>• Western Pebble-mound Mouse (15 records)</li> <li>• Northern Brushtail Possum (2 records).</li> </ul>
Birds (641 records)	84	42	<p>The most commonly recorded families were:</p> <ul style="list-style-type: none"> <li>• Honeyeaters and allies (family Meliphagidae) (97 records)</li> <li>• Crows (family Corvidae) (64 records) of a single species (Torresian Crow, <i>Corvus orru</i>) which was the most commonly recorded species during the survey.</li> <li>• Woodswallows and butcherbirds (family Artamidae) (28 records)</li> <li>• Hawks and eagles (family Accipitridae) (16 records).</li> </ul> <p>Species diversity, abundance and complexity was highly variable throughout the Study Area, particularly due to the variable presence and abundance of vegetation between sites.</p>



Group	Number of Species	Number of Families	Description
			<p>Two conservation significant birds were recorded during the current survey:</p> <ul style="list-style-type: none"> <li>• Grey Falcon: recorded once during the Phase 1 from direct observation of a group of four individuals (two adults and two young) and twice during the Phase 2 survey from direct observation of a single individual.</li> <li>• Peregrine Falcon: recorded once during both Phases of the survey, both from direct observation of a single individual.</li> </ul>
Amphibians (13 records)	3	2	<p>Amphibians were only recorded from two sites (VMRC-05 and VMRC-08) and four opportunistic locations, all of which had water present in varying capacities at the time of the record.</p> <p>The most commonly recorded amphibian during the survey was the Little Red Tree Frog (<i>Litoria rubella</i>), recorded a total of seven times.</p> <p>No frog species of conservation significance were recorded during the survey, nor are any known to occur within the Pilbara bioregion.</p>
Reptiles (117 records)	39	11	<p>The most common groups were:</p> <ul style="list-style-type: none"> <li>• Skinks (55 records)</li> <li>• Agamids (dragon lizards) (16 records)</li> <li>• Varanids (monitor lizards) (8 records with a high diversity of 7 species).</li> </ul> <p>The most commonly recorded species were the Inornate Ctenotus (<i>Ctenotus inornatus</i>), recorded 20 times from seven sites.</p> <p>Species diversity, composition and abundance was variable between sites.</p> <p>Note that three species of gecko, <i>Gehyra macra</i>, <i>Gehyra media</i>, and <i>Gehyra montium</i> were recorded for the first time in the area. This is due to revision of the <i>Gehyra punctata</i> species complex, where <i>G. macra</i> and <i>G. media</i> were previously known as <i>G. punctata</i>. The <i>Gehyra variegata</i> species complex was also revised and resulting in the distribution of <i>G. montium</i> being redefined.</p> <p>No conservation significant reptile species were recorded within the Study Area during the current survey.</p>

### 6.1.5 Conservation Significant Vertebrate Fauna

Conservation significant fauna includes species listed as:

- Threatened or Migratory under the EPBC Act
- Threatened or Specially Protected (includes migratory species) under the *Biodiversity Conservation Act 2016* (BC Act)
- Priority species listed by DBCA.



Seven vertebrate species recorded during the field survey are listed as conservation significant:

- Northern Quoll (89 records from 15 sites)
- Pilbara Leaf-nosed Bat (35 records from 14 sites)
- Western Pebble-mound Mouse (15 records from 15 sites)
- Ghost Bat (11 records from six sites)
- Northern Brushtail Possum (two records from one site)
- Grey Falcon (four records from one site)
- Peregrine Falcon (two records from two sites).

No conservation significant species were identified in the stockyard areas.

Based on regional records and habitats identified within the Study Area, five additional species were considered Likely to occur and 16 were considered Possible to occur. The remaining conservation significant species were considered to occur Rarely, Unlikely or Highly Unlikely. Table 6.5 summarises the 28 conservation significant fauna species that Biologic (2020a) confirmed were present or considered Likely or Possible to occur in the Study Area

Vertebrate species protected as Threatened under the BC Act and/or EPBC Act that were either 'Confirmed' or 'Likely' to be present based on Biologic (2019) are discussed in more detail in Sections 6.1.5.1 to 6.1.5.7.



Table 6.5 – Conservation Significant Fauna in the Study Area

Common Name	Species	EPBC Act <sup>1</sup>	BC Act <sup>2</sup>	DBCAs Lists <sup>3</sup>	Likelihood of Occurrence
Night Parrot	<i>Pezoporus occidentalis</i>	EN	CR	–	Possible
Northern Quoll	<i>Dasyurus hallucatus</i>	EN	EN	–	Confirmed
Pilbara Leaf-nosed Bat	<i>Rhinioncteris aurantius</i> 'Pilbara form'	VU	VU	–	Confirmed
Pilbara Olive Python	<i>Liasis olivaceus barroni</i>	VU	VU	–	Likely
Ghost Bat	<i>Macroderma gigas</i>	VU	VU	–	Confirmed
Greater Bilby	<i>Macrotis lagotis</i>	VU	VU	–	Possible
Grey Falcon	<i>Falco hypoleucos</i>	–	VU	–	Confirmed
Northern Brushtail Possum	<i>Trichosurus vulpecula arnhemensis</i>	–	VU	–	Confirmed
Peregrine Falcon	<i>Falco peregrinus</i>	–	OS	–	Confirmed
Black-tailed Godwit	<i>Limosa limosa</i>	MI	MI	–	Possible
Common Greenshank	<i>Tringa nebularia</i>	MI	MI	–	Possible
Common Sandpiper	<i>Tringa hypoleucos</i>	MI	MI	–	Possible
Fork-tailed Swift	<i>Apus pacificus</i>	MI	MI	–	Possible
Glossy Ibis	<i>Plegadis falcinellus</i>	MI	MI	–	Possible
Marsh Sandpiper	<i>Tringa stagnatilis</i>	MI	MI	–	Possible
Pectoral Sandpiper	<i>Calidris melanotos</i>	MI	MI	–	Possible
Oriental Plover	<i>Charadrius veredus</i>	MI	MI	–	Possible
Osprey	<i>Pandion haliaetus</i>	MI	MI	–	Possible
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	MI	MI	–	Possible
Wood Sandpaper	<i>Tringa glareola</i>	MI	MI	–	Possible
Gane's Blind Snake	<i>Anilius ganei</i>	–	–	P1	Likely
Black-lined Ctenotus	<i>Ctenotus nigrilineatus</i>	–	–	P1	Likely
Spotted Ctenotus	<i>Ctenotus uber johnstonei</i>	–	–	P2	Possible
Brush-tailed Mulgara	<i>Dasymercus blythi</i>	–	–	P4	Likely
Long-tailed Dunnart	<i>Sminthopsis longicaudata</i>	–	–	P4	Possible
Spectacled Hare-wallaby	<i>Lagorchestes conspicillatus leichardti</i>	–	–	P4	Likely
Short-tailed Mouse	<i>Leggadina lakedownensis</i>	–	–	P4	Possible



Common Name	Species	EPBC Act <sup>1</sup>	BC Act <sup>2</sup>	DBCA Lists <sup>3</sup>	Likelihood of Occurrence
Western Pebble-mound Mouse	<i>Pseudomys chapmani</i>	–	–	P4	Confirmed

Source: Biologic 2020a

Conservation status definitions:

- (1) EPBC Act: EN – Endangered, VU – Vulnerable, MIG – Migratory.
- (2) WA (BC Act): CR – Critically Endangered, EN – Endangered, VU – Vulnerable, MI – Migratory species not otherwise listed as threatened, OS – Other specially protected fauna.
- (3) WA (DBCA lists): P1 – Priority 1 (species that are known from one or a few locations (generally five or less) which are potentially at risk), P2 – Priority 2 (species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation), P3 – Priority 3 (species that are known from several locations, and the species does not appear to be under imminent threat, or from few or widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat), P4 – Priority 4 (rare, near threatened and other species in need of monitoring).

### 6.1.5.1 Northern Quoll

The Northern Quoll is listed as Endangered under the EPBC Act and BC Act. Quolls are carnivorous marsupials endemic to Australia and occur in Queensland, Northern Territory and WA. The Northern Quoll has undergone a rapid decline from cumulative effects of inappropriate fire regimes, predation, habitat loss and invasion of its habitat by cane toads (*Rhinella marina*) (Department of the Environment and Energy, 2019).

The species was originally found across northern Australia from the North-West Cape of Western Australia to south-east Queensland; however, its abundance has significantly declined in recent years. This species is now restricted to five regional populations across Queensland, the Northern Territory and Western Australia on both the mainland and offshore islands (Department of the Environment, 2016). Northern Quoll are known to occur within a range of habitats, including ironstone and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats dissected rocky escarpments, open forest of lowland savannah and woodland (Biologic, 2019). Rocky habitats tend to support higher densities, as they offer protection from predators and are generally more productive in terms of availability of resources (Biologic, 2020a).

The EPBC Act Referral guideline for the species defines critical habitat for Northern Quoll as habitat within the modelled distribution for the species which provides shelter for breeding, refuge from fire and/or predation by Cane Toad. This includes:

- Rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields and major drainage lines or treed creeks
- Structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs.

Habitat that is considered critical to the survival of this species also includes dispersal and foraging habitat associated with or connecting populations that are important to the long-term survival of the species (Department of the Environment, 2016). As per the referral guidelines, foraging or dispersal habitat is any land that comprises predominantly native vegetation in the immediate area (i.e. within 1 km) of shelter habitat, quoll records or land comprising predominantly native vegetation that is connected to shelter habitat within the range of the species.

Populations that constitute an important population for Northern Quoll include (Department of the Environment, 2016):



- High density quoll populations that occur in refuge-rich habitat that is critical to the survival of the species. This includes habitat where cane toads are present.
- Populations that are free of cane toads and are unlikely to sustain cane toad populations upon their arrival; for example, populations within a desert context and without permanent water, the granite habitats found in Western Australia.
- Populations subject to conservation or research programs – that is, populations that are monitored by government agencies or universities.

In addition to the above, the National Recovery Plan for the Northern Quoll (Hill & Ward, 2010) identifies four categories of important populations, including populations in the Pilbara region as these are outside of the predicted range of cane toads. Since publication of this guidance, predictions for the spread of cane toad have been revised to include the Pilbara within the area of spread (Department of Parks and Wildlife, 2017).

Of the five conservation significant mammal species recorded within the Study Area, Northern Quoll was the most commonly recorded species, with 89 records from 15 sites, including nine opportunistic locations. This number of records is considered to represent a permanent and important population of Northern Quoll (Biologic, 2020b). Evidence of Quolls (including scats and individuals) was identified in Gorge/ Gully, Major Drainage Line, Low Stony Hills, Hillcrest/Hillslope and Sand Plain habitats. The Hillcrest/Hillslope and Gorge/ Gully habitat provides foraging and denning habitat, while the other habitats provide foraging and dispersal habitat.

Records were as follows (Figure 6.5):

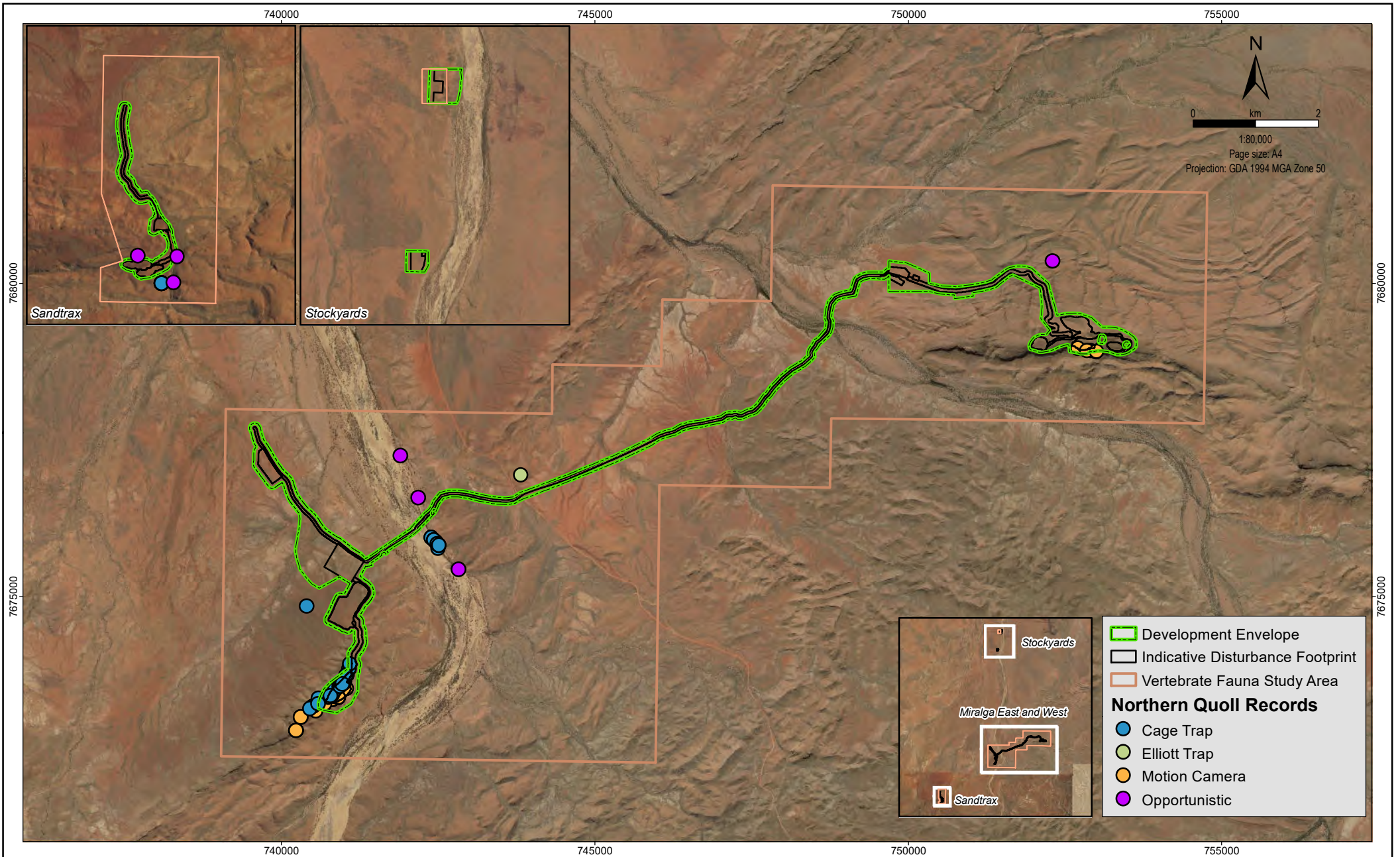
- 44 times from trapped individuals (comprising 28 unique individuals),
- 35 times from motion camera captures (comprising 10 or 11 unique individuals) and
- 10 times from secondary evidence (six scats and four tracks).

The species showed a strong association with Hillcrest/ Hillslope and Gully/ Gorge habitats, where available of suitable denning and/or foraging habitat is higher, with the majority of records occurring within these habitats. Northern Quoll are likely to occur throughout the Study Area, particularly within Gorge/ Gully and Hillcrest/ Hillslope habitats where suitable denning/shelter and/or foraging habitat is present. These two habitats form part of the core habitats critical to the survival of Northern Quoll (Department of the Environment, 2016).

Table 6.6 provides a summary of the species' occurrence in the area and the significance of broad fauna habitats for the species.

**Table 6.6 – Summary of Northern Quoll Occurrence and Habitat in Study Area**

Site	Habitat	Habitat Significance	Total Captures	No. of Unique Individuals			
				Male	Female	Indet.	Total
VMRC-02	Low Stony Hills	Dispersal (infrequent use of this habitat). Two young males captured - indicative of dispersing individuals, timing of their capture coincides with the early stages of the breeding season for the species, when males are most active and mobile.	1	1	–	–	1
VMRC-04	Sand Plain		1	1	–	–	1
VMRC-99	Hillcrest/ Hillslope	Denning/shelter and foraging. High number of females captured highlights the high value of denning /shelter habitat for breeding females.	25	7	11	–	18
VMRC-110	Major Drainage	Foraging/ dispersing. Individuals possibly moving between areas providing more suitable denning/shelter habitat.	10	2	2	1	5
VMRC-116	Major Drainage		–	–	–	–	0
VMRC-117	Hillcrest/ Hillslope	Denning/shelter and foraging.	–	–	–	–	0
VABY-12 (Abydos monitoring site L)	Gorge/ Gully	Denning/shelter and foraging.	7	1	2	–	3
<b>Total</b>			<b>44</b>	<b>12</b>	<b>15</b>	<b>1</b>	<b>28</b>



File Name: GIS\_2762\_MIR\_S38\_Fig6\_5\_NorthernQuoll Document Number : (QDMS number only)

Date: 2/04/2020

Author: Heath.Maconachie

Source & Notes:

**Northern Quoll Records**

Figure No:

**6-5**



### 6.1.5.2 Ghost Bat

The Ghost Bat is listed as Vulnerable under the EPBC Act and BC Act. As reported in Biologic (2020a), Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned mines. These features often occur within habitats including Gorge/Gully, Hillcrest/Hillslope and Low Hills.

Ghost Bats are known to require a number of suitable caves throughout their home ranges, due to both temporal factors (i.e. night/feeding roosts for feeding throughout the duration of the night, as well as day roosts for resting) and seasonal factors (use of certain caves as maternity roosts, depending on the right environmental conditions). The presence of day roosts and/or maternity roosts in an area is the most important indicator of suitable habitat for Ghost Bats, and these caves are generally the primary focus of conservation and/or monitoring (Threatened Species Scientific Committee, 2016).

Foraging habitat includes gullies and gorges with vertical vegetation complexity, presence of water including riparian drainage lines that are within a 5 to 10 km radius of roosts. Ghost Bats generally return to the same foraging areas each night. Information on the home ranges of Ghost Bats is limited; however, one report indicates a mean foraging area of 61 ha, centred on average approximately 1.9 km from daytime roosts (Threatened Species Scientific Committee, 2016), with the flight capability to travel up to 25 km in a single night (Bat Call WA, 2020).

Ghost Bats require a number of caves seasonally. They disperse when not breeding, but concentrate in a smaller number of roost sites during the breeding season. Few confirmed breeding sites are currently known. Persistence in the Pilbara is recognised as being dependent upon the presence of day (diurnal) roosts in humid, temperature-stable caves (Threatened Species Scientific Committee, 2016).

In the first stage of assessing the potential for impacts to the Ghost Bat, Atlas Iron commissioned Biologic (2020a) to conduct baseline survey work, and sought additional specific advice from Bat Call WA, commencing in November 2019. This advice has been updated as additional studies and modelling was completed, and culminates in Bat Call WA (2020).

Biologic (2020a) recorded the Ghost Bat across four habitats types in the Study Area:

- Major Drainage
- Hillcrest/ Hillslope
- Gorge/ Gully
- Stony Plain.

They are likely to occur in all six broad habitats in the Study Area as follows (Biologic, 2020a):

- Low Stony Hills – foraging
- Stony Plain – foraging
- Sand Plain – primary foraging
- Major Drainage – foraging / dispersal
- Hillcrest/ Hillslope – foraging / roosting



- Gorge/ Gully – foraging / roosting.

The species was recorded five times from direct observation (individuals observed at night and within or flushed from caves), ten times from ultrasonic call recordings and ten times from secondary evidence (scats). These observations were made at caves and standardised trapping sites (Biologic, 2020a).

Sixteen caves have been recorded in the Study Area, ten of which contained evidence of use by Ghost Bats. Thirteen caves are confirmed or potential roost caves for Ghost Bat. Table 6.7 provides more details on each cave, specific to Ghost Bat use. Bat Call WA (2020) determined there are four groups of caves important for the persistence of the Ghost Bat in the local area, including the Miralga East grouping containing caves CMRC-15 (a category 2 potential maternity roost), CMRC-13 (category 4) and CMRC-14 (category 3).

Timing of calls from most sites were consistent with bats originating from Lalla Rookh (Biologic, 2020a). Lalla Rookh is a permanent bat roost which lies outside of the Development Envelope, approximately 700 m south of the existing ALRE, which runs between Sandtrax and Miralga West. From Lalla Rookh, Sandtrax is approximately 9 km southwest, Miralga West 3 km northeast and Miralga East 19 km northeast.

Ghost Bat breeding populations inhabit a small number of maternity roosts across the Pilbara, with category 1 abandoned mine shafts comprising the largest of these populations (Bat Call WA, 2020). Numbers vary between roosts and over time, ranging from several hundreds to the low thousands (Bat Call WA, 2020). The population of Ghost Bat at the caves nearby the Proposed Action is likely to be an important population of at least 200 individuals that is based at the Lalla Rookh breeding site (Bat Call WA, 2020).

Atlas Iron commissioned the following additional studies to further investigate the potential for impacts to this species:

- Internal LIDAR mapping of CMRC -13, -14 and -15 by Land Surveys.
- Geotechnical assessment (including site visit) of caves CMRC-13, -14 and -15 by Pells Sullivan Meynink (PSM) (PSM, 2019), followed by an assessment of potential mining activities on the structural integrity of those caves (PSM, 2020).
- Assessment of blasting impacts and determination of appropriate blasting parameters to preserve Ghost Bat caves following mining activities (Blast It Global, 2020), which is discussed in more detail in Section 6.3.2.1 in relation to modelled vibration limits.

Throughout the baseline investigation and impact assessment process, Atlas has engaged closely with Bob Bullen, culminating in an overall assessment of impacts to the Ghost Bat (Bat Call WA, 2020), discussed in more detail in Sections 6.4 and 6.5 in relation to management and the anticipated outcome.



Table 6.7 – Ghost Bat Caves Recorded in the Study Area

Cave	Habitat Value To and Use By Ghost Bat	Category <sup>1</sup>				Distance to Nearest Proposed Pit <sup>2</sup>
		1	2	3	4	
<b>Sandtrax</b>						
CMRC-03	Nocturnal roost			✓		185 m
CMRC-07	Diurnal roost			✓		225 m
CMRC-19	Night roost				✓	385 m
<b>Miralga West</b>						
CMRC-02	Potential nocturnal roost				✓	Within pit
CMRC-04	Nocturnal roost				✓	340 m
CMRC-06	Diurnal roost		✓			400 m
CMRC-08	Nocturnal roost			✓		470 m
CMRC-10	Nocturnal roost			✓		450 m
CMRC-12	No usage				✓	340 m
<b>Miralga East (near pits 2 and 3)</b>						
CMRC-01	Nocturnal roost				✓	50 m <sup>3</sup>
CMRC-13	Nocturnal roost				✓	95 m
CMRC-14	Diurnal roost			✓		117 m
CMRC-15	Diurnal roost / possible maternity roost		✓			55 m
<b>Miralga East (west of pits)</b>						
CMRC-16	No usage				✓	~1,000 m
CMRC-17	No usage				✓	~1,000 m
CMRC-18	Potential diurnal roost			✓		~1,000 m

Sources: Biologic (2020a), Bat Call WA (2020).

(1) Cave category definitions (full definitions in Appendix A of Bat Call WA (2020)):

Category 1 – diurnal roosts with permanent occupancy

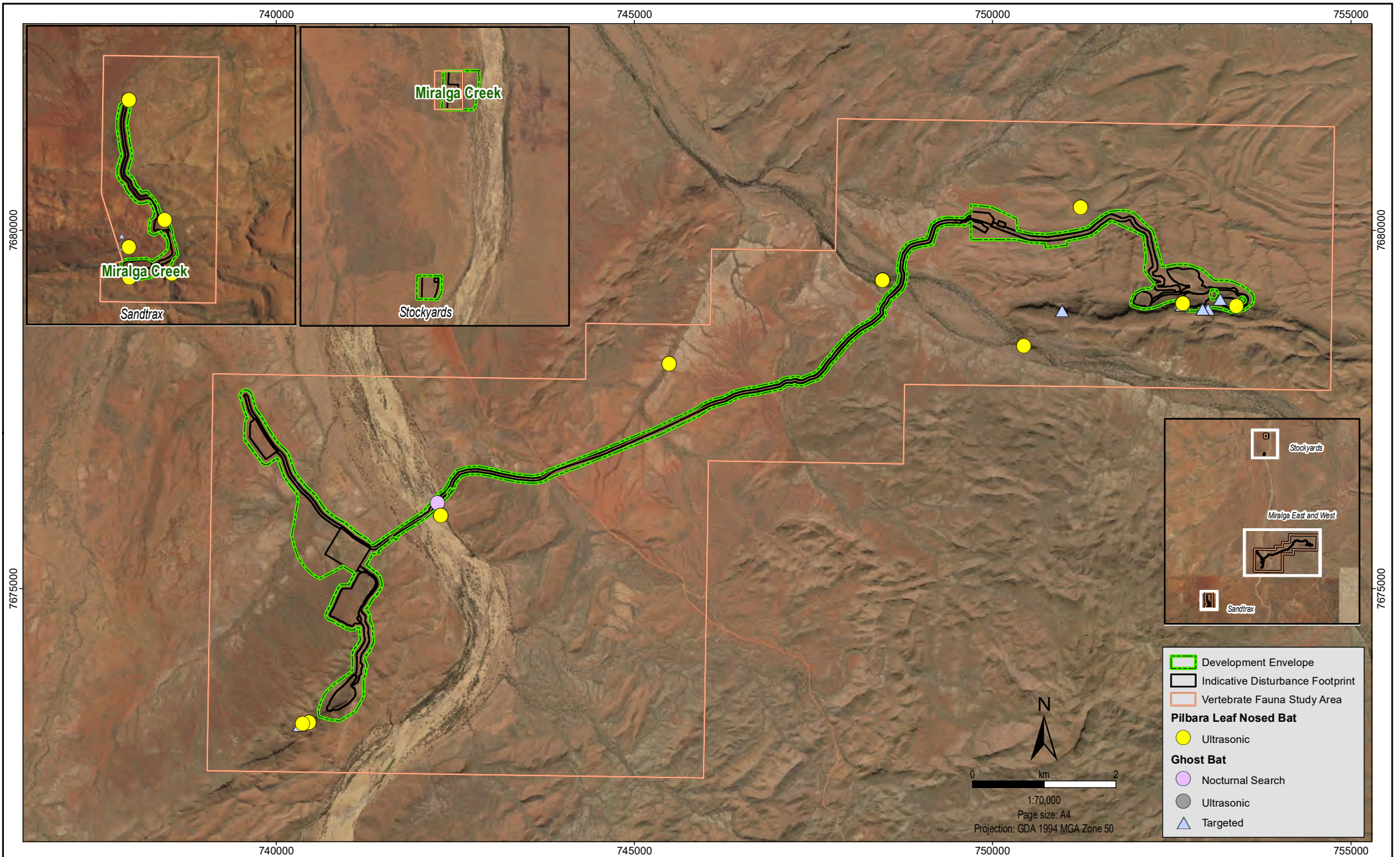
Category 2 – diurnal roosts with regular occupancy

Category 3 – roosts with occasional occupancy

Category 4 – nocturnal roosts with opportunistic usage

(2) Distance is measured from nearest edge of proposed pit disturbance to the cave entrance.

(3) Cave CMRC-01 was previously incorrectly reported as being on the edge of pit 3 at Miralga East. It is actually located midway between pits 2 and 3, approximately 50 m from pit 2 and 100 m from pit 3. See also Section 6.1.3.1.



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Date: 2/04/2020

Author: Heath.Maconachie

Source & Notes:

## Pilbara Leaf Nosed Bat and Ghost Bat Records

Figure No:

6-6



### **6.1.5.3 Pilbara Leaf Nosed Bat**

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the EPBC Act and BC Act. Pilbara Leaf-nosed Bat roost in undisturbed caves, deep fissures or abandoned mine shafts. The Pilbara Leaf-nosed Bat's limited ability to conserve heat and water means it requires warm (28–32°C) and very humid (85–100%) roost sites in caves and/or mine shafts, as these enable individuals to persist in arid climates by limiting water loss and energy expenditure (Biologic, 2020a). Such caves are relatively uncommon in the Pilbara, which limits the availability of diurnal roosts for this species, and these caves are therefore considered critical habitat (Threatened Species Scientific Committee, 2016).

Foraging habitat is diverse and includes gorges, gullies, water courses, riparian vegetation, hummock grassland and sparse tree and shrub savannah (Department of the Environment and Energy, 2019). Typically, Pilbara Leaf-nosed Bat emerge at dusk from their roosting sites to forage up to 10 km from their roosts.

During the dry season (approximately March to August), Pilbara Leaf-nosed Bat aggregate in colonies within caves that provide a suitably warm, humid microclimate. The species disperses from these main colonies during the wet season (approximately September to February) when suitably humid caves are more widely available (Threatened Species Scientific Committee, 2016).

The population of Pilbara Leaf-nosed Bat in the Pilbara and upper Gascoyne is identified as an important population. It comprises one isolated interbreeding population of national significance, which shows evidence of genetic divergence (Threatened Species Scientific Committee, 2016). The following roosts are defined as critical habitat for the survival of the species (Threatened Species Scientific Committee, 2016):

- Priority 1: Permanent diurnal roosts – occupied year-round and likely utilised for the nine-month breeding cycle
- Priority 2: Non-permanent breeding roosts – used during some part of the breeding cycle, but not occupied year round
- Priority 3: Transitory diurnal roosts – occupied for part of the year, outside of the breeding season and could facilitate long distance dispersal in the region.

Nocturnal refuges (Priority 4) are occupied at night for resting, feeding or other purposes and are not considered critical habitat, but are important for persistence in a local area.

The type and quality of potential foraging habitat surrounding known or suspected roost sites can be critical to the survival of the Pilbara Leaf-nosed Bat. Foraging habitats used by the Pilbara Leaf-nosed Bat are categorised by the Threatened Species Scientific Committee under the EPBC Act:

- Priority 1: Gorges with waterholes
- Priority 2: Gullies
- Priority 3: Rocky outcrop
- Priority 4: Major watercourses
- Priority 5: Open grassland and woodland.



Pilbara Leaf-nosed Bat were recorded a total of 35 times from 14 sites within the Study Area (Biologic, 2020a) (Figure 6.6). All records of the species were identified from ultrasonic call recorders. The species was recorded within all broad fauna habitats mapped within the Study Area. Call recordings suggest the species forages widely throughout the Study Area and is likely to forage nightly within the Study Area (Biologic, 2020a).

The number of Pilbara Leaf-nosed Bat calls at each record site ranged between two and 1,160 calls, with the greatest number of calls recorded at VMRC-106 (located near cave CMRC-15), within the Hillcrest/Hillslope habitat. VMRC-11 (adjacent to an artificial water source) had the second most recorded calls at 416. All other sites recorded less than 100 calls.

No evidence of diurnal roosting by the Pilbara Leaf-nosed Bat was observed within the caves in the Study Area or indicated by ultrasonic call recordings (Biologic, 2020a).

Based on the analysis of call recording data, timing of all the calls are consistent with bats originating from the Lalla Rookh roost located approximately 6 km southwest of Miralga West and 10 km northeast of the Sandtrax deposit (Biologic, 2020a) (Figure 6.6). Data and current survey effort suggest that none of the caves recorded within the Study Area is likely to represent a roosting cave for Pilbara Leaf-nosed Bat. Calls recorded near caves CMRC-15, -04, -11, -03, -07 and -19 are likely to be classed as nocturnal refuges, which are not considered critical habitat for Pilbara Leaf-nosed Bat but are important for their persistence in the local area (Threatened Species Scientific Committee, 2016). Additionally, all broad fauna habitats within the Study Area are likely to provide foraging habitat for the Pilbara Leaf-nosed Bat. This can be summarised as follows:

- Gorge/ Gully – nocturnal refuge and primary foraging habitat
- Hillcrest/ Hillslope – nocturnal refuge and primary foraging habitat
- Major Drainage Line – primary foraging habitat
- Sand Plain – foraging habitat
- Stony Plain – foraging habitat
- Low Stony Plains – foraging habitat.

#### **6.1.5.4 Pilbara Olive Python**

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and BC Act. The Pilbara subspecies of the Olive Python is endemic to Western Australia and is known only from ranges within the Pilbara region. This species is often associated with drainage systems, including areas with localised drainage and watercourses. In the inland Pilbara, the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Department of the Environment, Water, Heritage and the Arts, 2008).

Primary threats to the Pilbara Olive Python include predation by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*), particularly of juveniles the predation of food sources (quolls and rock-wallabies) by foxes; and destruction of habitat due to gas and mining development (Department of the Environment, Water, Heritage and the Arts, 2008).

No evidence of Pilbara Olive Python was recorded within the Biologic Study Area during the survey. However, the species is considered likely to occur due to presence of habitats known to support the species in Gorge/Gully, Hillcrest/Hillslope and Major Drainage habitats



mapped within the Study Area and the species' scattered but widespread distribution within the Pilbara region (Biologic, 2020a).

Within the Study Area, the species is likely to occur as a resident, but may also disperse into and from the area via dispersal corridors. Occurrence is likely to be associated with waterbodies, particularly permanent or long-standing waterbodies such as spring-fed systems which occur within Gorge/Gully and Major Drainage habitats. The species may also utilise these habitats as dispersal corridors to other areas within and outside of the Study Area (Biologic, 2020a). The species has previously been recorded multiple times within approximately 11 km southwest of the Study Area (Biologic, 2020a).

#### **6.1.5.5 Grey Falcon**

The Grey Falcon is listed as Vulnerable under the State *Biodiversity Conservation Act 1986* and is not considered to be MNES under the EPBC Act. Its preferred habitat is timbered lowlands, particularly *Acacia* shrublands and along inland drainage systems. It also frequents spinifex and tussock grassland (Burbidge, 2010; Olsen, 1986).

Grey Falcon were recorded three times during the survey, once from direct observation of a group of four individuals (two adults and two young) during the Phase 1 survey and twice during the Phase 2 survey, both times from direct observation of a single individual (Biologic, 2020a) (Figure 6.8).

Within the Study Area, all records of Grey Falcon were recorded within or in close proximity to Major Drainage habitat. It is possible the species is nesting within the Study Area within this habitat, particularly where riparian vegetation comprises large tall trees providing suitable nesting opportunities and vantage points for the species (Biologic, 2020a).

The species is likely to occur as a resident within or within a broader area encompassing the Study Area, with nesting potentially occurring within the continuous Major Drainage habitat occurring within the Study Area. Due to the large foraging range of the species, the species is likely to occur within the Study Area to forage, particularly within Sand Plain, Stony Plain and Major Drainage habitats.

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Projection: GDA 1994 MGA Zone 50

Stockyards



Sandtrax



Miralga East and West



-  Indicative Disturbance Footprint
-  Development Envelope
- Pilbara Olive Python Habitat Type**
-  Core
-  Dispersal/Foraging
-  Supporting
-  Vertebrate Fauna Study Area

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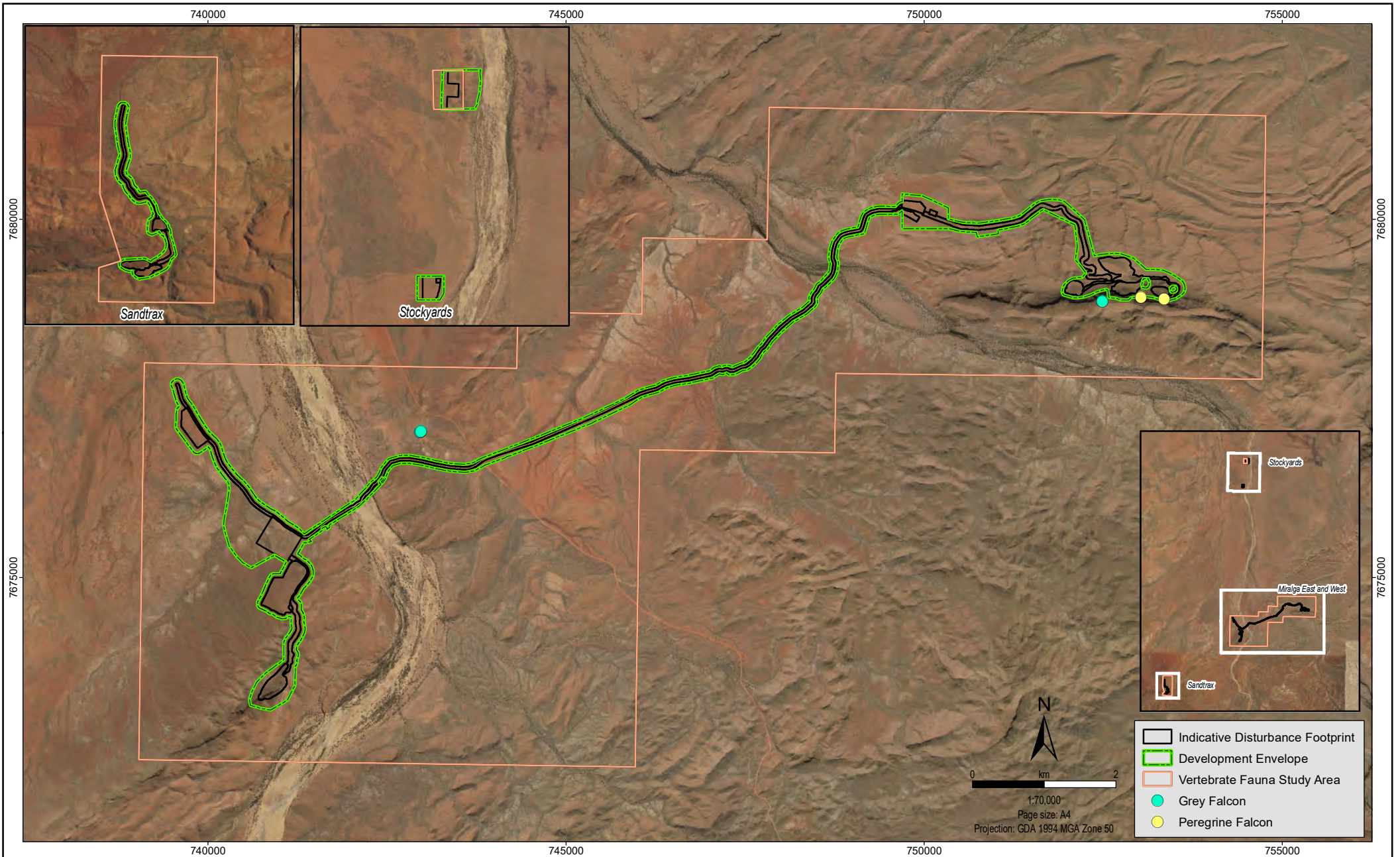



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 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

### Pilbara Olive Python

Figure No:  
**6-7**




 GIS\_2764\_MIR\_S38\_Fig6\_8\_Grey and PeregrineFalcon.mxd  
 Date: 2/04/2020  
 Author: Heath.Maconachie

Source & Notes:

## Peregrine Falcon and Grey Falcon Records

Figure No:  
**6-8**



#### **6.1.5.6 Peregrine Falcon**

The Peregrine Falcon is listed as Other Specially Protected Fauna under the State *Biodiversity Conservation Act 1986* and is not considered to be MNES under the EPBC Act. In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen P. D., 1989) (J. Olsen, 2004).

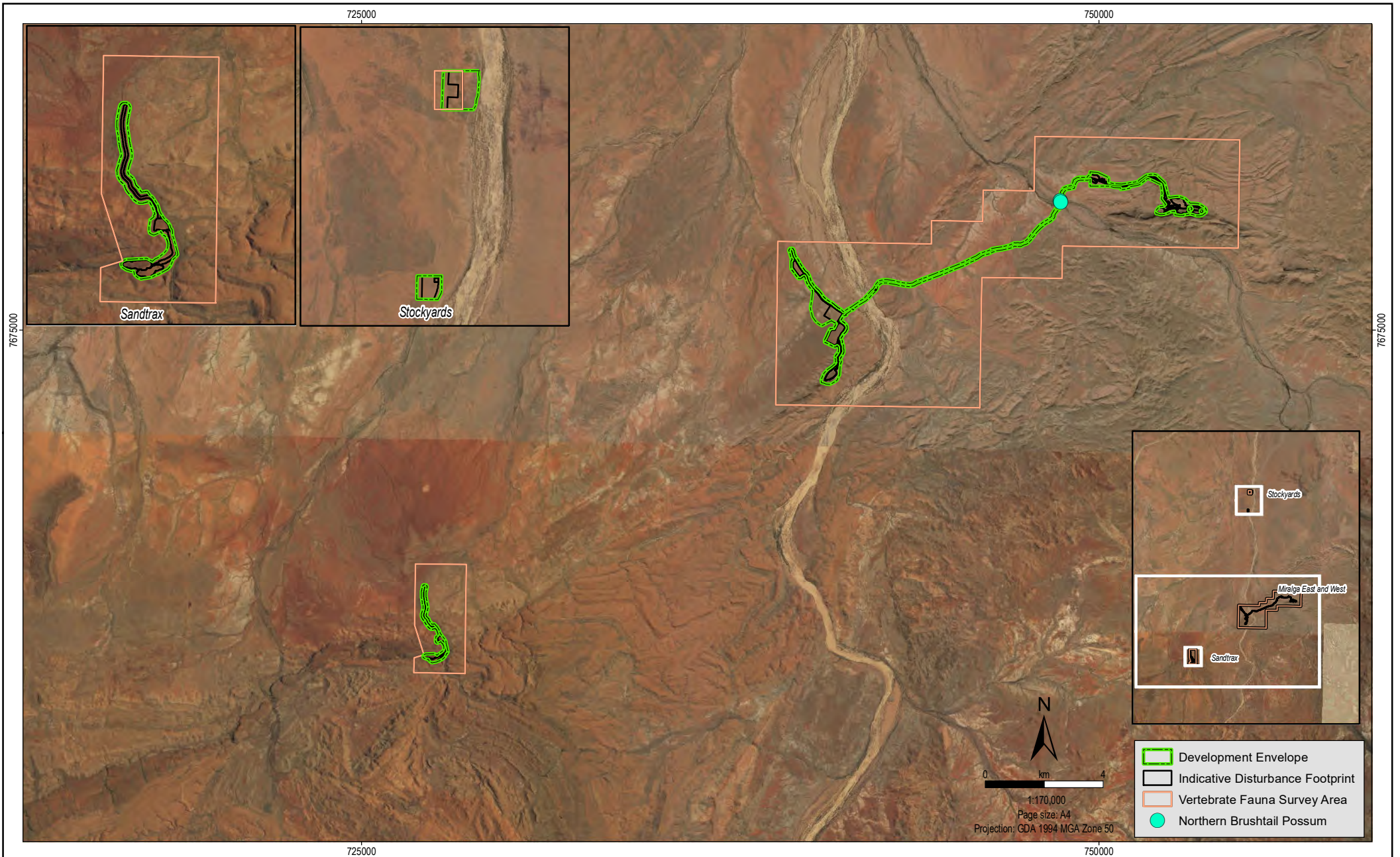
The Peregrine Falcon was recorded once during both phases of the field survey (Biologic, 2020a), both times as a direct observation of a single individual (Figure 6.8).

Within the Study Area, cliff areas within the fauna habitat type Hillcrest/ Hillslope may provide potential breeding areas; the habitat types Sand Plain, Major Drainage and Stony Plain provide foraging habitat (Biologic, 2020a).

#### **6.1.5.7 Northern Brushtail Possum**

The Northern Brushtail Possum is listed as Vulnerable under the State *Biodiversity Conservation Act 2016* but is not considered to be MNES under the EPBC Act. Within the Pilbara region the species generally exhibits flexibility in its habitat preferences and occupy an array of habitat types provided enough tree hollows and ground refuges (such as hollow logs, rockpiles and the burrows of other animals) are available (Kerle, 1992). It is largely known from gorges and major drainage lines with Eucalypt woodland (Department of Biodiversity, Conservation and Attractions, undated) (van Dyck, 2008). However, within the Pilbara region, the species is sparsely distributed and often only encountered in low abundance (Department of Biodiversity, Conservation and Attractions, 2019). The nearest record of the species to the Study Area is located approximately 80 km southwest (Department of Biodiversity, Conservation and Attractions, 2019).

A single adult female was recorded twice in cage traps at VMRC-116 along Miralga Creek, near waterhole WMRC-01 (Biologic, 2020a) (Figure 6.9). The individual was trapped in riparian vegetation within Major Drainage habitat with scattered *Eucalyptus* and *Melaleuca* species over a varied understory, often dominated by tussock grasses. Suitable habitat for the species is present within all Major Drainage habitat within the Study Area, in addition to suitable rocky habitat being present within Gorge/Gully habitat. It is unknown if the species occurrence within the Study Area represents a resident individual or population, or a transient individual which may be utilising Major Drainage habitat dissecting the Study Area (Biologic, 2020a).





### 6.1.6 Short-range Endemic Fauna

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale, the latter being commonly referred to as short-range endemism (Allen, 2006; Harvey, 2002). Short-range endemism is influenced by several factors including life history, physiology, habitat requirements, dispersal capabilities, biotic and abiotic interactions and historical conditions which not only influence the distribution of a species, but also the tendency for differentiation and speciation (Ponder, 2002).

An increasingly large number of terrestrial invertebrates are discovered to exhibit short-range endemism in Western Australia. While protection for species of conservation significance is provided under the BC Act and EPBC Act, the majority of SRE species and communities are not currently listed. This is due largely to incomplete taxonomic or ecological knowledge. As such, the assessment of conservation significance for SRE is guided primarily by expert advice provided by the Western Australian Museum (WAM) and other taxonomic experts.

The SRE status categories used in Biologic (2020a) is consistent with that usually used in EIA in WA, and broadly follows the WAM's revised categorisation for SRE invertebrates. This system is based upon the 10,000 km<sup>2</sup> range criterion proposed by Harvey (2002), and uses three broad categories to deal with varying levels of taxonomic certainty that may apply to any given taxon (Table 6.8).

**Table 6.8 – SRE Categorisation used by WAM Taxonomists**

Distribution	Taxonomic Certainty	Taxonomic Uncertainty
< 10,000 km <sup>2</sup>	<p>Confirmed SRE:</p> <ul style="list-style-type: none"> <li>A known distribution of &lt;10,000 km<sup>2</sup>.</li> <li>The taxonomy is well known.</li> <li>The group is well represented in collections and/or via comprehensive sampling.</li> </ul>	<p>Potential SRE:</p> <ul style="list-style-type: none"> <li>Patchy sampling has resulted in incomplete knowledge of geographic distribution.</li> <li>Incomplete taxonomic knowledge.</li> <li>The group is not well represented in collections.</li> </ul>
> 10,000 km <sup>2</sup>	<p>Widespread (not an SRE):</p> <ul style="list-style-type: none"> <li>A known distribution of &gt;10,000 km<sup>2</sup>.</li> <li>The taxonomy is well known.</li> <li>The group is well represented in collections and/or via comprehensive sampling.</li> </ul>	<ul style="list-style-type: none"> <li>Category applies where there are significant knowledge gaps.</li> </ul> <p>SRE Sub-categories may apply:</p> <ul style="list-style-type: none"> <li>(a) Data Deficient</li> <li>(b) Habitat Indicators</li> <li>(c) Morphology Indicators</li> <li>(d) Molecular Evidence</li> <li>(e) Research &amp; Expertise</li> </ul>

A desktop study undertaken by Biologic (2020b) identified a total of 668 invertebrate records that belonged to taxonomic groups that are prone to short-range endemism within 40 km of the Biologic Study Area, of these, four are regarded as Confirmed SRE:

- Two millipedes (*Antichiropus apricus* and *Antichiropus forcipatus*) – both recorded within the Development Envelope near Sandtrax
- One pseudoscorpion (*Faella tealei*)



- One gastropod (*Camaenidae* Gen. nov. cf. `Z` n. sp.).

A total of 184 invertebrate fauna specimens were collected within the Study Area Biologic (2020b):

- One mygalomorph spider
- Seven selenopid spiders
- 48 pseudoscorpions
- Eight scorpions
- 90 snails
- 29 isopods.

No Confirmed SRE taxa were recorded during the survey, however 18 Potential SRE taxa were recorded. The following potential SRE species were recorded within the Development Envelope by Biologic (2020a):

- *Karaops* sp. indet.
- *Olpidae* sp. indet.
- *Xenolpium* sp. indet.
- *Buddelundia* 'sp. 11'.

The following sections describe the six species identified in the Development Envelope, either during the field survey, or by others prior to the desktop assessment.

#### **6.1.6.1 *Antichiropus apricus***

There is a single record of this recently described millipede from within the Development Envelope (Car, 2019). It was collected from Drainage Line habitat in the Sandtrax region of the Study Area. However, Biologic (2020b) concluded it was more likely that this individual was dispersing through the drainage lines rather than using them as core habitat. It is likely that the species' preferred habitat is the surrounding more highly suitable habitats, such as Gorge/ Gully and Hillcrest/ Hillslope habitats where more stable, protected leaf litter microhabitats are available (Biologic, 2020b). All *Antichiropus* millipedes described from the Pilbara so far have highly restricted ranges, and all are considered Confirmed SRE. While no other records were found in the database search, *A. apricus* has been recorded from Marble Bar, 55 km to the east of this record (Car, 2019).

This species is a confirmed SRE.

#### **6.1.6.2 *Antichiropus forcipatus***

Similar to the above, there is a single record of this millipede, also recently described (Car, 2019) from the same location in the Sandtrax area. This millipede was not found elsewhere in the Study Area; however, there are 21 records of *A. forcipatus* from the WAM database search at several locations up to 14 km south-west of the Study Area, predominantly from the nearby Abydos minesite (Biologic, 2020b).

This species is a confirmed SRE.



#### **6.1.6.3 *Karaops sp. indet.***

Selenopid spiders including those in the genus *Karaops* are generally considered to have a reasonable likelihood of being SRE, due to their habitat specialisation within the cracks and crevices of rocky outcrops. *Karaops sp. indet.*, were collected from two sites within the Development Envelope, a Gorge/ Gully site and a Hillcrest/ Hillslope site. The five specimens collected were juveniles or females and could not be identified to species level.

*Karaops sp. indet.* were also collected outside the Development Envelope, at a Hillcrest/ Hillslope site and a Gorge/ Gully site. There is another record of a *Karaops sp. indet.* from the WAM database at Abydos.

The specimens are classified as Potential SRE, WAM categories 'A' (Data Deficient) and 'E' (Research and Expertise) (Biologic, 2020b).

#### **6.1.6.4 *Olpiidae sp. indet.***

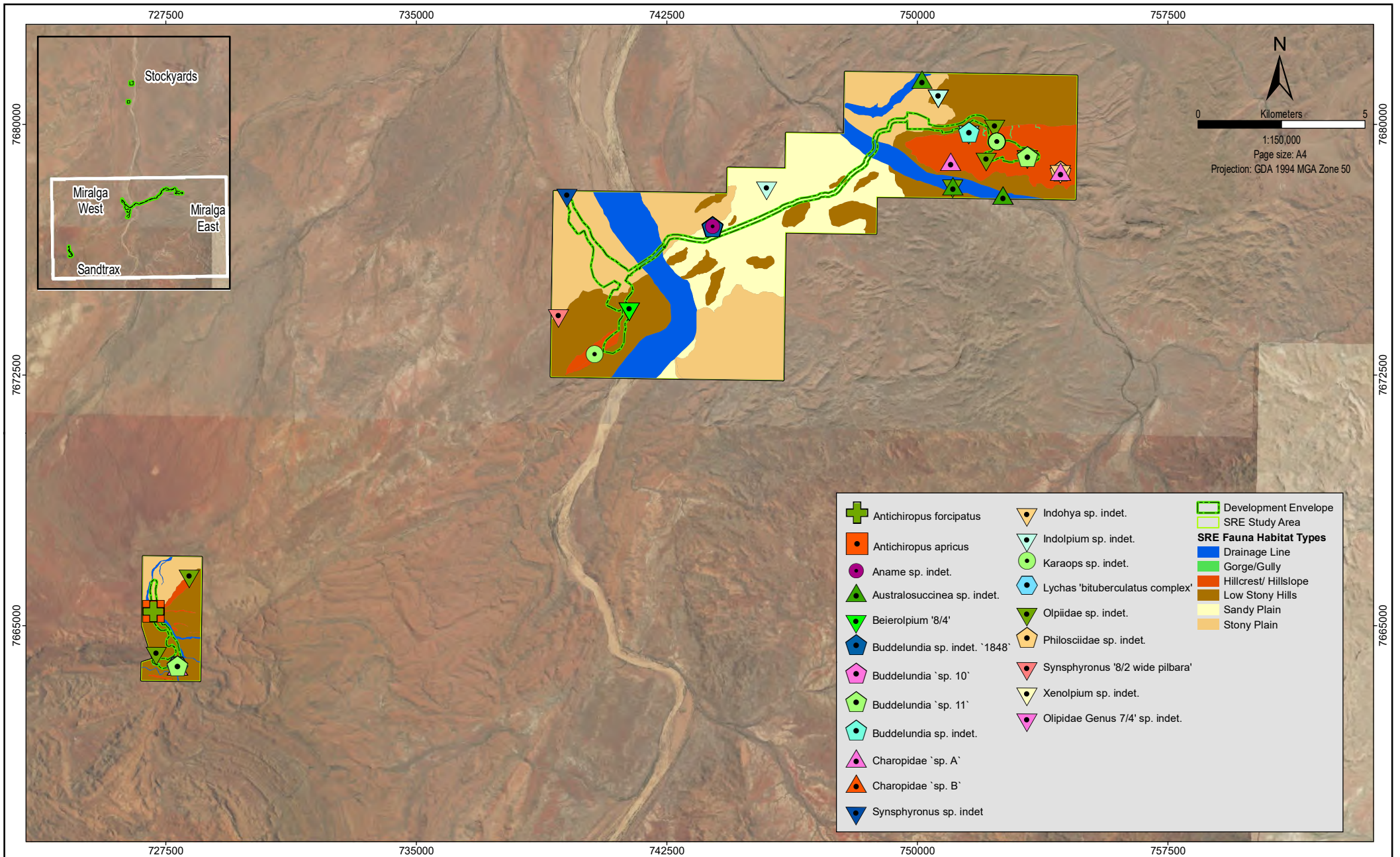
There are two records of this taxon from within the Development Envelope in Hillcrest/ Hillslope habitat. These and seven other records of *Olpiidae sp. indet.* from within the Study Area are likely to represent multiple species from the genera of either *Indolpium* or *Euryolpium*, both of which contain Potential SRE taxa (Biologic, 2020b).

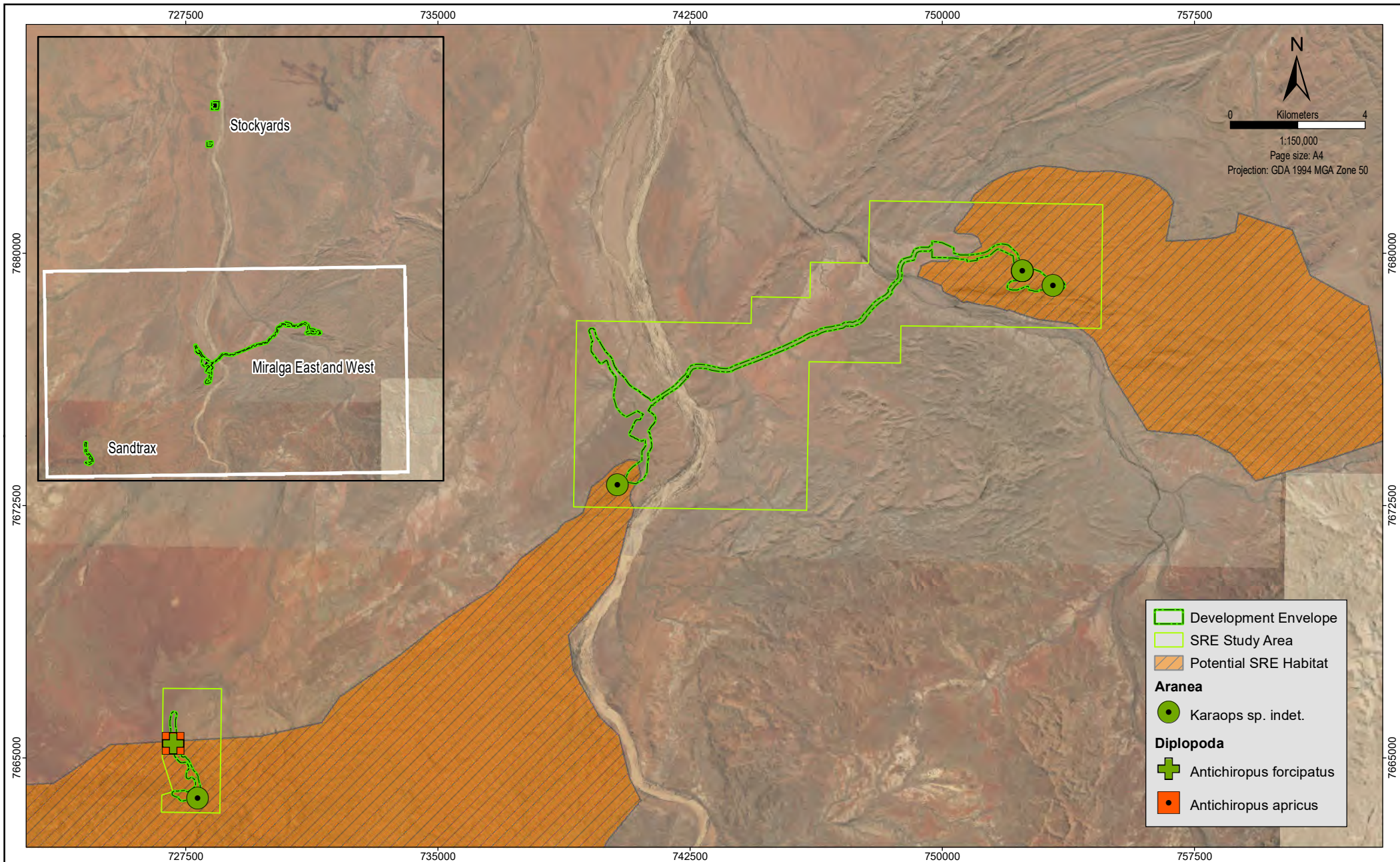
#### **6.1.6.5 *Xenolpium sp. indet.***

A single specimen of this taxon was recorded from within the Development Envelope, in Gorge/ Gully habitat (SMRC-021) at Miralga Creek. Two more specimens were collected in Hillcrest/ Hillslope habitat (SMRC-105) within the Study Area. The genus *Xenolpium* is found throughout the Pilbara and is poorly known taxonomically; however, it is regarded as likely to contain SRE species (Biologic, 2020b).

#### **6.1.6.6 *Buddelundia 'sp. 11'***

A single female specimen of this taxon was recorded from Hillcrest/ Hillslope habitat within the Development Envelope, and from Gorge/ Gully habitat in the broader Study Area. *Buddelundia 'sp. 11'* is regarded as a species complex containing species with restricted distributions (S. Judd, pers. comm. as reported in Biologic (2020b)). While this taxon is considered a Potential SRE, 36 records of this species complex were found in the WAM database search, from several sites to the south-west of the Study Area (Biologic, 2020b).





File Name: GIS\_2776\_MIR\_S38\_MIR\_Fig6\_11\_PotentialSREHabitat.mxd

Date: 2/04/2020

Author: Heath.Maconachie

Source & Notes:

## Extrapolation of Potential SRE Habitat

Figure No:

6-11



### 6.1.7 Introduced Fauna

European Cattle (*Bos taurus*), Camel (*Camelus dromedarius*) and dog/ dingo (*Canis familiaris*) were recorded in the Study Area during the survey (Biologic, 2020a).

## 6.2 Potential Impacts

Biologic was commissioned to undertake separate impact assessments on vertebrate fauna (Biologic, 2020b) (Appendix I) and SRE invertebrate fauna (Biologic, 2020c) (Appendix J), The impact assessment reports considered the entire Development Envelope.

Potential impacts to terrestrial fauna including direct, indirect and cumulative, as discussed by Biologic are:

- Removal, fragmentation or modification of habitat
- Impacts to habitat features
- Introduced species
- Disturbance from artificial lights
- Disturbance from noise and vibration
- Generation of dust
- Altered fire regimes
- Modification of water regimes
- Spills and contamination.

These potential impacts are discussed in detail in Section 6.4.

Potential impacts to Ghost Bats have been the subject of further work. These potential impacts include loss and/or temporary abandonment of caves used as roosts, and are discussed in further detail in Sections 6.3.2.1 and 6.3.4.2.

## 6.3 Assessment of Potential Impacts

### 6.3.1 Removal, Fragmentation and/or Modification of Fauna Habitat

Overall, habitat removal and degradation are considered to be the primary impact to conservation significant fauna within the Study Area, for both vertebrate and invertebrate groups.

Clearing would reduce the size and quality of habitats, through edge effects and habitat fragmentation, and is likely to heighten the effects of other threatening processes such as introduced flora, introduced fauna and altered fire regimes. The impact of clearing is higher when landforms such as caves, cliff lines and overhangs are removed, as there is limited opportunity and ability to recreate and rehabilitate such habitat features post mine closure.

Table 6.9 and Table 6.10 present the impact to each fauna habitat based on the Biologic survey (2020a) which was extrapolated by Biologic (2020b) to cover both northern stockyards.



Table 6.9 – Impacts to Vertebrate Fauna Habitats

Fauna Habitat (Value)	Study Area		Development Envelope <sup>1</sup>	
	Extent (ha)	Proportion of Study area (%)	Extent (ha)	% of Habitat Type in the Development Envelope
Low Stony Hills (Low)	2,586.3	32.8	167.4	26.9
Stony Plain (Low)	2,328.41	29.5	306.5	49.4
Sand Plain (Moderate)	1,535.85	19.5	67.7	10.9
Major Drainage (High)	996.32	12.6	19.6	3.2
Hillcrest/ Hillslope (High)	429.79	5.5	58.9	9.5
Gorge/ Gully (High)	4.58	0.1	0.8	0.1
<b>Total</b>	<b>7,881.25</b>	<b>100</b>	<b>620.9</b>	<b>100</b>

Source: Biologic (2020b)

(1) As noted in Section 5.1.4.1, the Development Envelope was revised down to 621.1 ha to avoid impacts to *Polymeria* sp. These calculations were completed by Biologic prior to the re-design. Numerical impacts are insignificant.

Table 6.10 – Impacts to Invertebrate Fauna Habitats

Fauna Habitat (Value)	Study Area		Development Envelope <sup>1</sup>	
	Extent (ha)	Proportion of Study Area (%)	Extent (ha)	% of Habitat Type in the Development Envelope
Low Stony Hills (Low)	2,213.78	28.09	130.24	20.96
Stony Plain (Low)	2,223.98	28.22	202.93	32.66
Sand Plain (Low-Moderate)	1,640.13	20.81	171.98	27.68
Drainage Line (Moderate)	1,000.13	12.69	19.76	3.18
Hillcrest/ Hillslope (Moderate-High)	791.47	10.04	95.24	15.33



Fauna Habitat (Value)	Study Area		Development Envelope <sup>1</sup>	
	Extent (ha)	Proportion of Study Area (%)	Extent (ha)	% of Habitat Type in the Development Envelope
Gorge/ Gully (High)	11.64	0.15	1.16	0.19
<b>Total</b>	<b>7,881.13</b>	<b>100</b>	<b>621.32</b>	<b>–</b>

Source: Biologic (2020c)

(1) As noted in Section 5.1.4.1, the Development Envelope was revised down to 621.1 ha to avoid impacts to *Polymeria* sp. These calculations were completed by Biologic prior to the re-design. Numerical impacts are insignificant.

Gorge/ Gully, Hillcrest/ Hillslope and Major Drainage habitats were considered to be of high significance for vertebrate fauna as they support species of conservation significance or contain core habitats for such species (Biologic, 2020a).

Biologic (2020b; 2020c) (Appendix I, Appendix J) used the following definition of the magnitude of impacts, and assessed this at the local and regional scale:

- Negligible: Displacement or loss of condition of individual animals.
- Low: Loss of individuals but no measurable change in population size.
- Moderate: Demonstrable change in population.
- High: Population persistence threatened.

Biologic (2020b) determined that the scale of impact to vertebrate fauna habitat within the Development Envelope to be Moderate (i.e. result in a demonstrable change in population) to Low (i.e. loss of individuals, but no measurable change in population size). Moderate impacts were associated with clearing for the pits, stockyard and waste dump; low impacts were associated with the haul road between Miralga West and Miralga East.

In relation to invertebrate fauna, some habitat loss and degradation is likely to occur throughout most of the habitats present (depending on the final footprint). Taking a conservative view and assuming that the entire Development Envelope is cleared (in reality less than half of the Development Envelope will be cleared), a total of 6.44% of the most important SRE habitat would be removed (summation of impacts to Drainage Line, Hillcrest/ Hillslope, Gorge/ Gully). If the entire extent of Hillcrest/ Hillslope habitat within the Development Envelope was cleared, 12.03% of that habitat type would be lost. Similarly, for Gorge/ Gully and Drainage Line the impacts would be 9.97% and 1.98%, respectively. This equates to a Low to Moderate impact at a local scale. However, it is important to note that each of these habitats are connected to similar habitat outside of the Development Envelope, and that none of the habitat types are restricted to the Study Area. On a regional scale, therefore, the impact is considered Negligible to Low.



## 6.3.2 Impacts to Habitat Features

### 6.3.2.1 Caves

#### Direct Impacts

Specific to the integrity of the important cave complex at Miralga East, Blast It Global was engaged to predict the effects of blasting on the structural integrity of caves CMRC-13, -14 and -15. Blast It Global developed a computer model to “study potential ground vibration levels and flyrock impact zones ... to determine a safe set of parameters for drilling and blasting activities” (Blast It Global, 2020; Appendix H). One of the outcomes of this work was that Atlas Iron was able to determine that its standard blasting methodology is appropriate and can be used at Miralga East without the need to mitigate the blasting pattern.

Blast criteria were established to set thresholds of vibration levels experienced at caves. The objective of the blast criteria were to limit vibration levels such that “the caves remain viable as diurnal roosts for Ghost Bats in the future, once mining has finished” (Blast It Global, 2020). In practical terms, this means the blast criteria need to guard against destruction of the cave, complete obstruction of entrances or alteration to the internal microclimate (e.g. through creation of a new entrances allowing through airflow). The criteria do not need to prevent the fall of hanging boulders inside the cave, as this would not change the cave habitat in a way that would affect its long-term viability as a diurnal roost for Ghost Bat (Bat Call, 2020).

Industry standards listed in Hoek and Bray (1981) suggest that a blast vibration criterion of 305 mm/s could be set to achieve the desired outcomes mentioned above. However, to account for the weathering and geological structures in cave CMRC-15 noted by PSM, a more conservative limit of 127 mm/s could be adopted. Accounting for all available information, Blast It Global recommended the following specific vibration criteria to be applied at CMRC-13, -14 and -15:

- All blasts to be designed to achieve 85 mm/s at the cave.
- Blast vibration not to exceed 100 mm/s at the cave.

Blast impacts were then modelled for a range of scenarios, each of which varied blast parameters such as the size and position of charges, detonation sequencing, etc. The blast modelling shows that, using the selected blast parameters, the 100 mm/s blast vibration limit can be achieved even at 23 m from cave CMRC-15 (Blast It Global, 2020). By inference, the vibration limit can be achieved at all caves at Miralga East. Furthermore, Atlas Iron is likely to design blasts at Miralga East with less energy than the scenarios modelled by Blast It Global, which would lead to even lower blast-induced vibration than predicted. The loss of cave CMRC-15 is now considered unlikely (Bat Call WA, 2020).

Cave CMRC-02, a nocturnal roost for Ghost Bat at Miralga West, is located inside the Indicative Disturbance Footprint and will be cleared. As an isolated category 4 cave, this roost is of the least value to Ghost Bat and is not considered important for the long-term presence of the Ghost Bat locally (Bat Call WA, 2020).

#### Indirect Impacts

Thirteen caves are located within 500 m of any pit (refer to Table 6.7). These caves have the potential to be affected by indirect impacts such as increased noise, dust, light and/or a change in microclimate. Any fauna using these caves, including Ghost Bat, may be disturbed



while mining activities are occurring nearby. These impacts are discussed further in Section 6.3.3 and in relation to specific species in Section 6.3.4.

The Proposal is not anticipated to have a significant indirect impact from noise and vibration on the remaining nocturnal refuges for Pilbara Leaf-nosed Bat and/or Ghost Bat, due to the caves' distance from the Proposal (particularly the distance from open pits). Indirect impacts from blasting operations will be further limited to daytime operations. This prediction is based on long term monitoring of a nocturnal roost at Atlas Iron's Mt Dove operation, which was approved to operate within 20 m of a nocturnal refuge for Pilbara Leaf-nosed Bat. Long-term monitoring of the nocturnal refuge at Mt Dove showed that while there was some minor physical damage to the entrance of the cave, mining had little to no negative effect on Pilbara Leaf-nosed Bat visitation (MWH, 2015).

### **6.3.2.2 Water Features**

Any water features near the Proposal, particularly those near the pits, waste dumps and other infrastructure associated with ongoing disturbances, may be affected by decreased water quality due to temporary water run-off (Biologic, 2020b). All water features mapped by Biologic (2020a; 2019) are outside of the Development Envelope and will not be directly impacted by clearing (Figure 6.4). Twenty-three of the water features mapped by Biologic (2020a; 2019) are beyond the 0.2 m modelled drawdowns and are not anticipated to be impacted from water supply activities (nine are approximately within the 0.2 to 0.4 m contours). The two potentially permanent water features (WMRC-14 and -15) will not be impacted by drawdown from the water supply borefields.

Road crossings are planned to be constructed across Miralga Creek and the Shaw River. The construction, maintenance and use of these roads will need to be managed appropriately to avoid impacts to water features located downstream. Providing appropriate controls are in place (e.g. culverts are used to ensure flow is not impeded, or roads are designed to over-top), the impact on water features located downstream is likely to be Low (Biologic, 2020b). If left unmanaged impacts could be Moderate.

### **6.3.3 Indirect Impacts**

Overall, habitat removal and degradation are together considered to be the primary impact to conservation significant fauna within the Study Area (Biologic, 2020b). Potential increases to the abundance of introduced species due to implementation of the Proposal could impact most conservation significant fauna via a range of means including predation, competition for food resources, and further habitat degradation, especially by introduced grazers. Vehicle strike may also have a moderate impact on some species.

It should be noted that, as for all developments, the direct and indirect impact sources that may affect key receptor species can be difficult to quantify and predict in advance of developments occurring (Biologic, 2020b). Although land clearing or degradation may be estimated, the final impact to the local populations or regional distribution of a species is difficult to quantify. The extent and magnitude of other impact sources, such as noise, light, or changed fire regimes, have not been well researched for Pilbara fauna species, so any assessment of impact from these sources is limited in accuracy (Biologic, 2020b). Impacts to vertebrate fauna from indirect sources were determined to be Moderate to Negligible at the local scale, and Low to Negligible at the Regional Scale for conservation significant species; widespread/ common species are anticipated to be impacted in similar way (Biologic, 2020b).



In terms of SRE invertebrate fauna, indirect impacts most likely to have an effect, albeit varied depending on the species, are alteration to surface drainage patterns and alteration to fire regimes (Biologic, 2020c).

### **6.3.3.1 Vehicle Strike**

Vehicle strike is a known threat to conservation significant fauna of the Pilbara, particularly for nocturnal species foraging or travelling near roads. The construction and operation of roads within the Development Envelope poses a risk to fauna through mortalities arising from collisions with vehicles. Mortalities may occur during initial clearing works, particularly for smaller and/or less mobile species that are unable to disperse once construction works have commenced. During operations, collisions with animals along roads are more likely to occur at night (Rowden, 2008). The presence of roadkill also has the potential to attract more species into the area.

### **6.3.3.2 Introduced Species**

Potential increases to the abundance of introduced species due to implementation of the Proposal could impact most conservation significant fauna in the Study Area via a range of means including predation, competition for food resources, and further habitat degradation, especially by introduced grazers.

As mentioned previously, vehicle strike is a known threat to conservation significant fauna of the Pilbara as well as other non-conservation significant fauna. The presence of roadkill has the potential to attract more species and/or individual animals into the area, particularly those using roadkill as food sources.

Introduced species pose a range of potential impact sources to Pilbara fauna. Potential impacts from introduced species include over-grazing and land degradation from introduced herbivores (e.g. camels and goats), competition (e.g. rabbits), habitat degradation from weeds (e.g. Buffel Grass), poisoning from cane toads (Prugh, 2009), disease (e.g. toxoplasmosis (Dickman, 1996)) and, most critically, the introduction of feral predators such as cats and red foxes (Carwardine, 2014). There is ample evidence that predation by introduced species such as feral cats is a primary factor in the decline of numerous taxa (Burbidge A. A., 1989). In addition, management of invasive species using poison (e.g. 1080 poison) is identified as a threat for some mammal species (Woinarski, 2014). Northern Quolls are identified as possibly being more susceptible to the toxin than other dasyurids (Calver, 1989).

Although weeds and feral animals are not a mining specific impact, there is the potential for a range of invasive species to be introduced or attracted to the area as a result of operational activities such as the expanded traffic network and increased traffic movements, waste and water management, and human habitation. Feral predators are considered likely to occur in greater numbers near areas of human settlement and roads.

Buffel grass is listed as high ecological impact and rapid invasiveness (Department of Biodiversity Conservation and Attractions, 2019), and has been previously recorded in the Study Area (Woodman Environmental, 2019a), as has the Cat, European Cattle and the Camel (Biologic, 2020a).

### **6.3.3.3 Disturbance from Artificial Light**

Temporary mobile lighting will be installed in active mine pits and active operational areas. Altered light environments may affect foraging, reproduction, migration, and communication (Longcore, 2004). The most likely disturbance responses of native fauna from increases in light spill are the avoidance of illuminated areas previously used for foraging by light-sensitive species, or changes to prey item aggregation for insectivorous species resulting in changes to foraging behaviour.

### **6.3.3.4 Disturbance from Noise and Vibration**

Species using audible cues for breeding activity, especially birds and amphibians, may experience disruption to breeding cycles or reduced breeding success due to increased noise. For example, traffic noise is thought to negatively impact on bird and amphibian communities by masking territorial or mate attracting calls (Parris, 2009; Shannon, 2014). Other behavioural responses to increased noise levels are reduced foraging time, through minimisation to exposure and by increased vigilance behaviour (Shannon, 2014).

However, there is a lack of research into the impact of these factors on native fauna in the Pilbara. Increased noise and vibration will be associated with all elements of the Project, particularly around the pit area and roads.

Impacts specific to Ghost Bats from drill and blast activities at Miralga East are discussed in more detail in Section 6.3.4.2.

### **6.3.3.5 Generation of Dust**

The development and operation of the Proposal will create dust emissions due to construction, blasting, haulage and general traffic activities, the impacts of which may not be confined to the Development Envelope.

Dust can indirectly affect fauna by altering the structure and composition of native vegetation (Farmer, 1993). Dust interferes with photosynthesis, respiration and transpiration and allows penetration of gaseous pollutants (Farmer, 1993). Most plant communities can be adversely affected by dust deposition, resulting in alteration of plant community structure (Prajapati, 2012). A decline in vegetation quality can impact faunal assemblages by reducing both food and habitat resources. However, no prior studies have been able to detect a significant adverse impact of airborne dust on plant function in the Pilbara (Grierson, 2015; Matsuki, 2016).

Dust may directly pollute water bodies by increasing turbidity or potentially altering water chemistry. Waterholes most at risk include the temporary waterholes to the north of Miralga East given their proximity to the Indicative Disturbance Footprint. This may in turn affect fauna and flora dependent on these waterholes including but not limited to the Pilbara Olive Python, Northern Quoll and Pilbara Leaf-nosed Bat.

Given the duration and size of the Proposal, the Proposal is not anticipated to have a significant impact at a regional level. (Air quality in relation to human exposure is discussed in Chapter 6.6.)



### **6.3.3.6 Altered Fire Regimes**

Fire is a natural process in the Pilbara that commonly arises through lightning strike. However, changes to fire regimes, particularly when fires are too frequent or intense, can have negative ecological impacts (Doherty, 2016). For example, understory growth that provides many reptiles and mammals with protection from predators can be lost when fires are too frequent or intense as can certain food resources, such as seeding grass for graminivorous birds (Carwardine, 2014). The impacts of an altered fire regime can vary between fauna species, and low frequency fires may also have an impact; for example, inhibiting movement through retention of high vegetation cover for Greater Bilbies (Bradley, 2015). Altered fire regimes have been identified as one of the causes of decline or extinction of medium-sized mammals in arid Australia (Burbidge A. A., 1989; Burrows, 2006). For invertebrate SRE fauna, alteration of fire regimes is more likely to affect species within vegetated habitats, or where leaf litter is an important microhabitat for the species; any increase in frequency or intensity of fires is likely to have an impact on species with these habitat requirements (Biologic, 2020c).

Although difficult to predict, it is possible that implementation of the Proposal may increase the frequency of fires due to increased incidences of ignition caused by an expanded traffic network and increased traffic movements or an increase in grassy fuel load. Conversely, implementation may instead reduce the scale/extent of natural wildfires due to infrastructure acting as firebreaks and on-site management (i.e., fire suppression).

### **6.3.3.7 Modification of Water Regimes**

Within the Pilbara, the growth of the mining industry presents new challenges for water management, from alteration of flow regimes and creation of new water sources on the surface (Carwardine, 2014). Without appropriate management, river crossings at the Shaw River and Miralga Creek may impact waterflow along these water courses impacting habitat downstream. However, as water flows are likely to result from post-cyclonic rainfall, impacts would be temporary and negligible in comparison to the volume of water expected.

Altered water regimes (in terms of either quality, quantity, or both) have the potential to impact the availability or nature of dispersal corridors used by SRE invertebrate fauna, mostly in relation to low-lying areas, such as Sand Plains, Drainage Areas/ Floodplain, Mulga Woodland and Major Drainage Line (Biologic, 2020c)

## **6.3.4 Conservation Significant Species**

The following sections summarise the significance of impacts to conservation significant species either recorded within, or considered likely to occur within, the Study Area, further detail is provided in Biologic (2020a). At the local scale, the magnitude of impacts to individual species from the implementation of the Proposal varied from Negligible to Low and Moderate. At the regional scale impacts were considered to be Negligible to Low. No High impacts were identified at either scale (Biologic, 2020b).

### **6.3.4.1 Northern Quoll**

Within the Study Area, high quality denning and foraging habitat for the species is found within the Gorge/ Gully and Hillcrest/ Hillslope habitats and foraging and dispersal habitat is found in the Major Drainage Line habitats. Implementation of the Proposal will result in clearing of up to 59.6 ha of denning and foraging habitat for the Northern Quoll (Biologic, 2020b). At a local scale, the species is likely to experience a Low to Moderate level of



impact, primarily from removal, fragmentation and modification of habitat, but also potentially vehicle strike and the increased threat of introduced species. Low level impacts may also be experienced by increased light and noise and changed fire regimes. At a regional level, impacts are predicted to be Low (Biologic 2020b).

#### **6.3.4.2 Ghost Bat**

Although the majority of habitats occurring within the Study Area would likely be used for foraging and dispersal by the Ghost Bat, roosting caves are restricted to the Hillcrest/Hillslope and Gorge/Gully habitats. The species was recorded 25 times during the most recent fauna survey with eight night roost sites, three confirmed diurnal roosts (of which one is possibly a maternity roost) and two potential diurnal roosts recorded. Of these roosts, four are located within the Development Envelope. Based on the position of the resource and current mine pit design, the Proposal will result in the removal of one nocturnal roost caves (CMRC-02) and will likely cause temporary disruption to other caves close to mine pits during active mining. Any bats exhibiting short-term abandonment from the caves in the Proposal area are expected to use Lalla Rookh as their preferred location (Bat Call WA, 2020).

Any bats exhibiting short-term abandonment from caves within the project area as a result of mining activities are expected to utilise Lalla Rookh as their preferred location (Bat Call WA, 2020). Mining related impacts from the development and operation of the Project are not anticipated at Lalla Rookh (Bat Call WA, 2020).

Longer-term observations have shown that the Ghost Bat congregates at important roosts then disperses, based on seasonal, climatic and other factors (Bat Call WA, 2020). Other roosts surrounding a category 1 roost such as Lalla Rookh support smaller local groups of Ghost Bat but are not occupied consistently (Bat Call WA, 2020). Retention of roost sites (particularly maternity roosts) is required for the persistence of the species in the Pilbara.

Short-term abandonment of caves by Ghost Bats is expected, but will not have an impact on the species long-term. Ghost Bats have a nightly foraging range of 10 km radius, travelling up to 25 km in a single night (Bat Call WA, 2020). All caves that may be impacted by implementation of the Proposal are within 25 km of Lalla Rookh. Given these roosts are used by smaller numbers of Ghost Bat and are not in constant use, individuals are expected to use Lalla Rookh as their preferred roost during mining activities (Bat Call WA, 2020). Although the interior of Lalla Rookh cannot be surveyed for safety reasons, the size of the underground workings is not a limiting factor. The large size of the abandoned underground workings at Lalla Rookh would not be a limitation in the roost site accommodating the small (approximately 10%) increase in Ghost Bat numbers (Bat Call WA, 2020).

Implementation of the Proposal will result in the loss of Gorge/Gully (0.1 ha out of 4.6 ha mapped, 2%) and Hillcrest/Hillslope (30.7 ha out of 495.2 ha mapped, 6%) habitat which provides potential roosting habitat.

The Proposal will result in the clearing of a 284.9 Indicative Disturbance Footprint within a 621.1 ha Development Envelope, the majority of which provides varying levels of foraging and dispersal habitat for the species. All habitats within the Indicative Disturbance Footprint are represented in the wider Study Area and in the Pilbara region with large portions of each habitat remaining outside of the Indicative Disturbance Footprint after clearing. Additionally, the Ghost Bat forages over a wide variety of habitats over 5 to 10 km from roosts when not breeding.



At a local scale, Biologic (2020b) considered the species is likely to experience a Low to Moderate level of impact, primarily from removal, fragmentation and modification of habitat, but also potentially noise, vibration and dust. Low level impacts may also potentially be experienced due to vehicle strike, introduced species and changed fire regimes.

#### **6.3.4.3 Pilbara Leaf-nosed Bat**

All habitat types in the Study Area are used by this species, however, Hillslope/ Hillcrest and Major Drainage Line habitats are especially frequented. The Proposal will result in the removal or significant impact on one nocturnal roost caves (CMRC-02) and will potentially cause disruption to a further eleven due to those caves being located within 500 m of proposed mining pits – including CMRC-15, which appears to be an important nocturnal refuge for the species. However, it is important to note that all caves in the Study Area are considered unlikely to be used for diurnal roosting, based on a lack of evidence that would suggest diurnal roosting was occurring (Biologic, 2020b). Further, the assessment of potential impacts against the MNES significant impact criteria for this species (see also Chapter 9) was low or negligible. The impacts considered to be of most significance for this species is habitat loss and degradation as well as potentially vehicle strike.

Impacts are considered unlikely to extend beyond the Study Area to the regional level (Biologic, 2020b).

#### **6.3.4.4 Pilbara Olive Python**

Major Drainage, Gorge/ Gully and Hillcrest/ Hillslope are key habitat types for this species. At a local level the species will be subject to Low to Moderate impacts, primarily from removal, fragmentation and modification of habitat and potential modification of the water regime. Moderate level impacts are unlikely to extend beyond the Study Area to the regional level.

Overall the Proposal is not likely to have a significant impact on the species on a local or regional scale (Biologic, 2020b).

#### **6.3.4.5 Grey Falcon**

This species uses all habitat types in the Study Area and the Major Drainage Line provides nesting habitat. At a local scale the species is likely to experience a Low to Moderate level of impact, primarily from removal, fragmentation and modification of habitat, but also potentially vehicle strike, the increased threat of introduced species and increased levels of light. Low level impacts may also be experienced due to increased levels of noise, dust and changed fire regimes.

Moderate level impacts are unlikely to extend beyond the Study Area to the regional level and the Proposal is not likely to have a significant impact on the species (Biologic, 2020b).

#### **6.3.4.6 Peregrine Falcon**

Potential nesting habitat for the Peregrine Falcon is present within Hillcrest/ Hillslope, Gorge/ Gully and Major Drainage Line habitat. The impact considered to be of most significance for this species is loss of a portion of habitat.

Overall the Project is not likely to have a significant impact on the species on a local or regional scale (Biologic, 2020b).



#### 6.3.4.7 Northern Brushtail Possum

The habitat types in the Study Area most suitable to support this species is the Major Drainage Line habitat, as well as other habitat that provides tree hollows and denning sites, such as the Gorge/Gully habitat. The impact considered to be of most significance for this species is habitat loss and degradation.

Overall the Proposal is not likely to have a significant impact on the species on a local or regional scale (Biologic, 2020b).

#### 6.3.4.8 SRE Invertebrates

The removal of habitat, including native vegetation, topsoil and landforms associated with ground disturbance and vegetation-clearing activities is considered the most significant impact of this Proposal. The Indicative Disturbance Footprint for the Project is estimated to be approximately 285 ha. The main areas of direct land disturbance are associated with the construction of a Waste Rock Dump (40.69 ha), and a Mining Pit (27.83 ha).

Some habitat loss and degradation will be expected to occur throughout most of the habitats present, including those considered of high to moderate significance, namely Gorge/ Gully, Hillcrest/ Hillslope and Major Drainage (9.97%, 12.03% and 0.7% of the total area of habitat type in the Study Area impacted, respectively). The Hillcrest/ Hillslope habitat has the largest proportion (12.03%) within the Study Area which will be impacted by the development, followed by the Sandy Plain habitat (10.49%). However, there is habitat connectivity outside of the Development Envelope in the Study Area and beyond. In addition, none of the habitat types are restricted to the Study Area. For most Potential SRE taxa present, the habitats within the Study Area represent only a portion of their wider extent in the region.

Biologic (2020b) assessed the significance of impacts to Potential SREs found within the Development Envelope and determined the following:

- The known SRE species *Antichiropus apricus* and *A. forcipatus* were found within the Development Envelope and are likely to occur throughout the local extent of connected Gorge/ Gully and Hillcrest/ Hillslope habitat where other records are known. As such, they are considered to be at low risk of impact by the current Proposal (Figure 6.11).
- The Potential SRE species *Karaops* sp. indet. is regarded as being at moderate risk of impact from the current Proposal as it was only recorded within the Development Envelope in the 2019 study, (in Gorge/ Gully and Hillcrest/ Hillslope habitat). In the absence of molecular studies to demonstrate the species presence beyond the Study Area a conservative approach has been undertaken, assuming that this taxon is limited to the Study Area. If this is the case, the removal of habitat from clearing and mining activities would be considered to have a Moderate impact. If its presence beyond the Study Area was confirmed in the future this assessment may reduce to Low impact, as was the case for both *Antichiropus* species. Indirect impacts from changes to surface hydrology, exotic pests, weeds, increased fire incidents, and spills/ contamination would be expected to be low and would be managed by current and proposed environmental management procedures.

The millipede species *Antichiropus apricus* and *Antichiropus forcipatus*, both Confirmed SREs, were found within the Development Envelope and are likely to occur throughout the local extent of connected Gorge/ Gully and Hillcrest/ Hillslope habitat where other records are known. As such, they are considered to be at low risk of impact by the current Proposal.



All three taxa of conservation significance have a potential range of connected habitat that extends well beyond the Development Envelope and the Study Area.

## 6.4 Mitigation

Atlas Iron has in place a HSEMS supported by an Environmental Management Plan (EMP), which defines Atlas Iron's approach to environmental management and integrates regulatory and HSEMS requirements. Atlas Iron has been operating iron ore mines in the Pilbara since 2008. During this time, Atlas Iron has developed, implemented and refined its Environmental Management Plans and Procedures.

The mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during Proposal design to reduce the Proposal's potential impacts to terrestrial fauna. Table 6.11 summarises the mitigations that will be applied during construction and operation of the Proposal.

Due to the importance of the cave complex at Miralga East for Ghost Bats (centred on CMRC-15), a specific discussion of mitigations is provided here, in addition to the summary in Table 6.11.

Management measures and monitoring were recommended by Blast It Global (2020) to validate predicted vibration and measure vibration received at caves. Atlas Iron will adopt the recommendations to ensure that blasting is carried out appropriately. Key measures include:

- Design blasts to perform to the blast criteria (i.e. limit to 100 mm/s but design to achieve 85 mm/s) using the reference values set out in Blast It Global (2020).
- Establish vibration monitors in the nearest cave to all blasting at Miralga East pits 2 and 3.
- Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.
- If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.
- Periodically inspect caves to confirm the vibration limits are fit for purpose.

The measures outlined above apply to caves CMRC-13, -14 and -15 at Miralga East.

Refer to Appendix H for the full blast impact assessment and further details on blast management to be adopted.

Bat Call WA (2020) included a number of recommendations to support the persistence of Ghost Bat in the Miralga Creek/ Lalla Rookh area. Atlas Iron will:

- Avoid direct disturbance of all caves except the category 4 cave CMRC-02 at Miralga West.
- Establish suitable exclusion zones around all remaining caves to prevent direct disturbance from the Proposed Action.
- Restrict personnel from entering any category 2 or 3 cave, except for survey personnel in accordance with the protocol outlined in Appendix B of Bat Call WA (2020).
- Monitor Ghost Bat usage of the category 2 caves CMRC-06 and -15 annually during operations and for one year following operations.



- Limit blasting vibrations at caves CMRC-13, -14 and -15 as per the recommendations of Blast It Global (2020).

Atlas Iron will establish exclusion zones to prevent direct disturbance of all caves surveyed (except for the category 4 cave, CMRC-02 which will be directly impacted by mining). Most caves are already excluded from both the Indicative Disturbance Footprint and the Development Envelope and will not be disturbed. Caves CMRC-14 and -15 are excluded from the Indicative Disturbance Footprint and will have exclusion zones established to avoid disturbance by the proposed activities. Additionally, personnel will be restricted from entering any category 2 or 3 caves unless undertaking survey activities in accordance with a disruption protocol (refer to Appendix B of Bat Call WA (2020)). Blast management as described in Sections 2.2.3 and 2.2.4 will protect the structural integrity of cave CMRC-15 and therefore maintain its viability as a potential maternity roost (as well as nearby supporting caves CMRC-13 and -14) for reoccupation following the cessation of mining activities.

It is considered unlikely that implementation of the Proposal will lead to a long term decrease in the size of the population given the following:

- Suitable habitat for the species (foraging, dispersal and roosting) will remain in the Development Envelope and wider area.
- The long term availability of potential roost caves.
- There is evidence of persistence of the Ghost Bat population persisting in the Pilbara region concurrent with mining operations (Biologic, 2020b; TSSC, 2016).

**Table 6.11 – Mitigation of Risks to Terrestrial Fauna**

	Mitigations to be Applied
<b>Avoidance</b>	<ul style="list-style-type: none"> <li>• The Proposal has avoided the need to clear additional fauna habitat by using the existing camp, Abydos Link Road (haul road; ALRE) and borefield infrastructure associated with Atlas Iron's Abydos Project.</li> <li>• The Proposal has been designed to avoid direct impacts to 15 out of the 16 caves in the Study Area, as well as the significant Lalla Rookh maternity cave which lies outside of the Development Envelope.</li> <li>• The Development Envelope has been designed to avoid the majority of mapped area of fauna habitats of most significance: <ul style="list-style-type: none"> <li>– In relation to the three most significant habitat types for vertebrate fauna: Approximately 99% of Gorge/ Gully habitat, 90% of Hillcrest/ Hillslope habitat and 96% of Major Drainage Line will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– In relation to the two most significant habitat types for invertebrate fauna: Approximately 10 ha of Gorge/ Gully habitat and 696 ha of Hillcrest/ Hillslope habitat will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– All known permanent waterholes are outside of the Development Envelope.</li> </ul> </li> </ul>



Mitigations to be Applied	
<b>Minimisation</b>	<p>The following plans and procedures will be implemented to assist in minimising impacts to fauna and fauna habitat:</p> <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Fauna Management Procedure (950-HSE-EN-PRO-0012).</li> <li>• Landfill Management Procedure (950-HSE-EN-PRO-0020).</li> <li>• Waste Management Procedure (950-HSE-EN-PRO-0023).</li> <li>• Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022).</li> <li>• Significant Species Management Plan (Appendix K).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Clearing will occur in accordance with Atlas Iron's Ground Disturbance Permit Procedure (GDP). No clearing will occur without prior authorisation from Atlas Iron's Ground Disturbance Permitting System. This will ensure that clearing does not occur outside the Development Envelope or exceed 284.9 ha.</li> <li>• Clearing in/ of sensitive habitats including caves, gorges and drainage lines will be kept to the minimum necessary for safe construction and operation of the Proposal.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> <li>• Turkey's nests will be constructed to ensure a point of fauna ingress/egress.</li> <li>• Borrow pits will be designed and constructed to permit egress of fauna.</li> <li>• Speed limits will be enforced across the site.</li> <li>• Off-road driving will be prohibited unless otherwise authorised by senior management to minimise potential vehicle strikes.</li> <li>• Night-time vehicle movements will be restricted where possible to minimise potential vehicle strikes.</li> <li>• All bins storing putrescible waste will have tightly secured lids to avoid fauna attraction and entry.</li> <li>• The landfill will be operated and managed in accordance with the Environmental Protection (Rural Landfill) Regulations 2002. This will include fencing to reduce the potential for attracting fauna.</li> <li>• Blasting operations will be limited to daytime only to limit disturbance to fauna including bats.</li> <li>• Noise, dust and light emissions will be controlled where possible to avoid excessive disturbance to native fauna, including directing lights to working areas, shielding lights to reduce glow, and using conventional dust suppression techniques (i.e. water trucks).</li> <li>• Awareness training will identify conservation significant fauna and habitat and discuss relevant management measures, personnel/contractor responsibilities, and incident reporting requirements (i.e. reporting of fauna observations and/or incidents).</li> <li>• All fauna mortalities and injuries will be reported to the Miralga Creek Environmental Advisor within 24 hours and recorded within Atlas Iron's incident reporting system.</li> </ul>



Mitigations to be Applied	
	<ul style="list-style-type: none"> <li>• All sightings of conservation significant fauna will be reported to the Miralga Creek Environmental Advisor.</li> <li>• Where required, fauna will be handled and transported in accordance with the procedures outlined in the DBCA Standard Operating Procedure Transport and Temporary Holding of Wildlife (Department of Biodiversity, Conservation and Attractions, 2017).</li> <li>• Interactions with fauna (e.g. feeding, harassment, capture, killing) are not permitted unless specifically authorised by the Senior Environmental Advisor.</li> <li>• The Miralga Creek Environmental Advisor will report all conservation significant fauna injuries and mortalities to DBCA within one week.</li> <li>• Domestic pets are prohibited to avoid interactions with or disturbance to conservation significant fauna.</li> <li>• Implementation of Atlas Iron' Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022), including recording all introduced fauna sightings and the implementation of a feral animal control program, as required (i.e., where sightings are regular and/or if nuisance or dangerous individuals are recorded).</li> <li>• In addition to the GDP, implementation of the following procedures to ensure weeds are controlled, as far as practicable: <ul style="list-style-type: none"> <li>– Flora Management Procedure (950-HSE-EN-PRO0010).</li> <li>– Weed Hygiene Procedure (950-HSE-EN-PRO-0002).</li> </ul> </li> </ul> <p>Specific to the management of cave CMRC-15:</p> <ul style="list-style-type: none"> <li>• Blasting will be undertaken in accordance with the recommendations contained in Blast It Global (2020) and detailed in the SSMP</li> <li>• Recommendation provided in Bat Call WA (2020) will be followed and included in the SSMP</li> </ul>
<b>Rehabilitation</b>	<ul style="list-style-type: none"> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP.</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining as stated in the MCP.</li> <li>• Rehabilitation works are expected to return disturbed areas (other than pits) to a stable and vegetated state. Revegetation is expected to provide some value for fauna although it is acknowledged that fauna habitats will not be restored to their pre-disturbance state.</li> </ul>
<b>Offset</b>	A contribution to the Pilbara Environmental Offset Fund is expected to be made based on the number of hectares of clearing in the Chichester subregion as detailed in Chapter 8.

## 6.5 Predicted Outcome

The predicted impacts to Terrestrial Fauna from the Proposal after applying the mitigation hierarchy (avoid, minimise, rehabilitate) are:

- Potential clearing of up to 59.6 ha of high quality denning and foraging habitat for the Northern Quoll (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).



- Potential clearing of up to 59.6 ha roosting habitat for the Ghost Bat (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).
- Loss of one occasional nocturnal roost for the Ghost Bat (the category 4 cave CMRC-02).
- Potential temporary abandonment of caves close to the mining areas by Ghost Bat.
- Increased reliance by Ghost Bat on Lalla Rookh and other nearby roosts as refuges during mining.
- Retention of 15 of 16 known caves post-mining, including the category 2 potential maternity roost CMRC-15.
- No direct impact to any permanent waterholes within or directly adjacent to the Development Envelope.
- No significant impact to SRE fauna or habitat.

The Proposal's most significant pre-mitigation impact is predicted to be impacts to the Ghost Bat cave grouping associated with CMRC-15. Atlas Iron has invested substantial effort into identifying and modelling impacts and seeking expert advice on this matter. This has resulted in the following conclusions being made:

- Bat Call WA's (2020) conclusion regarding risk of impact to the species aligns with the assessment in the vertebrate fauna impact assessment (Biologic, 2020b), which assessed the impact against all significant impact criteria as "unlikely" if cave CMRC-15 is retained without collapse and without alteration of its microclimate (Biologic, 2020b).
- Work completed by Blast It Global (2020) determined that drill and blast activities can be conducted, using the blast parameters modelled in their report, to within close proximity of the cave complex without resulting in significant vibration, damage to or collapse of the caves, nor adverse impacts from blast fume or dust. This applies to blasting up to the closest planned point, within 23 m of cave CMRC-15 (Blast It, 2020).

After the application of mitigation hierarchy (i.e., avoidance, minimisation and rehabilitation measures) and application of the offset package, Atlas Iron expects that the EPA's objective for Terrestrial Fauna can be met.

## 6.6 Terrestrial Fauna Summary

A summary of for this factor is provided in Table 6.12. Further details are provided in the remainder of this section.

**Table 6.12 – Terrestrial Fauna Summary**

Factor	Terrestrial Fauna Summary
<b>EPA Objective</b>	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
<b>Policy and Guidance</b>	The EPA has published a number of guidelines for the Terrestrial Fauna factor. Guidance relevant to the Proposal includes: <ul style="list-style-type: none"> <li>• Environmental Factor Guideline: Terrestrial Fauna</li> <li>• Technical Guidance: Sampling methods for terrestrial vertebrate fauna (Environmental Protection Authority, 2010).</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• Technical Guidance: Terrestrial Fauna Surveys (Environmental Protection Authority, 2004).</li> <li>• Technical Guidance: Sampling of short range endemic invertebrate fauna (Environmental Protection Authority, 2009).</li> </ul> <p>Several guidelines published by the DAWE, DBCA and their predecessors are also of relevance for species listed under the EPBC Act, including:</p> <ul style="list-style-type: none"> <li>• Survey Guidelines for Australia's Threatened Bats (DEWHA, 2010a).</li> <li>• Survey Guidelines for Australia's Threatened Birds (DEWHA, 2010b).</li> <li>• Survey Guidelines for Australia's Threatened Mammals (DSEWPAC, 2011a).</li> <li>• Survey Guidelines for Australia's Threatened Reptiles (DSEWPAC, 2011b).</li> <li>• EPBC Act referral guideline for the endangered northern quoll <i>Dasyurus hallucatus</i> (Department of the Environment, 2016).</li> <li>• Interim guideline for preliminary surveys of night parrot (<i>Pezoporus occidentalis</i>) in Western Australia (Department of Parks and Wildlife, 2017).</li> <li>• Conservation Advice, <i>Macroderma gigas</i>, Ghost bat (Threatened Species Scientific Communittee, 2016).</li> </ul>
<b>Receiving Environment</b>	<p>Six fauna habitat types mapped, being Hillcrest/ Hillslope, Low Stony Hills, Major Drainage Line, Sand Plain, Stony Plain and Gorge/ Gully.</p> <p>Sixteen caves known to support the Ghost Bat and/or Pilbara Leaf-nosed Bat, including potential Ghost Bat maternity roost CMRC-15.</p> <p>No perennial waterholes of value for fauna.</p> <p>Seven conservation significant fauna were confirmed present including the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Peregrine Falcon, Northern Brush-tailed Possum and Grey Falcon.</p>
<b>Potential Impacts</b>	<ul style="list-style-type: none"> <li>• Loss and/or degradation of fauna habitat, particularly for conservation significant fauna.</li> <li>• Loss and/or degradation of terrestrial fauna habitat due to increased presence of weed species.</li> <li>• Injuries to and mortalities of fauna caused by interactions with vehicles, infrastructure, machinery and the workforce.</li> <li>• Reduced diversity or abundance of foraging resources due to altered hydrological regimes.</li> <li>• Alteration in behaviour of fauna due to noise, vibration, artificial light emissions and dust.</li> <li>• Increased presence of non-indigenous fauna species.</li> <li>• Alteration to fire regimes.</li> </ul>
<b>Mitigation</b>	<p><b>Avoidance:</b></p> <ul style="list-style-type: none"> <li>• The Proposal has avoided the need to clear additional fauna habitat by using the existing camp, Abydos Link Road (haul road; ALRE) and borefield infrastructure associated with Atlas Iron's Abydos Project.</li> <li>• The Proposal has been designed to avoid direct impacts to 15 out of the 16 caves in the Study Area, as well as the significant Lalla Rookh maternity cave which lies 3 km outside of the Development Envelope.</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• The Development Envelope has been designed to avoid the majority of mapped area of fauna habitats of most significance:               <ul style="list-style-type: none"> <li>– In relation to the three most significant habitat types for vertebrate fauna: Approximately 99% of Gorge/ Gully habitat, 90% of Hillcrest/ Hillslope habitat and 96% of Major Drainage Line will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– In relation to the two most significant habitat types for invertebrate fauna: Approximately 10 ha of Gorge/ Gully habitat and 696 ha of Hillcrest/ Hillslope habitat will be retained outside of the Development Envelope. It is likely that additional parts of these habitat types will be retained in the final layout of the Disturbance Footprint.</li> <li>– All known permanent waterholes are outside of the Development Envelope.</li> </ul> </li> </ul> <p><b>Minimisation and management:</b></p> <p>The following plans and procedures will be implemented to assist in minimising impacts to fauna and fauna habitat:</p> <ul style="list-style-type: none"> <li>• GDP Procedure (950-HSE-EN-PRO-0001).</li> <li>• Clearing and Grubbing Procedure (950-HSE-EN-PRO-0004).</li> <li>• Fauna Management Procedure (950-HSE-EN-PRO-0012).</li> <li>• Landfill Management Procedure (950-HSE-EN-PRO-0020).</li> <li>• Waste Management Procedure (950-HSE-EN-PRO-0023).</li> <li>• Introduced Fauna / Pest Control Procedure (950-HSE-EN-PRO-0022).</li> <li>• Significant Species Management Plan (Appendix K).</li> <li>• Water Management Plan and Site Water Operating Plan (<i>in preparation</i>).</li> </ul> <p>Key management measures contained in these plans include:</p> <ul style="list-style-type: none"> <li>• No more than 284.9 ha of vegetation/habitat within the 621.1 ha Development Envelope will be cleared/disturbed.</li> <li>• Clearing in/of sensitive habitats including caves, gorges and drainage lines will be kept to the minimum necessary for safe construction and operation of the Proposal.</li> <li>• Speed limits will be enforced across the site.</li> <li>• Off-road driving will be prohibited unless otherwise authorised by senior management to minimise potential vehicle strikes.</li> <li>• Night-time vehicle movements will be restricted where possible to minimise potential vehicle strikes.</li> <li>• All bins storing putrescible waste will have tightly secured lids to avoid fauna attraction and entry.</li> <li>• The landfill will be operated and managed in accordance with the Environmental Protection (Rural Landfill) Regulations 2002. This will include fencing to reduce the potential for attracting fauna.</li> <li>• Blasting operations will be limited to daytime only to limit disturbance to fauna including bats.</li> <li>• Noise, dust and light emissions will be controlled where possible to avoid excessive disturbance to native fauna, including directing lights to working areas, shielding lights to reduce glow, and using conventional dust suppression techniques (i.e. water trucks).</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"> <li>• Clearing will occur in accordance with Atlas Iron's Ground Disturbance Permit Procedure. No clearing will occur without prior authorisation from Atlas Iron's Ground Disturbance Permitting System. This will ensure that clearing does not occur outside the Development Envelope or exceed 284.9 ha.</li> <li>• Atlas Iron will abstract water in accordance with 5C Licences to take groundwater, a Water Management Plan and Site Water Operating Plan in accordance with the Department of Water and Environmental Regulations requirements.</li> </ul> <p>Specific to the management of cave CMRC-15:</p> <ul style="list-style-type: none"> <li>• Blasting will be undertaken in accordance with the recommendations contained in Blast It Global (2020) and detailed in the SSMP. Key measures include: <ul style="list-style-type: none"> <li>– Design blasts to perform to the blast criteria (i.e. limit to 100 mm/s but design to achieve 85 mm/s) using the reference values set out in Blast It Global (2020).</li> <li>– Establish vibration monitors in caves CMRC-13, -14 and -15 for blasting at Miralga East pits 2 and 3.</li> <li>– Avoid blasting within 100 m of a cave until the results of monitoring validate predictions with a reasonable degree of confidence.</li> <li>– If vibration exceeds 100 mm/s, blasting should cease until the cause has been determined and steps to prevent a reoccurrence have been taken. A cave inspection is required to assess any impacts.</li> <li>– Periodically inspect caves to confirm the vibration limits are fit for purpose.</li> </ul> </li> <li>• Recommendations provided in Bat Call WA (2020) will be followed and included in the SSMP.</li> </ul> <p><b>Rehabilitation:</b></p> <ul style="list-style-type: none"> <li>• All areas of the Indicative Disturbance Footprint (except for open pits) will be progressively rehabilitated as soon as practicable and as required by the MCP.</li> <li>• A MCP will be updated triennially or as required when significant changes are made to the Proposal. A detailed MCP, which will contain further information on rehabilitation works, will be prepared approximately one year to six months prior to the cessation of mining as stated in the MCP.</li> <li>• Rehabilitation works are expected to return disturbed areas (other than pits) to a stable and vegetated state. Revegetation is expected to provide some value for fauna although it is acknowledged that fauna habitats will not be restored to their pre-disturbance state.</li> </ul> <p><b>Offset:</b></p> <ul style="list-style-type: none"> <li>• A contribution to the Pilbara Environmental Offset Fund is expected to be made based on the number of hectares of clearing in the Chichester subregion as detailed in Chapter 8.</li> </ul>
<b>Predicted Outcome</b>	<ul style="list-style-type: none"> <li>• Potential clearing of up to 59.6 ha of high quality denning and foraging habitat for the Northern Quoll (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).</li> <li>• Potential clearing of up to 59.6 ha roosting habitat for the Ghost Bat (Gorge/ Gully and Hillcrest/ Hill Slope habitat mapped within the Development Envelope).</li> <li>• Loss of one occasional nocturnal roost for the Ghost Bat (the category 4 cave CMRC-02).</li> <li>• Potential temporary abandonment of caves close to the mining areas by Ghost Bat.</li> </ul>



Factor	Terrestrial Fauna Summary
	<ul style="list-style-type: none"><li>• Increased reliance by Ghost Bat on Lalla Rookh and other nearby roosts as refuges during mining.</li><li>• Retention of 15 of 16 known caves post-mining, including the category 2 potential maternity roost CMRC-15.</li><li>• No direct impact to any permanent waterholes within or directly adjacent to the Development Envelope.</li><li>• No significant impact to SRE fauna or habitat.</li></ul>