Robe Valley Mesa H,
Ghost bat roost cave assessment,
April 2017

Prepared for Rio Tinto

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Document Revision History

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C	22 May 2017	Third draft incorporating client's comments
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Executive Summary

Rio Tinto commissioned Bat Call WA (Bat Call) to undertake a targeted assessment of bat conservation values of caves at Mesa H. This resource is located in the Robe River valley 17 km south west of Pannawonica, in the Pilbara region of Western Australia. This assessment was completed in parallel with a broader assessment of bat conservation values across the entire Robe River that is the subject of a separate report.

Level one and two fauna surveys have been conducted in the area previously, most recently by Astron Environmental Services in 2015/16. Two bat species of conservation significance have been recorded within the area, namely Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (Pilbara form of the Orange leaf-nosed bat) (PLNb) and Ghost bat (*Macroderma gigas*), both listed as Vulnerable under Federal and State legislation. PLNb have been assessed as using Mesa H for foraging while originating from a yet to be discovered roost further to the south or east (e.g. Bat Call 2016, 2017). Multiple Ghost bat records including echolocation recordings, visual observations and cave middens have been detected within and adjacent to the study area (e.g. Biota 2009; Astron 2016; Astron 2017).

This survey was designed to provide an assessment of the conservation value of caves associated with the presence of Ghost bats at Mesa H. A visual assessment of cave environments and an extensive search for Ghost bat presence, including roosting bats, was carried out. Ghost bat presence on Mesa H was determined to be irregular with the mesa being used for nocturnal foraging and occasional diurnal roosting. Ghost bat presence, in the form of guano and middens, was recorded across all of the different areas inspected. Eleven of twenty four sites were found to be used or suitable for use by the species. No colonies of diurnally roosting Ghost bats were found. Two caves on Mesa H (MH16-34 and AC04) were found to have the characteristics of diurnal roosts for the species with the possibility of occasional use as maternity roosts. Eight sites on Mesa H were assessed to be nocturnal feeding sites. One site south of Mesa H in the nearby Buckland Hills was also assessed to be a nocturnal feeding site. Thirteen sites on Mesa H were determined to be not currently used by Ghost bats and not suitable for regular occupancy. A number of additional overhangs nearby the caves and shelters were also assessed for signs of Ghost bat use but none were found.

The caves and surrounding environments at Mesa H were found to be supporting foraging Ghost bats originating from either the Buckland Hills to the south, Yeera Bluff between mesas G and H or the Three Peak Hills to the north-west. Two diurnal roost caves with maternity cave potential

have been confirmed. These are located in productive gullies and are associated with a number of near-by caves and shelters providing a series of escape and nocturnal foraging opportunities, including the presence of the Robe River riparian zone, required by the species for successful reproduction.

1.0 Introduction.

1.1 Project Background

Rio Tinto commissioned Bat Call to undertake a targeted assessment of bat conservation values at the Mesa H deposit located approximately 17 kilometres (km) south-west of Pannawonica in the Robe River valley, in the Pilbara region of Western Australia (WA), figure 1. Rio Tinto is considering sustaining its Robe Valley operations by including additional deposits to replace ore supply from the Mesa J operations as it nears the end of its mine life. In summary, the planned mining operation would involve the following main components and activities in addition to the existing approved operations:

- progressive open pit mining of ore and overburden from Mesa H using similar open pit mining techniques to those currently used at Mesa J. These operations are planned to remove the inner core of the mesa while leaving the rocky face of the perimeter intact to a width of at least 20m at the mesa surface,
- placement of overburden in out-of-pit waste dumps adjacent to the mesa, and
- construction and use of haul and access roads to the mine areas within the mesa.

Recent surveys have identified that two species of cave roosting bat of conservation significance are present in the area, the Ghost bat (*Macroderma gigas*) and the Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (PLNb). PLNb have been assessed as using the Mesas for foraging while originating from a yet to be discovered roost further to the south or east (Bat Call 2016, 2017). Multiple Ghost bat records including echolocation recordings, visual observations and cave middens have been detected within and adjacent to the study area (Biota 2009; Astron 2016; Astron 2017).

The purpose of this survey was to assess the conservation values of caves potentially associated with Ghost bats at Mesa H that had been previously identified by both external and internal resources. This involved a visual assessment of cave geometry and environments and an extensive search for Ghost bat presence, including bat colonies and/or middens. The study area is shown in figure 1. It includes the perimeter of Mesa H including its major central gully.

1.2 Existing Environment at Robe Valley Mesas and Surrounds

Topography

The Robe River Valley mesas cover an extensive area beginning at Mesa A and running approximately 100 km upstream. Mesa H lies immediately adjacent to that river riparian zone. It is roughly circular and is 3.5 km in diameter and stands approximately 50 m higher than a flat plain that is crossed by the river. It is bisected by a major gully running south to north toward the Robe River riparian zone.

Geology

Mesa H is a tertiary Robe Pisolite iron ore deposit, also known as a Channel Iron Deposit (CID), incised with deep gullies around the perimeter. It has overhangs, shelters and caves along extensive lengths of the perimeter and the central gully, e.g. plate 1.

Overhangs, shelters and caves are defined herein as:

- Overhangs are shallow hollows in a rock wall with a distinct roof structure. Their shape is such that they are fully lit by sunlight to their back wall. Their depth is typically 2 to 5 m.
- Shelters are deeper hollows or shallow caves in the rock wall that have ceiling structures from 1.0 to >5 m. They offer significant protection from predators and the weather, are typically 5 to 15 m deep and have dark twilight conditions at their rear extremities. Some have domed areas in their ceilings offering nocturnal roosting and feeding opportunities to Ghost bats. Some are occasionally used diurnally.
- Caves are defined as deep structures of various heights, widths and depths that are very dark in their deeper recesses. They often have additional rear chamber(s) separated from the entrance by a constriction point(s). Those chambers that have ceiling heights of over 2.5m offer excellent roosting opportunities for Ghost bats.
- All three can have cracks or voids that continue back from their rear walls that may lead to additional internal cavities within the rock strata behind or above. If these cavities are almost fully enclosed, have entrance cracks large enough, and can retain high levels of humidity, they provide roosting opportunities for PLNb and Ghost bats.

Overhang and shelter density is high along the majority of the mesa perimeters with the rock strata forming numerous shallow shelters in mid and higher levels of the walls. There are a

number of deeper caves formed in the Pisolite at mid and higher levels of the mesa walls but these rarely extend beyond 15 m in depth. Most shelters and caves were found on the mesa's cliff walls at or just above the top of the talus slope.

Land Systems (after Van Vreeswyk *et al.* 2004)

Mesas H including the gullies and the surrounding gravelly plains are elements of the Robe Land System. It is a low limonite mesa that support spinifex grasslands and scattered Snappy Gums. The lower slopes and adjacent gravelly plains support spinifex grasslands with sparse Acacia and Eucalypt shrubs with low trees that sometimes form thickets.

The adjacent Robe River is a very complex and productive linear river channel and flood plain with a Eucalyptus and Melaleuca woodland over tall Acacia and Petalostylis shrubland. It is an element of the Pilbara's River Land System

The Buckland Hills to the south of Mesa H and Yeera Bluff to the west are rugged jaspilite ridges and mountains of the Newman Land System supporting open shrublands and open low woodlands of Grevillia and Eucalypt over hummock grasses.

Climate

The climate in the district is semi-desert tropical. Mean monthly minimum and maximum temperatures in the lower Robe Valley range from 12 to 41 degrees Celsius (^{o}C). Annual rainfall is extremely variable and averages 400 mm, usually in cyclonic or thunderstorm events during the northern wet season. The northern dry season lasts from May to November and winter rainfall is uncommon.

Water Sources

Drainage systems in the immediate area are associated with ephemeral gullies on the perimeters of the mesas that run into the Robe River drainage system. That riparian zone has a number of permanent and ephemeral pools along its length such as Gnieraoora Pool at the base of Yeera Bluff.

Plate 1. Example of the presence of overhangs and shelters along the perimeters and within the incised gullies on Mesa H. This view is of the Cave H18, H19 complex.

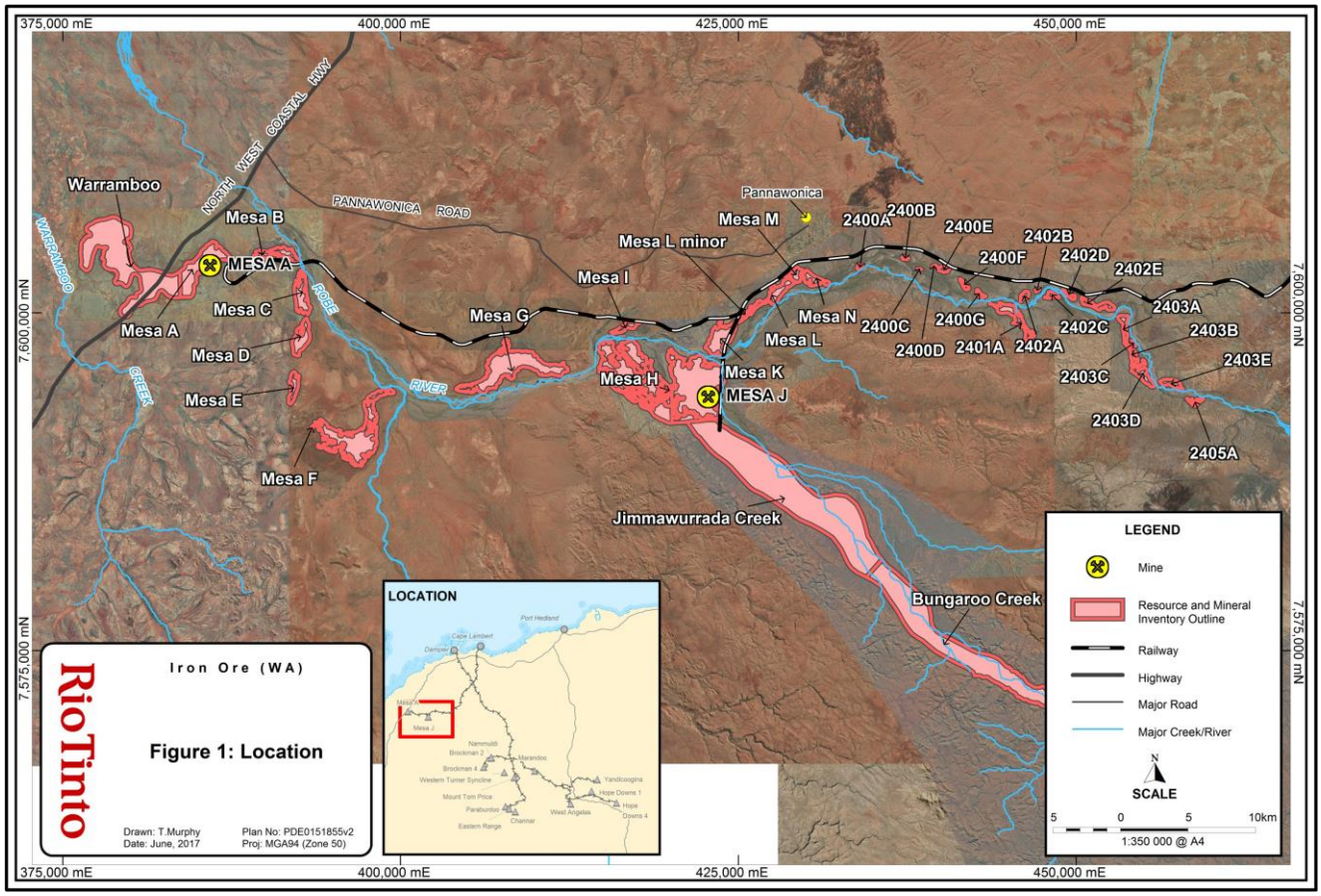


Figure 1. General Arrangement of Robe River valley mining area.

1.3 Bats of Conservation Significance

The Pilbara region contains 17 species of microbat, and of these, 13 have the potential to be found in the Mesa G-H vicinity (Van Dyke and Strahan 2008, McKenzie and Bullen 2009). A number of fauna surveys including targeted bat surveys have been previously conducted in the area, most recently by Astron in 2015 and 2016 and internal Rio Tinto ecologists in 2016-17, see table 1. Two Pilbara bat species of conservation significance have been recorded in the area, the Ghost bat (*Macroderma gigas*) and the PLNb (*Rhinonicteris aurantia*).

The Ghost bat is a large (130 g) carnivorous predator and the PLNb is a small (10 g) insectivore. Both are endemic to northern Australia and are obligate cave roosting species requiring specific cave environments for permanent roosting especially for their maternity colonies. The Ghost bat's foraging strategy and high trophic niche, as a top night-time carnivorous predator, is unique in Australian microbats. The Pilbara's Ghost bat and PLNb populations are isolated from Australia's other populations that are extant across the mesic tropics by the uninhabitable arid zone of the Great Sandy Desert to the north and east. Both species are "conservation significant" as they are semi-desert adapted populations that have specific roosting requirements. The Ghost bat has suffered significant range loss in historical times. The reasons for the range contraction are open to speculation but it is known that the species is sensitive to disturbance (e.g. Richards *et al*. 2008, Woinarski *et al.* 2014)).

The PLNb has been detected foraging across the mesas in the Middle Robe valley. A roost has not been identified on Mesa H and echolocation records indicate that it lies to the south or east of Mesa H or J.

The Ghost bat has also been detected within the study area.

1.3.1 Ghost bat (*Macroderma gigas*)

The Ghost bat is listed as Vulnerable under the commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act), Vulnerable under the Western Australian *Wildlife Conservation Act* (1950) and Vulnerable C1 (a vulnerable species numbering less than 10,000 and in decline) under the IUCN Redlist (IUCN 2017). The listing is on the basis of the impact of loss of suitable roost opportunities. The Pilbara Ghost bat population is estimated at 1500-2000 based on recently published estimates (approximately 600, N.L. McKenzie pers. comm. in IUCN 2016; approximately 1200, Armstrong and Anstee 2000; "more common than previously supposed", McKenzie and Bullen 2009) and author's unpublished database summarising data from a range of surveys carried out in recent years by Pilbara mining companies, including Rio

Tinto and other organisations, supplemented by author's own data (summarised in Threatened Species Scientific Committee (TSSC 2016). These recent data (estimates less than 15 years old) cover the entire Pilbara bioregion. Current population estimates in the Hamersley and Chichester subregions are approximately 350 and 1500 respectively (author's unpublished database summarised in TSSC (2016)).

Ghost bats hunt their prey in two primary ways. They hunt birds and bats "air-to-air" at cave entrances and elsewhere by swooping from above or from a perch. They also hunt ground level prey in their target food size range by dropping onto the prey from a perch, either tree branch or rock outcrop. Their diet includes small mammals including other bats, birds, reptiles, frogs and large insects. The proportion of food items in the diet varies with availability and reported foraging areas vary from a few to 10 km from the roost cave. One Ghost bat carcass was found recently entangled in a barbed wire fence in the Fortescue Marsh over 12 km from the nearest cave forming rocky strata suitable for roosting (Stephen Van Leeuwen pers. comm.).

Along the lower Robe River valley multiple Ghost bat records including visual observations and the presence of cave middens have been detected on the various mesas within and adjacent to the study area (table 1).

Ghost bat breeding colonies are known from a small number of maternity roosts in the Pilbara and reproduce during the northern wet season. The largest of these colonies are in abandoned mines in the Chichester subregion and number up to several hundred (Armstrong and Anstee 2000). Hamersley Range populations are typically between 5 and 25 individuals in local groups (author's unpublished database). There is one known large, permanent maternity roost (unpublished assessment by the author) numbering over 70 bats in the lower Robe River valley of the Hamersley subregion. For these groups to persist the bats need an "apartment block" of roosting opportunities, at least one deep cave with characteristics of a maternity roost, multiple caves/shelters and overhangs in close proximity offering nocturnal feeding and refuge opportunities, a productive set of gullies and gorges locally, a productive foraging area within 5 to 10 km radius, usually including a good quality riparian corridor or ephemeral fresh water lake bed and appropriate protection from human interference (author's unpublished data base). These groups are known to reproduce in good years using suitable natural roost caves. Examples are a group numbering 5 to 10 including reproducing females at West Angeles caves in 1980 (Dr Nic Dunlop pers. comm.), a small group including reproducing females at caves at Nammuldi/Silvergrass area (Hamersley Iron 1999), observation of a heavily pregnant female at a cave near Mt Robinson by the author in 2013 and a group numbering 14 including four juveniles

at another cave near Mt Robinson in 2015 (Mr. Morgan O'Connell pers. comm.). The Ghost bat is also known to spread great distances on an annual cycle from these locations depending upon seasonal weather conditions and availability of suitable day roosts. Sporadic records of Pilbara Ghost bats have been identified in the Gascoyne (author's unpublished data) and the Little Sandy Desert (sightings by W.H. Butler at Durba Spring in 1971 and others since). Genetic work by Worthington Wilmer and Armstrong (summarised in Woinarski *et al.* 2014) suggests that the females remain or return to their birthplace and that the males can move between districts.

Ghost bats use three types of roost regularly, these being nocturnal roosts or feeding sites, diurnal or day roosts that may be permanent or semi-permanent sites and maternity roosts that are diurnal roosts with the range of characteristics allowing regular or permanent occupancy.

Nocturnal roosts or feeding sites are only used at night, either habitually or for transitory visits. They are typically shallow caves and shelters that are well lit during the day. They are often high in the strata and may be well or poorly insulated from the elements. They often contain guano scatters and/or midden(s) of various sizes containing guano and food scraps but these remains are sometimes removed by rainfall and/or varieties of "dung beetle" that are known to forage on the scats (author's unpublished observations).

Diurnal roosts are caves and mine adits that are deeper and more complex. They typically have one or more large chambers at or beyond the twilight area with additional fissures or chambers at the rear in the fully dark regions. They have a minimum roof height in the chambers of 2 to 3 m providing protection from attack by terrestrial predators. They are often at mid-levels or lower in the strata and are well insulated overhead providing a stable temperature environment. They typically contain multiple scat piles and middens of guano and food remains that include feathers and skeletal material.

Maternity roosts are diurnal roosts that provide additional features to those listed above that are able to support a reproducing population. These features usually include an interior chamber that is rising toward the rear thereby trapping warmer and more humid air at the top allowing suitable conditions to form during the period when reproductive females and pups are present.

Being predators, during a night's foraging they may also hang for short periods in any deep overhang, shelter or cave with a high enough ceiling or tree branch above a cleared patch of ground for feeding or resting on an opportunistic basis. These sites are not routinely visited and usually show no evidence of Ghost bat presence.

1.3.2 Pilbara leaf-nosed bat (*Rhinonicteris aurantia*)

The PLNb is listed as 'Vulnerable' under the federal *Environment Protection and Biodiversity Act 1999* (EPBC Act) and by the Western Australian *Wildlife Conservation Act* (1950). This listing is on the basis of the impact on its population of the loss of suitable roosts with the correct microclimate.

The PLNb requires roosts with very specific requirements of high temperature and humidity for survival in the Pilbara. These are warm deep and humid caves and historical underground mines. The humidity required is higher than the Ghost bat, approaching 100%. The species is subject to rapid dehydration and death within a day if removed from its roost. It is known to have a usual foraging range up to 20 km from its primary roost caves (Bullen 2013). It also appears to spread from these roosts to satellite roosts when wet season conditions allow and to consolidate back to permanent sites during dry periods.

1.4 Summary of Previous Bat Surveys

Prior to 2017, a number of the fauna surveys commissioned by Rio Tinto in the lower Robe River valley have included microbat species listings. These indicated the presence of both significant species foraging across the area (e.g. Bat Call 2010). More recent surveys carried out since 2015, summarised in table 1 below, indicated that the Ghost bat may be roosting locally and may include a maternity colony at Mesa H and that the PLNb was foraging generally across all Robe valley mesas but not roosting on Mesa H.

Table 1. Summary of Fauna Surveys that Include Ghost Bat records in the Mesa H District

Date	Reference	Ghost bat activity detected.
2009	Biota (2009)	• Ghost bats harp trapped at Mesa G
2015	Astron (2016)	• Ghost bat echolocation calls detected at Mesa H and a number of shelters/caves with scats recorded
2016	Astron (2017)	• Ghost bat echolocation calls detected at Mesa G and a number of shelters/caves with scats recorded
2017	RTIO internal ecologists	• Ghost bat seen at cave H27on Mesa H.

2.0 Survey and Assessment Methods

A survey consisting of three days field work was completed in April 2017 (9th to 11th April) on Mesa H. Twenty four sites were assessed plus nearby overhangs and shallow shelters.

The fieldwork focussed on the assessment of potential roosting habitat of Ghost bat that previous surveys had indicated were important for this species. Eight sites listed as Ghost bat habitat were assessed. In addition, 13 caves/shelters on Mesa H that the Rio Tinto heritage surveys had recorded with depths greater than 10m were also included in the survey. Three previously unrecorded deep shelters suitable for Ghost bat use were also found and assessed.

On an opportunistic basis, a secondary set of overhangs and shelters recorded by the heritage surveys (often within 100m of the primary caves) were also searched.

2.1 Survey Team, Timing and Weather

The survey team consisted of two experienced ecologists. Ms Tenielle Brown (Rio Tinto) was team leader and Mr Robert Bullen (Bat Call) acted as principal ecologist.

The northern wet season of 2016-17 was wetter than average in the Pilbara region. Heavy rain fell in the district in the three months prior to the survey with 535 mm being recorded at the Bureau of Meteorology station at Pannawonica (Bureau of Meteorology station No 5069) between January and March. This rain continued until a week prior to the survey. The weather during the assessment was typical late wet season conditions being hot and dry with temperatures between 20 and 40^{O}C.

Sunset and sunrise were at 18:09 and 06:26 during the survey while dusk and dawn civil twilight were at 18:31 and 06:04 respectively. The moon phase was full.

2.2 Survey Techniques

The survey was designed to assess all Ghost bat (and any PLNb) roost cave candidates, to review cave morphology, geology and cave conditions, and to narrow down the list of potential Ghost bat maternity and/or PLNb roost caves. These visits were completed during daylight hours. Caves and shelters were entered after a rigorous safety inspection that assessed potential hazardous rock structures. Each was then measured for height, width and depth using a hand held laser (Bosch model PLR-50). Some caves and gorges had been surveyed earlier by Astron, for evidence of Ghost bat activity including the presence of middens and scats. Along the perimeter of Mesa H, twenty four sites were visited and were assessed by their attributes as probable night

feeding locations, seasonal day roost candidates or permanent day/maternity roost candidates. Numerous overhangs and shallow shelters identified by the Rio Tinto heritage surveyors near these sites were also assessed. These combined totals constituted all potential Ghost bat roost caves and shelters previously known or identified during the survey on the two mesas.

The presence of Ghost bat was confirmed by either of the following observations:

- Visual observation of a large pale bat entering or departing the cave. Note that the Ghost bat is distinctive in being much larger than any other cave dwelling bat in the region; or
- Detection of Ghost bat scats or middens on the floor of the caves or shelters entered, plate 2.

Plate 2. Typical Ghost bat midden containing scats and feathers on the floor of a cave

Caves and Shelters were then classified as maternal, diurnal, nocturnal or "not used" based on the cave characteristics and evidence found. The "not used" classification was applied when there is unsuitable characteristics such as low ceilings (typically <1.5m) and/or shallow depth (typically < 5m) with no physical evidence or other record such as a sighting or echolocation recording.

Observations of bat species other than the two conservation significant species were not recorded during this assessment.

2.3 Survey Effort

Sites previously identified were approached from either the top rim or from the plain below and scanned visually for the presence of caves. Caves were assessed for safe entry and sections of the perimeter that showed cave forming strata were then walked at the height of the top of the talus slope where the caves were most common. Twenty four caves and shelters were visited, see figure 2, and assessed for Ghost bat presence. One ecologist entered each cave following agreed Rio Tinto health and safety guidelines covering personal protective equipment (PPE), access limitations and communication strategies. The cave interior was searched for evidence of Ghost bat roosting including the presence of middens and adult Ghost bats. The team's second member remained at the entrance to observe any Ghost bat that might depart the cave behind the observer inside, a common behaviour of this species. Any Ghost bats that departed and/or entered the caves or were seen flying close to the entrance were thereby recorded visually. Any that departed could be tracked visually to record the alternative cave or shelter that they re-entered.

Figure 2 Mesa H with locations of caves and shelters assessed during the survey.

2.4 Survey Limitations

The primary objective of the survey was the characterisation of Ghost bat activity on Mesa H. All aspects of the survey including site access using 4WD, team make-up and experience levels, equipment used, logistics and safety support provided by Rio Tinto were suitable for the task.

No activities were undertaken that could cause harm to the bats present.

Detailed internal dimensions of a cave and its daytime use by bats cannot be reliably determined from the entrance or by the size of the entrance. Entry of candidate caves was therefore necessary to confirm internal characteristics including the bat species present. (Note that distinctive Ghost bat social calls heard from the entrance, or Ghost bats seen departing caves in daylight following the approach of survey parties, serve to confirm the presence of Ghost bats but do not provide information on their numbers or maternity status).

Detailed interior searches of caves were carried out under the guidelines of the Rio Tinto safety procedures. These prohibited entry into any cave that was deemed to have an unstable ceiling as characterised by loose rocks overhead or around the entrance, heavy cracking or the presence of fresh slab like roof material fallen to the floor. These procedures also prohibited entry into any chamber that required sliding on stomach or back or that required climbing or descending 2 m using rock-climbing techniques. The rear areas of some caves could therefore not be searched completely and the possible presence and number of Ghost bats in such caves was therefore not confirmed absolutely.

Due to the porous nature of the Robe Pisolite and the very high number of cracks and sinuous tubes and pipes throughout the strata, the floors of a number of caves had been washed clean of any evidence of Ghost bat occupation by the preceding heavy rain. In addition most caves were inhabited by a species of beetle that is known to act as a scat cleaner thereby removing Ghost bat scats. This combination resulted in fewer caves being identified with scats than expected from the previous surveys.

3.0 Results

A number of observations of Ghost bats middens and scat piles were made during this assessment with Ghost bat presence and foraging activity confirmed generally around the perimeter. In addition two diurnal roost caves with the characteristics of occasional maternity roosts have been located on Mesa H, figure 3.

Assessments of each cave and observations of Ghost bat activity are provided below, table 2, with detailed characteristics of the caves examined including floorplans and dimensions in Attachment A. Most caves were found to be less than 20 m deep and therefore not expected to be impacted by the mining behind the facade. Caves MH16-34 and AC4 were found to be over 30 m deep, depths that are significant when planning the facade to be retained.

Eleven sites were assessed as being suitable for roosting by Ghost bats including two diurnal roost caves and nine nocturnal roost shelters. Note that this total includes shelter AC05 that is in the Buckland Hills BIF strata (Newman land system) adjacent to Mesa H. The two assessed as diurnal roost caves are MH16-34 (50K 415815 7595655), a simple linear chamber 30 m deep with a single high dome at the distal end, and cave AC04 (50K 417586 7594895), a more complex cave with six ceiling domes between 2.5 and 3.9 m high along its length. Both were assessed as being maternity cave candidates although no evidence of significant Ghost bat use of this type was found during the survey. Cave AC04 had a number of scats present.

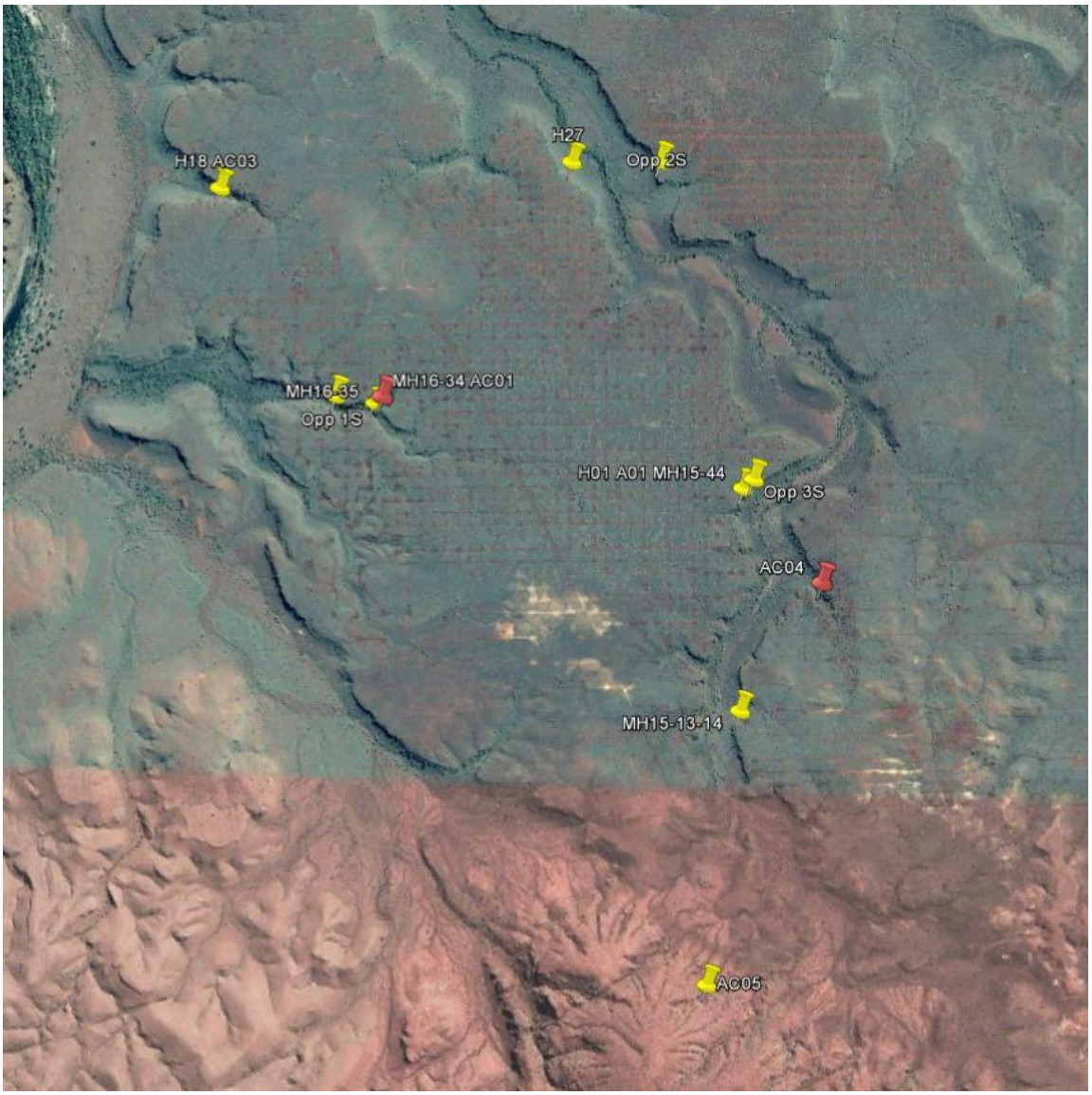


Figure 3. Mesa H caves and shelters where positive Ghost bat assessments were made. The red dots denote the diurnal caves MH16-34 and AC04. Yellow dots denote caves/shelters assessed as nocturnal feeding roosts.

Table 2. Summary of caves visited on Mesa H and assessed for Ghost bat usage.

Cave	Easting	Northing	Observations	Assessed Ghost Bat roost type
H01-A01 MH15- 44	417270	7595276	Shelter with a low internal dome. Several overhangs to the north and south. Ghost bat guano present	Nocturnal feeding roost
H2	414628	7597699	Overhang. No Ghost bat guano present	Overhang only. Not used
H3,H4,H5,H6,H7	414730	7597728	A series of overhangs along cliff face. No Ghost bat guano present	Overhang only. Not used
H16	415266	7596488	Shelter with low roof. No Ghost bat guano present. Additional overhangs nearby and on opposite side of gully with no Ghost bat evidence.	Shelter only. Not used
H18	415164	7596495	Shallow cave with two low domes. No Ghost bat guano present	Nocturnal feeding roost
H19	415126	7596488	Shelter with low roof. No Ghost bat guano present	Shelter only. Not used
H24	416776	7596072	Overhang. No Ghost bat guano present	Overhang only. Not used
H27	416587	7596590	Deep shelter with two low internal domes. Several overhangs to the north and south. No Ghost bat guano present	Nocturnal feeding roost
H34	415315	7595811	Shelter with several overhangs to the east and west. No Ghost bat guano present	Shelter only. Not regularly used
H36	415667	7595692	Unable to approach due to steep cliff. Assessed from opposite side of gully.	Shallow shelter only. Not used
MH15-13 MH15-14	417252	7594383.	Shelter with a high pipe in roof. Ghost bat guano present	Nocturnal feeding roost
MH15-25 H29	416571	7597124	Shelter with overhangs to west and east. No Ghost bat guano present	Shelter only. Not regularly used
MH15-47	417248	7595912	Shelter with low roof. No Ghost bat guano present	Not used
MH15-95	414938	7597150	Shelter with low roof. No Ghost bat guano present. Has additional overhangs nearby and on opposite face with no Ghost bat evidence.	Not regularly used
MH15-96	414925	7597127	Shelter with low roof. No Ghost bat guano present	Not used

Cave	Easting	Northing	Observations	Assessed Ghost Bat roost type
MH15-97	414899	7597103	Shelter with low roof. No Ghost bat guano present	Not used
MH16-34	415815	7595655	Deep cave with a single internal dome. No Ghost bats present	Diurnal roost. Possible maternal roost
MH16-35	415782	7595640	Shelter with overhangs to west and opposite. No Ghost bat guano present	Nocturnal feeding roost
AC04	417586	7594895	Cave with a multiple internal domes. Ghost bat scats present	Diurnal roost. Occasional use as a maternal roost possible but no current evidence of use this year
AC05	417109	7593285	Cave with a single internal dome. Ghost bat scats present	Nocturnal feeding roost
AC06	418068	7592683	Shelter with overhangs at creek level to the east. No Ghost bat guano present	Shelter only. Not regularly used
MH-Opp 1S	415625	7595659	Deep shelter with several overhangs to the east and west. No Ghost bat guano present	Nocturnal feeding roost
MH-Opp 2S	416948	7596585	Deep shelter with several overhangs to the north. No Ghost bat guano present	Nocturnal feeding roost
MH-Opp 3S	417330	7595332	Deep shelter with several overhangs to the south. No Ghost bat guano present	Nocturnal feeding roost

Note: All coordinates are zone 50K.

4.0 References

Armstrong, K.N. and Anstee, S.D. (2000). The ghost bat in the Pilbara; 100 years on. Australian Mammalogy 22(2) 93 – 101.

Astron Environmental Services (2016). Mesa H Level 2 fauna assessment. Unpublished report in draft prepared for Rio Tinto Iron Ore.

Astron Environmental Services (2017). Mesa H Ghost bat (Macroderma gigas) contextual study June 2016. Unpublished report in draft prepared for Rio Tinto Iron Ore.

Bat Call (2010). Robe Valley Mesas, Pilbara WA, Fauna Survey, October 2010, Echolocation survey of bat activity. Unpublished report prepared for Biota Environmental Sciences dated December 2010.

Bat Call (2016). Mesa H additional area survey, June 2016, Echolocation survey of bat activity. Unpublished report prepared for Astron Environmental Services dated June 2016.

Bat Call (2017). Mesa J PLN and Ghost bats. Email report prepared for Rio Tinto dated 27 March 2017.

Biota Environmental Sciences (2009). Mesa G Baseline fauna survey. Unpublished report for Rio Tinto Iron Ore.

Bullen, R. (2013). Pilbara leaf-nosed bat, *Rhinonicteris aurantia*: Summary of current data on distribution, energetics and threats. Presentation made to Western Australian Department of Environment and Conservation workshop on Pilbara leaf-nosed bats, 25 June 2013

Hamersley Iron (1999). Nammuldi/Silvergrass Exploration Project. Biological Survey Report November 1998 - May 1999. Hamersley Iron Pty. Ltd.

IUCN (2017). The IUCN Red List of Threatened Species. Version 2016-3. <www.iucnredlist.org>. Downloaded on 19 April 2017.

McKenzie, N.L. and Bullen, R.D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. Records of the Western Australian Museum, Supplement 78: 123-155.

Richards, G.C., Hand, S., Armstrong, K.N. and Hall, L.S. (2008). Ghost Bat. In Mammals of Australia, third edition (Van Dyke and Strahan eds.) Reed new Holland; Sydney.

Threatened Species Scientific Committee (2016). Conservation advice, Macroderma gigas, Ghost bat. Australian Government Department of Environment, dated 5 May 2016.

Van Dyke, S. and Strahan, R. editors (2008). Mammals of Australia 3rd Edition. Reed New Holland: Sydney.

Van Vreeswyk, A., Payne, A., Leighton, K and Hennig, P. (2004). An inventory and condition survey of the Pilbara region, Western Australia. Technical Bulletin No. 92 Department of Agriculture, Western Australia.

Woinarski, J.C., Burbidge, A.A. and Harrison, P.L. (2014). The action plan for Australian mammals, 2012. CSIRO Publishing: Collingwood, Australia.

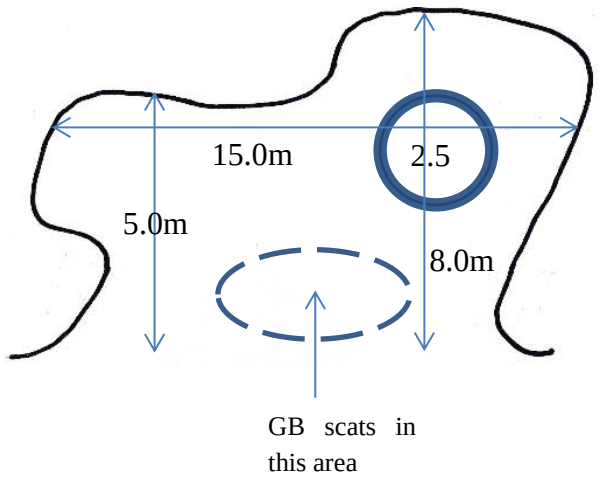
Attachment A: Characteristics of caves examined during this study.

Note that unboxed dimensions indicate cave/shelter width and depth and boxed or "dome height" (solid circles) dimensions indicate ceiling heights. Dotted ellipses indicate the locations of Ghost bat middens or scat piles.

Mesa H Shelter H01-A01 MH15-44:

Assessed Ghost bat usage: Nocturnal shelter with Ghost bat scats.	**Coordinates:** 50K 417270 7595276
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): Single wide entrance 9.0 x 1.5 m.	**Entrance Orientation:** South
Cave Grouping: Shelter has additional shallow overhangs along gully wall to the north and south.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shelter is 8 m deep with low roof and one low dome.	**Internal domed chamber:** Yes. 2.5 m high
Rear passages that may have roosts: No.	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, In central Mesa H gully that opens onto the Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 2.5 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:



Mesa H Shelter H2:

Assessed Ghost bat usage:	**Coordinates:**
Shallow shelter/Overhang only. No Gb guano present. Not used.	50K 414628 7597699
Entrance safe or unsafe to approach:	**Basic Geology: Land system at site**
Assessed safe	Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Wide shallow shelter.	North
Cave Grouping:	**Insulation from surface above:**
Shelter is a part of a complex of shelters and overhangs overlooking the Robe River.	Middle of local landscape
Cave Type:	**Internal domed chamber:**
Shallow shelter ~5 m deep.	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No.	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Excellent, Mesa H is adjacent to Robe River riparian zone.	Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

Mesa H Shelters H3, H4, H5, H6, H7:

Assessed Ghost bat usage:	**Coordinates:**
Shallow shelter/Overhang only. No GB guano present. Not used	50K 414730 7597728
Entrance safe or unsafe to approach:	**Basic Geology: Land system at site**
Assessed safe	Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m):	**Entrance Orientation:**
A series of wide shallow overhangs.	North
Cave Grouping:	**Insulation from surface above:**
A complex of shelters and overhangs along cliff face.	Middle of local landscape
Cave Type:	**Internal domed chamber:**
Shallow shelter ~5 m deep.	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Excellent, Mesa H is adjacent to Robe River riparian zone.	Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:

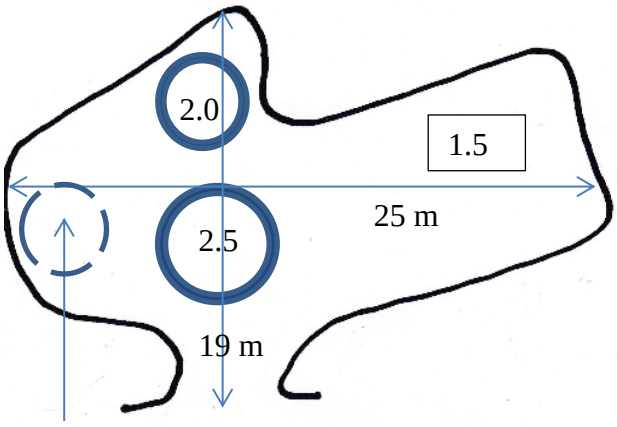
Mesa H Shelter H16:

Assessed Ghost bat usage:	**Coordinates:**
Shallow shelter/Overhang only. No GB guano present. Not used	50K 415266 7596488
Entrance safe or unsafe to approach:	**Basic Geology: Land system at site**
Assessed safe	Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m):	**Entrance Orientation:**
A wide shallow shelter among a group of caves, shelters and overhangs.	North
Cave Grouping:	**Insulation from surface above:**
Shelter is a part of a complex of shelters and overhangs along both sides of gully.	Middle of local landscape
Cave Type:	**Internal domed chamber:**
Shallow shelter ~5 m deep.	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Excellent, Mesa H is adjacent to Robe River riparian zone.	Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

Mesa H Cave H18:

Assessed Ghost bat usage: Nocturnal Roost. No GB guano present but cave was recently washed through by heavy rainfall.	**Coordinates:** 50K 415164 7596495
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): Single small entrance 2.6 x 1.7 m.	**Entrance Orientation:** North
Cave Grouping: Cave is a part of a complex of shelters and overhangs along both sides of gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Cave 19.0 m deep with low roof and two low domes.	**Internal domed chamber:** Yes. 2.5 m and 2.0 m high
Rear passages that may have roosts: Has multiple pipes through to the surface above.	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:



Multiple pipes through to surface in this area

Mesa H Shelter H19:

Assessed Ghost bat usage: Shallow shelter/Overhang only. No GB guano present. Not used	**Coordinates:** 50K 415126 7596488
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide shallow shelter among a group of caves, shelters and overhangs.	**Entrance Orientation:** North
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along both sides of gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:

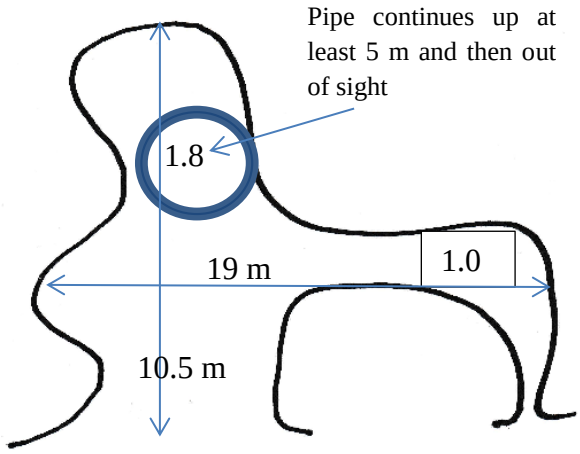
Mesa H Shelter H24:

Assessed Ghost bat usage: Shallow shelter/Overhang only. No GB guano present. Not used	**Coordinates:** 50K 416776 7596072
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A shallow shelter with an open entrance.	**Entrance Orientation:** East
Cave Grouping: Shelter is isolated in a gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H central gully opens onto the Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 3.5 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

Mesa H Shelter H27:

Assessed Ghost bat usage: Nocturnal Roost	**Coordinates:** 50K 416587 7596590
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): Two entrances, one 8.6 x 3.8 m and another very small entrance to the north.	**Entrance Orientation:** North east
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along the gully wall.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shelter is 10.5 m deep with low roof and a low dome with a sinuous vertical pipe.	**Internal domed chamber:** Yes. 1.8 m high
Rear passages that may have roosts: A sinuous vertical pipe rises at least 5 m and continues out of sight.	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H central gully opens onto the Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 3.5 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:



Mesa H Shelter H34:

Assessed Ghost bat usage: Shallow shelter/Overhang only. No GB guano present. Not regularly used	**Coordinates:** 50K 415315 7595811
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A shallow shelter among a group of overhangs.	**Entrance Orientation:** South
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along the north side of the gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 5 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo: 	

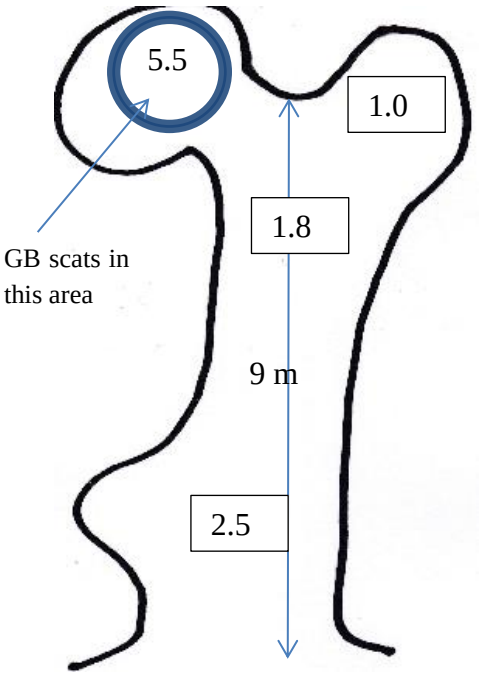
Mesa H Shelter H36:

Assessed Ghost bat usage: Shallow shelter. Unable to approach due to steep cliff. Assessed from opposite side of gully.	**Coordinates:** 50K 415667 7595692
Entrance safe or unsafe to approach: Assessed safe if approached from gully floor.	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide shallow shelter among a group of overhangs.	**Entrance Orientation:** South
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along the north side of the gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 5 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

Mesa H Shelter MH15-13 MH15-14:

Assessed Ghost bat usage: Nocturnal Roost. GB guano present under high pipe in roof.	**Coordinates:** 50K 417252 7594383
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): Single entrance 2.7 x 2.5 m.	**Entrance Orientation:** West
Cave Grouping: Isolated shelter near top of central Mesa H gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shelter is 9.0 m deep with low roof and a high pipe in the roof at the rear.	**Internal domed chamber:** Yes. 1.8 m dia pipe upwards at least 5.5 m high
Rear passages that may have roosts: No.	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 2.5 km distant. Resource evaluation drilling nearby on mesa top.

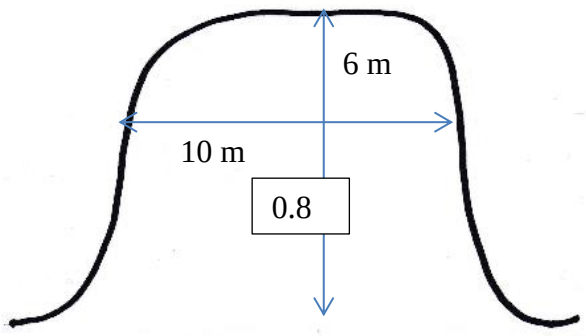
Cave floorplan and entrance photo:



Mesa H Shelter MH15-25 H29:

Assessed Ghost bat usage: Shallow shelter. No GB guano present. Not regularly used	**Coordinates:** 50K 416571 7597124
Entrance safe or unsafe to approach: Assessed safe.	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide shallow shelter among a group of overhangs. Entrance 10.0 x 2.0 m.	**Entrance Orientation:** South west
Cave Grouping: Shelter is amongst overhangs along the north side of the gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter 6 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 4 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:



Mesa H Shelter MH15-95:

Assessed Ghost bat usage: Shallow shelter. No GB guano present. Not regularly used.	**Coordinates:** 50K 414938 7597150
Entrance safe or unsafe to approach: Assessed safe.	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide shallow shelter among a group of overhangs. Roof ~0.5m high.	**Entrance Orientation:** South east
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along the north-west side of the gully. Other overhangs are opposite on the south-east side of the gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

Mesa H Shelter MH15-96:

Assessed Ghost bat usage: Shallow shelter. No GB guano present. Not used.	**Coordinates:** 50K 414925 7597127
Entrance safe or unsafe to approach: Assessed safe.	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide shallow shelter among a group of overhangs. Roof ~0.3 m high.	**Entrance Orientation:** South east
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along the north-west side of the gully. Other overhangs are opposite on the south-east side of the gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:

MH15-96 is the right hand entrance

Mesa H Shelter MH15-97:

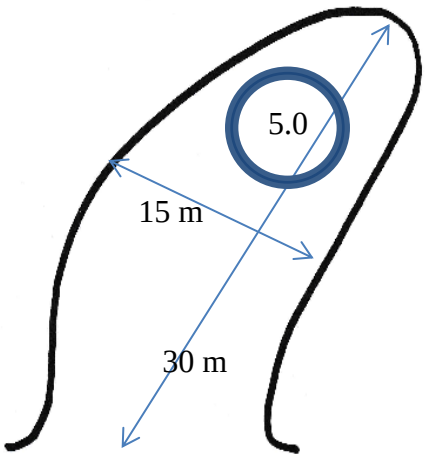
Assessed Ghost bat usage: Shallow shelter. No GB guano present. Not used.	**Coordinates:** 50K 414899 7597103
Entrance safe or unsafe to approach: Assessed safe.	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide shallow shelter among a group of overhangs. Roof ~0.3 m high.	**Entrance Orientation:** South east
Cave Grouping: Shelter is a part of a complex of shelters and overhangs along the north-west side of the gully. Other overhangs are opposite on the south-east side of the gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shallow shelter ~5 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 6 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

MH15-97 is the left hand entrance

Mesa H Cave MH16-34:

Assessed Ghost bat usage: Diurnal roost. Potential maternity roost but no GB current evidence.	**Coordinates:** 50K 415815 7595655
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A wide entrance among a group of overhangs at top of deep gully. Entrance 8.0 x 3.0 m.	**Entrance Orientation:** South west
Cave Grouping: Cave is a part of a complex of shelters and overhangs along the north side of the gully.	**Insulation from surface above:** Bottom of landscape
Cave Type: Deep cave with a single large dome.	**Internal domed chamber:** Yes. 5.0 m high
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 4.5 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo:



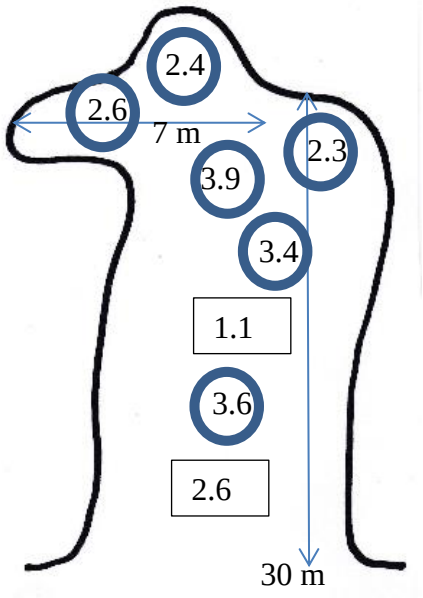
Mesa H Shelter MH16-35:

Assessed Ghost bat usage:	**Coordinates:**
Nocturnal roost. Shallow shelter. No GB guano present.	50K 415782 7595640
Entrance safe or unsafe to approach:	**Basic Geology: Land system at site**
Assessed safe.	Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m):	**Entrance Orientation:**
A shallow shelter among a group of overhangs.	North west
Cave Grouping:	**Insulation from surface above:**
Shelter is a part of a complex of shelters and overhangs at the top of the gully, opposite cave MH16-34.	Middle of local landscape
Cave Type:	**Internal domed chamber:**
Shallow shelter ~5 m deep.	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Excellent, Mesa H is adjacent to Robe River riparian zone.	Mesa J mine is 4.5 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:	

Mesa H Cave AC4:

Assessed Ghost bat usage: Diurnal roost. Potential maternal roost but no recent evidence. GB scats under domes at rear.	**Coordinates:** 50K 417586 7594895
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A large entrance 3.0 m x 2.8 m.	**Entrance Orientation:** North east
Cave Grouping: Cave is alone on the east side of the central Mesa H gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: 30 m deep cave with multiple domes.	**Internal domed chamber:** Yes. Six domes between 2.5 and 3.9 m high
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 2 km distant. Resource evaluation drilling nearby on mesa top.

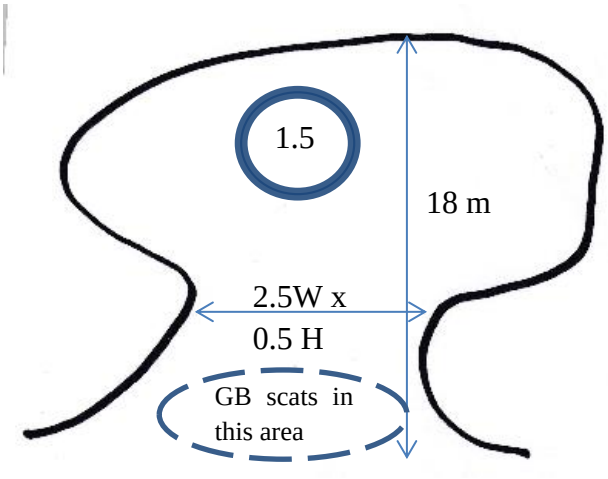
Cave floorplan and entrance photo:



Mesa H Cave AC5:

Assessed Ghost bat usage: Nocturnal roost. GB guano present.	**Coordinates:** 50K 417109 7593285
Entrance safe or unsafe to approach: Assessed safe.	**Basic Geology: Land system at site** Brockman BIF: Newman
Entrance type and dims – WxH (m): A shallow cave with a wide low entrance 10.0 x 1.5 m.	**Entrance Orientation:** South east
Cave Grouping: Cave is in a gully on a ridge south west of mesa H..	**Insulation from surface above:** Middle of landscape
Cave Type: Shallow cave 18 m deep with a single low dome.	**Internal domed chamber:** Yes. 1.5 m high
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, cave is 3.5 km from Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 2.5 km distant.

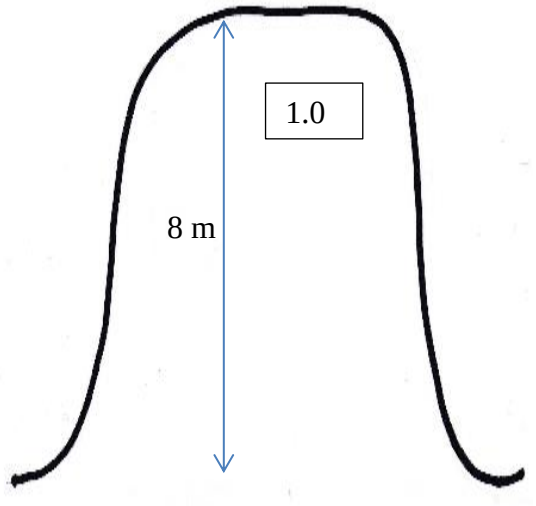
Cave floorplan and entrance photo:



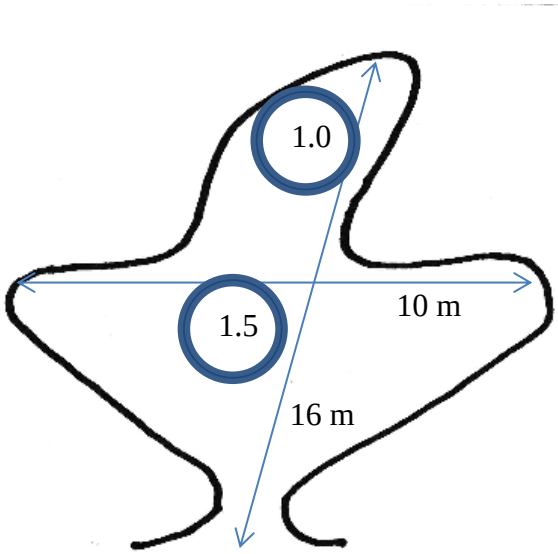
Mesa H Cave AC6:

Assessed Ghost bat usage: Shallow shelter. No GB guano present. Not regularly used.	**Coordinates:** 50K 418068 7592683
Entrance safe or unsafe to approach: Assessed safe.	**Basic Geology: Land system at site** Brockman BIF: Newman
Entrance type and dims – WxH (m): A shelter with a low entrance 1.5 x 2.0 m.	**Entrance Orientation:** North east
Cave Grouping: Shelter is on a ridge south west of Mesa H.	**Insulation from surface above:** Middle of landscape
Cave Type: A low shelter 8 m deep.	**Internal domed chamber:** No
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, cave is 4.5 km from Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 1.5 km distant.

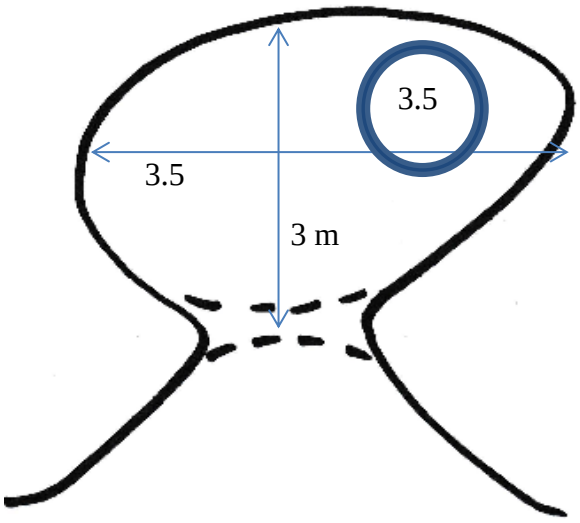
Cave floorplan and entrance photo:



Mesa H Shelter Opp-1S:

Assessed Ghost bat usage: Nocturnal roost. Deep shelter. No GB guano present.	**Coordinates:** 50K 415625 7595659
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A small entrance among a group of overhangs. Entrance 1.5 x 1.5 m.	**Entrance Orientation:** North
Cave Grouping: Shelter is a part of a complex of overhangs along the south side of the gully opposite shelter H34.	**Insulation from surface above:** Middle of local landscape
Cave Type: Deep shelter with a two low domes.	**Internal domed chamber:** Yes. 1.5 and 1.0 m high
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 4.5 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:  	

Mesa H Shelter Opp-2S:

Assessed Ghost bat usage: Nocturnal roost. Shallow shelter. No GB guano present.	**Coordinates:** 50K 416948 7596585
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A small constricted entrance 0.7 x 1.5 m.	**Entrance Orientation:** West
Cave Grouping: Shelter is a part of a complex of overhangs along the east side of the gully opposite shelter H27.	**Insulation from surface above:** Middle of local landscape
Cave Type: Shelter with small entrance and a low dome.	**Internal domed chamber:** Yes. 3.5 m high
Rear passages that may have roosts: No	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 3.5 km distant. Resource evaluation drilling nearby on mesa top.
Cave floorplan and entrance photo:  	

Mesa H Shelter Opp-3S:

Assessed Ghost bat usage: Nocturnal roost. No GB guano present.	**Coordinates:** 50K 417330 7595332
Entrance safe or unsafe to approach: Assessed safe	**Basic Geology: Land system at site** Robe Pisolite mesa: Robe
Entrance type and dims – WxH (m): A large entrance among a group of overhangs. Entrance 8.0 x 4.0 m.	**Entrance Orientation:** South east
Cave Grouping: Shelter is a part of a complex of overhangs along the west side of the central gully.	**Insulation from surface above:** Middle of local landscape
Cave Type: Deep shelter with a two levels. Upper level accessed by three pipes ~ 1.0 m diameter.	**Internal domed chamber:** No. Lower level has pipes in roof leading to upper level cavity that has numerous tunnels.
Rear passages that may have roosts: Yes in upper level	**Internal temp. and relative humidity:** Ambient
Local foraging opportunities: Excellent, Mesa H is adjacent to Robe River riparian zone.	**Current distance to disturbance:** Mesa J mine is 3.0 km distant. Resource evaluation drilling nearby on mesa top.

Cave floorplan and entrance photo: