FINAL REPORT

Tropicana Gold Project

Marsupial Mole Survey:

Proposed Infrastructure Corridor - Pinjin Option

Prepared for

AngloGold Ashanti Australia Limited

Level 13 St Martins Tower
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Perth WA 6000

20 February 2009

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ANGLOGOLD ASHANTI AUSTRALIA

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The Tropicana JV (TJV) is currently undertaking pre-feasibility study on the viability of establishing the Tropicana Gold Project (TGP), which is centred on the Tropicana and Havana gold prospects. The proposed TGP is located approximately 330 km east north-east of Kalgoorlie, and 15 km west of the Plumridge Lakes Nature Reserve, on the western edge of the Great Victoria Desert (GVD) biogeographic region of Western Australia. The project is a joint venture between AngloGold Ashanti Australia Limited (70% and Manager) and the Independence Group NL.

As part of the proposed TGP the TJV intends to construct an infrastructure corridor between Kalgoorlie and the proposed operational area. The infrastructure corridor could house an access road and possible fibre optical cable for the site communication and gas pipeline. The TJV is current evaluating two different routes one via the Pinjin Station and one via the existing Trans Australian Railway line Access Road. AngloGold Ashanti Australia Limited (AngloGold) commissioned URS Australia Ltd Pty (URS) on behalf of the Tropicana Joint Venture (TJV) to conduct a study to identify the presence of the Southern Marsupial Mole (*Notoryctes typhlops*) along the proposed Pinjin Infrastructure Corridor. The Survey Area is located between approximately 140 and 330 km east northeast of Kalgoorlie, within the Murchison and the Great Victoria Desert Biogeographic regions.

The main objective of this study was to determine whether the Marsupial Mole occurs within potentially suitable habitat along the Survey Area. A secondary objective of the study was to opportunistically collect:

- Predator scats to provide to AngloGold for further in-house research of the Marsupial Mole.
- Information on the following conservation significant species:
  - Sandhill Dunnart (*Sminthopsis psammophila,* listed as Endangered under the *Environment Protection and Biodiversity Conservation Act* 1999 [EPBC Act] and Schedule 1 under the *Wildlife Conservation Act* 1950)
  - Malleefowl (*Leipoa ocellata,* listed as Vulnerable under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act* 1950)
  - Mulgara (*Dasycercus cristicauda,* listed as Vulnerable under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act* 1950)

Prior to the field survey, a desktop assessment of aerial photography was undertaken to compile a preliminary list of sites within potentially suitable habitat along the survey corridor. The field assessment of the survey corridor was conducted between 22-28 November 2007, 4-10 March 2008 and 22-29 April 2008.

Surveying for the presence of the Marsupial Mole involves digging trenches in order to expose a vertical north facing soil wall, allowing the wall to thoroughly dry, and then inspecting the wall for pre-existing Marsupial Mole tunnels. These tunnels are backfilled with sand by the Marsupial Mole, and appear as circular or oval shaped outlines depending on the angle they make with the trench wall. After ground truthing, a penetrometer was initially utilised at apparently suitable sites to establish the compactness of the substrate. If the penetrometer indicated that the substrate may be suitable habitat for the Marsupial Mole (a preliminary approximate guide of <10 drops per 150 mm was used), surveying for the Marsupial Mole continued.

The surveying conducted along the proposed infrastructure corridor route between map 1 and map 23 confirms the potential previous presence of Marsupial Moles at sites 1-5c, 1-7b, 1-9b, 1-10a and 2-11a. These sites were all located within dunal, open scrub or low open woodland habitats, with a reddish yellow surface soil colour. URS recommends that the proposed infrastructure planned for the corridor should be installed to avoid dunal systems (believed to be the primary habitat for the Marsupial Mole).

The URS field team also opportunistically collected predator scats from the Survey Area, which URS understands were to be analysed for Marsupial Mole hair at a later date.

Executive Summary

No direct recent evidence of the Mulgara, Sandhill Dunnart or Malleefowl was noted within the Survey Area. However, an inactive Malleefowl mound and potentially suitable Mulgara habitats were identified in the Survey Area.

Section 1 Introduction

1.1 Overview

The Tropicana JV (TJV) is currently undertaking pre-feasibility study on the viability of establishing the Tropicana Gold Project (TGP), which is centred on the Tropicana and Havana gold prospects. The proposed TGP is located approximately 330 km east north-east of Kalgoorlie, and 15 km west of the Plumridge Lakes Nature Reserve, on the western edge of the Great Victoria Desert (GVD) biogeographic region of Western Australia (Figure 1-1). The project is a joint venture between AngloGold Ashanti Australia Limited (70% and Manager) and the Independence Group NL (30%).

The TGP consists of three main components (Figure 1-1):

- Operational Area. This area contains the mine, processing plant, aerodrome, village and other associated infrastructure
- Water Supply Area. Two basins have been investigated, the Minigwal Trough and Officer Basin
- Infrastructure Corridor. Two options are under consideration (Cable Haul and Pinjin Road options).

As part of the proposed TGP the TJV intends to construct an infrastructure corridor between Kalgoorlie and the project area. The infrastructure corridor will house an access road and / or fibre optical cable for the site communication. The TJV is current evaluating two different routes one via the Pinjin Station and one via the existing Trans Australian Railway line access road. This report describes a survey designed to identify the presence of the Southern Marsupial Mole (*Notoryctes typhlops*) along the one of the proposed Infrastructure Corridor from Pinjin to the proposed Operational Area, (the Survey Area). This Survey Area is located between approximately 140 and 330 km northeast of Kalgoorlie, within the Murchison and the Great Victoria Desert Biogeographic regions (Figure 1-1).

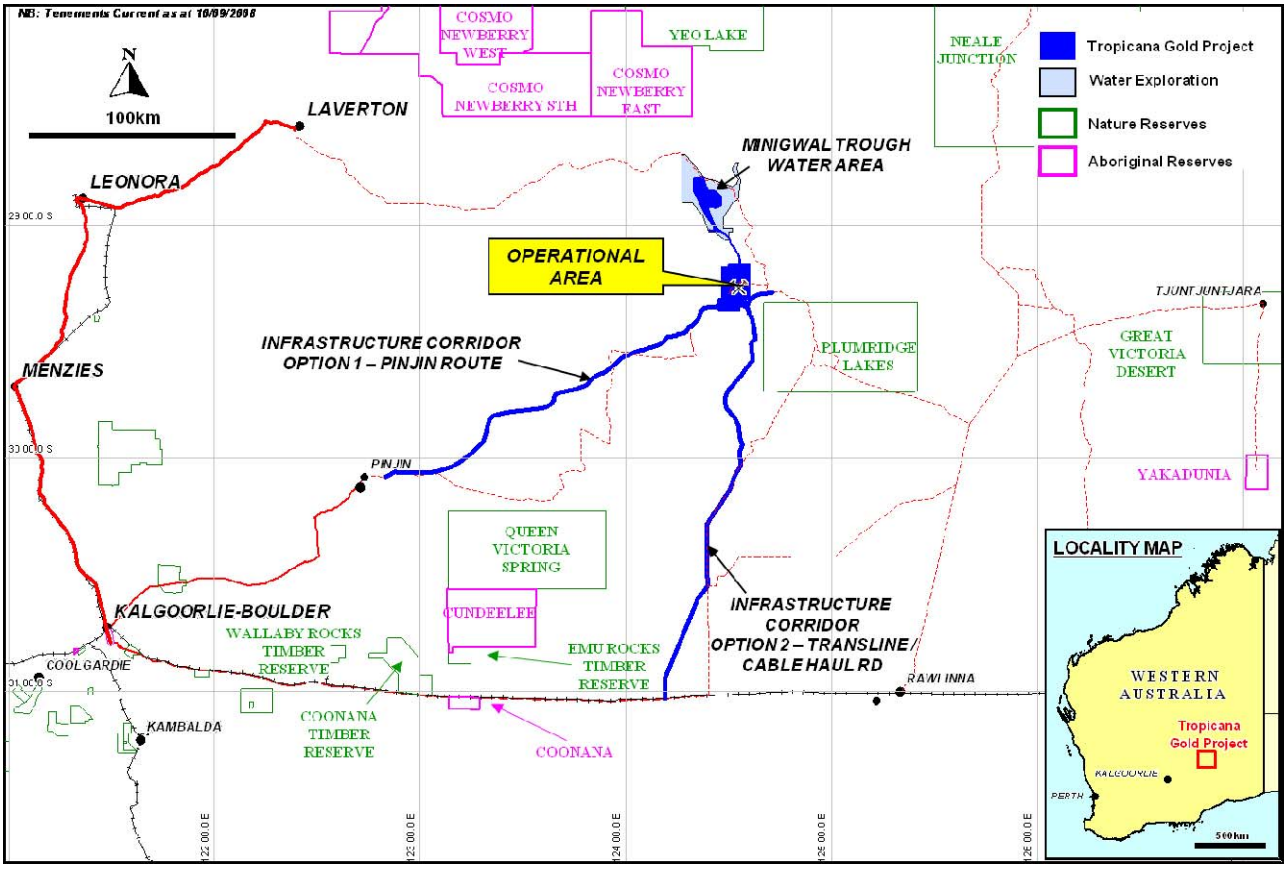

Figure 1-1 Survey Location

Section 1 Introduction

1.2 Objectives

The main objective of this study was to determine whether the Southern Marsupial Mole is likely to occur within the Survey Area (see Figures 3-1 and 3-2).

A secondary objective of the study was to opportunistically collect information on:

- The Southern Marsupial Mole through the collection of predator scats
- The following conservation significant species:
  - Sandhill Dunnart (*Sminthopsis psammophila,* listed as Endangered under the *Environment Protection and Biodiversity Conservation Act* 1999 [EPBC Act] and Schedule 1 under the *Wildlife Conservation Act* 1950)
  - Malleefowl (*Leipoa ocellata,* listed as Vulnerable under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act* 1950)
  - Mulgara (*Dasycercus cristicauda,* listed as Vulnerable under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act* 1950).

1.3 Conservation Significance

1.3.1 Commonwealth Legislation

An official list of endangered, vulnerable and presumed extinct fauna species was prepared (Schedule 1), and is regularly updated, following Australia signing the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1974. This list originally accompanied the *Endangered Species Protection Act* 1992, which in July 2000 was replaced by the EPBC Act.

The vertebrate fauna on the current Schedule are categorised as:

- Extinct
- Extinct in the wild
- Critically endangered
- Endangered
- Vulnerable.
- Conservation dependant.

The Southern Marsupial Mole is listed as Endangered under the EPBC Act.

1.3.2 State Legislation

The *Wildlife Conservation Act* 1950 is Western Australia's legislation to protect rare or endangered fauna species. In 2008, the list of conservation significant species was reviewed and the Wildlife Conservation (Specially Protected Fauna) Notice 2008 (2) was published. The Schedules defined under this legislation comprise:

- Schedule 1, fauna that is rare or is likely to become extinct
- Schedule 2, fauna presumed to be extinct
- Schedule 3, birds protected under an international agreement such as the Japan-Australian Migratory Bird Agreement (JAMBA) or the China-Australia Migratory Bird Agreement (CAMBA)
- Schedule 4, other specially protected fauna.

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1.3.3 Priority Species

The Western Australian Department of Environment and Conservation (DEC) maintains a State list of conservation significant and/or poorly understood Priority Fauna, which classifies species as:

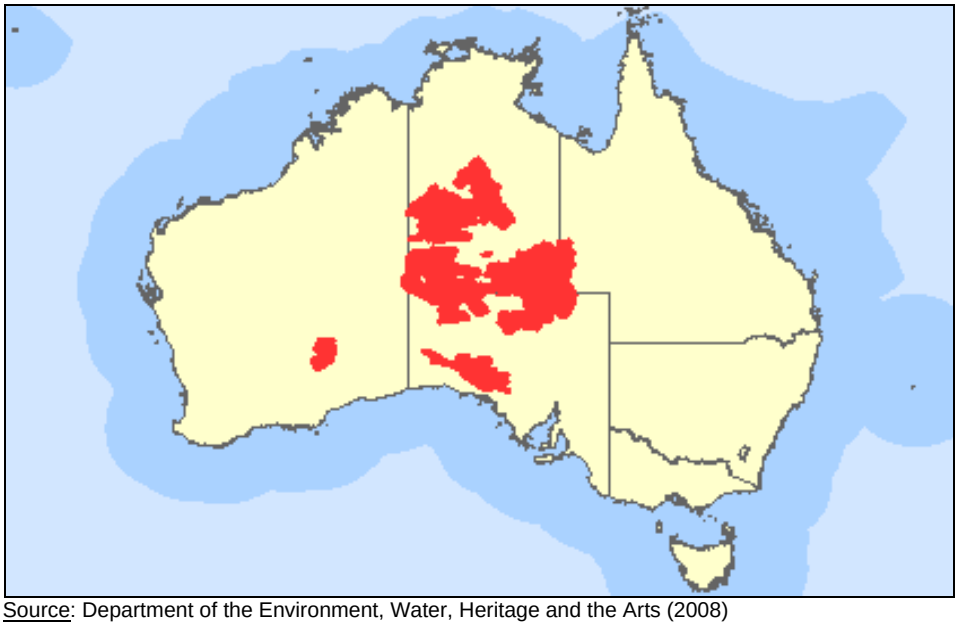
- Priority 1, taxa with few, poorly known populations on threatened lands.
- Priority 2, taxa with few, poorly known populations on conservation lands.
- Priority 3, taxa with several, poorly known populations, some on conservation lands.
- Priority 4, taxa in need of monitoring for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection.
- Priority 5, taxa in need of monitoring which are not considered threatened but are subject to a specific conservation programme.

1.4 Background Information

1.4.1 Southern Marsupial Mole

The Southern Marsupial Mole has evolved extreme specialisation for burrowing through sand, including: mole like tubular body with cone-shaped head and short, strong limbs; no functional eyes; ears reduced to a simple opening; leathery shield over muzzle; small mouth; 3rd and 4th foretoes with large shovel-like claws for digging (Menkhorst and Knight, 2004). It has dense and fine, uniformly pale golden white fur. Marsupial Moles have a head and body length of up to 140 mm and weigh from 30 to 60 g (Benshemesh, 2004).

The Marsupial Mole is sparsely distributed across much of arid Australia (Menkhorst and Knight, 2004), refer to Figure 1-2. Importantly, Benshemesh (2004) notes that Marsupial Moles are not capable of travelling far across hard ground and continuity of suitable habitat (sand dunes, swales, sand plains) is likely to be very important for the occurrence of Marsupial Moles in an area.



Source: Department of the Environment, Water, Heritage and the Arts (2008)

Figure 1-2 Indicative Distribution of the Southern Marsupial Mole Based on Best Current Available Knowledge

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Marsupial Moles are not closely related to any other taxa and comprise their own unique marsupial order, the Notoryctemorphia, which may have branched off from other lineages as much as 64 million years ago (Kirsch *et al.*, 1997).

1.4.2 Other Conservation Significant Species

Malleefowl

The Malleefowl belongs to the family Megapodiidae, the megapods or mound builders. The adult Malleefowl is a quiet bird, about the size of a small turkey (55 to 61 cm), approximately 1.5 kg in weight, with a greyish head/neck, a black mark down the foreneck and upperparts composed of barred grey, black, white, buff and pale chestnut feathers (Pizzey and Knight, 1999).

Malleefowl were once common and widespread in the semi-arid zone of Australia, mainly in the mallee and acacia scrublands, and especially in the north and east of the mulga-eucalypt line. The regional and national populations have been restricted by factors such as habitat clearing, increased fire frequency, competition with introduced herbivores including stock and exotic animals, and increased predation by feral animals such as foxes, cats and dogs.

Sandhill Dunnart

The Sandhill Dunnart is a nocturnal marsupial that looks quite similar to a common domestic mouse. Sandhill Dunnarts vary in colour from buff to grey, getting lighter down the sides of the body with white on the underside and feet. There are dark rings around the eyes in addition to a dark triangle on the forehead. The tail consists of a black top with a dark tip and is lighter on the underside.

The Department of Environment and Heritage (2008) stated that there were 36 documented Sandhill Dunnarts records across Eyre Peninsula, and a further 30 records from across greater South Australia including Yellabinna and Ooldea in the Great Victoria Desert.

During the day this animal prefers to hide in a structure of large spinifex. The Sandhill Dunnart will locate an appropriate clump of spinifex and burrow itself into the centre of the clump. There is cause for concern as the survival of the animal may be determined by the growth stages of spinifex (australianfauna.com, accessed December 2007).

Mulgara

The Mulgara is a small marsupial with a body length ranging from 120 mm to 220 mm, and a tail length of 75 mm to 130 mm. The Mulgara has sandy coloured fur on the back and upper parts with a pale grey belly. The tail is sandy in colour, with bushy black fur extending from approximately half way to the tip (australianfauna.com, accessed November 2007).

The Mulgara inhabits arid, sandy regions of central Australia and Western Australia, predominantly vegetated with spinifex. Mulgara burrow in the flat areas between sand dunes or on the low sides of sand dunes. Mulgara are predominantly nocturnal, emerging from their burrows at night to feed on small rodents, insects and small reptiles (australianfauna.com, accessed November 2007).

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2.1 Survey Site Selection

Prior to the field survey, URS conducted a desktop assessment of aerial photographs of the Survey Area to identify potentially suitable Marsupial Mole habitat, believed at this preliminary stage to predominantly be within sand dunes (URS 2007). Within this potentially suitable habitat, a preliminary list of survey sites was determined. Additional sites were identified in the field while traversing the Survey Area when the study team located habitats that may also be suitable for the Marsupial Mole. These sites were largely located within slight rolling or small dunal systems. Some of these additional sites were not surveyed, due to time constraints, but instead a penetrometer was utilised (Section 2.2.2) to indicate whether the substrate may be suitable Marsupial Mole habitat. Table 2-1 lists the sites surveyed. All coordinates in this report are in WGS 84 datum.

Table 2-1 Survey Sites

Site	Coordinates	
	mE	mN
1-1	599917	6730632
1-2	598865	6730106
1-3	595900	6729003
1-4	597404	6729513
1-5	602763	6731541
1-6	604303	6732012
1-7	616641	6737630
1-8	617033	6738220
1-9	618292	6738702
1-10	619214	6738987
1-11	586799	6721753
1-12	586119	6721263
2-1	511512	6675963
2-4	514624	6676979
2-5	523470	6683180
2-7	527270	6686718
2-9	542028	6702904
2-10	539747	6702558
2-11	538517	6702286
2-12	535341	6701378
2-13	543908	6703236
2-18	552799	6704282
2-19	554353	6704407
2-22	561635	6707109
2-24	564293	6711723
3-1	635668	6751942
3-2	634681	6751797

Note: Site coordinate indicates the middle trench, trench 'b'.

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2.2 Data Collection

2.2.1 Overview

Two URS Environmental Scientists conducted the field components of the Marsupial Mole Survey: Proposed Infrastructure Corridor in three field surveys, during 22-28 November 2007, 4-10 March 2008 and 22-29 April 2008. URS staff were assisted by AngloGold field staff.

Initially, a "Perth Sand" penetrometer was utilised at potentially suitable sites to establish the compactness of the substrate. If the penetrometer indicated that the substrate was relatively soft, (e.g. <10 drops per 150 mm down to a depth of at least 450 mm [refer to Section 2.2.2 for further detail]), surveying for the Marsupial Mole continued.

Surveying for the presence of the Marsupial Mole involves digging trenches in order to expose a vertical soil wall, allowing the wall to thoroughly dry, and then inspecting the wall for Marsupial Mole tunnels. These tunnels are backfilled with sand by the Marsupial Mole, and appear as circular or oval shaped outlines depending on the angle they make with the trench wall. Methodology generally follows that stated in Benshemesh (2005).

Secondary objectives of the study were fulfilled with the opportunistic collection of predator scats, and the recording of information on conservation significant fauna species and potentially suitable habitat observed, in the Survey Area.

2.2.2 Penetrometer

The penetrometer was utilised at all potential sites to provide an initial indication of the relative compactness of the substrate, and hence its potential suitability as Marsupial Mole habitat. The use of the penetrometer involved:

1) Placing the penetrometer rod tip on the soil surface.

2) Dropping the nine kilogram weight down the 600 mm long (16 mm diameter) rod.

3) Recording the number of drops required to penetrate every 150 mm of substrate, down to a total depth of 750 mm.

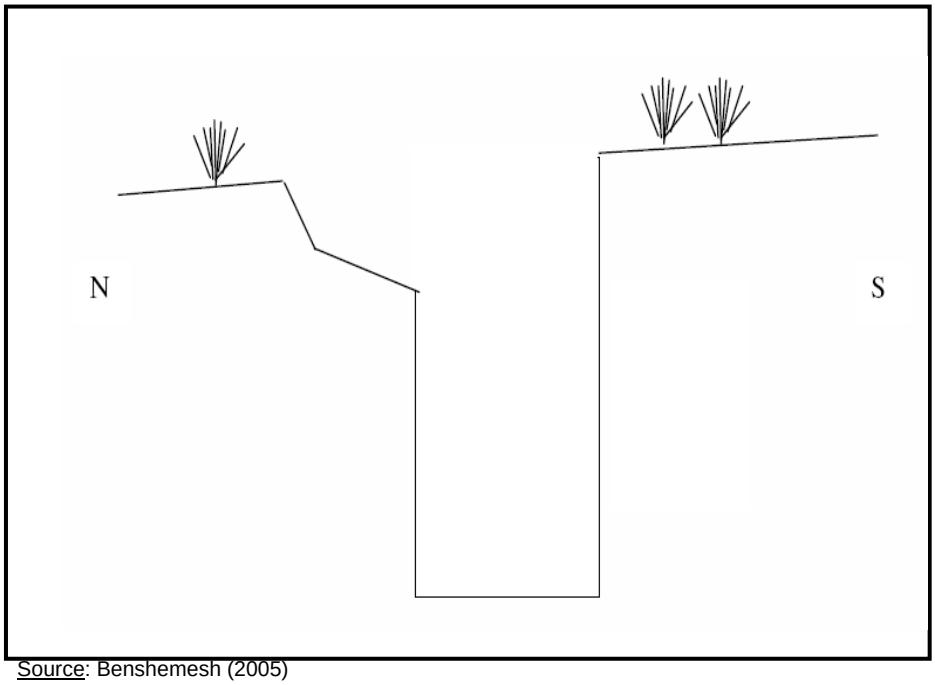
Based on the URS Scientists' field experience with the penetrometer, it was believed that for habitat to be potentially suitable for Marsupial Moles, <10 drops per 150 mm of substrate penetrated would be required, to a depth of at least 450 mm. Greater than 10 drops per 150 mm of substrate penetrated is likely to indicate soil that is difficult for the Marsupial Mole to dig through. Based on the field results of the penetrometer, sites were then surveyed, recommended for further surveying, or deemed unsuitable Marsupial Mole habitat.

2.2.3 Preparing Trenches

At sites surveyed, three trenches approximately 100 m apart were excavated. Trenches were positioned with their longest side facing north (i.e. longest side orientated east-west) in order to maximise sunlight and drying time on their most southern side (i.e. north facing wall). Trenches were excavated, where the soil allowed, to approximate dimensions: 1,200 mm long x 400 mm wide x 800 mm deep. To increase the amount of sunlight reaching into the trench, a step of about 300 mm was dug into the northern wall (south facing) along its full length (Figure 2-1).

GPS locations of the trenches were recorded and branches were placed in each trench as an escape route for fauna that may fall into the trench during the drying period. For health and safety reasons trenches were also delineated using pegs and flagging tape.

Section 2 Methodology



Source: Benshemesh (2005)

Figure 2-1 Cross-Section of Trench Structure

2.2.4 Inspecting Trenches

Detecting and Measuring Mole Holes

Trenches were inspected for mole holes two to three days after excavation. A thin surface layer of dry sand was removed from the north facing wall and handfuls of dry, loose sand were thrown lightly over the northern trench face to delineate mole holes further, if required.

To be identified as a mole hole, the structure had to meet all of Benshemesh's (2005) criteria:

- Oval or round shaped and larger than 25 mm in diameter
- Filled with sand with little, if any, airspace
- At least two thirds of the circumference discernible
- Symmetrical
- Continuous and does not disappear or reduce in diameter when rubbed.

Mole holes identified in the trenches were inspected, measured and photographed.

Subjective Scores

Subjective scores (1-3) were recorded to rate the distinctness of each mole hole. These are as follows, as sourced from Benshemesh (2005):

- **Clarity:** The clarity of the mole hole was described on a scale from one (unclear) to three (very clear)
- **Confidence:** The confidence which the URS field team had that the structure being inspected was in fact a mole hole. The scale from one (unconfident) to three (very confident) was used
- **Tap Test:** To gauge the comparable hardness of the substrate, the URS field team lightly tapped a few centimetres from the mole hole at the same depth, and then likewise in the centre of the mole

hole. A record of any difference in how much sand fell away between the outside and the centre of the mole hole was taken, one (no difference), two (some difference) or three (significant difference)

- **Age:** Age is an evaluation of the general appearance of the mole hole. The following guiding set of definitions was used:
  - Fresh: Loose sand pours out of the mole hole with little or no provocation
  - Recent: Clear and typically sharp edged, sand inside the mole hole very soft but not free flowing
  - Oldish: Mole hole neither recent nor highly degraded. This is usually the most common category
  - Old: Mole hole quite faint and easily missed, sand inside mole hole appears firm but is actually softer than surrounding sand
  - Very old: Very faint and very easily missed, but often made apparent when throwing sand onto the trench face.

Measurements

Mole hole measurements were recorded to describe the location, shape and condition of the mole hole. Measurements recorded comprise:

- The minimum and maximum diameter of each mole hole, including the angle of the long axis of the mole hole from the vertical
- The depth of the mole hole, measured from the surface to the middle of the mole hole
- The distance from the left edge of the trench face to the mole hole
- Trench face size: The length and depth of the rectangular trench face that has been examined.

2.2.5 Habitat Characterisation

The habitat immediately surrounding the trenches was then characterised by recording:

- topography
- gradient
- fire history
- vegetation:
  - structure (using vegetation structure classifications from Beard 1990)
  - percentage cover
  - dominant species
  - nearest species
- surface soil colour.

Soil samples (approximately two kilograms each) were collected in double ziplock bags from sites where mole holes were located, for potential future laboratory analysis.

After the trench and surrounding habitat had been inspected, all physical signs used for site marking were removed and the trenches filled in.

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2.2.6 Predator Scats

Canine and feline scats were opportunistically collected during the survey. Scats collected were bagged, labelled and locations recorded by GPS.

2.2.7 Other Conservation Significant Species

The URS field team opportunistically collected information on conservation significant fauna species and potentially suitable habitat, observed in the Survey Area. Generally, the sign of species presence or potentially suitable habitat location, and any other relevant information was recorded.

2.3 Study Team

The survey described in this report was planned, coordinated and executed by:

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Phone: 08 9326 0100
Fax: 08 9326 0138

Staff members:

- Blair Hardman: Master of Science (Environmental Management) on Endangered Marsupials. Approximately ten years' experience conducting biological surveys in Australia and overseas
- Jared Leigh: Bachelor of Science (Environmental) Zoology/Marine Biology. Approximately eight years' experience conducting biological surveys in Australia and overseas.

URS wishes to acknowledge the assistance of AngloGold staff (Belinda Bastow, Peter Bouteloup, Melanie Crowther and student Monika Bell).

2.4 Survey Limitations

Limiting factors for this study include:

- No evidence has been found to link Southern Marsupial Moles with any holes located within the Survey Area. However, given the perceived lack of presence of any other animal or vegetation capable of making similar soil disturbance, it is the belief of the authors that any holes fitting the description provided within Section 2.2.4 are likely to have been made by the Southern Marsupial Mole
- Light rainfall during five of the 16 days of the survey. This period of inclement weather would have slightly reduced the drying ability of the trenches, and therefore the clarity of, and ability to locate, mole holes within the trenches. Benshemesh (2004) recommends a drying period of three to four days per trench. Trenches excavated for this report generally had two to three days drying time, with some sites also receiving very small amounts of rainfall during this time. It is not known whether this rainfall and drying time difference affected the results of this study
- The paucity of information on the ecology of the Marsupial Mole. With greater knowledge of the abundance, lifecycle and habitat requirements of the Marsupial Mole, the study may have been able to more precisely target habitats in which to survey for the Marsupial Mole
- Ages of mole holes. Although a relative grouping of the age of the mole hole can be provided following the methodology of Benshemesh (2004), URS can provide no accurate timeframe for when the Marsupial Mole tunnel excavation occurred
- Recent fires affecting penetrometer results. Due to the recent significant fires within large sections of the Survey Area, URS believe that the penetrometer results may have been significantly different

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when used within a burnt area as opposed to an unburnt area, as illustrated at site 29P (Table 3-3). In a burnt area, the difference in the penetrometer results (less drops) may illustrate the changes in soil compactness post fire, possibly due to the lack of cohesion from reduced root/organic matter etc.

- Potentially suitable sites (not in prime Marsupial Mole habitat) identified in the field while traversing the Survey Area were not surveyed due to time constraints. These sites were generally not within significant dunes but within slight rolling or small dunal systems that could not be seen on the aerial photography. In these instances, a penetrometer was utilised to indicate whether the substrate may be suitable Marsupial Mole habitat (refer to Section 2.2.2).

Section 3 Results

3.1 Marsupial Mole Findings

During the field assessment of the Survey Area, 73 trenches were excavated at 25 sites. Within six of these 73 trenches, ten mole holes were identified. Figures 3-1 and 3-2 illustrate the location of the survey sites and mole holes, and Table 3-1 presents the habitat characteristics of these sites, with associated penetrometer recordings. Mole hole measurements recorded are presented in Table 3-2 and Plate 3-1 illustrates mole holes located.

Table 3-1 Site Habitat Characterisation

Site	Coordinates		Topography	Vegetation Classification	Vegetation Cover (%)	Surface Soil Colour	No. of Penetrometer Drops per 150mm				
	mE	mN					150	300	450	600	750
1-5c	602783	6731645	Slightly rolling dune	Open scrub	30	7.5YR7/6 Reddish Yellow	2	5	6	8	8
1-7b	616641	6737630	Mid-dune	Open scrub	50	7.5YR6/8 Reddish Yellow	1	3	3	5	5
1-9b	618292	6738702	Mid-dune	Open scrub	60	7.5YR6/8 Reddish Yellow	1	3	3	5	5
1-10a	619079	6739019	Mid-dune	Open scrub	40	7.5YR6/6 Reddish Yellow	1	3	4	4	4
2-11a	538517	6702286	Apex of rolling dune	Open low woodland	Burnt*	7.5YR6/8 Reddish Yellow	1	1	1	2	2
3-2a	634717	6751809	Mid-dune	Open low woodland	50-60	5YR6/8 Reddish Yellow	1	3	6	7	8

Notes: * the recently burnt vegetation at this site would have decreased soil compactness, thus affecting the penetrometer results.

Table 3-2 Mole Hole Measurements

Mole Hole ID	Trench	Mole Hole					Subjective Scores			
		Minimum Diameter (mm)	Maximum Diameter (mm)	Angle of the Longest Axis from the Vertical (°)	Depth (mm)	Distance from Left Edge of Trench (mm)	Clarity	Confidence	Tap Test	Age
1-1-5c	1-5c	28	29	25	200	1,230	1	3	3	Old
1-1-7b	1-7b	33	41	0	630	230	1	2	2	Very old
1-1-9b	1-9b	43	54	150	290	890	3	3	3	Fresh
1-1-10a	1-10a	43	43	0	350	800	1	1	3	Old
1-2-11a	2-11a	50	74	100	230	980	1	2	2	Very old
2-2-11a	2-11a	55	65	60	260	450	1	3	3	Old
3-2-11a	2-11a	40	50	70	220	220	1	3	2	Old
4-2-11a	2-11a	48	76	130	200	1,080	1	2	3	Old
1-3-2a	3-2a	44	53	90	250	0	2	3	3	Oldish
2-3-2a	3-2a	48	56	90	240	450	2	3	3	Oldish

Section 3 Results

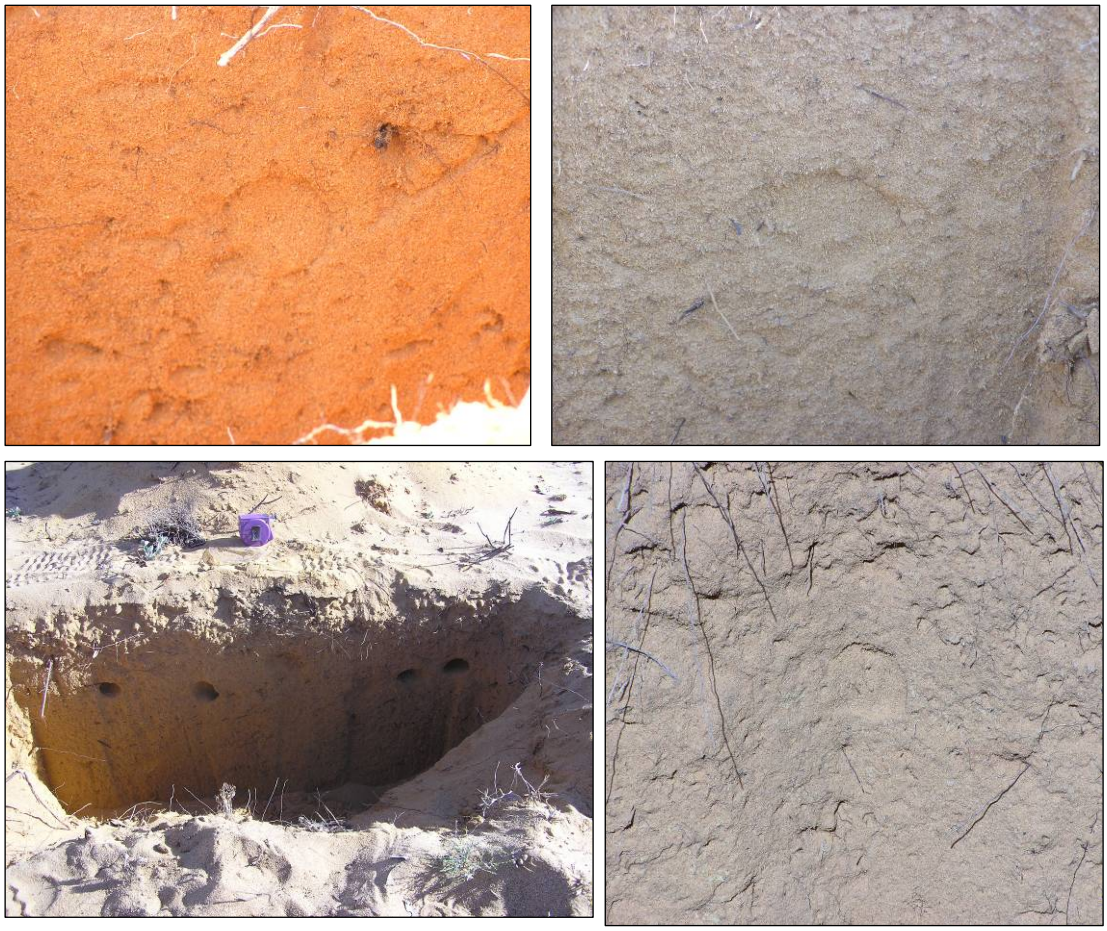

Plate 3-1 Mole Holes

Mole Hole ID 1-1-9b (top left), 1-2-11a (top right), trench 2-11a (bottom left, excavated) and 2-3-2a (bottom right)

3.2 Additional Sites

While traversing the Survey Area, URS noted areas that were not considered to be “ideal” Marsupial Mole habitat (i.e. sharply defined sand dunes), but may still support, or be used by, Marsupial Moles. These areas predominantly contained sandy soils on slight rolling dunes or small dunal systems. In the majority of these instances, due to time constraints, URS was not able to conduct a survey at these sites, but instead utilised the penetrometer to determine the compactness of the substrates as an indicator of Marsupial Mole habitat suitability, for potential surveying at a later date.

Table 3-3 presents the penetrometer readings from these additional sites.

URS replicated the use of the penetrometer at some sites (e.g. site 9Pa) due to the penetrometer rod not penetrating further into the substrate when the nine kilogram weight was dropped. The replication was used to determine whether a tree root, rock or other object had been struck by the penetrometer, or whether the substrate was compact enough to stop the penetrometer. A maximum of 20 drops per 150 mm was also used as an upper cut-out limit.

Section 3 Results

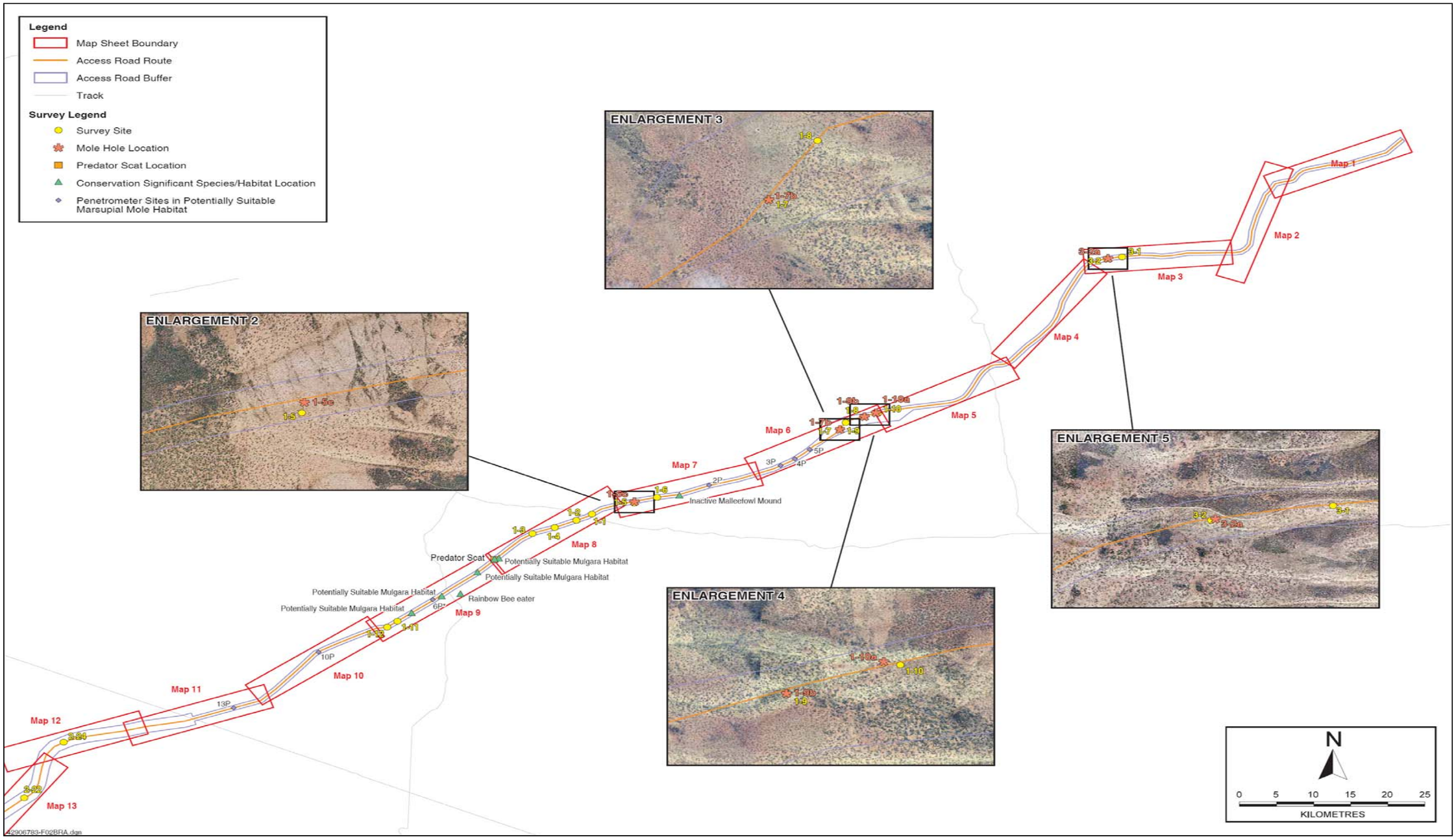

Figure 3-1 Survey Area (Maps 1-13) Illustrating Locations of Mole Holes and Other Data Obtained

Section 3 Results

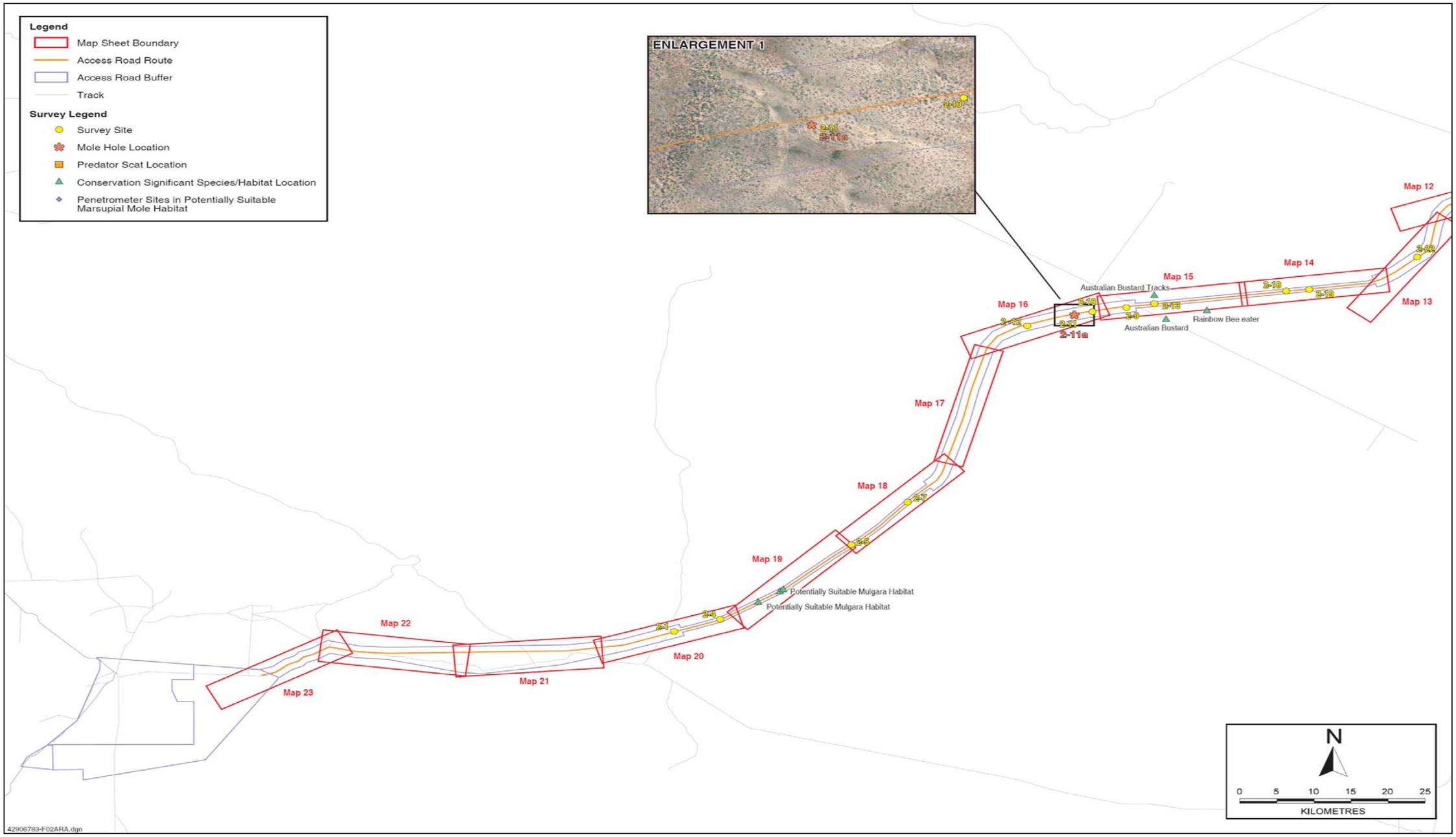

Figure 3-2 Survey Area (Maps 12-23) Illustrating Locations of Mole Holes and Other Data Obtained

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Table 3-3 Penetrometer Results for Additional Sites not Surveyed

Site	Coordinates		Topography	Surface Soil Colour	Depth				
	mE	mN		(Munsel)	150	300	450	600	750
1P	605444	6232306	Small dunal system	10YR7/6 Yellow	1	2	4	6	5
2P	607813	6733024	Small dunal system	7.5YR6/6 Reddish Yellow	1	1	4	5	5
3P	612638	6734650	Small dunal system	5YR6/8 Reddish Yellow	2	3	4	5	5
4P	613598	6735203	Small dunal system	7.5YR6/8 Reddish Yellow	1	4	4	6	5
5P	614594	6735993	Small dunal system	5YR6/6 Reddish Yellow	1	3	4	4	6
6P	589184	6723536	Small dunal system	2.5YR5/8 Red	4	5	6	8	7
7P	586195	6721354	-	5YR7/6 Reddish Yellow	2	4	4	6	8
8P	584631	6720823	-	7.5YR6/8 Reddish Yellow	2	5	8	10	11
9Pa	583178	6720143	Rolling dunal system	5YR5/8 Yellowish Red	2	6	18	>20	-
9Pb	583178	6720143	Rolling dunal system	5YR5/8 Yellowish Red	2	20	-	-	-
10P	581476	6719197	Small dunal system	7.5YR7/8 Reddish Yellow	2	4	5	6	8
11P	581101	6718918	Rolling dunal system	7.5YR6/8 Reddish Yellow	2	4	5	7	9
12P	577031	6714982	Slight rolling dunal system	7.5YR6/8 Reddish Yellow	1	2	4	5	6
13P	575756	6714572	Small dunal system	5YR6/8 Reddish Yellow	2	4	6	8	8
14P	574610	6714176	Slight rolling dunal system	5YR6/8 Reddish Yellow	2	2	4	4	5
15P	573285	6713754	Rolling plain	5YR5/8 Yellowish Red	2	4	5	5	7
16P	513177	6676464	Rolling plain	2.5YR5/8 Red	1	1	1	3	19
17Pa	514313	6676809	Rolling plain	2.5YR5/8 Red	1	1	11	>20	-
17Pb	514313	6676809	Rolling plain	2.5YR5/8 Red	1	3	>20	-	-
18P	515606	6677580	Flat plain	10R4/8 Red	3	2	9	>20	-
19P	517961	6678845	Flat plain	-	3	2	>20	-	-
20P	520628	6680905	Flat plain	-	1	2	15	>20	-
21Pa	525600	6684941	Apex of rolling plain	5YR5/8 Yellowish Red	1	1	2	5	>20
21Pb	525600	6684941	Apex of rolling plain	5YR5/8 Yellowish Red	1	1	1	2	>20
22P	529224	6688555	Mid slope of rolling dune	2.5YR6/6 Red	1	1	15	>20	-
23P	531134	6694063	Rolling dune	2.5YR5/6 Red	5	1	2	5	6
24P	531662	6696074	Apex of rolling dune	7.5YR7/8 Reddish Yellow	1	2	1	2	2
25P	545518	6703420	Valley of rolling plain	5YR5/8 Yellowish Red	1		1	2	2
26P	547038	6703598	Mid slope of rolling plain	7.5YR6/8 Reddish Yellow	1			1	1
27P	548683	6703818	Flat plain	2.5YR5/8 Red	10	>20	-	-	-
28Pa	550289	6703922	Flat plain	2.5YR5/8 Red	2	2	3	4	>20
28Pb	550289	6703922	Flat plain	2.5YR5/8 Red	2	2	3	4	>20
29Pa[1]	556073	6704726	Flat plain (Burnt)	7.5YR6/8 Reddish Yellow	1			1	1
29Pb[1]	556073	6704726	Flat plain	7.5YR6/8 Reddish Yellow	2	3	4	5	6
30P	559770	6705635	Flat plain	7.5YR6/8 Reddish Yellow	1	1	1	1	2

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Table 3-3 Continued

Site	Coordinates		Topography	Surface Soil Colour (Munsel)	Depth				
	mE	mN			150	300	450	600	750
31P	562647	6709114	Burnt	7.5YR6/8 Reddish Yellow	1	1	1	1	1
32P	571542	6713261	Burnt	7.5YR7/6 Reddish Yellow	1	3	5	10	>20
33P	570815	6713220	Burnt	5YR5/8 Yellowish Red	1	1	1	2	3

Notes: 1 29Pa and 29Pb were located at the same site within five metres of each other. However, 29Pa was located in a burnt area and 29Pb in an unburnt area. The difference in the penetrometer results may illustrate the changes in soil cohesion/compactness post fire.

3.3 Predator Scats

The URS field team collected canine (possibly fox) scats at 593343 mE 6726850 mN (refer to Figure 3-1). These scats were submitted to AngloGold for later laboratory analysis.

3.4 Other Conservation Significant Species

No direct recent evidence of the Mulgara, Sandhill Dunnart or Malleefowl was noted within the Survey Area. However, an inactive Malleefowl mound was located at 605813 mE 6732114 mN (refer to Figure 3-1 for the location and Plate 3-2 for a photograph of the inactive mound). Where identified, mature *Triodia* sp. hummock grasslands of thick ground cover, which may be suitable habitat for the Mulgara, were recorded during the survey and have been presented in

Table 3-4 and illustrated in Figures 3-1 and 3-2.

Plate 3-2 Inactive Malleefowl Mound

Section 3 Results

Table 3-4 Potentially Suitable Mulgara Habitat

Site	Coordinates		Approximate *Triodia* sp. Cover (%)
	mE	mN	
M1	593641	6726910	80 - 90
M2	593343	6726850	70 - 80
M3*	589785	6723761	80 - 90
M4*	587757	6722375	80 - 90
M5*	592188	6725751	70 - 80
M6	517192	6678375	60
M7	518648	6679264	20 - 80
M8	518878	6679428	20 - 90

Notes: * this is almost continuous habitat through Site M3, M4 and M5.
Coordinates are in WGS 84 datum.

URS also recorded:

- Sightings of a Rainbow Bee-eater (*Merops ornatus*), at 606820 mE 6664572 mN and 671042 mE 6683400 mN. This is listed as a Migratory and a Marine species under the EPBC Act (refer to Figures 3-1 and 3-2)
- One Priority 4 listed bird species, the Australian Bustard (*Ardeotis australis*), was observed at 544700 mE 6701900 mN, with tracks also recorded at 543908 mE 6703908 mN (refer to Figures 3-1 and 3-2).

Section 4 Discussion

4.1 Marsupial Mole Findings

This study confirms the possible previous presence of Marsupial Moles at sites 1-5c, 1-7b, 1-9b, 1-10a, 2-11a and 3-2a, within the Survey Area. URS recommends that the proposed Infrastructure planned be design to avoid if practical these sites and, in particular, the primary dunal habitat surrounding sites 1-7b, 1-9b, 1-10a and 3-2a. At this stage, primary Marsupial Mole habitat refers to significant dunes or dunal systems, which it is believed is preferable Marsupial Mole habitat. Possible Marsupial Mole holes may also be located within rolling dunes and small dunal systems, but evidence of their use of these areas is likely to be present at a lower density.

All mole holes were located in either open scrub/open low woodlands. This result concurs with findings of URS (2007) and the South Australian Arid Lands Natural Resources Management Board (undated). Regression analyses conducted by URS (2007) indicated that vegetation structure is a potentially significant predictor of suitable Marsupial Mole habitat, with all mole holes from that survey located in open scrub [$r^2(70)=0.34$, $p=0.003$]. As defined by Beard (1990), open scrub contains tall shrubs of approximately two metres, with the foliage cover of the tallest stratum <10%. The South Australian Arid Lands Natural Resources Management Board (undated) states that the Southern Marsupial Mole is usually found within a reasonably complex overstorey vegetation of woodlands, with a diversity of understorey shrubs and grasses.

The results of this survey, and previous surveys (URS 2007), provide data that may assist in the development of a guide to determine and identify possible Marsupial Mole habitat. These possible habitat indicators are listed below. However, given the small sample size, these factors should be taken as a preliminary guide only:

- Soil colour. Data collected to date have indicated that Marsupial Moles are found within soils of reddish yellow surface colour.
- Compaction. Use of the guide of approximately <10 drops per 150 mm to a depth of at least 450 mm when using the penetrometer.
- Vegetation type. The habitat is open scrub or low open woodland.

4.2 Additional Sites

As discussed in Section 3.2, URS was not able to survey all potentially suitable habitat encountered during the ground truthing of the Survey Area due to time constraints. In this instance, the penetrometer was utilised to gain a preliminary understanding of the compactness of the substrate, as an indication of potentially suitable Marsupial Mole habitat. As discussed, URS are using approximately <10 drops per 150 mm to a depth of at least 450 mm as a preliminary indicator of suitable Marsupial Mole habitat, until a greater sample size of Marsupial Mole sites and penetrometer readings can be obtained and statistical analyses conducted.

Based on these additional penetrometer readings, habitat type and surface soil colour, URS believes that sites 2P, 3P, 4P, 5P 10P, 11P, 12P, 13P 14P, 24P and 31P may be located within potential, though not prime, Marsupial Mole habitat.

4.3 Other

4.3.1 Predator Scats

Benshemesh (2004) states that the occurrence of Marsupial Mole remains in predator scats typically varies between 1-5% in areas in which Marsupial Moles are known to inhabit. URS opportunistically collected canine scats from the Survey Area (Figure 3-1), which URS understands AngloGold may test in the future for Marsupial Mole DNA.

Section 4 Discussion

Scats are more likely to contain Marsupial Mole remains after rains, when Marsupial Moles are more likely to have come to the surface and as a result be predated upon (Benshemesh, 2004). As discussed, some rainfall did occur during five of the 16 days of the survey, but it is believed that not enough rainfall occurred to significantly saturate soils and influence the rate at which Marsupial Moles come to the surface. It should be noted that the South Australian Arid Lands Natural Resources Management Board (undated) also states that the Marsupial Mole comes to the surface when underground conditions become difficult, such as when they encounter excessively compacted sands, gravels (especially lime) or rock when burrowing, and therefore DNA testing of the scats for Marsupial Mole remains may provide positive results.

4.3.2 Other Conservation Significant Species

As discussed in Section 3.3.2, no direct recent evidence of the Mulgara, Sandhill Dunnart or Malleefowl were noted within the Survey Area. However, an inactive Malleefowl mound and potentially suitable Mulgara habitats were located in the Survey Area (Figures 3-1 and 3-2). URS recommends that targeted Malleefowl, Mulgara and Sandhill Dunnart surveys are undertaken within the Survey Area, prior to further land disturbance activities.

AngloGold may also choose to record the sightings and evidence of the Australian Bustard and Rainbow Bee-eater within its site database.

4.4 Recommendations

URS recommends that the proposed infrastructure planned within the corridor be altered where possible to avoid the dunal systems (believed to be suitable Marsupial Mole habitat) at sites 1-5c, 1-7b, 1-9b, 1-10a and 2-11a.

Section 5 References

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Section 6 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of AngloGold Ashanti Australia Ltd (AngloGold) and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 5 October 2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between December 2007 and February 2009 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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