360 environmental

Lake Mackay Sulphate of Potash Project

Single Phase Level 2 Fauna Survey at Lake Mackay

Prepared for:
Agrimin Ltd

May 2018

people planet professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
2188 AB	A INTERNAL DRAFT	LS/RF	MR	1 Electronic (email)	27/07/17
2188 AB	B CLIENT DRAFT	360Env	GB	1 Electronic (email)	28/07/17
2188 AB	C CLIENT FINAL	RF		1 Electronic (email)	08/08/17
2188 AB	C CLIENT FINAL	FJ		1 Electronic (email)	18/05/18

Executive Summary

Agrimin Ltd (Agrimin) commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake a single phase level 2 fauna survey for the Lake Mackay Sulphate of Potash Project (SOP). Lake Mackay (the lake or locally known as Wilkinkara) is a seasonally inundated salt lake located in the Great Sandy Desert on the Western Australian (WA) and Northern Territory (NT) border, with most of the lake located in WA. The SOP comprises nine tenements covering the majority of Lake Mackay for a combined area of approximately 297,195 ha (Figure 1). The nearest township is Kiwirrkurra, approximately 65 km south-west of the lake.

Searches of the Department of Parks and Wildlife (DPaW) threatened fauna database (150 km search), EPBC Protected Matters Search Tool (60 km search) and NatureMap (3 x 40 km search, [40 km is the maximum search that can be undertaken with this database]) radial searches (centred on approximately the middle of the Survey Area) were undertaken to identify fauna species of conservation significance potentially occurring in the Survey Area.

The field survey was undertaken over a period of 10 days, from 10 – 19 May 2017. It involved a trapping programme, habitat assessments, camera traps, Song Meter 2 (SM2) acoustic recording units and opportunistic observations. The primary focus of the survey was two proposed infrastructure areas and two large islands in the lake, with assessments undertaken on other smaller islands and off lake.

Database searches returned 94 vertebrate species from 40 families. Of these, 37 were reptile species from eight families, 36 were bird species from 21 families and 21 were mammal species from 11 families. A total of 21 conservation significant species (including Priority species) were identified during the desktop review of database searches (Appendix B). These comprised one reptile species, 16 bird species from 11 families and three mammal species from two families. The likelihood of them occurring in the Survey Area is discussed in the report.

During the field survey, 94 species from 46 families were recorded. This consisted of two amphibian species from one family, 24 species of reptile from seven families, 57 bird species (including from the recent waterbird survey undertaken by 360 Environmental) from 31 families and 11 mammal species from seven families. Three of the 11 mammal species were introduced - the Red Fox (*Vulpes vulpes*), the European Rabbit (*Oryctolagus cininculus*) and the Camel (*Camelus dromedarius*).

Four broad fauna habitat types were identified in the Survey Area:

- Dune;
- Swale;
- Claypan Swale; and

- Lake Margin.

These habitats are widespread and common in areas adjacent to the Survey Area and more broadly across the region.

Five conservation significant species in total were recorded during the 10-day field survey and the recent waterbird survey - the Fork-tailed Swift (*Apus pacificus*), Australian Painted Snipe (*Rostratula australis*), Sharp-tailed Sandpiper (*Calidris acuminata*), Common Greenshank (*Tringa nebularia*) and Red-necked Stint (*Calidris ruficollis*). All, except for the Fork-tailed Swift, were recorded during the recent (April 2017) waterbird survey (360 Environmental 2017).

These migratory shorebirds (and other waterbirds) will likely utilise the Survey Area sporadically and are unlikely to depend exclusively on the foraging habitat present. This habitat is also widespread and common in the overall vicinity of the Survey Area and, importantly, is also more broadly represented around the lake and across the region. It should also be noted that these migratory birds are likely to only visit the lake and its claypans when episodically significant rainfall events occur and fill these waterbodies.

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1.1 The Project

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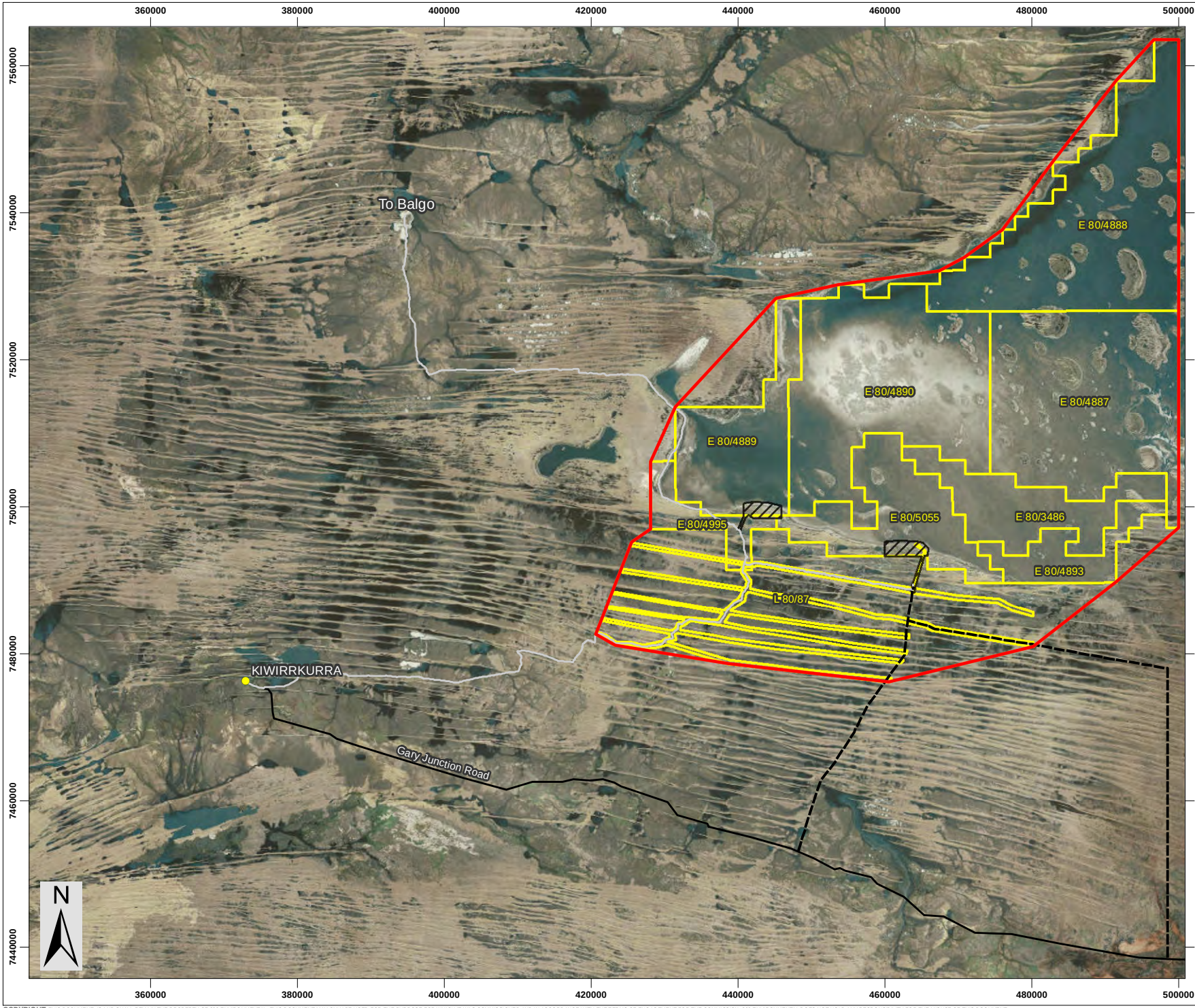
In September 2016, Ecologia (2017) undertook a level 1 fauna assessment in conjunction with a single phase level 2 flora survey. The current (May 2017) survey was primarily focused on two proposed infrastructure areas (adjacent to the southern boundary of the lake) and two islands located on the lake together with habitat assessments and opportunistic observations on several other small islands on the lake. These survey locations, along with other opportunistic aerial-based observations while travelling by helicopter between survey sites, are collectively referred to as the Survey Area (Figure 2).

The purpose of this assessment was to provide Agrimin with data to support environmental approvals for the SOP.

1.1.1 Objectives

The broad objectives of the level 2 fauna survey were to:

- Conduct a desktop assessment of fauna databases and relevant literature;
- Undertake a baseline fauna survey in order to characterise fauna in the Survey Area;
- Undertake habitat assessments to define and delineate the main broad habitats present; and
- Document all of the above in a comprehensive report.



Legend

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a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

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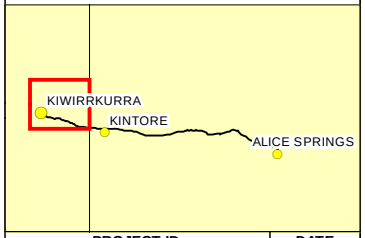
LOCALITY MAP



PROJECT ID	DATE
2188	4/08/2017

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 52

CREATED	CHECKED	APPROVED	REVISION
JA	CT	NW	0

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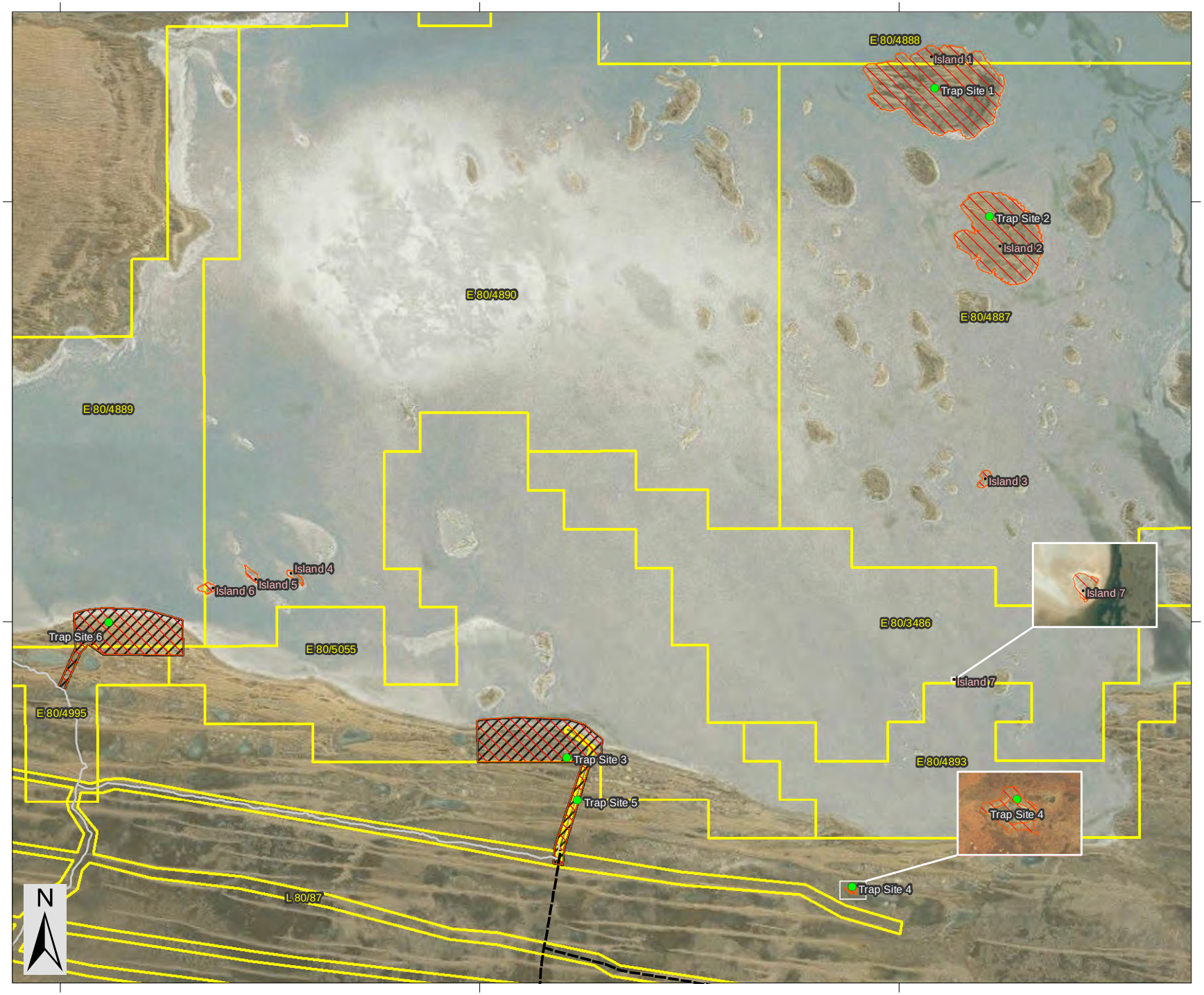
Sulphate of Potash Project
Lake Mackay, WA

Fauna Survey

Figure 1
Site location

K:\Projects\1.0 EBS\2188 Eco Surveys Lake Mackay\Figures\2188 Figure 1 Site Location.mxd



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t (08) 9388 8360
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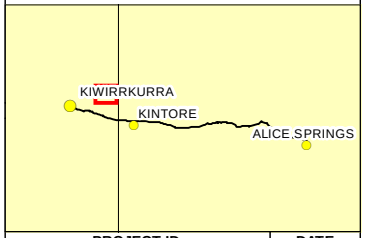
LOCALITY MAP



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Sulphate of Potash Project
Lake Mackay, WA

Fauna Survey

Figure 2

Survey Area

K:\Projects\1.0 EBS\2188 Eco Surveys Lake Mackay\Figures\Fauna Survey\2188 Fauna Habitat Figure 2 Assesment Locations Fauna Survey v1.mxd

1.2 Background to Protected Fauna

Fauna is protected formally and informally by various legislative and non-legislative measures.

Legislative measures:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Biodiversity Conservation Act 2016* (BC Act);
- *Wildlife Conservation Act 1950* (WC Act); and
- *Environmental Protection Act 1986* (EP Act).

Non-legislative measures:

- WA Department of (DPaW) Priority lists for flora, ecological communities and fauna; and
- Recognition of locally significant populations by DPaW.

Note: as of 1st July 2017, DPaW has been replaced by the WA Parks and Wildlife Service and incorporated within the new Department of Biodiversity, Conservation and Attractions (DBCA). However, because the survey was undertaken prior to this change, DPaW will still be used throughout this report.

A short description of each is given below. Other definitions, including species conservation categories, are provided in Appendix A.

1.2.1 EPBC Act

The EPBC Act aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the EPBC Act, the Commonwealth Department of the Environment and Energy (DEE) lists protected species and Threatened Ecological Communities (TECs) by criteria set out in the Act. Species are considered to be conservation significant if they are listed as Threatened (i.e. Critically Endangered, Endangered and Vulnerable) or Migratory.

Bird species protected as Migratory under the EPBC Act include those listed under international migratory bird agreements relating to the protection of birds which migrate between Australia and other countries, for which Australia has agreed. This includes the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Some marine fauna or terrestrial fauna that use marine habitats are listed as Marine under the EPBC Act. These species are only considered conservation significant when a proposed development occurs in a Commonwealth marine area (i.e. any Commonwealth Waters or Commonwealth Marine Protected Area). Outside of such areas, the EPBC Act

does not consider these species to be matters of national environmental significance so are not protected under the Act. As such, species listed as Marine only under the EPBC Act are not considered to be conservation significant in this assessment.

1.2.2 WC Act

DPaW lists taxa under the provisions of the WC Act as protected and are classified as Schedule 1 to Schedule 7 according to their need for protection (see Appendix A). The WC Act makes it an offence to 'take' threatened species without an appropriate licence. There are financial penalties for contravening the WC Act.

1.2.3 EP Act

Significant habitat necessary for the maintenance of fauna indigenous to Western Australia as well as TECs is given special consideration in environmental impact assessments, and areas covered by TECs have special status as Environmentally Sensitive Areas (ESAs) under the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

1.2.4 DPaW Priority Lists

DPaW lists 'Priority' fauna that have not been assigned statutory protection as 'Scheduled' under the WC Act, but which are under consideration for declaration as 'Scheduled' fauna. In summary, Priority 1 fauna are those with few, poorly known populations on threatened lands, Priority 2 fauna are species with few poorly known populations on conservation lands and Priority 3 fauna are those with several poorly known populations, some on conservation lands. Priority 4 fauna are species in need of monitoring: not currently threatened or in need of special protection, but could become so and usually represented on conservation lands. Priority 5 fauna are species in need of monitoring: not considered threatened, but the subject of a specific conservation programme, the cessation of which would result in the species becoming threatened within five years (Appendix A).

In addition, DPaW maintains a list of Priority Ecological Communities which identifies those communities that need further investigation before possible nomination for TEC status.

Although DPaW Priority species and communities have no formal legal protection, they are under consideration as 'Scheduled' taxa under the WC Act or as ESAs under the EP Act Informal Recognition of Fauna.

1.2.5 Informal Recognition of Threatened Fauna

Certain populations or communities of fauna may be of local significance or interest because of their patterns of distribution and abundance. For example, fauna may be locally significant because they are range extensions to the previously known distribution or are newly discovered species (and have the potential to be of more than local significance). In addition, many species are in decline as a result of threatening

processes (land clearing, grazing, and changed fire regimes) and relict populations of such species assume local importance for DPaW. It is not uncommon for DPaW to make comment on these species of interest.

2 Biophysical Environment

2.1 Climate

The Survey Area is located in the Great Sandy Desert bioregion of Western Australia. The Great Sandy Desert experiences an arid tropical climate in the north, grading into a temperate-subtropical climate in the south, where it experiences dry conditions with hot summers and mild winters. Rainfall is generally variable and unpredictable, but occurs typically in summer (Tille 2006).

The most relevant and reliable Bureau of Meteorology (BoM) weather station for the Survey Area is Walungurru Airport (Site No. 15664), approximately 80 km south-east of the southern boundary of the Survey Area. The Walungurru Airport station receives a mean minimum temperature that ranges from 10.4°C (July) to 26°C (January) and mean maximum that ranges from 23.2°C (June) to 39.4°C (January) (Figure 3). The annual average rainfall is 306.1 mm (BoM 2017).

Walungurru Airport weather station recorded 804.2 mm of rain in the 12 months prior to survey (May 2016 – April 2017) which is 498.1 mm above the long term average rainfall for the same period (Figure 3). In the three months prior to the survey (February 2017 – April 2017), 119.4 mm of rainfall was recorded which is just below the 130.8 mm average rainfall for the same period (BoM 2017).

It is worth noting that the Survey Area is a substantial distance (approximately 80 km) from the Walungurru Airport weather station. As a result, there can be differences in rainfall and temperatures recorded between the two locations due to variations in local conditions, particularly with regard to rainfall.

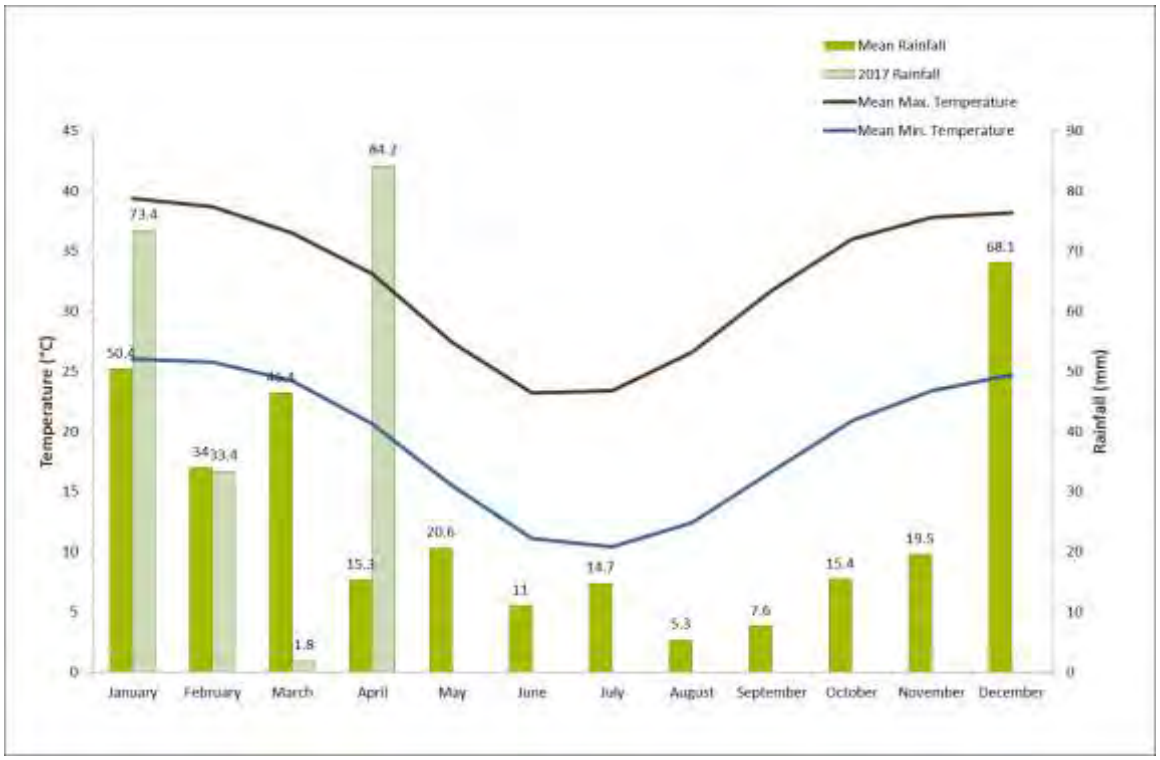


Figure 3: Average long term monthly rainfall (1998-2017), rainfall four months prior to the survey and average monthly maximum and minimum temperatures (2001-2017) from Walungurru Airport weather station (BoM 2017).

During the survey, no rainfall was noted in the Survey Area and none was recorded at the Walungurru Airport weather station (Table 1). On average, rainfall in May is quite low with the long-term average being 20.6 mm. Maximum temperatures during the survey were close to the long-term average, though slightly higher on five of the 10 survey days (Table 1). Minimum temperatures during the survey were relatively close to the long-term average on four of the 10 days, but below the long-term average on six of the 10 days (noticeably lower on five of the six days) (Table 1).

Table 1: Rainfall and maximum and minimum temperatures for Walungurru Airport weather station during the survey and annual average for the month of May (BoM 2017).

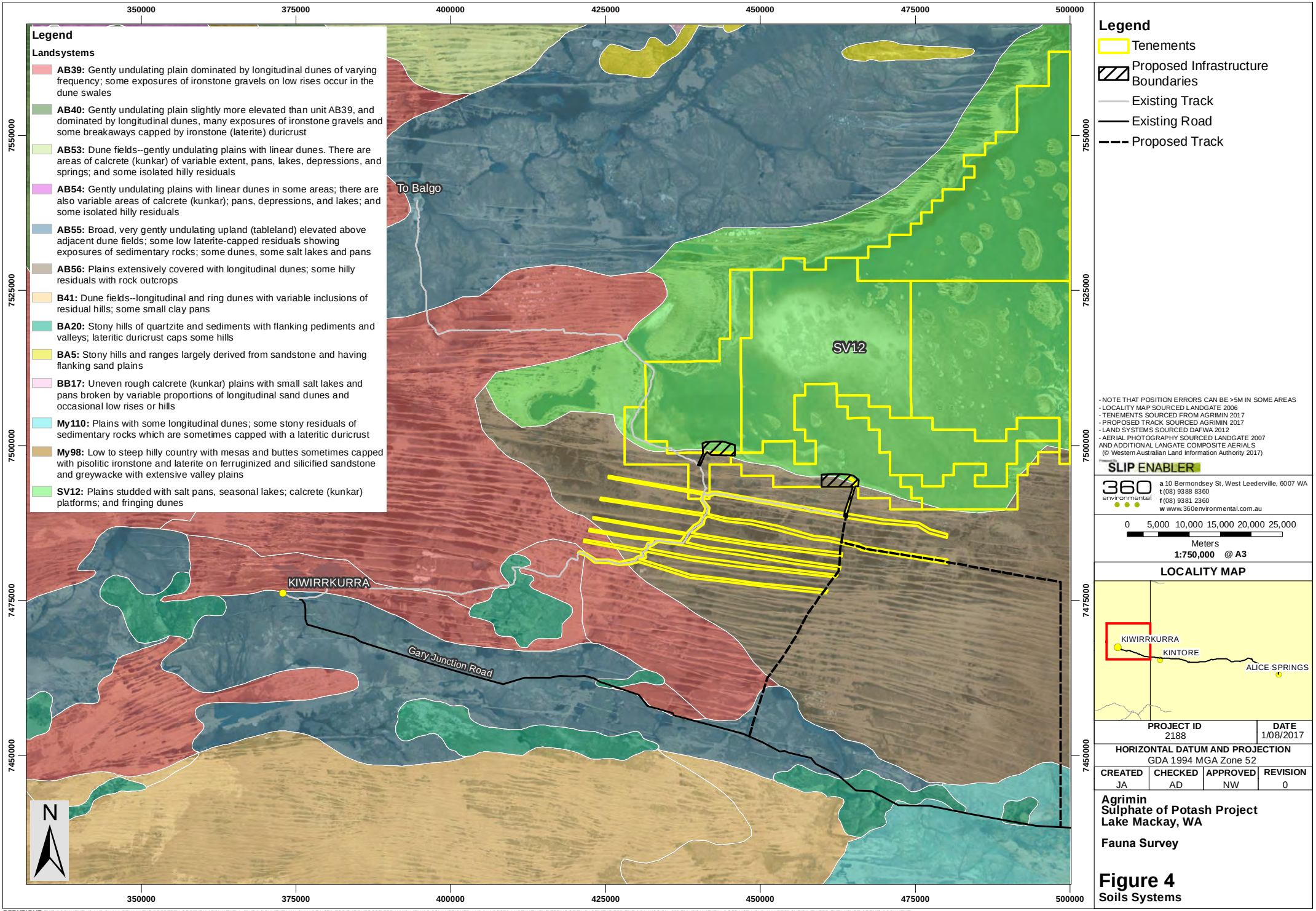
DATE	10/5	11/5	12/5	13/5	14/5	15/5	16/5	17/5	18/5	19/5	ANNUAL
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	20.6
Max Temp (°C)	26.5	27.4	28.8	29.5	28.9	29.7	30.4	27.4	23.8	25.4	27.4
Min Temp (°C)	15.3	13.5	15.4	14.2	15.6	11.1	11.6	12.8	11.6	11.7	15.5

2.1 Soils

The dominant soils of the Great Sandy Desert dune fields and sandplains are red deep sands and red sandy earths, with some red loamy earths and shallow gravels in depressions between dunes (Tille 2006). Hilly areas typically comprise red loamy earths, with red shallow loams, red shallow sands, stony soils and shallow gravels (Tille 2006). Four soil units have been mapped within the proposed disturbance areas and the surveyed islands, using the Digital Atlas of Australian soils (Bureau of Rural Sciences 2009) (Table 2 and Figure 4).

Table 2: Soil units and their occurrence in the Survey Area.

SOILS	DESCRIPTION	EXTENT IN PROPOSED DISTURBANCE AREAS (HA)	EXTENT IN SURVEYED ISLANDS (HA)
AB39	Gently undulating plain dominated by longitudinal dunes of varying frequency; some exposures of ironstone gravels on low rises occur in the dune swales	20.26	-
AB56	Plains extensively covered with longitudinal dunes; some hilly residuals with rock outcrops	2102.35	-
AB55	Broad, very gently undulating upland (tableland) elevated above adjacent dune fields; some low laterite-capped residuals showing exposures of sedimentary rocks; some dunes, some salt lakes and pans	82.57	-
SV12	Plains studded with salt pans, seasonal lakes; calcrete (kunkar) platforms; and fringing dunes	1334.23	5864.74
MY110	Plains with some longitudinal dunes; some stony residuals of sedimentary rocks which are sometimes capped with a lateritic dust	99.26	-



Legend

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- TENEMENTS SOURCED FROM AGRIMIN 2017
- PROPOSED TRACK SOURCED AGRIMIN 2017
- LAND SYSTEMS SOURCED DAFWA 2012
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2007 AND ADDITIONAL LANGATE COMPOSITE AERIALS (© Western Australian Land Information Authority 2017)

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LOCALITY MAP

PROJECT ID	DATE
2188	1/08/2017

HORIZONTAL DATUM AND PROJECTION
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CREATED	CHECKED	APPROVED	REVISION
JA	AD	NW	0

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Lake Mackay, WA

Fauna Survey

Figure 4
Soils Systems

2.2 Geology

The Survey Area lies in the Canning Province of the Great Sandy Desert bioregion as described by Tille (2006). The inland landforms of the Great Sandy Desert are predominantly east to west running linear dunes with swales opening locally onto sandplains. Some undulating plains and uplands occur. Among the dunes are areas of small claypans and isolated residual sandstone hills as well as areas of ironstone gravels and some breakaways capped by laterite duricrust (Tille 2006). Seven geological units have been mapped in the proposed disturbance areas and the surveyed islands as part of the Geological Series of WA (Table 3).

Table 3: Geology in the Survey Area.

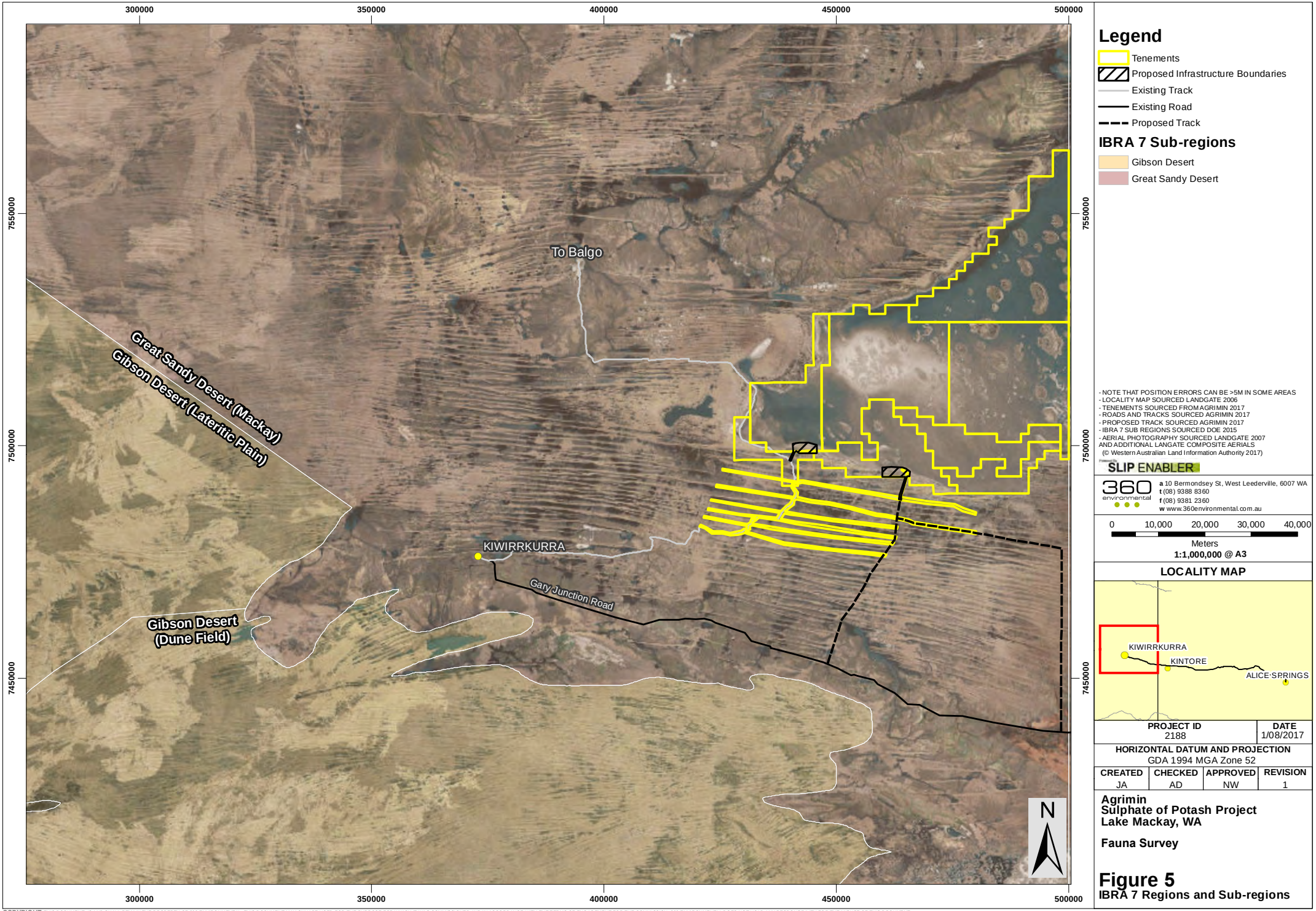
GEOLOGICAL CODE	DESCRIPTION	EXTENT IN PROPOSED DISTURBANCE AREAS (HA)	EXTENT IN SURVEYED ISLANDS (HA)
Sandplain 38499	Sandplain may include some residual alluvium; sand dominant; gravel, clay.	18.81	3444.13
Lake Deposits 38492	Lake and swamps deposits; mud, silt, evaporates, limestone and minor sand.	483.98	-
Lunette Dunes 72955	Quartz and gypsum dunes and mounds (kopi); may include minor silt, sand, gravel, and clay flats adjacent to playas; locally includes some playa sediments.	-	702.39
Alluvium 74331	Reworked or incised sandy alluvium in older stream channels; lateritised alluvial terraces above younger alluvium; alluvial and colluvial outwash deposits not in defined channel systems; sand, silt, gravel, clay, evaporates.	896.78	-
Calcrete 38497	Pisolitic, nodular or massive calcrete; ferruginous inclusions; calcerous cementing of bedrock and transported materials; locally with intercalated chalecony; as low mounds, in playa lakes, or as valley calcrete; locally dissected and karstified.	6831.51	702.88
Dunes 38496	Dunes, sandplain with dunes and swales; may include numerous interdune claypans; residual and Aeolian sand with minor silt and clay; Aeolian red quartz sand, clay and silt, in places gypsiferous; yellow hummocky sand.	1483.65	-

GEOLOGICAL CODE	DESCRIPTION	EXTENT IN PROPOSED DISTURBANCE AREAS (HA)	EXTENT IN SURVEYED ISLANDS (HA)
Colluvium 38491	Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.	52.55	-

2.3 Biogeographic Regionalisation of Australia

The Biogeographic Regionalisation of Australia (IBRA7) divides Australia into 89 bioregions based on major biological, geographical and geological attributes. These bioregions are subdivided into 419 subregions as part of a refinement of the IBRA framework (DEE 2016a). The Survey Area extends across the Mackay subregion which forms part of the Great Sandy Desert Bioregion (Figure 5).

The Great Sandy Desert Bioregion includes the tropical inland 'red-centre' desert as well as the 'Percival' and 'Auld' palaeoriver systems. It mainly comprises tree steppe grading to shrub steppe in the south, with open hummock grasslands of *Triodia pungens* and *Triodia schinzii* together with scattered trees of *Owenia reticulata* and Bloodwood (*Corymbia spp.*), and shrubs of *Acacia* spp., *Grevillea wickenhamii* and *G. refracta* on Quaternary red longitudinal sand dune fields overlying Jurassic and Cretaceous sandstones of the Canning and Amadeus Basins. *Casuarina decaisneana* (Desert Oak) occurs in the south and east of the region. Gently undulating lateritised uplands support shrub steppe such as *Acacia pachycarpa* shrublands over *Triodia pungens* hummock grass. Calcrete and evaporate surfaces are associated with occluded palaeo-drainage systems that traverse the desert. These include extensive salt lake chains with samphire low shrublands and *Melaleuca glomerata* to *M. lasiandra* shrublands. The climate is arid tropical with summer rainfall (Kendrick 2001).



Legend

- Tenements
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- Proposed Track

IBRA 7 Sub-regions

- Gibson Desert
- Great Sandy Desert

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2006
- TENEMENTS SOURCED FROM AGRIMIN 2017
- ROADS AND TRACKS SOURCED AGRIMIN 2017
- PROPOSED TRACK SOURCED AGRIMIN 2017
- IBRA 7 SUB REGIONS SOURCED DOE 2015
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LOCALITY MAP

PROJECT ID	DATE
2188	1/08/2017

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 52

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JA	AD	NW	1

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Lake Mackay, WA

Fauna Survey

Figure 5
IBRA 7 Regions and Sub-regions

2.4 Broad Vegetation Types

Mapping of the vegetation of the Great Sandy Desert region of WA was completed on a broad scale (1:1,000,000) by Beard (1976). These vegetation types were later re-assessed by Shepherd *et al.* (2001) to account for clearing in the intensive land use zones, dividing some larger vegetation units into smaller units. The current pre-European vegetation mapping dataset of WA is an output of a joint project between DAFWA and DPaW (Beard *et al.* 2013).

This mapping forms the basis of the vegetation extent statistics released annually by DPaW. There are four Shepherd *et al.* (2001) vegetation associations occurring within the proposed disturbance area and the surveyed islands. These vegetation types are described, along with their overall representation within the Survey Area, in Table 4.

Table 4: Broad vegetation types in the Survey Area.

SHEPHERD VEGETATION UNIT	DESCRIPTION	EXTENT IN PROPOSED DISTURBANCE AREAS (HA)	EXTENT IN SURVEYED ISLANDS (HA)
125-Great Sandy Desert	Bare areas; salt lakes.	602.80	-
134-Great Sandy Desert	Mosaic: Hummock grasslands, open low tree steppe, desert bloodwood and feathertop spinifex on sandhills/hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills.	1077.74	-
174-Great Sandy Desert	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex.	199.82	-
2041-Great Sandy Desert	Succulent steppe with scrub; tea tree over salt flats.	1758.33	4763.28

2.5 Previous Ecological Studies

The Survey Area is very remote, with the nearest community being Kiwirrkurra with around 200 people lying approximately 65 km to the south-west of Lake Mackay. The nearest population of note is Alice Springs which is approximately 580 km south-east of the Survey Area. Access to the lake from Kiwirrkurra is primarily limited to one main, unsealed track.

Given Lake Mackay's remoteness, there has been comparatively little fauna survey work undertaken in or surrounding the Survey Area. Nevertheless, there have been some relatively recent surveys completed associated with this project (Ecologia 2017) and nearby in the Kiwirrkurra Indigenous Protected Area (IPA) as part of the Bush Blitz programme (this is a partnership between the Australian Government through Parks Australia and the Australian Biological Resources Study, BHP Billiton Sustainable Communities and Earthwatch Australia).

As part of this current survey work programme for Agrimin, 360 Environmental also undertook recent waterbird, flora and vegetation assessments, each of which will be referred to in various sections of this report, with key outcomes also summarised in Table 5.

Please note that a level 1 fauna assessment was also undertaken close to the Survey Area for Toro Energy as part of the Theseus project (Outback Ecology 2012). This report is not publicly available and, therefore, has not been summarised herein.

Table 5: Summary of previous fauna surveys undertaken in the vicinity of the Survey Area.

*Conservation significance is based on listing as of submission date on report and includes species listed as Priority species by DPaW Service (Department of Biodiversity, Conservation and Attractions (DBCA)). Scheduled under the WC Act and threatened under the EPBC Act.

Reference	Survey Type	Survey Date	Proximity to Survey Area	Methods	Broad Habitats Described	*Conservation Significant Species Recorded
Waterbird Survey at Lake Mackay for Agrimin (360 Environmental July 2017)	Primarily a waterbird survey (also comprised other birds) that included ground and aerial assessments	14 -17 April 2017	Same Survey Area	o Ground survey with binoculars and spotting scope (visual and aural identification of birds) o Aerial survey with helicopter – identification with the unaided eye and binoculars	o Saline open water of Lake Mackay o Claypans to the south of Lake Mackay	o Australian Painted Snipe o Common Greenshank o Red-necked Stint o Sharp-tailed Sandpiper
Level 1 fauna and single phase level 2 flora assessment at Lake Mackay for Agrimin (Ecologia 2017)	Level 1 fauna and Level 2 flora and vegetation assessment (please note that only the fauna component is summarised here)	6-13 September 2016	Similar Survey Area	o Habitat assessments o Transects on foot to search for signs i.e. burrows, scats and footprints o Camera traps o Bat survey using Song Meter 2 (SM2) acoustic recording device	o Sandplains o Saline Flats o Dunefields o Samphire o Mulga Woodlands o Stony Rise	o Rainbow Bee-eater o Northern Marsupial Mole

Reference	Survey Type	Survey Date	Proximity to Survey Area	Methods	Broad Habitats Described	*Conservation Significant Species Recorded
				o Opportunistic observations		
Kiwirrkurra Indigenous Protected Area Bushblitz Survey (Cowan, M., Bray, R., & Paltridge, R. 2015)	Survey of mammals and reptiles	5-19 September 2015	Some sites in the current Survey Area, the remaining around Kiwirrkurra and Nyinmi (about 100 km west of Kiwirrkurra)	o Pitfall traps (20 Litre buckets) with 50-60 m drift fence o Funnel traps o Elliott traps o Camera traps o Bat survey using Song Meter 2 (SM2) acoustic recording device o Timed active foraging o Spotlighting o Opportunistic observations	o Sandplains o Dunes o Mulga Woodland o Low rocky hills o Boulder piles	o Great Desert Skink o Northern Marsupial Mole o Bilby

3 Methods

3.1 Background

The Level 2 vertebrate fauna survey was compliant with the EPA requirements for the environmental survey and reporting of fauna in WA and relevant EPBC Act survey guidelines, where practicable and relevant, and as set out in the following documents:

- Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3 (EPA 2002);
- Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56 (EPA 2004);
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA-DEC 2010);
- Survey Guidelines for Australia's Threatened Birds. EPBC Act survey guidelines 6.2 (2010a) (DSEWPaC);
- Survey Guidelines for Australia's Threatened Frogs. EPBC Act survey guidelines 6.3 (2010b) (DSEWPaC);
- Survey Guidelines for Australia's Threatened Mammals. EPBC Act survey guidelines 6.5 (2011a) (DSEWPaC);
- Survey Guidelines for Australia's Threatened Reptiles. EPBC Act survey guidelines 6.6 (2011b) (DSEWPaC);
- Department of the Environment, Water, Heritage and the Arts Survey Guidelines for Australia's Threatened Bats (DEWHA) (2010); and
- Existing vertebrate fauna survey data available for the Survey Area.

3.2 Fauna Survey Methods

3.2.1 Fauna Database Review

Searches of DPaW's threatened fauna database (150 km search), EPBC Protected Matters Search Tool (60 km search) and NatureMap (3 x 40 km search [40 km is the maximum search that can be undertaken with this database]) radial searches (centred on approximately the middle of the Survey Area) were undertaken to identify fauna species of conservation significance potentially occurring in the Survey Area (DPaW 2017a, DEE 2017; DPaW 2017b) (Appendix B). Please note that, originally, an 80 km radial search request of the threatened fauna database was submitted to DPaW, however, a 150 km buffer was applied in order to select a greater number of records that adequately demonstrate the potential species composition in the Survey Area. Due to the limitations of the NatureMap search capability, three 40 km searches were undertaken

and compiled to adequately demonstrate the potential species composition in the Survey Area.

Collectively, these sources were used to compile a list of species that have been previously recorded in the vicinity of the Survey Area (Appendix C). This list invariably includes some species that do not occur in the Survey Area as some fauna have a limited or patchy distribution or a high level of habitat specificity for habitats which are not located in the Survey Area. These fauna were examined and then excluded from the list, where relevant.

3.2.2 Field Survey

The field survey was undertaken for a total of 10 days from 10 – 19 May 2017 (there were an additional three days of travel). Three staff (Principal Zoologist, one Zoologist and one Principal Ecologist) set up the trap sites which included trap site selection, the digging of pitfall traps and fences, and the laying out of Elliott and cage traps before then proceeding to carry out the survey.

The purpose of the field survey was to verify the accuracy of the desktop assessment and to further delineate and characterise the fauna assemblages and fauna habitat in the Survey Area. The field survey consisted primarily of a baseline trapping programme, fauna habitat assessment, opportunistic observations, acoustic recordings of micro bat calls and camera traps (and spotlighting – though this was limited because of access to sites [see paragraph below]).

It is important to note that due to the vast size and remoteness of the Survey Area, it was not possible for it to be surveyed and accessed in its entirety. There are a very limited number of existing tracks and no off track driving is permitted as part of an agreement with the local Traditional Owners (Kiwirrkurra People). In addition, the larger Islands of Lake Mackay that were sampled are approximately 40 km from the end of the nearest track or about 35 km from the lake's edge.

Consequently, access for the most part was limited to the use of a helicopter (particularly as trapping equipment and digging tools cannot be carried far off tracks), with the survey effort primarily focussing on the proposed infrastructure areas and two large islands (habitat assessments were also undertaken across other smaller islands and in a few locations off the lake).

3.2.3 Baseline Trapping Programme

A total of six trap sites (systematic sample units) were sampled in a range of habitats in the proposed infrastructure areas and two islands. Trap site locations chosen were representative of the habitat types present in the Survey Area. Two trap sites were established on islands on the lake itself while four others were located off lake, one next to a wetland in a Claypan Swale and three within areas of proposed infrastructure construction.

Data collected systematically (i.e. where methods and effort are the same per sample unit) can be analysed to determine patterns in the species richness, abundance and composition of the fauna. Trap sites were selected to obtain a broad coverage of the habitats available in the Survey Area and to be readily accessible in order to check traps in a timely manner from an animal ethics perspective (Table 6 and Appendix D).

Table 6: Trap site locations.

TRAP SITE	LOCATION	HABITAT	EASTING	NORTHING
1	Island 1	Dune and Swale	481698	752386
2	Island 2	Dune and Swale	484307	7519278
3	Eastern Infrastructure Area	Claypan and Dune	464156	7493512
4	Surrounding Area	Claypan	477761	4787342
5	Access Area	Dune and Swale	464656	7491479
6	Western Infrastructure Area	Dune and Swale	442302	7499967

The trapping programme was carried out over seven nights at each of the trap sites, with the same survey effort (time, number of traps and search effort [defined as trap nights and person minutes]). All of the trap sites consisted of a 100 m x 100 m (1 ha) quadrat.

The trap site set up in each quadrat consisted of the following (Figure 5):

- Ten pitfall traps with drift fence, consisting of two lines of five pitfall traps (10 x 20 L buckets) at 5 m intervals, each with a 30 m section of drift fence;
- Set along the sides of the drift fence are 16 funnel traps (8 at each pitfall line);
- Around the perimeter of the quadrat 10 Elliott and four cage traps were spaced equidistantly; and
- Elliott and cage traps were baited with sardines and universal bait (peanut butter, oats and water).

Table 7 provides a summary of the survey effort. Please note that at trap sites 3 and 6, one bucket needed to be removed in each case from the pitfall trap line as ant infestation became a problem with the potential to harm captured animals.

Table 7: Summary of survey effort undertaken in the Survey Area at the trap sites.

Trap Site	Pitfall Buckets No. of nights	Funnel traps No. of nights	Elliott traps No. of nights	Cage traps No. of nights	Bird survey Person minutes
1	70	112	70	28	90
2	70	112	70	28	90
3	67	112	70	28	90
4	70	112	70	28	90
5	70	112	70	28	90
6	62	112	70	28	90
Total effort	409	672	420	168	540

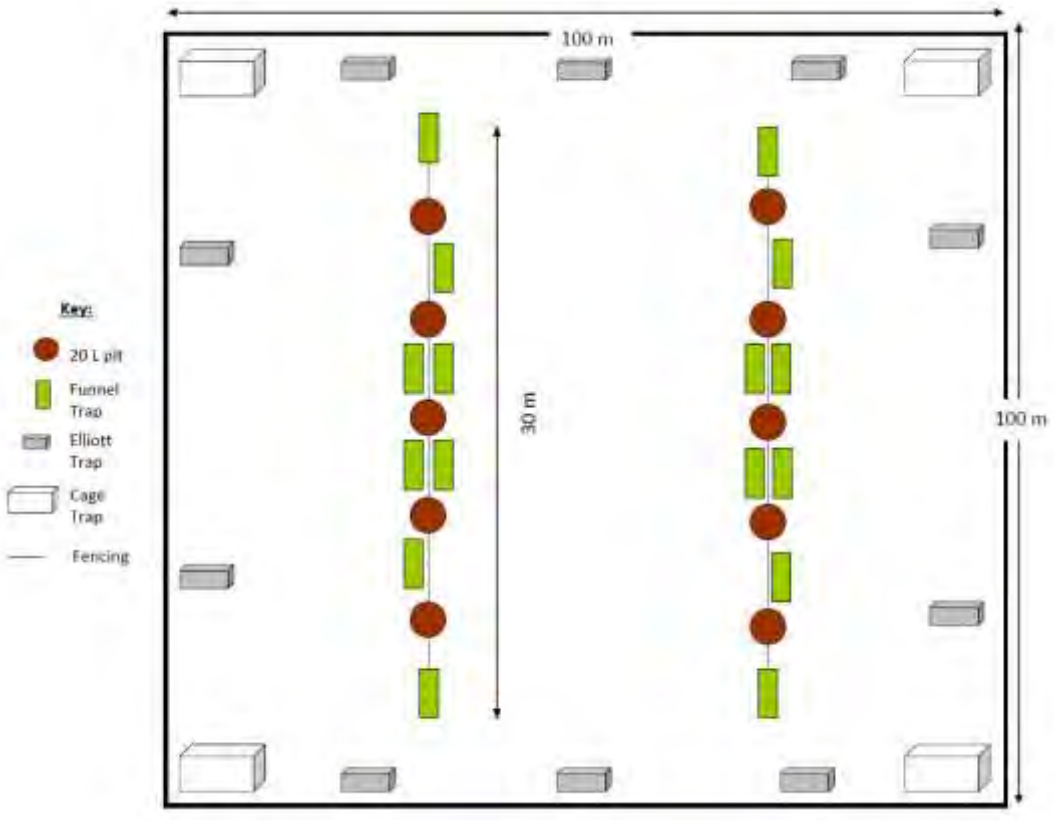


Figure 6: Quadrat Layout.

3.2.4 Habitat Assessment

Vegetation communities and landforms were used to identify the broad fauna habitats in the Survey Area. Habitat assessments were undertaken in each of the six trap sites and at an additional 16 other locations in the Survey Area (Appendix E). These fauna habitats were then assessed for their potential to support species of conservation significance and the quality of habitat they provide to a wider suite of fauna. The habitat assessments were documented systematically for each habitat type on standardised field sheets.

A total of 22 habitat assessments were completed for the Survey Area. Each broad habitat type description includes information on:

- Location of the broad habitat type within the Survey Area (GPS co-ordinate) and its relative percentage;
- Habitat condition was assessed at each trap site as 'completely degraded through to pristine, based on the scale given in Keighery (1994);
- Landscape position;
- Dominant vegetation and structure (e.g. number of vegetation strata);
- Hollow-bearing trees and dead stags (e.g. average size and abundance of hollows);
- Description of any rock and rocky outcrops;
- Logs (e.g. abundance and size);
- Substrate (e.g. leaf litter);
- Wetlands, creeks, rivers, dams and other water bodies;
- Description of any observed nests and roosts (if present);
- Subterranean roosts (e.g. caves, disused mineshafts and/or adits);
- Associated fauna species observed using the habitat;
- Disturbance (e.g. cattle grazing, fire); and
- Photo showing a typical example of the broad habitat type.

The location of the habitat assessments are illustrated in Figures 6-14.

3.2.5 Opportunistic Observations

Fauna were opportunistically observed and recorded during the survey. The opportunistic data supplements the systematic data collected at trap sites (Appendix F). Opportunistic observations were limited due to the logistics of accessing the Survey Area.

Opportunistic observations involved targeted searches of habitats in the Survey Area that potentially support fauna of conservation significance (though limited in the Survey Area).

During the opportunistic searches, the following techniques were used: raking through leaf litter, overturning rocks, looking under decorticating bark, investigating burrows, tracks and scats.

In addition, opportunistic records of fauna species encountered while travelling between trap sites were also documented (although, again, limited due to logistics). Opportunistic data comprises records of fauna species by location and coordinates are taken with a GPS in the case of any conservation significant fauna.

3.2.6 Systematic Bird Searches

Systematic bird surveys were undertaken in each of the six trap sites for a total effort of 90 minutes per trap site (see Table 7).

3.2.7 Nocturnal Spotlighting

Spotlighting and head torching at night from vehicles and on foot is an important survey tool as much of the region's fauna is nocturnal and/or crepuscular, particularly conservation significant species such as *Macrotis lagotis* (Bilby). Due to logistical constraints and the requirement of access via helicopter, spotlighting at each of the six trap sites was not possible. Spotlighting was, therefore, undertaken along either side of the access track near the camp for approximately 10 km. Spotlighting occurred on two consecutive nights for a total of 60 person minutes per night (two fieldworkers searching for 30 minutes each), totalling 120 minutes across two nights.

3.2.8 Bat Monitoring

Song Meter (SM2) acoustic recording units were set up at each trap site (and once at the camp) for a minimum of one night per trap site, to target bat species.

The SM2 units were also set up with an additional microphone to record bird song. This was to target *Pezoporus occidentalis* (Night Parrot) (see Figures 7-15 for a visual representation of where all the sites were located and Plate 1 for the SM2 unit).

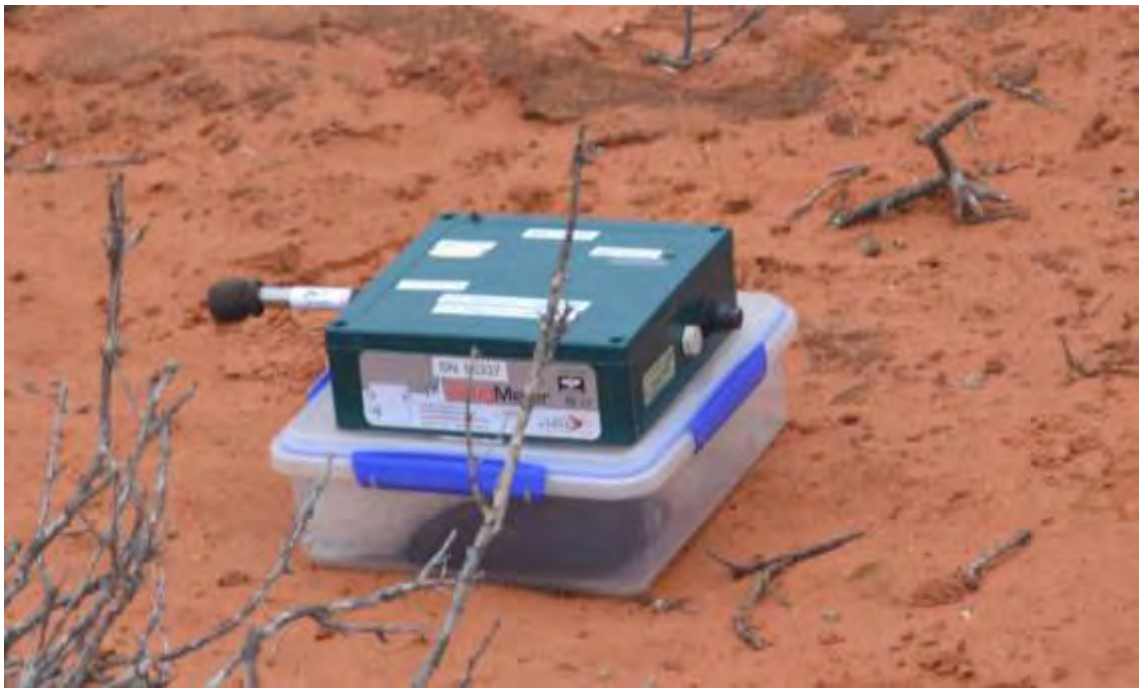


Plate 1: An example of an SM2 Unit.

3.2.9 Camera Traps

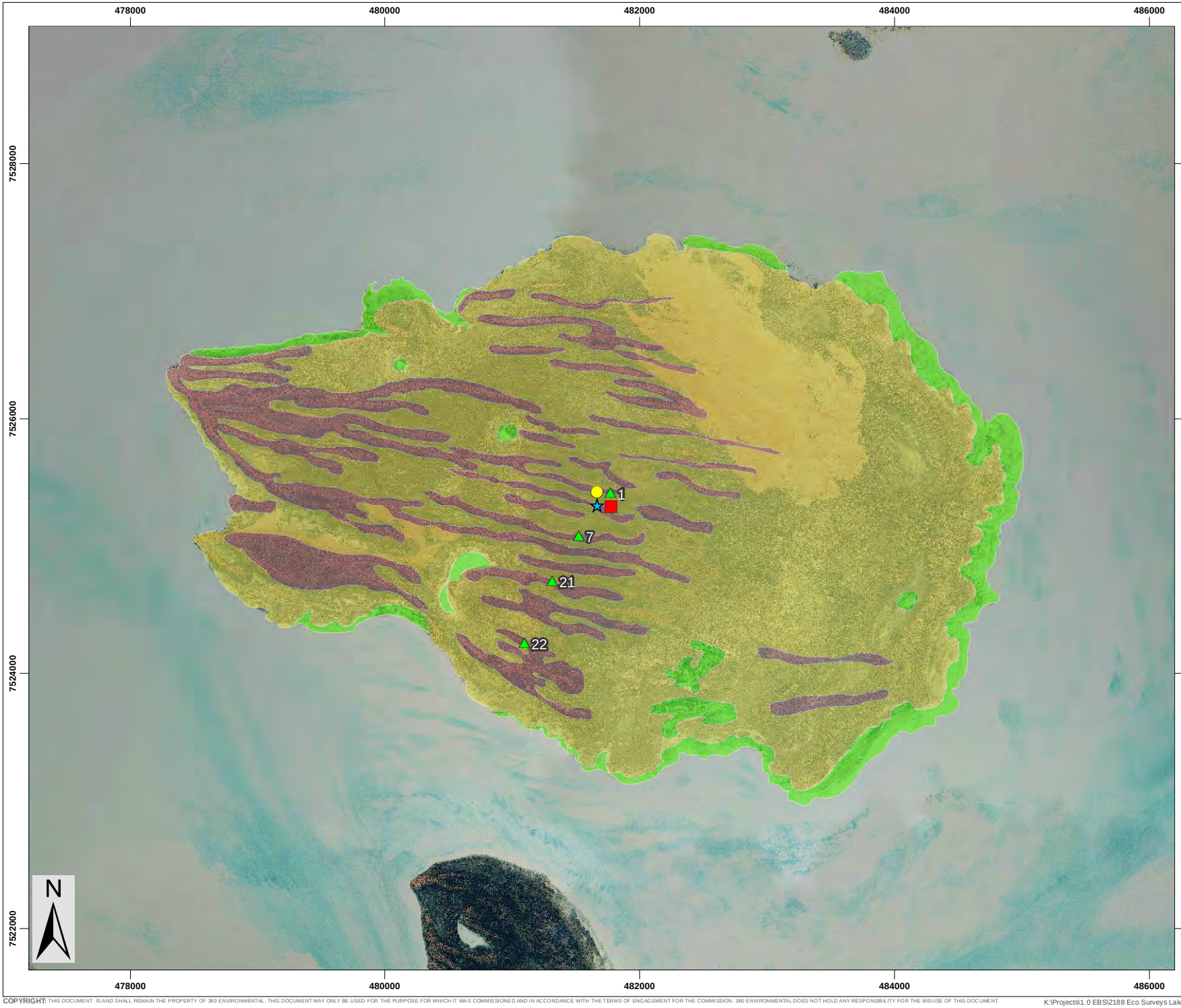
Camera traps were set up during the field survey at the six trap sites for a minimum of one night (Figures 6-14 and Plate 2). Camera traps were baited with sardines and universal bait (peanut butter, oats and water) and placed in their field of view. Cameras were used to target species of conservation significance such as *Macrotis lagotis* (Bilby).

Plate 2: An example of a Camera Trap.

3.2.10 Taxonomy

Where there is doubt on species names identified in the desktop assessment, (through subsequent name changes or taxonomic reviews), an effort was made to determine the current scientific name for each taxon. In some cases, old scientific names may be presented where correct nomenclature could not be determined due to name changes. Some taxon names may be followed by 'sp.', meaning that the species name was not given in the data source, or the identification is in doubt. Where there are previously recorded taxa such as this that have the potential to be a conservation significant species, they are discussed specifically in the results and discussion section.

Taxonomy and nomenclature in this report follows the accepted listing of published terrestrial vertebrate species. The listing for amphibians and reptiles follows Cogger (2014), the listing for birds follows Christidis & Boles (2008) and the listing for mammals follows Van Dyck & Strahan (2008).



Legend

Fauna Sites

- Fauna Trap Site 1
- Camera Trap
- Habitat Assessment Number
- SM2

Fauna Habitat

- Dune (359.43 ha)
- Lake Margin (1493.68 ha)
- Swale (907.37 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2006
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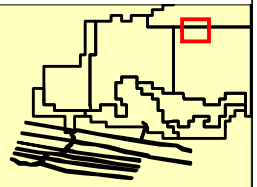
LOCALITY MAP



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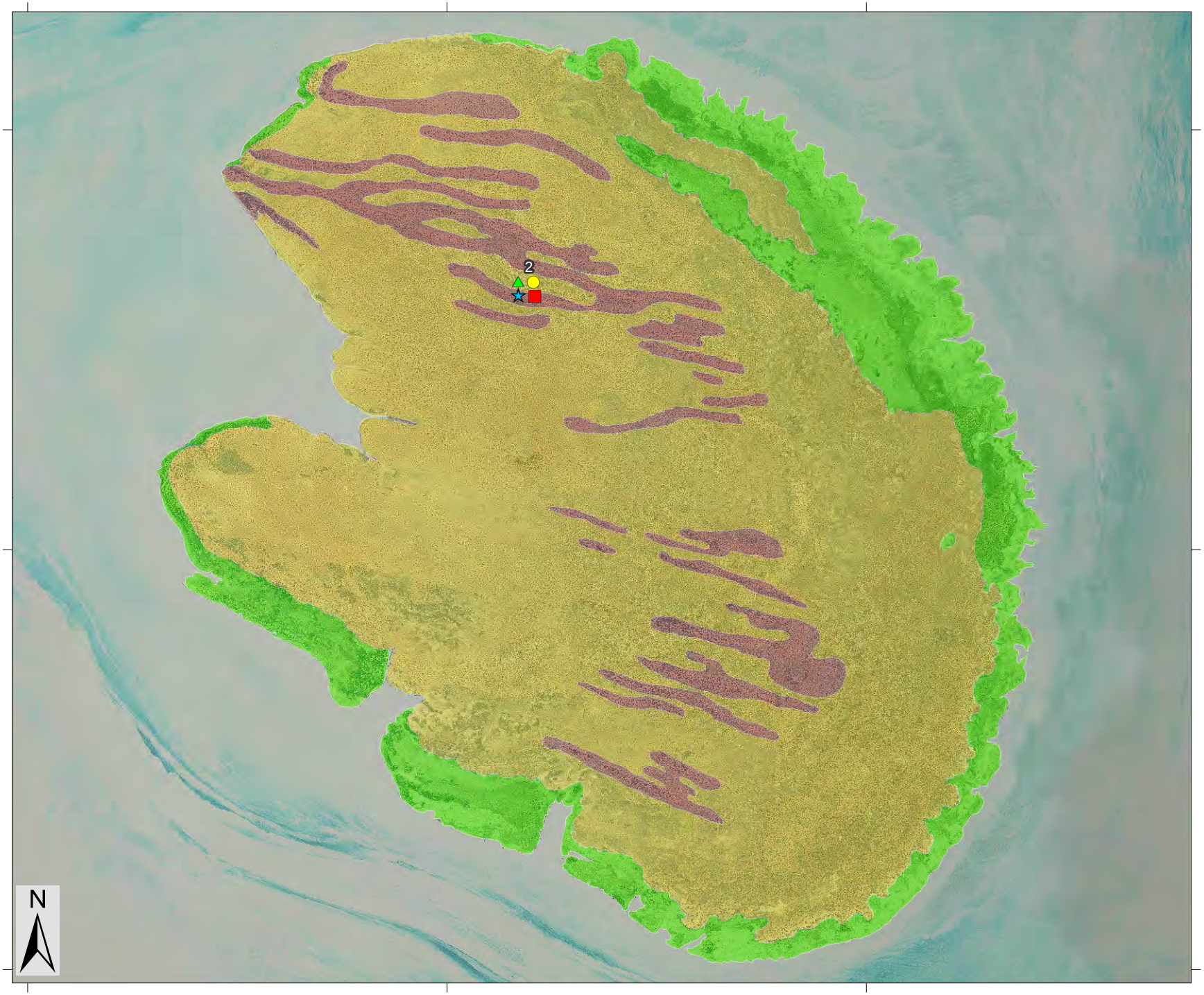
Agrimin
Sulphate of Potash Project
Lake Mackay, WA

Fauna Survey

Figure 7
Trap Site 1 (Island 1)



Legend

Fauna Sites

- Fauna Trap Site 2
- Camera Trap
- Habitat Assessment Number
- SM2

Fauna Habitat

- Dune (127.52 ha)
- Lake Margin (229.46 ha)
- Swale (907.37 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2006
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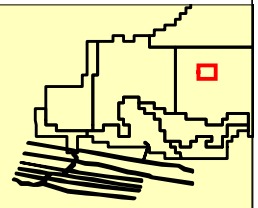

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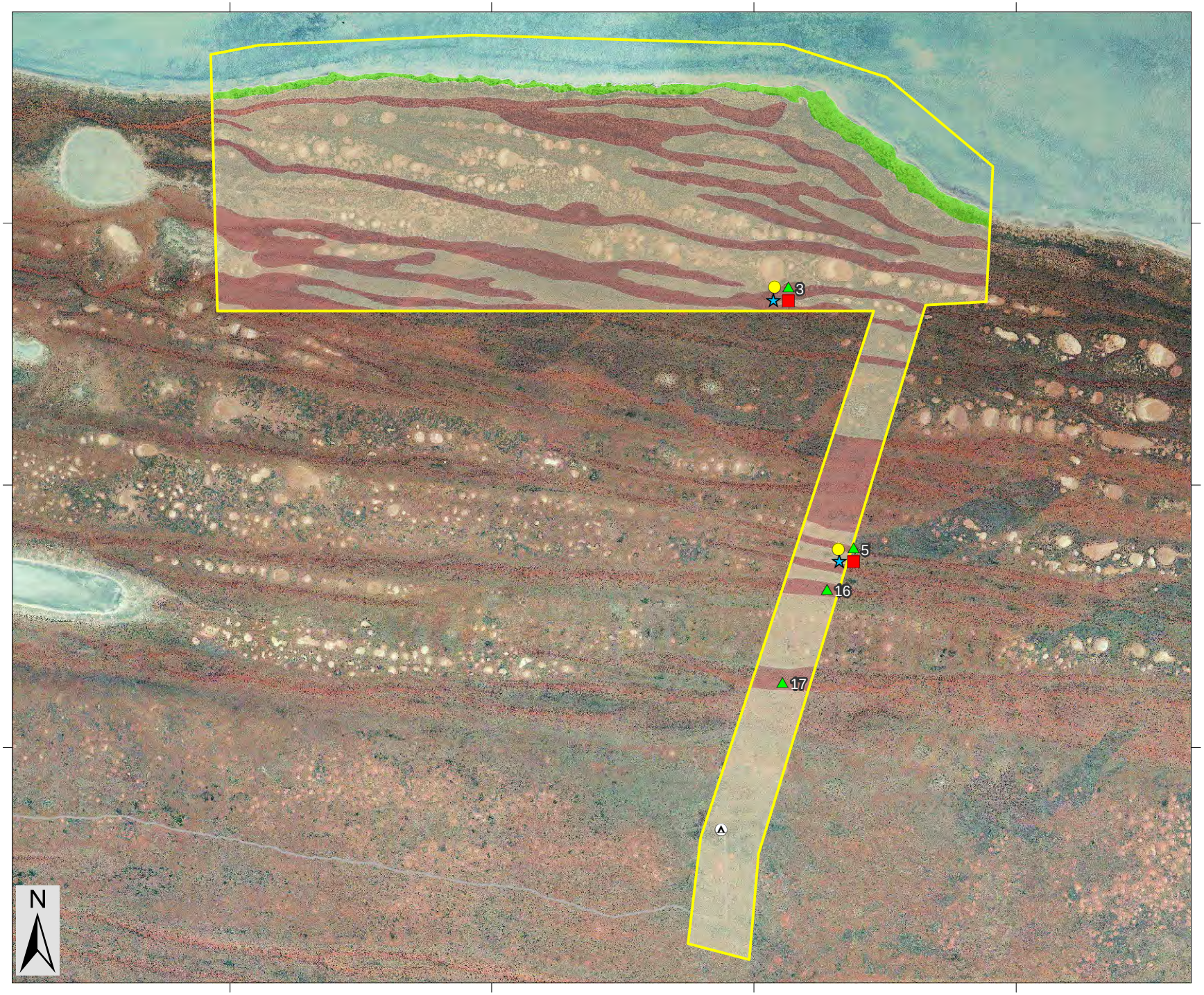
Lake Mackay, WA

Fauna Survey

Figure 8
Trap Site 2 (Island 2)



Legend

Proposed Infrastructure Boundary

Existing Track

Fauna Sites

- Camp Site
- Fauna Trap Site 3 & 5
- Camera Trap
- Habitat Assessment Number
- SM2

Fauna Habitat

- Claypan Swale (743.02 ha)
- Dune (374.83 ha)
- Lake Margin (52.17 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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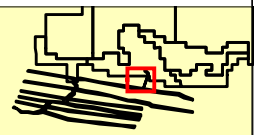

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Agrimin
Sulphate of Potash Project
Lake Mackay, WA

Vertebrate Fauna Survey

Figure 9
Trap Sites 3 and 5

Legend

Fauna Sites

- Fauna Trap Site 4
- Camera Trap
- Habitat Assessment Number
- SM2

Habitat

- Claypan Swale (5.89 ha)
- Open Water (9.44 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2006
- TENEMENTS SOURCED FROM AGRIMIN 2017
- RARE AND PRIORITY FLORA SOURCED DPAW 2017
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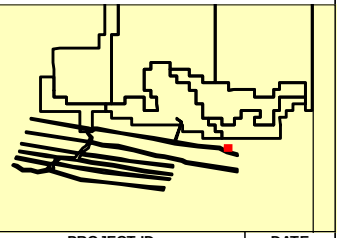

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Fauna Survey

Figure 10
Trap Site 4

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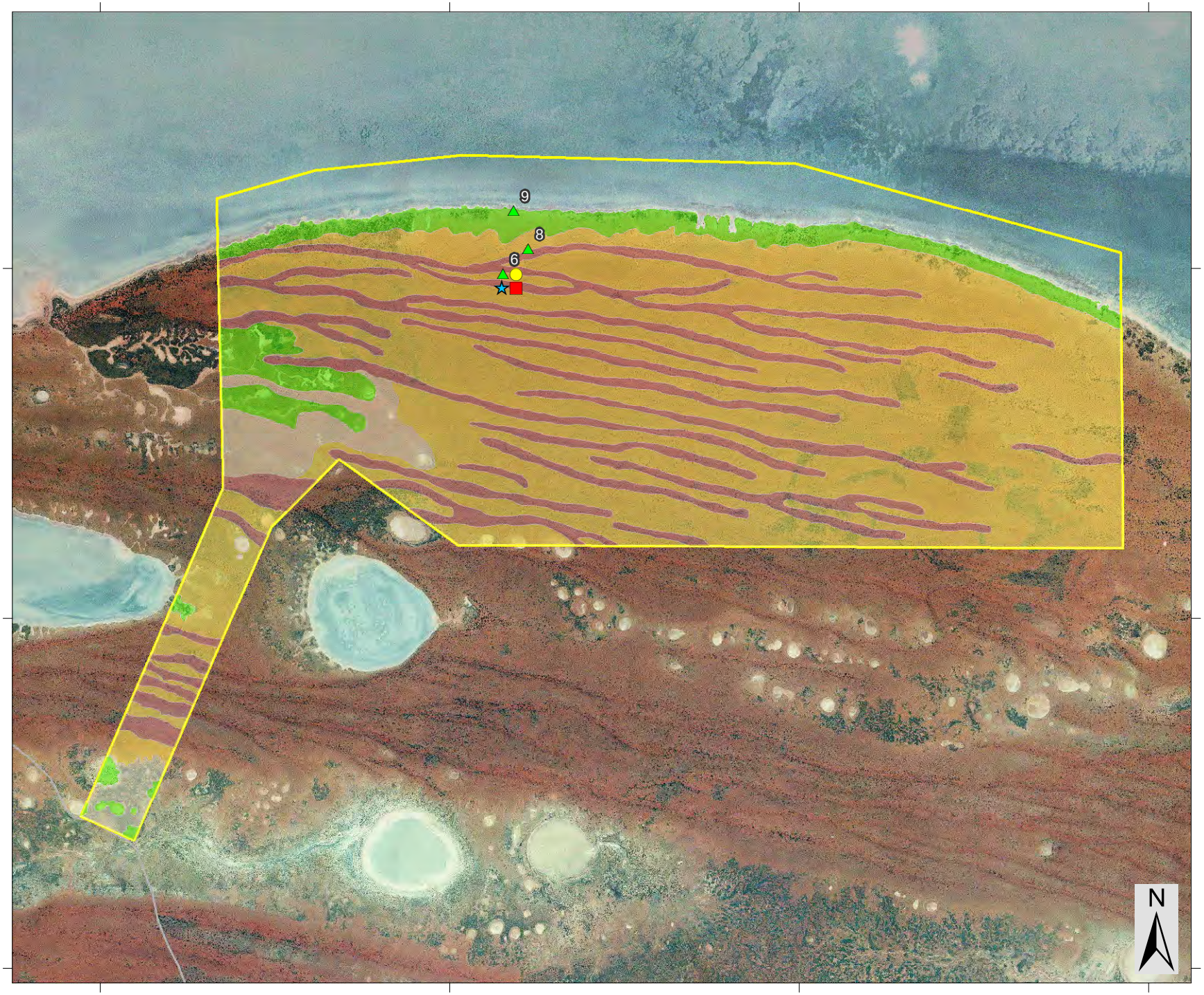

Legend

Proposed Infrastructure Boundaries

Existing Track

Fauna Sites

- Fauna Trap Site 6
- Camera Trap
- Habitat Assessment Number
- SM2

Fauna Habitat

- Claypan Swale (48.82 ha)
- Dune (216.43 ha)
- Lake Margin (89.86 ha)
- Swale (607.21 ha)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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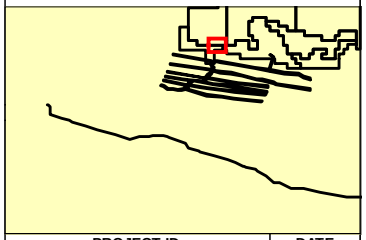

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CREATED	CHECKED	APPROVED	REVISION
EW	LS	RF	0

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Vertebrate Fauna Survey

Figure 11

Trap Site 6

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