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BUILDING A BETTER WORLD

Lake Annean Flora and Fauna Assessment

Prepared for Metals X Limited
September 2015

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Executive Summary

Metals X Limited (Metals X) are currently in the process of expanding their Central Murchison Gold Project (CMGP), located 35 kilometres (km) to the south-southwest of the mining town Meekatharra. To complement the expansion of the CMGP, Metals X are exploring the option of undertaking exploration drilling in the Lake Annean Study Area (Study Area). A large portion of the Study Area is made up by the Lake Annean Environmentally Sensitive Area (ESA). Under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004, a clearing permit is required.

The overarching objective of this assessment was to conduct a Level 1 Flora and Fauna Assessment over the Study Area to facilitate the preparation of a Native Vegetation Clearing Permit (NVCP). The specific objectives of this Survey were to:

- Complete a desktop review of relevant literature and database searches for the Study Area;
- Describe the vegetation communities, fauna habitats and their condition by means of a field survey;
- Delineate and map vegetation communities, vegetation condition and fauna habitats in the Study Area;
- Document vegetation associations and fauna habitats; and
- Provide a report that includes a brief statement of impact from a proposed drilling program against the 10 clearing principles

These objectives were addressed by way of a desktop study and field survey. The Survey was conducted between 14 and 17 July 2015. Flora and vegetation was sampled using 29 unbound sites (Relevés). Terrestrial fauna and fauna habitat was sampled via standardised habitat assessments, active searching and opportunistic sightings.

Flora

A total of 105 vascular taxa from 28 families and 50 genera, were recorded from the Study Area. This included three introduced taxa, one planted exotic and 101 native taxa. The dominant families were Chenopodiaceae, Poaceae, Scrophulariaceae and Fabaceae, while the most frequent genera included *Eremophila, Tecticornia, Maireana* and *Acacia*. This is a dominant floristic composition which is typical of the region dominated by Mulga Woodlands and samphire communities.

No Threatened Flora species or Priority Flora species were recorded during the on-ground survey. Database searches identified 41 flora taxa of conservation significance as potentially occurring in the Study Area, none of which were threatened flora. Of these, four were considered likely to occur and 12 taxa considered possible to occur. The four taxa considered likely to occur were *Acacia sclerosperma* subsp. *glaucescens* (P3), *Acacia speckii* (P4), *Ptilotus lazarides* (P3) and *Tecticornia cymbiformis* (P3). *Tecticornia cymbiformis* (P3) persists in Lake Annean and has the potential to occur within the study area. The remaining three priority taxa occur on the stony and sandy plains adjacent to Lake Annean. All four taxa occur in habitats within five kilometres of the Study Area.

Introduced flora species recorded within the Study Area included **Acetosa vesicaria, *Cenchrus ciliaris* and **Citrullus lanatus*, while the native taxon *Eucalyptus camaldulensis* (River Red Gum) has been previously planted and does not naturally occur within the Study Area.

Vegetation

A total of 14 vegetation associations were recorded across the Study Area. The vegetation of the Study Area was largely comprised of *Acacia* open woodlands and shrublands, *Hakea* open shrublands, Chenopod shrublands dominated by either *Maireana* species or *Salsola australis* and Samphire shrublands.

The vegetation associations recorded from the Study Area are representative of the dominant vegetation types throughout the region. None are analogous to any TEC or PEC and none are considered locally or regionally significant. The samphire communities are considered to be groundwater dependent ecosystems and are important as foraging and breeding habitat for migratory birds visiting Lake Annean.

Terrestrial Fauna

Five broad fauna habitat types and two minor habitat types were identified within the Study Area. Broad habitats included:

- Dunefields
- Stony plains
- Samphire
- Ironstone hills
- Lake Playa

Minor habitats included:

- Quartz outcrop
- Chenopod shrubland

Lake Annean is listed as an Environmentally Sensitive Area and listed on the Directory of Important Wetlands because it supports foraging and breeding habitat for a high number of the migratory, marine and waterbirds after periods of inundation. This has included hundreds of nesting Gull-billed Terns (*Sterna nilotica*) listed as Migratory (EPBC Act) and Schedule 3 (WC Act) along with nesting Whiskered Tern (*Sterna hybrida*) and Black-winged Stilt (*Himantopus himantopus*) which are both listed as Marine Migratory (EPBC Act). Additionally, the lake has been known to support thousands of waterbirds when full. Significant habitats within the Study Area that are likely to support these species include the Samphire and Playa habitats.

The desktop study identified a total of 236 species of vertebrate fauna, which have been recorded and/or have the potential to occur within the Study Area. A total of 29 vertebrate fauna species were recorded during the Survey. Of the vertebrate fauna species recorded via the desktop study, 55 are considered conservation significant, including one mammal, 52 bird and two reptiles. Additionally, two invertebrate species of conservation significance have been previously recorded and/or having the potential to occur.

Five fauna species listed as Marine (EPBC Act) were recorded during the survey and one species listed as Priority 1 (DPaw) was recorded form the Dunefields habitat during the Survey. These comprised:

- Meekatharra Slider (*Lerista eupoda*), which is listed as Priority 1 (DPaW)
- Red-capped Plover (Charadrius ruficapillus) which is listed as Marine (EPBC Act);
- Welcome Swallow (*Hirundo neoxena*) which is listed as Marine (EPBC Act);
- Australian Pipit (*Anthus australis*) which is listed as Marine (EPBC Act); and
- Australian Pelican (*Pelecanus conspicillatus*) which is listed as Marine (EPBC Act).

Based on the habitats which occur within the Study Area, 15 additional fauna species of conservation significance are considered Likely or Very Likely to occur. Of these, nine are Migratory (EPBC Act) wading birds and four Marine (EPBC Act) birds that may visit the Playa and Samphire habitats after the lake has experienced a period of inundation.

Five fauna considered 'Very Likely' to occur in the Study Area comprised:

- Gull-billed Tern (*Sterna nilotica*), which is listed as Migratory (EPBC Act) and Schedule 3 (WC Act);
- Eastern Great Egret (*Ardea modesta*), which is listed as Migratory (EPBC Act) and Schedule 3 (WC Act);
- Whiskered Tern (*Sterna hybrid*), which is listed as Marine (EPBC Act);
- Black-winged Stilt (*Himantopus himantopus*), which is listed as Marine (EPBC Act); and
- Red-necked Avocet (*Recurvirostra novaehollandiae*) which is listed as Marine (EPBC Act).

- Twelve fauna considered 'Likely' to occur in the Study Area comprised:
  - Rainbow Bee-eater (*Merops ornatus*), which is listed as Migratory (EPBC Act) and Schedule 3 (WC Act);
  - Fairy Shrimp (*Branchinella simplex*), which is listed as Priority 1 Fauna (DPaW);
  - Seven migratory wading bird species, which are listed as Migratory (EPBC Act) and Schedule 3 (WC Act); comprising:
    - Common Sandpiper (*Actitis hypoleucos*);
    - Sharp-tailed Sandpiper (*Calidris acuminata*);
    - Red-necked Stint (*Calidris ruficollis*);
    - Wood Sandpiper (*Tringa glareola*);
    - Common Greenshank (*Tringa nebularia*);
    - Marsh Sandpiper (*Tringa stagnatilis*); and
    - Glossy Ibis (*Plegadis falcinellus*).
  - Three Marine bird species (EPBC Act) with potential to occur in association with the saltlake; comprising:
    - Musk Duck (Biziura lobata);
    - Common Sandpiper (*Actitis hypoleucos*);
    - Straw-necked Ibis (Threskiornis spinicollis)

Conclusion

The Survey was conducted at an appropriate season for the sampling of flora, vegetation and vertebrate fauna, however many migratory, marine and waterbirds with potential to occur would not have been present as the lake was dry. Lake Annean occurs within an Environmentally Sensitive Area (ESA) and a nationally important wetland (WA056) that after inundation, can provide important feeding and breeding habitat for a number of marine and/or migratory bird species. Given that clearing will be required for the drilling program, an assessment against the ten clearing principles has been completed. The assessment indicated that the clearing is at variance to principles (f) and may be at variance to principles (h) and (i). The proposed drilling program is not at variance to principles (a), (b), (c), (d), (e), (g) and (j).

Metals X Limited
Lake Annean Flora and Fauna Assessment

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1.1 Background

Metals X Limited (Metals X) are currently in the process of expanding their Central Murchison Gold Project (CMGP). To complement the expansion of the CMGP, Metals X are exploring the option of undertaking exploration drilling in the Lake Annean Study Area (Study Area). A large portion of the Study Area is made up by the Lake Annean Environmentally Sensitive Area (ESA) and consequently, under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004, a clearing permit is required. This Survey has been completed to provide information required for an assessment against the ten clearing principles as required for a Native Vegetation Clearing Permit.

1.2 Location

The Study Area is located within the Shire of Meekatharra, approximately 35 kilometres (km) to the south-southwest of the mining town Meekatharra. The Study Area is located approximately 740 km north-east of Perth via the Great Northern Highway (**Figure 1-1**).

The Study Area is approximately 1,573 hectares (ha) in size and incorporates a portion of the environmentally sensitive area of Lake Annean and some historical mining pits and associated infrastructure (i.e. waste rock landforms) (**Figure 1-2**).

1.3 Report Terms

The following terms have been used in this document:

- Study area – refers to the 1,573 ha site that was subjected to the Level 1 flora and fauna assessment.
- Project – refers to the proposed exploration drilling program to occur (if approved) within the Study Area.

1.4 Objectives

The main objectives of the Level 1 flora and fauna assessment were to:

- Complete a desktop review of relevant literature and database searches for the Study Area;
- Describe the vegetation communities, fauna habitats and their condition by means of a field survey;
- Delineate and map vegetation communities, vegetation condition and fauna habitats in the Study Area;
- Establish photo sites to document vegetation associations and fauna habitats; and
- Provide a report that includes a brief statement of impact from a proposed drilling program against the 10 clearing principles.

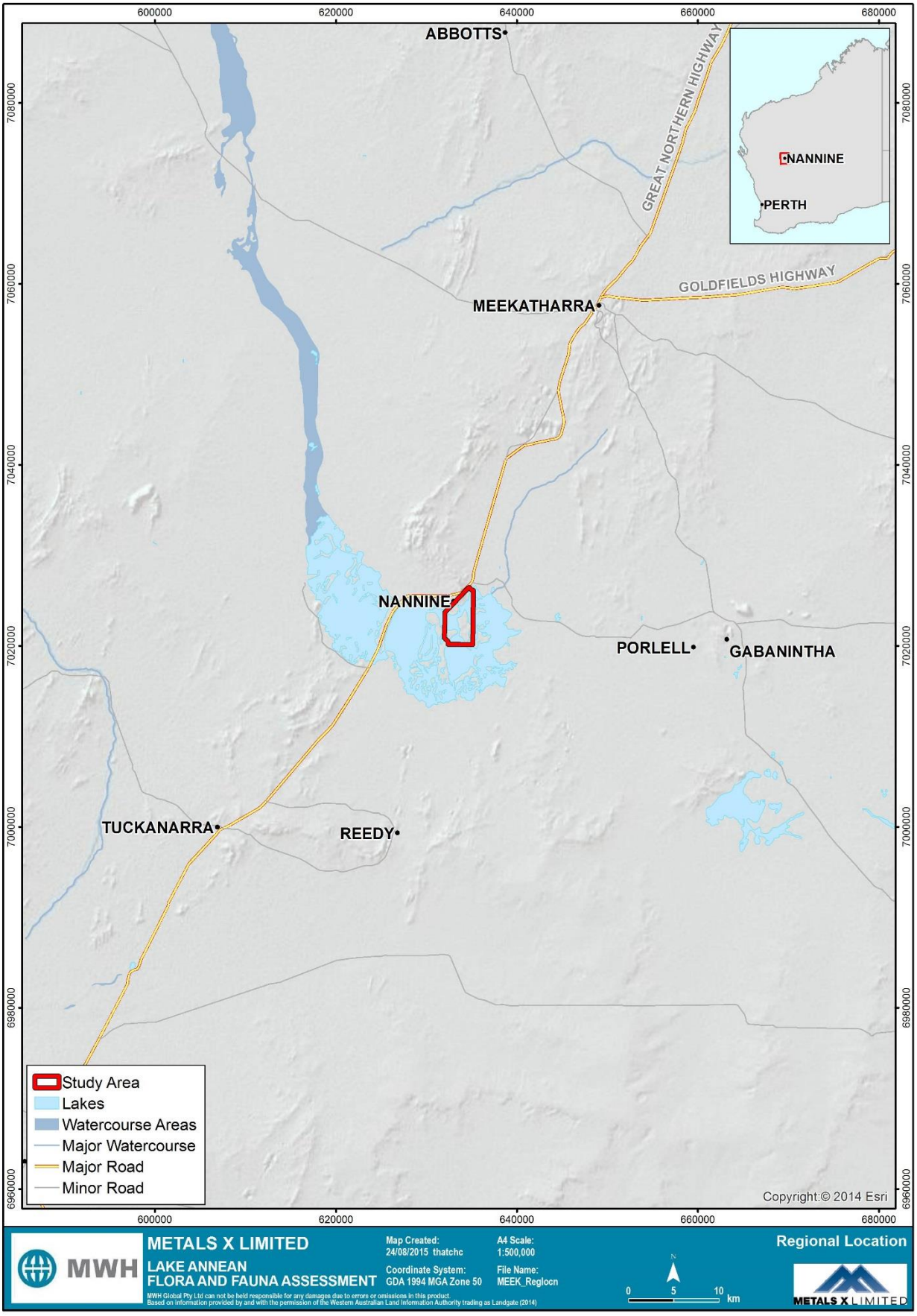

Figure 1-1: Regional location of the Study Area

Figure 1-2: The Study Area

2 Legislation

The flora and fauna assessment was undertaken in accordance with the requirements of the following environmental legislation and regulations:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth).
- Environmental Protection Act 1986 (EP Act) (WA).
- *Mining Act 1978* (Mining Act) (WA).
- Wildlife Conservation Act 1950 (WC Act) (WA).
- Biosecurity and Agriculture Management Act 2007 (BAM Act) (WA).
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA).

2.1 Commonwealth Legislation

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the key Commonwealth environmental legislation that protects and manages matters of national and international environmental significance. The administering agency for this act is the Commonwealth Department of the Environment (DOTE).

The eight Matters of National Environmental Significance (MNES) addressed under the Act are:

- World Heritage Sites.
- National Heritage places.
- Wetlands of international importance (i.e. Ramsar listed wetlands).
- Nationally threatened species and ecological communities.
- Migratory species (protected under international agreements).
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mining).
- A water resource, in relation to coal seam gas development and large coal mining development.

The key MNES relevant to this assessment are:

- Nationally threatened species;
- National threatened ecological communities; and
- Migratory species.

2.2 State Legislation

2.2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the primary legislation that governs environmental impact assessment (EIA) and protection in Western Australia. The aim of the Act is:

"to provide for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with foregoing".

In Section 4A of this Act there are five principles, which are necessary for the objectives of the Act to be realised. Three of these principles are applicable to native flora, vegetation and fauna:

- The precautionary principle.
- The principle of intergenerational equity.
- The principle of the conservation of biological diversity and ecological integrity.

Authorities under this Act include the Department of Environment Regulation (DER), Department of Parks and Wildlife (DPAW) (formerly the Department of Environment and Conservation (DEC)) and the Environmental Protection Authority (EPA), including the Office of the Environmental Protection Authority (OEPA).

Part IV of the EP Act relates to the assessment of environmental impacts, and Part V deals with licensing and control of pollution from prescribed premises and permits for land clearing.

2.2.2 Mining Act 1978

The *Mining Act 1978* (Mining Act) regulates mineral exploration and mining in Western Australia. The Mining Act is governed by the Western Australian Department of Mines and Petroleum (DMP). The aim of the act is to:

"consolidate and amend the law relating to mining and for incidental and other purposes"

Environmental approval for mining activities is one aspect governed by the Mining Act. Where a project is not considered to have a significant impact and does not trigger any of the criteria for referral defined in the Memorandum of Understanding between the DMP and the EPA, the requirement to also seek environmental approval under Part IV of the EP Act is not likely to be required.

2.2.3 Wildlife Conservation Act 1950

The Western Australia *Wildlife Conservation Act 1950* (WC Act) is:

"an act to provide for conservation and protection of wildlife"

Under the Act, all native flora and fauna are protected throughout the whole state at all times. In addition, the Minister for the Environment can publish a notice in the Government Gazette, declaring a list of flora and fauna species that are rare, likely to become extinct or otherwise in need of special protection.

Flora and Fauna that are declared Threatened (gazetted Declared Rare Flora or Specially Protected Fauna) are protected and may not be impacted on, unless authorised and carried out in accordance with the terms and conditions of licences issued under the Act.

2.2.4 Biosecurity and Agriculture Management Act 2007

The Western Australian Biosecurity and Agriculture Management Act 2007 (BAM Act) is:

"An Act to provide for; the control of certain organisms; the use of agricultural and veterinary chemicals; the identification and attainment of standards of quality and safety for agricultural products, animal feeds, fertilisers and other substances and things; the establishment of a Declared Pest Account, a Modified Penalties Revenue Account and accounts for industry funding schemes; and related matters".

The Act is managed by the Department of Agriculture and Food Western Australia (DAFWA) and specifically relates to the prohibition and regulation of the introduction and spread of pests (feral fauna) and weeds (introduced species) declared under the Act for the protection of agricultural management.

2.3 Environmental Guidance and Policy

The EPA, DMP and DPaW have produced a number of policy statements, guidelines and technical guides, which provide guidelines and advice regarding the government's position on the flora, vegetation and fauna of Western Australia. The documents relevant for this assessment include:

- Guidance for the Assessment of Environmental Factors No. 6 Rehabilitation of Terrestrial Ecosystems (EPA 2006).
- Guidance for the Assessment of Environmental Factors No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004c).
- Guidance for the Assessment of Environmental Factors No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b)
- Position Statement No. 2 Environmental Protection of Native Vegetation in Western Australia (EPA 2000).
- Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002).
- Position Statement No. 4 Environmental Protection of Wetlands (EPA 2004a).
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC 2010).

3 Existing Environment

3.1 Biogeographic region

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia in to 89 bioregions based on major biological and geographical or geological attributes (Thackway and Cresswell 1995). The bioregions have been further divided into 419 subregions which are more localised and homogenous geomorphological units in each bioregion. The Study Area is located in the Western Murchison (MUR02) subregion (close to the boundary of the Eastern Murchison subregion) of the Murchison bioregion as delineated by the Interim Biogeographical Regionalisation of Australia (IBRA, Version 7) (**Figure 3-1**). The subregional area is 7,847,996 ha in size.

The Western Murchison subregion is dominated by Mulga (*Acacia aneura* group complex) low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrop and fine textured Quaternary alluvial and eluvial surfaces (extensive hardpan washplains that dominate and characterise the subregion) mantling granitic and greenstone strata of the northern part of the Yilgarn Craton. Surfaces associated with the occluded drainage occur throughout with hummock grasslands on Quaternary sandplains, saltbush (*Atriplex* spp.) shrublands on calcareous soils and samphire (*Tecticornia* spp.) low shrublands on saline alluvia. The subregion contains the headwaters of the Murchison and Wooramel Rivers, which drain the subregion westwards to the coast (Desmond *et al.* 2001).

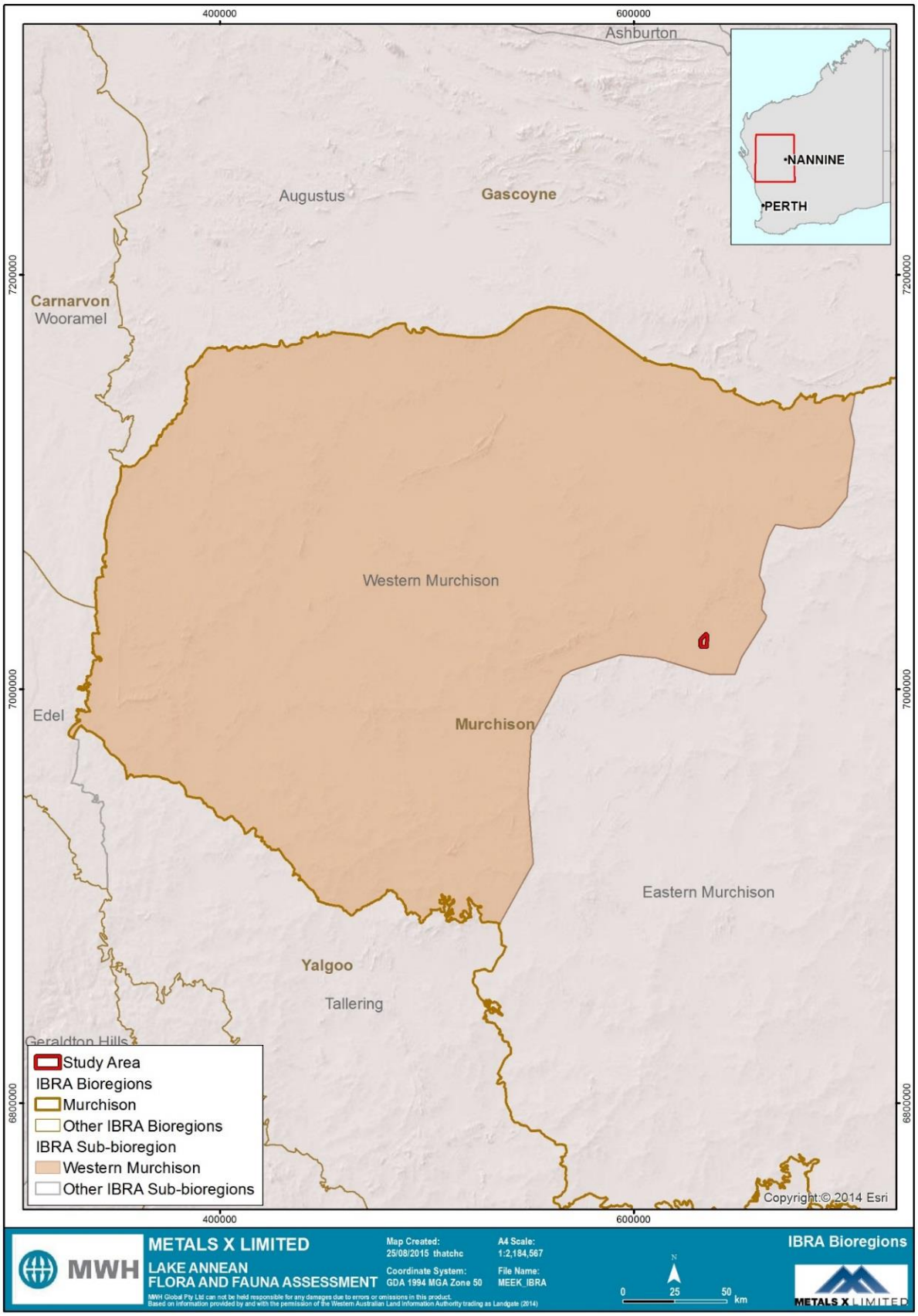

Figure 3-1: Location of the Study Area with respect to the IBRA bioregions and subregions

3.2 Land Systems

An assessment of land systems provides an indication of the occurrence and distribution of fauna habitats and vegetation within and surrounding the Study Area. Land systems across the Murchison have been mapped by the Natural Resources Assessment Group of the Department of Agriculture. Land systems are defined as areas or groups of areas throughout which can be recognised a recurring pattern of topography, soils and vegetation (Curry *et al.* 1994).

Three land systems occur within the Study Area, with the majority comprising the Gabanintha Land System (**Table 3-1**, **Figure 3-2**).

Table 3-1: Land systems occurring within the Study Area

Land system	Description	Extent within the Study Area (ha)
Austin	Saline stony plains with low rises and drainage foci supporting low halophytic shrublands with scattered mulga; occurs mainly adjacent to lakes Austin and Annean, below greenstone hill systems.	154.92
Carnegie	Salt lakes with extensive fringing saline plains, dunes and sandy banks, supporting low halophytic shrublands and scattered tall acacia shrublands; lake beds are highly saline, gypsiferous and mainly unvegetated.	1254.47
Gabanintha	Ridges, hills and foot slopes of various metamorphosed volcanic rocks (greenstones), supporting sparse acacia and other mainly non-halophytic shrub lands.	164.01

Source: Curry *et al.* (1994)

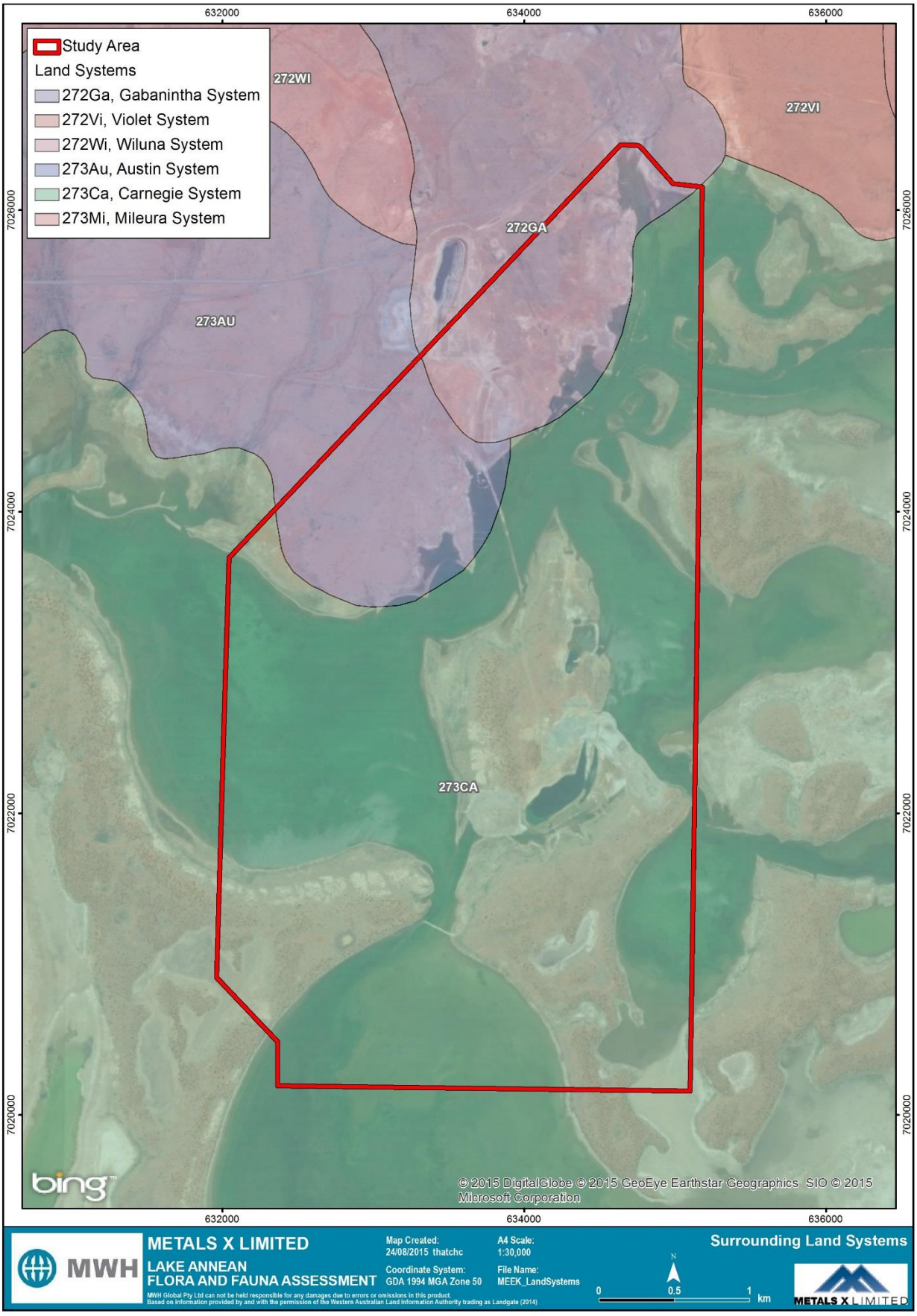

Figure 3-2: Land systems of the Study Area

3.3 Land uses

The Study Area is located in a historical mining precinct of the Murchison region, as a result, historical land uses have been centred on mining, specifically for gold. Several historical gold mines occur within or immediately adjacent to the Study Area. The historical gold mines include pits, waste rock landforms (WRL), infrastructure (i.e. old sheds), drainage corridors and access tracks. In addition to the larger scale gold mining, there are numerous old shafts, tunnels and smaller pits/quarries scattered throughout the Study Area.

The Murchison region is also home to pastoral stations, with cattle and sheep roaming the landscape. Two active pastoral leases, Annean and Polelle, overlap the Study Area. As a result, cattle currently roam through the Study Area feeding on the native vegetation.

3.4 Pre-European Vegetation

3.4.1 Vegetation Associations (Beard, 1976)

A systematic survey of native vegetation in Western Australia was undertaken during the 1970s, which described vegetation systems throughout Western Australia at either a 1:250,000 or 1:1,000,000 scale by Beard (1975). The Murchison region was mapped by Beard (1976) at a 1:1,000,000 scale.

According to the mapping undertaken by Beard (1976), four vegetation associations occur within the Study Area. The four vegetation associations are described as:

- 18 – Low woodland; Mulga (*Acacia aneura* group complex);
- 39 – Shrubland; Mulga (*Acacia aneura* group complex) scrub;
- 125 – Bare areas; salt lakes; and
- 1128 – Mosiac; succulent steppe with open scrub scattered *Acacia sclerosperma* and Bowgada (*Acacia ramulosa* var. *linophylla*) over saltbush (*Atriplex* spp.) and bluebush (*Maireana* spp.)/succulent steppe; samphire (*Tecticornia* spp.).

3.4.2 Vegetation System Associations (Shepherd et al., 2002)

The vegetation associations have since been reinterpreted and updated by Shepherd *et al.* (2002) to reflect the NVIS standards (ESCAVI 2003). The update also accounts for extensive clearing since Beard (1976) mapping. The reinterpretation of Beard's vegetation associations have resulted in several being separated to remove mosaics, however, due to the broad-scale of the mapping, mosaics still occur.

Shepherd *et al.* (2002) reinterpretation created a series of systems to assist with the separation of mosaics, while still maintaining the original vegetation association codes provided by Beard (1976). The Study Area is located within the Upper Murchison system, while the new vegetation system associations are: Upper Murchison 18.2; Upper Murchison 39.1; Upper Murchison 125; and Upper Murchison 1128. The description for each of the reinterpreted units are the same as the descriptions provided by Beard (1976) (see Section 3.8.1).

The extent of the vegetation system associations within the Study Area is provided in **Table 3-2** and **Figure 3-3**, while the extent of the vegetation system associations in the State, the Murchison bioregion, the Western Murchison subregion and the Shire of Meekatharra is provided in **Table 3-3**.

Table 3-2: Extent of vegetation system associations in the Study Area

Vegetation system association code	Extent within the Study Area (ha)	% extent within the Study Area
18.2	145.73	9.26
39.1	83.26	5.29
125	382.14	24.29
1128	962.26	61.16
Total	1,573	100.00

Table 3-3: Pre-European extent of vegetation system association remaining

Code	Scale	Pre-European extent (ha)	Current extent (ha)	Current extent remaining (%)
18.2	State	1,901,789.28	1,897,254.25	99.76
	Bioregion	1,900,879.19	1,896,344.15	99.76
	Subregion	1,640,344.46	1,635,842.49	99.73
	Shire of Meekatharra	710,099.37	705,877.38	99.41
39.1	State	411,827.21	410,748.29	99.74
	Bioregion	411,827.21	410,748.29	99.74
	Subregion	399,336.89	398,395.59	99.76
	Shire of Meekatharra	138,862.19	137,939.64	99.34
125	State	8,688.61	8,677.57	99.87
	Bioregion	8,688.61	8,677.57	99.87
	Subregion	8,688.61	8,677.57	99.87
	Shire of Meekatharra	6,624.75	6,613.71	99.83
1128	State	18,657.56	18,349.24	98.35
	Bioregion	18,657.56	18,349.24	98.35
	Subregion	18,657.56	18,349.24	98.35
	Shire of Meekatharra	18,467.29	18,158.97	98.33

Source: (Government of Western Australia 2015)

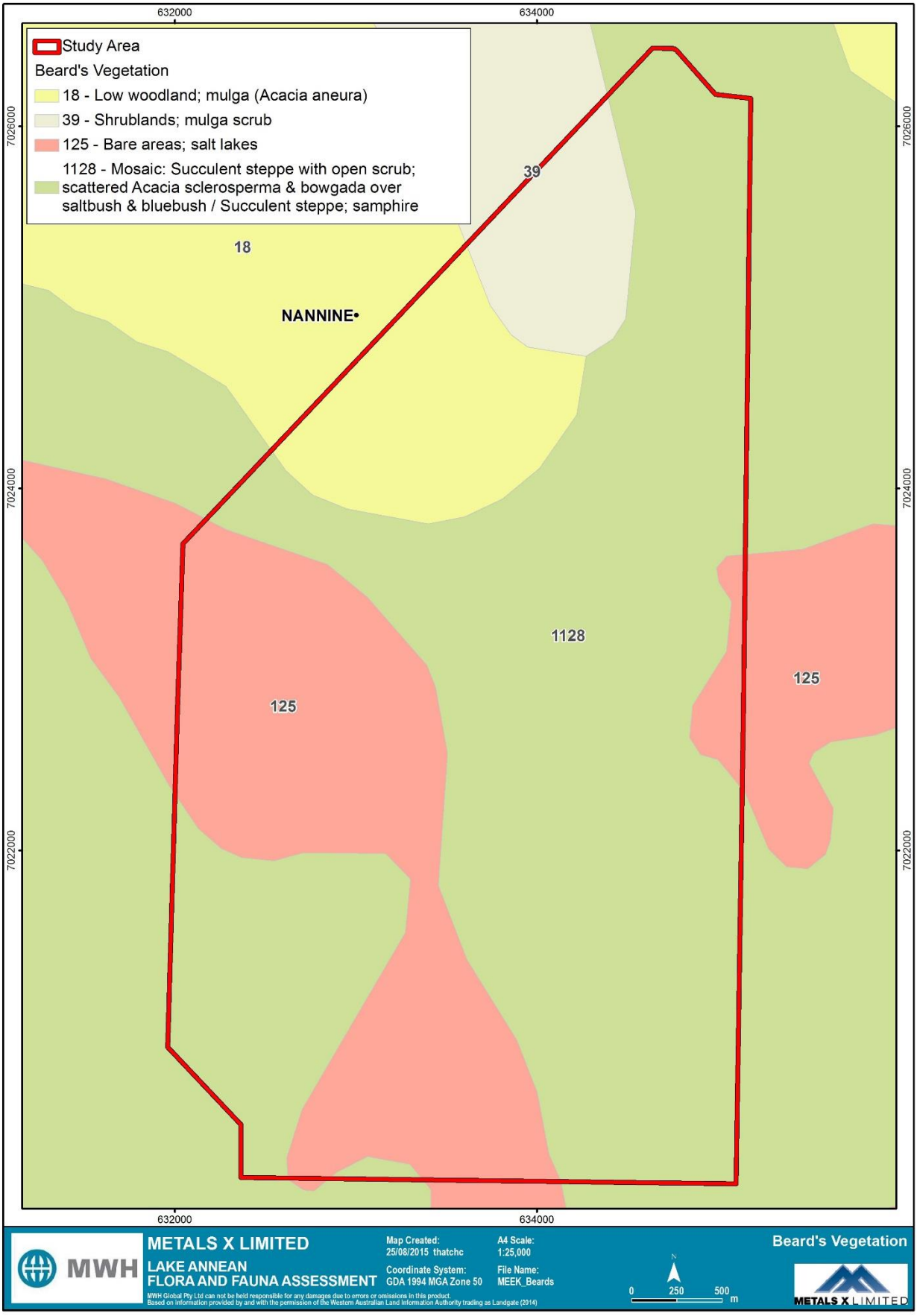

Figure 3-3: Beards vegetation mapping of the Study Area

3.5 Climate

The Murchison region is described as an arid climate characterised by summer and winter rainfall with annual totals rarely exceeding 200 millimetres (mm) (Beard 1990).

The nearest weather station that collects relevant climate data (i.e. rainfall, temperature, wind) is Meekatharra Airport (station number 007045), located 4.5 km east of Meekatharra (BoM 2015). The weather station has been operational since 1944.

The average annual rainfall for Meekatharra is 238 mm, while the median is 230 mm per annum. The majority of the rain falls between January and August, although it is sporadic with annual monthly totals rarely exceeding 30 mm. The rainfall during the winter months is considered to be more reliable and is associated with cold fronts moving from the south of the State. The rainfall during the summer months is more sporadic, although heavier resulting in large flooding events across the landscape. The summer rainfall is associated with thunderstorm bands and ex-tropical cyclones that influence the Pilbara coastline and move in a south-easterly direction across the State (BoM 2015).

The hottest months are from November to March, with average maximum temperatures exceeding 33°C, while minimum temperatures exceed 18°C (BOM, 2015). The coldest months are June to August, where the average minimum temperatures fall below 10°C, while the maximum daily temperatures rarely exceed 25°C (BoM 2015).

The long term climatic conditions at the Meekatharra Airport weather station is provided in **Figure 3-4**.

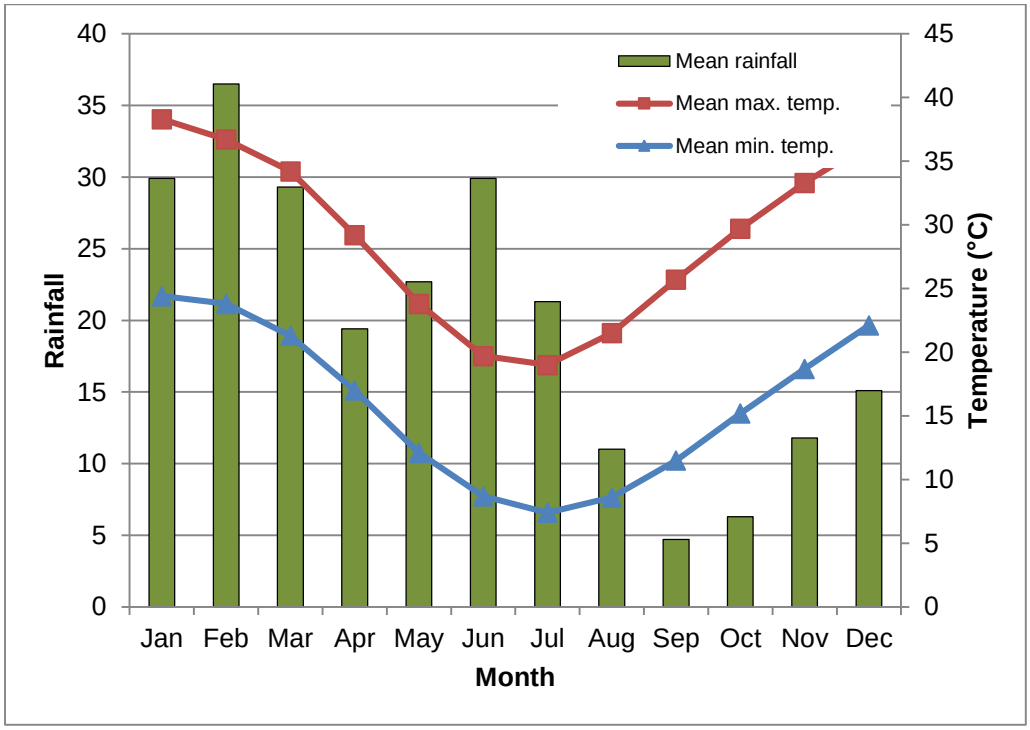

Figure 3-4: Long term climatic conditions at the Meekatharra Airport weather station (007045)

3.6 Lake Annean Environmentally Sensitive Area

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under section 51B of the *Environmental Protection Act 1986*, to prevent incremental degradation of important environmental values. ESAs generally include areas within 50 metres of protected wetlands, within 50 metres of declared rare flora, Bush Forever sites, and those areas containing a threatened ecological community. Lake Annean has been designated as an ESA, and consequently, it is protected under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. As such, exemptions contained in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 for routine low impact land management practices do not apply and a clearing permit is required.

3.7 Wetlands (DoE 2015b)

Lake Annean is listed as a Directory of Important Wetlands in Australia (DIWA), (listed as Anneen Lake (Lake Nannine) Ref no WA056) (DoE 2015b). Lake Annean has been listed as a nationally important wetland because it supports foraging and breeding habitat for a number of Federally-listed migratory andmarine bird species as well as various other water bird species. Hundreds of Gull-billed Terns (*Sterna nilotica*) listed as Migratory (EPBC Act) and Schedule 3 (WC Act) have been recorded breeding in the western portion of the lake (DoE 2015b). Few other locations in western Australia are known to support as many individuals of this species (DoE 2015b). Additionally, similar numbers of the Whiskered Tern (*Sterna hybrida*) listed as Marine (EPBC Act) have been observed nesting atop inundated samphire and lesser numbers of the Black-winged Stilt (*Himantopus himantopus*) listed as Marine (EPBC Act) have been observed nesting at the lake (DoE 2015b).

Although no systematic surveys of the lake have been undertaken, the lake apparently supports several thousand waterbirds when full, with high abundances of Black Swan (*Cygnus atratus*) (up to 1,500), Banded Stilt (*Cladorhynchus leucocephalus*) (1,000 plus), Australian Shelduck (*Tadorna tadornoides*) (500) and Gull-billed Tern and Whiskered Tern (200-300 each) (DoE 2015b). The Hoary-headed Grebe (*Poliocephalus poliocephalus*) has also been recorded nesting at the lake.

The lake is also a good example of a seasonal/intermittent saline/brackish lake and marsh system (DoE 2015b). The lake plays an important ecological and hydrological role in the landscape and provides habitat and refuge for significant invertebrate and vertebrate fauna.

Lake Annean is a megascale irregular sumpland, with numerous microscale and macroscale elongate islands and peninsulas, while a natural peninsula (ridge) almost separates the wetland into two lakes. An anastomosing creek system enters the north-east corner of the lake with a catchment extending 30 km north to near Meekatharra. Additional minor creeks flow from the landscape into the west and north sides of the lake. The catchments are all moderately disturbed from pastoral and mining related activities.

Surface water held in the lake drains northwards via Hope River into the Murchison River. Inundation over parts of the lake occurs periodically in most years, while the whole lake occasionally fills from episodic flooding (probably every five to ten years) caused by large summer-autumn rain events associated with tropical storms moving from the north-west. At its deepest point, the depth of the surface water can reach 1 m after large flooding events.

3.8 Landforms, geology and soils

The Murchison region is spread over the northern third of the Yilgarn Craton. The underlying rocks are predominantly Archaean even-grained porphyritic granitic rocks intruded by quartz veins and dolerite dykes (Tille 2006). Throughout the Craton are areas of Archaean migmatite and gneiss, common along the western margin, as well as in the north-west where Narryer Terrane and Yarlarweelor Gneiss Complex are located (Tille 2006). The latter consists of migmatite, gneiss, schist and quartzite (Tille 2006).

Soils within the region vary, with red loamy earths, red-brown hardpan shallow loams and some red shallow loams present on wash plains, while red sandy earths and red deep sands are found on sandy banks (Tille 2006). Red sandy earths and red deep sands, with some red loamy earths and calcareous loamy earth in low lying areas, are found on sandplains (Tille 2006). Yellow deep sands are found on sandplains in the south-west (Tille 2006). On mesas there are red shallow loams, red shallow sandy duplexes and red shallow sands, with some stony soils and red/brown non-cracking clays also present (Tille 2006).

Hilly terrain contains red shallow loams, stony soils and red shallow sands, with some bare rock and red shallow sandy duplexes (Tille 2006). Sandy soils tend to be more common on granitic hills (Tille 2006). Red shallow loams with red shallow sandy duplexes are found on stony plains, and red shallow sands occur on gritty plains over granite (Tille 2006). Red-brown hardpan shallow loams, calcareous loamy earths and red loamy earths are also present (Tille 2006).

Salt lake soils with some red deep sands occur on valley floors with red deep sandy duplexes, red/brown non-cracking clays, red shallow sandy duplexes and red-brown hardpan shallow loams also present, especially on floodplains in the north-west (Tille 2006). Calcareous shallow loams are found on the calcrete platforms (Tille 2006).

4 Methods

4.1 Desktop Study

A desktop study, comprising database searches and a literature review, was undertaken prior to the field survey to identify the flora, vegetation and terrestrial fauna potentially occurring in the Study Area (**Section 4.1.1** and **Section 4.1.2**). The likelihoods of occurrence of species of conservation significance are presented in **Section 4.1.4** and discussed further in **Section 5**. For further information on conservation rankings under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Wildlife Conservation Act 1950* (WC Act), and the Department of Parks and Wildlife's (DPaW) Priority list, see **Appendix A**.

4.1.1 Database Searches

Database searches were undertaken to generate a list of vascular flora and vertebrate fauna taxa previously recorded within, and nearby, the Study Area, including introduced species and specifically taxa of conservation significance. Six database searches were conducted around a central coordinate (50J 625550.83 mE, 7000609 mS), with varying buffers as deemed appropriate (**Table 4-1**).

Table 4-1: Database searches

Custodian	Database	Focus	Reference	Buffer (km)
DPaW	Threatened and Priority Fauna	Vertebrate Fauna	(DPaW 2015d)	75
DPaW	Threatened and Priority Ecological Communities	Vegetation	(DPaW 2015c)	40
DPaW	Threatened and Priority Flora	Flora	(DPaW 2015e)	40
DPaW	NatureMap	Flora and Vertebrate Fauna	(DPaW 2015b)	30
Birdlife Australia	Birdlife Birdata	Vertebrate Fauna	(Birdlife Australia 2015b)	75
Department of Environment	Protected Matters	Flora and Vertebrate Fauna	(DoE 2015c)	75

4.1.2 Literature Review

Existing biological surveys were reviewed to provide local context with regards to the survey intensity of the assessment and to identify additional threatened and priority listed flora, fauna and ecological communities undertaken in the region. A list of biological surveys reviewed prior to, and after, the field survey include:

- Level 1 flora, vegetation and fauna assessment, CMGP Reedy Project Dewatering Program. Unpublished report prepared for Metals X Limited (MWH 2015).
- Central Murchison Gold Project: Level 1 Vegetation, Flora and Fauna Assessment (Outback Ecology 2012)
- Level 2 flora and vegetation survey and impact assessment, Moyagee project area. Unpublished report prepared for Silver Lake Resources (Coffey Environments 2013c)

- Level 2 flora and vegetation assessment, Lake Austin discharge point. Unpublished report prepared for Silver Lake Resources (Coffey Environments 2013b).
- Flora, vegetation and fauna assessment, Mt Eelya survey areas. Unpublished report prepared for Silver Lake Resources (Coffey Environments 2013a)
- Level 1 flora, vegetation and fauna assessment, Tuckabianna Project Area. Unpublished report prepared for Silver Lake Resources (Coffey Environments 2012b)
- Level 1 flora, vegetation and fauna assessment, Comet Project Area. Unpublished report prepared for Silver Lake Resources (Coffey Environments 2012a)
- Baseline Biological Desktop Assessment, Silver Lake Murchison Project. Unpublished report prepared for Silver Lake Resources (ecologia Environment 2011)
- Flora and Vegetation Assessment. Jack Hills Mine Expansion. Unpublished Report for Crosslands Resources Ltd (ecologia Environment 2009a)
- Flora and Fauna Study. Report for Jack Hills to DNGP Gas Pipe Route, Crosslands Resources Limited (GHD 2009c)
- Ecological Survey. Report for Jack Hills to Weld Range Service Corridor, Crosslands Resources Limited (GHD 2009a)
- Flora and Fauna Assessment. Report for the Jack Hills Expansion Project-Associated Infrastructure, Crosslands Resources Limited (GHD 2009b)
- Vegetation and Flora Assessment, OPR Rail Development. Report for the Oakajee Port and Rail (ecologia Environment 2010)

4.1.3 Local and regional contextual information

In addition to database searches, regional and local context data was reviewed with reference to flora and vegetation, prior to, and after, the field survey. The review was undertaken to identify if the flora and vegetation associations delineated from the Study Area are of regional or local significance. The review concentrated on broad-scale mapping of plant assemblages. The review included:

- Native Vegetation in Western Australia: Extent, Type and Status. Technical Report 249 (Shepherd *et al.* 2002).
- Vegetation Survey of Western Australia – Murchison. Explanatory Notes and Map Sheet 5, 1:1,000,000 series (Beard 1976).
- Plant Life of Western Australia (Beard 1990).
- An inventory and condition survey of the Murchison River catchment and surrounds, Western Australia (Curry *et al.* 1994).
- Strategic review of the banded iron formation ranges of the Midwest and Goldfields (DEC 2007).

4.1.4 Likelihood of the Occurrence for Flora and Fauna

The likelihood of occurrence of each species of conservation significance in the Study Area was assessed and ranked. The rankings were assigned using the following definitions:

Confirmed – the presence of the species in the Study Area has been recorded unambiguously during the last ten years (i.e. during recent surveys of the Study Area or from reliable records obtained via database searches);

Very likely – the Study Area lies within the known distribution of the species and is likely to contain suitable habitat(s), plus the species generally occurs in suitable habitat and has been recorded nearby within the last 20 years;

Likely – the Study Area lies within the known distribution of the species and the species has been recorded nearby within the last 20 years; however, either:
a.the Study Area is likely to contain only a small area of suitable habitat, or habitat that is only marginally suitable; or
b.the species is generally rare and patchily distributed in suitable habitat;

Possible – there is an outside chance of occurrence, because:
a.the Study Area is just outside the known distribution of the species, but is likely to contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
b.the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
c.the Study Area lies on the edge of, or within, the known distribution and is likely to contain suitable habitat, but the species has not been recorded in the area for over 20 years.

Unlikely – the Study Area lies outside the known distribution of the species, the Study Area is unlikely to contain suitable habitat, and the species has not been recorded in the area for over 20 years.

4.1.5 Introduced taxa

The NatureMap (DPaW 2015b), Protected Matters (DoE: Department Environment 2015) database searches and the literature review identifed a list of introduced flora and fauna that may potentially occur within the Study Area. The introduced flora taxa identified from the field survey were reviewed to determine if they are considered to be Weeds of National Significance (WoNS), Declared Plant Pests (DPPs) or have a prioritisation weed rating of ‘High’ or ‘Very High’.

4.1.5.1 Weeds of National Significance

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 WoNS based on an assessment process that prioritised these weeds on their invasiveness, potential for spread and environmental, social and economic impacts. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation and administration of weeds. The WoNS were

selected as they require coordination among all levels of government, organisations and individuals with weed management responsibilities.

4.1.6 Declared Plant Pests

To protect Western Australian agriculture the DAFWA regulates harmful plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Plants that are prevented entry into the state or have control or keeping requirements within the state are known as declared pests. The main purposes of the BAM Act and its regulations related to declared plant pests are to: prevent new plant pests (weeds) from entering Western Australia; manage the impact and spread of those pests already present in the state; and safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act).
- Permitted (under Section 11 of the Act).
- Prohibited (under Section 12 of the Act).
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all declared plant pests are placed in one of three categories:

- C1 (Exclusion) — Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
- C2 (Eradication) — Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still feasible.
- C3 (Management) — Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

4.1.7 Weed Prioritisation

The Environmental Weed Strategy of Western Australia (CALM 1999) provided a ranking of weed species on a state-wide basis against three criteria: invasiveness; distribution; and environmental impacts. The state-wide ratings from the Strategy are deemed too broad to be of use from an on-ground operational perspective and are now out of date. In addition to these factors, the Strategy was meant to have developed an integrated approach to environmental weed management that included site and resource led control (CALM 1999) however, due to funding constraints, it did not carry out an assessment and ranking of weed species against the biodiversity assets they threaten nor did it consider feasibility of control.

In an effort to address these issues and implement an integrated approach to weed management on DPaW-managed lands in WA, the Weed Prioritisation Process for DPaW was developed in 2008. DPaW prioritised weeds in each region, based on their:

- Invasiveness;
- Ecological impact;
- Potential and current distribution; and
- Feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that weed species that are already widespread are not ranked as a high priority. DPaW are currently reviewing the weed prioritisation process (DPaW 2015a).

4.2 Field Survey Timing and Weather

The Level 1 flora, vegetation and fauna survey was undertaken between 14 and 17 July 2015, with eight person-days invested in the survey.

In the six months preceding the survey, Meekatharra received 145.6 mm of rain, which is comparable to the long term average of 167.7 mm for the same period (BoM 2015). A large portion of this rainfall occurred in March with a total of 85.6 mm recorded, well above the average of 29.3 mm. This rainfall provided suitable conditions for the emergence of ephemeral species and resulted in a number of taxa displayed material to allow suitable identification.

Weather experienced during the Survey was considered marginal for sampling fauna, with relatively cool days and showers. The maximum and minimum temperatures were 19.5°C and 5.3°C, respectively with a total of 4 mm recorded over the survey period (Table 4-2).

Table 4-2: Daily weather observations at Meekatharra for the Survey period

Date	Temperature (°C)		Rainfall (mm)
	Min	Max	
14 June 20015	8.6	12.5	2.4
15 June 20015	7.4	17.7	1.4
16 June 20015	5.3	17.9	0.2
17 June 20015	5.8	19.5	0

4.3 Survey Team and Licensing

The field survey was led by senior ecologist Clinton van den Bergh who was assisted by ecologist Paul Bolton. The field survey team held the necessary licences to sample flora and vegetation in Western Australia, including threatened flora. Clinton obtained a *Licence to take flora for scientific or other prescribed purposes* (SL011498) and a *Permit to take Declared Rare Flora* (88-1415).

4.4 Flora and Vegetation

4.4.1 Flora and vegetation assessment

A total of 29 non-systematic flora sampling points (i.e. relevés) were sampled throughout the Study Area, with a particular reference to intact native vegetation in good or better condition (**Figure 4-1**). As a result, the highly disturbed vegetation located in association with the historical mining was not sampled.

The relevés were marked by a central point recorded with a Global Positioning System (GPS) and an approximately radius of 30 m was sampled. Relevés are used for the purpose of recording vegetation structure, species composition, dominance, vegetation condition and contribute to species inventories.

The information recorded at each of the relevés sampled included:

- Location: GDA94 coordinates were taken from a central point for the relevé. The coordinates were taken using a handheld Garmin GPS to an accuracy of ±5 m.
- Vegetation description: the vegetation structure was described to broad floristic formation and vegetation association according to NVIS (ESCAVI 2003) (Table 4-3, Table 4-4 and Table 4-5).
- Disturbance details: vegetation condition was assessed according to Keighery (1994) (Table 4-6). Additional information on feral pests, introduced weeds, dieback and anthropogenic disturbances were recorded.
- Taxa list: an inventory of all taxa was taken.
- Foliage cover and height: the percentage foliar cover was estimated to the nearest percentage point, and height was visually estimated to within 0.1 m for each dominant taxon present.
- Habitat: the aspect and slope was recorded. Additional information of wetlands, or other prominent geological features was also recorded.
- Soil: colour and soil texture of surface soils was recorded.
- Rock and litter cover: estimates were made on the rock type, outcropping, size and litter and bare soil cover.

The broad floristic formations (BFF) and vegetation associations were described based on the floristic data recorded from the relevés and visual observations while traversing the Study Area, based on NVIS hierarchical level III (Broad Floristic Formation) and V (Vegetation Association) (ESCAVI 2003). Hierarchical level III requires the dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum. Hierarchical level V requires the dominant growth form,

cover, height and dominant species (three for each stratum) for each of the three traditional strata (i.e. upper, mid and ground to a maximum of nine taxa). These are provided in Table 4-3, and Table 4-4; the NVIS height class definition is provided in Table 4-5.

Table 4-3: NVIS hierarchical structure

Hierarchical level	Description	NVIS structural/floristic component required
I	Class	Dominant growth form for the ecologically or structurally dominant stratum
II	Structural Formation	Dominant growth form, cover and height for the ecologically or structurally dominant stratum
III	Broad Floristic Formation	Dominant growth form, cover, height and dominant land cover genus fort eh upper most or the ecologically or structurally dominant stratum
IV	Sub-formation	Dominant growth form, cover, height and dominant genus for each of the three traditional strata (i.e. Upper, Mid and Ground)
V	Association	Dominant growth form, height, cover and species (three species) for each of the three traditional strata (i.e. Upper, Mid, Ground)
VI	Sub-association	Dominant growth form, height, cover and species (five species) for all layers/sub-strata

Source: Table 1 from ESCAVI (2003).

Table 4-4: NVIS structural terminology

Stratum	Growth form	Height ranges (m)[1]	Structural formation classes (% cover)					
			80-100	50-80	20-50	0.25-20	0-0.25	Unknown
U	Tree, palm	Low; Mid; Tall	Closed forest	Open forest	Woodland	Sparse woodland	Isolated trees	Isolated clumps of trees
	Tree mallee	Low; Mid; Tall	Closed mallee forest	Open mallee forest	Mallee woodland	Sparse mallee woodland	Isolated mallee trees	Isolated clumps of mallee trees
M	Shrub, cycad	Low; Mid; Tall	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs	Isolated clumps of shrubs
	Mallee shrub	Low; Mid; Tall	Closed mallee shrubland	Mallee shrubland	Open mallee shrubland	Sparse mallee shrubland	Isolated mallee shrubs	Isolated clumps of mallee shrubs
	Heath shrub	Low; Mid; Tall	Closed heath shrubland	Heath shrubland	Open heath shrubland	Sparse heath shrubland	Isolated heath shrubland	Isolated clumps of heath shrubs
	Chenopod shrub	Low; Mid; Tall	Closed chenopod shrubland	Chenopod shrubland	Open chenopod shrubland	Sparse chenopod shrubland	Isolated chenopod shrubland	Isolated clumps of chenopod shrubs
	Samphire shrub	Low; Mid	Closed samphire shrubland	Samphire shrubland	Open samphire shrubland	Sparse samphire shrubland	Isolated samphire shrubland	Isolated clumps of samphire shrubs
G	Hummock grass	Low; Mid	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated hummock grasses	Isolated clumps of hummock grasses
	Tussock grass	Low; Mid	Closed tussock grassland	Tussock grassland	Open tussock grassland	Sparse tussock grassland	Isolated tussock grasses	Isolated clumps of tussock grasses
	Other grass	Low; Mid	Closed grassland	Grassland	Open grassland	Sparse grassland	Isolated grasses	Isolated clumps of grasses
	Sedge	Low; Mid	Closed sedgeland	Sedgeland	Open sedgeland	Sparse sedgeland	Isolated sedges	Isolated clumps of sedges
	Rush	Low; Mid	Closed rushland	Rushland	Open rushland	Sparse rushland	Isolated rushes	Isolated clumps of rushes
	Herb	Low; Mid	Closed herbland	Herbland	Open herbland	Sparse herbland	Isolated herbs	Isolated clumps of herbs

Source: ESCAVI (2003).

Note: Growth forms that do not occur or were not sampled within the Study Area were omitted (i.e. seagrass bed).

1: Refer to Table 5 for height range information.

Table 4-5: NVIS height class definition

Height class	Height range (m)	Growth forms			
		Tree, palm	Shrub (all forms), cycad	Tree mallee, mallee shrub	Hummock, tussock and other grass, sedge, rush, herb
8	>30	Tall			
7	10-30	Mid		Tall	
6	<10	Low		Mid	
5	<3			Low	
4	>2		Tall		Tall
3	1-2		Mid		Tall
2	0.5-1		Low		Mid
1	<0.5		Low		Low

Source: Table 3 from ESCAVI (2003).

The condition of the vegetation was described based on the rating scale developed by Keighery (1994) and published in the Bush Forever Strategy (Government of Western Australia 2000) (**Table 4-4**).

Table 4-6: NVIS condition definition

Condition code	Definition
P Pristine	Pristine or nearly so, no obvious signs of disturbance.
E Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are nonaggressive species.
VG Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
D Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
CD Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often referred to as parkland cleared with the flora composing weed or crop species with isolated native trees or shrubs.

Source: Bush Forever (Government of Western Australia 2000), originally developed by Keighery (1994).

4.4.2 Targeted searches

Sections of the Study Area with the potential to support significant flora and ecological communities were traversed on foot during the field. Ironstone ridges, quartz breakaways, and sand dunes were targeted because they are more likely to comprise higher levels of diversity, and support plants of conservation

significance in the mid-west. These areas also provide habitat to flora of conservation significance identified in the desktop study. The purpose of the targeted searches were to:

- Identify additional taxa not recorded at the sampling points.
- Identify and define populations of threatened and priority taxa listed under the EPBC Act, WC Act and by DPaW.
- Identify and define the extent of TECs and PECs listed under the EPBC Act and DPaW.
- WONS listed under the EPBC Act.
- Declared Pests listed under Section 22 of the BAM Act.
- Weed with a high or very high prioritisation rating.

If a population or individual of known or potential conservation significant taxa, ecological community or introduced taxa was recorded, a specimen was taken, the GPS location and a photo were recorded, while information on the population extent and vegetation and condition was documented.

4.4.3 Specimen identifications

Specimens not well known to the field botanist were collected and assigned a unique number in the field to facilitate tracking of the field data. The specimens were then appropriately dried, sorted and submitted to WAH to satisfy the quarantine requirements prior to identification of the specimens using the WAH reference herbarium.

The specimens were identified by senior ecologist Clinton van den Bergh utilising reference specimens, taxonomic keys and reference material. Assistance was also sought from WAH employees and volunteers were necessary. Additional assistance was sought from expert taxonomists for several genera.

4.5 Terrestrial Fauna

4.5.1 Terrestrial fauna assessment

Fauna habitat assessments were undertaken at seven locations throughout the Study Area (**Figure 4-1**). At each location, the following parameters were recorded:

- description of broad vegetation community;
- hollow bearing trees and dead stag trees (average size and abundance);
- rocky outcrops (average rock size and extent);
- coarse woody debris, i.e. logs and fallen timber (abundance and size);
- substrate (description of composition, presence of algal crust and % cover of leaf litter);
- wetland habitats and water courses including drainage lines, billabongs, floodplains, etc; and
- any nest, roosts or other evidence of breeding habitat present.

4.5.2 Targeted searches

Searches were conducted to search for fauna taxa of conservation significance and to develop a species list. Effort focused on habitat likely to support fauna of conservation significance, although all habitat types were sampled. Specifically:

- the dunefield habitat was targeted for the Malleefowl (*Leipoa ocellata*) which is listed as Vulnerable (EPBC Act) and Scheduel 1 (WC Act); and the Meekatharra Slider (*Lerista eupoda*) listed as Priorty 1 (DPaW);
- areas of rocky outcropping such as the Quartz Outcrop habitat was targeted for Western Spiny-tailed Skink (*Egernia stokesii badia*); and
- habitats associated with the lake, including the Playa and Samphire, were targeted for Federally listed Migratory and Marine species.

Searching methods included hand-searching for cryptic species, for example by overturning logs and stones, searching beneath the bark of dead trees, investigating crevices and searching for burrows, tracks, diggings, scats, and other signs of fauna. Aural surveys for avifauna were also carried out. All vertebrate fauna seen or heard, or whose presence was inferred from secondary evidence was documented.

4.5.3 Taxonomy and nomenclature

The nomenclature and taxonomy of mammals, reptiles and amphibians reported follow the Checklist of the Vertebrates of Western Australia, and those of birds follow the Birds Australia Checklist of Australian Birds, based on Christidis and Boles (2008). Relevant texts, from which information on more recent taxonomic updates and general patterns of distribution are available, were also considered for:

- mammals (van Dyck *et al.* 2013, Woinarski *et al.* 2014);
- birds (Johnstone and Storr 1998, 2004, Morcombe 2003, Pizzey and Knight 2007)
- reptiles (Cogger 2014, Storr *et al.* 1999, 2002, Wilson and Swan 2013); and
- amphibians (Cogger 2014, Tyler and Doughty 2009).

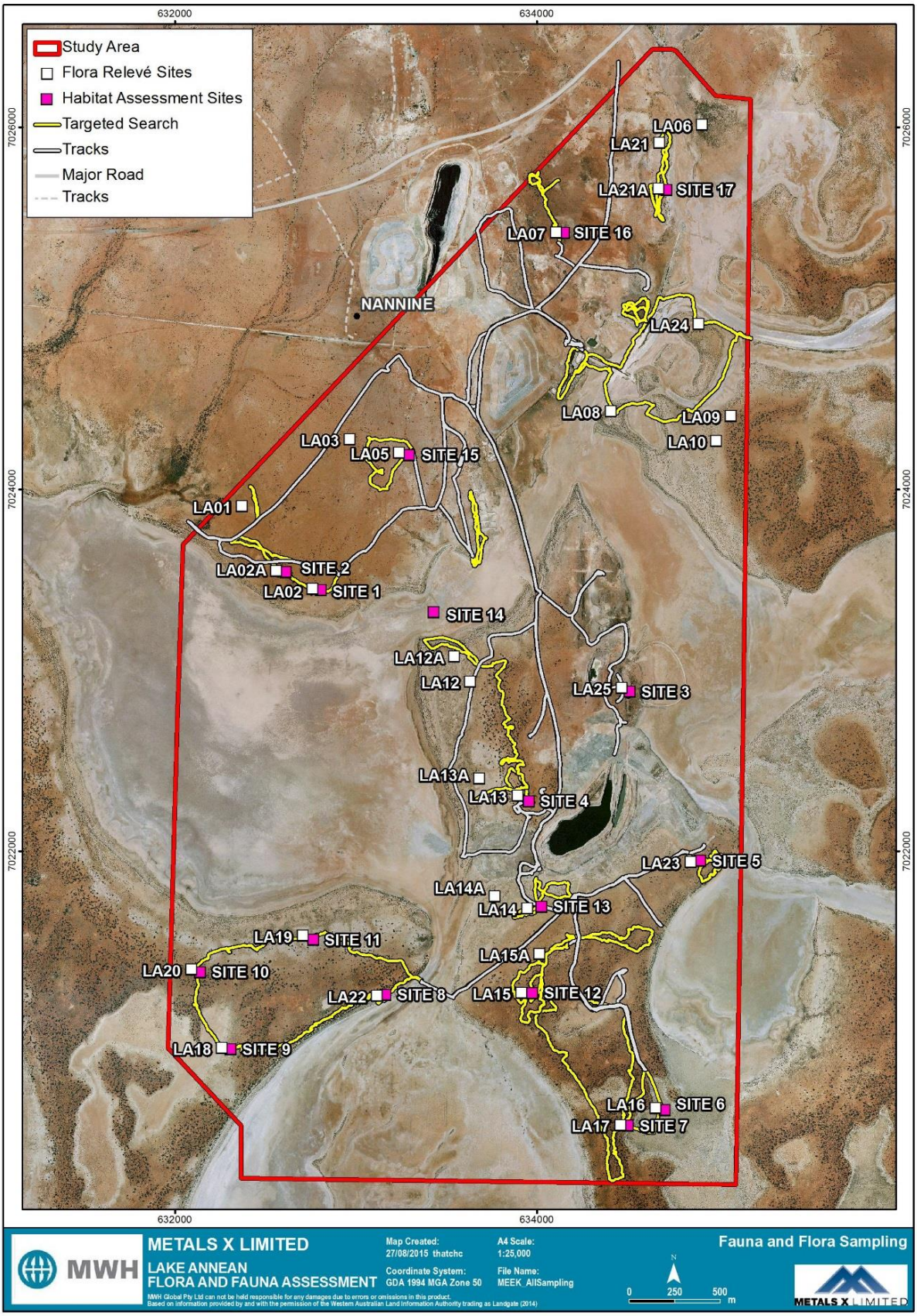

Figure 4-1: Sampling sites and tracks traversed during the field component

5 Results

5.1 Flora and Vegetation

5.1.1 Desktop Assessment

The database searches identified 41 flora taxa of conservation significance as potentially occurring in the Study Area. Of the 41 taxa identified from the desktop assessment, four are considered likely to occur and 12 taxa are considered possible to occur, while the remaining 25 taxa are considered unlikely to occur due to their current extents and habitat preferences (**Appendix B**).

The four taxa, *Acacia sclerosperma* subsp. *glaucescens* (P3), *Acacia speckii* (P4), *Ptilotus lazarides* (P3) and *Tecticornia cymbiformis* (P3), likely to occur have previously been recorded within 5 km of the Study Area and in habitat that occurs within the Study Area (**Figure 5-1**). *Tecticornia cymbiformis* (P3) has previously been recorded occurring in Lake Annean and is considered to persist in the Lake outside of, and potentially within the Study Area. The remaining three priority taxa considered likely to occur in the Study Area have been recorded on the stony and sandy plains adjacent to Lake Annean (**Figure 5-1**).

The desktop search did not identify any threatened flora as 'likely' or 'possible' to occur within the Study Area. One threatened flora, Eremophila *rostrata subsp. rostrata*, ranked as Critically Endangered under the WC Act and the EPBC Act, has previously been recorded 67 km south of the Study Area in a single locality to the north of Cue. The threatened taxon is highly unlikely to occur in the Study Area due to the restricted population and the rarity of the taxon.

No threatened ecological communities (TECs) or priority ecological communities (PECs) associated with flora or vegetation potentially occurring within the vicinity of the Study Area were identified by the desktop assessment. However three PECs associated with invertebrate assemblages potentially occurring within groundwater aquifers were identified (**Figure 5-1**) (**Section 5-2-1**)

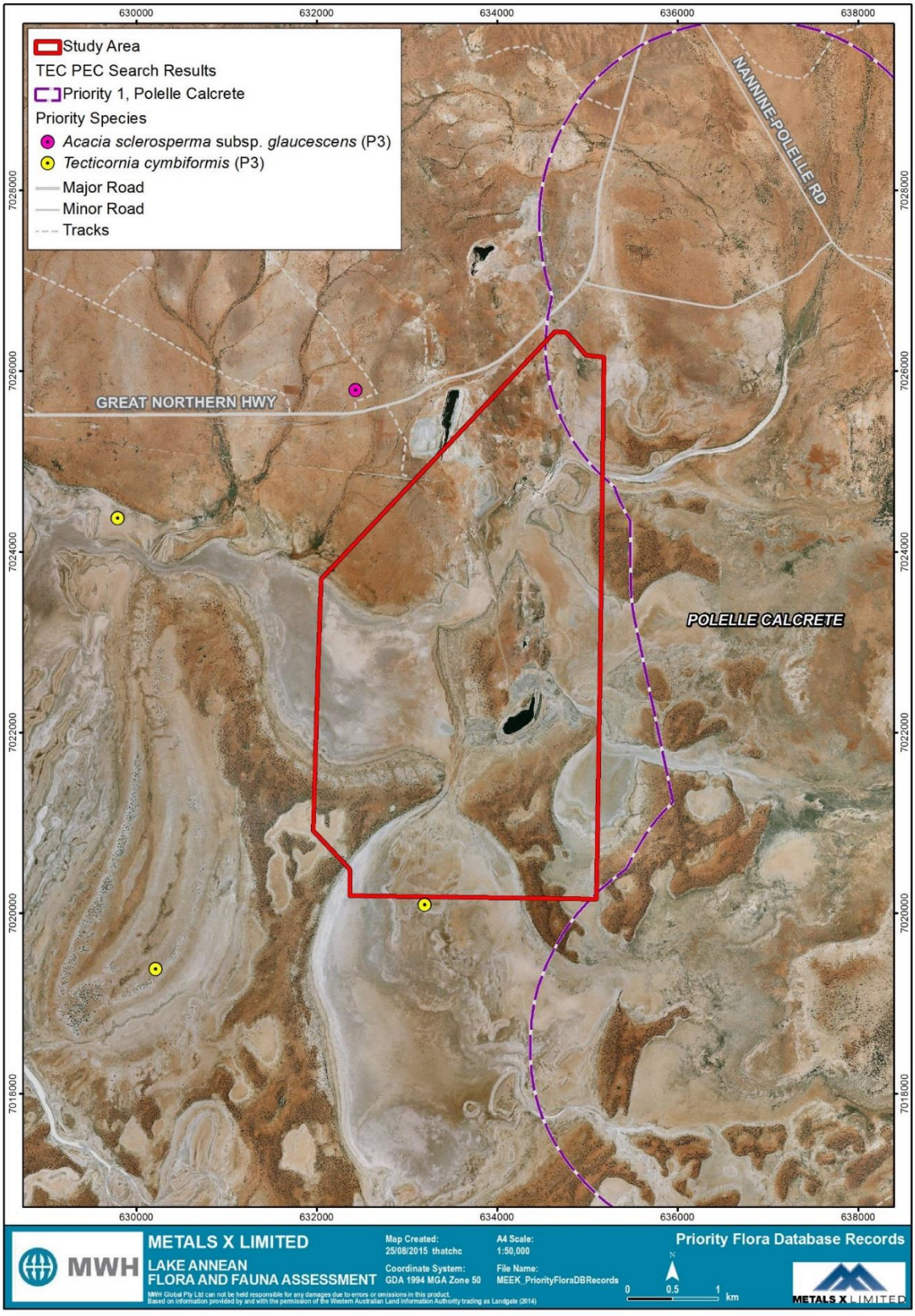

Figure 5-1: Flora of conservation significance recorded via the desktop study

5.1.2 Previous biological assessment results

Prior to, and at the completion of, the field survey, a review of previous biological assessments undertaken in close proximity to the Study Area which occurred in similar habitat was undertaken to identify additional significant flora and vegetation values that the database searches failed to identify. The database searches generally do not identify flora and vegetation of 'other conservation significance' which includes flora and vegetation communities potentially new to science, that are range extensions and unusual/unique taxa or vegetation that may warrant further research and science.

The review of the biological assessments centred on studies that have occurred on salt lakes and the adjacent habitats, including stony and sandy plains, gypsum rises and banded ironstone formations (BIF). The results of the review are summarised in **Table 5-2**.

Table 5-1: Review of biological assessments

Biological report	Location	Flora significance	Introduced taxa	Vegetation Significance
Moyagee	Approx. 96 km south-west	• Rhodanthe collina (P1); • Gunniopsis propinqua (P3); • Hibiscus krichauffianus (P3); • Grevillea inconspicua (P4); • Roycea divaricata (RE); • Plantago turrifera (RE); • *Acacia oswaldii* (variant) (U); • *Acacia oswaldii* (wider leaf variant) (U); • Goodenia sp. (aff. pinnatifida) (U)	• *Cenchrus ciliaris; • *Pentameris airoides subsp. airoides; • *Sonchus oleraceus; • *Lysimachia arvensis	• Lake Austin BIF (PEC); • Lake Austin Calcrete (PEC) • Sheet flow dependent Mulga vegetation.
Lake Austin	Approx. 94 km south-west	• Tecticornia fimbriata (P3); • Goodenia gypsicola (RE); • Chenopodium curvispicatum (RE); • Rhagodia latifolia subsp. recta (U); • Goodenia sp. (aff. pinnatifida) (U); • Tecticornia sp. (aff. auriculata) (U); • *Tecticornia* sp. (aff. *undulata* 'Barlee') (U); • *Tecticornia* sp. (aff. Burnerbinmah (D. Edinger et al. 101)) (U)	• *Sonchus oleraceus	• Lake Austin BIF (PEC); • Lake Austin Calcrete (PEC) • Sheet flow dependent Mulga vegetation. • Groundwater dependent vegetation (Samphire) on lake Austin

Biological report	Location	Flora significance	Introduced taxa	Vegetation Significance
Mt Eelya	Approx. 50 km south	• Stenanthemum mediale (P1); • *Baeckea* sp. London Bridge (M.E. Trudgen 5393) (P3); • Drummondita miniata (P3); • Gunniopsis propinqua (P3); • Hibiscus krichauffianus (P3); • Prostanthera petrophila (P3); • Sida picklesiana (P3); • Tribulus adelacanthus (P3); • Acacia speckii (P4); • *Calandrinia* sp. The Pink Hills (F. Obbens FO 19/06) (RE); • Enneapogon cylindricus (RE); • Eriochlamys eremaea (RE); • Neurachne minor (RE); • Ptilotus roei (RE); • *Sida* sp. verrucose glands (F.H. Mollemans 2423) (RE)	• *Erodium aureum	• Sheet flow dependent Mulga vegetation.
Reedy	Approx. 10 km south	• Ptilotus beardii (P3)	• *Cucumis myriocarpus; • *Cynodon dactylon; • *Sonchus oleraceus	• One vegetation unit that supports a Priority 3 taxon.

5.1.3 Vegetation condition

The condition of the vegetation present within the Study Area was considered to be variable and reflective of the historical mining and anthropogenic disturbances that have occurred within the Study Area (**Table 5-2**, **Figure 5-2**). The vegetation condition ranged from excellent to completely degraded, with the majority of the vegetation considered to be very good to good.

The vegetation located in the northern section and on the northern section of Baileys Island was considered to be in poorer condition as a direct result of the historical mining and pressures from cattle and feral herbivore grazing. Small pits, shafts, tunnels and informal tracks were located throughout the northern section of the Study Area, while infrastructure, including a shed and old concrete slabs, associated with the historical mining were evident.

The vegetation located in association with the lake, and along the eastern and southern extremities were in better condition. Evidence of grazing from cattle and feral herbivores were present, however, the larger-scale impacts from mining were not evident.

Table 5-2: Vegetation condition in the Study Area

Vegetation Condition	Portion of Study Area	
	Area ha	%
Completely Degraded	118.42	7.53
Degraded	19.13	1.22
Good	82.43	5.24
Good – Degraded	94.24	5.99
Very Good - Good	212.7	13.52
Very Good	202.77	12.89
Excellent	843.68	53.62
Total	**1573.37**	**100.00**

Figure 5-2: Vegetation condition of the Study Area

5.1.4 Broad floristic formations and vegetation associations

Eight broad floristic formations were recorded from the Study Area during the field component of the assessment. The eight broad floristic formations are described below, and generally consist of Mulga trees or shrublands and shrublands dominated by members of the Chenopodiaceae family.

- *Acacia* open tall shrubland.
- *Acacia* scattered low trees.
- *Acacia* scattered tall shrubs.
- *Hakea* open tall shrubland.
- *Maireana* chenopod shrubland.
- *Melaleuca* open tall shrubland.
- *Salsola* low chenopod shrubland.
- *Tecticornia* samphire shrubland.

In addition to the eight broad floristic formations described above, an additional two units described as lake playa, or lake bed and mine infrastructure have been mapped as occurring within the Study Area. The lake bed occurs within Lake Annean and is devoid of native vegetation, including samphire vegetation. The lake bed was the most dominant mapping unit across the Study Area. The mine infrastructure mapping includes the historical mine pits, infrastructure, waste rock landforms, tailing facilities and associated tracks.

Following the delineation of the broad floristic formations, 14 vegetation associations were described based on the releve data collected, aerial interpretation and ground-truthing. The 14 vegetation associations are described in **Table 5-3**. The mapped extent of the vegetation associations is provided in **Figure 5-3**. Detailed descriptions for each relevé are provided in **Appendix C**.

The samphire vegetation consists of a complex array of samphire communities that are dependent on separate zonation requirements. These requirements can include soil drainage, soil moisture, salt concentration, soil composition and temperature. As a result, small changes in height above the lake playa can result in a series of different biotic factors that influences the presence of *Tecticornia* species. Samphire species have evolved to fill these different niches in the hostile environments they inhabit.

Aerial interpretation of the samphire communities occurring in Lake Annean was undertaken to assist in the mapping of the separate samphire communities. However, due to these microclimates and small changes in topography within Lake Annean, mapping the individual communities is difficult without high resolution aerial imagery. As such, the samphire communities were not separated and have been referred to as a mosaic of samphire vegetation (VA03: *Tecticornia* samphire shrubland. Mosaic of mid to tall samphire shrubland dominated by *Tecticornia* species on moist clay).

Table 5-3: Vegetation associations recorded in the Study Area

Code	Broad Floristic Formation	Vegetation Association	Sample sites	Area within the Study Area (ha)	Photograph
LB	Bare lake bed (playa)	Bare lake bed (playa)	NS	434.26	No photo taken
MI	Mine infrastructure	Historical mining infrastructure, consisting of pits, waste rock landforms, tailings landforms, causeways	NS	113.94	
VA01	*Maireana* chenopod shrubland	Scattered shrubs of *Maireana pyramidata* and *Cratystylis subspinescens* over low chenopod shrubland of *Maireana tomentosa, Maireana triptera* and *Dissocarpus paradoxus* over scattered low tussock grassland of *Aristida contorta* on red/brown sandy, clay loam.	LA01; LA02a	24.73	

Code	Broad Floristic Formation	Vegetation Association	Sample sites	Area within the Study Area (ha)	Photograph
VA02a	*Acacia* scattered tall shrubland	Scattered tall shrubs of *Acacia pteraneura* and *Acacia tetragonophylla* over scattered mid shrubs of *Senna* sp. Meekatharra (E. Bailey 1-26) and *Senna artemisioides* subsp. *helmsii* over open low shrubland of *Maireana triptera, Eremophila ? jucunda* subsp. *jucunda* and *Ptilotus obovatus* over very open low tussock grassland of *Aristida contorta* on red/brown loamy sand with stony surface.	LA03	14.97	
VA02b	*Acacia* scattered tall shrubland	Scattered tall shrubs of *Acacia pteraneura* over open low chenopod shrubland of *Maireana pyramidata, Maireana triptera* and *Rhagodia eremaea* over very open low tussock grassland of *Aristida contorta* on red/brown stony, loamy sand with stony surface.	LA02; LA05	216.53	
VA03	*Tecticornia* samphire shrubland	Mosaic of mid to tall samphire shrubland dominated by *Tecticornia* species on moist clay. (see Section 5-1-4 above).	LA06; LA08; LA10; LA12a; LA14a; LA16; LA22; LA24	452.23	

Code	Broad Floristic Formation	Vegetation Association	Sample sites	Area within the Study Area (ha)	Photograph
VA04	*Acacia* open tall shrubland	Open tall shrubland to scattered tall shrubs of *Acacia fuscaneura* and occasional *Acacia synchronicia* over open mid shrubland of *Eremophila latrobei* subsp. *latrobei, Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila* spp. over scattered low shrubs of *Ptilotus obovatus* and *Solanum lasiophyllum* over open low chenopod shrubland of *Maireana triptera* and *Sclerolaena* spp. over very open low tussock grassland of *Aristida contorta* and *Enneapogon caerulescens* on skeletal red/brown loamy sand with ironstone outcropping.	LA07; LA25	47.19	
VA05	*Hakea* open tall shrubland	Open tall shrubland to isolated patches of tall shrubs of *Hakea preissii* and *Acacia sclerosperma* subsp. *sclerosperma* over open mid shrubland to scattered mid shrubs of *Dodonaea viscosa* subsp. *angustissima, Maireana pyramidata* and *Cratystylis subspinescens* over scattered mid chenopod shrubs of *Maireana triptera* and *Atriplex vesicaria* over scattered low tussock grassland of *Aristida contorta* on red/orange loamy sand.	LA09; LA23	43.27	
VA06	*Salsola* low chenopod shrubland	Scattered mid shrubs of *Maireana pyramidata* and *Eremophila longifolia* over low chenopod shrubland to low open chenopod shrubland of *Salsola australis*, *Sclerolaena diacantha* and *Dissocarpus paradoxus* over scattered low herbs of *Swainsona paradoxa* on red/orange fine clayey loam.	LA12; LA14	47.94	

Code	Broad Floristic Formation	Vegetation Association	Sample sites	Area within the Study Area (ha)	Photograph
VA07a	*Acacia* scattered low trees	Scattered low trees of *Acacia fuscaneura* over open tall shrubland to isolated patches of tall shrubs of *Acacia sclerosperma* subsp. *sclerosperma* and *Hakea preissii* over open mid shrubland of *Eremophila* sp. B, *Senna artemisioides* subsp. *filifolia* and *Senna artemisioides* subsp. *helmsii* over scattered low shrubs of *Ptilotus obovatus* on orange/red clayey, sand.	LA13; LA20	103.48	
VA07b	*Acacia* scattered low trees	Scattered low trees of *Acacia pteraneura* over scattered tall shrubs of *Hakea preissii* over mid shrubland of *Senna* sp. Meekatharra (E. Bailey 1-26), *Senna* sp. Billabong (J.D. Alonzo 721) and *Eremophila* sp. A on red/orange loamy sand.	LA15a	6.48	
VA07c	*Acacia* scattered low trees	Open tall shrubland of *Acacia fuscaneura* over open mid shrubland of *Eremophila* sp. A over scattered mid chenopod shrubs of *Salsola australis*, *Maireana pyramidata* and *Maireana tomentosa* over scattered mid tussock grasses of *Eragrostis* sp. on red loamy sand.	LA15	9.02	

Code	Broad Floristic Formation	Vegetation Association	Sample sites	Area within the Study Area (ha)	Photograph
VA08	*Acacia* scattered tall shrubland	Isolated patches of mid shrubs of *Acacia sclerosperma subsp. sclerosperma* over scattered low shrubs to open low shrubland of *Frankenia laxiflora, Sclerolaena fimbriolata* and *Enchylaena tomentosa* var. *tomentosa* over open low tussock grassland of *Eragrostis eriopoda* and *Enneapogon caerulescens* on orange/red loamy sand with gypsum outcropping	LA13a; LA19	25.82	
VA09	*Melaleuca* open tall shrubland	Open tall shrubland of *Melaleuca stereophloia* over open mid samphire shrubland of *Tecticornia* ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552) over scattered low shrubs of *Frankenia laxiflora* on red/orange clayey sand.	LA17	1.55	
VA10	*Maireana* chenopod shrubland	Scattered mid shrubs of *Lawrencia helmsii* and *Maireana pyramidata* over low chenopod shrubland of *Atriplex vesicaria* and *Maireana amoena* on red/brown clayey sand.	LA18	23.05	

Code	Broad Floristic Formation	Vegetation Association	Sample sites	Area within the Study Area (ha)	Photograph
VA11	*Acacia* open tall shrubland	Open tall shrubland of *Acacia fuscaneura* over scattered mid shrubs to open mid shrubland of *Eremophila macmillaniana* and *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Ptilotus obovatus, Solanum lasiophyllum* and *Maireana pyramidata* over very open low tussock grassland of *Aristida contorta* and *Enneapogon caerulescens* on red/orange/white skeletal sandy loam with quartz outcropping.	LA21; LA21a	8.88	

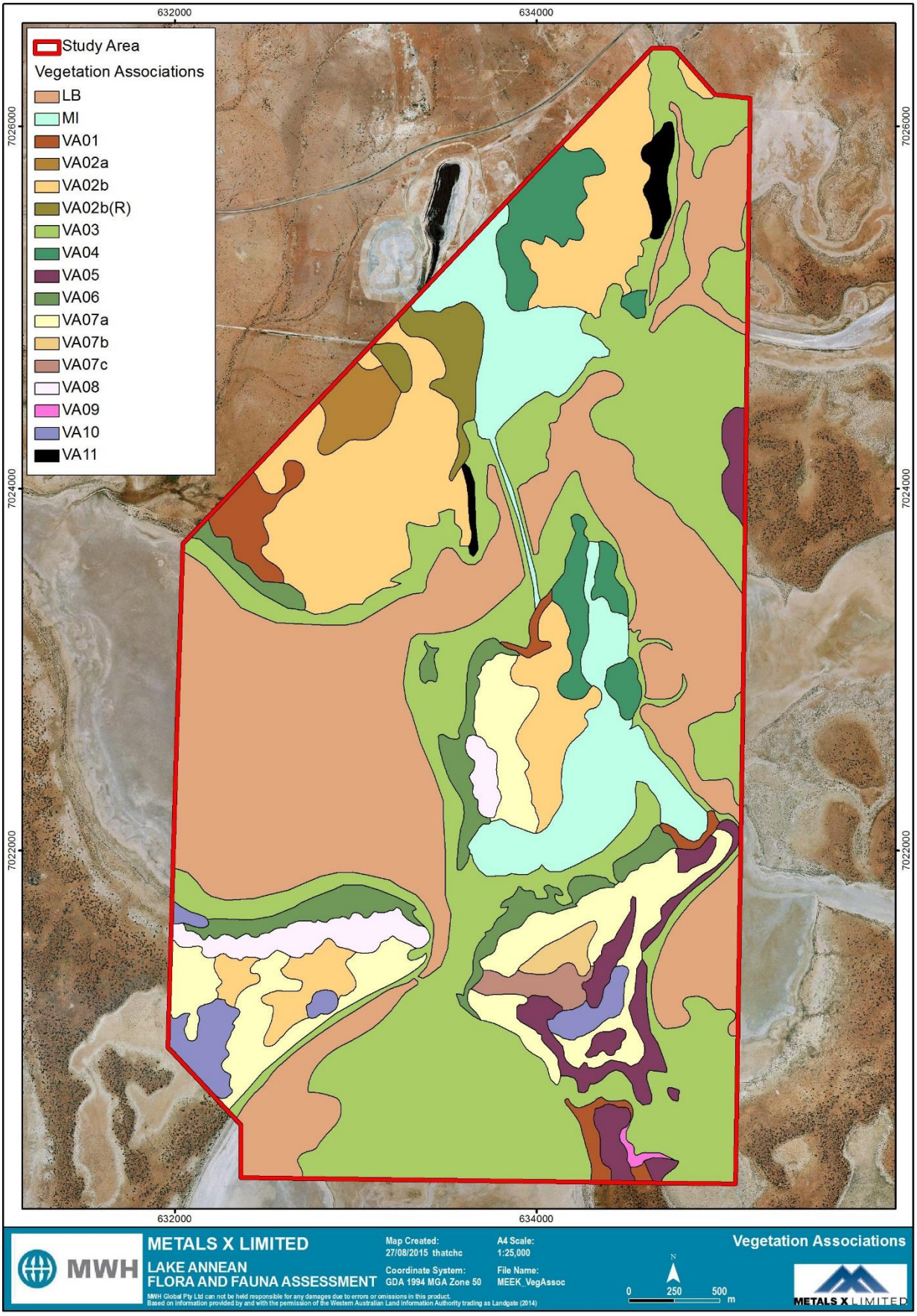

Figure 5-3: Vegetation communities of the Study Area

5.1.5 Vegetation significance

5.1.5.1 Poorly protected bioregion and subregions

The bioregions and subregions are the reporting unit for assessing the status of native ecosystems and their level of protection in the National Reserve System. In this way, IBRA is used as a dynamic tool for monitoring progress towards building a comprehensive, adequate and representative (CAR) reserve system (DOTE, 2014a).

According to the National Reserve System, the Murchison bioregion is considered to be an under represented bioregion and has less than 10% protection. Both the Murchison bioregion and the Western Murchison subregion have between 5 and 10% of their current area protected within IUCN Class I-IV Reserves (i.e. National Parks, Nature Reserves).

5.1.5.2 Threatened and Priority Ecological Communities

The vegetation associations described from the Study Area are not considered to represent any TECs or PECs known to occur in close proximity to the Study Area or the wider Western Murchison subregion.

5.1.5.3 Vegetation System Associations (Shepherd et al., 2002)

The status of native ecosystems and the level of protection they are awarded in the National Reserve System is assessed by bioregions and subregions (NRMMC, 2009). IBRA is used to monitor progress in building a comprehensive, adequate and representative (CAR) reserve system (DPaW 2014). Governments use this information to prioritise allocation of funding to meet national biodiversity protection targets.

The National Objectives and targets for Biodiversity Conservation 2001-2005 recognises that a retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected (ANZECC, 2000). EPA Position Statement No. 2 defines the threshold level of vegetation preservation, below which species loss appears to accelerate exponentially at the ecosystem level, as being 30% of the pre-clearing extent of the vegetation type (EPA 2000). In addition to the ANZECC 30% retention target, the EPA has adopted a 10% level of pre-clearing extent as representing 'endangered' (EPA 2000).

The four vegetation associations occurring within the Study Area are not protected within any IUCN Class I-IV Reserves. However, greater than 98% of the pre-European extent remains within the Murchison bioregion and the Western Murchison subregion (**Table 3-3**). Therefore, the vegetation associations in the bioregion and subregion are not considered to be at threat of exponential biodiversity and species loss.

5.1.5.4 Ecological corridors

The Study Area is located within the Western Murchison subregion, which historically, has not been extensively cleared. Clearing and disturbance of vegetation has been concentrated on mineral deposits, townsites, infrastructure corridors, pastoral station and along ephemeral drainage lines. This is evident by

99.9% of the pre-European extent of the Western Murchison subregion still remaining intact (Government of Western Australia, 2014).

The proposed clearing and associated exploration drilling works within the Study Area will not impact on the connectivity of the surrounding vegetation. The clearing is proposed to be small in size and concentrated in the north of the Study Area.

5.1.6 Flora diversity

A total of 105 vascular taxa from 28 families and 50 genera, were recorded from the Study Area. This included three introduced taxa, one planted exotic and 101 native taxa (**Appendix D**). The dominant families and genera are presented in **Table 5-4** and **Table 5-5**.

Table 5-4: Dominant families recorded from the Study Area

Family name	Common name	Number of native taxa	Number of introduced taxa
Chenopodiaceae	Goosefoot family	29	0
Poaceae	Grass family	12	1
Scrophulariaceae	Foxglove family	13	0
Fabaceae	Wattle family	12	0

Of the 28 families represented in the Study Area, 16 were represented by one taxa, while the dominant four families (Chenopodiaceae, Poaceae, Scrophulariaceae and Fabaceae) represented 64% of the total number of taxa recorded from the Study Area.

Of the 50 genera represented in the Study Area, 36 were represented by one taxon, while the dominant four genera (Eremophila, Tecticornia, Maireana and Acacia) represented 36% of the total number of taxa recorded from the Study Area.

Table 5-5: Dominant genera recorded from the Study Area

Genera	Common name	Native taxa	Introduced taxa
Eremophila	Poverty Bushes	13	0
Tecticornia	Samphires	11	0
Maireana	Bluebushes	8	0
Acacia	Wattles	6	0

The floral diversity and composition recorded from the Study Area is consistent with the Murchison goldfields, the landforms (i.e. salt lake), the time of the year the survey was undertaken and the level of, and sampling intensity (relevés) of the survey (i.e. Level 1). A comparison of floral diversity between surveys undertaken in close proximity to the Study Area is presented in **Table 5-6**.

Table 5-6: Comparison with other surveys in close proximity

Reference	Size of survey (ha)	Sampling points	Sampling intensity (sites/ha)	Total taxa recorded	Native taxa	Introduced taxa
Mt Eelya (Coffey Environments, 2013c)	2,052	62	0.030	225	223	2
Moyagee (Coffey Environments, 2013a)	3,037	44	0.014	206	202	4
Lake Austin (Coffey Environments, 2013b	2,381	23	0.012	156	155	1
This survey	**1577**	**29**	**0.018**	**105**	**101**	**4**
Reedy (MWH, 2015)	5254	19	0.004	101	98	3
Comet (Coffey Environments, 2012a)	316	12	0.038	54	54	0
Tuckabianna (Coffey Environments, 2012b)	490	12	0.024	53	52	1
Central Murchison (Outback Ecology, 2012)	3,846	19	0.005	151	143	8

Of the specimens collected, 20 specimens were unable to be confidently identified to species or infraspecies level due to a lack of flowering and/or fruiting material. The timing of the survey was the limiting factor in being unable to identify the specimens accurately. Flowering and/or fruiting material was not present, which is required for accurate identifications.

The specimens were identified to genera level, with some also being identified to species level. Nine specimens were not identified to species level, five were tentatively identified to species level, while the remaining six were not able to be confidently identified to infraspecies level. The 20 specimens with tentative identifications are not considered to be analogous with any of the 'likely' or 'possible' priority flora potentially occurring in the Study Area.

5.1.7 Flora of conservation significance

5.1.7.1 Threatened flora

The field survey did not record or identify any threatened flora as occurring within the Study Area. The desktop assessment identified one threatened taxon, *Eremophila rostrata* subsp. *rostrata*, ranked as critically endangered under the WC Act and the EPBC Act, as potentially occurring in the Study Area. The threatened

taxon is not considered to occur in the Study Area due its current known location and rarity. In addition, the Study Area does not meet the requirements of 'Critical Habitat', which is the area of known occupancy; areas of similar habitat within 200 m of known populations; and additional occurrences of similar habitat that may represent translocation sites (Stack and English, 2003).

5.1.7.2 Priority Listed flora

The field survey did not identify any priority listed taxa as occurring within the Study Area. However, as discussed in Section 5.1.1, *Tecticornia cymbiformis*, a Priority 3 taxon, is known to occur at Lake Annean (**Figure 5-1**). Although no individuals were not recorded from the Study Area, this is not considered to exclude the taxon from the Study Area. Due to the complexities of the samphire vegetation and the size of Lake Annean, it is possible that *Tecticornia cymbiformis* exists within the Study Area. The entire extent of the samphire vegetation within the Study Area was not traversed and individual *Tecticornia* species can be difficult to discern *in situ*, which amounts to a level of uncertainty in the identification of all *Tecticornia* species present within the Study Area.

The *Tecticornia* species collected during the field survey were compared to reference samples at the Western Australian Herbarium to determine if there were any similarities between the collected specimens and Priority *Tecticornia* species, including *Tecticornia cymbiformis* and *Tecticornia fimbriata*, which has previously been recorded from Lake Annean and other nearby salt lakes. The specimens collected from the field were confirmed to not represent any priority *Tecticornia* species.

No other priority flora species were recorded from the Study Area, while the remaining three priority taxa considered likely to occur, *Acacia sclerosperma* subsp. *glaucescens* (P3)*, Acacia speckii* (P4) and *Ptilotus lazaridis* (P3), were not identified during the field survey. *Acacia sclerosperma* subsp. *glaucescens* and *Acacia speckii* are both readily identifiable from vegetative material, while *Ptilotus lazaridis* would have been flowering at the time of the field survey ensuring a confident identification if present.

5.1.7.3 Flora of other conservation significance

No other flora specimens recorded from the Study Area represent flora of significance and worth conserving. The exclusion to this is the samphire communities, which are a cryptic and complex group of taxa undergoing revision. Due to the constraints of the survey, including timing and scope, the majority of the *Tecticornia* specimens are only tentative and may warrant further review by an expert taxonomist, for example Dr Kelly Shepherd at the Western Australian Herbarium, to accurately identify the *Tecticornia* species present.

5.1.8 Introduced Flora

Three introduced taxa, **Acetosa vesicaria* (Ruby Dock), **Cenchrus ciliaris* (Buffel Grass) and **Citrullus lanatus* (Pie Melon), and one native, planted exotic, *Eucalyptus camaldulensis* (River Red Gum), were recorded from the Study Area during the field survey. The number of introduced taxa recorded from the Study Area is considered to be low and would undoubtedly increase following a more systematic survey of the Study

Area in the optimum flowering season. It is anticipated that introduced annuals and biennials would be present in higher numbers in association with the historic mining infrastructure.

5.1.8.1 Weeds of National Significance

The three introduced taxa are not considered to be weeds of national significance. The specimens that were tentatively identified are not analogous with any introduced taxa that are considered to be WONS.

5.1.8.2 Declared Pests

The three introduced taxa are not considered to be Declared Plant Pests and are listed as Permitted under Section 11 of the BAM Act.

5.1.8.3 Environmental Weeds and Weed prioritisation process

DPaW are currently revising the weed prioritisation process for the Mid-west/Goldfields region, as such the current prioritisation ranking for each of the three introduced species is difficult to ascertain. The three introduced taxa are present in varying densities throughout the Murchison bioregion, so it is feasible to assume that the three introduce taxa do not have a 'Very High' or 'High' prioritisation ranking. The ranking for each introduced taxa may be 'Medium' to 'Low'.

5.2 Terrestrial Fauna

5.2.1 Desktop Study

The desktop study identified a total of 236 species of vertebrate fauna, which have been recorded and/or have the potential to occur within the Study Area (**Appendix E**). This total comprises eight native mammal, eight introduced mammal, 181 native bird, one introduced bird, 36 native reptile and two amphibian species. Many of these species are unlikely to occur in the Study Area because, as leading practice, these records are from a large area encompassing a wide range of habitats, many of which do not occur within the Study Area. Furthermore, some small, common, ground-dwelling reptile and mammal species tend to be patchily distributed even where appropriate habitats are present, and many species of bird can occur as regular migrants, occasional visitors or vagrants.

The desktop assessment identified three priority ecological communities (PECs) as occurring in close proximity to the Study Area. All are associated with invertebrate assemblages potentially occurring within groundwater aquifers (**Table 5-7**). A small portion of the buffered PEC zone of "Polelle Calcrete" is partially located across the northern section in association with Lake Annean and also touches the south-eastern corner of the Study Area (**Figure 5-1**) (**Table 5-7**). Unique assemblages of invertebrates have been identified in the groundwater calcretes of this PEC. The groundwater calcretes occur along the eastern side of Lake Annean, in association with Porlell Lake on the Polelle Station.

Table 5-7: Likelihood of the PECs occurring within the Study Area

PEC Code	Description	Conservation rating	Location	Likelihood of occurrence
Polelle Calcrete	Polelle calcrete groundwater assemblage type on Murchison palaeodrainage on Polelle Station	Priority 1	Located immediately adjacent to the eastern boundary of the Study Area. A small portion in the north-east and south-east of the Study Area occurs within the buffered PEC zone.	Present. The Study Area is partially located within the buffered zone of the PEC.
Taincrow Calcrete	Taincrow calcrete groundwater assemblage type on Murchison palaeodrainage on Taincrow Station	Priority 1	Located approximately 43 km south-west of the Study Area.	Unlikely. The PEC is located in association with the Taincrow Calcrete on Taincrow Station, which does not occur within the Study Area.
Nowthanna Calcrete	Nowthanna Hill calcrete groundwater assemblage type on Murchison palaeodrainage on Yarrabubba Station	Priority 1	Located approximately 28 km south-east of the Study Area.	Unlikely. The PEC occurs in association with the Nowthanna Hill calcrete which does not occur in the Study Area

5.2.2 Species Composition

A total of 29 vertebrate fauna species were recorded during the field survey (**Table 5-8**), comprising five mammals (three native), 17 birds, six reptile species and one amphibian. Two introduced vertebrate fauna taxa were recorded during the Survey, European Cattle (*Bos taurus*) and Rabbit (*Oryctolagus cuniculus*).

Five fauna species listed as Marine (EPBC Act) were recorded during the survey and one species listed as Priority 1 (DPaw) was recorded from the Dunefields habitat during the Survey (**Figure 5-4**)(**Plate 1**).

Table 5-8: Vertebrate fauna recorded during the Survey

Family and Species name	Common name	Conservation status	
		EPBC Act	In WA
Mammals			
Bovidae			
**Bos taurus*	European Cattle		
Canidae			
Canis lupus	Dog/Dingo		
Leporidae			
**Oryctolagus cuniculus*	Rabbit		
Macropodidae			
Macropus robustus	Euro		
Tachyglossidae			
Tachyglossus aculeatus	Short-beaked Echidna		
Birds			
Anatidae			
Cygnus atratus	Black Swan		
Tadorna tadornoides	Australian Shelduck		
Casuariidae			
Dromaius novaehollandiae	Emu		
Charadriidae			
Charadrius ruficapillus	Red-capped Plover	Marine	
Corvidae			
Corvus orru	Torresian Crow		
Dicruridae			
Rhipidura leucophrys	Willie Wagtail		
Estrildidae			
Taeniopygia guttata	Zebra Finch		
Falconidae			
Falco cenchroides	Australian Kestrel	Marine	
Hirundinidae			
Hirundo neoxena	Welcome Swallow	Marine	
Maluridae			
Malurus leucopterus	White-winged Fairy-wren		
Meliphagidae			
Epthianura aurifrons	Orange Chat		
Lichenostomus virescens	Singing Honeyeater		
Motacillidae			
Anthus australis	Australian Pipit	Marine	
Pachycephalidae			
Oreoica gutturalis	Crested Bellbird		
Pelecanidae			
Pelecanus conspicillatus	Australian Pelican	Marine	
Podicipedidae			

Family and Species name	Common name	Conservation status	
		EPBC Act	In WA
Poliocephalus poliocephalus	Hoary-headed Grebe		
Turnicidae			
Turnix velox	Little Button-quail		
Reptiles			
Agamidae			
Ctenophorus caudicinctus	Ring-tailed Dragon		
Ctenophorus salinarum	Salt Pan Dragon		
Egerniidae			
Egernia depressa	Southern Pygmy Spiny-tailed Skink		
Eugongylidae			
Menetia greyii			
Gekkonidae			
Gehyra variegata			
Sphenomorphidae			
Lerista eupoda	Meekatharra Slider		P1
Amphibians			
Hylidae			
Litoria rubella	Little Red Tree Frog		

Plate 1: The Priority 1 Meekatharra Slider (*Lerista eupoda*) recorded within the Study Area

Figure 5-4: Records of conservation significant fauna within the Study Area

5.2.3 Fauna Habitats

Five broad fauna habitat types and two minor habitat types were identified within the Study Area (**Table 5-9**, **Figure 5-4**). See **Appendix F** for detailed descriptions of fauna habitats. Broad habitats included:

- Dunefields
- Stony plains
- Samphire
- Ironstone hills
- Lake Playa

Minor habitats included:

- Quartz outcrop
- Chenopod shrubland

Each of these habitats differed substantially in the type of substrate, type and structure of vegetation, and the amount of ground cover available as shelter for fauna. The diversity of habitats were not inconsistent with habitats encountered around salt lakes elsewhere in the Murchison.

The habitat types in the Study Area were assessed on their extents and levels of significance according to the following criteria:

- Distribution: those habitats widespread and common within the surrounding regions were categorized as widespread; otherwise they were categorised as limited; and
- Significance: those habitats considered capable of supporting species of conservation significance or distinct fauna assemblages were categorised as significant; otherwise they were categorised as limited significance.

Table 5-9: Fauna habitats recorded within the Study Area

Habitat type	Extent	Land system	Disturbance and condition	Value to fauna
Dunefields • Limited • significant	161.61 ha (10.27%)	Carnegie System	Very Good Disturbances include: cattle grazing, rabbits and some limited historic exploration clearing for tracks and logging.	This habitat tends to be confined in the region to salt lakes and is consequently of limited extent in the landscape. Vegetation consisted of an open Mulga (*Acacia anura* sp complex) woodland with *Hakea preisii* or *Senna artemisiodies* over an open shrubland of *Eremophillia, Maireana* and *Atriplex* species, over an open tussock grassland. Large trees containing hollows were absent, making this habitat unsuitable for hollow-nesting birds and mammals. The denser areas of vegetation would be suitable for supporting an abundance of small birds, reptiles and mammals. Substrate comprised of deep red sands suitable for burrowing species such as the Meekatharra Slider (Priority 1) which was recorded within this habitat during the Survey.
Stony plains • Widespread • Limited significance	231.51 ha (14.71%)	Austin System Gabanintha System	Very Good – Degraded Disturbances: Cattle grazing, tracks, weeds, historic mining (clearing, rubbish, shafts, machinery)	This habitat occurs in the northern portion of the Study Area and is widespread in the landscape within the bioregion. Vegetation consisted of open Mulga (*Acacia anura* sp complex) woodland over an open shrubland of *Maireana triptra*, *Ptilotus obovardus*, *Solanum lasophylum*, over a sparse tussock grassland or chenopod shrubland. Substrate comprised of red-brown sandy loam with quartz fragments 20-60mm common. There was low burrowing potential on the undulating stony plains and limited woody debris, hollows or crevices suitable for providing shelter for smaller mammals or reptiles. This habitat has limited potential to support fauna species of conservation significance.
Samphire • Limited • significant	475.29 ha (30.21%)	Carnegie System (predominantly)	Excellent - Very Good Disturbances: some cattle grazing.	The samphire habitat is restricted to the vegetated portions of the salt lake and the lake margins. This habitat is limited in then landscape as it only occurs in association with salt lakes. Vegetation consisted of a *Tecticornia* spp shrubland on a clay loam substrate. This habitat is prone to flooding and waterlogging. This habitat has limited potential to support fauna due to limited cover in the form of woody debris, hollows or crevices, however after periods of inundation, this habitat is likely to support foraging migratory wading birds and is likely to provide nesting habitat for marine species.

Habitat type	Extent	Land system	Disturbance and condition	Value to fauna
Ironstone hills • Limited • Limited significance	47.19 ha (3.00%)	Gabanintha System	Good - Degraded Disturbances: Historic mining activities (tracks, clearing, rubbish), weeds, cattle grazing	The Ironstone Hills habitat occurs in the north of the Study Area with a small portion occurring centrally in the Study Area. Much of this habitat had been disturbed by historic mining. Vegetation was sparse and comprised of *Acacia aneura* species complex open woodland over a sparse shrubland of *Senna glutenosa*, *Eremophilia* sp., and *Ptilotua obovardua*, over *Sclerinea*, *Maireana* spp and *Solanum lasophylum*. The substrate was hard and stony which provided low suitability for burrowing species, however the outcropping of ironstone at these sites provided some potential shelter for fauna in the form of rock crevices. The degree of disturbance to this habitat combined with the limited shelter means that this habitat is unlikely to support species of conservation significance.
Lake Playa • Limited • significant	434.26ha (27.60%)	Carnegie System (predominantly)	Excellent - Very Good Disturbances: Some historic mining activity (tracks, excavations)	The Lake Playa comprised unvegetated portions of the lake which is a limited habitat in the region. This habitat provides limited potential to support fauna for much of the year, however after periods of inundation, the lake playa would be important for migratory wading birds that are protected under international agreements and for marine species that may use this habitat for nesting.
Quartz outcrop • Limited • Limited significance	8.88 ha (0.56%)	Gabanintha System Austin System	Very Good - Good Disturbances: historic mining (clearing, mine shafts tracks, excavations), rabbits and cattle grazing.	The Quartz Outcrop habitat was of limited extent in the Study Area, occurring in two areas in the northern and central portion of the Study Area. The habitat is also of limited extent in the region. This habitat provided numerous crevices for reptiles such as *Egernia depressa* which was recorded at two locations within this habitat during the Survey. However, the limited extent of the habitat, the level of disturbance and the lack of vegetation means that this habitat is unlikely to support species of conservation significance.
Chenopod shrubland • Limited • Limited significance	100.68 ha (6.40%)	Carnegie System (predominantly)	Good Disturbances: Cattle grazing and trampling, rabbits, weeds and tracks	The chenopod shrubland habitat was of limited extent in the Study Area and it occurred around the lake margins. Vegetation within this habitat consisteded of low chenopod shrubs including *Tecticornia*, *Atriplex* and *Salsola australis*. The habitat had some potential for burrowing species in the higher margins of the lake dunes which had often been excavated by rabbits and varanids. The lower areas of this habitat were less likely to support fauna species due to the habitat being prone to flooding and the lack of shelter.
Mine Infrastructure	113.94 ha (7.24%)	Various	Degraded - Completely Degraded Disturbances: Historical mining infrastructure, consisting of pits, waste rock landforms, tailings landforms, causeways	Limited

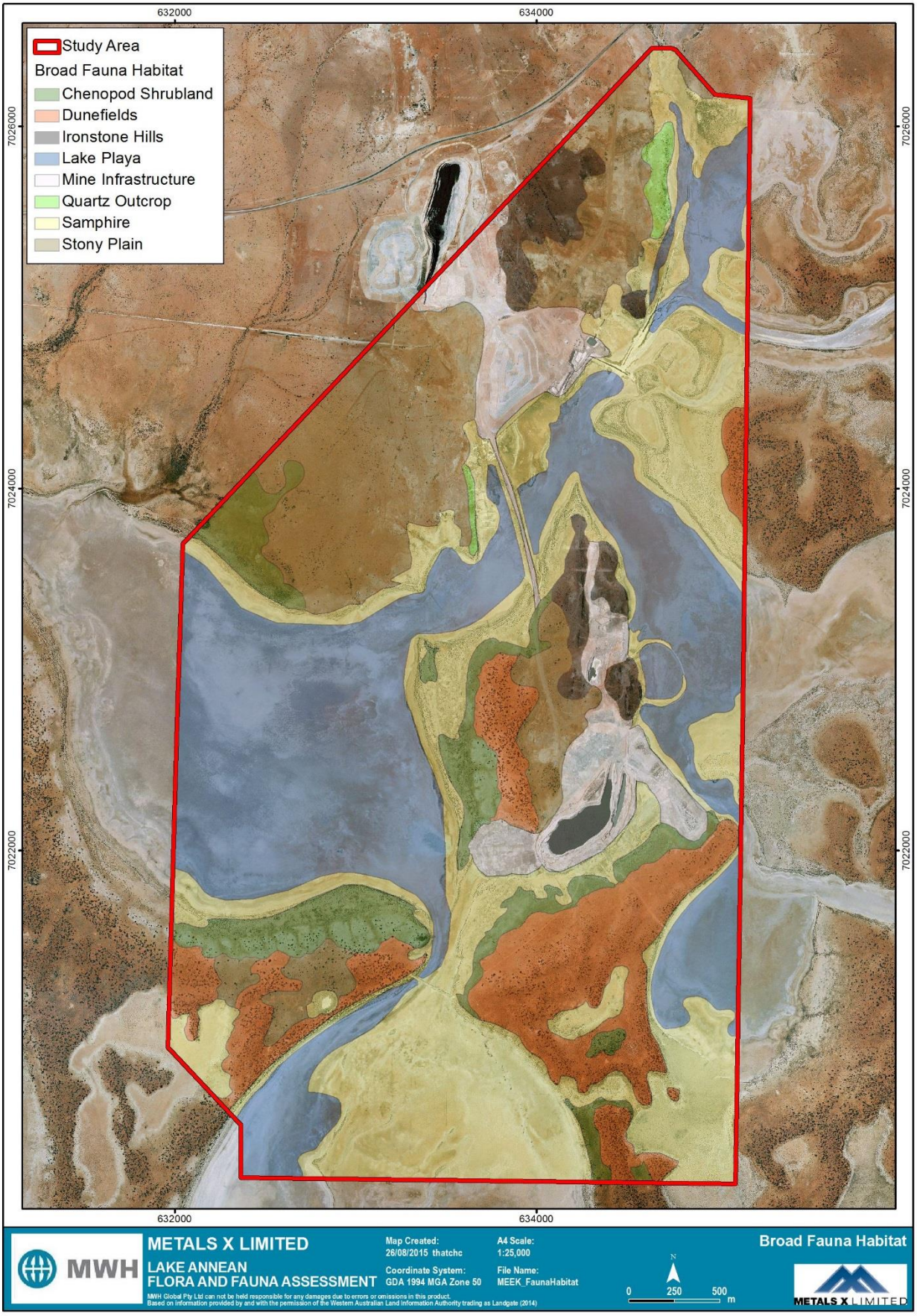

Figure 5-5: Fauna habitats within the Study Area

5.2.4 Fauna of Conservation Significance

Of the 236 species of vertebrate fauna identified as being previously recorded and/or having the potential to occur, 55 are considered conservation significant, including one mammal, 52 bird and two reptiles. Additionally, two invertebrate species of conservation significance have been previously recorded and/or having the potential to occur. Five fauna species listed as Marine (EPBC Act) were recorded during the survey and one species listed as Priority 1 (DPaw) was recorded form the Dunefields habitat during the Survey. Of the 55 species recorded from the desktop study:

- Six species are listed as Threatened under the EPBC Act and/or WC Act (**Table 5-10**). Legislation has been developed at national (EPBC Act) and state (WC Act) levels to protect species of fauna that have been formally recognised as rare, threatened with extinction or having high conservation value (**Appendix A**)
- Four are recognised by DPaW as Priority fauna. DPaW recognises several species that are not listed under the WC Act or the EPBC Act but for which there is some conservation concern, and has produced a supplementary list of Priority fauna (**Appendix A**);
- One species is listed recognised by state (WC Act) to be in need of special protection; and
- Twenty species are listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. Many species of migratory bird are listed under the EPBC Act, the WC Act and international agreements including the Japan-Australia Migratory Bird Agreement, the China-Australia Migratory Bird Agreement, the Republic of Korea-Australia Migratory Bird Agreement and the Bonn Convention on the Conservation of Migratory Species of Wild Animals (**Appendix A**).
- Twenty-seven species listed as Marine under the EPBC Act (but not listed as migratory). Of these, 14 have potential to occur in association with inland saltlakes and the potential for occurring is discussed further is **Table 5-11**. All other species are not discussed further in this section, but are listed in **Appendix E**.

Some of the species referred to above are listed as Threated, Migratory and/or Priority fauna may be included in multiple groups listed above. The likelihood of each of these species of conservation significance occurring in the Study Area has been assessed and ranked (**Table 5-10**). The rankings were assigned following definitions described in the desktop study methodology (**Section 4.1.4**). Those conservation significant fauna recorded in the vicinity of the Study Area during the desktop study are presented in **Figure 5-6**.

Table 5-10: Fauna of conservation significance potentially occurring within the Study Area

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Greater Bilby (*Macrotis lagotis*)	VU	S1	Variety of habitats on soft soil including spinifex hummock grassland, acacia shrubland, open woodland and cracking clays (Burrows *et al.* 2012).	**Unlikely** Few recent records of the species within the vicinity of the Study Area and the species is likely to be locally extinct (Woinarski *et al.* 2014). Nearest DPaW (2015b) record was located ~65 km southeast of the Study Area in 1929 and 80 km west of the Study Area in 1984.
Malleefowl (*Leipoa ocellata*)	VU	S1	Mainly scrubs and thickets of mallee, boree and bowgada, but also other litter forming shrublands (Johnstone and Storr 1998).	**Possible** The species has been recorded at three locations within 100 km of the Study Area between 1999 and 2010 (Birdlife Australia 2015a, DPaW 2015b). The species is only thought to be scattered throughout the region (Benshemesh 2007) with the majority of records occurring further to the south (DoE 2015a). The species tends to occur in dense shrublands and low woodlands which may provide leaf litter suitable for use in the construction of nesting mounds (DoE 2015a). The species may occur in low numbers in the region, if it does occur it is likely to be at low densities. The Dunefield habitat is the only habitat within the Study Area with any potential to support this species. Targeted searches over a large proportion of this habitat did not find any evidence of the species.
Western Spiny-tailed Skink (*Egernia stokesii badia*)	EN	S1	Small, isolated stands of granite to larger, more extensive clusters of rock (DoE 2015a).	**Unlikely** The species has been recorded at three locations ~80 km southwest of the Study Area (DPaW 2015b). The black form of *Egernia stokesii badia* from the Murchison region inhabits areas ranging from small, isolated stands of granite to larger, more extensive clusters of rock (DoE 2015a). This species is unlikely to occur in the Study Area given that habitat which support this species (rocky Granite outcrops) is not present in Study Area. The only similar prospective habitat within the Study Area was the Quartz Outcrop habitat. This habitat was extensively searched and no evidence of the species was found. However, the related smaller species *Ergernia depressa* was found at two locations within this habitat. Note: The population of *Egernia stokesii* on Baudin Island, within Shark Bay that was previously known as *Egernia stokesii aethiops*, has now been included under *Egernia stokesii badia* (DoE 2015a). This is mentioned because *Egernia stokesii aethiops* was identified as a separate species with potential to occur in the Study Area in the recent database search results from the DPaW and DoE.

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Shield-backed Trapdoor (*Idiosoma nigrum*)	VU	S1	At the Weld Range, 50 km west of the Study Area, the species has been found to occur within the boundaries of drainage lines, predominantly under Acacias, on the slopes, footslopes or plains along BIF ranges (DoE 2015a, ecologia Environment 2009b). Substrate predominantly comprises clay and rocks (54%) or clay rock and sand 38% (DoE 2015a, ecologia Environment 2009b).	**Unlikely** There is estimated to be a population in excess of 3,000 individuals at Weld Range located approximately 45 km west of the Study Area (DoE 2015a, DPaW 2015b, ecologia Environment 2009b). The species appears to occur as isolated populations in the Midwest at Jack Hills, Weld Range and Blue Hills. Given the isolation of these populations and they association with prominent ranges, it appears unlikely that this species occurs within the Study Area.
Invertebrates within groundwater of Polelle calcretes		PEC	Calcrete groundwaters	**Possible** The Polelle Calcrete PEC consists of a unique assemblage of invertebrates that persist in the groundwater calcretes of Porlell Lake approximately 10 km to the east. The Study Area is adjacent to the buffered PEC boundary and may not interact with the groundwater assemblage of the PEC. Hydrogeological investigations, include groundwater invertebrate sampling, would be required to confirm if the Study Area interacts with the PEC**.**
Curlew Sandpiper (*Calidris ferruginea*)	Mi/Ma	S1/S3	Commonly inhabits coastal areas namely exposed tidal mudflats, and less frequently on inland freshwater wetlands (Geering *et al.* 2007).	**Possible** Species recorded approximately 7 km west of Study Area in 1980 (Birdlife Australia 2015a), this records represents one of the few inland DPaW (2015b) records for central WA. The species is considered rare inland of north-west Australia and may be recorded on their southward migratory flights (Johnstone and Storr 1998). Suitable habitat (shallow ephemeral open waterbodies) occurs present within the Study Area.
Gull-billed Tern (*Sterna nilotica*)	Mi/Ma	S3	Shallow sheltered seas close to land, estuaries, tidal creeks; and inundated samphire flats, flooded saltlakes, claypans and watercourses in the interior (Johnstone and Storr 1998).	**Very Likely** 200-300 individuals of this species have previously been recorded nesting in the western portion of Lake Annean (DoE 2015b). It is highly likely that this species occurs within the Study Area when the lake fills with water.

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Grey Falcon (Falco hypoleucos)		S1	Mainly lightly wooded coastal and riverine plains (Johnstone and Storr 1998).	**Possible** The species was recorded 15 km southwest of the Study Area in 2003 (Birdlife Australia 2015a, DPaW 2015b). The species occurs in the northern half of the state as far south as 26°S, however has been known to occasionally occur further south in historical times (Johnstone and Storr 1998). The Study Area occurs just south of the species recent distribution and there has been a recent record in vicinity of the Study Area, consequently it is possible that it occurs in the Study Area from time to time for foraging, however it is unlikely to be dependent upon the Study Area for nesting due to a lack of suitable habitat.
Peregrine Falcon (*Falco peregrinus*)	-	S4	The species occurs along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes nesting on cliffs, granite outcrops, quarries (Johnstone and Storr 1998).	**Possible** Species has been recorded 2 km west of the Study Area in 2000 and there are an additional six records within 50 km from 1999-2013 (Birdlife Australia 2015a, DPaW 2015b). The Dunefields habitat of the Study Area provide suitable foraging resources for the species however there is no suitable nesting habitat for the species in the Study Area.
Fork-tailed Swift (*Apus pacificus*)	Mi/Ma	S3	Aerial species, which forages high above the tree canopy and rarely lower (Johnstone and Storr 1998).	**Possible** Species previously recorded approximately 5 km west of the Study Area in 1980 and 60 km southwest of the Study Area in 2001 (Birdlife Australia 2015a, DPaW 2015b). The Study Area is located within the species distribution. The species is an irregular visitor within the region (Johnstone and Storr 1998) and it is possible that the species may fly over and forage above the Study Area on an irregular basis but is not likely to be dependent upon habitat in the Study Area.
Eastern Great Egret (*Ardea modesta*)	Mi/Ma	S3	Shallow freshwater, riverpools, claypans, swamps, lagoons, inundated pastures and wheatfields, ephemeral pools, dams and sewage ponds (Johnstone and Storr 1998).	**Very Likely** This species has been recorded approximately 2.5 km to the northeast of the Study Area in 2011 and there are numerous records from Lake Austin approximately 50 km southwest of the Study Area. The species is considered a uncommon to very common visitor to flooded claypans or flooded samphire after periods of rain (Johnstone and Storr 1998). The species very likely to occur within the Playa and Samphire habitats for foraging when these habitats are inundated with water.
Oriental Plover (*Charadrius veredus*)	Mi/Ma	S3	The species is found on sparsely vegetated plains including Samphire, Spinifex plains (particularly after fire), as well as beaches and tidal flats (Johnstone and Storr 2004)	**Unlikely** There are no records of this species within the vicinity of the Study Area, with the closest record being approximately 500 km away, however the DoE (2015a) suggests that 'habitat may occur' in the vicinity of the Study Area. The species is common to coastal areas and may casually occur in inland areas. Suitable habitat in the form of the lake Playa habitat occurs within the Study Area.

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Rainbow Bee-eater (*Merops ornatus*)	Mi/Ma	S3	Lightly wooded, often sandy country, preferring areas near water (Johnstone and Storr 1998).	**Likely** The species is considered a partial migrant in the region and generally a common species (Barrett *et al.* 2003, Boland 2004). The species has previously been recorded within the vicinity of Study Area. The species may occur over the Study Area as a resident or as a migrant and is more likely to frequent areas where water accumulates such as the claypans that occur in association with the Plays and Samphire habitats
Common Sandpiper (*Actitis hypoleucos*)	Mi/Ma	S3	Edge of sheltered waters, salt or fresh, estuaries, river pools, claypans, drying swamps etc. (Johnstone and Storr 1998).	**Likely** This species has been recorded 50 km south of the Study Area in 2001, however the majority of records of this species are along the Western Australian coastline (Birdlife Australia 2015a, DPaW 2015b). The species prefers large open water bodies and may occur within the Play and Samphire habitats after periods of inundation.
Ruddy Turnstone (*Arenaria interpres*)	Mi/Ma	S3	Tidal mudflats and reef flat, sheltered rocky coasts, pebbly beaches of near coastal saltlakes (Johnstone and Storr 1998).	**Possible** Lake Annean lies outside the species normal distribution, however the lake may provide suitable habitat for foraging during periods of inundation. The species was recorded at Lake Annean in 1983 (DoE 2015b).
Sharp-tailed Sandpiper (*Calidris acuminata*)	Mi/Ma	S3	Coastal and inland areas saline and freshwater but prefers non-tidal fresh or brackish wetlands (Geering *et al.* 2007)	**Likely** This species has been recorded at Lake Austin approximately 50 km south of the Study Area (Birdlife Australia 2015a, DPaW 2015b). The species is more likely to occur in coastal habitats, but may occur inland after substantial rainfall events (Johnstone and Storr 1998). Consequently, the species may visit the large open water bodies Playa habitat within the Study Area after periods of inundation.
Pectoral Sandpiper (*Calidris melanotos*)	Mi/Ma	S3	Mainly freshwaters but also samphires and around saltlakes (Johnstone and Storr 1998).	**Unlikely** There are few inland records of the species (Birdlife Australia 2015a, DPaW 2015b). The Study Area occurs beyond its normal distribution.
Red-necked Stint (*Calidris ruficollis*)	Mi/Ma	S3	Edge of sheltered salt, brackish or fresh waters, mainly estuaries and near coastal wetlands (Johnstone and Storr 1998).	**Likely** The species has previously been recorded 50 km southwest of the Study Area at Lake Nallan (Birdlife Australia 2015a, DPaW 2015b). The species has a preference for shallow open water bodies and may irregularly visit the large salt lakes in the region after periods of rainfall (Johnstone and Storr 1998), however it is unlikely to frequent the area on a regular basis. The species is likely to occur within Playa and Samphire habitats in the Study Area during periods of inundation.

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Long-toed Stint (*Calidris subminuta*)	Mi/Ma	S3	Mainly freshwater swamps but also samphires and around saltlakes (Johnstone and Storr 1998).	**Unlikely** There are few inland records of the species (Birdlife Australia 2015a, DPaW 2015b). The Study Area occurs beyond its normal distribution.
Black-tailed Godwit (*Limosa limosa*)	Mi/Ma	S3	Shallows of freshwater lakes, swamps and river pools. Also, estuarine flats, rocky and muddy coasts and near-coastal saltlakes (Johnstone and Storr 1998).	**Possible** Lake Annean lies outside the species normal distribution, however the lake may provide suitable habitat for foraging during periods of inundation. The species was recorded at Lake Annean in 1983 (DoE 2015b).
Wood Sandpiper (*Tringa glareola*)	Mi/Ma	S3	Freshwater wetlands and occasional brackish intertidal mudflats (Geering *et al.* 2007).	**Likely** The species has previously been recorded 50 km southwest of the Study Area at Lake Nallan (Birdlife Australia 2015a, DPaW 2015b). The species has a preference for shallow open water bodies and may irregularly visit the freshwater claypans associated with the large salt lakes in the region after periods of rainfall (Johnstone and Storr 1998), however it is unlikely to frequent the area on a regular basis. The species is likely to occur within the Play and Samphire habitats in the Study Area during periods of inundation.
Common Greenshank (*Tringa nebularia*)	Mi/Ma	S3	Intertidal mudflats, as well as fresh and saltwater wetlands of the coast or inland (Johnstone and Storr 1998).	**Likely** The species has previously been recorded 7.5 km west of the Study Area in 1980 and has been recorded numerous times as recently as 2013 at Lake Nallan located 50km southwest of the Study Area (Birdlife Australia 2015a, DPaW 2015b). The species has a preference for shallow open water bodies and may irregularly visit the freshwater claypans and large salt lakes in the region after periods of rainfall (Johnstone and Storr 1998), however it is unlikely to frequent the area on a regular basis. The species is likely to occur within the Play and Samphire habitats in the Study Area during periods of inundation.
Marsh Sandpiper (*Tringa stagnatilis*)	Mi/Ma	S3	It inhabits freshwater or saltwater wetlands but avoids open beaches and mudflats unless well protected (Geering *et al.* 2007, Johnstone and Storr 1998).	**Likely** The species has previously been recorded 50 km southwest of the Study Area at Lake Nallan as recently as 2013 (Birdlife Australia 2015a, DPaW 2015b). The species inhabits freshwater or saltwater wetlands and may irregularly visit the freshwater claypans and large salt lakes in the region after periods of rainfall (Johnstone and Storr 1998), however it is unlikely to frequent the area on a regular basis. The species is likely to occur within the Play and Samphire habitats in the Study Area during periods of inundation.

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Glossy Ibis (*Plegadis falcinellus*)	Mi/Ma	S3	Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone *et al.* 2013)	**Likely** The species has previously been recorded 50 km southwest of the Study Area at Lake Nallan as recently as 2005 (Birdlife Australia 2015a, DPaW 2015b). This species known to occur in the north-east and south-west Kimberley and the Swan Coastal Plain, however it may occur in more arid areas of WA when inundated after rainfall (Johnstone and Storr 1998). Within these areas it is known to frequent shallow and adjacent flats of freshwater lakes and swamps (Johnstone and Storr 1998) and consequently it may occur within the Play and Samphire habitats in the Study Area during periods of inundation.
White-winged Tern (*Chlidonias leucopterus*)	Mi/Ma	S3	Mainly estuaries and sheltered seas in the north and freshwater lakes in the south, but also inhabits samphire, short-grass flats, saltlakes and sewage ponds (Johnstone and Storr 1998).	**Possible** The species was recorded 50 km southwest of the Study Area at Lake Nallan in 1999 (Birdlife Australia 2015a, DPaW 2015b). This species tends to prefer estuaries and lakes along the coast (Johnstone and Storr 1998) and rarely occurs on inland wetlands in WA (DoE 2015a). It is possible that the species may occur at the nearby salt lakes when inundated, and consequently, it is possible that it will occur in the Playa and Samphire habitats after periods of inundation.
Caspian Tern (*Sterna caspia*)	Mi/Ma	S3	Sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred (DoE 2015a).	**Unlikely** The species is represented by a single record within the vicinity of the Study Area in 1999 (Birdlife Australia 2015a, DPaW 2015b). This species is widespread in coastal regions but may occur in near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks (DoE 2015a). Given the paucity of records away from the coast, it is considered unlikely for the species to occur within the Study Area.
Oriental Pratincole (*Glareola maldivarum*)	Mi/Ma	S3	Usually inhabits open plains, flood plains or short grassland, or occurs near wetlands, and reservoirs, salt works and around the margins of sewage farms (DoE 2015a, Johnstone and Storr 1998).	**Unlikely** The closest record is 400km west of the Study Area along the WA coast (Birdlife Australia 2015a, DPaW 2015b), however the DoE (2015a) suggests that 'habitat may occur' in the vicinity of the Study Area. Although records of this species align closely with the coast, there have been scattered records inland, mostly north of 20°S (DoE 2015a). Although potential habitat occurs in the Study Area, the species is unlikely to occur given that the Study Area is outside of the species normal distribution.
Lerista eupoda		P1	Open Mulga areas on loamy soils (Wilson and Swan 2013).	**Confirmed** The species was recorded at two locations within the Dunefield habitat within the Study Area. Additionally, there are 21 records within the vicinity of the Study Area (DPaW 2015b).

Common name (*Scientific name*)	Status		Broad habitat type	Likelihood of occurrence: Reason for likelihood
	EPBC Act	In WA		
Branchinella simplex		P1	Ephemeral claypans associated with larger saltlakes (Gooderham and Tsyrlin 2002).	**Likely** This species of fairy shrimp was recorded within a claypan 3 km from the Study Area in 1978 (DPaW 2015b). The species has scattered records across WA as far east as Laverton and as far south as Corrigin (DPaW 2015b). Given that the close proximity of the record and the suitability and well connected nature of the Playa habitat within the Study Area, it is likely that this species occurs in the lake and/or associated claypan habitats within the Study Area after periods of inundation.
Blue-billed Duck (*Oxyura australis*)		P4	A diving duck of the south-west that prefers deep freshwater swamps and lakes, but occasionally saltlakes and estuaries freshened by floodwaters (Johnstone and Storr 1998).	**Possible** Lake Annean is outside the range of the freshwater south-west species however, there has been a single record 50 km southwest of the Study Area at Lake Nallan in 2000. However the vast majority of this species records occur in the southwest of WA (Birdlife Australia 2015a, DPaW 2015b). The species prefers deep waterbodies, but may occasionally visit the salt lakes surrounding the Study Area after periods of inundation. The species may possibly occur within the Playa habitat within the Study Area after periods of inundation.
Thick-billed Grasswren (*Amytornis textilis*)		P4	Acacia shrubland especially where there is *Ptilotus obovardus* and deadfall providing cover (Johnstone and Storr 2004).	**Unlikely** The species was recorded 70 km southwest of the Study Area in 1899, but is now considered extinct with the exception of two localities vicinity of Shark Bay, 400 km northwest of the Study Area.

Table 5-11: Fauna listed as Marine (EPBC Act) and with potential to occur in association salt lake habitats the Study Area

Common name (*Scientific name*)	Likelihood of occurrence: Reason for likelihood
Musk Duck (*Biziura lobata*)	**Likely** A southwest diving duck of deep freshwater lagoons, with dense reed beds and the Study Area is outside of the core range of the species (Johnstone and Storr 2004). Nevertheless,records as recent as 2006 have occurred within 10 km of the Study Area. Additionally, in excess of 10 other records occur within 100 km of the Study Area at nearby lakes (DPaW 2015b).
Red-capped Plover (*Charadrius ruficapillus*)	**Confirmed** This species was recorded during the survey on from the Playa habitat and is likely to frequent the Study Area during the presence of water. Numerous records occur in the vicinity of the Study Area (DPaW 2015b). .
Hooded Plover (*Charadrius rubricollis*)	**Unlikely** Although the species has been recorded as recently as the year 2000 near the town of Cue approximately 70 km southwest of the Study Area, the records are beyond the normal distribution of the species (DPaW 2015b).

Common name (*Scientific name*)	Likelihood of occurrence: Reason for likelihood
Welcome Swallow (*Hirundo neoxena*)	**Confirmed** This species was recorded during the survey flying over water on from the Playa habitat. Numerous records of this species occur across the State and in the vicinity of the Study Area (DPaW 2015b). . This species is likely to be limited to any particular habitats in the Study Area.
Whiskered Tern (*Sterna hybrid*)	**Highly Likely** This species has been known to nest atop inundated samphire at the western end of Lake Annean outside of the Study Area (DoE 2015b). It is highly likely that the species would occur in the Study Area when the lake fills.
Silver Gull (*Larus novaehollandiae*)	**Unlikely** There exists a single record of this species approximately 100 km southwest of the Study Area in 2012 (DPaW 2015b) and there are few other records in the region. The Study Area is beyond the species usual range and it is unlikely to occur.
Lesser Crested Tern (*Thalasseus bengalensis*)	**Unlikely** This species is recorded along the cost north of Shark Bay (DPaW 2015b). There are no inland records and the species is considered unlikely to occur in the Study Area.
Australian Pipit (*Anthus australis*)	**Confirmed** This species was recorded from the Stony Plain habitat within the Study Area. Additionally, there are approximately five records of the species within 100 km of the Study Area (DPaW 2015b).
Australian Pelican (*Pelecanus conspicillatus*)	**Confirmed** Tracks of this species were recorded on the lake Playa during the survey. The species is likely to visit the Study Area and surrounding lake after periods of rainfall.
Black-winged Stilt (*Himantopus himantopus*)	**Highly Likely** The species has been recorded at Lake Annean in close procimity to the Study Area on six occaisions and at nearby lakes in recent years (DPaW 2015b). The species is likely to occur after the lake fills.
Red-necked Avocet (*Recurvirostra novaehollandiae*)	**Highly Likely** The species is a regular visitor to inland salt lakes after they fill. The species has been recorded on five occasions at Lake Annean in close procimity to the Study Area (DPaW 2015b).
Pectoral Sandpiper (*Calidris melanotos*)	**Unlikely** There are few inland records of this species and none within the vicinity fo the Study Area.
Australian White Ibis (*Threskiornis molucca*)	**Possible** The species was recorded 50 km southwest of the Study Area at Lake Nallan in and in the surrounding region (Birdlife Australia 2015a, DPaW 2015b).
Straw-necked Ibis (*Threskiornis spinicollis*)	**Likely** The species ahs been recorded previously on three occasions at Lake Annean in 1999 in close procimity to the Study Area (Birdlife Australia 2015a, DPaW 2015b). The species has also been recorded at other lakes and claypans in the region.

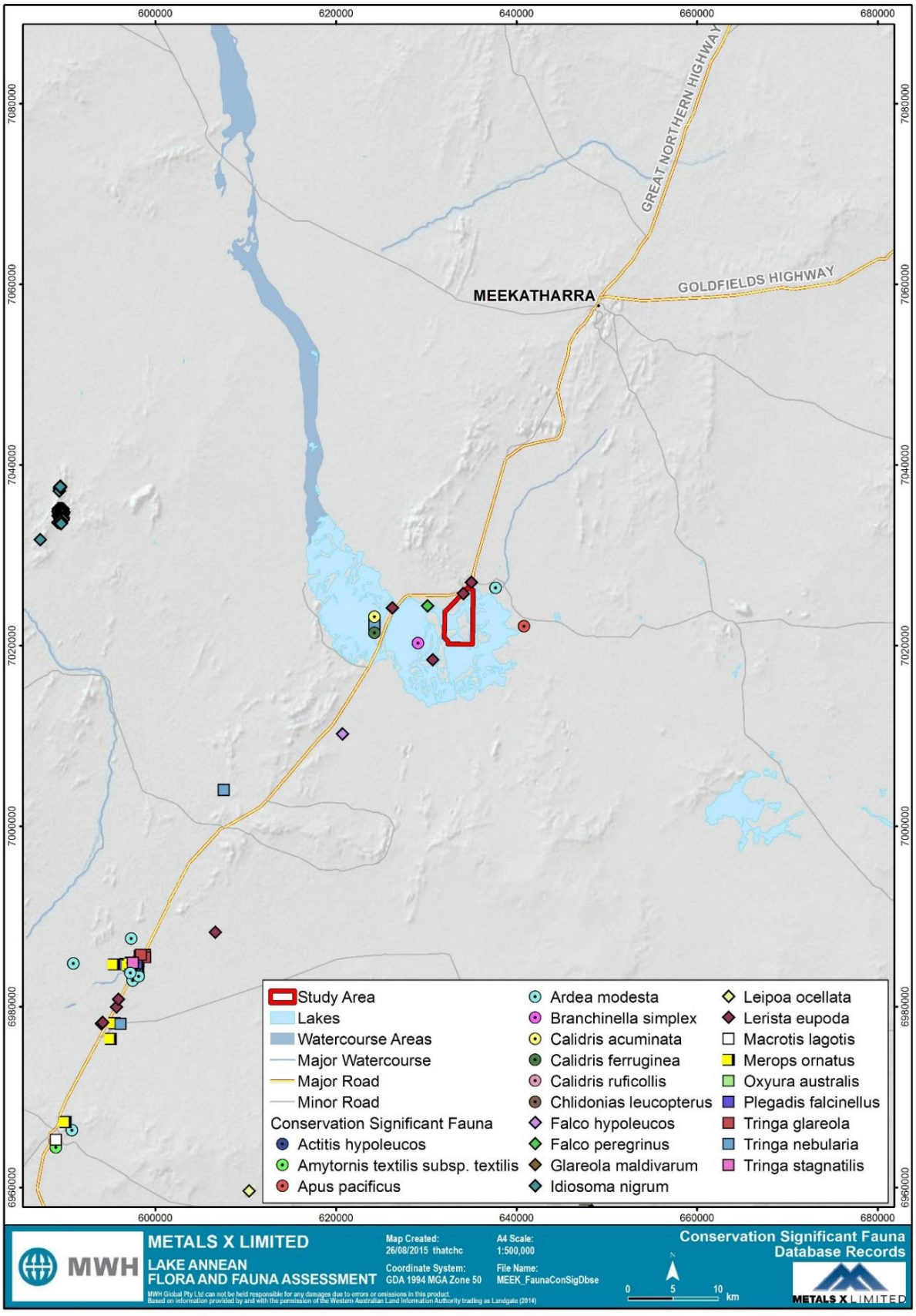

Figure 5-6: Fauna of conservation significance (excluding marine species) recorded via the desktop study

5.3 Survey Limitations

The Level 1 flora, vegetation and fauna survey was undertaken in accordance with the requirements of Guidance Statement No. 51 and 56 (EPA 2004b, c) and with due consideration for Position Statement No. 3 (EPA 2002). Although the survey was undertaken approximately 4 to 6 weeks prior to the optimal flowering period for the region, the Study Area had received average rainfall in June and in the six months preceeding the Survey (**Section 4.2**). In addition, approximately 4 mm of rain fell during the survey period (13-17 July 2015).

The grasses, some perennials and several annuals were noted as flowering suggesting the optimal period to undertake flora and vegetation surveys in the Murchison (i.e. late winter to early spring) was nearing. However, a portion of the perennials, including the Mulga's (*Acacia aneura* group complex) and some of the dominant *Eremophila* spp. were not flowering or were beginning to flower, suggesting the timing of the survey was a little early.

The timing of the survey is not considered to be a constraint to the assessment. A Level 1 survey was conducted, which can be undertaken at any time of the year, depending on the objectives and the outcomes of the proposed activities. Based on the objectives of the assessment, a Level 1 survey conducted in July was considered sufficient.

As is typical for vascular flora surveys, fungi and non-vascular flora (e.g. bryophytes, mosses, etc.) were not collected or recorded. The limitations of this assessment are summarised in **Table 4-5**.

Table 5-12: Survey limitations

Limitation	Constraint (yes or no)	Comment
Competency/experience of the survey team conducting the survey and the identifications	No	Clinton van den Bergh is a senior ecologist with over nine years' experience in conducting surveys and taxonomic identifications. Clinton has also completed several surveys on inland salt lake (i.e. Lake Austin). Paul Bolton is an experienced zoologist with over eight years of experience in conducting fauna surveys including Murchison region.
Level of survey	No	A Level 1 flora and vegetation survey was conducted, with 29 releves sampled and a high proportion of the Study Area traversed on foot. Additionally, fauna habitat assessments were conducted over a total of 17 locations and targeted searches were conducted overall all habitats represented within the Study Area. A total of eight person-days were invested in the Survey.
Sources of information	No	The Murchison region, including the major mining towns of Cue and Meekatharra have been subjected to numerous biological surveys (see Section 4.1.2), which were accessed during this assessment.
Scope	No	The entire scope was met.
• Proportion of: • Flora collected and identified; • Fauna habitats and species identified; and	• No • No • No	• Approximately 70% of the expected taxa to occur within the study area has been recorded. This is based on the July survey, the intensity of the survey (Level 1) and the scope.

Limitation	Constraint (yes or no)	Comment
• Task achieved and further work that may be required		• The entire task was achieved, with no further work considered necessary based on the activities proposed by Metals X which dictated the current survey. Further survey work may be necessary, depending on what Metals X have proposed in the future.
Completeness	No	The Study Area was adequately traversed and sampled.
Mapping reliability	Yes	The mapping reliability outside of the salt lake, for example, the stony plains in the north of the Study Area or the dunes in the central portion of the Study Area, have a high mapping reliability. The samphire (*Tecticornia* spp.) shrublands within the salt lake have a moderate mapping reliability due to the complex ecological requirements of particular samphire species and their preferred habitat in the landscape. In addition, discrete samphire communities are only discernible from high resolution aerial photography.
Timing/weather/season/cycle	No	Although the survey was undertaken approximately 4-6 weeks prior to the optimal season for conduction flora surveys in the Murchison, this is not considered to be a constraint. Targeted searches for flora and fauna conservation significant species were not hampered. The timing of the survey was suitable for the level of survey required. However, many migratory, marine and waterbirds with potential to occur would not have been present as the lake was dry. The scope and requirements of the Level 1 survey were met during the July 2015 survey.
Disturbances which affected the results of the survey	Yes	Several historical mines and their associated infrastructure occur adjacent and within the Study Area. As a result, disturbances to the flora assemblages were noted, which may impact on the designation of vegetation associations within the landscape.
Intensity of the survey	No	The intensity of the survey was sufficient to meet the scope. Approximately 0.02 flora sampling sites per hectare were assessed. This ratio does not take into account the areas that have been cleared of native vegetation (i.e. mine pits) or are devoid of native vegetation (i.e. the lake playa). A total of five broad and two minor fauna habitats were identified. The survey was conducted over 8 person days. This level of on-ground survey effort is appropriate for a Level 1 flora assessment.
Resources	No	Adequate resources were assigned to the field survey, specimen identifications and the reporting components of the assessment.
Remoteness and/or access problems	No	The Study Area was accessible from the Great Northern Highway, approximately 35 km south of Meekatharra. Historical tracks from mining, exploration and pastoralism were readily available.
Availability of contextual information	No	Contextual information for the Western Murchison and the Meekatharra region are available and were access prior to, and after, the field survey.

6 Discussion

6.1 Flora and vegetation

6.1.1 Flora

The flora diversity recorded from the Study Area is considered to be representative of salt lake ecosystems in the Murchison bioregion. The diversity of the flora within salt lake systems is generally depauperate and dominated by members of the *Tecticornia* genera and other salt tolerant genus and families. This is reflected in the results of the field survey, with the family Chenopodiaceae and its genera *Tecticornia* and *Maireana* dominant across the landscape.

The uplands adjacent to Lake Annean are consistent with the flora of the Murchison bioregion, with Mulga (*Acacia aneura* and related species) open woodlands and shrublands dominant with poverty bushes (*Eremophila* species) and members of the Fabaceae family (i.e. *Acacia* and *Senna*) mid-storey over herbs and grasses.

The flora diversity recorded from the Study Area is consistent with similar surveys undertaken in close proximity. The diversity recorded is representative of the survey effort (0.018 sample sites per hectare) and intensity (Level 1 survey) for a flora and vegetation survey undertaken in July after sufficient winter rainfall. It is anticipated that the diversity of the flora within the Study Area would increase following systematic sampling and targeted surveys undertaken during the optimal period for completing flora and vegetation surveys (late winter to early spring).

No threatened or priority listed flora were recorded from the Study Area during the field survey. Based on the desktop assessment, the review of habitat preferences, the known locations of threatened flora and the results of the field survey, no threatened flora are considered likely to occur within the Study Area. A targeted search of priority areas more likely to support a higher level of diversity and plants of conservation significance that rely on unique isolated habitats (eg . Ironstone ridges, quartz rises and deep sandy dunes) did not identify any threatened flora as occurring within the Study Area.

The desktop assessment identified that four priority taxa were likely to occur within the Study Area. The field survey confirmed that three of these four taxa do not occur within the Study Area based on the site visit, targeted searches and the results of the field survey. The remaining priority taxon, *Tecticornia cymbiformis*, was not recorded from the Study Area, however is considered to occur within the Study Area based on the known location of the priority taxon within Lake Annean and the preferred habitat located throughout the lake margins of the Study Area. Due to survey effort and intensity the entire salt lake was not able to be traversed. In addition, the samphire (*Tecticornia* species) communities are difficult to identify *in situ* and the likelihood of overlooking the priority taxon is considered to be high.

Based on the known locations of priority flora within the Study Area, no priority flora will be directly impacted by the proposed drilling program (**Figure 7-1**). The likelihood of the priority taxon *Tecticornia cymbiformis* occurring within the proposed drilling location is considered be moderate, however if any individuals do occur, the impact on the populations persisting in Lake Annean is considered to be non-existent. Additional populations of *Tecticornia cymbiformis* occur outside of the Study Area and they will not be directly or indirectly impacted by the proposed drilling program.

6.1.2 Vegetation

Eleven vegetation associations from eight broad floristic formations were described from the Study Area. The vegetation associations described and delineated from the Study Area are consistent with vegetation known to occur in association with salt lake systems in the Murchison bioregion. The vegetation consisted of *Acacia* woodland and shrublands, *Maireana* chenopod shrublands and *Tecticornia* samphire shrublands. The dominant vegetation association recorded from the Study Area was the Samphire Mosaic (unit SM) which occurred across the salt lake and consisted of a mosaic of *Tecticornia* species depending on the depth to the groundwater. The *Maireana* chenopod shrubland was the least extensive across the Study Area and occurred along the margins of the salt lake in isolated patches.

The vegetation associations recorded from the Study Area are not considered to represent a threatened or a priority ecological community. No other TECs or PECs associated with vegetation or flora are known to occur in close proximity to the Study Area.

The Study Area supports groundwater dependent and surface water or sheet flow dependent vegetation. According to the Groundwater Dependent Ecosystem (GDE) Atlas managed by BOM, Lake Annean is considered to be an ecosystem that relies on the surface expression of groundwater. The samphire communities occurring along the margins and along the small rises within Lake Annean are considered to be groundwater dependent ecosystems with the *Tecticornia* species dependent on the groundwater for their survival.

Mulga is a name that is most commonly applied to the large, woody, perennial, Australian species *Acacia aneura* F.Muell. ex Benth. and some of its close relatives. The name is also used to denote the vegetation type dominated by these species (Maslin and Reid, 2012). Mulga is a keystone group in the Australian arid zone and Mulga communities occupy over 150 million hectares or about 20% of the land surface of the continent (Sattler 1986). Mulga communities are critically important to the ecology, functioning and viability of rangeland landscapes, acting as resource ‘hotspots’ due to the species’ ability to capture, retain and cycle scarce sediments, nutrients and water resources (Maslin and van Leeuwen, 2006).

Mulga generally occurs in groves or as distinct patches and can produce a banding pattern across the landscape. These groves act as a sink for water and nutrients. Groves intercept sheet flow, thus increasing soil moisture and making nutrient available for plant uptake; due to high biological activity Mulga vegetation creates fertile patches in a landscape that is generally impoverished in terms of soil nutrients (adapted from

Astron, 2010). Mulga is considered to be generally shallow-rooted (likely less than 2 m in depth) and utilises water from shallow surface soils (EPA, 2012). It is generally accepted that groved Mulga communities have a strong reliance on sheet flow to replenish soil water in the groves (EPA, 2012).

While most vegetation in the gently undulating plains of arid Australia can reasonably be expected to be dependent on sheet flow to some extent, only Mulga vegetation has been studied intensively and has been shown to be highly dependent on sheet flow. Mulga groves (banding and patches) do not occur in the Study Area, with most of the Mulga trees occurring as individuals or sparse, low density patches on stony and sandy plains (**Figure 5-3**). It is difficult to determine if sheet flow in the Study Area is significant for the Mulga vegetation. The Mulga vegetation may be interacting with the groundwater in close association to Lake Annean. Further studies would be required to determine if this is occurring in the Study Area.

The proposed drilling program (**Figure 7-1**) will directly impact on some samphire communities within the Study Area. In addition, it is anticipated that the drilling program will impact on surface water ponding due to the possible construction of raised causeways to avoid driving on the lake playa. The disturbance is considered to be localised and may be offset with the construction of culverts to allow surface water movement. If a raised causeway is not required, the creation of tyre tracks may provide an impediment to surface water movement.

The impact on the vegetation is considered to be localised around the proposed drill sites and is not considered to be detrimental to the remaining samphire communities mapped within the Study Area.

6.2 Fauna

Lake Annean is listed as an Environmentally Sensitive Area and listed a on the Directory of Important Wetlands because it forms an important wetland that supports foraging and breeding habitat for a number of migratory, marine and waterbirds after periods of inundation (See Section 3.7). The Study Area includes a portion of Lake Annean and includes habitats that are likely to support these species when the lake fills, namely the Samphire and Playa habitats. Based on the findings of the desktop study, nine migratory wading birds and seven Marine birds are considered Confirmed, likely or very likely to occur in the Study Area after periods of inundation.

Additionally, the Dunefield was considered to be a significant habitat as it was found to support the Meekatharra Slider. All other habitats were considered to have limited significance as they were unlikely to support species of conservation significance or support fauna associations that were unlikely to occur in the surrounding region.

Large areas of the Study Area had been substantially altered by recent mining activity and has been delineated in this report as Mine Infrastructure. Additional disturbance has occurred in the surrounding habitats as a result of historic mining with dilapidated mine shafts, old machinery and previous clearing evident in the Stony Plains, Ironstone Hills, Quartz Outcrop habitats. Other habitats were largely in good to very good

condition, with disturbances including grazing from cattle and rabbits, along with tracks associated with exploration activity.

Fauna recorded during the survey were representative of the region, with all species having been previously recorded during previous surveys in the area as identified by the desktop study. Two introduced fauna, the European Cattle and the Rabbit were recorded by sighting or evidence at almost all sites within the Study Area.

The Study Area is located adjacent to the buffered PEC boundary of Polelle Calcrete, consisting of a unique assemblage of invertebrates that persist in the groundwater calcretes of Porlell Lake, with small portions of the PEC located within the Study Area in the north-east and south-east corners. Hydrogeological investigations would be required to confirm if the Study Area interacts with the PEC, however a localised drilling program is unlikely to impact the aquifer, or the invertebrate community it supports.

7 Assessment against the ten clearing principles

Lake Annean is considered to be an Environmentally Sensitive Area (ESA) and is also a Nationally Important Wetland (WA056). Consequently the proposed drilling program within Study Area will require an approved clearing permit before it is able to proceed. The clearing and disturbance of vegetation within ESAs are not exempt under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

This flora, vegetation and fauna survey has been undertaken to accompany an application to the DMP for a permit to clear native vegetation. To assist the assessment of the clearing permit application, the proposed drilling program has been assessed against the ten clearing principles (**Table 7-1**) to determine if the clearing will be at variance to the ten clearing principles. The location of proposed drill holes within the Lake Annean ESA is provided in **Figure 7-1** to inform the assessment against the ten clearing principles.

Table 7-1: Assessment of the proposa against the ten clearing principles

Principle		Assessment	Is the proposal at variance?
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity	The proposed drilling program occurs within Lake Annean which is considered to be a Nationally Important Wetland and an ESA. Lake Annean has been listed as a nationally important wetland because it supports foraging and breeding habitat for a high number of the migratory, marine and waterbirds after periods of inundation. This has included hundreds of nesting Gull-billed Terns (*Sterna nilotica*) listed as Migratory (EPBC Act) and Schedule 3 (WC Act) along with nesting Whiskered Tern (*Sterna hybrida*) and Black-winged Stilt (*Himantopus himantopus*) which are both listed as Marine Migratory (EPBC Act). Additionally, the lake has been known to support thousands of waterbirds when full (see Section 3.8). Consequently, the Study Area has potential to support a high level of biological diversity, but this would only be when the lake fills. At all other times, these species would not be expected to occur at the lake and hence drilling on the lake when it is dry would be unlikely to affect these species. The Study Area is located adjacent (with minor portions located within) to a Priority 1 ecological community, Polelle Calcrete. The proposed drilling program is located approximately 1 km to the west of the PEC. The PEC is a groundwater dependent PEC based on the calcrete aquifer supporting a unique assemblage of invertebrate. The proposed drilling program is highly unlikely to impact on the calcrete aquifer. No threatened or priority flora were recorded from the Study Area, while the flora diversity recorded during the assessment is considered to be consistent with samphire communities and the stony and sandy plains adjacent to the Lake. The Study Area does not represent a high level of flora diversity. Samphire communities have been mapped as occurring within the Study Area. The proposed drilling program will impact on a portion of samphire communities which are considered to rely on the groundwater for a portion of their lifecycle. The Meekatharra Slider (*Lerista eupoda*) was recorded from two locations in the south of the Study Area. The two locations are within Mulga woodlands on dunefields. The proposed drilling program will not occur within the dunefields. The Study Area is considered to support a moderate level of biological diversity, consistent with the Lake and adjacent upland habitats.	The proposal is not at variance to this principle

Principle		Assessment	Is the proposal at variance?
(b)	Native vegetation should not be cleared if it comprises the whole, or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia	A desktop assessment undertaken prior to the field survey identified four species listed as Threatened under the EPBC Act and/or WC Act that have potential to occur. On the basis of habitat within the Study Area and the location of previous records, three of these species are considered unlikely to occur with the Malleefowl considered to possibly occur within the Duefield habitat. Targeted searches in the dune field habitat did not find any evidence of the Malleefowl. The proposed drilling program will not directly or indirectly impact on any habitat with potential to support threatened species identified from the desktop study.	The proposal is not at variance to this principle
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora	A review of threatened flora databases and previous biological assessments suggests that only one threatened flora species, *Eremophila rostrata* subsp. *rostrata,* occurs in close proximity (67 km to the south) to the Study Area. The flora and vegetation survey did not identify any individuals of *Eremophila rostrata* subsp. *rostrata*, or any other threatened flora species, as occurring within the Study Area. In addition, critical habitat for *Eremophila rostrata* subsp. *rostrata,* identified in the interim recovery plan, does not occur within the Study Area. Therefore it is highly unlikely that any threatened flora species currently occurs within the Study Area and may potentially be impacted by the proposed exploration drilling.	The proposal is not at variance to this principle
(d)	Native vegetation should be cleared if it comprises the whole, or a part of, or is necessary for the maintenance of, a threatened ecological community	A desktop assessment undertaken prior to the field survey did not identify any threatened ecological communities as occurring within or in close proximity to the Study Area. The proposed drilling program will not directly or indirectly impact on any threatened communities.	The proposal is not at variance to this principle
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	The Study Area occurs in association with four vegetation system associations (Upper Murchison 18.2, 39.1, 125 and 1128) as mapped by Beard (1976) and reinterpreted by Shepherd *et al.* (2002). At the bioregion (Murchison), subregion (Western Murchison) and local government authority scale (Shire of Meekatharra), the four vegetation system associations have in excess of 98% of their pre-European extent currently remaining. That is, the area has not been extensively cleared. The proposed drilling program is minor in size and will not result in large-scale clearing of vegetation. As such the proposed drilling program is highly unlikely to result in extensive clearing reducing the current extent to levels that would be considered to be significant. The clearing will not	The proposal is not at variance to this principle

Principle		Assessment	Is the proposal at variance?
		occur in an area considered to be a significant remnant within an area that has been extensively cleared.	
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	The proposed drilling program is located within Lake Annean, which is also considered to be a Nationally Important Wetland and an ESA. Although the clearing for the proposed drilling program will be minor, it will occur in a nationally important wetland (WA056).	The proposal is at variance to this principle
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	The proposed drilling program is unlikely to cause appreciable land degradation. The drilling program is located within a section of the Study Area that has previously been disturbed from historical mining. Man-made drains and ponds, waste rock landforms and raised causeways all occur in close proximity to the proposed drilling program. The clearing associated with the drilling program is minor and will at times occur in areas of lake playa that do not support native vegetation.	The proposal is not at variance to this principle
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area	No areas managed for conservation purposes such as conservation parks, national parks, nature reserves, marine nature reserves, marine parks or marine management areas occur in the vicinity. However, the proposed exploration drill holes are located within a nationally important wetland (WA056) and an ESA; Lake Annean. The proposed drilling program is located in association with existing man-made drains and ponds that have been present since historical mining occurred in the Study Area. The clearing is considered to be minor and temporary, and unlikely to have a high impact on the ESA..	The proposal may be at variance to this principle
(i)	Native vegetation should not be cleared if the clearing of vegetation is likely to cause deterioration in the quality of surface or underground water	Vegetation is limited in the area of the lake proposed to be cleared. The vegetation that is present is also influenced by the presence of the man-made drains and ponds. Earthworks, provided they require minimal excavation, are unlikely to influence surface water, while ground water is unlikely to be affected. The current drains and ponds are having a greater impact on surface and ground water movement and quality.	The proposal may be at variance to this principle
(j)	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding	The proposed drilling program is located within Lake Annean which is considered to be sump for the local catchment, before discharging into the Hope River in the North-west of Lake Annean. The proposed drilling program will not cause or exacerbate the incidence or intensity of flooding in the landscape.	The proposal is not at variance to this principle

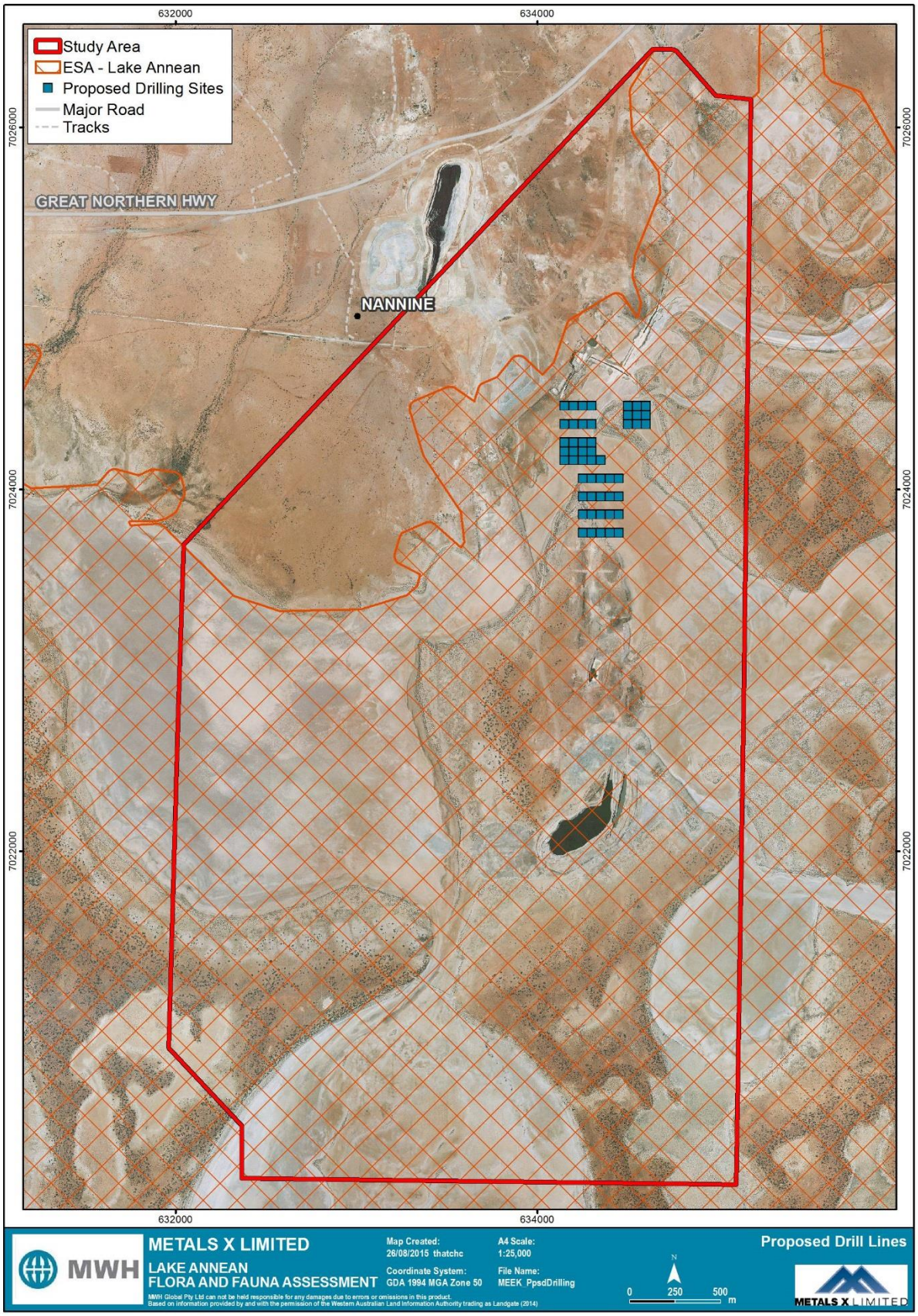

Figure 7-1: Proposed Drill Hole locations with respect to the Study Area and the Lake Annean Environmentally Sensitive Area

8 Conclusion

A total of 105 vascular taxa from 28 families and 50 genera, were recorded from the Study Area. This included three introduced taxa, one planted exotic and 101 native taxa. The dominant families were Chenopodiaceae, Poaceae, Scrophulariaceae and Fabaceae, while the most frequent genera included *Eremophila, Tecticornia, Maireana* and *Acacia*. This is a dominant floristic composition which is typical of the region dominated by Mulga Woodlands and samphire communities. No Threatened Flora species or Priority Flora species were recorded during the on-ground survey. Introduced flora species recorded within the Study Area included **Acetosa vesicaria, *Cenchrus ciliaris* and **Citrullus lanatus*, while the native taxon *Eucalyptus camaldulensis* (River Red Gum) has been previously planted and does not naturally occur within the Study Area.

The vegetation condition within the Study Area ranged from excellent (in association with the undisturbed samphire communities) to completely degraded (in association with the historic mines). Disturbances to vegetation included previous mining activities and grazing by feral herbivores (i.e. goats, rabbits and cows).

A total of 14 vegetation associations were recorded across the Study Area. The vegetation of the Study Area was largely comprised of *Acacia* open woodlands and shrublands, *Hakea* open shrublands, Chenopod shrublands dominated by either *Maireana* species or *Salsola australis* and Samphire shrublands.

The vegetation associations recorded from the Study Area are representative of the dominant vegetation types throughout the region. None are analogous to any TEC or PEC and none are considered locally or regionally significant. The samphire communities are considered to be groundwater dependent ecosystems and are important as foraging and breeding habitat for migratory birds visiting Lake Annean.

A total of 29 vertebrate fauna species were recorded during the Survey. The desktop study identifies 55 vertebrate fauna of conservation significance that may occur, or have previously been recorded within the vicinity of the Study Area. Five fauna species listed as Marine (EPBC Act) were recorded during the survey and one species listed as Priority 1 (DPaW) was recorded from the Dunefields habitat during the Survey. Based on the habitats which make-up the Study Area, 15 additional fauna species of conservation significance are considered Likely or Very Likely to occur. Of these, nine are Migratory (EPBC Act) wading birds and four Marine (EPBC Act) birds that may visit the Playa and Samphire habitats after the lake has experienced a period of inundation.

Lake Annean occurs within an Environmentally Sensitive Area (ESA) and a nationally important wetland (WA056) that after inundation, can provide important feeding and breeding habitat for a number of marine and/or migratory bird species. Given that clearing will be required for the drilling program, an assessment against the ten clearing principles has been completed.

The assessment of the proposed drilling program against the ten clearing principles, indicated that the clearing is at variance to principles (f) and may be at variance to principles (h) and (i). The proposed drilling program is not at variance to principles (a), (b), (c), (d), (e), (g) and (j).

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Appendix A Codes and Terms Used to Describe Conservation Significance

Fauna and flora may be accorded legislative protection by being listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) and/or the *Wildlife Conservation Act 1950* (WA) (WC Act), or by being listed on the WA Department of Environment and Conservation's *Priority Species List*. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Definitions of codes and terms used to describe flora and fauna of conservation significance

Status	Code	Description
Categories used under the EPBC Act		
Critically Endangered	Cr	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	En	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	Vu	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	Mi	Fauna that migrate to, over and within Australia and its external territories.
Schedules used under the WC Act		
Schedule 1 (Threatened)	S1	Taxa that is rare or likely to become extinct. Threatened taxa listed under Schedule 1 of the WC Act are further ranked by the DPaW, according to the level of threat facing each species. The ranks are Cr, En and Vu.
	Th	Flora taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such
Schedule 2	S2	Taxa that is presumed to be extinct
Schedule 3	S3	Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds
Schedule 4	S4	Taxa that is in need of special protection, other than for reasons mentioned above
DPaw Priority flora and fauna lists		
Priority 1	P1	Taxa with few, poorly known populations on threatened lands. These are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Status	Code	Description
Priority 2	P2	Taxa with few, poorly known populations on conservation lands. These are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands. These are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4	P4	Taxa in need of monitoring. These are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring. These are not considered threatened but are subject to a specific conservation programme, the cessation of which would result in the species becoming threatened within five years.

Definitions of codes and terms used to describe Threatened Ecological Communities and Priority Ecological Communities

Status	Code	Description
Threatened Ecological Communities TECs are indirectly protected under the Western Australian *Environmental Protection Act 1986* and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.		
Presumed Totally Destroyed	PD	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): a) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or b) All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered	Cr	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (a, b or c):

Status	Code	Description
		a. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. b. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely Vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely Vulnerable to known threatening processes. c. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered	En	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (a, b, or c): a. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. b. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very Vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very Vulnerable to known threatening processes.

Status	Code	Description
		c. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable	Vu	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (a, b or c): a. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. b. The ecological community may already be modified and would be Vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. c. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority One	P1	Poorly-known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally =5 occurrences or a total area of = 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	P2	Poorly-known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally =10 occurrences or a total area of =200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	P3	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority Four	P4	Rare or Near Threatened Ecological Communities or Ecological communities that have been removed from the list of threatened communities during the past five years. These communities require regular monitoring. **Rare**: Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection,

Status	Code	Description
		but could be if present circumstances change. These communities are usually represented on conservation lands. **Near Threatened**: Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
Priority Five	P5	Conservation dependant ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix B Conservation significant flora likelihood assessment

Table 9-1: Likelihood of conservation significant flora occurring within the Study Area

Taxon	Conservation code			Habitat	Nearest locality (km)	Likelihood	Reason
	EPBC Act	WC Act	DPaW				
Acacia burrowsiana			P3	Red-brown loams with ironstone rubble on surface, calcrete soils, laterite, quartz. Flats adjacent to watercourses, crests of low rises, breakaways.	53 W	Possible	The Study Area may support suitable habitat, while the Study Area is located in the known distribution
Acacia dilloniorum			P1	Red clay-loam over exposed dolerite outcropping. Gully. Dry fluviatile gravel. Granite boulder.	63 W	Unlikely	The Study Area does not support suitable habitat
Acacia sclerosperma subsp. glaucescens			P3	Sand, sandy loam, stony soils.	3 W	Likely	The nearest record is located adjacent to the Study Area, while suitable habitat is present
Acacia speckii			P4	Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	10 N	Likely	The Study Area supports suitable habitat while a known population is located in close proximity
Angianthus microcephalus			P2	Sandy or clayey soils. Salt swamps & pans.	85 S	Possible	The Study Area supports suitable habitat and is located within the known distribution
Angianthus uniflorus			P1	Margin of calcrete rise near gypseous salt lake.	85 S	Possible	The Study Area supports suitable habitat
Bergia auriculata			P2	Clay soils. Mud flats.	52 S	Unlikely	The Study Area is unlikely to support suitable habitat
Calotis sp. Perrinvale Station (R.J. Cranfield 7096)			P3	Banded ironstone, red-brown soils	68 SW	Unlikely	The Study Area does not support suitable habitat for the taxon
Calytrix verruculosa			P3	Sandy clay	20 N	Possible	The Study Area is located in the known distribution and suitable habitat is present
Dodonaea amplisemina			P4	Red-brown sandy clay on basalt and gabbro and banded ironstone or on dolerite and quartzite. Rocky hills.	62 W	Unlikely	The Study Area is unlikely to support suitable habitat
Drummondita miniata			P3	Laterite. Breakaways.	44 E	Unlikely	The Study Area does not support suitable habitat

Taxon	Conservation code			Habitat	Nearest locality (km)	Likelihood	Reason
	EPBC Act	WC Act	DPaW				
Eremophila fasciata			P3	Hills, breakaways, plains. Red-brown ironstone gravel.	24 E	Possible	The Study Area is unlikely to support suitable habitat, however it occurs within the known distribution
Eremophila pungens			P4	Sandy loam, clayey sand over laterite. Plains, ridges, breakaways.	115 E	Unlikely	The Study Area is unlikely to support suitable habitat, and is located outside of the known distribution
Eremophila retropila			P1	Gravelly loam. Stony flats.	20 N	Possible	The Study Area is located in close proximity to known location and suitable habitat is present
Eremophila rhegos			P1	Skeletal stony loam over granite.	72 W	Unlikely	The Study Area does not support suitable habitat
Eremophila rostrata subsp. *rostrata*	CR	T (CR)		Saline quartzite loams. Hills and flats.	67 S	Unlikely	The taxon occurs in a defined area and is very rare (Critically Endangered)
Eremophila sp. Meekatharra (D.J. Edinger 4430) PN			P1		38 SE	Unlikely	The Study Area is located outside of the known distribution
Eremophila youngii subsp. *lepidota*			P4	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.	364 W	Unlikely	The Study Area is located outside of the known distribution
Euryomyrtus recurva			P3	Yellow/red sand, brown/yellow sandy clay. Gravel pits, catchment slopes.	106 S	Unlikely	The nearest known record is a significant distance away
Goodenia berringbinensis			P4	Red sandy loam. Along watercourses.	50 S	Unlikely	The Study Area is unlikely to support suitable habitat
Grevillea inconspicua			P4	Loam, gravel. Along drainage lines on rocky outcrops, creeklines.	58 W	Possible	The Study Area may support suitable habitat, and is located within the known distribution
Hemigenia tysonii			P3	Red sand, sandy clay, lateritic sand. Flats, sand dunes, hills.	16 W	Possible	The Study Area supports suitable habitat, with a population located in close proximity
Hemigenia virescens			P3	Brown very rocky sand. Hillside. Rangeland. Brown ironstone gravel. Yellow-red sandy clay. Shallow loam.	13 W	Possible	The Study Area is located in close proximity to a known population and suitable habitat is present

Taxon	Conservation code			Habitat	Nearest locality (km)	Likelihood	Reason
	EPBC Act	WC Act	DPaW				
Jacksonia lanicarpa			P1	Red sand	67 S	Unlikely	The Study Area is located a significant distance from the nearest population
Maireana prosthecochaeta			P3	Laterite. Hills, salty places.	67 S	Unlikely	The Study Area is unlikely to support suitable habitat
Menkea draboides			P3	Red sand or clay, granite.	44 N	Unlikely	The Study Area is unlikely to support suitable habitat
Micromyrtus placoides			P3	Red-orange sandy clay, orange-yellow sandy clay to clayey loam, coarse gravel, banded ironstone, laterite, quartz, basalt. Gently undulating plains, dry creek beds, hillcrests, ridges.	52 W	Unlikely	The Study Area is unlikely to support suitable habitat and the nearest population is located at Weld Range
Millotia depauperata			P1	Sandy loam. Granite outcrops.	72 W	Unlikely	The Study Area does not support suitable habitat
Minuria tridens			P1	Roadsides	85 S	Unlikely	The taxon has never been recorded again since the original collection in 1986
Podotheca pritzelii			P3	Sand. Sand ridges in salt flats.	317 SW	Unlikely	The nearest population to the Study Area is a significant distance to the south-west
Prostanthera petrophila			P3	Lateritic soils	52 W	Unlikely	The Study Area is unlikely to support suitable habitat
Ptilotus crosslandii			P3	Sandy soils. Colluvial plains.	117 N	Unlikely	The Study Area is unlikely to support suitable habitat and the Study Area is not located within the known distribution
Ptilotus lazaridis			P3	Clay loam. Floodplains.	5 E	Likely	The Study Area is likely to support suitable habitat, while the nearest population is located 5 km to the east of the Study Area
Ptilotus luteolus			P3	Hills and gravelly slopes. Brown, rocky soil with quartzite.	20 N	Possible	The Study Area
Rhodanthe sphaerocephala			P1	Clayey loam. On flats.	64 NW	Unlikely	The Study Area is located outside of the known distribution

Taxon	Conservation code			Habitat	Nearest locality (km)	Likelihood	Reason
	EPBC Act	WC Act	DPaW				
Sida picklesiana			P3	Breakaways and ridges. Sandy loam with quartz and ironstone gravels and patches of BIF.	32 S	Possible	The Study Area may support small amounts of suitable habitat
Stenanthemum patens			P1	Rocky hillside.	62 W	Unlikely	The Study Area does not support significant stretches of suitable habitat
Tecticornia cymbiformis			P3	Saline soils. Along the edge of creeklines.	3 W	Likely	The Study Area supports suitable habitat, while Lake Annean is known to support a population
Tecticornia fimbriata			P3	Clay, loam. Margins of salt & gypsum lakes.	88 SW	Possible	The Study Area may support suitable habitat
Trithuria australis			P4		422 SW	Unlikely	The Study Area is located a significant distance from the known distribution
Verticordia jamiesonii			P3	Sandy clay soils. Lateritic breakaways.	52 W	Unlikely	The Study Area is unlikely to support suitable habitat

Appendix C Flora Relevés

Lake Annean - Metals X – LA01

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 632395 mE 7023897 mN

Environmental Variables:

Landform: Plain
Slope: Very gentle to flat

Soils:

Soil Texture: Sandy loam
Soil Colour: Red/brown
Rock Type: Decaying granite, quartz

Coarse Surface Particles:

Site coverage: <2%
Size: 0.1 to 2 cm
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered shrubs of *Maireana pyramidata* and *Cratystylis subspinescens* over low chenopod shrubland *Maireana tomentosa*, *Dissocarpus paradoxus* and *Maireana triptera* with scattered low shrubs of *Frankenia setosa*

Species List

Species Name	Height (m)	Cover (%)
Aristida contorta	0.1	+
Atriplex codonocarpa	0.2	1
Cratystylis subspinescens	0.8	1
Dissocarpus paradoxus	0.3	1
Eragrostis dielsii	0.1	+
Eragrostis pergracilis	0.15	+
Frankenia setosa	0.3	2
Maireana carnosa	0.1	+
Maireana sp.	0.05	+
Maireana tomentosa	0.3	3-4
Maireana triptera	0.4	1
Sclerolaena sp.	0.05	+
Tragus australianus	0.1	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
60%	<3%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA01
Photo Number: 589, 590

Lake Annean - Metals X – LA02

Site Details:

Described by: Clinton van den Bergh
Date: 14/07/2015
Type: Relevé
MGA Zone: 50 632784 mE 7023440 mN

Environmental Variables:

Landform: Low dune
Slope: Very gentle

Soils:

Soil Texture: Stony sandy, clay
Soil Colour: Red/brown
Rock Type: Quartz and decaying granite (?)

Coarse Surface Particles:

Site coverage: ~50%
Size: 1 to 15 cm
Outcropping: None

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered tall shrubs of *Acacia pteraneura* over low open chenopod shrubland of *Maireana triptera*, *Maireana pyramidata* and *Rhagodia eremaea* over very open tussock grassland of *Aristida contorta*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	2.8	+
Acacia pteraneura	4	1
Acacia synchronicia	0.7	+
Aristida contorta	0.2	2
Eremophila longifolia	0.2	+
Maireana pyramidata	0.4	+
Maireana triptera	0.4	4
Portulaca oleracea	0.05	+
Ptilotus obovatus	0.5	+
Rhagodia eremaea	0.5	+
Senna artemisioides subsp. *helmsii*	0.5	+
Solanum lasiophyllum	0.3	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
30%	<1%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: no obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA02
Photo Number: 544

Lake Annean - Metals X – LA02a

Site Details:

Described by:	Clinton van den Bergh	
Date:	14/07/2015	
Type:	Relevé	
MGA Zone: 50	632585 mE	7023539 mN

Environmental Variables:

Landform: Depression on sandy plain
Slope: Very gentle

Soils:

Soil Texture: Clayey, sand
Soil Colour: Orange/brown
Rock Type: None present

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: None

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Low open chenopod shrubland of *Maireana ? platycarpa* and *Maireana tomentosa* over scattered tussock grassland of *Aristida contorta*

Species List

Species Name	Height (m)	Cover (%)
Eragrostis pergracilis		
Maireana ? platycarpa		
Maireana tomentosa		
Wurmbea tenella		

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
55%	<1%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No evidence of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA02a
Photo Number: 545

Lake Annean - Metals X – LA03

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 632990 mE 7024265 mN

Environmental Variables:

Landform: Stony plain
Slope: Very gentle

Soils:

Soil Texture: Loamy sand
Soil Colour: Red/brown
Rock Type: Quartz and granite

Coarse Surface Particles:

Site coverage: 12%
Size: 1 to 15cm
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered tall shrubs of *Acacia pteraneura* and *Acacia tetragonophylla* over scattered shrubs of *Senna sp. Meekatharra (E. Bailey 1-26)* and *Senna artemisioides subsp. helmsii* over low open shrubland of *Maireana triptera*, *Eremophila ? jucunda subsp. jucunda* and *Ptilotus obovatus* over very open tussock grassland of *Aristida contorta*

Species List

Species Name	Height (m)	Cover (%)
Acacia pteraneura	4.5	2
Acacia tetragonophylla	2.2	1
Aristida contorta	0.2	1
Dissocarpus paradoxus	0.1	+
Eremophila ? jucunda subsp. *jucunda*	0.6	3
Eremophila galeata	0.5	+
Maireana triptera	0.4	3
Ptilotus obovatus	0.4	2
Senna artemisioides subsp. *helmsii*	1.2	1
Senna sp. *Meekatharra* (E. Bailey 1-26)	1.5	1
Solanum lasiophyllum	0.4	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
45%	<5%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA03
Photo Number: 591-592

Lake Annean - Metals X – LA05

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 633264 mE 7024191 mN

Environmental Variables:

Landform: Plain
Slope: Gentle

Soils:

Soil Texture: Fine loamy sand
Soil Colour: Red/brown
Rock Type: Quartz

Coarse Surface Particles:

Site coverage: 65%
Size: 1 to 15 cm
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered tall shrubs of *Acacia pteraneura* over low open shrubland *Maireana triptera* and *Ptilotus obovatus* over scattered tussock grassland *Aristida contorta*

Species List

Species Name	Height (m)	Cover (%)
Acacia pteraneura	4.2	1
Acacia tetragonophylla	3.2	+
Aristida contorta	0.2	+ (1)
Eremophila galeata	0.6	+
Maireana triptera	0.4	3
Ptilotus obovatus	0.5	1
Rhagodia eremaea	0.7	+
Senna artemisioides subsp. *helmsii*	1	+
Solanum lasiophyllum	0.4	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
15%	<3%	

Veg Condition: Good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA05
Photo Number: 593, 594

Lake Annean - Metals X – LA06

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 634937 mE 7026004 mN

Environmental Variables:

Landform: Salt lake
Slope: Very gentle to flat

Soils:

Soil Texture: Clay
Soil Colour: white/light brown
Rock Type: Quartz

Coarse Surface Particles:

Site coverage: <10%
Size: 1 to 3 cm
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Samphire shrubland of *Tecticornia dying* and *Tecticornia ?pergranulata*

Species List

Species Name	Height (m)	Cover (%)
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	1.7	30
Tecticornia sp. *?* aff. *auriculata*	0.5	40

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
<10%	<10%	

Veg Condition: Excellent to very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA06
Photo Number: 613, 614

Lake Annean - Metals X – LA07

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 634130 mE 7025408 mN

Environmental Variables:

Landform: Hill
Slope: Moderate

Soils:

Soil Texture: Skeletal fine loamy sand
Soil Colour: Red/brown
Rock Type: Ironstone

Coarse Surface Particles:

Site coverage: 60%
Size: 1 to 50 cm
Outcropping: 15%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Acacia fuscaneura* and *Acacia synchroncia* over open shrubland of *Eremophila latrobei subsp. latrobei*, *Maireana pyramidata* and *Senna sp. Meekatharra (E. Bailey 1-26)* and *Eremophila forrestii subsp. forrestii* over low open shrubland of *Maireana triptera*, *Ptilotus obovatus* and *Solanum lasiophyllum* over very open tussock grassland of *Aristida contorta* and *Enneapogon caerulescens*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	3.8	1
Acacia synchronicia	2.7	+
Aristida contorta	0.2	1
Enneapogon caerulescens	0.1	1
Eremophila ? lachnocalyx	0.7	+
Eremophila forrestii subsp. *forrestii*	1.1	1
Eremophila latrobei subsp. *latrobei*	1.4	3
Maireana pyramidata	1.2	2
Maireana triptera	0.3	2
Ptilotus nobilis	0.05	+
Ptilotus obovatus	0.4	1
Rhagodia eremaea	1	+
Senna sp. *Meekatharra* (E. Bailey 1-26)	1	1
Solanum lasiophyllum	0.4	1

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
<10%	<2%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA07
Photo Number: 607, 608

Lake Annean - Metals X – LA08

Site Details:

Described by:	Clinton van den Bergh	
Date:	16/07/2015	
Type:	Relevé	
MGA Zone: 50	634434 mE	7024420 mN

Environmental Variables:

Landform: Small dunal rise in salt lake
Slope: Flat (on top of the dunal rise)

Soils:

Soil Texture: Fine sandy clay
Soil Colour: Red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Samphire shrubland ov *Tecticornia ? Sp. Dennys Crossing (K.A. Shepherd & J. English KS 552*

Species List

Species Name	Height (m)	Cover (%)
Eragrostis dielsii	0.05	+
Eragrostis falcata	0.1	+
Swainsona paradoxa	0.1	+ (1)
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.7	30

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
65%	<5%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA08
Photo Number: 605, 606

Lake Annean - Metals X – LA09

Site Details:

Described by:	Clinton van den Bergh	
Date:	16/07/2015	
Type:	Relevé	
MGA Zone: 50	635096 mE	7024395 mN

Environmental Variables:

Landform: Dune
Slope: Gentle

Soils:

Soil Texture: Fine-grained sand
Soil Colour: red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Isolated patches of tall shrubs of *Hakea preissii* over open shrubland of *Dodonaea viscosa subsp. angustissima*, *Maireana pyramidata* and *Cratystylis subspinescens* over scattered tussock grasses of *Aristida contorta*

Species List

Species Name	Height (m)	Cover (%)
Acacia tetragonophylla	1.4	+
Aristida contorta	0.2	+ (1)
Cratystylis subspinescens	1.4	3
Dodonaea viscosa subsp. *angustissima*	1.9	1
Hakea preissii	4	2
Maireana pyramidata	1.2	3
Ptilotus obovatus	0.5	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
75%	<2%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildifres

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA09
Photo Number: 597-598

Lake Annean - Metals X – LA10

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 635016 mE 7024256 mN

Environmental Variables:

Landform: Salt lake edge
Slope: Gentle

Soils:

Soil Texture: Fine loamy clay
Soil Colour: Red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Rabbits and cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Samphire shrubland of *Tecticornia indica subsp. bidens* and *Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)*

General Notes: On the playa edges there are isolated occurrences of *Tecticornia caterpillar* and *Tecticornia green* (wpt 448 and photos 603, 604)

Species List

Species Name	Height (m)	Cover (%)
Frankenia laxiflora	0.3	+
Maireana amoena	0.3	+
Swainsona paradoxa	0.2	+
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.6	1-3
Tecticornia indica subsp. *bidens*	0.5	30-35

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
55%	<5%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA10
Photo Number: 599, 600

Lake Annean - Metals X – LA12

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 633655 mE 7022926 mN

Environmental Variables:

Landform: Plain
Slope: Very gentle to flat

Soils:

Soil Texture: Fine clayey loam
Soil Colour: Red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered shrubs of *Maireana pyramidata* and *Eremophila longifolia* over open low chenopod shrubland *Sclerolaena diacantha*, *Salsola australis* and *Dissocarpus paradoxus*

Species List

Species Name	Height (m)	Cover (%)
Acacia sclerosperma subsp. *sclerosperma*	1.9	+ (1)
Dissocarpus paradoxus	0.3	+
Enneapogon caerulescens	0.3	1
Eragrostis dielsii	0.05	+
Eremophila longifolia	1.5	+
Lycium australe	1.2	+
Maireana pyramidata	1.3	+ (1)
Salsola australis	0.3	1
Sclerolaena diacantha	0.4	3
Solanum lasiophyllum	0.4	+
Swainsona paradoxa	0.1	1

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
40%	10%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA12
Photo Number: 582, 583

Lake Annean - Metals X – LA12a

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 633568 mE 7023066 mN

Environmental Variables:

Landform: Salt lake
Slope: very gentle to flat

Soils:

Soil Texture: Fine loamy clay
Soil Colour: Light brown/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Rabbits and cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Samphire shrubland of *Tecticornia ? indica*, *Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)* and *Tecticornia halocnemoides*

Species List

Species Name	Height (m)	Cover (%)
Dysphania simulans	0.1	+
Eragrostis dielsii	0.1	+
Salsola australis	0.3	+
Swainsona paradoxa	0.1	+
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.6	10
Tecticornia halocnemoides	0.6	10
Tecticornia indica subsp. *?*	0.9	20
Zygophyllum tetrapterum	0.2	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
40%	10%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA12a
Photo Number: 584, 585

Lake Annean - Metals X – LA13

Site Details:

Described by: Clinton van den Bergh
Date: 14/07/2015
Type: Relevé
MGA Zone: 50 633918 mE 7022296 mN

Environmental Variables:

Landform: Dune
Slope: very gentle

Soils:

Soil Texture: Fine clayey, sand
Soil Colour: Orange/red
Rock Type: None present

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered low trees of *Acacia fuscaneura* over tall shrubland to isolated patches of tall shrubs of *Acacia sclerosperma subsp. sclerosperma* and *Hakea preissii* over open shrubland of *Eremophila sp. B*, *Senna artemisioides subsp. filifolia* and *Senna artemisioides subsp. helmsii*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	5	+
Acacia sclerosperma subsp. *sclerosperma*	3.8	10
Aristida contorta	0.2	+
Atriplex vesicaria	0.4	+
Enchylaena tomentosa var. *tomentosa*	0.3	+
Eremophila sp. *B*	1.3	2
Hakea preissii	3.5	1
Maireana pyramidata	0.9	+
Ptilotus obovatus	0.6	+
Salsola australis	0.2	+
Scaevola spinescens	1	+
Senna artemisioides subsp. *filifolia*	1.9	+
Senna artemisioides subsp. *helmsii*	1	+
Solanum lasiophyllum	0.3	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
65%	5%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA13
Photo Number: 548, 549

Lake Annean - Metals X – LA13a

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 633705 mE 7022392 mN

Environmental Variables:

Landform: Gypsum dune
Slope: Gentle to moderate

Soils:

Soil Texture: Fine clayey loam
Soil Colour: Light brown/orange
Rock Type: Gypsum

Coarse Surface Particles:

Site coverage: 10%
Size: 1 to 5 cm
Outcropping: 40%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered tall shrubs of *Acacia sclerosperma subsp. sclerosperma* over low open shrubland of *Frankenia laxiflora*, *Sclerolaena fimbriolata* and *Enchylaena tomentosa var. tomentosa* over open tussock grassland of *Eragrostis eriopoda*

Species List

Species Name	Height (m)	Cover (%)
Acacia sclerosperma subsp. *sclerosperma*	2.4	1
Atriplex vesicaria	0.4	+
Enchylaena tomentosa var. *tomentosa*	0.4	+ (1)
Enneapogon caerulescens	0.1	+
Eragrostis eriopoda	0.3	3
Frankenia laxiflora	0.4	3
Lycium australe	0.9	+
Rhagodia eremaea	0.6	+
Sclerolaena fimbriolata	0.4	1
Solanum lasiophyllum	0.5	+
Zygophyllum compressum	0.1	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
30%	<2%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA13a
Photo Number: 580, 581

Lake Annean - Metals X – LA14

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 633971 mE 7021674 mN

Environmental Variables:

Landform: Plain
Slope: Very gentle to flat

Soils:

Soil Texture: Fine loamy clay
Soil Colour: Light brown/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered low shrubs of *Eremophila longifolia* and *Ptilotus obovatus* over chenopod shruband of *Salsola australis* over scattered herbs of *Swainsona paradoxa*

Species List

Species Name	Height (m)	Cover (%)
Atriplex vesicaria	0.5	+
Enneapogon caerulescens	0.2	+
Eragrostis dielsii	0.1	+ (1)
Eragrostis eriopoda	0.3	+ (1)
Eremophila longifolia	0.8	+
Ptilotus obovatus	0.5	+
Salsola australis	0.4	20
Sclerolaena sp.	0.1	2
Swainsona paradoxa	0.1	+ (1)

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
30%	20%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA14
Photo Number: 576-577

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Lake Annean - Metals X – LA14a

Site Details:

Described by:	Clinton van den Bergh	
Date:	15/07/2015	
Type:	Relevé	
MGA Zone: 50	633791 mE	7021741 mN

Environmental Variables:

Landform: Depression
Slope: Very gentle to flat

Soils:

Soil Texture: Fine loamy clay
Soil Colour: Light brown/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Samphire shrubland of *Tecticornia halocnemoides*, *Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)* and *Tecticornia indica subsp. ? bidens*

Species List

Species Name	Height (m)	Cover (%)
Eragrostis dielsii	0.1	+
Maireana amoena	0.3	+
Salsola australis	0.3	+
Swainsona paradoxa	0.1	+
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.4	2
Tecticornia halocnemoides	0.7	15
Tecticornia indica subsp. *?*	0.4	1
Tecticornia indica subsp. *? bidens*	0.4	1

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
60%	7%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA14a
Photo Number: 578, 579

Lake Annean - Metals X – LA15

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 633939 mE 7021207 mN

Environmental Variables:

Landform: Consolidated dune
Slope: Gentle

Soils:

Soil Texture: Fine-grained loamy sand
Soil Colour: Red
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Acacia fuscaneura* over shrubland of *Eremophila sp. A* over scattered low chenopod shrubs of *Salsola australis*, *Maireana pyramidata* and *Maireana tomentosa* over scattered tussock grasses of *Eragrostis sp.*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	4	4
Acacia grasbyi	2.2	+
Aristida contorta	0.3	+
Calandrinia sp.	0.05	+
Eragrostis sp.	0.4	1
Eremophila sp. *A*	1.5	14
Euphorbia tannensis	0.3	+
Maireana pyramidata	0.8	1
Maireana tomentosa	0.4	1
Salsola australis	0.4	1

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
35%	8%	

Veg Condition: Very good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA15
Photo Number: 570-571

Lake Annean - Metals X – LA15a

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 634039 mE 7021421 mN

Environmental Variables:

Landform: Dune
Slope: Gentle

Soils:

Soil Texture: Fine-textured loamy sand
Soil Colour: Red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered low trees of *Acacia pteraneura* over scattered tall shrubs of *Hakea preissii* over shrubland of *Senna sp. Meekatharra (E. Bailey 1-26)*, *Senna sp. Billabong (J.D. Alonzo 721)* and *Eremophila sp. A*

Species List

Species Name	Height (m)	Cover (%)
Acacia pteraneura	5.8	1
Eremophila sp. *A*	1	1
Hakea preissii	3.2	1
Maireana pyramidata	1	1
Senna sp. *Billabong* (J.D. Alonzo 721)	1.4	8
Senna sp. *Meekatharra* (E. Bailey 1-26)	1.5	12

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
65%	<2%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA15a
Photo Number: 572-573

Lake Annean - Metals X – LA16

Site Details:

Described by:	Clinton van den Bergh	
Date:	14/07/2015	
Type:	Relevé	
MGA Zone: 50	634681 mE	7020569 mN

Environmental Variables:

Landform: Samphire lake
Slope: Very gentle to flat

Soils:

Soil Texture: Clay
Soil Colour: light brown
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Low samphire shrubland of *Tecticornia indica subsp. ?*

Species List

Species Name	Height (m)	Cover (%)
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.3	+
Tecticornia indica subsp. *?*	0.3	30
Tecticornia indica subsp. *bidens*	0.3	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
50%	5%	

Veg Condition: Excellent to very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA16
Photo Number: 552-553

Lake Annean - Metals X – LA17

Site Details:

Described by: Clinton van den Bergh
Date: 14/07/2015
Type: Relevé
MGA Zone: 50 634487 mE 7020476 mN

Environmental Variables:

Landform: Dune (low foredune from salt lake)
Slope: Gentle

Soils:

Soil Texture: Fine to medium-grained sand
Soil Colour: Red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall shrubland of *Melaleuca stereophloia* over open samphire shrubland of *Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)* over scattered low shrubs of *Frankenia laxiflora*

Species List

Species Name	Height (m)	Cover (%)
Frankenia laxiflora		
Frankenia laxiflora		
Melaleuca stereophloia		
Muellerolimon salicorniaceum		
Salsola australis		
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)		

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
45%	<5%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfire

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA17
Photo Number: 554-555

Lake Annean - Metals X – LA18

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 632283 mE 7020902 mN

Environmental Variables:

Landform: Claypan edge
Slope: Very gentle to flat

Soils:

Soil Texture: Clayey sand
Soil Colour: Red/brown
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Scattered shrubs of *Lawrencia helmsii* and *Maireana pyramidata* over low chenopod shrubland of *Atriplex vesicaria* and *Maireana amoena*

Species List

Species Name	Height (m)	Cover (%)
Atriplex vesicaria	0.7	10
Eragrostis dielsii	0.1	+
Frankenia laxiflora	0.3	+
Lawrencia helmsii	1.3	1
Maireana amoena	0.4	1
Maireana pyramidata	1.2	1
Muellerolimon salicorniaceum	0.4	+
Solanum lasiophyllum	0.7	+
Swainsona paradoxa	0.2	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
50%	<5%	

Veg Condition: Very good to good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA18
Photo Number: 561-562

Lake Annean - Metals X – LA19

Site Details:

Described by:	Clinton van den Bergh	
Date:	15/07/2015	
Type:	Relevé	
MGA Zone: 50	632731 mE	7021522 mN

Environmental Variables:

Landform: Gypsum dune
Slope: Gentle

Soils:

Soil Texture: Fine textured loamy sand
Soil Colour: Orange/red
Rock Type: Gypsum

Coarse Surface Particles:

Site coverage: 5%
Size: 1 to 5 cm
Outcropping: 15%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Isolated patches of shrubs of *Acacia sclerosperma subsp. sclerosperma* over scattered low shrubs to low open shrubland of *Frankenia laxiflora* over open tussock grassland of *Eragrostis eriopoda* and *Enneapogon caerulescens*

Species List

Species Name	Height (m)	Cover (%)
Acacia sclerosperma subsp. *sclerosperma*	1.9	3
Atriplex vesicaria	0.4	+
Enneapogon caerulescens	0.2	1
Eragrostis eriopoda	0.3	6
Frankenia laxiflora	0.4	+
Lycium australe	1.8	+
Solanum lasiophyllum	0.7	+
Zygophyllum compressum	0.1	+
Zygophyllum tetrapterum	0.1	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
20%	<5%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA19
Photo Number: 565-566

Lake Annean - Metals X – LA20

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 632116 mE 7021337 mN

Environmental Variables:

Landform: Dune
Slope: Very gentle

Soils:

Soil Texture: Loamy sand
Soil Colour: Red/brown
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Hakea preissii* and *Acacia sclerosperma subsp. sclerosperma* over shrubland of *Eremophila sp. B* and *Senna artemisioides subsp. filifolia* over low scattered shrubs of *Ptilotus obovatus* and *Atriplex vesicaria*

Species List

Species Name	Height (m)	Cover (%)
Acacia sclerosperma subsp. *sclerosperma*	3.2	1-2
Aristida contorta	0.3	+
Atriplex vesicaria	0.6	1
Eremophila pantonii	1	+
Eremophila sp. *B*	1.1	8-10
Hakea preissii	4	1
Maireana pyramidata	1.2	+
Ptilotus obovatus	0.7	1
Senna artemisioides subsp. *filifolia*	1.3	+
Sida sp.	1.2	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
60%	<3%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA20
Photo Number: 563-564

Lake Annean - Metals X – LA21

Site Details:

Described by:	Clinton van den Bergh	
Date:	16/07/2015	
Type:	Relevé	
MGA Zone: 50	634700 mE	7025905 mN

Environmental Variables:

Landform: Hill
Slope: Moderate to steep

Soils:

Soil Texture: Skeletal sandy loam
Soil Colour: Red/orange/white
Rock Type: Quartz

Coarse Surface Particles:

Site coverage: 40%
Size: 1 to 40 cm
Outcropping: 20%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Acacia fuscaneura* over scattered shrubs to open shrubland of *Eremophila macmalliniana* and *Eremophila latrobei subsp. latrobei* over low open shrubland *Maireana pyramidata*, *Ptilotus obovatus* and *Solanum lasiophyllum* over very open tussock grassland *Aristida contorta* and *Enneapogon caerulescens*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	4.2	3
Aristida contorta	0.2	1
Cheilanthes brownii	0.15	+
Enneapogon caerulescens	0.2	+ (1)
Eremophila latrobei subsp. *latrobei*	1.9	3
Eremophila macmillaniana	2	1
Maireana pyramidata	0.7	+ (1)
Portulaca oleracea	0.05	+
Ptilotus obovatus	0.5	1
Solanum lasiophyllum	0.4	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
15%	<5%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA21
Photo Number: 611, 612

Lake Annean - Metals X – LA21a

Site Details:

Described by: Clinton van den Bergh
Date: 16/07/2015
Type: Relevé
MGA Zone: 50 634696 mE 7025651 mN

Environmental Variables:

Landform: Hill
Slope: Moderate to steep

Soils:

Soil Texture: skeletal sandy loam
Soil Colour: red/orange/white
Rock Type: Quartz

Coarse Surface Particles:

Site coverage: 40%
Size: 1 to 50 cm
Outcropping: 30%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Acacia fuscaneura* over open shrubland of *Eremophila latrobei subsp. latrobei* over low open shrubland of *Maireana pyramidata* over scattered tussock grasses of *Aristida contorta*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	4	3
Acacia grasbyi	2.2	+
Aristida contorta	0.2	+ (1)
Cheilanthes brownii	0.1	+
Enneapogon caerulescens	0.1	+
Eremophila latrobei subsp. *latrobei*	1.5	2
Maireana pyramidata	0.8	1
Ptilotus obovatus	0.3	+
Rhagodia eremaea	0.9	+
Salsola australis	0.2	+
Sclerolaena sp.	0.1	+
Solanum lasiophyllum	0.4	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
10%	<5%	

Veg Condition: Very good to good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA21a
Photo Number: 609, 610

Lake Annean - Metals X – LA22

Site Details:

Described by: Clinton van den Bergh
Date: 15/07/2015
Type: Relevé
MGA Zone: 50 633141 mE 7021190 mN

Environmental Variables:

Landform: Salt lake edge
Slope: Very gentle

Soils:

Soil Texture: fine textured clayey sand
Soil Colour: light brown/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance:
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Low samphire shrubland of *Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)* and *Tecticornia indica subsp. ?*

General Notes: Along the edge of the playa (a drop of half metre in topography) there is a thin strip (approximately 5m) of *Tecticornia ?indica green* (wpt425 and photos 559-560)

Species List

Species Name	Height (m)	Cover (%)
Eragrostis dielsii	0.1	+
Eragrostis falcata	0.1	+
Salsola australis	0.2	+
Swainsona paradoxa	0.1	+
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.4	25
Tecticornia indica subsp. *?*	0.2	10
Tecticornia sp. *A*		

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
35%	<5%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA22
Photo Number: 557-558

Lake Annean - Metals X – LA23

Site Details:

Described by: Clinton van den Bergh
Date: 14/07/2015
Type: Relevé
MGA Zone: 50 634875 mE 7021930 mN

Environmental Variables:

Landform: Plain, within a slight depression
Slope: Very gentle to flat

Soils:

Soil Texture: Medium-grained sandy clay
Soil Colour: Red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping:)5

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Hakea preissii* and *Acacia sclerosperma subsp. sclerosperma* over low chenopod shrubland of *Maireana pyramidata*, *Atriplex vesicaria* and *Maireana tomentosa* over scattered low shrubs of *Eremophila* sp. B

Species List

Species Name	Height (m)	Cover (%)
Acacia sclerosperma subsp. *sclerosperma*	2.2	1
Aristida contorta	0.1	+
Atriplex vesicaria	0.5	3
Calandrinia sp.	0.01	+
Eragrostis dielsii	0.01	+
Eremophila sp. *B*	0.8	3
Hakea preissii	4	2
Maireana pyramidata	0.9	3
Maireana tomentosa	0.4	1
Ptilotus obovatus	0.3	+
Salsola australis	0.2	+
Sclerolaena diacantha	0.1	+
Senna artemisioides subsp. *filifolia*	1.9	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
40%	<5%	

Veg Condition: Very good to good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA23
Photo Number: 550-551

Lake Annean - Metals X – LA24

Site Details:

Described by:	Clinton van den Bergh	
Date:	16/07/2015	
Type:	Relevé	
MGA Zone: 50	634919 mE	7024903 mN

Environmental Variables:

Landform: Small lake dune
Slope: Very gentle

Soils:

Soil Texture: Sandy clay
Soil Colour: red/orange
Rock Type: None

Coarse Surface Particles:

Site coverage: 0%
Size:
Outcropping: 0%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle and rabbits

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Samphire shrubland of *Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)*

Species List

Species Name	Height (m)	Cover (%)
Calandrinia sp.	0.01	+
Eragrostis dielsii	0.05	+
Eragrostis falcata	0.2	+
Maireana amoena	0.3	+
Ptilotus nobilis	0.2	+
Swainsona paradoxa	0.1	+
Tecticornia ? sp. *Dennys Crossing* (K.A. Shepherd & J. English KS 552)	0.9	45
Tecticornia indica subsp. *?*	0.5	+ (1)

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
35%	10%	

Veg Condition: Very good
Weeds:

Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfires

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA24
Photo Number: 595, 596

Lake Annean - Metals X – LA25

Site Details:

Described by: Clinton van den Bergh
Date: 14/07/2015
Type: Relevé
MGA Zone: 50 634493 mE 7022893 mN

Environmental Variables:

Landform: Ironstone hill
Slope: Moderate

Soils:

Soil Texture: Fine loamy clay (skeletal)
Soil Colour: Brown/red
Rock Type: Ironstone and other rocks

Coarse Surface Particles:

Site coverage: 40%
Size: 1 to 15 cm
Outcropping: 10%

Impacts:

Waterlogging:
Inundation:
Flooding:
Erosion:
Human disturbance: Historical mining
Introduced species: Cattle

FAUNA HABITAT DATA

Habitat trees (Lge w > 20cm DBH): None

FLORA AND VEGETATION DATA

Description: Tall open shrubland of *Acacia fuscaneura* over open shrubland of *Eremophila latrobei subsp. latrobei*, *Senna sp. Meekatharra (E. Bailey 1-26)* and *Eremophila ? Lachnocalyx* over scattered low chenopod shrubs of *Maireana triptera*

Species List

Species Name	Height (m)	Cover (%)
Acacia fuscaneura	3.5	8
Enneapogon caerulescens	0.2	+
Eremophila ? lachnocalyx	1.3	1
Eremophila latrobei subsp. *latrobei*	1.8	4
Euphorbia tannensis	0.1	+
Maireana georgei	0.3	+
Maireana triptera	0.3	2
Portulaca oleracea	0.05	+
Ptilotus nobilis	0.1	+
Ptilotus obovatus	0.4	1
Rhagodia eremaea	0.6	+
Senna glutinosa subsp. *x luerssenii*	1.5	1
Senna sp. *Meekatharra* (E. Bailey 1-26)	1.2	1
Solanum lasiophyllum	0.3	+
Zygophyllum ? kochii	0.05	+

Ground Cover (percent)

Bare soil	Litter	Perennial ground cover
<10%	<5%	

Veg Condition: Very good to good
Weeds:
Fire Age: >10 years
Fire Notes: No obvious signs of recent wildfire

SITE PHOTOGRAPH

Project: Lake Annean - Metals X
Site: LA25
Photo Number: 546,547

Appendix D Inventory of Vascular Flora Taxa Recorded During the Survey

29 PTERIDACEAE

Cheilanthes brownii

109 COLCHICACEAE

Wurmbea tenella

163 POACEAE

Aristida contorta
* *Cenchrus ciliaris*
Cymbopogon sp.
Enneapogon caerulescens
Eragrostis dielsii
Eragrostis eriopoda
Eragrostis falcata
Eragrostis pergracilis
Eragrostis sp.
Eriachne aristidea
Eriachne helmsii
Eriachne pulchella
Tragus australianus

175 PROTEACEAE

Hakea preissii

199 ZYGOPHYLLACEAE

Tribulus suberosus
Zygophyllum ? kochii
Zygophyllum compressum
Zygophyllum tetrapterum

201 FABACEAE

Acacia fuscaneura
Acacia grasbyi
Acacia pteraneura
Acacia sclerosperma subsp*. sclerosperma*
Acacia synchronicia
Acacia tetragonophylla
Senna artemisioides subsp. *filifolia*
Senna artemisioides subsp. *helmsii*
Senna glutinosa subsp. *x luerssenii*
Senna sp. Billabong (J.D. Alonzo 721)
Senna sp. Meekatharra (E. Bailey 1-26)

Swainsona paradoxa

224 CUCURBITACEAE

* *Citrullus lanatus*

242 EUPHORBIACEAE

Euphorbia tannensis

281 MYRTACEAE

ǂ *Eucalyptus camaldulensis*
Melaleuca stereophloia
Melaleuca xerophila

299 SAPINDACEAE

Dodonaea viscosa subsp. *angustissima*

309 MALVACEAE

Lawrencia helmsii
Sida ectogama
Sida sp.

328 GYROSTEMONACEAE

Gyrostemon ramulosus

332 BRASSICACEAE

Lepidium phlebopetalum

338 SANTALACEAE

Santalum spicatum

342 FRANKENIACEAE

Frankenia laxiflora
Frankenia setosa

344 PLUMBAGINACEAE

Muellerolimon salicorniaceum

345 POLYGONACEAE

* *Acetosa vesicaria*

357 AMARANTHACEAE

Ptilotus nobilis
Ptilotus obovatus
Ptilotus polystachyus
Ptilotus schwartzii

358 CHENOPODIACEAE

Atriplex codonocarpa

Atriplex vesicaria
Dissocarpus paradoxus
Dysphania simulans
Enchylaena tomentosa var*. tomentosa*
Maireana ? platycarpa
Maireana amoena
Maireana carnosa
Maireana georgei
Maireana pyramidata
Maireana sp.
Maireana tomentosa
Maireana triptera
Rhagodia eremaea
Salsola australis
Sclerolaena diacantha
Sclerolaena fimbriolata
Sclerolaena sp.
Tecticornia ? sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)
Tecticornia disarticulata
Tecticornia halocnemoides
Tecticornia indica subsp. ?
Tecticornia indica subsp. ? *bidens*
Tecticornia indica subsp*. bidens*
Tecticornia peltata
Tecticornia pergranulata subsp. ? *elongata*
Tecticornia pergranulata subsp. ? *pergranulata*
Tecticornia sp. ? aff. *auriculata*
Tecticornia sp. A

364 AIZOACEAE

Tetragonia diptera

374 PORTULACACEAE

Calandrinia sp.
Portulaca oleracea

409 RUBIACEAE

Psydrax rigidula

413 APOCYNACEAE

Rhyncharrhena linearis

417 SOLANACEAE

Lycium australe
Solanum lasiophyllum

428 SCROPHULARIACEAE

Eremophila ? jucunda subsp*. jucunda*
Eremophila ? lachnocalyx

Eremophila forrestii subsp. ?
Eremophila forrestii subsp*. forrestii*
Eremophila galeata
Eremophila glutinosa
Eremophila latrobei subsp*. latrobei*
Eremophila longifolia
Eremophila macmillaniana
Eremophila pantonii
Eremophila pterocarpa subsp*. pterocarpa*
Eremophila sp. A
Eremophila sp. B

458 GOODENIACEAE

Scaevola spinescens

460 ASTERACEAE

Cratystylis subspinescens
Minuria leptophylla

471 PITTOSPORACEAE

Pittosporum angustifolium

Native species	101
Introduced species	4
Total species	105

* Denotes introduced (weed) species

ǂ Denotes planted (exotic) species

Appendix E Vertebrate Fauna Identified From the Desktop Study

Table Codes:

Databases

A. *Department of Parks and Wildlife Priority and Threatened Database* (DPaW 2015d)
B. *Department of Parks and Wildlife, NatureMap Database* (DPaW 2015b)
C. *Birdlife Australia Birdata Custom Bird Atlas* (Birdlife Australia 2015b)
D. *Department of the Environment, Protected Matters Database* (DoE 2015c)
E. *Central Murchison Gold Project: Level 1 Vegetation, Flora and Fauna Assessment* (Outback Ecology 2012)

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Mammals											
Bovidae	*Bos taurus**	European Cattle			x					x	
Bovidae	*Capra hircus**	Goat								x	
Bovidae	*Ovis aries**	Sheep								x	
Canidae	*Canus lupus**	Dog			x					x	
Dasyuridae	*Pseudantechinus woolleyae*	Woolley's Pseudantechinus					x				
Dasyuridae	*Sminthopsis dolichura*	Little long-tailed Dunnart					x				
Dasyuridae	*Sminthopsis macroura*	Stripe-faced Dunnart					x			x	
Equidae	*Equus caballus**	Brumby / Horse								x	
Felidae	*Felis catus**	Cat								x	
Leporidae	*Oryctolagus cuniculus**	Rabbit			x		x			x	
Macropodidae	*Macropus robustus*	Euro			x					x	
Macropodidae	*Macropus rufus*	Red Kangaroo								x	
Potoroidae	*Bettongia lesueur*	Burrowing Bettong	Ex	S2			x				
Rodentia	*Mus musculus**	House Mouse								x	
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			x		x			x	
Thylacomyidae	*Macrotis lagotis*	Bilby	Vu	S1		x					
Birds											
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill					x	x		x	
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill					x	x			
Acanthizidae	*Acanthiza iredalei*	Slender-billed Thornbill						x			
Acanthizidae	*Acanthiza robustirostris*	Slaty-backed Thornbill					x	x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Acanthizidae	*Acanthiza uropygialis*	Chestnut-rumped Thornbill					x	x			
Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface					x	x			
Acanthizidae	*Aphelocephala nigricincta*	Banded Whiteface					x	x			
Acanthizidae	*Calamanthus campestris*	Rufous Fieldwren						x			
Acanthizidae	*Gerygone fusca*	Western Gerygone					x	x			
Acanthizidae	*Pyrrholaemus brunneus*	Redthroat					x	x			
Acanthizidae	*Smicrornis brevirostris*	Weebill						x			
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk					x	x			
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	Ma				x	x			
Accipitridae	*Circus approximans*	Swamp Harrier	Ma				x	x			
Accipitridae	*Circus assimilis*	Spotted Harrier					x	x		x	
Accipitridae	*Haliastur sphenurus*	Whistling Kite	Ma				x	x			
Accipitridae	*Hamirostra isura*	Square-tailed Kite					x				
Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard					x	x			
Accipitridae	*Milvus migrans*	Black Kite						x			
Accipitridae	*Aquila audax*	Wedge-tailed Eagle					x	x		x	
Accipitridae	*Elanus caeruleus*	Black-shouldered Kite						x			
Accipitridae	*Aquila morphnoides*	Little Eagle						x			
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar					x	x			
Anatidae	*Anas gracilis*	Grey Teal					x	x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Anatidae	*Anas rhynchotis*	Australasian Shoveler					x	x			
Anatidae	*Anas superciliosa*	Pacific Black Duck					x	x		x	
Anatidae	*Aythya australis*	Hardhead					x	x			
Anatidae	*Biziura lobata*	Musk Duck	Ma				x	x			
Anatidae	*Chenonetta jubata*	Australian Wood Duck					x	x			
Anatidae	*Cygnus atratus*	Black Swan			x		x	x			
Anatidae	*Malacorhynchus membranaceus*	Pink-eared Duck					x	x			
Anatidae	*Oxyura australis*	Blue-billed Duck		P4		x		x			
Anatidae	*Tadorna tadornoides*	Australian Shelduck			x		x	x			
Anatidae	*Anas castanea*	Chestnut Teal						x			
Anatidae	*Stictonetta naevosa*	Freckled Duck					x	x			
Anhingidae	*Anhinga melanogaster*	Darter						x			
Apodidae	*Apus pacificus*	Fork-tailed Swift	Mi	S3		x			x		
Ardeidae	*Ardea modesta*	Eastern Great Egret	Mi/Ma	S3		x	x	x	x		
Ardeidae	*Ardea pacifica*	White-necked Heron					x	x			
Ardeidae	*Ardea novaehollandiae*	White-faced Heron						x			
Artamidae	*Artamus cinereus*	Black-faced Woodswallow					x	x		x	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow					x	x			
Artamidae	*Artamus personatus*	Masked Woodswallow					x	x			
Artamidae	*Artamus superciliosus*	White-browed Woodswallow					x	x			
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew						x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	Ma				x				
Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike						x			
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike						x		x	
Campephagidae	*Lalage tricolor*	White-winged Triller						x			
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar	Ma				x	x			
Casuariidae	*Dromaius novaehollandiae*	Emu			x		x	x			
Charadriidae	*Charadrius veredus*	Oriental Plover	Mi/Ma	S3					x		
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover	Ma		x		x	x			
Charadriidae	*Erythrogonys cinctus*	Red-kneed Dotterel					x	x			
Charadriidae	*Peltohyas australis*	Inland Dotterel					x				
Charadriidae	*Vanellus tricolor*	Banded Lapwing					x	x			
Charadriidae	*Peltohyas australis*	Inland Dotterel					x	x			
Charadriidae	*Charadrius melanops*	Black-fronted Dotterel						x			
Charadriidae	*Charadrius rubricollis*	Hooded Plover	Ma					x	x		
Cinclosomatidae	*Cinclosoma castaneothorax*	Chestnut-breasted Quail-thrush					x	x			
Cinclosomatidae	*Cinclosoma marginatum*	Western Quail-thrush					x				
Cinclosomatidae	*Psophodes occidentalis*	Western Wedgebill					x	x		x	
Climacteridae	*Climacteris affinis*	White-browed Treecreeper						x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Columbidae	*Columba livia*	Domestic Pigeon						x			
Columbidae	*Geopelia cuneata*	Diamond Dove					x	x		x	
Columbidae	*Geopelia striata*	Zebra Dove					x	x			
Columbidae	*Geophaps plumifera*	Spinifex Pigeon						x			
Columbidae	*Ocyphaps lophotes*	Crested Pigeon					x	x			
Columbidae	*Phaps chalcoptera*	Common Bronzewing					x	x		x	
Columbidae	*Streptopelia senegalensis**	Laughing Turtle-Dove						x			
Corvidae	*Corvus bennetti*	Little Crow					x	x			
Corvidae	*Corvus orru*	Torresian Crow			x		x	x			
Cracticidae	*Cracticus nigrogularis*	Pied Butcherbird					x	x		x	
Cracticidae	*Cracticus tibicen*	Australian Magpie					x	x		x	
Cracticidae	*Cracticus torquatus*	Grey Butcherbird					x	x			
Cracticidae	*Cracticus tibicen*	Australian Magpie					x	x			
Cuculidae	*Cacomantis pallidus*	Pallid Cuckoo	Ma				x	x			
Cuculidae	*Chrysococcyx basalis*	Horsfield's Bronze Cuckoo	Ma					x			
Cuculidae	*Chrysococcyx osculans*	Black-eared Cuckoo	Ma					x			
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird					x	x			
Dicruridae	*Grallina cyanoleuca*	Magpie-lark					x	x		x	
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail			x		x	x		x	
Dicruridae	*Rhipidura fuliginosa*	Grey Fantail						x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Estrildidae	*Taeniopygia guttata*	Zebra Finch			x		x	x		x	
Falconidae	*Falco berigora*	Brown Falcon					x	x			
Falconidae	*Falco cenchroides*	Australian Kestrel	Ma		x		x	x		x	
Falconidae	*Falco hypoleucos*	Grey Falcon		S1		X	X	x			
Falconidae	*Falco longipennis*	Australian Hobby					x	x			
Falconidae	*Falco peregrinus*	Peregrine Falcon		S4		X	X	x			
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	Mi/Ma	S3		x					
Halcyonidae	*Todiramphus pyrrhopygius*	Red-backed Kingfisher					x	x			
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	Ma				x	x			
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	Ma		x		x	x			
Hirundinidae	*Hirundo ariel*	Fairy Martin						x			
Hirundinidae	*Hirundo nigricans*	Tree Martin	Ma					x			
Laridae	*Chlidonias leucopterus*	White-winged Black Tern	Mi/Ma	S3		x		x			
Laridae	*Sterna hybrida*	Whiskered Tern	Ma			x	x				
Laridae	*Sterna nilotica*	Gull-billed Tern	Mi/Ma	S3				x			x
Laridae	*Larus novaehollandiae*	Silver Gull	Ma				x	x			
Laridae	*Sterna caspia*	Caspian Tern	Mi/Ma	S3				x			
Laridae	*Thalasseus bengalensis*	Lesser Crested Tern	Ma								x
Maluridae	*Amytornis textilis*	Thick-billed Grasswren		P4		x					
Maluridae	*Malurus lamberti*	Variegated Fairy-wren					x	x		x	
Maluridae	*Malurus leucopterus*	White-winged Fairy-wren			x		x	x			
Maluridae	*Malurus splendens*	Splendid Fairy-wren					x	x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Megapodiidae	*Leipoa ocellata*	Malleefowl	Vu	S1		x			x		
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater					x	x			
Meliphagidae	*Certhionyx variegatus*	Pied Honeyeater					x				
Meliphagidae	*Epthianura albifrons*	White-fronted Chat						x			
Meliphagidae	*Epthianura aurifrons*	Orange Chat			x		x	x			
Meliphagidae	*Epthianura tricolor*	Crimson Chat					x	x			
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater					x				
Meliphagidae	*Manorina flavigula*	Yellow-throated Miner					x	x			
Meliphagidae	*Ptilotula penicillatus*	White-plumed Honeyeater					x				
Meliphagidae	*Purnella albifrons*	White-fronted Honeyeater					x	x			
Meliphagidae	*Sugomel niger*	Black Honeyeater					x	x			
Meliphagidae	*Lacustroica whitei*	Grey Honeyeater						x			
Meliphagidae	*Ptilotula penicillatus*	White-plumed Honeyeater						x			
Meliphagidae	*Ptilotula plumulus*	Grey-fronted Honeyeater						x			
Meliphagidae	*Gavicalis virescens*	Singing Honeyeater			x			x			
Meropidae	*Merops ornatus*	Rainbow Bee-eater	Mi/Ma	S3		x		x	x		
Motacillidae	*Anthus australis*	Australian Pipit	Ma		x			x		x	
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella					x	x			
Otididae	*Ardeotis australis*	Australian Bustard					x	x			
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush					x	x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird			x		x	x			
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler					x	x			
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote						x			
Pardalotidae	*Pardalotus striatus*	Striated Pardalote					x	x			
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	Ma		x		x	x			
Petroicidae	*Microeca fascinans*	Jacky Winter						x			
Petroicidae	*Petroica goodenovii*	Red-capped Robin					x	x			
Petroicidae	*Petroica cucullata*	Hooded Robin						x			
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant						x			
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant					x	x			
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant						x			
Phasianidae	*Coturnix pectoralis*	Stubble Quail	Ma				x	x			
Podargidae	*Podargus strigoides*	Tawny Frogmouth						x			
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe						x			
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe			x		x	x			
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe					x	x			
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler					x	x		x	
Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler					x	x			
Psittacidae	*Cacatua sanguinea*	Little Corella					x	x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Psittacidae	*Melopsittacus undulatus*	Budgerigar					x	x		x	
Psittacidae	*Neophema elegans*	Elegant Parrot						x			
Psittacidae	*Neophema bourkii*	Bourke's Parrot					x				
Psittacidae	*Nymphicus hollandicus*	Cockatiel					x	x		x	
Psittacidae	*Platycercus zonarius*	Australian Ringneck					x	x			
Psittacidae	*Cacatua roseicapilla*	Galah						x		x	
Psittacidae	*Platycercus varius*	Mulga Parrot						x			
Ptilonorhynchidae	*Ptilonorhynchus guttatus*	Western Bowerbird					x	x			
Rallidae	*Fulica atra*	Eurasian Coot					x	x			
Rallidae	*Gallinula ventralis*	Black-tailed Native-hen					x	x			
Rallidae	*Porzana fluminea*	Australian Spotted Crake						x			
Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt					x	x		x	
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	Ma				x	x			
Recurvirostridae	*Recurvirostra novaehollandiae*	Red-necked Avocet	Ma				x	x			
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt					x				
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	Mi/Ma	S3							x
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper	Mi/Ma	S3		x		x			
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	Mi/Ma	S1/S3		x		x			
Scolopacidae	*Calidris melanotos*	Pectoral Sandpiper	Mi/Ma	S3				x			
Scolopacidae	*Calidris ruficollis*	Red-necked Stint	Mi/Ma	S3		x		x			

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Scolopacidae	*Calidris subminuta*	Long-toed Stint	Mi/Ma	S3							x
Scolopacidae	*Limosa limosa*	Black-tailed Godwit	Mi/Ma	S3							x
Scolopacidae	*Tringa glareola*	Wood Sandpaper	Mi/Ma	S3		x		x			
Scolopacidae	*Tringa nebularia*	Common Greenshank	Mi/Ma	S3		x		x			
Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	Mi/Ma	S3		x		x			
Scolopacidae	*Tringa hypoleucos*	Common Sandpiper	Mi/Ma	S3		x		x			
Strigidae	*Ninox connivens*	Barking Owl						x			
Strigidae	*Ninox novaeseelandiae*	Boobook Owl	Ma					x			
Sylviidae	*Cincloramphus cruralis*	Brown Songlark					x	x			
Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark					x	x			
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill					x	x			
Threskiornithidae	*Platalea regia*	Royal Spoonbill						x			
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	Mi/Ma	S3		x		x			
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	Ma				x	x			
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	Ma				x	x			
Turnicidae	*Turnix velox*	Little Button-quail			x		x	x		x	
Tytonidae	*Tyto alba*	Barn Owl						x			
Zosteropidae	*Zosterops lateralis*	Silvereye	Ma					x			
Reptiles											
Agamidae	*Ctenophorus caudicinctus*				x		x				
Agamidae	*Pogona minor*	Dwarf Bearded Dragon					x				
Agamidae	*Ctenophorus nuchalis*	Central Netted Dragon					x				

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Agamidae	*Ctenophorus reticulatus*	Western Netted Dragon					x			x	
Agamidae	*Ctenophorus salinarum*	Salt Pan Dragon			x		x				
Agamidae	*Ctenophorus scutulatus*						x			x	
Boidae	*Antaresia perthensis*	Pygmy Python					x				
Carphodactylidae	*Nephrurus wheeleri*						x				
Diplodactylidae	*Diplodactylus pulcher*						x				
Diplodactylidae	*Rhynchoedura ornata*	Western Beaked Gecko					x				
Diplodactylidae	*Strophurus wellingtonae*						x				
Egerniidae	*Egernia depressa*	Southern Pygmy Spiny-tailed Skink			x		x				
Egerniidae	*Egernia stokesii badia*	Western Spiny-tailed Skink	En	S1			x		x		
Elapidae	*Parasuta monachus*						x				
Elapidae	*Pseudechis butleri*	Spotted Mulga Snake					x				
Elapidae	*Pseudonaja modesta*	Ringed Brown Snake					x				
Eugongylidae	*Menetia greyii*				x		x				
Gekkonidae	*Gehyra punctata*						x				
Gekkonidae	*Gehyra variegata*				x		x				
Gekkonidae	*Heteronotia binoei*	Bynoe's Gecko					x				
Pygopodidae	*Lialis burtonis*						x				
Pygopodidae	*Pygopus nigriceps*						x				
Sphenomorphidae	*Ctenotus leonhardii*						x				

Family	Species Name	Common Name	Conservation Code		This Survey	Database Searches				Literature Review	General Literature
			EPBC Act	In WA		A	B	C	D	E	
Sphenomorphidae	*Ctenotus schomburgkii*						x				
Sphenomorphidae	*Ctenotus severus*						x				
Sphenomorphidae	*Ctenotus uber*						x				
Sphenomorphidae	*Eremiascincus richardsonii*	Broad-banded Sand Swimmer					x				
Sphenomorphidae	*Lerista bipes*						x				
Sphenomorphidae	*Lerista eupoda*			P1	x	x	x				
Sphenomorphidae	*Lerista muelleri*						x				
Sphenomorphidae	*Lerista nicholsi*						x				
Sphenomorphidae	*Lerista macropisthopus*						x				
Sphenomorphidae	*Lerista timida*						x				
Varanidae	*Varanus caudolineatus*						x				
Varanidae	*Varanus gouldii*	Gould's Monitor								x	
Varanidae	*Varanus panoptes*	Yellow-spotted Monitor					x				
Amphibians											
Hylidae	*Cyclorana maini*	Sheep Frog					x				
Hylidae	*Litoria rubella*	Little Red Tree Frog			x		x				

Appendix F Fauna Habitat Assessments

Sites			Landform	Condition	Habitat Type
4, 5, 7, 10, 12			Undulating Plain	Good	Dunefield
% Ground Cover	Rock	0			
	Soil	75-85			
	Leaf Litter	5			
	Vegetation	15-25			
Rocks	Type	n/a			
	Size (mm)	n/a			
	Abundance (%)	0			
	Exposed Bedrock	0			
Soil	Type	Sand or sandy loam			
	Colour	Red			
Habitat Features	Water	None	Vegetation		
	Fire Presence	None	Stratum	Form	Stage / Height (m) / Cover (%) / Species
	Woody Debris	Moderate	Upper	Tree	Mature phase / 2-7 / 0-10 / *Acacia aneura* species complex, *Hakea presii*, *Senna artemisiodies*
	Peeling Bark	Rare/Moderate			
	Rock Crevices	None	Middle	Shrub	Mature phase / 0.5-2 / 5-15 / *Eremophila, Maireana, Atriplex*
	Burrowing Suitability	High			
	Tree Hollows (<10cm)	None/Rare	Lower	Tussock grass	Mature phase / 0.1-0.2 / 0-15 / *Aristida*
	Tree Hollows (>10cm)	None			

Sites			Landform	Condition	Habitat Type
1, 15			Plain	Good	Stony Plain
% Ground Cover	Rock	0-80			
	Soil	15-80			
	Leaf Litter	0-2			
	Vegetation	5-20			
Rocks	Type	Quartzite			
	Size (mm)	20-60			
	Abundance (%)	20-90			
	Exposed Bedrock	0			
Soil	Type	Sandy loam			
	Colour	Brown – Red brown			
Habitat Features	Water	None	Vegetation		
	Fire Presence	None	Stratum	Form	Stage	Height (m)	Cover (%)	Species
	Woody Debris	Rare	Upper	Tree	Mature phase	2-5	0-5	*Acacia aneura* species complex
	Peeling Bark	Rare						
	Rock Crevices	None	Middle	Shrub	Mature phase	0.2-0.8	0-20	*Maireana triptra, Ptilotus obovardus, Solanum lasophylum*
	Burrowing Suitability	Low						
	Tree Hollows (<10cm)	None	Lower	Tussock grass or chenopod	Mature Phase	0.1-0.4	0-15	*Aristida contorta or Maireana sp, Ptilotus obovardus*, *Aristida contorta*
	Tree Hollows (>10cm)	None						

Sites			Landform	Condition	Habitat Type
6,8,14			Plain	Good	Samphire
% Ground Cover	Rock	0			
	Soil	70-85			
	Leaf Litter	0-2			
	Vegetation	15-18			
Rocks	Type	n/a			
	Size (mm)	n/a			
	Abundance (%)	0			
	Exposed Bedrock	0			
Soil	Type	Clay loam			
	Colour	Light brown			
Habitat Features	Water	None, but prone to flooding and water logging	Vegetation		
	Fire Presence	None	Stratum	Form	Stage	Height (m)	Cover (%)	Species
	Woody Debris	None	Upper	- Na	Na	Na	Na	Na
	Peeling Bark	None						
	Rock Crevices	None	Middle	Na	Na	Na	Na	Na
	Burrowing Suitability	Low						
	Tree Hollows (<10cm)	None	Lower	Samphire or chenopod shrubland	Mature Phase	0.1-0.4	5-20	*tecticornia spp* or *Maireana* spp, *Atriplex* sp, *Frankenia* sp?, grasses
	Tree Hollows (>10cm)	None						

Sites			Landform	Condition	Habitat Type
3, 6			Low hills	Degraded	Ironstone Hills
% Ground Cover	Rock	80-90			
	Soil	5-15			
	Leaf Litter	1-2			
	Vegetation	10-15			
Rocks	Type	Ironstone			
	Size (mm)	6-600			
	Abundance (%)	50-90			
	Exposed Bedrock	2-10			
Soil	Type	Sandy loam			
	Colour	Red brown			
Habitat Features	Water	None	Vegetation		
	Fire Presence	None	Stratum	Form	Stage	Height (m)	Cover (%)	Species
	Woody Debris	Rare	Upper	Tree	Mature phase	2-6	0-10	*Acacia aneura* Species complex
	Peeling Bark	Rare						
	Rock Crevices	Moderate	Middle	Shrub	Mature phase	1-2	0-10	*Senna glutenosa, Eremophilia, Ptilotus obovardus*
	Burrowing Suitability	Low						
	Tree Hollows (<10cm)	Rare	Lower	Hummock grass	Mature Phase	1-2	0-10	*Maireana triptra*, *Maireana pyramidada* *Solanum lasophylum, Senna artemisiodies?*
	Tree Hollows (>10cm)	None						

Sites			Landform	Condition	Habitat Type
17			Outcrop	Degraded	Quartz Outcrop
% Ground Cover	Rock	80			
	Soil	15			
	Leaf Litter	5			
	Vegetation	15			
Rocks	Type	Quartzite			
	Size (mm)	6-2000			
	Abundance (%)	50-90			
	Exposed Bedrock	20-50			
Soil	Type	Sandy loam			
	Colour	Red brown			
Habitat Features	Water	None	Vegetation		
	Fire Presence	None	Stratum	Form	Stage	Height (m)	Cover (%)	Species
	Woody Debris	Rare	Upper	Tree	Mature phase	2-5	0-15	*Acacia aneura* sp. complex
	Peeling Bark	Rare						
	Rock Crevices	Moderate	Middle	Shrub	Mature phase	0.5-2	0-15	*Eremophila* spp.
	Burrowing Suitability	Low						
	Tree Hollows (<10cm)	Rare	Lower	Tussock grass	Mature Phase	0.1-0.5	5-15	Grasses
	Tree Hollows (>10cm)	None						

Sites			Landform	Condition	Habitat Type
2, 9, 11, 13			Plain	Good - Degraded	Chenopod Shrubland
% Ground Cover	Rock	0			
	Soil	80-90			
	Leaf Litter	0-2			
	Vegetation	5-20			
Rocks	Type	n/a			
	Size (mm)	n/a			
	Abundance (%)	0			
	Exposed Bedrock	0			
Soil	Type	Sandy loam			
	Colour	Light brown			
Habitat Features	Water	None	Vegetation		
	Fire Presence	None	Stratum	Form	Stage	Height (m)	Cover (%)	Species
	Woody Debris	Rare	Upper	Na	Na	Na	Na	Na
	Peeling Bark	Rare						
	Rock Crevices	None	Middle	Shrub	Mature Phase	0.1-1.4	0-20	*Maireana* sp. *Lorencia* sp., *Maireana* spp., *Solanum lasophylum*, *Ptilotus obovardus*
	Burrowing Suitability	Moderate						
	Tree Hollows (<10cm)	None	Lower	Samphire Shrubland or Tussock grasses	Mature Phase	0.1-0.4	0-20	*Tecticornia* sp., *Atriplex* spp *Salsola australis* or *Erogrostis*
	Tree Hollows (>10cm)	None						