accendo AUSTRALIA

CLEARING PERMIT APPLICATION

M70/1382 & L70/193 Lake Lockhart, Newdegate

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1 INTRODUCTION

1.1 Applicant

The applicant for this Clearing Permit is Regan Scott Grant. Details for the applicant are as follows:

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1.2 Background

The applicant is seeking to extract gypsum from a 66 hectare (ha) area within mining tenement M70/1382, accessed through miscellaneous lease L70/193, approximately 20 km south of Newdegate (herein referred to as the subject site) (refer **Figure 1**). The subject site is located within the Shire of Lake Grace and is adjacent to Lockhart Nature Reserve. The proposed gypsum extraction will be completed over a 20 year period with approximately 10,000 to 30,000 tonnes of gypsum extracted per year depending on demand and climatic factors.

To enable the proposed gypsum extraction, the removal of 66 ha of native vegetation within M 70/1382 and approximately 4 ha of vegetation within L 70/193 is required (refer to **Figure 1**).

1.3 Scope and Purpose

This document has been prepared to support an application for a Clearing Permit (Purpose Permit) pursuant to Section 51E of the *Environmental Protection Act 1986* (EP Act). This document provides information regarding the current environmental condition of the clearing area, including the predicted impacts of clearing and proposed management actions to mitigate predicted impacts. It also provides an assessment against the ten clearing principles and other relevant legislation and policy.

1.4 Relevant Legislation and Policy

Western Australian legislation relevant to this Clearing Permit application includes:

- *Bush Fires Act 1954;*
- *Biodiversity and Conservation Act 2016;*
- *Environmental Protection Act 1986; and*
- *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

2 BIOPHYSICAL ENVIRONMENT

During the compilation of this clearing permit application, a range of specific environmental and heritage issues were explored in relation to the clearing area. This involved a detailed desktop assessment.

2.1 Topography, Landform and Soils

The current topography of the subject site can be described as generally flat. Online mapping from the Department of Primary Industries and Regional Development's (DPIRD's) Natural Resource Information (NRInfo) database indicates an elevation of approximately 290 metres (m) Australian Height Datum (AHD) across the subject site.

The NRInfo database indicates that the subject site is primarily located within the Lagan System, part of the South-eastern Zone of Ancient Drainage. This system is comprised of chains of large salt lakes, saline valley floors and lunettes with salt lake soils, saline wet soils and calcareous loamy earths (refer to **Figure 2**). Three soil types have been mapped within the subject site:

- Lagan 1 salt lake Phase: Large seasonally dry salt lakes within the Lagan 1 subsystem, consisting of saline and gypsiferous clays and silts.
- Lagan 1 lake fringes Phase: Lunettes, dunes and swales associated with salt lakes within the Lagan 1 subsystem. Soils are mainly saline loams and clays, calcareous loamy earths, salt lake soils and some sandy lunettes.
- Lagan 1 saline Phase: Recently salinized alluvial plains not yet affected by aeolian processes with the Lagan 1 subsystem. Soils are mainly saline wet soils with minor grey duplex soils and calcareous loamy earths.

2.2 Hydrology

2.2.1 Groundwater

The subject site is located within the proclaimed Karri groundwater area. The principal groundwater aquifers for this area includes the Fractured Rock West – Paleochannel, Alluvium and fractured rock aquifers. Water bores in the area generally intersected layers of clay and sand material before intersecting weathered granite at depths below 4 m below ground level (BGL) with water being struck at approximately 20 m BGL. Depending on the rainfall of the previous winter, it is possible that perched water tables may be present at depths shallower than 20 m BGL. This surficial groundwater is usually highly saline and any intersection should not be detrimental to the lake hydrology (Austwide, 2019).

To protect the State's drinking water resources the Department of Water and Environmental regulation (DWER) has defined certain Priority Classification Areas within Public Drinking Water Source Areas (PDWSA) providing three levels of groundwater quality protection. These are based on the principles of risk avoidance (Priority 1), risk minimisation (Priority 2) and pollution limiting (Priority 3). The subject site does not lie within any existing or potential PDWSAs.

2.2.2 Surface Water

Lake Lockhart is approximately 12 km long and between 3.5 km to 5 km wide. It is part of the Lake Magenta to Lake Biddy system. Lake Lockhart is typical of many lakes on this palaeodrainage system. The largest source of water inflow to the lake is from rainfall and small surface streams draining the catchment. There is no channel connecting Lake Magenta with Lake Lockhart and surface flows would only occur after periods of exceptional rainfall.

Murphy-White and Leoni (2005) indicate that the subject site has low gradient slopes with poor surface drainage. The subject site is prone to periodic flooding, the most recent in 2017, whereby vegetation is destroyed and regenerates. The removal of vegetation within the subject site for a mining season, prior to the replacement of the topsoil containing seed bank is unlikely to impact on the surface water flow or quality of the subject site. The impact the proposal will have on the lake's holding capacity, and downstream environments are considered minimal as there is very limited flow of water on the lake environment with most water on the lake surface being the result of rainfall not inflow from upstream.

There will be no effect on Lake Magenta Reserve as the reserve is upstream. There will be no extraction on the lake bed that will affect ponding in depressions. Any ponding will be the result of heavy rainfall. (Austwide, 2019)

Areas of wetlands have been mapped across the Wheatbelt at a scale of 1:100,000 to 1:250,000. This mapping has been converted into a digital dataset that is maintained by Department of Biodiversity, Conservation and Attractions (DBCA) and is referred to as the '*Wheatbelt Wetlands Stage 1'* dataset. This dataset maps the subject site as a 'basin' wetland with no conservation significance assigned.

2.3 Flora and Vegetation

2.3.1 Flora

A flora and vegetation survey completed by Rick (2019) identified the subject site as containing 'Samphire shrublands' in an 'Excellent' condition overall, with some low lying areas regenerating after inundation. Weed species were present only in very low densities (refer **Appendix A**). No species of conservation significance were identified within this vegetation type (Rick 2019).

A ridge containing 'Samphire shrubland/forbland' in 'Very Good' condition due to a higher density of weeds and a history of inundation is located on the eastern shore of the salt lake on the western boundary of the subject site. Two Priority 3 species (*Angianthus halophilus* and *Frankenia* sp. Southern gypsum) and one Priority 4 species (*Haegiela tatei*) were identified within this vegetation type.

Two forms of *Fitzwillia axilliflora*, a Priority 2 species, were collected during the survey. The collection from the north of the tenement, outside the subject site is typical of the species. The other collection (*Fitzwillia* aff. *axilliflora*) occurring within the ridge containing the 'Samphire shrubland/forbland' is possibly a new species (Rick 2019). No clearing will occur within this ridge, therefore no impacts to these species is expected.

A number of Priority 3 species, *Frankenia drummondii* and *Goodenia orchardii* were located within L70/193 (refer to **Figure 1**). Given the width of this lease is approximately 70 m wide and the clearing for the access track will be approximately 6-7 m wide, any priority flora or significant Eucalyptus trees identified within L70/193 will be avoided.

2.3.2 Vegetation Types

The *Interim Biogeographical Regionalisation of Australia* (IBRA) divides Western Australia into 23 IBRA Bioregions which are subdivided into 53 IBRA sub regions. IBRA regions are large geographically distinct areas of similar climate, geology, landform, vegetation and fauna communities (Thackway and Cresswell 1995, and Paczkowska and Chapman 2000). The subject site is within the Western Mallee IBRA sub region, a sparsely populated sub region with an area of about 47,000 square kilometers. The sub region is largely cleared for agriculture with about 31% of the sub regions native vegetation remaining (Rick 2019). Mapping undertaken by Beard (1970) identified the subject site to consist of the Hyden Vegetation System.

The mapped vegetation associations can be used to determine vegetation extent and status within the Mallee region (refer to **Table 1**). The EPA recognises vegetation associations that are not well represented in reserves as being 'significant'.

Table 1. Extent of pre-European vegetation remaining within the Western Mallee IBRA region.

System	Pre-European (ha)	Current Extent (ha)	Remaining Extent (%)	Extent in Managed Lands (%)
IBRA Sub region Western Mallee	3,981,717	1,471,048	37	9
Local Government Shire of Grace	1,188,460	456,516	38	40
Beard Association Hyden vegetation system	3,485,785	3,146,487	90	8

The national objectives and targets for biodiversity conservation in Australia have a target to prevent clearance of ecological communities with an extent below 30% of their pre- European extent remaining. In consideration of **Table 1**, the Hyden vegetation system has greater than 30% of its pre-European extent remaining denoting that it is well represented.

2.3.1 Ecological Communities

Threatened Ecological Communities (TECs) are defined by the DBCA and are assigned to a category of Priority 1 to Priority 5.

Selected TECs are also afforded statutory protection at a Federal level pursuant to the *Environment Protection and Biodiversity Conservation Act 1998* (EPBC Act). The EPBC Act provides for the protection of TECs that are listed under section 181 of the Act, and are defined as "Critically Endangered", "Endangered" or "Vulnerable".

In addition to listing as a TEC, a community may be listed as a Priority Ecological Community (PEC). An ecological community that is under consideration for listing as a TEC, but does not yet meet the survey criteria or has not been adequately defined, is placed on the list of PECs in either Category 1, 2 or 3.

The flora and vegetation survey (Rick 2019) included a desktop analysis to identify the possible presence of any TEC. The result of this search indicated 'Herblands and Bunch grasslands on gypsum lunette dunes alongside playa lakes' was recorded approximately 34.2 km south, south east of the subject site. During the field survey, this TEC was not encountered (Rick 2019).

Adjacent to the subject site are small areas of the Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt including approximately 4 ha of *Eucalyptus sargentii* ssp *sergentii* (*Eucalyptus* aff. *sargentii)* woodlands and a small patch (approximately 3 ha) of *Eucalyptus kondininensis* woodlands to the North East (Rick 2019). This area is located outside of the clearing footprint and will therefore not be impacted by this proposal.

2.3.2 Environmentally Sensitive Areas

Section 51B of the EP Act allows the Minister to declare an Environmentally Sensitive Area (ESA). Once declared, the exemptions to clear native vegetation under the regulations do not apply in these areas. Current declared ESAs are listed in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

There are no ESAs located within the subject site.

2.4 Fauna

A search of the DBCA NatureMap database to establish whether species declared as 'Rare or likely to become extinct' (Threatened), 'Birds protected under an international agreement' (International Agreement (IA)) and 'Other specially protected fauna' (S) as listed under the *Biodiversity Conservation Act 2016* (BC Act) have been recorded in proximity (within a 10 km buffer) to the subject site. One fauna species listed as 'Threatened' species and three Priority 4 fauna species were identified within the buffer (refer to **Table 2**) (Austwide 2019).

The EPBC Act Protected Matters Search Tool also identified several threatened and migratory species that could potentially occur within or in proximity to the subject site. This included two species classified as 'Vulnerable', and two 'Endangered' species (refer to **Table 2**).

Table 2. Significant fauna potentially occurring within the subject site as identified by State and Commonwealth database searches (Austwide 2019)

Name	Status/Priority	Likelihood of Occurrence
Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)	Endangered (PMST) Rare or likely to become extinct (Nature Map)	May be observed in flight in the area
Leipoa ocellate (Malleefowl)	Vulnerable (PMST)	Possible
Dasyurus geoffroii (Chuditch, Western Quoll)	Vulnerable (PMST)	Unlikely
Phascogale calura (Red-tailed Phascogale)	Endangered (PMST)	Unlikely
Notamacropus irma (Western Brush Wallaby)	Priority 4 (Nature Map)	Possible – human presence will result in species moving away
Psophodes nigrogularis subsp. oberon (Western Whipbird (western mallee), Western Whipbird (mallee))	Priority 4 (Nature Map)	The subspecies' extent of occurrence is bounded by Lake Grace, Pingrup, the Stirling Ranges and Cape Riche (~90 km east northeast of Albany) to the west, and Ravensthorpe and Hopetoun (~165 km west of Esperance) to the east. The Western Whipbird (Western Mallee) is not listed as threatened under the *Wildlife Conservation Act 1950* (Western Australia). It is unlikely to occur within the subject site.

Name	Status/Priority	Likelihood of Occurrence
Thinornis rubricollis (Hooded Plover, Hooded Dotterel)	Priority 4 (Nature Map)	The hooded plover is a stocky, medium-sized wading bird about 20 cm long. It is likely to be found throughout SW Western Australia. Possible when water is on the lake – clearing will be undertaken only when the lake is dry and therefore this species will not be affected by the clearing activities.

Of the abovementioned conservation significant species, based on known occurrences and preferred habitat types, three species have the potential to occur within the subject site. A further assessment to determine the likelihood of these species occurring within the subject site is provided below.

Carnaby's Black Cockatoos

Breeding Habitat

The breeding habitat of Carnaby's cockatoo is made up of the eucalypt woodlands that provide breeding hollows, together with areas for feeding and watering sites within foraging distance of breeding sites (Commonwealth of Australia 2012). A 20 m buffer to eucalypt woodlands located adjacent to the subject site will be maintained at all times, therefore impacts to breeding habitat for Carnaby's black cockatoo is very unlikely.

Foraging Habitat

During the non-breeding season (January to July) the majority of the birds migrate to the higher rainfall coastal regions of their range in the Midwest coast, Swan Coastal Plain and south coast, which contain better natural water sources over the summer period and historically had extensive areas of proteaceous woodlands and shrublands to provide feed for young birds, and good resources for adult birds to stock up for the following breeding season (Commonwealth of Australia 2012). The absence of these food species along with introduced species such as plantation pines and commercial broad acre crops such as canola *Brassica napas* and *B. juncea* utilised as feed by Carnaby's black cockatoo indicate the area is not an important foraging region for the black cockatoos.

Malleefowl (*Leipoa ocellata*)

The Malleefowl is found in semi-arid to arid shrublands and low woodlands, especially those dominated by mallee and/or acacias (Benshemesh, J. 2007). A walk through of the Licence area did not observe any Malleefowl nesting sites. Consequently, an on-ground survey was deemed unnecessary (Austwide 2019). However, their presence within the subject site is possible and more likely within the Licence area, therefore a pre-clearing inspection by a qualified fauna spotter will be required to ensure impacts to the species are minimised by the clearing activities.

Western Brush Wallaby (*Notamacropus Irma*)

The western brush wallaby (*Macropus irma*), also known as the black-gloved wallaby, is a species of wallaby found in the southwest of Western Australia from north of Kalbarro to Cape Arid. The optimum habitat is through to be open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland (DWER 2012).

The main threat to the species is predation by the introduced red fox (*Vulpes vulpes)*. The IUCN lists the western brush wallaby as 'Least Concern', as it remains fairly widespread and the population is believed to be stable or increasing, as a results of fox control programs (Austwide 2019).

The food preferences of the wallaby are not well known with one study finding Western Brush Wallaby's consuming 29 species of plants, the three most common dietary items including *Carpobrotus edulis, Cynodon dactylon* and *Nuytsia floribunda* none of which were identified during the vegetation and flora survey undertaken by Rick (2019).

Therefore, the Western Brush Wallaby are unlikely to rely on the subject site for survival and clearing activities are unlikely to impact the population as human presence prior to clearing will result in the species moving away.

2.5 Aboriginal Heritage

All Aboriginal sites in Western Australia are provided protection under the *Aboriginal Heritage Act 1972* in which it is an offence for anyone to excavate, damage, destroy, conceal or in any way alter an Aboriginal site without the Minister's permission.

An online search for relevant Aboriginal heritage information was undertaken using the Department of Planning, Lands and Heritage Aboriginal Inquiry System that incorporates both the heritage site register and the heritage survey database. The Aboriginal Heritage Site Register is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* and contains information on over 22,000 listed Aboriginal sites throughout Western Australia.

Results of the Aboriginal Inquiry System database search revealed the presence of no Aboriginal heritage sites within the subject site or within a 5 km radius.

3 CLEARING ASSESSMENT

3.1 Avoidance and Mitigation Measures

The applicant undertook an assessment of the area prior to determining the suitability of the clearing footprint. This included an assessment of vegetation and flora within the proposed clearing area. Based on this flora and vegetation survey, all identified priority flora and significant vegetation communities will be avoided during the clearing process.

Clearing will be undertaken on an as needs basis and clearing areas will be progressively rehabilitated at the end of each mining season (November to April).

To avoid any direct or indirect environmental impacts, the applicant has also committed to various management measures as discussed in **Section 4**.

3.2 Assessment Against the Ten Clearing Principles

Any clearing of native vegetation requires a permit in accordance with Part V of the EP Act, except where an exception applies under Schedule 6 of the Act or is prescribed by regulation in the *Environmental Protection (Clearing Native Vegetation) Regulations 2004*.

The clearing of 66 ha of native vegetation for the extraction of gypsum and approximately 4 ha of native vegetation for access and infrastructure will require an approved clearing permit. Clearing applications are assessed against the Ten Clearing Principles outlined in Schedule 5 of the EP Act. These principles aim to ensure that all potential impacts resulting from the removal of native vegetation can be assessed in an integrated manner.

An examination of the Ten Clearing Principles applied against a desktop investigation, review of previous assessments and results from a recent site visit is provided below.

a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

The subject site is located within the Western Mallee subregion of the Mallee IBRA region. Mapping of Western Australian vegetation undertaken by Beard (1970) identified the subject site to consist of vegetation of the Hyden system. This vegetation system is well represented with over 90% of its pre-European extent remaining.

The subject site does not contain any TECs or PECs, as supported by the findings of the flora and vegetation survey (Rick 2019). All Priority flora identified within the tenement will be avoided with a minimum of a 20 m buffer maintained at all times during clearing.

The 'Critically Endangered – Eucalypt Woodlands of the Western Australian Wheatbelt' were found to potentially occur within the Licence area. This area is not proposed to be cleared. Furthermore, a 20 m buffer will be maintained to the potential TEC vegetation at all times during clearing. This TEC will therefore not be impacted by this proposal.

A flora and vegetation inspection of the clearing footprint will be undertaken prior to clearing to ensure that Priority flora or significant vegetation (that which may be classed as Eucalyptus Woodlands of the Western Australian Wheatbelt) is avoided during clearing with the demarcation of a 20 m buffer around identified individuals.

As discussed under Principle (b), the subject site is not likely to comprise habitat which conservation significant fauna species rely on and the temporary removal of this vegetation in the wider environment is not likely to impact these species.

While the clearing required is not likely to impact conservation significant flora or fauna, the vegetation is classified as being in 'Excellent' condition and is likely to comprise a high level of biological diversity. Therefore, the proposal may be considered to be at variance to this Principle.

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.

While a targeted fauna survey has not been undertaken within the subject site, a desktop assessment identified three fauna species of conservation significance with potential to be present at the subject site. As discussed within **Section 2.4** the proposed clearing activities are unlikely to have a significant impact on the conservation status of these species given that they are not reliant on the vegetation present within the subject site for breeding or survival.

Prior to clearing within L70/193, a qualified fauna spotter will undertake an inspection of the site to identify any black cockatoo nesting trees or malleefowl mounds to ensure no impact on these species occurs.

On this basis, the proposal is unlikely to impact habitat critical for the survival of conservation significant species. Therefore, the proposal is not considered to be 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 targeted flora survey has been undertaken within the subject site and the presence and location of rare flora has been identified. Any clearing undertaken in association with this proposal will actively avoid any identified rare flora and significant vegetation. A qualified botanist will undertake inspections within the proposed clearing footprint prior to clearing to identify any flora or vegetation of significance that will require avoidance. On this basis, there will be no impacts to flora or vegetation of conservation significance and therefore, the proposal is not considered to be at variance to this Principle.

d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threated ecological community.

A search of the DBCAs TEC database and the EPBC Act Protected Matters database within a 10 km proximity to the clearing area, revealed the possible presence of Eucalypt Woodlands of the WA Wheatbelt (Critically Endangered).

The flora and vegetation survey (Rick 2019) included a desktop analysis which identified the Herblands and Bunch grasslands on gypsum lunette dunes alongside playa lakes TEC, as being recorded approximately 34.2 km SSE of the subject site (Rick 2019). The field survey did not identify this TEC within the subject site.

Additionally, during this survey the Eucalypt woodlands located adjacent to the subject site possessed key characteristics of the critically endangered 'Eucalypt Woodlands of the WA Wheatbelt' TEC (Rick 2019). This area is not proposed to be cleared and a 20 m buffer will be maintained from any identified significant vegetation prior to clearing activities. Therefore, this TEC will not be impacted by this proposal.

Based on the flora and vegetation survey completed it is unlikely either of these TEC's will be impacted by the proposed clearing activities. Therefore, the proposal is not considered to be at variance to this Principle.

e) Native vegetation should not be cleared if it is a remnant of native vegetation in an area that has been extensively cleared.

The EPA has a target to retain all remaining areas of each system where less than 30% remains (EPA 2003a). As discussed in **Section 2.3.2** the subject site is mapped within the Hyden System which has . greater than 90% of its pre-European extent remaining denoting that it is well represented. The removal of 70 ha of vegetation within this system is equal to approximately 0.002% of the remaining vegetation within the system. Accordingly, the clearing will not significantly impact the extent of the Hyden System. This proposal is not considered to be at variance to this Principle.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

As discussed in **Section 2.2.2**, the clearing area is located largely within Lake Lockhart. Vegetation will only be removed in areas large enough for the excavation undertaken during the season and will be revegetated at the end of each season minimising the cleared area as far as possible. However, due to the proposal occurring within the lake it 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 clearing area is located within the following land phases:

- Lagan 1 salt lake Phase: Large seasonally dry salt lakes within the Lagan 1 subsystem, consisting of saline and gypsiferous clays and silts.
- Lagan 1 lake fringes Phase: Lunettes, dunes and swales associated with salt lakes within the Lagan 1 subsystem. Soils are mainly saline loams and clays, calcareous loamy earths, salt lake soils and some sandy lunettes.
- Lagan 1 saline Phase: Recently salinized alluvial plains not yet affected by aeolian processes with the Lagan 1 subsystem. Soils are mainly saline wet soils with minor grey duplex soils and calcareous loamy earths.

All three Phases are mapped as having 0% risk of the phase having a high to extreme water erosion risk.

The Lagan 1 salt lake and lake fringes phases have both been mapped as having 0% risk of the phase having a high to extreme wind erosion risk, with 4% of the Lagan 1 saline phase having a high to extreme wind erosion risk.

Therefore, the proposed clearing 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.

The Lake Magenta Reserve is located upstream of the proposed clearing area and there is no connecting channel between it and Lake Lockhart. The impact associated with downstream environments is considered minimal as there is very limited water flow within Lake Lockhart, with most water being the result of rainfall, not inflow from upstream watercourses (Austwide 2019).

A buffer of at least 200m will be maintained from the proposed clearing area to the Lockhart Nature Reserve, ensuring no impacts from the clearing works will occur within the Reserve. Based on this, the proposed clearing is not at variance to this Principle.

i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

As discussed within **Section 2.2.2** the impact associated with the proposed clearing on surface water flow and quality is considered minimal. The area is subject to periodic flooding, and this causes periodic degradation and rejuvenation of vegetation without deterioration of the quality of the surface or underground water. The groundwater is currently too saline for use by the local farmers and the removal of vegetation within the clearing area is unlikely to further exacerbate this.

The operation of heavy machinery within the clearing area is not possible during times when the ground conditions are too wet, therefore the clearing of vegetation will occur directly prior to the gypsum extraction at the beginning of each season in December or January when the lakes are dry enough. Therefore, it is unlikely that the proposed clearing will reduce the quality of surface or groundwater and therefore the proposal is not 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.

Given the topography, soil type and history of flooding within the clearing area, it is considered unlikely that the proposed clearing will increase the incidence of flooding and therefore the proposal is not at variance to this Principle.

4 ENVIRONMENTAL MANAGEMENT MEASURES

In order to mitigate potential impacts associated with the proposed clearing activities, the following site specific management activities will be implemented.

4.1 Vegetation and Flora Management

4.1.1 Background

Vegetation clearing will be required for the 66 ha of proposed extraction within M70/1382 and for approximately 4 ha to facilitate access and the construction of site infrastructure and amenities within L70/193 (refer to **Figure 2**).

4.1.2 Management Plan

In order to ensure that the potential impacts associated with vegetation clearing is minimised as far as practicable, the following management measures are proposed.

Table 3. Vegetation clearing and construction management plan.

Vegetation Clearing and Construction	
Responsibility • Project Manager. • Contractors.	
Objectives • Prevent clearing outside of the designated clearing boundaries. • Avoid clearing of Priority flora and TECs. • Minimise soil erosion and sedimentation.	
Potential Impacts • Clearing conservation significant flora and vegetation. • Inadvertent additional clearing of vegetation. • Impacts on fauna species. • Weed and disease invasion.	
Management Strategies	**Timing**
• All site personnel will be inducted on the clearing controls for this proposal.	• Prior to clearing.
• Vegetation required to be removed will be marked with white flagging tape to avoid any unnecessary disturbance to adjacent vegetation.	• Prior to clearing.
• A site inspection will be undertaken by qualified fauna and flora experts prior to clearing. Priority flora and vegetation associated with the TEC will be identified and marked to ensure they are not cleared. A 20 m buffer to all conservation significant flora and vegetation will be demarcated.	• Prior to clearing.
• The flagging tape which demarcates the trees to be cleared will be checked on a daily basis to ensure that the clearing requirements remain clearly visible.	• During clearing.
• No movement of vehicles or personnel within the vegetation retention areas will be allowed.	• During clearing.
• No stockpiling of topsoil or other material is to occur outside of the clearing boundary.	• During clearing.

• The location and area of vegetation cleared will be checked on a daily basis.	• During clearing.
Performance Indicators • No unauthorised clearing is undertaken. • No flora or vegetation of conservation significance is directly impacted during clearing.	
Monitoring • Daily checks to ensure that clearing is consistent with the approved clearing boundaries. • Daily checks to ensure that no flora and vegetation of conservation significance have been impacted.	
Reporting • The DMIRS will be notified immediately if clearing beyond the approved clearing boundaries occurs, or if any fauna is directly impacted. Work may be stopped and the site inspected by DMIRS and a remedy determined before work restarts. • A review of the performance indicators will be undertaken upon completion of clearing to determine the success of the vegetation clearing and construction management measures. Where non-compliances are identified the DMIRS will be notified accordingly.	

4.2 Fauna Management

4.2.1 Background

As discussed in **Section 2.4**, there is potential for three species of conservation significance to occur within the subject site. On this basis, the implementation of appropriate management measures is required during clearing and construction works.

4.2.2 Management Plan

A series of management and mitigation measures have been developed as documented below which will further support the protection of the above species of conservation significance within the subject site.

Table 4. Fauna management plan.

Species of conservation significance	
Responsibility • Project Manager. • Contractors.	
Objectives • Minimise direct and indirect impacts to species of conservation significance during construction. • Long term preservation of species of conservation significance within the subject site.	
Potential Impacts • Direct impacts to species of conservation significance during construction works.	
Management Strategies • Clearing will be undertaken as per **Section 4.1.2.** • The following clearing protocols will be implemented to avoid impacts to species of conservation significance: ○ Immediately prior to any clearing commencing a qualified expert with a current DBCA Regulation 15 or Regulation 17 fauna handling licence will undertake a pre-clearing inspection of the clearing zone and nearby areas to confirm the location of tree hollows currently or likely to be occupied by black cockatoos and Mallefowl nesting sites and mark these trees/areas as necessary.	**Timing** • During clearing. • Prior to and during clearing.

○ Prior to clearing commencing, the clearing operators will be briefed by the same qualified expert who will explain to operators which areas of the subject site are more sensitive in relation to the presence of species of conservation significance and the techniques and approaches that will need to be employed during the clearing operations. ○ In the event that a species of conservation significance is observed in a tree that is about to be cleared and there is a tree/area marked for retention near the tree which is to be cleared then the tree will be gently lowered to the ground to enable the animal to safely evacuate. The animal/s will be encouraged to move towards and occupy the trees to be retained. ○ If operators encounter injured species of conservation significance during clearing then arrangements will be made for the care and welfare of the injured animals. • In relation to the qualified expert, the following requirements need to be met: ○ They need to be able to recognise suitable habitat for species of conservation significance adjacent to the clearing. ○ They need to have demonstrated capture and animal handling experience.	• Prior to clearing.
Performance Indicators • Environmental induction and species of conservation significance clearing protocols implemented. • No species of conservation significance deaths occur during construction works. • Disturbance on site is limited to the approved area.	
Reporting • The DMIRS will be notified immediately if clearing beyond the approved clearing boundaries occurs, or if any individuals are directly impacted. • A report prepared by the qualified expert will be provided to DMIRS to advise on implementation of this plan and report on species of conservation significance observed and or handled.	

4.3 Weed and Pathogen Management

4.3.1 Background

During the flora and vegetation survey (Rick 2019), it was noted "Weed density was higher in the samphire/forbland vegetation which was in Very Good condition and regenerating after flooding. Some low lying samphire shrublands were also regenerating after inundation. More weeds were present in areas adjacent to the grazing lease on the eastern boundary of the proposed mine. Weed species recorded include *Mesembryanthemum nodiflorum, Arctotheca calendula, Hypochaeris glabra, Senecio vulgaris, Sonchus oleraceus, Ursinia anthemoides, Spergularia rubra, Trifolium arvense, Avena fatua*, *Bromus rubens, Hordeum leporinum, Parapholis incurva* and *Pentameris airoides*."

The spreading of weeds and introduction of new species is viewed as a low risk activity, however weed management measures are recommended to minimise the spread and potential infestation. The key objective associated with weed management is to prevent the introduction and/or spread of weeds throughout the subject site.

4.3.2 Management Plan

The following controls will be implemented within the subject site to assist in the control of weed movement.

Table 5. Weed management plan.

***Phytophthora* dieback and weed management**	
Responsibility	
• Project Manager. • Contractors.	
Objectives	
• To prevent the introduction and spread of weeds within the subject site.	
Potential Impacts	
• Introduction and spread of weeds.	
Management Strategies	**Timing**
• Training will be provided to all personnel during the safety and environment induction course.	• Prior to clearing.
• All earthmoving and ground engaging equipment will be inspected and cleaned of vegetation and soil prior to entry and exit of the subject site.	• Prior to clearing.
• Access to the subject site during construction will be restricted to the proposed roads and driveways. No other access points should be established. The access location and vehicle inspection point should be clearly sign posted.	• Prior to and during clearing.
• As far as practicable, onsite drainage shall be designed to contain runoff from building envelopes and roads within disturbed areas.	• Prior to and during clearing.
• Reduce vehicle and plant movement into and within the site as much as possible, particularly during wet conditions.	• During clearing.
• All material will be transported such that soil shall not fall from the vehicle onto road verges.	• During and post clearing.
Performance Indicators	
• Hygiene procedures are adopted during works.	
Monitoring	
• Project Manager will ensure control measures are implemented during construction works.	
Reporting	
• Contractors to confirm that weed management measures have been implemented.	

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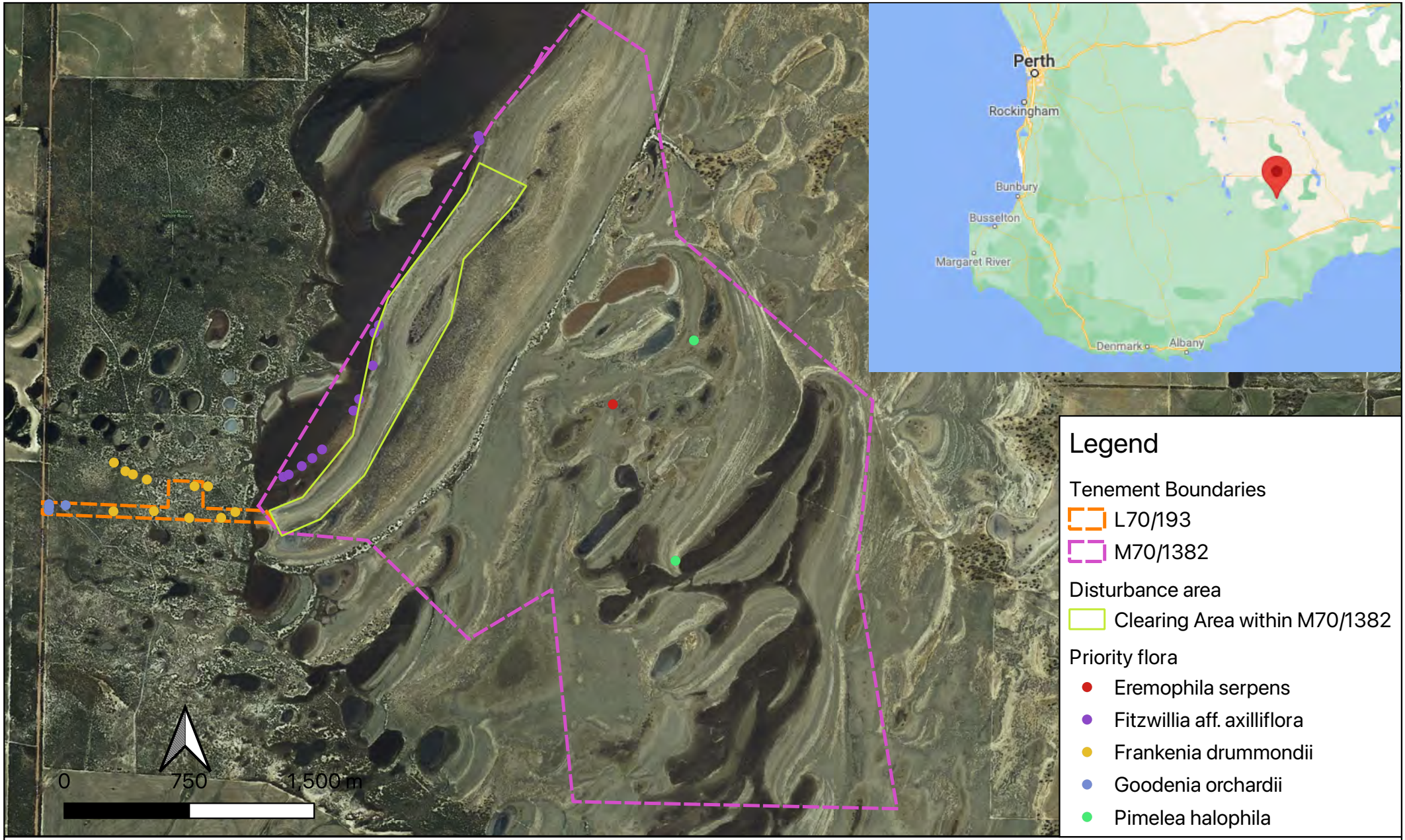
FIGURES



PROJECT	Lake Lockhart (M70/1382 & L 70/193)
DRAWING TITLE	Figure 1 Site Locality & Extent
CLIENT	Lakeside Minerals Pty Ltd

accendo AUSTRALIA
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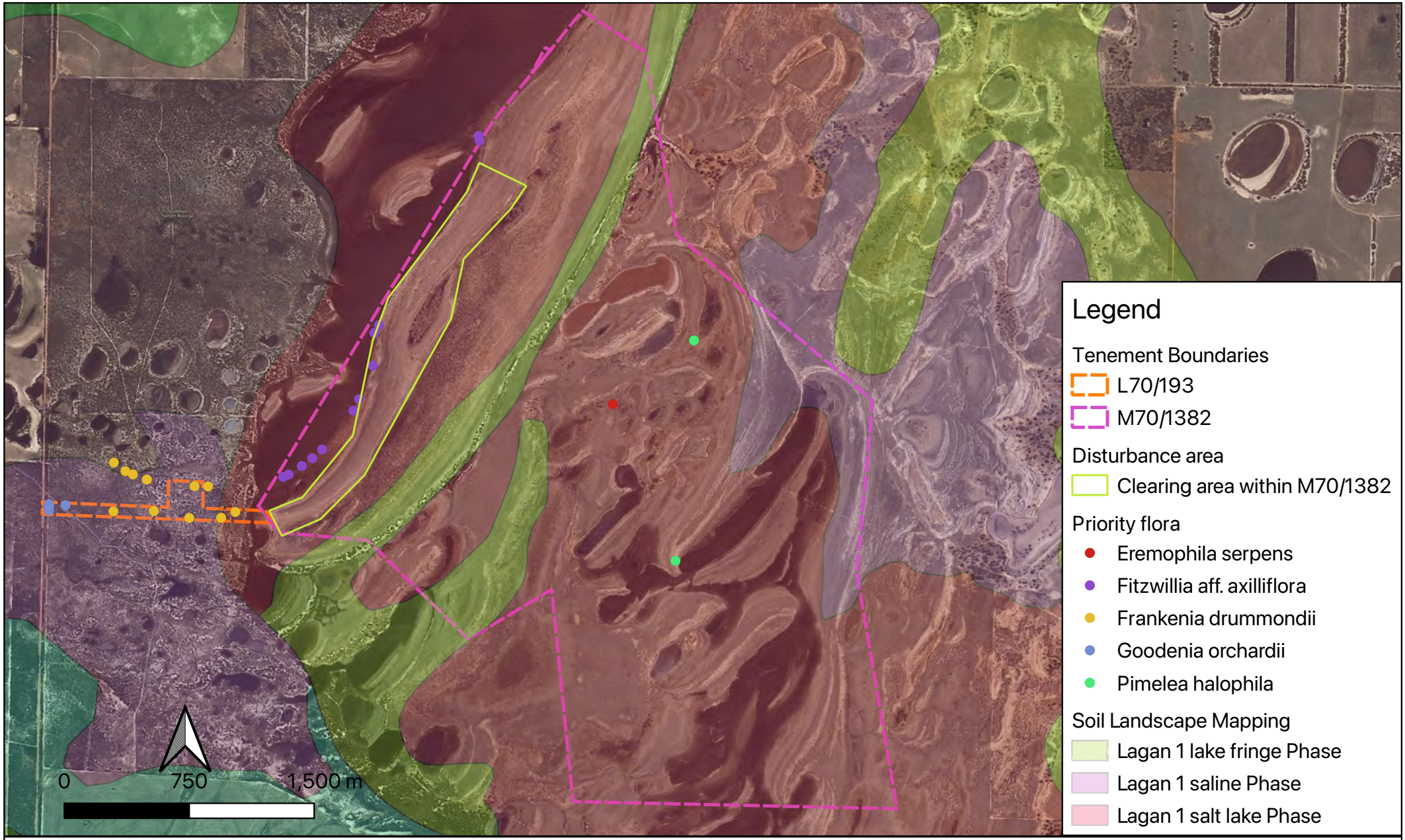
Project Number	2171	Designed	PN
Drawing Number	Figure 1	Drawn	PN
Revision	A	Checked	
Date	22/02/2022	Approved	
Sheet 1 of 1		Local Authority	Shire of Lake Grace



PROJECT	Lake Lockhart (M70/1382 & L 70/193)
DRAWING TITLE	Figure 2 - Soil landscape mapping
CLIENT	Lakeside Minerals Pty Ltd

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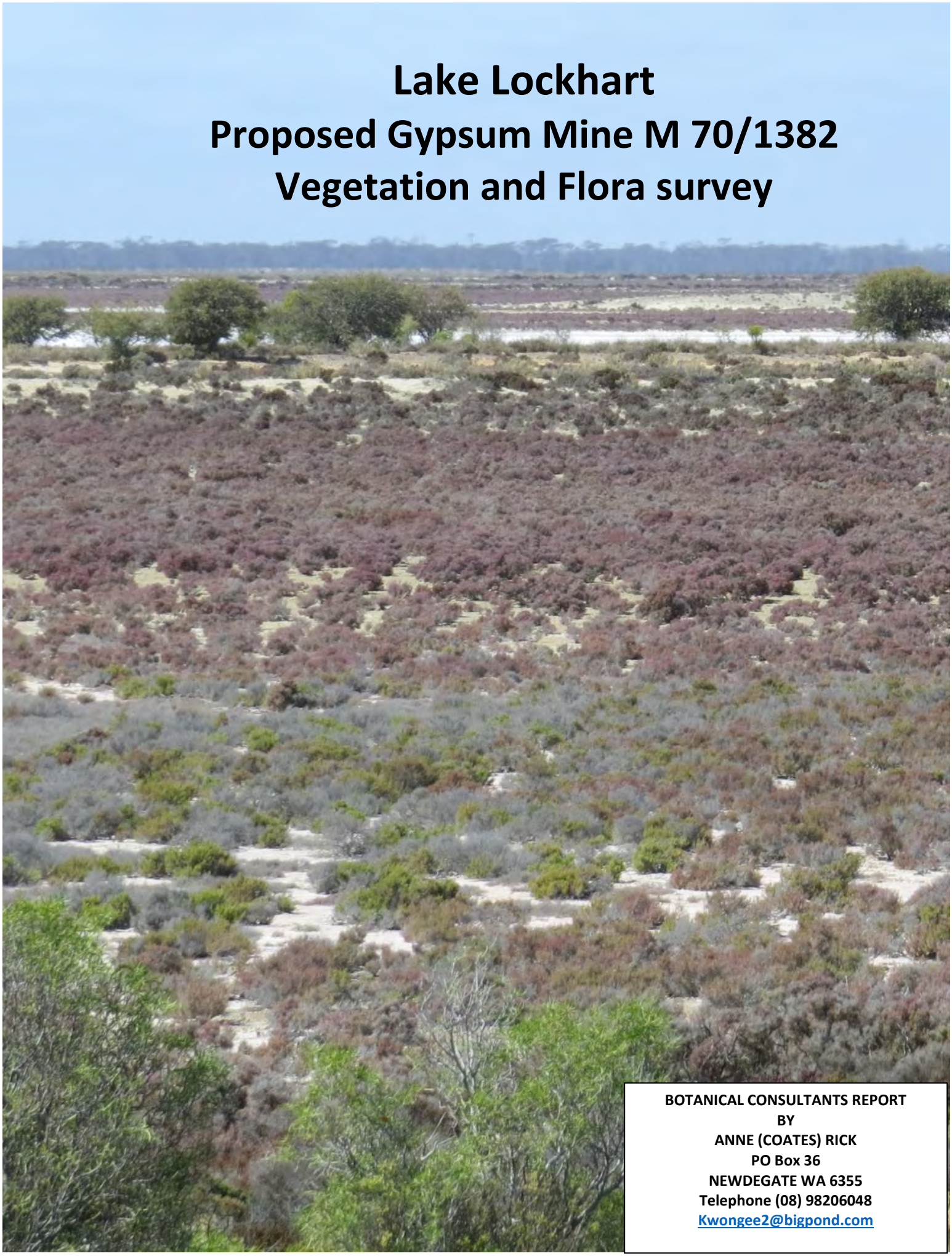
Project Number	2171	Designed	PN
Drawing Number	Figure 2	Drawn	PN
Revision	A	Checked	
Date	22/02/2022	Approved	
Sheet 1 of 1		Local Authority	Shire of Lake Grace

APPENDIX A. FLORA AND VEGETATION SURVEY

Lake Lockhart
Proposed Gypsum Mine M 70/1382
Vegetation and Flora survey



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March 2019

Disclaimer and Limitations

The scope of the survey may have been limited by time, budget, season, access and or other constraints. In the undertaking of this work the author has made every effort to ensure accuracy of the information provided. Data presented, maps, opinions and conclusions made in the report are done in good faith and the author is not responsible for the interpretation of this information subsequently by others.

SUMMARY

The study area subject to the vegetation and flora survey is the Unallocated Crown Land (UCL) included in exploration licence M 70/1382 covering Lake Lockhart and the proposed access area situated on privately owned land. The survey was carried out in order to provide information required for approvals to mine gypsum on the lake. Lake Lockhart is situated approximately 16.5 kms south of the Newdegate town site in the Lake Grace Shire.

The ground survey of the vegetation and flora was carried out on the 22nd, 25th and 27th October 2018. Data collection was through targeted and opportunistic searches including multiple releves and traverses. Areas of interest delineated from aerial photographs were visited for accurate vegetation mapping. Releves were sampled to assist with the vegetation mapping and the flora survey. Plant voucher specimens were collected to assist in accurate plant identification. Searches for Threatened, Priority and other significant flora were made during the traverses walked through the survey area.

Information collected at each site or releve included a GPS location, a vegetation description (Muir 1977) (ESCAVI 2003), vegetation condition (B.J. Keighery 1994), an inventory of plant species, the presence of Threatened or Priority Flora, a physical description including soils and topography and an estimate of % canopy cover for each stratum. A high resolution digital photograph was also taken.

The vegetation types mapped and described in this study include samphire shrublands growing on gypsum over clay covering low lying areas of flat terrain on the lake bed. Samphire shrubland/forbland is found on a low gypsum ridge that has been subject to inundation after the floods of 2017. Mixed species shrubland occurs on low rises/ridges of gypsum and open tall shrubland is found growing on the larger dunes and ridges scattered throughout the study area. In the proposed access area *Melaleuca* shrubland, shrubland/forbland and *Eucalyptus sargentii* subsp. *onesis* mallee form a mosaic of vegetation types.

No Threatened Ecological communities occurring on gypsiferous soils were found during the present survey. Adjacent to the proposed mining lease are small areas of the Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt including ~4ha of *Eucalyptus sargentii* ssp *sargentii* (*Eucalyptus* aff. *sargentii)* woodland and a small patch (~3ha) of *Eucalyptus kondininensis* woodland to the north east. Areas of *Eucalyptus kondininensis* also occur to the north of the proposed access area but were not included in the present survey

A total of 141 plant species were recorded during the flora and vegetation survey including 13 introduced species or weeds. Due to the time and seasonal constraints the species list only represents part of the flora of the area.

No Threatened (Declared Rare) species were found during the survey. Five priority species were recorded in the area of the proposed mining lease including *Fitzwillia axilliflora* P2, *Pimelea halophila* P2, *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3, *Eremophila serpens*

P4 and *Haegiela tatei* P4. *Angianthus halophilus* P3 was recorded adjacent to the boundary of the proposed mining lease on gypsum soils and therefore has a high probability of also occurring within the proposed mine area. *Angianthus halophilus* has not been previously recorded in the Lake Magenta salt lake system. A further three priority species were recorded in the proposed access area including *Dampiera orchardii* P2, *Frankenia drummondii* P3 and *Eucalyptus sargentii* subsp. *onesis* P3.

Two forms of *Fitzwillia axilliflora* were collected during the survey. The collection from the north of the proposed mine is typical of the species. The other collection (Fitzwillia aff. axilliflora) occurring within the proposed mine site on a gypsum ridge is possibly a new species (Mike Hislop DBCA pers comm.)The identification of *Eucalyptus sargentii* subsp. *onesis (*mallee) and *Eucalyptus sargentii* subsp. sargetii (tree) occurring in the Lake Lockhart area is at present under review. This *Eucalypus* is possible a new tree species (Eucalyptus aff. sargentii) with a lignotuber which will resprout as a mallee after fire (Malcolm French pers. comm.)

Chains of salt lakes such as the Lake Magenta system are important vegetation corridors in an already extensively cleared landscape. In general salt lake chains and gypsum dune systems constitute a relatively small portion of the overall native vegetation of the Western Mallee sub region and therefore have a high conservation value. In the Lake Magenta salt lake chain there are extensive areas of salt lake vegetation including areas of gypsum conserved in the Lake Magenta Nature Reserve. However large areas of this salt lake country have yet to be surveyed and it is therefore difficult to assess the extent of the vegetation types that are confined to gypsum.

Other species of interest recorded during the survey include *Kippistia suaedifolia* and *Calendrinia* sp Gypsum which are possible gypsophiles. *Kippistia suaedifolia* has a wide distribution in WA and *Calendrinia* sp. Gypsum is fairly common in the Magenta and Lake King salt lake chains on gypsum. Mining activities should not affect the over all conservation of these species however because of their restricted habitat preference they are more at risk than other plants which grow on a range of soil types. *Acacia lanuginophylla* Declared Rare Flora and *Eremophila veneta* P4 occur in the Lockhart Nature Reserve and adjacent private property and *Eucalyptus mimica* subsp. continens P1 is found adjacent to Lockhart Road near the proposed access area.

ACKNOWLEDGEMENTS

The assistance of Western Australian Herbarium staff and other Botanists, particularly Greg Keighery (*Angianthus*), Mike Hislop (*Fitzwillia* aff. *axilliflora*), Malcolm French (*Eucalyptus* aff. sargentii), Dean Nicolle (*Eucalyptus)* and Frank Obbens (*Calandrinia*), in helping to identify specimens collected at Lake Lockhart is gratefully appreciated. Access to the WA Herbarium collections was essential for carrying out the survey.

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1.0 INTRODUCTION

1.1 Survey Objectives

The study area subject to the vegetation and flora survey is the Unallocated Crown Land (UCL) included in exploration licence M 70/1382 covering Lake Lockhart and the proposed access area which is situated on privately owned land. The survey was carried out in order to provide information required for approvals to mine gypsum. This project follows the guidance for a detailed survey outlined in the Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment published by the EPA in December 2016 except for the set up of quadrats. Explanations are provided where deviation from the guidance occur. This report includes

- the description and mapping of vegetation types
- the assessment and mapping of the condition of the vegetation
- the representation in a regional and local context of the vegetation and flora
- a list of plant species recorded during the survey
- a report on Threatened, Priority and other significant flora and Threatened Ecological Communities in the area
- Data collection through targeted and opportunistic searches including multiple releves and traverses

1.2 Background Information

The Interim Biogeographical Regionalisation of Australia Version 7 (2012) divides Western Australia into 23 IBRA Bioregions which are subdivided into 53 IBRA sub regions. IBRA regions are large geographically distinct areas of similar climate, geology, landform, vegetation and fauna communities. The boundaries of the IBRA regions are broadly comparable with the earlier Beard's phytogeographic regions made up of Botanical districts and sub districts. The survey area at Lake Lockhart is situated in the Western Mallee IBRA sub region.

The Western Mallee is a sparsely populated sub region with an area of about 47,000 square kilometers. The sub region is largely cleared for agriculture with about 31% of the sub region's native vegetation remaining. These areas are under environmental stress from threats such as rising salinity (especially valley floor woodlands), vegetation fragmentation, weeds, fire and feral animals. Areas low on the landscape eg salt lakes are also at risk from excess nutrient run off. Around 10% of the sub region is held within nature reserves for conservation purposes covering about 25% of the remaining native vegetation (Sheperd et al 2002). The trends are for decline or rapid decline in vegetation associations and many ecosystems are unknown. Salt lake chains and gypsum dune systems constitute a relatively small portion of the overall native vegetation (McKenzie et al 2002).

The sub region is semi-arid, with a warm, dry, Mediterranean climate. It has seven to eight dry months, and a winter rainfall typically between 250 and 500 millimetres (10–19 in). Industries other than Agriculture include gypsum mining and a tourist industry centered on Wave Rock near Hyden.

There are 3 major salt lake systems in the sub region. These include the Lake Grace, Lake Magenta and the Lake King salt lake chains. Lake Lockhart is part of the Lake Magenta system which includes Lake Stubbs, Lake Burkett, Lake Buchan, Lake Lockhart, Lake Cobham, Lake Morris and Lake Magenta (Figure 1). Lake Lockhart is situated approximately 16.5 km south of the Newdegtate town site in the Lake Grace Shire. Figures 2 from the Department of Mines and Petroleum show the cadastral information and the outline of exploration license M 70/1382. The vegetation and flora covering the UCL within the exploration license was surveyed (997ha) and adjacent privately owned property designated for the access track (see Figure 3).

Figure 1: Lake Magenta salt lake chain. (Imagery Google Earth)

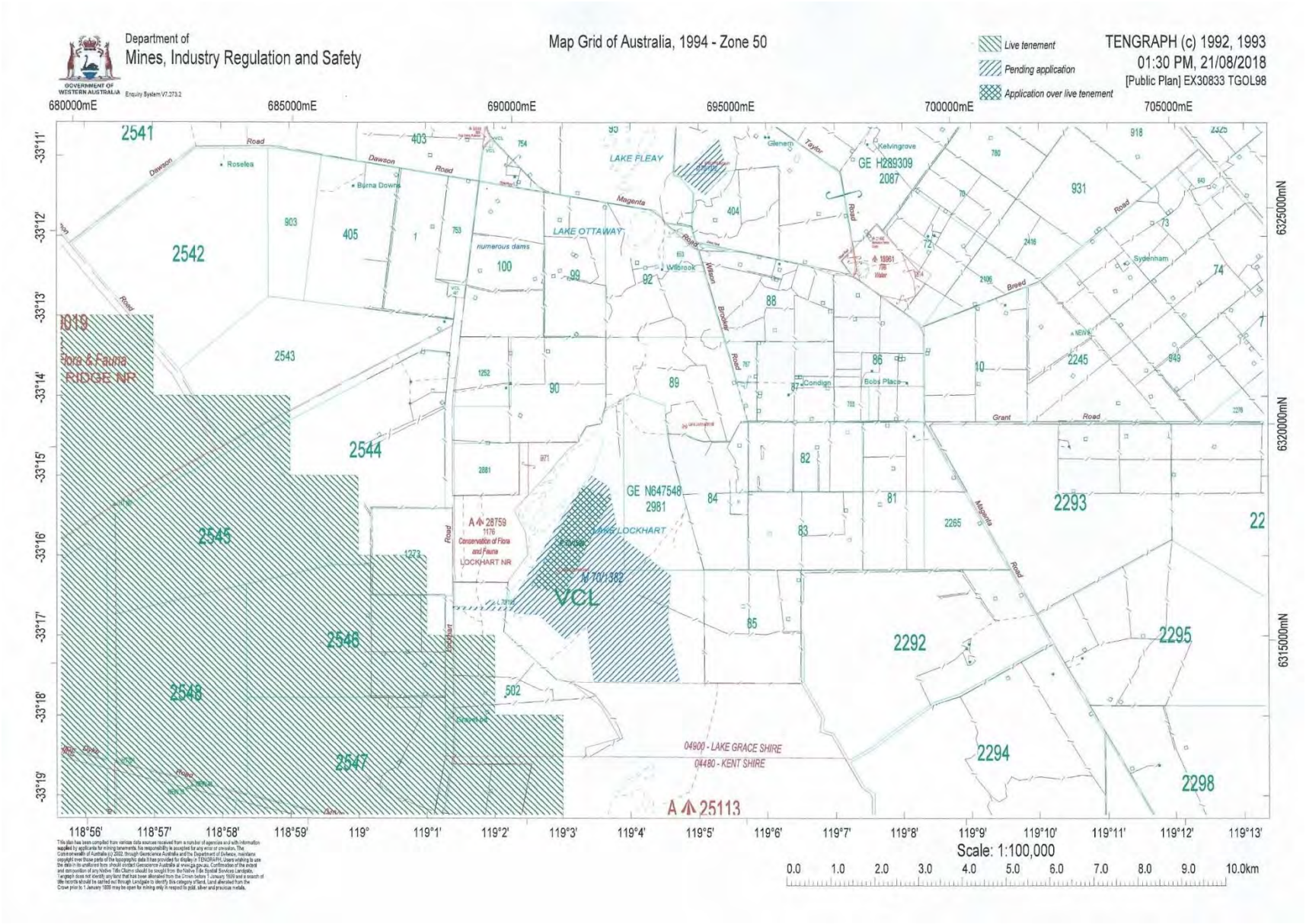


Figure 2: Cadastral information and the outline of exploration license M 70/1382 .

Figure 3: Lake Lockhart showing the boundary of exploration license M 70/1382

1.3 Desk Top Survey

1.3.1 Previous surveys in the Lake Lockhart area.

The survey area is situated in the Western Mallee Interim Biogeographical Regionalisation of Australia (IBRA) sub region and Beard's Hyden Vegetation System which is a subdivision of the Roe Botanical District.

Beard (1979) describes the vegetation of the salt lake areas in the Hyden Vegetation System as bare salt lake of mud/salt crystals or vegetated with samphire, lake margins with small *Frankenia* and around the lake edge boree of *Melaleuca* species. A little further out are trees of *Eucalyptus kondininensis*, next *Eucalyptus salmonophloia* and *Eucalyptus longicornis*. In the boree zone the ground may be bare or covered with scattered grasses and samphire. In woodlands a saltbush understorey of *Atriplex* may be seen in the vicinity of salt lakes otherwise the lower layer consists of scattered woody shrubs of *Acacia*, *Eremophila, Pittosporum* and some grasses.

Beard (1979) has mapped the Lake Lockhart area at a scale of 1:250 000. The map unit covering the study area is bare salt lake with map unit Mi (mixed woodland in lakes country E *salmonophloia*, E *longicornis*, E *salubris*, E *kondininenses*) adjacent.

Mattiske Consulting Pty ltd recorded information from 7 quadrats situated in the Lake Magenta salt lake chain in 1995 as part of "A Review of Botanical values on a range of gypsum dunes in the Wheatbelt of WA". This included 3 quadrats situated on Lake Lockhart (Appendix 3). The Mattiske report also includes a description of a site on UCL east of Lake Magenta which is now a Threatened Ecological Community (Appendix 3).

"Survey and Analysis of Plant Communities Growing on Gypsum in the WA Wheatbelt" by Anne Rick (2011) includes quadrat data collected on gypsiferous soils in the Lake King, Lake Magenta and Lake Grace salt lake systems. Quadrats located in the Lake Magenta system includes the 7 quadrats from Mattiske (1995), 1 quadrat from Lyons et al (2004) and 2 quadrats from Gibson et el (2004). Field work carried out for this project in 2009 included 24 quadrats situated in the Lake Magenta chain, 4 on Lake Lockhart (Appendix 4).

Vegetation and Flora surveys carried out by the author in the Lake Magenta and Lake King salt lake chains in relation to gypsum mining include Lake Cobham (Rick 2010), Lake Morris (Rick 2014), Proposed Gypsum Mine M70/1342 south Lake King (Rick 2015), Lake Buchan (Rick 2016), Lake Carmody (Rick 2016) and Lake Kathleen (Rick 2017).

1.3.2 Threatened Ecological Communities

In Western Australia the Minister for Environment may list an ecological community as being threatened if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. As of May 2014, 376 ecological communities in WA have been entered into the threatened ecological community database. The WA Minister for Environment has endorsed 69 of these and the remaining 307 are allocated to one of

five priority categories. Ecological communities with insufficient information available to be considered a threatened ecological community, or which are rare but not currently threatened, are placed on the Priority list and referred to as Priority Ecological Communities**.** 25 of these threatened ecological communities are also listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999. The following communities occur within and adjacent to salt lake systems in the Western Mallee IBRA sub region.

State Listed Threatened Ecological Communities

The following Threatened ecological community is recorded ~34.2km SSE of the Lake Lockhart proposed mining lease in the Lake Magenta Lake Chain. The description of this community from Mattiske (1995) G226 is included in Appendix 2. The level of gypsum at this site was 5% at 0 and 50cms.

> *The 'Vunerable' threatened ecological community – 'Herblands and Bunch grasslands on gypsum lunette dunes alongside saline playa lakes'*

State Listed Priority Ecological Communities

The priority ecological community below is situated in the Lake Grace salt lake chain ~62 km SW of Lake Lockhart.

> *Priority 2: Ecological Commumity - Gypsum Dunes (Lake Chinocup) Eucalyptus aff. incrassata mallee over low scrub on gypsum dunes.*

Commonwealth Listed Threatened Ecological Communities

> *Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt*

The Threatened Ecological Community "Eucalypt Woodlands of the Western Australian Wheatbelt" has been listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 as Critically Endangered. Western Australia has listed this threatened community as a Priority 3 (iii) Ecological Community. Red Morrel Woodland of the Wheatbelt (a component of the Eucalypt Woodlands of the WA Wheatbelt EPBC listed TEC) has been listed as Priority 1.

> *Priority 1: Red Morrell Woodland of the Wheatbelt (a component of the Eucalypt Woodlands of the WA Wheatbelt EPBC listedTEC)*

1.3.3 Threatened and Priority Flora

Department of Biodiversity, Conservation and Attractions Conservation Codes
The Department of Biodiversity, Conservation and Attractions classifies Threatened and Priority Flora into categories which reflect their conservation status. These categories are listed below:

T Threatened Species
Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. These categories include Critically Endangered, Endangered, Vulnerable and Presumed Extinct species

P Priority Species
Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Flora lists under Priority 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require further monitoring.

Details of codes can be found in Appendix 6.

The Department of Biodiversity, Conservation and attractions supplied information on Threatened and Priority flora known to occur in the Lake Lockhart area. Information was included from the Threatened (Declared Rare) Flora database (DEFL), the WA Herbarium Specimen database (waherb) and the Declared Rare and Priority Flora List (this list is searched using place names) and information from Rick (2011). This information has been updated using NatureMap (https://naturemap.dpaw.wa.gov.au/) and FloraBase (http://florabase.dpaw.wa.gov.au/)

Appendix 7 lists Threatened and Priority Flora occurring on gypsum soils in the Lake Magenta, Lake King and Lake Grace salt lake chains. Species recorded for salt lakes and surrounds but not on gypsum soils are listed in Appendix 8. Threatened and Priority Flora recorded in the Lake Magenta system are in red.

2.0 METHOD

2.1 Scope of survey

This survey was carried out in order to provide information required for approvals to mine gypsum on Lake Lockhart. The field work for the present survey takes into consideration the Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment published by the EPA in December 2016. The survey follows the guidance for a detailed survey except for the requirement for detailed quadrat work. This was not carried out due to time limitations. A lage number of site/releve descriptions were needed in order to fully describe the flora and vegetation of the area and time restrictions did not allow for the setting up of marked quadrats. The releves were however defined in area and data collected was similar to that of detailed quadrat work. The area of the releves however was only occasionally measured by tape and was usually measured by pacing the boundaries. Releves were generally 10 x 10m except in areas of mallee or woodland 20x20m and along narrow ridges 20 x 5m. Percentage cover was estimated for each stratum and not for individual species. A full species list was recorded and dominant and requently occurring species noted for NVIS descriptions.

2.2 Field Survey

The ground survey of the vegetation and flora of the study area was carried out on the 22nd, 25th and 27th October 2018. The work included data collection through targeted and opportunistic searches. Traverses were made through the survey area to collect data to map vegetation boundaries, describe vegetation types and examine habitat where rare flora was likely to occur.

General vegetation divisions were noted using aerial photography. Areas of interest thus delineated were examined in the field and the vegetation at selected sites (releves) described. Releves were sampled in areas characteristic of the vegetation types encountered. Because of time limitations and difficulties with access some areas were not covered in detail in the ground survey and mapping was carried out by extrapolation of known vegetation associations using the aerial photographs. A GPS was used in the field to increase the accuracy of the vegetation and flora mapping.

Vegetation type descriptions were based on the National Vegetation Information System (NVIS) (ESCAVI 2003) as per the Guidance requirements (EPA 2016) Table 2. Descriptions are to Level 6 (Sub-Association). The classification system devised by Muir (1977) which was specifically designed for describing wheatbelt vegetation was also used (see Table 1). The Muir descriptions were included so that comparisons can be made with previous surveys that have used this classification system in the past. The Muir classification system has been used extensively in the Wheatbelt and Mallee regions.

The condition of the vegetation described follows the Vegetation Condition Scale modified from Trudgen 1991 by B.J. Keighery for the Swan Coastal Plain Survey 1994 (Table 3).

Information recorded at each releve included:

- GPS location at the approximate centre of releve
- Vegetation classification - Muir description (1977) and NVIS (2003)
- Vegetation condition
- Inventory of plant species
- Any Threatened or Priority species
- Physical description including soils and topography.
- % canopy cover of each vegetation layer
- A high resolution digital photograph

Specimens of plant species encountered were collected and identified using keys and by comparison with specimens at the Western Australian Herbarium. Plant specimens of interest will be lodged in the WA Herbarium. Experts involved in revising particular genera were consulted wherever possible to ensure accuracy with identification. Searches for Threatened, Priority and other significant flora were made during the traverses walked through the survey area.

2.3 Survey Limitations

Information on previous gypsum vegetation and flora surveys that have been carried out in the Lake Magenta salt lake chain has been summarized in Section 1.3 of this report. Extensive areas of salt lake country have still to be surveyed and our knowledge of gypsum vegetation and flora is still limited. It is therefore difficult to assess the rarity of gypsum vegetation types and some plant species.

Figures from the nearest Bureau of Meteorology Station (Newdegate Research Station) indicate that 2018 was a dry year in the Lake Lockhart area with an annual rainfall of 230.2mm. The average annual rainfall for the station is 370.0mm. A comparison of Quadrats between 2009 and the present survey show a lack of annuals on the larger well drained gypsum dunes. Due to flooding in the summer of 2017 low lying areas in the Lake Lockhart area were inundated for at least 18 months. These conditions have adversely affected some of the plants which are now largely regenerating.

The author has over 30 years work experience as a Botanical Consultant specifically in plant identification, vegetation mapping and rare flora work in the Avon Wheatbelt and Western Mallee sub regions and lives locally at Newdegate. She is also a member of the Great Southern District Threatened Flora Recovery Team (DBCA).

Fieldwork which covers only 3 days of the year cannot be expected to exclude the possibility that there are still rare flora on the lake that have not as yet been located and mapped populations may be more extensive. The spring was the best time of year

for the flora survey and will provide the most comprehensive species list however further survey work at different times of the year will increase our knowledge of the flora at Lake Lockhart. Some plant species will flower at other times of the year, some species do not flower every year and some species are not identifiable or even visible except for short periods of time

Most of M 70/1382 was covered in detail during the survey however vehicle access was only to Lockhart Road or the edge of Lockhart Nature Reserve and access on foot was time consuming. This limited the survey work carried out in the eastern section of the proposed mine.

2.4 PRIMER Analysis

The multivariate statistics package used to analyse the species information for each releve was PRIMER v6 (Clarke & Gorley, 2006). Releves were classified according to similarities in species composition (presence/absence data) using the Bray-Curtis Similarity Coefficient. The results of the Cluster classification are illustrated in a dendogram. A SIMPROF test (similarity profile) was used in conjunction with cluster to test the significance of divisions displayed in the dendogram. A SIMPROF test was carried out at each node of the dendogram. The data set without the introduced weeds was used in the analysis.

Table 1: Muir System of Vegetation Classification

LIFE FORM/ HEIGHT CLASS	CANOPY COVER			
	DENSE 70-100% d	MID-DENSE 30-70% c	SPARSE 10-30% i	VERY SPARSE 2-10% r
T Trees > 30m **M** Trees 15-30m **LA** Trees 5-15m **LB** Trees < 5m	Dense Tall Forest Dense Forest Dense Low Forest A Dense Low Forest B	Tall Forest Forest Low Forest A Low Forest B	Tall Woodland Woodland Low Woodland A Low Woodland B	Open Tall Woodland Open Woodland Open Low Woodland A Open Low Woodland B
KT Mallee tree form **KS** Mallee shrub form	Dense Tree Mallee Dense Shrub Mallee	Tree Mallee Shrub Mallee	Open Tree Mallee Open Shrub Mallee	Very Open Tree Mallee Very Open Shrub Mallee
S Shrubs > 2m **SA** Shrubs 1.5-2.0m **SB** Shrubs 1.0-1.5m **SC** Shrubs 0.5-1.0m **SD** Shrubs 0.0-0.5m	Dense Thicket Dense Heath A Dense Heath B Dense Low Heath C Dense Low Heath D	Thicket Heath A Heath B Low Heath C Low Heath D	Scrub Low Scrub A Low Scrub B Dwarf Scrub C Dwarf Scrub D	Open Scrub Open Low Scrub A Open Low Scrub B Open Dwarf Scrub C Open Dwarf Scrub D
P Mat plants **H** Hummock Grass **GT** Bunch grass > 0.5m **GL** Bunch grass < 0.5m **J** Herbaceous spp.	Dense Mat plants Dense Hum. Grass Dense Tall Grass Dense Low Grass Dense Herbs	Mat plants Mid-Dense Hum. Grass Tall Grass Low Grass Herbs	Open Mat plants Hummock Grass Open Tall Grass Open Low Grass Open Herbs	Very Open Mat plants Open Hummock Grass Very Open Tall Grass Very Open Low Grass Very Open Herbs
VT Sedges > 0.5m **VL** Sedges < 0.5m	Dense Tall Sedges Dense Low Sedges	Tall Sedges Low Sedges	Open Tall Sedges Open Low Sedges	Very Open Tall Sedges Very Open Low Sedges
X Ferns Mosses, liverwort	Dense Ferns Dense Mosses	Ferns Mosses	Open Ferns Open Mosses	Very Open Ferns Very Open Mosses

Table 2: NVIS structural Formation Terminology (ESCAVI 2003)

	Cover Characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
	Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
	% Cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	<0.5,>0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
bryophyte	<0.5	closed bryophyteland	bryophyteland	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	0-0.5,<1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
seagrass	0-0.5,<1	closed seagrass bed	seagrassbed	open seagrassbed	sparse seagrassbed	isolated seagrasses	isolated clumps of seagrasses	seagrasses

Table 3: Vegetation Condition Scale

Table 3 : Vegetation Condition Scale Modified from Trudgen 1991 by B.J. Keighery for the Swan Coastal Plain Survey 1993
1 = Pristine Pristine or nearly so, no obvious signs of disturbance
2 = Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. For example damage to trees caused by fire, the presence of non - aggressive weeds and occasional vehicle tracks.
3 = 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.
4 = Good Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate to it. 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.
5 = 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 some very aggressive weeds, partial clearing, dieback and grazing.
6 = 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 described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

3.0 VEGETATION SURVEY

3.1 Vegetation Types in the Study Area

The vegetation types mapped and described in this study are outlined in Table 5. General descriptions of the vegetation can be found in Appendix 1. Releve data is presented in Appendix 2. Muir (1977) and NVIS vegetation descriptions are included. The distribution of these vegetation types within the survey area is shown on the vegetation maps, Figures 5, 6 and 7. Structural Formation Terminology used in vegetation descriptions (Appendix 1) are from the NVIS classification system.

Samphire shrublands growing on gypsum over clay cover low lying areas of flat terrain on the lake bed. Samphire shrubland/forbland is found on a low gypsum ridge adjacent to bare salt lake and has been subject to inundation after the floods of 2017. Mixed species shrubland occurs on low rises/ridges of gypsum and open tall shrubland is found growing on the larger dunes and ridges scattered throughout the study area. In the proposed access area *Melaleuca* shrubland*,* shrubland/forbland and *Eucalyptus sargentii* subsp. *onesis* mallee form a mosaic of vegetation types.

Adjacent to the proposed mining lease are small areas of the Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt including ~4ha of *Eucalyptus sargentii* ssp *sargentii* (*Eucalyptus* aff. *sargentii)* woodland and a small patch (~3ha) of *Eucalyptus kondininensis* woodland to the North East. Areas of *Eucalyptus kondininensis* also occur to the north of the proposed access area but were not included in the present survey.

3.2 PRIMER analysis

The data set used for the analysis excluded weeds. The SIMPROF test indicates those divisions which are statistically significant (black lines). The results are displayed by the dendogram in Figure 5.

Differences between the vegetation classification based on characteristic species and vegetation structure and the classification based on the analysis of floristic composition data i.e. presence/absence of species at each releve are discussed below.

The Primer analysis indicates no significant diffence (SIMPROF test) in species composition between open tall shrubland – *Hakea* and the open tall shrubland vegetation types. Open Tall shrubland – *Hakea* has been mapped separately as it differs from open tall shrubland with regard to soil type and the absence of *Melaleuca* shrubs in the over storey. *Hakea preissii* shrubland has been described as a sepatate vegetation type elsewhere in the Lake Magenta system (Rick 2016)

Eucalyptus sargentii subsp. *sargentii* (*Eucalyptus* aff. *sargentii*) open forest has a similar species composition to the tall shrubland releves which also occur on the same sandy ridge but has an upper stratum of *Eucalyptus sargentii* trees and is mapped separately.

Austrostipa juncifolia open grassland forms an overstorey at releve 8 and the Primer analysis shows a significant difference in species composition at this site to other releves in the samphire/forbland vegetation. This area was considered too small to map as a separate vegetation type.

Releves in the proposed access area cluster together which indicates similarities in species composition. These vegetation types are all distinct in the field.

3.3 Vegetation Condition

The condition of the vegetation across the survey area was in general Excellent with little disturbance noted and weed species in very low density. Weed density was higher in the samphire/forbland vegetation which was in Very Good condition and regenerating after flooding. Some low lying samhire shrublands were also regenerating after inundation. More weeds were present in areas adjacent to the grazing lease on the eastern boundary of the proposed mine. Weed species recorded include *Mesembryanthemum nodiflorum, Arctotheca calendula, Hypochaeris glabra, Senecio vulgaris, Sonchus oleraceus, Ursinia anthemoides, Spergularia rubra, Trifolium arvense, Avena fatua*, *Bromus rubens, Hordeum leporinum, Parapholis incurva* and *Pentameris airoides*. Rabbit activitly was also noted especially on the larger dunes.

3.4 Threatened Ecological Communities

Threatened Ecological communities occurring on gypsiferous soils listed in section 1.3 were not found during the present survey. Eucalypt woodlands occurring in areas adjacent to the proposed gypsum mine that meet the key diagnostic characteristics for Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt include 3 ha of *Eucalyptus kondininensis* woodland to the north east and ~ 4 ha of *Eucalyptus sargentii* ssp *sargentii* open forest. A small patch of *Eucalyptus salicola* was too small to meet the required characteristics. Eucalypt woodlands to the north of the proposed access area may also meet the key diagnostic characteristic but were not included in the present survey.

The key diagnostic characteristics for Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt are listed below and Table 5 details the minimum condition required for these woodlands.

- They occur in the Western Mallee IBRA sub region
- The structure of these woodlands is over 10% canopy cover with usually a maximum of 40%. The canopy cover can be higher in certain circumstances e.g. mallet form can be more densely spaced.
- Key species of the tree canopy are characteristic species of Eucalypt woodlands of the Wheatbelt
- Native understory is present but is of variable composition

Table 4: Minimum condition for patches of the WA Wheatbelt Woodlands ecological community. For each category, both the weed cover and mature tree presence criteria must apply plus one of either patch size or patch width, depending on whether the patch is a roadside remnant or not.

Cover of exotic plants (weeds) AND	**Mature trees [1] AND**	**Minimum patch size (non-roadside patches)[2] OR**	**Minimum patch width (roadsides only) [3]**
Category A: *Patches likely to correspond to a condition of Pristine / Excellent / Very good (Keighery, 1994) or a High RCV (RCC, 2014).*			
Exotic plant species account for 0 to 30% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees may be present or absent.	2 hectares or more	5 metres or more
Category B: *Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014), AND retains important habitat features.*			
Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy)	Mature trees are present with at least 5 trees per 0.5 ha.	2 hectares or more	5 metres or more
Category C: *Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014).*			
Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees either absent or less than 5 trees per 0.5 ha are present.	5 hectares or more	5 metres or more
Category D: *Patches likely to correspond to a condition of Degraded to Good (Keighery, 1994) or a Medium-Low to Medium-High RCV (RCC, 2014) BUT retains important habitat features.*			
Exotic plant species account for more than 50 to 70% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees are present with at least 5 trees per 0.5 ha.	5 hectares or more	5 metres or more

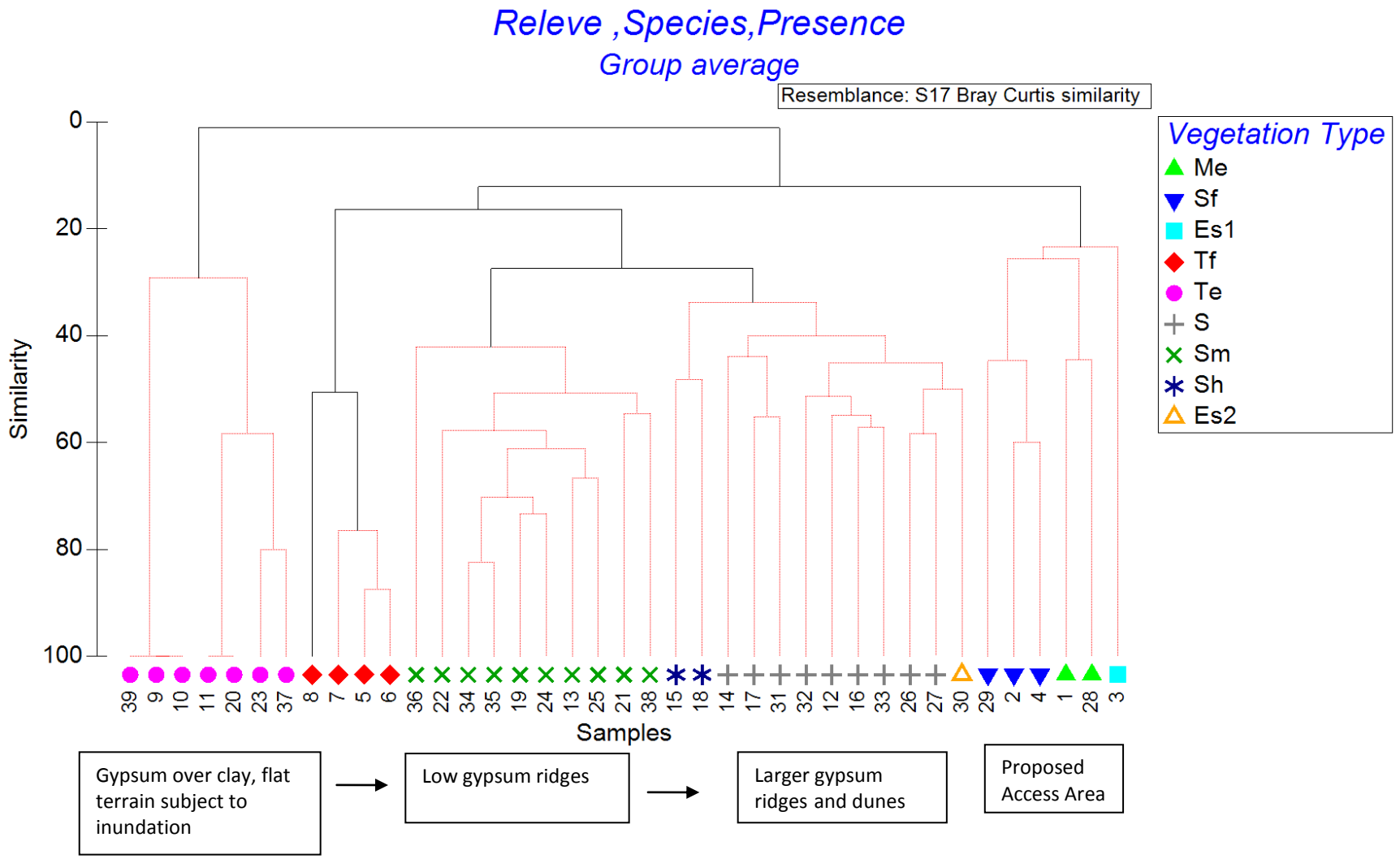


Figure 4: Dendrogram of the releve group classification

Table 5 - Vegetation Types in the study area

Vegetation Type	Map Unit	Soils	Topography	Releves	Comments
Eucalyptus sargentii subsp. *onesis* mallee	Es1	Sand or sandy loam soils over clay	On slightly higher ground with deeper sandy soils over clay	3	Access area. *Eucalyptus sargentii* subsp. *onesis* P3
Eucalyptus sargentii subsp. *sargentii* woodland	Es2	Sandy soils (?gypsum) over clay	Sandy ridge	30	~ 4 ha adjacent proposed mining lease. Critically Endangered – Eucalypt Woodlands of the WA Wheatbelt
Melaleuca shrubland	Me	Sand or sandy loam over clay	Mostly flat terrain	1, 28	Access area *Dampiera orchardii* P2
Shrubland/ forbland	Sf	Shallow sandy soils over clay.	Low lying areas subject to inundation	2, 4, 29	Access area *Frankenia drummondii* P3
Open tall shrubland	S	Gypsum soils	Dunes and larger ridges of gypsum	12, 14, 16, 17, 26, 27, 31, 32, 33	Small areas scattered throughout the proposed mining lease Eremophila serpens P4, *Frankenia* sp. southern gypsum P3,
Open tall shrubland - *Hakea*	Sh	Sandy soils (?gypsum)	Dune and slight rise	15, 18	Two small areas recorded within the proposed mining lease
Mixed species shrubland	Sm	Gypsum	Low ridges /rises on the lake bed	13, 19, 21, 22, 24, 25, 34, 35, 36, 38	Small areas scattered throughout M 70/1382 *Frankenia* sp. southern gypsum P3, Pimelea halophila P2
Samphire shrubland/forbland	Tf	Gypsum soils.	Ridge on eastern shore of salt lake Subject to recent inundation	5, 6, 7, 8	Regeneration after flooding. *Angianthus halophilus* P3, *Fitzwillia* aff *axilliflora*, *Haegiela tatei* P4, *Frankenia* sp. southern gypsum P3
Samphire shrubland	Te	Gypsum over clay	Lake bed, flat terrain. Areas subject to inundation	9, 10, 11, 20, 23, 37, 39	Extensive

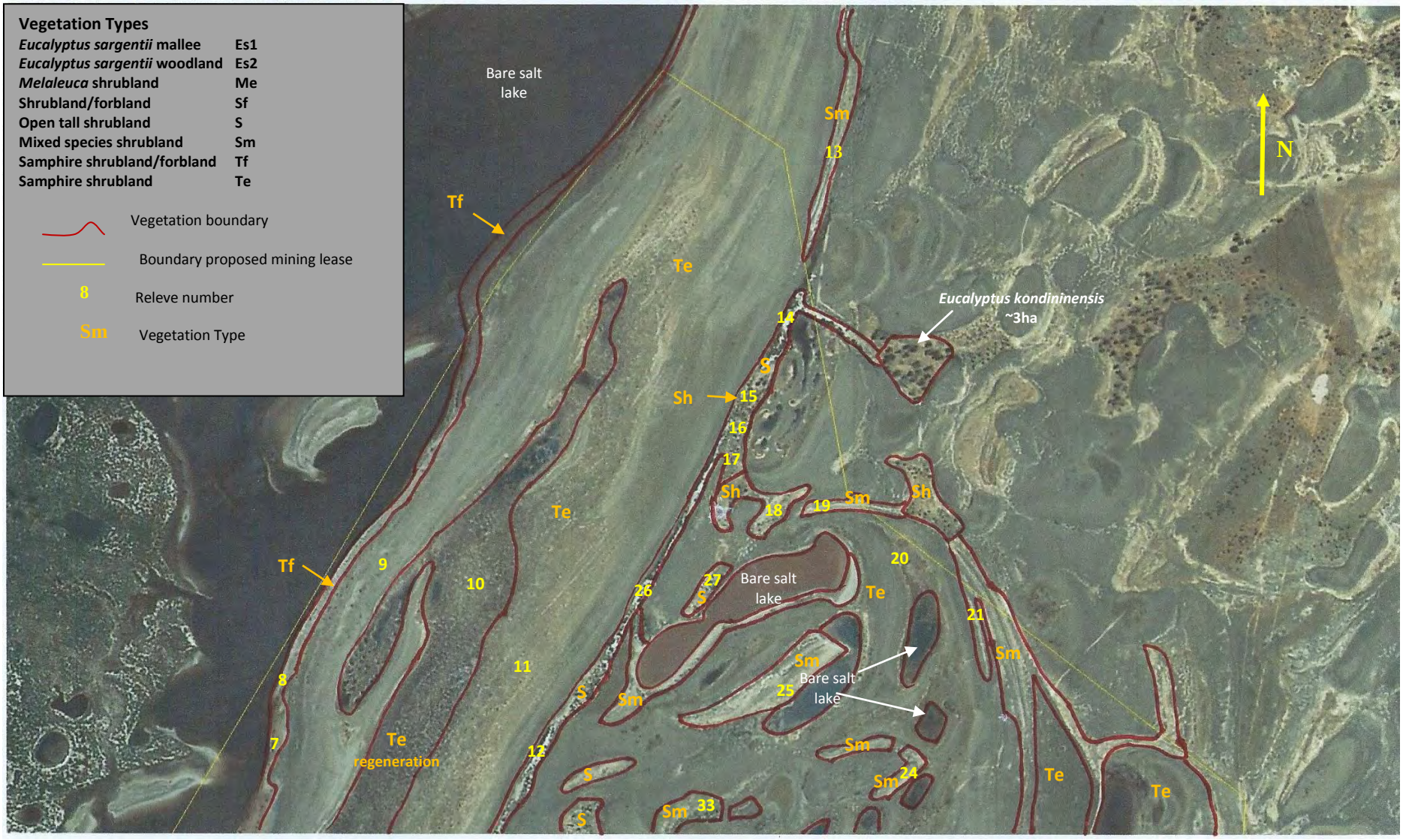


Figure 5: Vegetation map of the proposed mining lease M 70/1382 and surrounds Lake Lockhart - North.

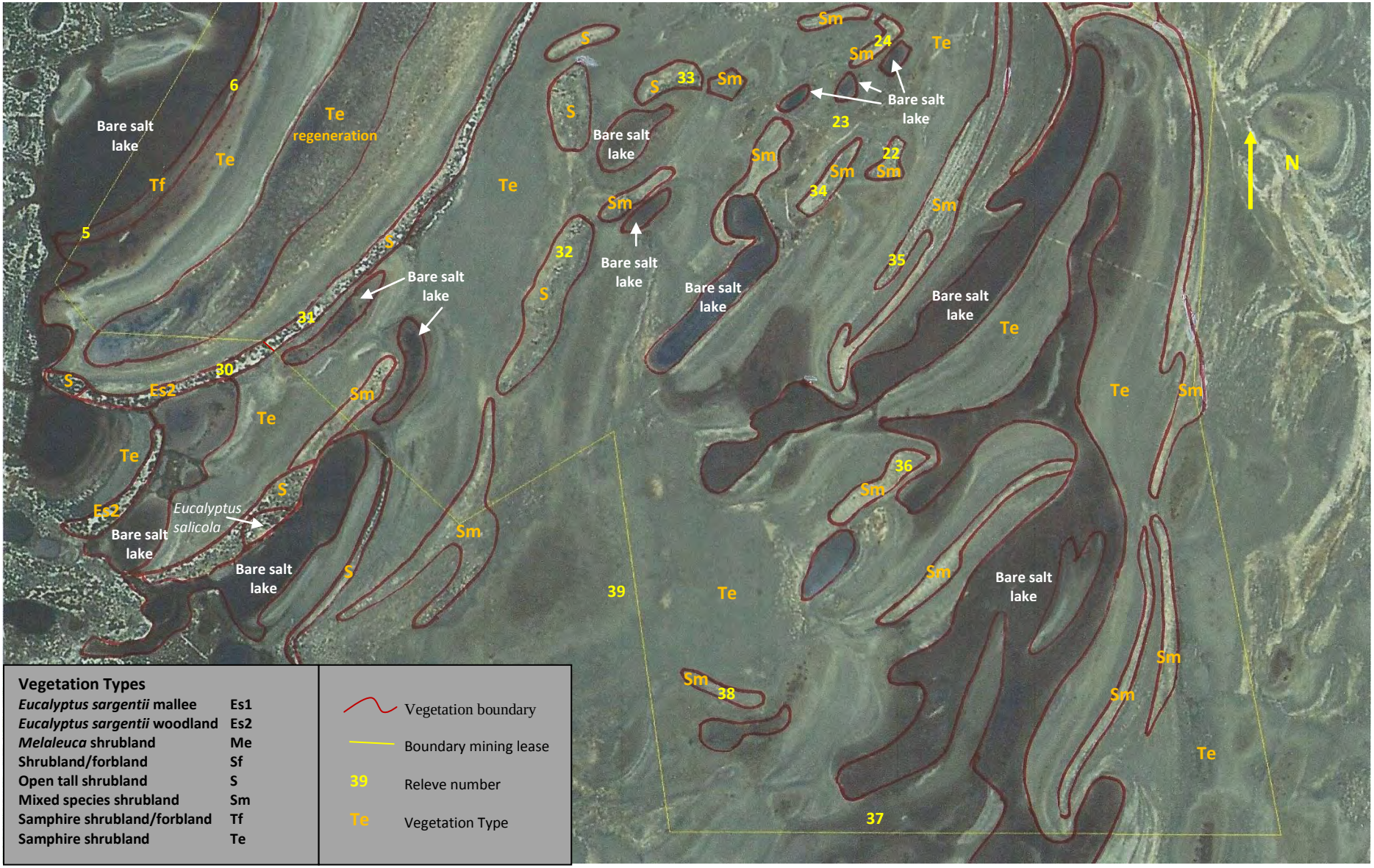
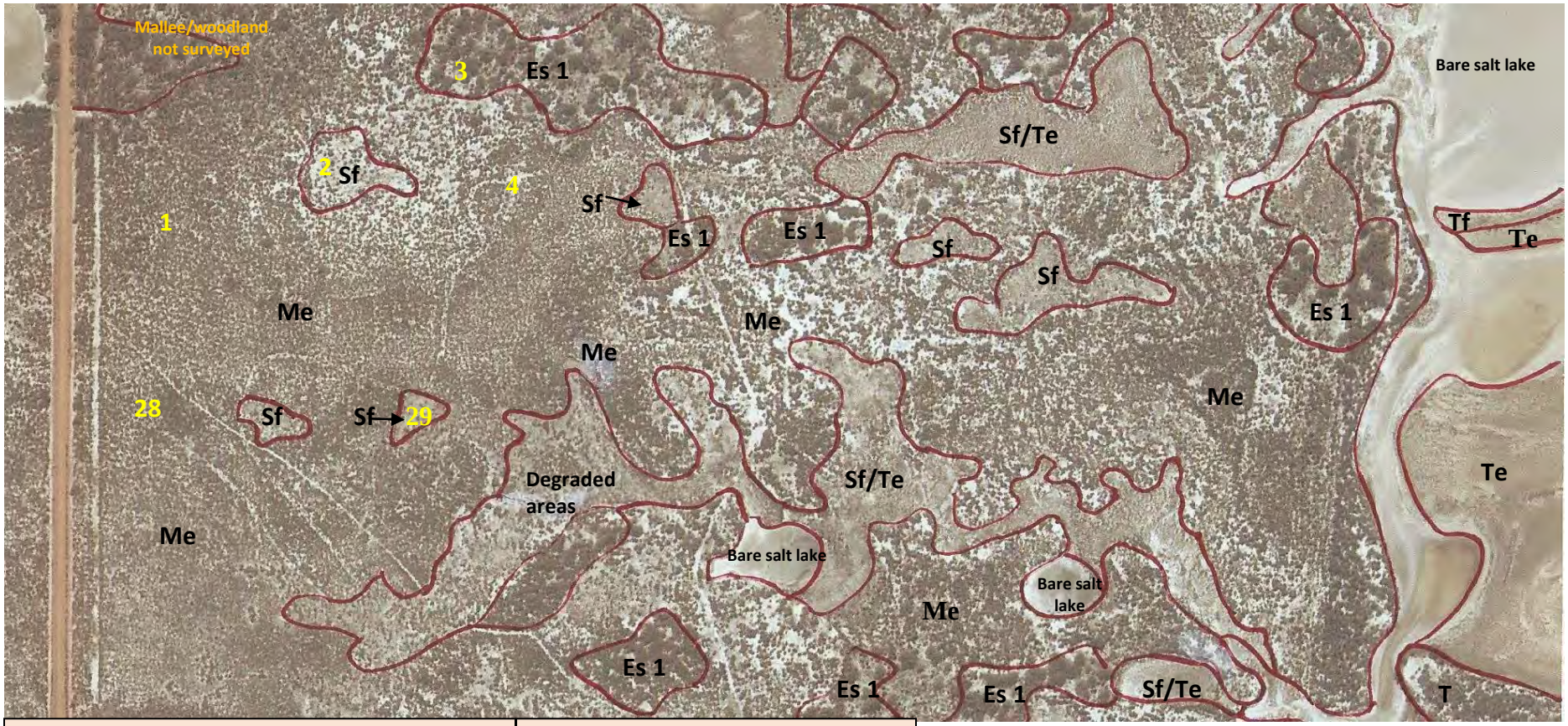


Figure 6: Vegetation map of the proposed mining lease M 70/1382 and surrounds Lake Lockhart - South.

Figure 7: Vegetation map of the proposed access area and surrounds - Lake Lockhart.



Vegetation Types	
Eucalyptus sargentii subsp. onesis mallee	Es1
Melaleuca shrubland	Me
Shrubland/forbland	Sf
Open tall shrubland	S
Samphire shrubland/forbland	Tf
Samphire shrubland	Te

	Vegetation boundary
28	Releve number
Me	Vegetation Type

4.0 FLORA SURVEY

4.1 Flora of the Study Area.

A total of 141 plant taxa are recorded in Appendix 5 as occurring in the study area, 13 are introduced or weed species. Identifications with the name followed by "?" are uncertain due to a lack of flowering or fruiting material or to confusion in the current taxonomy of the group concerned. The nomenclature follows that of the Census of Western Australian Plants and Animals (The WA Herbarium data base). MAX V3 was used for the plant species list and plant labels for the WA Herbarium.

Due to the time and seasonal constraints, Appendix 5 only represents part of the flora of the area. The spring is the best time of year for a flora survey and will provide the most comprehensive species list however further survey work at different times of the year will increase our knowledge of the flora of Lake Lockhart.

The families with the largest representatives of genera and species are listed in Table 6. The families Asteraceae (daisies), Chenopodiaceae (salt bush, samphire etc), Myrtaceae (*Melaleuca*, Eucalypts), Poaceae (grasses), Aizoaceae (pigface) and Frankeniaceae were the most strongly represented in the flora of the study area as would be expected in the salt lake areas.

Table 6: The number of species and genera represented within the major families in the study area.

Family	No. taxa	No. Genera	Introduced Weeds
Asteraceae (daisies)	32	24	5
Chenopodiaceae (salt bush, samphire etc)	18	8	0
Myrtaceae (*Melaleuca, Eucalyptus*)	17	6	0
Poaceae (grasses)	15	8	5
Frankeniaceae (*Frankenia*)	4	1	0
Aizoaceae (pigface)	4	4	1

4.2 Threatened and Priority Flora

Appendix 7 and 8 lists Threatened and Priority Flora recorded in the Lake Magenta, Lake King and Lake Grace salt lake chains. Appendix 7 lists those species recorded on gypsum soils and Appendix 8 lists species recorded for salt lakes and surrounds on other soil types. Species recorded for the Lake Magenta salt lake system are in red.

No Threatened (Declared Rare) species were found during the survey. Five priority species were recorded in the area of the proposed mining lease including *Fitzwillia axilliflora* P2, *Pimelea halophila* P2, *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3, *Eremophila serpens* P4 and *Haegiela tatei* P4. *Angianthus halophilus* P3 was recorded adjacent to the boundary of the proposed mining lease on gypsum soils and therefore has a high probability of also occurring within the proposed mine area. *Angianthus halophilus* has not been previously recorded in the Lake Magenta salt lake system. A further three priority species were recorded in the proposed access area including *Dampiera orchardii* P2, *Frankenia drummondii* P3 and *Eucalyptus sargentii* subsp. *onesis* P3. Two forms of *Fitzwillia axilliflora* were collected during the survey. The collection from the north of the proposed mine is typical of the species. The other collection (Fitzwillia aff. axilliflora) occurring within the proposed mine site on a gypsum ridge is possibly a new species (Mike Hislop DBCA pers comm.)The identification of *Eucalyptus sargentii* subsp. *onesis (*mallee) and *Eucalyptus sargentii* subsp. sargetii (tree) occurring in the Lake Lockhart area is at present under review. This *Eucalypus* is possible a new tree species (Eucalyptus aff. sargentii) with a lignotuber which will resprout as a mallee after fire (Malcolm French pers. comm.)

It should also be noted that *Eucalyptus mimica* subsp. *continens* P1 occurs adjacent to Lockhart Road approximately 0.5 kms south of the proposed access area and *Acacia lanuginophylla* DRF and *Eremophila veneta* P4 are situated in the north western section of Lockhart Nature Reserve and adjacent private property.

Information on the location and the habitat in which the populations and sub populations of the priority species occur are listed in Table 7. GPS coordinates can be found in Appendix 9 and releve coordinates in Appendix 2. Figure 8 maps the extent of the populations and sub populations. Guidelines from the Threatened and Priority Flora Report Form Field Manual (Department of Parks and Wildlife 2010) which were used to determine sub populations include

- Plants within 500m of a known population are considered to be part of that population
- Within a recognized population, plants that have considerable, recognizable separation between them are considered to be separate subpopulations (in this case the plants are separated by areas of samphire or bare salt lake but are within 500m of each other).

Figure 8: Location of Threatened and Priority Flora on Lake Lockhart and surrounds.

Table 7: Priority Flora in the study area

Taxa	Cons Code	Way Points	Releve	Voucher	Habitat
Angianthus halophilus	P3	201		8882	Samphire shrubland/forbland edge lake
Eremophila serpens	P4	243	33	8926	Open tall shrubland on sandy (?gypsum) soils
Eucalyptus sargentii subsp. *onesia (Eucalyptus* aff. *sargentii)*	P3	Es1 areas as mapped	3	8744	Sandy soils over clay, well drained
Fitzwillia axilliflora	P2	107		8810	Northern edge of lake in gypsum
Fitzwillia aff. *axilliflora*		26 to 30, 33, 36 to 38, 42, 43, 191, 192	5, 6, 7, 8	8766	Samphire/forbland in gypsum
Frankenia drummondii	P3	8, 10, 11, 14, 19, 20, 91, 212, 216, 219, 221, 222	29	8753, 8907	Sandy soils over clay in open areas shrubland/forbland
Frankenia sp. southern gypsum	P3	widespread		8776, 8790, 8809	Edges of ridges and dunes on gypsum
Goodenia orchardii	P2	103, 104, 206, 208	28	8797	Sandy soils over clay *Melaleuca* shrubland
Haegiela tatei	P4		5, 6	8761	Samphire/forbland in gypsum
Pimelea halophila population 1	P2	163		8798	Open exposed area on gypsum amongst mixed species shrubland
Pimelea halophila Population 2 (sub population a)	P2	255		8939	Open exposed area on gypsum amongst mixed species shrubland
Pimelea halophila Population 2 (sub population b)	P2		36		Mixed species shrubland

***Fitzwillia axilliflora* P2**

Fitzwillia axilliflora is an annual herb 3 to 13.5 cm in height, flowering from September to November and growing in sand, clay loam and gypsum associated with salt lakes. This species is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). *Fitzwillia axilliflora* has been recorded in the shires of Kent, Lake Grace, Morawa and Wyalkatchem. The typical form of this species was collected to the north of the proposed mining lease voucher number AC 8810.

Fitzwillia* aff. *axilliflora

The following information was supplied by Mike Hislop taxonomist at the WA Herbarium with regard to the voucher collection 8766 from Lake Lockhart.

"This collection is not typical of the species although it is clear that it is at least closely related. The most significant differences relate to the capitulum-subtending bracts and the pappus. Relative to typical *F. axilliflora* the capitulum-subtending bracts of the new morphotype are longer i.e. always much longer than the florets compared to slightly shorter than, to slightly longer than the florets in *F. axilliflora.* They are also strongly recurved longitudinally which produces that characteristically broad, depressed hemispherical look to the inflorescence. In *F. axilliflora* they are ± straight, varying from slightly incurved to slightly recurved. There don't appear to be any other differences between the two in the basic structure or detail of the inflorescence. However at the level of the individual floret there is a difference in the pappus length: 0.7–1.2 mm long in the new morphotype vs 0.2–0.5 in typical *F. axilliflora*. These differences are likely to be taxonomically significant and AC 8766 probably represents a currently unrecognised taxon. *F. axilliflora* is still poorly known (only 7 collections at the WA Herbarium) and to make sure the new morphotype is not just a representation of previously unknown variation within the species collections from new populations are needed."

***Fitzwillia axilliflora* (photo Kevin Thiele)**

Fitzwillia* aff. *axilliflora

***Dampiera orchardii* P2**

Dampiera orchardii P2 is an erect perennial, herb 0.2-0.4 m in hight with mauve flowers growing in sandy soils. It has been recorded in the shires of Dundas, Kent, Lake Grace and Ravensthorpe. This species was found in the proposed access area at releve 28 and surrounds in open areas and in the *Melaleuca* shrubland.

***Dampiera orchardii* P2**

***Pimelea halophila* P2**

Pimelea halophila is a dwarf, cushion-like shrub, 1.5cm to 15 cm in height and flowers from August to October. It occurs on clayey sand, sand over clay and sandy soils with gypsum in salt lake habitats. This species is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). *Pimelea halophila* has previously been known to occur from Lake King to North and East of Esperance and has recently been revised from P4 to P2. The author has previously collected this species from Lake Morris in the Lake Magenta salt Lake system. Two populations were recorded during the present survey with population 2 made up of 2 sub populations less than 500ms apart.

***Pimelea halophila* P2**

***Angianthus halophilus* P3**

Angianthus halophilus P3 is an erect to spreading annual herb to 5cm high, flowering from October to November and growing on saline soils and gypsum in salt lake country. This species is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). This priority plant has been previously found at Lake King, Lake Grace and Lake Cairlocup and has not been previously recorded in the Lake Magenta salt lake system. The voucher specimen was collected just outside the proposed mining lease growing on gypsum and there is a high probability that it also occurs within the lease area.

***Angianthus halophilus* P3**

***Eucalyptus sargentii* subsp. *onesia* P3 (Eucalyptus aff. sargentii)**

Eucalyptus sargentii subsp. *onesia* is a mallee to 4 meters in height, lignotuberous with rough bark. It has a very restricted distribution in the central-western wheatbelt and several small populations in the southern wheatbelt on the margins of lakes from Lake Buchan to Lake Magenta (French 2012). It differs from *Eucalyptus sargentii* subsp. *sargentii* which is a mallet (obligate seeder). *Eucalyptus sargentii* subsp. *sargentii* was identified on a sandy ridge at releve 30 just outside the proposed mining lease. However the growth form was not the typical erect mallet tree form. Malcolm French has been consulted and is of the opinion that the Eucalypt previously identified as *Eucalyptus sargentii* at Lake Lockhart is probably a new species of tree habit with inconspicuous lignotubers and if burnt or cleared, will resprout from the lignotubers (French pers. Comm.).

***Eucalyptus sargentii* subsp. *onesia* P3 (*Eucalyptus* aff. *sargentii*)**

***Eucalyptus* aff. *sargentii* at releve 30 (tree form)**

***Frankenia drummondii* P3**

Frankenia drummondii is a prostrate shrub found in sandy soils at the edge of salt lakes and has been recorded growing in gypsiferous soils. Flowers are usually white, occasionally pink. This species is known from only a few widespread populations in the Bruce Rock, Coolgardie, Dundus, Esperance, Gnowangerup, Kent, Kondinin, Kulin, Lake Grace, Narrogin and Quairading Shires. Plants were found scattered throughout a large section of the proposed access area.

***Frankenia drummondii* P3**

***Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3**

Frankenia sp. southern gypsum (M.N. Lyons 2864) P3 is a possible gypsophile (Rick 2011) ie mostly restricted to gypsum soils. In the present survey this species was found throughout the area surveyed on the edges of gypsum ridges. Previously in 2009 this species was also found on the samphire flats. Recent flooding is probably responsible for its absence from these areas during the present survey. *Frankenia* sp. southern gypsum has now been collected by the author from a number of salt lakes in the Magenta and Lake King salt lake chains Rick (2010), Rick (2011), Rick (2014), Rick (2015), Rick (2016a), Rick (2016b) and Rick (2017).

***Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3**

***Eremophila serpens* P4**

Eremophila serpens is a prostrate, creeping shrub, 0.03-0.4 m in height, forming large patches to 2 m wide. Flower appear in Setember to December or March to May. It has been recorded on white/grey sand, alluvium and loam in winter-wet depressions, sub-saline flats, drainage lines and salt lakes. Distribution is between Hyden and salmon gums. This species was found at releve 33 and in an adjacent area within 500ms.

***Eremophila serpens* P4**

Haegiela tatei P4

Haegiela tatei P4 is an ascending to erect annual herb, 2 to 8cm high with white and yellow flowers. This species flowers from August to November and has been recorded in clay, sandy loam and gypsum soils in saline habitats. *Haegiela tatei* is thought to be a gypsovag (gypsum tolerant) as it also grows in non-gypsum soils (Rick 2011). Plants have been recorded in the Coolgardie, Dundus, Esperance, Gnowangerup, Kent, Kondinin, Lake Grace and Yalgoo shires. One population was recorded during the present survey along a gypsum ridge including releves 5 and 6.

Haegiela tatei P4

4.3 Other flora of significance

***Kippistia suaedifolia* (gypsophile)**

Kippistia suaedifolia is a compact, dwarf shrub, 0.1 to 0.6 m high, with yellow flowers in August to November (FloraBase). This species is associated with salt lakes and claypans and has been recorded on gypsum, sand and clay soils according to information on herbarium labels which can sometimes be misleading (Rick 211). It has a wide distribution in WA recorded in the Shires of Cue, Dundas, Esperance, Kalgoorlie-Boulder, Kondinin, Lake Grace, Laverton, Meekatharra, Menzies, Ngaanyatjarraku, Wiluna, Wyalkatchem and Yalgoo. It is thought that *Kippistia suaedifolia* is largely confined to gypsum soils and is possibly a gypsophile (Rick 2011). Because of its restricted habitat preference this species is more at risk than other plants which grow on a range of soil types. *Kippistia suaedifolia* is considered endangered in NSW

Kippistia suaedifolia

Calandrinia sp. Gypsum

Frank Obbens is in the process of describing this species which commonly occurs on gypsiferous soils in the Magenta and Lake King salt lake chains. The revision may find that this species is restricted to gypsum and is a possible gypsophile.

Calandrinia sp. Gypsum

Acacia lanuginophylla Declared rare Flora and ***Eremophila veneta*** **P4** occur in the Lockhart Nature Reserve and adjacent private property and ***Eucalyptus mimica*** **subsp. continens P1** is found adjacent to Lockhart Road near the proposed access area.

Acacia lanuginophylla Declared rare Flora

Eremophila veneta **P4**

5.0 CONSERVATION SIGNIFICANCE

5.1 Conservation Significance of Vegetation associations

Factors such as the condition of the vegetation, rarity and connectivity need to be taken into account when assessing the conservation significance of the vegetation on the proposed mining lease M 70/1382 and proposed access area at Lake Lockhart.

Most of the remnant vegetation in the study area was in excellent condition with small areas in Very Good condition. The loss of biodiversity due to degradation caused by weeds, rabbits and altered hydrology was therefore minimal at the time of survey. Areas affected by the floods of 2017 were regenerating.

The remnant vegetation on the UCL on which the proposed mining lease is situated is part of the vegetation connecting Lockhart Nature Reserve and salt lake country to the north with the rest of the Lake Magenta salt lake chain with Lake Magenta Nature Reserve on the southern boundary. Chains of salt lakes such as the Lake Magenta system are important vegetation corridors in an already extensively cleared landscape.

In general salt lake chains and gypsum dune systems constitute a relatively small portion of the overall native vegetation of the Western Mallee sub region and therefore have a high conservation value. In the Lake Magenta salt lake chain there are extensive areas of salt lake vegetation including areas of gypsum conserved in the Lake Magenta Nature Reserve. However large areas of this salt lake country have yet to be surveyed and it is therefore difficult to assess the extent of the vegetation types that are confined to gypsum.

No Threatened Ecological communities occurring on gypsiferous soils listed in section 1.3 were found during the present survey. Small areas of woodland adjacent to the proposed mining lease meet key diagnostic characteristics for the “Eucalypt Woodlands of the WA Wheatbelt” which have been classified as Critically Endangered. The presence of these adjacent woodlands needs to be taken into consideration when planning mining operations.

5.2 Conservation Significance of Flora

Five priority species were recorded in the area of the proposed mining lease including *Fitzwillia axilliflora* P2, *Pimelea halophila* P2, *Frankenia* sp. southern gypsum (M.N. Lyons 2864) P3, *Eremophila serpens* P4 and *Haegiela tatei* P4. *Angianthus halophilus* P3 was recorded adjacent to the boundary of the proposed mining lease on gypsum soils and therefore has a high probability of also occurring within the proposed mine area. *Angianthus halophilus* has not been previously recorded in the Lake Magenta salt lake system. A further three priority species were recorded in the proposed access area including *Dampiera orchardii* P2, *Frankenia drummondii* P3 and *Eucalyptus sargentii* subsp. *onesis* P3. Two forms of *Fitzwillia axilliflora* were collected during the survey. The collection from the north of the proposed mine is typical of the species. The other collection (Fitzwillia aff. axilliflora) occurring within the proposed mine site is possibly a new species (Mike Hislop DBCA pers comm.)The identification of *Eucalyptus sargentii* subsp. *onesis (*mallee) and *Eucalyptus sargentii* subsp. sargetii (tree) occurring in the Lake Lockhart area is at present under review. This *Eucalypus* is possible a new tree species (Eucalyptus aff. sargentii) with a lignotuber which will resprout as a mallee after fire (Malcolm French pers. comm.)

Other species of interest recorded during the survey include *Kippistia suaedifolia* and *Calendrinia* sp Gypsum which are possible gypsophiles. *Kippistia suaedifolia* has a wide distribution in WA and *Calendrinia* sp. Gypsum is fairly common in the Magenta and Lake King salt lake chains on gypsum. Mining activities should not affect the over all conservation of these species however because of their restricted habitat preference they are more at risk than other plants which grow on a range of soil types.

Acacia lanuginophylla Declared Rare Flora and *Eremophila veneta* P4 occur in the Lockhart Nature Reserve and adjacent private property and *Eucalyptus mimica* subsp. continens P1 is found adjacent to Lockhart Road near the proposed access area.

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