

Lake Lockhart

Proposed Gypsum Mine M 70/1382

Vegetation and Flora survey

BOTANICAL CONSULTANTS REPORT

BY

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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 relevés and traverses. Areas of interest delineated from aerial photographs were visited for accurate vegetation mapping. Relevés 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 relevé 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. *sargentii* (tree) occurring in the Lake Lockhart area is at present under review. This *Eucalyptus* 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 *Calandrinia* sp. Gypsum which are possible gypsophiles. *Kippistia suaedifolia* has a wide distribution in WA and *Calandrinia* 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

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Contents

SUMMARY	3
ACKNOWLEDGEMENTS.....	4
1.0 INTRODUCTION.....	7
1.1 Survey Objectives.....	7
1.2 Background Information	7
1.3 Desk Top Survey.....	11
1.3.1 Previous surveys in the Lake Lockhart area.	11
1.3.2 Threatened Ecological Communities	11
1.3.3 Threatened and Priority Flora.....	13
2.0 METHOD.....	14
2.1 Scope of survey	14
2.2 Field Survey	14
2.3 Survey Limitations.....	15
2.4 PRIMER Analysis.....	16
3.0 VEGETATION SURVEY.....	19
3.1 Vegetation Types in the Study Area.....	19
3.2 PRIMER analysis	19
3.3 Vegetation Condition	20
3.4 Threatened Ecological Communities	20
4.0 FLORA SURVEY	27
4.1 Flora of the Study Area.	27
4.2 Threatened and Priority Flora.....	28
4.3 Other flora of significance.....	37
5.0 CONSERVATION SIGNIFICANCE	39
5.1 Conservation Significance of Vegetation associations.....	39
5.2 Conservation Significance of Flora.....	39
6.0 REFERENCES.....	40

APPENDICES

Appendix 1: Vegetation type descriptions

Appendix 2: Releve Descriptions

Appendix 3: Sites from Matiske (1995)

Appendix 4: Sites from Rick (2011)

Appendix 5: Plant Species List

Appendix 6: Priority Conservation Codes for WA Flora

Appendix 7: Threatened and Priority Flora recorded on gypsum in the Lake Magenta, Lake King and Lake Grace salt lake chains

Appendix 8: Threatened and Priority Flora recorded for salt lakes and surrounds but not on gypsum soils in the Lake Magenta, Lake King and Lake Grace salt lake chains.

Appendix 9: GPS coordinates for Priority Flora locations

LIST OF FIGURES

Figure 1: Lake Magenta salt lake system

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

Figure 4: Dendrogram of the releve group classification

Figure 5: Vegetation map of the proposed mining lease and surrounds Lake Lockhart - North

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

Figure 7: Vegetation Map of the proposed access area

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

LIST OF TABLES

Table 1: Muir (1977) System of Vegetation Classification

Table 2: NVIS structural Formation Terminology

Table 3: Vegetation Condition Scale (Keighery 1994)

Table 4: Minimum condition for the WA Wheatbelt Woodlands ecological community

Table 5: Vegetation Types in the study area

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

Table 7: Priority flora in the study area

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 relevés 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.

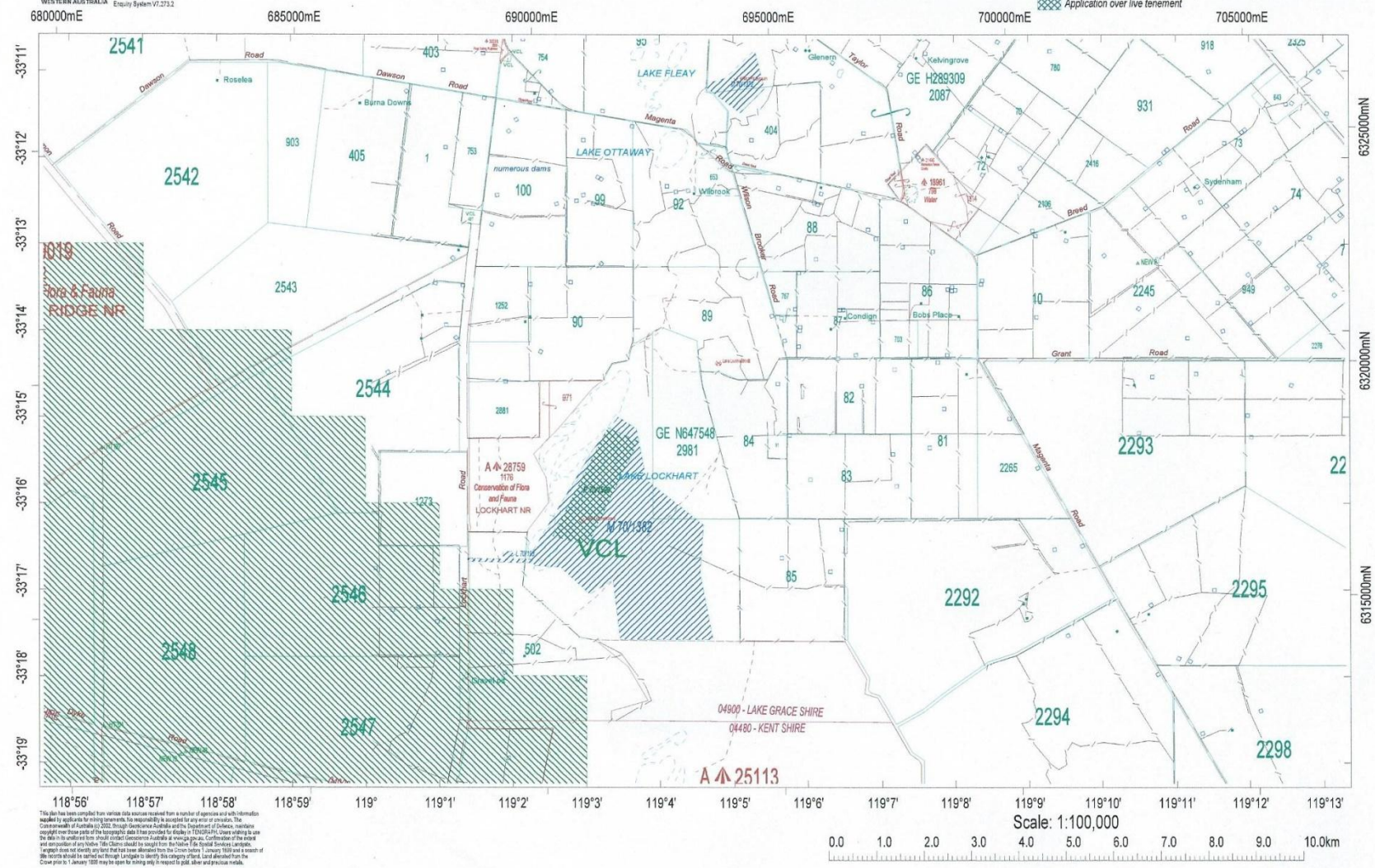
The Western Mallee is a sparsely populated sub region with an area of about 47,000 square kilometers. The sub region is largely cleared for agriculture with about 31% of the sub region's native vegetation remaining. These areas are under environmental stress from threats such as rising salinity (especially 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 Newdegate 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)



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

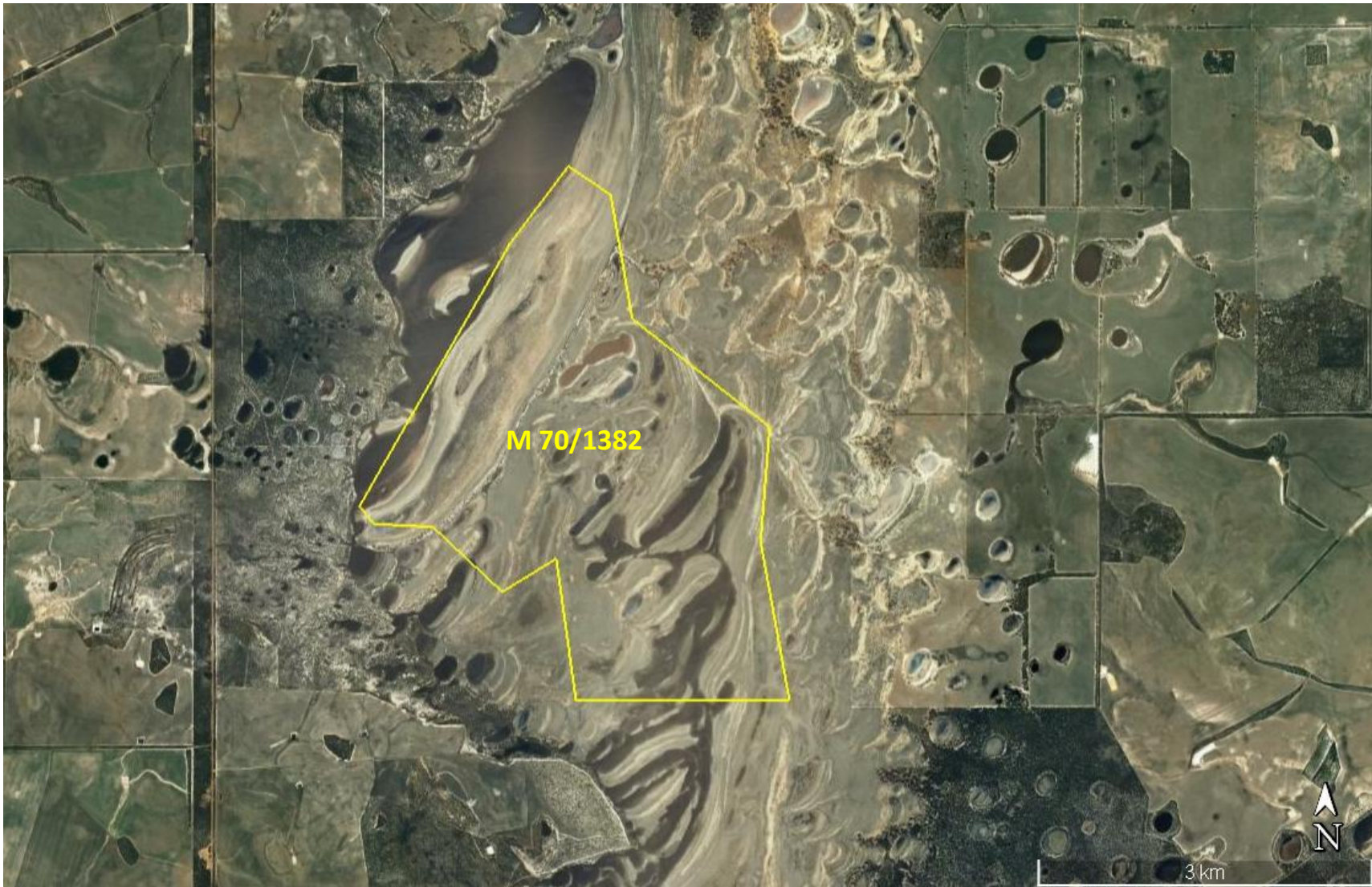


Figure 3: Lake Lockhart showing the boundary of exploration license M 70/1382

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 al (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 'Vulnerable' 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 Community - 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 Morrell 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 listed TEC)

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 large 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 frequently 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). Relevés 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 dendrogram. A SIMPROF test (similarity profile) was used in conjunction with cluster to test the significance of divisions displayed in the dendrogram. A SIMPROF test was carried out at each node of the dendrogram. 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 dendrogram 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 difference (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 separate 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 relevés in the samphire/forbland vegetation. This area was considered too small to map as a separate vegetation type.

Relevés 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 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*. Rabbit activity 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
<i>Category A: Patches likely to correspond to a condition of Pristine / Excellent / Very good (Keighery, 1994) or a High RCV (RCC, 2014).</i>			
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
<i>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.</i>			
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
<i>Category C: Patches likely to correspond to a condition of Good (Keighery, 1994) or a Medium-High RCV (RCC, 2014).</i>			
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 <u>less than</u> 5 trees per 0.5 ha are present.	5 hectares or more	5 metres or more
<i>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.</i>			
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

Releve , Species, Presence Group average

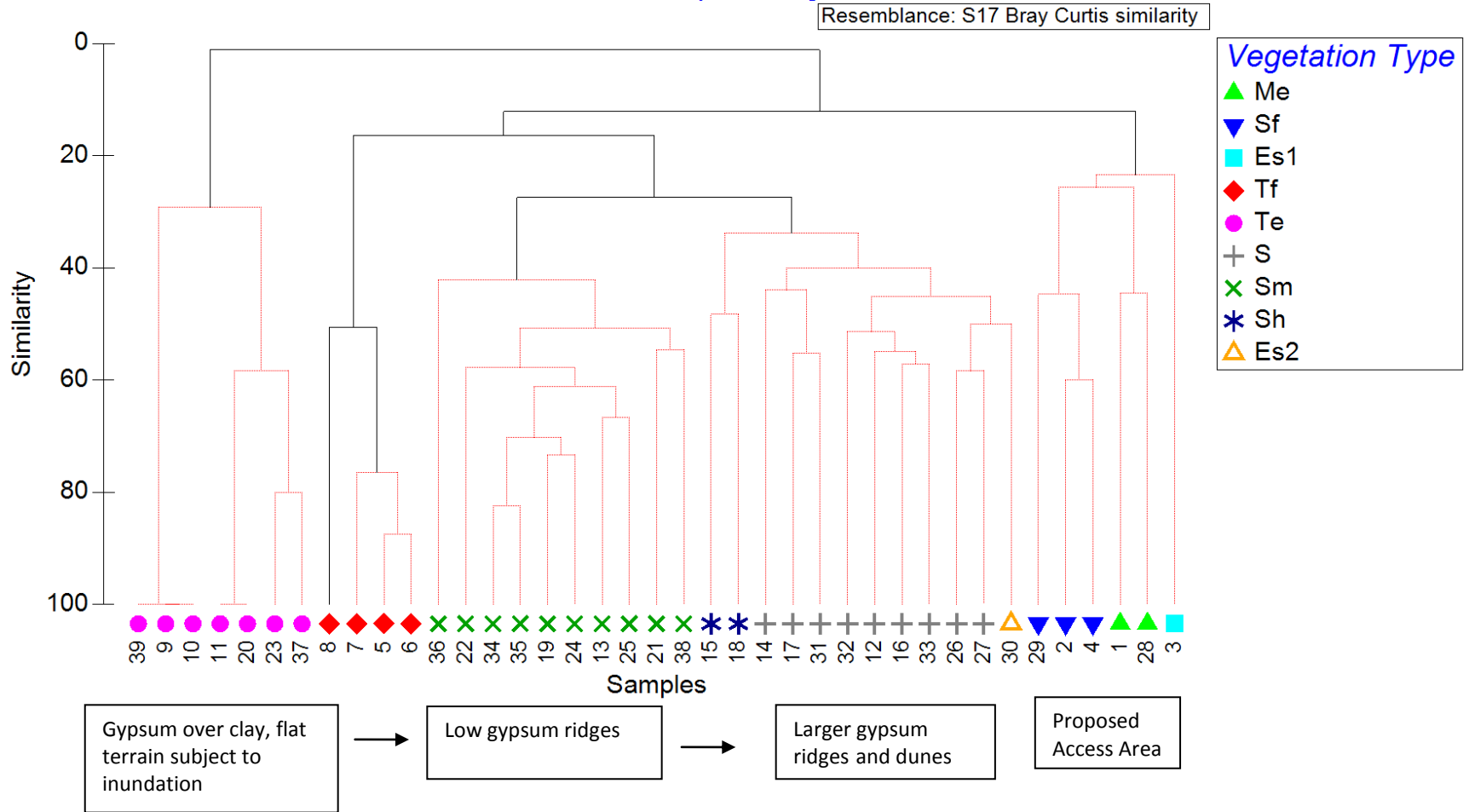


Figure 4: Dendrogram of the releve group classification

Table 5 - Vegetation Types in the study area

Vegetation Type	Map Unit	Soils	Topography	Releves	Comments
<i>Eucalyptus sargentii</i> subsp. <i>onesis</i> mallee	Es1	Sand or sandy loam soils over clay	On slightly higher ground with deeper sandy soils over clay	3	Access area. <i>Eucalyptus sargentii</i> subsp. <i>onesis</i> P3
<i>Eucalyptus sargentii</i> subsp. <i>sargentii</i> woodland	Es2	Sandy soils (?gypsum) over clay	Sandy ridge	30	~ 4 ha adjacent proposed mining lease. Critically Endangered – Eucalypt Woodlands of the WA Wheatbelt
<i>Melaleuca</i> shrubland	Me	Sand or sandy loam over clay	Mostly flat terrain	1, 28	Access area <i>Dampiera orchardii</i> P2
Shrubland/forbland	Sf	Shallow sandy soils over clay.	Low lying areas subject to inundation	2, 4, 29	Access area <i>Frankenia drummondii</i> 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 <i>Eremophila serpens</i> P4, <i>Frankenia</i> sp. southern gypsum P3,
Open tall shrubland - <i>Hakea</i>	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 <i>Frankenia</i> sp. southern gypsum P3, <i>Pimelea halophila</i> 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. <i>Angianthus halophilus</i> P3, <i>Fitzwillia aff axilliflora</i> , <i>Haegiela tatei</i> P4, <i>Frankenia</i> 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

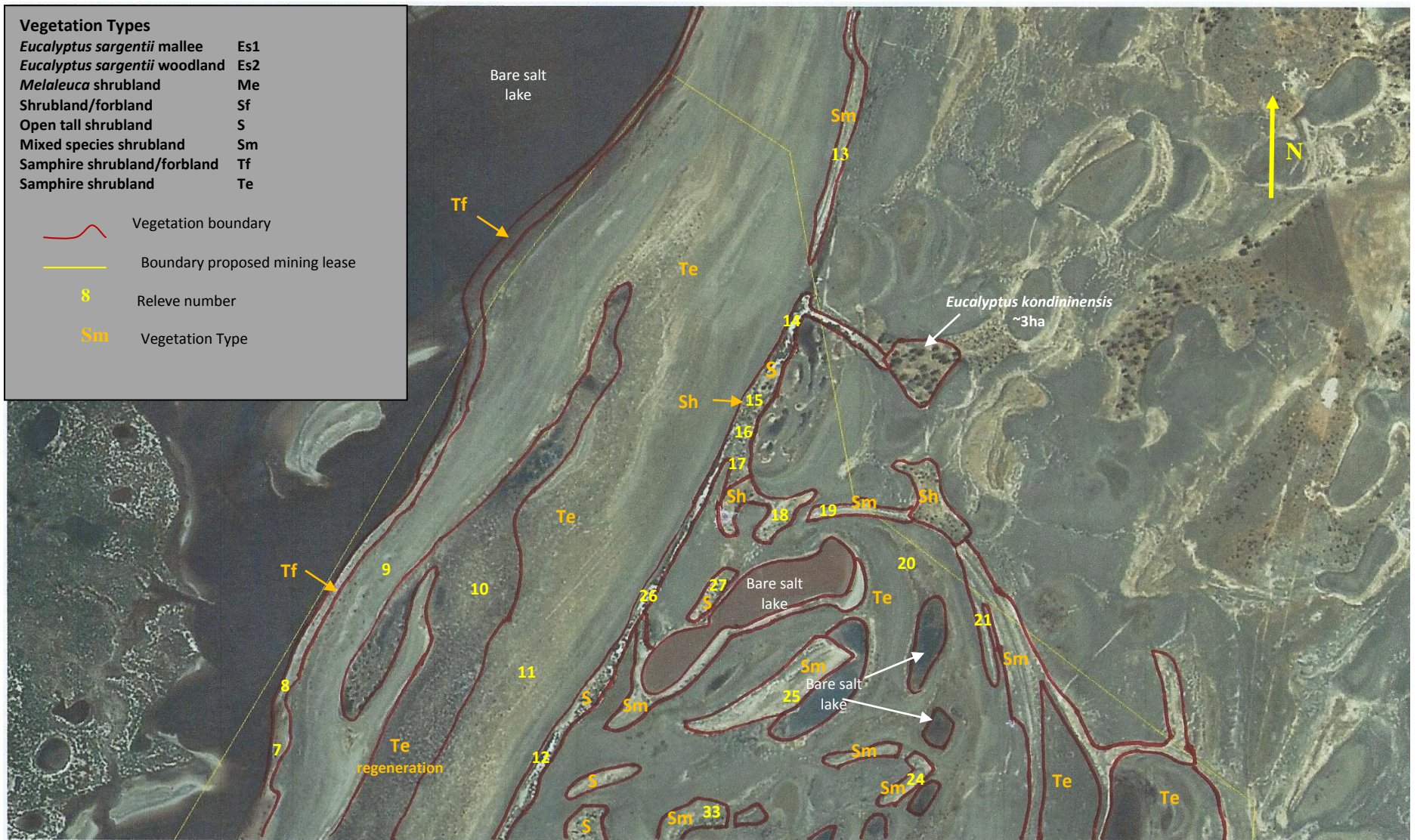


Figure 5: Vegetation map of the proposed mining lease M 70/1382 and surrounds Lake Lockhart - North.

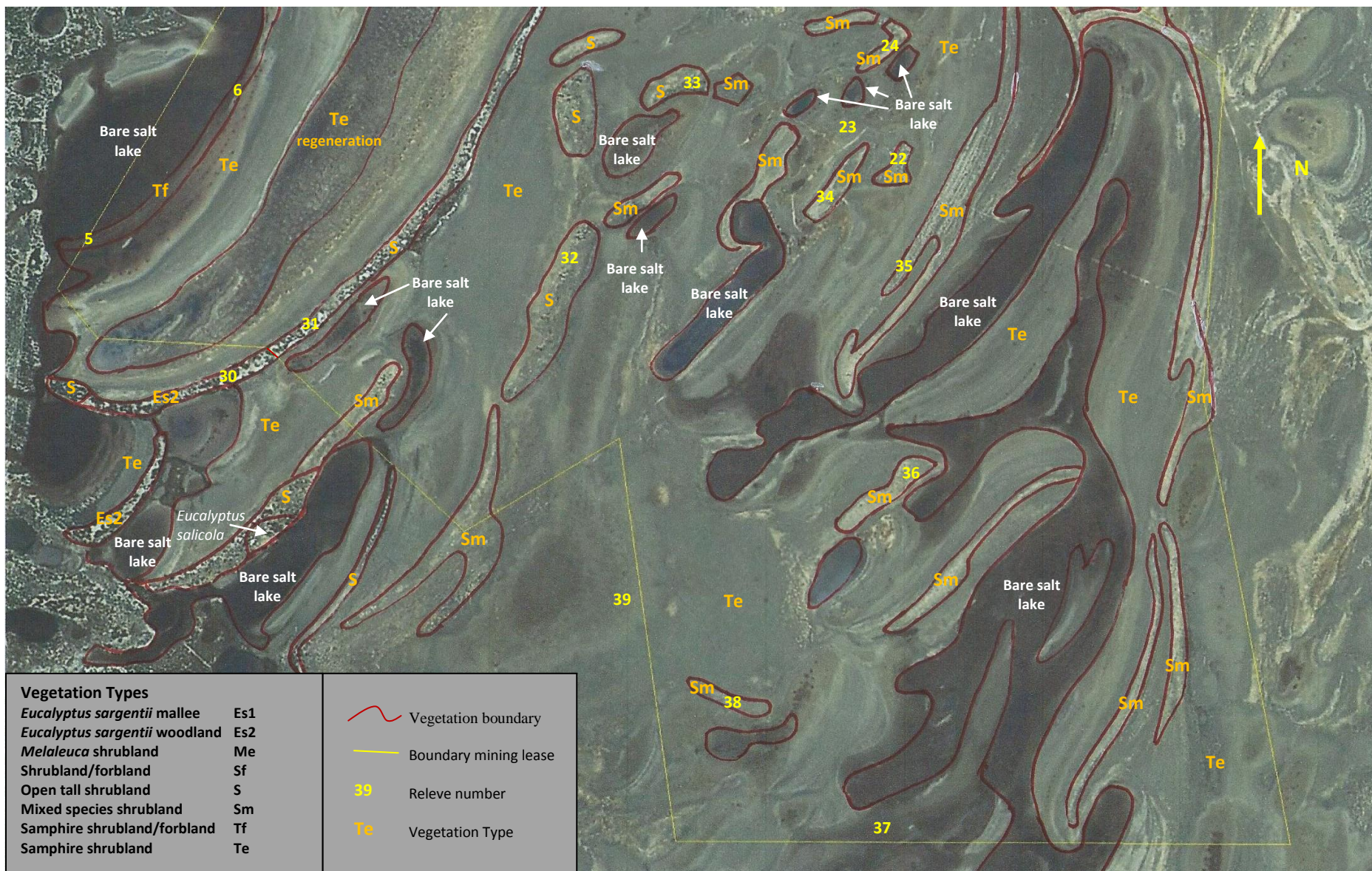
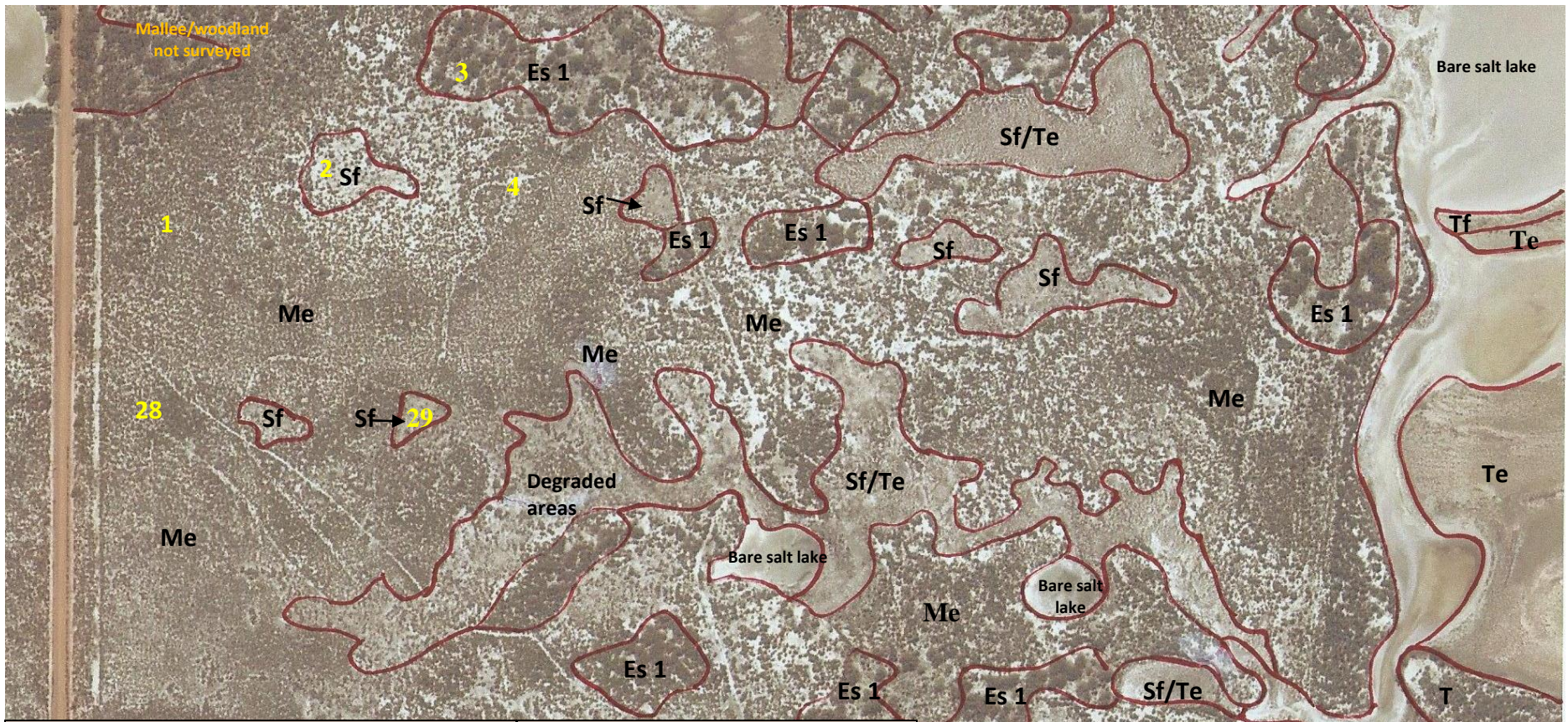



Figure 6: Vegetation map of the proposed mining lease M 70/1382 and surrounds Lake Lockhart - South.

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



Vegetation Types			
<i>Eucalyptus sargentii</i> subsp. onesis mallee	Es1		Vegetation boundary
<i>Melaleuca</i> shrubland	Me	28	Releve number
Shrubland/forbland	Sf	Me	Vegetation Type
Open tall shrubland	S		
Samphire shrubland/forbland	Tf		
Samphire shrubland	Te		

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 (<i>Melaleuca</i> , <i>Eucalyptus</i>)	17	6	0
Poaceae (grasses)	15	8	5
Frankeniaceae (<i>Frankenia</i>)	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 *Eucalyptus* 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).

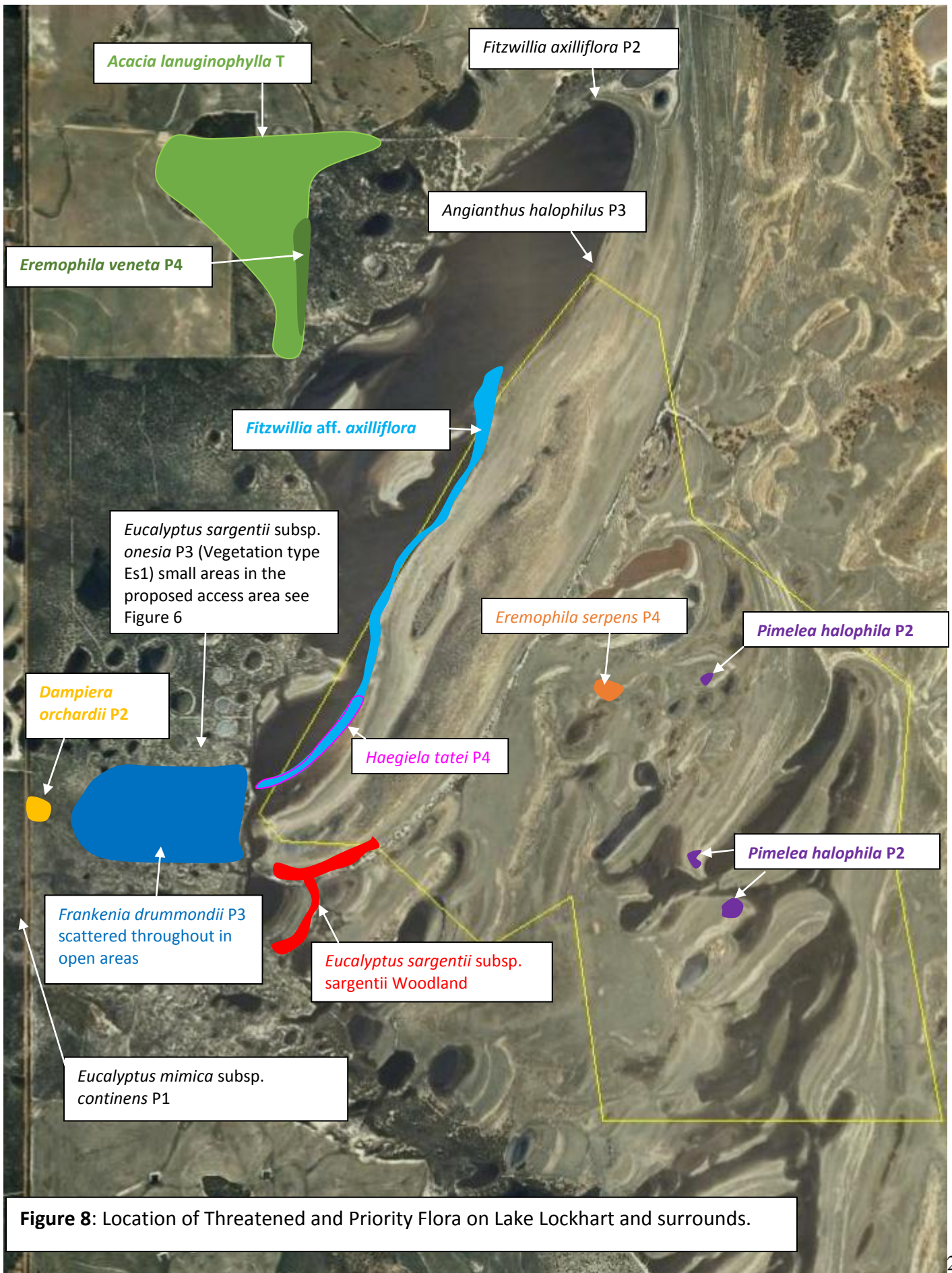


Figure 8: Location of Threatened and Priority Flora on Lake Lockhart and surrounds.

Table 7: Priority Flora in the study area

Taxa	Cons Code	Way Points	Releve	Voucher	Habitat
<i>Angianthus halophilus</i>	P3	201		8882	Samphire shrubland/forbland edge lake
<i>Eremophila serpens</i>	P4	243	33	8926	Open tall shrubland on sandy (?gypsum) soils
<i>Eucalyptus sargentii</i> subsp. <i>onesia</i> (<i>Eucalyptus</i> aff. <i>sargentii</i>)	P3	Es1 areas as mapped	3	8744	Sandy soils over clay, well drained
<i>Fitzwillia axilliflora</i>	P2	107		8810	Northern edge of lake in gypsum
<i>Fitzwillia</i> aff. <i>axilliflora</i>		26 to 30, 33, 36 to 38, 42, 43, 191, 192	5, 6, 7, 8	8766	Samphire/forbland in gypsum
<i>Frankenia drummondii</i>	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
<i>Frankenia</i> sp. southern gypsum	P3	widespread		8776, 8790, 8809	Edges of ridges and dunes on gypsum
<i>Goodenia orchardii</i>	P2	103, 104, 206, 208	28	8797	Sandy soils over clay <i>Melaleuca</i> shrubland
<i>Haegiela tatei</i>	P4		5, 6	8761	Samphire/forbland in gypsum
<i>Pimelea halophila</i> population 1	P2	163		8798	Open exposed area on gypsum amongst mixed species shrubland
<i>Pimelea halophila</i> Population 2 (sub population a)	P2	255		8939	Open exposed area on gypsum amongst mixed species shrubland
<i>Pimelea halophila</i> 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 \pm 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 height 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, Dundas, 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. *sargentii* (tree) occurring in the Lake Lockhart area is at present under review. This *Eucalyptus* 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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Appendix 1

Vegetation type Descriptions

Eucalyptus sargentii subsp. *onesis* (*Eucalyptus* aff. *sargentii*) Mallee Es1

Releve 3

The *Eucalyptus* here identified as *Eucalyptus sargentii* subsp. *onesis* is possibly a new species (see section 4.2). This shrub mallee covers small areas in the proposed access area on sandy soils over clay on slightly higher ground with better drainage in comparison to the adjacent *Melaleuca* shrubland. *Eucalyptus sargentii* subsp. *onesis* is a P3 species.

At releve 3, *Eucalyptus sargentii* subsp. *onesis* and *Eucalyptus perangusta* shrub mallee to 5 meters in height form a patchy stratum 30-70% canopy cover. Isolated shrubs to 1.5m were also recorded including *Santalum acuminatum* and *Acacia chrysella*. An open shrubland of chenopod shrubs and shrubs to 1.0 meters in height 10-30% canopy cover form a ground layer with isolated shrubs to 0.5 meters, forbs and tussock grasses.

Chenopod shrubs - *Rhagodia drummondii*

Shrubs to 1.5m - *Santalum acuminatum*, *Acacia chrysella*

Shrub to 1.0m – *Darwinia* sp. Karonie, *Cyathostemon blackettii*, *Olearia* sp. Eremicola, *Acacia hemiteles*, *Adenanthos glabrescens*, *Disphyma crassifolium*, *Dodonaea viscosa*, *Leucopogon* sp. Kau Rock, *Melaleuca carrii*, *Melaleuca halmaturorum*, *Melaleuca lateriflora*

Shrub species to 0.5m - *Boronia crenulata*, *Frankenia tetrapetala*

Vine - *Billardiera lehmanniana*

Forbs - *Calandrinia granulifera*, *Carpobrotus modestus*, **Ursinia anthemoides*

Tussock grass - *Austrostipa pycnostachya*

The condition of the vegetation is excellent with only the weed **Ursinia anthemoides* recorded.



Eucalyptus sargentii subsp. *onesis* (*Eucalyptus* aff. *sargentii*) Mallee Es1

Eucalyptus sargentii subsp. *sargentii* (*Eucalyptus* aff. *sargentii*) Es2

Releve 30

Eucalyptus sargentii subsp. *sargentii* is possibly a new species (see section 4.2). This open forest/woodland occurs just outside of the proposed gypsum mine on a sandy ridge, covers approximately 4 ha and meets key diagnostic characteristics for Critically Endangered - Eucalypt Woodlands of the WA Wheatbelt.

The PRIMER analysis indicates that releve 30 has a similar species composition to the open tall shrubland releves which occur on the same sandy ridge and other larger ridges and dunes. The patchy upper stratum consists of an open forest of trees (with lignotuber?) of *Eucalyptus sargentii* to 10 meters in height and a patchy 30-70%/10-30% canopy cover over the area. Isolated shrubs of *Pittosporum angustifolium* occur in the mid stratum with a groundcover of chenopod shrubs, shrubs, forbs and vine forming an open stratum to 0.5 meters 10-30% cover.

Chenopod shrubs - *Atriplex paludosa* *Rhagodia crassifolia*

Shrubs - *Disphyma crassifolium*, *Threlkeldia diffusa*, *Frankenia tetrapetala*

Forbs - *Carpobrotus modestus*, *Roepera glauca*

Vine – *Billardiera lehmanniana*

The vegetation was in excellent condition with some disturbance from rabbits.



Eucalyptus sargentii subsp. *sargentii* (*Eucalyptus* aff. *sargentii*) woodland Es2

Melaleuca shrubland – proposed access area

Me

Releves 1, 28

Melaleuca shrubland covers large areas of the proposed access area. This vegetation type grows in sandy soils over clay on flat terrain. *Melaleuca* shrubs are dominant including *Melaleuca brophyi*, *Melaleuca halmaturorum*, *Melaleuca lateriflora*, *Melaleuca thyoides* and *Melaleuca acuminata*. The shrubs form a stratum to 1.0 meters 30-70% canopy cover. Isolated shrub mallee of *Eucalyptus sporadica* to 3 meters and shrubs to 2 meters occur in some areas. Isolated shrubs, chenopod shrubs, sedges, rush and forbs to 0.5m are also present.

Shrub Mallee - *Eucalyptus sporadica*

Shrubs to 1.0m – *Melaleuca brophyi*, *Melaleuca halmaturorum*, *Melaleuca lateriflora*, *Melaleuca thyoides*, *Melaleuca acuminata*. *Chamelaucium ciliatum*, *Cyathostemon blackettii*

Shrubs to 0.5m – *Darwinia* sp. *Karonie*, *Leucopogon* sp. *Kau Rock*, *Mirbelia multicaulis*

Chenopod shrub - *Rhagodia crassifolia*

Sedges – *Gahnia trifida*, *Schoenus calcatus*, *Hypolaena humilis*

Forbs - *Carpobrotus modestus*, *Brachyscome pusilla*, *Podolepis capillaries*, *Crassula exserta*, *Dampiera orchardii* P2, *Isotoma scapigera*

Tussock grass - *Austrostipa juncifolia*

Rush - *Lomandra micrantha* subsp. *teretifolia*

The Vegetation condition was usually excellent. Some degradation was noted in the southern section from past waterlogging/ salinity.



Melaleuca shrubland Me

Shrubland/forbland – proposed access area Sf

Releve 2, 4, 29

Areas of shrubland/forbland occur scattered amongst the *Melaleuca* shrubland in the proposed access area. This vegetation type occurs on shallow sandy soils over clay and is poorly drained. In some areas *Tecticornia* (samphire) shrubs are more prominent. A shrubland with shrubs, chenopod shrubs, tussock grasses and forbs under 0.5 meters, 10-70% canopy cover, form a patchy stratum. Isolated shrubs to 1.0m were also recorded. The prostrate shrub *Wilsonia humilis* is often prominent.

Shrub to 1.0ms - *Melaleuca halmaturorum*

Shrubs to 0.5m – *Wilsonia humilis*, *Disphyma crassifolium*, *Acacia hemiteles*, *Frankenia tetrapetala*, *Frankenia drummondii* P3

Chenopod shrubs - *Rhagodia crassifolia*, *Didymanthus roei*, *Atriplex vesicaria*, *Enchylaena tomentosa*

Samphire shrubs - *Tecticornia pergranulata*

Forbs - *Brachyscome pusilla*, *Isotoma scapigera*, *Calandrinia granulifera*, *Crassula exserta*, *Lawrenzia diffusa*, *Podolepis capillaris*, *Gnephosis acicularis*, **Mesembryanthemum nodiflorum*, *Pogonolepis stricta*, *Senecio glossanthus*, *Siloxerus pygmaeus*,

Tussock grass – *Austrostipa pycnostachya*

Sedge - *Schoenus calcatus*

The condition of this vegetation type was Excellent to Very Good with samphire shrubs more prominent in some areas. The weed **Mesembryanthemum nodiflorum* was also prominent in some areas



Shrubland/forbland

Open tall shrubland

S

Relevés - 12, 14, 16, 17, 26, 27, 31, 32, 33

This shrubland vegetation type covers the larger ridges and dunes of gypsum. Sandy surface soils are present at some localities. Areas covered are small but relatively common in the proposed mining lease.

Open tall shrubland includes shrubs to 4 meters in height which form a patchy stratum, usually 10-30% canopy cover, but occasionally 2-10% on the lower dunes or 30-70% over short distances. *Melaleuca* shrubs are usually prominent including *Melaleuca hamulosa* and *Melaleuca halmaturorum*. A sub stratum of lower shrubs is often present with shrubs to 2m, 10-30% canopy cover or less. The ground layer is a sparse shrubland to shrubland with tussock grasses, forbs and rushes also present. Sparse tussock grassland was also recorded at relevés 12 and 27.

The condition of this vegetation type was in general excellent. Weeds species recorded include **Parapholis incurva*, **Avena species*, **Ursinia anthemoides*, **Mesembryanthemum nodiflorum* and **Trifolium arvense*. There was also some rabbit and kangaroo activity.

Shrubs to 3m - *Melaleuca hamulosa*, *Melaleuca halmaturorum*, *Pittosporum angustifolium*, *Santalum acuminatum*

Shrubs to 2m - *Melaleuca hamulosa*, *Melaleuca halmaturorum*, *Exocarpos aphyllus*, *Olearia sp. Eremicola*,

Ground shrubs - *Disphyma crassifolium*, *Frankenia tetrapetala*, *Frankenia sp. southern gypsum P3*, *Eremophila serpens P4*, *Solanum hoplopetalum*

Chenopod shrubs - *Atriplex paludosa*, *Rhagodia crassifolia*, *Maireana oppositifolia*, *Rhagodia drummondii*, *Threlkeldia diffusa*, *Enchylaena tomentosa*

Tecticornia shrub - *Tecticornia syncarpa*, *Tecticornia pergranulata*, *Tecticornia pterygosperma* subsp. *pterygosperma*, *Tecticornia moniliformis*

Grasses - *Austrostipa hemipogon*, *Austrostipa trichophylla*, *Austrostipa pycnostachya*, *Austrostipa elegantissima*, *Austrostipa drummondii*, *Austrostipa scabra*, *Austrostipa vickeryana*, *Rytidosperma setaceum*, **Parapholis incurva**, **Avena species*, *Eragrostis dielsii*

Forbs - *Angianthus pygmaeus*, *Calandrinia sp. Gypsum*, *Carpobrotus modestus*, **Ursinia anthemoides*, *Gnephosis drummondii*, *Crassula exserta*, *Gnephosis drummondii*, *Roepera glauca*, **Mesembryanthemum nodiflorum*, **Trifolium arvense*

Rush - *Lomandra effusa*

Vine - *Billardiera lehmanniana*



Open tall shrubland at Releve 14



Open tall shrubland at Releve 28

Open tall shrubland – *Hakea*

Sh

Relevés – 15, 18

The PRIMER analysis shows no significant difference in species composition between the Open tall shrubland relevés and the Open tall shrubland – *Hakea* relevés. However soil analysis at releve 15 in 2009 shows only 0.5% gypsum in top soils and soils at releve 18 are described as sandy loam (?gypsum) over clay. The *Melaleuca* shrubs typical of the upper storey of the Open tall shrubland vegetation type are absent. This vegetation type has been therefore described separately however it covered only 2 small areas in the proposed mining lease. Vegetation types with *Hakea preissii* prominent have been recorded elsewhere in the Magenta system.

The mid stratum is formed by an open shrubland of shrubs 1.5 to 3m in height, 2-30% canopy cover, including *Hakea preissii* (releve 18) and *Pittosporum angustifolium*. Plants in this stratum can form two sub strata in some areas. The ground strata consist of chenopod shrubs, 10-70% canopy cover, sometimes forming two substrata with tussock grasses and rushes. *Hakea strumosa* was recorded at releve 15. Forbs recorded at releve 15 in 2009 were not present in 2018.

The condition of the vegetation type was in general Excellent.

Shrubs over 2ms - *Hakea preissii*, *Pittosporum angustifolium*

Shrubs over 1.5m - *Pittosporum angustifolium*, *Exocarpos aphyllus*, *Bossiaea cucullata*

Shrubs to 1.0m - *Hakea strumosa*

Chenopod shrubs to 1.0m – *Atriplex paludosa*

Shrubs to 0.5m – *Lawrencia squamata*, *Disphyma crassifolium*

Chenopod shrubs to 0.5m - *Maireana oppositifolia*, *Rhagodia crassifolia*, *Enchylaena tomentosa*, *Maireana erioclada*, *Rhagodia drummondii*

Samphire shrub - *Tecticornia pterygosperma* subsp. *pterygosperma*, *Tecticornia moniliformis*

Tussock grass – *Austrostipa juncifolia*, *Austrostipa elegantissima*, *Rytidosperma setaceum*, *Austrostipa trichophylla*, **Parapholis incurva*

Rush – *Lomandra effusa*

Forbs – *Carpobrotus modestus*

Vine - *Comesperma integerrimum*



Open tall shrubland – *Hakea* at Releve 15



Open tall shrubland – *Hakea* at Releve 18

Mixed species shrubland

Sm

Relevés – 13, 19, 21, 22, 24, 25, 34, 35, 36, 38

Mixed species shrubland occurs on low ridges of gypsum, better drained and less prone to inundation than the surrounding flats. In most cases this vegetation type occurs as narrow strips covering a relatively small area in total.

This shrubland is characterized by shrubs to 0.5m, 30-70% canopy cover, of mixed species. Chenopod shrubs, especially *Atriplex paludosa* are usually prominent along with shrubs, samphire shrubs, tussock grasses and forbs.

The species composition at Releve 36 separates in the PRIMER cluster analysis however the SIMPROF test shows this difference in species composition is not statistically significant. Species recorded at Releve 36 but not in other mixed species shrubland relevés include *Alyxia buxifolia*, *Scaevola spinescens*, *Pimelea halophila* P2, *Lomandra micrantha* subsp. *teretifolia*, *Comesperma integerrimum*, *Billardiera lehmanniana* and *Dianella brevicaulis*.

This vegetation type is usually in excellent condition with some weed species recorded including **Avena species* (along fence lines), **Bromus rubens*, **Parapholis incurva* and **Trifolium arvense*.

Chenopod shrubs to 0.5m – *Atriplex paludosa*, *Maireana oppositifolia*, *Enchylaena tomentosa*

Shrubs to 0.5m – *Lawrenzia squamata*, *Disphyma crassifolium*, *Frankenia sp. southern gypsum* P3, *Kippistia suaedifolia*, *Frankenia tetrapetala*, *Eremophila decipiens*, *Scaevola spinescens*

Samphire shrubs to 0.5m – *Tecticornia moniliformis*, *Tecticornia syncarpa*

Tussock grasses – *Austrostipa elegantissima*, *Austrostipa trichophylla*, *Austrostipa pycnostachya*, *Austrostipa juncifolia*, *Rytidosperma setaceum*, *Eragrostis dielsii*, **Avena species*, **Bromus rubens*, **Parapholis incurva*

Forbs – *Isotoma scapigera*, *Brachyscome ciliaris*, *Calandrinia sp. Gypsum*, *Senecio glossanthus*, *Vittadinia gracilis*, *Trichanthodium skirrophorum*, *Angianthus pygmaeus*, *Asteridea athrixioides*, *Asteridea chaetopoda*, *Erymophyllum tenellum*, *Lepidium phlebopetalum*, *Waitzia suaveolens*, **Trifolium arvense*

Rush - *Lomandra effusa*



Mixed species shrubland at Releve 22



Mixed species shrubland at Releve 36

Samphire shrubland/forbland Tf

Relevés – 5, 6, 7, 8,

Samphire shrubland/forbland is situated on a ridge of gypsum adjacent to bare salt lake. This area is regenerating after flooding from heavy summer rain in 2017. Dead *Tecticornia* shrubs and seedlings were both recorded. Four priority species were present at the time of survey *Frankenia* sp. southern gypsum P3, *Haegiela tatei* P4, *Fitzwillia axilliflora* P2 (*Fitzwillia* aff. *axilliflora*) and *Angianthus halophilus* P3. The morphotype of *Fitzwillia axilliflora* P2 collected in this vegetation type is a possible new species (see section).

Open samphire shrubland of samphire shrubs, shrubs, chenopod shrubs, tussock grasses and forbs form a stratum to 0.5 meters, 30-30% or 30-70% canopy cover.

At Releve 8 - *Austrostipa juncifolia* open grassland forms an overstorey and the PRIMER analysis shows a significant difference in species composition at this site. This area was considered too small to map as an individual vegetation type.

The overall condition of this vegetation type was Very Good. Weeds have invaded the gypsum ridge including **Senecio vulgaris*, **Sonchus oleraceus*, **Mesembryanthemum nodiflorum* and **Parapholis incurva* and the area is regenerating after flooding.

Samphire shrubs - *Tecticornia pergranulata*, *Tecticornia halocnemoides*, *Salicornia blackiana*, *Tecticornia moniliformis*

Shrubs - *Disphyma crassifolium*, *Frankenia cinerea*, *Frankenia tetrapetala*, *Frankenia* sp. southern gypsum P3, *Lawrenzia squamata*,

Chenopod shrubs – *Atriplex spongiosa*, *Maireana oppositifolia*

Forbs - *Isotoma scapigera*, *Fitzwillia* aff. *axilliflora*, *Haegiela tatei* P4, *Triglochin nana*, *Trichanthodium skirrophorum*, *Carpobrotus modestus*, **Senecio vulgaris*, **Sonchus oleraceus*, **Mesembryanthemum nodiflorum*, *Angianthus halophilus* P3

Tussock grasses - *Austrostipa juncifolia* , **Parapholis incurva*



Samphire shrubland/forbland at Revele 7



Samphire shrubland/forbland with *Austrostipa juncifolia* at Revele 8

Samphire shrubland Te

Relevés – 9, 10, 11, 20, 23, 37, 39

Samphire shrubland covers large areas of the proposed mining lease on gypsum over clay on flat terrain subject to inundation.

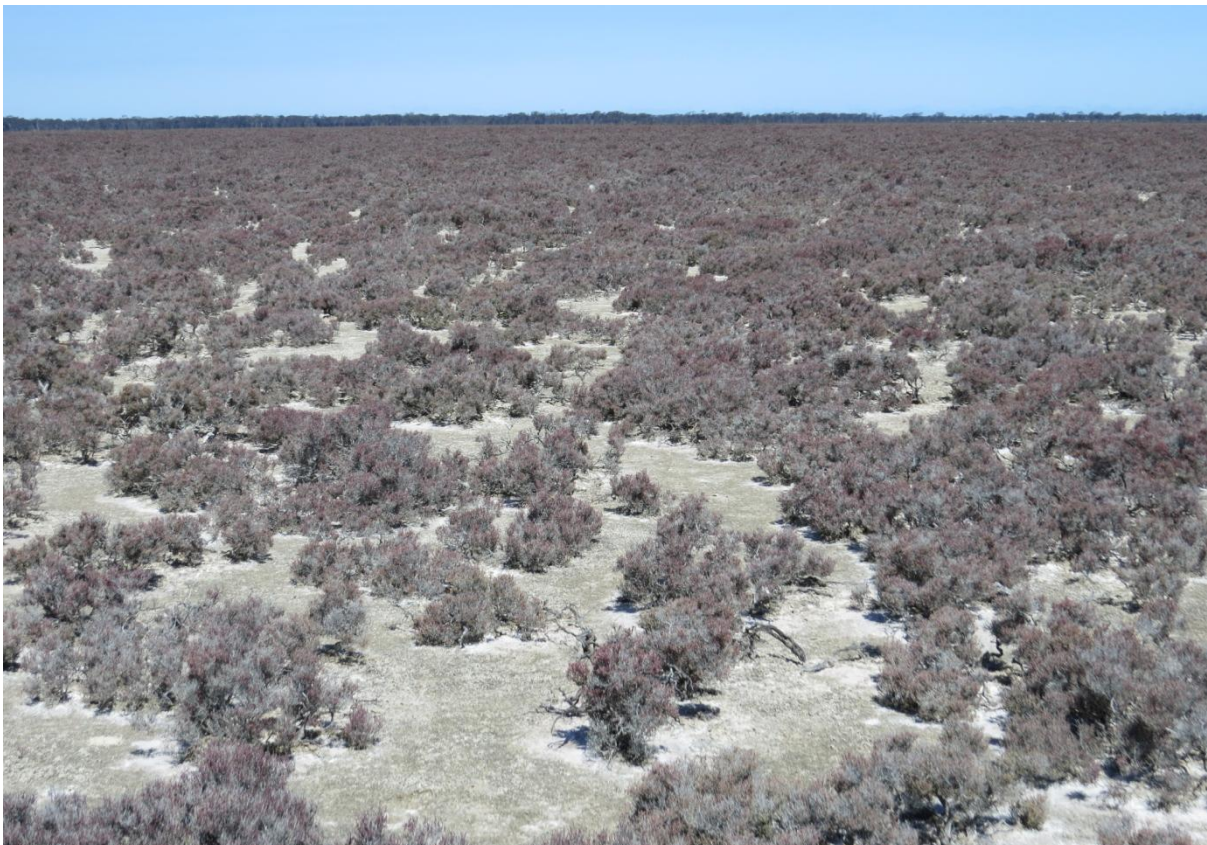
In 2009 *Frankenia* sp. southern gypsum P3 was recorded in this vegetation type but in the present survey this species was confined to slightly higher ground on the edges of gypsum ridges and low rises. Past flooding is the probable cause.

Samphire shrubs under 0.5m in height form a stratum usually 30-70% canopy cover but occasionally 10-30%. Over most of the area *Tecticornia loriae* was recorded with *Tecticornia halocnemoides* more common in regenerating areas. Both species were recorded in the same quadrat in 2009.

This vegetation type was in general in excellent condition. Some areas are regenerating after the 2017 floods and small areas are covered by dead shrubs with no regeneration at the time of survey.

Samphire shrubs - *Tecticornia loriae*, *Tecticornia halocnemoides*

Shrub - *Frankenia cinerea*



Samphire shrubland at Revele 41

Appendix 2

Releve Descriptions

Eucalyptus sargentii subsp. *onesis mallee*

Es1

Releve 3 : 20x20m
Date Surveyed: 22-10-18
Location/WP: 006
GPS (GDA 94): 33° 16' 28.996" 119° 01' 36.728"
Soils and topography: Sandy loam over clay, slightly higher ground

Diagnosis (Muir 1977): Shrub mallee over Dwarf Scrub C (scattered shrubs to 1.5, shrubs to 0.5m, herbs and grasses)

NVIS: M1+ ^ *Eucalyptus sargentii*, *Eucalyptus perangusta* \ *Eucalyptus* \ ^shrub mallee\6\c; M2 ^ *Santalum acuminatum*, *Acacia chrysellae* ^ *Santalum* \3\bi; G1 ^ *Rhagodia drummondii*, *Acacia hemiteles*, *Darwinia* sp. *Karonie*, *Cyathostemon blackettii*, *Olearia* sp. *Eremicola* \ *Rhagodia* \ ^Chenopod shrub, shrub, vine\2\i; G2 ^ *Disphyma crassifolium*, *Frankenia tetrapetala*, *Carpobrotus modestus*, *Calandrinia granulifera*, *Austrostipa pycnostachya* \ *Disphyma* \ ^shrub, forb, tussock grass\1\bi

Condition: Excellent * *Ursinia anthemoides*

Species	Growth Form Code	Height Code
<i>Acacia chrysellae</i>	S	3
<i>Acacia hemiteles</i>	S	2
<i>Adenanthos glabrescens</i>	S	2
<i>Austrostipa pycnostachya</i>	G	1
<i>Billardiera lehmanniana</i>	L	2
<i>Boronia crenulata</i>	S	1
<i>Calandrinia granulifera</i>	F	1
<i>Carpobrotus modestus</i>	F	1
<i>Cyathostemon blackettii</i>	S	2
<i>Darwinia</i> sp. <i>Karonie</i>	S	2
<i>Disphyma crassifolium</i>	S	1
<i>Dodonaea viscosa</i>	S	2
<i>Eucalyptus perangusta</i>	Y	6
<i>Eucalyptus sargentii</i> subsp. <i>onesis</i> P3	Y	6
<i>Frankenia tetrapetala</i>	S	1
<i>Leucopogon</i> sp. <i>Kau Rock</i>	S	2
<i>Melaleuca carrii</i>	S	2
<i>Melaleuca halmaturorum</i>	S	2
<i>Melaleuca lateriflora</i>	S	2
<i>Olearia</i> sp. <i>Eremicola</i>	S	2
<i>Rhagodia crassifolia</i>	C	2
<i>Santalum acuminatum</i>	S	3
* <i>Ursinia anthemoides</i>	F	1



Releve 3



***Eucalyptus sargentii* subsp. *onesis* (*Eucalyptus* aff. *sargentii*)**

Eucalyptus sargentii subsp. sargentii woodland

Es2

Releve 30: 20x20m

Date Surveyed: 27-10-18

Location/WP: 225

GPS (GDA 94): 33° 16' 46.4" 119° 02' 35.4"

Soils and topography: Sandy loam over clay and ?gypsum, sandy ridge

Diagnosis (Muir 1977): Low Forest A over Dwarf Scrub D (scattered shrubs to 2.5m)

NVIS: U1+^{Eucalyptus sargentii} \Eucalyptus\^tree\6\c; M1^{Pittosporum angustifolium} \^shrub\4\bi; G1^{Atriplex paludosa, Rhagodia crassifolia, Disphyma crassifolium, Threlkeldia diffusa, Carpobrotus modestus} \Atriplex\^chenopod shrub, shrub, forb, vine\1\i

Condition: Excellent

Species	Growth form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Billardiera lehmanniana</i>	L	1
<i>Carpobrotus modestus</i>	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Eucalyptus sargentii</i> subsp. <i>sargentii</i>	T	6
<i>Frankenia tetrapetala</i>	S	1
<i>Pittosporum angustifolium</i>	S	4
<i>Rhagodia crassifolia</i>	C	1
<i>Roepera glauca</i>	F	1
<i>Threlkeldia diffusa</i>	S	1



Releve 30



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

Melaleuca shrubland – access area

Me

Releve 1: 10x10m

Date Surveyed: 22-10-18

Location/WP: 002

GPS (GDA 94): 33° 16' 34.2" 119° 01' 26.9"

Soils and topography: Sandy loam over clay, flat terrain

Diagnosis (Muir 1977): Low Heath C (scattered shrub mallee, shrubs to 0.5m, sedges and herbs)

NVIS: M1 *Eucalyptus sporadica* \ *Eucalyptus* ^shrub mallee\6\bi; G1+ *Melaleuca brophyi*, *Melaleuca halmaturorum*, *Melaleuca lateriflora* \ *Melaleuca* \2\c; G2 *Darwinia* sp Karonie, *Leucopogon* sp. Kau Rock, *Carpobrotus modestus*, *Gahnia trifida*, *Brahyscome pusilla* ^shrub, chenopod shrub, sedge, forb\1\bi

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Brachyscome pusilla</i>	F	1
<i>Carpobrotus modestus</i>	F	1
<i>Crassula exserta</i>	F	1
<i>Darwinia</i> sp. Karonie	S	1
<i>Eucalyptus sporadica</i>	Y	6
<i>Gahnia trifida</i>	V	1
<i>Leucopogon</i> sp. Kau Rock	S	1
<i>Melaleuca brophyi</i>	S	2
<i>Melaleuca halmaturorum</i>	S	2
<i>Melaleuca lateriflora</i>	S	2
<i>Podolepis capillaris</i>	F	1
<i>Rhagodia crassifolia</i>	C	1
<i>Schoenus calcatuus</i>	V	1

Melaleuca shrubland – access area Me

Releve 28: 10x10m

Date Surveyed: 27-10-18

Location/WP: 207

GPS (GDA 94): 33° 16' 38.9" 119° 01' 26.6"

Soils and topography: Loamy sand over clay, flat terrain

Diagnosis (Muir 1977): Low Heath C (scattered shrubs to 2m, shrubs to 0.5m, sedges and herbs)

NVIS: M1 ^ *Melaleuca brophyi* \Melaleuca \3\bi; G1+ ^ *Melaleuca brophyi*, *Melaleuca halmaturorum*, *Chamelaucium ciliatum*, *Cyathostemon blackettii* \Melaleuca\2\c; G1 ^ *Rhagodia preissii*, *Brachyscome pusilla*, *Isotoma scapigera*, *Austrostipa juncifolia*, *Dampiera orchardii* \Rhagodia \^ chenopod shrub, shrub, forb, tussock grass, rush, sedge\1\bi

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Austrostipa juncifolia</i>	G	2
<i>Brachyscome pusilla</i>	F	1
<i>Chamelaucium ciliatum</i>	S	2
<i>Crassula exserta</i>	F	1
<i>Cyathostemon blackettii</i>	S	2
<i>Dampiera orchardii</i> P2	F	1
<i>Eucalyptus sporadica</i>	Y	5
<i>Hypolaena humilis</i>	V	1
<i>Isotoma scapigera</i>	F	1
<i>Lomandra micrantha</i> subsp. <i>teretifolia</i>	R	1
<i>Melaleuca brophyi</i>	S	2
<i>Melaleuca halmaturorum</i>	S	2
<i>Mirbelia multicaulis</i>	S	1
<i>Podolepis capillaris</i>	F	1
<i>Rhagodia crassifolia</i>	C	1



Releve 1



Releve 28

Shrubland/Forbland – access area Sf

Releve 2: 10x10m

Date Surveyed: 22-10-18

Location/WP: 004

GPS (GDA 94): 33° 16' 31.944" 119° 01' 32.956"

Soils and topography: Sandy soils over clay, flat terrain

Diagnosis (Muir 1977): Open Dwarf Scrub D over Open Low Grass/Open Herbs (scattered sedges)

NVIS: G1+^ *Disphyma crassifolium*, *Brachyscome pusilla*, *Isotoma scapigera*, *Calandrinia granulifera*, *Austrostipa pycnostachya* \^shrub, chenopod shrub, forb, tussock grass, sedge \1\i

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Acacia hemiteles</i>	S	1
<i>Austrostipa pycnostachya</i>	G	1
<i>Brachyscome pusilla</i>	F	1
<i>Calandrinia granulifera</i>	F	1
<i>Crassula exserta</i>	F	1
<i>Didymanthus roei</i>	C	1
<i>Disphyma crassifolium</i>	S	1
<i>Isotoma scapigera</i>	F	1
<i>Lawrenzia diffusa</i>	F	1
<i>Podolepis capillaris</i>	F	1
<i>Rhagodia crassifolia</i>	C	1
<i>Schoenus calcatas</i>	V	1



Releve 2



Releve 4

Shrubland/Forbland – access area Sf

Releve 4 : 10x10m

Date Surveyed: 22-10-18

Location/WP: 012

GPS (GDA 94): 33° 16' 32.275" 119° 01' 44.576"

Soils and topography: Shallow sandy soils over clay, poorly drained flat terrain

Diagnosis (Muir 1977): Low Heath D/Herbs (scattered sedges)

NVIS: G1+ ^*Wilsonia humilis*, *Disphyma crassifolium*, *Frankenia tetrapetala*, *Calandrinia granulifera*, *Brachyscome pusilla*\^shrub, forb, chenopod shrub, sedge\1\c

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Brachyscome pusilla</i>	F	1
<i>Calandrinia granulifera</i>	F	1
<i>Didymanthus roei</i>	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Frankenia tetrapetala</i>	S	1
<i>Isotoma scapigera</i>	F	1
<i>Rhagodia crassifolia</i>	C	1
<i>Wilsonia humilis</i>	S	1

Shrubland/Forbland - access area Sf

Releve 29: 10x10m

Date Surveyed: 27-10-18

Location/WP: 211

GPS (GDA 94): 33° 16' 39.5" 119° 01' 36.4"

Soils and topography: Shallow sandy loam over clay, poorly drained, flat terrain

Diagnosis (Muir 1977): Low Heath D/Herbs (scattered shrubs to 1.0m)

NVIS: G1 ^*Melaleuca halmaturorum*\Melaleuca\^shrub\2\bi; G2+ ^*Wilsonia humilis*, *Disphyma crassifolium*, *Podolepis capillaris*, *Gnephosis acicularis*, *Pogonolepis stricta*\Wilsonia\^shrub, chenopod shrub, forb, samphire shrub
\1\c

Condition: Excellent , past waterlogging **Mesembryanthemum nodiflorum*

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex vesicaria</i>	C	1
	<i>Brachyscome pusilla</i>	F	1
	<i>Didymanthus roei</i>	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Enchylaena tomentosa</i>	S	1
	<i>Frankenia drummondii</i> P3	S	1
	<i>Frankenia tetrapetala</i>	S	1
	<i>Gnephosis acicularis</i>	F	1
	<i>Isotoma scapigera</i>	F	1
	<i>Lawrenzia diffusa</i>	F	1
	<i>Melaleuca halmaturorum</i>	S	2
*	<i>Mesembryanthemum nodiflorum</i>	F	1
	<i>Podolepis capillaris</i>	F	1
	<i>Pogonolepis stricta</i>	F	1
	<i>Senecio glossanthus</i>	F	1
	<i>Siloxerus pygmaeus</i>	F	1
	<i>Tecticornia pergranulata</i>	U	1
	<i>Wilsonia humilis</i>	S	1



Releve 29



Releve 29

Open Tall Shrubland

S

Releve 12: 20x5m

Date Surveyed: 22-10-18

Location/WP: 062

GPS (GDA 94): 33° 16' 10.1" 119° 03' 11.5"

Soils and topography: Sandy loam over clay and ?gypsum, narrow ridge

Diagnosis (Muir 1977): Scrub over Low Scrub B over Very Open Low Grass/Open Dwarf Scrub D (scattered herbs)

NVIS: M1+[^]*Melaleuca hamulosa*, *Pittosporum angustifolium*, *Santalum angustifolium**Melaleuca*\[^]shrub\4\j; M2 [^]*Melaleuca hamulosa*, *Exocarpos aphyllus*, *Olearia* sp. *Eremicola**Melaleuca*\[^]shrub\3\j; G1 [^]*Austrostipa hemipogon*, *Austrostipa trichophylla*, *Atriplex paludosa*, *Disphyma crassifolium*, *Angianthus pygmaeus**Austrostipa*\[^]tussock grass, shrub, chenopod shrub, forb, rush\1\r

Condition: Excellent

Weed	Species	Growth Form Code	Height Code
	<i>Angianthus pygmaeus</i>	F	1
	<i>Atriplex paludosa</i>	C	1
	<i>Austrostipa hemipogon</i>	G	1
	<i>Austrostipa pycnostachya</i>	G	1
	<i>Austrostipa trichophylla</i>	G	1
	<i>Calandrinia</i> sp. <i>Gypsum</i>	F	1
	<i>Carpobrotus modestus</i>	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Exocarpos aphyllus</i>	S	3
	<i>Frankenia tetrapetala</i>	S	1
	<i>Lomandra effusa</i>	R	1
	<i>Melaleuca hamulosa</i>	S	4
	<i>Olearia</i> sp. <i>Eremicola</i>	S	3
*	<i>Parapholis incurva</i>	G	1
	<i>Pittosporum angustifolium</i>	S	4
	<i>Rhagodia crassifolia</i>	C	1
	<i>Santalum acuminatum</i>	S	4
	<i>Tecticornia syncarpa</i>	U	1
*	<i>Ursinia anthemoides</i>	F	1



Releve 12



Releve 14

Open Tall Shrubland

S

Releve 14: 20x5m

Date Surveyed: 25-10-18

Location/WP: 125

GPS (GDA 94): 33° 15' 25.4" 119° 03' 40.9"

Soils and topography: Sandy loam over clay ?gypsum, narrow ridge

Diagnosis (Muir 1977): Scrub over Low Scrub A over Low Heath C (scattered grasses, herbs)

NVIS: M1+ ^*Melaleuca hamulosa*, *Melaleuca halmaturorum* \Melaleuca
\shrub\4\j; M2 ^*Melaleuca hamulosa*, *Melaleuca halmaturorum* \Melaleuca
\shrub\3\j; G1 ^*Frankenia tetrapetala*, *Atriplex paludosa*, *Tecticornia*
syncarpa, *Maireana oppositifolia*, *Austrostipa hemipogon* \Frankenia\^shrub,
chenopod shrub, samphire shrub, tussock grass, forb\1\c

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa hemipogon</i>	G	1
<i>Austrostipa pycnostachya</i>	G	1
<i>Frankenia tetrapetala</i>	S	1
<i>Gnephosis drummondii</i>	F	1
<i>Maireana oppositifolia</i>	C	1
<i>Melaleuca halmaturorum</i>	S	4
<i>Melaleuca hamulosa</i>	S	4
<i>Rhagodia drummondii</i>	C	1
<i>Tecticornia pergranulata</i>	U	1
<i>Tecticornia syncarpa</i>	U	1

Open Tall Shrubland

S

Releve 16: 10x10m

Date Surveyed: 25-10-18

Location/WP: 130

GPS (GDA 94): 33° 15' 36.8" 119° 03' 35.1"

Soils and topography: Gypsum (90%) Mattiske (1995) G238, Rick(2011) GYP022, large dune

Diagnosis (Muir 1977): Scrub over Open Low Scrub A over Dwarf Scrub D

NVIS: M1+ ^Melaleuca hamulosa\Melaleuca\^shrub\4\i;M2 ^Exocarpos aphyllus, Pittosporum angustifolium\Exocarpos\^shrub\3\r;G1 ^Frankenia tetrapetala, Tecticornia pterygosperma, Atriplex paludosa, Maireana oppositifolia, Austrostipa elegantissima\Frankenia\^shrub, chenopod shrub, samphire shrub, tussock grass\1\i

Condition: Excellent. Herbs recorded in 2009 not present in 2018 including *Brachyscome ciliaris*, *Crassula exerta* and *Isotoma scapigera*

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa drummondii</i>	G	1
<i>Austrostipa elegantissima</i>	G	1
<i>Austrostipa pycnostachya</i>	G	1
<i>Disphyma crassifolium</i>	S	1
<i>Exocarpos aphyllus</i>	S	3
<i>Frankenia tetrapetala</i>	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Melaleuca hamulosa</i>	S	4
<i>Pittosporum angustifolium</i>	S	3
<i>Rhagodia crassifolia</i>	C	1
<i>Tecticornia pterygosperma</i> subsp. <i>pterygosperma</i>	U	1



Quadrat GYP022 Surveyed 2009 (see Appendix 4)



Releve 16

Open Tall Shrubland

S

Releve 17: 10x10m

Date Surveyed: 25-10-18

Location/WP: 132

GPS (GDA 94): 33° 15' 41.6" 119° 03' 34.1"

Soils and topography: Dune slope, gypsum soils

Diagnosis (Muir 1977): Dwarf Scrub C over Dwarf scrub D (scattered shrubs to 1.5m, grasses, herbs)

NVIS: M1^*Pittosporum angustifolium*, *Exocarpos aphyllus*, *Lycium australis*\Pittosporum\^shrub\3\bi; G1+ ^*Atriplex paludosa*, *Tecticornia moniliformis*, *Tecticornia syncarpa*\Atriplex\^shrub, samphire shrub\2\i; G2 ^*Frankenia tetrapetala*, *Frankenia* sp. southern gypsum, *Diphyma crassifolium*, *Maireana oppositifolium*, *Austrostipa elegantissima* \Frankenia\^shrub, samphire shrub, chenopod shrub, tussock grass, forb\1\i

Condition: Excellent, some weed **Avena species*, **Parapholis incurva*

Species	Growth form code	Height Code
<i>Atriplex paludosa</i>	C	2
<i>Austrostipa elegantissima</i>	G	1
<i>Austrostipa trichophylla</i>	G	1
* <i>Avena species</i>	G	1
<i>Crassula exserta</i>	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Eragrostis dielsii</i>	G	1
<i>Exocarpos aphyllus</i>	S	3
<i>Frankenia</i> sp. southern gypsum P3	S	1
<i>Frankenia tetrapetala</i>	S	1
<i>Lycium australe</i>	S	3
<i>Maireana oppositifolia</i>	C	1
* <i>Parapholis incurva</i>	G	1
<i>Pittosporum angustifolium</i>	S	3
<i>Rhagodia crassifolia</i>	C	1
<i>Rhagodia drummondii</i>	C	1
<i>Tecticornia moniliformis</i>	U	1
<i>Tecticornia syncarpa</i>	U	1
<i>Threlkeldia diffusa</i>	S	1



Releve 17



Releve 26

Open Tall Shrubland

S

Releve 26: 20x5m

Date Surveyed: 25-10-18

Location/WP: 178

GPS (GDA 94): 33° 16' 54.7" 119° 03' 23.6"

Soils and topography: Sandy loam over clay, gypsum content? Low sandy ridge

Diagnosis (Muir 1977): Thicket over Dwarf Scrub D (scattered grasses)

NVIS: M1+*Melaleuca hamulosa*, *Pittosporum angustifolium*
Melaleuca shrub; G1 *Tecticornia syncarpa*, *Tecticornia moniliformis*,
Threlkeldia diffusa, *Rhagodia crassifolia*, *Maireana oppositifolia*
Tecticornia samphire shrub, Chenopod shrub, shrub, tussock grass,
forb

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa elegantissima</i>	G	1
<i>Austrostipa scabra</i>	G	1
<i>Carpobrotus modestus</i>	F	1
<i>Enchylaena tomentosa</i>	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Melaleuca hamulosa</i>	S	4
<i>Pittosporum angustifolium</i>	S	4
<i>Rhagodia crassifolia</i>	C	1
<i>Tecticornia moniliformis</i>	U	1
<i>Tecticornia syncarpa</i>	U	1
<i>Threlkeldia diffusa</i>	S	1

Open Tall Shrubland

S

Releve 27: 10x10m

Date Surveyed: 25-10-18

Location/WP: 180

GPS (GDA 94): 33° 15' 53.5" 119° 03' 31.4"

Soils and topography: Large dune gypsum soils, gentle slope

Diagnosis (Muir 1977): Scrub over Dwarf Scrub D/ Very Open Low Grass

NVIS: M1+ ^*Melaleuca hamulosa*, *Pittosporum angustifolium* \ *Melaleuca* \ ^shrub\4/I;G1 ^*Atriplex paludosa*, *Lawrencia squamata*, *Tecticornia moniliformis*, *Disphyma crassifolium*, *Austrostipa vickeryana* \ *Atriplex* \ ^Chenopod shrub, shrub, samphire shrub, tussock grass, forb\1\i

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa vickeryana</i>	G	1
<i>Billardiera lehmanniana</i>	L	1
<i>Carpobrotus modestus</i>	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Frankenia tetrapetala</i>	S	1
<i>Lawrencia squamata</i>	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Melaleuca hamulosa</i>	S	4
<i>Pittosporum angustifolium</i>	S	4
<i>Tecticornia moniliformis</i>	U	1
<i>Tecticornia syncarpa</i>	U	1



Releve 27



Releve 31

Open Tall Shrubland

S

Releve 31: 5x20m

Date Surveyed: 27-10-18

Location/WP: 227

GPS (GDA 94): 33° 16' 42.6" 119° 02' 43.4"

Soils and topography: Sandy loam over clay gypsum content? Low sandy ridge

Diagnosis (Muir 1977): Scrub over Dwarf Scrub C over Dwarf Scrub D (scattered grasses and herbs)

NVIS: M1+ ^*Melaleuca hamulosa*, *Melaleuca halmaturorum*\^*Melaleuca* \
^shrub\4\i; G1 ^*Rhagodia crassifolia*, *Rhagodia drummondii*
\^*Rhagodia*\^chenopod shrub\2\i; G2 ^*Threlkeldia diffusa*, *Disphyma*
crassifolium, *Maireana oppositifolia*, *Tecticornia syncarpa*, *Austrostipa*
elegantissima *Threlkeldia*\^chenopod shrub, shrub, samphire shrub, tussock
grass, forb\1\i

Condition: Excellent

Weed	Species	Growth Form Code	Height Code
	<i>Austrostipa elegantissima</i>	G	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Frankenia sp. southern gypsum P3</i>	S	1
	<i>Gnephosis drummondii</i>	F	1
	<i>Maireana oppositifolia</i>	C	1
	<i>Melaleuca halmaturorum</i>	S	4
	<i>Melaleuca hamulosa</i>	S	4
*	<i>Mesembryanthemum nodiflorum</i>	F	1
	<i>Rhagodia crassifolia</i>	C	2
	<i>Rhagodia drummondii</i>	C	2
	<i>Roepera glauca</i>	F	1
	<i>Tecticornia syncarpa</i>	U	1
	<i>Threlkeldia diffusa</i>	S	1

Open Tall Shrubland

S

Releve 32: 10x10m

Date Surveyed: 27-10-18

Location/WP: 231

GPS (GDA 94): 33° 16' 36.5" 119° 03' 15.3"

Soils and topography: gypsum, ridge

Diagnosis (Muir 1977): Scrub over Open Dwarf Scrub D (scattered grasses)

NVIS: M1+ ^Melaleuca hamulosa\Melaleuca\^shrub\4\i; G1 ^Atriplex paludosa, Disphyma crassifolium, Rhagodia crassifolia, Frankenia tetrapetala, Austrostipa elegantissima\Atriplex\^chenopod shrub, shrub, tussock grass, forb\1\r

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa elegantissima</i>	G	1
<i>Austrostipa hemipogon</i>	G	1
<i>Carpobrotus modestus</i>	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Enchylaena tomentosa</i>	C	1
<i>Frankenia tetrapetala</i>	S	1
<i>Melaleuca hamulosa</i>	S	4
<i>Rhagodia crassifolia</i>	C	1
<i>Rhagodia drummondii</i>	C	1
<i>Rytidosperma setaceum</i>	G	1



Releve 32



Releve 33

Open Tall Shrubland

S

Releve 33: 5x20m

Date Surveyed: 27-10-18

Location/WP: 242

GPS (GDA 94): 33° 16' 17.0" 119° 03' 31.0"

Soils and topography: Sandy soils over clay, ? gypsum content

Diagnosis (Muir 1977): Dwarf Scrub C over Dwarf Scrub D (scattered shrubs to 4m, grasses and forbs)

NVIS: M1 ^*Melaleuca hamulosa*, *Pittosporum angustifolium*\Melaleuca\4\bi; G1+ ^*Atriplex paludosa*, *Exocarpos aphyllus*\Atriplex\^chenopod shrub, shrub\2\i; G2 ^*Eremophila serpens*, *Tecticornia moniliformis*, *Frankenia tetrapetala*, *Carpobrotus modestus*, *Rytidosperma setaceum*\Eremophila\^shrub, chenopod shrub, samphire shrub, tussock grass, forb\1\i

Condition: Excellent, some weed **Trifolium arvense*

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex paludosa</i>	C	2
	<i>Austrostipa elegantissima</i>	G	1
	<i>Austrostipa pycnostachya</i>	G	1
	<i>Austrostipa trichophylla</i>	G	1
	<i>Carpobrotus modestus</i>	F	1
	<i>Crassula exserta</i>	F	1
	<i>Eremophila serpens</i> P4	S	1
	<i>Exocarpos aphyllus</i>	S	2
	<i>Frankenia tetrapetala</i>	S	1
	<i>Melaleuca hamulosa</i>	S	4
	<i>Pittosporum angustifolium</i>	S	4
	<i>Rhagodia crassifolia</i>	C	1
	<i>Rytidosperma setaceum</i>	G	1
	<i>Schoenus calcatus</i>	V	1
	<i>Solanum hoplopetalum</i>	S	1
	<i>Tecticornia moniliformis</i>	U	1
*	<i>Trifolium arvense</i>	F	1

Open Tall Shrubland - Hakea Sh

Releve 15: 10x10m

Date Surveyed: 25-10-18

Location/WP: 128

GPS (GDA 94): 33° 15' 34.5" 119° 03' 36.4"

Soils and topography: Light brown loamy sand gypsum 0.5% (Rick 2011 quadrat GYP023)

Diagnosis (Muir 1977): Open Scrub over Open Low Scrub A over Low Heath C over Open Dwarf Scrub D

NVIS: M1 *Pittosporum angustifolium*\Pittosporum\^shrub\4\bi; *Pittosporum angustifolium*\Pittosporum\^shrub\3\bi; G1+ *Hakea strumosa*, *Lomandra effusa*, *Atriplex paludosa*, *Comesperma integerrimum*\Hakea\^shrub, rush, chenopod shrub, vine\2\c; G2 *Rhagodia crassifolia*, *Enchylaena tomentosa*, *Maireana erioclada*, *Austrostipa elegantissima*, *Rytidosperma setaceum*\Rhagodia\^chenopod shrub, tussock grass\1\r

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	2
<i>Austrostipa elegantissima</i>	G	1
<i>Austrostipa trichophylla</i>	G	1
<i>Comesperma integerrimum</i>	L	2
<i>Enchylaena tomentosa</i>	C	1
<i>Hakea strumosa</i>	S	2
<i>Lomandra effusa</i>	R	2
<i>Maireana erioclada</i>	C	1
<i>Pittosporum angustifolium</i>	S	4
<i>Rhagodia crassifolia</i>	C	1
<i>Rytidosperma setaceum</i>	G	1



Quadrat GYP023 Rick (2011) see Appendix 4



Releve 15

Open Tall Shrubland - Hakea

Sh

Releve 18: 10x10m

Date Surveyed: 25-10-18

Location/WP: 136

GPS (GDA 94): 33° 15' 46.9" 119° 03' 39.0"

Soils and topography: Sandy loam over clay ?gypsum content, sandy ridge

Diagnosis (Muir 1977): Open Scrub over Low Scrub B/Very Open Tall Grass over Dwarf Scrub D
(scattered low grasses and herbs)

NVIS: M1 ^*Hakea preissii*\Hakea\^shrub\4/r; M2+ ^*Pittosporum angustifolium*,
Austrostipa juncifolia, *Exocarpos aphyllus*, *Bossiaea cucullata* \Pittosporum
\^ shrub, tussock grass\3\i; G1 ^*Maireana oppositifolia*, *Lawrencia*
squamata, *Rhagodia crassifolia*, *Disphyma crassifolium*, *Tecticornia*
moniliformis\Maireana\^chenopod shrub, shrub, samphire shrub, tussock
grass, rush\1\i

Condition: Excellent, **Parapholis incurva*

Weed	Species	Growth Form Code	Height Code
	<i>Austrostipa elegantissima</i>	G	1
	<i>Austrostipa juncifolia</i>	G	3
	<i>Bossiaea cucullata</i>	S	3
	<i>Carpobrotus modestus</i>	F	1
	<i>Comesperma integerrimum</i>	L	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Exocarpos aphyllus</i>	S	3
	<i>Hakea preissii</i>	S	4
	<i>Lawrencia squamata</i>	S	1
	<i>Lomandra effusa</i>	R	1
	<i>Maireana erioclada</i>	C	1
	<i>Maireana oppositifolia</i>	C	1
*	<i>Parapholis incurva</i>	G	1
	<i>Pittosporum angustifolium</i>	S	3
	<i>Rhagodia crassifolia</i>	C	1
	<i>Rhagodia drummondii</i>	C	1
	<i>Rytidosperma setaceum</i>	G	1
	<i>Tecticornia moniliformis</i>	U	1
	<i>Tecticornia pterygosperma</i> subsp. <i>pterygosperma</i>	U	1



Releve 18



Releve 18

Mixed Species Shrubland

Sm

Releve 13: 5x20m

Date Surveyed: 25-10-18

Location/WP: 119

GPS (GDA 94): 33° 15' 5.281" 119° 3' 47.909"

Soils and topography: Sandy loam and gypsum, slight ridge along fence line

Diagnosis (Muir 1977): Low Heath D (scattered herbs and grasses)

NVIS: G1+ ^*Atriplex paludosa*, *Lawrencia squamata*, *Tecticornia moniliformis*, *Disphyma crassifolium*, *Austrostipa elegantissima*\^*Atriplex*\^chenopod shrub, shrub, samphire shrub, tussock grass, forb\1\c

Condition: Excellent, some weed including wild oats **Avena* species

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex paludosa</i>	C	1
	<i>Austrostipa elegantissima</i>	G	1
*	<i>Avena species</i>	G	1
	<i>Brachyscome ciliaris</i>	F	1
	<i>Calandrinia sp. Gypsum</i>	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Frankenia sp. southern gypsum P3</i>	S	1
	<i>Isotoma scapigera</i>	F	1
	<i>Lawrencia squamata</i>	S	1
	<i>Senecio glossanthus</i>	F	1
	<i>Tecticornia moniliformis</i>	U	1
	<i>Vittadinia gracilis</i>	F	1



Releve 13



Releve 19

Mixed Species Shrubland Sm

Releve 19: 5x20m

Date Surveyed: 25-10-18

Location/WP: 139

GPS (GDA 94): 33° 15' 45.3" 119° 03' 44.8"

Soils and topography: Gypsum soils, slight ridge

Diagnosis (Muir 1977): Low Heath D (scattered grasses and herbs)

NVIS: G1+ ^*Atriplex paludosa*, *Tecticornia moniliformis*, *Lawrencia squamata*, *Maireana oppositifolia*, *Austrostipa trichophylla*\^*Atriplex*\^chenopod shrub, samphire shrub, shrub, tussock grass, forb\1\c

Condition: Excellent, some weed, **Bromus rubens*

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex paludosa</i>	C	1
	<i>Austrostipa elegantissima</i>	G	1
	<i>Austrostipa pycnostachya</i>	G	1
	<i>Austrostipa trichophylla</i>	G	1
	<i>Brachyscome ciliaris</i>	F	1
*	<i>Bromus rubens</i>	G	1
	<i>Calandrinia sp. Gypsum</i>	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Frankenia sp. southern gypsum P3</i>	S	1
	<i>Kippistia suaedifolia</i>	S	1
	<i>Lawrencia squamata</i>	S	1
	<i>Maireana oppositifolia</i>	C	1
	<i>Rytidosperma setaceum</i>	G	1
	<i>Senecio glossanthus</i>	F	1
	<i>Tecticornia moniliformis</i>	U	1
	<i>Trichanthodium skirrophorum</i>	F	1

Mixed Species Shrubland Sm

Releve 21: 10x10m

Date Surveyed: 25-10-18

Location/WP: 150

GPS (GDA 94): 33° 15' 56.1" 119° 04' 03.8"

Soils and topography: Gypsum, slight ridge

Diagnosis (Muir 1977): Low Heath D

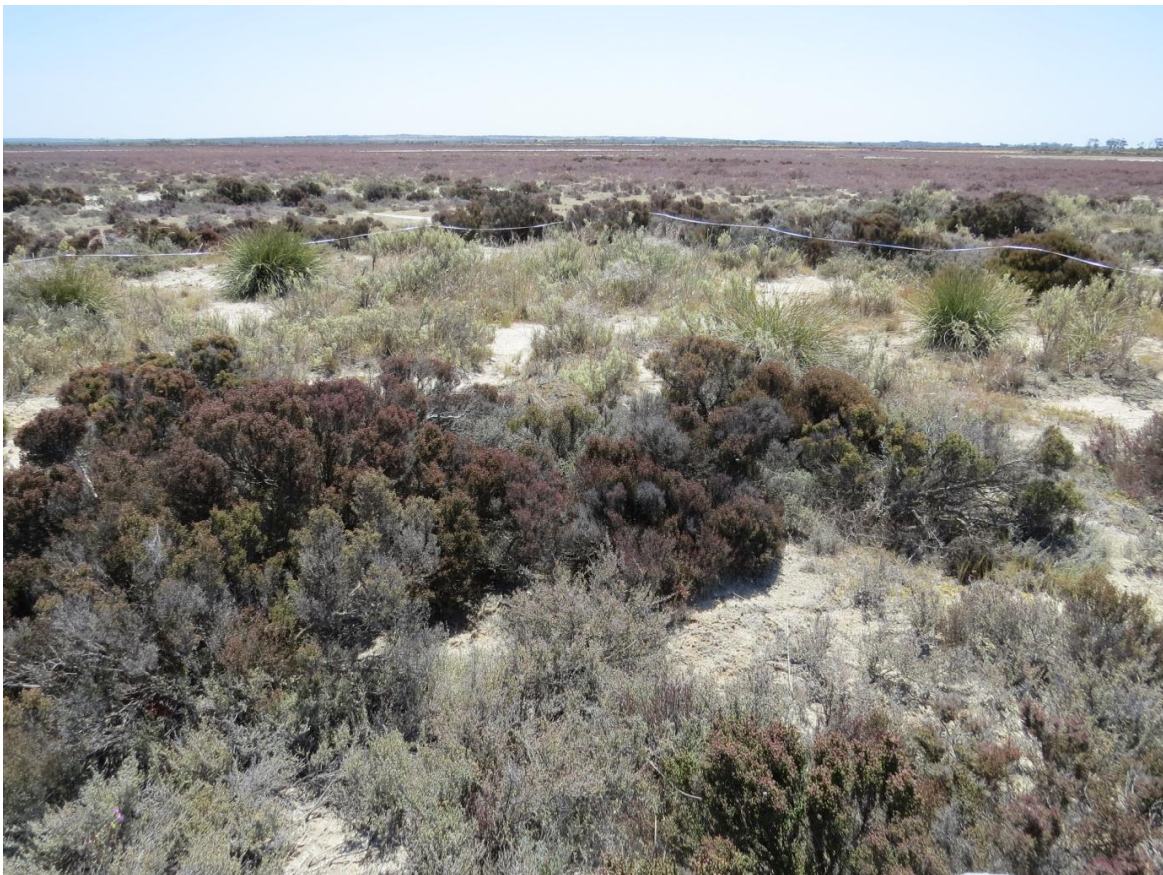
NVIS: G1+ ^*Maireana oppositifolia*, *Tecticornia moniliformis*, *Disphyma crassifolium*, *Frankenia* sp southern gypsum, *Atriplex paludosa**Maireana*\^chenopod shrub, samphire shrub, shrub\1\c

Condition: Excellent, some dead shrubs

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Disphyma crassifolium</i>	S	1
<i>Frankenia</i> sp. southern gypsum P3	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Tecticornia moniliformis</i>	U	1



Releve 21



Releve 22

Mixed Species Shrubland Sm

Releve 22: 10x10m

Date Surveyed: 25-10-18

Location/WP: 157

GPS (GDA 94): 33° 16' 23.5" 119° 03' 56.8"

Soils and topography: Gypsum ridge

Diagnosis (Muir 1977): Low Heath D/Very Open Low Grass (scattered herbs)

NVIS: G1 ^*Lomandra effusa*\Lomandra\^rush\2\bi; G2+ ^*Atriplex paludosa*, *Tecticornia moniliformis*, *Lawrencia squamata*, *Maireana oppositifolia*, *Austrostipa trichophylla*\Atriplex\^chenopod shrub, samphire shrub, shrub, tussock grass, forb\1\c

Condition: Excellent, some weed, * *Parapholis incurva*, * *Trifolium arvense*

Weed	Species	Growth Form Code	Height Code
	<i>Angianthus pygmaeus</i>	F	1
	<i>Asteridea athrixioides</i>	F	1
	<i>Asteridea chaetopoda</i>	F	1
	<i>Atriplex paludosa</i>	C	1
	<i>Austrostipa elegantissima</i>	G	1
	<i>Austrostipa trichophylla</i>	G	1
	<i>Brachyscome ciliaris</i>	F	1
	<i>Calandrinia</i> sp. Gypsum	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Enchylaena tomentosa</i>	C	1
	<i>Eragrostis dielsii</i>	G	1
	<i>Erymophyllum tenellum</i>	F	1
	<i>Frankenia</i> sp. southern gypsum P3	S	1
	<i>Frankenia tetrapetala</i>	S	1
	<i>Lawrencia squamata</i>	S	1
	<i>Lepidium phlebopetalum</i>	F	1
	<i>Lomandra effusa</i>	R	2
	<i>Maireana oppositifolia</i>	C	1
*	<i>Parapholis incurva</i>	G	1
	<i>Rytidosperma setaceum</i>	G	1
	<i>Tecticornia moniliformis</i>	U	1
	<i>Trichanthodium skirrophorum</i>	F	1
*	<i>Trifolium arvense</i>	F	1
	<i>Vittadinia gracilis</i>	F	1

Mixed Species Shrubland Sm

Releve 24: 10x10m

Date Surveyed: 25-10-18

Location/WP: 165

GPS (GDA 94): 33° 16' 12.5" 119° 03' 56.5"

Soils and topography: Gypsum dune

Diagnosis (Muir 1977): Low Heath D (scattered grasses and herbs)

NVIS: G1+ ^*Atriplex paludosa*, *Eremophila decipiens*, *Lawrencia squamata*, *Disphyma crassifolium*, *Austrostipa trichophylla*\^*Atriplex*\^chenopod shrub, shrub, grass, samphire shrub, forb\1\c

Condition: Excellent, some weed, * *Bromus rubens*, * *Trifolium arvense*

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex paludosa</i>	C	1
	<i>Austrostipa elegantissima</i>	G	1
	<i>Austrostipa juncifolia</i>	G	1
	<i>Austrostipa pycnostachya</i>	G	1
	<i>Austrostipa trichophylla</i>	G	1
*	<i>Bromus rubens</i>	G	1
	<i>Calandrinia</i> sp. Gypsum	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Eremophila decipiens</i>	S	1
	<i>Lawrencia squamata</i>	S	1
	<i>Lomandra effusa</i>	R	1
	<i>Maireana oppositifolia</i>	C	1
	<i>Rytidosperma setaceum</i>	G	1
	<i>Tecticornia moniliformis</i>	U	1
	<i>Trichanthodium skirrophorum</i>	F	1
*	<i>Trifolium arvense</i>	F	1
	<i>Waitzia suaveolens</i>	F	1



Releve 24



Releve 25

Mixed Species Shrubland Sms

Releve 25: 10x10m

Date Surveyed: 25-10-18

Location/WP: 170

GPS (GDA 94): 33° 16' 05.3" 119° 03' 38.2"

Soils and topography: Gypsum ridge adjacent to a small salt lake

Diagnosis (Muir 1977): Dwarf Scrub D (scattered grasses and herbs)

NVIS: G1+ ^ Maireana oppositifolia, Tecticornia moniliformis, Lawrencina squamata, Atriplex paludosa, Frankenia sp. southern gypsum\Maireana\^chenopod shrub, samphire shrub, shrub, forb, tussock grass\1\i

Condition: Excellent

Weed	Species	Growth Form Code	Height Code
	Asteridea athrixioides	F	1
	Asteridea chaetopoda	F	1
	Atriplex paludosa	C	1
	Austrostipa pycnostachya	G	1
	Calandrinia sp. Gypsum	F	1
	Disphyma crassifolium	S	1
	Frankenia sp. southern gypsum P3	S	1
	Isotoma scapigera	F	1
	Lawrencina squamata	S	1
	Maireana oppositifolia	C	1
*	Parapholis incurva	G	1
	Tecticornia moniliformis	U	1
	Trichanthodium skirrophorum	F	1
	Vittadinia gracilis	F	1

Mixed Species Shrubland Sm

Releve 34: 10x10m

Date Surveyed: 27-10-18

Location/WP: 249

GPS (GDA 94): 33° 16' 27.54" 119° 03' 49.39"

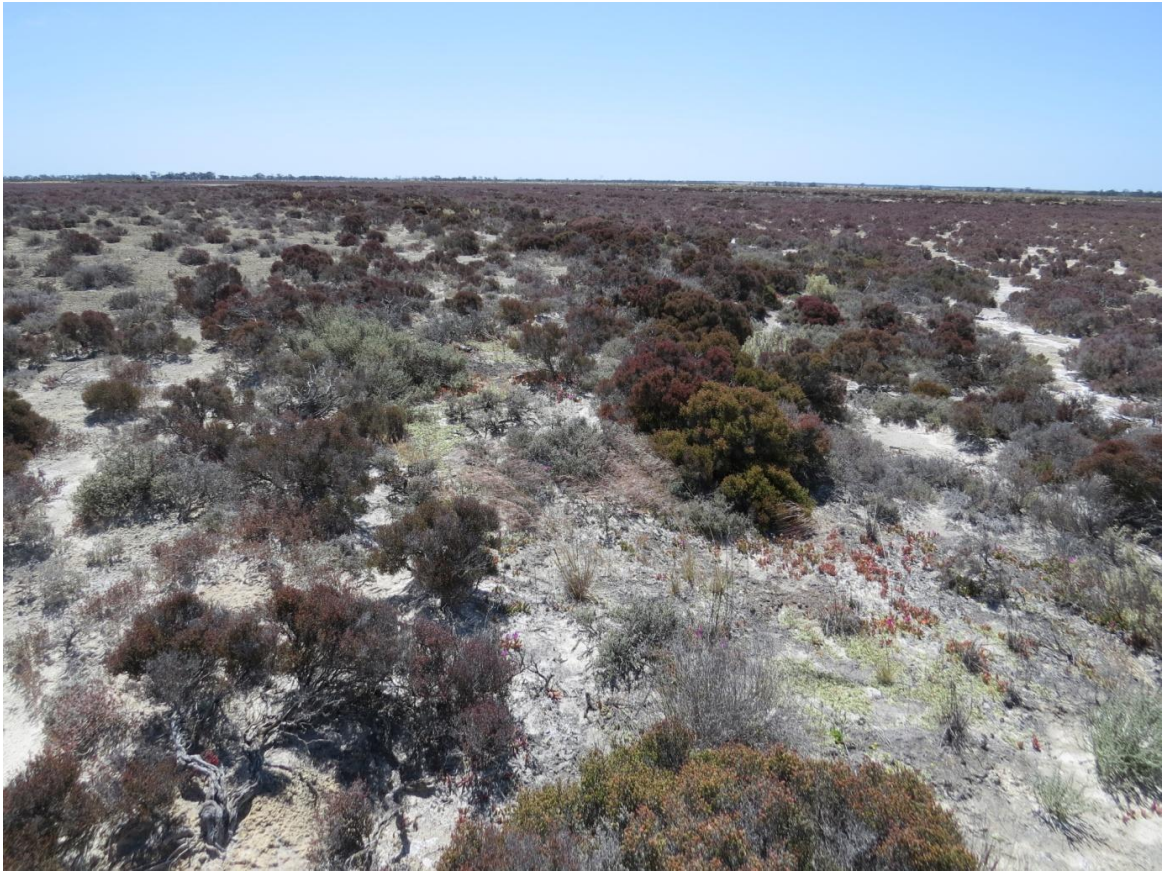
Soils and topography: Low gypsum ridge

Diagnosis (Muir 1977): Dwarf Scrub D (scattered grasses, herbs)

NVIS: G1+ ^ *Maireana oppositifolia*, *Tecticornia moniliformis*, *Lawrencia squamata*, *Atriplex paludosa*, *Disphyma crassifolium* \Maireana\^chenopod shrub, samphire shrub, shrub, tussock grass, forb\1\i

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa trichophylla</i>	G	1
<i>Calandrinia</i> sp. Gypsum	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Lawrencia squamata</i>	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Tecticornia moniliformis</i>	U	1
<i>Trichanthodium skirrophorum</i>	F	1



Releve 34



Releve 35

Mixed Species Shrubland Sm

Releve 35: 5x20m

Date Surveyed: 27-10-18

Location/WP: 251

GPS (GDA 94): 33° 16' 38.1" 119° 03' 54.9"

Soils and topography: Low gypsum ridge

Diagnosis (Muir 1977): Low Heath D (scattered grasses, herbs)

NVIS: G1+ ^*Atriplex paludosa*, *Tecticornia moniliformis*, *Maireana oppositifolia*, *Lawrencia squamata*, *Disphyma crassifolium*\^*Atriplex*\^chenopod shrub, samphire shrub, shrub, tussock grass, forb\1\c

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Atriplex paludosa</i>	C	1
<i>Austrostipa pycnostachya</i>	G	1
<i>Austrostipa trichophylla</i>	G	1
<i>Calandrinia</i> sp. Gypsum	F	1
<i>Disphyma crassifolium</i>	S	1
<i>Frankenia</i> sp. southern gypsum P3	S	1
<i>Lawrencia squamata</i>	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Tecticornia moniliformis</i>	U	1

Mixed Species Shrubland Sms

Releve 36: 10x10m

Date Surveyed: 27-10-18

Location/WP: 257

GPS (GDA 94): 33° 16' 56.4" 119° 03' 56.6"

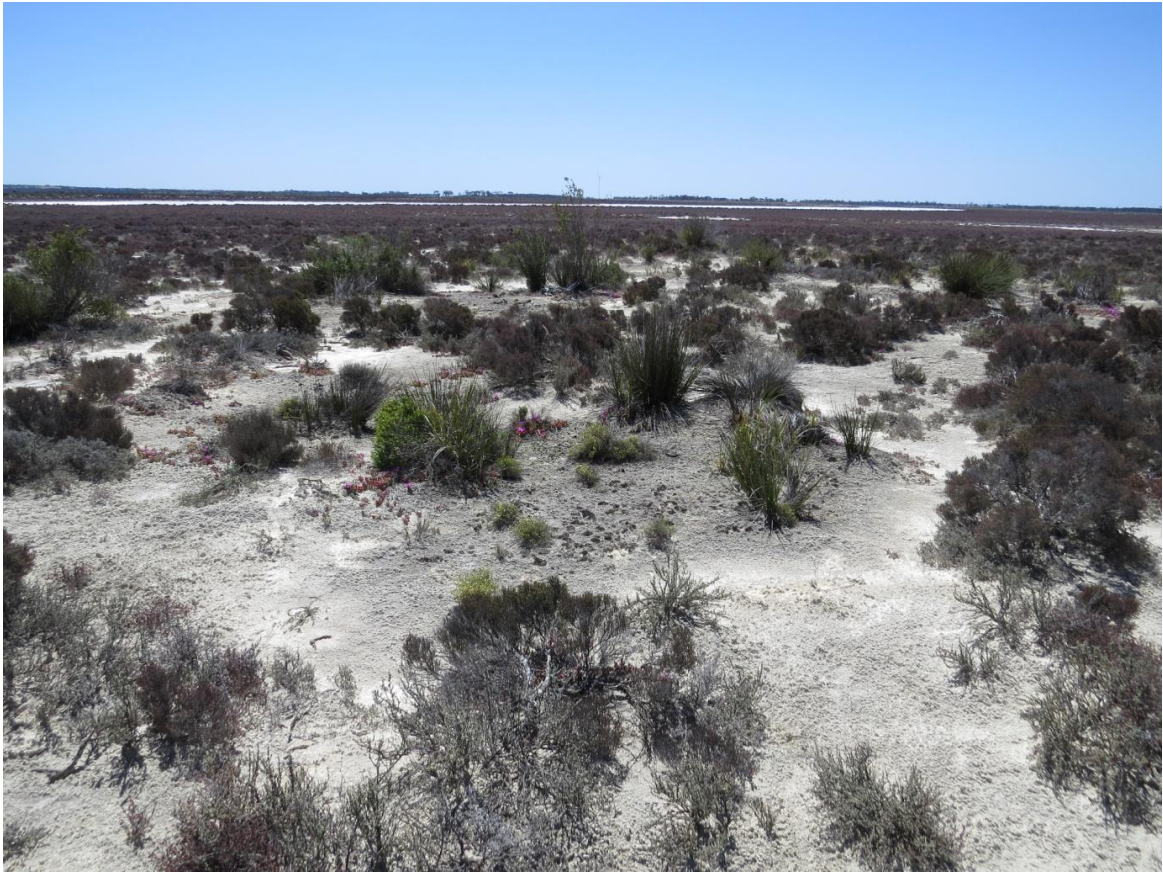
Soils and topography: Gypsum ridge, some sand

Diagnosis (Muir 1977): Low Heath D (scattered shrubs to 2m, to 1.0m, grasses and herbs)

NVIS: M1 ^*Alyxia buxifolia*, *Scaevola spinescens* \Alyxia\^shrub\3\bi; G1 ^*Lomandra micrantha* subsp. *teretifolia*, *Dianella brevicaulis* \Lomandra\^rush\2\bi; G2+ ^*Maireana oppositifolia*, *Lawrencia squamata*, *Tecticornia moniliformis*, *Disphyma crassifolium*, *Austrostipa trichophylla* \Maireana\^chenopod shrub, shrub, samphire shrub, tussock grass, vine\1\c

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Alyxia buxifolia</i>	S	3
<i>Austrostipa pycnostachya</i>	G	1
<i>Austrostipa trichophylla</i>	G	1
<i>Billardiera lehmanniana</i>	L	1
<i>Comesperma integerrimum</i>	L	1
<i>Dianella brevicaulis</i>	R	1
<i>Disphyma crassifolium</i>	S	1
Frankenia sp. southern gypsum P3	S	1
<i>Kippistia suaedifolia</i>	S	1
<i>Lawrencia squamata</i>	S	1
<i>Lomandra micrantha</i> subsp. <i>teretifolia</i>	R	2
<i>Maireana oppositifolia</i>	C	1
Pimelea halophila P2	S	1
<i>Scaevola spinescens</i>	S	3
<i>Tecticornia moniliformis</i>	U	1



Releve 36



Releve 38

Mixed Species Shrubland Sm

Releve 38: 10x10m

Date Surveyed: 27-10-18

Location/WP: 270

GPS (GDA 94): 33° 17' 20.0" 119° 03' 35.1"

Soils and topography: Low gypsum ridge

Diagnosis (Muir 1977): Low Heath D

NVIS: G1+ ^*Maireana oppositifolia*, *Lawrenzia squamata*, *Tecticornia moniliformis*, *Tecticornia syncarpa*, *Frankenia* sp. southern gypsum \Maireana\
^chenopod shrub, shrub, samphire shrub, forb\1\c

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Calandrinia</i> sp. Gypsum	F	1
<i>Frankenia</i> sp. southern gypsum P3	S	1
<i>Lawrenzia squamata</i>	S	1
<i>Maireana oppositifolia</i>	C	1
<i>Tecticornia moniliformis</i>	U	1
<i>Tecticornia syncarpa</i>	U	1

Samphire Shrubland/Forbland Tf

Releve 5 : 5x20m

Date Surveyed: 22-10-18

Location/WP: 025

GPS (GDA 94): 33° 16' 32.93" 119° 2' 17.4"

Soils and topography: Low gypsum ridge, edge of Lake Lockhart, damp soils

Diagnosis (Muir 1977): Dwarf Scrub D over Very Open Herbs (scattered grasses)

NVIS: G1+ ^*Tecticornia perangusta*, *Tecticornia halocnemoides*, *Disphyma crassifolium*, *Isotoma scapigera*, *Fitzwillia* aff. *axilliflora* \Tecticornia
\samphire shrub, shrub, forb, tussock grass\1\i

Condition: Very Good– disturbance - inundation ~18 months, some weed **Parapholis incurva*, **Senecio vulgaris*. Dead samphire shrubs, samphire seedlings present

weed	Species	Growth Form Code	Height Code
	<i>Disphyma crassifolium</i>	S	1
	<i>Fitzwillia</i> aff. <i>axilliflora</i>	F	1
	<i>Frankenia cinerea</i>	S	1
	<i>Haegiela tatei</i> P4	F	1
	<i>Isotoma scapigera</i>	F	1
*	<i>Parapholis incurva</i>	G	1
*	<i>Senecio vulgaris</i>	F	1
	<i>Tecticornia halocnemoides</i>	U	1
	<i>Tecticornia pergranulata</i>	U	1
	<i>Triglochin nana</i>	F	1



Releve 5



Releve 6

Samphire Shrubland/Forbland Tf

Releve 6: 5x20m

Date Surveyed: 22-10-18

Location/WP: 034

GPS (GDA 94): 33° 16' 18.8" 119° 02' 35.0"

Soils and topography: Gypsum ridge, edge of Lake Lockhart

Diagnosis (Muir 1977): Low Heath D (scattered grasses and herbs)

NVIS: G1+ ^*Tecticornia perangusta*, *Tecticornia halocnemoides*, *Disphyma crassifolium*, *Isotoma scapigera*, *Fitzwillia* aff. *axilliflora*\ *Tecticornia* \
^samphire shrub, shrub, forb, tussock grass\1\c

Condition: Very Good– disturbance - inundation ~18 months, some weed **Parapholis incurva*, **Senecio vulgaris*, **Sonchus oleraceus*. Dead samphire shrubs, healthy samphire seedlings also present

Weed	Species	Growth Form Code	Height Code
	<i>Disphyma crassifolium</i>	S	1
	<i>Fitzwillia</i> aff. <i>axilliflora</i>	F	1
	<i>Frankenia tetrapetala</i>	S	1
	<i>Haegiela tatei</i> P4	F	1
	<i>Isotoma scapigera</i>	F	1
*	<i>Parapholis incurva</i>	G	1
*	<i>Senecio vulgaris</i>	F	1
*	<i>Sonchus oleraceus</i>	F	1
	<i>Tecticornia halocnemoides</i>	U	1
	<i>Tecticornia pergranulata</i>	U	1
	<i>Triglochin nana</i>	F	1

Samphire Shrubland/Forbland Tf

Releve 7: 5x20m

Date Surveyed: 22-10-18

Location/WP: 039

GPS (GDA 94): 33° 16' 09.1" 119° 02' 39.0"

Soils and topography: Gypsum ridge, edge of Lake Lockhart, subject to inundation

Diagnosis (Muir 1977): Low Heath D over Very Open Low Grass (scattered herbs)

NVIS: G1+ ^*Tecticornia perangusta*, *Tecticornia halocnemoides*, **Parapholis incurva*, *Disphyma crassifolium*, *Isotoma scapigera*\Tecticornia\ ^samphire shrub, tussock grass, shrub, forb, chenopod shrub \1\c

Condition: Very Good– disturbance - inundation ~18 months, some weed **Mesembryanthemum nodiflorum*, **Parapholis incurva*, **Senecio vulgaris*, **Sonchus oleraceus*. **Arctotheca calendula* adjacent. Some dead samphire shrubs, healthy samphire seedlings also present

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex spongiosa</i>	C	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Frankenia tetrapetala</i>	S	1
	<i>Isotoma scapigera</i>	F	1
*	<i>Mesembryanthemum nodiflorum</i>	F	1
*	<i>Parapholis incurva</i>	G	1
*	<i>Senecio vulgaris</i>	F	1
*	<i>Sonchus oleraceus</i>	F	1
	<i>Tecticornia halocnemoides</i>	U	1
	<i>Tecticornia pergranulata</i>	U	1
	<i>Trichanthodium skirrophorum</i>	F	1
	<i>Triglochin nana</i>	F	1



Releve 7



Releve 8

Samphire Shrubland/Forbland Tf

Releve 8: 5x20m

Date Surveyed: 22-10-18

Location/WP: 044

GPS (GDA 94): 33° 16' 01.4" 119° 02' 40.5"

Soils and topography: Low gypsum ridge, edge of Lake Lockhart, subject to inundation

Diagnosis (Muir 1977): Open Tall Grass over Dwarf Scrub D (scattered herbs)

NVIS: M1+ ^Austrostipa juncifolia\Austrostipa\^Tussock grass\2\i; G1 ^Tecticornia perangusta, Tecticornia moniliformis, Maireana oppositifolia, Disphyma crassifolium, Isotoma scapigera\Tecticornia\ ^samphire shrub, Chenopod shrub, shrub, forb, tussock grass\1\i

Condition: Very Good –some disturbance – inundation of edges ~18 months, some weed *Mesembryanthemum nodiflorum, *Parapholis incurva, *Senecio vulgaris, Some dead samphire shrubs, healthy samphire seedlings at edges of ridge

Weed	Species	Growth Form Code	Height Code
	<i>Atriplex spongiosa</i>	C	1
	<i>Austrostipa juncifolia</i>	G	2
	<i>Carpobrotus modestus</i>	F	1
	<i>Disphyma crassifolium</i>	S	1
	<i>Fitzwillia</i> aff. <i>axilliflora</i>	F	1
	<i>Frankenia</i> sp. southern gypsum P3	S	1
	<i>Isotoma scapigera</i>	F	1
	<i>Lawrenca squamata</i>	S	1
	<i>Maireana oppositifolia</i>	C	1
*	<i>Mesembryanthemum nodiflorum</i>	F	1
*	<i>Parapholis incurva</i>	G	1
	<i>Salicornia blackiana</i>	U	1
*	<i>Senecio vulgaris</i>	F	1
	<i>Tecticornia moniliformis</i>	U	1
	<i>Tecticornia pergranulata</i>	U	1
	<i>Trichanthodium skirrophorum</i>	F	1
	<i>Triglochin nana</i>	F	1

Samphire Shrubland

Te

Releve 9: 10x10m

Date Surveyed: 22-10-18

Location/WP: 051

GPS (GDA 94): 33° 15' 49.78" 119° 2' 53.62"

Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Low Heath D

NVIS: G1+ ^*Tecticornia loriae**Tecticornia*\^samphire shrub\1\c

Condition: Excellent

Species	Growth Form Code	Height Code
<i>Tecticornia loriae</i>	U	1



Releve 9

Samphire Shrubland

Te

Releve 10: 10x10m

Date Surveyed: 22-10-18

Location/WP: 056

GPS (GDA 94): 33° 15' 54.7" 119° 13' 03.7"

Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Low Heath D

NVIS: G1+ ^*Tecticornia loriae*\Tecticornia\^samphire shrub\1\c

Condition: Very Good. Dead shrubs present from inundation. Area regenerating

Species	Growth Form Code	Height Code
<i>Tecticornia loriae</i>	U	1



Releve 10

Samphire Shrubland

Te

Releve 11: 10x10m

Date Surveyed: 22-10-18

Location/WP: 057

GPS (GDA 94): 33° 16' 03.6" 119° 03' 09.3"

Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Dwarf Scrub D

NVIS: G1+ ^*Tecticornia halocnemoides**Tecticornia*\^samphire shrub\1\i

Condition: Very Good. Dead shrubs present from inundation. Area regenerating

Species	Growth Form Code	Height Code
<i>Tecticornia halocnemoides</i>	U	1



Releve 11

Samphire Shrubland

Te

Releve 20: 10x10m

Date Surveyed: 25-10-18

Location/WP: 144

GPS (GDA 94): 33° 15' 49.37" 119° 3' 54.98"

Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Dwarf Scrub D

NVIS: G1+ ^*Tecticornia halocnemoides**Tecticornia*\^samphire shrub\1\i

Condition: Very Good. Dead shrubs present from inundation. Area regenerating

Species	Growth Form Code	Height Code
<i>Tecticornia halocnemoides</i>	U	1



Releve 20

Samphire Shrubland

Te

Releve 23: 10x10m

Date Surveyed: 25-10-18

Location/WP: 161

GPS (GDA 94): 33° 16' 20.9" 119° 03' 51.0"

Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Low Heath D

NVIS: G1+ ^*Tecticornia halocnemoides*, *Tecticornia loriae**Tecticornia*\^samphire shrub\1\c

Condition: Excellent. Some dead shrubs

Species	Growth Form Code	Height Code
<i>Tecticornia halocnemoides</i>	U	1
<i>Tecticornia loriae</i>	U	1



Releve 23

Samphire Shrubland

Te

Releve 37: 10x10m

Date Surveyed: 27-10-18

Location/WP: 266

GPS (GDA 94): 33° 17' 32.38" 119° 3' 54.54"

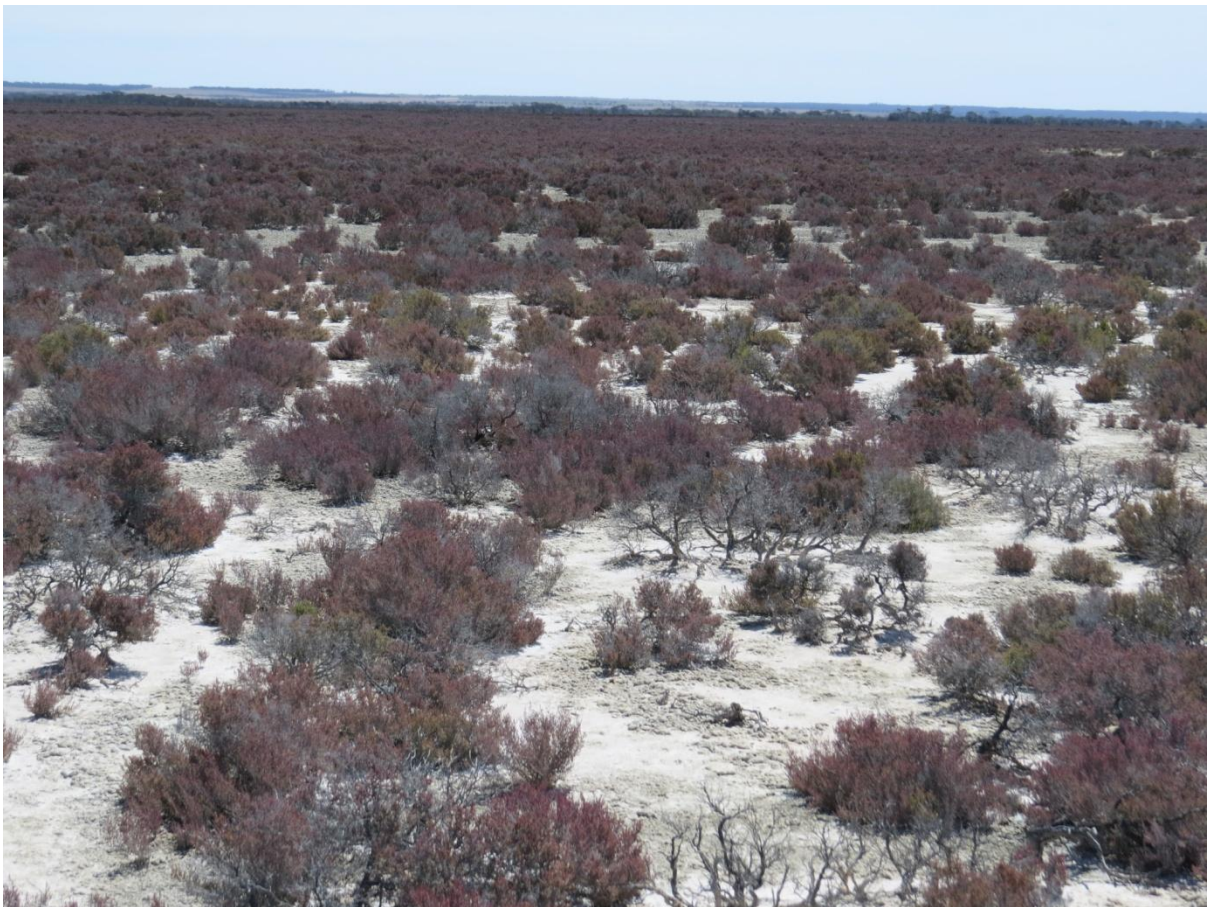
Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Low Heath D

NVIS: G1+ ^*Tecticornia loriae*, *Tecticornia halocnemoides*, *Frankenia cinerea* \
Tecticornia *^samphire shrub, shrub* \1\c

Condition: Excellent. Some dead shrubs

Species	Growth Form Code	Height Code
<i>Frankenia cinerea</i>	S	1
<i>Tecticornia halocnemoides</i>	U	1
<i>Tecticornia loriae</i>	U	1



Releve 37

Samphire Shrubland

Te

Releve 39 : 10x10m

Date Surveyed: 27-10-18

Location/WP: 272

GPS (GDA 94): 33° 17' 10.35" 119° 3' 23.57"

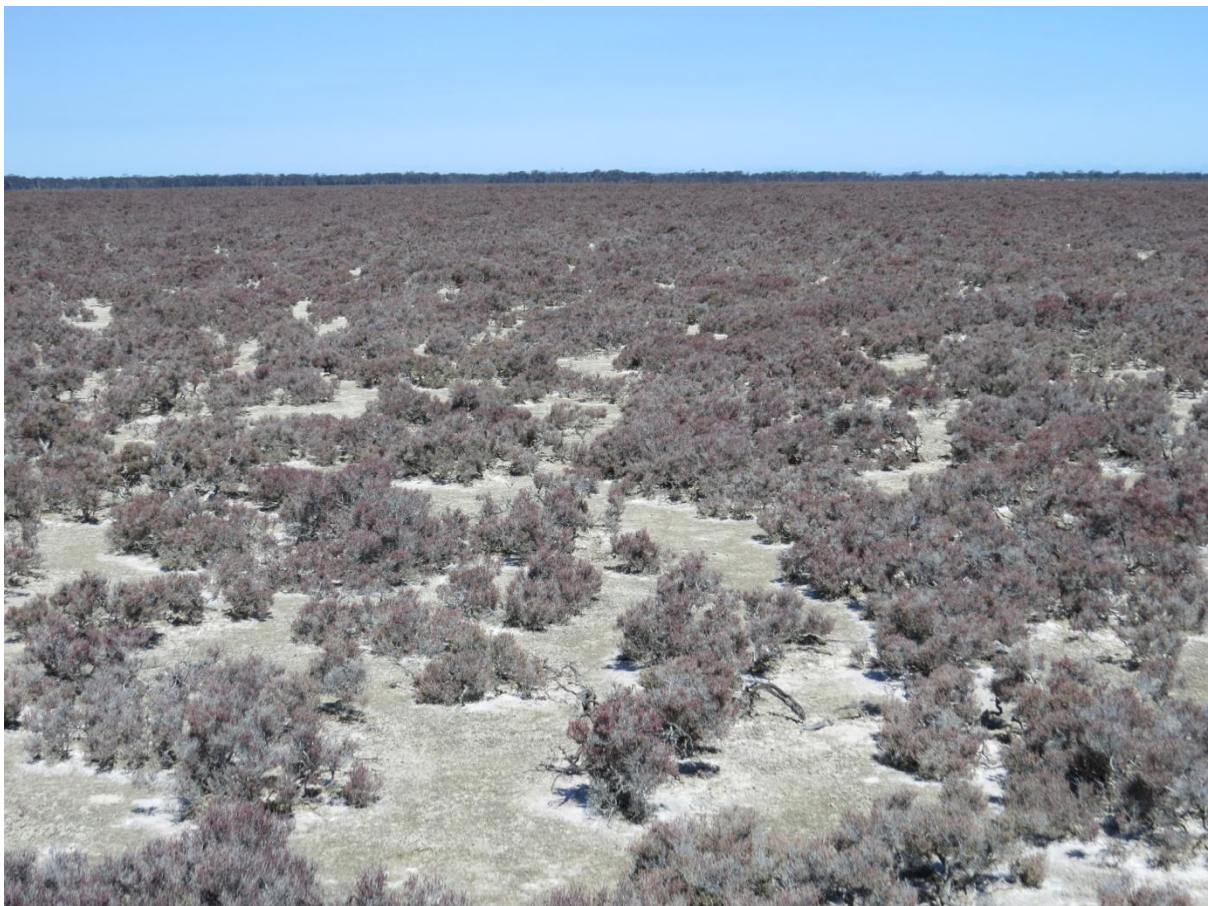
Soils and topography: Flat, gypsum over clay, lake bed, subject to inundation

Diagnosis (Muir 1977): Low Heath D

NVIS: G1+ ^*Tecticornia loriae*\Tecticornia\^samphire shrub\1\c

Condition: Excellent. Some dead shrubs

Species	Growth Form Code	Height Code
<i>Tecticornia loriae</i>	U	1



Releve 39

Appendix 3

Site descriptions Mattiske (1995)

G238 Lake Lockhart

VCL - Dune on east side of lake MSG 25/01/95 33.15.41 119.03.30
Top of dune Light grey gypsum Heavy grazing by rabbits in past

Site No. G238 Location: Lake Lockhart

Atriplex paludosa
Danthonia caespitosa
Exocarpos aphyllus
Frankenia tetrapetala
Melaleuca hamulosa
Pittosporum phylliraeoides
Rhagodia crassifolia
Stipa elegantissima

Hakea preissii
Lomandra effusa
Scaevola spinescens
Waitzia suaveolens var. *suaveolens*



Photograph 75: Site No. G238. Location: Lake Lockhart

G239 Lake Lockhart

VCL - approx 200m north-north-east of G238 MSG Date 25/01/95

33.15.36 119.03.35 Western mid-slope of dune

0cm - mottled white/brown sandy gypsum; 45cm - crystalline gypsum flakes present; 50cm - band of "seed" gypsum and crystalline flakes

Site No. G239 Location: Lake Lockhart

Danthonia caespitosa
Frankenia tetrapetala
Maireana oppositifolia
Melaleuca thyoides
Pittosporum phylliraeoides
Rhagodia crassifolia
Sclerostegia moniliformis
Stipa elegantissima
Stipa trichophylla
Threlkeldia diffusa
Trisetaria cristata

Asteridea chaetopoda
Atriplex stipitata
Centaurea melitensis
Gnephosis tenuissima
Podolepis capillaris
Siloxerus pygmaeus



Photograph 76: Site No. G239. Location: Lake Lockhart

G240 Lake Lockhart

VCL - Low dune, east edge of small lake, north-east tip of Lake Lockhart

MSG Date 25/01/95 33.14.26 119.03.39

Top of dune 0cm - light brown gypsum; 30cm - pale nodules present

Site No. G240 Location: Lake Lockhart

Disphyma crassifolium

Halosarcia syncarpa

Maireana oppositifolia

Asteridea chaetopoda

Atriplex paludosa

Erymophyllum glossanthus

Haegiela tatei



Photograph 77: Site No. G240. Location: Lake Lockhart

Mattiske Site G226

Location: VCL east of Reserve 25113

Location Notes: Two adjacent small lakes, 2.4km west of intersection of Magenta Rd and Reserve Rd.

Recorder: Mal Graham

Date: 2/12/94

Topography: Top of eastern lake edge dune.

Soils: Grey sandy clay

Soil analysis: 5% gypsum

GPS 33° 34' 47"

119° 13' 41"

Comments: Not grazed by livestock despite appearance in photo. Site is apparently natural and undisturbed.

Site	Locn. (within 5m of central point)	Species	Height cm	% cover
G226	5	?Chenopodiaceae sp.	1	5
G226	5	<i>Danthonia caespitosa</i> = <i>Austrodanthonia setacea</i> group	1	45
G226	5	<i>Lawrenzia squamata</i>	20	2
G226	5	<i>Maireana marginata</i>	3	0.01
G226	5	<i>Podolepis rugosa</i> = <i>Podolepis rugata</i>	10	0.01
G226	5	<i>Senecio lautus</i> ssp. <i>maritimus</i> = <i>Senecio pinnatifolius</i> var. <i>maritimus</i>	4	0.01
G226	+5	<i>Asteridea chaetopoda</i>	3	0.01
G226	+5	<i>Atriplex paludosa</i> subsp. ? <i>cordata</i>	20	0.01
G226	+5	<i>Halosarcia syncarpa</i> = <i>Tecticornia syncarpa</i>	30	0.01
G226	+5	<i>Halosarcia</i> aff. <i>syncarpa</i> = <i>Tecticornia syncarpa</i>	30	0.1
G226	+5	<i>Scaevola spinescens</i>	40	0.01
G226	+5	<i>Stipa juncifolia</i> = <i>Austrostipa juncifolia</i>	50	0.01



Photograph 63: Site No. G226. Location: VCL East of Reserve 25113



Photograph 62: Site No. G225. Location: Lake Cobham

Appendix 4

Quadrat Descriptions Rick (2011)

Quadrat GYP021 **Date Surveyed:** 30-10-2009

Location: Lake Lockhart **Mattiske site G240 - gypsum 90%**

Topography: Top of low dune

Soils: 5-15cm 20% gypsum 50cm 27% gypsum

Quadrat orientation: SW

Photograph reference and orientation: IMG_1746 S IMG_1747 SSW

GPS (WGS 84) NW corner 33° 14' 22.4" 119° 03' 45.1"

Diagnosis (Muir 1977): Low Heath D

Condition: Excellent. Some weed adjacent and dead plants – dry year

Life Form	Species	Height cm	% canopy cover
Shrub	<i>Tecticornia syncarpa</i>	30-40	30
Shrub	<i>Maireana oppositifolia</i>	45	20
Shrub	<i>Disphyma crassifolium</i>	5	<1
Herb	<i>Calandrinia</i> ?sp. Meckering (F. Obbens 42/02)	10	<1
	Adjacent to quadrat		
Shrub	<i>Atriplex paludosa</i>		



Photograph 41 **GYP021**



Photograph 42 **GYP021**

Quadrat GYP022 **Date Surveyed:** 31-10-2009

Location : Lake Lockhart. **Mattiske site G238**

Topography and Elevation: Large dune – eastern side. 294.5 +/- 5.0 m

Soils: 5-15cm 90% gypsum 50cm 90% gypsum - from Mattiske (1995)

Quadrat orientation: S

Photograph reference and orientation: IMG_1749 SE IMG_1751 S

GPS (WGS 84) NW corner 33° 15' 36.8" 119° 03' 35.1"

Diagnosis (Muir 1977): Scrub over Open Low Scrub A over Dwarf Scrub D

Condition: Excellent. Rabbits, foxes and some minor weeds.

Life Form	Species	Height cm	% canopy cover
Shrub	<i>Melaleuca hamulosa</i>	200-400	2
Shrub	<i>Exocarpos aphyllus</i>	200	2
Shrub	<i>Pittosporum angustifolium</i>	150	<1
Shrub	<i>Rhagodia crassifolia</i>	100	<1
Shrub	<i>Tecticornia pterygosperma</i> subsp. <i>pterygosperma</i>	50	20
Shrub	<i>Frankenia tetrapetala</i>	10	1
Shrub	<i>Atriplex paludosa</i>	30	<1
Shrub	<i>Maireana oppositifolia</i>	30	<1
Grass	<i>Austrostipa drummondii</i>	15	<1
Grass	<i>Austrostipa elegantissima</i>	100	1
Grass	<i>Austrostipa pycnostachya</i>	20	<1
Herb	<i>Brachyscome ciliaris</i>	8	<1
Herb	<i>Crassula exserta</i>	5	<1
Herb	<i>Isotoma scapigera</i>	5	<1
	Adjacent to quadrat		
Shrub	<i>Lycium australe</i>	150	
Shrub	<i>Billardiera lehmanniana</i>		
Shrub	<i>Frankenia</i> sp. southern gypsum (M.N. Lyons 2864)	10	
Herb	<i>Lomandra effusa</i>	25	
Shrub	<i>Enchylaena tomentosa</i>	15	
Shrub	<i>Threlkeldia diffusa</i>	15	
Grass	* <i>Bromus rubens</i>	5	



Photograph 43 **GYP022**



Photograph 44 **GYP022**

Quadrat GYP023 **Date Surveyed:** 31-10-2009

Location : Lake Lockhart.

Topography and Elevation: Large dune 290.3 m

Soils: 5-15 light brown loamy sand gypsum 0.5%

Quadrat orientation: S

Photograph reference and orientation: IMG_1749 SE IMG_1751 S

GPS (WGS 84) NW corner 33° 15' 34.5" 119° 03' 36.4"

Diagnosis (Muir 1977): Open Scrub over Open Low Scrub A over Low heath C over Open Dwarf Scrub D

Condition: Excellent. Rabbits, foxes and some minor weeds. Kangaroos some dead plants

Life Form	Species	Height cm	% canopy cover
Shrub	<i>Pittosporum angustifolium</i>	150-300	15
Shrub	<i>Hakea strumosa</i>	80	30
Shrub	<i>Atriplex paludosa</i>	50-60	1
Shrub	<i>Rhagodia crassifolia</i>	60	<1
Shrub	<i>Enchylaena tomentosa</i>	15	<1
Shrub	<i>Frankenia tetrapetala</i>	10	1
Shrub	<i>Comesperma integerrimum</i>	vine	<1
Shrub	<i>Maireana erioclada</i>	20	<1
Grass	<i>Austrodanthonia setacea</i>	30	
Grass	<i>Austrostipa elegantissima</i>	50	<1
Grass	<i>Austrostipa trichophylla</i>	30	<1
Herb	<i>Waitzia suaveolens</i> var. <i>suaveolens</i>	20	<1
Herb	<i>Lomandra effusa</i>	80	15
Herb	<i>Lepidium rotundum</i>	15	<1
Herb	* <i>Trifolium</i> sp		
	Adjacent to quadrat		
Shrub	<i>Lycium australe</i>	150	
Shrub	<i>Santalum acuminatum</i>	200	



GYP023



GYP023

Quadrat GYP024 **Date Surveyed:** 31-10-2009

Location : Lake Lockhart **Mattiske site G239**

Topography and Elevation: End of large dune. 291.3 +/- 5.3

Soils: From Mattiske (1995) 5-15cm 60% gypsum 50cm 60% gypsum

Quadrat orientation: SSW

Photograph reference and orientation: IMG_1768 S IMG_1769 SSW

GPS (WGS 84) NW corner 33° 15' 31.6" 119° 03' 37.9"

Diagnosis (Muir 1977): Scrub over Dwarf Scrub D (scattered shrubs to 1.5 m, scattered grasses)

Condition: Excellent. Rabbits, foxes, some weed adjacent.

Life Form	Species	Height cm	% canopy cover
Shrub	<i>Melaleuca thyoides</i>	280	2
Shrub	<i>Tecticornia moniliformis</i>	50	30
Shrub	<i>Tecticornia syncarpa</i>	40	
Shrub	<i>Maireana oppositifolia</i>	30	2
Shrub	<i>Frankenia cinerea</i>	10	<1
Shrub	<i>Enchylaena tomentosa</i>	30	<1
Shrub	<i>Pittosporum angustifolium</i>	150	<1
Shrub	<i>Threlkeldia diffusa</i>	10	<1
Shrub	<i>Lawrencina squamata</i>	30	<1
Grass	<i>Austrostipa trichophylla</i>	20	<1
Grass	<i>Austrostipa elegantissima</i>	100	<1
Grass	* <i>Bromus rubens</i>	10	<1
	Adjacent to quadrat		
Shrub	<i>Carpobrotus modestus</i>	10	
Shrub	<i>Rhagodia crassifolia</i>	60	
Shrub	<i>Atriplex paludosa</i>	50	
Herb	<i>Lomandra effusa</i>	20	
Herb	<i>Calandrinia</i> ?sp. Meckering (F. Obbens 42/02)	15	



Photograph 45 **GYP024**



Photograph 46 **GYP024**

Quadrat GYP025 **Date Surveyed:** 31-10-2009

Location: Lake Lockhart.

Topography and Elevation: Slight rise on lake bed. Subject to inundation.
289.1 +/- 5.1

Soils: 5-15cm 78% gypsum

Quadrat orientation:

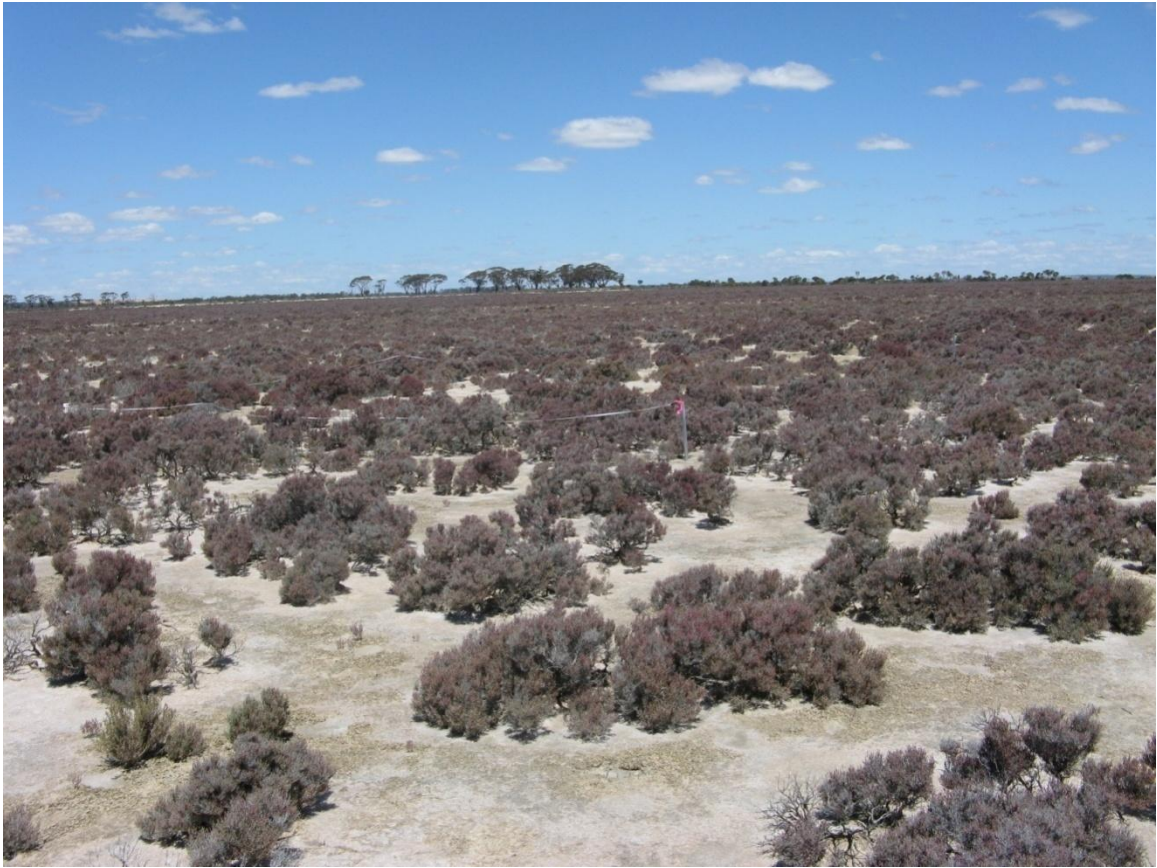
Photograph reference and orientation: IMG_1776 IMG_1777

GPS (WGS 84) NW corner 33° 15' 05.9" 119° 03' 37.0"

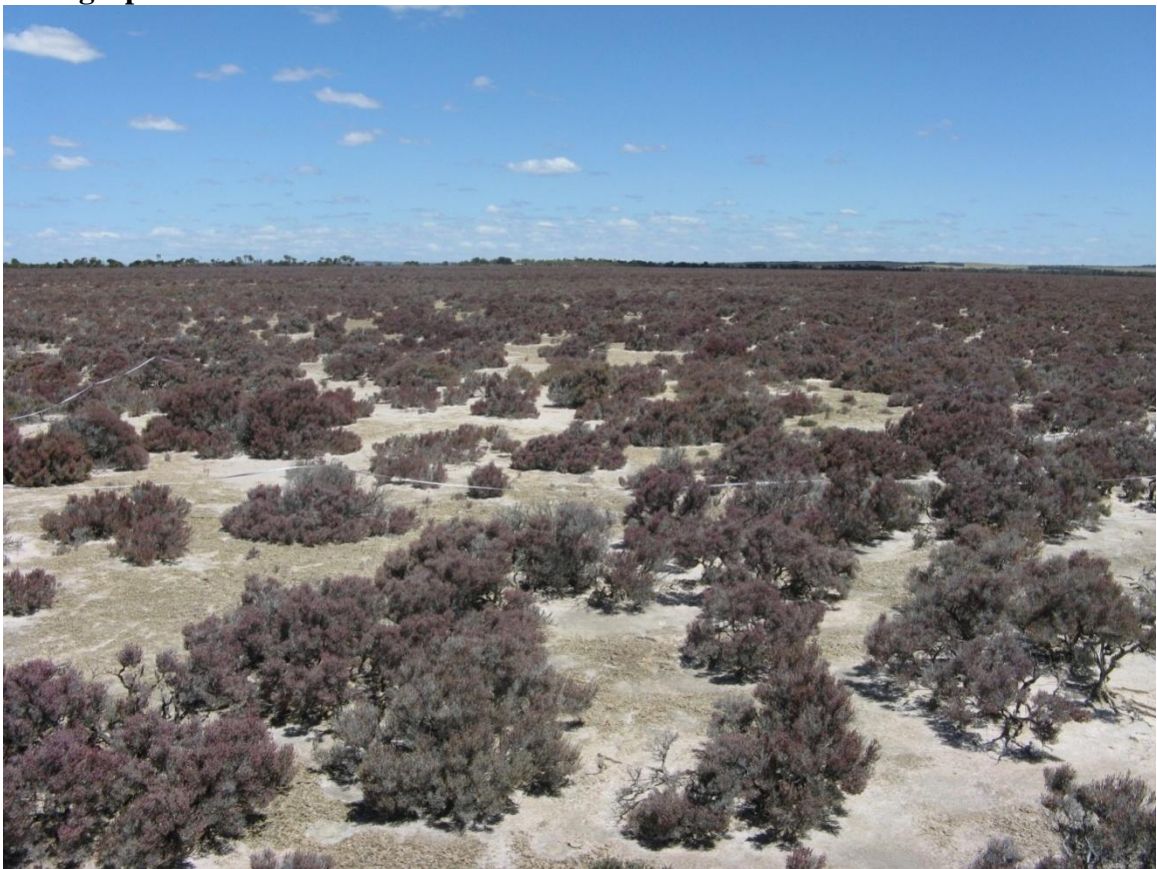
Diagnosis (Muir 1977): Low Heath D

Condition: Pristine

Life Form	Species	Height cm	% canopy cover
Shrub	<i>Tecticornia halocnemoides</i> subsp. <i>caudata</i>	50	50
Shrub	<i>Tecticornia loriae</i>	50	
Shrub	<i>Frankenia</i> sp. southern gypsum (M.N. Lyons 2864)	10	1



Photograph 47 **GYP025**



Appendix 5

Plant Species List

Species List for the proposed mining lease M 70/1382 and access area – Lake Lockhart

Family	Weed	Species Name	Cons Code
Aizoaceae		Carpobrotus modestus	
Aizoaceae		Disphyma crassifolium	
Aizoaceae		Gunniiopsis septifraga	
Aizoaceae	*	Mesembryanthemum nodiflorum	
Apocynaceae		Alyxia buxifolia	
Asparagaceae		Lomandra effusa	
Asparagaceae		Lomandra micrantha subsp. teretifolia	
Asteraceae		Angianthus halophilus	3
Asteraceae		Angianthus pygmaeus	
Asteraceae	*	Arctotheca calendula	
Asteraceae		Argyrolottis turbinata	
Asteraceae		Asteridea athrioides	
Asteraceae		Asteridea chaetopoda	
Asteraceae		Brachyscome ciliaris	
Asteraceae		Brachyscome pusilla	
Asteraceae		Cotula cotuloides	
Asteraceae		Erymophyllum tenellum	
Asteraceae		Fitzwillia aff. axilliflora	
Asteraceae		Fitzwillia axilliflora	2
Asteraceae		Gnephosis acicularis	
Asteraceae		Gnephosis drummondii	
Asteraceae		Gnephosis tridens	
Asteraceae		Haegiela tatei	4
Asteraceae		Hyalosperma demissum	
Asteraceae	*	Hypochaeris glabra	
Asteraceae		Kippistia suaedifolia	
Asteraceae		Olearia sp. Eremicola (Diels & Pritzel s.n. PERTH 00449628)	
Asteraceae		Podolepis capillaris	
Asteraceae		Pogonolepis stricta	
Asteraceae		Pseudognaphalium luteoalbum	
Asteraceae		Senecio glossanthus	
Asteraceae	*	Senecio vulgaris	
Asteraceae		Siloxerus pygmaeus	
Asteraceae	*	Sonchus oleraceus	
Asteraceae		Trichanthodium skirrophorum	
Asteraceae	*	Ursinia anthemoides	
Asteraceae		Vittadinia gracilis	
Asteraceae		Waitzia acuminata	

Asteraceae		Waitzia suaveolens	
Brassicaceae		Lepidium phlebopetalum	
Brassicaceae		Stenopetalum sphaerocarpum	
Campanulaceae		Isotoma scapigera	
Caryophyllaceae	*	Spergularia rubra	
Celastraceae		Stackhousia muricata	
Chenopodiaceae		Atriplex paludosa	
Chenopodiaceae		Atriplex spongiosa	
Chenopodiaceae		Atriplex vesicaria	
Chenopodiaceae		Didymanthus roei	
Chenopodiaceae		Enchylaena tomentosa	
Chenopodiaceae		Maireana brevifolia	
Chenopodiaceae		Maireana erioclada	
Chenopodiaceae		Maireana oppositifolia	
Chenopodiaceae		Rhagodia crassifolia	
Chenopodiaceae		Rhagodia drummondii	
Chenopodiaceae		Salicornia blackiana	
Chenopodiaceae		Tecticornia halocnemoides	
Chenopodiaceae		Tecticornia lorae	
Chenopodiaceae		Tecticornia moniliformis	
Chenopodiaceae		Tecticornia pergranulata	
Chenopodiaceae		Tecticornia pterygosperma subsp. pterygosperma	
Chenopodiaceae		Tecticornia syncarpa	
Chenopodiaceae		Threlkeldia diffusa	
Convolvulaceae		Wilsonia humilis	
Crassulaceae		Crassula exserta	
Cyperaceae		Gahnia trifida	
Cyperaceae		Schoenus calcatus	
Dilleniaceae		Hibbertia gracilipes	
Ericaceae		Conostephium roei	
Ericaceae		Leucopogon sp. Kau Rock (M.A. Burgman 1126)	
Fabaceae		Acacia chrysellia	
Fabaceae		Acacia hemiteles	
Fabaceae		Bossiaea cucullata	
Fabaceae		Mirbelia multicaulis	
Fabaceae	*	Trifolium arvense	
Frankeniaceae		Frankenia cinerea	
Frankeniaceae		Frankenia drummondii	3
Frankeniaceae		Frankenia sp. southern gypsum (M.N. Lyons 2864)	3
Frankeniaceae		Frankenia tetrapetala	

Goodeniaceae		Dampiera orchardii	2
Goodeniaceae		Lechenaultia heteromera	
Goodeniaceae		Scaevola spinescens	
Hemerocallidaceae		Dianella brevicaulis	
Hemerocallidaceae		Dianella revoluta	
Juncaginaceae		Triglochin nana	
Malvaceae		Lawrenzia diffusa	
Malvaceae		Lawrenzia squamata	
Montiaceae		Calandrinia granulifera	
Montiaceae		Calandrinia sp. Needilup (K.R. Newbey 4892)	
Myrtaceae		Chamelaucium ciliatum	
Myrtaceae		Cyathostemon blackettii	
Myrtaceae		Darwinia sp. Karonie (K. Newbey 8503)	
Myrtaceae		Eucalyptus kondininensis	
Myrtaceae		Eucalyptus perangusta	
Myrtaceae		Eucalyptus salicola	
Myrtaceae		Eucalyptus sargentii subsp. sargentii	
Myrtaceae		Eucalyptus sargentii subsp. onesis	3
Myrtaceae		Eucalyptus sporadica	
Myrtaceae		Leptospermum erubescens	
Myrtaceae		Melaleuca acuminata	
Myrtaceae		Melaleuca brophyi	
Myrtaceae		Melaleuca carrii	
Myrtaceae		Melaleuca halmaturorum	
Myrtaceae		Melaleuca hamulosa	
Myrtaceae		Melaleuca lateriflora	
Myrtaceae		Melaleuca thyoides	
Pittosporaceae		Billardiera lehmanniana	
Poaceae		Austrostipa drummondii	
Poaceae		Austrostipa elegantissima	
Poaceae		Austrostipa hemipogon	
Poaceae		Austrostipa juncifolia	
Poaceae		Austrostipa pycnostachya	
Poaceae		Austrostipa scabra	
Poaceae		Austrostipa trichophylla	
Poaceae		Austrostipa vickeryana	
Poaceae	*	Avena fatua	
Poaceae	*	Bromus rubens	
Poaceae		Eragrostis dielsii	
Poaceae	*	Hordeum leporinum	
Poaceae	*	Parapholis incurva	
Poaceae	*	Pentameris airoides	

Poaceae		Rytidosperma setaceum	
Polygalaceae		Comesperma integerrimum	
Polygonaceae		Muehlenbeckia adpressa	
Proteaceae		Adenanthos glabrescens	
Proteaceae		Hakea preissii	
Proteaceae		Hakea strumosa	
Restionaceae		Hypolaena humilis	
Rutaceae		Boronia crenulata	
Santalaceae		Exocarpos aphyllus	
Santalaceae		Santalum acuminatum	
Sapindaceae		Dodonaea viscosa	
Scrophulariaceae		Eremophila decipiens	
Scrophulariaceae		Eremophila drummondii	
Scrophulariaceae		Eremophila serpens	4
Solanaceae		Lycium australe	
Solanaceae		Solanum hoplopetalum	
Thymelaeaceae		Pimelea cracens	
Thymelaeaceae		Pimelea halophila	2
Zygophyllaceae		Zygophyllum aurantiacum	
Zygophyllaceae		Zygophyllum glaucum	
Zygophyllaceae		Zygophyllum halophilum	

Appendix 6

**Department of Biodiversity, Conservation and
Attractions**

CONSERVATION CODES
For the Western Australian Flora and Fauna



CONSERVATION CODES

For Western Australian Flora and Fauna

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

T Threatened species

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

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

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 as detailed below.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.



CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 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 or fauna.

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 species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Appendix 7

**Threatened and Priority Flora recorded on gypsum in the
Lake Magenta, Lake King and Lake Grace salt lake chains**

Threatened and Priority Flora recorded on gypsum in the Lake Magenta, Lake King and Lake Grace salt lake chains

<i>Taxon</i>	Cons Code	Site Description	Geographical Distribution	Suggested Gypsophile (g) or gypsum tolerant (t)
<i>Angianthus globuliformis</i>	P1	Gypsiferous dune 54% gypsum	South Lake Altham	g
<i>Angianthus halophilus</i>	P3	Sandy ridge/island in lake - gypsum	Lake King, Lake Kathleen, Lake Grace, Lake Cairlocup	t
<i>Austrostipa geoffreyi</i>	P1	Lake margins and dunes gypsum , sand, gypsum dune	Lake Grace, Chinocup, Lake King, Lake Tay	g
<i>Eucalyptus exigua</i>	P3	Embankment lake edge clay, gypsum	East Lake King north to COO2 sub region NW to Cowcowing	t
<i>Eucalyptus quaerenda</i>	P3	gypsum, sandy soils over clay, near salt lake	Lake Altham area to Lake King and upper Phillips River	t
<i>Fitzwillia axilliflora</i>	P2	saline lake, edge salt lake, saline basin, gypsum	Lake Bryde north to Morawa area Lake Kathleen	t
<i>Frankenia drummondii</i>	P3	dune adjacent saline pan, gypsum dune, sandy clay, sand dune, edge salt pan	Kondinin to Salmon Gums south to Gnowangerup Shire	t
<i>Frankenia</i> sp. southern gypsum (M.N. Lyons 2864)	P3	Low rise gypsum, gypsum, saline grey clay	South Pingaring, Quarry Lake area, Lake Magenta, Lake King, Lake Cobham	g
<i>Goodenia integerrima</i>	T	gypsum, clay sand, margin salt lake, sandy island in salt lake	Lake King	g
<i>Goodenia salina</i>	P2	gypsiferous dune on shore of saline pan, previous gypsum mine, islet in salt lake	Lake King, Lake Altham, Lake Cairlocup, Lake Cobham	g

<i>Haegiela tatei</i>	P4	gypsum dune, sand dune, Greens mining lease, gypsum	Mainly MAL1 and MAL2 sub regions. 2 sites in COO2 and 1 site east of Geraldton	t
<i>Hydrocotyle</i> sp. Hexaptera (T Erickson TEE 173)	P1	sandy island, sand fringing salt lake, low flat subject to inundation, gypsum	Lake King,	g
<i>Microseris walteri</i>	P3	Kopi dune, lunette adjacent to saline pan, sand, gypsum	Mainly MAL1 and MAL2 sub regions	t
<i>Millotia steetziana</i>	P2	saline flat, sandy soils over clay, rise adjacent to salt lake, 20% gypsum	Kondinin, Chinocup, Lake King, Lake Magenta	t
<i>Pimelea halophila</i>	P2	sandy island in salt lake, sand over clay, adjacent to gypsum mine, edge of salt lake, sandy soil with gypsum	Lake King, Lake Morris, Ravensthorpe shire, Esperance shire	t
<i>Roycea pycnophylloides</i>	T	samphire/gypsum dune, edge of salt lake, low rise, sandy salt lands, clay pan, adjacent to salt lake	Cunderdin to Lake King and south to Kent shire	t
<i>Sarcocornia globosa</i>	P3	Saline flat adjacent to salt lake, sand , sandy clay, gypsum, southern shore	Chinocup and Lake Fox to East Geraldton, Lake Magenta NR	t
<i>Stenantha pungens</i> (prev. <i>Conostephium pungens</i>)	P2	?gypsum and sandy soils	Chinocup NR	t

Appendix 8

**Threatened and Priority Flora recorded for salt lakes and surrounds
but not on gypsum soils in the Lake Magenta, Lake King and Lake
Grace salt lake chains.**

Threatened and Priority Flora recorded for salt lakes and surrounds but not on gypsum soils in the Lake Magenta, Lake King and Lake Grace salt lake chains.

Taxon	Cons Code	Site description	Geographical Distribution	Comments
<i>Acacia lanuginophylla</i>	T	Sand, clayey sand, flats, along drainage lines	Lake Grace and Yilgarn Shires	Recorded from valley floor
<i>Dampiera orchardii</i>	P2	Upper beach slope of salt lake.	Dundas, Kent, lake Grace and Ravensthorpe shires	Recorded on salt lake
<i>Drosera salina</i>	P2	Drainage line sand, adjacent salt lake sandy soils over clay, sand over clay silt	Esperance, Kent and Lake Grace shires	Associated with salt lake margins
<i>Eremophila biserrata</i>	P4	Alluvial flats, salt flats and lakes	Esperance, Kondinin and Lake Grace Shires	Associated with salt lakes
<i>Eremophila serpens</i>	P4	sandy soils, sandy loam, dunes, margin of salt lakes	Hyden, Newdegate, Esperance	Associated with salt lakes
<i>Eremophila subteretifolia</i>	T	sand or sandy loam, margin of salt lakes	Lake king area and NW Ravensthorpe	Associated with salt lakes
<i>Eremophila veneta</i>	P4	Clay to loam, sand, plain flats, slopes	Shires of Corrigin, Gnowangerup, Kent, Kondinin, Kulin, Lake Grace	Recorded from valley floor
<i>Eremophila verticillata</i>	T	Clay loam, loam over limestone, dolomite	Lake Grace Shire	Near salt lake
<i>Eucalyptus mimica</i> subsp. <i>continens</i>	P1	Sand, sandy clay, flats, moist areas	Kent and Lake Grace Shires	Valley floor
<i>Eucalyptus mimica</i> subsp. <i>mimica</i>	P3	Sandy clay, clayey loam, flats, near salt lakes	Kent, Yilgarn and Lake Grace Shires	Near salt lakes
<i>Hydrocotyle muriculata</i>	P1	raised margin of salt lake, clay loam	Broomhill-Tambellup, Cranbrook, Kent, Kulin and Lake Grace (Lake Burkett) shires	SE edge of salt lake,

<i>Lepidobolus spiralis</i>	P2	sand fringing salt lake	Lake King, Frank Hann NP	edge of salt lakes
<i>Olearia laciniifolia</i>	P2	White sand	Dumbleyung, Esperance, Kondinin, Lake Grace shires	Around playa lakes
<i>Melaleuca sculponeata</i>	P3	White sand, clay-loam, slight slope to lake,	Jerramungup, Kent, Lake Grace, Ravensthorpe shires	Recorded from salt lakes
<i>Pauridia salina</i> (previously <i>Hypoxis salina</i>)	P1	saline drainage line, sandy soils over clay	Chinocup Lake King	Associated with salt lake margins
<i>Pultenaea daena</i>	P3	Adjacent to salt lake. Loam soils over dolomite and sandy soils.	Esperance, Jerramungup, Kondinin, Lake Grace, Ravensthorpe shires	Recorded from salt lakes
<i>Seorsus clavifolius</i>	P2	Sandy soils adjacent to salt lakes	Lake Grace and Perenjori Shires	Near salt lakes
<i>Stylidium pulviniforme</i>	P3	small dune west shore, sand, clay	Lake Cobham to Salmon Gums and into Dundas and Yilgarn shires	Salt lakes, saline sand
<i>Tecticornia uniflora</i>	P4	Bed of salt lake	Albany to Kent shire	Salt lakes
<i>Tribonanthes minor</i>	P3	slight rise above salt lake, shallow sand at lake edge, sand over clay, flat terrain	Lake king, Chinocup	Salt Lake edge

Appendix 9

Priority Flora GPS Coordinated

GPS coordinates for Priority Flora recorded in proposed mining lease M 70/1382 and the proposed access area.

Taxa	GPS	Coordinates Latitude Degrees, minutes, seconds	Coordinates Longitude Degrees, minutes, seconds
<i>Angianthus halophilus</i>	201	33,14,57.217	119,3,27.630
<i>Eremophila serpens</i>	243	33,16,16.993	119,3,34.805
<i>Fitzwillia axilliflora</i>	107	33,14,27.956	119,3,26.464
<i>Fitzwillia</i> aff. <i>axilliflora</i>	26	33,16,32.426	119,2,18.668
<i>Fitzwillia</i> aff. <i>axilliflora</i>	27	33,16,31.926	119,2,19.914
<i>Fitzwillia</i> aff. <i>axilliflora</i>	28	33,16,30.234	119,2,22.934
<i>Fitzwillia</i> aff. <i>axilliflora</i>	29	33,16,28.672	119,2,25.307
<i>Fitzwillia</i> aff. <i>axilliflora</i>	30	33,16,26.900	119,2,27.578
<i>Fitzwillia</i> aff. <i>axilliflora</i>	33	33,16,19.225	119,2,34.649
<i>Fitzwillia</i> aff. <i>axilliflora</i>	36	33,16,16.975	119,2,35.905
<i>Fitzwillia</i> aff. <i>axilliflora</i>	38	33,16,10.348	119,2,38.926
<i>Fitzwillia</i> aff. <i>axilliflora</i>	42	33,16, 4.012	119,2,39.113
<i>Fitzwillia</i> aff. <i>axilliflora</i>	43	33,16, 2.438	119,2,40.171
<i>Fitzwillia</i> aff. <i>axilliflora</i>	191	33,15,26.075	119,3, 2.675
<i>Fitzwillia</i> aff. <i>axilliflora</i>	192	33,15,25.178	119,3, 2.412
<i>Frankenia drummondii</i>	8	33,16,30.263	119,1,39.328
<i>Frankenia drummondii</i>	10	33,16,31.897	119,1,42.042
<i>Frankenia drummondii</i>	11	33,16,32.495	119,1,43.799
<i>Frankenia drummondii</i>	14	33,16,33.467	119,1,47.046
<i>Frankenia drummondii</i>	19	33,16,34.579	119,1,58.141
<i>Frankenia drummondii</i>	20	33,16,34.536	119,2, 1.262
<i>Frankenia drummondii</i>	212	33,16,39.778	119,1,39.418
<i>Frankenia drummondii</i>	216	33,16,39.598	119,1,48.835
<i>Frankenia drummondii</i>	219	33,16,40.793	119,1,57.025
<i>Frankenia drummondii</i>	221	33,16,40.627	119,2, 4.459
<i>Frankenia drummondii</i>	222	33,16,39.428	119,2, 7.706
<i>Goodenia orchardii</i>	103	33,16,39.817	119,1,24.424
<i>Goodenia orchardii</i>	104	33,16,38.608	119,1,24.456
<i>Goodenia orchardii</i>	206	33,16,39.119	119,1,24.506
<i>Goodenia orchardii</i>	208	33,16,38.752	119,1,28.315
<i>Pimelea halophila</i>	163	33,16,14.239	119,3,53.323
<i>Pimelea halophila</i>	255	33,16,47.255	119,3,50.036