

AUGUST 2017



*Providing sustainable environmental strategies,
management and monitoring solutions
to industry and government.*



**TAWANA RESOURCES
BALD HILL PROJECT
RECONNAISSANCE FLORA AND VEGETATION ASSESSMENT**

This page has been left blank intentionally.

Document Status						
Rev.	Author(s)	Reviewer	Date	Approved for Issue		
				Name	Distributed To	Date
0	A. Craigie	S. Grein	29/08/2017	S. Grein	J. Shepherdson	29/08/2017

ecologia Environment (2017). Reproduction of this report in whole or in part by electronic, mechanical or chemical means, including photocopying, recording or by any information storage and retrieval system, in any language, is strictly prohibited without the express approval of Tawana Resources

ecologia Environment
45 Gladstone Street
East Perth WA 6004
Phone: 08 6168 7200
Email: admin@ecologia.com.au

This page has been left blank intentionally.

INTRODUCTION

Project Background

ecologia Environment (*ecologia*) was commissioned by Tawana Resources to undertake reconnaissance flora and vegetation assessment in the vicinity of the Bald Hill project in the Coolgardie bioregion of Western Australia, approximately 85 km north-east of Norseman, on the northern edge of Lake Cowan (Figure 1).

The primary objective of the survey was to provide broad contextual information on the flora and vegetation communities present within the study area, and to verify information obtained through a desktop study, that is, the presence of suitable habitat potentially supporting Threatened and Priority listed plant species or vegetation communities (EPA 2016).

METHODOLOGY

Desktop Assessment

Prior to the field survey, a search of Threatened and Priority listed plant species occurring in the vicinity of the study area was undertaken using DBCA's NatureMap database. The search area comprised a polygon encompassing Lake Cowan, extending approximately 10 km from its edge. Habitat preferences and flowering times for these species were determined, where available, from relevant taxonomic literature, FloraBase (Western Australian Herbarium 1998–2017), or specimen data from Australia's Virtual Herbarium (AVH) (CHAH 2017).

Current lists of Threatened (DPaW 2016) and Priority (DPaW 2017) Ecological Communities were also assessed in relation to the location of the study area.

Field Methodology

A reconnaissance flora and vegetation survey was conducted at the study area (207 ha) and southern disturbance envelope (Figure 2) on 23 August 2017. The Threatened and Priority Flora species identified from database search were targeted during the survey, and the study area was assessed to determine the presence of habitat potentially supporting these species.

Eleven low-intensity survey sites were assessed to determine the broad vegetation communities present within the study area and vegetation condition. The following attributes were recorded at each site:

- Site number and GPS coordinate;
- Photograph of the vegetation;
- Dominant growth form, height, cover and up to three species for the three traditional strata (upper, mid and ground) compatible with NVIS Level V (ESCAVI 2003);
- Additional information to assist vegetation classification, including landform, soils, slope, aspect, rock type and abundance, litter, and fire history; and
- Vegetation condition according to the scale of (Keighery 1994) (Table 1) and description of disturbance.

Table 1 – Vegetation condition scale (Keigherry 1994)

Vegetation Condition	Criterion
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.

350000


400000

450000

6500000

6450000



 Study area

ecologia
ENVIRONMENT

Drawn: AC Project ID: 1714
Date: August 2017 A4



0 5 10
Kilometers
Scale: 1:500,000
MGA94 (Zone 51)

Regional location of the study area

Figure:

1

RESULTS AND DISCUSSION

Threatened and Priority Listed Plant Species

A search of the NatureMap database identified 23 Threatened and Priority listed species occurring in the vicinity of Lake Cowan (Table 2). No conservation significant species were recorded during the current survey. However, based on the proximity of previous records and the presence of suitable habitat, eight species identified from the database search are considered to potentially occur within the study area and the disturbance envelope (see Table 2).

The Threatened and Priority listed species potentially occurring within the study area and disturbance envelope are those that tend to be associated with salt-lake fringing vegetation, including saline depressions and dunes, but also those with habitat preferences that are broadly or poorly defined.

Threatened and Priority Ecological Communities

Currently there are no Threatened Ecological Communities (TECs) listed for the Coolgardie IBRA Bioregion (DPaW 2016). Sixty-three Priority Ecological Communities (PECs) are listed for the Goldfields region (DPaW 2017). The majority of these are vegetation or fauna assemblages associated with banded ironstone formations or other landforms that do not occur within the study area, and 33 are unique invertebrate assemblages occurring in groundwater calcretes. Four land systems occurring in the Goldfields are listed as PECs, i.e. the Boonderoo, Cundlegum, Emu, and Ponton land systems, however none of these occur in the vicinity of the study area.

Vegetation Types

The vegetation of the study area is comprised of salt-lake fringing vegetation associated with the north-eastern edge of Lake Cowan. Four broad vegetation communities were described and mapped within the study area as part of this survey, three of which occur within the disturbance envelope (Figure 2; Figure 3):

- 1 *Callitris preissii* scattered low trees over *Dodonaea viscosa* subsp. *angustissima*, *Eremophila* spp. (*E. scoparia*, *E. decipiens*) mid open shrubland, over *Atriplex* spp. (*A. nana*, *A. vesicaria*) and *Gunniopsis quadrifida* low open shrubland, over *Eragrostis dielsii* scattered tussock grasses. This community occurs on low dunes and covers approximately 153 ha of the study area.
- 2 *Tecticornia* spp. (*T. pergranulata*, *T. pruinosa*, *T. ?halocnemoides*, *T. undulata*, *T. sp.* Dennys Crossing (K.A. Shepherd & J. English KS 552) and *Frankenia cinerea sens. lat.* low shrubland. This community occurs in saline and clay depressions and covers approximately 31 ha of the study area.
- 3 *Callitris preissii* low open woodland over *Acacia ligulata* and *Dodonaea viscosa* subsp. *angustissima* tall open shrubland, over *Ptilotus obovatus* and *Rhagodia drummondii* low open shrubland, over *Eragrostis eriopoda* scattered tussock grasses. This community occurs in the south of the study area on taller dunes, covering approximately 5 ha of the study area, but does not occur within the disturbance envelope.
- 4 *Tecticornia ?halocnemoides*, *Frankenia setosa*, *Gunniopsis quadrifida*, and *Maireana amoena* low open shrubland, over *Eragrostis dielsii* scattered tussock grasses. This community was recorded on an undulating plain in the north-west of the study area, cover approximately 17 ha.

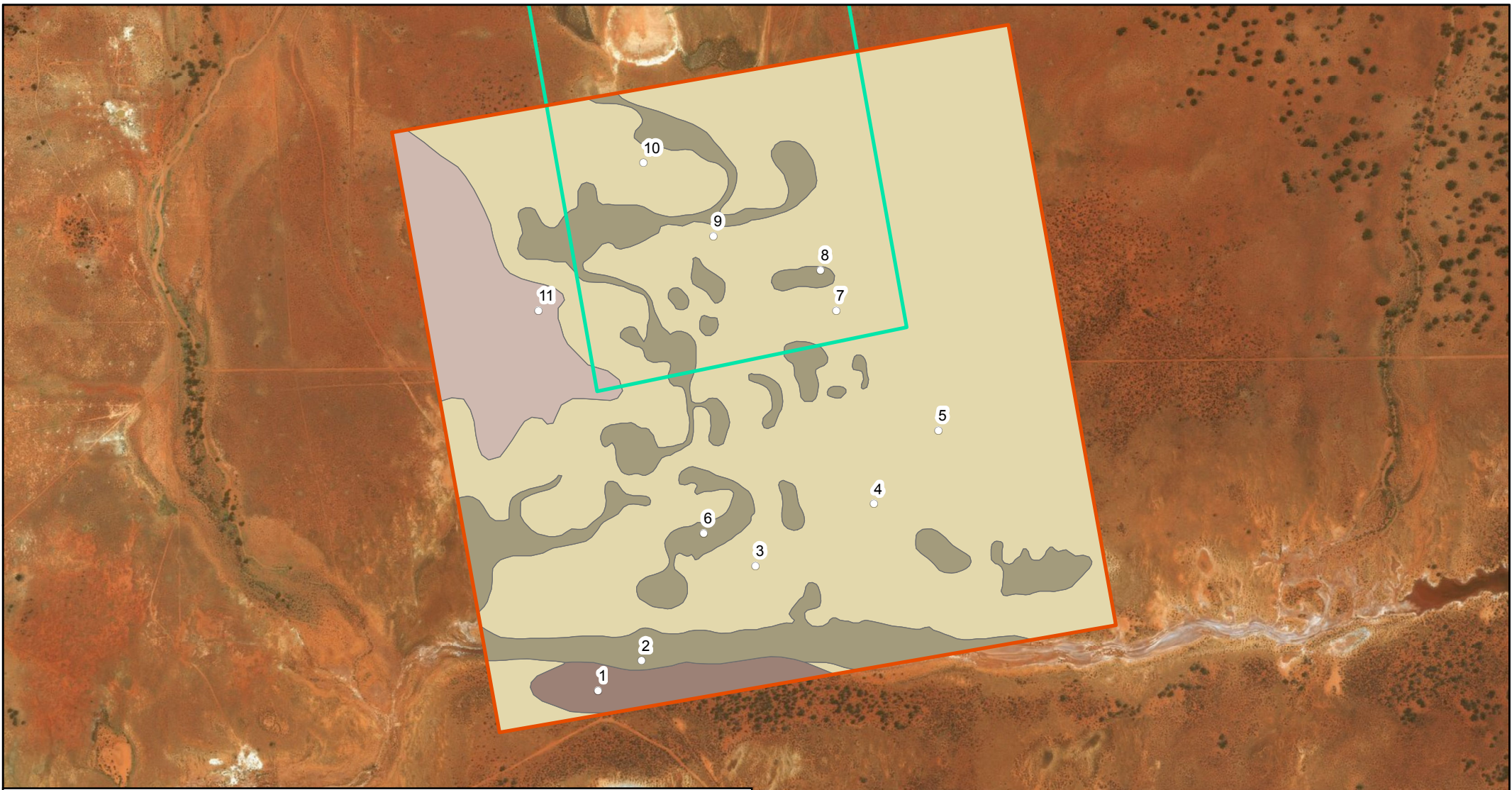
Vegetation Condition

Broadly, there has been little significant disturbance to the vegetation within the study area and as consequence vegetation condition was mostly assessed as Very Good or Excellent according to the scale of Keighery (1994). Evidence of cattle and kangaroo grazing was present across much of the area surveyed, but this has had little overall impact on vegetation condition. The few weed species present (e.g. *Salvia verbenaca*) were in low abundance, and were typically confined to the edges of vehicle tracks.

Vegetation in the northern section of the study area (e.g. at Site 10, and northwards) is in comparatively poorer condition. This area was somewhat more heavily grazed than vegetation to the south, although vegetation structure remains intact.

Table 2 – Threatened and Priority listed plant species records from the NatureMap database search


Status	Species Name	Habitat	Flowering period	Likelihood of occurrence
T	<i>Daviesia microcarpa</i>	Gravelly red granitic loam. Shrubland of <i>Allocasuarina helmsii</i> , <i>Melaleuca</i> , <i>Triodia</i> and <i>Eucalyptus concinna</i> .	September	Unlikely
	<i>Eucalyptus platydisca</i>	Granitic soils, clay.		Unlikely
P1	<i>Acacia dorsenna</i>	Rocky sandy loam or clay loam. Low rocky hills.	August to September	Unlikely
	<i>Calandrinia</i> sp. Widgiemooltha (F. Obbens & E. Reid FO 9/05)	Saline flats.	October	Possible
	<i>Eremophila lucida</i>	Clay loam, sandy loam. Adjacent to samphire flats & granite outcrops.	October	Possible
	<i>Eucalyptus jimberlanica</i>	Loam. Valley edges.		Unlikely
	<i>Grevillea phillipsiana</i>	Red sand, stony loam. Granite hills.	July to September	Unlikely
	<i>Micromyrtus papillosa</i>	Sandy or clay soils, ironstone, granite. Rocky sites, outcrops, on hills from base to summit.	April to October	Unlikely
	<i>Prostanthera splendens</i>	Stony loam, shallow soils with ironstone pebbles. Breakaways.	August to October	Unlikely
	<i>Ptilotus rigidus</i>	Associated with salt lakes.		Possible
P2	<i>Acacia kerryana</i>	Granitic loamy sand, stony clayey loam or clayey sand. Low stony ridges, undulating plains.	October to February	Unlikely
	<i>Aotus</i> sp. Dundas (M.A. Burgman 2835)	Sandy soils. Salt-lake dunes.	September	Possible
	<i>Newcastelia insignis</i>	Red or yellow sandy soils.	September to November	Possible
	<i>Thysanotus brachyantherus</i>	Clay over limestone, loam. Saline/subsaline flats.	October to December	Possible
P3	<i>Acacia dissona</i> var. <i>indoloria</i>	Sand, sandy loam. Undulating plains.	August to September	Unlikely
	<i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i>	Stony loam, laterite clay. Granite outcrops.		Unlikely
	<i>Chrysocephalum apiculatum</i> subsp. <i>norsemanense</i>	Yellow or red sand, yellow sandy clay and calcareous soils.	January to December	Possible
	<i>Eremophila purpurascens</i>	Sandy clay, stony loam over greenstone. Granite hills & rocks.	August to October	Unlikely
P4	<i>Eucalyptus kruseana</i>	Sandy loam. Granite outcrops & hills.	June to September	Unlikely
	<i>Eucalyptus x brachyphylla</i>	Sandy loam. Granite outcrops.	June	Unlikely
	<i>Frankenia glomerata</i>	Associated with salt lakes.	November	Possible
	<i>Lepidosperma lyonsii</i>	Gentle hill slopes, upper slopes of large hill.		Unlikely
	<i>Myriophyllum petraeum</i>	Strictly confined to ephemeral rock pools on granite outcrops.		Unlikely

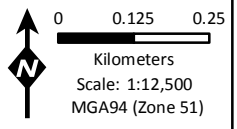


Study area
 Disturbance envelope

Vegetation Community

- Callitris preissii* low open woodland over *Acacia ligulata* and *Dodonaea viscosa* subsp. *angustissima* tall open shrubland.
- Callitris preissii* scattered low trees over *Dodonaea viscosa* subsp. *angustissima* and *Eremophila* spp. low open shrubland.
- Tecticornia ?halocnemoides*, *Frankenia setosa*, *Gunniopsis quadrifida*, and *Maireana amoena* low open shrubland.
- Tecticornia* spp. and *Frankenia cinerea sens. lat.* low shrubland.


 Drawn: AC Project ID: 1714
 Date: August 2017 A4



Broad vegetation communities



1. *Callitris preissii* scattered low trees over *Dodonaea viscosa* subsp. *angustissima* and *Eremophila* spp. low open shrubland on low dunes.



2. *Tecticornia* spp. and *Frankenia cinerea* sens. lat. low shrubland in saline depressions and on claypans.



3. *Callitris preissii* low open woodland over *Acacia ligulata* and *Dodonaea viscosa* subsp. *angustissima* tall open shrubland on low dunes.



4. *Tecticornia ?halocnemoides*, *Frankenia setosa*, *Gunniopsis quadrifida*, and *Maireana amoena* low open shrubland on undulating plain.

Figure 3 – Broad vegetation communities of the study area

REFERENCES

- CHAH. 2017. Australia's Virtual Herbarium. Available at <http://avh.chah.org.au>.
- DPaW. 2016. List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment (6 October 2016). Species and Communities Branch, Department of Parks and Wildlife.
- DPaW. 2017. Priority Ecological Communities for Western Australia version 27 (30 June 2017). Species and Community Branch, Department of Parks and Wildlife, Western Australia.
- EPA. 2016. Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment, Environmental Protection Authority, Western Australia. December 2016.
- ESCAVI. 2003. Australian Vegetation Attribute Manual: National Vegetation Information System (NVIS), Version 6.0. Department of the Environment and Heritage, Canberra.
- Keighery, B. 1994. Bushland plant survey. A guide to plant community survey for the community. Wildflower Society of Western Australia, Nedlands, Western Australia.
- Western Australian Herbarium. 1998–2017. FloraBase – The Western Australian Flora. Department of Parks and Wildlife. <http://florabase.dpaw.wa.gov.au>.

APPENDIX A SITE DATA

Site 1

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422025.96 m E 6509998.23 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Callitris preissii low open woodland over *Acacia ligulata* and *Dodonaea viscosa* subsp. *angustissima* tall open shrubland over *Ptilotus obovatus* and *Rhagodia drummondii* low open shrubland over *Eragrostis eriopoda* scattered tussock grasses.



Site 2

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422127.15 m E 6510068.15 m N
Landform	Saline creek
Soil Colour	Orange
Soil Texture	Sandy loam
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Tecticornia pergranulata, *Tecticornia pruinosa*, *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J. English KS 552), and *Frankenia cinerea sens. lat.* low shrubland.



Site 3

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422393.11 m E 6510289.59 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Callitris preissii scattered low trees over *Dodonaea viscosa* subsp. *angustissima* and *Acacia kalgoorliensis* tall/mid open shrubland over *Eremophila decipiens*, *Gunniopsis quadrifida*, and *Rhagodia drummondii* low open shrubland over *Eragrostis eriopoda* scattered tussock grasses.



Site 4

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422668.76 m E 6510433.61 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Dodonea viscosa subsp. *angustissima* and *Eremophila scoparia* mid open shrubland over *Atriplex nana*, *Frankenia interioris*, *Maireana amoena*, and *Maireana glomerifolia* low open shrubland, over *Eragrostis dielsii* scattered tussock grasses.



Site 5

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422818.92 m E 6510604.51 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Dodonea viscosa subsp. *angustissima* and *Eremophila scoparia* mid open shrubland over *Atriplex nana*, *Frankenia interioris*, *Frankenia setosa*, *Maireana amoena*, and *Gunniopsis quadrifida* low open shrubland, over *Eragrostis dielsii* scattered tussock grasses.



Site 6

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422272.40 m E 6510364.48 m N
Landform	Claypan (Depression)
Soil Colour	Brown
Soil Texture	Clay-loam
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Tecticornia ?halocnemoides, *Tecticornia pergranulata*, and *Tecticornia undulata* low shrubland.



Site 7

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422581.17 m E 6510884.35 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Callitris preissii isolated trees over *Dodonaea viscosa* subsp. *angustissima* tall open shrubland over *Atriplex vesicaria*, *Eremophila decipiens*, *Gunniopsis quadrifida*, and *Rhagodia drummondii* low open shrubland over *Eragrostis dielsii* scattered tussock grasses.



Site 8

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422544.60 m E 6510978.36 m N
Landform	Saline depression
Soil Colour	Orange
Soil Texture	clay-loam
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Tecticornia ?halocnemoides, *Frankenia cinerea sens. lat.* and *Atriplex nana* low open shrubland over *Eragrostis dielsii* scattered tussock grasses.



Site 9

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422294.68 m E 6511057.10 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Callitris preissii isolated trees over *Dodonaea viscosa* subsp. *angustissima* tall open shrubland over *Atriplex vesicaria*, *Gunniopsis quadrifida*, *Maireana amoena*, and *Rhagodia drummondii* low open shrubland over *Eragrostis dielsii* scattered tussock grasses.



Site 10

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 422131.81 m E 6511228.08 m N
Landform	Low dune
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Good - Very Good
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Dodonaea viscosa subsp. *angustissima* tall open shrubland over *Atriplex vesicaria*, *Frankenia interioris*, *Gunniopsis quadrifida*, and *Ptilotus obovatus* low open shrubland over *Austrostipa scabra* scattered tussock grasses.



Site 11

Botanist	Andrew Craigie
Date	23/08/2017
NW Corner Coordinates	51 J 421900.15 m E 6510920.02 m N
Landform	Undulating Plain
Soil Colour	Orange
Soil Texture	Sandy
Rock Type	No Rocks
Vegetation Condition	Very Good - Excellent
Disturbance Type	Grazing (Cattle/Kangaroo)
Time since Fire	> 5 Years
Leaf Litter Distribution and Cover	Low <10%

Vegetation Description

Tecticornia ?halocnemoides, *Atriplex vesicaria*, *Frankenia setosa*, *Gunniopsis quadrifida*, and *Maireana amoena* low open shrubland over *Eragrostis dielsii* scattered tussock grasses.

