APPENDIX G: TECTICORNIA SURVEY (PHOENIX ENVIRONMENTAL SCIENCES)

PHOENIX
ENVIRONMENTAL SCIENCES

Flora and vegetation survey for the St Ives Gold Mine Beyond 2018 Project – Report Addendum

Prepared for St Ives Gold Mining Company Pty Ltd

March 2018

Final Report

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Final Report

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1 INTRODUCTION

In December 2017, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Talis Consultants Pty Ltd (Talis) on behalf of St Ives Gold Mining Company Pty Ltd (SIGM), a company that is part of the Gold Fields Australia (GFA) group of companies, the ultimate parent company of which is Gold Fields Limited (Gold Fields), to undertake a targeted survey of *Tecticornia* spp. for the Beyond 2018 Project (the 'B2018 Project'). The B2018 Project is located near Kambalda, approximately 50 km south of the City of Kalgoorlie-Boulder stretching across central parts of Lake Lefroy (Figure 1-1).

The initial flora and vegetation assessment relevant to this addendum report was conducted for the Project over 12 days from the 28 September – 6 October 2016 and 7–10 November 2016 and is reported in Phoenix (2017b).

This report addendum documents an additional targeted survey for *Tecticornia* spp. conducted for the B2018 Project and is supplementary to Phoenix (2017b).

1.1 BACKGROUND

Previous surveys undertaken by Phoenix in spring 2016 and autumn 2017 for the B2018 Project included:

- a single season Level 2/detailed flora and vegetation assessment within the B2018 Project Area (B2018 study area) (Phoenix 2017b)
- additional flora and vegetation assessment to increase local and regional knowledge of the flora and vegetation values within the B2018 study area (Phoenix 2017a).

The combined surveys identified *Tecticornia* spp. communities occurring within the riparian zone of Lake Lefroy and on adjacent claypans. A total of 26 *Tecticornia* taxa were recorded within the B2018 study area during the 2016 spring survey, including 15 taxa identified to species level, two taxa representing potentially new *Tecticornia* species (*T.* sp. nov. 1 and *T.* sp. nov. 2) and nine taxa that could not be identified to species level. The Priority 1 taxa *Tecticornia mellarium* was recorded at several locations within the riparian zone of Lake Lefroy.

In autumn 2017, a survey was conducted to revisit the recorded locations of the Priority 1 species and the two potentially new *Tecticornia* species to collect further specimens and conduct population counts for each species. This survey was intended to provide population sizes and boundaries for the significant flora to facilitate assessment of impacts to these species from future mining activities.

Population counts of some of the *Tecticornia mellarium* populations were completed in autumn 2017 and one record for *T*. sp. nov. 2 was revisited where it was determined that this species was either *T. undulata* or *T. lepidosperma*. Several populations of *T. mellarium*, one record for *T.* sp. nov. 2 and two records for *T.* sp. nov. 1 were inaccessible at the time of the autumn 2017 survey and subsequently population counts and boundary delineation were not completed.

With regard to the *Tecticornia* communities within the B2018 study area, the Environmental Protection Authority (EPA) identified the following requirements in the Environmental Scoping Document (ESD) for the Project:

- Survey effort needs to be greater for Chenopodiaceae (saltbush) family within areas influenced by Lake Lefroy. The vegetation surveys must be a 3 m by 3 m or equivalent area, succession of quadrats from playa edge to terrestrial vegetation assemblages (transect), recording species zonation and collecting voucher specimens following a methodology that allows recollection of the same individual at a later date.

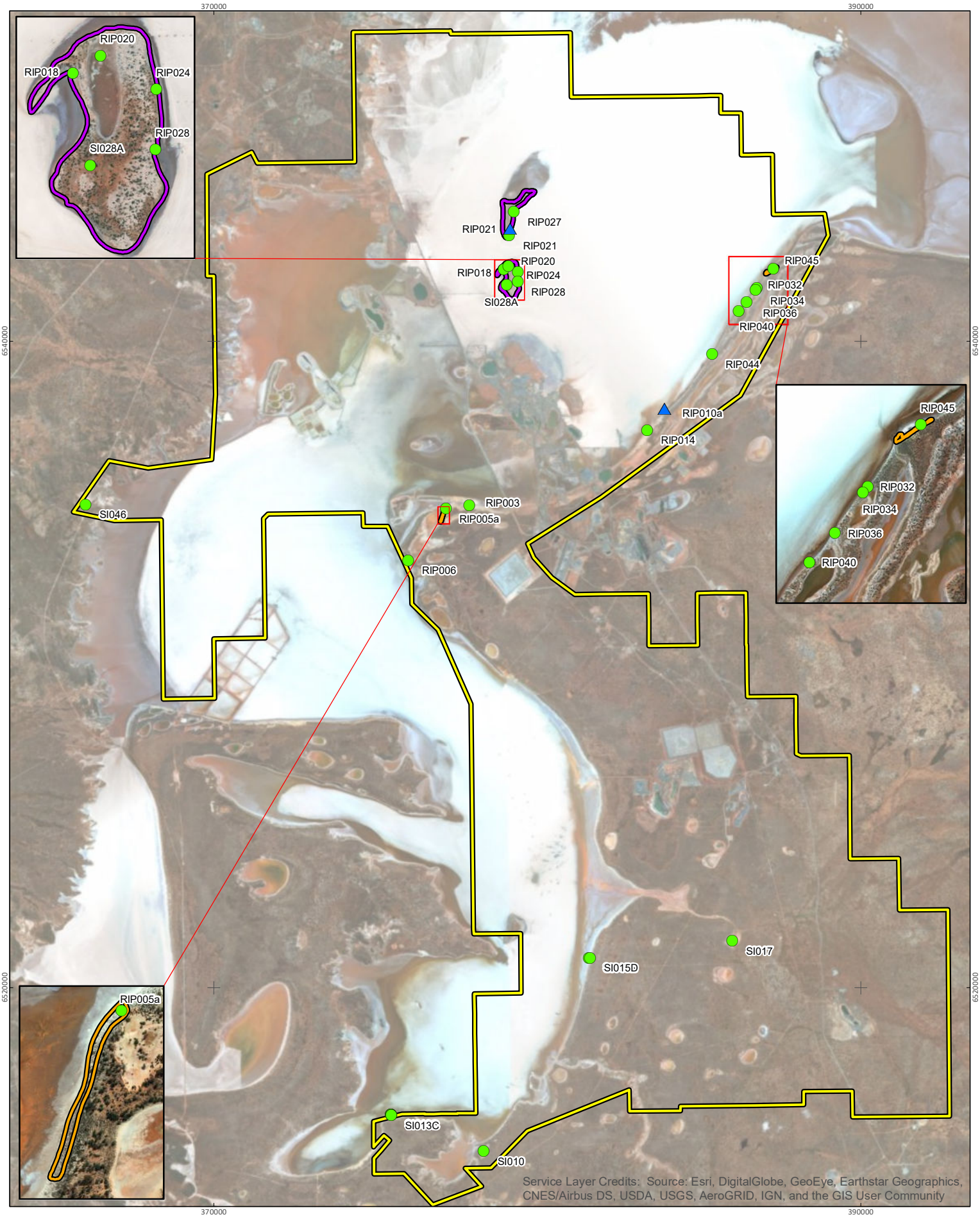
- A large number of *Tecticornia* species have been identified in the proposal survey area and surrounds. To optimise the identification of *Tecticornia* taxa, two sampling events are required for each quadrat in the lake edge survey: the first sampling event to occur between August and October when winter-flowering taxa are in fruit and spring flowering taxa are in late flower, and a second in December or January if voucher specimens are unable to be identified from the first sampling and/or if it is recommended by relevant experts at the WA Herbarium, when spring-flowering taxa are in fruit. All *Tecticornia* specimens are to be identified by relevant experts at the WA Herbarium.

Phoenix provided the following response to the first point, "For the majority of the lake edge the width of the riparian Chenopodiaceae dominated vegetation types on the lake playa to the shrublands on the lake dunes/beaches was less than 3 m in width precluding installation of transects to record species zonation. At a few locations, short transects were installed in riparian vegetation but again typically the sections dominated by Chenopodiaceae species was less than 3 m in width. We can update the methodology in the report to reflect this." The EPA responded indicating that if the riparian vegetation is only 1 m wide, then a quadrat of 1 m by 9 m should be used to describe the vegetation.

Subsequently, in summer (January) 2018 Phoenix undertook targeted survey for *Tecticornia* spp.

1.2 STUDY AREA

The study area for the targeted survey for *Tecticornia* spp. (Figure 1-1) included populations of *Tecticornia mellarium*, *T.* sp. nov. 1 and *T.* sp. nov. 2 not revisited in autumn 2017, previous survey locations from the spring 2016 survey where *Tecticornia* spp. could not be identified to species level due to insufficient taxonomic characters, and spring 2016 survey sites where transect surveys were not previously conducted.



St Ives Gold Mine
Beyond 2018 Project

Project No	1181
Date	08-Mar-18
Drawn by	AL
Map author	KC

0 3 6
Kilometres

1:150,000 (at A4) GDA 1994 MGA Zone 51

B2018 study area

Survey sites

- old sites revisited during survey
- new sites

***Tecticornia* survey areas**

- *Tecticornia* sp. nov. 1
- *Tecticornia* sp. nov. 2

Figure 1-1

Study area and survey site locations

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1.3 SURVEY OBJECTIVE AND SCOPE OF WORKS

To fulfil the requirements of the ESD in regard to *Tecticornia* communities, Phoenix undertook the following scope of works:

- revisit records of *Tecticornia mellarium*, *T.* sp. nov. 1 and *T.* sp. nov. 2 records that were inaccessible during the autumn 2017 survey and conduct population counts and delineate population boundaries
- revisit all survey locations where *Tecticornia* taxa collected were not identified to species level to recollect specimens
- revisit survey locations where transect surveys were not conducted due to the limited width of the vegetation and conduct quadrat surveys in accordance with the advice provided by EPA.
- preparation of a succinct technical report documenting the additional surveys.

Where applicable survey design, methodology and technical reporting adhered to relevant legislation, principles and guidelines, including:

- EPA *Statement of Environmental Principles, Factors and Objectives* EPA (2016b)
- EPA *Environmental Factor Guideline: Flora and vegetation* (EPA 2016c)
- EPA *Technical Guidance: Flora and vegetation surveys for Environmental Impact Assessment* (EPA 2016a).

1.4 CLIMATE AND WEATHER

In the 12 months preceding the targeted survey for *Tecticornia* spp., average monthly minimum and maximum temperatures at City of Kalgoorlie-Boulder Airport Bureau of Meteorology (BoM) weather station (the closest to the study area) were mostly similar or slightly above the long-term averages (Figure 1-2). The one minor anomaly of potential relevance to the survey was the February maxima being ~3°C cooler than the long-term average for the month.

Total monthly rainfall for the 12 months preceding the survey was below the long-term monthly average in most months; however, summer rainfall (January and February) was considerably higher than average (Figure 1-2).

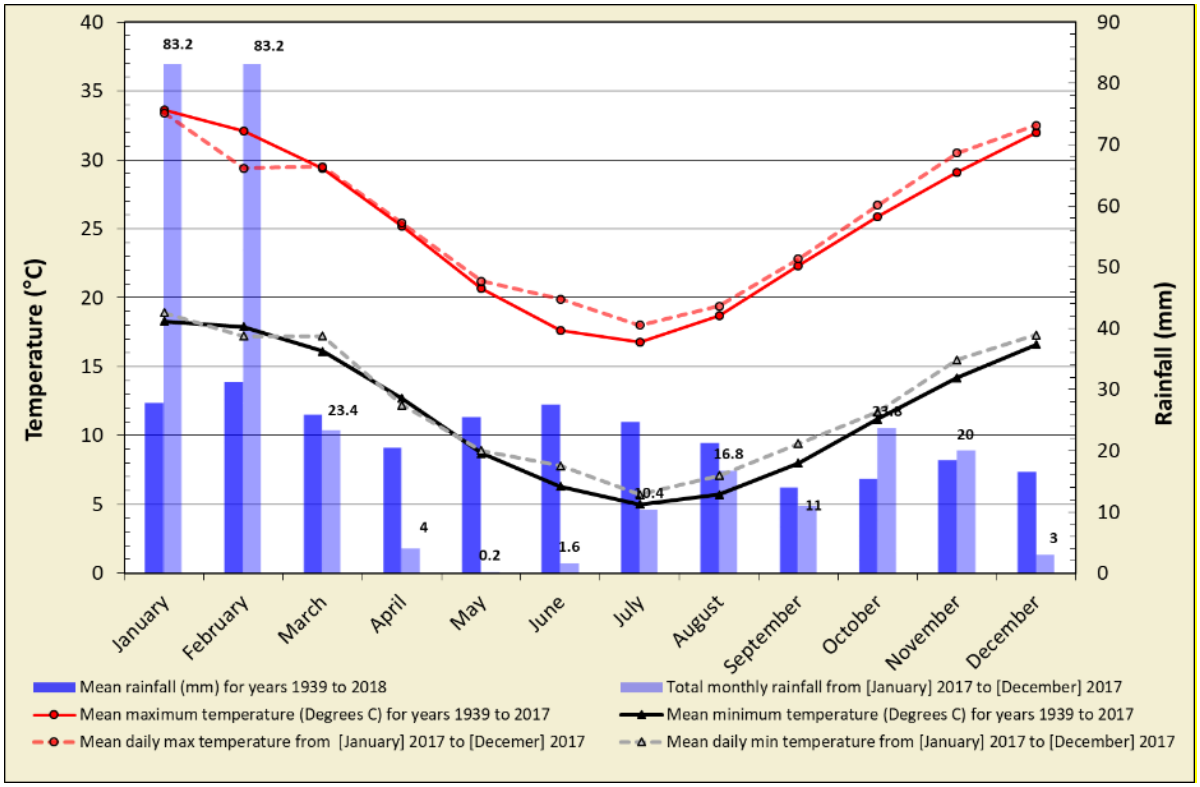


Figure 1-2 **Annual climate data and records for the year prior to the survey for City of Kalgoorlie-Boulder Airport (no. 12038) (BoM 2018)**

2 METHODS

Prior to the field survey, Phoenix Access and GIS databases were interrogated to identify survey locations of *Tecticornia* communities that required revisiting. Specimens of the potentially new *Tecticornia* species and specimens not identified to species level were compiled into a field herbarium to facilitate relocating plants during the field survey.

A field survey of the *Tecticornia* survey locations and populations of significant species was conducted by Dr Grant Wells and Alice Watt from 15–19 January 2018. Work undertaken included:

- populations of *Tecticornia mellarium* (P1) and the two potentially new species were foot searched to record the extent of each population and the number of plants present
- transect surveys were conducted at riparian *Tecticornia* vegetation communities in accordance with EPA requirements to survey 3 x 3 m quadrats, where possible, or adjust quadrat size where required to maintain a 9 m^2 survey area
- field herbarium specimens were used to relocate *Tecticornia* taxa not previously identifed to species level and specimens were collected
- photographs were taken of all plants from which specimens were collected

Populations were defined using the guidelines of Stack (2010) where plants separated by 500 m were classed as separate populations.

Transect surveys were conducted at previous quadrat location (Figure 1-1) Nine transects were conducted, including four locations on the edge of Lake Lefroy, four locations on the beaches of islands within Lake Lefroy and one within a clay pan (Figure 1-1). Transects were of varying length, with each transect commencing where vegetation commenced from the lakes edge and terminating at the

transition of vegetation on the lake beaches. Quadrats were placed at even intervals along the transect. Cover and density data for all species present was collected in sequential 3 m x 3 m plots or an overall 9 m^2 survey area. The number of quadrats at each transect varied depending on the length, ranging from three to five.

The following attributes were recorded for each transect:

- site code
- location, with GPS coordinates (estimate of their accuracy) and datum for each corner of each quadrat
- quadrat dimensions
- photograph/s from the beginning of the transect
- landform and soil description
- dominant growth form, height, cover and species for the three traditional strata (upper, mid and ground) compatible with NVIS Level V (Executive Steering Committee for Australian Vegetation Information ESCAVI 2003) (Appendix 1)
- any other location information that might be useful in vegetation classification including slope, aspect, litter, fire history, vegetation/landform/soil correlations
- assessment of vegetation condition and description of disturbances in accordance with the vegetation condition scale of EPA (2016c) for the South-western Interzone botanical province (Table 2-1)
- a comprehensive species list, including weeds list –including the name of every flora species present within the quadrat; to ensure accurate taxonomic identification of flora species present collections were made of each specimen at least once and each collection was pressed and documented for identification using the WA Herbarium resources
- height and percentage foliage cover (PFC) – a visual estimate of the canopy cover of each species present within each 9m^2 quadrat along the transect was recorded as a percentage, as was the total vegetation cover, cover of shrubs and trees >2 m tall, cover of shrubs <2 m, total grass cover and total herb cover.

Table 2-1 Vegetation condition rating scale (Keighery 1994)

Vegetation condition rating	Vegetation condition	Description
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
3	Very Good	Vegetation structure altered obvious signs of disturbance
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not in a state approaching good condition without intensive management
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost without native species

2.1 TAXONOMY AND NOMENCLATURE

Plant species were identified using local and regional flora keys, and comparisons with named species held at the WA Herbarium. Nomenclature for flora and vegetation used in this report follows that used by FloraBase (DBCA 2018b) and the WA Herbarium. The conservation status of all recorded flora was compared against the current lists available on FloraBase and the EPBC Act Threatened flora list (Department of the Environment and Energy 2018).

All *Tecticornia* specimens were identified by Dr Kelly Shepherd, as is the requirement by the EPA for this genus.

2.2 SURVEY PERSONNEL

The personnel involved in the survey are presented below (Table 2-2).

Table 2-2 Project team

Name	Qualifications	Role/s
Dr Grant Wells	PhD. (Botany)	Project manager, field survey, report review, taxonomy
Ms Alice Watt	BSc. Hons (Cons Biol. and Botany)	Field survey, reporting
Dr Grace Wells	PhD. (Botany)	GIS
Dr Kelly Shepherd (WA Herbarium)	PhD. (Botany)	Taxonomy – *Tecticornia* spp.
Karen Crews	BSc. Hons (Env Biol.)	Report review

2.3 SURVEY LIMITATIONS

The limitations of the survey have been considered in accordance with the *Technical Guidance: Flora and vegetation surveys for Environmental Impact Assessment* (EPA 2016c) (Table 2-3).

Table 2-3 Survey limitations

Limitations	Limitation for this survey?	Comments
Availability of contextual information at a regional and local scale	No	Extensive botanical information exists for St Ives Gold Mine tenements which provided good contextual information for the current survey. High resolution aerial photography was available for the additional study area which was used for the vegetation mapping.
Competency/experience of survey personnel, including taxonomy, and experience in the region surveyed	No	The field leader, Dr Grant Wells has worked extensively in the Goldfields region. The other survey botanist, Alice Watt supported the lead botanist. Dr Kelly Shepherd is a specialist DBCA taxonomist for *Tecticornia* species.

Limitations	Limitation for this survey?	Comments
Proportion of flora recorded and/or collected, and any identification issues	Minor	Some plants were highly senesced at some locations making it difficult to locate plants with fruit and seed and distinguish between taxa. Some species could not be identified to species level due to insufficient flowering and fruiting material. However, boundary mapping was completed for all significant *Tecticornia* populations
Effort and extent; was the appropriate area fully surveyed	No	All prior survey locations that required revisiting for transect survey or collection of additional *Tecticornia* specimens and all populations of significant flora were accessed during the field survey.
Access within the survey area	No	As above.
Timing, rainfall, season	Minor	Below average rainfall in the immediate month before the survey (December 2017) may have limited fruit and seed set in some *Tecticornia* spp.
Disturbance that may have affected the results of the survey	No	No disturbances affected the survey.

3 RESULTS

All previous riparian *Tecticornia* survey locations requiring transect surveys, all sites where *Tecticornia* taxa were not identified to species level and all populations of significant species that were inaccessible during the 2017 spring survey were revisited during the current survey (Table 3-1). Additional transect surveys were also conducted for *Tecticornia mellarium* populations at two new sites (Figure 1-1).

Table 3-1 Survey locations and reason for survey

Site	Reason for survey	Species
OPP005	Population counts	*Tecticornia mellarium*
OPP006	Population counts	*Tecticornia mellarium*
RIP003	Population counts	*Tecticornia mellarium*
RIP005a	Specimen collection, population counts	*Tecticornia* sp. nov. 1
RIP006	Specimen collection, population counts, transect survey	*Tecticornia* sp. nov. 2
RIP014	Population counts	*Tecticornia mellarium*
RIP018	Specimen collection, population counts, transect survey	*Tecticornia mellarium*, *Tecticornia* SIRS10
RIP020	Specimen collection	*Tecticornia* SIRS10, *Tecticornia* SIRS9
RIP021	Population counts	*Tecticornia mellarium*
RIP024	Specimen collection, population counts, transect survey	*Tecticornia* sp. nov. 2
RIP027	Population counts, transect survey	*Tecticornia mellarium*
RIP028	Specimen collection, population counts, transect survey	*Tecticornia* sp. nov. 2, *Tecticornia* SIRS10
RIP032	Population counts	*Tecticornia mellarium*
RIP034	Population counts	*Tecticornia mellarium*
RIP036	Population counts	*Tecticornia mellarium*
RIP040	Population counts	*Tecticornia mellarium*
RIP044	Population counts	*Tecticornia mellarium*
RIP045	Specimen collection, population counts, transect survey	*Tecticornia* sp. nov. 1
SI010	Specimen collection, transect survey	*Tecticornia* SIGMa, *Tecticornia* SIGMb
SI013	Specimen collection	*Tecticornia* SIGMa
SI013A	Specimen collection	*Tecticornia* SIGMa
SI013B	Specimen collection	*Tecticornia* SIGMa
SI013C	Specimen collection	*Tecticornia* SIGMa
SI015A	Specimen collection	*Tecticornia* SIGMe
SI015D	Specimen collection	*Tecticornia* SIGMe
SI017	Specimen collection	*Tecticornia* SIGMf
SI028A	Specimen collection	*Tecticornia* SIGMl, *Tecticornia* SIGMm
SI046	Specimen collection	*Tecticornia* SIGMq

3.1 SIGNIFICANT *TECTICORNIA* SPECIES

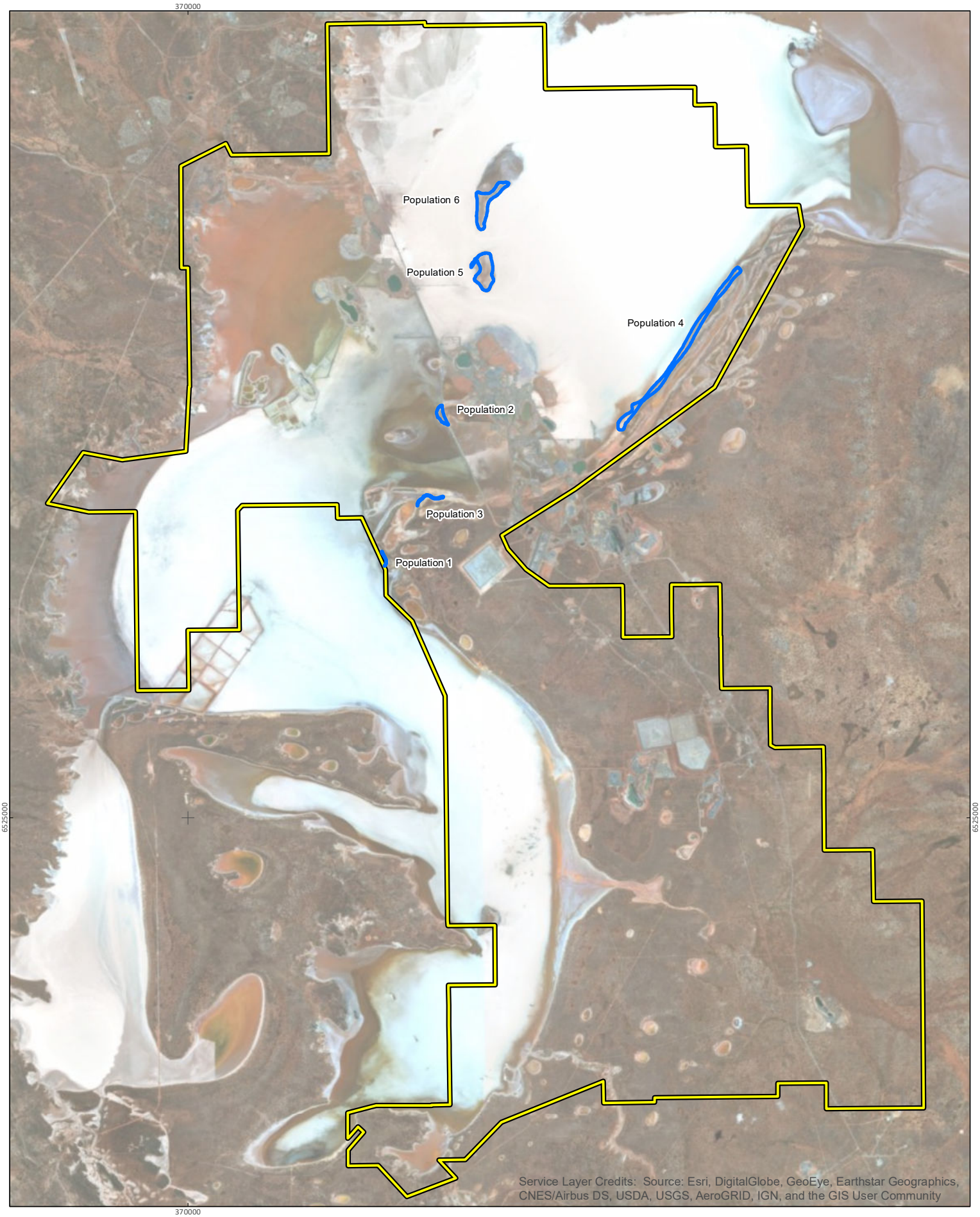
Boundary mapping and counts were completed for all records of *Tecticornia mellarium*, *T.* sp. nov. 1 and *T*. sp. nov. 2. Specimens of each taxon were collected at several locations.

3.1.1 *Tecticornia mellarium* (P1)

A total of four populations of *Tecticornia mellarium* were mapped and the number of plants recorded during the current survey (Figure 3-1; Figure 3-2). This brings the total number of populations recorded for the B2018 study area to seven with the inclusion of the populations surveyed in 2017 (Phoenix 2017a). Population size ranged from 23 to 1,192 plants with a total of 2,667 plants recorded within the B2018 study area (Table 3-2).

For *Tecticornia mellarium*, the growth habit of the species (Figure 3-3) made it difficult to distinguish between individuals. As the plants become partially buried by sand it was not possible (without spending time excavating around the plants) to definitively identify each individual. Subsequently, some 'clumps' of plants recorded as a single individual may in fact represent multiple individuals and conversely a solitary individual may have been recorded as multiple plants.

Figure 3-1 ***Tecticornia mellarium*** **plant in situ**



St Ives Gold Mine
Beyond 2018 Project

Project No	1181
Date	08-Mar-18
Drawn by	AL
Map author	KC

0 3 6
Kilometres

1:150,000 (at A4) GDA 1994 MGA Zone 51

B2018 study area

Tecticornia mellarium population

Figure 3-2

Location of *Tecticornia mellarium* populations from the current survey and the (Phoenix 2017a) survey

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Table 3-2 *Tecticornia mellarium* population details

Population code	Total number of plants	Population extent
Population 1[1]	194	594 m along shoreline
Population 2[1]	249	1,800 m around perimeter of small island
Population 3	23	320 m along shoreline
Population 4	345	6,600 m along shoreline
Population 5	1192	4,800 m entire perimeter of island and perimeter of 'inland' clay pan
Population 6	664	4,100 m entire perimeter of island

[1]Surveyed in autumn 2017 (Phoenix 2017a).

Figure 3-3 *Tecticornia mellarium* population showing growth habit

3.1.2 *Tecticornia* sp. nov. 1

A total of five specimens of *Tecticornia* sp. nov. 1 were collected, three from the previous record for the species near survey site RIP005a and two from the previous record at survey site RIP045 (Figure 1-1).

A specimen collected at survey site RIP005a was identified as *Tecticornia* sp. Dennys Crossing (Figure 3-4). Two further specimens collected whilst conducting population counts and mapping of the taxon (defined by the *Tecticornia* sp. Nov 1 survey area boundaries in Figure 1-1) could not definitively be identified with one considered to be *T.* sp. Dennys Crossing and the other considered to be part of the *T. halocnemoides* complex. At survey site RIP045, the specimen was identified as *T. syncarpa* (Figure 3-4), a second specimen collected whilst conducting population counts and mapping could not definitively be identified but was considered to be part of the *T. halocnemoides* complex.

Review of the original specimens named as *T.* sp. nov. 1 by Dr Shepherd, conducted concurrently with the identification of specimens from the current survey, identified both specimens to represent *T. syncarpa*. *T. syncarpa* was previously recorded at survey site RIP005a and was recorded at RIP045 in the current survey (Figure 1-1). *T. syncarpa* is not listed as a significant species.

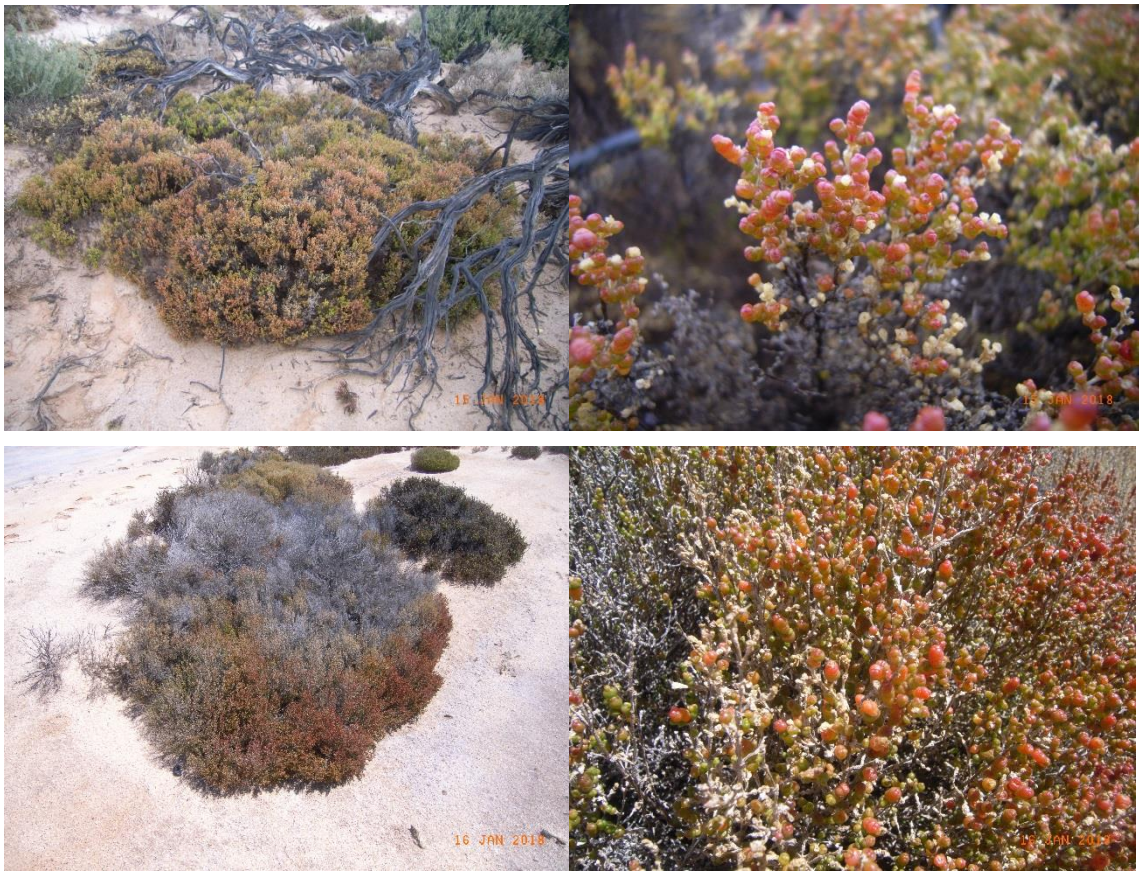

Figure 3-4 ***Tecticornia* sp. nov. 1 identified as *T.* sp. Dennys Crossing (top) and *T. syncarpa* (bottom)**

3.1.3 *Tecticornia* sp. nov. 2

A total of seven specimens were collected, one from survey site RIP006 (Figure 1-1) and three at two populations that occur on the beach of two islands including from sites RIP028 and RIP024 where the species was previously recorded. The other specimens were collected at random points whilst counting plants and mapping the distribution of the taxon (defined by the *Tecticornia* sp. Nov 2 survey area boundaries in Figure 1-1). All specimens collected were identified to be *Tecticornia undulata* (Figure 3-5) by Dr Kelly Shepherd at the state herbarium. This species is not a listed significant flora.

A review of the two original *Tecticornia* sp. nov. 2 specimens by Dr Shepherd, conducted concurrently with the identification of specimens for the current survey, identified one specimen to be *T. undulata* and the second *T. pruinosa*. Neither species are listed significant species.

Figure 3-5 ***Tecticornia* sp. nov. 2 identified to be *T. undulata***

3.2 TRANSECT SURVEYS

Quadrat data for the nine transect sites is provided in Appendix 2. A list of species recorded is provided in Appendix 3.

For each of the sites located on the lake edge or beach of an island, the *Tecticornia* community occupied a width of 3 m or less (Figure 3-6; Appendix 2). Typically, the community was patchy with large expanses of shoreline or beach devoid of any *Tecticornia* plants (Figure 3-7). The second and subsequent transect quadrats were then located in shrublands or woodlands where the 3 m x 3 m quadrats were not really well suited to documenting the vegetation type, being too small and frequently dominated by a single plant species (Appendix 2).

Figure 3-6 Examples of transect sites

Figure 3-7 Expanse of Lake Lefroy shoreline devoid of *Tecticornia* shrubs

3.3 UNIDENTIFIED *TECTICORNIA* SPP.

Specimens were collected of each *Tecticornia* taxon previously not identified to species level. At some survey locations, plants were substantially senesced which hampered identification during the current survey (Figure 3-8; Figure 3-9). The state of the plants precluded identification to species level, despite areas being thoroughly searched in order to find the best specimen available. Conversely, at other locations plants were in a healthy state and plant material bearing fruiting bodies was collected.

A total of 42 specimens were collected and sent to the state herbarium for identification by Dr Kelly Shepherd. Of these, 33 were identifiable to species level.

Specimens collected at five survey sites could not be definitively identifed to species level due to a lack of reproductive features (Table 3-3). This includes the species at survey site SI046 where virtually all vegetation was highly senesced at the time of the current survey (Figure 3-8). Notably, surveys of these sites have now been conducted in spring (either October or November 2016) and summer (January 2018).

Two specimens (*Tecticornia* SIGMa and *Tecticornia* SIGMa) at survey site SI010 were not identifiable in either the spring or summer survey. Specimens collected in the current survey were possibly *T. monoliliformis* or *T. tenuis* but cannot be confirmed. As noted previously, the specimens from survey site SI046 could not be identified to species level but were also considered to likely represent *T. monoliliformis* or *T. tenuis*.

Two specimens of *Tecticornia* SIRS10 collected at different survey sites could not be identified to species level; however, a specimen collected at a third site was identified to be *Tecticornia syncarpa*.

Specimens collected at site SI028a were identified to be *Tecticornia pterygosperma* subsp. *pterygosperma* providing a seventeenth identified *Tecticornia* species for the study area. All other species identified from specimens collected during the current survey were recorded at other locations within the study area during previous surveys.

Figure 3-8 Vegetation at site SI046 in January 2019 (top) and October 2016 (bottom)

Figure 3-9 ***Tecticornia mellarium*** **individual at RIP006 January 2018 (top) and April 2017 (bottom)**

Table 3-3 Identified *Tecticornia* species details

Site	Unidentified species	Species identification	Comments (pers. com. Kelly Shepherd)
RIP005a	*Tecticornia* sp. nov. 1	*Tecticornia* sp. sterile 4	Possibly *T.* sp. Dennys crossing but cannot confirm
RIP005a	*Tecticornia* sp. nov. 1	*Tecticornia* sp. Dennys crossing	
RIP006	*Tecticornia* sp. nov. 2	*Tecticornia undulata*	
RIP018	*Tecticornia* SIRS10	*Tecticornia* sp. sterile 5	Could be one of several named species, e.g. *T. undulata, T. syncarpa* or *T indica* subsp. *bidens.*
RIP020	*Tecticornia* SIRS9	*Tecticornia peltata*	
RIP020	*Tecticornia* SIRS10	*Tecticornia* sp. sterile 2	Possibly *T. peltata* but cannot confirm
RIP024	*Tecticornia* sp. nov. 2	*Tecticornia undulata*	
RIP028	*Tecticornia* sp. nov. 2	*Tecticornia undulata*	
RIP028	*Tecticornia* SIRS10	*Tecticornia syncarpa*	
RIP045	*Tecticornia* sp. nov. 1	*Tecticornia syncarpa*	
RIP045	*Tecticornia* sp. nov. 1	*Tecticornia* sp. sterile 3	Probably part of the *T. halocnemoides* complex but cannot confirm
SI010	*Tecticornia* SIGMa	*Tecticornia* sp. sterile 1	Possibly *T. monoliliformis* or *T. tenuis* but cannot confirm
SI010	*Tecticornia* SIGMb	*Tecticornia* sp. sterile 1	Possibly *T. monoliliformis* or *T. tenuis* but cannot confirm
SI013	*Tecticornia* SIGMa	*Tecticornia lepidosperma*	
SI015	*Tecticornia* SIGMe	*Tecticornia lylei*	
SI017	*Tecticornia* SIGMf	*Tecticornia indica* subsp. *bidens*	
SI028A	*Tecticornia* SIGMl	*Tecticornia pterygosperma* subsp. *pterygosperma*	
SI028A	*Tecticornia* SIGMm	*Tecticornia pterygosperma* subsp. *pterygosperma*	
SI046	*Tecticornia* SIGMq	*Tecticornia* sp. sterile	Possibly *T. monoliliformis* or *T. tenuis* but cannot be confirmed

4 DISCUSSION

A total of 42 *Tecticornia* specimens were collected during the field survey, including at least one specimen for each of the taxa not identified to species level previously and multiple collections of *T. mellarium*, *T.* sp. nov. 1 and *T*. sp. nov. 2.

The population counts for *Tecticornia mellarium* provide a fairly accurate estimate of plant numbers but should not be considered an actual count of the number of individuals due to the incapacity to distinguish between individuals in some instances. The counts should provide sufficient detail for impact assessment by identifying large as opposed to smaller populations.

The results of the current survey and review of the original specimens identified as *Tecticornia* sp. nov. 1 in Phoenix (2017b) have determined that the species was *T.* sp. Dennys Crossing at one original survey site (RIP005a) and *T. syncarpa* at the other (RIP045). Other specimens collected whilst conducting population mapping and inventory could not be definitively identified to species level but were considered by Dr Shepherd to resemble named unthreatened *Tecticornia* spp. Dr Shepherd (pers. comm. telephone conversation to Dr Grant Wells 01/03/2018) is now of the opinion that it is more likely the unidentifiable plants were sterile plants of named species rather than a potentially new species. However, in adherence to the precautionary principle, it is recommended to minimise impacts to the populations surveyed in the current study (defined by the *Tecticornia* sp. Nov 1 survey area boundaries in Figure 1-1).

The results of the current survey have determined that the species initially identified as *Tecticornia* sp. nov. 2 in Phoenix (2017b) is *T. undulata* with one specimen identified to be *T. pruinosa*. Neither of these species are listed as significant flora and subsequently the local significance initially inferred for *T.* sp. nov. 2 is no longer valid. Both *T. undulata* and *T. pruinosa* have broad distributions across Western Australia (DBCA 2018a).

Of the 11 species not identified to species level in previous surveys (Phoenix 2017b):

- six (*Tecticornia* SIGMe, *Tecticornia* SIGMf, *Tecticornia* SIGMl, *Tecticornia* SIGMm, *Tecticornia* SIRS9 and *Tecticornia* sp. nov. 2) were identified to species level from collections in the current survey
- some specimens of three taxa (*Tecticornia* SIGMa, *Tecticornia* sp. nov. 1 and *Tecticornia* SIRS10) were identified to species level from collections in the current survey, and possible species identities were suggested for other specimens
- the identity of two taxa (*Tecticornia* SIGMb and *Tecticornia* SIGMq) still could not be identified to species level despite collections in both spring and summer.

None of the identified species from the current survey were listed significant flora, none of the unidentified species resemble listed significant flora and there were no evident range extensions for any species.

DBCA (2018a) lists one significant *Tecticornia* species for the Eastern Goldfields subregion, *T. flabelliformis* (Priority 1 at State level, Vulnerable at Federal level); a recent Phoenix survey conducted for the B2018 Project (Phoenix 2017a) located populations of this species at Lake Lefroy but outside the B2018 study area. The presence of a second significant species at Lake Lefroy, *T. mellarium* (Priority 1), was confirmed in the previous survey conducted in the B2018 study area (Phoenix 2017b) and a regional flora and vegetation survey conducted for the B2018 Project (Phoenix 2017c).

None of the *Tecticornia* specimens that could not be identified to species level from previous collections or specimens collected during the current survey resemble either *T. flabelliformis* or *T. mellarium*. This indicates that none of the specimens represent significant *Tecticornia* taxa known to

occur in the Eastern Goldfields subregion. However, it cannot be stated with certainty that none of the collected specimens represent new/undescribed species.

The *Tecticornia* communities in the riparian areas of Lake Lefroy within the B2018 study area typically occur as a thin band restricted to the foredune of the kopi dunes that surround much of the lake. The vegetation then frequently turns into tall to mid shrublands of *Acacia* and *Melaleuca* spp. over *Jacksonia arida* and *Darwinia* sp. Karonie. Notably, the 'band' of *Tecticornia* shrubs is frequently intermittent with large areas of foredune with no *Tecticornia* shrubs present.

The *Tecticornia* shrublands on the foredune were not readily discernible from aerial imagery and typically covered too small an area to be mapped as a separate unit.

The use of the transect/quadrat survey method for the riparian vegetation of Lake Lefroy is problematic as the 9 m^2 survey area can cause misrepresentation of the *Tecticornia* communities. Cover values in the quadrat frequently equate to the community being classed as shrublands (utilising NVIS descriptive) where, in fact the plants represent isolated shrubs. In addition, 9 m^2 quadrats are insufficient to describe the adjacent shrublands.

It was notable during the current survey that at a number of sites, plants appeared more highly stressed/senesced than was evident in earlier surveys. None of these sites had been impacted by mining activities or operations indicating that the senescence has resulted from natural environmental factors. These observations should be considered when designing (if required) any vegetation health monitoring of *Tecticornia* shrublands for the B2018 Project. Conducting baseline assessments should include at least two field surveys, one following optimal conditions (i.e. after good seasonal rainfall) when plants are more likely to be identifiable, and the other following a dry period when the plants are likely to express the natural senesced state.

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Appendix 1 Vegetation structural classes (NVIS)

Height Classes

Height	Growth form					
Height class	Height range (m)	Tree, vine (Mid & Upper), palm (single-stemmed)	Shrub, heath shrub, chenopod shrub, ferns, Samphire shrub, cycad, tree-fern, Grass-tree, palm (multi-stemmed)	Tree mallee, Mallee Shrub	Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (Ground)	Bryophyte, lichen, seagrass, aquatic
8	>30	tall	N/A	N/A	N/A	N/A
7	10-30	mid	N/A	tall	N/A	N/A
6	<10	low	N/A	mid	N/A	N/A
5	<3	N/A	N/A	low	N/A	N/A
4	>2	N/A	tall	N/A	tall	N/A
3	1-2	N/A	mid	N/A	tall	N/A
2	0.5-1	N/A	low	N/A	mid	tall
1	<0.5	N/A	low	N/A	low	low

Structural Formation Classes

Growth form	Height ranges (m)	Structural formation classes					
Foliage cover % (cover #)		70-100% (5)	30-70% (4)	10-30% (3)	<10% (2)	0-5% (1)	≈0% (N)
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of 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
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of 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
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of 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

Growth form	Height ranges (m)	Structural formation classes					
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
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of 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
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes
forb	<0.5,>0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns
bryophyte	<0.5	closed bryophyteland	Bryophyte-land	open bryophyte-land	sparse bryophyte-land	isolated bryophytes	isolated clumps of bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines
aquatic	0-0.5,<1	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics
seagrass	0-0.5,<1	closed seagrass bed	seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses

Appendix 2 Flora survey site descriptions with species recorded at each site

Site details			
Site:	RIP006-01	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.328789, 121.696601 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	0	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	1	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Isolated low *Tecticornia undulata* and *Tecticornia lepidosperma*		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia lepidosperma	00.5	00.10		
Tecticornia undulata	00.5	00.10		

Site details			
Site:	RIP006-02	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.328751, 121.696792 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	50	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	50	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Jacksonia arida* and *Darwinia* sp. Karonie shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Jacksonia arida	30.0	00.50		
Darwinia sp. Karonie (K. Newbey 8503)	20.0	00.30		

Site details			
Site:	RIP006-03	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.328726, 121.696826 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	5	**Soil:**	sand,
Grass cover (%):	35	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Isolated *Jacksonia arida* shrubs over *Triodia irritans* grassland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Triodia irritans	35.0	00.30		
Jacksonia arida	05.0	00.50		

Site details			
Site:	RIP010a-01	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.28839, 121.780555 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	15	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	15	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Tecticornia mellarium* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia mellarium	15.0	00.10		P1 (WC Act)

Site details			
Site:	RIP010a-02	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.288433, 121.780645 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	50	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	50	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Darwinia* sp. Karonie and *Jacksonia arida* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	48.0	00.40		
Jacksonia arida	02.0	00.50		

Site details			
Site:	RIP010a-03	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.288548, 121.780821 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	30	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	30	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Mid *Jacksonia arida* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Jacksonia arida	30.0	01.60		

Site details			
Site:	RIP018-01	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.247902, 121.728874 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow, grey,
Shrub cover <2 m (%):	40	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Very Good, EPA (2016)	**Disturbance**	litter,
Land system:	Lefroy System		
Vegetation description and type:	Low *Tecticornia undulata* and *Frankenia cinerea* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia undulata	30.0	00.20		
Frankenia cinerea	10.0	00.10		

Site details			
Site:	RIP018-02	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.24784, 121.728973 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	25	**Soil colour:**	red-brown,
Shrub cover <2 m (%):	15	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Calytrix columellaris* woodland over low *Darwinia* sp. Karonie, *Westringia cephalantha* and *Scavola spinescens* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Callitris columellaris	25.0	04.00		
Scaevola spinescens	10.0	00.40		
Darwinia sp. Karonie (K. Newbey 8503)	01.0	00.40		
Westringia cephalantha	00.5	00.15		
Jacksonia arida	00.1	00.10		

Site details			
Site:	RIP018-03	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.247776, 121.729092 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	10	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	10	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Mid open *Jacksonia arida* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Jacksonia arida	10.0	01.70		

Site details			
Site:	RIP018-04	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.247728, 121.729174 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	50	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	50	**Soil colour:**	brown,
Shrub cover <2 m (%):	0	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Calytrix columellaris* woodland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Callitris columellaris	50.0	04.00		

Site details			
Site:	RIP021a-01	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.237601, 121.731067 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	20	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-brown,
Shrub cover <2 m (%):	20	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	gypsum
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Tecticornia mellarium* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia mellarium	20.0	00.10		P1 (WC Act)

Site details			
Site:	RIP021a-02	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.237551, 121.730974 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	30	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-brown,
Shrub cover <2 m (%):	30	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	calcrete
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Darwinia* sp. Karonie shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	30.0	00.30		

Site details			
Site:	RIP021a-03	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.237561, 121.730843 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-orange,
Shrub cover <2 m (%):	40	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Mid isolated *Acacia ligulata* shrubs over low *Darwinia* sp. Karonie shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	39.0	00.40		
Acacia ligulata	01.0	01.70		

Site details			
Site:	RIP024-01	**Type:**	Transect (2 m x 4.5 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248621, 121.733558 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-brown, black,
Shrub cover <2 m (%):	40	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Tecticornia undulata* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia undulata	40.0	00.20		

Site details			
Site:	RIP024-02	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248591, 121.733495 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	5	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-brown,
Shrub cover <2 m (%):	5	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low isolated *Jacksonia arida* shrubs		

Species	Cover (%)	Height (m)	Weed	Conservation status
Jacksonia arida	05.0	01.60		

Site details			
Site:	RIP024-03	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248659, 121.733363 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	30	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-brown,
Shrub cover <2 m (%):	30	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Mid *Acacia ligulata* and *Jacksonia arida* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Acacia ligulata	30.0	00.40		
Jacksonia arida	1.00	00.40		

Site details			
Site:	RIP027-01	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.231772, 121.732407 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	65	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	brown, whitish,
Shrub cover <2 m (%):	65	**Soil:**	sandy loam,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Very Good, EPA (2016)	**Disturbance**	litter,
Land system:	Lefroy System		
Vegetation description and type:	Low *Tecticornia undulata*, *T. pruinosa* and *T. syncarpa*		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia pruinosa	25.0	00.50		
Tecticornia syncarpa	20.0	00.40		
Tecticornia undulata	20.0	00.30		

Site details			
Site:	RIP027-02	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.231745, 121.732271 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	15	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-orange,
Shrub cover <2 m (%):	15	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	gypsum
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Darwinia* sp. Karonie shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	15.0	00.40		

Site details			
Site:	RIP027-03	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.231691, 121.732275 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	25	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-brown,
Shrub cover <2 m (%):	25	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Darwinia* sp. Karonie shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	25.0	00.40		

Site details			
Site:	RIP027-04	**Type:**	Transect (3 m x 3 m)
Date(s):	19 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.231712, 121.732224 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	10	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	red-orange,
Shrub cover <2 m (%):	10	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Isolated *Acacia ligulata* trees over open *Grevillea acuaria* and *Maireana pentratropis* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Grevillea acuaria	10.0	00.40		
Acacia ligulata	00.1	04.00		
Maireana pentatropis	00.1	00.40		

Site details			
Site:	RIP028-01	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.251376, 121.733471 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	15	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	15	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low open *Tecticornia mellarium*, *T. undulata* and *T. pterygosperma* subsp. *pterygosperma* chenopod shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia undulata	13.0	00.10		
Tecticornia mellarium	02.0	00.10		P1 (WC Act)
Tecticornia pterygosperma subsp. *pterygosperma*				

Site details			
Site:	RIP028-02	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.251356, 121.733356 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	60	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	60	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	calcrete
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Darwinia* sp. Karonie shrubland with isolated *Cassytha* sp.		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	60.0	00.40		
Cassytha sp.	00.1	00.40		

Site details			
Site:	RIP028-03	**Type:**	Transect (3 m x 3 m)
Date(s):	18 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.251375, 121.733267 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	40	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	calcrete
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Darwinia* sp. Karonie shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Darwinia sp. Karonie (K. Newbey 8503)	40.0	00.30		

Site details			
Site:	RIP045-01	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248441, 121.815958 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	35	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	35	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Tecticornia undulata* and *Frankenia cinerea* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Frankenia cinerea	34.0	00.10		
Tecticornia undulata	01.0	00.10		

Site details			
Site:	RIP045-02	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248515, 121.816004 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	45	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	45	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Frankenia cinerea* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Frankenia cinerea	45.0	00.10		

Site details			
Site:	RIP045-03	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248601, 121.816084 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	45	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	45	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Frankenia cinerea* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Frankenia cinerea	45.0	00.10		

Site details			
Site:	RIP045-04	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248587, 121.816107 (North-west)

Vegetation		Physical features	
Total vegetation cover (%):	55	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	55	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Low *Frankenia cinerea* shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Frankenia cinerea	55.0	00.10		

Site details			
Site:	RIP045-05	**Type:**	Transect (3 m x 3 m)
Date(s):	17 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.248765, 121.816234 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	25	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	25	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	quartz
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none,
Land system:	Lefroy System		
Vegetation description and type:	Mid *Jacksonia arida* open shrubland		

Species	Cover (%)	Height (m)	Weed	Conservation status
Jacksonia arida	25.0	01.80		

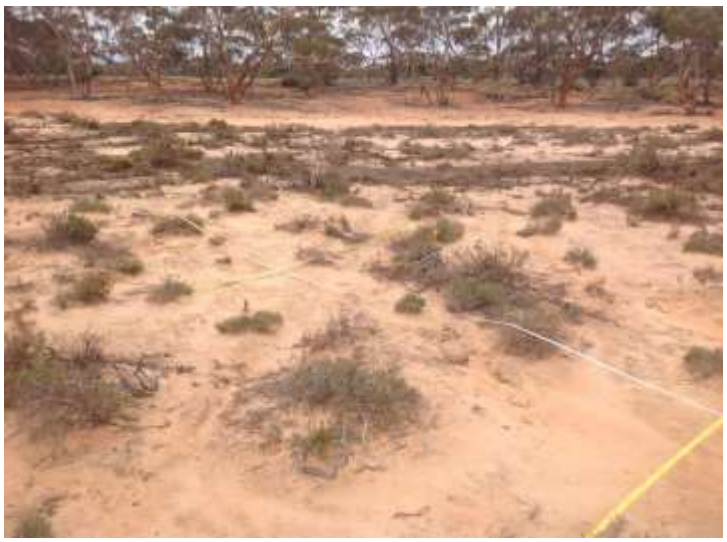
Site details			
Site:	SI010-01	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.494388, 121.719032 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	35	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	35	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none
Land system:	Lakeside System		
Vegetation description and type:	Low *Tecticornia* ? *moniliformis* and *Frankenia fecunda* shrubland over isolated *Disphyma crassifolium* and *Surreya diandra* forbs		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia ? *moniliformis*	30.0	00.40		
Frankenia fecunda	05.0	00.10		
Maireana oppositifolia	02.0	00.30		
Surreya diandra	01.0	00.20		
Disphyma crassifolium	00.1	00.05		

Site details			
Site:	SI010-02	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.494402, 121.719188 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	20	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	20	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	1	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none
Land system:	Lakeside System		
Vegetation description and type:	Low *Jacksonia arida*, *Tecticornia* sp. sterile 1 and *Frankenia fecunda* open shrubland over isolated *Disphyma crassifolium* forbs and *Eragrostis dielsii* tussock grasses		

Species	Cover (%)	Height (m)	Weed	Conservation status
Frankenia fecunda	10.0	00.20		
Jacksonia arida	05.0	00.50		
Tecticornia sp. sterile 1	05.0	00.30		
Disphyma crassifolium	01.0	00.05		
Eragrostis dielsii	00.1	00.05		

Site details			
Site:	SI010-03	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.494226, 121.719346 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	40	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none
Land system:	Lakeside System		
Vegetation description and type:	Low *Frankenia fecunda* and *Tecticornia* sp. sterile 1 shrubland over isolated clumps of *Surreya diandra* and *Dasyphium crassifolium* forbs		



Species	Cover (%)	Height (m)	Weed	Conservation status
Frankenia fecunda	30.0	00.20		
Tecticornia sp. sterile 1	05.0	00.20		
Surreya diandra	00.1	00.20		
Disphyma crassifolium	00.1	00.05		

Site details			
Site:	SI010-04	**Type:**	Transect (3 m x 3 m)
Date(s):	16 January 2018	**Permanent:**	No
Observer(s):	Grant Wells	**Position:**	-31.494116, 121.719512 (North-west)
Vegetation		**Physical features**	
Total vegetation cover (%):	40	**Topography:**	sand dune
Tree/shrub cover >2 m (%):	0	**Soil colour:**	yellow,
Shrub cover <2 m (%):	40	**Soil:**	sand,
Grass cover (%):	0	**Rock type:**	none
Herb cover (%):	0	**Fire age:**	not evident
Vegetation condition:	Excellent, EPA (2016)	**Disturbance**	none
Land system:	Lakeside System		
Vegetation description and type:	Low open *Frankenia fecunda* and *Tecticornia* sp. sterile 1. over isolated clumps of *Surreya diandra* and *Disphyssa crassifolium* forbs		

Species	Cover (%)	Height (m)	Weed	Conservation status
Tecticornia sp. sterile 1	30.0	00.40		
Surreya diandra	05.0	00.10		
Frankenia fecunda	02.0	00.10		
Disphyma crassifolium	00.1	00.05		

Appendix 3 Taxa recorded in the additional study area, by family

Family	Genus and species
Aizoaceae	*Disphyma crassifolium*
Amaranthaceae	*Surreya diandra*
Chenopodiaceae	*Maireana oppositifolia*
Chenopodiaceae	*Maireana pentatropis*
Chenopodiaceae	*Tecticornia* ?*moniliformis*
Chenopodiaceae	*Tecticornia indica* subsp. *bidens*
Chenopodiaceae	*Tecticornia lepidosperma*
Chenopodiaceae	*Tecticornia lylei*
Chenopodiaceae	*Tecticornia mellarium* (P1 WC Act)
Chenopodiaceae	*Tecticornia peltata*
Chenopodiaceae	*Tecticornia pruinosa*
Chenopodiaceae	*Tecticornia pterygosperma* subsp. *pterygosperma*
Chenopodiaceae	*Tecticornia* sp. Dennys Crossing
Chenopodiaceae	*Tecticornia* sp. sterile 1
Chenopodiaceae	*Tecticornia* sp. sterile 2
Chenopodiaceae	*Tecticornia* sp. sterile 3
Chenopodiaceae	*Tecticornia* sp. sterile 4
Chenopodiaceae	*Tecticornia syncarpa*
Chenopodiaceae	*Tecticornia undulata*
Cupressaceae	*Callitris columellaris*
Fabaceae	*Acacia ligulata*
Fabaceae	*Jacksonia arida*
Frankeniaceae	*Frankenia cinerea*
Frankeniaceae	*Frankenia fecunda*
Goodeniaceae	*Scaevola spinescens*
Lamiaceae	*Westringia cephalantha*
Lauraceae	*Cassytha* sp.
Myrtaceae	*Darwinia* sp. Karonie (K. Newbey 8503)
Poaceae	*Eragrostis dielsii*
Poaceae	*Triodia irritans*
Proteaceae	*Grevillea acuaria*