

# Lot 211 Quinns Rocks

---

## Flora and Vegetation Survey - Detailed and Targeted



Prepared for the City of Wanneroo

FEBRUARY 2020



PO Box 118  
MAYLANDS WA 6931  
Phone: (08) 9371 9491  
ABN: 15 159 204 976

---

**Project:** P1904: Lot 211 Quinns Rocks - Flora and Vegetation Survey  
**Version History:** Draft 1.0 (**Issued:** 5 February 2020) **Prepared by:** KM **Reviewed by:** CoW  
Final 1.0 (**Issued:** X January 2020 **Prepared by:** KM)

---

© 2020 One Tree Botanical Pty Ltd. Reproduction of this document in whole or in part, by any means, is strictly prohibited. Neither the document nor its contents may be referred to or quoted in any form for purposes other than stated in this document without the express approval of One Tree Botanical Pty Ltd, Terrestrial Ecosystems and City of Wanneroo.

# CONTENTS

<b>1.</b>	<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
1.1	Flora .....	1
1.1.1	Priority Flora.....	1
1.1.2	Species of ‘Other’ Conservation Significance.....	3
1.1.3	Introduced Flora .....	3
1.2	Vegetation.....	3
1.2.1	Context.....	3
1.2.2	Vegetation Types .....	4
1.2.3	Threatened Ecological Community (TEC) ( <i>EPBC Act, 1999</i> ) (Commonwealth).....	6
1.2.4	Threatened Ecological Community (TEC) ( <i>BC Act 2016</i> ) (Western Australia) .....	6
1.2.5	Priority Ecological Communities .....	6
<b>2.</b>	<b>PROJECT.....</b>	<b>7</b>
2.1	Context.....	7
2.2	Scope .....	7
<b>3.</b>	<b>BACKGROUND.....</b>	<b>9</b>
3.1	Geology Landforms and Soil.....	9
3.2	Land Use.....	9
3.3	Climate and Seasonal Conditions .....	10
3.4	Previous Studies .....	10
3.4.1	Interim Biogeographical Regionalisation of Australia (IBRA) Region .....	10
3.4.2	Vegetation Complexes (Hedde <i>et al.</i> , 1980) .....	10
3.4.3	Vegetation Survey of Western Australia (Beard, 1979).....	11
3.4.4	Flora of the Quindalup Dunes (Griffin, 1993).....	12
3.4.5	Bush Forever.....	13
3.4.6	Ecoscape (2015) .....	13
3.5	Legislation and Guidelines .....	14
3.5.1	<i>Planning and Development Act 2005</i> .....	14
3.5.2	<i>Western Australian Environmental Protection Act 1986</i> .....	15
3.5.3	<i>Western Australian Biodiversity Conservation Act 2016</i> .....	15
3.5.4	<i>Federal Environmental Protection Biodiversity Conservation Act 1999</i> .....	15
3.5.5	Flora.....	15
3.5.6	Vegetation.....	18
3.5.7	Weeds .....	21
<b>4.</b>	<b>METHODS .....</b>	<b>23</b>
4.1	Field Survey.....	23
4.1.1	Traverses.....	23
4.1.2	Quadrats.....	23
4.1.3	Opportunistic Sampling.....	23
4.1.4	Condition Assessment and Mapping .....	24
4.1.5	Licencing .....	24
4.2	Flora Identifications, Taxonomy and Nomenclature .....	25
4.3	Data Analysis.....	25
4.3.1	Floristic and Structural Analysis of Study Area Quadrats .....	25

4.3.2	Floristic Community Type (FCT) Analysis Against Gibson <i>et al.</i> (1994) Dataset .....	25
4.3.3	Other Contextual Data .....	26
4.3.4	Vegetation Mapping .....	26
4.4	Desktop Assessment .....	26
4.5	Conservation Significance Assessment .....	27
4.5.1	Threatened Species and Communities .....	27
4.5.2	Flora of ‘Other’ Conservation Significance (EPA, 2016) .....	27
4.5.3	Vegetation of ‘Other’ Conservation Significance (EPA, 2016) .....	27
<b>5.</b>	<b>RESULTS .....</b>	<b>29</b>
5.1	Flora .....	29
5.1.1	Statistics .....	29
5.1.2	Threatened and Priority Flora Database Search Results .....	30
5.1.3	Conservation Significant Flora .....	31
5.1.4	Introduced Flora .....	39
5.2	Vegetation .....	41
5.2.1	Threatened and Priority Ecological Community Search Results .....	41
5.2.2	Vegetation Type Summary .....	43
5.2.3	Detailed Vegetation Type Descriptions .....	45
5.2.5	Statistical Analysis of Vegetation .....	55
5.2.6	Conservation Significant Vegetation .....	61
<b>6.</b>	<b>DISCUSSION .....</b>	<b>63</b>
6.1	Flora .....	63
6.2	Vegetation .....	64
6.2.1	Threatened Ecological Community (TEC) ( <i>BC Act 2016</i> ) (Western Australia) .....	64
6.2.2	Priority Ecological Communities .....	67
6.2.3	Condition .....	68
6.3	Limitations .....	68
<b>7.</b>	<b>ACKNOWLEDGEMENTS .....</b>	<b>70</b>
<b>8.</b>	<b>REFERENCES .....</b>	<b>71</b>

## Figures

Figure 1:	Lot 211 Quinns Rocks Locality Map .....	8
Figure 2:	Priority Flora Location Map .....	38
Figure 3:	Vegetation Type Map .....	53
Figure 4:	Vegetation Condition Map .....	54
Figure 5:	Statistical Analysis of Quadrat Data (Bray-Ward) (floristics, foliar cover NVIS cover class) .....	56
Figure 6:	Floristic Analysis of Informal Quadrat QR17 against Gibson <i>et al.</i> (1994) dataset. ....	58
Figure 7:	Floristic Analysis of Informal Quadrat QR17 against Gibson <i>et al.</i> (1994), Griffin (1993) and miscellaneous extra unpublished data. ....	58

## Tables

Table 1:	Four Broad Groupings of Relevés Across Quindalup Dunes Between Irwin and Swan Rivers (Griffin, 1993). 12
Table 2:	Definition of Threatened Species (Flora) (Dept. Biodiversity Conservation and Attractions, 2019a). ....
Table 3:	Priority Flora Conservation Codes and Definitions (Dept. Biodiversity Conservation and Attractions, 2019a). 17
Table 4:	Categories of Threatened Flora Species under the <i>EPBC Act 1999</i> (IUCN-Equivalent Status). ....
Table 5:	Criteria for Western Australian Threatened Ecological Communities (TECs) (Dept. of Environment and Conservation, 2013) .....

Table 6:	Priority Ecological Communities (PECs) Definitions and Criteria (Dept. of Environment and Conservation, 2013).....	20
Table 7:	Threatened Ecological Communities (TECs) Definitions and Criteria ( <i>EPBC Act</i> Regulations, 2013). ....	20
Table 8:	Criteria of Weeds under WAEWS (Dept. of Conservation and Land Management, 1999) .....	21
Table 9:	Rating of Weeds under WAEWS (Dept. of Conservation and Land Management, 1999).....	21
Table 10:	Categories of Declared Pest under the <i>BAM Act 2007</i> (Dept. of Primary Industries and Regional Development, 2019).....	22
Table 11:	Vegetation Condition Rating for the South West Botanical Province (EPA, 2016) and Bush Forever Condition Scale (Keighery, 1994 from Govt. of WA, 2000).....	24
Table 12:	Dominant Vascular Plant Families Recorded in the Study Area .....	29
Table 13:	Dominant Vascular Plant Genera Recorded in the Study Area .....	29
Table 14:	Threatened and Priority Flora Database Search Results (DBCA and EPBC Act Protected Matters Databases) ..	30
Table 15:	Species of ‘Other Conservation Significance’ as Defined by EPA (2016).....	36
Table 16:	Environmental Weeds High to Moderate Rating (Dept. Conservation and Land Management, 1999) Recorded in the Study Area.....	39
Table 17:	Threatened and Priority Ecological Communities Database Search Results (DBCA PEC and TEC Databases and EPBC Protected Matters Database).....	41
Table 18:	Floristic Community Type (FCT) Analysis Summary.....	58
Table 19:	Limitations of the Assessment (EPA, 2016) .....	68

## Appendices

- Appendix A : Field Survey Species List – Flora
- Appendix B : Flora and Vegetation Species by Site Table
- Appendix C : Vegetation Detailed Site Quadrat Data
- Appendix D : Flora and Vegetation Location Data

# 1. EXECUTIVE SUMMARY

Following the closure of the Quinns Rocks Caravan Park in 2012, the City of Wanneroo began a process to evaluate the long-term future of the area.

As any development may include an expansion of the caravan park site, this study covered the entirety of Lot 211 Quinns Rocks Road Quinns Rocks (the ‘study area’).

To assist planning and for Environmental Impact Assessment (EIA) purposes, a Flora and Vegetation Survey was commissioned. The findings of the survey are presented in this report.

This report presents the findings of botanical assessment that are consistent with Technical Guide Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016) survey types:

- Targeted Survey; and
- Detailed Survey.

## 1.1.1 Flora

A total of 232 taxa were recorded from the study area, of which 128 or 55% were natives.

A DBCA Threatened Species and Communities Branch species database search did not identify any records of state listed Threatened Flora (TF) as being previously known from within the study area boundaries. The search did identify four previous records of Priority Flora from the database search. Two of these were database errors from plants collected near Bibra Lake. Two of these were records of Priority 3 Flora *Stylidium maritimum* and *Conostylis bracteata* collected during a previous survey of the site by Ecoscape (2015).

A search of the *EPBC Act* Protected Matters Search Tool (Department of Environment and Energy, 2019) listed nine Threatened Flora (TF) as potentially occurring in the region. None of these species have previously been recorded from within the study area.

No Threatened Flora (TF) species as listed under the *Biodiversity Conservation Act 2016* were recorded during the field survey. No TF under the *Environmental Protection and Biodiversity Conservation Act 1999* were recorded.

## 1.1.2 Priority Flora

During the survey six Priority Flora species were recorded from the study area during the current survey. These were a single Priority 1 species *Leucopogon maritimus*, four Priority 3 species *Hibbertia spicata* subsp. *leptotheca*, *Pimelea calcicola*, *Sarcocolla bicarinata* and *Stylidium maritimum* and a possible hybrid of a Priority 4 species *Conostylis pauciflora* subsp. *pauciflora* Intergrade *C. aculeata* subsp. *cygnorum*.

### ***Leucopogon maritimus*** (Priority 1)

This plant is a low spreading shrub to 40cm tall by 60cm wide (Plate 1) from the heath family (Ericaceae). There are 17 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) known from a small range in a narrow coastal band from Alkimos to north of Two Rocks. During the survey a single individual was recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type D1 (Figure 3).

### ***Hibbertia spicata* subsp. *leptotheca*** (Priority 3)

This plant is a low shrub to 50cm tall (Plate 3), with semi-glossy leaves and small yellow flowers on a short few-flowered spike (Plate 4) from the guinea-flower family (Dilleniaceae). Grows on shallow sand over near-coastal limestone ridges, outcrops and cliffs (WA Herbarium, 1998-). There were 36 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between south of Mandurah to north of Lancelin. 486 individuals were recorded from the study area (Figure 2) from Vegetation Type D1 (Figure 3).

***Pimelea calcicola*** (Priority 3)

This plant is a woody shrub to 1m tall (Plate 5), with opposite decussate green leaves and showy terminal clustered pink flowers (Plate 6) from the Thymelaeaceae family. Grows on coastal limestone ridges (WA Herbarium, 1998-). There were 27 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between south of Mandurah and Seabird. During the survey a single individual was recorded from the study area (Figure 2) from the boundary of Vegetation Types D1 and D2 (Figure 3).

***Sarcozona bicarinata*** (Priority 3)

This plant is a perennial herb or subshrub to 10cm tall, with fleshy succulent leaves (Plate 8) from the Pigface family (Aizoaceae). Grows on white sand (WA Herbarium, 1998-). There were 6 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mindarie and Seabird. Also known from the coastline around Adelaide. During the survey five individuals were recorded from the study area (Figure 2) mainly from Vegetation Type D1 with one record in D2 (Figure 3).

***Stylidium maritimum*** (Priority 3)

This plant is a perennial herb to 70cm tall, with tufted linear strappy grass-like leaves (Plate 9) 10-40cm long to 5.5cm wide from the triggerplant family (Stylidiaceae). Grows on sand over limestone, dunes, coastal heath and/or *Banksia* woodland (WA Herbarium, 1998-). There were 42 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mandurah and Leeman. During the survey 392 individuals were recorded from the study area (Figure 2) mainly from Vegetation Type D1 (Figure 3).

***Conostylis pauciflora* subsp. *pauciflora* Intergrade *C. aculeata* subsp. *cygnorum*** (Priority 4)

This plant is a low herb with strappy variously hairy grass-like leaves to 40cm tall by 60cm wide (Plate 11) from the Kangaroo Paw and Bloodroot family (Haemodoraceae). *Conostylis pauciflora* subsp. *pauciflora* is a Priority 4 species. The plants in the project area are likely to be a hybrid between this species and the more common *C. aculeata* subsp. *cygnorum*. It appears that a previous survey (Ecoscape, 2015) identified this entity as *C. bracteata*. *Conostylis pauciflora* and *C. bracteata* are supposedly stabilised hybrids between *C. aculeata* and *C. candicans*, however the boundaries are often blurred between the groups. It is likely that whichever entity is present in the study area, it is likely to all be the same. The same duty botanist confirmed the identity of the material from both this study and the Ecoscape (2015) study. They stated that further taxonomic work was required on this group.

There were 14 collections of *C. pauciflora* subsp. *pauciflora* in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) known from Preston in the south and Two Rocks in the north. *C. aculeata* subsp. *cygnorum* has a similar north-south range, between Mandurah to near Yanchep, but generally

occurs further inland. During the survey approximately 91 individuals were recorded from the study area (Figure 2) mainly from Vegetation Type C1 (Figure 3).

#### 1.1.3 Species of ‘Other’ Conservation Significance

A potential new discovery was also recorded.

##### ***Tetragonia tetragonoides* sens. lat.**

The duty botanist at the WA Herbarium stated that there was one other similar specimen of this type at the WA Herbarium, collected by G.J. Keighery (PERTH 11361) from Mullaloo. This was determined as *Tetragonia tetragonoides* sens. lat. by Aizoaceae specialist Bob Chinnock. However, the fruit is not typical for that species and the stamen number appears to be consistently 4, which is also not typical. The conclusion by the duty botanist was that it may well be a different taxon, with the possibility that it is an introduction. A single specimen (Figure 2) was seen in the study area, on relatively bare ground underneath *Melaleuca cardiophylla*.

#### 1.1.4 Introduced Flora

Of the 104 species of introduced flora recorded in the study area, 13 were given a High rating for invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (Department of Conservation and Land Management, 1999) (Table 16). Thirty-seven weeds recorded in the study area were given a Moderate rating.

Three declared pest plant species on the WA Organism List (WAOL) under the *Biosecurity and Agriculture Management Act 2007* were recorded. One-leaf Cape Tulip *\*Moraea flaccida* is a Declared Pest for the City of Wanneroo. Athel Pine *\*Tamarix aphylla* is listed as a Declared Pest for the whole of the state. Lantana *\*Lantana camara* is a woody shrub usually to 3m but often taller that is a Declared Pest for the whole of the state.

Three Weeds of National Significance (WONS) were recorded in the study area, Bridal Creeper *\*Asparagus asparagoides*, Lantana *\*Lantana camara* and Athel Pine *\*Tamarix aphylla*.

## 1.2 VEGETATION

### 1.2.1 Context

The study area is in the Interim Biogeographical Regionalisation of Australia (IBRA) region of the Swan Coastal Plain (SCP) in sub-region SWA2: Perth (Thackway and Cresswell, 1995) (Department of Environment and Heritage, 2000).

According to 1:250,000-scale vegetation mapping by Heddle *et al.* (1980), the study area is on a transition between vegetation Complex 55: Quindalup in the Quindalup Dunes and Complex 52: Cottesloe Complex-Central and South in the Spearwood Dunes.

The original extent of Quindalup Complex within the IBRA region of Swan Coastal Plain has been calculated as 54,573.87 hectares, of which 33,011.637 hectares or 60.49 % remains (Government of Western Australia, 2019a).

The original extent of Cottesloe Complex-Central and South within the IBRA region of Swan Coastal Plain has been calculated as 45,299.61 hectares, of which 14,567.86 hectares or 32.16 % remains (Government of Western Australia, 2019a).

Beard (1979) mapped the study area as bLi: Banksia Low Woodland. Within the Guilderton System, which is the vegetation of the Quindalup Dunes between Fremantle to Green Head. Shepherd *et al.* (2002) defined this vegetation type as Vegetation Association 949: “Low woodland; banksia”

Vegetation Association 949 is described as originally consisting of 218,194 hectares of which 123,104 hectares or 56% remains. Of what remains, 37,569 hectares or 13.81% is protected or proposed for protection (Government of WA, 2019b). The study area is part of a Bush Forever site therefore it would represent a part of those areas protected or proposed for protection.

The study area is within Bush Forever Site 397: “Coastal Strip from Wilbinga to Mindarie”. Bush Forever Site 397 is approximately 400 hectares in size in total.

Inferred Floristic Community Types present in Bush Forever Site 397 were listed as:

- **Supergroup 2:** Seasonal Wetlands:
- FCT 16: Highly saline seasonal wetlands (*Frankenia pauciflora* on Tamala Limestone Cliffs)
- **Supergroup 4:** Uplands centred on Quindalup and Spearwood Dunes.
- FCT 29a: Coastal shrublands on shallow sands.
- FCT 29b: *Acacia* shrublands on taller dunes.
- FCT S11: Northern *Acacia rostellifera* – *Melaleuca systema* shrublands.
- FCT S13: Northern *Olearia axillaris* – *Scaevola crassifolia* shrublands.
- FCT S14: *Spinifex longifolius* grasslands and low shrublands.

### 1.2.2 Vegetation Types

Nine intact and four variously disturbed vegetation types were identified within the study area:

#### **A DUNES ON UNCONSOLIDATED SAND**

**A1: Primary Dune:** Open Shrubland *Olearia axillaris* and *Scaevola crassifolia* over Grassland *Spinifex longifolius* with patches of *S. hirsutus* near beach.

#### **B: COASTAL LIMESTONE CLIFF**

**B1: Above Ridgeline:** Shrubland *Scaevola crassifolia*, *Myoporum insulare*, *Thomasia triphylla* and *\*Tetragonia decumbens*, Sparse Vineland *Hardenbergia comptoniana* Sparse Forbland *Acanthocarpus preissii* and Sparse Sedgeland *Lepidosperma gladiatum*.

**B2: Cliff Face:** Scattered Shrubs to Shrubland *Frankenia pauciflora* var. *pauciflora*, *Scaevola crassifolia*, *Thomasia triphylla* and *\*Tetragonia decumbens*.

#### **C: INLAND DUNES ON SEMI-CONSOLIDATED SAND**

**C1: Dune Slopes and Crests:** Low Shrubland (<0.5m) dominated by *Melaleuca systema* but also typically *Acacia rostellifera*, *Spyridium globulosum*, *Phyllanthus calycinus* and *Cryptandra mutila*. Forbland dominated by *Lomandra maritima* but also typically *Acanthocarpus preissii* and *Opercularia vaginata*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland *Desmocladius*

*asper* and Sparse Tussock Grassland *Austrostipa flavescens*, *Poa porphyroclados* and weeds *\*Lagurus ovatus*, *\*Bromus diandrus*.

**C2: Dune Swales and Lower Slopes:** Shrubland to Open Shrubland of often tall emergent *Acacia cyclops* over *Spyridium globulosum*, *Banksia sessilis* var. *cygnorum*, *Calothamnus quadrifidus* var. *quadrifidus* and *Rhagodia baccata* subsp. *baccata*. Vineland *Hardenbergia comptoniana*, *Clematis linearifolia* and *Cassytha racemosa* forma. *racemosa*. Forbland mixed but typically included *Conostylis aculeata* subsp. *cygnorum*, *Dianella revoluta* var. *divaricata*, *Acanthocarpus preissii* and weeds *\*Crassula glomerata*, *\*Stellaria media* and *\*Galium murale*. Often Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmoclados flexuosa* and Sparse to Open Tussock Grassland.

**D: SHALLOW SANDS OVER LIMESTONE**

**D1: Crests of Low Limestone Ridges:** Open Shrubland to Shrubland dominated by *Melaleuca huegelii* subsp. *huegelii* but species rich with other typical shrubs *Templetonia retusa*, *Grevillea preissii* subsp. *preissii*, *Acacia truncata*, *Melaleuca systema*, *Trymalium ledifolium* var. *ledifolium*, *Hibbertia spicata* subsp. *leptotheca* (P3). Sparse Forbland also species-rich, dominated by *Lomandra maritima*, *Opercularia vaginata*, *Tricoryne elatior*, *Stylidium maritimum* (P3) and weeds *\*Minuartia mediterranea* and *\*Galium murale*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland to Rushland *Desmoclados asper* and *D. flexuosus* and Sparse Tussock Grassland *Austrostipa flavescens*, *\*Bromus diandrus* and *\*Lolium perenne*.

**D2: Upper Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Melaleuca cardiophylla* with *Rhagodia baccata* subsp. *baccata* over Forbland *Rhodanthe corymbosa*, *Calandrinia brevipedata*, *C. tholiformis*, *Crassula colorata* var. *acuminata*, *Daucus glochidiatus* and weeds *\*Stellaria media* and *\*Minuartia mediterranea* and/or Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared) with bare understorey.

**D3: Lower Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Banksia sessilis* var. *cygnorum* with *Rhagodia baccata* subsp. *baccata* over Forbland of weeds *\*Galium murale*, *\*Crassula glomerata*, *\*Euphorbia terracina* and Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared).

**D4: Periphery of Low Limestone Ridges:** Closed tall Shrubland to Forest *Melaleuca lanceolata* over Isolated Shrubs *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa*.

**E: MODIFIED OR MANAGED AREAS**

**E1: Historically Disturbed Areas:** informal and formal walking paths, vehicular tracks, infrastructure, firebreaks, ex-caravan park site. Degraded to Completely Degraded.

**E2: Cultivated or Managed Areas:** Includes rehabilitated areas along the foreshore. Revegetation or landscaping using more or less local species.

**E3: Regrowth (cleared 2004-2006).** Closed tall Shrubland to Forest *Acacia rostellifera* over mainly bare ground and/or patches of weeds but with isolated Shrubs *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa* and various scattered native species representative of adjacent vegetation types.

**E4: Weedy Eucalypt.** Closed Mallee Forest *\*Eucalyptus utilis*. Over scattered native species and weeds.

See Figure 3 for a map of vegetation type. Condition was patchy across the study area. See Figure 4 for a map of vegetation condition.

#### 1.2.3 Threatened Ecological Community (TEC) (*EPBC Act, 1999*) (Commonwealth)

No Threatened Ecological Communities (TECs) protected under the Commonwealth *EPBC Act 1999* were recorded in the study area.

#### 1.2.4 Threatened Ecological Community (TEC) (*BC Act 2016*) (Western Australia)

It appeared that a ‘type or sub-type’ of a TEC listed under the Western Australian *Biodiversity Conservation Act 2016* SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain” may be present in the study area. There was significant ambiguity surrounding this record, please see Section 6.2.1 for a full discussion.

#### 1.2.5 Priority Ecological Communities

Two Priority 3 PECs were recorded in the study area:

- **PEC SWAN 21** (FCT29a): “Coastal shrublands on shallow sands, southern Swan Coastal Plain”.
- **PEC SWAN 26** (FCT24): “Northern Spearwood shrublands and woodlands”

Priority 3 (P3) PECs are generally poorly known ecological communities. All intact vegetation across the site represented P3 PECs. This vegetation was mainly in Good to Very Good condition, with localised Degraded patches.

PEC SWAN 21 (FCT29a) occurred approximately across the western half of the study area, while PEC SWAN 26 (FCT24) occurred in the eastern half. The study area occurred on the transition between the Quindalup Dunes and an unusual near-coastal example of the Spearwood Dunes. FCT29a occurred mainly in areas mapped as the Quindalup Dunes and FCT24 was more typical in areas mapped as Spearwood Dunes.

Vegetation Type D1 (Figure 3) from the limestone ridges in the study area is likely to be an unusual vegetation type. It had elements of FCT24, FCT29a and some floristic elements also from FCT26a, which is a state listed TEC. It was very species rich, particularly for near coastal vegetation, with the three quadrats containing  $68.7 \pm 3.5$  taxa. It was the most intact vegetation in the study area. It supported five Priority Flora species, two of which were dominants in their respective strata. It is unlikely that these co-occur anywhere else. It is very unusual in near-coastal vegetation to record such a high number of conservation significant species. Regardless of its formal status, due to all these factors combined, Vegetation Type D1 (Figure 3) is likely to be extremely conservation significant.

## 2. PROJECT

### 2.1 CONTEXT

Following the closure of the Quinns Rocks Caravan Park in 2012, the City of Wanneroo began a process to evaluate the long-term future of the area.

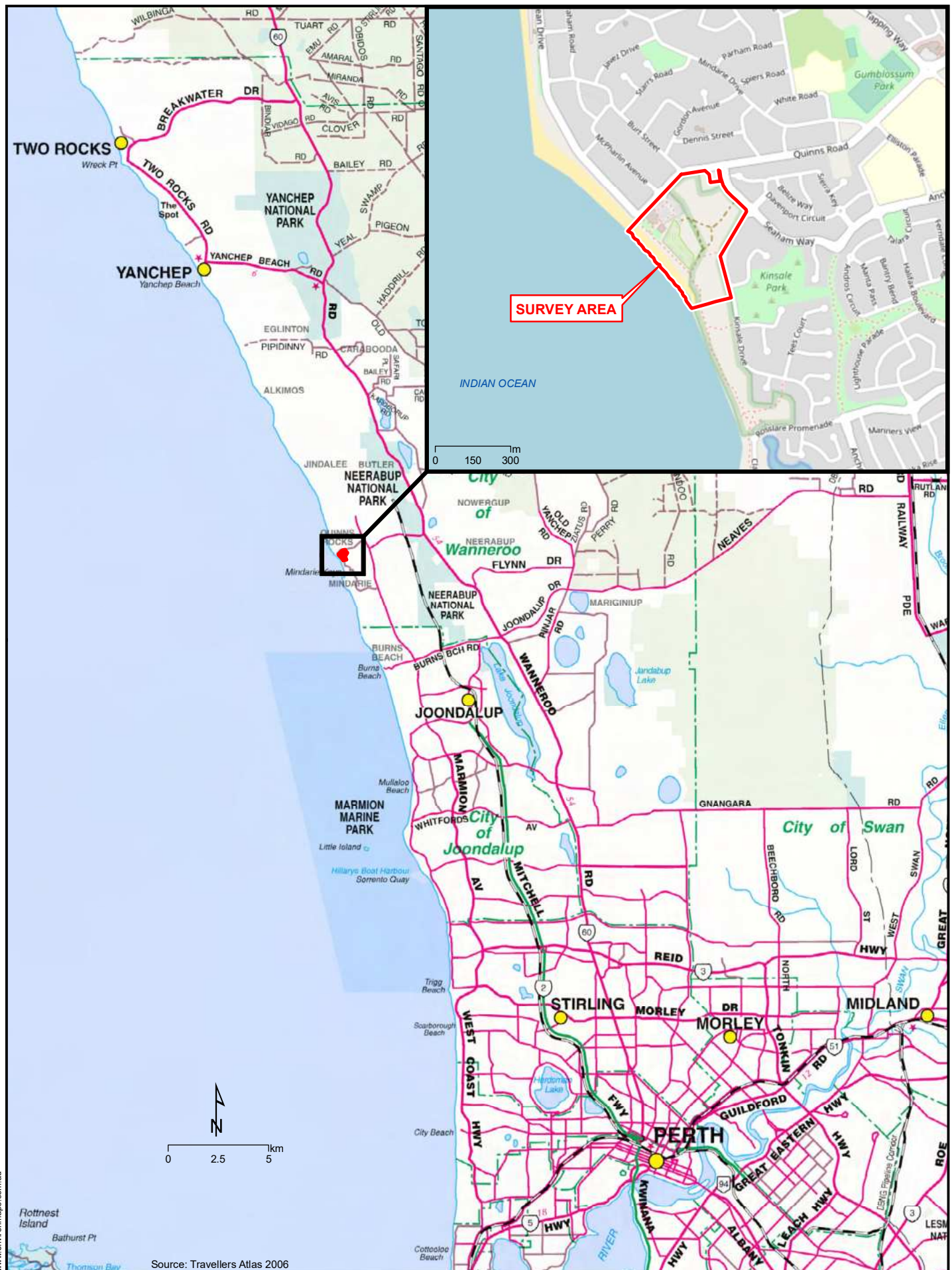
As any development may include an expansion of the caravan park site, this study covered the entirety of Lot 211 Quinns Rocks Road Quinns Rocks (the ‘study area’). The study area is owned freehold by the City of Wanneroo and includes the Quinns Mindarie Surf Lifesaving Club and Portofinos Restaurant. It is 11.042 hectares in size, of which approximately half is vegetated. The study area is within Bush Forever Site 397: “Coastal Strip from Wilbinga to Mindarie”.

To assist planning and for Environmental Impact Assessment (EIA) purposes, a Flora and Vegetation Survey was commissioned. The findings of the survey are presented in this report.

### 2.2 SCOPE

This report presents the findings of botanical assessment that are consistent with Technical Guide Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016) survey types:

- Targeted Survey; and
- Detailed Survey.



Source: Travellers Atlas 2006

Client: City of Wanneroo  
 Job: P1904 - Quinns Rocks  
 Date: 21/01/2020  
 E: kelli@onetreebotanical.com.au  
 P: (08) 9371 9491  
 M: 0407 423 928

ONE TREE  
 BOTANICAL

FIGURE 1

# LOT 211 QUINNS ROCKS LOCALITY MAP

## 3. BACKGROUND

### 3.1 GEOLOGY LANDFORMS AND SOIL

The study area is a part of the Swan Coastal Plain, a sedimentary plain of largely aeolian deposits approximately 20-30km wide between the Darling Scarp in the east and the Indian Ocean in the west. The sedimentation consists of aeolian deposits formed into a series of sand dunes. Churchward and McArthur (1980) describe the dune systems of the Swan Coastal Plain as arranged in an age sequence from east to west. The Bassendean Dunes are the oldest in the east, the Spearwood then the Quindalup the youngest dunes are closest to the coast in the west.

The study area is on a transition area between the Quindalup and Spearwood Dunes. Unusually the Spearwood Dunes extend all the way to the coast at the south end of the study area.

Quindalup Dunes are described as calcareous sands formed into parabolic dunes and beach ridge plains. These can then further be divided into four age profiles. Q4 dunes (Vegetation Type A1) (Figure 3) are the youngest and least extensive of the four phases and occur on the seaward margin of the Quindalup Dunes. Where Q4 consist of low dune systems, further inland Q3 dunes are taller and steeper. These are also not extensive as Q1 and Q2 further inland. Both Q3 and Q4 are characterised by unconsolidated sandy soil that has little organic matter. Q3 dunes (possibly Vegetation Type C1) (Figure 3) occur further inland again and extend up to 4km. These and are the most widespread in the Quindalup Dune system. They are taller dunes with consolidated sand at their core, with an organic rich soil profile (Gozzard, 2007). Q1 dunes are the oldest and furthest inland. These sit lower in the landscape and also consist of consolidated sand with an organic rich soil profile.

Gozzard (2007) further describes the coastal landforms as including Tamala Limestone, extensive but discontinuous pockets of limestone described as “cemented coastal sand dunes” and “calcreted surfaces (beach rock), karstic features (sinkholes, caves), raised beaches, and elevated shoreline platforms”.

The Spearwood Dunes generally occur further inland, in a band 3km to 15km wide and are older than the Quindalup Dunes. They are irregular dune systems that formed from aeolian deposits derived from Tamala Limestone.

Both dune systems can include outcroppings of Tamala Limestone.

### 3.2 LAND USE

Adjacent to the beach in the northern part of the study area includes a surf lifesaving club and restaurant and associated car parks and gardens.

To the south of this is the vacant site of the old Quinns Rocks Caravan Park. This was established in the 1960's and closed in 2012. All infrastructure associated with the park has been removed in recent years. All that remains is bare areas with road base, a park area and some remnant garden plants.

A well utilised near-coastal walk path runs in a north-south direction through the study area.

The eastern half of the study area supports natural vegetation. There are formal walking paths through the area. Condition is patchy indicating a disturbance history of some kind, perhaps grazing. Historical aerial photography shows localised clearing occurring in patches, particularly around 2006. These areas had grown back but represented disturbed vegetation types with high weed cover in the understorey.

### 3.3 CLIMATE AND SEASONAL CONDITIONS

The closest Bureau of Meteorology (BoM) weather recording station with long term data is Wanneroo (Site No. 009105) (Latitude: 31.73° S, Longitude: 115.79° E). The mean annual rainfall between 1905 and 2018 for Wanneroo is 795.8mm (Bureau of Meteorology, 2019). Most rainfall (724.4mm) occurs between the months of April and October.

Rainfall for the months of April to September 2019 leading up to the field survey was 517.2mm. This is compared to 113-year average for Wanneroo over the same period of 677.5mm. This represented a 23% rainfall shortfall from the long-term mean.

### 3.4 PREVIOUS STUDIES

#### 3.4.1 Interim Biogeographical Regionalisation of Australia (IBRA) Region

The study area is in the Interim Biogeographical Regionalisation of Australia (IBRA) region of the Swan Coastal Plan (SCP) in sub-region SWA2: Perth (Thackway and Cresswell, 1995) (Department of Environment and Heritage, 2000).

#### 3.4.2 Vegetation Complexes (Heddlé *et al.*, 1980)

According to 1:250,000-scale vegetation mapping by Heddlé *et al.* (1980), the study area is on the boundary of two vegetation complexes. Vegetation Complex 55: “Quindalup” and an unusual near-coastal occurrence of Spearwood Dunes: Vegetation Complex 52: “Cottesloe Complex-Central and South”. The Quindalup Complex covers a quarter of the study area, along the north west boundary running approximately parallel to Quinns Road. The remainder is Spearwood Dunes: Cottesloe Complex-Central and South.

#### *Vegetation Complex 55: Quindalup*

Heddlé *et al.* (1980) describe this vegetation as being restricted to coastal dunes that can be divided into two alliances:

- The foredunes and beach strand which contain *Angianthus cunninghamii*, *\*Trachyandra divaricata*, *\*Arctotheca populifolia*, *Atriplex isatidea*, *\*Cakile maritima*, *Leucophyta brownii*, *Carpobrotus virescens*, *\*Pelargonium capitatum*, *Senecio lautus*, *Acites megalocarpus*, *Spinifex longifolius*, *\*Tetragonia decumbens* and *T. implexicoma*.
- Mobile and stable dune alliance which contains *Acacia cyclops*, *Anthocercis littorea*, *Lepidosperma gladiatum*, *Myoporum insulare*, *Nitraria billardiarei*, *Olearia axillaris*, *Scaevola crassifolia*, *S. nitida*, *Spyridium globulosum*, *Westringia dampieri* and *Wilsonia backhousei*, with the composition depending on the degree of protection from salt laden winds. Other variations include *Eucalyptus foecunda*, *Santalum*, *acuminatum*, *Exocarpos sparteus* and *Acacia rostellifera*. Small localised pockets of *Melaleuca lanceolata* and *Callitris preissii* occur, uncommon but were once more widespread along the coast.

Government of Western Australia (2019a) describe it as a “Coastal dune complex consisting mainly of two alliances - the strand and fore-dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata* (Rottneest Teatree) - *Callitris preissii* (Rottneest Island Pine), the closed scrub of *Acacia rostellifera* (Summer-scented Wattle) and the low closed *Agonis flexuosa* (Peppermint) forest of Geographe Bay”.

The original extent of Quindalup Complex within the IBRA region of Swan Coastal Plain has been calculated as 54,573.87 hectares, of which 33,011.637 hectares or 60.49 % remains (Government of Western Australia, 2019a).

16.16% of what remains of the Quindalup Complex is located within the City of Wanneroo LGA boundary. Within the City of Wanneroo, the original extent of the Quindalup Complex was 8,818.26 hectares of which 5,352.77 hectares or 60.70% remains (Government of Western Australia, 2019a).

These figures do not take into account fully the condition of the remaining areas or rarer vegetation types that constitute the complexes. Nomenclature and taxonomy used in these descriptions has been updated from that used in the original publication.

### *Vegetation Complex 52: Cottesloe Complex-Central and South*

This vegetation is described by Heddle *et al.* (1980) as supporting heath on limestone outcrops which 'resemble those in the north' (Cottesloe Complex-North). Characteristic understorey species associated with limestone outcrops are described as including *Melaleuca huegelii*, *M. cardiophylla*, *Trymalium ledifolium*, *Grevillea thelemanniana* (now *G. preissii*), *G. vestita*, *Jacksonia hakeoides* and *Conospermum triplinervium*. With deeper sands supporting a mosaic of Tuart woodland and open forest of Tuart-Jarra-Marri.

Government of Western Australia (2019a) describe this complex as a "Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops". It is unclear why this publication described mainly one vegetation type of the many that are known to be present in this complex.

The original extent of Cottesloe Complex-Central and South within the IBRA region of Swan Coastal Plain has been calculated as 45,299.61 hectares, of which 14,567.86 hectares or 32.16 % remains (Government of Western Australia, 2019a).

29.39% of what remains of the Cottesloe Complex-Central and South is located within the City of Wanneroo LGA boundary. Within the City of Wanneroo, the original extent of the Quindalup Complex was 13,313.58 hectares of which 5,545.39 hectares or 41.65% remains (Government of Western Australia, 2019a).

These figures do not take into account fully the condition of the remaining areas or rarer vegetation types that constitute the complexes. Nomenclature and taxonomy used in these descriptions has been updated from that used in the original publication as much as was possible.

### 3.4.3 Vegetation Survey of Western Australia (Beard, 1979)

Beard (1979) mapped the study area as bLi: Banksia Low Woodland. Within the Guilderton System, which is the vegetation of the Quindalup Dunes between Fremantle to Green Head. Shepherd *et al.* (2002) defined this vegetation type as Vegetation Association 949: "Low woodland; banksia"

Beard (1979) describes the narrow beach strand as being colonised by *\*Cakile maritima* and *\*Arctotheca calendula*, *Spinifex hirsutus* and *S. longifolius* with *\*Ammophila arenaria* and *\*Tetragonia decumbens*. Sheltered hollows behind the foredunes are described as supporting *\*Tetragonia decumbens*, *Ficinia nodosa*, *Leucophyta brownii*, *Carpobrotus* sp. and *Spinifex longifolius*.

On the crests of taller dunes, the vegetation is described as becoming thicker with shrubs *Myoporum insulare*, *Scaevola crassifolia*, *Olearia axillaris*, *Acacia cyclops* and *Lepidosperma gladiatum*. Shrubs are wind pruned on the windward side and taller and more luxuriant on the sheltered landward side. Further inland on stable dunes sheltered from the wind are low dense thicket of *Olearia axillaris*, *Melaleuca systena* and *Acacia lasiocarpa*. Taller thickets to low forests can form, but are frequently destroyed by fire, with taller species including *Callitris preissii* (now uncommon and possibly the apex community) and *Acacia rostellifera* (most common). The latter often occurs with *Melaleuca huegelii*, *Acacia cyclops*, *A. cochlearis* and *Dodonaea aptera*. Fire is described as returning the apex community to the *Melaleuca systena*/*Acacia lasiocarpa* low dense thicket.

Vegetation Association 949 is described by Government of WA (2019b) as “Low woodland; banksia”.

Vegetation Association 949 is described as originally consisting of 218,194 hectares of which 123,104 hectares or 56% remains. Of what remains, 37,569 hectares or 13.81% is protected or proposed for protection (Government of WA, 2019b). The study area is part of a Bush Forever site therefore it would represent a part of those areas protected or proposed for protection.

It is worth noting that while these mapped units are described as ‘vegetation associations’, they actually represent broader groupings of a number of vegetation associations. Which means that extent remaining figures in that context can be misleading in terms of accurately reflecting how much of an individual vegetation association remains.

Nomenclature and taxonomy used in these descriptions has been updated from that used in the original publication.

#### 3.4.4 Flora of the Quindalup Dunes (Griffin, 1993)

Griffin (1993) surveyed the Quindalup Dunes between the Irwin and Swan Rivers. The methodology used was similar to that used in this survey in terms of collecting floristic data within plant communities. While this current study used 100m<sup>2</sup> bounded quadrats, Griffin (1993) used unmeasured quadrats that approximated 100m<sup>2</sup>. They referred to them as relevés (although strictly speaking in vegetation science, a relevé is a measured quadrat).

Griffin described the difficulty in defining vegetation of the Quindalup Dunes in traditional sense. They investigated several methods including analysing presence/absence and cover of relevé data. Their conclusion was that floristic presence/absence was the most useful parameter to use across such a large geographical area.

Table 1 presents perhaps the most contextually useful grouping of relevé data in the context of this study.

Table 1: Four Broad Groupings of Relevés Across Quindalup Dunes Between Irwin and Swan Rivers (Griffin, 1993).

<b>1: Incipient Foredunes</b>	<b>Mainly on very young land surfaces.</b> Usually dominated by <i>Spinifex longifolius</i> and <i>*Tetragonia decumbens</i> , but also in places <i>Spinifex hirsutus</i> , <i>Atriplex isatidea</i> or <i>A. cinerea</i> .
<b>2: Foredunes &amp; Young Beach Ridge Plains</b>	<b>Mainly on very young land surfaces.</b> Usually dominated by <i>Olearia axillaris</i> and <i>Scaevola crassifolia</i> but also important in some were <i>Myoporum insularis</i> , <i>Rhagodia baccata</i> and <i>Acanthocarpus preissii</i> .

	<p><b>Variable depending on age and land surface:</b></p> <p><b>3a:</b> More or less bare. Important species were variable but included one or several of the following: <i>Leucophyta brownii</i>, <i>Opercularia vaginata</i>, <i>Hibbertia racemosa</i> and <i>Scaevola crassifolia</i>.</p> <p><b>3b:</b> Very young. Dominance generally was low but main species usually were <i>Allocasuarina lehmanniana</i>, <i>Spyridium globulosum</i>, <i>Gastrolobium capitatum</i> or <i>Banksia sessilis</i>.</p> <p><b>3c:</b> Young. Similar species to 3b above usually quite dominant but also important were <i>Acrotriche cordata</i> or <i>Acacia truncata</i>.</p> <p><b>3d:</b> Older. Tended to be dominated by <i>Melaleuca systema</i> and <i>M. huegelii</i> or <i>M. cardiophylla</i> or <i>Thryptomene baeckeacea</i> or <i>Banksia sessilis</i>.</p>
<b>4: Inland Dunes</b>	<p><b>Variable depending partly on age:</b></p> <p><b>4a:</b> Younger. Tending to be dominated by <i>Acacia rostellifera</i> and in some cases <i>Melaleuca huegelii</i> or <i>M. cardiophylla</i> tall shrublands, with <i>Acanthocarpus preissii</i>; and</p> <p><b>4b:</b> Older. With much less <i>Acacia rostellifera</i> but with <i>Melaleuca systema</i> usually dominant with combinations of <i>Desmocladius flexuosus</i> (would include <i>D. aspera</i>) and <i>Lomandra maritima</i>.</p>

Nomenclature and taxonomy used in these descriptions has been updated from those used in the original publication.

#### 3.4.5 Bush Forever

The study area is within Bush Forever Site 397: “Coastal Strip from Wilbinga to Mindarie”. This site is approximately 400 hectares in size.

No detailed survey was completed for this site (Government of WA, 2000). Multiple part-surveys have been completed. A part-survey by Robinson (1995) of coastal reserves north of Quinns Rocks indicated that there were 83 native flora and 23 weed flora present, representing >60% of the expected flora.

Inferred Floristic Community Types present at Bush Forever Site 397 are listed as:

#### Supergroup 2: Seasonal Wetlands:

- FCT 16: Highly saline seasonal wetlands (*Frankenia pauciflora* on Tamala Limestone Cliffs)

#### Supergroup 4: Uplands centred on Quindalup and Spearwood Dunes

- FCT 29a: Coastal shrublands on shallow sands
- FCT 29b: *Acacia* shrublands on taller dunes
- FCT S11: Northern *Acacia rostellifera* – *Melaleuca systema* shrublands
- FCT S13: Northern *Olearia axillaris* – *Scaevola crassifolia* shrublands
- FCT S14: *Spinifex longifolius* grasslands and low shrublands

#### 3.4.6 Ecoscape (2015)

A flora and vegetation survey was completed of the study area by consulting firm Ecoscape (2015). It included Lot 211 Two Rocks Road, exclusive however of the foredune area. The methodology was equivalent to a single-phase Detailed (quadrat-based) and Targeted (10m traverse) Flora and Vegetation survey (EPA, 2016). The survey was conducted in October and November 2015.

This study recorded A total of 120 vascular flora species from 97 genera and 42 families. Forty-six (38.33%) of which were introduced.

No Threatened Flora (TF) were recorded. Two Priority Flora (PF) were recorded, *Conostylis bracteata* and *Stylidium maritimum*. Both of which are Priority 3 Flora.

Eight vegetation types were described (two of which were disturbed or rehabilitation):

**Vegetation Types:**

- *Acacia cyclops* tall open shrubland over *Spyridium globulosum*, *Melaleuca huegelii* and *Rhagodia baccata* subsp. *baccata* shrubland over *Lomandra maritima* and *\*Ehrharta* spp. open Forbland/Tussock Grassland. Inconclusively FCT24 and/or FCT29a.
- *Acacia rostellifera* tall Closed Shrubland over *\*Ehrharta* spp. Tussock Grassland. Inconclusively FCT29a, FCT29b and/or FCT24.
- *Banksia sessilis* closed shrubland over *Lomandra maritima* and *\*Ehrharta calycina* open Forbland/Tussock Grassland. Inconclusively FCT24 with some association with FCT26a and FCT26b.
- *Lomandra maritima* Forbland with scattered *Acacia rostellifera* and *A. saligna* shrubs. Inconclusively FCT29a, FCT29b and/or FCT24.
- *Melaleuca cardiophylla* Shrubland over *\*Ehrharta* spp. Sparse Tussock Grassland. Inconclusively FCT29a, FCT29b and/or FCT24.
- *Melaleuca huegelii* low shrubland over *Desmocladius asper* and *Lomandra maritima* open Sedgeland/Forbland. Inconclusively FCT26a, FCT26b, FCT29a and/or FCT29b.

**Non-Remnant (disturbed) Vegetation:**

- Planted *\*Eucalyptus utilis* trees/mallees and some *E. gomphocephala* trees fringing caravan park footprint and in south east extent of study area. *\*Eucalyptus utilis* open Mallee forest over *Templetonia retusa*, *Melaleuca huegelii* and *M. lanceolata* tall shrubland.
- Rehabilitation Areas.

The FCT analysis overall was inconclusive, each vegetation type had associations with two or three FCTs. However with the exception of FCT26b, these were all Western Australian Priority (PEC) or Threatened (TEC) Ecological Communities.

Three were Priority 3 PECs:

- SCP24 (FCT24) “Northern Spearwood shrublands & woodlands”.
- SCP29a (FCT29a) “Coastal shrublands on shallow sands”.
- SCP29b (FCT29b) “Acacia shrublands on taller dunes”.

One of these was Western Australian TEC:

- SCP26a (FCT26a) “*Melaleuca huegelii*-*M. acerosa* (*M. systema*) shrublands of limestone ridges”.

## 3.5 LEGISLATION AND GUIDELINES

### 3.5.1 *Planning and Development Act 2005*

Bush Forever sites have some protection under State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region under the *Planning and Development Act 2005*. There are a number of specific requirements for Environmental Impact Assessment (EIA) when a Bush Forever site is involved.

### 3.5.2 Western Australian *Environmental Protection Act 1986*

The *Environmental Protection (EP) Act 1986* is the guiding legislation for EIA in Western Australia. Formal assessments for projects that are likely to have significant impacts are completed by the Environmental Protection Authority (EPA) under this legislation.

#### *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

The *EP Act* includes the *Clearance of Native Vegetation Regulations 2004* under which clearing permits are required to clear native vegetation. The permit system is administered by either the Western Australian Department of Water and Environmental Regulation (DWER), or for exploration activities, the Department of Mines, Industry Regulation and Safety (DMIRS).

#### Technical Guidance under the *EP Act 1986*

The EPA's Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016) outlines the supporting information required for botanical assessments under the *EP Act 1986*.

EPA (2016) replaced the EPA's Guidance Statement 51.

### 3.5.3 Western Australian *Biodiversity Conservation Act 2016*

As of January 1<sup>st</sup> 2019, the *Biodiversity Conservation (BC) Act 2016* replaced the *Wildlife Conservation Act 1950* in Western Australia.

The *BC Act 2016* introduces the protection of state listed Threatened Ecological Communities (TECs) in addition to Threatened Flora (TF). Threatened Flora were previously known as Declared Rare Flora (DRF).

There are substantially higher and broader ranging fines, up to \$500,000 for individuals and \$2,500,000 for corporate entities for 'taking' TECs and TF. Additionally, there are substantial fines to individuals and organisations for failing to report matters of environmental significance.

### 3.5.4 Federal *Environmental Protection Biodiversity Conservation Act 1999*

Threatened Ecological Communities (TECs) as well as Threatened Flora (TF) listed as Matters of National Environmental Significance (MNES) are protected under the Commonwealth *Environmental Protection Biodiversity Conservation (EPBC) Act 1999*.

### 3.5.5 Flora

All native flora species are protected under the *BC Act 2016*. Flora cannot be taken without a permit.

#### *Threatened Flora (TF) (Western Australia)*

Additionally, the Western Australian Minister for Environment can declare any species thought 'rare' an extra level of protection. Species on this list are referred to as Threatened Flora (TF) (Table 2) (previously referred to as DRF or Declared Rare Flora). Each TF species is also given a rank consistent with IUCN Red List criteria.

The TF list is regularly reviewed with updates published in the Government Gazette. The TF status of species is also published on Florabase (WA Herbarium, 1998-).

Table 2: Definition of Threatened Species (Flora) (Dept. Biodiversity Conservation and Attractions, 2019a).

<b>T: Threatened species</b>	<p>Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the <i>Biodiversity Conservation Act 2016</i> (BC Act).</p> <p><b>Threatened flora</b> is that subset of ‘Rare Flora’ listed under schedules 1 to 3 of the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for Threatened Flora.</p> <p>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:</p> <p><b>CR: Critically Endangered</b> Threatened species considered to be “<i>facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines</i>”.</p> <p><b>EN: Endangered</b> Threatened species considered to be “<i>facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines</i>”.</p> <p><b>VU: Vulnerable</b> Threatened species considered to be “<i>facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines</i>”.</p>
<b>X: Presumed extinct species</b>	<p><b>EX Extinct species</b></p> <p>Species where “<i>there is no reasonable doubt that the last member of the species has died</i>”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).</p> <p>Published as presumed extinct under schedule 4 of the <i>Wildlife Conservation (Specially Protected Fauna) Notice 2018</i> for extinct fauna or the <i>Wildlife Conservation (Rare Flora) Notice 2018</i> for extinct flora.</p> <p><b>EW Extinct in the wild species</b></p> <p>Species that “<i>is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form</i>”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).</p> <p>Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.</p>

### *Priority Flora (PF) (Western Australia)*

A supplementary Priority Flora (PF) list is maintained by the Department of Biodiversity Conservation and Attractions (DBCA). Species on the PF list are not specifically protected under current legislation however they are closely considered in environmental impact assessment processes. They are listed in EPA (2016) as flora of ‘other’ conservation significance.

Priority 1 to 3 flora are species that are awaiting assessment for Threatened Flora (TF) status but which do not currently have enough information to enable that assessment. The three categories represent the order of priority for assessment.

Priority 4 species are those species that are adequately known, rare but not threatened and which require regular monitoring.

The four categories of PF are defined in Table 3. The status of PF are regularly updated and published on Florabase (WAH, 1998-).

Table 3: Priority Flora Conservation Codes and Definitions (Dept. Biodiversity Conservation and Attractions, 2019a).

<b>P1: Priority One:</b> 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.
<b>P2: Priority Two:</b> 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.
<b>P3: Priority Three:</b> 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.
<b>P4: Priority Four:</b> Rare, Near Threatened and other species in need of monitoring	<p>(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.</p> <p>(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.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

### *Threatened Flora (TF) (Federal)*

Some flora species have additional protection under the *Commonwealth Environmental Protection Biodiversity Conservation Act, 1999 (EPBC Act)*. There is significant overlap in that state-listed TF are largely the same as TF listed under the federal *EPBC Act*.

There are six categories of Threatened Flora under the *EPBC Act* (Table 4).

Table 4: Categories of Threatened Flora Species under the *EPBC Act 1999* (IUCN-Equivalent Status)

<b>EX: Extinct</b>	No reasonable doubt that the last member of the species has died.
<b>EW: Extinct in the Wild</b>	Species known only to survive in cultivation, in captivity or as a naturalised population well outside its past range or it has not been recorded in its known habitat in an appropriate season anywhere in its past range despite exhaustive surveys.
<b>CR: Critically Endangered</b>	Species is considered to be facing an extremely high risk of extinction in the wild.
<b>EN: Endangered</b>	Species is not critically endangered; and it is facing a very high risk of extinction in the wild in the near future.
<b>VU: Vulnerable</b>	Species is not critically endangered or endangered; and it is facing a high risk of extinction in the wild in the medium-term future.
<b>CD: Conservation Dependent</b>	Species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered.

### 3.5.6 Vegetation

#### *Threatened Ecological Communities (TECs) (Western Australia)*

In Western Australia, Threatened Ecological Communities (TECs) are protected under the *BC Act 2016*. There are four criteria for state listed TECs (Table 5).

Currently there are 69 TECs that have been endorsed by the Western Australian Minister for Environment of which 20 are Critically Endangered, 17 are Endangered, 28 are Vulnerable and 4 Presumed Destroyed (Dept. of Biodiversity Conservation and Attractions, 2018).

Table 5: Criteria for Western Australian Threatened Ecological Communities (TECs) (Dept. of Environment and Conservation, 2013)

<b>Presumed Totally Destroyed (PD)</b>	<p>An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed, or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.</p> <p>An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):</p> <p><b>A)</b> Records within the last 50 years have not been confirmed despite searches of known or likely habitats; or</p> <p><b>B)</b> All occurrences recorded within the last 50 years have since been destroyed.</p>
<b>Critically Endangered (CR)</b>	<p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored.</p> <p>An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):</p> <p><b>A)</b> The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):</p> <ol style="list-style-type: none"> <li>geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); or</li> <li>modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.</li> </ol> <p><b>B)</b> Current distribution is limited, and one or more of the following apply (i, ii or iii):</p> <ol style="list-style-type: none"> <li>geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); or</li> <li>there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; or</li> <li>there may be many occurrences, but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.</li> </ol> <p><b>C)</b> The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).</p>

<b>Endangered (EN)</b>	<p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p> <p>An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):</p> <p><b>A)</b> The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):</p> <ul style="list-style-type: none"> <li>i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short-term future (within approximately 20 years);</li> <li>ii) modification throughout its range is continuing such that in the short-term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.</li> </ul> <p><b>B)</b> Current distribution is limited, and one or more of the following apply (i, ii or iii):</p> <ul style="list-style-type: none"> <li>i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short-term future (within approximately 20 years);</li> <li>ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;</li> <li>iii) there may be many occurrences, but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.</li> </ul> <p><b>C)</b> The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).</p>
<b>Vulnerable (VU)</b>	<p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.</p> <p>An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):</p> <p><b>A)</b> The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.</p> <p><b>B)</b> The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.</p> <p><b>C)</b> The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.</p>

### *Priority Ecological Communities (PECs) (Western Australia)*

In Western Australia, potential TECs that do not meet criteria or that are not adequately defined or do not have adequate information are added to the Priority Ecological Community (PEC) List as Priority 1, 2 or 3 (Table 6). Communities that are rare but not threatened and are adequately known, or that have been recently removed from the threatened list, are placed in Priority 4 for regular monitoring purposes. Conservation dependent communities are placed in Priority 5 (Dept. of Environment and Conservation, 2013).

As of January 2019, there were 393 PECs listed by the DBCA Threatened Species and Communities Branch (Dept. of Biodiversity Conservation and Attractions, 2019b).

Table 6: Priority Ecological Communities (PECs) Definitions and Criteria (Dept. of Environment and Conservation, 2013).

<b>Priority One:</b> Poorly-known ecological communities	Ecological communities that are known from very few occurrences with a very restricted distribution (generally $\leq 5$ occurrences or a total area of $\leq 100$ ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
<b>Priority Two:</b> Poorly-known ecological communities	Communities that are known from few occurrences with a restricted distribution (generally $\leq 10$ occurrences or a total area of $\leq 200$ ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
<b>Priority Three:</b> Poorly known ecological communities	<p>i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or;</p> <p>ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approx. 10 years), or;</p> <p>iii) Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
<b>Priority Four:</b> Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.	<p>i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.</p> <p>iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
<b>Priority Five:</b> Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

### *Threatened Ecological Communities (TECs) (Federal) (EPBC Act)*

The *Environmental Protection Biodiversity Conservation Act 1999 (EPBC Act)* provides legislative protection for Threatened Ecological Communities (TECs).

The criteria for listing of TECs under the *EPBC Act* are presented in Table 7.

Table 7: Threatened Ecological Communities (TECs) Definitions and Criteria (*EPBC Act* Regulations, 2013).

<b>Critically Endangered (CR)</b>	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
<b>Endangered (EN)</b>	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
<b>Vulnerable (VU)</b>	If, at that time, an ecological community is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium-term future (indicative timeframe being the next 50 years).

### 3.5.7 Weeds

#### *Environmental Weeds*

There is currently no coordinated approach to prioritising and managing environmental weeds in Western Australia.

Under the Western Australian *Conservation and Land Management Act 1984*, the state environmental agency the Department of Biodiversity Conservation and Attractions (DBCA) is required to monitor and manage weeds. As a part of this responsibility, the Western Australian Environmental Weed Strategy (WAEWS) (Dept. Conservation and Land Management, 1999) was developed, which presents a list of environmental weeds and gives each a rating (Table 9) depending on its invasiveness, distribution and environmental impact (Table 8).

The purpose of this publication was also to eventually tie into the Weeds of National Significance (WONS) project (Dept. Conservation and Land Management, 1999 p58), providing a compatible rating system to be applied to Western Australian environmental weed species. The idea was also to eventually provide a regionally based rating system, using the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) regions. None of this has been completed, and the list is out of date in some respects, however it still provides a good general idea of what serious environmental weeds are present in a study area.

Table 8: Criteria of Weeds under WAEWS (Dept. of Conservation and Land Management, 1999)

<b>Invasiveness</b>	Ability to invade bushland in good to excellent condition or ability to invade waterways.
<b>Distribution</b>	Wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world.
<b>Environmental Impact</b>	Ability to change the structure, composition and function of ecosystems, in particular an ability to form a monoculture in a vegetation community.

Table 9: Rating of Weeds under WAEWS (Dept. of Conservation and Land Management, 1999)

<b>H: High</b>	A weed species that scores ‘yes’ for all three criteria. Rating a weed species as High would indicate prioritising this weed for control and/or research i.e. prioritising funding to it.
<b>Mo: Moderate</b>	A weed species would have to score ‘yes’ for two of the above criteria. Control or research effort should be directed to it if funds are available, however it should be monitored (possibly a high level of monitoring).
<b>Mi: Mild</b>	A weed species scoring ‘yes’ for one of the criteria. A Mild rating would indicate monitoring of the weed and control where appropriate.
<b>L: Low</b>	A weed species would score none of the criteria. A Low ranking would mean that this species would require a low level of monitoring.

#### *Biosecurity and Agriculture Management Act 2007 (BAM Act)*

This act replaces amongst other related legislation, the *Agriculture and Related Resources Protection Act 1976*, which legislated for the control of Declared Plants in Western Australia (Sandy Lloyd DAFWA, pers. comm.). The *BAM Act* represents the only legally binding requirement for weed control and/or eradication in Western Australia.

Under the under the *BAM Act* the “Declared Plants” list has been replaced by the Western Australian Organism List (WAOL). The WAOL is administered by the Western Australian Department of Agriculture and Food (Department of Primary Industries and Regional Development, 2019). There are three categories of Declared Pest on the WAOL list (Table 10).

This list is more relevant to agricultural than environmental weeds.

Table 10: Categories of Declared Pest under the *BAM Act 2007* (Dept. of Primary Industries and Regional Development, 2019)

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

### *Weeds of National Significance (WONS)*

The Weeds of National Significance (WONS) (Dept. of Environment and Energy, 2019) project is an initiative of the Commonwealth in collaboration with state governments aimed at establishing a national prioritisation process for environmental weeds. Thirty-two species of WONS have currently been prioritised, based on invasiveness, potential for spread and environmental, social and economic impacts. Their ability to be managed was also taken into account. This programme is in the early stages of development and is a work in progress. It only includes an extremely limited subset of environmental weeds.

## 4. METHODS

### 4.1 FIELD SURVEY

The field survey consisted of a Detailed Survey and a Targeted Survey (EPA, 2016 p. 5). Sampling techniques consisted of Traverses, Quadrats, Opportunistic Sampling and Vegetation Condition Rating (EPA, 2016 p. 7).

#### 4.1.1 Traverses

A traverse survey was completed on the 24<sup>th</sup> September 2019.

Traverses were conducted on foot at 20m intervals across all vegetated areas to record:

- Priority, Threatened and other flora of conservation significance (as defined by EPA, 2016);
- Weed species;
- Vegetation type and condition boundaries; and
- Any matters of interest e.g. including but not limited to rubbish, vegetation, condition.

#### 4.1.2 Quadrats

An early spring quadrat survey was conducted on the 5<sup>th</sup> to 8<sup>th</sup> September 2019, with a late spring revisit to quadrats on the 15<sup>th</sup> to 16<sup>th</sup> October 2019. Sixteen quadrats were surveyed.

Quadrat sizes were 10m x 10m in line with established methodology for the Swan Coastal Plain. An area surrounding the quadrat was also surveyed to record other species typical of the vegetation type.

The information recorded for each quadrat included:

- AMG Coordinates in GDA94 datum (accuracy <3m) for all four corners of quadrat (Appendix D);
- All flora species present (floristics) in quadrat and their height and cover/density (structure) (Appendix B). Percentage cover refers to the foliage cover (as required by EPA, 2016) of each species within the 100m<sup>2</sup> quadrat (1m<sup>2</sup> cover = 1% cover). Species that overhung the quadrat were included;
- Description of vegetation and documentation of vegetation structure based on National Vegetation Information System (NVIS) (ESCAVI, 2003) (as required by EPA, 2016);
- Photographs of vegetation (taken from NW corner of quadrat) (Appendix C);
- Habitat information including but not limited to landform, aspect and soil and leaf litter; and
- A condition rating was given according to the condition scale(s) in Table 9.

Quadrats were permanently marked, with all four corners pegged with 25mm by 25mm jarrah stakes (visible approximately 15cm above the soil surface). The top 100mm is painted white. The quadrat number is written on top of the stakes (01, 02, 03 etc), with the full quadrat number on the side with the corner reference (QR01NW, QR01SW, QR01SE, QR01NE etc). The labels will degrade in sunlight over time.

#### 4.1.3 Opportunistic Sampling

Any points of interest were recorded using a GPS with an accuracy of <3m using datum GDA94.

#### 4.1.4 Condition Assessment and Mapping

As requested by the City of Wanneroo the Bush Forever (Government of WA, 2000) condition scale was used. This was to ensure that condition mapping was consistent with historical mapping.

EPA (2016) provides a condition scale to be used in EIA. While it is not referenced, this condition scale originated in Bush Forever.

On comparing the two scales it was found that they are almost identical. This is demonstrated in Table 11. Condition mapping will therefore still be consistent with the requirements of EPA (2016).

Table 11: Vegetation Condition Rating for the South West Botanical Province (EPA, 2016) and Bush Forever Condition Scale (Keighery, 1994 from Govt. of WA, 2000)

Condition		EPA (2016) Condition Scale	Bush Forever (Govt. of WA, 2000) Condition Scale
<b>P</b>	<b>Pristine</b>	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	Pristine or nearly so, no obvious signs of disturbance.
<b>E</b>	<b>Excellent</b>	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.	Vegetation structure intact, disturbance affecting individual species; weeds are non-aggressive species.
<b>VG</b>	<b>Very Good</b>	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.	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.
<b>G</b>	<b>Good</b>	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.	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate 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.
<b>D</b>	<b>Degraded</b>	Basic vegetation structure severely 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.	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
<b>CD</b>	<b>Completely Degraded</b>	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 comprising weed or crop species with isolated native trees and shrubs.	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 comprising weed or crop species with isolated native trees and shrubs.

The original scale was developed by Bronwen Keighery (Keighery, 1994) which was modified from a scale developed by Malcolm Trudgen (Trudgen, 1991).

#### 4.1.5 Licencing

The survey was completed by botanist Kelli McCreery under Licence for Scientific or Other Prescribed Purposes No. SL012488 and Permit to Take Threatened Flora No. 27-1920.

Written permission to conduct a survey was obtained from land owners, the City of Wanneroo.

## 4.2 FLORA IDENTIFICATIONS, TAXONOMY AND NOMENCLATURE

Flora identifications were completed by a survey botanist with 23 years of experience on the Swan Coastal Plain (SCP). Flora were identified using the taxonomic, reference material and other resources of the WA Herbarium.

All Priority Flora were confirmed by the duty botanist at the WA Herbarium.

Nomenclature was based on Florabase (Western Australian Herbarium, 1998-). All taxa were cross-referenced against Florabase to ensure that names were current at the time of publication.

## 4.3 DATA ANALYSIS

Numerical analyses were conducted on quadrat data collected during the survey. Data was analysed using a two-way multivariate analysis run on the programme 'R' (R Development Core Team, 2007). The agglomerative methods used were Bray-Curtis distance and Ward's clustering. Other clustering methods were also run to test possible alternative groupings.

These methods were used in the context of not necessarily providing an absolute result, but as a powerful tool to aid in defining vegetation types present within the study area.

### 4.3.1 Floristic and Structural Analysis of Study Area Quadrats

Only data from the 16 quadrats collected in the study area during this survey were used at this stage.

Different parameters were tested, presence-absence (floristics) data alone. Foliar cover percentage (floristics and structure). Foliar cover percentages were then converted to the Braun-Blanquet style cover class scale used in NVIS, which is an analysis of floristics and simplified structure.

The results were used as a tool to aid in defining and mapping the vegetation types present in the study area.

### 4.3.2 Floristic Community Type (FCT) Analysis Against Gibson *et al.* (1994) Dataset

The 16 quadrats recorded as a part of this survey were also then compared to quadrats surveyed as a part of A Floristic Survey of the Southern Swan Coastal Plain (Gibson *et al.*, 1994). Many TECs and PECs were originally defined on the basis of the floristic analysis in Gibson *et al.* (1994) so therefore the aim of this methodology was to help quantify the presence or otherwise of TECs and PECs.

A floristic presence-absence analysis was completed only, as the Gibson *et al.* (1994) data did not include information on plant cover/density. Floristics alone were also the basis of the analysis in that study.

To ensure the datasets were as compatible as possible the nomenclature and taxonomy of flora was reverted back to what it would have been in 1994. To test for any methodological differences in the parameters set for the multivariate analysis, a test run was completed first, using only the SCP dataset to ensure that the results for the grouping were consistent with the original findings of that study. Then the quadrats recorded in this survey were run one at a time against the Gibson *et al.* (1994) dataset. The aim was to see which Gibson *et al.* (1994) quadrats the study area quadrats were most floristically similar to.

This was a floristic analysis based on presence-absence of flora species within a 10m x 10m quadrat.

The agglomerative methods used were Bray-Curtis distance and Ward's clustering as this was found to most closely replicate the results of the original study.

#### 4.3.3 Other Contextual Data

A large dataset was consolidated and a floristic analysis completed, in an attempt to gain an overall contextual insight into some of the challenges inherent in assigning FCTs in the Quindalup-Spearwood transition areas. This dataset included quadrat data from Gibson *et al.* (1994), selected from Griffin (1993), quadrat data from this study as well as quadrat data from similar near-coastal study areas at Yanchep Lagoon and Two Rocks.

Adding and/or reanalysing quadrat data from a previous survey (Ecoscape, 2015) was considered. The quadrat data was collected in November 2015. This is late in the season and significantly later than the methods used in both Gibson *et al.* (1994) and the current study. The quadrats had approximately half the species richness. Inconsistencies to this degree introduce noise into data and the decision was made not to make use of this in the numerical analyses.

#### 4.3.4 Vegetation Mapping

Polygons were drawn using a combination of aerial photography interpretation and field observations. Some boundaries were defined using GPS coordinates recorded during on-ground surveys.

Simon Crofts from Environmaps produced the mapping presented in this report.

Vegetation type within each polygon was defined on the basis of a wide range of information. In particular the statistical analysis of quadrat data, previous studies, field observations and generalised post-survey analysis of data. Both structural and floristic characteristics of the vegetation were taken into account.

Descriptions of vegetation types used NVIS (ESCAVI, 2003) structural formation terminology as per the requirements of the EPA (2016).

### 4.4 DESKTOP ASSESSMENT

A search of the Department of Biodiversity Conservation and Attractions (DBCA) Species and Communities Branch database was completed in September 2019. This was to identify any Western Australian listed Threatened (TF) or Priority (PF) Flora previously known from the study area or surrounds. Summary results are presented in Table 14.

A search of the Department of Biodiversity Conservation and Attractions (DBCA) Species and Communities Branch database was completed in September 2019. This was to identify any Threatened (TECs) and/or Priority Ecological Communities (PECs) previously known from the study area or surrounds. Summary results are presented in Table 17.

A search of the *EPBC Act 1999* Protected Matters Search Tool (Department of Environment and Energy, 2017) was also completed in November 2019 to identify any federally listed Threatened Flora (Table 14) or Threatened Ecological Communities (Table 17) likely to occur in the vicinity of the study area.

All searches were based on a search area bounded by the coordinates:

-31.784° 115.732°  
-31.762° 115.781°

-31.310° 115.530°  
-31.332° 115.478°

The purpose of these searches was not only to identify any matters of significance previously known from the study area, but also to identify any likely to occur based on proximity and habitat preference. This is why the search area coordinates cover a much larger area than the study area alone. This search area was designed to capture near-coastal species and communities from the Quindalup and Spearwood Dunes in a narrow coastal strip between Mullaloo and Guilderton.

A review of previous studies relevant to the study area was completed, including but not limited to those studies summarised in Section 3.4. A variety of resources were accessed as otherwise described in this report. Naturemap (Dept. of Biodiversity Conservation and Attractions, 2019) was used to identify and expected species list ahead of the field survey. NationalMap (Government of Australia, 2019) was used to check planning boundaries and other relevant spatial information.

## 4.5 CONSERVATION SIGNIFICANCE ASSESSMENT

Conservation significance was assessed based on the following criteria.

### 4.5.1 Threatened Species and Communities

Assessment of the conservation significance of flora and vegetation recorded during the survey involved cross-referencing all taxa recorded against criteria for significance under state and federal legislation and guidelines (Section 3.5). This included Threatened Flora and Threatened Ecological Communities under the Western Australian *Biodiversity Conservation Act 2016* and the Federal *Environmental Protection Biodiversity Conservation Act 1999*.

### 4.5.2 Flora of ‘Other’ Conservation Significance (EPA, 2016)

Species other than those listed under state and federal legislation and guidelines e.g. Threatened Flora, may have conservation significance. These are defined by the EPA (2016) as those species that may include but not be limited to those that have or are:

- Priority flora species;
- Locally endemic or associated with a restricted habitat type;
- New species or anomalous features that indicate a potential new species;
- Representation of a species range (extensions, edges of ranges or an outlier population);
- Unusual species including restricted sub-species, varieties or naturally occurring hybrids; and/or
- Relictual status, representative of taxonomic groups no longer in the broader landscape.

For range implications, the geographic distributions of all flora species recorded were checked using the map-based resources of the Australian Virtual Herbarium (Council of Heads of Australasian Herbaria, 2013) and Florabase (Western Australian Herbarium, 1998-).

### 4.5.3 Vegetation of ‘Other’ Conservation Significance (EPA, 2016)

Vegetation other than that listed under state and federal legislation and guidelines e.g. TECs, may have conservation significance. This is defined by the EPA (2016) that which may include but not be limited to vegetation that:

- Represents a Priority Ecological Community (PEC);

- Has a restricted distribution;
- Has implications due to historical impacts;
- Has a role as a refuge; and/or
- Provides a function required to maintain the ecological integrity of a significant ecosystem.

## 5. RESULTS

### 5.1 FLORA

#### 5.1.1 Statistics

A total of 232 taxa were recorded from the study area, of which 128 or 55% were natives.

The 232 taxa represented 67 different plant families and 169 plant genera. The families represented by the largest number of species are shown in Table 12. The genera represented by the largest number of species are shown in Table 13.

See Appendix A for a full list of species recorded for the study area.

Table 12: Dominant Vascular Plant Families Recorded in the Study Area

Family	Common Name	Native	Introduced	Total
ASTERACEAE	Daisies	3	16	19
POACEAE	Grasses	6	12	18
FABACEAE	Peas, Wattles	12	5	17
MYRTACEAE	Paperbarks, Gum Trees	7	7	14
PROTEACEAE	Banksia, Grevillea, Hakea etc.	9	1	10
ASPARAGACEAE	Asparagus-Lily Family	4	2	6
CYPERACEAE	Sedges	5	1	6
*CARYOPHYLLACEAE	Pink-Carnation Family	0	6	6
BRASSICACEAE	Brassica Family	0	6	6
AIZOACEAE	Pigface Family	3	2	5
GERANIACEAE	Geranium Family	2	3	5
CRASSULACEAE	Stonecrop Family	2	3	5

Table 13: Dominant Vascular Plant Genera Recorded in the Study Area

Genus	Common Name	Native	Introduced	Total
<i>Acacia</i>	Wattles	8	0	8
<i>Melaleuca</i>	Paperbark, Teatree, Bottlebrush	4	2	6
<i>Cassytha</i>	Dodder Laurels (parasitic)	4	0	4
<i>Drosera</i>	Sundews (carnivorous)	4	0	4
<i>Calandrinia</i>	Purslanes	4	0	4
<i>Crassula</i>	Stonecrops	2	2	4
<i>Grevillea</i>	Grevillea	3	1	4
<i>Allocasuarina</i>	Casuarinas	2	1	3
<i>Eucalyptus</i>	Gum Trees	2	1	3
* <i>Ehrharta</i>	Veldt Grasses	0	3	3
* <i>Euphorbia</i>	Spurges	0	3	3
<i>Hakea</i>	Hakea	3	0	3
<i>Scaevola</i>	Fanflowers	3	0	3
<i>Senecio</i>	Groundsel	2	1	3

### 5.1.2 Threatened and Priority Flora Database Search Results

A search of the *EPBC Act* Protected Matters Search Tool (Department of Environment and Energy, 2019a) listed nine Threatened Flora (TF) as potentially occurring in the region. None of these species have previously been recorded from within the study area.

The DBCA Threatened Species and Communities Branch species database search did not identify any records of state listed Threatened Flora (TF) as being previously known from within the study area boundary.

The DBCA Threatened Species and Communities Branch species database search identified four records of PF as being previously known from within the study area boundary.

Two of these were errors, with incorrect coordinates for plants that were collected from the Bibra Lake area south of the river. The other two were taxa recorded during surveys by Ecoscape (2015). These were two Priority 3 taxa *Stylidium maritimum* and *Conostylis bracteata*.

The existing *Stylidium maritimum* record was from the same place as QR05 in this study (Figure 3).

The *Conostylis bracteata* record was from immediately to the west of QR13 in this study (Figure 3). The *Conostylis* in this area were extensively sampled during this study. This is discussed at length later, however all material collected was subsequently confirmed by the WA Herbarium duty botanist as *Conostylis candicans* subsp. *calcicola* intergrade *Conostylis pauciflora* subsp. *euryrhipis* (Priority 4). This was the same duty botanist identified the material from the Ecoscape (2015) study. They stated that there are unresolvable taxonomic issues associated with this group of *Conostylis*. It is likely that whatever the true identity of this taxa is, the material in the study area is likely to represent the one entity and it should be treated as Priority Flora.

Table 14 summarises the results from both the DBCA Threatened Species and Communities Branch flora database search and the *EPBC Act* Protected Matters Report and identifies the likelihood of each occurring within the study area.

Table 14: Threatened and Priority Flora Database Search Results (DBCA and EPBC Act Protected Matters Databases)

WESTERN AUSTRALIA	CONSERVATION STATUS*			OCCURRENCE (Known/Likely/Possible/Unlikely)
	Rating	WA	EPBC	
<i>Chorizema varium</i>	T	EN	EN	Possible, habitat present (sand over limestone) but known from further N.
<i>Diuris micrantha</i>	T	VU	EN	Unlikely. Known from wetland habitats.
<i>Diuris purdiei</i>	T	EN	EN	Unlikely. Known from wetland habitats further S and E.
<i>Drakaea elastica</i>	T	CR	VU	Unlikely. Known from areas adjacent to wetlands, mostly further S and inland.
<i>Drakaea micrantha</i>	T	EN	VU	Unlikely. Known from further S and/or more inland.
<i>Eleocharis keigheryi</i>	T	VU	VU	Unlikely. Known from wetlands.
<i>Eucalyptus argutifolia</i>	T	VU	VU	Possible, within known distribution and habitat present (sand over limestone). Not recorded.
<i>Marianthus paralius</i>	T	EN	EN	Very possible, within known distribution and habitat present (sand over limestone), known record in bushland immediately to E of study area. Not recorded.
<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705)	T	EN	EN	Unlikely, known distribution to E.
<i>Baeckea</i> sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1			Possible but unlikely, known from limestone ridges but further inland. P1 are not well understood species.
<i>Grevillea</i> sp. Ocean Reef (D. Pike Joon 4)	P1			Very possible. Habitat present (sand over limestone). Known from a record 9km to S. Not recorded.
<i>Haloragis</i> sp. Parrot Ridge (G.J. Keighery 11563)	P1			Possible but unlikely, distribution limestone ridges further inland. P1 are poorly understood.

WESTERN AUSTRALIA	CONSERVATION STATUS*			OCCURRENCE (Known/Likely/Possible/Unlikely)
	Rating	WA	EPBC	
<i>Leucopogon maritimus</i>	P1			<b>Recorded during this study.</b>
<i>Acacia benthamii</i>	P2			Possible. Not recorded.
<i>Fabronia hampeana</i>	P2			Moss. Outside scope of study.
<i>Hakea oligoneura</i>	P2			Possible. Not recorded.
<i>Lecania turicensis</i> var. <i>turicensis</i>	P2			Lichen. Outside scope of study.
<i>Austrostipa mundula</i>	P3			Possible but unlikely. Known distribution further inland.
<i>Beyeria cinerea</i> subsp. <i>cinerea</i>	P3			Possible. Not recorded.
<i>Calandrinia oraria</i>	P3			Possible. Coastal dunes. Not recorded.
<i>Conostylis bracteata</i>	P3			<b>Previously recorded in study area</b> (Ecoscape, 2015). This group has taxonomic issues. Likely to represent <i>Conostylis pauciflora</i> subsp. <i>pauciflora</i> Intergrade <i>C. aculeata</i> subsp. <i>cygnorum</i> in this study. See Section 5.1.2.
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	P3			<b>Recorded during this study.</b>
<i>Lasiopetalum membranaceum</i>	P3			Possible but unlikely. Habitat sand over limestone. Known distribution further inland.
<i>Leucopogon</i> sp. Yanchep (M. Hislop 1986)	P3			Unlikely. Mainly further to N and E. Various coastal habitats, sand and limestone. Not recorded.
<i>Pimelea calcicola</i>	P3			<b>Recorded during this study.</b>
<i>Sarcozona bicarinata</i>	P3			<b>Recorded during this study.</b>
<i>Sphaerolobium calcicola</i>	P3			Unlikely. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas
<i>Stylidium maritimum</i>	P3			<b>Recorded during this study.</b> Previous record from study area (Ecoscape, 2015).
<i>Stylidium paludicola</i>	P3			Unlikely. Wetland habitat.
<i>Caladenia speciosa</i>	P4			Possible. Known from sand over limestone. Within known distribution. Not recorded.
<i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i>	P4			Possible. Within distribution, coastal dune habitat present. Not recorded.
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>	P4			<b>Recorded during this study.</b> <i>Conostylis candicans</i> subsp. <i>calcicola</i> intergrade <i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i> recorded in this study. See discussion in Section 5.1.3.
<i>Dodonaea hackettiana</i>	P4			Possible. Not recorded.
<i>Jacksonia sericea</i>	P4			Possible but unlikely. A fairly common species but further N than known distribution. Not recorded.
<i>Lepidium pseudotasmanicum</i>	P4			Possible. Known from tall sand dunes and wetlands. Not recorded.

\* See Section 3.5.5 for definitions of conservation status codes. Habitat preference information from WAH (1998-) and DBCA database search results.

### 5.1.3 Conservation Significant Flora

#### *Threatened Flora*

No Threatened Flora (TF) species as listed under the *Biodiversity Conservation Act 2016* were recorded during the field survey.

No TF under the *Environmental Protection and Biodiversity Conservation Act 1999* were recorded.

#### *Priority Flora*

Six Priority Flora species were recorded from the study area.

These were a single Priority 1 species *Leucopogon maritimus*, four Priority 3 species *Hibbertia spicata* subsp. *leptotheca*, *Pimelea calcicola*, *Sarcozona bicarinata* and *Stylidium maritimum* and a possible hybrid of a Priority 4 species *Conostylis pauciflora* subsp. *pauciflora* Intergrade *C. aculeata* subsp. *cygnorum*.

***Leucopogon maritimus* (Priority 1 Flora)**

This plant is a low spreading shrub to 40cm tall by 60cm wide (Plate 1) from the heath family (Ericaceae). It has a fire sensitive rootstock. Flowers are small and white and clustered at the end of the branchlets (Plate 2). The flowers are white-hairy on the inside as is typical of *Leucopogon*. Flowering is documented as occurring between November and August, with the peak likely to be between April and June (Hislop, 2011). During the survey, the plant was flowering in early September. It is an inconspicuous shrub when not in flower.

There are 17 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) known from a small range in a narrow coastal band from Alkimos to north of Two Rocks. During the survey a single individual was recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type D1 (Figure 3).

Priority 1 Flora are those flora species that are poorly known, from fewer than five populations and that are potentially under threat. Such species are in urgent need of further survey to enable assessment for Threatened status. See Section 3.5.5 for more detail.



Plate 1 *Leucopogon maritimus* Priority 1 Flora. Habit.



Plate 2 *Leucopogon maritimus* Priority 1 Flora. Flowering in early September 2019.

***Hibbertia spicata* subsp. *leptotheca* (Priority 3)**

This plant is a low shrub to 50cm tall (Plate 3), with semi-glossy leaves and small yellow flowers on a short few-flowered spike (Plate 4) from the guinea-flower family (Dilleniaceae). Flowering is documented as occurring from July to October. It was recorded flowering in early September in the study area but was finished by the end of the month. Grows on shallow sand over near-coastal limestone ridges, outcrops and cliffs (WA Herbarium, 1998-). Superficially very similar to *Hibbertia hypericoides* subsp. *hypericoides*, which also grows in the project area but only on deeper sands. *H. hypericoides* has single-stalked flowers while *H. spicata* subsp. *leptotheca* has a small number of flowers arranged along one stalk (a spike).

There were 36 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between south of Mandurah to north of Lancelin.

486 individuals were recorded from the study area (Figure 2) from Vegetation Type D1 (Figure 3).

Priority 3 Flora are those flora species that are known from several locations, that do not appear to be under immediate threat. Can be comparatively well known but still not meet survey requirements for assessment for Threatened Flora status. See Section 3.5.5 for more detail.



Plate 3 *Hibbertia spicata* var. *leptotheca* Priority 3 Flora. Habit, in soil pockets in limestone.



Plate 4 *Hibbertia spicata* var. *leptotheca* Priority 3 Flora. Flowering in early September 2019.

### ***Pimelea calcicola* (Priority 3)**

This plant is a woody shrub to 1m tall (Plate 5), with opposite decussate green leaves and showy terminal clustered pink flowers (Plate 6) from the Thymelaeaceae family. Flowering documented between September to November. Grows on coastal limestone ridges (WA Herbarium, 1998-).

There were 27 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between south of Mandurah and Seabird. During the survey a single individual was recorded from the study area (Figure 2) from the boundary of Vegetation Types D1 and D2 (Figure 3).

Priority 3 Flora are those flora species that are known from several locations, that do not appear to be under immediate threat. Can be comparatively well known but still not meet survey requirements for assessment for Threatened Flora status. See Section 3.5.5 for more detail.

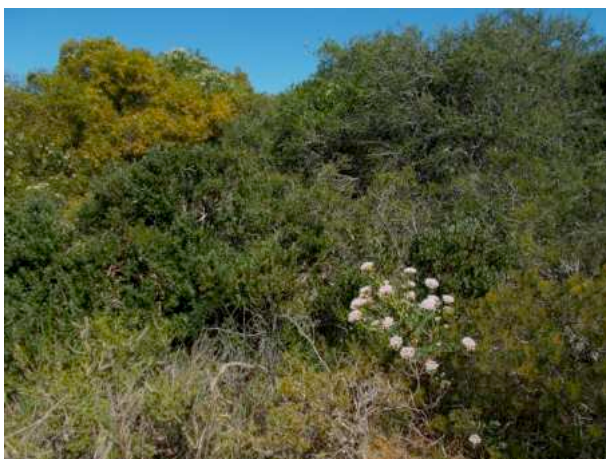


Plate 5 *Pimelea calcicola* Priority 3 Flora. Habit and habitat.



Plate 6 *Pimelea calcicola* Priority 3 Flora. Flowering 25<sup>th</sup> September 2019.

***Sarcozona bicarinata* (Priority 3)**

This plant is a perennial herb or subshrub to 10cm tall, with fleshy succulent leaves (Plate 8) from the Pigface family (Aizoaceae). Superficially similar to *Carpobrotus* spp. (see cover photo) that are also present in the study area, but it is much less robust. The former is more common on deeper sands while the latter is restricted to limestone outcrop areas. Flowers are smaller than *Carpobrotus*, but are also Pigface-shaped flowers and are white in colour. Flowering documented from July to October. Was recorded in early flower in the study area in early September (Plate 8) and fruit in October (Plate 7). Grows on white sand (WA Herbarium, 1998-).

There were 6 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mindarie and Seabird. Also known from the coastline around Adelaide.

During the survey five individuals were recorded from the study area (Figure 2) mainly from Vegetation Type D1 with one record in D2 (Figure 3).

Priority 3 Flora are those flora species that are known from several locations, and does not appear to be under immediate threat. Can be comparatively well known but still not meet survey requirements for assessment for Threatened Flora status. See Section 3.5.5 for more detail.



Plate 7 *Sarcozona bicarinata* Priority 3 Flora. Habit and habitat (in soil pockets on limestone hill). Fruiting in mid-October 2019.



Plate 8 *Sarcozona bicarinata* Priority 3 Flora. Early flowering stage in early September 2019.

***Stylidium maritimum* (Priority 3)**

This plant is a perennial herb to 70cm tall, with tufted linear strappy grass-like leaves (Plate 9) 10-40cm long to 5.5cm wide from the triggerplant family (Stylidiaceae). Flowers are showy, in panicles on long stems, large white to purple but commonly pink triggerplant-shaped flowers (Plate 2), with flowering in September to November. Grows on sand over limestone, dunes, coastal heath and/or *Banksia* woodland (WA Herbarium, 1998-).

There were 42 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mandurah and Leeman.

During the survey 392 individuals were recorded from the study area (Figure 2) mainly from Vegetation Type D1 (Figure 3).

Priority 3 Flora are those flora species that are known from several locations, and does not appear to be under immediate threat. Can be comparatively well known but still not meet survey requirements for assessment for Threatened Flora status. See Section 3.5.5 for more detail.



Plate 9 *Stylidium maritimum* Priority 3 Flora. Habit.



Plate 10 *Stylidium maritimum* Priority 3 Flora. Flowers.

***Conostylis pauciflora* subsp. *pauciflora* Intergrade *C. aculeata* subsp. *cygnorum* (Priority 4)**

*Conostylis pauciflora* subsp. *pauciflora* is a Priority 4 species. The plants in the project area as confirmed by a botanist at the WA Herbarium, are likely to be a hybrid between this species and the more common *C. aculeata* subsp. *cygnorum*.

This plant is a low herb with strappy variously hairy grass-like leaves to 40cm tall by 60cm wide (Plate 11) from the Kangaroo Paw and Bloodroot family (Haemodboraceae). The flowers are held as a cluster at the end of a tall flower stalk, with the individual flowers yellow, hairy and tube-like. *Conostylis pauciflora* has been recorded flowering between August and October (WA Herbarium, 1998-). *Conostylis aculeata* has been recorded flowering between August and November. During the survey, plants were in flower in early September to mid-October.

There were 14 collections of *C. pauciflora* subsp. *pauciflora* in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) known from Preston in the south and Two Rocks in the north. *C. aculeata* subsp. *cygnorum* has a similar north-south range, between Mandurah to near Yanchep, but generally occurs further inland. Non-hybrid *C. aculeata* subsp. *cygnorum* also occurred in the study area but in a different habitat. It is rare for this taxon to occur so close to the coast.

During the survey approximately 91 individuals were recorded from the study area (Figure 2) mainly from Vegetation Type C1 (Figure 3).

Priority 4 Flora are those flora species rare, near-Threatened and other species in need of monitoring. See Section 3.5.5 for more detail.

*Conostylis pauciflora* and *C. bracteata* are supposedly stabilised hybrids between *C. aculeata* and *C. candicans*, however the boundaries are often blurred between the groups. A previous survey of the study area (Ecoscape, 2015) identified *C. bracteata* as occurring in the study area. It is likely that whichever

entity is present in the study area, it is likely to all be the same. The same duty botanist confirmed the identity of the material from both this study and the Ecoscape (2015) study. They stated that further taxonomic work was required on this group.



Plate 11 *Conostylis pauciflora* subsp. *pauciflora*  
Intergrade *C. aculeata* subsp. *cygnorum* Priority  
4 Flora. Habit.

### *Species of ‘Other’ Conservation Significance*

See Section 4.5.2 for a definition of species of ‘other’ conservation significance. Species of ‘other’ conservation significance also technically includes Priority Flora (see previous section).

Due to the study area being located on the western coastline of the continent, most species recorded are at the western most extent of their known range. Only those species that have extra range implications over and above westerly extent have been listed here.

Due to the Spearwood system being uncommonly close to the coast in the study area, there are a few species not usually known from near-coastal areas. These species are described in Table 15 as being rare near the coast.

Table 15: Species of ‘Other Conservation Significance’ as Defined by EPA (2016)

Species	Significance
<i>Cassythia aurea</i> var. <i>aurea</i>	S extent known range. 40km range extension (closest collection from Guilderton).
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Uncommon on SCP. Rockingham and Rottnest Island only.
<i>Grevillea preissii</i> X ? <i>G. olivacea</i>	“Unusual species including restricted sub-species, varieties or naturally occurring hybrids”. See discussion below.
<i>Leucopogon maritimus</i> (P1)	Short range endemic <50km. Endemic to SCP. Range extension 10km to SE.
<i>Lomandra preissii</i>	Rare near coast.
<i>Melaleuca cardiophylla</i>	Close to S extent of known range.
<i>Mesomelaena pseudostygia</i>	Rare near coast.
<i>Nitraria billardiarei</i>	Not common SCP mainland. More common Rottnest, Carnac and Garden Islands.
<i>Rhodanthe corymbosa</i>	Rare near coast.
<i>Sarcozona bicarinata</i>	Short range endemic with linear range <50km. Poorly collected (six records WAH) Also known from SA.
<i>Tetragonia tetragonoides</i> sens. lat.	“New species or anomalous features that indicate a potential new species”. See discussion below.
<i>Wurmbea tenella</i>	Rare near coast and only in Busselton-Dunsborough area.

There is no further action required for these particular species. Any quality plant specimen material collected will be forwarded to the WA Herbarium. This will ensure that there is a verifiable record of the extended range for each species and/or extra collections supplied where collection numbers are low.

Two particular collections require some clarification.

***Grevillea preissii* X ?*G. olivacea***

This taxon was included as having ‘other’ conservation significance nominally under “Unusual species including restricted sub-species, varieties or naturally occurring hybrids”. Two individuals of this hybrid were recorded, one inside QR05 (Figure 3) on a low limestone hill, with a larger (1.5m) specimen immediately to the east of the same quadrat (Appendix D). The hybrids are much more robust and upright than the *Grevillea preissii* subsp. *preissii* that is common and naturally occurring in the same habitat. The duty botanist at the WA Herbarium stated that it was likely to be a hybrid between *G. preissii* subsp. *preissii* and another species which is used commonly in gardens and landscaping, *Grevillea olivacea*. With similar hybrids seen in horticultural situations and possibly due to cross-pollination by birds. Similar material has been observed in natural bushland on limestone in Hepburn Heights (K. McCreery, pers. obs.).

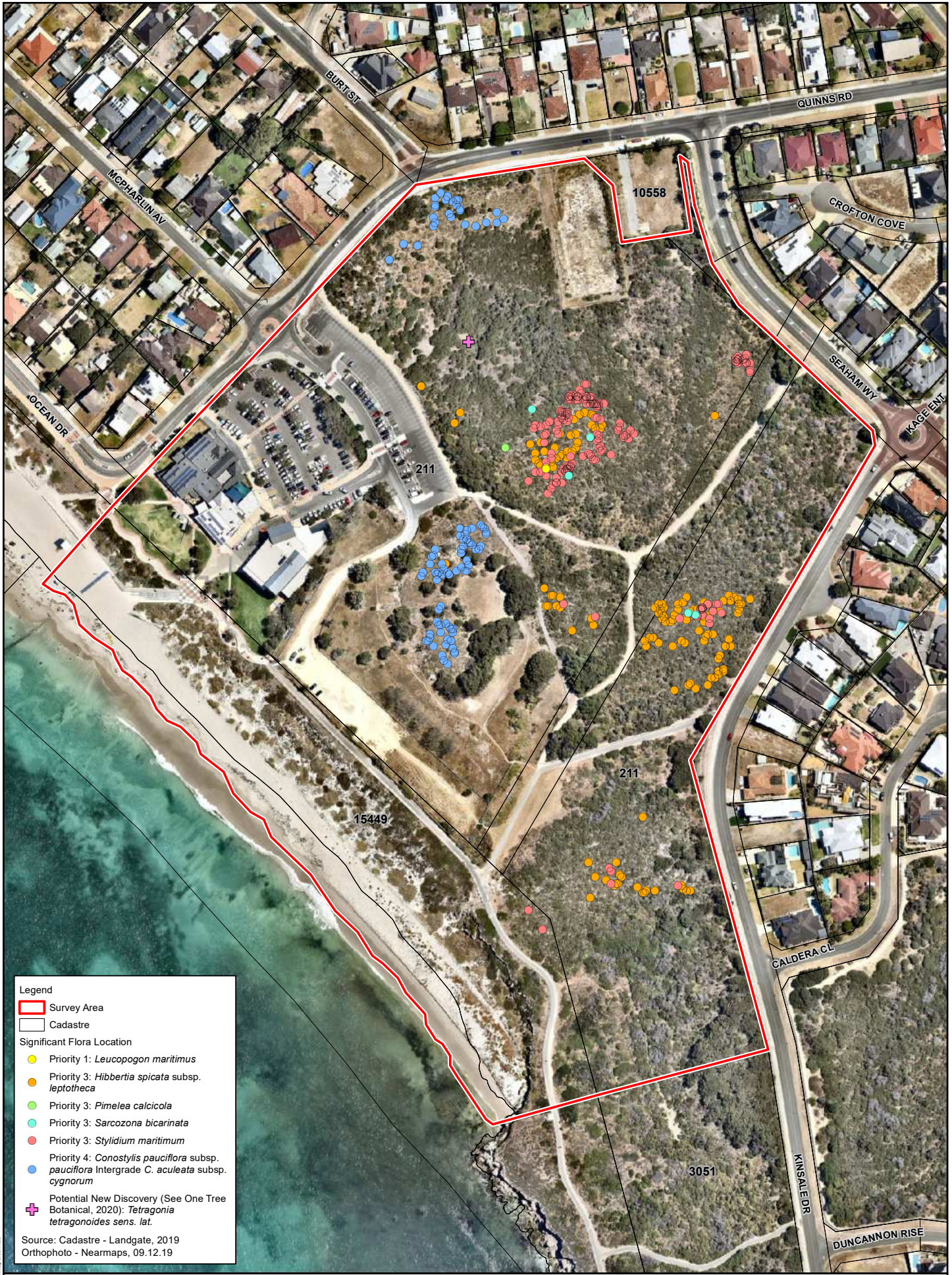
*G. olivacea* is a Priority 4 species when recorded from its natural range. It is known from limestone rises in a small area between Jurien Bay and Dongara, with an outlier towards Geraldton. As discussed however, it is commonly planted in Perth. It is highly unlikely therefore that the records in the study area are natural hybrids and therefore the Priority Flora status does not apply.

***Tetragonia tetragonoides* sens. lat.**

One specimen was of particular interest potentially under the category of “New species or anomalous features that indicate a potential new species”. Sens. lat. is an abbreviation of sensu lato that translates to “in the broader sense”, meaning it falls within a range of apparent variation within a species.

The duty botanist at the WA Herbarium stated that there was one other similar specimen of this type at the WA Herbarium, collected by G.J. Keighery (PERTH 11361) from Mullaloo. This was determined as *Tetragonia tetragonoides* sens. lat. by Aizoaceae specialist Bob Chinnock. However, the fruit is not typical for that species and the stamen number appears to be consistently 4, which is also not typical. The conclusion by the duty botanist was that it may well be a different taxon, with the possibility that it is an introduction.

The material collected in the survey will be forwarded to the WA Herbarium. Eventually taxonomic work will be completed to resolve this, but this may take many years. A single specimen (Figure 2) was seen in the study area, on relatively bare ground underneath *Melaleuca cardiophylla*.



**Legend**

Survey Area

Cadastre

**Significant Flora Location**

- Priority 1: *Leucopogon maritimus*
- Priority 3: *Hibbertia spicata* subsp. *leptotheca*
- Priority 3: *Pimelea calcicola*
- Priority 3: *Sarcosoma bicarinata*
- Priority 3: *Stylidium maritimum*
- Priority 4: *Conostylis pauciflora* subsp. *pauciflora* Intergrade *C. aculeata* subsp. *cygnorum*
- + Potential New Discovery (See One Tree Botanical, 2020): *Tetragonia tetragonoides* sens. lat.

Source: Cadastre - Landgate, 2019  
Orthophoto - Nearmaps, 09.12.19

Client: City of Wanneroo

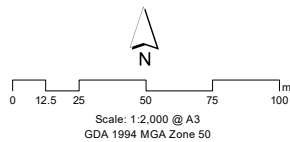
Job: P1904 Quinns Rocks

Date: 21/01/2020

E: keili@onetreebotanical.com.au

P: (08) 9371 9491

M: 0407 423 928



**FIGURE 2**

**LOT 211 QUINNS ROCKS  
SIGNIFICANT FLORA LOCATIONS MAP**

## 5.1.4 Introduced Flora

### *Environmental Weeds*

Of the 104 species of introduced flora recorded in the study area, 13 were given a High rating for invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (Dept. of Conservation and Land Management, 1999) (Table 16). Thirty-seven weeds recorded were given a Moderate rating. See Section 3.5.7 for more detail on these criteria.

Table 16: Environmental Weeds High to Moderate Rating (Dept. Conservation and Land Management, 1999)  
Recorded in the Study Area

Species	Common Name	Rating (CALM, 1999)
<i>*Asparagus asparagoides</i>	Bridal Creeper	High
<i>*Brassica tournefortii</i>	Mediterranean Turnip	High
<i>*Bromus diandrus</i>	Great Brome	High
<i>*Ehrharta calycina</i>	Perennial Veldt Grass	High
<i>*Eragrostis curvula</i>	African Love Grass	High
<i>*Euphorbia terracina</i>	Geraldton Carnation Weed	High
<i>*Freesia alba × leichtlinii</i>	Freesia	High
<i>*Lagurus ovatus</i>	Hare's Tail Grass	High
<i>*Leptospermum laevigatum</i>	Eastern States Tea Tree	High
<i>*Lupinus cosentinii</i>	Sandplain Lupin	High
<i>*Moraea flaccida</i>	One-leaf Cape Tulip	High
<i>*Pelargonium capitatum</i>	Rose Pelargonium	High
<i>*Romulea rosea</i>	Guildford Grass	High
<i>*Arctotheca calendula</i>	Cape Weed	Moderate
<i>*Arctotheca populifolia</i>	Dune Arctotheca	Moderate
<i>*Avena barbata</i>	Bearded Oat	Moderate
<i>*Avena fatua</i>	Wild Oat	Moderate
<i>*Bellardia trixago</i>	Bellardia	Moderate
<i>*Briza maxima</i>	Blowfly Grass	Moderate
<i>*Briza minor</i>	Shivery Grass	Moderate
<i>*Cakile maritima</i>	Sea Rocket	Moderate
<i>*Carpobrotus edulis</i>	Hottentot Fig	Moderate
<i>*Crassula glomerata</i>	(stonecrops)	Moderate
<i>*Cynodon dactylon</i>	Couch Grass	Moderate
<i>*Dischisma arenarium</i>	-	Moderate
<i>*Ehrharta brevifolia</i> var. <i>cuspidata</i>	-	Moderate
<i>*Ehrharta longiflora</i>	Annual Veldt Grass	Moderate
<i>*Euphorbia paralias</i>	Sea Spurge	Moderate
<i>*Euphorbia peplus</i>	Petty Spurge	Moderate
<i>*Ficus carica</i>	Common Fig	Moderate
<i>*Galium murale</i>	Small Goosegrass	Moderate
<i>*Gladiolus caryophyllaceus</i>	Pink Gladiolus	Moderate
<i>*Heliophila pusilla</i>	-	Moderate
<i>*Hypochaeris glabra</i>	Flatweed	Moderate
<i>*Lactuca serriola</i>	Prickly Lettuce	Moderate
<i>*Lantana camara</i>	Common Lantana	Moderate
<i>*Lysimachia arvensis</i>	Pimpernel	Moderate
<i>*Melilotus indicus</i>	Indian Sweet-clover	Moderate
<i>*Oenothera drummondii</i>	Beach Evening Primrose	Moderate
<i>*Olea europaea</i>	Olive	Moderate
<i>*Schinus terebinthifolia</i>	Japanese Pepper Tree	Moderate
<i>*Sisymbrium orientale</i>	Indian Hedge Mustard	Moderate
<i>*Solanum nigrum</i>	Black Berry Nightshade	Moderate
<i>*Sonchus oleraceus</i>	Common Sowthistle	Moderate
<i>*Stenotaphrum secundatum</i>	Buffalo Grass	Moderate
<i>*Tamarix aphylla</i>	Athel Tree	Moderate
<i>*Tetragonia decumbens</i>	Sea Spinach	Moderate
<i>*Trifolium campestre</i> var. <i>campestre</i>	Hop Clover	Moderate
<i>*Ursinia anthemoides</i> subsp. <i>anthemoides</i>	Ursinia	Moderate
<i>*Wahlenbergia capensis</i>	Cape Bluebell	Moderate

### *Declared Pest Plants (BAM Act 2007)*

There are 920 declared pest plant species on the WA Organism List (WAOL) under the *Biosecurity and Agriculture Management Act 2007* for the City of Wanneroo.

Three species recorded in the study area were on the WAOL.

One-leaf Cape Tulip *\*Moraea flaccida* is a Declared Pest for the City of Wanneroo. It appears that the reason this plant is listed is because it is toxic to livestock i.e. an agricultural weed. During the survey it was recorded at four locations in vegetation in quadrats QR07, QR09 and QR10 and south of QR05 (Figure 3).

Athel Pine *\*Tamarix aphylla* is listed as a Declared Pest for the whole of the state. More commonly referred to as Tamarisk locally. It is a tree to 12m. This species is listed because it is considered an environmental weed. A single plant was recorded in the study area, from the edge of the walk path in the old caravan park site.

Lantana *\*Lantana camara* is a woody shrub usually to 3m but often taller. It is a Declared Pest for the state. It is unclear what the difference is between *Lantana camara* and *Lantana camara* hybrids, as it seems likely that all are hybrids given its horticultural origins. The former has generalised requirements for control, the latter is a Declared Pest (Prohibited). It is described as an environmental weed in the south west and in rangelands. In the study area a single plant was recorded from natural bushland immediately to the north-east of QR10 (Figure 3).

See Appendix D for exact location information for each of these species. See Section 3.5.7 for more information on Declared Pests. Species descriptions all from Western Australian Herbarium (1998–).

### *Weeds of National Significance*

Three Weeds of National Significance (WONS) were recorded in the study area.

Bridal Creeper *\*Asparagus asparagoides* is a tuberous rhizomatous perennial climbing herb. It was recorded in three locations in an area roughly bounded by QR07, QR09 and QR10 (Figure 3). The specimens observed were young seedlings. It is likely to be scattered throughout this area.

Lantana *\*Lantana camara* is a woody shrub to 3m though sometimes taller. A single plant was recorded from natural bushland immediately to the north-east of quadrat QR10 (Figure 3).

Athel Pine *\*Tamarix aphylla*. More commonly referred to as Tamarisk locally. It is a tree to 12m. A single plant was recorded in the study area, from the edge of the walk path in the old caravan park site.

See Appendix D for precise location information. See Section 3.5.7 for more information on WONS. Species descriptions all from Western Australian Herbarium (1998–).

## 5.2 VEGETATION

### 5.2.1 Threatened and Priority Ecological Community Search Results

The DBCA Threatened Species and Communities Branch species database search did not identify any records of state listed TECs or PECs as being previously known from within the study area boundaries.

A search of the *EPBC Act* Protected Matters Search Tool (Department of Environment and Energy, 2019a) listed five TECs as potentially occurring in the region. None of these species have previously been recorded from within the study area.

Table 17 summarises the results from the database searches and identifies the likelihood of each occurring within the study area.

Table 17: Threatened and Priority Ecological Communities Database Search Results (DBCA PEC and TEC Databases and EPBC Protected Matters Database)

WESTERN AUSTRALIA	COMMONWEALTH EQUIVALENT ( <i>EPBC Act</i> 1999)	CONSERVATION STATUS*			OCCURRENCE Known/Likely/Possible/Unlikely
		DBCA	BC Act	EPBC Act	
<i>Banksia</i> Dominated Woodlands of the Swan Coastal Plain (SCP) IBRA Region.	<i>Banksia</i> Woodlands of the SCP.	P3		EN	Unlikely. Study area is too close to the coast.
<b>SCP20a:</b> <i>Banksia attenuata</i> woodlands over species rich dense shrublands.	Rarer sub-type of above.		EN	EN	Unlikely. Study area is too close to the coast.
Tuart ( <i>Eucalyptus gomphocephala</i> ) woodlands and forests of the SCP.	Tuart ( <i>Eucalyptus gomphocephala</i> ) Woodlands and Forests of the SCP.	P3		CR	Unlikely. Natural systems are dynamic however and there is some potentially suitable habitat present (Spearwood Dunes). One Tuart was recorded in disturbed area.
<b>SCP25:</b> Southern <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands.	Rarer sub-type of above.	P3		CR	Unlikely. Known from further south. Northern-most natural occurrence of <i>Agonis flexuosa</i> (planted in study area) is at Bold Park.
<b>SCP24:</b> Northern Spearwood shrublands and woodlands.		P3			<b>Recorded during current study.</b>
<b>SCP29a:</b> Coastal shrublands on shallow sands.		P3			<b>Recorded during current study.</b>
<b>SCP29b:</b> Acacia shrublands on taller dunes.		P3			Possible. This FCT typical in near-coastal areas. Possibly absent due to incursion of Spearwood Dunes at this point in coastline.
<b>SCP26a:</b> <i>Melaleuca huegelii</i> - <i>Melaleuca systena</i> shrublands on limestone ridges (FCT 26a as originally described in Gibson <i>et al.</i> , 1994).			EN		Possible. Closely related to FCT24 but generally known from Spearwood Dunes further inland.
<b>SCP30a:</b> <i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i> ) forests and woodlands, SCP.			VU		'Type or sub-type' possibly present. Known distribution further S. Thought to be an

WESTERN AUSTRALIA	COMMONWEALTH EQUIVALENT ( <i>EPBC Act</i> 1999)	CONSERVATION STATUS*			OCCURRENCE Known/Likely/Possible/Unlikely
		DBCA	BC Act	EPBC Act	
					apex community within for example long-unburnt FCT29-type communities. See Section 6.2.1 for further discussion.
<b>SCP19b:</b> Woodlands over sedgeland in Holocene dune swales of the southern SCP (original description; Gibson <i>et al.</i> , 1994).	Sedgeland in Holocene dune swales of the southern SCP.		CR	EN	Unlikely. Suitable habitat not present.
<b>CAVES SCP01:</b> Aquatic Root Mat Community Number 1 of Caves of the SCP.	Aquatic Root Mat Community in Caves of the SCP.		CR	EN	Unlikely. Subterranean ecology outside the scope of this assessment.
Coastal Saltmarsh.	Subtropical and Temperate Coastal Saltmarsh			VU	Unlikely. An estuarine ecological community.

\* See Section 3.5 for definitions of conservation status codes.

## 5.2.2 Vegetation Type Summary

### A DUNES ON UNCONSOLIDATED SAND

**A1: Primary Dune:** Open Shrubland *Olearia axillaris* and *Scaevola crassifolia* over Grassland *Spinifex longifolius* with patches of *S. hirsutus* near beach.

### B: COASTAL LIMESTONE CLIFF

**B1: Above Ridgeline:** Shrubland *Scaevola crassifolia*, *Myoporum insulare*, *Thomasia triphylla* and *\*Tetragonia decumbens*, Sparse Vineland *Hardenbergia comptoniana* Sparse Forbland *Acanthocarpus preissii* and Sparse Sedgeland *Lepidosperma gladiatum*.

**B2: Cliff Face:** Scattered Shrubs to Shrubland *Frankenia pauciflora* var. *pauciflora*, *Scaevola crassifolia*, *Thomasia triphylla* and *\*Tetragonia decumbens*.

### C: INLAND DUNES ON SEMI-CONSOLIDATED SAND

**C1: Dune Slopes and Crests:** Low Shrubland (<0.5m) dominated by *Melaleuca systema* but also typically *Acacia rostellifera*, *Spyridium globulosum*, *Phyllanthus calycinus* and *Cryptandra mutila*. Forbland dominated by *Lomandra maritima* but also typically *Acanthocarpus preissii* and *Opercularia vaginata*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland *Desmoclados asper* and Sparse Tussock Grassland *Austrostipa flavescens*, *Poa porphyroclados* and weeds *\*Lagurus ovatus*, *\*Bromus diandrus*.

**C2: Dune Swales and Lower Slopes:** Shrubland to Open Shrubland of often tall emergent *Acacia cyclops* over *Spyridium globulosum*, *Banksia sessilis* var. *cygnorum*, *Calothamnus quadrifidus* var. *quadrifidus* and *Rhagodia baccata* subsp. *baccata*. Vineland *Hardenbergia comptoniana*, *Clematis linearifolia* and *Cassytha racemosa* forma. *racemosa*. Forbland mixed but typically included *Conostylis aculeata* subsp. *cygnorum*, *Dianella revoluta* var. *divaricata*, *Acanthocarpus preissii* and weeds *\*Crassula glomerata*, *\*Stellaria media* and *\*Galium murale*. Often Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmoclados flexuosa* and Sparse to Open Tussock Grassland.

### D: SHALLOW SANDS OVER LIMESTONE

**D1: Crests of Low Limestone Ridges:** Open Shrubland to Shrubland dominated by *Melaleuca huegelii* subsp. *huegelii* but species rich with other typical shrubs *Templetonia retusa*, *Grevillea preissii* subsp. *preissii*, *Acacia truncata*, *Melaleuca systema*, *Trymalium ledifolium* var. *ledifolium*, *Hibbertia spicata* subsp. *leptotheca* (P3). Sparse Forbland also species-rich, dominated by *Lomandra maritima*, *Opercularia vaginata*, *Tricoryne elatior*, *Stylidium maritimum* (P3) and weeds *\*Minuartia mediterranea* and *\*Galium murale*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland to Rushland *Desmoclados asper* and *D. flexuosus* and Sparse Tussock Grassland *Austrostipa flavescens*, *\*Bromus diandrus* and *\*Lolium perenne*.

**D2: Upper Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Melaleuca cardiophylla* with *Rhagodia baccata* subsp. *baccata* over Forbland *Rhodanthe corymbosa*, *Calandrinia brevipedata*, *C. tholiformis*, *Crassula colorata* var. *acuminata*, *Daucus glochidiatus*

and weeds *\*Stellaria media* and *\*Minuartia mediterranea* and/or Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared) with bare understorey.

**D3: Lower Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Banksia sessilis* var. *cygnorum* with *Rhagodia baccata* subsp. *baccata* over Forbland of weeds *\*Galium murale*, *\*Crassula glomerata*, *\*Euphorbia terracina* and Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared).

**D4: Periphery of Low Limestone Ridges:** Closed tall Shrubland to Forest *Melaleuca lanceolata* over Isolated Shrubs *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa*.

**E: MODIFIED OR MANAGED AREAS**

**E1: Historically Disturbed Areas:** informal and formal walking paths, vehicular tracks, infrastructure, firebreaks, ex-caravan park site. Degraded to Completely Degraded.

**E2: Cultivated or Managed Areas:** Includes rehabilitated areas along the foreshore. Revegetation or landscaping using more or less local species.

**E3: Regrowth (cleared 2004-2006).** Closed tall Shrubland to Forest *Acacia rostellifera* over mainly bare ground and/or patches of weeds but with isolated Shrubs *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa* and various scattered native species representative of adjacent vegetation types.

**E4: Weedy Eucalypt.** Closed Mallee Forest *\*Eucalyptus utilis*. Over scattered native species and weeds.

See Figure 3 for vegetation type mapping. See Figure 4 for vegetation condition mapping.

### 5.2.3 Detailed Vegetation Type Descriptions

#### A PRIMARY DUNES ON UNCONSOLIDATED SAND

**A1: Primary Dune:** Open Shrubland *Olearia axillaris* and *Scaevola crassifolia* over Grassland *Spinifex longifolius* with patches of *S. hirsutus* near beach. (Plate 12). This vegetation was on the dune closest to the ocean.

Other scattered shrubs included *\*Tetragonia decumbens* and *Leucophyta brownii*. There was a Sparse Forbland that included the weeds *\*Trachyandra divaricata*, *\*Euphorbia paralias*, *\*Crassula glomerata*, *\*Pelargonium capitatum*. There were scattered Tussock Grasses of the weeds *\*Lolium perenne*, *\*Lagurus ovatus* and/or *\*Bromus diandrus*.

There were two quadrats in this vegetation (QR02 and QR08) with an average species richness of 14.

This vegetation was equivalent to FCT29a: "Coastal shrublands on shallow sands" (Gibson *et al.*, 1994) and S14: "Spinifex longifolius grasslands and low shrublands." (Griffin, 1993) (Government of WA, 2000). PEC SWAN 21 (FCT29a) is a Priority 3 ecological community.

This vegetation was in Good to Very Good condition (Figure 4) due to low to moderate weed invasion at the time of the survey, with localised areas of disturbance (weeds and informal tracks). Weeds consisted mainly of cosmopolitan coastal species.



Plate 12 Vegetation Type A1: Open Shrubland *Olearia axillaris* and *Scaevola crassifolia* over Grassland *Spinifex longifolius* with patches of *S. hirsutus*. QR02 looking S.

#### B: COASTAL LIMESTONE CLIFF

**B1: Terrace Above Cliff:** Shrubland *Scaevola crassifolia*, *Myoporum insulare*, *Thomasia triphylla* and *\*Tetragonia decumbens*, Sparse Vineland *Hardenbergia comptoniana* Sparse Forbland *Acanthocarpus preissii* and Sparse Sedgeland *Lepidosperma gladiatum*. (Plate 13).

Shrubs were wind pruned and low. Other scattered shrub species included *Rhagodia baccata* subsp. *baccata* and *Olearia axillaris*. There were scattered sedges *Ficinia nodosa*. There was a Sparse Forbland of *Parietaria debilis*, *Calandrinia brevipedata* and the weeds *\*Euphorbia terracina* and *\*Gazania linearis* and Sparse Tussock Grassland of weeds *\*Bromus diandrus* and *\*Ehrharta longiflora*.

There was one quadrat in this vegetation (QR16) with a species richness of 25.

The analysis indicated that QR16 was equivalent to FCT29a: “Coastal shrublands on shallow sands” (Gibson *et al.*, 1994) and S13: “Northern *Olearia axillaris* - *Scaevola crassifolia* shrublands” (Griffin, 1993) (Government of WA, 2000). It seems likely on an intuitive level however, that this vegetation type is equivalent to FCT16: “Highly saline seasonal wetlands (*Frankenia pauciflora* Low Shrubland on Tamala Limestone Cliffs)”. PEC SWAN 21 (FCT29a) is a Priority 3 ecological community.

This vegetation was in Good to Very Good condition (Figure 4) due to low to moderate weed invasion at the time of the survey, with localised areas of quite significant disturbance (weeds, historically cleared patches and informal tracks). Weeds consisted mainly of cosmopolitan coastal species.

**B2: Cliff Face:** Scattered Shrubs to Shrubland *Frankenia pauciflora* var. *pauciflora*, *Scaevola crassifolia*, *Thomasia triphylla* and *\*Tetragonia decumbens*. (Plate 14).

Other scattered shrub species included *Rhagodia baccata* subsp. *baccata* and *Olearia axillaris*. There was a Sparse Forbland of weeds including *\*Trachyandra divaricata*, *\*Crassula glomerata*, *\*Euphorbia paralias* and *\*Cakile maritima* and Sparse Tussock Grassland *Spinifex longifolius* and grass weeds *\*Bromus diandrus* and *\*Lolium perenne*.

There was one quadrat in this vegetation (QR03) with a species richness of 18.

While the analysis indicated that QR03 was equivalent to FCT29a: “Coastal shrublands on shallow sands” (Gibson *et al.*, 1994) and S13: “Northern *Olearia axillaris* - *Scaevola crassifolia* shrublands” (Griffin, 1993) (Government of WA, 2000). PEC SWAN 21 (FCT29a) is a Priority 3 ecological community.

This vegetation was in Good to Very Good condition (Figure 4) due to low to moderate weed invasion at the time of the survey. Weeds consisted mainly of cosmopolitan coastal species.



Plate 13 Vegetation Type B1: Shrubland *Scaevola crassifolia*, *Myoporum insulare*, *Thomasia triphylla* and *\*Tetragonia decumbens* and Sparse Sedgeland *Lepidosperma gladiatum*.



Plate 14 Vegetation Type B2: Scattered Shrubs to Shrubland *Frankenia pauciflora* var. *pauciflora*, *Scaevola crassifolia*, *Thomasia triphylla* and *\*Tetragonia decumbens*.

## C: INLAND DUNES ON SEMI-CONSOLIDATED SAND

**C1: Dune Slopes and Crests:** Low Shrubland (<0.5m) dominated by *Melaleuca systema* but also typically *Acacia rostellifera*, *Spyridium globulosum*, *Phyllanthus calycinus* and *Cryptandra mutila*. Forbland

dominated by *Lomandra maritima* but also typically *Acanthocarpus preissii*, *Conostylis pauciflora* Intergrade *C. aculeata* and *Opercularia vaginata*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland *Desmocladius asper* and Sparse Tussock Grassland *Austrostipa flavescens*, *Poa porphyroclados* and weeds *\*Lagurus ovatus* and *\*Bromus diandrus*. (Plate 15).

Other typical shrubs included *Leucopogon parviflorus*, *Olearia axillaris*, *Rhagodia baccata* subsp. *baccata*, *Hibbertia spicata* subsp. *leptotheca*, *Gompholobium tomentosum* and/or *Hemiandra glabra*. The forb strata also included the weeds *\*Pelargonium capitatum*, *\*Euphorbia terracina*, *\*Romulea rosea*, *\*Crassula glomerata*, *\*Trifolium campestre* var. *campestre*. Other typical grasses were weeds *\*Lolium perenne* and *\*Avena barbata*. There was a Sparse Vineland of *Hardenbergia comptoniana*.

There were two quadrats in this vegetation (QR11 and QR12) which had an average species richness of  $41 \pm 0$ .

The analysis indicated that QR11 and QR12 were equivalent to FCT24: "Northern Spearwood shrublands and woodlands" (Gibson *et al.*, 1994). PEC SWAN 26 (FCT24) is a Priority 3 ecological community.

This vegetation was fairly consistently in Good condition (Figure 4). Species diversity was moderately intact, weed cover was high.



Plate 15 Vegetation Type C1: Low Shrubland dominated by *Melaleuca systema* and Forbland dominated by *Lomandra maritima*.

**C2: Dune Swales and Lower Slopes:** Shrubland to Open Shrubland of sometimes tall emergent *Acacia cyclops* over *Spyridium globulosum*, *Banksia sessilis* var. *cygnorum*, *Calothamnus quadrifidus* var. *quadrifidus* and *Rhagodia baccata* subsp. *baccata*. Vineland *Hardenbergia comptoniana*, *Clematis linearifolia* and *Cassytha racemosa* forma. *racemosa*. Forbland mixed but typically included *Conostylis aculeata* subsp. *cygnorum*, *Dianella revoluta* var. *divaricata*, *Acanthocarpus preissii* and weeds *\*Crassula glomerata*, *\*Stellaria media* and *\*Galium murale*. Often Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmocladius flexuosa* and mixed weedy Sparse to Open Tussock Grassland. (Plate 16 and 17).

Shrub diversity variable across vegetation type depending on distance from the coast and included *Melaleuca systema*, *M. huegelii* subsp. *huegelii*, *M. cardiophylla*, *Templetonia retusa*, *Acacia rostellifera*, *A. saligna*, *Grevillea preissii* subsp. *preissii*, *Hakea lissocarpha*, *H. prostrata*, *Hibbertia hypericoides* subsp.

*hypericoides*, *Myoporum insulare*, *Santalum acuminatum*, *Olearia axillaris* and/or weed *\*Tetragonia decumbens*.

The forb strata also typically included *Crassula colorata* var. *acuminata*, *Caladenia latifolia*, *Microtis media* subsp. *media*, *Parietaria debilis* and weeds *\*Euphorbia terracina* and *\*Lysimachia arvensis*.

There were three quadrats in this vegetation (QR04, QR10 and QR15) which had an average species richness of  $40.7 \pm 12$ .

The analysis indicated that QR04 and QR15 were equivalent to FCT29a: "Coastal shrublands on shallow sands" (Gibson *et al.*, 1994) while QR10 was equivalent to FCT24: "Northern Spearwood shrublands and woodlands" (Gibson *et al.*, 1994). Both PEC SWAN 26 (FCT24) and PEC SWAN 21 (FCT29a) are Priority 3 ecological communities.

The condition of this vegetation was patchy across its distribution, but mostly varied from Very Good to Good (Figure 4) with localised disturbed areas (tracks, historical clearing, dense weeds). Species diversity was moderately intact. Weed cover was moderate, but also very variable across this vegetation type.



Plate 16 Vegetation Type C2: Dune Swales and Lower Slopes: Shrubland to Open Shrubland of sometimes tall emergent *Acacia cyclops* over *Spyridium globulosum*. Taller vegetation further inland. Near QR15.



Plate 17 Vegetation Type C2: Dune Swales and Lower Slopes: Shrubland to Open Shrubland of sometimes tall emergent *Acacia cyclops* over *Spyridium globulosum*. Shorter vegetation nearer to coast. Near QR04.

## D: SHALLOW SANDS OVER LIMESTONE

**D1: Crests of Low Limestone Ridges:** Low to medium Open Shrubland to Shrubland dominated by *Melaleuca huegelii* subsp. *huegelii* but species rich with other typical shrubs *Templetonia retusa*, *Grevillea preissii* subsp. *preissii*, *Acacia truncata*, *Melaleuca systema*, *Trymalium ledifolium* var. *ledifolium*, *Hibbertia spicata* subsp. *leptotheca* (P3). Sparse Forbland also species-rich, dominated by *Lomandra maritima*, *Opercularia vaginata*, *Tricoryne elatior*, *Stylidium maritimum* (P3) and weeds *\*Minuartia mediterranea* and *\*Galium murale*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland to Rushland *Desmoclados asper* and *D. flexuosus* and Sparse Tussock Grassland *Austrostipa flavescens*, *\*Bromus diandrus* and *\*Lolium perenne*. (Plate 18 and 19).

Other typical shrubs included *Spyridium globulosum*, *Leucopogon parviflorus*, *Rhagodia baccata* subsp. *Baccata*, *Banksia dallanneyi* var. *dallanneyi*, *Acacia rostellifera*, *A. cyclops*, *Gompholobium tomentosum*, *Acacia lasiocarpa* var. *lasiocarpa*, *Scaevola thesioides* subsp. *thesioides*, *Eremophila glabra* subsp.

*albicans*, *Olearia axillaris*, *Petrophile serruriae*, *Phyllanthus calycinus* and/or *Diplopeltis huegelii* subsp. *huegelii*. Other typical forbs included *Dianella revoluta* var. *divaricata*, *Acanthocarpus preissii*, *Caladenia latifolia*, *Poranthera microphylla*, *Triglochin isingiana*, *Calandrinia tholiformis* and the weeds *\*Crassula glomerata*, *\*Petrorhagia dubia*, *\*Gladiolus caryophyllaceus* and *\*Lysimachia arvensis*. There was also an Open to Sparse Vineland of *Clematis linearifolia*, *Hardenbergia comptoniana* and *Cassytha* spp. Other grasses included the weeds *\*Ehrharta longiflora* and *\*Briza maxima*.

There were three quadrats in this vegetation (QR01, QR05 and QR07) with an average species richness of  $68.7 \pm 3.5$ .

The statistical analysis indicated that QR01 and QR05 most closely grouped with FCT29a: "Coastal shrublands on shallow sands" (Gibson *et al.*, 1994) while QR07 most closely grouped with FCT24: "Northern Spearwood shrublands and woodlands" (Gibson *et al.*, 1994). Both PEC SWAN 26 (FCT24) and PEC SWAN 21 (FCT29a) are Priority 3 ecological communities.

This vegetation was in Very Good condition (Figure 4). Species diversity was high. Weed cover was low and this vegetation verged on Excellent condition, however there were quite a few species of weeds present including some serious bushland weeds. The location of this vegetation on relatively inaccessible limestone ridges appears to have protected this vegetation from the degrading influences suffered by much of the surrounding vegetation.



Plate 18 Vegetation Type D1: Crests of Low Limestone Ridges: Low to medium Open Shrubland to Shrubland dominated by *Melaleuca huegelii* subsp. *huegelii*. Near QR07.



Plate 19 Vegetation Type D1: Crests of Low Limestone Ridges: Low to medium Open Shrubland to Shrubland dominated by *Melaleuca huegelii* subsp. *huegelii*. Near QR05.

**D2: Upper Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Melaleuca cardiophylla* with *Rhagodia baccata* subsp. *baccata* over Forbland *Rhodanthe corymbosa*, *Calandrinia brevipedata*, *C. tholiformis*, *Crassula colorata* var. *acuminata*, *Daucus glochidiatus* and weeds *\*Stellaria media* and *\*Minuartia mediterranea* and/or Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared) with bare understorey. (Plate 20).

Other typical shrubs included *Acacia xanthina*, *Rhagodia baccata* subsp. *baccata*, *Melaleuca systena*, *M. huegelii* subsp. *huegelii*, *Spyridium globulosum*, *Banksia sessilis* var. *cygnorum*, *Templetonia retusa*, *Leucopogon parviflorus*. Other forbs included *Triglochin isingiana*, *Tricoryne elatior*, *Lomandra maritima*, *Caladenia latifolia* and weeds *\*Crassula glomerata*, *\*Euphorbia peplus*, *\*Silene gallica*, *\*Sonchus*

*oleraceus*, *\*Hypochaeris glabra*. Other scattered tussock grasses included *Poa porphyroclados*, *Austrostipa flavescens* and weeds *\*Lolium perenne*, *\*Bromus diandrus* and/or *\*Lagurus ovatus*.

There were two quadrats in this vegetation (QR06 and QR14) with an average species richness of  $51.5 \pm 4.9$ .

The statistical analysis indicated that QR06 and QR14 most closely grouped with FCT29a: "Coastal shrublands on shallow sands" (Gibson *et al.*, 1994). PEC SWAN 21 (FCT29a) is a Priority 3 ecological community.

This vegetation varied from Good to Degraded to Good condition (Figure 4). At some point this vegetation appears to have been disturbed. Some historical clearing had occurred in recent years and the vegetation in these areas was evidently regrowth. Areas underneath dense thickets of *Melaleuca cardiophylla* had a very high weed cover and low understorey species diversity, with weed cover up to 90% in places. Other generally more open areas had moderate weed cover with higher diversity.



Plate 20 Vegetation Type D2: Upper Slope of Low Limestone Ridges: Shrubland to Closed Shrubland tall shrub *Melaleuca cardiophylla*

**D3: Lower Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Banksia sessilis* var. *cygnorum* with *Rhagodia baccata* subsp. *baccata* over Forbland of weeds *\*Galium murale*, *\*Crassula glomerata*, *\*Euphorbia terracina* and Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared). (Plate 21).

Other typical but usually scattered shrubs included *Calothamnus quadrifidus* subsp. *quadrifidus*, *Hakea prostrata*, *H. trifurcata*, *H. lissocarpha*, *Banksia dallanneyi* var. *dallanneyi*, *Hibbertia hypericoides* subsp. *hypericoides*, *Bossiaea eriocarpa*, *Melaleuca systema*, *Grevillea preissii* subsp. *preissii*. Other forbs included *Crassula colorata* var. *acuminata*, *Lomandra maritima*, *Dianella revoluta* var. *divaricata*, *Conostylis aculeata* var. *cygnorum*, *Acanthocarpus preissii* and weeds *\*Stellaria media*, *\*Sonchus oleraceus*, *\*Hypochaeris glabra*, *Lysimachia arvensis*, *\*Pelargonium capitatum*. Other scattered tussock grasses included *Austrostipa flavescens* and weeds *\*Bromus diandrus*, *\*Briza maxima* and/or *\*Lolium perenne*. There were Isolated Clumps of Sedges including *Lepidosperma calcicola*, *Mesomelaena pseudostygia* and/or *Schoenus clandestinus*. Isolated Clumps of Rushes *Desmocladus flexuosus* and/or *D. asper*.

There were two quadrats in this vegetation (QR09 and QR13) with an average species richness of  $42.5 \pm 12$ .

QR09 and QR13 most closely grouped with FCT24: “Northern Spearwood shrublands and woodlands” (Gibson *et al.*, 1994). PEC SWAN 26 (FCT24) is a Priority 3 ecological community.

This vegetation was mostly in Good condition (Figure 4). At some point this vegetation appears to have been disturbed, the tall thickets had a dense understorey of weeds and low understorey species diversity. Rare open patches had a higher species diversity in the understorey.



Plate 21 Vegetation Type D3: Lower Slope of Low Limestone Ridges: Shrubland to Closed Shrubland tall shrub *Banksia sessilis* var. *cygnorum*.



Plate 22 Vegetation Type D4: Periphery of Low Limestone Ridges: Closed tall Shrubland to Forest *Melaleuca lanceolata* over Isolated Shrubs *Rhagodia b. ssp. baccata* and *Threlkeldia diffusa*.

**D4: Periphery of Low Limestone Ridges:** Closed tall Shrubland to Forest *Melaleuca lanceolata* over Isolated Shrubs *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa*. Possibly regrowth.

This vegetation type was present as scattered clumps of dense *Melaleuca lanceolata* over mostly bare soil and leaf litter. Other scattered species included the shrub *Enchylaena tomentosa* var. *tomentosa*, the vine *Clematis linearifolia* and Scattered Forb weeds *\*Sonchus oleraceus* and *\*Galium murale*. (Plate 22).

The patches of this vegetation were too small for quadrats. A releve was completed in the largest patch (QR17), where eight species were recorded. The statistical analysis indicated that this vegetation most closely grouped with FCT29a: “Coastal shrublands on shallow sands” (Gibson *et al.*, 1994) and S11: “Northern *Acacia rostellifera* – *Melaleuca acerosa* (*M. systema*) shrublands” (Griffin, 1993) (Government of WA, 2000). PEC SWAN 21 (FCT29a) is a Priority 3 ecological community. There were secondary associations with FCT30a however which represents Western Australian TEC SCP30a. Please see Sections 5.2.6 and 6.2 for further discussion.

There were small patches of this vegetation along the eastern boundary of the study area (Figure 3). It was mapped as Good to Degraded condition (Figure 4).

The origins of these patches was difficult to determine. They were not mature stands, however were quite advanced and had developed some floristic diversity in the understorey. Although *Melaleuca lanceolata* communities are naturally species poor. They did not appear to have been planted. The pattern of growth at the road-vegetation interface indicates perhaps a response to disturbance. *M. lanceolata* is thought to be an indicator of an apex community near-coastal areas where fire has not been too frequent, so it is a possibility it was the result of natural progression.

**E: MODIFIED OR MANAGED AREAS**

- E1: Historically Disturbed Areas:** informal and formal walking paths (Plate 23), vehicular tracks, infrastructure, firebreaks, old caravan park site, urban drainage sump, localised clearing, landscaped and/or disturbed edges. Degraded to Completely Degraded.
- E2: Cultivated or Managed Areas:** Includes rehabilitated areas along the foreshore. Revegetation or landscaping using more or less local species.
- E3: Regrowth (cleared 2004-2006).** Closed tall Shrubland to Forest *Acacia rostellifera* over mainly bare ground and/or patches of weeds but with isolated Shrubs *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa* and various scattered native species representative of adjacent vegetation types. Plate 24.
- E4: Weedy Eucalypt.** Closed Mallee Forest *\*Eucalyptus utilis*. Scattered native species and weeds in the understorey. *\*Eucalyptus utilis* was known previously as *E. platypus* var. *heterophylla*, or Coastal Moort. This species is native to the south coast. It was unclear whether this area was deliberately rehabilitated using this species or whether it naturalised. Historical aerial photography indicates that this area was still more or less natural bushland around 2002. This species can become weedy outside its natural range. Scattered natives in the understorey included *Rhagodia baccata* subsp. *baccata*, *Templetonia retusa*, *Acacia cyclops*.



Plate 23 Vegetation Type E1: Historically Disturbed Areas: formal walking paths. Annual weedy growth common, in this case common coastal weeds grass *\*Bromus diandrus* and forb *\*Euphorbia terracina*.



Plate 24 Vegetation Type E3: Regrowth (cleared 2004-2006). Closed tall Shrubland to Forest *Acacia rostellifera* over mainly bare ground.



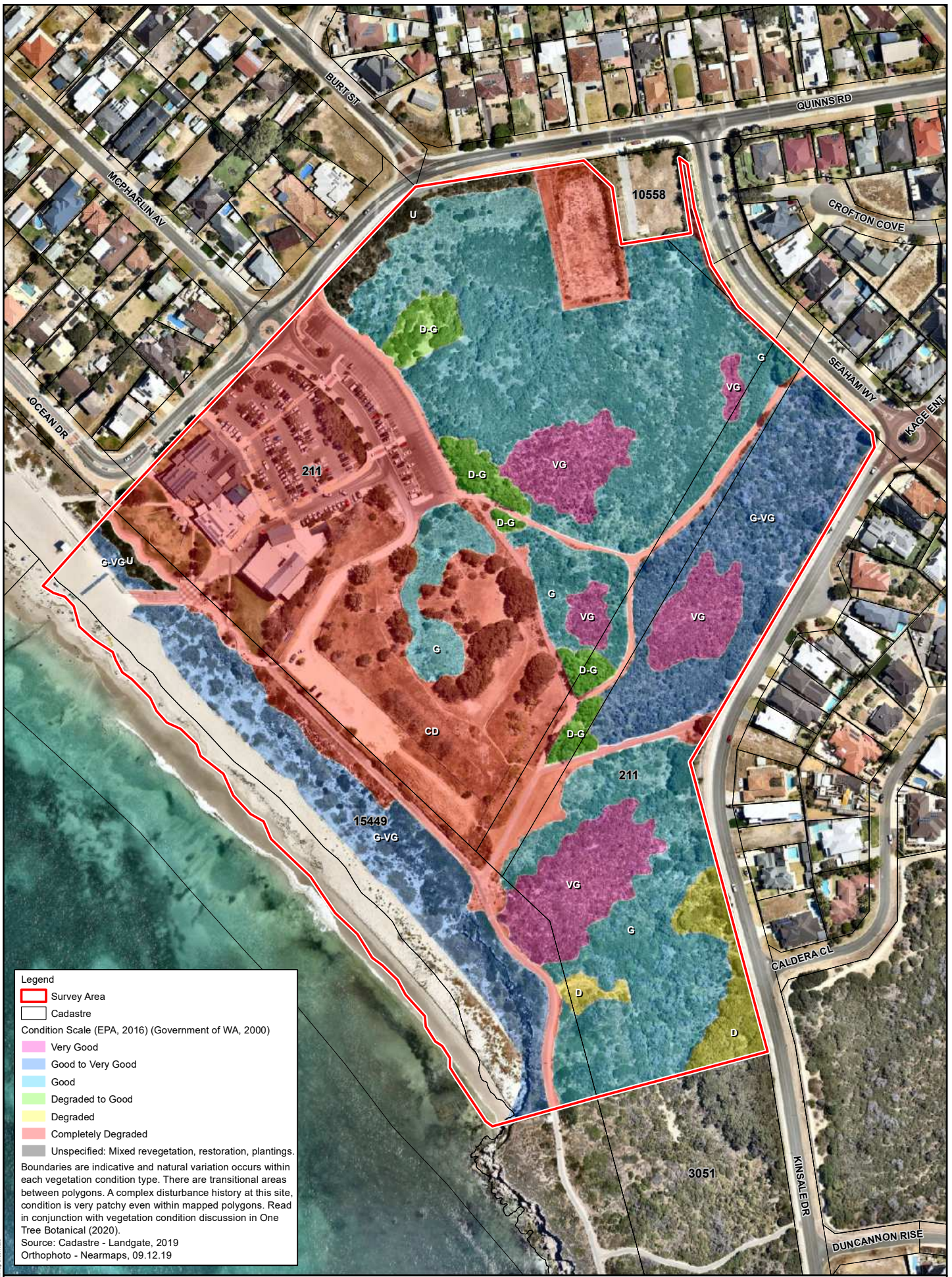


FIGURE 4

## LOT 211 QUINNS ROCKS VEGETATION CONDITION MAP

## 5.2.5 Statistical Analysis of Vegetation

### *Study Area Quadrats*

A multivariate analysis of quadrat data collected from this survey only was used to help define the vegetation present in the study area. The results are presented in Figure 5.

Unlike the analysis used to determine Floristic Community Types (FCTs) (see next section), this analysis incorporated not only floristics but a weighting for structure (foliar cover % cover ranges as per NVIS structural classes). This is one reason why results may not always align between the two methods. This is a more detailed analysis than FCT, useful for identifying patterns locally, however unlike the FCT analysis, it does not provide a regional context.

The quadrats split into two main groups as represented by the primary branch in the dendrogram (Figure 5).

The first group contained two vegetation types. The first was vegetation on inland consolidated parabolic dunes (QR11, QR12) (Vegetation Type C1) (Figure 3). The second was vegetation on limestone outcrops (QR01, QR05, QR07) (Vegetation Type D1). Both vegetation types were relatively species rich and had several dominant species in common such as *Melaleuca systema* and *Lomandra maritima*, *Lepidosperma calcicola*, *Desmocladus asper* etc.

The second group included three high level divisions.

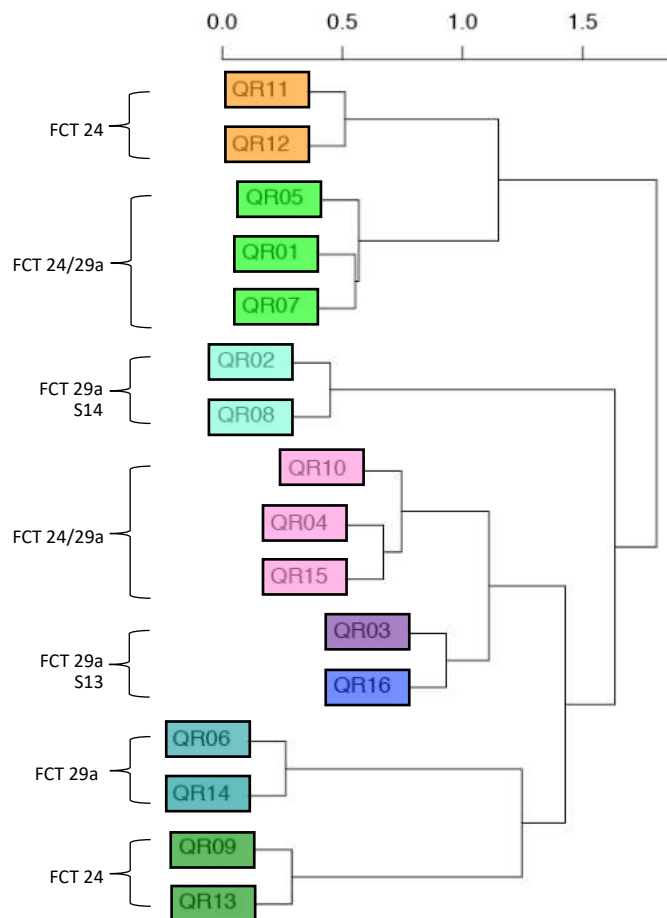
The first separated early on and included the foredunes along the beach dominated by *Spinifex longifolius* (QR02, QR08) (Vegetation Type A1) (Figure 3).

The second group included somewhat incongruously the coastal limestone cliff vegetation (Vegetation Types B1 and B2) and mixed taller vegetation on dune slopes and swales further inland (Vegetation Type C2). The co-occurrence of typical near coastal species such as *Scaevola crassifolia*, *Rhagodia baccata* subsp. *baccata*, *Olearia axillaris* etc as well as some common weeds is perhaps why these grouped together. Vegetation Type C2 does become less influenced by these species with distance from the coast and towards the east of the study area.

The third group were the Tall Shrublands to Closed Shrublands in the north east of the project area of *Melaleuca cardiophylla* (Vegetation Type D2) and *Banksia sessilis* var. *cygnorum* (Vegetation Type D3) (Figure 3). These two vegetation types were clearly different structurally, however their understoreys were similar. This is where most of the species diversity was. Their close proximity and being on similar soil and landforms also meant that there were numerous co-occurring understorey species. These included particularly the weedy forbs *\*Galium murale* and *\*Stellaria media* and grasses *\*Ehrharta longiflora* and *\*Briza maxima* as dominants, amongst others. Many shrub species were shared also, notably *Rhagodia baccata* subsp. *baccata*, *Grevillea preissii* subsp. *preissii* and *Banksia dallanneyi* subsp. *dallanneyi*.

These groupings variously aligned with the findings of the FCT analysis, as described in the next section, although the results were not entirely straightforward. See Figure 5.

Figure 5: Statistical Analysis of Quadrat Data (Bray-Ward) (floristics, foliar cover NVIS cover class)



### Corresponding Vegetation Types:

#### A DUNES ON UNCONSOLIDATED SAND

**A1:** **Primary Dune:** Open Shrubland *Olearia axillaris* and *Scaevola crassifolia* over Grassland *Spinifex longifolius* with patches of *S. hirsutus* near beach.

#### B: COASTAL LIMESTONE CLIFF

**B1:** **Above Ridgeline:** Shrubland *Scaevola crassifolia*, *Myoporum insulare*, *Thomasia triphylla* and *\*Tetragonia decumbens*, Sparse Vineland *Hardenbergia comptoniana* Sparse Forbland *Acanthocarpus preissii* and Sparse Sedgeland *Lepidosperma gladiatum*.

**B2:** **Cliff Face:** Scattered Shrubs to Shrubland *Frankenia p. var. pauciflora*, *Scaevola crassifolia*, *Thomasia triphylla* and *\*Tetragonia decumbens*.

#### C: INLAND DUNES ON SEMI-CONSOLIDATED SAND

**C1:** **Dune Slopes and Crests:** Low Shrubland (<0.5m) dominated by *Melaleuca systena* but also typically *Acacia rostellifera*, *Spyridium globulosum*, *Phyllanthus calycinus* and *Cryptandra mutila*. Forbland dominated by *Lomandra maritima* but also typically *Acanthocarpus preissii* and *Opercularia vaginata*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland *Desmodium asper* and Sparse Tussock Grassland *Austrostipa flavescentis*, *Poa porphyroclados* and weeds *\*Lagurus ovatus*, *\*Bromus diandrus*.

**C2:** **Dune Swales and Lower Slopes:** Shrubland to Open Shrubland of often tall emergent *Acacia cyclops* over *Spyridium globulosum*, *Banksia sessilis* var. *cygnorum*, *Calothamnus q. var. quadrifidus* and *Rhagodia b. subsp. baccata*. Vineland *Hardenbergia comptoniana*, *Clematis linearifolia* and *Cassytha r. forma. racemosa*. Forbland mixed but typically included *Conostylis aculeata* subsp. *cygnorum*, *Dianella revoluta* var. *divaricata*, *Acanthocarpus preissii* and weeds *\*Crassula glomerata*, *\*Stellaria media* and *\*Galium murale*. Often Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmodium flexuosa*.

#### D: SHALLOW SANDS OVER LIMESTONE

**D1:** **Crests of Low Limestone Ridges:** Open Shrubland to Shrubland dominated by *Melaleuca h. subsp. huegelii* but species rich with other typical shrubs *Templetonia retusa*, *Grevillea p. subsp. preissii*, *Acacia truncata*, *Melaleuca systena*, *Trymalium l. var. ledifolium*, *Hibbertia spicata* subsp. *leptotheca* (P3). Sparse Forbland also species-rich, dominated by *Lomandra maritima*, *Opercularia vaginata*, *Tricoryne elatior*, *Stylidium maritimum* (P3) and weeds *\*Minuartia mediterranea* and *\*Galium murale*. Sparse Sedgeland *Lepidosperma calcicola*, Sparse Rushland to Rushland *Desmodium asper* and *D. flexuosus* and Sparse Tussock Grassland *Austrostipa flavescentis*, *\*Bromus diandrus* and *\*Lolium perenne*.

**D2:** **Upper Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Melaleuca cardiophylla* with *Rhagodia b. subsp. baccata* over Forbland *Rhodanthe corymbosa*, *Calandrinia brevipedata*, *C. tholiformis*, *Crassula colorata* var. *acuminata*, *Daucus glochidiatus* and weeds *\*Stellaria media* and *\*Minuartia mediterranea* and/or Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared) with bare understorey.

**D3:** **Lower Slope of Low Limestone Ridges:** Shrubland to Closed Shrubland tall shrub *Banksia sessilis* var. *cygnorum* with *Rhagodia b. subsp. baccata* over Forbland of weeds *\*Galium murale*, *\*Crassula glomerata*, *\*Euphorbia terracina* and Tussock Grassland *\*Ehrharta longiflora*. Regrowth in places (historically cleared).

### *Floristic Analysis Gibson et al. (1994)*

The results of the floristic analysis were consistent with the study area straddling the Quindalup and Spearwood Dune systems.

When comparing study area quadrat data to Gibson *et al.* (1994) alone, quadrats either clustered with FCT29a, which is a typical Quindalup Dune FCT or with FCT24, which is more typical of the Spearwood Dunes (Table 18).

When extra data was added from Griffin (1993) and other sources, most sites grouped more or less more closely with FCT24.

The exception were the quadrats closest the coast (QR02, QR03, QR08, QR16) (Figure 3), which grouped with FCTs S13 and S14 from Griffin (1993). The S13 and S14 quadrats in this group were all from near coastal areas to the north at Wilbinga, Two Rocks and Yanchep and to the south at Mindarie, Burns Beach and Swanbourne. One FCT29a quadrat was also in this grouping, BURN-2 from Burns Beach. While the Gibson *et al.* (1994) dataset was lacking near-coastal quadrat data, there was some geographical overlap with the Griffin (1993) dataset which likely accounts for this. S13 and S14 are not formalised FCTs. They were described but not quantified in Bush Forever (Government of WA, 2000). They were derived from an unpublished analysis of the Griffin (1993) data. DBCA advice (Val English pers. comm.) was that when considering PEC/TEC status, the best fit to the Gibson *et al.* (1994) dataset is what takes precedence. While not ideal, S13 and S14 were therefore treated as FCT29a in the conservation significance assessment, even though they represent either rarer subtypes of FCT29a or FCTs in their own right. Additional formalised regional studies are required to resolve some of these issues and it is outside the scope of this study to resolve this issue.

Ecoscape (2015) states that FCT26a was likely to be present in those areas dominated by *Melaleuca huegelii*. In this study this related to Vegetation Type D1 (quadrats QR01, QR05 and QR07) (Figure 3). FCT26a is equivalent to TEC SCP26a: “*Melaleuca huegelii* - *Melaleuca systena* shrublands on limestone ridges”. The floristic analysis in this study did not support this, in favour of FCT24 and FCT29a. The Gibson *et al.* (1994) data indicates that *M. huegelii* occurred in 82% of FCT26a quadrats, 44% of FCT29a quadrats and 11% of FCT24 quadrats. It is not restricted to FCT26a. FCT24 and FCT29a typically have more near-coastal species than FCT26a including *Acanthocarpus preissii*, *Olearia axillaris*, *Dianella revoluta* and *Poa porphyroclados* for example. These species were commonly present in Vegetation Type D1. While FCT26a has species such as *Astroloma microcalyx*, *Wurmbea monantha*, *Stylidium maritimum* and *Hydrocotyle hispidula*, which were also present in Vegetation Type D1. See Section 6.2.2 for further discussion.

There was a question to be answered about whether or not the patches of *Melaleuca lanceolata* in the study area represented FCT30a. FCT30a equals TEC SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain”, which is a Western Australian TEC. The patches present onsite were not large or discrete enough for a formal quadrat, however an informal site was completed to collect floristic data. While it was not ideal to use such data in an analysis, it was run against Gibson *et al.* (1994) to attempt to shed some light on the question. QR17 came out closest with FCT29a quadrats. The next closest cluster of quadrats were from FCT30a (Figure 6). In a larger dataset however, it clustered away from the main FCT29a grouping, forming an alliance with a somewhat random collection of quadrats from FCT29a (PRES1), FCT30c (SEAB1) (reclassified to FCT30a2 in later unpublished studies) and S11 (MI08, rott01) (Figure 7). There was again a secondary association with FCT30a quadrats from Gibson *et al.* (1994) (Figure 7).

SEAB1 (Figure 7) while designated FCT30c in Gibson *et al.* (1994), it is frequently a problematic quadrat that often clusters closer with FCT29a. In a later unpublished analysis, this quadrat is redesignated as FCT30a2, which is a 'type or subtype' of FCT30a.

MI08 is a Griffin (1993) quadrat from Mindarie, that does not contain *M. lanceolata*. Quadrat rott01 is data collected by G. Keighery from Rotttnest, that does contain *M. lanceolata*. In an unpublished analysis both MI08 and rott01 were determined to represent S11. As discussed, DBCA advise that unverified FCTs such as S11 are treated in conservation significance assessments according to their original Gibson *et al.* (1994) groupings, in this case FCT29a. It was notable that in a bigger dataset, QR17 clustered away from all other Quinns Rocks sites and also from sites at Yanchep Lagoon. In both analysis QR17 clustered closest to PRES1, which is a quadrat from Preston south of Mandurah. PRES1 also contains *M. lanceolata*. Only four quadrats in Gibson *et al.* (1994) contained *M. lanceolata*, the quadrat at Preston and three on Garden Island. In total seven quadrats contained *M. lanceolata* in the combined dataset, the three additional sites being from Rotttnest.

Please see Sections 5.2.6 and 6.2.1 for further discussion.

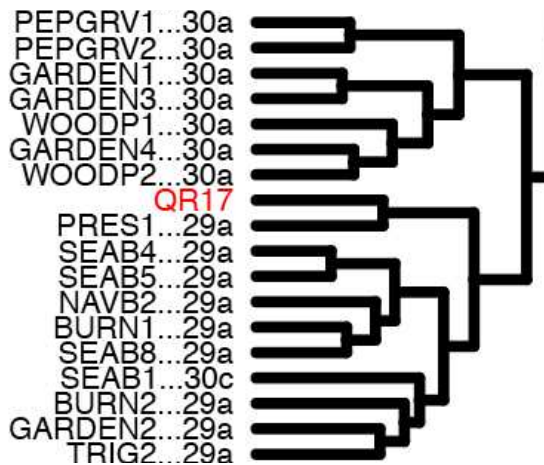


Figure 6: Floristic Analysis of Informal Quadrat QR17 against Gibson *et al.* (1994) dataset.



Figure 7: Floristic Analysis of Informal Quadrat QR17 against Gibson *et al.* (1994), Griffin (1993) and miscellaneous extra unpublished data.

The original dendrograms are too numerous and/or large to be practicably incorporated into this report, therefore a summary of the results incorporating both analyses is presented in Table 18. See Sections 5.2.6 and 6.2.1 for a further discussion on these results.

Table 18: Floristic Community Type (FCT) Analysis Summary

Quadrat (Fig. 3)	Gibson <i>et al.</i> (1994) Quadrats	Griffin (1993) Relevés†	Geographical Distribution	Floristic Community Type (Gibson <i>et al.</i> , 1994)(Griffin, 1993)(Govt. WA, 2000)
QR01	SEAB4, SEAB5, PRES1, NAVB2, BURN1, SEAB8 (FCT29a).	No close association. Clustered closely with limestone communities inland from Yanchep Lagoon.	FCT29a: Seabird, Preston, Kwinana, Burns Beach.	FCT29a: Coastal shrublands on shallow sands.

Quadrat (Fig. 3)	Gibson <i>et al.</i> (1994) Quadrats	Griffin (1993) Relevés†	Geographical Distribution	Floristic Community Type (Gibson <i>et al.</i> , 1994)(Griffin, 1993)(Govt. WA, 2000)
QR02	SEAB8, BURN1, NAVB2, PRES1, BURN2, TRIG2, GARDEN2 ( <b>FCT29a</b> ).	MI10, MI13, MI14, MI15, MI16, MI20 ( <b>S14</b> ).	<b>FCT29a</b> : Seabird, Burns Beach, Kwinana, Preston, Trigg, Garden Island. <b>S14</b> : Mindarie.	<b>FCT29a</b> : Coastal shrublands on shallow sands. <b>S14</b> : <i>Spinifex longifolius</i> grasslands and low shrublands.
QR03	PRES1, SEAB4, SEAB5, SEAB8, BURN1, BURN2, GARDEN2, TRIG2, NAVB2 ( <b>FCT29a</b> ). SEAB1 ( <b>FCT30c</b> )*	MI10, MI13, MI14, MI15, MI16, MI20 ( <b>S14</b> ).	<b>FCT29a</b> : Preston, Seabird, Burns Beach, Garden Island, Trigg, Kwinana. <b>S14</b> : Mindarie.	<b>FCT29a</b> : Coastal shrublands on shallow sands. <b>S14</b> : <i>Spinifex longifolius</i> grasslands and low shrublands. <b>FCT16</b> : Highly saline seasonal wetlands ( <i>Frankenia pauciflora</i> Low Shrubland on Tamala Limestone Cliffs)(inferred).
QR04	BURN2, BURN1, GARDEN2, TRIG2, PRES1, NAVB2, SEAB8 ( <b>FCT29a</b> ).	No close association. (Actually clusters closer to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	<b>FCT29a</b> : Burns Beach, Garden Island, Trigg, Preston, Kwinana, Seabird.	<b>FCT29a</b> : Coastal shrublands on shallow sands.
QR05	SEAB4, SEAB5, SEAB8, BURN1, BURN2, GARDEN2, TRIG, PRES1, NAVB2 ( <b>FCT29a</b> ). SEAB1 ( <b>FCT30c</b> )*	No close association. (Actually clusters closer to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	<b>FCT29a</b> : Seabird, Burns Beach, Garden Island, Trigg, Preston, Kwinana.	<b>FCT29a</b> : Coastal shrublands on shallow sands.
QR06	PRES1, NAVB2, BURN1, SEAB8, GARDEN2, TRIG2, BURN2 ( <b>FCT29a</b> ).	No close association. (Actually clusters closer to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	<b>FCT29a</b> : Preston, Kwinana, Burns Beach, Seabird, Garden Island, Trigg.	<b>FCT29a</b> : Coastal shrublands on shallow sands.
QR07	NAVB4, MTB2, MTB3, NAVB3, CHIDPT1, BOLD3, BOLD4, MTB4, COOL02, COOL03, COOL08 ( <b>FCT24</b> ).	No close association. (clusters closest to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	<b>FCT24</b> : Kwinana, Henderson, Chidley Point, Bold Park, Warnbro.	<b>FCT24</b> : Northern Spearwood shrublands and woodlands.
QR08	GARDEN2, TRIG2, BURN1, BURN2, PRES1, NAVB2, SEAB8 ( <b>FCT29a</b> ).	MI10, MI13, MI14, MI15, MI16, MI20 ( <b>S14</b> ).	<b>FCT29a</b> : Garden Island, Trigg, Burns Beach, Preston, Kwinana, Seabird. <b>S14</b> : Mindarie.	<b>FCT29a</b> : Coastal shrublands on shallow sands. • <b>S14</b> : <i>Spinifex</i> <i>longifolius</i> grasslands and low shrublands.
QR09	BOLD1, BOLD2, TRIG5, PTWALT1, NAVB3, CHIDPT1, BOLD3, BOLD4, NEER7, NEER10 ( <b>FCT24</b> )	No close association. (clusters closest to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	<b>FCT24</b> : Bold Park, Trigg, Kwinana, Chidley Point, Neerabup, Point Walter	<b>FCT24</b> : Northern Spearwood shrublands and woodlands.
QR10	NAVB4, MTB2, MTB3, NAVB3, CHIDPT1, BOLD3, BOLD4, COOL02, COOL03, COOL08, MTB4, BOLD1, BOLD2, TRIG5, PTWALT1, NEER7, NEER8, NEER10 ( <b>FCT24</b> ).	No close association. (clusters closest to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	<b>FCT24</b> : Kwinana, Henderson, Chidley Point, Bold Park, Warnbro, Trigg, Neerabup.	<b>FCT24</b> : Northern Spearwood shrublands and woodlands.

Quadrat (Fig. 3)	Gibson <i>et al.</i> (1994) Quadrats	Griffin (1993) Relevés†	Geographical Distribution	Floristic Community Type (Gibson <i>et al.</i> , 1994)(Griffin, 1993)(Govt. WA, 2000)
QR11	COOL08, NAVB3, CHIDPT1, BOLD3, BOLD4, NEER7, NEER9, NEER10, PTWALT1, TRIG5, BOLD1, BOLD2 (FCT24) TRIG1 (FCT29b)	No close association. (clusters closest to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	FCT24: Warnbro, Kwinana, Chidley Point, Bold Park, Neerabup, Trigg, Point Walter.	FCT24: Northern Spearwood shrublands and woodlands.
QR12	COOL08, NAVB3, CHIDPT1, BOLD3, BOLD4, NEER7, NEER9, NEER10, PTWALT1, TRIG5, BOLD1, BOLD2 (FCT24).	No close association. (clusters closest to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	FCT24: Warnbro, Kwinana, Chidley Point, Bold Park, Neerabup, Trigg, Point Walter.	FCT24: Northern Spearwood shrublands and woodlands.
QR13	NAVB4, MTB2, MTB3, NAVB3, CHIDPT1, BOLD3, BOLD4, BTB4, COOL02, COOL03, COOL08, BOLD1, BOLD2, TRIG5, PTWALT1, NEER7, NEER9, NEER10 (FCT24).	No close association. (clusters closest to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	FCT24: Warnbro, Kwinana, Chidley Point, Bold Park, Neerabup, Trigg, Point Walter.	FCT24: Northern Spearwood shrublands and woodlands.
QR14	BURN1, NAVB2, TRIG2, PRES1, BURN2, GARDEN2 (FCT29a).	No close association. (Actually clusters closer to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	FCT29a: Burns Beach, Kwinana, Trigg, Preston, Garden Island.	FCT29a: Coastal shrublands on shallow sands.
QR15	BURN1, TRIG2, BURN2, GARDEN2, PRES1 (FCT29a).	No close association. (Actually clusters closer to Gibson <i>et al.</i> [1994] FCT24 in a bigger dataset).	FCT29a: Burns Beach, Trigg, Preston, Garden Island.	FCT29a: Coastal shrublands on shallow sands.
QR16	PRES1, BURN2, GARDEN2, TRIG2, SEAB4, SEAB5, NAVB2, BURN1, SEAB8 (FCT29a). SEAB1 (FCT30c)*	Wilb02, MI11, MI12, MI17, MI19, MI22, TR03, SWA02, SWA03, SW04 (S13).	FCT29a: Preston, Burns Beach, Garden Island, Trigg, Seabird, Kwinana. S13: Wilbinga, Mindarie, Trigg, Swanbourne.	FCT29a: Coastal shrublands on shallow sands. S13: Northern <i>Olearia axillaris</i> – <i>Scaevola crassifolia</i> shrublands.
QR17 (Informal quadrat)	PRES1, SEAB4, SEAB5, SEAB8, NAVB2, BURN1, BURN2, GARDEN2, TRIG2 (FCT29a). SEAB1 (FCT30c)* These quadrats were part of a larger group with FCT30a quadrats (GARDEN1, GARDEN3, PEPGRV1, PEPGRV2, WOODP1, WOODP2, GARDEN4) (Figure 6)	PRES1 (FCT29a). SEAB1 (FCT30c*). MI08 (S11). Secondary association with GARDEN1, GARDEN3, PEPGRV1, PEPGRV2, WOODP1, WOODP2, GARDEN4 (FCT30a) and rott01 (S11) (Figure 7).	FCT29a: Preston, Seabird, Kwinana, Burns Beach, Garden Island, Trigg. S11: Mindarie, Rottnest. FCT30a: Garden Island, Rottnest, Woodman Point, Peppermint Grove.	FCT29a: Coastal shrublands on shallow sands. S11: Northern <i>Acacia rostellifera</i> – <i>Melaleuca acerosa</i> ( <i>M. systema</i> ) shrublands. ?FCT30a: <i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i> ) forests and woodlands (type or sub-type).

\* possibly mis-categorised in original study, consistently falls out with FCT29a, or other FCTs in bigger datasets. Recategorised to FCT30a2 in later unpublished analyses.

† Dataset included other quadrat data from the Quindalup Dunes as discussed.

## 5.2.6 Conservation Significant Vegetation

### *Threatened Ecological Communities (Commonwealth)*

No Threatened Ecological Communities (TECs) listed under the Federal *EPBC Act 1999* were recorded in the study area.

### *Threatened Ecological Communities (Western Australia)*

A ‘type or sub-type’ of a TEC listed under the Western Australian *Biodiversity Conservation Act 2016* may be present; TEC SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain”.

There were some patches of mature *Melaleuca lanceolata* present in the study area which were mapped as Vegetation Type D4 (Figure 3) (Plate 22). *Callitris preissii* was also infrequently present in the study area, in Vegetation Types A1 and D2 (Figure 3). Although these two species were not observed to co-occur within the study area.

Both species are known to be fire-sensitive species that disappear from the landscape with too frequent fire (Department of Parks and Wildlife, 2014).

This TEC was not identified in the DBCA database search (Table 17) as it has only been documented further south. The most northerly documented record of this TEC is at Trigg.

Please see Section 6.2.1 for further discussion.

### *Priority Ecological Communities*

Two Priority 3 PECs were recorded in the study area.

**Priority Ecological Community (PEC) SWAN 21 (FCT29a):** “Coastal shrublands on shallow sands, southern Swan Coastal Plain”. Priority 3 (i) PEC. Described as heaths on shallow sands over limestone close to the coast, with no single dominant but including *Spyridium globulosum*, *Rhagodia baccata* and *Olearia axillaris* (DBCA, 2019). Also known as Floristic Community Type (FCT) 29a (Gibson *et al.* 1994). This FCT occurred on the western half of the study area. It is documented as occurring in a narrow coastal band from south of Mandurah to Seabird. In the study area it was represented across Vegetation Types A1, B1, B2, D2 and western parts of C2 (QR01) and D1 (QR04) (Figure 3). Vegetation Type D4 is also associated with this FCT however please see the previous section for discussion on its association with TEC SCP30a (FCT30a).

**Priority Ecological Community (PEC) SWAN 26 (FCT24):** “Northern Spearwood shrublands and woodlands”. Priority 3 (i) PEC. Also known as Floristic Community Type (FCT) 24 (Gibson *et al.* 1994). Described by DBCA (2019) as “Heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system”. This FCT is documented as occurring in a near-coastal but slightly inland band from Rockingham in the south to inland from Yanchep in the north. In the study area it was represented in Vegetation Types C1, D3 and eastern parts of C2 (QR10, QR15) and D1 (QR05, QR07) (Figure 3).

Interestingly PEC SWAN 21 (FCT29a) occurred in the western half of the study area, while PEC SWAN 26 (FCT24) occurred in the eastern half. There were a few factors involved that may account for this. This coincided roughly with the mapping of vegetation complexes in the area with FCT29a occurring in the

Quindalup Dunes and FCT24 more typical in the areas mapped as Spearwood Dunes Cottesloe Complex Central and South. Please see Section 6.2 for further discussion.

## 6. DISCUSSION

### 6.1 FLORA

A total of 232 taxa were recorded from the study area, of which 128 or 55% were natives. Near-coastal areas are usually relatively species poor. For a study area approximately 11 hectares in size on the coast, this represents a relatively high species diversity. The study area is part of the larger (400 ha) Bush Forever Site 397: “Coastal Strip from Wilbinga to Mindarie”. Government of WA (2000) quotes a part-survey of Bush Forever Site 397 as supporting 83 native taxa and 27 weed taxa which was estimated >60% of the expected flora. While this was only a part survey, it does provide some context in terms of the expected species richness of the near-coastal vegetation.

No Threatened Flora listed under the Western Australian *BC Act 2016* or the Federal *EPBC Act 1999* were recorded in the study area.

Six Priority Flora were recorded from across the study area (Figure 2). This is extraordinarily high for a small near-coastal area. Additionally, most of these were concentrated and co-occurred on low limestone rises in the central and eastern part of the study area (Vegetation Type D1) (Figure 3). Two of these *Stylidium maritimum* and *Hibbertia spicata* subsp. *leptotheca* (Priority 3) were dominant species within their respective stratum in in Vegetation Type D1. *Sarcozona bicarinata* (Priority 3) occurred infrequently across Vegetation Type D1. Two other species were recorded from a single location each within Vegetation Type D1, *Leucopogon maritimus* (Priority 1) and *Pimelea calcicola* (Priority 3).

The sixth Priority Flora species was potential hybrid *Conostylis pauciflora* subsp. *pauciflora* Intergrade *C. aculeata* subsp. *cygnorum* (Priority 4) (Figure 2). This taxa was concentrated in Vegetation Type C1 on low consolidated sand dunes. It was widespread within this vegetation but not recorded elsewhere, and a dominant species in its respective strata.

In a previous study of the study area (Ecoscape, 2015), this species had been identified as *Conostylis bracteata*. The material from both studies was confirmed by the same duty botanist at the WA Herbarium. They stated that this group requires a revision in terms of clarifying the taxonomy. *Conostylis bracteata* and *C. pauciflora* are thought to be stabilised hybrids of *C. aculeata* and/or *C. candicans*. It is apparent to anyone looking closely at the group, that they are not necessarily ‘stabilised’ and represent continuums in places. This group is a regular problem for botanists completing impact assessment surveys in the northern near-coastal Perth Metropolitan Region. This is an issue that won’t be resolved until the taxonomy is revisited.

In EIA hybrids with a Priority (PF) or Threatened (TF) Flora parent, have been afforded the same status as that PF/TF parent.

It may be that after further study, these are for one reason or another, found to be not particularly conservation significant. In the absence of ‘scientific certainty’ however as per the Precautionary Principle in the EP Act 1996, these should be treated as a Priority 4 species.

*“The precautionary principle:*

*Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

*In the application of the precautionary principle, decisions should be guided by —*

(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and

(b) an assessment of the risk-weighted consequences of various options.”

## 6.2 VEGETATION

As alluded to throughout the report, there were challenges to assessing the representation of vegetation in a regional context. The lack of a consolidated regional dataset of quadrat data in Western Australia is the major underlying and ongoing barrier to more meaningful assessments.

The vegetation in WA is much less well understood and documented than the flora and fauna is. There are many undocumented ecological communities. This lack of research is reflected in PEC and TEC listings. No vegetation has been added to the WA TEC since around the time the list was established in 2002 for example. Gibson *et al.* (1994) is 25 years old and little subsequent work has been completed to further refine and build on this study. The TECs and PECs derived from it have been treated as an end point, when ongoing studies and further listings should have occurred.

In this context, there will be plant communities that do not neatly fit documented vegetation types. This creates inherent difficulties in assessing the conservation significance of vegetation for EIA.

In this context, the quadrat data from this study was compared to the Gibson *et al.* (1994) dataset. Which provided useful but not unequivocal insight into the Floristic Community Types (FCTs) present. These results were then used to assess the likely presence or otherwise of TECs and Priority Ecological Communities (PECs) in the study area.

Some of the ambiguity in results in near-coastal areas can be due to a lack of quadrat data in the Gibson *et al.* (1994) dataset from near-coastal and Quindalup Dune areas. In an attempt to remedy this, extra relevé data from Griffin (1993) was sourced. An additional analysis was run using some of this data to attempt to gain further insight into near-coastal FCTs.

While this was useful in gaining insight to the vegetation present, and its regional representation, FCTs informally assigned using Griffin (1993) data in Bush Forever (Government of WA, 2000) have never been assessed in the context of their PEC or TEC status. Val English from the Species and Communities Branch (DBCA) (pers. comm.) stated that in the absence of this, that the original FCTs from Gibson *et al.* (1994) should be used as the basis for assessing PEC/TEC status. This is highly unsatisfactory from a conservation significance assessment perspective, but it at least provides some clarity in how to deal with these vegetation types in the legal sense demanded by the EIA process.

Any residual ambiguity involved is beyond the scope of this study to resolve. It requires that state government agencies research and provide adequate contextual guidelines, criteria and information to support listings of ecological communities.

Below is a discussion of some of the findings of this study and a discussion of any limitations in each case.

### 6.2.1 Threatened Ecological Community (TEC) (*BC Act 2016*) (Western Australia)

A ‘type or sub-type’ of a TEC listed under the Western Australian *Biodiversity Conservation Act 2016* may be present in the study area, TEC SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain”.

There is ambiguity around this finding, no formal criteria exist that validates the ‘types and sub-types’ described in the recovery plan (Department of Parks and Wildlife, 2014). The study area is significantly outside the formally documented range for this TEC, currently described as Rockingham to Trigg and including Rottnest and Garden Islands. However Val English (DBCA Species and Communities Branch, pers. comm.) states that further studies are required to assess potential occurrences outside this range.

Generally speaking, *Melaleuca lanceolata* and *Callitris preissii* are not common plants on the southern Swan Coastal Plain. To have them co-occurring is even more uncommon. Both species occurred within the study area, although they were not observed growing together.

There were some patches of *Melaleuca lanceolata* approaching maturity (to 6m tall) present in the study area. These were mapped separately (Vegetation Type D4) (Figure 3). The understorey was largely bare soil and leaf litter with some scattered shrubs such as *Rhagodia baccata* subsp. *baccata* and *Threlkeldia diffusa* and herbs, however a bare understorey and low species richness is often typical of this vegetation type.

Only two small *Callitris preissii* were seen, in Vegetation Types D2 and A1 (Figure 3). It is possible that given time and the absence of fire, these in conjunction with further recruitment may form into mature stands.

*Melaleuca lanceolata* and *Callitris preissii* are fire sensitive species thought to be typical of an apex community which is rare in a fire prone landscape (Department of Parks and Wildlife, 2014). This would explain their intermittent presence and at varying maturity in the study area. Long unburnt examples elsewhere of SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain” form tall dense closed forests and woodlands, as can be seen on Rottnest Island.

Beard (1979) stated that taller thickets to low forests can form in dune systems, but these are frequently destroyed by fire, with taller species including “*Callitris preissii* (now uncommon and possibly the apex community) and *Acacia rostellifera* (most common)”. Fire is described as returning the apex community to the *Melaleuca systema*/*Acacia lasiocarpa* low dense thicket. Areas of *Acacia rostellifera* occur in the study area, as regrowth following clearing (Vegetation Type E3) (Figure 3). Areas of *Melaleuca systema* and/or *Acacia lasiocarpa* also occur.

Originally TEC SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain” was defined by FCT30a in Gibson *et al.* (1994). The floristic analysis of quadrats in the study area against the Gibson *et al.* (1994) dataset did not identify FCT30a as being present. However, informal quadrat QR17 in Vegetation Type D4 (Figure 3) clustered closest with FCT29a with a secondary influence from FCT30a. This connection became closer in a floristic analysis of a larger dataset (See Section 4.3.2).

The Department of Parks and Wildlife (2014) state that ‘types and sub-types’ of this TEC may also be associated with FCT29a. FCT29a was widely recorded in the study area. The Department of Parks and Wildlife (2014) state that in the absence of other evidence however, only the presence of *Callitris preissii* is an unequivocal indicator of the presence of this TEC. Vegetation Type D4 only contained *Melaleuca lanceolata*. The occurrences of *C. preissii* in the study area were very young and seemingly random in other vegetation types.

Department of Parks and Wildlife (2014) stated in the recovery plan for TEC SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain”, that:

“*Keighery et al. (1997) reported that Callitris preissii occurred in some locations of a series of floristic community types and sub-types that were later named in Bush Forever (2000); these are:*

29a - ‘Coastal shrublands on shallow sands’

30C2 - ‘Woodlands and shrublands on Holocene dunes’, and

S13 – ‘Northern *Olearia axillaris* – *Scaevola crassifolia* shrublands’.”

And;

*“Prior to European impacts it is considered that the vegetation composition in the *Callitris preissii* community on Rottnest, would have been more similar to other areas such as Garden Island. Therefore the Rottnest examples, **and other areas of native vegetation that naturally contain *Callitris preissii* in appropriate habitat near Perth** are considered to represent **types and sub-types** of the *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands.”*

Val English (pers. comm.) from the DBCA Species and Communities Branch confirmed the statements in bold.

FCT S13 (Table 18) was also found to be likely to occur within the study area, associated with FCT29a in secondary dunes (Vegetation Type B1). One of the two *Callitris preissii* seen was observed immediately to the north of this vegetation. FCT30c2 was also linked to the

The criteria establishing TECs in Western Australia are poorly defined in comparison to commonwealth TECs. Few resources have been available to complete further studies. Department of Parks and Wildlife (2014) outlines the requirement for further studies including an example in the northern suburbs:

*“The identity of the floristic community types of potential additional occurrences needs to be confirmed. Potential occurrences at Hillarys (Ern Halliday recreation camp) require further investigation as it is unclear whether *Callitris preissii* present has been planted. Statistical analyses of quadrat data for this particular site completed in 2013 indicate alignment with floristic community type 29a ‘coastal shrublands on shallow sands’, however, the *Callitris preissii* community links to the coastal shrublands type when it has suffered a level of degradation (G. Keighery personal communication).”*

Hillarys is also further north than the known range of this TEC. Val English (pers. comm.) from the DBCA Species and Communities Branch also confirmed that further work was required across this TECs potential range. In regard to the last comment, FCT29a vegetation in the study area containing *Callitris preissii* was in Good to Very Good condition. However both occurrences were at the edges of vegetated areas. It is possible that this species in the study area is associated with some disturbance, but it would be very difficult to prove either way.

As discussed in Section 6.1, where uncertainty and in this case the lack of hard data exists, the Precautionary Principle under the *EP Act 1996* may apply. It is recommended that in the absence of more rigorous criteria, Vegetation Type D4 be treated as ‘types or sub-types’ of TEC SCP30a: “*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain”. The presence of saplings of *Callitris preissii* amongst vegetation representing FCT29a within the study area may be more difficult to both quantify and manage in terms of TEC SCP30a status.

There is ambiguity involved however that is beyond the scope of this study to resolve. It requires state government agencies provide adequate contextual guidelines, criteria and information to support listings of TECs under the *BC Act 2016* to a similar comprehensiveness that the Commonwealth does under the *EPBC Act 1999*.

This record would represent a significant northerly extension to the known range of this TEC.

The *BC Act 2016* requires that all new records of TECs are reported, including substantial fines to botanists for failure to report. It is as yet unclear as to what specific process applies and whether IBSA reporting satisfies this requirement.

## 6.2.2 Priority Ecological Communities

Two Priority 3 PECs (or variants or combinations of) were recorded in the study area.

As discussed, PEC SWAN 21 (FCT29a) occurred in the western half of the study area, while PEC SWAN 26 (FCT24) occurred in the eastern half. All vegetated areas in the study area therefore represented Priority 3 ecological communities. Priority 3 (i) PECs are those communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation.

Informal FCTs S13 and S14 (Griffin, 1993) (Government of WA, 2000) were also recorded. As discussed, these have no formal status, however they are effectively rarer sub-types of FCT29a.

### *Limestone Ridges with Melaleuca huegelii*

A previous study (Ecoscape, 2015) indicated FCT26a was likely to be present in those areas dominated by *Melaleuca huegelii*. FCT26a is equivalent to Threatened Ecological Community (TEC) SCP26a: “*Melaleuca huegelii* - *Melaleuca systena* shrublands on limestone ridges”.

In this study this vegetation was represented by Vegetation Type D1 (QR01, QR05 and QR07) (Figure 3). The results of the statistical analysis in this study did not support the theory that this vegetation was FCT26a, aligning it closely to FCT24 and FCT29a.

FCT26a usually occurs further inland in Spearwood Dunes. However, an unusual example of near-coastal Spearwood Dunes does occur in the study area. There are known occurrences of FCT26a 2-4km inland from the coast in the suburb of Butler. The closest example is 2.6km ENE of the study area. As discussed in Section 5.2.5 there was an unusual mix of species typical of near-coastal areas in this vegetation e.g. *Acanthocarpus preissii*, *Olearia axillaris*, *Poa porphyroclados* and which are more typical of FCT24 and FCT29a. Additionally however there were species more typical of FCT26a that you would not expect to see so near the coast e.g. *Astroloma microcalyx*, *Wurmbea monantha* and *Hydrocotyle hispidula*. It is possible that the vegetation is an unusual mix of near-coastal (FCT29a), intermediary (FCT24) and inland (FCT26a) floristic community types.

The other notable feature of this vegetation is the unusually high number of conservation significant flora it supported. Near-coastal areas do not support high numbers of listed species as a rule as speciation is not high compared to older dune systems on the SCP. Probably due to the dynamic nature of the landforms. Of the six Priority Flora recorded in the study area, five of them occurred in Vegetation Type D1. Two species were dominants in their respective strata; the forb *Stylidium maritimum* (P3) and the shrub *Hibbertia spicata* subsp. *leptotheca* (P3). One species *Sarcozona bicarinata* (P3) is only known from six other locations in WA. *Leucopogon maritimus* (P1) was not known so far south prior to this study. It is unlikely that the five Priority Flora present in the study area co-occur anywhere else.

Vegetation Type D1 was also in the best condition of all the vegetated areas in the study area. . It was very species rich, particularly for near coastal vegetation, with the three quadrats containing  $68.7 \pm 3.5$  taxa. It is possible that the stoniness and thick vegetation protected it from some of the historical disturbance. Naturalised bushland weeds were the main disturbance factor observed.

Regardless of its formal status, due to all these factors combined, Vegetation Type D1 (Figure 3) is likely to be extremely conservation significant.

### 6.2.3 Condition

The study area appeared to have had a significant disturbance history.

Most of the area behind the primary dunes had been cleared for either current infrastructure or the currently vacant site where the Quinns Rocks Caravan Park used to be.

The eastern portion of the study area was vegetated. However parts of it appeared to have experienced significant historical disturbance. The understorey in Vegetation Types D2 and D3 (Figure 3) and the south-western area of Vegetation Type C2 were dominated by weed species. It was unclear what was responsible, whether it was due to clearing some time ago and the vegetation was established regrowth, or whether grazing had occurred historically. There had been more recent clearing in patches also, and historical aerial photography demonstrated that these areas were regrowth.

While all vegetation in the study area is conservation significant as discussed, those areas in Good to Very Good and Very Good condition (Figure 4) represent the most significant vegetation. Those areas were the most intact with the greatest chance of long-term viability compared to less intact examples.

In the south-east corner is what appears to be an old rehabilitated area. *\*Eucalyptus utilis* Coastal Moort (Vegetation Type E1a) (Figure 3) dominates in the overstorey. It is unclear whether this species naturalised by itself or was planted. It has in the past commonly been used for coastal planting due to its resilience, however this species can develop weedy tendencies. The spread of this species may need to be monitored.

## 6.3 LIMITATIONS

EPA (2016) provides a framework for identifying the limitations that may arise during a survey. These have been presented and discussed in Table 19.

Table 19: Limitations of the Assessment (EPA, 2016)

Limitation	Comment
Availability of contextual information at a regional and local scale.	Appropriate scale and up to date regional information particularly for vegetation is poor across Western Australia. To adequately assess vegetation a comprehensive consolidated and curated regional quadrat/plot database is required to complete a proper regional assessment in line with the full expectations of EPA, 2016. This is a significant limitation for all detailed vegetation surveys.  Broad scale contextual information was available such as vegetation type, vegetation complex mapping etc.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed.	A botanist with 23 years of experience in completing botanical surveys on the SCP for EIA, completed all aspects of the assessment from planning, field work, flora identifications, data analysis and reporting.  The duty botanist at the WA Herbarium confirmed identifications of Priority Flora species.

Limitation	Comment
Proportion of flora recorded and/or collected, any identification issues.	<p>Always difficult to estimate on a percentage value. Estimate &gt;70% of the flora would have been recorded. There is no way to account for dark diversity in snapshot surveys.</p> <p>A total of 232 taxa were recorded from the study area, of which 128 or 55% were natives. This is a high species diversity for near-coastal study area approximately 11 ha in size.</p> <p>Coverage of study area was intensive with a two-season quadrat survey and 20m traverses spread over three surveys over the peak flowering period (Sept-Oct). All vascular flora encountered at the time of the survey were recorded including weeds.</p> <p>Species accumulation curves are not a useful catch-all measure of overall expected species present when completing snapshot surveys, and they weren't used. Species richness recorded within quadrats were higher than any comparable studies seen regionally.</p> <p>The duty botanist at the WA Herbarium confirmed identifications of Priority Flora species.</p>
Was the appropriate area fully surveyed (effort and extent)?	<p>Coverage of study area was intensive with a two-season quadrat survey and 20m traverses spread over three surveys over the peak flowering period (Sept-Oct).</p> <p>Survey effort consisted of approximately 77 person hours over approximately 11 hectares.</p>
Access restrictions within the study area.	No access issues.
Survey timing, rainfall, season of survey.	<p>Survey spread over three visits over the peak flowering period (Sept-Oct).</p> <p>Rainfall for the months of April to September 2019 leading up to the field survey was 517.2mm compared to 113-year average for Wanneroo over the same period of 677.5mm. This represented a 23% rainfall shortfall from the long-term mean.</p>
Disturbance that may have affected the results of survey such as fire, flood or clearing.	No significant barriers to assessment of site were present. Any cleared areas were mapped as such. There had been no recent fires.

## 7. ACKNOWLEDGEMENTS

Several people kindly provided information and advice on a number of matters:

- Frank Obbens (Calandrinia taxonomist and consultant) identified Calandrinia.
- Mike Hislop (WA Herbarium) for confirmation of Priority Flora species.
- Greg and Bronwen Keighery for providing supplementary releve/quadrat data from Griffin (1993), DEP and System 6 surveys on the Quindalup Dunes.
- Val English from the DBCA Species and Community Branch provided advice on PECs and TECs.

## 8. REFERENCES

- Beard, J.S. (1979). The Vegetation of the Perth Area, Western Australia. Map and Explanatory Memoir 1:250,000 Series. Vegetation Survey of Western Australia. Vegmap Publications, Perth.
- Bureau of Meteorology. (2019). Climate Data Monthly Rainfall, Wanneroo weather recording station (Site No. 009105). Accessed Nov 2019. Bureau of Meteorology, Melbourne.
- Churchward, H.M. and McArthur, W.M. (1980). Atlas of Natural Resources Darling System Western Australia: Landforms and Soils of the Darling System, Western Australia. Department of Conservation and Environment, Perth.
- Council of Heads of Australasian Herbaria. (2013). Australia's Virtual Herbarium. Accessed November 2019 at [https://avh.ala.org.au/search/#tab\\_advanceSearch](https://avh.ala.org.au/search/#tab_advanceSearch)
- Department of Biodiversity Conservation and Attractions. (2018). List of Threatened Ecological Communities Endorsed by Western Australian Minister for Environment 28 June 2018. DBCA, Como. Factsheet accessed online November 2019 at <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>.
- Department of Biodiversity Conservation and Attractions. (2019). NatureMap: mapping Western Australia's biodiversity. Department of Biodiversity, Conservation and Attractions and Western Australian Museum. Accessed August 2019 at <http://naturemap.dbca.wa.gov.au/>
- Department of Biodiversity Conservation and Attractions. (2019a). Conservation Codes for Western Australian Plants and Animals. DBCA, Como. Factsheet accessed online November 2019 at <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities>.
- Department of Biodiversity Conservation and Attractions. (2019b). Priority Ecological Communities for Western Australia Version 28. Species and Communities Programme. DBCA, Como. Accessed online November 2019 at <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities>
- Department of Conservation and Land Management. (1999). Environmental Weeds Strategy for Western Australia. Department of Conservation and Land Management, Perth.
- Department of Environment and Heritage. (2000). Version 5.1 update of An Interim Biogeographical Regionalisation for Australia: a framework for setting priority in the National Reserves System. Government of Australia, Canberra.
- Department of Environment and Conservation. (2013). Definitions, Categories and Criteria for Threatened and Priority Flora. DEC, Perth. Accessed online <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>
- Department of Environment and Conservation (2013b). Definitions, Categories and Criteria for Threatened and Priority Ecological Communities. Department of Biodiversity Conservation and Attractions, Como. Accessed online at <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities>

- Department of Environment and Energy, 2019. Weeds of National Significance (WONS) Government of Australia, Canberra. Accessed online November 2019 at <https://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>
- Department of Environment and Energy. (2019a). *EPBC Act protected matters search tool*. Accessed November 2019 at <http://www.environment.gov.au/epbc/protected-matters-search-tool>
- Department of Parks and Wildlife. (2014). *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands (Swan Coastal Plain community type 30a – Gibson *et al.* 1994). Interim Recovery Plan No. 340. Department of Parks and Wildlife, Perth.
- Department of Primary Industries and Regional Development. (2019). Western Australian Organism List (WAOL). Agriculture and Food, DPIRD, Perth. Accessed online November 2019 at <https://www.agric.wa.gov.au/organisms>
- Ecoscape. (2015). Quinns Rock Caravan Park Environmental Assessment. Unpublished report for City of Wanneroo. Ecoscape (Australia) Pty Ltd, Perth.
- Environmental Protection Authority (2016). *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment*. Environmental Protection Authority, Perth.
- ESCAVI. (2003). *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*. Executive Steering Committee for Australian Vegetation Information (ESCAVI). Department of the Environment and Heritage, Canberra.
- Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994). *A Floristic Survey of the southern Swan Coastal Plain*. Unpublished Report for the Australian Heritage Commission prepared By Department of Conservation and Land Management and the Conservation Council of Western Australia, Perth.
- Government of Australia. (2019). NationalMap; Spatial Platform for Australian Government Agencies. Government of Australia Digital Transformation Agency, Canberra. Accessed online November 2019 at <https://nationalmap.gov.au>
- Government of WA. (2000). *Bush Forever: Keeping the Bush in the City*. Western Australian Planning Commission, Perth.
- Government of Western Australia. (2019a). *2018 South West Vegetation Complex Statistics. Current as of March 2019*. WA Department of Biodiversity, Conservation and Attractions, Perth. <https://catalogue.data.wa.gov.au/dataset/dbca> (accessed 26 November 2019).
- Government of Western Australia. (2019b). *2018 State-wide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report)*. Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth. Accessed 26<sup>th</sup> November 2019 at <https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics>.
- Gozzard, J.R. (2007). *Geology and Landforms of the Perth Region*: Western Australia Geological Survey. Department of Industry and Resources, Perth.

- Griffin, E.A. (1993). Flora of the Quindalup dunes between Swan and Irwin Rivers, Western Australia. Griffin and Associates, Unpublished report to the Coastal Planning Branch, Department of Planning and Urban Development and the Heritage Council of WA, Perth.
- Hedde, E.M., Loneragan, O.W. and Havel, J.J. (1980). *Atlas of Natural Resources Darling System Western Australia: Geology, Mineral Resources and Hydrogeology of the Darling System, Western Australia*. Department of Conservation and Environment, Perth.
- Hislop, M. (2011). New, locally endemic taxa in Leucopogon (Ericaceae: Styphelioideae: Styphelieae) from the Perth and midwest regions of Western Australia. *Nuytsia* 21 (2): 75–89 Western Australian Herbarium, Department of Environment and Conservation, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983.
- Keighery, B.J. (1994). Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Nedlands, Western Australia.
- R Development Core Team (2007). R: *A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing Vienna, Austria. ISBN 3-900051-07-0, <http://www.R-project.org>.
- Robinson, N. (1995). A Survey of the Flora and Vegetation of Coastal Reserves North of Quinns Rocks Western Australia. Unpublished report for Environmental Management Edith Cowan University. Churchlands, Perth.
- Thackway, R and Cresswell, I. (1995). An Interim Biogeographic Regionalisation for Australia: A Framework for Setting Priorities in the National Reserves System (as amended). Australian Nature Conservation Agency, Canberra.
- Trudgen, M.E. (1991). A flora and vegetation survey of the coast of the City of Mandurah. Department of Planning and Urban Development, Perth WA.
- Western Australian Herbarium (1998–). Florabase - the Western Australian Flora. Department of Biodiversity Conservation and Attractions, Perth. Accessed online November 2019 at <https://florabase.dpaw.wa.gov.au>

## Appendix A: Field Survey Species List – Flora

\* = Indicates weed flora.

FAMILY		SPECIES	
052	CUPRESSACEAE		<i>Callitris preissii</i>
080	LAURACEAE		<i>Cassytha aurea</i> var. <i>aurea</i>
			<i>Cassytha flava</i>
			<i>Cassytha racemosa</i> forma. <i>pilosa</i>
			<i>Cassytha racemosa</i> forma. <i>racemosa</i>
089	JUNCAGINACEAE		<i>Triglochin isingiana</i>
109	COLCHICACEAE		<i>Burchardia congesta</i>
			<i>Wurmbea monantha</i>
			<i>Wurmbea tenella</i>
115	ORCHIDACEAE		<i>Caladenia latifolia</i>
			<i>Diuris magnifica</i>
			<i>Microtis media</i> subsp. <i>media</i>
			<i>Pterostylis aspera</i>
124	IRIDACEAE	*	<i>Freesia alba</i> × <i>leichtlinii</i>
		*	<i>Gladiolus caryophyllaceus</i>
		*	<i>Moraea flaccida</i>
		*	<i>Romulea rosea</i>
128	ASPARAGACEAE		<i>Acanthocarpus preissii</i>
		*	<i>Agave americana</i>
		*	<i>Asparagus asparagoides</i>
			<i>Lomandra maritima</i>
			<i>Lomandra preissii</i>
			<i>Thysanotus manglesianus</i>
129	ASPHODELACEAE	*	<i>Asphodelus fistulosus</i>
		*	<i>Trachyandra divaricata</i>
130	HEMEROCALLIDACEAE		<i>Dianella revoluta</i> var. <i>divaricata</i>
			<i>Tricoryne elatior</i>
133	ARECACEAE	*	<i>Washingtonia filifera</i>
138	HAEMODORACEAE		<i>Conostylis aculeata</i> subsp. <i>cygnorum</i>
			<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i> Intergrade <i>C. aculeata</i> subsp. <i>cygnorum</i> (P4)
156	CYPERACEAE		<i>Ficinia nodosa</i>
		*	<i>Isolepis marginata</i>
			<i>Lepidosperma calcicola</i>
			<i>Lepidosperma gladiatum</i>
			<i>Mesomelaena pseudostygia</i>
			<i>Schoenus clandestinus</i>
159	RESTIONACEAE		<i>Desmocladius asper</i>
			<i>Desmocladius flexuosus</i>
163	POACEAE		<i>Austrostipa compressa</i>
			<i>Austrostipa flavescens</i>
		*	<i>Avena barbata</i>
		*	<i>Avena fatua</i>
		*	<i>Briza maxima</i>
		*	<i>Briza minor</i>
		*	<i>Bromus diandrus</i>
		*	<i>Catapodium rigidum</i>
		*	<i>Cynodon dactylon</i>
		*	<i>Ehrharta brevifolia</i> var. <i>cuspidata</i>

FAMILY		SPECIES	
		*	<i>Ehrharta calycina</i>
		*	<i>Ehrharta longiflora</i>
		*	<i>Eragrostis curvula</i>
		*	<i>Lagurus ovatus</i>
		*	<i>Lolium perenne</i>
		*	<i>Poa annua</i>
			<i>Poa porphyroclados</i>
163	POACEAE		<i>Rytidosperma occidentale</i>
			<i>Spinifex hirsutus</i>
			<i>Spinifex longifolius</i>
		*	<i>Stenotaphrum secundatum</i>
		*	<i>Vulpia muralis</i>
166	PAPAVERACEAE	*	<i>Fumaria capreolata</i>
171	RANUNCULACEAE		<i>Clematis linearifolia</i>
175	PROTEACEAE		<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>
			<i>Banksia sessilis</i> var. <i>cygnorum</i>
			<i>Grevillea crithmifolia</i>
		*	<i>Grevillea olivacea</i> (planted)
			<i>Grevillea preissii</i> subsp. <i>preissii</i>
			<i>Grevillea preissii</i> x ? <i>G. olivacea</i>
			<i>Hakea lissocarpha</i>
			<i>Hakea prostrata</i>
			<i>Hakea trifurcata</i>
			<i>Petrophile serruriae</i>
181	DILLENIACEAE		<i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>
			<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)
192	CRASSULACEAE		<i>Crassula colorata</i> var. <i>acuminata</i>
			<i>Crassula colorata</i> var. <i>colorata</i>
		*	<i>Crassula decumbens</i> var. <i>decumbens</i>
		*	<i>Crassula glomerata</i>
		*	<i>Sedum praealtum</i>
201	FABACEAE		<i>Acacia cochlearis</i>
			<i>Acacia cyclops</i>
			<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>
			<i>Acacia pulchella</i> var. <i>glaberrima</i>
			<i>Acacia rostellifera</i>
			<i>Acacia saligna</i>
			<i>Acacia truncata</i>
			<i>Acacia xanthina</i>
			<i>Bossiaea eriocarpa</i>
			<i>Gompholobium tomentosum</i>
			<i>Hardenbergia comptoniana</i>
		*	<i>Lathyrus tingitanus</i>
		*	<i>Lupinus cosentinii</i>
		*	<i>Medicago polymorpha</i>
		*	<i>Melilotus indicus</i>
			<i>Templetonia retusa</i>
		*	<i>Trifolium campestre</i> var. <i>campestre</i>
203	POLYGALACEAE		<i>Comesperma confertum</i>
			<i>Comesperma integerrimum</i>
208	RHAMNACEAE		<i>Cryptandra mutila</i>
			<i>Spyridium globulosum</i>
			<i>Trymalium ledifolium</i> var. <i>ledifolium</i>

FAMILY		SPECIES	
211	MORACEAE	*	<i>Ficus carica</i>
212	URTICACEAE		<i>Parietaria debilis</i>
217	CASUARINACEAE		<i>Allocasuarina humilis</i>
			<i>Allocasuarina lehmanniana</i> subsp. <i>lehmanniana</i>
		*	<i>Allocasuarina verticillata</i> (planted)
		*	<i>Casuarina equisetifolia</i>
232	OXALIDACEAE	*	<i>Oxalis pes-caprae</i>
242	EUPHORBIACEAE	*	<i>Euphorbia paralius</i>
		*	<i>Euphorbia peplus</i>
		*	<i>Euphorbia terracina</i>
		*	<i>Ricinus communis</i>
247	PHYLLANTHACEAE		<i>Phyllanthus calycinus</i>
			<i>Poranthera microphylla</i>
261	VIOLACEAE		<i>Hybanthus calycinus</i>
274	GERANIACEAE	*	<i>Erodium botrys</i>
			<i>Geranium solanderi</i>
		*	<i>Pelargonium</i> × <i>hortorum</i>
		*	<i>Pelargonium capitatum</i>
			<i>Pelargonium littorale</i>
279	ONAGRACEAE	*	<i>Oenothera drummondii</i>
281	MYRTACEAE	*	<i>Agonis flexuosa</i>
		*	<i>Callistemon</i> x (planted)
			<i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>
			<i>Eucalyptus gomphocephala</i>
			<i>Eucalyptus petrensis</i>
		*	<i>Eucalyptus utilis</i>
		*	<i>Leptospermum laevigatum</i>
			<i>Melaleuca cardiophylla</i>
			<i>Melaleuca huegelii</i> subsp. <i>huegelii</i>
			<i>Melaleuca lanceolata</i>
		*	<i>Melaleuca nesophila</i>
		*	<i>Melaleuca quinquenervia</i> (planted)
			<i>Melaleuca systema</i>
		*	<i>Meterosideros tomentosa</i> (planted)
295	NITRARIACEAE		<i>Nitraria billardierei</i>
298	ANACARDIACEAE	*	<i>Schinus terebinthifolia</i>
299	SAPINDACEAE		<i>Diplopeltis huegelii</i> subsp. <i>huegelii</i>
299	SAPINDACEAE		<i>Dodonaea aptera</i>
300	RUTACEAE		<i>Philotheca spicata</i>
309	MALVACEAE	*	<i>Lagunaria patersonia</i>
		*	<i>Malva parviflora</i>
			<i>Thomasia triphylla</i>
311	THYMELACEAE		<i>Pimelea calcicola</i> (P3)
332	BRASSICACEAE	*	<i>Brassica</i> x <i>napus</i>
		*	<i>Brassica tournefortii</i>
		*	<i>Cakile maritima</i>
		*	<i>Cardamine hirsuta</i>
		*	<i>Heliophila pusilla</i>
		*	<i>Sisymbrium orientale</i>
336	OLACACEAE		<i>Olax benthamiana</i>
338	SANTALACEAE		<i>Exocarpos sparteus</i>
			<i>Leptomeria empetriflora</i>
			<i>Leptomeria pauciflora</i>

FAMILY		SPECIES	
			<i>Santalum acuminatum</i>
342	FRANKENIACEAE		<i>Frankenia pauciflora</i> var. <i>pauciflora</i>
343	TAMARICACEAE	*	<i>Tamarix aphylla</i>
344	PLUMBAGINACEAE	*	<i>Plumbago capensis</i> (planted)
346	DROSERACEAE		<i>Drosera ?ramellosa</i> (sterile)
			<i>Drosera erythrorhiza</i>
			<i>Drosera macrantha</i>
			<i>Drosera pallida</i>
355	CARYOPHYLLACEAE	*	<i>Cerastium glomeratum</i>
		*	<i>Minuartia mediterranea</i>
		*	<i>Petrorrhagia dubia</i>
		*	<i>Polycarpon tetraphyllum</i>
		*	<i>Silene gallica</i>
		*	<i>Stellaria media</i>
358	CHENOPODIACEAE		<i>Atriplex isatidea</i>
			<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>
			<i>Rhagodia baccata</i> subsp. <i>baccata</i>
			<i>Threlkeldia diffusa</i>
364	AIZOACEAE	*	<i>Carpobrotus edulis</i>
			<i>Carpobrotus</i> sp. (sterile)
			<i>Carpobrotus virescens</i>
			<i>Sarcozona bicarinata</i> (P3)
		*	<i>Tetragonia decumbens</i>
			<i>Tetragonia tetragonoides</i> sens. lat.
374	MONTIACEAE		<i>Calandrinia brevipedata</i>
			<i>Calandrinia corrigioloides</i>
			<i>Calandrinia liniflora</i>
			<i>Calandrinia tholiformis</i>
392	PRIMULACEAE	*	<i>Lysimachia arvensis</i>
403	ERICACEAE		<i>Astroloma microcalyx</i>
			<i>Leucopogon maritimus</i> (P1)
			<i>Leucopogon parviflorus</i>
409	RUBIACEAE	*	<i>Galium murale</i>
			<i>Opercularia vaginata</i>
410	GENTIANACEAE		<i>Schenkia australis</i>
416	CONVOLVULACEAE	*	<i>Cuscuta planiflora</i>
417	SOLANACEAE	*	<i>Physalis peruviana</i>
		*	<i>Solanum nigrum</i>
423	OLEACEAE	*	<i>Olea europaea</i>
428	SCROPHULARIACEAE	*	<i>Bellardia trixago</i>
		*	<i>Dischisma arenarium</i>
			<i>Eremophila glabra</i> subsp. <i>albicans</i>
			<i>Myoporum insulare</i>
432	LAMIACEAE		<i>Hemiandra glabra</i>
		*	<i>Westringia fruticosa</i> (planted)
441	VERBENACEAE	*	<i>Lantana camara</i>
450	CAMPANULACEAE		<i>Lobelia tenuior</i>
		*	<i>Wahlenbergia capensis</i>
452	STYLIDIACEAE		<i>Stylidium maritimum</i> (P3)
			<i>Stylidium rigidulum</i>
458	GOODENIACEAE		<i>Lechenaultia linarioides</i>
			<i>Scaevola crassifolia</i>
			<i>Scaevola nitida</i>

FAMILY		SPECIES	
			<i>Scaevola thesioides</i> subsp. <i>thesioides</i>
460	ASTERACEAE	*	<i>Arctotheca calendula</i>
		*	<i>Arctotheca populifolia</i>
		*	<i>Conyza bonariensis</i>
		*	<i>Gamochaeta coarctata</i>
		*	<i>Gazania linearis</i>
		*	<i>Hypochaeris glabra</i>
		*	<i>Lactuca serriola</i>
		*	<i>Leontodon rhagadioloides</i>
			<i>Leucophyta brownii</i>
			<i>Olearia axillaris</i>
		*	<i>Osteospermum ecklonis</i>
		*	<i>Reichardia tingitana</i>
			<i>Rhodanthe corymbosa</i>
		*	<i>Senecio angulatus</i>
			<i>Senecio pinnatifolius</i> var. <i>latilobus</i>
		*	<i>Senecio vulgaris</i>
		*	<i>Sonchus oleraceus</i>
		*	<i>Taraxacum khatoonae</i>
		*	<i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>
467	CAPRIFOLIACEAE	*	<i>Centranthus macrosiphon</i>
474	APIACEAE		<i>Daucus glochidiatus</i>
		*	<i>Foeniculum vulgare</i>
			<i>Hydrocotyle hispidula</i>
	ARAUCARIACEAE	*	<i>Araucaria heterophylla</i>
	AGAVACEAE	*	<i>Yucca aloefolia</i>

## Appendix B: Flora and Vegetation Species by Site Table

H = Height (cm); C = Cover (% of quadrat area); X = outside quadrat but within 10m of quadrat boundary; CR = creeper; \* = introduced flora.  
CP = Old Caravan Park Site. RPD = Rehabilitated area Primary Dune. SLC = Surf Lifesaving Club (and surrounds).

SPECIES	QR01		QR02		QR03		QR04		QR05		QR06		QR07		QR08		QR09		QR10		QR11		QR12		QR13		QR14		QR15		QR16		OPPORTUNISTIC
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C			
<i>Acacia cochlearis</i>																																50J 376357 6494422.	
<i>Acacia cyclops</i>	60	0.1			150	30							X	X			X	X	350	1						40	0.1	350	3	X	X	RPD.	
<i>Acacia l. var. lasiocarpa</i>									40	1				40	2																		
<i>Acacia pulchella</i> var. <i>glaberrima</i>																	90	0.1	50	0.1													
<i>Acacia rostellifera</i>	40	0.1			X	X	40	1											X	X	50	2	150	2		40	0.1	X	X				
<i>Acacia saligna</i>																			X	X	180	0.1	X	X	X							Rehabilitation N.	
<i>Acacia truncata</i>	50	0.1							50	12				70	3																		
<i>Acacia xanthina</i>									20	0.1	150	2													X	X							
<i>Acanthocarpus preissii</i>	20	1			20	0.1							40	1			70	0.1			50	3	40	1				50	1	40	1		
* <i>Agave americana</i>																																CP.	
* <i>Agonis flexuosa</i>																																CP. SLC.	
<i>Allocasuarina humilis</i>																	X	X														50J 376687 6494541.	
<i>Allocasuarina l. ssp. lehmanniana</i>																																	50J 376503 6494642.
* <i>Allocasuarina verticillata</i>																				X	X												
* <i>Araucaria heterophylla</i>																																	CP.
* <i>Arctotheca calendula</i>																																	50J 376618 6494192.
* <i>Arctotheca populifolia</i>			10	0.1												10	0.1																
* <i>Asparagus asparagoides</i>																				20	0.1												
* <i>Asphodelus fistulosus</i>																																	See Appendix D.
<i>Astroloma microcalyx</i>	X	X											30	0.1																			50J 376503 6494642. Sump.
<i>Atriplex isatidea</i>				X	X																												
<i>Austrostipa compressa</i>											20	0.1																					
<i>Austrostipa flavescens</i>	40	0.3						20	0.1								20	0.1			80	1	50	0.5	20	0.1	20	0.1	60	0.1			
* <i>Avena barbata</i>	40	0.1									40	0.1	40	0.1			70	0.1			100	2	90	1		70	0.2						Rehabilitation N. Sump.
* <i>Avena fatua</i>																																	50J 376522 6494563.
<i>Banksia d. var. dallanneyi</i>	30	1						30	2	X	X	X	30	0.1			X	X							10	0.1							
<i>Banksia sessilis</i> var. <i>cygnorum</i>	X	X			130	5	X	X	X	X	X	X	X	X			250	75	150	10					180	95	20	0.1	120	1			
* <i>Bellardia trixago</i>																											20	0.1					
<i>Bossiaea eriocarpa</i>	X	X											15	0.1			30	0.5							40	0.1							50J 376666 6494496.
* <i>Brassica napus</i>																																	Sump.
* <i>Brassica tournefortii</i>																					40	0.1	20	0.1						30	0.1		Sump.

SPECIES	QR01		QR02		QR03		QR04		QR05		QR06		QR07		QR08		QR09		QR10		QR11		QR12		QR13		QR14		QR15		QR16		OPPORTUNISTIC		
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C					
*Briza maxima	10	0.2								10	0.2	20	0.1	15	0.1			10	0.3	20	0.2					20	0.1	20	1				50J 376666 6494496.		
*Briza minor													10	0.1																					
*Bromus diandrus	30	1	30	0.1	20	0.2	40	5	40	1			20	0.1	30	0.1	30	0.3	20	0.1	40	5	20	4	50	0.5	40	10			30	0.5	Rehabilitation N. Sump.		
Burchardia congesta																																50J 376681 6494448.			
*Cakile maritima			10	0.1	10	0.1									20	0.2																			
Caladenia latifolia	20	0.1					X	X	X	X	20	0.1	20	0.1						10	0.1						X	X	15	0.1					
Calandrinia brevipedata	2	0.1									10	3	3	0.1													10	0.1			10	0.1			
Calandrinia corrigioloides																	5	0.1																	
Calandrinia liniflora																																50J 376632 6494553.			
Calandrinia tholiformis	2	0.1							1	0.1	10	3																							
*Callistemon hybrid (planted)																																	SLC, Road Verge.		
Callitris preissii																																	50J 376474 6494559, 376422 6494351.		
Calothamnus q. ssp. quadrifidus							X	X	40	0.1			40	0.5			60	1	90	12					120	0.1			170	2					
*Cardamine hirsuta																																	Sump.		
*Carpobrotus edulis					X	X	10	0.1																									50J 376641 6494122.		
Carpobrotus sp. (sterile)					10	0.1			10	0.1															3	0.1									
Carpobrotus virescens							X	X																											
Cassylha aurea var. aurea	CR	1	CR	0.1																													50J 376489 6494268.		
Cassylha flava									CR	1			CR	1																					
Cassylha racemosa forma. pilosa	CR	15																																	
Cassylha r. forma. racemosa	CR	5					CR	1											CR	2															
*Casuarina equisetifolia																																	CP. Road Verge NE.		
*Catapodium rigidum	X	X																								10	0.1								
*Centranthus macrosiphon																																			
*Ceratium glomeratum							10	1			10	0.1								10	0.1									10	0.1				
Clematis linearifolia							CR	0.5	20	0.1			CR	0.1			CR	1	CR	2							CR	0.1	CR	15					
Comesperma confertum													40	0.1																					
Comesperma integririmum														CR	0.1																				
Conostylis aculeata ssp. cygnorum	X	X					10	0.1					X	X			20	0.1	40	0.2	30	0.1													
Conostylis p. ssp. pauciflora									X	X											20	1	20	1											
Intergrade C. aculeata ssp. cygnorum (P4)																																			
*Coryza bonariensis																				20	0.1									X	X		50J 376641 6494122.		
Crassula colorata var. acuminata	3	0.1					3	0.1	2	0.1	5	3					3	1	3	0.1															
Crassula c. var. colorata																										3	0.5	5	0.1	3	0.1				
*Crassula d. var. decumbens																	1	0.1	3	0.5										3	1				
*Crassula glomerata	3	0.1	3	0.2	2	0.2	3	1	3	0.2	3	0.1	3	0.1			3	1	3	0.5	3	0.1	3	1	3	1	3	2	3	2					
Cryptandra mutila									X	X											50	1	50	1									50J 376522 6494517.		

[illegible]

SPECIES	QR01		QR02		QR03		QR04		QR05		QR06		QR07		QR08		QR09		QR10		QR11		QR12		QR13		QR14		QR15		QR16		OPPORTUNISTIC	
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C		
*Gladiolus caryophyllaceus	60	0.5							40	0.5			40	0.2			90	0.3	90	0.2						90	0.1						RPD.	
Gompholobium tomentosum	40	0.5							30	1			30	1							20	1											50J 376641 6494605.	
Grevillea crithmifolia																																	Road Verge NE.	
*Grevillea olivacea (planted)																																		
Grevillea p. ssp. preissii	40	2			X	X			30	2	X	X	40	2			70	0.1	40	0.1						60	0.1	30	0.1					
Grevillea preissii x ?G. olivacea									60	0.1																								
Hakea lissocarpa																	90	1	70	1						X	X						50J 376503 6494642.	
Hakea prostrata																	X	X	X	X						X	X							
Hakea trifurcata																	X	X	X	X						200	3							
Hardenbergia comptoniana	CR	1					CR	1	CR	1	X	X	CR	1					CR	2	CR	0.1	CR	1			CR	1	CR	10	CR	10	RPD.	
*Heliophila pusilla	10	0.1							10	0.1			10	0.1					10	0.1														
Hemiandra glabra																					20	0.1	20	0.1										
Hibbertia h. ssp. hypericoides											X	X	30	0.1			60	3	70	6						50	0.1							
Hibbertia spicata ssp. leptotheca	40	3							40	2			40	3							30	1					X	X						
Hybanthus calycinus																	X	X																
Hydrocotyle hispidula	2	0.1											3	0.1																				
*Hypochoeris glabra	1	0.1			1	0.1	1	0.1	1	0.1	1	0.1	1	0.1			1	0.1	3	2					1	0.1	5	0.1	10	1	10	0.1		
*Isoplepis marginata									3	0.1	3	0.1	3	0.1			3	0.1	10	0.2	5	0.1	5	0.1	5	0.1								
*Lactuca serriola																													X	X				
*Lagunaria patersonia																																	CP.	
*Lagurus ovatus	X	X	10	0.2					50	0.3							10	0.2			30	8	20	2			20	2			20	0.1		
*Lantana camara																			X	X													50J 376717 6494490.	
*Lathyrus tingitanus																																		50J 376666 6494496.
Lechenaultia linarioides																	10	0.1															Rehabilitation N.	
*Leontodon rhagadioloides																																	Sump.	
Lepidosperma calcicola	20	0.1							20	0.1	20	0.1	15	1			60	0.1	30	8	20	2	20	0.1	30	0.1	30	0.1	20	0.1				
Lepidosperma gladiatum					X	X																									70	4	RPD. SLC.	
Leptomeria empetriformis									40	0.1																								
Leptomeria pauciflora	X	X																																
*Leptospermum laevigatum																																		See Appendix D.
Leucophyta brownii																20	0.1																RPD.	
Leucopogon maritimus (PI)									X	X																								50J 376571 6494485.
Leucopogon parviflorus	40	1							40	1			30	0.1							70	2						50	1	90	0.1			
Lobelia tenuior											20	0.1																						
*Lolium perenne	20	1	30	0.2	10	0.5	20	0.1	20	2	30	0.1	20	0.1	20	0.2					30	5	20	2				30	2	20	0.1	10	0.3	RPD.
Lomandra maritima	30	2							30	3	30	0.1	30	3				30	0.1	35	1	30	15	40	40	30	0.1	X	X	20	0.1			
Lomandra preissii																				50	0.1													
*Lupinus cosentinii									X	X														20	0.2									


SPECIES	QR01		QR02		QR03		QR04		QR05		QR06		QR07		QR08		QR09		QR10		QR11		QR12		QR13		QR14		QR15		QR16		OPPORTUNISTIC		
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C			
*Lysimachia arvensis	20	0.5					3	0.1	10	0.5	10	0.1	10	0.1			10	0.1	10	0.1	3	0.1	3	0.1	3	0.1	10	0.1	10	0.1	1			50J 376618 6494192.	
*Malva parviflora																																			
*Medicago polymorpha	10	0.1							10	0.1													20	0.1			10	0.1	10	0.1					
Melaleuca cardiophylla											250	80	X	X			X	X									180	65	200	2					
Melaleuca h. ssp. huegelii	80	15			X	X	X	X	50	12	150	1	90	55													80	0.1	120	2	X	X			
Melaleuca lanceolata																			X	X													50J 376701 6494401.		
*Melaleuca nesophila																																		50J 376463 6494333. CP.	
*Melaleuca quinquenervia (planted)																																		SLC.	
Melaleuca systena	40	2					60	0.1	40	8	50	0.1	30	1			60	0.1	70	2	50	15	50	6	50	2	70	1	40	0.1			Rehabilitation N.		
*Melilotus indicus	20	0.1			10	0.1			20	0.2																								CP.	
Mesomelaena pseudostygia																	70	0.1	40	0.1															
*Metrosideros tomentosa (planted)																																		CP. SLC.	
Microtis media ssp. media																																			
*Minuartia mediterranea	3	1					1	0.1	3	0.5	3	0.1	3	0.1							3	0.1	3	0.1				3	1					50J 376563 6494471 10 plants.	
*Moraea flaccida																																90	4		
Myoporum insulare					X	X	X	X					X	X	X	X																			
Nitratia billardierei							X	X																											
*Oenothera drummondii																																		50J 376618 6494192. CP.	
Olaix benthamiana	X	X							X	X																									SLC.
*Olea europaea																																			
Olearia axillaris	110	0.5	40	0.1	X	X	X	X	40	0.1			70	0.1	30	1					50	0.1	40	0.1			20	0.1	40	0.1	40	0.1		RPD. CP.	
Opercularia vaginata	20	2							20	3			20	3							X	X	20	2						X	X				
*Osteospermum ecklonis																					X	X								X	X				
*Oxalis pes-caprae							10	0.1																											
Parietaria debilis								10	1																							10	0.2	Under Acacia thickets.	
*Pelargonium × hortorum																																		CP.	
*Pelargonium capitatum				30	0.5	X	X	10	0.1	20	0.1		20	0.1	20	0.1	40	0.1	30	0.1	40	3	10	0.1	10	0.1	10	0.1	20	0.1	10	0.1		RPD.	
Pelargonium littorale										3	0.1	5	0.1	10	0.1				3	0.1															
Petrophile serruriae													40	1																				50J 376666 6494496.	
*Petrorhagia dubia	10	0.2							5	0.1	20	0.1	5	0.1							20	0.1	20	0.3			2	0.1							
Philotheca spicata																																		50J 376690 6494523.	
Phyllanthus calycinus	X	X							30	3											50	1	50	2			20	0.1	X	X					
*Physalis peruviana																																		Sump.	
Pimelea calcicola (P3)																																		50J 376548 6494497.	
*Plumbago capensis (planted)																																		CP.	
*Poa annua																																		SLC.	
Poa porphyroclados	30	0.3										5	0.1								40	1	50	1			20	0.5							
*Polycarpon tetraphyllum							1	0.1									10	0.1																	

SPECIES	QR01		QR02		QR03		QR04		QR05		QR06		QR07		QR08		QR09		QR10		QR11		QR12		QR13		QR14		QR15		QR16		OPPORTUNISTIC		
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C					
<i>Poranthera microphylla</i>	1	0.1							5	0.1			2	0.1												2	0.1								
<i>Pterostylis aspera</i>																			15	0.1															
<i>*Reichardia tingitana</i>	10	0.1											10	0.1				10	0.1	10	0.1	10	0.1	10	0.1										
<i>Rhagodia b. ssp. baccata</i>	20	0.1			30	0.1	90	8	40	1	150	1	50	1				70	1	70	1	40	2	40	0.1	150	3	70	2	150	10	60	0.1	RPD. CP.	
<i>Rhodanthe corymbosa</i>									3	0.1	10	0.5														10	1								
<i>*Ricinus communis</i>																																	Sump. CP.		
<i>*Romulea rosea</i>	10	1											15	0.1				10	0.1		20	3	10	0.1											
<i>Rytidosperma occidentale</i>													20	0.1																					
<i>Santalum acuminatum</i>							90	3																							X	X			
<i>Sarcosona bicarinata</i> (P3)									10	0.1	3	0.1	X	X																			50J 376652 6494403.		
<i>Scaevola crassifolia</i>			50	1	40	0.1	X	X							30	1					X	X					15	0.1			90	70	RPD.		
<i>Scaevola nitida</i>									X	X																									
<i>Scaevola t. ssp. thesioides</i>	30	0.1							30	0.1			30	0.1							15	0.1													
<i>Schenkia australis</i>																																		50J 376638 6494155.	
<i>*Schinus terebinthifolia</i>																										10	0.1	140	1					CP. Road Verge NE. Sump.	
<i>Schoenus clandestinus</i>																		5	0.1																
<i>*Sedum praealtum</i>																																		CP.	
<i>*Senecio angulatus</i>																																		CP.	
<i>Senecio pinnatifolius</i> var. <i>latilobus</i>												20	0.1																					50J 376522 6494563.	
<i>*Senecio vulgaris</i>											10	0.1																							
<i>*Silene gallica</i>									10	0.1	10	0.2															2	0.1							
<i>*Sisymbrium orientale</i>	20	0.1											15	0.1																					
<i>*Solanum nigrum</i>											4	0.1																						Sump.	
<i>*Sonchus oleraceus</i>	10	0.1	10	0.1	10	0.2	50	0.1	5	0.1	10	0.1	5	0.1	5	0.1	5	0.1	10	0.2	10	0.1	10	0.1	10	0.1	10	0.3	10	0.1	10	0.1			
<i>Spinifex hirsutus</i>			40	2											50	4																			
<i>Spinifex longifolius</i>			50	20	40	0.1									70	50																		RPD.	
<i>Spyridium globulosum</i>	120	1					120	15	30	0.1	10	0.1	100	3					200	10	90	0.1	150	4	120	0.1	120	1	190	15	X	X			
<i>*Stellaria media</i>	10	0.1					10	1	10	0.1	10	3							10	0.1						10	3	10	0.3	10	10	10	0.1		
<i>*Stenotaphrum secundatum</i>																																		CP.	
<i>Sydlidium maritimum</i> (P3)	25	0.1							30	0.5	20	0.1	20	1																					
<i>Sydlidium rigidulum</i>													10	0.1																					
<i>*Tamarix aphylla</i>																																		CP.	
<i>*Taraxacum khatoonae</i>					20	0.1	10	0.1																											
<i>Templetonia retusa</i>	80	15					X	X	50	3			90	6												70	1	50	1						
<i>*Tetragonia decumbens</i>					50	15	90	8							20	1															40	2		RPD.	
<i>Tetragonia tetragonoides</i> sens. <i>lat.</i>																																		50J 376527 6494557.	
<i>Thomasia triphylla</i>	40	1			30	1																								60	2	50	1		
<i>Threlkeldia diffusa</i>	10	0.1			30	1																								60	2	50	1		


SPECIES	QR01		QR02		QR03		QR04		QR05		QR06		QR07		QR08		QR09		QR10		QR11		QR12		QR13		QR14		QR15		QR16		OPPORTUNISTIC	
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C				
<i>Thysanotus manglianus</i>	CR	0.1							CR	0.1	CR	0.1	CR	0.1					CR	0.1					CR	0.1	CR	0.1						
<i>*Trachyandra divaricata</i>			20	5	30	0.5			20	0.1					40	0.5	20	0.1			20	0.1	20	0.1		20	0.1	20	0.1		30	0.1	RPD. CP.	
<i>Tricoryne elatior</i>	40	0.5							40	1	20	0.1	30	1												30	0.1	X						
<i>*Trifolium c. var. campestre</i>	10	0.1							10	0.1		10	0.1				3	0.1			10	0.1	20	0.5										
<i>Triglochin isingiana</i>	10	0.1							5	0.1	10	1	10	0.1			3	0.1																
<i>Trymalium l. var. ledifolium</i>	30	0.5							40	5			40	3												40	0.1							
<i>*Ursinia a. ssp. anthemoides</i>																	10	0.1																
<i>*Vulpia muralis</i>											10	0.1	10	0.1																				
<i>*Wahlenbergia capensis</i>																	2	0.1	5	0.2														
<i>*Washingtonia filifera</i>																																	Road Verge NE.	
<i>*Westringia fruticosa (planted)</i>																																	SLC.	
<i>Wurmbea monantha</i>									X	X																								
<i>Wurmbea tenella</i>	10	0.1																																
<i>*Yucca aloefolia</i>																																	SLC.	

## Appendix C: Vegetation Detailed Site Quadrat Data


## SITE: QR01

<b>Survey Date 1:</b>	05 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376600	6494252	<b>Datum:</b>	GDA94
	NE	50J 376608	6494256	<b>Accuracy:</b>	±3m
	SE	50J 376612	6494248	<b>Aspect:</b>	NW
	SW	50J 376604	6494243	<b>Altitude:</b>	12m
<b>Landform:</b>	Limestone ridgeline.			<b>Soil:</b>	Brown loamy sand (consolidated)
<b>Leaf Litter:</b>	10% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Very Good (Good in patches)			<b>Details:</b>	Weeds 5-15%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs 1-2m	0.25-5%	<i>Spyridium globulosum</i> , <i>Olearia axillaris</i> .	
	G1	Shrubs 0.5-1m	30-70%	<i>Melaleuca huegelii</i> subsp. <i>huegelii</i> , <i>Templetonia retusa</i> .	
	G2	Shrubs <0.5m	10-30%	<i>Melaleuca systema</i> , <i>Banksia d.</i> var. <i>dallanneyi</i> , <i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3), <i>Leucopogon parviflorus</i> , <i>Thomasia triphylla</i> .	
	G3	Vine 0.5-1m	10-30%	<i>Hardenbergia comptoniana</i> , <i>Cassytha racemosa</i> .	
	G4	Forbs <0.5m	10-30%	<i>Lomandra maritima</i> , <i>Acanthocarpus preissii</i> , <i>Opercularia vaginata</i> , <i>Tricoryne elatior</i> .	
	G5	Rush <0.5m	30-70%	<i>Desmocladius asper</i> .	
	G6	Grass 0.5-1m	0.25-5%	<i>Austrostipa flavescens</i> , <i>Poa porphyroclados</i> .	
<b>Species:</b>	<i>Acacia cyclops</i> , <i>A. rostellifera</i> , <i>A. truncata</i> , <i>Acanthocarpus preissii</i> , <i>Austrostipa flavescens</i> , <i>*Avena barbata</i> , <i>Banksia d.</i> var. <i>dallanneyi</i> , <i>*Briza maxima</i> , <i>*Bromus diandrus</i> , <i>Caladenia latifolia</i> , <i>Calandrinia brevipedata</i> , <i>C. tholiformis</i> , <i>Cassytha racemosa</i> forma. <i>pilosa</i> , <i>Cassytha r.</i> forma. <i>racemosa</i> , <i>Crassula colorata</i> var. <i>acuminata</i> , <i>*C. glomerata</i> , <i>*Cuscuta planiflora</i> , <i>Daucus glochidiatus</i> , <i>Desmocladius asper</i> , <i>D. flexuosus</i> , <i>Dianella revoluta</i> var. <i>divaricata</i> , <i>*Ehrharta longiflora</i> , <i>Eremophila glabra</i> subsp. <i>albicans</i> , <i>*Euphorbia peplus</i> , <i>*Galium murale</i> , <i>*Gladiolus caryophyllaceus</i> , <i>Gompholobium tomentosum</i> , <i>Grevillea p.</i> subsp. <i>preissii</i> , <i>Hardenbergia comptoniana</i> , <i>*Heliophila pusilla</i> , <i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3), <i>Hydrocotyle hispidula</i> , <i>*Hypochaeris glabra</i> , <i>Lepidosperma calcicola</i> , <i>Leucopogon parviflorus</i> , <i>*Lolium perenne</i> , <i>Lomandra maritima</i> , <i>*Lysimachia arvensis</i> , <i>*Medicago polymorpha</i> , <i>Melaleuca h.</i> subsp. <i>huegelii</i> , <i>M. systema</i> , <i>*Melilotus indicus</i> , <i>*Minuartia mediterranea</i> , <i>Olearia axillaris</i> , <i>Opercularia vaginata</i> , <i>*Petrorhagia dubia</i> , <i>Poa porphyroclados</i> , <i>Poranthera microphylla</i> , <i>*Reichardia tingitiana</i> , <i>Rhagodia b.</i> subsp. <i>baccata</i> , <i>*Romulea rosea</i> , <i>Scaevola t.</i> subsp. <i>thesioides</i> , <i>*Sisymbrium orientale</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>Stylidium maritimum</i> (P3), <i>Templetonia retusa</i> , <i>Thomasia triphylla</i> , <i>Thysanotus manglesianus</i> , <i>Tricoryne elatior</i> , <i>*Trifolium c.</i> var. <i>campestre</i> , <i>Triglochin isingiana</i> , <i>Trymalium l.</i> var. <i>ledifolium</i> , <i>Wurmbea tenella</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR02

<b>Survey Date 1:</b>	05 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376433	6494304	<b>Datum:</b>	GDA94
	NE	50J 376440	6494309	<b>Accuracy:</b>	±3m
	SE	50J 376444	6494299	<b>Aspect:</b>	Undulating.
	SW	50J 376439	6494295	<b>Altitude:</b>	9m
<b>Landform:</b>	Foredune.			<b>Soil:</b>	White sand (unconsolidated)
<b>Leaf Litter:</b>	5% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Very Good-Good			<b>Details:</b>	Weeds 6%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	G1	Grass 0.5-1m	10-30%	<i>Spinifex hirsutus</i> , <i>Spinifex longifolius</i> .	
	G2	Shrubs <0.5m	0.25-5%	<i>Olearia axillaris</i> , <i>Scaevola crassifolia</i> .	
	G3	Forbs <0.5m	5-10%	<i>*Trachyandra divaricata</i> .	
<b>Species:</b>	<i>*Bromus diandrus</i> , <i>*Cakile maritima</i> , <i>Cassytha aurea</i> var. <i>aurea</i> , <i>*Crassula glomerata</i> , <i>*Euphorbia paralius</i> , <i>*Lagurus ovatus</i> , <i>*Lolium perenne</i> , <i>Olearia axillaris</i> , <i>*Pelargonium capitatum</i> , <i>Scaevola crassifolia</i> , <i>*Sonchus oleraceus</i> , <i>Spinifex hirsutus</i> , <i>Spinifex longifolius</i> , <i>*Trachyandra divaricata</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR03

<b>Survey Date 1:</b>	05 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376559	6494138	<b>Datum:</b>	GDA94
	NE	50J 376563	6494138	<b>Accuracy:</b>	±3m
	SE	50J 376557	6494119	<b>Aspect:</b>	NW
	SW	50J 376552	6494120	<b>Altitude:</b>	8m
<b>Landform:</b>	Limestone cliff.			<b>Soil:</b>	White sand (pockets in limestone)
<b>Leaf Litter:</b>	1% cover; 0-1cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Very Good - Good			<b>Details:</b>	Weeds 3%. Pegs were removed between surveys.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	G1	Shrubs <0.5m	10-30%	<i>Frankenia pauciflora</i> subsp. <i>pauciflora</i> , <i>*Tetragonia decumbens</i> , <i>Threlkeldia diffusa</i> .	
	G2	Forbs <0.5m	0.25-5%	<i>*Trachyandra divaricata</i> , <i>*Crassula glomerata</i> , <i>*Sonchus oleraceus</i> .	
	G3	Forbs <0.5m	0.25-5%	<i>*Bromus diandrus</i> , <i>*Lolium perenne</i> .	
<b>Species:</b>	<i>*Arctotheca populifolia</i> , <i>*Bromus diandrus</i> , <i>*Cakile maritima</i> , <i>Carpobrotus</i> sp. (sterile), <i>*Crassula glomerata</i> , <i>*Euphorbia paralius</i> , <i>Frankenia pauciflora</i> var. <i>pauciflora</i> , <i>*Lolium perenne</i> , <i>*Melilotus indicus</i> , <i>*Oxalis pes-caprae</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>Scaevola crassifolia</i> , <i>*Sonchus oleraceus</i> , <i>Spinifex longifolius</i> , <i>*Taraxacum khatoonae</i> , <i>*Tetragonia decumbens</i> , <i>Thomasia triphylla</i> , <i>*Trachyandra divaricata</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR04

<b>Survey Date 1:</b>	05 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376593	6494154	<b>Datum:</b>	GDA94
	NE	50J 376603	6494153	<b>Accuracy:</b>	±3m
	SE	50J 376602	6494144	<b>Aspect:</b>	NW
	SW	50J 376593	6494144	<b>Altitude:</b>	10m
<b>Landform:</b>	Dune.			<b>Soil:</b>	Cream sand.
<b>Leaf Litter:</b>	10% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good			<b>Details:</b>	Weeds 10-30%. Regrowth?
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs 1-2m	10-30%	<i>Acacia cyclops</i> , <i>Spyridium globulosum</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> .	
	G1	Shrubs 0.5-1m	10-30%	<i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>Santalum acuminatum</i> , <i>*Tetragonia decumbens</i> .	
	G2	Grass <0.5m	10-30%	<i>*Ehrharta longiflora</i> , <i>*Bromus diandrus</i> .	
	G3	Vineland 0.5-1m	0.25-5%	<i>Hardenbergia comptoniana</i> , <i>Cassytha aurea</i> var. <i>aurea</i> , <i>Clematis linearifolia</i> .	
	G4	Forbs <0.5m	0.25-5%	<i>*Euphorbia terracina</i> , <i>*Crassula glomerata</i> , <i>*Cerastium glomeratum</i> .	
<b>Species:</b>	<i>Acacia cyclops</i> , <i>Acanthocarpus preissii</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>*Bromus diandrus</i> , <i>*Carpobrotus edulis</i> , <i>Cassytha aurea</i> var. <i>aurea</i> , <i>Cassytha racemosa</i> forma. <i>racemosa</i> , <i>*Cerastium glomeratum</i> , <i>Clematis linearifolia</i> , <i>Conostylis aculeata</i> subsp. <i>cygnorum</i> , <i>Crassula colorata</i> var. <i>acuminata</i> , <i>*Crassula glomerata</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia terracina</i> , <i>*Galium murale</i> , <i>Hardenbergia comptoniana</i> , <i>*Hypochaeris glabra</i> , <i>*Lolium perenne</i> , <i>*Lysimachia arvensis</i> , <i>Melaleuca systema</i> , <i>*Minuartia mediterranea</i> , <i>Parietaria debilis</i> , <i>*Pelargonium capitatum</i> , <i>*Polycarpon tetraphyllum</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>Santalum acuminatum</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>*Taraxacum khatoonae</i> , <i>*Tetragonia decumbens</i> .				
<b>Photo (NW Corner):</b>					

## SITE: QR05

<b>Survey Date 1:</b>	06 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376574	6494491	<b>Datum:</b>	GDA94
	NE	50J 376583	6494491	<b>Accuracy:</b>	±3m
	SE	50J 376584	6494481	<b>Aspect:</b>	S
	SW	50J 376575	6494481	<b>Altitude:</b>	13m
<b>Landform:</b>	Limestone ridgeline, crest low hill.			<b>Soil:</b>	Brown loamy sand (consolidated)
<b>Leaf Litter:</b>	50% cover; 0-5 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Very Good.			<b>Details:</b>	Weeds 8%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	G1	Shrubs <0.5m	30-70%	<i>Melaleuca h. subsp. huegelii</i> , <i>Templetonia retusa</i> , <i>Acacia truncata</i> , <i>Trymalium l. var. ledifolium</i> .	
	G2	Forbs <0.5m	10-30%	<i>Lomandra maritima</i> , <i>Opercularia vaginata</i> , <i>Stylidium maritimum</i> (P3), <i>Tricoryne elatior</i> .	
	G3	Rush <0.5m	0.25-5%	<i>Desmocladius asper</i> .	
	G4	Grass <0.5m	0.25-5%	<i>Austrostipa flavescens</i> , <i>*Lolium perenne</i> , <i>*Lagurus ovatus</i> , <i>*Ehrharta longiflora</i> , <i>*Bromus diandrus</i> .	
<b>Species:</b>	<i>Acacia l. var. lasiocarpa</i> , <i>A. rostellifera</i> , <i>A. truncata</i> , <i>A. xanthina</i> , <i>Austrostipa flavescens</i> , <i>Banksia d. var. dallanneyi</i> , <i>*Briza maxima</i> , <i>*Bromus diandrus</i> , <i>Calandrinia tholiformis</i> , <i>Calothamnus q. subsp. quadrifidus</i> , <i>Carpobrotus sp. (sterile)</i> , <i>Cassytha flava</i> , <i>Clematis linearifolia</i> , <i>Crassula colorata var. acuminata</i> , <i>*Crassula glomerata</i> , <i>*Cuscuta planiflora</i> , <i>Desmocladius asper</i> , <i>Desmocladius flexuosus</i> , <i>Dianella revoluta var. divaricata</i> , <i>Diplopeltis h. subsp. huegelii</i> , <i>Drosera macrantha</i> , <i>*Ehrharta longiflora</i> , <i>Eremophila glabra subsp. albicans</i> , <i>*Erodium botrys</i> , <i>*Galium murale</i> , <i>*Gladiolus caryophyllaceus</i> , <i>Gompholobium tomentosum</i> , <i>Grevillea p. subsp. preissii</i> , <i>Grevillea preissii x ?G. olivacea</i> , <i>Hardenbergia comptoniana</i> , <i>*Heliophila pusilla</i> , <i>Hibbertia spicata subsp. leptotheca</i> (P3), <i>*Hypochaeris glabra</i> , <i>*Isolepis marginata</i> , <i>*Lagurus ovatus</i> , <i>Lepidosperma calcicola</i> , <i>Leptomeria empetriflora</i> , <i>Leucopogon parviflorus</i> , <i>*Lolium perenne</i> , <i>Lomandra maritima</i> , <i>*Lysimachia arvensis</i> , <i>*Medicago polymorpha</i> , <i>Melaleuca h. subsp. huegelii</i> , <i>Melaleuca systema</i> , <i>*Melilotus indicus</i> , <i>Microtis m. subsp. media</i> , <i>*Minuartia mediterranea</i> , <i>Olearia axillaris</i> , <i>Opercularia vaginata</i> , <i>*Pelargonium capitatum</i> , <i>Pelargonium littorale</i> , <i>*Petrohragia dubia</i> , <i>Phyllanthus calycinus</i> , <i>Poranthera microphylla</i> , <i>Rhagodia b. subsp. baccata</i> , <i>Rhodanthe corymbosa</i> , <i>Sarcozona bicarinata</i> (P3), <i>Scaevola t. subsp. thesioides</i> , <i>*Silene gallica</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>Stylidium maritimum</i> (P3), <i>Templetonia retusa</i> , <i>Thysanotus manglesianus</i> , <i>*Trachyandra divaricata</i> , <i>Tricoryne elatior</i> , <i>*Trifolium sp. (immat.)</i> , <i>Triglochin isingiana</i> , <i>Trymalium l. var. ledifolium</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR06

<b>Survey Date 1:</b>	06 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376563	6494519	<b>Datum:</b>	GDA94
	NE	50J 376574	6494523	<b>Accuracy:</b>	±3m
	SE	50J 376576	6494512	<b>Aspect:</b>	N
	SW	50J 376565	6494511	<b>Altitude:</b>	14m
<b>Landform:</b>	Upper slope dune over limestone ridge.			<b>Soil:</b>	Brown loamy sand (consolidated)
<b>Leaf Litter:</b>	20% cover; 0-10 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good			<b>Details:</b>	Weeds 30%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs >2m	30-70%	<i>Melaleuca cardiophylla</i>	
	G1	Forbs <0.5m	10-30%	<i>Calandrinia brevipedata</i> , <i>Calandrinia tholiformis</i> , <i>Crassula colorata</i> var. <i>acuminata</i> , <i>*Cerastium glomeratum</i> , <i>*Galium murale</i> , <i>Rhodanthe corymbosa</i> .	
	G2	Grass <0.5m	10-30%	<i>*Ehrharta longiflora</i> .	
	G3	Rush <0.5m	0.25-5%	<i>Desmocladius asper</i> .	
<b>Species:</b>	<i>Acacia xanthina</i> , <i>Austrostipa compressa</i> , <i>*Avena barbata</i> , <i>*Briza maxima</i> , <i>Caladenia latifolia</i> , <i>Calandrinia brevipedata</i> , <i>Calandrinia tholiformis</i> , <i>*Cerastium glomeratum</i> , <i>Crassula colorata</i> var. <i>acuminata</i> , <i>*Crassula glomerata</i> , <i>Daucus glochidiatus</i> , <i>Desmocladius flexuosus</i> , <i>*Dischisma arenarium</i> , <i>*Ehrharta brevifolia</i> var. <i>cuspidata</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia peplus</i> , <i>*Galium murale</i> , <i>*Gamochaeta coarctata</i> , <i>*Hypochaeris glabra</i> , <i>*Isolepis marginata</i> , <i>Lepidosperma calcicola</i> , <i>Lobelia tenuior</i> , <i>*Lolium perenne</i> , <i>Lomandra maritima</i> , <i>*Lysimachia arvensis</i> , <i>Melaleuca cardiophylla</i> , <i>Melaleuca huegelii</i> subsp. <i>huegelii</i> , <i>Melaleuca systema</i> , <i>*Minuartia mediterranea</i> , <i>Parietaria debilis</i> , <i>Pelargonium littorale</i> , <i>*Petrorhagia dubia</i> , <i>Poa porphyroclados</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>Rhodanthe corymbosa</i> , <i>Sarcozona bicarinata</i> (P3), <i>Senecio pinnatifolius</i> var. <i>latilobus</i> , <i>*Senecio vulgaris</i> , <i>*Silene gallica</i> , <i>*Solanum nigrum</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>Stylidium maritimum</i> (P3), <i>Thysanotus manglesianus</i> , <i>Tricoryne elatior</i> , <i>Triglochin isingiana</i> , <i>*Vulpia muralis</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR07

Survey Date 1:	06 September 2019			Surveyor:	Kelli McCreery
Survey Date 2:	15 October 2019			Quadrat Size:	10m X 10m (100m <sup>2</sup> )
Quadrat Location:	NW	50J 376656	6494402	Datum:	GDA94
	NE	50J 376666	6494404	Accuracy:	±3m
	SE	50J 376668	6494393	Aspect:	SW
	SW	50J 376659	6494393	Altitude:	22m
Landform:	Limestone ridge.			Soil:	Brown loamy sand.
Leaf Litter:	60% cover; 0-3 cm depth.			Fire History:	>10 years
Condition:	Very Good.			Details:	Weeds 5%.
Vegetation NVIS:	Stratum	Form	Cover	Dominant Species	
	G1	Shrubs 0.5-1m	30-70%	Melaleuca h. subsp. huegelii, Templetonia retusa, Spyridium globulosum, Acacia truncata.	
	G2	Shrubs <0.5m	10-30%	Trymalium l. var. ledifolium, H. spicata ssp. leptotheca (P3), Acacia l. var. lasiocarpa.	
	G3	Forb <0.5m	10-30%	Lomandra maritima, Opercularia vaginata, Acanthocarpus preissii, Stylidium maritimum (P3), *Galium murale.	
	G4	Rush <0.5m	10-30%	Desmocladius asper, D. flexuosus.	
	G5	Sedge <0.5m	0.25-5%	Lepidosperma calcicola	
Species:	Acacia l. var. lasiocarpa, A. truncata, Acanthocarpus preissii, Astroloma microcalyx, *Avena barbata, Banksia d. var. dallanneyi, Bossiaea eriocarpa, *Briza maxima, *B. minor, *Bromus diandrus, Caladenia latifolia, Calandrinia brevipedata, Calothamnus q. ssp. quadrifidus, Cassytha flava, Clematis linearifolia, Comesperma confertum, C. integerrimum, *Crassula glomerata, Daucus glochidiatus, Desmocladius asper, D. flexuosus, Dianella revoluta var. divaricata, Drosera macrantha, *Ehrharta longiflora, *Galium murale, *Gladiolus caryophyllaceus, Gompholobium tomentosum, Grevillea p. ssp. preissii, Hardenbergia comptoniana, *Heliophila pusilla, Hibbertia h. ssp. hypericoides, H. spicata ssp. leptotheca (P3), Hydrocotyle hispidula, *Hypochaeris glabra, *Isolepis marginata, Lepidosperma calcicola, Leucopogon parviflorus, *Lolium perenne, Lomandra maritima, *Lysimachia arvensis, Melaleuca h. subsp. huegelii, M. systema, Microtis m. ssp. media, *Minuartia mediterranea, *Moraea flaccida, Olearia axillaris, Opercularia vaginata, *Pelargonium capitatum, Pelargonium littorale, Petrophile serruriae, *Petrorhagia dubia, Poranthera microphylla, *Reichardia tingitiana, Rhagodia b. ssp. baccata, *Romulea rosea, Rytidosperma occidentale, Scaevola t. ssp. thesioides, *Sisymbrium orientale, *Sonchus oleraceus, Spyridium globulosum, Stylidium maritimum (P3), S. rigidulum, Templetonia retusa, Thysanotus manglesianus, Tricoryne elatior, *Trifolium c. var. campestre, Triglochin isingiana, Trymalium l. var. ledifolium, *Vulpia muralis.				
Photo (NW Corner):					

## SITE: QR08

<b>Survey Date 1:</b>	06 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376371	6494385	<b>Datum:</b>	GDA94
	NE	50J 376360	6494384	<b>Accuracy:</b>	±3m
	SE	50J 376375	6494378	<b>Aspect:</b>	SW
	SW	50J 376365	6494373	<b>Altitude:</b>	7m
<b>Landform:</b>	Primary dune.			<b>Soil:</b>	White sand (unconsolidated)
<b>Leaf Litter:</b>	10% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Very Good.			<b>Details:</b>	Weeds 2-3%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	G1	Shrubs <0.5m	0.25-5%	<i>Scaevola crassifolia</i> , <i>Olearia axillaris</i> , <i>*Tetragonia decumbens</i> .	
	G2	Grass <0.5m	30-70%	<i>Spinifex longifolius</i> , <i>Spinifex hirsutus</i> .	
	G3	Forbs <0.5m	0.25-5%	<i>*Cakile maritima</i> , <i>*Trachyandra divaricata</i> .	
<b>Species:</b>	<i>*Arctotheca populifolia</i> , <i>*Bromus diandrus</i> , <i>*Cakile maritima</i> , <i>*Euphorbia paralius</i> , <i>Leucophyta brownii</i> , <i>*Lolium perenne</i> , <i>Olearia axillaris</i> , <i>*Pelargonium capitatum</i> , <i>Scaevola crassifolia</i> , <i>*Sonchus oleraceus</i> , <i>Spinifex hirsutus</i> , <i>Spinifex longifolius</i> , <i>*Tetragonia decumbens</i> , <i>*Trachyandra divaricata</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR09

<b>Survey Date 1:</b>	07 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376645	6494527	<b>Datum:</b>	GDA94
	NE	50J 376654	6494527	<b>Accuracy:</b>	±3m
	SE	50J 376654	6494517	<b>Aspect:</b>	Dune/limestone hill mid-slope.
	SW	50J 376644	6494516	<b>Altitude:</b>	15m
<b>Landform:</b>	Consolidated dune over limestone.			<b>Soil:</b>	Brown loamy sand.
<b>Leaf Litter:</b>	60% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years.
<b>Condition:</b>	Good.			<b>Details:</b>	Weeds 40% (5-60%).
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs >2m	70-100%	<i>Banksia sessilis</i> var. <i>cygnorum</i>	
	G1	Shrubs 0.5-1m	0.25-5%	<i>Hibbertia</i> h. subsp. <i>hypericoides</i> , <i>Calothamnus</i> q. subsp. <i>quadrifidus</i> , <i>Rhagodia</i> b. subsp. <i>baccata</i> , <i>Hakea lissocarpha</i> .	
	G2	Grass 0.5-1m	30-70%	<i>*Ehrharta calycina</i> , <i>*Ehrharta longiflora</i> .	
	G3	Forbs <0.5m	10-30%	<i>*Euphorbia terracina</i> , <i>*Galium murale</i> .	
<b>Species:</b>	<i>Acacia pulchella</i> var. <i>glaberrima</i> , <i>Acanthocarpus preissii</i> , <i>Austrostipa flavescens</i> , <i>*Avena barbata</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>Bossiaea eriocarpa</i> , <i>*Briza maxima</i> , <i>*Bromus diandrus</i> , <i>Calandrinia corrigioloides</i> , <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i> , <i>Clematis linearifolia</i> , <i>Conostylis aculeata</i> subsp. <i>cygnorum</i> , <i>Crassula colorata</i> var. <i>acuminata</i> , <i>*Crassula decumbens</i> var. <i>decumbens</i> , <i>*Crassula glomerata</i> , <i>Desmocladius asper</i> , <i>Desmocladius flexuosus</i> , <i>Dianella revoluta</i> var. <i>divaricata</i> , <i>Drosera macrantha</i> , <i>*Ehrharta calycina</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia terracina</i> , <i>*Galium murale</i> , <i>*Gladiolus caryophyllaceus</i> , <i>Grevillea preissii</i> subsp. <i>preissii</i> , <i>Hakea lissocarpha</i> , <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i> , <i>*Hypochaeris glabra</i> , <i>*Isolepis marginata</i> , <i>*Lagurus ovatus</i> , <i>Lechenaultia linarioides</i> , <i>Lepidosperma calcicola</i> , <i>*Lolium perenne</i> , <i>Lomandra maritima</i> , <i>*Lysimachia arvensis</i> , <i>Melaleuca systema</i> , <i>Mesomelaena pseudostygia</i> , <i>Microtis media</i> subsp. <i>media</i> , <i>*Moraea flaccida</i> , <i>*Pelargonium capitatum</i> , <i>*Polycarpon tetraphyllum</i> , <i>*Reichardia tingitana</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>*Romulea rosea</i> , <i>Schoenus clandestinus</i> , <i>*Sonchus oleraceus</i> , <i>*Trachyandra divaricata</i> , <i>*Trifolium campestre</i> var. <i>campestre</i> , <i>Triglochin isingiana</i> , <i>*Ursinia anthemoides</i> subsp. <i>anthemoides</i> , <i>*Wahlenbergia capensis</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR10

<b>Survey Date 1:</b>	07 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376716	6494487	<b>Datum:</b>	GDA94
	NE	50J 376716	6494487	<b>Accuracy:</b>	±3m
	SE	50J 376718	6494473	<b>Aspect:</b>	NW
	SW	50J 376705	6494473	<b>Altitude:</b>	12m
<b>Landform:</b>	Consolidated dune over limestone.			<b>Soil:</b>	Light brown loamy sand (yellow).
<b>Leaf Litter:</b>	70% cover; 0-10 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good			<b>Details:</b>	Weeds 5-8%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs >2m	0.25-5%	<i>Acacia cyclops</i> .	
	M2	Shrubs 1-2m	10-30%	<i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>Spyridium globulosum</i> .	
	M3	Vines >2m	5-10%	<i>Hardenbergia comptoniana</i> , <i>Clematis linearifolia</i> , <i>Cassytha racemosa</i> forma. <i>racemosa</i> .	
	G1	Shrubs 0.5-1m	10-30%	<i>Calothamnus</i> q. subsp. <i>quadrifidus</i> , <i>Hibbertia</i> h. subsp. <i>hypericoides</i> .	
	G2	Forbs <0.5m	10-30%	<i>Lomandra maritima</i> , <i>*Hypochaeris glabra</i> , <i>*Crassula glomerata</i> .	
	G3	Sedge <0.5m	5-10%	<i>Lepidosperma calcicola</i> .	
	G4	Rush <0.5m	5-10%	<i>Desmocladius asper</i> , <i>Desmocladius flexuosus</i> .	
	G5	Grass <0.5	0.25-5%	<i>*Ehrharta calycina</i> , <i>*Ehrharta longiflora</i>	
<b>Species:</b>	<i>Acacia cyclops</i> , <i>A. pulchella</i> var. <i>glaberrima</i> , <i>*Asparagus asparagoides</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>*Briza maxima</i> , <i>*Bromus diandrus</i> , <i>Caladenia latifolia</i> , <i>Calothamnus</i> q. subsp. <i>quadrifidus</i> , <i>Cassytha racemosa</i> forma. <i>racemosa</i> , <i>*Cerastium glomeratum</i> , <i>Clematis linearifolia</i> , <i>Conostylis aculeata</i> subsp. <i>cygnorum</i> , <i>*Conyza bonariensis</i> , <i>Crassula colorata</i> var. <i>acuminata</i> , <i>*C. d.</i> var. <i>decumbens</i> , <i>*C. glomerata</i> , <i>Desmocladius asper</i> , <i>D. flexuosus</i> , <i>Dianella revoluta</i> var. <i>divaricata</i> , <i>Drosera ?ramellosa</i> (sterile), <i>Drosera erythrorhiza</i> , <i>Drosera pallida</i> , <i>*Ehrharta calycina</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia peplus</i> , <i>*E. terracina</i> , <i>*Galium murale</i> , <i>*Gladiolus caryophyllaceus</i> , <i>Grevillea p.</i> subsp. <i>preissii</i> , <i>Hakea lissocarpha</i> , <i>Hardenbergia comptoniana</i> , <i>*Heliophila pusilla</i> , <i>Hibbertia</i> h. subsp. <i>hypericoides</i> , <i>*Hypochaeris glabra</i> , <i>*Isolepis marginata</i> , <i>Lepidosperma calcicola</i> , <i>Lomandra maritima</i> , <i>L. preissii</i> , <i>*Lysimachia arvensis</i> , <i>Melaleuca systema</i> , <i>Mesomelaena pseudostygia</i> , <i>Microtis m.</i> subsp. <i>media</i> , <i>*Moraea flaccida</i> , <i>*Pelargonium capitatum</i> , <i>Pelargonium littorale</i> , <i>Pterostylis aspera</i> , <i>*Reichardia tingitana</i> , <i>Rhagodia</i> b. subsp. <i>baccata</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>Thysanotus manglesianus</i> , <i>*Wahlenbergia capensis</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR11

<b>Survey Date 1:</b>	07 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376506	6494435	<b>Datum:</b>	GDA94
	NE	50J 376515	6494441	<b>Accuracy:</b>	±3m
	SE	50J 376516	6494429	<b>Aspect:</b>	SE
	SW	50J 376509	6494425	<b>Altitude:</b>	19m
<b>Landform:</b>	Parabolic dune.			<b>Soil:</b>	White sand.
<b>Leaf Litter:</b>	20% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good (Degraded near edges).			<b>Details:</b>	Weeds 20%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	G1	Shrubs <0.5m	10-30%	<i>Melaleuca systema</i> , <i>Leucopogon parviflorus</i> , <i>Phyllanthus calycinus</i> , <i>Acanthocarpus preissii</i> , <i>Acacia rostellifera</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> .	
	G2	Forbs <0.5m	10-30%	<i>Lomandra maritima</i> , * <i>Romulea rosea</i> , * <i>Pelargonium capitatum</i> .	
	G3	Sedge <0.5m	0.25-5%	<i>Lepidosperma calcicola</i> .	
	G4	Rush <0.5m	5-10%	<i>Desmocladius asper</i> .	
	G5	Grass <0.5	10-30%	<i>Poa porphyroclados</i> , <i>Austrostipa flavescens</i> , * <i>Lagurus ovatus</i> , * <i>Bromus diandrus</i> .	
<b>Species:</b>	<i>Acacia rostellifera</i> , <i>Acacia saligna</i> , <i>Acanthocarpus preissii</i> , <i>Austrostipa flavescens</i> , * <i>Avena barbata</i> , * <i>Brassica tournefortii</i> , * <i>Bromus diandrus</i> , <i>Conostylis aculeata</i> subsp. <i>cygnorum</i> , <i>Conostylis pauciflora</i> subsp. <i>pauciflora</i> Intergrade <i>C. aculeata</i> subsp. <i>cygnorum</i> (P4), * <i>Crassula glomerata</i> , <i>Cryptandra mutila</i> , <i>Desmocladius asper</i> , * <i>Ehrharta longiflora</i> , * <i>Euphorbia terracina</i> , * <i>Gazania linearis</i> , <i>Gompholobium tomentosum</i> , <i>Hardenbergia comptoniana</i> , <i>Hemianandra glabra</i> , <i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3), * <i>Isolepis marginata</i> , * <i>Lagurus ovatus</i> , <i>Lepidosperma calcicola</i> , <i>Leucopogon parviflorus</i> , * <i>Lolium perenne</i> , <i>Lomandra maritima</i> , * <i>Lysimachia arvensis</i> , <i>Melaleuca systema</i> , * <i>Minuartia mediterranea</i> , <i>Olearia axillaris</i> , * <i>Pelargonium capitatum</i> , * <i>Petrorhagia dubia</i> , <i>Phyllanthus calycinus</i> , <i>Poa porphyroclados</i> , * <i>Reichardia tingitana</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , * <i>Romulea rosea</i> , <i>Scaevola thesioides</i> subsp. <i>thesioides</i> , * <i>Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , * <i>Trachyandra divaricata</i> , * <i>Trifolium campestre</i> var. <i>campestre</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR12

<b>Survey Date 1:</b>	07 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376532	6494638	<b>Datum:</b>	GDA94
	NE	50J 376539	6494639	<b>Accuracy:</b>	±3m
	SE	50J 376543	6494631	<b>Aspect:</b>	SE
	SW	50J 376534	6494629	<b>Altitude:</b>	16m
<b>Landform:</b>	Parabolic dune.			<b>Soil:</b>	White-grey sand.
<b>Leaf Litter:</b>	10% cover; 0-2 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good			<b>Details:</b>	Weeds 15%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs 1-2m	5-10%	<i>Spyridium globulosum</i> , <i>Acacia rostellifera</i> .	
	G1	Shrubs <0.5m	10-30%	<i>Melaleuca systema</i> , <i>Phyllanthus calycinus</i> , <i>Cryptandra mutila</i> .	
	G3	Forb <0.5m	30-70%	<i>Lomandra maritima</i> , <i>Conostylis pauciflora</i> Intergrade <i>C. aculeata</i> (P4), <i>*Crassula glomerata</i>	
	G4	Rush <0.5m	5-10%	<i>Desmocladius asper</i> .	
	G4	Grass <0.5m	10-30%	<i>Poa porphyroclados</i> , <i>Austrostipa flavescens</i> , <i>*Bromus diandrus</i> , <i>*Lagurus ovatus</i> , <i>*Lolium perenne</i> .	
<b>Species:</b>	<i>Acacia rostellifera</i> , <i>Acanthocarpus preissii</i> , <i>Austrostipa flavescens</i> , <i>*Avena barbata</i> , <i>*Brassica tournefortii</i> , <i>*Bromus diandrus</i> , <i>*Centranthus macrosiphon</i> , <i>Conostylis pauciflora</i> subsp. <i>pauciflora</i> Intergrade <i>C. aculeata</i> subsp. <i>cygnorum</i> (P4), <i>*Crassula glomerata</i> , <i>Cryptandra mutila</i> , <i>Desmocladius asper</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia terracina</i> , <i>*Fumaria capreolata</i> , <i>*Galium murale</i> , <i>Hardenbergia comptoniana</i> , <i>Hemiandra glabra</i> , <i>*Hypochaeris glabra</i> , <i>*Isolepis marginata</i> , <i>*Lagurus ovatus</i> , <i>Lepidosperma calcicola</i> , <i>*Lolium perenne</i> , <i>Lomandra maritima</i> , <i>*Lupinus cosentinii</i> , <i>*Lysimachia arvensis</i> , <i>*Medicago polymorpha</i> , <i>Melaleuca systema</i> , <i>*Minuartia mediterranea</i> , <i>Olearia axillaris</i> , <i>Opercularia vaginata</i> , <i>*Pelargonium capitatum</i> , <i>*Petrorhagia dubia</i> , <i>Phyllanthus calycinus</i> , <i>Poa porphyroclados</i> , <i>*Reichardia tingitana</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>*Romulea rosea</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Trachyandra divaricata</i> , <i>*Trifolium campestre</i> var. <i>campestre</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR13

<b>Survey Date 1:</b>	08 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376548	6494607	<b>Datum</b>	GDA94
	NE	50J 376557	6494607	<b>Accuracy</b>	±3m
	SE	50J 376558	6494597	<b>Aspect:</b>	E
	SW	50J 376548	6494597	<b>Altitude:</b>	10m
<b>Landform:</b>	Dune over limestone.			<b>Soil:</b>	Light brown loamy sand.
<b>Leaf Litter:</b>	90% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good to Degraded.			<b>Details:</b>	Weeds 80%.
<b>Vegetation</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
<b>NVIS:</b>	M1	Shrubs 1-2m	70-100%	<i>Banksia sessilis</i> var. <i>cygnorum</i> .	
	G1	Grass <0.5	30-70%	<i>*Ehrharta longiflora</i> .	
<b>Species:</b>	<i>Austrostipa flavescens</i> , <i>Banksia dallanneyi</i> var. <i>dallanneyi</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>Bossiaea eriocarpa</i> , <i>*Briza maxima</i> , <i>*Bromus diandrus</i> , <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i> , <i>Carpobrotus</i> sp. (sterile), <i>Crassula colorata</i> var. <i>colorata</i> , <i>*Crassula glomerata</i> , <i>Desmocladius asper</i> , <i>Dianella revoluta</i> var. <i>divaricata</i> , <i>*Ehrharta calycina</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia peplus</i> , <i>*Euphorbia terracina</i> , <i>*Fumaria capreolata</i> , <i>*Galium murale</i> , <i>*Gladiolus caryophyllaceus</i> , <i>Grevillea preissii</i> subsp. <i>preissii</i> , <i>Hakea trifurcata</i> , <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i> , <i>*Hypochaeris glabra</i> , <i>*Isolepis marginata</i> , <i>Lepidosperma calcicola</i> , <i>Lomandra maritima</i> , <i>*Lysimachia arvensis</i> , <i>Melaleuca systema</i> , <i>*Pelargonium capitatum</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>Thysanotus manglesianus</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR14

<b>Survey Date 1:</b>	08 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	16 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376500	6494532	<b>Datum:</b>	GDA94
	NE	50J 376508	6494540	<b>Accuracy:</b>	±3m
	SE	50J 376515	6494532	<b>Aspect:</b>	NE
	SW	50J 376505	6494526	<b>Altitude:</b>	15m
<b>Landform:</b>	Slope of limestone hill.			<b>Soil:</b>	Grey loamy sand.
<b>Leaf Litter:</b>	50% cover; 0-5 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good to Degraded (under thickets)			<b>Details:</b>	Weeds 5-20%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs 1-2m	30-70%	<i>Melaleuca cardiophylla</i> .	
	G1	Shrubs 0.5-1m	5-10%	<i>Templetonia retusa</i> , <i>Melaleuca systema</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> .	
	G2	Forb <0.5m	10-30%	<i>*Galium murale</i> , <i>*Crassula glomerata</i> , <i>*Minuartia mediterranea</i> .	
	G3	Grass <0.5m	30-70%	<i>*Ehrharta longiflora</i> , <i>*Bromus diandrus</i> , <i>*Lagurus ovatus</i> , <i>*Lolium perenne</i> .	
<b>Species:</b>	<i>Acacia cyclops</i> , <i>Acacia rostellifera</i> , <i>Austrostipa flavescens</i> , <i>*Avena barbata</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>*Bellardia trixago</i> , <i>*Briza maxima</i> , <i>*Bromus diandrus</i> , <i>Calandrinia brevipedata</i> , <i>*Catapodium rigidum</i> , <i>Clematis linearifolia</i> , <i>Crassula colorata</i> var. <i>colorata</i> , <i>*Crassula glomerata</i> , <i>Daucus glochidiatus</i> , <i>Desmoclados asper</i> , <i>Dianella revoluta</i> var. <i>divaricata</i> , <i>*Ehrharta longiflora</i> , <i>Eremophila glabra</i> subsp. <i>albicans</i> , <i>*Euphorbia terracina</i> , <i>*Fumaria capreolata</i> , <i>*Galium murale</i> , <i>Grevillea preissii</i> subsp. <i>preissii</i> , <i>Hardenbergia comptoniana</i> , <i>*Hypochaeris glabra</i> , <i>*Lagurus ovatus</i> , <i>Lepidosperma calcicola</i> , <i>Leucopogon parviflorus</i> , <i>*Lolium perenne</i> , <i>*Lysimachia arvensis</i> , <i>*Medicago polymorpha</i> , <i>Melaleuca cardiophylla</i> , <i>Melaleuca huegelii</i> subsp. <i>huegelii</i> , <i>Melaleuca systema</i> , <i>*Minuartia mediterranea</i> , <i>Olearia axillaris</i> , <i>*Pelargonium capitatum</i> , <i>*Petrorhagia dubia</i> , <i>Phyllanthus calycinus</i> , <i>Poa porphyroclados</i> , <i>Poranthera microphylla</i> , <i>*Reichardia tingitiana</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>Rhodanthe corymbosa</i> , <i>Scaevola crassifolia</i> , <i>*Schinus terebinthifolia</i> , <i>*Silene gallica</i> , <i>*Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , <i>*Stellaria media</i> , <i>Templetonia retusa</i> , <i>Thysanotus manglesianus</i> , <i>*Trachyandra divaricata</i> , <i>Tricoryne elatior</i> , <i>Trymalium ledifolium</i> var. <i>ledifolium</i> .				
<b>Photo (NW Corner):</b>					


## SITE: QR15

<b>Survey Date 1:</b>	08 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376608	6494341	<b>Datum:</b>	GDA94
	NE	50J 376619	6494347	<b>Accuracy:</b>	±3m
	SE	50J 376621	6494336	<b>Aspect:</b>	W
	SW	50J 376610	6494333	<b>Altitude:</b>	15m
<b>Landform:</b>	Dune slope.			<b>Soil:</b>	Brown loam.
<b>Leaf Litter:</b>	70% cover; 0-10 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good			<b>Details:</b>	Weeds 20%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs >2m	0.25-5%	<i>Acacia cyclops</i> .	
	M2	Shrubs 1-2m	10-30%	<i>Spyridium globulosum</i> , <i>Melaleuca cardiophylla</i> , <i>Melaleuca huegelii</i> subsp. <i>huegelii</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i>	
	M3	Vines 1-2m	10-30%	<i>Hardenbergia comptoniana</i> , <i>Clematis linearifolia</i>	
	G2	Forbs <0.5m	10-30%	<i>Acanthocarpus preissii</i> , <i>Diuris magnifica</i> , * <i>Stellaria media</i> , * <i>Cerastium glomeratum</i> , * <i>Galium murale</i> ,	
	G3	Rush <0.5m	0.25-5%	<i>Desmocladius flexuosus</i>	
<b>Species:</b>	<i>Acacia cyclops</i> , <i>Acanthocarpus preissii</i> , <i>Austrostipa flavescens</i> , <i>Banksia sessilis</i> var. <i>cygnorum</i> , <i>Caladenia latifolia</i> , <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i> , * <i>Cerastium glomeratum</i> , <i>Clematis linearifolia</i> , <i>Crassula colorata</i> var. <i>colorata</i> , * <i>Crassula decumbens</i> var. <i>decumbens</i> , * <i>Crassula glomerata</i> , <i>Daucus glochidiatus</i> , <i>Desmocladius flexuosus</i> , <i>Dianella revoluta</i> var. <i>divaricata</i> , <i>Diuris magnifica</i> , * <i>Ehrharta longiflora</i> , * <i>Euphorbia terracina</i> , * <i>Galium murale</i> , * <i>Gamochaeta coarctata</i> , <i>Hardenbergia comptoniana</i> , * <i>Hypochaeris glabra</i> , <i>Lepidosperma calcicola</i> , <i>Leucopogon parviflorus</i> , * <i>Lolium perenne</i> , <i>Lomandra maritima</i> , * <i>Lysimachia arvensis</i> , * <i>Medicago polymorpha</i> , <i>Melaleuca cardiophylla</i> , <i>Melaleuca huegelii</i> subsp. <i>huegelii</i> , <i>Melaleuca systema</i> , <i>Olearia axillaris</i> , * <i>Pelargonium capitatum</i> , * <i>Reichardia tingitana</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , * <i>Schinus terebinthifolia</i> , * <i>Sonchus oleraceus</i> , <i>Spyridium globulosum</i> , * <i>Stellaria media</i> , <i>Templetonia retusa</i> , <i>Thomasia triphylla</i> .				
<b>Photo (NW Corner):</b>					

## SITE: QR16

<b>Survey Date 1:</b>	08 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	15 October 2019			<b>Quadrat Size:</b>	10m X 10m (100m <sup>2</sup> )
<b>Quadrat Location:</b>	NW	50J 376502	6494269	<b>Datum:</b>	GDA94
	NE	50J 376509	6494277	<b>Accuracy:</b>	±3m
	SE	50J 376514	6494269	<b>Aspect:</b>	SW
	SW	50J 376507	6494261	<b>Altitude:</b>	11m
<b>Landform:</b>	Dune on terrace above limestone cliff.			<b>Soil:</b>	White sand (unconsolidated)
<b>Leaf Litter:</b>	70% cover; 0-3 cm depth.			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Very Good (Good)			<b>Details:</b>	Weeds 5-10%.
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	G1	Shrubs 0.5-1m	70-100%	<i>Scaevola crassifolia</i> , <i>Myoporum insulare</i> .	
		Shrubs <0.5m	0.25-5%	<i>Threlkeldia diffusa</i> , <i>*Tetragonia decumbens</i> .	
	G2	Sedges 0.5-1m	0.25-5%	<i>Lepidosperma gladiatum</i> .	
	G3	Vines 0.5-1m	5-10%	<i>Hardenbergia comptoniana</i>	
<b>Species:</b>	<i>Acanthocarpus preissii</i> , <i>*Brassica tournefortii</i> , <i>*Bromus diandrus</i> , <i>Calandrinia brevipedata</i> , <i>*Ehrharta longiflora</i> , <i>*Euphorbia terracina</i> , <i>Ficinia nodosa</i> , <i>*Gazania linearis</i> , <i>Hardenbergia comptoniana</i> , <i>*Lagurus ovatus</i> , <i>Lepidosperma gladiatum</i> , <i>*Lolium perenne</i> , <i>Myoporum insulare</i> , <i>Olearia axillaris</i> , <i>*Oxalis pes-caprae</i> , <i>Parietaria debilis</i> , <i>*Pelargonium capitatum</i> , <i>*Reichardia tingitiana</i> , <i>Rhagodia baccata</i> subsp. <i>baccata</i> , <i>Scaevola crassifolia</i> , <i>*Sonchus oleraceus</i> , <i>*Stellaria media</i> , <i>*Tetragonia decumbens</i> , <i>Thomasia triphylla</i> , <i>Threlkeldia diffusa</i> , <i>*Trachyandra divaricata</i> .				
<b>Photo (NW Corner):</b>					

## SITE: YL17 (informal)

<b>Survey Date 1:</b>	9 September 2019			<b>Surveyor:</b>	Kelli McCreery
<b>Survey Date 2:</b>	-			<b>Quadrat Size:</b>	Unbounded
<b>Quadrat Location:</b>	NW	50J 376701	6494401	<b>Datum:</b>	GDA94
				<b>Accuracy:</b>	±3m
				<b>Aspect:</b>	
				<b>Altitude:</b>	19m
<b>Landform:</b>	Slope of limestone hill/dunes.			<b>Soil:</b>	Brown sand.
<b>Leaf Litter:</b>	-			<b>Fire History:</b>	>10 years
<b>Condition:</b>	Good?			<b>Details:</b>	Regrowth?
<b>Vegetation NVIS:</b>	<b>Stratum</b>	<b>Form</b>	<b>Cover</b>	<b>Dominant Species</b>	
	M1	Shrubs >2m	70-100%	<i>Melaleuca lanceolata</i> .	
	G1	Shrubs <0.5m	0.25-5%	<i>Rhagodia b. subsp. baccata</i> , <i>Threlkeldia diffusa</i> .	
<b>Species:</b>	<i>Acacia saligna</i> , <i>Clematis linearifolia</i> , <i>Enchylaena tomentosa</i> subsp. <i>tomentosa</i> , * <i>Galium murale</i> , <i>Melaleuca lanceolata</i> , * <i>Sonchus oleraceus</i> , <i>Threlkeldia diffusa</i> .				
<b>Photo (NW Corner):</b>					

## Appendix D: Flora and Vegetation Location Data

[illegible]

CATEGORY	FEATURE	COORDINATE (GDA94)	#
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376543 6494625	10
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376537 6494625	10
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376531 6494623	10
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376525 6494624	10
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376516 6494630	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376522 6494633	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376522 6494632	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376520 6494635	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376518 6494637	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376521 6494638	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376520 6494638	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376515 6494640	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376514 6494638	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376511 6494642	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376508 6494639	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376508 6494635	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376508 6494634	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376507 6494628	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376508 6494625	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376507 6494623	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376498 6494612	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376490 6494613	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376482 6494604	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	51 J 376543 6494631	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376547 6494627	10
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376517 6494628	10
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376512 6494379	1
Priority Flora	<i>Conostylis p. ssp. pauciflora</i> Intergrade <i>C. aculeata</i> ssp. <i>cygnorum</i>	50J 376506 6494435	10
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376602 6494495	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376599 6494508	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376597 6494510	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376602 6494508	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376603 6494510	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376598 6494515	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376597 6494516	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376593 6494517	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376590 6494516	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376587 6494513	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376585 6494504	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376579 6494505	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376568 6494500	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376562 6494499	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376565 6494494	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376565 6494490	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376567 6494488	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376568 6494487	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376575 6494486	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376577 6494491	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376579 6494492	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376580 6494493	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376583 6494495	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376586 6494495	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376588 6494497	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376589 6494500	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376588 6494505	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376576 6494497	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376570 6494495	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376574 6494489	5
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376519 6494511	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376522 6494517	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376570 6494417	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376574 6494413	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376575 6494413	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376579 6494412	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376579 6494406	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376577 6494407	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376572 6494407	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376571 6494407	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376586 6494393	1

[illegible]

CATEGORY	FEATURE	COORDINATE (GDA94)	#
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376653 6494245	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376649 6494246	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376633 6494245	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376628 6494245	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376626 6494244	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376627 6494244	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376623 6494247	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376596 6494241	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376599 6494253	3
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376605 6494251	3
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376610 6494248	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376611 6494249	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376612 6494249	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376614 6494253	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376613 6494254	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376611 6494261	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376595 6494261	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376514 6494431	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376514 6494426	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376664 6494402	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376658 6494393	15
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376661 6494398	20
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376661 6494401	20
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376667 6494515	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376583 6494491	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376656 6494402	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376506 6494435	1
Priority Flora	<i>Hibbertia spicata</i> subsp. <i>leptotheca</i> (P3)	50J 376500 6494532	1
Priority Flora	<i>Leucopogon maritimus</i> (P1)	50J 376571 6494485	1
Priority Flora	<i>Pimelea calcicola</i> (P3)	50J 376548 6494497	1
Priority Flora	<i>Sarcozona bicarinata</i> (P3)	50J 376563 6494519	1
Priority Flora	<i>Sarcozona bicarinata</i> (P3)	50J 376656 6494402	1
Priority Flora	<i>Sarcozona bicarinata</i> (P3)	50J 376596 6494503	1
Priority Flora	<i>Sarcozona bicarinata</i> (P3)	50J 376584 6494481	1
Priority Flora	<i>Sarcozona bicarinata</i> (P3)	50J 376652 6494403	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376608 6494256	4
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376687 6494540	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376574 6494491	10
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376580 6494477	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376577 6494477	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376577 6494477	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376598 6494490	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376599 6494490	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376597 6494492	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376621 6494505	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376619 6494507	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376617 6494505	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376616 6494504	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376618 6494502	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376615 6494503	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376615 6494504	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376613 6494511	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376613 6494509	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376612 6494508	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376612 6494507	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376604 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376601 6494521	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376600 6494520	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376600 6494521	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376600 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376599 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376601 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376599 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376598 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376598 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376596 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376597 6494524	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376596 6494525	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376597 6494526	1

CATEGORY	FEATURE	COORDINATE (GDA94)	#
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376596 6494526	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376594 6494526	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376594 6494526	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376594 6494525	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376593 6494524	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376594 6494522	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376589 6494524	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376589 6494526	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376589 6494526	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376591 6494528	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376590 6494530	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376593 6494533	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376594 6494533	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376588 6494527	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376588 6494524	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376586 6494526	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376585 6494527	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494526	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494526	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494525	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494524	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376585 6494524	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376579 6494518	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376580 6494518	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376580 6494517	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376581 6494517	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376582 6494517	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494517	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494516	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376582 6494515	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376580 6494515	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376580 6494514	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376581 6494513	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376578 6494512	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376578 6494510	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376573 6494512	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376571 6494510	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376568 6494509	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376565 6494510	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376564 6494508	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376561 6494478	5
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376572 6494471	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376574 6494474	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376575 6494476	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376577 6494480	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376580 6494483	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376581 6494485	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376582 6494484	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494483	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376582 6494484	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494485	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494485	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494485	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494487	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494487	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376585 6494487	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376585 6494486	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376586 6494488	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376592 6494492	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376596 6494493	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376595 6494494	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376602 6494498	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376601 6494497	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376603 6494496	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376602 6494495	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376608 6494493	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376601 6494502	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376601 6494504	3
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376600 6494505	3

CATEGORY	FEATURE	COORDINATE (GDA94)	#
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376602 6494513	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376600 6494514	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376599 6494514	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376577 6494507	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376578 6494505	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376571 6494505	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376570 6494504	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376570 6494500	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376568 6494483	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376565 6494483	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376571 6494481	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376585 6494492	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376574 6494494	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376571 6494489	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376571 6494486	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376583 6494512	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494514	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376599 6494401	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376581 6494408	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376647 6494400	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376659 6494405	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376657 6494402	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376660 6494402	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376659 6494405	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376660 6494406	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376660 6494406	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376663 6494408	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376668 6494408	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376671 6494403	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376669 6494408	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376646 6494248	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376569 6494223	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376608 6494249	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376607 6494258	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376561 6494234	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376664 6494400	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376657 6494401	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376660 6494406	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376660 6494405	10
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376600 6494501	10
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376687 6494541	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376687 6494545	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376685 6494545	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376685 6494545	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376684 6494545	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376683 6494547	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376684 6494548	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376685 6494550	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376679 6494548	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376680 6494549	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376680 6494547	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376681 6494548	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376679 6494546	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376679 6494546	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376680 6494547	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376680 6494545	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376664 6494397	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376584 6494481	1
Priority Flora	<i>Stylidium maritimum</i> (P3)	50J 376666 6494404	5
Quadrat	QR01NE	50J 376608 6494256	
Quadrat	QR01NW	50J 376600 6494252	
Quadrat	QR01SE	50J 376612 6494248	
Quadrat	QR01SW	50J 376604 6494243	
Quadrat	QR02NE	50J 376440 6494309	
Quadrat	QR02NW	50J 376433 6494304	
Quadrat	QR02SE	50J 376444 6494299	
Quadrat	QR02SW	50J 376439 6494295	
Quadrat	QR03NE	50J 376563 6494138	
Quadrat	QR03NW	50J 376559 6494138	

CATEGORY	FEATURE	COORDINATE (GDA94)	#
Quadrat	QR03SE	50J 376557 6494119	
Quadrat	QR03SW	50J 376552 6494120	
Quadrat	QR04NE	50J 376603 6494153	
Quadrat	QR04NW	50J 376593 6494154	
Quadrat	QR04SE	50J 376602 6494144	
Quadrat	QR04SW	50J 376593 6494144	
Quadrat	QR05NE	50J 376583 6494491	
Quadrat	QR05NW	50J 376574 6494491	
Quadrat	QR05SE	50J 376584 6494481	
Quadrat	QR05SW	50J 376575 6494481	
Quadrat	QR06NE	50J 376574 6494523	
Quadrat	QR06NW	50J 376563 6494519	
Quadrat	QR06SE	50J 376576 6494512	
Quadrat	QR06SW	50J 376565 6494511	
Quadrat	QR07NE	50J 376666 6494404	
Quadrat	QR07NW	50J 376656 6494402	
Quadrat	QR07SE	50J 376668 6494393	
Quadrat	QR07SW	50J 376659 6494393	
Quadrat	QR08NE	50J 376360 6494384	
Quadrat	QR08NW	50J 376371 6494385	
Quadrat	QR08SE	50J 376375 6494378	
Quadrat	QR08SW	50J 376365 6494373	
Quadrat	QR09NE	50J 376654 6494527	
Quadrat	QR09NW	50J 376645 6494527	
Quadrat	QR09SE	50J 376654 6494517	
Quadrat	QR09SW	50J 376644 6494516	
Quadrat	QR10NE	50J 376716 6494487	
Quadrat	QR10NW	50J 376704 6494484	
Quadrat	QR10SE	50J 376718 6494473	
Quadrat	QR10SW	50J 376705 6494473	
Quadrat	QR11NE	50J 376515 6494441	
Quadrat	QR11NW	50J 376506 6494435	
Quadrat	QR11SE	50J 376516 6494429	
Quadrat	QR11SW	50J 376509 6494425	
Quadrat	QR12NE	50J 376539 6494639	
Quadrat	QR12NW	50J 376532 6494638	
Quadrat	QR12SE	50J 376543 6494631	
Quadrat	QR12SW	50J 376534 6494629	
Quadrat	QR13NE	50J 376557 6494607	
Quadrat	QR13NW	50J 376548 6494607	
Quadrat	QR13SE	50J 376558 6494597	
Quadrat	QR13SW	50J 376548 6494597	
Quadrat	QR14NE	50J 376508 6494540	
Quadrat	QR14NW	50J 376500 6494532	
Quadrat	QR14SE	50J 376515 6494532	
Quadrat	QR14SW	50J 376505 6494526	
Quadrat	QR15NE	50J 376619 6494347	
Quadrat	QR15NW	50J 376608 6494341	
Quadrat	QR15SE	50J 376621 6494336	
Quadrat	QR15SW	50J 376610 6494333	
Quadrat	QR16NE	50J 376509 6494277	
Quadrat	QR16NW	50J 376502 6494269	
Quadrat	QR16SE	50J 376514 6494269	
Quadrat	QR16SW	50J 376507 6494261	
Quadrat	QR17 (informal quadrat)	50J 376701 6494401	
Significant Flora	<i>Tetragonia tetragonoides</i> s. lat. (potentially undescribed taxa)	50J 376527 6494557	1
Weed	* <i>Asparagus asparagoides</i>	50J 376681 6494448	1
Weed	* <i>Asparagus asparagoides</i>	50J 376676 6494493	1
Weed	* <i>Asparagus asparagoides</i>	50J 376716 6494487	1
Weed	* <i>Lantana camara</i>	50J 376717 6494490	1
Weed	* <i>Leptospermum laevigatum</i>	50J 376577 6494596	1
Weed	* <i>Leptospermum laevigatum</i>	50J 376464 6494471	1
Weed	* <i>Leptospermum laevigatum</i>	50J 376631 6494607	1
Weed	* <i>Leptospermum laevigatum</i>	50J 376575 6494590	1
Weed	* <i>Moraea flaccida</i>	50J 376666 6494404	1
Weed	* <i>Moraea flaccida</i>	50J 376644 6494516	1
Weed	* <i>Moraea flaccida</i>	50J 376716 6494487	1
Weed	* <i>Moraea flaccida</i>	50J 376563 6494471	10
Weed	* <i>Tamarix aphylla</i>	50J 376473 6494318	1

NOTIFICATIONS AND INTERESTS

Note:

M

MINERAL RESERVATION  
See Transfer 1247/1930

N

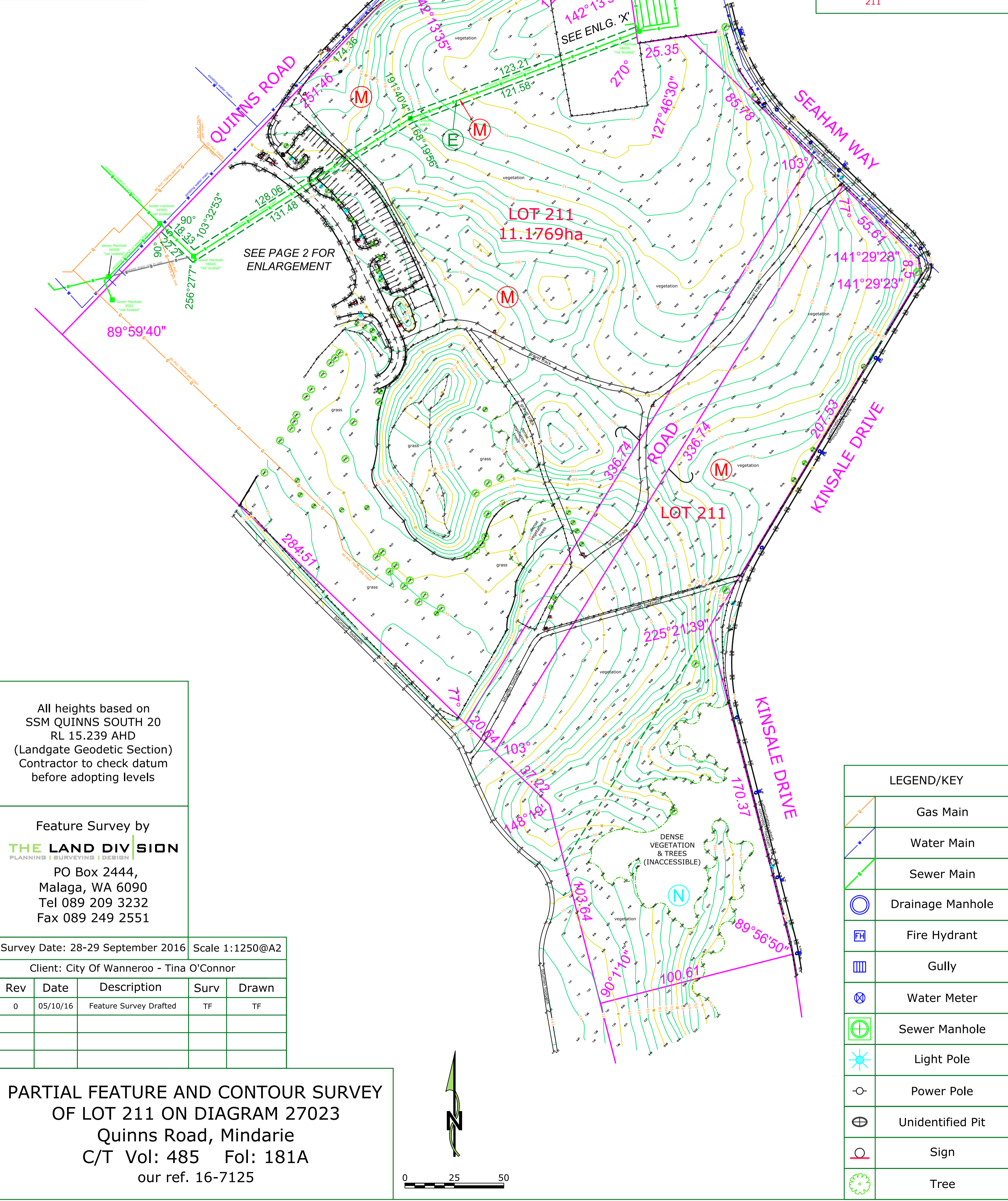
MINERAL RESERVATION  
See Transfer 7033/1940

E

EASEMENT  
See Doc. K742662

Note: DP 407262 has  
been lodged at Landgate  
but not yet dealt on.

Page 1 of 2



All heights based on  
SSM QUINNS SOUTH 20  
RL 15.239 AHD  
(Landgate Geodetic Section)  
Contractor to check datum  
before adopting levels

Feature Survey by  
**THE LAND DIVISION**  
PLANNING | SURVEYING | DESIGN  
PO Box 2444,  
Malaga, WA 6090  
Tel 089 209 3232  
Fax 089 249 2551

Survey Date: 28-29 September 2016			Scale 1:1250@A2	
Client: City Of Wanneroo - Tina O'Connor				
Rev	Date	Description	Surv	Drawn
0	05/10/16	Feature Survey Drafted	TF	TF

PARTIAL FEATURE AND CONTOUR SURVEY  
OF LOT 211 ON DIAGRAM 27023  
Quinns Road, Mindarie  
C/T Vol: 485 Fol: 181A  
our ref. 16-7125

LEGEND/KEY	
	Gas Main
	Water Main
	Sewer Main
	Drainage Manhole
	Fire Hydrant
	Gully
	Water Meter
	Sewer Manhole
	Light Pole
	Power Pole
	Unidentified Pit
	Sign
	Tree

NOTES: 1) CONSULT LEGAL ADVICE ON EASEMENTS, ENCUMBRANCES AND CAVEATS THAT MAY APPEAR ON THE CERTIFICATE OF TITLE. 2) LEVELS ON ADJOINING PROPERTIES ARE APPROXIMATE DUE TO ACCESS RESTRICTIONS. 3) SERVICES PLOTTED AS VISUALLY SEEN ON SITE AND ARE APPROXIMATE. 4) SEWER POSITION AND LEVELS FROM WATER CORPORATION PLANS. 5) CONSULT DIAL BEFORE YOU DIG TO CHECK LOCATION OF UNDERGROUND SERVICES. 6) BEWARE OF OVERHEAD POWER LINE HAZARDS. 7) CONSULT TLD ON ANY ANOMALY BEFORE DESIGN AND CONSTRUCTION. 8) POSITION AND DEPTH OF SERVICES TO BE CONFIRMED ON SITE BY CONTRACTOR.



# Planning Outcomes WA

town planning, urban design, landscaping + appeals

## NO. 2 (LOT 211) QUINNS ROAD, MINDARIE

### ECO-TENT RESORT, RESTAURANT, RECEPTION CENTRE & CARETAKERS DWELLING

#### PRELIMINARY PLANNING RESEARCH



<b>Owner</b>	City of Wanneroo
<b>Area</b>	110, 570m <sup>2</sup> / 11.0570 ha. / 27.322 acres
<b>Encumbrances</b>	Easement (sewer, see below).
<b>Contours</b>	Undulating, earthworks may be required for non-glamping structures.
<b>Existing Structures</b>	Surf LS Club, <u>conflicting plans</u> . Restaurants (2), large car-park and playground, footpaths. Public purpose (drainage sump).
<b>Other</b>	Residential neighbours have means and influential with landowner (City), evidence of <u>strong political issues</u> .

#### State Government Level

**Zoning** (Regional): Parks & Recreation (Scheme Amendment required?). City feels does not require AMD, advice requested from the DPLH. Unclear, State policy DC5.3 on Parks & Rec:

(b) private businesses, which:

- (i) are in accordance with a management plan endorsed by the WAPC;
- (ii) are open to and provide services for the public; and
- (iii) have a purpose which is ancillary and incidental to the primary purposes of the resN.

NB: the City has stated that there is no Mgt Plan.

**Bushfire Prone Area:** Yes,

- Will require high-level bushfire reports for tourism uses.
- Does not have two emergency access routes.
- Bushfire setbacks ~20m Asset Protection Zones for buildings / bushfire setbacks ~3m Low Fuel Zones for tents.
- Site Visit & Assessment booked, date unknown.

**Services** (see attached plans):

- Stormwater not available, onsite soakage required.
- Overhead Power and Underground power on Quinns Rd.
- Water on Quinns Rd, Sewerage through the site.
- Gas on Quinns Rd and through the site.

- NBN & telecommunications through site.

**Flora & Fauna:** Bush-Forever site, #397.

See F&F Survey – identifies some priority species and high-end condition areas, however not currently in the proposed development area.

See Fauna Survey – Some species of significance presumed onsite, however suggests low likelihood of roosting/ nesting, or infrequent, especially in the degraded areas of proposed development.

Clearing may require a DWER permit.

**Flood Risk:** Sea level rising, coastal hazard identified (see below), may require specialist advice on implications to development.

**Acid Sulphate Soils:** Nil.

**Heritage:** Nil (inc. Aboriginal).

#### Local Government Level

**Zoning (Local):** Nil. (Scheme Amendment required?).

**Special Control Area / Structure Plans / LDP's:** Nil.

**Land-Uses:** All 'D' (discretionary).

**Setbacks & Building Height Limit:** Nil... Use surrounding planning control(s) as guide(s).

**Transport:** Preliminary traffic report incoming. Specialist TIA report required.

**Local Policy LPP4.13:** Local policy identifies karsts on the site being medium risk, which could require a geo-tech survey, noting that this has not been mentioned by the City as yet.

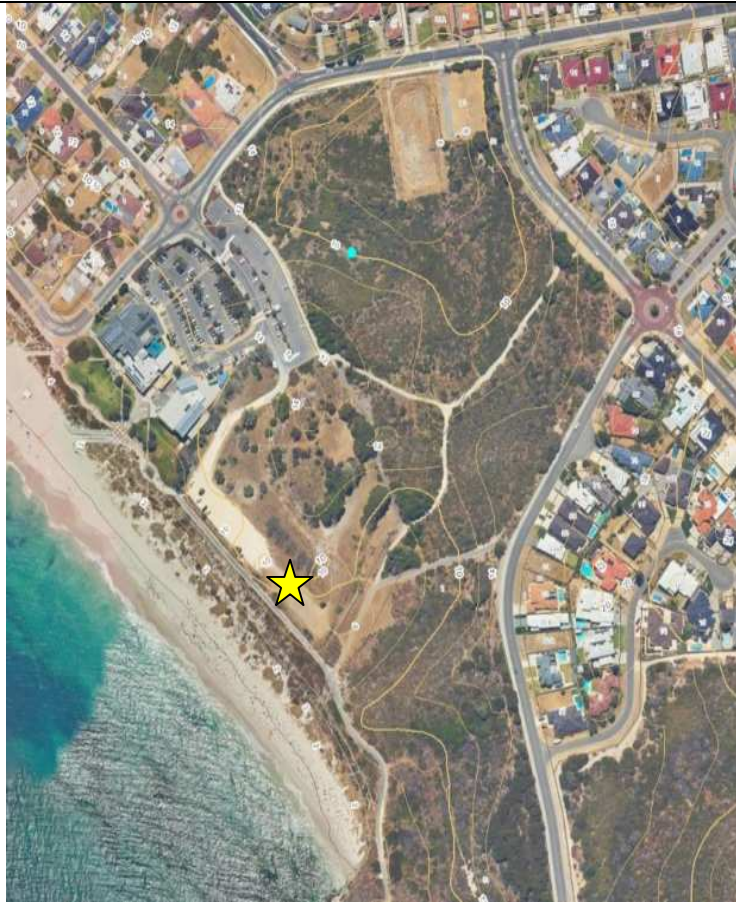
**Verge Infrastructure:** Footpaths.

**Noise:** Potential impact upon sensitive land-uses, acoustic report required.

**Transport:** Potential impact upon local road network, report required.

**Master Plan:** Need plan for specialist reports.

**Local Contact:** Spoke with City Planning team (various).



**Contours**



**Bush Forever**



**Coastal Hazards**



**Easement – Sewer Line**



**Disclaimer:** Please note that this is preliminary advice only on tourist accommodation, and advice could change on completion of fully researching this matter and lodgement of a development application. Many aspects are also based upon information from third parties (e.g. GIS), and any errors or omissions from that source may impact advice to the client. All liability assumed by the prospective tenant.

If the client seeks further planning advice, such as preparing and lodging a development application, please do not hesitate to contact me.

Yours sincerely



Matt Stuart

**Principal Town Planning Consultant**

**BA (URP) Hons | Grad Cert (UD) | MLGPA**

0408 000 477 | [matt@townplanningadvice.com.au](mailto:matt@townplanningadvice.com.au)

23 January 2023