

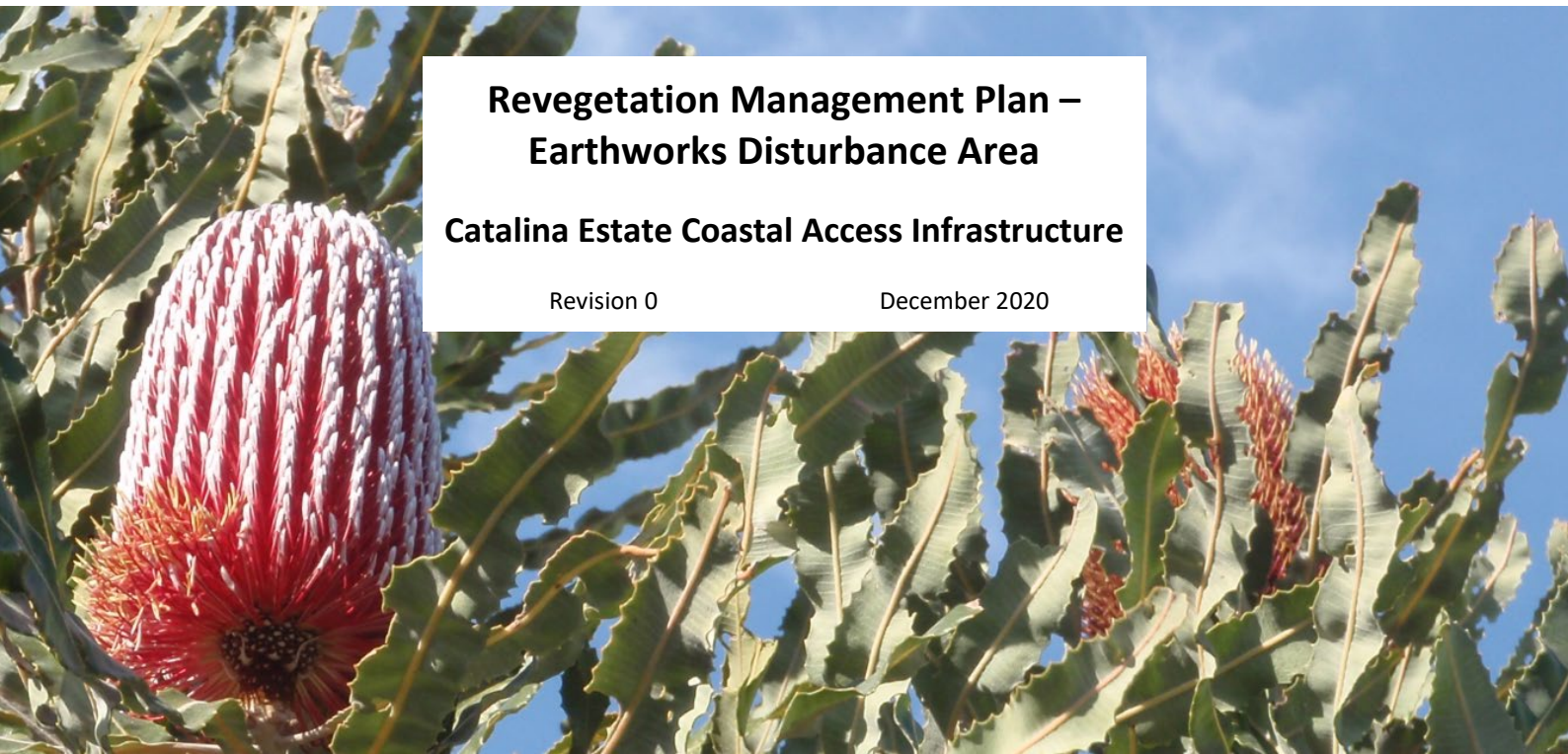


COTERRA  
ENVIRONMENT

**Revegetation Management Plan –  
Earthworks Disturbance Area  
Catalina Estate Coastal Access Infrastructure**

Revision 0

December 2020



CALIBRE | COMMITMENT | COLLABORATION

**This report was prepared by:** Coterra Pty Ltd trading as COTERRA ENVIRONMENT

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**This report was prepared for:**

Tamala Park Regional Council

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# 1 Introduction

## 1.1 Project Background

The Tamala Park urban development project, marketed as Catalina Estate is located in the north-west corridor of the Perth Metropolitan Region (Figure 1).

The Tamala Park Regional Council (TPRC) is the corporate entity established in 2006 for the specific purpose of facilitating rezoning, subdivision, development, marketing and sale of the Tamala Park landholding. The TPRC comprises the following 7 local government members: Town of Cambridge, City of Joondalup, City of Perth, City of Stirling, Town of Victoria Park, City of Vincent and City of Wanneroo. These member Councils have a joint holding in the project. The Satterley Property Group act as project managers and exclusive selling agents on the TPRC's behalf.

The Catalina Project is subject to the Tamala Park Local Structure Plan which was approved by the Western Australian Planning Commission (WAPC) in 2011 and will facilitate a new urban development comprising around 2,500 lots. The first phase of construction and development commenced in 2011. To date, over 900 lots have been sold in the Catalina Estate with approximately 700 houses completed or under construction.

Consisting a total of approximately 180 ha, the development area is divided into three Precincts known as 'Catalina Beach' located west of Marmion Avenue, 'Catalina Central' located east of Marmion Avenue and 'Catalina Grove' located east of Connolly Drive.

Given the expected demand for access to beach areas from the local population in the future it is proposed that a formal coastal access route be created to enable the local community to access the section of the coast to the west of the Catalina Estate to enable convenient access to a safe swimming beach as an alternative to Claytons Beach, which is subject to hazards to swimmers. At present, a number of informal bush tracks exist, used by people to gain four-wheel-drive access to the beach. Given the informal nature of these tracks and the uncontrolled access which has occurred this has resulted in damage to vegetation and dune structures which is enhanced further by wind erosion.

## 1.2 Proposed Coastal Infrastructure

The proposed coastal access road has been designed to provide a local route to the beach for Catalina residents and the general public. It comprises:

- An asphalt two-way road is proposed to be constructed, leading visitors to a beach carpark adjacent to the foredune, providing at least 30 bays (including one ACROD bay).
- From the car park, a path will provide access to the beach for pedestrians as well as authorised vehicles as necessary.

The alignment of the proposed access route and the location of the carpark area have been carefully selected to minimise impacts to flora and values in the area. Where possible the proposed access route follows the alignment of existing informal bush tracks or areas of damaged vegetation. The proposed carpark area is to be located within a degraded area of minimal or declining vegetation.

### 1.2.1 Infrastructure Design and Location

Engineering plans for the coastal access infrastructure are provided in Appendix 1. The infrastructure traverses the following three reserve lots:

- R20561 (Primary interest holder: City of Wanneroo)
- R35890 (Primary interest holder: City of Wanneroo)
- Lot 9005 (Registered Proprietor: Western Australian Planning Commission)



### **1.2.2 Native Vegetation Clearing Requirements**

The overall clearing area will comprise 1.88 ha, with 1.28ha which will be disturbed construction for the formation of batter etc, to be revegetated post construction of the infrastructure (Figure 2). This will leave 0.60 ha permanently cleared. This residual impact will be managed as described in Offset Site Revegetation Plan (Coterra, 2020).

### **1.3 Scope and Purpose of Report**

In order to facilitate the clearing of native vegetation to allow the coastal access road to be constructed a Native Vegetation Clearing Permit (NVCP) is required from the Department of Water and Environmental Regulation (DWER). This revegetation plan is being prepared for submission to DWER as supporting information for the clearing permit application to describe the revegetation proposed for the earthworks disturbance area.

It is noted that the Revegetation Plan is to be reviewed and approved by the City of Wanneroo prior to any works being undertaken onsite. As such this report may be updated prior to implementation.

### **1.4 Management Plan Objectives**

The objective of this Revegetation Management Plan is to provide measures to address the construction disturbance impacts of clearing within the coastal access infrastructure reserve.

## 2 Environmental Context

Contextual environmental information has been provided in detail within the Foreshore Management Plan (Coterra Environment, 2019). From that report, sections relevant to the works proposed as part of the Revegetation Management Plan within the coastal infrastructure reserve are detailed below.

### 2.1 Landform and Geography

The foreshore area is located within the Quindalup Dune System, a coastal dune formation of unconsolidated Holocene aeolian deposits (Safety Bay Sand) and Tamala limestone, occurring to the west of the Spearwood Dunes. The major formations are moderately inclined to steep sided, complex parabolic dunes. Active foredune ridges also occur adjacent to the coast. The dominant soils are rapidly drained, uniform pale calcareous sands with minimal profile development (Wells and Clarke, 1986).

### 2.2 Groundwater

Regional groundwater contours mapped in the Perth Groundwater Atlas (DoW, 2017) indicate that maximum groundwater levels occur between 2 mAHD at the eastern portion of the access road, to 0 mAHD at the water's edge (groundwater flows in a westerly direction discharging to the ocean).

### 2.3 Vegetation and Flora

Bennett Environmental Consulting undertook a detailed flora and vegetation report of the site in 2016 (Appendix 2). The key finding from this assessment of the site are summarised below:

- Four vegetation units were recorded from the survey area as follows:
  - Open Heath of *Melaleuca cardiophylla* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Herbland dominated by *\*Raphanus raphanistrum*, *\*Crassula glomerata* and *\*Petrorhagia dubia* over Sedgeland dominated by *Lomandra maritima* and *Desmocladius flexuosus*;
  - Tall Open Scrub of *Acacia rostellifera* and *Spyridium globulosum* over Low Shrubland of *Melaleuca systena* over Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *\*Lysimachia arvensis* over Very Open Sedgeland of *Lomandra maritima* and *Desmocladius flexuosus*;
  - Shrubland of *Acacia rostellifera* over Low Shrubland dominated by *Rhagodia baccata* subsp. *dioica* and *Scaevola crassifolia* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *Acanthocarpus preissii*, *\*Crassula glomerata* and *\*Trachyandra divaricata* over Sedgeland of *Lepidosperma gladiatum*; and
  - Low Open Shrubland of *Olearia axillaris*, *Scaevola crassifolia*, *\*Pelargonium capitatum* and *Rhagodia baccata* subsp. *dioica* over Grassland dominated by *Spinifex longifolius* over Very Open Herbland dominated by *\*Trachyandra divaricata*.
- The vegetation condition varied between Very Good and Good except along the track where it was Degraded.
- A total of 31 vascular plant families, 58 genera and 68 taxa were recorded during the survey, of which 26 taxa were weeds (i.e. 42 taxa were native).
- Native species recorded with greater than 10% cover in the monitoring quadrats included:
  - *Acacia rostellifera*
  - *Cassytha flava*

- *Conostylis aculeata* subsp. *cygnorum*
- *Desmocladius flexuosus*
- *Lepidosperma gladiatum*
- *Lomandra maritima*
- *Melaleuca cardiophylla*
- *Melaleuca systema*
- *Spinifex longifolius*
- *Spyridium globulosum*
- The number of native species recorded per 10m x 10m quadrat were as follows, which equates to an average 20 species/quadrat or 0.2 species/m<sup>2</sup> within the quadrats:
  - Quadrat 1 – 13 species with coverage % recorded, plus 12 opportunistic records
  - Quadrat 2 – 13 species with coverage % recorded, plus 9 opportunistic records
  - Quadrat 3 – 8 species with coverage % recorded, plus 11 opportunistic records
  - Quadrat 4 - 7 species with coverage % recorded, plus 7 opportunistic records
- Weeds were common throughout the remnant bushland but were very dense only along the edges of the track.
- None of the species were threatened or priority species and none of the weeds were listed as Declared Plants.
- Species with greater than 10% weed cover in the monitoring quadrats included:
  - *Crassula glomerata* – 10% (Quadrat 3)
  - *Ehrharta longiflora* – 20% (Quadrat 1)
  - *Ehrharta longiflora* – 10% (Quadrat 2)
  - *Lysimachia arvensis* – 15% (Quadrat 2)
  - *Petrorhagia dubia* – 15% (Quadrat 1)
  - *Raphanus raphanistrum* – 20% (Quadrat 1)
  - *Silene gallica* – 10% (Quadrat 1)
  - *Trachyandra divaricata* – 15% (Quadrat 4)

The key findings from the AECOM (2018) assessment of the Tamala Park Reserve are summarised below:

- Eleven vegetation communities were mapped within the Survey Area; two woodlands, seven shrublands and one thicket.
- Three Priority 3 Ecological Communities were identified to be present in the survey area: PEC 29a Coastal Shrubland on shallow sands, PEC 29b Acacia shrublands on taller dunes and PEC 24 Northern Spearwood shrublands and woodlands.
- Vegetation condition ranged from Very Good to Completely Degraded.
- 86 flora species were recorded during the survey including 34 weed species.
- No Threatened flora species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* or *Wildlife Conservation Act 1950* were recorded.
- No Priority flora species listed by the DBCA were recorded.

- One Weed of National Significance (WoNS) (*Asparagus asparagoides*) was recorded adjacent tracks at several locations within the Survey Area.
- Thirty four weed species were recorded within quadrats and at 80 weed population areas, mainly adjacent to existing tracks.

### 3 Revegetation Strategy and Completion Criteria

The overall revegetation works to be undertaken for the project will address both the construction disturbance impacts and the residual impact. The strategy outlined below is relevant only to revegetation of the 1.28ha earthworks disturbance area adjacent to the infrastructure footprint (Figure 2).

The revegetation proposal utilises the baseline flora and vegetation data relevant to this area as reported in the following:

- Bennett Environmental Consulting. 2016. *Botanical Assessment of Proposed Access Roads from Catalina to the Beach*. Prepared for Coterra Environment.
- AECOM. 2018. *Tamala Park Reserve – Biological Report*. Report prepared for the City of Wanneroo.

#### 3.1 Revegetation Methodology

The proposed revegetation methodology will generally comprise the following:

##### 3.1.1 Species Selection

A species planting list has been derived from the species list recorded by Bennett Environmental Consulting (2016) with input from a specialist rehabilitation consultant in relation to the stock onsite available for collection and most suitable species to include in the program. A copy of the proposed planting list is provided as Appendix 3.

Final species selection and location of planting will be confirmed based on availability and suitability in proposed rehabilitation areas.

##### 3.1.2 Planting

Direct seeding may be used in conjunction with tubestock planting within the revegetation areas. Plants to be used in these works will be sourced as follows:

- Seed and cutting collection is proposed to be undertaken within and surrounding the proposal clearing area for use in the revegetation program.
- Additional stock will be sourced from local nurseries to supplement the collected seed and cutting resources. Where, possible local provenance material will be used.

##### 3.1.3 Weed Control

Pre-planting weed control will comprise:

- Two weed control events will be undertaken in the six months prior to planting.
- Weed control will be undertaken within and extending to 2m beyond the revegetation areas extent prior to planting being undertaken.

Post-planting weed control will comprise:

- This will be undertaken in late winter/early spring following planting. This will allow for additional removal of weeds prior to flowering and seed propagation.
- Following establishment, a spring weed monitoring event will occur annually, and weed control will be undertaken where necessary up until handover.

### 3.1.4 Additional Considerations

To assist with survival success plants may have plant guards installed following planting, to be removed once deemed large and robust enough to survive without this protection. Fencing of revegetation area with rabbit proof fencing may also be considered if this is deemed preferable to plant guards.

Application of brushing and/or hydromulching (no seed impregnated) may be undertaken in erosion prone areas to assist with surface stabilisation.

Fencing will be installed along the coastal infrastructure boundaries to prevent access into the coastal reserves from this area. This will also prevent access into the revegetation area.

## 3.2 Completion Criteria

The following completion criteria are proposed for the revegetation program:

**Table 1: Completion Criteria**

Characteristic	Measure	Baseline Flora Data	Completion Target	Completion Criteria
			Vegetation in Good condition as per Keighery (1994)	
A. Species Richness	i) Total Species Richness	42 native species	Minimum of 60% of native species returned, based on baseline data.	Minimum of 25 native species to be present in the revegetation areas
	ii) Quadrat Species Richness	20 native species (0.2 species/m <sup>2</sup> )	Minimum of 60% of native species returned based on baseline data.	Minimum of 0.12 native species per m <sup>2</sup> on average within the monitoring quadrats.
B. Species Density	i) Total	Information not previously recorded. An average plant density of 2 plants/m <sup>2</sup> in dryland environments is used as a baseline measure.	Minimum of 60% of stems returned based on baseline data.	Minimum of 1.2 stems/m <sup>2</sup> on average within the revegetation area.
C. Species diversity	i) Total	The following 10 species were recorded with >10% coverage in the monitoring quadrats: <ul style="list-style-type: none"> <li>• <i>Acacia rostellifera</i></li> <li>• <i>Cassytha flava</i></li> <li>• <i>Conostylis aculeata</i> subsp. <i>cygnorum</i></li> <li>• <i>Desmocladus flexuosus</i></li> <li>• <i>Lepidosperma gladiatum</i></li> <li>• <i>Lomandra maritima</i></li> <li>• <i>Melaleuca cardiophylla</i></li> <li>• <i>Melaleuca systema</i></li> </ul>	Minimum of 60% of dominant species returned, based on baseline data.	At least 6 of the following species are to be present in the revegetation areas: <ul style="list-style-type: none"> <li>• <i>Acacia rostellifera</i></li> <li>• <i>Cassytha flava</i></li> <li>• <i>Conostylis aculeata</i> subsp. <i>cygnorum</i></li> <li>• <i>Desmocladus flexuosus</i></li> <li>• <i>Lepidosperma gladiatum</i></li> <li>• <i>Lomandra maritima</i></li> <li>• <i>Melaleuca cardiophylla</i></li> </ul>



Characteristic	Measure	Baseline Flora Data	Completion Target	Completion Criteria
			Vegetation in Good condition as per Keighery (1994)	
		<ul style="list-style-type: none"> <li>• <i>Spinifex longifolius</i></li> <li>• <i>Spyridium globulosum</i></li> </ul>		<ul style="list-style-type: none"> <li>• <i>Melaleuca systema</i></li> <li>• <i>Spinifex longifolius</i></li> <li>• <i>Spyridium globulosum</i></li> </ul>
D. Weed Cover	ii) General Weed Cover	Weeds observed in the clearing reference area were generally competitive species. The high weed cover recorded was: <ul style="list-style-type: none"> <li>• <i>Ehrharta longiflora</i> – 20%</li> <li>• <i>Lysimachia arvensis</i> – 15%</li> <li>• <i>Petrorhagia dubia</i> – 15%</li> <li>• <i>Raphanus raphanistrum</i> – 20%</li> <li>• <i>Trachyandra divaricata</i> – 15%</li> </ul>	Weed cover no greater than 15%	Maximum of 15% weed cover
	iii) Declared Weeds	No declared weeds recorded in the vegetation survey	No declared weeds to be present within the revegetation areas	0% cover

### 3.3 Monitoring

Monitoring of the progress in relation to the completion criteria will include the following:

- establish quadrat monitoring sites within revegetated areas;
- monitor quadrats at least annually; and
- monitoring of quadrats is to be undertaken by an environmental specialist.

Specific details including quadrat numbers, size and approximate location will be provided in the first monitoring report.

The target for the program will be to achieve the completion criteria after a three year monitoring period for the revegetation areas.

### 3.4 Contingency Actions

Where monitoring indicates that revegetation has not met the completion criteria, the following contingency actions will be considered and implemented as needed:

- Additional revegetation planting and/or direct seeding to achieve the completion criteria targets;
- Undertake further weed control activities;

- Undertake watering activities; and/or
- Further restrict access to the revegetation sites through additional fencing etc.

## 4 References

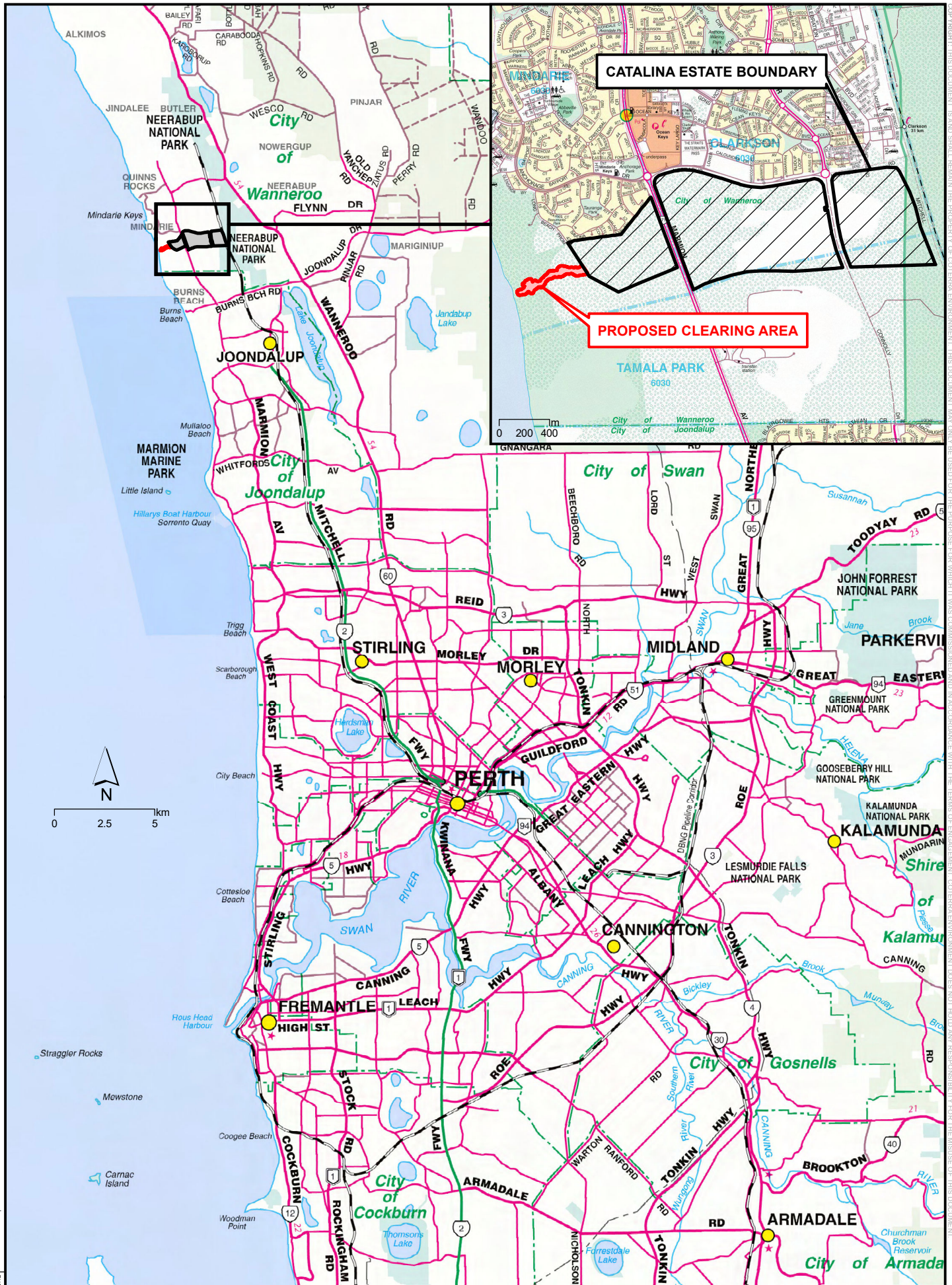
- AECOM (2018). *Tamala Park Reserve – Biological Report*. Report prepared for the City of Wanneroo.
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- WAPC (2012). *Tamala Conservation Park Establishment Plan*. State Government of Western Australia.
- Wells, M. R. & Clarke, A. J. (1986). *Shire of Wanneroo – a Study of Land Resources and Planning Considerations*. Resource Management Technical Report No.47. Department of Agriculture, June 1986.



## Figures

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CATALINA COASTAL ACCESS AND CARPARK  
LOTS 15448, 3050 & 9505 TAMALA PARK

**SITE LOCATION**

**Figure 1**





**LEGEND**

- Cadastre
- Permanently Cleared Zone
- Clearing with Future Revegetation Zone

N

0 12.5 25 50 75 100  
m

Scale: 1:2,000 @ A3  
GDA 1994 MGA Zone 50

ENVIRONMAPS | 0406 590 006  
Environmental Mapping Solutions | www.environmentmaps.com.au

Source: Cadastre - Landgate, 2020  
Orthophoto - NearMaps, 12.09.20  
Layout - Cossill Webley, 6037-BAR

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Tamala Park Regional Council  
CATALINA COASTAL ACCESS ROAD AND CARPARK (NVCP)  
LOTS 15448, 3050 & 9505 TAMALA PARK

**CLEARING ZONES**

**Figure 2**



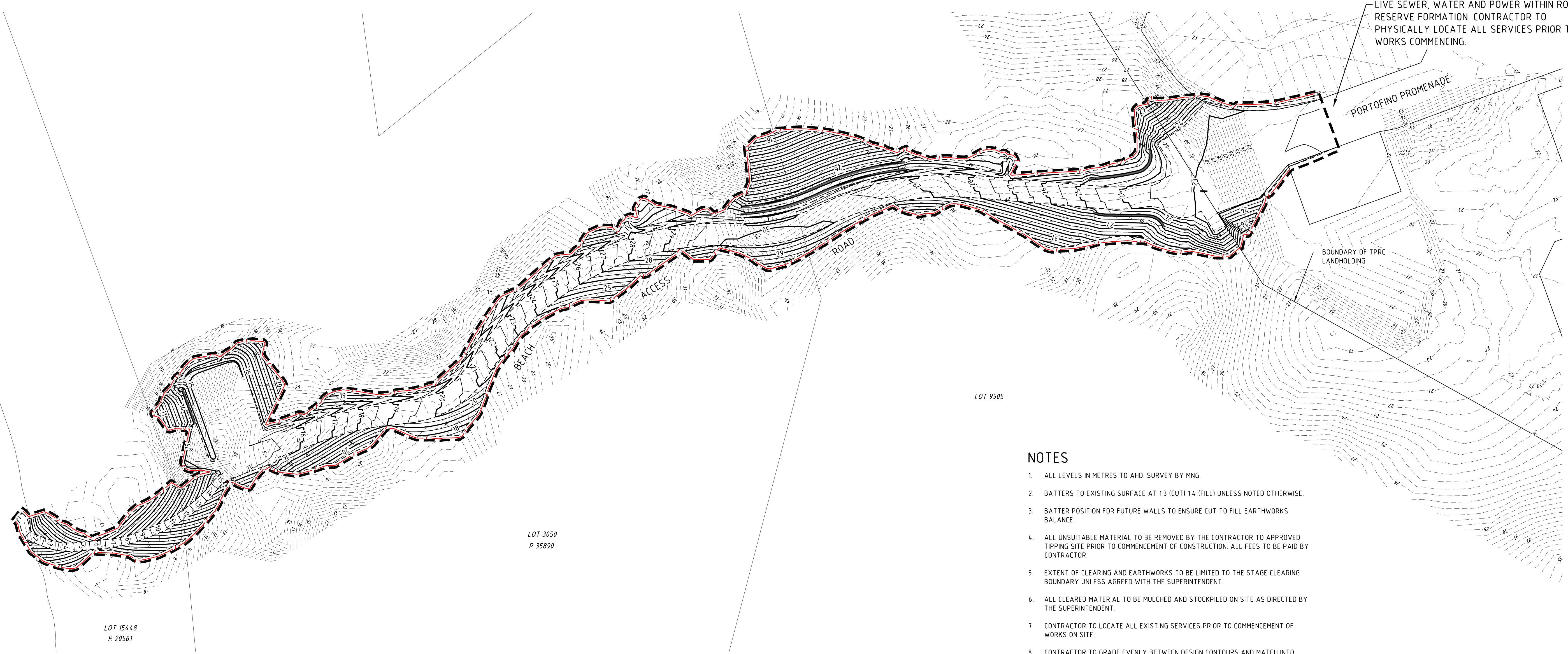


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## **Appendix 1 Coastal Access Infrastructure Engineering Plans**

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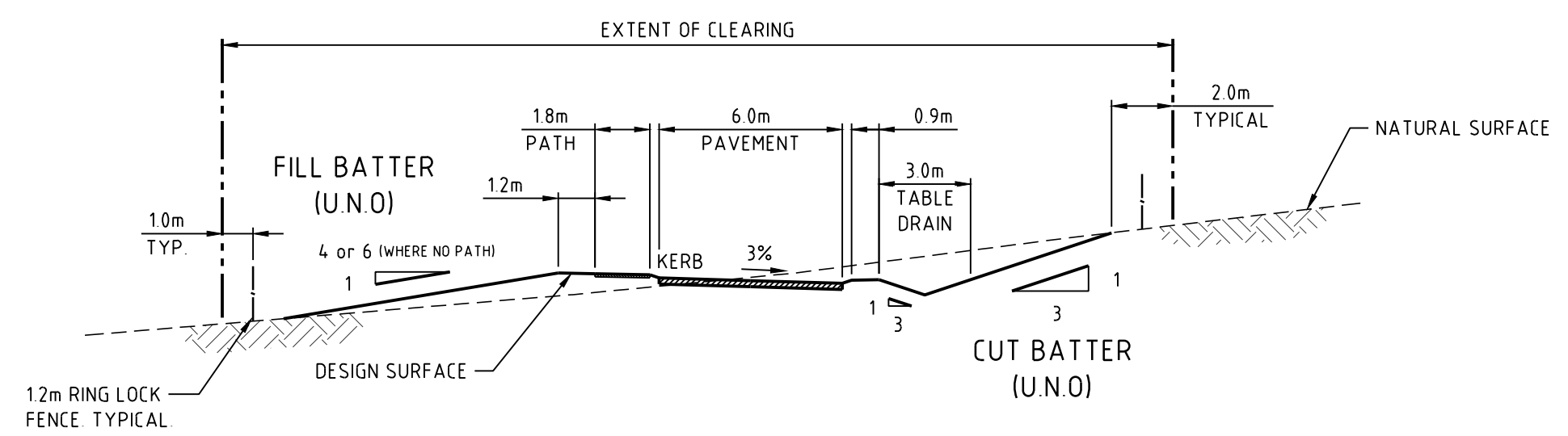




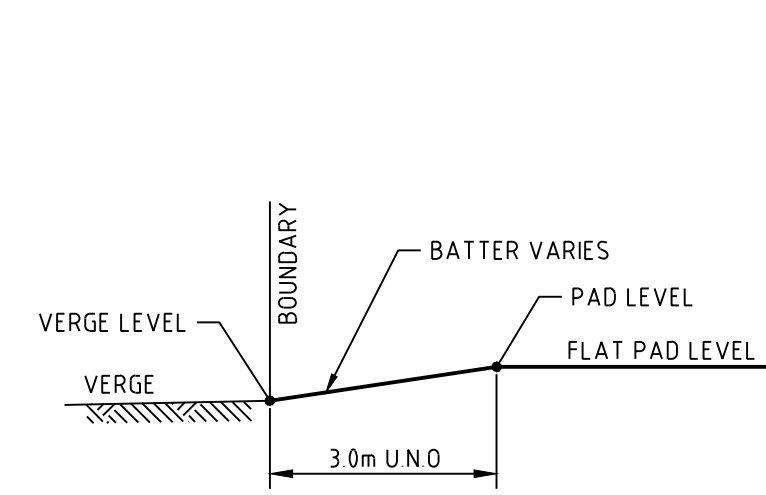
**NOTES**

1. ALL LEVELS IN METRES TO AHD SURVEY BY MNG.
2. BATTERS TO EXISTING SURFACE AT 1:3 (CUT) 1:4 (FILL) UNLESS NOTED OTHERWISE.
3. BATTER POSITION FOR FUTURE WALLS TO ENSURE CUT TO FILL EARTHWORKS BALANCE.
4. ALL UNSUITABLE MATERIAL TO BE REMOVED BY THE CONTRACTOR TO APPROVED TIPPING SITE PRIOR TO COMMENCEMENT OF CONSTRUCTION. ALL FEES TO BE PAID BY CONTRACTOR.
5. EXTENT OF CLEARING AND EARTHWORKS TO BE LIMITED TO THE STAGE CLEARING BOUNDARY UNLESS AGREED WITH THE SUPERINTENDENT.
6. ALL CLEARED MATERIAL TO BE MULCHED AND STOCKPILED ON SITE AS DIRECTED BY THE SUPERINTENDENT.
7. CONTRACTOR TO LOCATE ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF WORKS ON SITE.
8. CONTRACTOR TO GRADE EVENLY BETWEEN DESIGN CONTOURS AND MATCH INTO EXISTING SURFACE AT LIMIT OF EARTHWORKS BOUNDARY WHERE APPROPRIATE.
9. EXCESS CUT FROM EARTHWORKS SHALL BE PLACED ON SITE AS DIRECTED BY THE SUPERINTENDENT.
10. WHERE LIMESTONE IS WITHIN 600mm OF THE FINAL SURFACE LEVEL THE CONTRACTOR SHALL TREAT THE SITE IN ACCORDANCE WITH THE SPECIFICATION.
11. DESIGN LEVELS SHOWN SHALL BE ON THE FINISHED SURFACE INCLUDING TOPSOIL WHERE SPECIFIED.
12. THE CONTRACTOR SHALL LIMIT THE MOVEMENT OF EQUIPMENT AND MANPOWER TO THE MINIMUM AREA NECESSARY AND PROTECT ALL VEGETATION AND EXISTING SERVICES ON SITE.
13. ADJACENT RESIDENTS TO BE NOTIFIED OF THE WORKS AT LEAST TWO WEEKS IN ADVANCE. CONTRACTOR TO PROVIDE MOBILE NUMBER FOR SUPERVISOR AS PART OF NOTIFICATION.

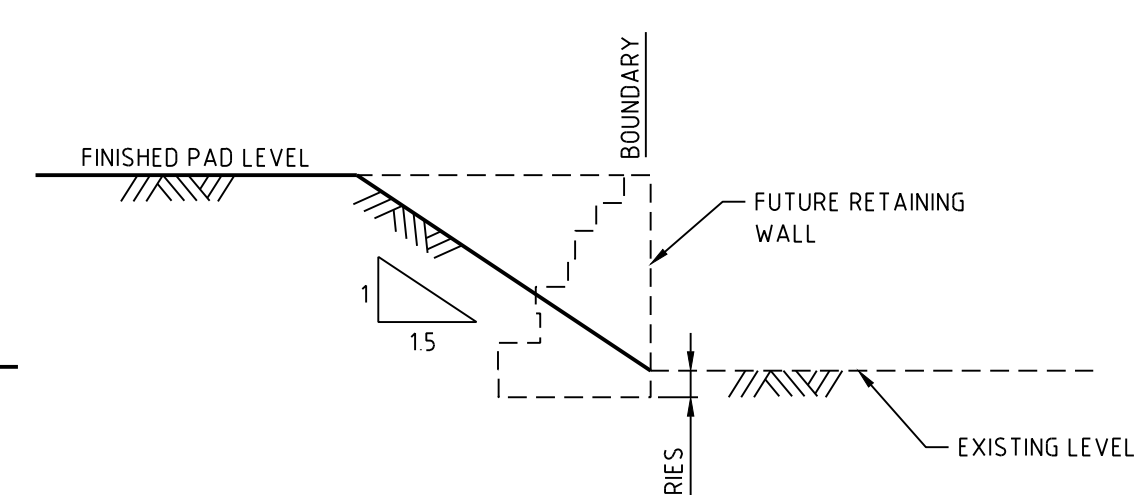
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DESCRIPTION	SYMBOL
LIMIT OF WORKS BOUNDARY	--- --
FINISHED SURFACE CONTOUR MAJOR	— 25 —
FINISHED SURFACE CONTOUR MINOR	— — — —
EXISTING SURFACE CONTOUR MAJOR	- - - - -
EXISTING SURFACE CONTOUR MINOR	- - - - -
12m HIGH RING LOCK FENCE	— / —



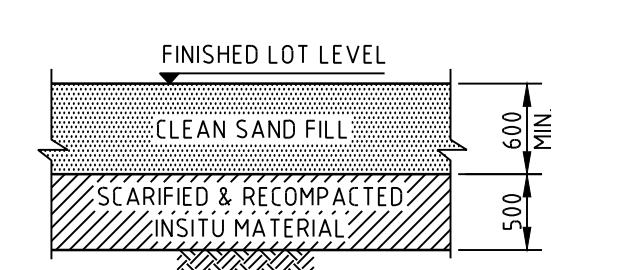
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SCALE: 1:200



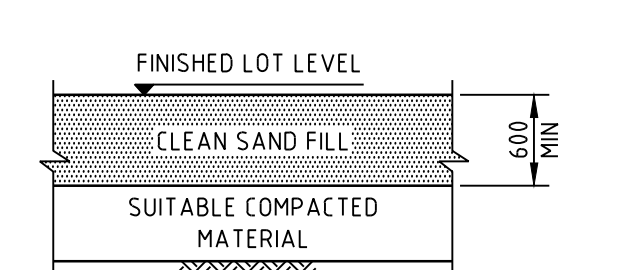
**TYPICAL BATTER TO FRONT OF TRADITIONAL LOTS**  
SCALE: N.T.S.



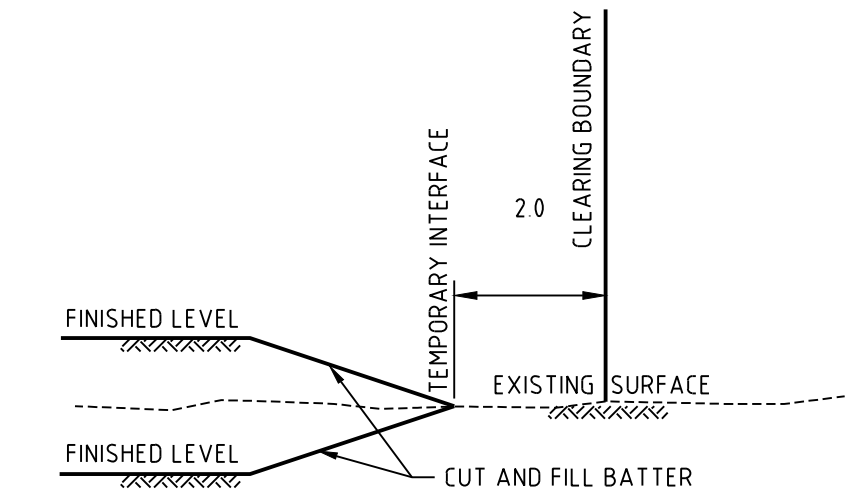
**PROPOSED BOXOUT AND BATTER DETAIL FOR FUTURE RETAINING WALLS**  
SCALE: N.T.S.



**TYPICAL CUT SECTION FOR LOTS IN LIMESTONE AREAS**  
SCALE: N.T.S.



**TYPICAL FILL SECTION FOR LOTS IN SAND AREAS**  
SCALE: N.T.S.



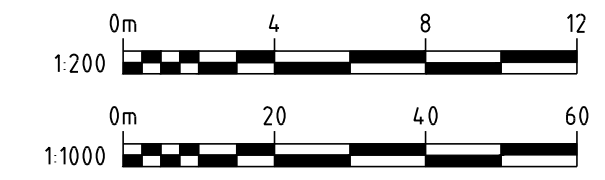
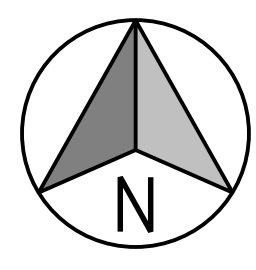
**TEMPORARY EARTHWORKS INTERFACE**  
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**WARNING TO CONTRACTOR UXO**  
THE SITE IS IDENTIFIED AS HAVING RISK OF UNEXPLODED ORDNANCE.  
  
"NO EXCAVATION OR OTHER DISTURBANCE OF THE SOIL ON THIS SITE SHOULD BE CARRIED OUT WITHOUT FIRST OBTAINING CLEARANCE FROM THE UNEXPLODED ORDNANCE BRANCH OF THE W.A. POLICE DEPARTMENT."

**NOTICE TO CONTRACTOR**  
IT IS THE CONTRACTORS RESPONSIBILITY TO INVESTIGATE THE NATURE AND LOCATION OF ALL SERVICES WHICH MAY BE ENCOUNTERED AND TO CONSULT WITH THE RELEVANT SERVICE AUTHORITIES PRIOR TO COMMENCEMENT OF EXCAVATIONS. FAILURE TO DO SO OR TO TAKE DUE CARE SHALL NOT LIMIT THE CONTRACTORS LIABILITY FOR REPAIR OF ALL SERVICES DAMAGED BY HIM DURING CONSTRUCTION WORKS. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY FOR THE PROTECTION OF ALL EXISTING SERVICES.

P:\6037 Tamala Park\Stage Beach Access Road\Acad\6037-BAR-200.dwg, 21/09/2020 11:41:41 PM, johne, Digital Signing PDF, p3, 1.1 - CIV References

C	21/09/20	JAE		NB	ISSUED FOR APPROVAL
B	10/06/20	JAE	TBL	N BUTSON	ISSUED FOR APPROVAL
A	18/03/20	JAE	TBL	N BUTSON	ISSUED FOR APPROVAL
REV	DATE	DRN	CKD	APP	AMENDMENT



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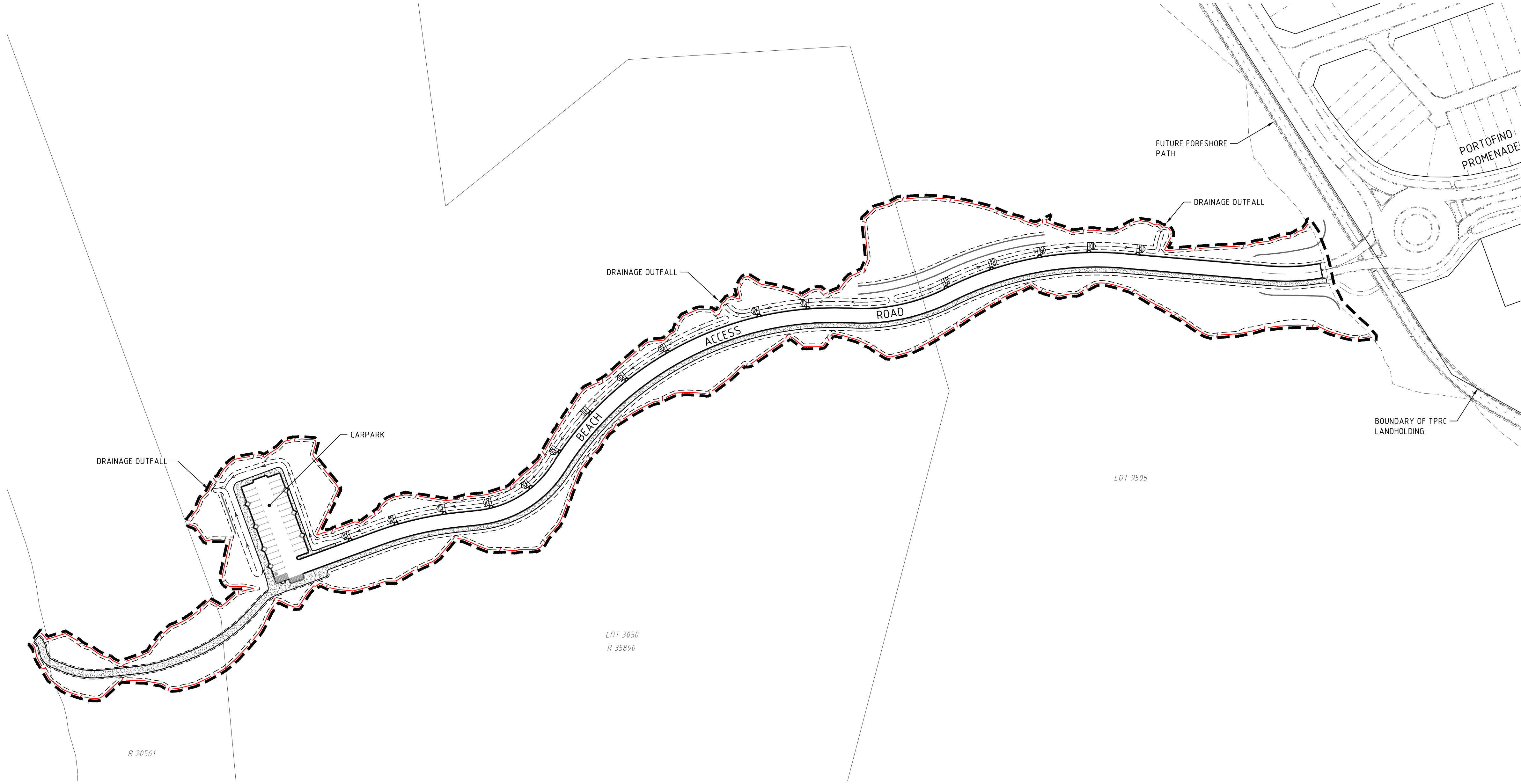
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**CLIENT**  
TAMALA PARK REGIONAL COUNCIL  
APPROVED: 19/03/20, DESIGNED: JAE  
NATHAN BUTSON

**PROJECT**  
CATALINA - BEACH ACCESS ROAD  
**TITLE**  
EARTHWORKS SHEET 1 OF 1  
WAPC No., DRAWING No. 6037-BAR-200, REVISION C

ORIGINAL SIZE A1





LEGEND	
DESCRIPTION	SYMBOL
LIMIT OF WORKS BOUNDARY	--- --- --- ---
PROPOSED ROAD	—
EXISTING ROAD	- - - - -
FUTURE ROAD	· · · · ·
PROPOSED DRAINAGE PIPE	—
EXISTING DRAINAGE PIPE	- - - - -
FUTURE DRAINAGE PIPE	· · · · ·
PROPOSED DRAINAGE PIPE WITH JUNCTION PIT (JP), SIDE ENTRY PIT (SEP), GRATED PIT (GP) AND CIRCULAR GRATED PIT (GPI)	—●—
DRAINAGE PIT LABEL	* GR LINER LID LEVEL EXISTING FUTURE PIT TYPE PIT ID CHAINAGE OR CO-ORD
DRAINAGE PIT LID NOTATION	* PROVIDE TEMPORARY LID ● CONVERT EXISTING LID
UPSTREAM INVERT LEVEL	PROPOSED EXISTING FUTURE
PIPE DIAMETER / GRADE	U/S 20 50 U/S 20 50 U/S 20 50 300/100 0 300/100 0 300/100 0 50 0 50 0 50 0
DISTANCE BETWEEN PITS	D/S 20 00 D/S 20 00 D/S 20 00
DOWNSTREAM INVERT LEVEL	
TABLE DRAIN	→
PROPOSED CONCRETE PATH AND PRAM RAMP	—
PROPOSED KERB TRANSITION	MM
POST WITH STREET NAME PLATES	↓
CHEVRON BOARD	—
PROPOSED RETAINING WALL	—
EXISTING RETAINING WALL	—
FUTURE RETAINING WALL	—
1.2m HIGH RING LOCK FENCE	—

KERB TYPES	
DESCRIPTION	SYMBOL
MOUNTABLE KERB	MK
SPECIAL MOUNTABLE KERB	MK(S)
SEMI MOUNTABLE KERB	SMK
REINFORCED SEMI-MOUNTABLE KERB	SMK(R)
BARRIER KERB	BK
SPECIAL BARRIER KERB	BK(S)
FLUSH KERB	FK
REINFORCED FLUSH KERB	RFK
600mm CONCRETE RAMP	CR
1200mm CONCRETE RAMP	12CR

PAVEMENT DETAILS			
SYMBOL	TYPE	ELEMENT	THICKNESS (mm)
[Pattern]	EXISTING	N/A	N/A
[Blank]	BLACK ASPHALT	LIMESTONE SUB-BASE	200
[Blank]		HIGH FATIGUE RESISTANT BASE COURSE ASPHALT	40
[Blank]		FINAL COURSE ASPHALT	25

**STANDARD NOTES**

- ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE SPECIFICATION AND REQUIREMENTS OF THE LOCAL AUTHORITY.
- THE CONTRACTOR SHALL LIAISE WITH ALL PUBLIC UTILITIES PRIOR TO COMMENCING WORK TO LOCATE ALL SERVICES WITHIN THE CONTRACT SITE.
- ALL LEVELS SHALL BE LOCATED FROM ESTABLISHED BENCHMARKS AS ESTABLISHED BY THE PROJECT SURVEYOR.
- ALL CONNECTIONS TO EXISTING WORK SHALL BE SMOOTH AND OF NEAT APPEARANCE.
- REFER INTERSECTION DETAIL DRAWINGS FOR CORNER RADII AT INTERSECTIONS AND CUL-DE-SACS.
- ALL KERBING TO BE MOUNTABLE TYPE UNLESS NOTED OTHERWISE.
- TRANSITION BETWEEN DIFFERENT KERB TYPES SHALL BE MADE OVER A LENGTH OF 2m.
- WHERE POSSIBLE, STREET SIGNS TO BE STRAPPED TO STREET LIGHT POLES.
- ALL CUTS THROUGH LIMESTONE SHALL BE EXCAVATED TO A DEPTH OF 100mm BELOW SUB-GRADE LEVEL AND 200mm BELOW THE FINISHED LEVEL OF VERGES.
- STORMWATER PIPES SHALL BE REINFORCED CONCRETE (CLASS 2) R R J UNLESS NOTED OTHERWISE.
- DRAINAGE PIPES TO BE INSTALLED IN ACCORDANCE WITH AS3725. CONTRACTOR TO CONSIDER GROUND CONDITIONS, HAUNCHING, TRENCH CONDITIONS, LOAD PARAMETERS AND COMPACTION METHODS TO ENSURE INTEGRITY OF PIPE.
- MANHOLES AND SIDE ENTRY PITS SHALL BE LOCATED IN POSITIONS SHOWN IRRESPECTIVE OF THE INDICATED PIPE LENGTHS AND WHERE APPLICABLE THE PITS SHALL BE LOCATED AT THE ACTUAL LOW POINT.
- MINIMUM COVER TO DRAINAGE PIPES TO BE 600mm UNLESS NOTED OTHERWISE. CLEARANCE WITH ALL OTHER SERVICES TO BE 150mm. CONTRACTOR TO ADVISE OF ANY DISCREPANCIES.
- WHERE A SEWER LINE INTERSECTS WITH A STORMWATER DRAINAGE LINE AND THE SEWER PASSES OVER THE DRAIN THEN THE SEWER SHALL HAVE A TIMBER PILE AND KEEL PROVIDED FOR THE FULL EXTENT NECESSARY TO SUPPORT THE SEWER DURING EXCAVATION FOR THE DRAIN.
- THE ROADWORKS AND DRAINAGE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE SEWERAGE RETICULATION PLAN(S) AND THE STANDARD DRAWING(S).
- STORMWATER ACCESS CHAMBER LIDS IN VERGES ARE TO BE SET TO MATCH VERGE CROSSFALLS AND LEVELS.

**STAGE NOTES**

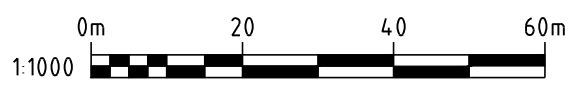
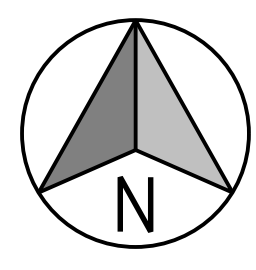
- LOCAL AUTHORITY - CITY OF WANNEROO
- PROJECT SURVEYOR - MNG
- LANDSCAPE ARCHITECT - PLAN E
- REFERENCE DRAWINGS:  
 ROADWORKS AND STORMWATER DRAINAGE 6037-BAR-610  
 CARPARK DETAILS 6037-BAR-620  
 ROAD LONGITUDINAL SECTIONS 6037-BAR-650  
 ROAD AND STORMWATER DRAINAGE DETAILS 6037-BAR-660

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 "NO EXCAVATION OR OTHER DISTURBANCE OF THE SOIL ON THIS SITE SHOULD BE CARRIED OUT WITHOUT FIRST OBTAINING CLEARANCE FROM THE UNEXPLODED ORDNANCE BRANCH OF THE W.A. POLICE DEPARTMENT."

P:\6037 Tamala Park\Stage 2\Access Road\Access\6037-BAR-600.dwg, 21/09/2020 1:41:56 PM, John, Digital Signing PDF, p3, 1.1 - CIV Reference

C	21/09/20	JAE		NB	ISSUED FOR APPROVAL
B	10/06/20	JAE	TBL	N BUTSON	ISSUED FOR APPROVAL
A	09/04/20	JAE	TBL	N BUTSON	ISSUED FOR APPROVAL
REV	DATE	DRN	CKD	APP	AMENDMENT



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**CLIENT**  
 TAMALA PARK REGIONAL COUNCIL

APPROVED: 09/04/20  
 DESIGNED: JAE  
 NATHAN BUTSON

SCALE: 1:1000

**PROJECT**  
 CATALINA - BEACH ACCESS ROAD

**TITLE**  
 ROADWORKS GENERAL ARRANGEMENT  
 SHEET 1 OF 1

WAPC No: -  
 DRAWING No: 6037-BAR-600  
 REVISION: C

**ORIGINAL SIZE A1**



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## **Appendix 2      Flora and vegetation report (Bennett Environmental Consulting 2016)**

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## Botanical Assessment of Proposed Access Roads from Catalina to the Beach

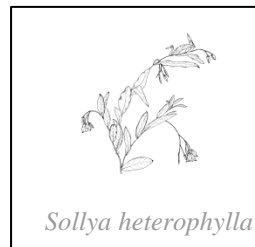


**Prepared for:**

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**Prepared by:**

Bennett Environmental Consulting Pty Ltd



PO Box 341  
KALAMUNDA 6926  
November 2016

## **STATEMENT OF LIMITATIONS**

### **Scope of Services**

This report (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Eleanor Bennett (“the Author”). In some circumstances a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services.

### **Reliance on Data**

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report (“the data”). Except as otherwise stated in the report, the Author has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (“conclusions”) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

### **Environmental Conclusions**

In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

### **Report for Benefit of Client**

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## SUMMARY

Bennett Environmental Consulting Pty Ltd undertook a Level 2 botanical survey of two proposed access roads from the new development at Catalina through remnant bushland to the beach. Some sections of the proposed roads were common, namely the eastern end where it commences at the edge of the housing development and the western end where there is a car park proposed. It is proposed to make a hard surface road with a car park close to the beach where it bifurcates the southern survey area was through remnant bushland and the northern section was along a current off road track.

Four different vegetation units recorded from the survey area. These were:

1. Open Heath of *Melaleuca cardiophylla* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Herbland dominated by *\*Raphanus raphanistrum*, *\*Crassula glomerata* and *\*Petrohragia dubia* over Sedgeland dominated by *Lomandra maritima* and *Desmocladius flexuosus*;
2. Tall Open Scrub of *Acacia rostellifera* and *Spyridium globulosum* over Low Shrubland of *Melaleuca systena* over Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *\*Lysimachia arvensis* over Very Open Sedgeland of *Lomandra maritima* and *Desmocladius flexuosus*;
3. Shrubland of *Acacia rostellifera* over Low Shrubland dominated by *Rhagodia baccata* subsp. *dioica* and *Scaevola crassifolia* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *Acanthocarpus preissii*, *\*Crassula glomerata* and *\*Trachyandra divaricata* over Sedgeland of *Lepidosperma gladiatum*; and
4. Low Open Shrubland of *Olearia axillaris*, *Scaevola crassifolia*, *\*Pelargonium capitatum* and *Rhagodia baccata* subsp. *dioica* over Grassland dominated by *Spinifex longifolius* over Very Open Herbland dominated by *\*Trachyandra divaricata*.

The vegetation condition varied between very good and good except along the track where it was degraded. Weeds were common throughout the remnant bushland but were very dense only along the edges of the track.

A total of 31 vascular plant families, 58 genera and 68 taxa were recorded during the survey, of which 26 taxa were weeds. None of the species were threatened or priority species and none of the weeds were listed as Declared Plants.

Recommendations were made on the construction of the tracks, the hard stand near the beach, rehabilitation due to site works associated with this construction and closure and rehabilitation of other off road tracks through the area. It is important that endemic species relevant to each vegetation unit be planted, in particular *Spinifex longifolius* and *Spinifex hirsutus* in preference to Marram Grass close to the strand line and in the foredunes.

# 1. INTRODUCTION

## 1.1 Background

Bennett Environmental Consulting Pty Ltd was commissioned by Coterra Environment to undertake a Level 2 assessment of two alternate routes proposed for a hard surfaced road from the new extension of the Catalina housing development to the beach. The development at Catalina commenced in 2012 and a new section is currently being prepared for additional housing.



**Diagram 1. Study area outlined in red/white lines. The white area indicates current tracks and the red line at the top right hand corner is where the current expansion will terminate.**

Both of the tracks in Diagram 1 end in a rectangular area where it is proposed to construct a car park.

The survey area is included in the conservation area known as Tamala Park and managed by the Western Australian Planning Commission. The narrow coastal section is included in Bush Forever Site Number 322 – Burns Beach Bushland (Government of Western Australia, 2000). The Tamala Park Regional Council (2016) was formed in 2006 specifically to implement the urban development of the Tamala Park Project, marketed as Catalina. As part of environmental offsets, the Tamala Park Regional Council transferred 91 hectares of land, adjoining the foreshore reserve, to the Western Australian Planning Commission to form part of the future Coastal reserve from Burns Beach to Mindarie. This offset includes the study area.

## 1.2 Scope of Works

The requirements for this project were to:

- i. Undertake a Level 2 vegetation survey (Environmental Protection Authority and Department of Parks and Wildlife, 2015) of the proposed roads and the car parking area as indicated in Diagram 2; and
- ii. Search for threatened or priority flora within the proposed development areas.

## 2. BACKGROUND INFORMATION

### 2.1 Geology and Landform

The site is included in the Quindalup unit which consists of calcareous sands occurring as beach ridges and parabolic dunes. A detailed description of the soils and landforms was undertaken for the coastal area Mindarie to Quinns Rocks (Ecoscape Australia Pty. Ltd, 2004). A typical transect from west to east through the dune system included fore dunes gradually rising to higher primary and secondary dunes further away from the coast.

Although the current study area was not included in this detailed dune analysis some soil units can be inferred. Diagram 2 is a section of this study showing Mindarie which is just north of the survey area and the dune system recorded there.

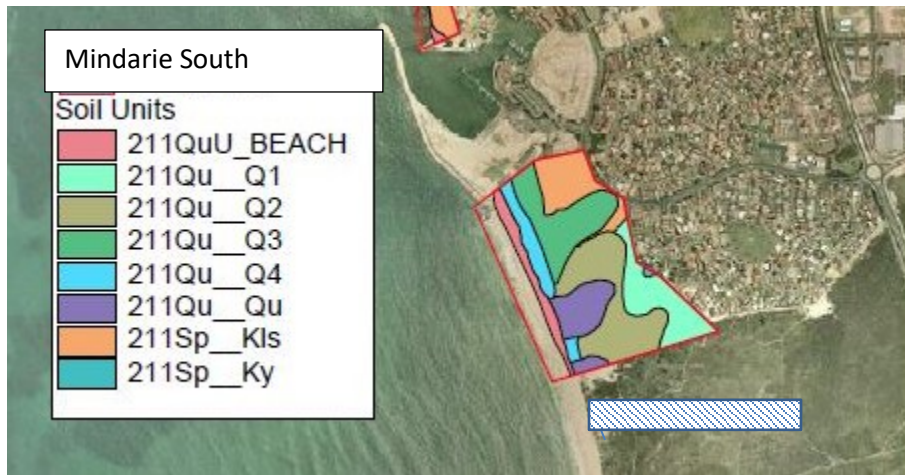


Diagram 2. Soils and Landforms described for Mindarie South including the cross hatched current study area.

From Diagram 2 it can be inferred that the current study area includes following the soil units: which are described as:

211QuU\_Beach = Beach;

211Qu\_Qu = Presently unstable sand;

211Qu\_Q4 = the youngest Quindalup phase of irregular dunes with slopes up to 20%, consisting of loose pale brown sand with no soil profile development;

211Qu\_Q2 = the second Quindalup phase consisting of a complex pattern of dunes with moderate relief. These sands have organic staining to a depth of about 20cm, passing into pale brown sand with some cementation below 1m;

211Qu\_Q1 = the oldest Quindalup phase of dunes or remnants with low relief, consisting of calcareous soils with organic staining to 30cm, overlying pale brown sand with definite cementation below 1m.

### 2.2 Vegetation

The Interim Biogeographical Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) recognizes 85 bioregions. The IBRA is used as the common unit to compare biological and biophysical attributes. Bioregions represent a landscape-based approach to classifying the land surface and each region is defined by a set of major environmental influences, which shape the occurrence of flora and fauna and their interaction with the physical environment. The site occurs in the Swan Coastal Plain, which has been subdivided into the northern section and the southern section. The study area is located in the southern section, abbreviated SWA2 (Mitchell, Williams and Desmond, 2002).

Prior to the above classification Beard (1981) classified the vegetation of Western Australia. Western Australia was divided into three main Botanical Provinces, Southwest, Eremaean and Northern. The



survey area occurs in the Southwest Botanical Province Beard (1990). Beard (1981) described the vegetation of the site as Coastal Heath and Thicket.

Heddlé *et al.* (1980) described the vegetation complexes of the Darling System at a scale of 1:250 000. There was found to be a distinct pattern of plant distribution linked to landforms, soils and climate. The most obvious trend was associated with increasing aridity from west to east on the Darling Plateau. The vegetation changes observed were a decrease in height and percentage cover of the tallest stratum and a distinct change in floristics. The site occurs within the Quindalup Vegetation Complex which is restricted to the coastal dunes. The Quindalup Complex consists of two alliances - the strand and fore dune alliance and the mobile and stable dune alliance. The vegetation differs in the species composition from one area to another because of differences in the dune environment due to edaphic and topographical factors and shelter from salt laden winds.

Bush Forever (Government of Western Australia, 2000) states that 48% of the Quindalup Complex remained vegetated within the Swan Coastal Plain in 2000. The area proposed for protection is 20%.

### 2.3 Threatened Ecological Communities

An ecological community is a naturally occurring biological assemblage that occurs in a particular type of habitat. A Threatened Ecological Community is one which falls into one of the following categories, presumed totally destroyed, critically endangered, endangered or vulnerable (Department of Parks and Wildlife, 2016b).

A restricted ecological community which does not meet the criteria for a Threatened Ecological Community is added to the Priority Ecological Community List. Priorities 1, 2, and 3 are adequately known but are not currently believed to be threatened. Those that have recently been removed from the threatened list are listed as Priority 4. Conservation dependent ecological communities are placed in Priority 5.

The Department of Parks and Wildlife (2016b) lists Threatened and Priority Ecological Communities recorded for Western Australia but none were listed as occurring in the study area.

### 2.4 Significant Flora

Prior to undertaking the field work a search was undertaken of NatureMap (Department of Parks and Wildlife, 2016d) for a 5 km buffer from the centre at 115° 42' 26" E, 31° 42' 06"S. This search resulted in the species listed in Table 2.

**Table 1. Code and description of Threatened and Priority Flora (Government Gazette of WA (2015) with the threatened species split into their IUCN (2015) categories**

Code	Declared Rare and Priority Flora Categories
T	T (Threatened) -Extant Taxa. Taxa, which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection. This category is further subdivided: CE: Flora that are considered likely to become extinct or rare, as critically endangered flora. E: Flora that are considered likely to become extinct or rare, as endangered flora. V: Flora that are considered likely to become extinct or rare, as vulnerable flora.
X	DRF (Declared Rare Flora) -Presumed Extinct Taxa. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
1	Priority One -Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
2	Priority Two -Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3	Priority Three -Poorly Known Taxa. Taxa, which are known from several populations, at least some of which are not believed to be under immediate threat.
4	Priority Four -Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

Table 1 presents the definitions of Declared Rare and the four Priority Flora ratings under the Wildlife Conservation Act (1950) as extracted from Government Gazette of WA (2015).

**Table 2. Threatened and Priority Flora Species List recorded in the selected area with W.A. Government Gazette Threatened Flora code and categories and Priority Flora code and categories listed by the Department of Parks and Wildlife (2016a). Description extracted from FloraBase (Western Australian Herbarium, 2016)**

Taxon	Code	Description
<b>Threatened Flora</b>		
<i>Eucalyptus argutifolia</i>	V	(Mallee), 1.5-4 m high, bark smooth. Fl. white, Mar to Apr. Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops.
<i>Marianthus paralius</i>	CE	Almost prostrate, eventually scandent, woody shrub. Fl. red, Sep to Nov. White sand over limestone. Low coastal cliffs.
<b>Priority Flora</b>		
<i>Acacia benthamii</i>	P2	Shrub, ca 1 m high. Fl. yellow, Aug to Sep. Sand. Typically on limestone breakaways.
<i>Fabronia hampeana</i>	P2	Moss commonly on <i>Macrozamia riedlei</i> trunks.
<i>Lecania turicensis</i> var. <i>turicensis</i>	P2	Lichen
<i>Tetrasia</i> sp. Chandala (G.J. Keighery 17055)	P2	No description provided.
<i>Conostylis bracteata</i>	P3	Rhizomatous, tufted or shortly proliferous perennial, grass-like or herb, 0.2-0.45 m high. Fl. yellow, Aug to Sep. Sand, limestone. Consolidated sand dunes.
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	P3	Erect or spreading shrub, 0.2-0.5 m high. Fl. yellow, Jul to Oct. Sand. Near-coastal limestone ridges, outcrops & cliffs.
<i>Jacksonia gracillima</i>	P3	No description provided.
<i>Pimelea calcicola</i>	P3	Erect to spreading shrub, 0.2-1 m high. Fl. pink, Sep to Nov. Sand. Coastal limestone ridges.
<i>Sarcozona bicarinata</i>	P3	Shrub, ca 0.1 m high. Fl. white, Aug. White sand.
<i>Jacksonia sericea</i>	P4	Low spreading shrub, to 0.6 m high. Fl. orange, usually Dec or Jan to Feb. Calcareous & sandy soils.

### 3. METHOD

The site was surveyed using the method set out in the Environmental Protection Authority and Department of Parks and Wildlife (2016). The two proposed roads were walked to ensure a record was made of each vegetation unit, their associated species and any additional species (opportunistic species) recorded outside of the quadrat but within the same vegetation unit. Where a vegetation unit was recorded a temporary 10m x 10m quadrat was set up using a compass and oriented due N,S,E,W. Quadrats were placed to record the variation in the vegetation and associated species. The location of the quadrats is shown in Appendix D Map 1. All species, including weeds were recorded. The vegetation, flora, Threatened and Priority Flora surveys were conducted concurrently. For each quadrat, the following were recorded in the field:

- GPS reading (WGS84, equivalent to Geocentric Datum of Australia 1994 (GDA94)) at NW corner;
- Digital photograph taken at the NW corner;
- Soil type;
- Presence, size and type of any outcropping rocks;
- Topography – eg. ridge, upper slope, middle slope, lower slope, drainage line, minor creek, major creek, wetland;
- Vegetation condition using the scale of Keighery (1994) outlined in Table 5;
- Presence of any Threatened or Priority Flora or other significant flora;
- Additional information including dieback, age since fire, predators, erosion, weeds, grazing, tracks etc.; and
- All species were listed together with their percentage cover within the quadrat and average height.



The area outside of each quadrat was also surveyed to record additional (opportunistic) species for that vegetation unit.

The vegetation units recorded at the site are described using the vegetation classification in Bush Forever (from Government of Western Australia, 2000) as described in Table 3 and the vegetation condition (from Keighery, 1994) as in Table. 4.

**Table 3. Vegetation Classification (from Government of Western Australia, 2000)**

LIFE FORM / HEIGHT CLASS	Canopy Cover			
	DENSE 70 % - 100%	MID DENSE 30% - 70%	SPARSE 10% - 30%	VERY SPARSE 2% - 10%
Trees over 30 m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10 – 30 m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2 m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1 – 2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

**Table 4. Explanation of Vegetation Condition Rating (Keighery, 1994)**

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

#### 4. RESULTS

A botanical survey was undertaken on 17<sup>th</sup> November 2016 when transects were walked within the proposed roads. Prior to undertaking the field work an overlay on an aerial photograph of the track options was provided on the aerial of the site together with the easting and northing. To ensure the transects walked and the quadrats established were within the proposed development areas, way points were entered into the GPS to be used in the field. This enabled walking from one of the way points to the next ensuring that the transects walked were within the proposed area of disturbance.

By referring to Diagram 1 it can be seen that there is one road nominated from the current development site for a distance before it bifurcates, resulting in two possible road alignments which remain separated but both lead to the same larger area proposed as a car park

A total of four quadrats were surveyed. The locations of these are mapped in Appendix D Map 1, and a full description for each quadrat is provided in Appendix B.

#### 4.1 Vegetation

There were four different vegetation units recorded from the survey area. These were:

1. Open Heath of *Melaleuca cardiophylla* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Herbland dominated by *\*Raphanus raphanistrum*, *\*Crassula glomerata* and *\*Petrohragia dubia* over Sedgeland dominated by *Lomandra maritima* and *Desmocladius flexuosus*. This was represented by quadrat caq1;
2. Tall Open Scrub of *Acacia rostellifera* and *Spyridium globulosum* over Low Shrubland of *Melaleuca systena* over Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *\*Lysimachia arvensis* over Very Open Sedgeland of *Lomandra maritima* and *Desmocladius flexuosus*. This was represented by quadrat caq2;
3. Shrubland of *Acacia rostellifera* over Low Shrubland dominated by *Rhagodia baccata* subsp. *dioica* and *Scaevola crassifolia* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *Acanthocarpus preissii*, *\*Crassula glomerata* and *\*Trachyandra divaricata* over Sedgeland of *Lepidosperma gladiatum*. This was represented by quadrat caq3; and
4. Low Open Shrubland of *Olearia axillaris*, *Scaevola crassifolia*, *\*Pelargonium capitatum* and *Rhagodia baccata* subsp. *dioica* over Grassland dominated by *Spinifex longifolius* over Very Open Herbland dominated by *\*Trachyandra divaricata*. This was represented by quadrat caq4.

The vegetation units are mapped in Appendix D, Map 2. The vegetation changed from the east (quadrat caq1), then further west to quadrat caq2, then quadrat caq3 and near the beach to quadrat caq4. This change was gradual with an overlap of some species. Just above the strand line there was an area up to 5m wide where Marram Grass (*\*Ammophila arenaria*) was established in amongst the endemic grass *Spinifex longifolius*. The Marram Grass plants were all relatively young so it was uncertain if they had been planted or if rhizomes had come down on the current from Mindarie. Marram Grass has been used a lot to stabilize dunes but it is a weed which has the ability to change the ecosystem of the dunes it invades.

#### 4.2 Vegetation Condition

Bushland has been historically subject to ongoing degradation and is especially susceptible to disturbances arising as a result of indirect impacts from surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation, edge effects, weed invasion, plant diseases, changes in fire frequency, landscape fragmentation, increased predation on native fauna by feral animals, decrease in species richness and general modification of ecological function. These issues affect the biodiversity rating and ecological viability of areas of remnant vegetation and should be assessed in line with conservation values.

Vegetation condition was rated according to the vegetation condition scale used in Keighery (1994). Table 4 provides the vegetation condition rating and Table 5 the vegetation condition of each of the quadrats.

**Table 5. Vegetation Condition Recorded from the quadrats surveyed**

Vegetation Condition	Quadrat Number
Very good	caq3
Very good to good	caq1, caq4
Good	caq2
Good to degraded	Some sections in the area of caq4
Degraded	Track through part of northern route

It can be seen from Table 5 that most of the vegetation was in good or better condition. The only area which was degraded was the along the off road vehicle track. The vegetation condition is mapped in Appendix D Map 3.

#### 4.3 Taxa

A total of 31 vascular plant families, 58 genera and 68 taxa were recorded during the survey. All species observed are listed under vascular plant families in Appendix A.

#### 4.4 Significant Taxa

No threatened or priority species were located during the survey.

#### 4.5 Weeds

A total of 26 weeds were recorded from the survey area. All have been determined as weeds by the Western Australian Herbarium (2016) and Department of Parks and Wildlife (2016c). There are several ratings allocated to each weed in the Invasive Plant Prioritisation but only three have been selected to include in this report. These are ecological impacts, invasiveness and current distribution which are shown in Table 8 for each of the non-endemic species recorded. Thirteen of the weeds recorded have a high ecological impact on the natural vegetation.

Weeds that are, or may, become, a problem to agriculture or the environment can be formally classified as Declared Plants under the *Agriculture and Related Resources Protection Act, 1976* (Department of Agriculture and Food, 2016). The Department of Agriculture and Food Western Australia and the Agriculture Protection Board maintain a list of Declared Plants for Western Australia. None of the weeds listed in Table 6 are Declared Plants.

**Table 6. Weeds Recorded From the Site**

Species	Common Name	Ecological Impacts	Invasiveness	Current Distribution
		Ecological impact L = low impact species M = medium impact species H=high impact species U = unknown impact	Rate of dispersal R=rapid M=moderate S=slow U=unknown	L = limited (localised) M = moderate H = high E = extensive (widespread) U =unknown
* <i>Ammophila arenaria</i>	Marram Grass	U	S	L
* <i>Avena barbata</i>	Bearded Grass	H	R	E
* <i>Briza maxima</i>	Blowfly Grass	U	R	E
* <i>Bromus diandrus</i>	Great Brome	H	R	E
* <i>Crassula glomerata</i>	Stonecrop	U	R	E
* <i>Cuscuta epithymum</i>	Lesser Dodder	M	M	E
* <i>Ehrharta calycina</i>	Perennial Veldt Grass	H	R	E
* <i>Ehrharta longiflora</i>	Annual Veldt Grass	H	R	E
* <i>Euphorbia terracina</i>	Geraldton Carnation Weed	H	R	H
* <i>Heliophila pusilla</i>	Heliophila	H	M	H
* <i>Hordeum leporinum</i>	Barley Grass	H	U	E
* <i>Lactuca serriola</i>	Prickly Lettuce	H	R	H
* <i>Lagurus ovatus</i>	Hare's Tail Grass	H	R	E
* <i>Lolium loliaceum</i>	Stiff Rye Grass	H	R	E
* <i>Lysimachia arvensis</i>	Pimpernel	U	R	E
* <i>Oenothera glazioviana</i>	Evening Primrose	L	M	H
* <i>Pelargonium capitatum</i>	Rose Pelargonium	H	R	E
* <i>Petrorhagia dubia</i>	Velvet Pink	M	R	E
* <i>Raphanus raphanistrum</i>	Wild Radish	U	M	M
* <i>Romulea rosea</i>	Guildford Grass	U	R	E
* <i>Silene gallica</i>	French Catchfly	L	M	E
* <i>Sonchus oleraceus</i>	Common Sowthistle	U	R	E
* <i>Tetragona decumbens</i>	Sea Spinach	H	R	E
* <i>Trachyandra divaricata</i>	Dune Onion Weed	M	R	H
* <i>Urospermum picroides</i>	False Hawkbit	M	R	M
* <i>Vulpia myuros</i>	Rat's Tail Fescue	H	R	H

Thirteen of the weeds listed above are recorded as having a high impact on the environment. The most common weeds listed as having a high impact throughout the site were *\*Avena barbata*, *\*Ehrharta longiflora*, *\*Euphorbia terracina*, *\*Lagurus ovatus* and *\*Pelargonium capitatum*.

#### 4.6 Rehabilitation

With the planned development of an access road rehabilitation and weed control will need to be undertaken. It is essential that all species used in rehabilitation are endemic to the particular vegetation unit. Appendix C lists all endemic species together with the quadrat they were recorded. By referring back to Section 4.1 the vegetation unit associated with each quadrat can be determined.

Four species were recorded from all vegetation units; *Acacia cyclops*, *Acanthocarpus preissii*, *\*Olearia axillaris* and *Spyridium globulosum*. Seed collection should commence immediately and seedlings established before any site works are undertaken. Cuttings especially of *Spinifex longifolius* and *Spinifex hirsutus* should be undertaken in the sections of the car park area proposed for disturbance. The manual prepared by the Department of Planning (2011) provides excellent examples of how to propagate species. For example “the rooted cuttings of grasses (e.g. *Spinifex hirsutus* and *Spinifex longifolius*) that grow on the seaward slope of foredunes have given good results. The roots used for cuttings must be healthy and either yellowish or white in colour and the transplant site should be well moistened”. Successes have been achieved by the methods they outline and *Spinifex* plants must be used along the strand line and foredune in preference to Marram Grass.

Marram Grass has been used a lot to stabilize dunes as it is adapted to sand accretion with the burial promoting leaf elongation and the development of rhizomes from the axillary buds. Florabase (Western Australian Herbarium, 2016) includes a comprehensive description about this species its general biology, notes and general control. In the notes section the following information is provided. “It traps sand and builds dunes at rates much greater than that of the native species, thus out competing the native species. It interferes with the natural dynamics of the dune systems. It out-competes native vegetation and interferes with the natural dynamics of dune systems, including changing topography, adversely affecting long term development of coastal barriers, inhibits transgressive dune development, increases steepness of slopes and restricts movement of sand from beach to interior dunes. Also disrupts structure and reduces diversity of dunal arthropod communities. Harbours symbiotic nitrogen-fixing bacteria within stems and rhizomes that may contribute to its proliferation on nutrient-poor sand. Seed set, viability and survival is low, however viability of buds remains high following submergence in seawater, giving the potential for long-distance vegetative dispersal to other beaches.”

The above information exemplifies why *Spinifex longifolius* and *Spinifex hirsutus* root cuttings should be propagated and used in preference to Marram Grass.

Coastal Planning and Management Manual (Department of Planning, (2011) provides a lot of information including weeds and their management and the selection of species for rehabilitation. In addition it outlines the different methods that can be used in rehabilitation including, direct seeding, use of nursery grown seedlings, seeds and required treatments to break dormancy, cuttings, division, layering as well as the different methods used for planting out. Planting and direct seeding must be undertaken with the onset of the winter rains.

#### 4.7 Management of the Tamala Park Region

Several committees have been established that deal with the management of the coastal area from Mindarie to Burns Beach. These include:

1. The Tamala Park Regional Council (TPRC) is a local government group formed in 2006 specifically to implement the urban development of the Tamala Park Project (marketed as Catalina) with representatives from Town of Cambridge, City of Joondalup, City of Perth, City of Stirling, Town of Victoria Park, City of Vincent and City of Wanneroo. They manage the development of the Tamala Park Local Structure Plan covering residential density and associated requirements.

2. The Community Advisory Committee (set up in 2008 with representatives from the City of Wanneroo and City of Joondalup) was formed to produce a plan for the long term environmental management of the area between Burns Beach and Mindarie. This committee developed the Tamala Conservation Park plan, and includes members from a wide cross section of State and Local Government Agencies and community organisations. One of the many initiatives suggested by the committee is “that funding for comprehensive weed mapping and flora and fauna surveys be provided as a matter of priority for interim management of the area” – which is endorsed by author of tis current survey.
3. In March 2012 a Tamala Conservation Park was proposed and an establishment plan prepared (Western Australian Planning Commission, 2012). The area under consideration is outlined below in Diagram 3 and it can be seen that it includes the current survey area. This was proposed to be managed by the Department of Environment and Conservation (now Department of Parks and Wildlife). The Establishment Plan did not include a timetable for creation of the Conservation Park as it is understand that part of the land covered remains in private ownership. The Tamala Conservation Park has three broad zones of usage, conservation and protection, natural environmental use and recreational use (Western Australian Planning Commission, 2012). With conservation and protection the primary management concern is to ensure no further disturbance to the bushland ensuring that public access is restricted and only via walk paths. Access to the beach has been poorly managed with off road vehicle tracks crossing the bushland.



**Diagram 3. Area outlined in red proposed as Tamala Conservation Park.**

## 5. DISCUSSION

The proposed access roads were through remnant bushland with a section of the northern alternative route along an existing off road track. Four different vegetation units were recorded from the survey area. These were:



- 1 Open Heath of *Melaleuca cardiophylla* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Herbland dominated by *\*Raphanus raphanistrum*, *\*Crassula glomerata* and *\*Petrorhagia dubia* over Sedgeland dominated by *Lomandra maritima* and *Desmocladius flexuosus*;
- 2 Tall Open Scrub of *Acacia rostellifera* and *Spyridium globulosum* over Low Shrubland of *Melaleuca systena* over Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *\*Lysimachia arvensis* over Very Open Sedgeland of *Lomandra maritima* and *Desmocladius flexuosus*;
- 3 Shrubland of *Acacia rostellifera* over Low Shrubland dominated by *Rhagodia baccata* subsp. *dioica* and *Scaevola crassifolia* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *Acanthocarpus preissii*, *\*Crassula glomerata* and *\*Trachyandra divaricata* over Sedgeland of *Lepidosperma gladiatum*; and
4. Low Open Shrubland of *Olearia axillaris*, *Scaevola crassifolia*, *\*Pelargonium capitatum* and *Rhagodia baccata* subsp. *dioica* over Grassland dominated by *Spinifex longifolius* over Very Open Herbland dominated by *\*Trachyandra divaricata*.

The vegetation condition varied between very good and good except along the track where it was degraded. Weeds were common throughout the remnant bushland but were very dense along the edges of the track.

A total of 31 vascular plant families, 58 genera and 68 taxa were recorded during the survey, of which 26 taxa were weeds. None of the species were threatened or priority species and none of the weeds were listed as Declared Plants.

Marram grass (*\*Ammophila arenaria*) was established in amongst *Spinifex longifolius* plants above the strand. The Marram plants were all relatively young so it was uncertain if they had been planted or if they had established from rhizomes which had come down on the current from Mindarie.



**Photograph of Marram Grass established above the strand line.**

It is important that native species in particular *Spinifex longifolius* and *Spinifex hirsutus* be planted in preference to Marram Grass close to the strand line and in the foredunes.



It is suggested that the northern route be the one selected as some sections of this route are already degraded. The car park area should be fenced off to ensure off road drivers do not continue across the dunes and onto the beach. A fenced off sand track path should be constructed down to the beach from the car park.

The sides of the selected road must be stabilised as both routes traverse steep sided dunes, although this is not such a concern on the northern route as a track has already cut through a section of the area. In some sections the sand may need to have a wall constructed otherwise erosion will cause the sides to collapse and cover the road which could make it impassable. The environment must be conserved. This includes the dune system as well as the vegetation. People must be discouraged from walking through the dunes as this will most likely result in the destruction of some area.

The Community Advisory Committee (set up in 2008 with representatives from the City of Wanneroo and City of Joondalup) recommended that there be fenced, hard stand access from Long Beach Promenade through the reserve to the beach but with no hard stand access through to the beach. Public access to the beach must be managed to protect the environmental values of the area.

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**APPENDIX A**  
**Species List**

**LEGEND**

<b>ABBREVIATION</b>	<b>DESCRIPTION</b>
subsp.	subspecies
var.	variety
*	weed

<b>Vascular Plant Family</b>	<b>Taxon</b>
<b>Aizoaceae</b>	
	<i>Carpobrotus virescens</i>
	* <i>Tetragonia decumbens</i>
<b>Asparagaceae</b>	
	<i>Acanthocarpus preissii</i>
	<i>Lomandra maritima</i>
	<i>Thysanotus arenarius</i>
<b>Asphodelaceae</b>	
	* <i>Trachyandra divaricata</i>
<b>Asteraceae</b>	
	* <i>Lactuca serriola</i>
	<i>Olearia axillaris</i>
	<i>Ozothamnus cordatus</i>
	<i>Senecio pinnatifolius</i> var. <i>latilobus</i>
	* <i>Sonchus oleraceus</i>
	* <i>Urospermum picroides</i>
<b>Brassicaceae</b>	
	* <i>Heliophila pusilla</i>
	* <i>Raphanus raphanistrum</i>
<b>Caryophyllaceae</b>	
	* <i>Petrorhagia dubia</i>
	* <i>Silene gallica</i>
<b>Chenopodiaceae</b>	
	<i>Rhagodia baccata</i> subsp. <i>baccata</i>
	<i>Rhagodia baccata</i> subsp. <i>dioica</i>
	<i>Threlkeldia diffusa</i>
<b>Convolvulaceae</b>	
	* <i>Cuscuta epithymum</i>
<b>Crassulaceae</b>	
	<i>Crassula colorata</i>
	* <i>Crassula glomerata</i>
<b>Cyperaceae</b>	
	<i>Isolepis marginata</i>
	<i>Lepidosperma calcicola</i>
	<i>Lepidosperma gladiatum</i>
<b>Ericaceae</b>	
	<i>Leucopogon parviflorus</i>
<b>Euphorbiaceae</b>	
	* <i>Euphorbia terracina</i>
<b>Fabaceae</b>	
	<i>Acacia cyclops</i>
	<i>Acacia rostellifera</i>
	<i>Acacia saligna</i>
	<i>Gompholobium capitatum</i>
	<i>Hardenbergia comptoniana</i>
	<i>Kennedia prostrata</i>

<b>Vascular Plant Family</b>	<b>Taxon</b>
<b>Geraniaceae</b>	
	<i>*Pelargonium capitatum</i>
<b>Goodeniaceae</b>	
	<i>Scaevola crassifolia</i>
	<i>Scaevola globulifera</i>
<b>Haemodoraceae</b>	
	<i>Conostylis aculeata</i> subsp. <i>cygnorum</i>
	<i>Conostylis candicans</i>
<b>Hemerocallidaceae</b>	
	<i>Dianella revoluta</i> var. <i>divaricata</i>
<b>Iridaceae</b>	
	<i>*Romulea rosea</i>
<b>Lamiaceae</b>	
	<i>Hemiandra pungens</i>
<b>Lauraceae</b>	
	<i>Cassytha flava</i>
<b>Myrtaceae</b>	
	<i>Melaleuca cardiophylla</i>
	<i>Melaleuca systema</i>
<b>Onagraceae</b>	
	<i>*Oenothera glazioviana</i>
<b>Phyllanthaceae</b>	
	<i>Phyllanthus calycinus</i>
<b>Poaceae</b>	
	<i>*Ammophila arenaria</i>
	<i>Austrostipa flavescens</i>
	<i>*Avena barbata</i>
	<i>*Briza maxima</i>
	<i>*Bromus diandrus</i>
	<i>*Ehrharta calycina</i>
	<i>*Ehrharta longiflora</i>
	<i>*Hordeum leporinum</i>
	<i>*Lagurus ovatus</i>
	<i>*Lolium loliaceum</i>
	<i>Paspalum vaginatum</i>
	<i>Poa porphyroclados</i>
	<i>Spinifex hirsutus</i>
	<i>Spinifex longifolius</i>
	<i>*Vulpia myuros</i>
<b>Polygalaceae</b>	
	<i>Comesperma integerrimum</i>
<b>Primulaceae</b>	
	<i>*Lysimachia arvensis</i>
<b>Ranunculaceae</b>	
	<i>Clematis linearifolia</i>
<b>Restionaceae</b>	
	<i>Desmocladius flexuosus</i>

<b>Vascular Plant Family</b>	<b>Taxon</b>
<b>Rhamnaceae</b>	
	<i>Spyridium globulosum</i>
<b>Rubiaceae</b>	
	<i>Opercularia vaginata</i>
<b>Santalaceae</b>	
	<i>Exocarpos sparteus</i>



**APPENDIX B**

**Quadrat Data**

**LEGEND**

<b>ABBREVIATION</b>	<b>DESCRIPTION</b>
subsp.	subspecies
var.	variety
*	weed

**QUADRAT caq1****GPS (WGS84):** 377775E; 6492000N**Location:** Most eastern section of the proposed road**Topography:** Upper slope to crest of sand dune**Soil:** Grey sand**Litter:** Branches 10%; Leaves 20%**Vegetation Description:** Open Heath of *Melaleuca cardiophylla* over Very Open Grassland dominated by \**Ehrharta longiflora* over Herbland dominated by \**Raphanus raphanistrum*, \**Crassula glomerata* and \**Petrorhagia dubia* over Sedgeland dominated by *Lomandra maritima* and *Desmocladius flexuosus***Vegetation Condition:** Good to very good**Notes:** Numerous weeds

SPECIES	HEIGHT (cm)	% COVER
<i>Acacia cyclops</i>	70	1
<i>Acanthocarpus preissii</i>	30	2
<i>Austrostipa flavescens</i>	90	1
* <i>Avena barbata</i>	90	5
* <i>Bromus diandrus</i>	60	<1
<i>Conostylis aculeata</i> subsp. <i>cygnorum</i>	50	12
* <i>Crassula glomerata</i>	5	15

SPECIES	HEIGHT (cm)	% COVER
<i>Desmodcladus flexuosus</i>	50	10
<i>Dianella revoluta</i> subsp. <i>divaricata</i>	70	1
* <i>Ehrharta calycina</i>	90	2
* <i>Ehrharta longiflora</i>	80	20
* <i>Euphorbia terracina</i>	70	5
<i>Hardenbergia comptoniana</i>	twiner	<1
* <i>Lagurus ovatus</i>	30	2
<i>Leucopogon parviflorus</i>	60	1
* <i>Lolium loliaceum</i>	70	<1
<i>Lomandra maritima</i>	60	50
* <i>Lysimachia arvensis</i>	20	5
<i>Melaleuca cardiophylla</i>	200	50
* <i>Petrorhagia dubia</i>	60	15
<i>Phyllanthus calycinus</i>	50	2
* <i>Raphanus raphanistrum</i>	90	20
<i>Rhagodia baccata</i> subsp. <i>baccata</i>	50	2
* <i>Silene gallica</i>	60	10
* <i>Sonchus oleraceus</i>	50	1
<i>Spyridium globulosum</i>	200	5
* <i>Urospermum picroides</i>	60	3
<i>Acacia rostellifera</i>	opportunistic	
<i>Acacia saligna</i>	opportunistic	
<i>Clematis linearifolia</i>	opportunistic	
<i>Comesperma integerrimum</i>	opportunistic	
<i>Exocarpus sparteus</i>	opportunistic	
<i>Gompholobium capitatum</i>	opportunistic	
* <i>Hordeum leporinum</i>	opportunistic	
<i>Isolepis marginata</i>	opportunistic	
<i>Kennedia prostrata</i>	opportunistic	
<i>Lepidosperma calcicola</i>	opportunistic	
<i>Melaleuca systema</i>	opportunistic	
<i>Olearia axillaris</i>	opportunistic	
* <i>Pelargonium capitatum</i>	opportunistic	
<i>Thysanotus arenarius</i>	opportunistic	



**QUADRAT caq2****GPS (WGS84):** 377550E; 6491850E**Location:** Southern proposed track**Topography:** Middle slope**Soil:** Grey sand**Litter:** Branches 5%; Leaves 25%**Vegetation Description:** Tall Open Scrub of *Acacia rostellifera* and *Spyridium globulosum* over Low Shrubland of *Melaleuca systena* over Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *\*Lysimachia arvensis* over Very Open Sedgeland of *Lomandra maritima* and *Desmocladius flexuosus***Vegetation Condition:** Good**Notes:** Very occasional *Xanthorrhoea preissii* recorded opportunistically

SPECIES	HEIGHT (cm)	% COVER
<i>Acacia rostellifera</i>	300	15
<i>Austrostipa flavescens</i>	90	2
<i>*Briza maxima</i>	50	5
<i>Clematis linearifolia</i>	twiner	2
<i>Conostylis aculeata</i> subsp. <i>cygnorum</i>	30	1
<i>*Crassula glomerata</i>	10	5
<i>Desmocladius flexuosus</i>	40	5
<i>Dianella revoluta</i> subsp. <i>divaricata</i>	70	1

SPECIES	HEIGHT (cm)	% COVER
* <i>Ehrharta calycina</i>	80	5
* <i>Ehrharta longiflora</i>	60	10
* <i>Euphorbia terracina</i>	60	5
<i>Gompholobium capitatum</i>	30	<1
* <i>Lagurus ovatus</i>	50	<1
<i>Lepidosperma calcicola</i>	50	1
* <i>Lolium loliaceum</i>	90	<1
<i>Lomandra maritima</i>	50	5
* <i>Lysimachia arvensis</i>	30	15
<i>Melaleuca systema</i>	80	10
<i>Opercularia vaginata</i>	40	<1
<i>Poa porphyroclados</i>	70	1
* <i>Romulea rosea</i>	40	<1
* <i>Sonchus oleraceus</i>	60	<1
<i>Spyridium globulosum</i>	250	40
<i>Acanthocarpus preissii</i>	opportunistic	
* <i>Bromus diandrus</i>	opportunistic	
<i>Cassytha flava</i>	opportunistic	
<i>Comesperma integerrimum</i>	opportunistic	
<i>Conostylis candicans</i>	opportunistic	
<i>Hardenbergia comptoniana</i>	opportunistic	
<i>Leucopogon parviflorus</i>	opportunistic	
<i>Olearia axillaris</i>	opportunistic	
* <i>Pelargonium capitatum</i>	opportunistic	
<i>Rhagodia baccata</i> subsp. <i>baccata</i>	opportunistic	
<i>Scaevola globulifera</i>	opportunistic	
* <i>Trachyandra divaricata</i>	opportunistic	



## QUADRAT caq3

**GPS (WGS84):** 377425E; 6491800N

**Location:** Last tall dune before beach

**Topography:** Upper slope to crest

**Soil:** Pale grey sand

**Litter:** Leaves 20%

**Vegetation Description:.** Shrubland of *Acacia rostellifera* over Low Shrubland dominated by *Rhagodia baccata* subsp. *dioica* and *Scaevola crassifolia* over Very Open Grassland dominated by *\*Ehrharta longiflora* over Open Herbland dominated by *Acanthocarpus preissii*, *\*Crassula glomerata* and *\*Trachyandra divaricata* over Sedgeland of *Lepidosperma gladiatum*

**Vegetation Condition:** Very Good

**Notes:** Valleys between the dunes had dense cover (>75%) of *Lepidosperma gladiatum*



SPECIES	HEIGHT (cm)	% COVER
<i>Acacia rostellifera</i>	150	15
<i>Acanthocarpus preissii</i>	30	5
<i>*Bromus diandrus</i>	80	1
<i>*Crassula glomerata</i>	5	10
<i>*Ehrharta longiflora</i>	70	5
<i>Hardenbergia comptoniana</i>	twiner	<1
<i>*Lactuca serriola</i>	10	<1

<b>SPECIES</b>	<b>HEIGHT (cm)</b>	<b>% COVER</b>
<i>Lepidosperma gladiatum</i>	120	40
<i>Olearia axillaris</i>	70	1
* <i>Pelargonium capitatum</i>	50	1
<i>Rhagodia baccata</i> subsp. <i>dioica</i>	100	5
<i>Scaevola crassifolia</i>	80	5
<i>Senecio pinnatifolius</i> var. <i>latilobus</i>	40	1
* <i>Sonchus oleraceus</i>	70	2
* <i>Trachyandra divaricata</i>	60	5
<i>Carpobrotus virescens</i>	opportunistic	
<i>Cassutha flava</i>	opportunistic	
<i>Clematis linearifolia</i>	opportunistic	
* <i>Cuscuta epithymum</i>	opportunistic	
* <i>Heliophila pusilla</i>	opportunistic	
<i>Hemiandra pungens</i>	opportunistic	
* <i>Lagurus ovatus</i>	opportunistic	
<i>Melaleuca systema</i>	opportunistic	
<i>Ozothamnus cordatus</i>	opportunistic	
<i>Poa porphyroclados</i>	opportunistic	
<i>Scaevola globulifera</i>	opportunistic	
<i>Spyridium globulosum</i>	opportunistic	
* <i>Tetragona decumbens</i>	opportunistic	
<i>Threlkeldia diffusa</i>	opportunistic	
<i>Thysanotus arenarius</i>	opportunistic	



**QUADRAT caq4****GPS (WGS84):** 377325E; 6491875N**Location:** Just back from the beach**Topography:** Fore dune**Soil:** Pale grey/white sand**Litter:** Leaves 5%**Vegetation Description:.** Low Open Shrubland of *Olearia axillaris*, *Scaevola crassifolia*, *\*Pelargonium capitatum* and *Rhagodia baccata* subsp. *dioica* over Grassland dominated by *Spinifex longifolius* over Very Open Herbland dominated by *\*Trachyandra divaricata***Vegetation Condition:** Good to very good**Notes:** Just before the drop down to the water there was a belt about 5m wide where young Marram grass (*\*Ammophila arenaria*) was dominant and growing between the plants of *Spinifex longifolius*. Many of the plants recorded a dense infestation of the native parasitic twiner *Cassytha flava*. If the infestation is very heavy it has the capacity to kill plants

SPECIES	HEIGHT (cm)	% COVER
<i>Acanthocarpus preissii</i>	50	2
<i>*Avena barbata</i>	100	5
<i>Cassytha flava</i>	twiner	30
<i>*Crassula glomerata</i>	10	2
<i>Olearia axillaris</i>	100	3
<i>Ozothamnus cordatus</i>	40	<1



<b>SPECIES</b>	<b>HEIGHT (cm)</b>	<b>% COVER</b>
<i>*Pelargonium capitatum</i>	50	5
<i>Rhagodia baccata</i> subsp. <i>dioica</i>	50	2
<i>Scaevola crassifolia</i>	50	5
<i>*Sonchus oleraceus</i>	70	1
<i>Spinifex longifolius</i>	80	40
<i>*Tetragona decumbens</i>	30	1
<i>*Trachyandra divaricata</i>	60	15
<i>*Vulpia myuros</i>	15	2
<i>Acacia cyclops</i>	opportunistic	
<i>*Ammophila arenaria</i>	opportunistic	
<i>Carpobrotus virescens</i>	opportunistic	
<i>Crassula colorata</i>	opportunistic	
<i>*Oenothera glazioviana</i>	opportunistic	
<i>Paspalum vaginatum</i>	opportunistic	
<i>Spinifex hirsutus</i>	opportunistic	
<i>Spyridium globulosum</i>	opportunistic	
<i>Threlkeldia diffusa</i>	opportunistic	

**APPENDIX C****Endemic species recorded from each quadrat (introduced species removed)****LEGEND**

<b>ABBREVIATION</b>	<b>DESCRIPTION</b>
subsp.	subspecies
var.	variety
*	weed
+	species recorded

ENDEMIC SPECIES	QUADRAT NUMBER			
	caq1	caq2	caq3	caq4
<i>Acacia cyclops</i>	+	+	+	+
<i>Acacia rostellifera</i>	+	+	+	
<i>Acacia saligna</i>	+			
<i>Acanthocarpus preissii</i>	+	+	+	+
<i>Ammophila arenaria</i>				+
<i>Austrostipa flavescens</i>	+	+		
<i>Carpobrotus virescens</i>			+	+
<i>Cassutha flava</i>		+	+	+
<i>Clematis linearifolia</i>	+	+	+	
<i>Comesperma integerrimum</i>	+	+		
<i>Conostylis aculeata</i> subsp. <i>cygnorum</i>	+	+		
<i>Conostylis candicans</i>		+		
* <i>Crassula glomerata</i>	+	+	+	+
<i>Desmocladius flexuosus</i>	+	+		
<i>Dianella revoluta</i> subsp. <i>divaricata</i>	+	+		
<i>Exocarpus sparteus</i>	+			
<i>Gompholobium capitatum</i>	+	+		
<i>Hardenbergia comptoniana</i>	+	+	+	
<i>Hemiandra pungens</i>			+	
<i>Isolepis marginata</i>	+			
<i>Kennedia prostrata</i>	+			
<i>Lepidosperma calcicola</i>	+	+		
<i>Lepidosperma gladiatum</i>			+	
<i>Leucopogon parviflorus</i>	+	+		
<i>Lomandra maritima</i>	+	+		
<i>Melaleuca cardiophylla</i>	+			
<i>Melaleuca systema</i>	+	+	+	
<i>Olearia axillaris</i>	+	+	+	+
<i>Opercularia vaginata</i>		+		
<i>Ozothamnus cordatus</i>			+	+
<i>Paspalum vaginatum</i>				+
<i>Phyllanthus calycinus</i>	+			
<i>Poa porphyroclados</i>		+	+	
<i>Rhagodia baccata</i> subsp. <i>baccata</i>	+	+		
<i>Rhagodia baccata</i> subsp. <i>dioica</i>			+	+
<i>Scaevola crassifolia</i>			+	+
<i>Scaevola globulifera</i>		+	+	
<i>Senecio pinnatifolius</i> var. <i>latilobus</i>			+	
<i>Spinifex hirsutus</i>				+
<i>Spinifex longifolius</i>				+

ENDEMIC SPECIES	QUADRAT NUMBER			
	caq1	caq2	caq3	caq4
<i>Spyridium globulosum</i>	+	+	+	+
<i>Threlkeldia diffusa</i>			+	
<i>Thysanotus arenarius</i>	+		+	

## **APPENDIX D**

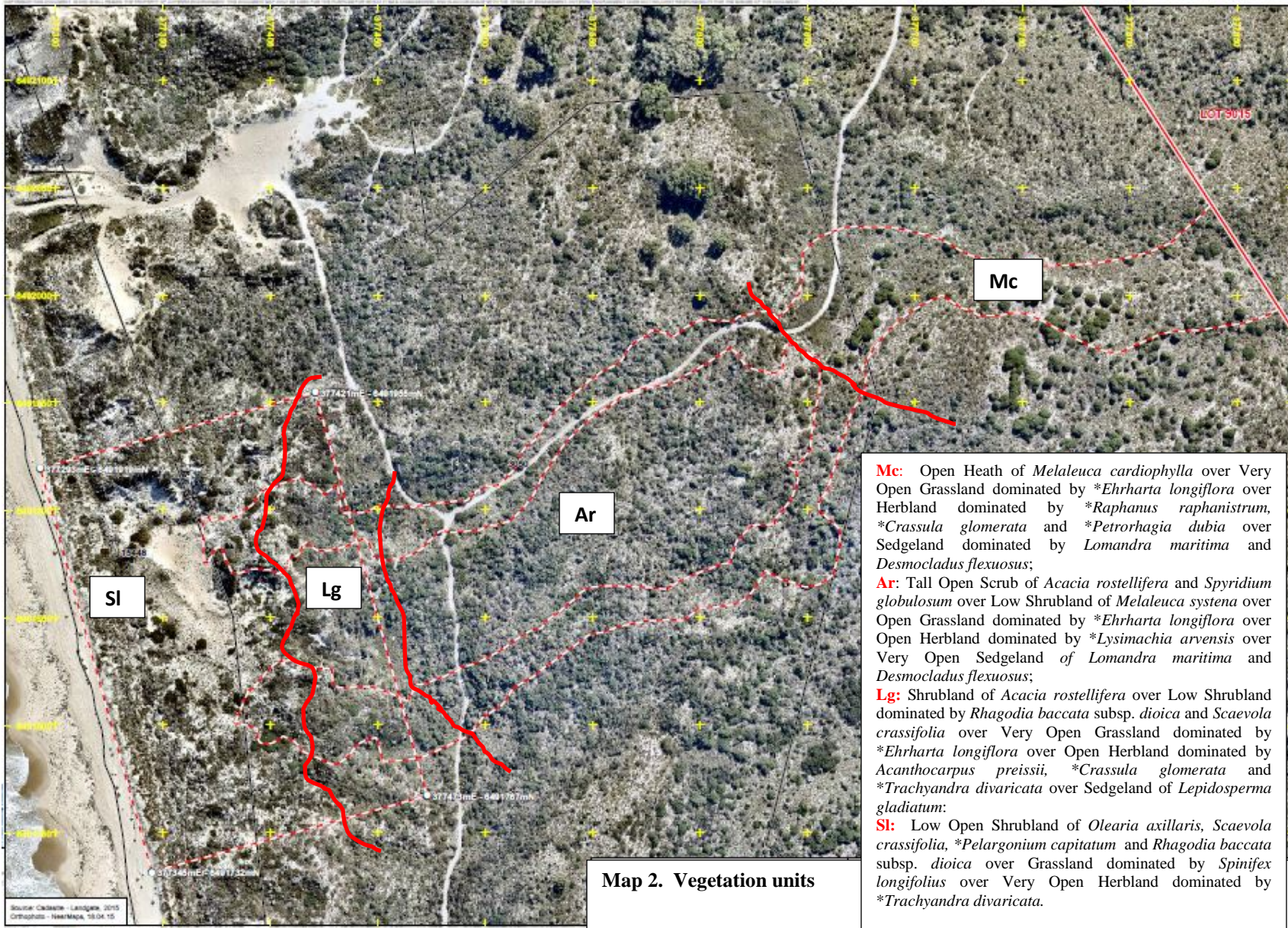
### **Maps**

1. Location of quadrats
2. Vegetation units
3. Vegetation condition

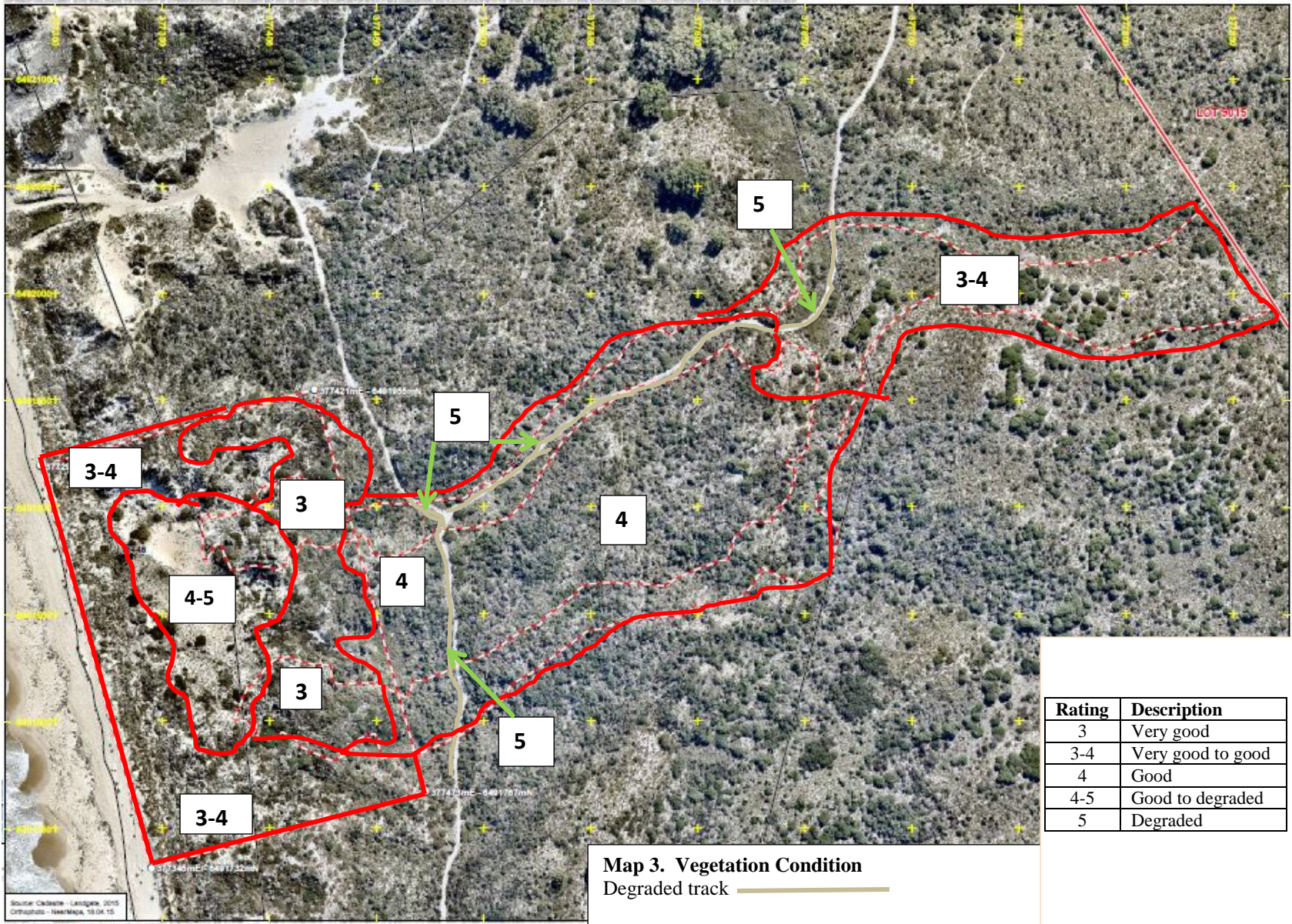


Map 1. Location of quadrats









**Map 3. Vegetation Condition**  
 Degraded track —————



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## Appendix 3      Proposed Revegetation Species List

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## Coterra Environment Catalina Foreshore - Proposed Species List

### Revegetation Notes:

\* denotes low representation recommended

\*\* denotes high representation recommended

Blue refers to species requiring 12-18 months lead time for provenance grown seedlings

Orange refers to species observed and additional to the Botanical Assessment

### Revegetation Species List

Species	Habit	Mg Zone	Ar Zone	Lg Zone	SI Zone
<i>Acacia cyclops</i>	Shrub	*	*		
<i>Acacia lasiocarpa</i>	Shrub		*	*	
<i>Acacia rostellifera</i>	Shrub		**	*	
<i>Acacia saligna</i>	Shrub	*			
<i>Acanthocarpus preissii</i>	Herb	**	**	**	**
<i>Austrostipa flavescens</i>	Grass	*			
<i>Carpobrotus virescens</i>	Groundcover			*	**
<i>Clematis linearifolia</i>	Climber	**	**	*	*
<i>Conostylis aculeata subsp. cygnorum</i>	Herb	**	*	*	
<i>Conostylis candicans</i>	Herb			*	*
<i>Dianella revoluta var. divaricata</i>	Herb	*			
<i>Ficinia nodosa</i>	Sedge				*
<del>.....</del>	<del>.....</del>	<del>.....</del>	<del>.....</del>	<del>.....</del>	<del>.....</del>
<i>Hardenbergia comptoniana</i>	Climber	**	**	*	
<i>Hemiandra pungens</i>	Groundcover	*	*		
<i>Kennedia prostrata</i>	Groundcover	*	*	*	
<i>Lepidosperma calcicola</i>	Sedge	*			
<i>Lepidosperma gladiatum</i>	Sedge		**	**	
<i>Melaleuca cardiophylla</i>	Shrub	**	*		
<i>Melaleuca systema</i>	Shrub	**	**	**	
<i>Olearia axillaris</i>	Shrub	*	*	**	**
<i>Pithocarpa cordatus</i>	Shrub			*	*
<i>Phyllanthus calycinus</i>	Herb	*			
<i>Poa porphyroclados</i>	Grass	*			
<i>Rhagodia baccata</i>	Shrub	*	*	**	
<i>Scaevola crassifolia</i>	Shrub			*	**
<i>Scaevola globulifera</i>	Shrub				
<i>Senecio pinnatifolius var. latilobus</i>	Herb				*
<i>Spinifex hirsutus</i>	Grass				*
<i>Spinifex longifolius</i>	Grass			*	**
<i>Spyridium globulosum</i>	Shrub	**	**	**	
<i>Threlkeldia diffusa</i>	Groundcover			*	*
<i>Thysanotus arenarius</i>	Herb	*	*		



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