GOLDEN BAY

MINISTERIAL IMPLEMENTATION STATEMENT NO. 297 COMPLIANCE ASSESSMENT REPORT YEAR 2016

Prepared for:	Peet Golden Bay Pty Ltd/Department of Communities and Housing
Report Date:	30 August 2017
Version:	1
Report No.	2017-337

pgv ENVIRONMENTAL

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1 INTRODUCTION

1.1 Background

The proposal to develop Part Lot 12 and Reserve 34664, Golden Bay for urban development was referred to the Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* (EP Act) in 1992 by H & B Developments. The EPA set the level of assessment as a Public Environmental Review (PER) (Assessment No. 604). The Minister for the Environment approved the proposal through Ministerial Statement 297 subject to environmental conditions in January 1993 (Attachment A).

Ministerial Statement 297 gave environmental approval subject to conditions to develop the landholding then known as Part Lot 12 and Reserve 34664, Golden Bay.

The Minister for the Environment confirmed on 30 July 1997 that the project had been substantially commenced, and as a result the environmental approval remains valid.

The Department of Environmental Protection (now the Department of Water and Environmental Regulation (DWER)) recognised the change in ownership to the Department of Housing and Works (now known as the Department of Communities and Housing (DCH)) and issued an Audit Table detailing the status of the Environmental Conditions and Commitments on 3 April 2001 (Attachment B).

The landholding is now referred to as Lot 2 Warnbro Sound Avenue and Lot 3 Dampier Drive, Golden Bay.

1.2 Golden Bay Project Description

Golden Bay is located on the coast, approximately 62km south of the Perth Central Business District and 20km south of The City of Rockingham (Figure 1).

The landholding covers an area of approximately 161 hectares (ha) and is situated west of Mandurah Road (Figure 2). Lot 2 has approximately 800m of coastal frontage and the foreshore reserve covers an area of 10.61ha with vegetation that is largely in Excellent condition. Lot 3 has a Landscape Protection Area that conserves the parabolic dunal formation associated with Mandurah Hill, the highest point in the region.

The key environmental elements of the Golden Bay Proposal as described in the PER were listed as:

- Foreshore Reserve designation;
- Foreshore Reserve management;
- Landscape protection;
- Southern Brown Bandicoot Protection; and
- Protection of the heritage site.

1.3 Proponent

Peet Golden Bay Pty Ltd (Peet) partnered with the Housing Authority (now DCH) in November 2015. The change in Proponent was endorsed by the OEPA (now DWER) on 1 August 2016.

1.4 Environmental Approval to Implement the Project

The proposal to develop the site was assessed through a Section 38 Public Environmental Review (PER) assessment process under the WA *Environmental Protection Act 1986* (EP Act). The project was approved through Ministerial Statement 297 in January 1993 (Appendix 1).

The Minister for the Environment confirmed on 30 July 1997 that the project had been substantially commenced.

1.5 Scope of the Report

Condition 8 of MS297 states the following:

8. Compliance Auditing

In order to ensure that environmental conditions and commitments are met, an audit system is required.

8-1 The Proponent shall prepare periodic 'Progress and Compliance Reports' to help verify the environmental performance of this project, in consultation with the Environmental Protection Authority.

Procedure

The Environmental Protection Authority is responsible for verifying compliance with the conditions contained in this statement, with the exception of conditions stating that the proponent shall meet the requirements of the Minister for the Environment or any other government agency.

If the Environmental Protection Authority, other government agency or proponent is in dispute concerning compliance with the conditions contained in this statement, that dispute will be determined by the Minister for the Environment.

This is the fifth Compliance Assessment Report (CAR), the previous CARs were provided on 20 May 2010, 30 May 2011, 30 May 2012 and 30 August 2016. The reporting requirements set out in the Audit Table indicated that the first compliance report was due before clearing activities commenced and the second one year after the clearing had commenced. Thereafter the submission of compliance reports was as required by the OEPA.

The OEPA advised in correspondence dated 8 April 2016 (Appendix 2) that a CAR was required to be submitted by 30 August 2016 and annually thereafter and to report on the period of the previous calendar year

This CAR has been prepared in accordance with the OEPA *Guidelines for Preparing a Compliance Assessment Report, August 2012*.

This report is based on the Proponent's assessment of compliance with the conditions in accordance with the MS297 and MS297 Audit Table. This CAR covers the period between January 2016 to December 2016.

2 CURRENT STATUS OF PROJECT IMPLEMENTATION

2.1 Golden Bay Project

Peet is delivering the urban development project on behalf of the landowners in accordance with the approved Comprehensive Development Plan (Figure 2) will deliver the following:

- Residential Lots;
- Commercial Precinct;
- Primary and Secondary Schools;
- Local Public Open Space (recreational and drainage functions);
- Landscape protection area; and
- A Foreshore Reserve.

2.2 Current Project Activities

Development construction has progressed over Lot 2 both east and west of Warnbro Sound Avenue (Figure 2). The following tasks have been undertaken to date:

- 16 stages of development have been completed to December 2016;
- The Foreshore Reserve adjacent to Lot 2 has been surveyed and demarcated with flagging tape;
- The Southern Brown Bandicoots are being managed on the site and within the foreshore reserve;
- The wetlands within the foreshore reserve have been monitored annually; and
- Rehabilitation works have commenced in the southern portion of the foreshore reserve adjacent to the existing Golden Bay.

No development works were undertaken on Lot 3 during 2016.

3 INSTANCES OF POTENTIAL NON-COMPLIANCE AND PREVENTATIVE ACTIONS UNDERTAKEN

In accordance with Condition 8-1of MS 297, all instances of potential non-compliance with the conditions of MS 297 that are identified during the reporting period are to be reported in the annual CAR, and corrective and preventative actions taken are to be described. The status of all conditions is presented in Table 1 and Appendix 3.

There were no non-compliance issues during this reporting period.

4 PUBLIC AVAILABILITY OF REPORT

This CAR will be made publicly available within one month of being submitted to the OEPA. A copy of the most recent CAR will be placed on the Proponent's website until the subsequent annual CAR is placed on the website.

The website URL is www.peet.com.au/GoldenBay

5 COMPLIANCE

5.1 Compliance Assessment Method

An audit of the Golden Bay project was conducted in June/July 2017 to facilitate the assessment of compliance against MS 297 and the implementation of actions to meet environmental conditions. The audit was conducted by Belinda Heath of PGV Environmental.

The compliance status terminology to define the level of compliance used during the audit follows the EPA *Post Assessment Guideline for Preparing an Audit Table* and is listed below:

- C = Compliant;
- CLD = Completed;
- NC = Non – compliant
- NR = Not Required at this stage;
- IP = In Process may only be used by the proponent in circumstances outlined in Section 2.8 of the guideline

The information reviewed and the evidence obtained during this audit has been presented within the Compliance Assessment Audit Table (Appendix 3), along with additional information gathered during a desktop study/investigation.

5.2 Statement of Compliance

The Statement of Compliance and the Compliance Assessment Audit Table are attached at Appendix 3.

5.3 Summary Audit Table

Details on compliance with the MS297 conditions and management plans are presented below in a summary audit table (Table 1). The detailed Compliance Assessment Audit Table is provided in Appendix 3.

Table 1: Summary Audit Table Status

Audit Code	Requirement	Status	Comment
297:M1-1	Fulfil the commitments	CLD	All commitments have been fulfilled
297:M2-1	Adhere to the Proposal	C	
297:M2-2	Seek approval for modifications to the Proposal	C	No modifications sought
297:M3-1	Provide a foreshore reserve for conservation and recreation which: 1. Protects the Peelhurst Wetlands and the Southern Brown Bandicoot (Isoodon obesulus) population; and 2. Includes landscape and recreation values at least equivalent to the area affected by this proposal which is within System 6 Recommendation M107 Area.	CLD	4 June 1993
297:M3--2	Transfer to public ownership the proposed foreshore reserve as required by M3-1.	CLD	4 June 1993
297:M4-1	Liaise with the Department of Planning and Urban Development and the CoR to incorporate planning measures which recognise and protect the landscape value of the parabolic ridge on the eastern edge of Golden Bay.	CLD	5 April 1994
297:M5-1:1	Establish the regional implications of disturbing the population of the Southern Brown Bandicoot (Isoodon obesulus) at Golden Bay.	CLD	6 February 1996
297:M5-1:2	Initiate management of the population of the Southern Brown Bandicoot (Isoodon obesulus)	CLD	Submitted 20 May 2010
297:M5-2:1	Carry out the ongoing management of the population of the Southern Brown Bandicoot (Isoodon obesulus) at Golden Bay as proposed in M5-1.	C	All stages of development have included a relocation program prior to any clearing activity.
297:M5-2:2	Carry out the ongoing management of the population of the Southern Brown Bandicoot (Isoodon obesulus) at Golden Bay as proposed in M5-1.	NR	Post development management
297:M6-1	Seek approval for transfer of ownership, control or management of this project.	C	Proponents are DCH and Peet Golden Bay Pty Ltd
297:M7-1	Seek approval to extend approval to implement proposal.	CLD	Minister for Environment confirmed project has commenced on 30 July 1997
297:M8	Prepare a periodic 'Progress and Compliance Report' to help verify the environmental performance of this project.	C	OEPA has requested (Appendix 2) that from August 2016 compliance reports are to be submitted annually by 30

			August for the previous calendar year.
297:P1	Provide in exchange for the development of the currently proposed System 6 Area M107, additional Regional and Public Open Space adjacent the Coastal Reserve as shown in the Structure Plan, in excess to that which would normally be required by DPUD.	CLD	26 October 1995 Not Audited (duplicated by condition M3-1) – Audit Branch
297:P2	Prepare a Management plan for the coastal reserve at Golden Bay.	CLD	Golden Bay Foreshore Management Plan approved by the OEPA on 30 March 2012 (on advice from DoP and CoR) An addendum to the FMP to address the interface between the development and foreshore reserve was submitted and approved by the OEPA on 29 September 2016
297:P3	Include the historic aboriginal camping site within the proposed Public Open Space for the development.	CLD	13 December 1995
297:P4	Protect against Bushfire	CLD	Fire Management Plan for the Golden Bay Structure Plan Area was approved by the City of Rockingham in March 2012.
297:P5	Provide reticulated sewerage and stormwater drainage designated to infiltrate stormwater into the soil within the development site.	CLD	A Local Water Management Strategy (LWMS) has been prepared for the Structure Plan Area and approved by the Department of Water and the City of Rockingham. Urban Water Management Plans are being prepared in accordance with the

			LWMS for each stage of subdivision.
297:P6	Liaise with CALM regarding the presence of bandicoots at Golden Bay and examine feasibility of relocating bandicoots if required by CALM.	CLD	13 December 1995

5.4 Compliance with Management Plans

Commitment 2 of the Ministerial Statement required that a management plan be prepared for the foreshore reserve on advice from the Department of Planning and the City of Rockingham.

The Golden Bay Foreshore Management Plan was prepared in consultation with the Department of Planning and the City of Rockingham and approved by the OEPA on 30 March 2012 (Appendix 3).

An addendum to the FMP to address the interface between the development and foreshore reserve was submitted and approved by the OEPA on 29 September 2016 (Appendix 8).

The FMP provides for the management and conservation of the Peelhurst Wetlands, Southern Brown Bandicoot, TEC 19a (Sedgelands in Holocene Dune Swales) and the Indigenous Heritage site located within the approved Foreshore Reserve. In addition, the FMP details the proposed infrastructure, recreational activities and relevant management strategies as proposed in the Public Environmental Review.

Implementation of the FMP has commenced and a status update on the management actions are provided in Appendix 4.

5.4.1 TEC19a Photo Point Monitoring

The condition of the TEC19a (*Sedgelands in Holocene Dune Swales*) has been recorded annually through photo point monitoring survey conducted in late September/October. The survey records the overall condition of the TEC and provides a basis to determine if the TEC is improving/degrading over time.

The photo point monitoring survey results are provided in Appendix 5.

Plate 1: TEC19a (Sedgelands in Holocene Dune Swales)

5.4.2 Southern Brown Bandicoot Monitoring

The local population of Southern Brown Bandicoots within the foreshore reserve have been monitored in autumn and spring each year since 2012.

Based on the results of this trapping program, there appears to have been a reduction in the population of Southern Brown Bandicoots in the Foreshore Reserve. The likely causes of this reduction are a reduced area of native vegetation as a result of a fire which occurred in the foreshore reserve on 1 January 2016 and an increase in the number of foxes and cats in the area.

A fox and cat management program was undertaken in February 2016 where four feral cats and one fox were removed from the foreshore reserve.

The monitoring reports for 2016 are provided at Appendix 6.

Plate 2: Southern Brown Bandicoot (photo source G. Thomson Terrestrial Ecosystems)

5.4.3 Groundwater Levels Monitoring

The groundwater levels in the foreshore reserve are monitored each month. The levels for the period July 2012 to October 2016 are provided at Appendix 7.

Plate 3: Groundwater Monitoring Bore

5.4.4 Landscape Protection Management Plan

There was no development in the eastern Lot 3 Dampier Drive part of the Golden Bay development in the reporting period or prior. Therefore, there has been no requirement to implement the Golden Bay Landscape Protection Management Plan prepared and approved as required by Condition 4-1 of MS 297.

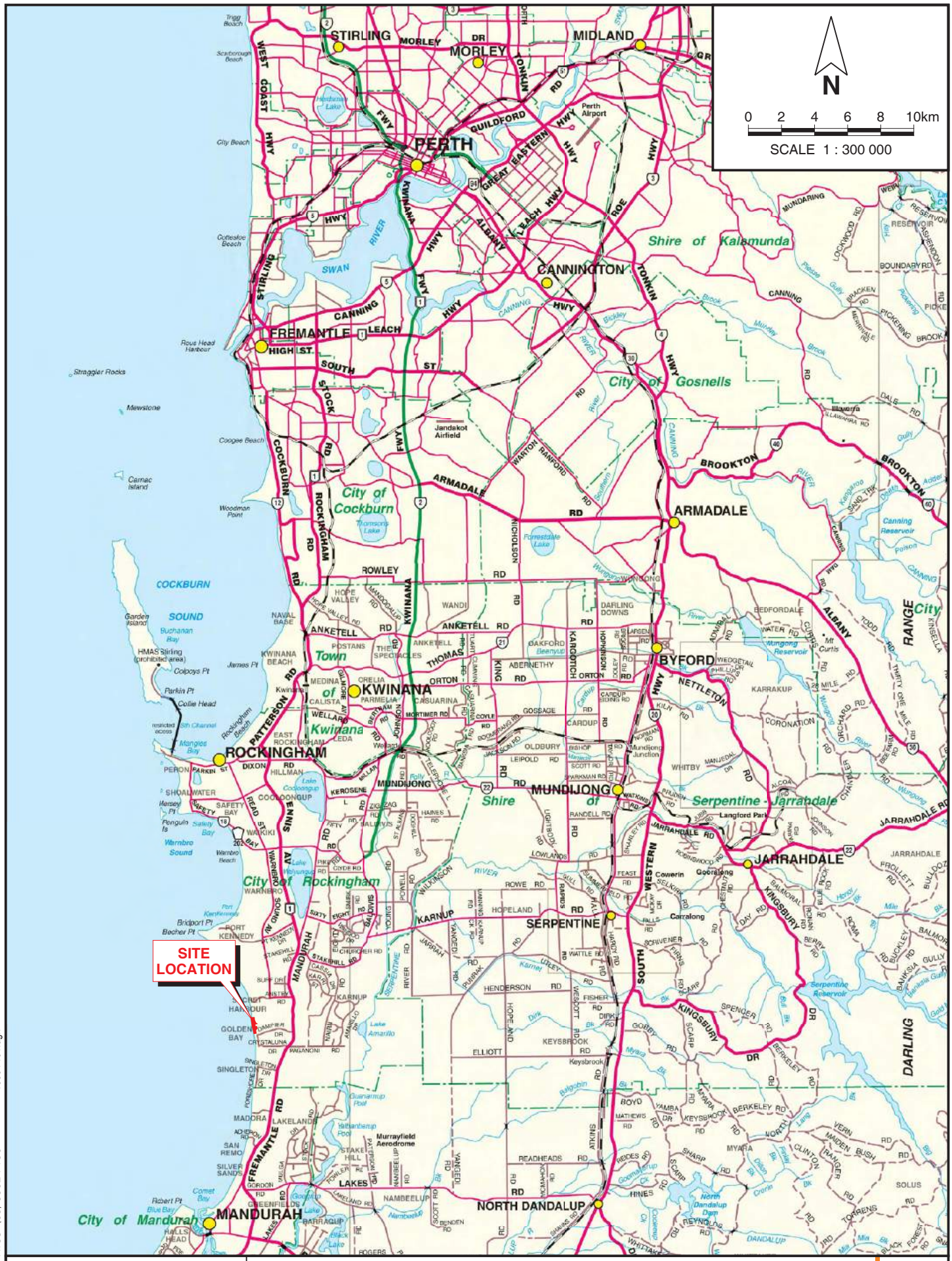
6 REFERENCES

Environmental Protection Authority (EPA) (2012) *Post Assessment Guideline No. 3 for Preparing a Compliance Assessment Report* Perth Western Australia.

Office of the Environmental Protection Authority (2012). *Post Assessment Guideline for Preparing an Audit Table*. Office of the Environmental Protection Authority, Government of Western Australia. August 2012

Office of the Environmental Protection Authority (2010c). *Post Assessment Guideline for making information publicly available.* Office of the Environmental Protection Authority, Government of Western Australia. August 2012

FIGURES



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Department of Housing
COMPLIANCE ASSESSMENT REPORT
GOLDEN BAY

Drawn: B. Heath	Date: 10 Aug 2011
Job: 10004	Revision: A

REGIONAL LOCATION

Figure 1

PINPOINT CARTOGRAPHICS (08) 9562 7136 10004-f01.dgn

LEGEND

- Comprehensive Development Plan Boundary
- Stage 1 Boundary (Refer note 6)
- 400m Walkable Catchment to Neighbourhood Centre

Zones:

- Residential R5
- Residential R20
- Residential R30
- Residential R40
- Residential R60
- Residential R80
- Commercial Zone Neighbourhood Centre Precinct - (Refer notes 4 and 5)

Road Heirachy:

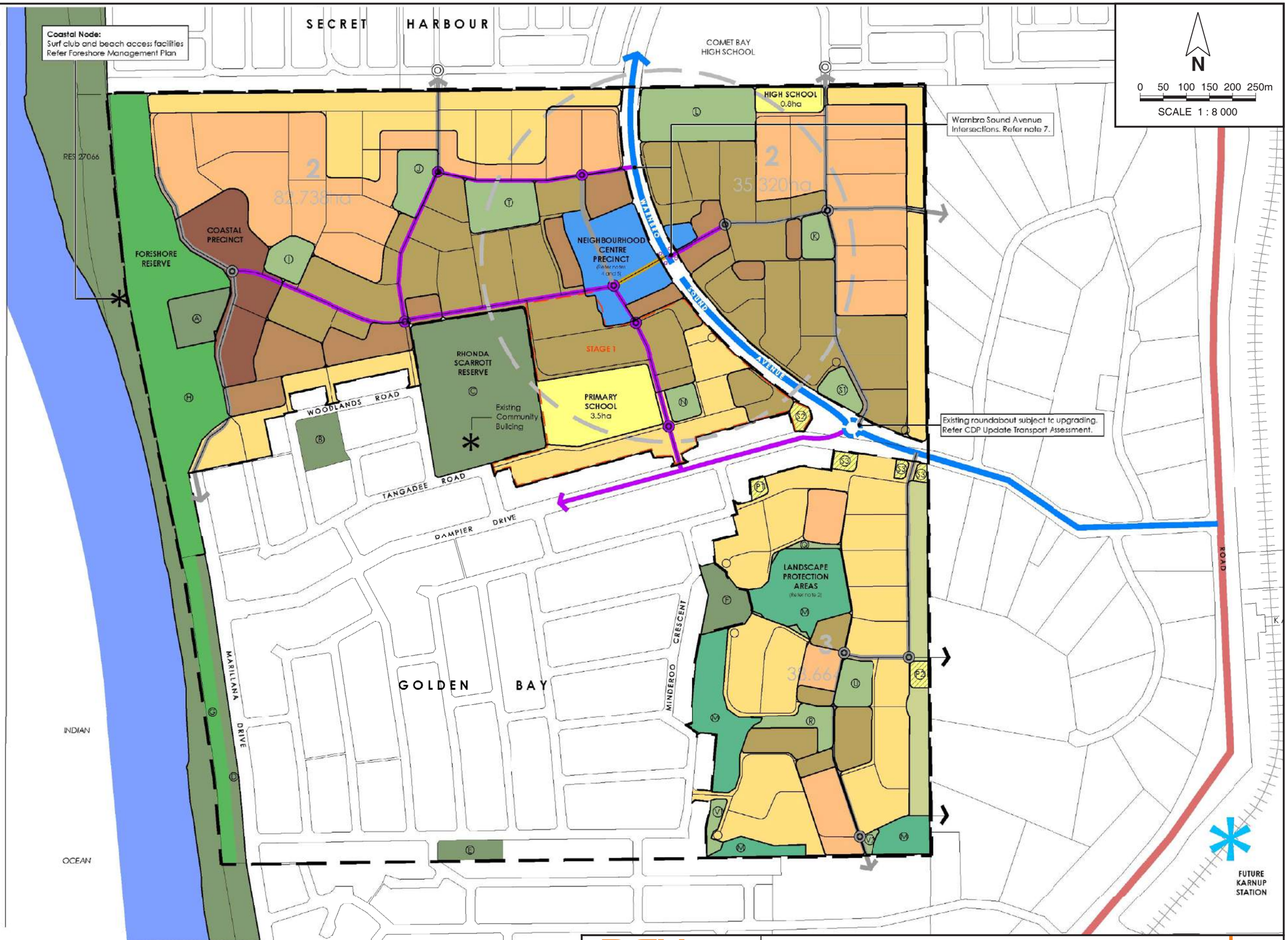
- Primary Distributor
- District Distributor A / Integrator A
- Integrator B
- Neighbourhood Connector A
- Neighbourhood Connector B

Reserves:

- Public Open Space/ Drainage
- Local Reserve Public Purposes Drainage
- Existing Open Space
- Landscape Protection Area (refer note 2)
- Existing MRS Parks and Recreation Reserve
- MRS Reserve Public Purposes Primary School/High School

NOTES:

1. The boundary to the Comprehensive Development Plan (CDP) Update is in accordance with the approved CDP 1994 and original lot 12 boundary.
2. Landscape Protection Areas are in accordance with the approval of the State Minister for the Environment 1993.
3. *The access street layout is indicative only* and subject to refinement as part of the detailed subdivision design process.
4. The Neighbourhood Centre Precinct is a main street based centre and is subject to the preparation of a Detailed Area Plan. Refer CDP Update Report.
5. Where residential uses are proposed in the Neighbourhood Centre Precinct an R60 density code shall apply.
6. Stage 1 approved pursuant to endorsed CDP, refer WAPC Ref: 141268 and 142741.
7. Full movement four way intersection at Wambro Sound Avenue and Coastal Boulevard, and full movement T intersection north of traffic lights as approved in principle by Main Roads WA Dec 2010.
8. POS areas are indicative only and subject to further detailed design and drainage considerations.
9. All road carriageway detail depicted on this Plan including pavements, road treatments, medians and parking are for illustrative purposes only and are subject to final engineering design and any relevant approvals. The detail reflects the intent of the road network standards preferred for this subdivision. All dimensions and areas depicted on this Plan are subject to pre-cal and final survey and will vary from the figures shown.
10. All development on lots that fall within a hazard separation zone, as identified by the endorsed Golden Bay Fire Management Plan, must be constructed to the appropriate standard as specified in *Australian Standard 3959 Construction of Buildings In Bushfire Prone Areas*.



SOURCE: Chappell Lambert Everett, Plan No. 2187-29U-01, 28-02-2011.

CHAPPELL LAMBERT EVERETT

pgv ENVIRONMENTAL	Department of Housing FCOMPLIANCE ASSESSMENT REPORT GOLDEN BAY
Drawn: B. Heath	Date: 10 Aug 2011
Job: 10004	Revision: A
COMPREHENSIVE DEVELOPMENT PLAN	**Figure 2**

PINPOINT CARTOGRAPHICS (08) 9562 7136 10004f02.dgn

APPENDIX 1

MINISTERIAL STATEMENT 297

WESTERN AUSTRALIA
MINISTER FOR THE ENVIRONMENT

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

URBAN DEVELOPMENT OF PART LOT 12 & RESERVE 34664 (AFFECTING PART OF SYSTEM SIX RECOMMENDATION M107), GOLDEN BAY (604)

H & B DEVELOPMENTS PTY LTD

This proposal may be implemented subject to the following conditions:

1 Proponent Commitments
The proponent has made a number of environmental management commitments in order to protect the environment.

1-1 In implementing the proposal, the proponent shall fulfil the commitments (which are not inconsistent with the conditions or procedures contained in this statement) made in the Consultative Environmental Review and included in Environmental Protection Authority Bulletin 648. (A copy of the commitments is attached.)

2 Implementation
Changes to the proposal which are not substantial may be carried out with the approval of the Minister for the Environment.

2-1 Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material in any way that the Minister for the Environment determines on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

3 Foreshore Reserve

3-1 The proponent shall provide a foreshore reserve for conservation and recreation which:

1 protects the Peelhurst wetlands and the Southern Brown Bandicoot (*Isoodon obesulus*) population; and
2 includes landscape and recreation values at least equivalent to the area affected by this proposal which is within System 6 Recommendation M107 Area.

3-2 Prior to the lifting of Urban Deferment, the proponent shall identify the foreshore reserve as required by condition 3-1, and at subdivision the proponent shall transfer to public ownership the proposed foreshore reserve, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

Published on
12 JAN 1993

18th FLOOR, ALLENDALE SQUARE, 77 ST GEORGE'S TERRACE, PERTH, W.A. 6000 TELEPHONE 325 9422 FAX. 325 5621

4 Landscape Protection
The landscape value of the parabolic dune ridge on the eastern edge of Golden Bay should be recognised.

4-1 Prior to subdivision approval, the proponent shall liaise with the Department of Planning and Urban Development and the City of Rockingham to incorporate planning measures which recognise and protect the landscape value of the parabolic dune ridge on the eastern edge of Golden Bay, to the requirements of the Minister for the Environment and the Minister for Planning on advice of the Department of Planning and Urban Development, the City of Rockingham and the Environmental Protection Authority.

5 Southern Brown Bandicoot (*Isoodon obesulus*)
The population of the Southern Brown Bandicoot (*Isoodon obesulus*) at Golden Bay requires special consideration.

5-1 Prior to the commencement of development and in consultation with the Department of Conservation and Land Management, the proponent shall establish the regional implications of disturbing the population of the Southern Brown Bandicoot (*Isoodon obesulus*) at Golden Bay and shall initiate management of the population, to the requirements of the Minister for the Environment on advice of the Department of Conservation and Land Management.

5-2 The proponent shall carry out the on-going management of the population of the Southern Brown Bandicoot (*Isoodon obesulus*) at Golden Bay to the requirements of the Department of Conservation and Land Management.

6 Proponent
These conditions legally apply to the nominated proponent.

6-1 No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

7 Time Limit on Approval
The environmental approval for the proposal is limited.

7-1 If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced. Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period, to the Minister for the Environment by way of a request for a change in the condition under Section 46 of the Environmental Protection Act. (On expiration of the five year period, further consideration of the proposal can only occur following a new referral to the Environmental Protection Authority.)

8 Compliance Auditing
In order to ensure that environmental conditions and commitments are met, an audit system is required.

8-1 The proponent shall prepare periodic "Progress and Compliance Reports", to help verify the environmental performance of this project, in consultation with the Environmental Protection Authority.

Procedure

The Environmental Protection Authority is responsible for verifying compliance with the conditions contained in this statement, with the exception of conditions stating that the proponent shall meet the requirements of either the Minister for the Environment or any other government agency.

If the Environmental Protection Authority, other government agency or proponent is in dispute concerning compliance with the conditions contained in this statement, that dispute will be determined by the Minister for the Environment.

Jim McGinty, MLA
MINISTER FOR THE ENVIRONMENT

12 JAN 1993

PROPONENT'S COMMITMENTS

URBAN DEVELOPMENT OF PART LOT 12 & RESERVE 34664 (AFFECTING PART OF SYSTEM SIX RECOMMENDATION M107) GOLDEN BAY (604)

H & B DEVELOPMENTS PTY LTD

The proponent has made the following environmental commitments:

CONSOLIDATED LIST OF COMMITMENTS FOR GOLDEN BAY

1. The proponent will provide, in exchange for the development of the currently proposed System 6 Area M107, additional Regional and Public Open Space adjacent to the Coastal Reserve as shown in the Structure Plan, in excess to that which would normally be required by DPUD. This will be done to the satisfaction of the EPA, DPUD and the Local Authority at the rezoning stage.

2. The proponent will prepare a Management Plan for the Coastal Reserve at Golden Bay prior to development commencing. This will be done to the satisfaction of DPUD and the Local Authority.

3. The proponent will include an historic aboriginal camping site within the proposed Public Open Space for the development. This will be done to the satisfaction of the Local Authority.

4. The proponent will continue to provide and maintain a network of firebreaks and access tracks to protect against bushfire until the Local Authority takes on this responsibility. This will be done to the satisfaction of the Local Authority.

5. The proponent will provide reticulated sewerage and will design the development so that stormwater drainage is disposed of on site. This will be done during the installation of services within the development to the satisfaction of DPUD and the Local Authority.

6. The proponent will liaise with CALM regarding the presence of bandicoots at Golden Bay and if required by CALM will examine the feasibility of relocating the bandicoots to an appropriate location elsewhere. This will be done prior to any disturbance of the vegetation at Golden Bay and will be done to the satisfaction of both CALM and the EPA.

APPENDIX 2

OEPA CORRESPONDENCE

Government of **Western Australia**
Office of the **Environmental Protection Authority**

Mr Alex Horsburgh
Senior Project Manager
Department of Housing
169 Hay Street
EAST PERTH WA 6175

3RD HAY ST.

Our Ref: *16-006294*
Enquiries: *Rowan Inglis, 6145 0849*
Email: *rowan.inglis@epa.wa.gov.au*

Dear Mr Horsburgh

MINISTERIAL STATEMENT 297 – URBAN DEVELOPMENT OF PART LOT 12 & RESERVE 34664, GOLDEN BAY – ANNUAL COMPLIANCE ASSESSMENT REPORT REQUIRED

Ministerial Statement 297 places conditions on the implementation of the proposal above. Condition 8-1 of Statement 297 requires preparation and submission of a Compliance report.

The Office of the Environmental Protection Authority (OEPA) advises the Department of Housing that a Compliance Report reporting on the period of the previous calendar year (January to December 2015) is required to be submitted by **30 August 2016** and annually thereafter to demonstrate compliance with Statement 297.

The CAR must be developed in accordance with the following:

- Post Assessment Guideline for Preparing a Compliance Assessment Report
- Post Assessment Guideline for Preparing an Audit Table

These documents are available on the OEPA website www.epa.wa.gov.au

If you have any queries regarding this matter, or wish to align the submission of the Compliance Report with reporting submitted to other government agencies, please contact Rowan Inglis on 6145 0849.

Yours sincerely

Mr Ian Munro
MANAGER COMPLIANCE BRANCH

31 March 2016

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Locked Bag 10, East Perth WA 6892

www.epa.wa.gov.au

Reserve Enquiry Detail [5100L]

Screen Friendly Print Page

Reserve	34664	**Legal Area (ha)**	1.2757
Name		**Status**	Current
Type		**Current Purpose**	PUBLIC RECREATION
Notes			
File Number	3915/62		

Class	Responsible Agency	Date of Last Change
C	DEPARTMENT FOR PLANNING AND INFRASTRUCTURE	23/10/1995

Management Orders	Document	Land Use	Local Government Authority
THE CITY OF ROCKINGHAM		PUBLIC RECREATION	ROCKINGHAM, CITY OF

Add Item	CLT Number	Parcel Identifier	Street Address	Suburb	File Number	PIN	Area (sqm)	Map Viewer
☐	LR3067-211	Lot 2486 On Diagram 28721			3915/1962.	368857	12757.0	

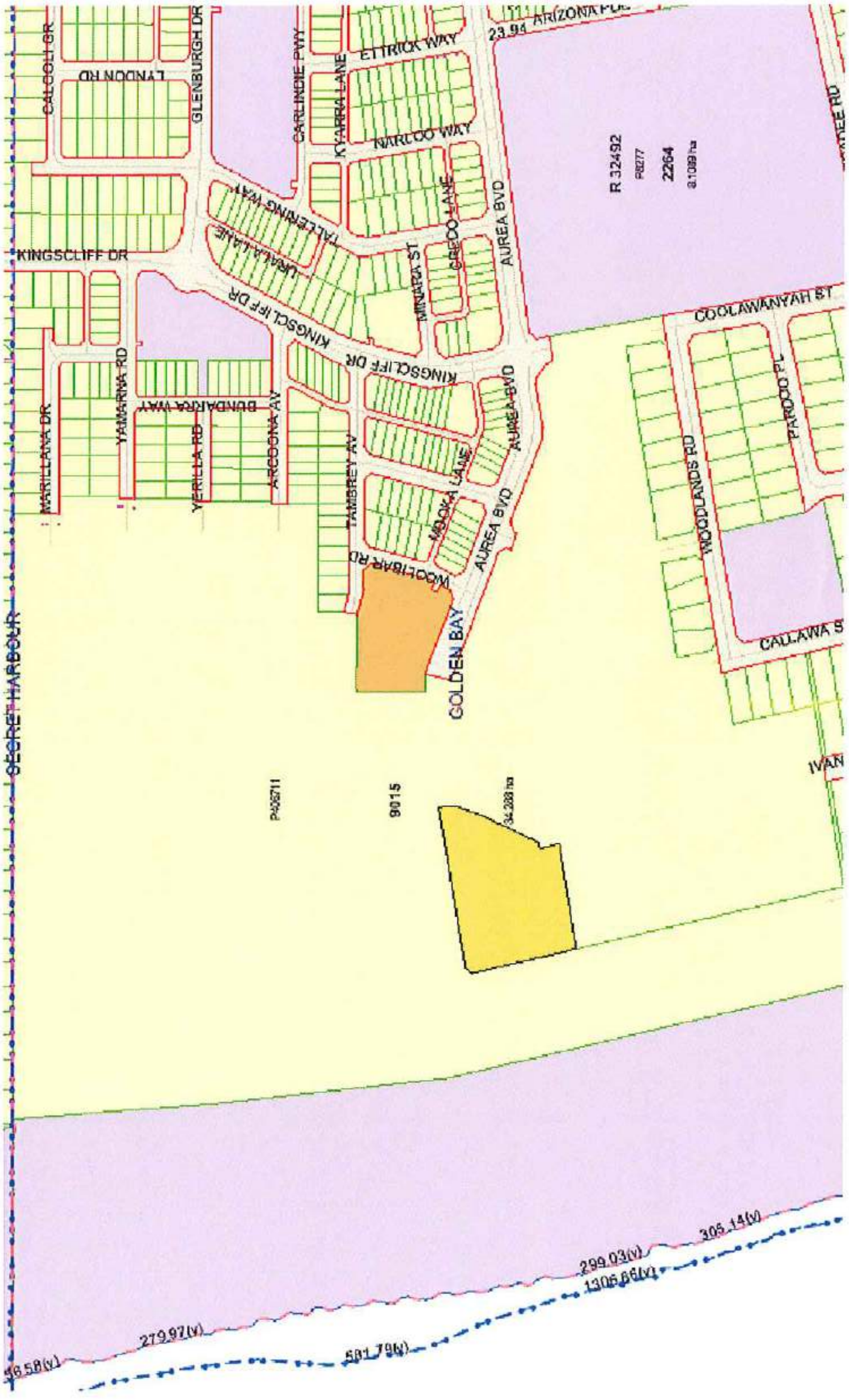
Reserve Number 34664

Previous Certificates of Title		Historic Crown Allotments		
LR3053-222	Cancelled	COCKBURN SOUND	Location	2486

Gaz Page/Document	Date	Type	Text
4852	17/10/1995	Current Area	1.2757
4852	17/10/1995	Public Plan	BG33 (2) 7.13
2593	12/08/1977	Current Vesting	VEST SHIRE OF ROCKINGHAM
1841	17/06/1977	Formerly	FORMERLY PTN COCKBURN SOUND 16 LOT 246-D:28721
1841	17/06/1977	Original Gazettal and page	ORIGINAL GAZETTE
	17/06/1977	Class	C
	17/06/1977	Current Purpose	PUBLIC RECREATION
	17/06/1977	Correspondence File Number	3915/62
	17/06/1977	Historical Area	2.4306
	17/06/1977	Location	COCKBURN SOUND,2486

Appendix 2

Appendix 2



CALOOLI DR
LYNDON RD
GLENBURGH DR
CARLINDIE PWY
KYARRA LANE
ETTRICK WAY
NARLOO WAY
R 32492
2264
AUREA BVD
CREDO LANE
MINARA ST
TALLERING WAY
URALLA LANE
KINGSCLIFF DR
COOLAWANYAH ST
PAROO PL
WOODLANDS RD
YAMARNA RD
BUNDARRA WAY
MARILLANA DR
YERILLA RD
ARGOONA AV
TAMBREY AV
MOOKA LANE
WOOLIBAR RD
GOLDEN BAY
SECRET HARBOUR
9015

APPENDIX 3
STATEMENT OF COMPLIANCE AND AUDIT TABLE

Statement of Compliance

1 Proposal and Proponent Details

Proposal Title	*Urban Development of Part Lot 12 & Reserve 34664 (Affecting Part of System 6 Recommendation M107), Golden Bay (604)*
Statement Number	*297*
Proponent Name	*Housing Authority and Peet Golden Bay Pty Ltd*
Proponent's Australian Company Number (where relevant)	Housing Authority ABN 56 167 671 885 Peet Golden Bay Pty Ltd ABN 94 600 325 175

2 Statement of Compliance Details

Reporting Period	*1/01/16* to *31/12/16*

Implementation phase(s) during reporting period (please tick ✓ relevant phase(s))							
Pre-construction		Construction	✓	Operation		Decommissioning	

Audit Table for Statement addressed in this Statement of Compliance is provided at Attachment:	2
An audit table for the Statement addressed in this Statement of Compliance must be provided as Attachment 2 to this Statement of Compliance. The audit table must be prepared and maintained in accordance with the Office of the Environmental Protection Authority's (OEPA) *Post Assessment Guideline for Preparing an Audit Table*, as amended from time to time. The 'Status Column' of the audit table must accurately describe the compliance status of each implementation condition and/or procedure for the reporting period of this Statement of Compliance. The terms that may be used by the proponent in the 'Status Column' of the audit table are limited to the Compliance Status Terms listed and defined in Table 1 of Attachment 1.	

Were all implementation conditions and/or procedures of the Statement complied with within the reporting period? (please tick ✓ the appropriate box)			
No (please proceed to Section 3)		Yes (please proceed to Section 4)	✓ t

Each page (including Attachment 2) must be initialed by the person who signs Section 4 of this Statement of Compliance. INITIALS: _____

3 Details of Non-compliance(s) and/or Potential Non-compliance(s)

The information required Section 3 must be provided for each non-compliance or potential non-compliance identified during the reporting period covered by this Statement of Compliance.

Non-compliance/potential non-compliance 3-1

Which implementation condition or procedure was non-compliant or potentially non-compliant?
Was the implementation condition or procedure non-compliant or potentially non-compliant?
On what date(s) did the non-compliance or potential non-compliance occur (if applicable)?

Was this non-compliance or potential non-compliance reported to the General Manager, OEPA?	
☐ Yes ☐ Reported to OEPA verbally Date _____ ☐ Reported to OEPA in writing Date _____	☐ No

What are the details of the non-compliance or potential non-compliance and where relevant, the extent of and impacts associated with the non-compliance or potential non-compliance?
What is the precise location where the non-compliance or potential non-compliance occurred (if applicable)? (please provide this information as a map or GIS co-ordinates)
What was the cause(s) of the non-compliance or potential non-compliance?
What remedial and/or corrective action(s), if any, were taken or are proposed to be taken in response to the non-compliance or potential non-compliance?
What measures, if any, were in place to prevent the non-compliance or potential non-compliance before it occurred? What, if any, amendments have been made to those measures to prevent re-occurrence?
Please provide information/documentation collected and recorded in relation to this implementation condition or procedure: • in the reporting period addressed in this Statement of Compliance; and • as outlined in the approved Compliance Assessment Plan for the Statement addressed in this Statement of Compliance. (the above inform ation may be provided as an attachment to this Statement of Compliance)

For additional non-compliance or potential non-compliance, please duplicate this page as required.

4 Proponent Declaration

I, Craig Raynor (Senior Development Manager) declare that I am authorised on behalf of Peet Golden Bay Pty Ltd (being the person responsible for the proposal) to submit this form and that the information contained in this form is true and not misleading.

Signature:..... Date:.....

Please note that:

- it is an offence under section 112 of the *Environmental Protection Act 1986* for a person to give or cause to be given information that to his knowledge is false or misleading in a material particular; and
- the General Manager of the OEPA has powers under section 47(2) of the *Environmental Protection Act 1986* to require reports and information about implementation of the proposal to which the statement relates and compliance with the implementation conditions.

5 Submission of Statement of Compliance

One hard copy and one electronic copy (preferably PDF on CD or thumb drive) of the Statement of Compliance are required to be submitted to the General Manager, OEPA, marked to the attention of Manager, Compliance Branch.

Please note, the OEPA has adopted a procedure of providing written acknowledgment of receipt of all Statements of Compliance submitted by the proponent, however, the OEPA does not approve Statements of Compliance.

6 Contact Information

Queries regarding Statements of Compliance, or other issues of compliance relevant to a Statement may be directed to Compliance Branch, OEPA:

Manager, Compliance Branch
Office of the Environmental Protection Authority

Postal Address: Locked Bag 10
EAST PERTH WA 6892

Phone: (08) 6145 0800

Email: compliance@epa.wa.gov.au

7 Post Assessment Guidelines and Forms

Post assessment documents can be found at www.epa.wa.gov.au in the following locations:

- Post Assessment Guidelines: Home>Policies and Guidelines>Post Assessment Guidelines;
- Post Assessment Forms: Home>Post Assessment Forms.

ATTACHMENT 1

Table 1 Compliance Status Terms

Compliance Status Terms	Abbrev	Definition	Notes
Compliant	C	Implementation of the proposal has been carried out in accordance with the requirements of the audit element.	This term applies to audit elements with: • ongoing requirements that have been met during the reporting period; and • requirements with a finite period of application that have been met during the reporting period, but whose status has not yet been classified as 'completed'.
Completed	CLD	A requirement with a finite period of application has been satisfactorily completed.	This term may only be used where: • audit elements have a finite period of application (e.g. construction activities, development of a document); • the action has been satisfactorily completed; and • the Office of the Environmental Protection Authority (OEPA) has provided written acceptance of 'completed' status for the audit element.
Not required at this stage	NR	The requirements of the audit element were not triggered during the reporting period.	This should be consistent with the 'Phase' column of the audit table.
Potentially Non-compliant	PNC	Possible or likely failure to meet the requirements of the audit element.	This term may apply where during the reporting period the proponent has identified a potential non-compliance and has not yet finalized its investigations to determine whether non-compliance has occurred.
Non-compliant	NC	Implementation of the proposal has not been carried out in accordance with the requirements of the audit element.	This term applies where the requirements of the audit element are not "complete" have not been met during the reporting period.

In Process	IP	Where an audit element requires a management or monitoring plan be submitted to the OEPA or another government agency for approval, that submission has been made and no further information or changes have been requested by the OEPA or the other government agency and assessment by the OEPA or other government agency for approval is still pending.	**The term 'In Process' may not be used for any purpose other than that stated in the Definition Column.** The term 'In Process' may not be used to describe the compliance status of an implementation condition and/or procedure that requires implementation throughout the life of the project (e.g. implementation of a management plan).

Urban Development of Part Lot 12 and Reserve 34664, Golden Bay (Assessment 604, Statement 297)

Ministerial Statement 297 Audit Table

Note:

Phases that apply in this table = Pre-Construction, Construction, Operation, Decommissioning, Overall (several phases)

This audit table is a summary and timetable of conditions and commitments applying to this project. Refer to the Minister's Statement for full detail/precise wording of individual elements.

Code prefixes: M = Minister's condition; P = Proponent's commitment; A = Audit specification; N = Procedure.

Abbreviations: CAR = Compliance Assessment Report; LPA= Landscape Protection Area; FMP- Foreshore Management Plan; CEO = Chief Executive Officer of OEPA; Minister for Env = Minister for the Environment; OEPA = Office of the Environmental Protection Authority; CoR - City of Rockingham; DoT - Department of Transport; CALM Conservation and Land Management (now known as Department of Parks and Wildlife); DPUD = Department of Planning and Urban Development (now Department of Planning)

Compliance Status: C = Compliant, CLD = Completed, NC = Non – compliant, NR = Not Required at this stage. Please note the terms NA = Not Audited and VR = Verification Required are only for OEPA use. IP = In Process may only be used by the proponent in circumstances outlined in Section 2.8 of the *Post Assessment Guideline for Preparing an Audit Table*.

Audit Code	Subject	Requirement	How	Evidence	Phase	To requirements of On advice from	Timeframe	Status	Comment
297: M1-1	Commitments	Fulfil the commitments	As per attachment to the Minister's statement.	CAR	Overall	EPA DPaW		C	
297: M2-1	The Proposal	Adhere to the Proposal	In accordance with any designs, specifications, plans or other technical material submitted by the Proponent to the OEPA.	CAR	Overall	EPA DPaW	Throughout life of the project	C	No changes proposed
297: M2-2	The Proposal	Seek approval for modifications to the Proposal	Submit a written request to the Minister for Env. Detailing changes to designs, specifications, plans or other technical material.	Correspondence to OEPA	Overall	Minister for Env. EPA	Throughout life of the project	C	No changes proposed
297: M3-1	Foreshore Reserve	Provide a foreshore reserve for conservation and recreation which: 3. Protects the Peelhusrt Wetlands and the Southern Brown Bandicoot (Isoodon obesulus) population; and 4. Includes landscape and recreation values at least equivalent to the area affected by this proposal which is within System 6 Recommendation M107 Area.	Make a submission to the Minister for Env. For approval on advice of the EPA.	Submission to the Minister for Env.	Pre development	Minister for Env. EPA	Prior to lifting of 'Urban Deferred'	CLD	4 June 1993
297: M3--2	Foreshore Reserve	Transfer to public ownership the proposed foreshore reserve as required by M3-1.	Make a submission to the Minister for Env. On advice of the Department of Conservation and Land Management	Submission to the Minister for Env.	Pre development	Minister for Env. EPA	Prior to lifting of 'Urban Deferred'	CLD	4 June 1993
297: M4-1	Landscape Protection	Liaise with the Department of Planning and Urban Development and the CoR to incorporate planning measures which recognise and protect the landscape value of the parabolic ridge on the eastern edge of Golden Bay.	Make a submission to the Minister for Env. And the Minister for Planning for approval on advice of the DPUD, CoR, EPA	Submission to the Minister for Env. And Minister for Planning	Pre development	Minister for Env Minister for Planning DPUD CoR EPA.	Before or as a condition of subdivision	CLD	5 April 1994

Audit Code	Subject	Requirement	How	Evidence	Phase	To requirements of On advice from	Timeframe	Status	Comment
297: M5-1:1	Southern Brown Bandicoot	Establish the regional implications of disturbing the population of the Southern Brown Bandicoot (Isoodon obesulus) at Golden Bay.	Make a submission to the Minister for Env. On advice of the Department of Conservation and Land Management	Correspondence with Minister for Env.	Pre development	Minister for Env CALM	Prior to any clearing/construction activities commencing	CLD	6 February 1996
297: M3-1:2	Southern Brown Bandicoot	Initiate management of the population of the Southern Brown Bandicoot (Isoodon obesulus)		Report on this in the first report required under M8	Pre development	Minister for Env CALM	Prior to any clearing/construction activities commencing	CLD	CAR Submitted 20 May 2010
297: M5-2:1	Southern Brown Bandicoot	Carry out the ongoing management of the population of the Southern Brown Bandicoot (Isoodon obesulus) at Golden Bay as proposed in M5-1.	Agreement with CALM	Report on this under M8	Development	CALM	Ongoing	C	All stages of development have included a relocation program prior to any clearing activity.
297: M5-2:2	Southern Brown Bandicoot	Carry out the ongoing management of the Southern Brown Bandicoot (Isoodon obesulus) at Golden Bay as proposed in M5-1.	Agreement with CALM	Report on this under M8	Post Development	CALM	Ongoing	NR	
297: M6-1	Project Ownership, management, control	Seek approval for transfer of ownership, control or management of this project.	Letter to the Minister for Env. Together with the new proponent's endorsement of the Ministerial Statement	Letter and statement endorsed by the replacement proponent	overall	Minister for Env. EPA	Before transfer of ownership	C	DCH and Peet Golden Bay Pty Ltd were recognised by the OEPA as joint Proponents 1 August 2016.
297: M7-1	Time limit on approval	Seek approval to extend approval to implement proposal.	Application to be made before the end of five years (from the publish date of the Minister's statement)	Letter application	Overall	Minister for Env. EPA	Before 12 January 1998 if project has not commenced substantially	CLD	
297: M8	Compliance auditing	Prepare a periodic 'Progress and Compliance Report' to help verify the environmental performance of this project.	The report (CAR) should be an update on the project giving evidence of how compliance has been achieved. It should list each condition and commitment to be reported on showing for each: its code no. Form the audit table; what action it requires; what has been done to meet the condition or commitment including any problems that may have arisen and what the proponent has done to address them; how compliance can be verified.	CAR providing evidence of compliance for each relevant audit element in the audit table.	Overall	EPA	First report before clearing activities commence, second report one year after clearing has commenced, then as required by the OEPA.	C	OEPA has requested (Appendix 2) that from August 2016 compliance reports are to be submitted annually in August for the previous calendar year.
297: P1	Foreshore Reserve	Provide in exchange for the development of the currently proposed System 6 Area M107, additional Regional and Public Open Space adjacent the Coastal Reserve as shown in the Structure Plan, in excess to that which would normally be required by DPUD.	Duplicated by M3-1		Predevelopment	EPA, DPUD CoR	At the rezoning stage	CLD	26 October 1995 Not Audited (duplicated by condition M3-1) – Audit Branch
297: P2	Management Plan	Prepare a Management plan for the coastal reserve at Golden Bay.	In a submission to the local authority, Minster for Planning and EPA.	Management Plan for foreshore reserve to be submitted	Predevelopment	EPA, Minister for planning, local authority, DEP	before clearing/construction activities commence	CLD	Golden Bay Foreshore Management Plan approved by the OEPA on 30 March 2012 (on advice from DoP and CoR).

Audit Code	Subject	Requirement	How	Evidence	Phase	To requirements of On advice from	Timeframe	Status	Comment
									An addendum to the FMP to address the interface between the development and foreshore reserve was submitted and approved by the OEPA on 29 September 2016.
297: P3	Historic Site	Include the historic aboriginal camping site within the proposed Public Open Space for the development.	Present a submission to the local authority		Predevelopment	EPA Local Authority	before clearing/construction activities commence	CLD	13 December 1995
297: P4	Fire	Protect against Bushfire	By providing and maintaining a network of firebreaks and access tracks until the local authority takes on this responsibility	Report on this under M8	overall	EPA DEP	until the local authority takes on this responsibility	CLD	Fire Management Plan for the Golden Bay Structure Plan Area has been approved by the City of Rockingham in March 2012.
297: P5	Reticulated sewerage and stormwater drainage:	Provide reticulated sewerage and stormwater drainage designated to infiltrate stormwater into the soil within the development site.	To the satisfaction of Minister for planning and local authority	Report on this under M8	Development	EPA Minister for Planning Local Authority	During provision of services within the development	CLD	A Local Water Management Strategy (LWMS) has been prepared for the Structure Plan Area and approved by the Department of Water and the City of Rockingham. Urban Water Management Plans will be prepared in accordance with the LWMS for each stage of subdivision.
297: P6	Bandicoots	Liaise with CALM regarding the presence of bandicoots at Golden Bay and examine feasibility of relocating bandicoots if required by CALM.	Duplicated by M5			EPA CALM	Prior to any disturbance of the vegetation at Golden Bay	CLD	13 December 1995

APPENDIX 4

FORSHORE MANAGEMENT PLAN MANAGEMENT ACTION TABLE

FORESHORE MANAGEMENT PLAN

MANAGEMENT COMMITMENTS AND RESPONSIBILITIES

Compliance Status: C = Compliant, CLD = Completed, NC = Non – compliant, NR = Not Required at this stage.

Task	Responsibility	Timeframe FMP Stages	Priority	Status
Locate roads, access tracks and DUPs, and the Coastal node along existing routes where possible, or realign them to move through areas of disturbed vegetation	Developer	Stage 4	2	C
Erect temporary fencing between the Foreshore Reserve vegetation and proposed development	Developer	Stage 2	1	C
Survey and peg the Foreshore Reserve area to ensure this is protected from potential impacts of subdivision development	Developer	Stage 2	1	CLD
Replace temporary fencing in appropriate areas with a permanent barrier once earthworks have been completed, to prevent unauthorised access to areas of native vegetation (embedded limestone and native vegetation can be used for this purpose)	Developer	Stage 3	3	NR
Erect interpretative signage on access paths near the TEC to inform DUP users of the conservation value of the vegetation	Developer	Stage 4	3	NR
Maintain grassed parkland area, toilets and showers, access paths, DUPS and fences.	Developer (2 years post- construction)	Stage 3-5	3	NR

	then City of Rockingham			
Transfer of proposed Foreshore Reserve to public ownership (to the City of Rockingham)	Developer	Post Stage 5	3	NR
Machinery and vehicles will use the cleared, degraded areas for access, and must be clean on entry to the site.	Developer	Stage 2-5	2	NR
Vegetation clearing will be undertaken in weather conditions that are conducive to effective dust control.	Developer	Stage 2-5	1	NR
Wind-fencing will be used as required in conjunction with water sprays and tankers to control and limit excessive dust from earthworks operations and roads.	Developer	Stage 2-5	2	NR
The size of soil stockpiles will be limited and water or stabilising agents used to control dust.	Developer	Stage 2-5	2	NR
Soil stabilisation methods will be used to reduce the risks associated with wind erosion through the use of mulches, dust suppression agents or by revegetation as appropriate.	Developer	Stage 2-5	2	NR
Work will be planned to ensure construction or stabilisation follows demolition wherever possible.	Developer	Stage 2-5	2	NR
Dust suppression equipment and/or agents will be regularly inspected and maintained as required to prevent unacceptable dust emissions.	Developer	Stage 2-5	2	NR
Regular inspections of adjacent roads will be undertaken for dust creating materials.	Developer	Stage 2-5	2	NR

Excessive build-up of mud, debris or any other deleterious matter deposited on any road used for access to or egress from the project site will be removed.	Developer	Stage 2-5	2	NR
Construction staff will be made aware of issues relevant to dust control and will be familiar with the requirements prescribed in this management plan.	Developer	Stage 2-5	2	NR
Revegetate areas not likely to be impacted during construction as indicated in Figure 5	Developer	Stage 1	1	NR
Apply brush to large dune “blowout” area	Developer	Stage 1-3	1	NR
Revegetate areas impacted during construction with species consistent with City of Rockingham’s *Coastal Rehabilitation Policy* (CoR, 2002a)	Developer	Stage 2-5	2-3	NR
Implement a monitoring program using visual inspections and photographs to monitor the progress of revegetation plans.	Developer (2 years post- construction) then City of Rockingham	Stage 1-5 Monitoring will be undertaken on a six-monthly basis, reviewed annually	3	NR
Replace failed plants if coverage is not adequately achieved.	Developer (2 years post- construction) then City of Rockingham	As required, on a yearly basis post-construction	3	NR
Carry out a visual inspection onsite to determine the success of weed control applied as determined in above task, and establish a weed control program for the following two years.	Developer	Stage 2-5	2	NR

		Six monthly following initial weed management		
Carry out the weed control program devised in the above task. Potentially regular spot-spraying or removal by hand, done periodically over several years.	Developer (2 years post- construction) then City of Rockingham	Stage 2-5 Pre-, during and post-construction	3	NR
Erect a dog-proof fence between the residential subdivision and the Foreshore Reserve to protect Bandicoots within the conservation areas from domestic pets and feral animals.	Developer	Stage 2 During Construction	2	NR
Construct fauna access underpasses beneath paths intersecting known Bandicoot habitat vegetation.	Developer	Stage 3	2	NR
Ensure site crew are aware of the 24hr Wildcare Helpline number to call ((08) 9474 9055) in the case of wildlife being encountered during clearing of construction.	Developer	Stage 2-5	2	C
Erect signage indicating the conservation status of the Bandicoot nearby to their known habitat areas.	Developer	Stage 4	3	NR
Educate landowners on the effect of domestic animals on native fauna, such as by erecting signs addressing responsible pet ownership and protection of habitat for Bandicoot. Signs should also include information on the general biology of Bandicoots.	Developer (2 years post- construction) then City of Rockingham	Stage 3-5	2	NR
Consider seeking community consent for the trapping of cats (particularly after Bandicoot breeding) within conservation areas in the Foreshore Reserve	Developer (2 years post- construction)	Ongoing	3	NR

	then City of Rockingham			
Conserve and rehabilitate any good quality, dense wetland habitat which is planned for protection and provides protection for Bandicoots. The addition of further vegetation and cover (such as hollow logs) may assist with the survival of Bandicoot within protected areas at the Golden Bay site. (Such management actions should continue in parallel with the population monitoring.)	Developer (2 years post- construction) then City of Rockingham	Ongoing	1	C TEC19a Photo Point Monitoring Survey
Undertake an annual bandicoot trapping survey of seven nights in spring and autumn each year within the Foreshore Reserve (targeting conservation areas with known Bandicoot habitat).	Developer	Stage 2-5 During construction and for a period of 2 years post-construction.	1	C Bandicoot Monitoring Survey
Continue to rehabilitate areas degraded as a result of construction and implement weed control.	Developer (2 years post- construction) then City of Rockingham	Ongoing	3	NR
Removal of debris from bandicoot underpasses to prevent blockages.	Developer (2 years post- construction) then City of Rockingham	Ongoing (monthly)	3	NR
Remove all rubbish from conservation areas.	Developer (2 years post- construction) then City of Rockingham	Ongoing (monthly)	3	NR

Have regard to the Aboriginal Heritage site reserve boundary and erect signage to indicate the significance of the site.	Developer	Stage 1-5 Construction	2	C
Ensure adequate provision of emergency vehicle access through the Foreshore Reserve.	Developer	Ongoing	2	C
Provide suitable drainage infrastructure such as soakwells for hardstand areas (e.g. Car parks)	Developer	Stage 2-5 Construction	2	NR
Provision of passive surveillance such as lighting within the Foreshore Reserve.	Developer	Stage 2-5 Construction	2	NR

APPENDIX 5

TEC19A PHOTO POINT MONITORING SURVEY

GOLDEN BAY FORESHORE RESERVE

2016 VEGETATION PHOTO POINT MONITORING REPORT

Prepared for:	Peet Golden Bay Pty Ltd and Department of Communities and Housing
Report Date:	30 August 2017
Version:	1
Report No.	2017-336

pgv ENVIRONMENTAL

CONTENTS

LIST OF ATTACHMENTS

1 INTRODUCTION

1.1 Background

The urban development of Lots 2 and 3, Golden Bay was subject to a Public Environmental Review (EPA Assessment 604) and was approved in Ministerial Statement 297 in January 1993 (Appendix A). Ministerial Statement 297 contains three conditions relevant to the Foreshore Reserve at Golden Bay as follows:

> *Condition 3-1 The proponent shall provide a foreshore reserve for the conservation and recreation which:*
>
> > *1 Protects the Peelhurst wetlands and the Southern Brown Bandicoot (Isoodon obesulus) population; and*
> >
> > *2 Includes landscape and recreation values at least equivalent to this proposal which is within System 6 Recommendation M106 Area.*
>
> *Commitment P-2 The proponent will prepare a Management Plan for the Coastal Reserve at Golden Bay prior to development commencing. This will be done to the satisfaction of the DPUD* [now Department of Planning, Lands and Heritage] *and the Local Authority.*

1.2 Location

The Golden Bay Foreshore Reserve (the study area) is situated 50km south of Perth and 16km south of the Rockingham Town Centre, within the City of Rockingham (Figure 1). The site is bounded by Secret Harbour to the north, the developing residential area on Lots 2 Warnbro Sound Avenue to the east and the existing Golden Bay Township to the south.Foreshore Reserve Description

The Foreshore Reserve covers an area of approximately 10.61ha, is 800m in length and incorporates the beach, foredune and near-coastal dune systems. The width of the reserve from the back of the beach to its eastern extent ranges between approximately 400m (centre), 200m (southern end) and 250m (northern end). The western boundary of the reserve is marked by the high-water mark, the northern and southern boundaries in line with the northern and southern Lot 2 property boundaries and the eastern boundary marks the western limit of urban zoning. The extent of the reserve is shown in Figure 3.

1.2.1 Foreshore Reserve Ecological Values

The Foreshore Reserve contains wetlands that belong to the Peelhurst suite of wetlands. These wetlands form in low lying depressions within the Quindalup Dunes which have intercepted the water table and are typically small, seasonally inundated sumplands or seasonally wet damplands. The Golden Bay wetlands have been listed as Conservation Category in the *Geomorphic Wetlands of the Swan Coastal Plain* database.

The Threatened Ecological Community (TEC) 19a *Sedgelands in Holocene Dune Swales* is located in all the wetlands in the Foreshore Reserve at Golden Bay. This TEC is listed as “Critically Endangered”

under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and is also recognised as a TEC at State level.

The vegetation in the Foreshore Reserve supports a population of Southern Brown Bandicoot (*Isoodon obesulus fusciventer*). Bandicoots have been identified as a species of state significance and are listed as a Priority 5 species by the Department of Biodiversity Conservation and Attractions (DBCA).

An indigenous heritage site (DIA 2519) is located in the southern end of the Foreshore Reserve.

1.3 Report Purpose

A Foreshore Management Plan (FMP) was prepared for the study area by the developers of Lot 2 Warnbro Sound Ave (Peet Golden Bay Pty Ltd and Department of Housing) and approved on 30 March 2012. An addendum to the FMP to address the interface between the development and foreshore reserve was submitted and approved by the OEPA on 29 September 2016.

The FMP contained a commitment to monitor the health of the vegetation in the wetlands using permanent photo points.

The initial photo point monitoring assessment was conducted in October 2012. This report documents the methods and results of the annual photo point monitoring undertaken in the Golden Bay Foreshore Reserve over the period from 2012 to 2016.

The objectives of the photo point monitoring report are to:

- Provide a qualitative assessment of the condition of the TEC19a vegetation in the wetlands;
- Assess any requirement for weeding;
- Assess any requirement for grazing control; and
- Determine if any erosion control is required.

2 EXISTING ENVIRONMENT

2.1 Topography

The topography of the Foreshore Reserve ranges from 1 to 10m AHD. The dunes closest to the coast are part of a recent parallel dune ridge system with dune crests up to 5-6m AHD. The eastern half of the Foreshore Reserve contains a low linear flat swale at an elevation of 1-2m AHD with some taller dunes up to 10m AHD.

2.2 Wetlands

The eastern half of the Foreshore Reserve contains a number of small wetlands within the flat swale directly behind the frontal dunes. The wetlands are described as sumplands and contain shallow freshwater above-ground in spring during an average rainfall season. The wetlands are rated as Conservation Category wetlands.

2.3 Vegetation

The Foreshore Reserve was subject to a bushfire on 1 January 2016. The fire was reported as being ignited by fireworks/boat flares. The area of the Foreshore Reserve impacted by the fire was estimated to be approximately 7ha. The northern section was burnt in patches and the eastern part of the central section was largely burnt.

The area burnt by the 1 January bushfire is being monitored in accordance with the FRP to assess the progress of regeneration. The monitoring will determine whether any supplementary planting will be required to assist regeneration and whether any weed control needs to be undertaken during the recovery period. The Post Fire Vegetation Monitoring Baseline Survey results are provided in Appendix 8 of the Compliance Report 2016.

2.3.1 Vegetation Types

A variety of coastal Quindalup vegetation types occur in the Foreshore Reserve as listed below:

Western Half

- *Spinifex hirsutus* Grassland: Located on the foredune with *Spinifex longifolius, Tetragonia decumbens* and *Cakile maritima* present on the seaward facing slopes and *Ficinia nodosa* and *Carpobrotus virescens* frequent near the crest and leeward sides.
- *Olearia axillaris* Shrubland: Located immediately behind the foredune and forms a wide band parallel to the coast, containing *Cassytha* sp., *Pelargonium capitatum* and *Trachyandra divaricata*. It grades into the *Spyridium globulosum* Open Heath.
- *Spyridium globulosum* Open Heath: Located on the lower dunes and containing *Acacia cyclops, Hibbertia cuneiformis, Alyxia buxifolia, Pelargonium capitatum* and the creeper *Hardenbergia comptoniana*.

Eastern Half

- *Acacia rostellifera/Spyridium globulosum* Closed Shrub: An intermediate unit located in the central part of the site.

- *Juncus kraussii* Sedgeland: Located within the eastern low linear flat swale in the wetland areas, containing *Baumea juncea, Centella asiatica, Ficinia nodosa, Dampiera alata* and *Lepidosperma gladiatum.* Three isolated, mature Paperbark trees (*Melaleuca rhaphiophylla* and *Melaleuca cuticularis*) also occur in the wetlands.
- *Spyridium globulosum* Closed Heath: Making up the majority of the transitional vegetation on slightly higher ground within the swale, it contains similar species to the *Spyridium globulosum* Open Heath on the low dunes and additionally a dense ground coverage of the Sword Sedge *Lepidosperma gladiatum*.

The *Juncus kraussii* Sedgeland generally describes the vegetation in the wetlands.

2.3.2 Vegetation Condition

The vegetation in most of the Foreshore Reserve was rated as mostly being in Excellent condition with only a few tracks through it. Some wetland areas had previously been impacted by off road vehicles. These tracks have been closed off to allow for natural regeneration of the wetlands.

A weed survey of the Foreshore Reserve conducted by PGV Environmental in May 2015, identified the most prevalent introduced species in the area as Rose Pelargonium (*Pelargonium capitatum*) and False Onion Weed (*Trachyandra divaricata*). Both species were more common on the western part of the Foreshore Reserve on sand dunes than in the eastern swales. Hares Tail Grass *(Lagurus ovatus)* and Geraldton Carnation Weed *(Euphorbia terracina)* were also present in parts of the Foreshore Reserve.

The wetlands on the site contained few weeds.

2.4 Native Fauna

The Foreshore Reserve at Golden Bay contains a population of Southern Brown Bandicoots (*Isoodon obesulus*). The size and health of the Bandicoot population has been monitored by the developers for 5 years. The number of Bandicoots surveyed in the foreshore reserve was reduced in 2016 most likely due to the fire event and predation.

The Foreshore Reserve contains an itinerant population of Western Grey Kangaroos (*Macropus fuliginosus*) that moves within the foreshore reserves north and south of Golden Bay. The presence of kangaroos may impact on the vegetation in the Foreshore Reserve, especially as the native vegetation in the adjoining urban area is removed.

The condition of the wetland vegetation may be impacted by kangaroos moving through or resting in the dense sedgelands. Management of the kangaroo population is not limited to Golden Bay as they range up and down the coastal corridor. A global approach across multiple land managers may be required if the number of kangaroos needs to be managed.

2.5 Pest Fauna

The Foreshore Reserve contains a large number of rabbits as evidenced by the amount of rabbit droppings, diggings and a burrow.Foxes and feral cats are known to occur in the Foreshore Reserve. Fox and cat trapping was undertaken post the fire event.

3 MONTORING RESULTS

3.1 Photo Point Monitoring

Photo point monitoring was undertaken on 25 September 2016 at the eight monitoring sites established in the wetland vegetation in 2012 (Plate 1). Sites 5 and 7 have been combined into one site due to their proximity (4m apart).

Four photos (east, north, west, south) were taken from the permanent photo points which are marked with a metal dropper and flagging tape. The location of markers is recorded in eastings and northings as shown in Table 1 and shown in Plate 1.

Table 1: Photo Point Locations.

Site	Eastings	Northings
1	382526.47	6411985.56
2	382499.95	6412041.62
3	382544.18	6412057.23
4	382496.77	6412180.17
5	382463.035	6412272.17
6	382507.72	6412293.34
7		
8	382458	641236

3.2 Condition Assessment Method

The condition of the vegetation in the wetland areas was assessed using key indicators to facilitate comparison between the results from different years. A number of indicators were considered in the condition assessment, each of which were allocated a score using a three-point scoring system of 1 to 3 (Table 2). Relevant comments on condition indicators were also recorded as supplementary information. The scoring system will enable broad comparison over time between results, however, due to the subjective nature of the method, the scores are indicative only.

The nature of many of the indicators for the condition assessment is such that they will not change over the short term, for example surface water and fire history. The attributes most likely to change over time include weed invasion, grazing and flattening.

A standard proforma is used to document the condition assessment to ensure consistency across the subsequent monitoring events. The proforma is provided at Appendix 1.

Table 2: Condition Indicators

Indicator	Rating	Measure
Grazing	1	Severe/heavy
	2	moderate (limited but evident)
	3	

		nil very low
Clearing	1	30% +cleared
	2	10-30% cleared
	3	<10% cleared
Weeds	1	30% +cover
	2	1-30% cover
	3	<10% cover
Erosion	1	severe impacting >30% of site
	2	moderate (limited but evident)
	3	nil very low (minimal impact)
Fire History	1	<10 years
	2	10 to 20 years
	3	>20 years
Surface Water	1	Damp at Surface
	2	<10cm
	3	>10cm

Plate 1: Photo Point Locations

3.3 Condition Assessment Results

The results of the qualitative condition assessment for each monitoring point are provided in Table 3. The condition assessment photos are shown in Appendix 2.

Seven of the eight monitoring sites were damp at the surface but did not contain any above ground water. Site 1 contained some (<10cm depth) surface water. This is similar to the results for 2015 where none of the sites contained above ground water but apparently drier than the 2012 results where four of the sites were inundated. The groundwater levels in the two monitoring bores in the foreshore wetlands showed maximum levels of around 1.1m AHD in October 2016 (Appendix 3). This is higher or the same level as the preceding 3 years (2013-2015) but slightly lower than the level for bore WB02 in 2012 (1.27m AHD).

There was a decrease in the number of kangaroo trails and resting places through the wetlands as the sedges were resprouting and the vegetation surrounding the wetlands was burnt and did not provide any shelter. Site 1 had a similar number of tracks as the previous year. There was evidence of grazing on the new sedges in Sites 2, 4, 5, 6, 7 and 8.

Weed invasion has not changed significantly since 2012.

Erosion rating has not changed significantly since 2012.

Site 3 is a wetland that has had a 4WD track through it for many years and, as such, started with a low condition score and high rating for clearing. Site 3 had evidence of additional clearing either during or post fire. An area of approximately 0.2ha of burnt scrub has been pushed flat possibly during the fire to allow for fire fighting vehicles to turn around.

Table 3: Condition Assessment (2015)

Condition Attribute	Site	1	2	3	4	5	6	7	8
Grazing/flattening by rabbits or kangaroos	2016	2	3	3	3	3	3	3	3
	2015	2	2	2	2	2	3	2	3
	2012	1	2	3	3	3	3	3	2
Clearing	2016	3	3	1	2	2	2	2	2
	2015	3	3	1	3	3	2	3	3
	2012	3	3	1	3	3	1	3	2
Weed Invasion	2016	3	3	2	2	2	2	2	2
	2015	3	3	2	3	2	2	3	3
	2012	3	3	2	3	3	2	3	2
Erosion	2016	3	3	1	3	3	3	3	3
	2015	3	3	2	3	3	3	3	3
	2012	3	3	1	3	3	2	3	2
Fire History	2016	2	1	1	1	1	1	1	1
	2015	2	2	2	2	2	1	2	2

	2012	2	2	2	2	2	2	2	2
Surface Water	2016	2	1	1	1	1	1	1	1
	2015	1	1	1	1	1	1	1	1
	2012	2	1	1	1	2	1	2	2

3.4 Photo Point Monitoring Results

The full set of photos for each site year 2016 is provided in Appendix 2.

3.4.1 Site 1

Comparison of photos from 2015 and 2016 showed that there was similar damage by kangaroos passing through and/or sleeping in the wetland at Site 1. There was less than 10cm of standing water in the wetland. The previous year there was no standing water.

Plate 2: Year 2015

Plate 3: Year 2016

3.4.2 Site 2

Comparison of photos from 2015 and 2016 shows the impact of the fire on Site 2. The sedges in the wetland have regrown to approximately 40cm in height. There was some evidence of the surrounding vegetation regenerating. The wetland was less damp than previous years and there was some evidence of dumping of household waste.

Plate 4: Year 2015

Plate 5: Year 2016

3.4.3 Site 3

Comparison of photos from 2015 and 2016 showed the impact of the fire to the north of the track. The vegetation south of the track was not burnt. There was evidence of dumping of household waste including asbestos-bearing material. There was evidence of some clearing north of the track between sites 2 and 3.

Plate 6: Year 2015

Plate 7: Year 2016

3.4.4 Site 4

Comparison of photos from 2015 and 2016 shows the impact of the fire which burnt through the wetland and surrounding vegetation. The sedges in the wetland have regenerated and were approximately 20-30cm in height. The wetland was less damp than previous years and there was evidence of increase of kangaroos passing through the wetland.

Plate 8: Year 2015

Plate 9: Year 2016

3.4.5 Site 5

Comparison of photos from 2015 and 2016 shows the impact of the fire on the wetland and surrounding vegetation. The wetland was less damp than previous years with no water at the surface and there was some evidence of kangaroos passing through the sedges.

Plate 10: Year 2015

Plate 11: Year 2016

3.4.6 Site 6

Comparison of photos from 2015 and 2016 shows the impact of the fire.

Plate 12: Year 2015

Plate 13: Year 2016

3.4.7 Site 8

Comparison of photos from 2015 and 2016 shows the impact of the fire. There was no standing water in the wetland.

Plate 14: Year 2015

Plate 15: Year 2016

4 CONCLUSIONS

The photo monitoring of vegetation in the wetlands of the Golden Bay Foreshore Reserve shows the impact of the fire on 1 January 2016. The sedges in the wetlands have regrown and there is regeneration in the surrounding vegetation.

There has been little change in the condition of the wetland in site 1 which wasn't impacted by the fire.

The impact of the fire in increasing weeds in the fire-affected areas is being monitored and, if required, weed control will be implemented.

There is continued evidence of kangaroos passing through the wetlands and some evidence of grazing on the new sedges. The impact of kangaroos on the vegetation will be monitored further. If the impact is considered to be having long-term adverse effects, a programme to remove the kangaroos from the Foreshore Reserve will need to be investigated. Any kangaroo management in the Foreshore Reserve, however, will need to be a collaborative effort between all developers in the area, the City of Rockingham and the Department of Parks and Wildlife.

5 REFERENCES

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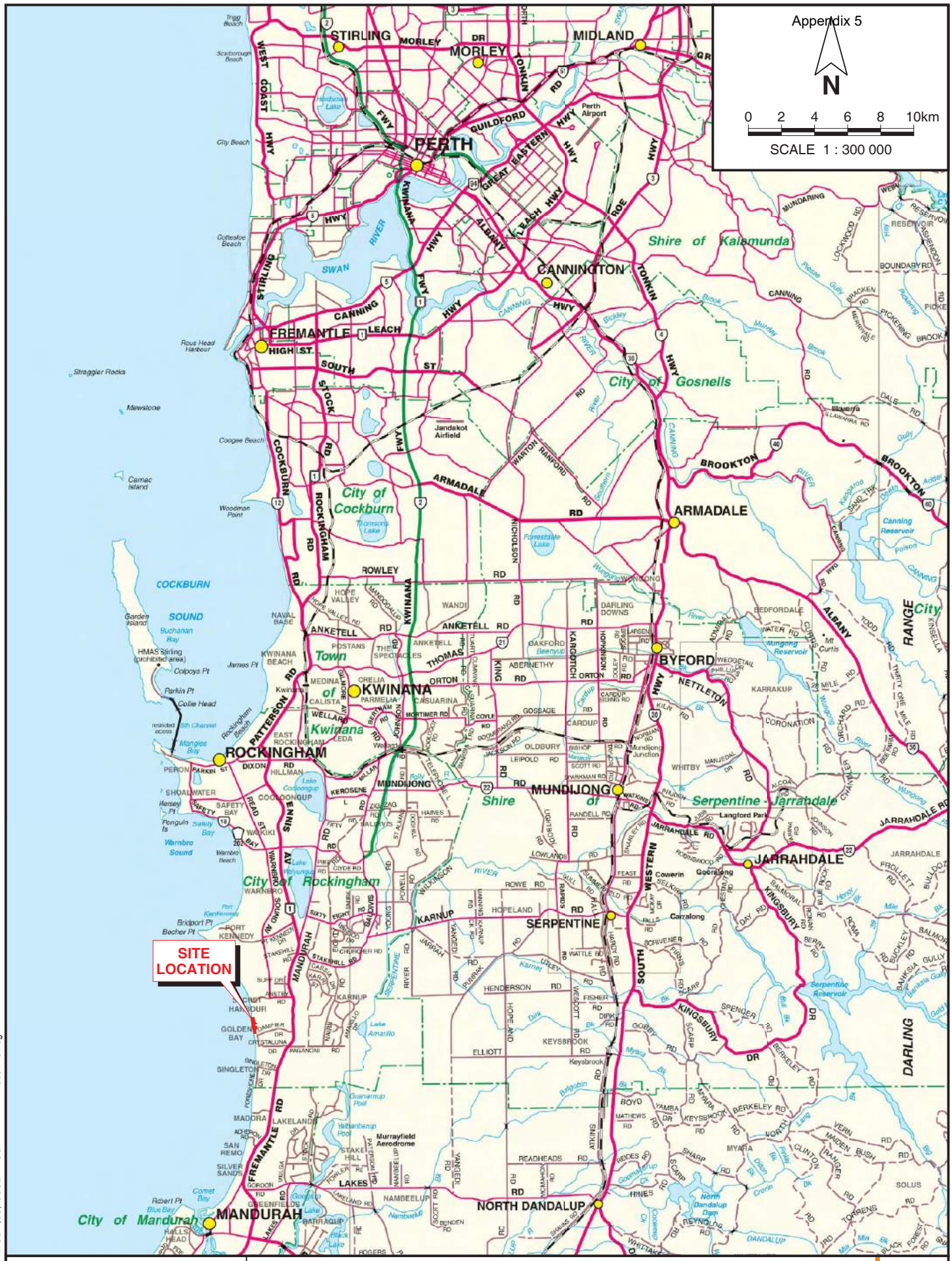
FIGURES



PINPOINT CARTOGRAPHICS (08) 9562 7136 10004-f01.dgn

pgv ENVIRONMENTAL

Department of Housing
VEGETATION PHOTO POINT MONITORING REPORT
GOLDEN BAY

Drawn: B. Heath	Date: 10 Aug 2011
Job: 10004	Revision: A

REGIONAL LOCATION

Figure 1

CADASTRAL SOURCE: Landgate, May 2015.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown September 2015.

pgv ENVIRONMENTAL

Department of Housing and Peet Golden Bay Pty Ltd
VEGETATION PHOTO POINT MONITORING REPORT
LOT 2 WARNBRO SOUND AVENUE, GOLDEN BAY FORESHORE RESERVE

Drawn: J-M. Ward	Date: 22 Mar 2016
Job: 10004 Rpt: 2015-207	Revision: A

WETLAND AND TEC MAPPING

Figure 2

APPENDIX 1

SITE ASSESSMENT PROFORMA

Site No.	**Recorder (s)**		**Date**	
GPS Point	**Easting**		**Northing**	
Fencing: fully/partial/not fenced	**Current Land Use**			
Monitoring Photos No. (taken from Stake)	**East**	**South**	**West**	**North**
Position of Marker in TEC				
Attribute of Site	**Score**	**Comments**		
Grazing				
1 = severe/heavy				
2= moderate (limited but evident)				
3=nil very low				
Clearing				
1 = 30% + cleared				
2 = 10-30% cleared				
3 = <10% cleared				
Weed Invasion				
1 = 30% + cover				
2 = 1--30%				
3 = <10%				
Erosion				
1 = severe impacting >30% of site				
2= moderate (limited but evident)				
3=nil very low (minimal impact)				
Fire History				
1 = <20 years				
2 = 20-50 years				
3 = > 50 years				
Surface Water				
1 = Damp at surface (no standing water)				
2 = < 10cm				
3 = >10cm				

APPENDIX 2

SITE PHOTOS

Site Photos 2015 – Taken from permanent marker in each of the wetlands

Site 1

382526.47 m E **6411985.564 m S**

-32 25 22.93 **115 45 2.08**

Plate 1: Looking East

Plate 2: Looking south

Plate 3: Looking west

Plate 4: Looking north

Site 2

382499.953m E **6412041.616m N**

32 25 21.10 **115 45 1.90**

Plate 5: Looking East

Plate 6: Looking south

Plate 7 Looking west

Plate 8: Looking north

Site 3

382544.179 m E **6412057.225 m S**

32 25 20.61 **115 45 2.79**

Plate 9: Looking East

Plate 10: Looking south

Plate 11: Looking west

Plate 12: Looking north

Site 4

382496.765 m E **6412180.174 m S**

32 25 16.6 **115 45 1.03**

Plate 13: Looking East

Plate 14: Looking south

Plate 15 Looking west

Plate 16: Looking north

Site 5 and 7 combined

384030.222m E **6412290.389m S**

32 25 13.6 **115 44 59.78**

Plate 17: Looking East

Plate 18: Looking south

Plate 19: Looking west

Plate 20: Looking north

Site 6 -

382507.72 m E **6412293.335 m S**

32 25 12.93 **115 45 1.5**

Plate 21: Looking East

Plate 22: Looking south

Plate 23 Looking west

Plate 24: Looking north

Site 7

384030.222m E **6412290.389m S**

32 25 13.6 **115 44 59.78**

Plate 25: Looking East

Plate 26: Looking south

Plate 27 Looking west

Plate 28: Looking north

Site 8

382458.00 m E **6412346.00 m S**

Plate 29: Looking East

Plate 30: Looking south

Plate 31: Looking west

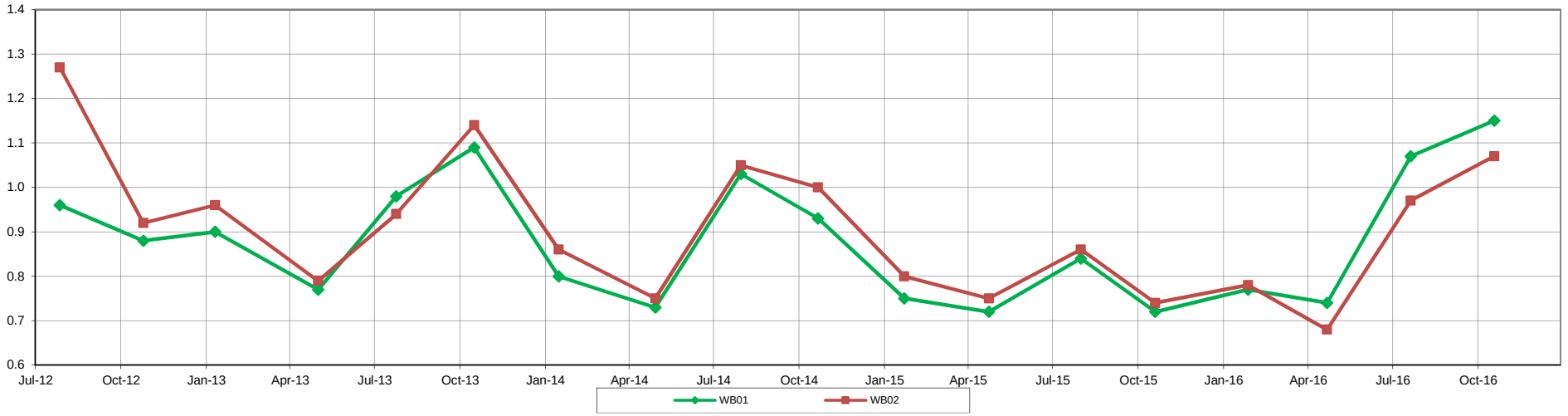
Plate 32: Looking north

APPENDIX 3

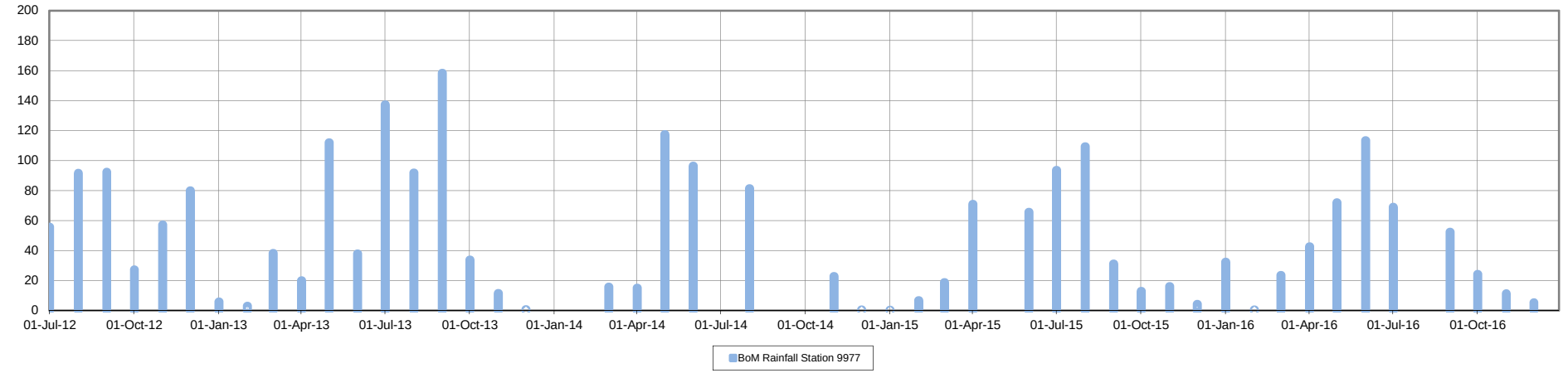
GROUNDWATER LEVELS IN WETLAND BORES

Wetland Bores - Groundwater Levels 2016

Groundwater Levels (mAHD)



Rainfall (mm)



Job No. J6464

PEET / Dept of Housing
Golden Bay Groundwater Monitoring
Figure 1: Groundwater Levels in Wetland Bores

APPENDIX 6

SOUTHERN BROWN BANDICOOT MONITORING SURVEY REPORTS

Southern Brown Bandicoot Monitoring
Golden Bay
Spring 2016

Version 1. October 2016

Prepared for:

Peet Ltd
Level 7
200 St Georges Terrace
Perth WA 6000

By:

Terrestrial Ecosystems
10 Houston Place
Mt Claremont
WA 6010

Record of Distribution

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
Electronic	2016-0053-002-st V1	Final	25 October 2016	Peet Ltd and Department of Housing	ST

Disclaimer

Front Cover: Southern Brown Bandicoot showing its digging front feet (*Isoodon obesulus fusciventer*)

Contents

1 INTRODUCTION

Peet Ltd, on behalf of the Peet Ltd and the Department of Housing, requested a follow up monitoring survey of the Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) population in the Foreshore Reserve adjacent to Lot 2, Warnbro Sound Ave, Golden Bay (i.e. 'project area'). This follows on from an initial survey in spring 2012 and monitoring surveys in autumn and winter of 2013 and 2014, autumn and spring 2015 and autumn 2016. Southern Brown Bandicoot monitoring is a requirement under the Ministerial Statement 150 and compliance reports will be provided to the Office of the Environmental Protection Authority on an annual basis.

The Foreshore Reserve includes the fore dune and swale, and the hinterland vegetation inland for about 400m from the ocean (Figure 1). The Foreshore Reserve includes a Conservation Category Wetland and a Threatened Ecological Community (TEC) that supports dense vegetation. There project area was extensively burnt in January 2016 and the only continuous habitat remains at the southern end of the area. There are patches of unburnt habitat spread throughout the burnt area, however, none of these were considered substantial enough to maintain resident Southern Brown Bandicoots. Vegetation clearing is now within 10m of the Foreshore Reserve in the central and northern sections.

There is a sand track that runs the length of the Reserve east of the fore dune and along the fence line, with numerous tracks running at right angles to the beach in the southern section. Closer to the beach is a sand track used by walkers that runs parallel to the beach. In July 2013, a firebreak was cleared near the eastern boundary of the Foreshore Reserve, but this has now mostly disappeared and is part of the cleared area.

The developer, Peet in conjunction with the Department of Housing, is clearing the vegetation and developing residential lots to the east of the Foreshore Reserve. Past monitoring indicated that Southern Brown Bandicoots in the Foreshore Reserve were moving freely between the remaining areas to be cleared and the Foreshore Reserve. The majority of the vegetation clearing was completed in July 2016 and a small patch of habitat remains in the south-west corner (Figure 1).

1.1 Scope of this Southern Brown Bandicoot survey for long-term monitoring

The Foreshore Reserve will remain public open space and the developer has made a commitment to monitor the health of the Southern Brown Bandicoot population on a twice yearly basis during the construction and development stages (PGV Environmental 2011).

Coffey Environments recorded eight Southern Brown Bandicoots in the Reserve during its survey in mid-February 2010 (PGV Environmental 2011). It was reported that Southern Brown Bandicoots preferred scrubby, often swampy vegetation with a dense understorey of cover up to one metre high. The TEC and wetland areas within the Foreshore Reserve were considered suitable habitat to sustain a bandicoot population in the long-term (PGV Environmental 2011).

A Southern Brown Bandicoot relocation program has being undertaken for each stage of development prior to vegetation clearing from Lot 2, Warnbro Sound Ave and Lot 3, Dampier Drive as required under Ministerial Statement 150. This program was implemented to minimise the impact of vegetation clearing on bandicoots residing in these lots. All bandicoots caught prior to the last vegetation clearing program in July 2016 were relocated as there would have been insufficient habitat remaining to sustain this population given the area that had been burnt in January 2016.

The results of seven previous monitoring surveys are shown in Table 1.

Table 1. Number of Southern Brown Bandicoots in the previous monitoring programs

	Spring 2012	Winter 2013	Spring 2013	Winter 2014	Spring 2014	Autumn 2015	Spring 2015	Autumn 2016
# of indiv. captured	31	30	28	39	48	53	36	26
# of males	13	10	7	12	10	16	14	8
# of females	15	20	21	27	25	34	22	18
# of juveniles	3	-	-	1	12	3	6	-

This report provides the outcomes of the ninth monitoring survey of Southern Brown Bandicoots in the Foreshore Reserve.

2 BIOLOGY AND ECOLOGY OF SOUTHERN BROWN BANDICOOTS

The Southern Brown Bandicoot (*I. obesulus*) is a medium-sized, ground-dwelling marsupial that belongs to the Peramelidae family (Van Dyck and Strahan 2008). Populations of Southern Brown Bandicoots occur widely throughout southern Australia (Rees and Paull 2000, Van Dyck and Strahan 2008).

Isoodon obesulus fusciventer is the Western Australian subspecies and it was listed as a Schedule 1 species (Fauna that is rare or likely to become extinct) under the Western Australian *Wildlife Conservation Act 1950* until 1998. An increase in the population, which was attributed to the implementation of fox baiting throughout the state, meant that in 1998 the Southern Brown Bandicoot was removed from the threatened species list. The Southern Brown Bandicoot is now listed as a Priority 4 species ('Taxa in need of monitoring') on the Department of Parks and Wildlife's (DPaWs) Priority Fauna List.

Southern Brown Bandicoots are found in the wetter sections of the south-west of Western Australia, mostly along the Swan Coastal Plain from the Moore River to Walpole and the Fitzgerald River area. Populations of Southern Brown Bandicoots are found in a variety of habitats in this region, and appear to be able to survive a level of habitat destruction and live in close proximity to urban and industrial developments. The Southern Brown Bandicoot prefers habitats with a dense shrub understorey up to one metre high, but they are found in a variety of habitats including Banksia, Eucalypt and Melaleuca woodlands, but most often in close proximity to a wetland where the vegetation is often more dense (Stoddard and Braithwaiter 1979, Ramalho et al. 2013). In areas of thick undergrowth, Southern Brown Bandicoots are able to establish runways that are difficult to detect beneath the interlocking vegetation (Craven 1981). They are vulnerable to cat, fox and dog predation and are occasionally seen dead on the roads in urban environments, with the result that they are increasingly under threat due to the clearing of bushland leading to habitat fragmentation, bushland degradation and predation by introduced predators including foxes, cats and dogs (Friend 1991).

The Southern Brown Bandicoot is both nocturnal and diurnal, but are mostly active during the day early in the morning or late afternoon (Van Dyck and Strahan 2008). Individuals are mostly solitary, but with overlapping home ranges. The home range size of Southern Brown Bandicoots decreases with increasing population size (Broughton and Dickman 1991). The smallest home range estimates of 2.1ha for males and 1.4ha for females were recorded for a high density population (1.3 – 1.4 animals ha^{-1}) on Franklin Island, South Australia (Copley et al. 1990). The largest home range estimates of 5.3ha for males and 2.3ha for females and were calculated for a low density population (0.07 – 0.2 animals ha^{-1}) in Tasmania (Heinsohn 1966). A recent study of Southern Brown Bandicoots in the Perth metropolitan area found that the animals' increased their home range size and grazed in more open habitats in areas when predator control was implemented, compared to areas where there was no predator control (Gardner 2004).

Southern Brown Bandicoots are omnivorous, feeding on invertebrates (including earthworms, beetles and larvae), underground fungi, subterranean plant material, and occasionally small vertebrates such as lizards (Broughton and Dickman 1991). Southern Brown Bandicoots build a nest consisting of a heap of ground litter over a shallow depression providing an internal chamber with loose regions at both ends for entry and exit. The dense vegetation probably protects the nest from extremes in temperature and wind, rain and predators.

Heinsohn (1966) reported Southern Brown Bandicoots reach sexual maturity at five to six months of age when they weigh approximately 600g. As males produce sperm throughout the year, it is the reproductive activity of the female that determines the beginning and length of the breeding season (Heinsohn 1966). Breeding peaks in spring (Thomas 1987, Mallick et al. 1998) and females have a gestation period of 12 to 13 days and litters of one to six young are produced, although litters of two to four are most common. Two or three litters may be reared during a single breeding season, although this is dependent upon the availability of food resources (Friend 1991, Mallick et al. 1998) and rainfall (Barnes and Gemmell 1984).

Studies have reported the sex ratio of Southern Brown Bandicoot populations to be from 1.7 males to one female to 0.33 males to one female (Craven 1981, Thomas 1987, Mallick et al. 1998). The lifespan of the Southern Brown Bandicoot in the wild is estimated to be two to three years (Craven 1981).

3 METHODOLOGY

Sixty-eight baited wire cage traps were set in locations shown in Figure 1 (Appendix A). Cage traps were baited with a peanut butter sandwich and were set for seven nights between 9-16 October 2016. Traps were located in the vegetated areas that were likely to support Southern Brown Bandicoots. The layout of traps was different to that in previous surveys due to the fire in January 2016 and vegetation clearing in July 2016. Traps were baited when they were opened, when they had no bait and on every other day if they had bait. In addition, there were 15 large cage traps baited with sardines which were targeting feral cats. These traps were open during the monitoring period. All traps had a hessian cover and were placed under vegetation. Traps were cleared from first light each morning. Staff in the Department of Parks and Wildlife (DPaW) requested that tissue samples were taken from caught bandicoots, which was done and the tissue samples will be given to DPaW at a later date. Southern Brown Bandicoot scats were also collected for a Murdoch University research program.

Trapping was conducted under License SF010600. All Southern Brown Bandicoots that had not previously been caught had a microchip inserted on the dorsal surface near the shoulder blades. Captured bandicoots were identified and released near their site of capture.

3.1 Data analysis

Trap success rate was determined by dividing the trapping effort by the number of bandicoots caught per trap-night. There were 68 ordinary cage traps specifically targeting Southern Brown Bandicoots and an additional 15 larger cage traps targeting cats which also caught Southern Brown Bandicoots. The total trapping effort is therefore 581 trap nights. Trapping data are compared with previous survey data.

3.2 Signs

As recommended in the winter 2014 monitoring report (Terrestrial Ecosystems 2014) signs (Plate 1) were prepared by Peet and placed on each track leading into the survey area. These signs were designed to reduce the number of people and dogs interfering with traps and captured bandicoots. In addition, flagging tape and signs indicating that a feral animal trapping program was in progress were also deployed.

Plate 1. Sign placed near the end of an access track

4 RESULTS AND DISCUSSION

4.1 Survey monitoring

The Southern Brown Bandicoot trapping results are as shown in Table 2. Twelve individual bandicoots were caught with three adult females and three adult males, with two of the females carrying pouch young. Four female bandicoots weighing 60g, and a male and a female each weighing 380g were captured (i.e. juveniles). Including non-target captures the trapping success was 13.4% and for bandicoots only it was 6.4%.

Eleven of the 12 bandicoots captured during this survey were new to the monitoring program. This might have been expected, as all bandicoots captured prior to the vegetation clearing program in July 2016 were relocated off-site. The Southern Brown Bandicoot that had been caught in the previous monitoring program was caught every day during this survey, indicating it had become accustomed to the bait and not afraid of the traps.

In addition to the Southern Brown Bandicoots, cat (*Felis catus*), rats (*Rattus rattus*), bobtails (*Tiliqua rugosa*), rabbit (*Oryctolagus cuniculus*), house mouse (*Mus musculus*) and Western blue-tongued lizard (*Tiliqua occipitalis*) were caught in the traps.

Prior to the trapping program there was one fox active in the area, however, there were no signs of this fox after the trapping commenced. One large female cat was caught in the concurrently operated feral and pest management program. No cat tracks were recorded after this capture indicating no other cats are present. This will make a significant difference to improving the chances of the Southern Brown Bandicoot population remaining viable while the burnt bushland rehabilitates.

The rabbit population is quite low after the fire but expected to increase as the new vegetation emerges in the foreshore reserve next winter. Maintaining a low rabbit population in the short-term may be beneficial in taking the predation pressure off the Southern Brown Bandicoots (Pedler et al. 2016). Kangaroos were seen on multiple occasions, and move through the burnt and unburnt areas. They are also seen feeding in the nearby residential areas. The movement of kangaroos into the residential area may be due to a lack of sufficient foraging areas.

Impacts on the trapping program

Baits taken by House Mice (*M. musculus*), rats (*R. rattus*) and bobtails reduced the number of Southern Brown Bandicoots caught as these animals take the bait and cause traps to be closed stopping the capture of bandicoots. This is an unavoidable aspect of using bait that attracts multiple species. All non-native species were euthanased.

There were no disturbances by residents that would impact on the results of this survey.

Status of the population

The total number of Southern Brown Bandicoots caught during this monitoring program (12) was substantially less than during autumn 2016 (26), spring 2015 (36) and autumn 2015 (56 bandicoots; see Table 1). This decline was expected after there were signs of a progressive decline in population in spring 2015 but particularly after the January 2016 fire burnt most of the available habitat and opened up the area to increased predation by cats and foxes, and then the majority of the remaining unburnt vegetation was cleared in July 2016.

As a result of the limited available habitat, any bandicoots that remain in the foreshore reserve will be concentrated into one small area until the vegetation in the burnt area can re-establish. As all of the traps were also confined to this same area we are confident that most of the bandicoots were caught.

Two females had pouched young which is promising for the establishment of a bandicoot population and four of the newly captured animals weighed less than 100g indicating that recruitment is occurring. Mortality of young has been very high, and surveys in the past three years have indicated that only a small proportion of juveniles in the size range of 100-300g survive to adulthood.

Continuing the management program for foxes and cats is critical to maintaining a viable population of Southern Brown Bandicoots in the Foreshore Reserve.

Western Grey Kangaroos

There are about 11 Western Grey Kangaroos in the Foreshore Reserve and surrounds. With the growth on new vegetation after the fire it is likely that this population will increase by 25-30% each year. If Peet or the City of Rockingham wanted these kangaroos relocated, then now is the time for this to happen as their habitat has been significantly reduced. These kangaroos are particularly wary, as they have almost certainly been chased by people and local dogs, so any removal program will be difficult. However, a relocation program involving darting and sedating each kangaroo is probably the most effective option.

Rabbits

The population of rabbits in the Foreshore reserve and the adjacent beach dunes is likely to be at its lowest level due to the January 2016 fire. Rabbits move along and through the vegetation on the coastal dunes, but the higher density populations are in the remnant native vegetation like the Foreshore Reserve. A recent paper by Pedler et al. (2016) demonstrated the importance of rabbit control in maintaining populations of native mammals. Rabbits are likely to significantly impact on the regenerating native vegetation, eating the emerging vegetation. If a rabbit control program was envisaged by Peet or the City of Rockingham, then this autumn would be a good time. The use of the biological control agent - rabbit hemorrhagic disease virus (RHDV) and fumigating and closing warrens can most effectively be done when the regenerated vegetation is in an early stage and there is good access to most of the area.

4.2 Conclusion

Based on the results of this trapping program, there has been a significant reduction in the population of Southern Brown Bandicoots in the Foreshore Reserve. This is likely to be the result of reduced habitat availability after the January 2016 fire, the relocation of bandicoots prior to the July 2016 vegetation clearing program, and increased predation pressure from cats and foxes. Although reduced, the small remaining population of Southern Brown Bandicoots should be sufficient to recolonise the area as the vegetation regrows post fire presuming that predation pressures are maintained at low levels.

Given the reduced quantity of native vegetation, it is very important that feral predators remain at a very low level until the bandicoot population has recovered. It is therefore recommended that a fox and cat management program is repeated in autumn 2017 to allow any young bandicoots a chance of survival during 2017. Consideration should also be given to a rabbit reduction program, as this will assist the regeneration of vegetation and also reduce competition for foraging opportunities for bandicoots.

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N

0 20 40 60 80 100m

SCALE 1 : 3 000 at A3 (MGA)

LEGEND

- Foreshore Reserve Boundary
- Reserve Boundary
- Cadastral Boundary
- Trapping Site - Bandicoot
- Trapping Site - Cat

382 250mE

382 500mE

6 412 500mN

6 412 250mN

6 412 000mN

6 411 750mN

Cat 15
Cat 14
Cat 13
Cat 12
Cat 11
Cat 6
Cat 7
Cat 8
Cat 9
Cat 10
Cat 1
Cat 2
Cat 3
Cat 4
Cat 5

2486
R 34664

2030
R 27066

2031
R 27066

2533
R 35364

8009
V CROWN LAND

9015

CADASTRAL SOURCE: Landgate, April 2016.
AERIAL PHOTOGRPAH SOURCE: NearMap, flown March 2016.

TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson

Date: 26 Oct 2016

Peet Ltd and Department of Housing
BANDICOOT MONITORING
GOLDEN BAY - SPRING 2016

TRAPPING SITES

Figure 1

Job: 2016-0053

Table 2. Southern Brown Bandicoot trapping results

							Trapping days and trap number							
Sex	**Mass**	**HL**	**HW**	**Pes**	**Testis**	**Chip No**	**10-10-16**	**11-10-16**	**12-10-16**	**13-10-16**	**14-10-16**	**15-10-16**	**16-10-16**	**No times caught**
F	60	25	37	31		6B3C3B8					16			1
F	60	22	45	35		6E1E623				66				1
F	60	23	55	35		6E21F7E			41					1
F	60	20	59	38		6E231A6			4				4	2
M	380	29	57	49	8	6E24EAD		43		35	45	30	33	5
F	380	23	59	42		6E2564C		66						1
F	560	32	68	53		6E2364A	44	41	27	33	18	23	21	7
F	760	38	74	57		6E2536A				10			66	2
F	770	32	68	53		6E22B20	7	13	18	37	51	12		6
M	960	34	76	61	28	6E21B2C				9			50	2
M	1360	67	84	63	28	6B3E91C				19		17	45	3
M	1400	40	85	61	31	6E22596	17		19	11	19	19	18	6

Appendix A. Trapping site locations (GDA94; Zone 50)

Site	Easting	Northing
1	382512	6411878
2	382515	6411884
3	382518	6411887
4	382521	6411897
5	382523	6411900
6	382521	6411917
7	382524	6411919
8	382530	6411923
9	382535	6411926
10	382538	6411928
11	382546	6411932
12	382554	6411934
13	382562	6411940
14	382561	6411943
15	382574	6411951
16	382579	6411953
17	382585	6411955
18	382588	6411962
19	382591	6411971
20	382589	6411990
21	382586	6411992
22	382586	6412000
23	382586	6412010
24	382581	6412019
25	382581	6412025
26	382575	6412032
27	382573	6412041
28	382565	6412045
29	382560	6412047
30	382556	6412049
31	382546	6412047
32	382540	6412045
33	382533	6412035
34	382529	6412030
35	382528	6412022
36	382528	6412022
37	382525	6412019
38	382520	6412017
39	382515	6412007
40	382512	6412006
42	382509	6411998

Site	Easting	Northing
43	382506	6411993
44	382505	6411987
45	382500	6411981
46	382495	6411970
47	382497	6411961
48	382496	6411952
49	382499	6411946
50	382504	6411941
51	382508	6411937
52	382516	6411926
53	382519	6411925
54	382480	6411963
55	382477	6411953
56	382466	6411953
57	382464	6411953
58	382452	6411959
59	382445	6411970
60	382440	6411973
61	382426	6411979
62	382433	6411947
63	382438	6411944
64	382449	6411935
65	382455	6411935
66	382458	6411935
67	382464	6411935
68	382483	6411931
Cat 1	382443	6411929
Cat 2	382469	6411929
Cat 3	382483	6411924
Cat 4	382497	6411919
Cat 5	382516	6411909
Cat 6	382463	6412179
Cat 7	382442	6412140
Cat 8	382484	6412094
Cat 9	382488	6412042
Cat 10	382485	6412013
Cat 11	382526	6412294
Cat 12	382514	6412480
Cat 13	382525	6412494
Cat 14	382530	6412531
Cat 15	382520	6412569

Southern Brown Bandicoot Monitoring
Golden Bay
Autumn 2016

Version 1. April 2016

Prepared for:

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Record of Distribution

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Disclaimer

Front Cover: Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)

Contents

1 INTRODUCTION

Peet Ltd, on behalf of the Peet Ltd and the Department of Housing, requested a follow up monitoring survey of the Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) population in the Foreshore Reserve adjacent to Lot 2, Warnbro Sound Ave, Golden Bay (i.e. 'project area'). This follows on from an initial survey in spring 2012 and monitoring surveys in autumn and winter of 2013 and 2014 and autumn and spring 2015. Southern Brown Bandicoot monitoring is a requirement under the Ministerial Statement 150 and compliance reports will be provided to the Office of the Environmental Protection Authority on an annual basis.

The Foreshore Reserve includes the fore dune and swale, and the hinterland vegetation inland for about 400m from the ocean (Figure 1). The Foreshore Reserve includes a Conservation Category Wetland and a Threatened Ecological Community (TEC) that supports dense vegetation. There project area was extensively burnt in January 2016 and the only continuous habitat remains at the southern end of the area. There are patches of unburnt habitat spread throughout the burnt area, however, none was considered substantial enough to maintain resident Southern Brown Bandicoots. Vegetation clearing is now within 10m of the Foreshore Reserve in the central and northern sections.

There is a sand track that runs the length of the Reserve east of the fore dune and along the fence line, with numerous tracks running at right angles to the beach in the southern section. Closer to the beach is a sand track used by walkers that runs parallel to the beach. In July 2013, a firebreak was cleared near the eastern boundary of the Foreshore Reserve.

The developer, Peet in conjunction with the Department of Housing, is clearing the vegetation and developing residential lots to the east of the Foreshore Reserve. Past monitoring indicated that Southern Brown Bandicoots in the Foreshore Reserve were moving freely between the area to be cleared and the Foreshore Reserve.

The spring 2013 survey deployed traps along either side of the firebreak track that was cleared along the eastern side of the Reserve and on tracks leading off this firebreak track. This has been the location of the traps for monitoring surveys up until spring 2015.

1.1 Scope of this Southern Brown Bandicoot survey for long-term monitoring

The Foreshore Reserve will remain public open space and the developer has made a commitment to monitor the health of the Southern Brown Bandicoot population on a twice yearly basis during the construction and development stages (PGV Environmental 2011).

Coffey Environments recorded eight Southern Brown Bandicoots in the Reserve during its survey in mid-February 2010 (PGV Environmental 2011). It was reported that Southern Brown Bandicoots preferred scrubby, often swampy vegetation with a dense understorey of cover up to one metre high. The TEC and wetland areas within the Foreshore Reserve were considered suitable habitat to sustain a bandicoot population in the long-term (PGV Environmental 2011).

A Southern Brown Bandicoot relocation program has being undertaken for each stage of development prior to vegetation clearing from Lot 2, Warnbro Sound Ave and Lot 3, Dampier Drive as required under Ministerial Statement 150. This program was implemented to minimise the impact of vegetation clearing on bandicoots residing in these lots. The results of seven previous monitoring surveys are shown in Table 1.

Table 1. Number of Southern Brown Bandicoots in the trapping program

	Spring 2012	Winter 2013	Spring 2013	Winter 2014	Spring 2014	Autumn 2015	Spring 2015
# of indiv. captured	31	30	28	39	48	53	36
# of males	13	10	7	12	10	16	14
# of females	15	20	21	27	25	34	22
# of juveniles	3			1	12	3	6

This report provides the outcomes of the seventh monitoring survey of Southern Brown Bandicoots in the Foreshore Reserve.

2 BIOLOGY AND ECOLOGY OF SOUTHERN BROWN BANDICOOTS

The Southern Brown Bandicoot (*Isoodon obesulus*) is a medium-sized, ground-dwelling marsupial that belongs to the Peramelidae family (Van Dyck and Strahan 2008). Populations of Southern Brown Bandicoots occur widely throughout southern Australia, with isolated populations on the north Queensland coast (Rees and Paull 2000, Van Dyck and Strahan 2008). They occupy a variety of habitats including dry sclerophyll forests, grasslands and heathlands (Stoddard and Braithwaiter 1979).

Isoodon obesulus fusciventer is the Western Australian subspecies and it was listed as a Schedule 1 species (Fauna that is rare or likely to become extinct) under the Western Australian *Wildlife Conservation Act 1950* until 1998. An increase in the population, which was attributed to the implementation of fox baiting throughout the state, meant that in 1998 the Southern Brown Bandicoot was removed from the threatened species list. The Southern Brown Bandicoot is now listed as a Priority 4 species ('Taxa in need of monitoring') on the Department of Parks and Wildlife's (DPaWs) Priority Fauna List.

Southern Brown Bandicoots are found in the wetter sections of the south-west of Western Australia, mostly along the Swan Coastal Plain from the Moore River to Walpole and the Fitzgerald River area. Populations of Southern Brown Bandicoots are found in a variety of habitats, and appear to be able to survive a level of habitat destruction and live in close proximity to urban and industrial development. The Southern Brown Bandicoot prefers habitats with a dense shrub understorey up to one metre high, but they are found in a variety of habitats including Banksia, Eucalypt and Melaleuca woodlands, but most often in close proximity to a wetland (Ramalho et al. 2013). In areas of thick undergrowth, Southern Brown Bandicoots are able to establish runways that are difficult to detect beneath the interlocking vegetation (Craven 1981). They are vulnerable to cat, fox and dog predation and are occasionally seen dead on the roads in urban environments, with the result that they are increasingly under threat due to the clearing of bushland leading to habitat fragmentation, bushland degradation and predation by introduced predators including foxes, cats and dogs (Friend 1991).

The Southern Brown Bandicoot is both nocturnal and diurnal, but are mostly active during the day early in the morning or late afternoon (Van Dyck and Strahan 2008). Individuals are mostly solitary, but with overlapping home ranges. The home range size of Southern Brown Bandicoots decreases with increasing population size (Broughton and Dickman 1991). The smallest home range estimates of 2.1ha for males and 1.4ha for females were recorded for a high density population (1.3 – 1.4 animals ha^{-1}) on Franklin Island, South Australia (Copley et al. 1990). The largest home range estimates of 5.3ha for males and 2.3ha for females and were calculated for a low density population (0.07 – 0.2 animals ha^{-1}) in Tasmania (Heinsohn 1966). A recent study of Southern Brown Bandicoots in the Perth metropolitan area found that the animals' increased their home range size and grazed in more open habitats in areas when predator control was implemented, compared to areas where there was no predator control (Gardner 2004).

Southern Brown Bandicoots are omnivorous, feeding on invertebrates (including earthworms, beetles and larvae), underground fungi, subterranean plant material, and occasionally small vertebrates such as lizards (Broughton and Dickman 1991). Southern Brown Bandicoots build a nest consisting of a heap of ground litter over a shallow depression providing an internal chamber with loose regions at both ends for entry and exit. The dense vegetation probably protects the nest from extremes in temperature and wind, rain and predators.

Heinsohn (1966) reported Southern Brown Bandicoots reach sexual maturity at five to six months of age when they weigh approximately 600g. As males produce sperm throughout the year, it is the reproductive activity of the female that determines the beginning and length of the breeding season (Heinsohn 1966). Breeding peaks in spring (Thomas 1987, Mallick et al. 1998) and the female has a gestation period of 12 to 13 days and litters of one to six young are produced, although litters of two to four are most common. Two or three litters may be reared during a single breeding season, although this is dependent upon the availability of food resources (Friend 1991, Mallick et al. 1998) and rainfall (Barnes and Gemmell 1984).

Studies have reported the sex ratio of Southern Brown Bandicoot populations to be from 1.7 males to one female to 0.33 males to one female (Craven 1981, Thomas 1987, Mallick et al. 1998). The lifespan of the Southern Brown Bandicoot in the wild is estimated to be two to three years (Craven 1981).

3 METHODOLOGY

Eighty baited wire cage traps were set in locations shown in Figure 1 (Appendix A). Cage traps were baited with a peanut butter sandwich and were set for 7 nights between 13 and 19 April 2016. Traps were located in the vegetated areas that were likely to support Southern Brown Bandicoots. The layout of traps was different to previous surveys due to the fire in January 2016. Traps were baited when they were opened, when they had no bait and on every other day if they had bait. In addition, there were 20 large cage traps baited with sardines which were targeting feral cats. These traps were open during the monitoring period. Southern Brown Bandicoots were also caught in these traps. All traps had a hessian cover and were placed under vegetation. Traps were cleared from first light each morning. Staff in the Department of Parks and Wildlife (DPaW) requested that tissue samples were taken from caught bandicoots, which was done and the tissue samples will be given to DPaW at a later date.

Trapping was conducted under License SF010600. All Southern Brown Bandicoots that had not previously been caught had a microchip inserted on the dorsal surface between the shoulder blades. Captured bandicoots were identified and released near their site of capture.

3.1 Data analysis

Trap success rate was determined by dividing the trapping effort by the number of bandicoots caught per trap-night. There were 80 ordinary cage traps specifically targeting Southern Brown Bandicoots and an additional 20 larger cage traps targeting cats which also caught Southern Brown Bandcoots. The total trapping effort is therefore 700 trap nights. Trapping data are compared with previous survey data.

3.2 Signs

As recommended in the winter 2014 monitoring report (Terrestrial Ecosystems 2014) signs (Plate 1) were prepared by Peet and placed each track leading into the survey area. These signs were designed to reduce the number of people and dogs interfering with traps and captured bandicoots. In addition, flagging tape and signs indicating that a feral animal trapping program was in progress were also deployed.

Plate 1. Sign placed at the end of the firebreak track

4 RESULTS AND DISCUSSION

4.1 Survey monitoring

The Southern Brown Bandicoot trapping results are as shown in Table 2. Twenty six individual bandicoots were caught with 18 adult females and 8 adult males. No bandicoots less than 300g (i.e. juvenile) were captured and no females had pouched young or showed signs of recently have young. Including non-target captures the trapping success was 16.7% and for bandicoots only it was 13.6%.

Nine new bandicoots were captured during this survey. Southern Brown Bandicoots which were recorded for the first time were captured less frequently than bandicoots caught in previous surveys (2.1 vs 4.5 capture events). This indicates that bandicoots that had previously been caught were accustom to the bait and were not afraid of the traps.

In addition to the Southern Brown Bandicoots, cats (*Felis catus*), rats (*Rattus rattus*), bobtails (*Tiliqua rugosa*), rabbits (*Oryctolagus cuniculus*), house mice (*Mus musculus*) and a raven (*Corvus coronoides*) were caught in the traps.

There is one fox active in the area and numerous cats. Four cats were caught in the concurrently operated pest management program which will make a significant difference to improving the chances of the Southern Brown Bandicoot population remaining viable while the burnt bushland rehabilitates.

The rabbit population is quite low after the fire but expected to increase as the new vegetation emerges in the foreshore reserve this winter. Maintaining a rabbit population in the short-term may be beneficial in taking the predation pressure off the Southern Brown Bandicoots. Kangaroos were seen on multiple occasions, and move through the burnt and unburnt areas. They are also seen feeding in the nearby residential areas. The move into the residential area may be due to a lack of sufficient foraging areas.

Impacts on the trapping program

Baits taken by House Mice (*M. musculus*), rats (*R. rattus*), cats and bobtails reduced the number of Southern Brown Bandicoots caught as these animals take the bait and cause traps to be closed stopping the capture of bandicoots. This is an unavoidable aspect of using bait that attracts multiple species. All non-native species were euthanased.

There were no disturbances by residents that would impact on the results of this survey.

Status of the population

The total number of Southern Brown Bandicoots caught during this monitoring program (26) was substantially less than during autumn 2015 (56 bandicoots) and spring 2015 (36 bandicoots; see Table 1). This decline was expected after there were signs of a progressive decline in population in spring 2015 but particularly after the January 2016 fire burnt most of the available habitat and opened up the area to increased predation by cats and foxes.

As a result of the limited available habitat, any bandicoots that remain in the foreshore reserve will be concentrated into one area until the vegetation in the burnt area can re-establish. As all of the traps were also confined to this same area we are confident that most of the bandicoots were caught.

No females had pouched young or showed signs of having recently had young. This is most probably due to a lack of available resources (i.e. food and shelter) but also due to increased predation by cats and foxes. Mortality of young is very high, and the past three years of surveys indicates that only a small proportion of juveniles in the size range of 100-300g survive to adulthood.

Continuing the management program for foxes and cats is critical to maintaining a viable population of Southern Brown Bandicoots in the Foreshore Reserve.

Western Grey Kangaroos

There are about five Western Grey Kangaroos in the Foreshore Reserve. If Peet or the City of Rockingham wanted these kangaroos relocated, then now is the time for this to happen as their habitat has been significantly reduced. A relocation program will involve sedating each kangaroo with a drug contained in a dart that is fired into the large muscles of the hind limb.

4.2 Conclusion

Based on the results of this trapping program, there has been a significant reduction in the population of Southern Brown Bandicoots in the Foreshore Reserve. This is likely to be the result of reduced habitat availability after the January 2016 fire and increased predation pressure from cats and foxes. Although reduced, the existing population is sufficient to recolonise the area as the vegetation regrows post fire presuming that predation pressures are maintained at low levels.

Given the reduced quantity of native vegetation and the planned vegetation clearing in the eastern sections, it is very important that feral predators remain at a very low level until the bandicoot population has recovered. It is therefore recommended that a fox and cat management program is repeated in spring 2016 to allow any young bandicoots a chance of survival during the spring and summer 2016 period.

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Table 2. Southern Brown Bandicoot trapping results

							Trapping days and trap number							
Sex	**Mass**	**HL**	**HW**	**Pes**	**Testis**	**Chip No**	**13/4/2016**	**14/4/2016**	**15/4/2016**	**16/4/2016**	**17/4/2016**	**18/4/2016**	**19/4/2016**	**No times caught**
f	1250		77	33	56	6b35ed7		Cat 19	Cat 17	29	Cat 16	38	37	6
m	860	82	34	56	26	6b3c456	Cat 19	29	30	38	27	70	Cat 17	7
f						6b3c76f							27	1
f	650	73	34	52		6b3cc48	3	16	12	26		14	19	6
m	1250	85	38	60	30	6e1e048		Cat 16	Cat 20		Cat 19		39	4
f	600	75	34	55		6e1f246	25	12	72	27		67		5
f	800	77	36	56		6e21b4e	13	18	22	14	2	9		6
f		81	33	56		6e21d48	Cat 13							1
f	640	72	34	52		6e21ff1	27	27	31		38	39	35	6
f	650	68	31	54		6e2290c						18		1
f	450	65	33	50		6e22be5		Fox 5						1
m	1250	92	34	60	29	6e2336c	Cat 14	Cat 15						2
f	700	74	31	51		6e23418	12		5	8		6	2	5
f	720	82	32	53		6e23603	43	31	37	30			36	5
f	430	66	31	53		6e2364a	59			70	9	12	27	5
m	870	80	35	57	28	6e23cdc	46	37		39	37	29		5
f	370	63	30	28		6e23eaa			6				8	2
f	430	68	30	53		6e24051						56		1
m	1260	88	40	60	28	6e2421c	6	32	36	2		30	16	6
f	530	70	29	49		6e24504			29			28		2
f	410	64	29	51		6e2472a			2			8	6	3
f	750	75	34	57		6e24984					33			1
m	1250	84	37	61	30	6e24d23			Cat 16	Cat 19	Cat 3	27	12	5
m	550	75	59	50	22	6e25006						25		1
f	370	60	25	45		6e25177		4	19				18	3
m	860	81	56	59	29	6e251b7		3	Cat 19	Cat 18		Cat 16	Cat 18	5

Appendix A. Trapping site locations (GDA94; Zone 50)

Site	Easting	Northing
1	382620	6411896
2	382614	6411903
3	382617	6411916
4	382613	6411922
5	382604	6411931
6	382596	6411929
7	382585	6411931
8	382574	6411932
9	382563	6411925
10	382565	6411938
11	382546	6411936
12	382538	6411928
13	382615	6411938
14	382621	6411951
15	382610	6411953
16	382621	6411966
17	382600	6411971
18	382616	6411973
19	382619	6411975
20	382616	6411986
21	382600	6411988
22	382602	6411992
23	382617	6411999
24	382612	6412003
25	382601	6412005
26	382603	6412012
27	382597	6412023
28	382603	6412031
29	382599	6412045
30	382595	6412043
31	382598	6412034
32	382589	6412034
33	382585	6412038
34	382578	6412041
35	382573	6412043
36	382563	6412052
37	382569	6412069
38	382571	6412071
39	382574	6412076
40	382572	6412086
42	382572	6412102
43	382574	6412108
44	382578	6412113
45	382583	6412125
46	382598	6412140
47	382595	6412143
48	382606	6412145
49	382439	6411970
50	382453	6411960
51	382463	6411953
52	382472	6411950
53	382475	6411955
54	382480	6411963
55	382499	6411937
56	382497	6411946
57	382497	6411946

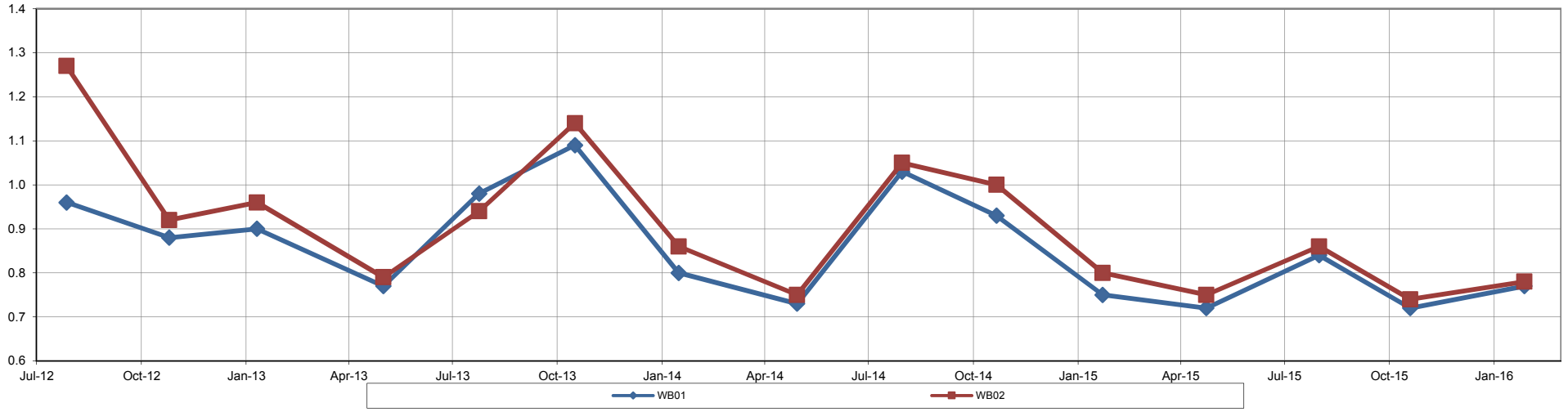
Site	Easting	Northing
58	382500	6411959
59	382492	6411965
60	382498	6411970
61	382498	6411972
62	382497	6411981
63	382501	6411989
64	382501	6411996
65	382495	6412000
66	382512	6412007
67	382520	6412015
68	382526	6412020
69	382529	6412028
70	382537	6412041
71	382540	6412048
72	382540	6412048
73	382549	6412048
74	382551	6412050
75	382582	6412178
76	382581	6412182
77	382585	6412199
78	382585	6412208
79	382597	6412228
80	382597	6412236
Cat 1	382484	6411966
Cat 2	382494	6411952
Cat 3	382488	6411942
Cat 4	382481	6412013
Cat 5	382474	6412033
Cat 6	382479	6412055
Cat 7	382472	6412053
Cat 8	382608	6411885
Cat 9	382633	6411891
Cat 10	382647	6411905
Cat 11	382799	6412103
Cat 12	382799	6412125
Cat 13	382782	6412101
Cat 14	382798	6412083
Cat 15	382787	6412075
Cat 16	382740	6412054
Cat 17	382731	6412049
Cat 18	382727	6412036
Cat 19	382764	6412049
Cat 20	382786	6412059
Fox 1	382794	6412072
Fox 2	382776	6412081
Fox 3	382767	6412077
Fox 4	382784	6412097
Fox 5	382787	6412112
Fox 6	382497	6411985
Fox 7	382498	6411991
Fox 8	382520	6412013
Fox 9	382485	6412040
Fox 10	382484	6412040
Fox 11	382455	6412033
Fox 12	382454	6412033

APPENDIX 7

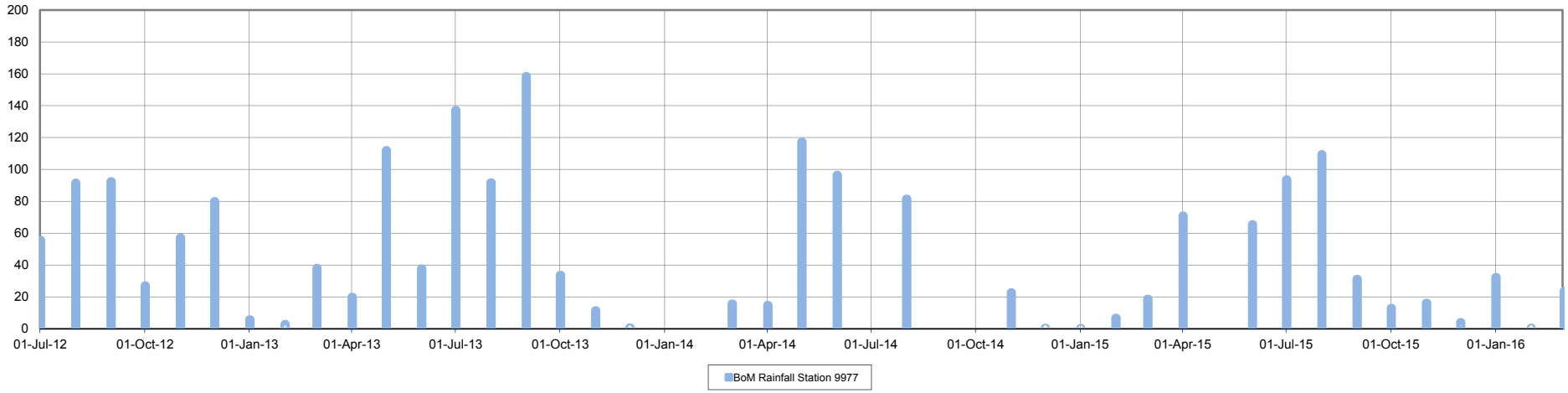
FORESHORE RESERVE GROUNDWATER LEVELS

Wetland Bores - Groundwater Levels 2016

Groundwater Levels (mAHD)



Rainfall (mm)



Job No. J6257

PEET / Dept of Housing

Golden Bay Groundwater Monitoring

Figure 1: Groundwater Levels in Wetland Bores

APPENDIX 8

POST FIRE BASELINE VEGETATION MONITORING REPORT

LOT 2 WARNBRO SOUND AVENUE, GOLDEN BAY FORESHORE RESERVE

POST-FIRE VEGETATION MONITORING BASELINE SURVEY

Prepared for:	The Housing Authority and Peet Golden Bay Pty Ltd
Report Date:	20 January 2017
Version:	2
Report No.	2016-275

pgv ENVIRONMENTAL

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1 INTRODUCTION

1.1 Background

The Housing Authority and Peet Golden Bay Pty Ltd are developing Lot 2 Warnbro Sound Avenue and Lot 3 Dampier Drive, Golden Bay for residential purposes. The development abuts a Foreshore Reserve, established under Condition 3 of Ministerial Statement 297 which is the environmental approval for the development.

A Foreshore Management Plan (FMP) has been prepared by the developers for the Foreshore Reserve and was approved by the Environmental Protection Authority (EPA) on 30 March 2012. Subsequent to the approval of the FMP a Foreshore Rehabilitation Plan (FRP) has been prepared to outline the rehabilitation and weed management requirements to be implemented within the Foreshore Reserve.

The Foreshore Reserve was subject to a bushfire on 1 January 2016. The fire was reported as being ignited by fireworks/boat flares. The area of the Foreshore Reserve impacted by the fire was estimated to be approximately 7ha (Appendix 1). The northern section was burnt in patches and the eastern part of the central section was largely burnt out (Plates 1 and 2).

The area burnt by the 1 January bushfire is required by the FRP to be monitored to assess the progress of regeneration. The monitoring will determine whether any supplementary planting will be required to assist regeneration and whether any weed control needs to be undertaken during the recovery period.

This report presents the results of the first two monitoring assessments undertaken in 2016.

1.2 Site Location

The Golden Bay Foreshore Reserve is located approximately 50km south of Perth and 16km south of Rockingham Town Centre, within the City of Rockingham (Figure 1). The site is bound by Secret Harbour to the north, the Lot 2 Golden Bay development to the east, the existing Golden Bay Township to the south and the high water mark of the Indian Ocean to the west.

The Foreshore Reserve covers an area of approximately 10.61ha and is around 800m in length from north to south and ranges between approximately 150m to 300m wide.

1.3 Objectives

The objectives of the post-fire vegetation monitoring report are to:

- Set up permanent monitoring plots in a range of vegetation types burnt in the 1 January 2016 fire;
- Measure current species regeneration;
- Assess post-fire recovery mechanisms for each species;
- Assess any requirement for weeding during the post-fire recovery period; and
- Establish criteria for successful regeneration.

2 EXISTING ENVIRONMENT

2.1 Topography

The topography of the Foreshore Reserve ranges from 1 to 10m AHD. The dunes closest to the coast are part of a recent parallel dune ridge system with dune crests up to 5-6m AHD. The eastern half of the Foreshore Reserve contains a low linear flat swale at an elevation of 1-2m AHD with some taller dunes up to 10m AHD.

The 1 January fire was largely contained to the eastern half of the Foreshore Reserve.

2.2 Wetlands

The eastern half of the Foreshore Reserve contains a number of small wetlands within the flat swale directly behind the frontal dunes. The wetlands are described as Sumplands and contain shallow freshwater above-ground in spring during an average rainfall season. The wetlands are rated as Conservation Category wetlands.

The 1 January fire burnt more than half the area of wetlands in the Foreshore Reserve.

2.3 Vegetation

2.3.1 Vegetation Types

A variety of coastal Quindalup vegetation types occur in the Foreshore Reserve as listed below:

Western Half

- *Spinifex hirsutus* Grassland: Located on the foredune with *Spinifex longifolius, Tetragonia decumbens* and *Cakile maritima* present on the seaward facing slopes and *Ficinia nodosa* and *Carpobrotus virescens* frequent near the crest and leeward sides.
- *Olearia axillaris* Shrubland: Located immediately behind the foredune and forms a wide band parallel to the coast, containing *Cassytha* sp*., Pelargonium capitatum* and *Trachyandra divaricata*. It grades into the *Spyridium globulosum* Open Heath.
- *Spyridium globulosum* Open Heath: Located on the lower dunes and containing *Acacia cyclops, Hibbertia cuneiformis, Alyxia buxifolia, Pelargonium capitatum* and the creeper *Hardenbergia comptoniana*.

Eastern Half

- *Acacia rostellifera/Spyridium globulosum* Closed Shrub: An intermediate unit located in the central part of the site.
- *Juncus kraussii* Sedgeland: Located within the eastern low linear flat swale in the wetland areas, containing *Baumea juncea, Centella asiatica, Ficinia nodosa, Dampiera alata* and *Lepidosperma gladiatum.* Three isolated, mature Paperbark trees (*Melaleuca rhaphiophylla* and *Melaleuca cuticularis*) also occur in the wetlands.
- *Spyridium globulosum* Closed Heath: Making up the majority of the transitional vegetation on slightly higher ground within the swale, it contains similar species to the *Spyridium globulosum*

Open Heath on the low dunes and additionally a dense ground coverage of the Sword Sedge *Lepidosperma gladiatum*.

The vegetation in the wetlands in the Foreshore Reserve is a Threatened Ecological Community (TEC) – Floristic Community Type 19 'Sedgelands in Holocene Dune Swales'.

The 1 January fire did not affect any of the vegetation types on the western half of the Foreshore Reserve. All three vegetation types in the eastern half including large sections of the TEC were burnt to some extent.

2.3.2 Vegetation Condition

The vegetation in most of the Foreshore Reserve pre-fire was rated as mostly being in Excellent Condition with only a few tracks through it.

A weed survey of the Foreshore Reserve conducted by PGV Environmental in May 2015 identified the most prevalent introduced species in the area as Rose Pelargonium (*Pelargonium capitatum*) and False Onion Weed (*Trachyandra divaricata*). Both species were more common on the western part of the Foreshore Reserve on sand dunes. The wetlands on the site contained few weeds.

Hares Tail Grass *(Lagurus ovatus)* and Geraldton Carnation Weed *(Euphorbia terracina)* were also present in parts of the Foreshore Reserve.

Plate 1: Aerial Photography of a Section of the Site from January 2016 showing burnt areas (Nearmap, 2016)

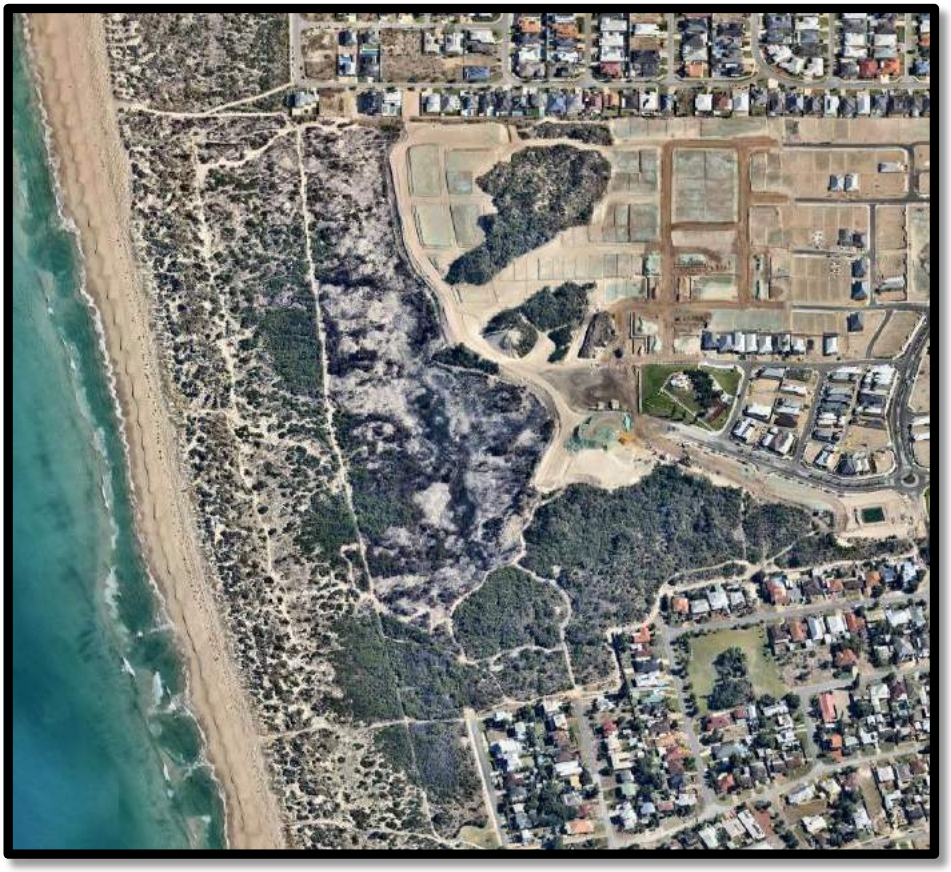


Plate 2: Burnt Central Section of the Foreshore Reserve (January 2016)

2.4 Native Fauna

The Foreshore Reserve at Golden Bay contains a population of Southern Brown Bandicoots, or Quenda (*Isoodon obesulus*). The size and health of the Bandicoot population has been monitored by the developers for 4 years.

A number of the Quenda were relocated to Paganoni Reserve in July 2016 due to the reduced habitat as a result of the fire in the Foreshore Reserve. The remaining population in the Foreshore Reserve will continue to be monitored during Spring and Autumn. Once the habitat in the foreshore reserve has recovered sufficiently it will be determined by the Department of Parks and Wildlife if Quenda will be re-introduced to supplement the existing population.

The Foreshore Reserve contains an itinerant population of Western Grey Kangaroos (*Macropus fuliginosus*) that moves within the foreshore reserves north and south of Golden Bay. The presence of kangaroos may impact on the vegetation in the burnt area by grazing the regenerating plants. The condition of the wetland vegetation may be impacted by kangaroos moving through or resting in the dense sedgelands. Management of the kangaroo population is not limited to Golden Bay as they range up and down the coastal corridor. A global approach across multiple land managers may be required if the number of kangaroos needs to be managed.

2.5 Pest Fauna

The Foreshore Reserve contains a large number of rabbits as evidenced by the amount of rabbit faeces, diggings and a burrow. The abundance of rabbits may affect the regeneration of plants in the burnt area by over-grazing.

3 MONITORING RESULTS

3.1 Monitoring Plot Establishment

A total of nine 10m x 10m monitoring plots was established in the burnt areas of the Foreshore Reserve on 27 July 2016 by Dr Paul van der Moezel of PGV Environmental.

The plots were chosen to be representative of the variety of vegetation types burnt.

The plots were aligned on northings and eastings with the corners of each plot pegged with small steel pegs. The co-ordinates of the plot were taken using a hand-held GPS from the centre of the plot. A photo was taken from the south-east corner of each plot looking towards the north-west corner.

The pre-fire vegetation type was assessed for each plot using the burnt vegetation as a guide.

Within each plot the percentage cover and average height of all species recovering after the fire were recorded. Where possible, the post-fire recovery mechanism was assessed for each species.

A follow-up assessment of the plots on 11 October 2016 was made to record any new emergence of ephemeral species in spring.

3.2 Monitoring Plot Results

Six of the nine monitoring plots were located on low sand dunes while three were in flat swales containing wetland TEC vegetation. Plot GBF6 was transitional between the dryland and wetland vegetation types while plot GBF7 contained slightly raised areas on the edge of the wetland swale.

The pre-fire vegetation in the monitoring plots was assessed as being the following:

Dunes

Plot GBF1 *Acacia rostellifera/Spyridium globulosum* Open Heath over *Lepidosperma gladiatum* Open Sedgeland

Plot GBF 3 *Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub (3.5-4m, >70%) over *Lepidosperma gladiatum* Sedgeland (30%)

Plot GBF4 *Acacia rostellifera/Spyridium globulosum* Shrubland (1.5m, 10%) over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (60%)

Plot GBF6 *Spyridium globulosum/Exocarpos sparteus* Open Heath (1.5m, 50-70%) over *Lepidosperma gladiatum/Baumea juncea* Open Sedgeland (20-30%)

Plot GBF8 *Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub (4m, 70-80%) over *Lepidosperma gladiatum* Sedgeland

Plot GBF9 *Spyridium globulosum* Tall Shrubland (3.5m, 10%) over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (50%)

Wetland/TEC

Plot GBF2 *Baumea juncea/Ficinia nodosa* Closed Sedgeland (90%) over *Centella asiatica* Herbland

Plot GBF5 *Baumea juncea* Sedgeland (90%) over *Centella asiatica* Herbland

Plot GBF7 *Baumea juncea* Closed Sedgeland (80-90%) over *Centella asiatica* Herbland

The vegetation in the dunal plots was very uniform and varied mostly in the height and density of the dominant *Acacia rostellifera* and *Spyridium globulosum* shrubs. *Lepidosperma gladiatum* was common in the understorey of all six plots.

The composition of the wetland plots was also uniform with *Baumea juncea* the dominant sedge species and *Centella asiatica* a common ground cover. Plot GBF7 contained more of a mix of different vegetation types compared to the uniformity of plots GBF2 and GBF5.

The monitoring plot data are provided in Appendix 1 and summarised in Tables 1 and 2.

Table 1: Summary of Monitoring Plot Regeneration

Plot	Vegetation (Pre-fire)	Pre-fire		Post-fire (July 2016)		
	Dunal Vegetation	Height (m)	% Cover[1]	Height (m)	% Cover dominant stratum	Overall cover (%)
GBF1	*Acacia rostellifera/Spyridium globulosum* Open Heath over *Lepidosperma gladiatum* Open Sedgeland (10-20%)	1.5	20-30	<0.1	<1	1-2
GBF3	*Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub over *Lepidosperma gladiatum* Sedgeland (30%)	3.5-4	>70	0.6	20	30-40
GBF4	*Acacia rostellifera/Spyridium globulosum* Shrubland over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (60%)	1.5	10	0.3	1	40-50
GBF6	*Spyridium globulosum/Exocarpos sparteus* Open Heath over *Lepidosperma gladiatum/Baumea juncea* Open Sedgeland (20-30%)	1.5	50-70	<0.1	<1	5
GBF8	*Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub over *Lepidosperma gladiatum* Sedgeland (20-30%)	4	70-80	0.4	15	25-30
GBF9	*Spyridium globulosum* Tall Shrubland over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (50%)	3.5	10	<0.1	<1	30-40
	Wetland/TEC					
GBF2	*Baumea juncea/Ficinia nodosa* Closed Sedgeland (90%) over *Centella asiatica* Herbland	1	90	0.5	70	70-75

GBF5	*Baumea juncea* Sedgeland (90%) over *Centella asiatica* Herbland	1	90	0.4	75	75-80
GBF7	*Baumea juncea* Closed Sedgeland (80-90%) with occasional *Acacia saligna* shrubs over *Centella asiatica* Herbland	1	80-90	0.4	60	60-70

The growth of dominant shrubs in the six dunal plots was at a very early stage in both the July and October 2016 monitoring events (Table 1). In July, the seedlings of *Acacia rostellifera* and *Spyridium globulosum* were only just emerging 7 months after the fire and were less than 10cm high. By October the seedlings had grown a small amount. Regrowth of sprouts from underground stems of *Acacia rostellifera* was up to 0.4-0.6m tall by July.

Lepidosperma gladiatum was regenerating quickly in all the six dunal plots and contributed most to the overall percentage cover of the plots.

The growth of sedges in the three wetland/TEC plots was well advanced even in July. All three plots had an estimated 80-90% pre-fire cover of sedges. The percentage cover 7 months after the fire was 60-80%. The height of the sedges pre-fire was difficult to assess due to the impact of the fire in completely burning the stems. Examination of monitoring photos taken in the Golden Bay Foreshore Reserve indicates that *Baumea juncea* had an average height up to 1m in areas of TEC before the fire. The post-fire height ranged from 0.4-0.5m. The growth of the dominant ground cover in each plot, *Centella asiatica*, was also well-advanced by July, ranging from 10-40%.

Table 2: Summary of Monitoring Plot Data

Plot	Vegetation (Pre-fire)	No. Species - July 2016			No. Species - October 2016		
	Dunal Vegetation	**native**	**Non-native**	**Total**	**native**	**Non-native**	**Total**
GBF1	*Acacia rostellifera/Spyridium globulosum* Open Heath over *Lepidosperma gladiatum* Open Sedgeland (10-20%)	7	4	11	9	12	21
GBF3	*Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub over *Lepidosperma gladiatum* Sedgeland (30%)	7	7	14	10	10	20
GBF4	*Acacia rostellifera/Spyridium globulosum* Shrubland over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (60%)	6	7	13	10	14	24
GBF6	*Spyridium globulosum/Exocarpos*	7	5	12	10	11	21

	sparteus Open Heath over *Lepidosperma gladiatum/Baumea juncea* Open Sedgeland (20-30%)						
GBF8	*Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub over *Lepidosperma gladiatum* Sedgeland (20-30%)	5	4	9	7	10	17
GBF9	*Spyridium globulosum* Tall Shrubland over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (50%)	6	7	13	9	13	22
	Wetland/TEC						
GBF2	*Baumea juncea/Ficinia nodosa* Closed Sedgeland (90%) over *Centella asiatica* Herbland	8	4	12	8	5	13
GBF5	*Baumea juncea* Sedgeland (90%) over *Centella asiatica* Herbland	6	2	8	8	5	13
GBF7	*Baumea juncea* Closed Sedgeland (80-90%) with occasional *Acacia saligna* shrubs over *Centella asiatica* Herbland	9	11	20	13	16	29

Species richness in the six dunal plots increased from an average of 12.0 (range 9-14) in July to 20.8 in October (Table 2). The increase was due primarily to the germination of ephemeral and perennial non-native species as well as some native species. Species that were recorded in many of the plots following the July monitoring period included the native species *Isolepis marginata, Crassula colorata* and *Scaevola crassifolia* and the non-native species *Dischisma arenarium, Carpobrotus edulis, Cerastium glomeratum* and *Oenothera* species.

Species richness in the three wetland TEC plots increased from an average of 13.3 (range 8-20) in July to 18.3 (range 13-29) in October (Table 2). Most of the newly recorded species were non-native anuual species.

No *Exocarpos sparteus* seedlings or sprouts were observed in plot GBF6 despite the species being common in the plot pre-fire. The regeneration of this species in the plot or close by should be further examined in future monitoring.

Many *Acacia rostellifera* seedlings were recorded in GBF5. *Acacia rostellifera* was not present in the *Baumea juncea* Sedgeland or other nearby parts of the wetland before the fire but was common within close proximity to the plot. The spread of *Acacia rostellifera* into wetland areas as a result of fire will need to be monitored closely. It is possible that the young seedlings will not tolerate being inundated when the TEC water levels rise above ground in September. However, in the October

monitoring period none of the TEC areas were inundated. The *Acacia rostellifera* seedlings in GBF5 were still present and healthy.

Similarly, *Acacia cyclops* was a common seedling growing in the wetland plot GBF7 and *A. saligna* was also recorded in low numbers. A few dead *Acacia saligna* shrubs were recorded in the plot and nearby. The growth of *Acacia* seedlings in the wetland will need to be followed to determine whether fire is an agent that promotes the growth of *Acacia* species in wetland swales.

3.3 Weeds

Rose Pelargonium (*Pelargonium capitatum*) was recorded in all nine monitoring plots (Table 3). It is highly likely that the species was present in all plots pre-fire given its previously recorded abundance in the Foreshore Reserve. Rose Pelargonium regenerates from seed and most seedlings were very young. The number of seedlings in some plots suggests that the species will be dominant post-fire.

Table 3: Introduced Species Recorded in more than three Monitoring Plots (July and October)

Species	Common Name	Dunal Plots	Wetland Plots	Total
Pelargonium capitatum	Rose Pelargonium	6	3	9
Oenothera species	Evening Primrose	7	1	8
Lolium perenne	Rye Grass	6	2	8
Crassula glomerata		6	1	7
Carpobrotus edulis	Pigface	4	2	6
Dischisma arenarium		5	1	6
Solanum nigrum	Blackberry Nightshade	4	1	5
Hypochaeris species	Flatweed	4	1	5
Trachyandra divaricata	False Onion Weed	4	1	5
Conyza bonariensis	Fleabane	4	0	4
Lysimachia arvensis	Pimpernel	3	1	4
Cerastium glomeratum	Chickweed	4	0	4
Sonchus oleraceus	Sow Thistle	2	1	3

Trachyandra divaricata was recorded in five plots but was abundant in only two.

The other species are all commonly recorded in coastal dunes in the Perth Metropolitan Region. Most are ephemeral weeds that would be extremely difficult to eradicate and are not considered a problem weed in the foreshore reserve, such as Chickweed, Pimpernel, Sow Thistle, *Dischisma arenarium* and *Crassula glomerata*. Several species including Pigface and Evening Primrose can help to stabilise bare sand dunes, however can cause long-term competition with native species. The growth of these species should be the focus of monitoring in the next few years.

3.4 Post-Fire Regeneration Mechanisms

A total of 67 plant species were recorded in the nine monitoring plots (Appendix 2). Of these, 38 were native and 29 introduced. Several species were not able to be positively identified at this early stage after the fire.

Appendix 2 lists the post-fire regeneration mechanism of the species recorded where it was able to be observed. Plant species generally have two mechanisms of regeneration after fire. The first

mechanism is for the burnt plant to resprout either from underground stems or bulbs/corms etc. The second mechanism is regeneration from seed, usually after the parent plant has been completely killed by the fire. Some species are able to regenerate by both sprouting and seeding. The heat of the fire can also influence the mechanism of regeneration for some species. For example, a plant may be able to recover by sprouting after a relatively cool burn but regenerates from seed after a hot burn that kills the entire plant.

The majority of native plants in the Foreshore Reserve were recorded as regenerating after fire by seeding. The two dominant shrub species on the dunal areas, *Acacia rostellifera* and *Spyridium globulosum* both regenerated by seed (Plates 3 and 4), however *Acacia rostellifera* was also observed to resprout from the base of burnt shrubs and from underground roots away from the parent plant (Plate 3).

Plate 3: *Acacia rostellifera* regenerating by sprouting (a) and by seed (b)

(a) **(b)**

Plate 4: *Spyridium globulosum* seedling

Regeneration by resprouting has the advantage of being able to grow sooner after a fire than regenerating by seed which requires winter rains to germinate the seed. The difference in early

growth for *Acacia rostellifera* from sprouting compared to seed shows the competitive advantage of the sprouting mechanism, at least in the early stages. Comparing the growth of *Acacia rostellifera* and *Spyridium globulosum* plants where they occurred together before the fire will be recorded in future monitoring.

The wetland sedge species all regenerate by sprouting from the underground stems which is the reason for the rapid regeneration of these areas soon after the fire.

3.5 Grazing

Grazing by rabbits, and possibly kangaroos, was observed on some narrow and flat leaved species including *Baumea juncea, Trachyandra divaricata* and *Lepidosperma gladiatum* (Plates 5 and 6). The percentage of plants grazed was overall very low. The grazing on wetland sedge *B. juncea* appeared to only be around the margins of the wetlands where the sedge was less dense and not the denser central parts.

Plate 5: *Trachyandra divaricata* grazed by rabbits

Plate 6: *Baumea juncea* and *Lepidosperma gladiatum* grazed by rabbits and/or kangaroos.

3.6 Completion Criteria

The monitoring program set up in the Golden Bay Foreshore Reserve has been established to determine whether the burnt vegetation will regenerate by itself back to its pre-fire condition or whether some intervention is required such as supplementary planting of native species and/or weed control.

To establish the natural regeneration rate for burnt coastal vegetation in the City of Rockingham area historical aerial photographs from other fires were examined.

Two fires have occurred nearby in coastal vegetation similar to that burnt at Golden Bay, ie. older Quindalup dune Acacia-dominated Scrub/Heath and Sedgelands in wetlands containing TEC19.

The first fire occurred Secret Harbour in January 1995 and the second fire occurred in Port Kennedy in May 2008.

The post-fire pattern of recovery is limited by the date of aerial photographs available on the Landgate website and no on-ground data are available on post-fire recovery of the vegetation. Nevertheless, the pattern of recovery can be seen in the available photographs.

The Secret Harbour fire in 1995 occurred in Anstey Q Swamp and completely burnt all the different wetland and dryland vegetation types in the area (Plate 7). The aerial photograph taken 5 years after the fire in February 2000 (Plate 8) shows dense vegetation in the wetland area and strong regrowth in the surrounding dunes. No artificial regeneration or weeding was required in the post-fire area.

Plate 7: Anstey Q Swamp February 1995

Plate 8: Anstey Q Swamp February 2000

The Port Kennedy fire in May 2008 covered a large part of the Scientific Park from the beach up to 1.5km inland. The vegetation in the area burnt included beach ridge plain heath and scrub and long linear swales with TEC19 Sedgelands. Plate 9 shows the area before the fire while Plate 10 shows the area recently burnt as at 18 May 2008. A north-south trending firebreak was able to contain most of the fire to the west, leaving the eastern side unburnt. The firebreak and the historic aerial photographs provide a useful comparison on the recovery rate of the burnt area.

Plate 11 shows the same area in January 2010, around 2 years after the fire. The 2010 photograph shows that the linear wetland swales, seen as dark lines on the aerial, have recovered very quickly and that other areas seemingly scorched in the 2008 fire are recovering quickly. The dark green shades on the photo are dense areas of *Acacia rostellifera*. Plate 12 shows the same area around 8 years after the fire. There appears little difference in the vegetation cover from before the pre-fire and 8 years after the burn.

Plate 9: Port Kennedy April 2006 (pre-fire)

Plate 10: Port Kennedy May 2008

Plate 11: Port Kennedy January 2010

Plate 12: Port Kennedy February 2016

In summary, given the examples at Secret Harbour and Port Kennedy, it is anticipated that the burnt areas are expected to retain their pre-fire cover within around 5 years after the fire without any necessary intervention with regards to revegetation.

Any weed control of burnt areas should be undertaken in conjunction with the weed management strategy outlined in the Golden bay Foreshore Reserve Foreshore Rehabilitation Plan (PGV Environmental, 2016).

4 CONCLUSIONS

The post-fire vegetation monitoring of the Golden Bay Foreshore Reserve following the 1 January 2016 fire concludes the following:

- Nine 10m x 10m permanent monitoring plots was established in the burnt areas of the Foreshore Reserve. Six plots were on low sand dunes and three in swales containing wetlands and Threatened Ecological Community 19;
- The plots were monitored for species presence and height on 27 July and 11 October 2016;
- The growth of dominant shrubs in the six dunal plots, *Acacia rostellifera* and *Spyridium globulosum,* was at a very early stage. The seedlings height 10 months after the fire were around 10cm high. Regrowth of *Acacia rostellifera* from underground stems was more rapid with growth up to 0.4-0.6m tall;
- The growth of sedges in the three wetland/TEC plots was well advanced. All three plots had an estimated 80-90% pre-fire cover of sedges;
- *Acacia rostellifera* seedlings were observed in one wetland/TEC area that did not contain *Acacia* shrubs before the fire. Further monitoring will be undertaken to determine whether the seedlings survive waterlogging/inundation in the future;
- The majority of native species in the Foreshore Reserve were recorded as regenerating after fire by seeding. The remainder regenerated by sprouting from underground stems and roots and bulbs/corms etc. *Acacia rostellifera* regenerated by both seeding and sprouting;
- The main weed species identified all appear to have been present in the plots before the fire. No infestation of new weed species in the burnt section of the Foreshore Reserve appears to have occurred;
- Grazing by rabbits, and possibly kangaroos, was observed on some narrow and flat leaved species including *Baumea juncea, Trachyandra divaricata* and *Lepidosperma gladiatum*;
- The burnt areas are expected to retain their pre-fire cover within around 5 years after the fire without any necessary intervention with regards to revegetation; and
- Further monitoring of the burnt area in the Foreshore Reserve will occur in April 2017 and 6 monthly thereafter until spring 2018.

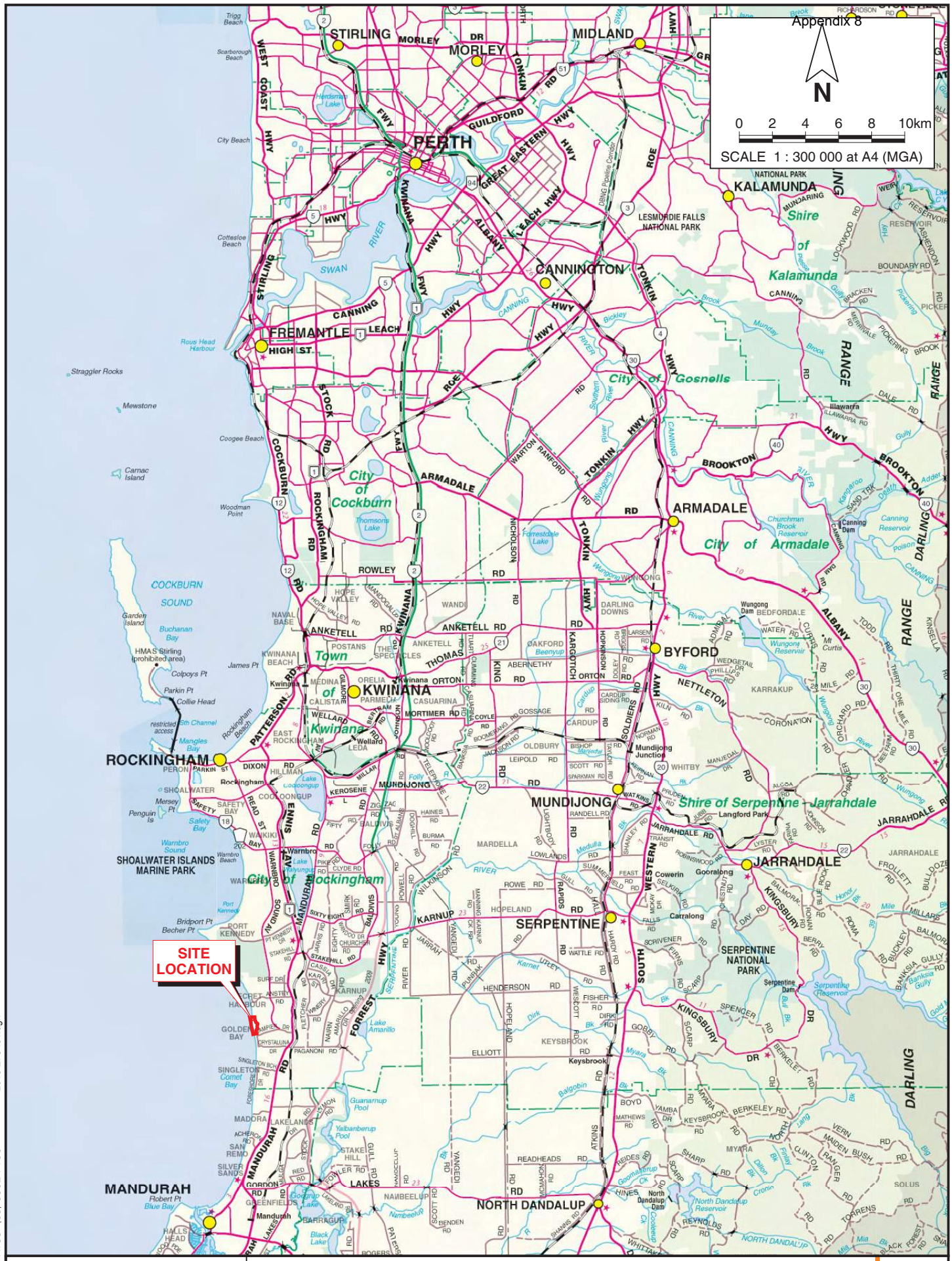
5 REFERENCES

Alan Tingay and Associates (1992) *Amendment to the Metropolitan Region Scheme Public Environmental Review.* Prepared for H & B Developments Pty Ltd. Perth, Western Australia.

PGV Environmental (2011) *Lot 2 Warnbro Sound Avenue and Lot 3 Dampier Drive Golden Bay Foreshore Management Plan*. Prepared for Department of Housing. Perth, Western Australia.

PGV Environmental (2016) *Lot 2 Warnbro Sound Avenue and Lot 3 Dampier Drive Golden Bay Foreshore Rehabilitation Plan*. Prepared for Department of Housing and Peet Golden Bay Pty Ltd. Perth, Western Australia.

FIGURES



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The Housing Authority and Peet Golden Bay Pty Ltd
POST-FIRE VEGETATION MONITORING BASELINE SURVEY
LOT 2 WARNBRO SOUND AVENUE, GOLDEN BAY FORESHORE RESERVE

Drawn: P. van der Moezel	Date: 11 Aug 2016
Job: 10004 Rpt: 2016-275	Revision: A

SITE LOCATION

Figure 1

PINPOINT CARTOGRAPHICS (08) 9562 7136 2016-275-f01.dgn

382 250mE
382 500mE
382 750mE
6 412 500mN
6 412 250mN
6 412 000mN

GBF9
GBF8
GBF7
GBF5
GBF6
GBF4
GBF1
GBF3
GBF2

N

0 20 40 60 80 100m

SCALE 1 : 3 000 at A3 (MGA)

Legend

- Foreshore Reserve Boundary
- Cadastral Boundary
- Topographic Contour (m AHD)
- Coffey Environments and DEC Approved TEC19a Boundary October 2010
- Monitoring Plot Location

CADASTRAL SOURCE: Landgate, May 2015.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown January 2016.

pgv ENVIRONMENTAL

The Housing Authority and Peet Golden Bay Pty Ltd
POST-FIRE VEGETATION MONITORING BASELINE SURVEY
LOT 2 WARNBRO SOUND AVENUE, GOLDEN BAY FORESHORE RESERVE

Drawn: P. van der Moezel | Date: 11 Aug 2016
Job: 10004 Rpt: 2016-275 | Revision: A

MONITORING PLOT LOCATIONS

Figure 3

APPENDIX 1

Monitoring Plot Data

QUADRAT GBF1

50 382543 E 6412176 N

Pre-fire Vegetation: *Acacia rostellifera/Spyridium globulosum* Open Heath (1.5m, 20-30%) over *Lepidosperma gladiatum* Open Sedgeland (10-20%)

Landform: Flat, low-lying, not wetland

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Lepidosperma gladiatum	Up to 0.3, mostly 0.1	1
Ficinia nodosa	0.3	<1
Acacia rostellifera	Very young seedlings <0.1	<1
Baumea juncea	Up to 0.4	<1
**Sonchus sp*	0.2	<1
**Lysimachia arvensis*	0.1	<1
**Dischisma arenarium*	0.1	<1
Crassula colorata	0.1	<1
**Conyza bonariensis*	0.1	<1
Senecio pinnatifolius	0.1	<1
**Carpobrotus edulis*	0.1	<1
**Lolium perenne*	0.1	<1
**Brassicaceae sp*	0.1	<1
Spyridium globulosum	Seedlings <0.1	<1
Calandrinia sp.	<0.1	<1
**Crassula glomerata*	<0.1	<1
**Pelargonium capitatum*	Seedling <0.1	<1
Caladenia latifolia	flat	<1
**Hypochaeris radicata*	flat	<1
**Taraxacum officinale*	flat	<1
**Oenothera drummondii*	flat	<1

SPECIES	HEIGHT (m)	COVER (%)
TOTAL COVER		1-2

* introduced species

Red = newly recorded species

QUADRAT GBF2

50 382501 E 6412149 N

Pre-fire Vegetation: *Baumea juncea/Ficinia nodosa* Closed Sedgeland (90%) over *Centella asiatica* Herbland

Landform: Swale, damp peaty soil, wetland

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Baumea juncea	0.5	40
Ficinia nodosa	0.5	30
Samolus repens	Seedling 0.3	<1
Acacia saligna	Seedling 0.3	<1
**Lolium perenne*	0.3	<1
Sporobolus virginicus	0.1	<1
Apium prostratum	0.1	<1
Lobelia anceps	Seedlings 0.1	<1
Centella asiatica	<0.1	10
**Sonchus oleraceus*	<0.1	<1
**Carpobrotus edulis*	<0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1
**Trifolium campestre*	<0.1	<1
TOTAL COVER		**70-75**

* introduced species

Red = newly recorded species

QUADRAT GBF3

50 382461 E 6412160 N

Pre-fire Vegetation: *Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub (3.5-4m, >70%) over *Lepidosperma gladiatum* Sedgeland (30%)

Landform: Top of low rise, dry sandy soils

Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Acacia rostellifera	sprouting 0.6	20
Lepidosperma gladiatum	0.6	10
**Trachyandra divaricata*	0.4	<1
**Lolium perenne*	0.2	<1
**Lagurus ovatus*	0.2	<1
Calandrinia liniflora	0.1	5
**Hypochaeris radicata*	flat	<1
Parietaria debilis	0.1	1
**Dischisma arenarium*	0.1	<1
Scaevola crassifolia	0.1	<1
**Bromus diandrus*	0.1	<1
**Crassula glomerata*	<0.1	<1
**Cerastium glomeratum*	<0.1	<1
Isolepis marginata	<0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1
Spyridium globulosum	Seedlings <0.1	<1
**Conyza bonariensis*	flat	<1
Thysanotus patersonii	climber	<1
Clematis linearifolia	climber	<1
Hardenbergia comptoniana	climber	<1
TOTAL COVER		**30-40**

* introduced species

Red = newly recorded species

QUADRAT GBF4

50 382427 E 6412262 N

Pre-fire Vegetation: *Acacia rostellifera/Spyridium globulosum* Shrubland (1.5m, 10%) over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (60%)

Landform: Upper slopes of low rise, dry sandy soil

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Acacia rostellifera	0.3	1
Lepidosperma gladiatum	0.5	20
Trachyandra divaricata	0.4	20
**Podotheca angustifolia*	0.4	<1
**Solanum nigrum*	0.2	<1
**Sonchus ?oleraceus*	0.2	<1
Conostylis candicans	0.2	<1
**Lolium perenne*	0.2	<1
Calandrinia liniflora	0.1	5
**Crassula glomerata*	0.1	2
Parietaria debilis	0.1	<1
**Cynodon dactylon*	0.1	<1
**Ehrharta calycina*	0.1	<1
Isolepis marginata	0.1	<1
**Dischisma arenarium*	0.1	<1
**Euphorbia terracina*	0.1	<1
Crassula colorata	<0.1	<1
**Cerastium glomeratum*	<0.1	<1
Spyridium globulosum seedling	<0.1	<1

SPECIES	HEIGHT (m)	COVER (%)
Scaevola crassifolia seedlings	<0.1	<1
**Carpobrotus edulis*	<0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1 (v. many seedlings)
**Oenothera drummondii*	flat	<1
**Cuscuta epithymum*	climber	<1
TOTAL COVER		**40-50**

* introduced species

Red = newly recorded species

QUADRAT GBF5

50 382466 E 6412278 N

Pre-fire Vegetation: *Baumea juncea* Sedgeland (90%) over *Centella asiatica* Herbland

Landform: Swale, damp peaty soil, wetland

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Baumea juncea	0.4	75
Ficinia nodosa	0.5	5
Centella asiatica	0.1	40
Acacia rostellifera	Seedlings 0.1- 0.4	<1
Samolus junceus	0.4	<1
Samolus repens	0.3	<1
Apium prostratum	0.3	<1
**Lolium perenne*	0.3	<1
**Lysimachia arvensis*	0.2	<1
**Romulea rosea*	0.1	<1
Atriplex sp.	0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1
**Arctotheca calendula*	flat	<1
TOTAL COVER		**75-80**

* introduced species

Red = newly recorded species

QUADRAT GBF6

50 382527 E 6412277 N

Pre-fire Vegetation: *Spyridium globulosum/Exocarpos sparteus* Open Heath (1.5m, 50-70%) over *Lepidosperma gladiatum/Baumea juncea* Open Sedgeland (20-30%)

Landform: Flat, low-lying, not wetland

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Lepidosperma gladiatum	0.2-0.5	2
Baumea juncea	0.2-0.5	2
Leucopogon parviflorus	0.4	<1
**Solanum nigrum*	0.3	<1
**Lolium perenne*	0.3	<1
Parietaria debilis	0.2	<1
**Crassula glomerata*	0.1	<1
Calandrinia liniflora	0.1	<1
**Dischisma arenarium*	0.1	<1
Olearia axillaris	0.1	<1
**Lysimachia arvensis*	0.1	<1
Isolepis marginata	0.1	<1
**Carpobrotus edulis*	0.1	<1
**Cerastium glomeratum*	0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1
Spyridium globulosum	Seedlings <0.1	<1
Acacia saligna	Very young seedling <0.1	<1
**Hypochaeris glabra*	flat	<1
**Conyza bonariensis*	flat	<1

SPECIES	HEIGHT (m)	COVER (%)
**Oenothera stricta*	flat	<1
Hardenbergia comptoniana	Seedlings <0.1	<1
TOTAL COVER		**5**

* introduced species

Red = newly recorded species

QUADRAT GBF7

50 382459 E 6412348 N

Pre-fire Vegetation: *Baumea juncea* Closed Sedgeland (80-90%) with occasional *Acacia saligna* shrubs over *Centella asiatica* Herbland

Landform: Swale, damp peaty soil, wetland, some water in north-east corner

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Juncus pallidus	1	<1
Baumea juncea	0.4	50
**Cyperus tenuiflorus*	0.4	10
Ficinia nodosa	0.5	1
?Schoenoplectus validus	0.5	<1
Lepidosperma gladiatum	0.4	2
Apium prostratum	0.6	<1
**Trachyandra divaricata*	0.3	<1
**Lolium perenne*	0.3	<1
**Lagurus ovatus*	0.2	<1
**Sonchus sp*	0.2	<1
**Romulea rosea*	0.2	<1
Olearia axillaris	0.2	<1
Centella asiatica	0.1	20
**Dischisma arenarium*	0.1	1
**Oenothera drummondii*	0.1	<1
Trachymene pilosa	0.1	<1
Eryngium pinnatifidum	0.1	<1
Acacia cyclops	Seedlings 0.1	<1 (many)
**Solanum nigrum*	0.1	<1

SPECIES	HEIGHT (m)	COVER (%)
**Trifolium sp.*	0.1	<1
**Cynodon dactylon*	0.1	<1
Acacia saligna	Seedlings <0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1
**Carpobrotus edulis*	<0.1	<1
**Oenothera stricta*	<0.1	<1
**Crassula glomerata*	<0.1	<1
**Hypochaeris glabra*	flat	<1
Hardenbergia comptoniana	climber	<1
TOTAL COVER		**60-70**

* introduced species

Red = newly recorded species

QUADRAT GBF8

50 382413 E 6412428 N

Pre-fire Vegetation: *Acacia rostellifera/Spyridium globulosum* Closed Tall Scrub (4m, 70-80%) over *Lepidosperma gladiatum* Sedgeland (20-30%)

Landform: Upper slopes of dune

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Acacia rostellifera	Sprout and seedling 0.4	15
Lepidosperma gladiatum	0.5	10
**Podotheca angustifolia*	0.4	<1
**Trachyandra divaricata*	0.3	1
**Lysimachia arvensis*	0.2	<1
**Oenothera drummondii*	0.2	<1
**Solanum nigrum*	0.1	5
**Ehrharta calycina*	0.1	2
Calandrinia liniflora	0.1	1
**Dischisma arenarium*	0.1	<1
Isolepis marginata	0.1	<1
**Pelargonium capitatum*	Seedlings 0.1	<1
Parietaria debilis	0.1	<1
**Crassula glomerata*	<0.1	<1
Calandrinia brevipedata	<0.1	<1
**Conyza bonariensis*	flat	<1
Cassytha sp	climber	<1
TOTAL COVER		**25-30**

* introduced species

Red = newly recorded species

QUADRAT GBF9

50 382410 E 6412509 N

Pre-fire Vegetation: *Spyridium globulosum* Tall Shrubland (3.5m, 10%) over *Lepidosperma gladiatum/Trachyandra divaricata* Sedgeland (50%)

Landform: Mid-slope of dune

QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Lepidosperma gladiatum	0.4	10
**Trachyandra divaricata*	0.3	15
Adriana quadripartita	0.4	<1
**Crassula glomerata*	0.1	5
**Solanum nigrum*	0.1	2
**Sonchus oleraceus*	0.1	<1
**Lysimachia arvensis*	0.2	<1
Parietaria debilis	0.1	<1
**Dischisma arenarium*	0.1	<1
Isolepis marginata	0.1	<1
Crassula colorata	0.1	<1
**Carpobrotus edulis*	0.1	<1
**Cerastium glomeratum*	0.1	<1
**Brassicaceae sp.*	0.1	<1
Calandrinia liniflora	<0.1	<1
Calandrinia brevipedata	<0.1	<1
Hardenbergia comptoniana	Seedlings <0.1	<1
**Pelargonium capitatum*	Seedlings <0.1	<1
Spyridium globulosum	Seedlings <0.1	<1
**Oenothera drummondii*	flat	<1

SPECIES	HEIGHT (m)	COVER (%)
**Oenothera stricta*	flat	<1
**Cuscuta epithymum*	climber	<1
TOTAL COVER		**30-40**

* introduced species

Red = newly recorded species

APPENDIX 2

Quadrat Data

Species List - Golden Bay Foreshore Reserve Post-Fire Monitoring Plots

Species	Regeneration Mechanism	
	Seed	Sprout/Bulb
MONOCOTYLEDONS		
Baumea juncea		+
**Bromus diandrus*	+	
Caladenia latifolia	ND	ND
Conostylis candicans	?	?
Cynodon dactylon		+
**Cyperus tenuiflorus*		+
Ficinia nodosa		+
Isolepis cernua		+
Isolepis marginata	+	
Juncus pallidus		+
**Lagurus ovatus*	+	
Lepidosperma gladiatum		+
**Lolium perenne*	+	
**Poa annua*	+	
**Romulea rosea*		+
?Schoenoplectus validus		+
Sporobolus virginicus		+
Thysanotus patersonii		+
**Trachyandra divaricata*	?	?
DICOTYLEDONS		
Acacia cyclops	+	
Acacia rostellifera	+	+
Acacia saligna	+	
Adriana quadripartita		+
Alyxia buxifolia	+	
Apium prostratum	+	
**Arctotheca calendula*	+	
Atriplex sp.	+	
**Bartsia trixago*	+	
Brassicaceae sp.	+	
Calandrinia liniflora	+	
Calandrinia brevipedata	+	
**Carpobrotus edulis*	+	
Cassytha sp		+
Centella asiatica		+
**Cerastium glomeratum*	+	
Clematis linearifolia		+

Species	Regeneration Mechanism	
	Seed	Sprout/Bulb
**Conyza bonariensis*	+	
Crassula colorata	+	
**Crassula glomerata*	+	
**Cuscuta epithymum*	+	
**Dischisma arenarium*	+	
?Eryngium pinnatifidum	+?	
**Euphorbia terracina*	+	
Exocarpos sparteus	+	
Hardenbergia comptoniana	+	+
**Hypochaeris glabra*	+	
**Hypochaeris radicata*	+	
Leucopogon parviflorus		+
Lobelia anceps	+	
**Lysimachia arvensis*	+	
**Oenothera drummondii*	+	
**Oenothera stricta*	+	
Olearia axillaris	+	
**Pelargonium capitatum*	+	
**Podotheca angustifolia*	+	
Samolus junceus	+	
Samolus repens	+	
Scaevola crassifolia	+	
Senecio pinnatifolius	+	
**Solanum nigrum*	+	
**Sonchus oleraceus*	+	
**Sonchus sp*	+	
**Parietaria debilis*	+	
Spyridium globulosum	+	
**Taraxacum officinale*	+	
Trachymene pilosa	+	
**Trifolium campestre*	+	

* introduced species

APPENDIX 3

Memo – Golden Bay Foreshore Reserve Fire

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Memo - Golden Bay Foreshore Reserve Fire

13 January 2016

The foreshore reserve in Golden Bay was subject to a bushfire on the 1 January 2016. The fire was reported as being ignited by fireworks/boat flares just after midnight. The extent of the fire is shown on Plan 1. Please note the boundary is an approximation the perimeter has not been formally mapped. The area of the foreshore reserve impacted on by the fire is estimated to be 7ha.

Impact

The fire has burnt through a large portion of the foreshore reserve in different intensities. The northern section has been burnt in patches (see photos 1-3) and the central section has largely been burnt out (see photos 4-9). The fire has not carried through to the beach, there is a strip of vegetation remaining to the west of the foreshore reserve (see photo 10). The portion of the foreshore reserve south of the long conservation category wetland (Threatened Ecological Community 19a) has not been impacted by the fire (see photos 9 and 10).

The Quenda population in the foreshore reserve may have been impacted by the fire if they were unable to keep ahead of the fire front.

The ground water monitoring bore located on the northern end of the long conservation category wetland is likely to have been impacted by the fire.

Management

The coastal vegetation in the foreshore reserve including TEC 19a will regenerate in a reasonably short time. This is based on experience with a fire in the same vegetation types in Anstey Q Swamp in neighbouring Secret Harbour in 1995. The vegetation was completely burnt out and has recovered well to its present very densely vegetated condition. Fencing of the TEC 19a areas is not considered necessary as the areas will re-cover quickly as demonstrated by the Anstey Q Swamp fire. Vegetation recovery will be monitored in the annual photo point wetland vegetation survey in accordance with the Foreshore Management Plan.

Weed control will likely be required in the early stages of regeneration to minimise competition for resources. A survey of the burnt area after the first rains is recommended to assess the weed impacts and inform the weed control program.

The southern portion of the foreshore reserve will likely contain the remaining Quenda population which will be surveyed in autumn 2016 in accordance with the Foreshore Management Plan.

Predator (foxes and cats) control is going to be an important management action to protect the remaining Quenda in the foreshore reserve. The spring 2015 Quenda survey showed the number of individuals had reduced and there was increased evidence of predators in the foreshore reserve. It is recommended that a predator control program is put in place as soon as possible.

The ground water monitoring bore on the northern end of the conservation category wetland will need to be assessed for damage. If damaged a new bore will need to be constructed as the ground water levels require monitoring on a monthly basis in accordance with the Foreshore Management Plan.

Regulatory Agencies

The foreshore reserve is managed in accordance with the Foreshore Management Plan which fulfils Condition 297:P2 of Ministerial Statement 297. The Foreshore Management Plan was prepared in consultation with the Department of Planning Coastal Branch and the City of Rockingham, with the final approval of the plan by the OEPA.

A letter and this memo should be should be submitted to the above agencies.

Plan 1: Estimated Extent of Fire

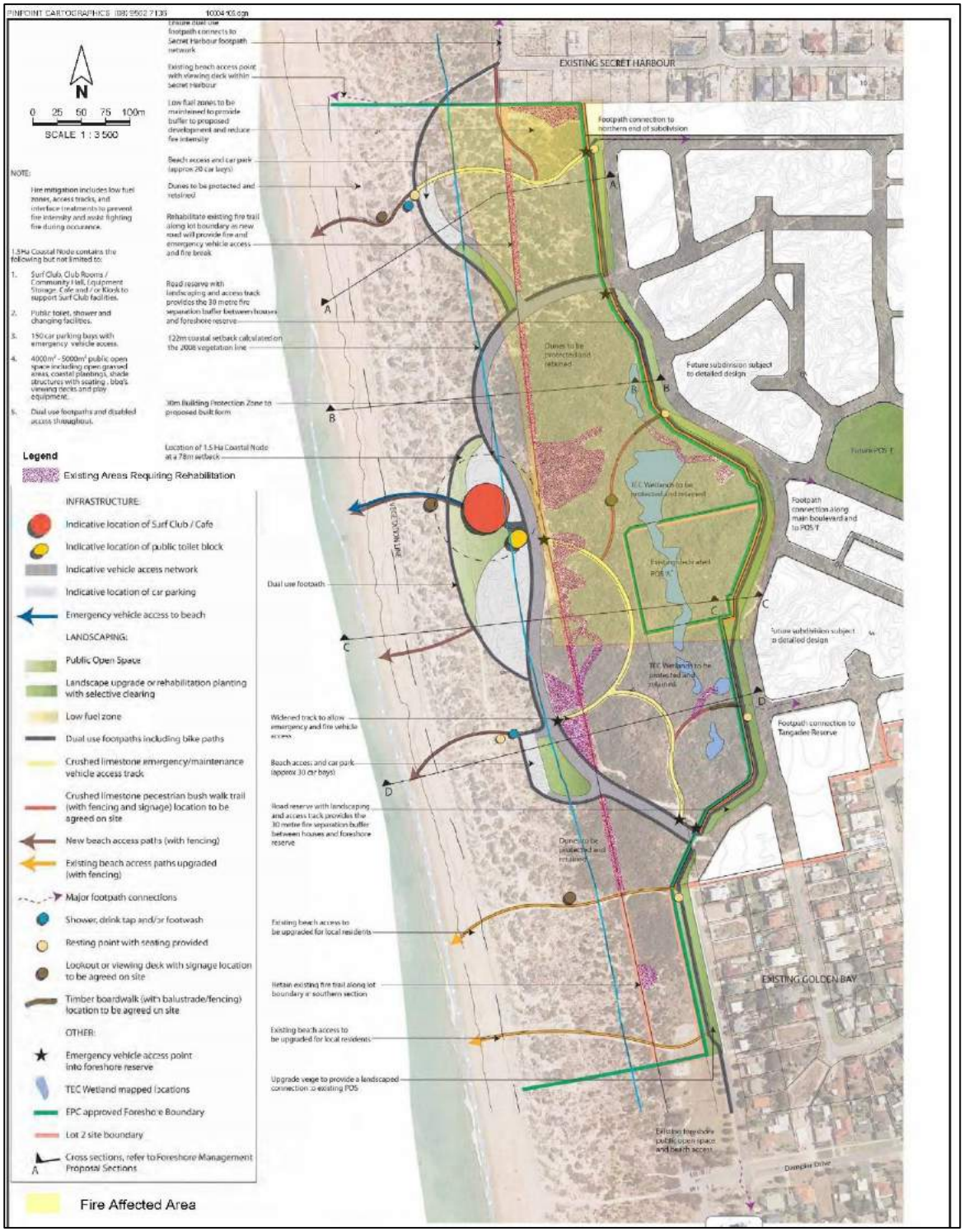

Photo 1: Looking south from Secret Harbour (viewed form 48 Turtles Bend)

Photo 2: Looking south east from Secret Harbour Beach lookout

Photo 3: Looking south east from Secret Harbour Lookout Beach Lookout

Photo 4, 5 and 6: Looking south west from the park look out at the western end of Aurea Bvd

Photo 6, 7, 8 and 9: Looking west from park look out at the western end of Aurea Bvd

Photo 10: Looking south along the western boundary of the foreshore reserve (taken from Secret Harbour Beach Lookout)