



North Alkimos Foreshore Management Plan

**Prepared for Peet Limited
August 2012
Project Number V9034**



Cardno (WA) Pty Ltd

ABN 77 009 119 000

11 Harvest Terrace

West Perth WA 6005

Australia

PO Box 447, West Perth

Western Australia 6872 Australia

Telephone: 08 9273 3888

Facsimile: 08 9486 8664

International: +61 8 9273 3888

perth@cardno.com.au

www.cardno.com.au

Document Control

Version	Date	Author		Reviewer	
01a	18 February 2010	Gillian Turner	GFT	Barbara Pedersen	BP
01b	19 April 2010	Jess Lisle	JHL	Barbara Pedersen	BP
01c	27 September 2010	Jess Lisle	JHL	Barbara Pedersen	BP
02	10 December 2010	Jess Lisle	JHL	Barbara Pedersen	BP
03	30 March 2011	Barbara Pedersen	BP	Barbara Pedersen	BP
04	20 May 2011	Gemma Blick	GB	Barbara Pedersen	BP
04a	17 November 2011	Gemma Blick	GB	Barbara Pedersen	BP
Final	8 August 2012	Gemma Blick	GB	Barbara Pedersen	BP
Filename	V9034-GFT90017.final--BP.Doc				

Author: Gemma Blick
Position Title: Environmental Planner

Reviewer: Barbara Pedersen
Position Title: Section Leader Environmental Planning

"© 2012 Cardno (WA) Pty Ltd All Rights Reserved. Copyright in the whole and every part of this document belongs to Cardno (WA) Pty Ltd and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person without the prior written consent of Cardno (WA) Pty Ltd."

Executive Summary

Cardno (WA) Pty Ltd (Cardno) was engaged by Peet Limited (Peet) to prepare a Foreshore Management Plan (FMP) for the foreshore adjoining residential development at Alkimos north; called “Shorehaven” (**Figure 1**). Peet are currently developing Lots 1005 and 1006 Marmion Avenue as a Coastal Village for residential and commercial purposes. This FMP focuses on the design, rehabilitation and stabilisation, and ongoing management of the 28.38ha foreshore reserve (**Figure 2**) (referred to as the subject site).

The FMP provides a guiding framework for the restoration and protection of coastal landforms and vegetation, as well as the management and integration of the 1.74km coastal frontage and foreshore reserve with the adjoining Coastal Village Precinct. Ongoing management is particularly important to maintain the long term condition and amenity of the foreshore while providing for the increased usage and pressures that will result from establishment of the Shorehaven Coastal Village Precinct. The FMP sets out the standards for management of the foreshore, and describes the facilities to be provided for visitors to the foreshore and beach including the path network which will link the foreshore reserve to future foreshore reserves north and south.

Preparation of the FMP involved a review of the existing legislation and policy context as well as assessment of the existing environmental conditions of the subject site. Based on the legislation, policy context and coastal studies, the following management principles and objectives have been developed for the foreshore:

- Development of the foreshore will be in accordance with the Minister for the Environment’s Statement 722 and with the State Coastal Planning Policy;
- Areas identified as having unique landscape, scientific and cultural significance are to be managed with respect for these values;
- Natural habitats, particularly areas of conservation value, are to be protected, restored and enhanced as far as possible;
- Public places, facilities and access to the beach in the foreshore reserve are to be developed in a manner that does not compromise ecological values while supporting recreational uses;
- Development in the foreshore reserve is to be in nodes; and
- Ongoing monitoring of areas of dune stabilisation, drainage treatments and areas of revegetation will protect environmental values.

Understanding the existing environmental context of the subject site was developed through a review of the climate, land use context, landforms, geology, soils and topography, coastal processes and marine interface, acid sulphate soils, hydrology, flora and vegetation, fauna, heritage, recreation and aesthetic values.

Environmental constraints, issues and opportunities associated with the foreshore were derived from the assessment of the legislative and policy context, with a review of previous coastal studies providing information regarding the existing environment and foreshore condition. From this review the key constraints, issues and opportunities identified were:

- Coastal processes setback (Constraint);
- Potential damage of “Excellent” or “Very Good” condition vegetation (Issue);
- Spread or introduction of weed species (Issue);
- Impact of strong coastal winds on dune stability and community use within the foreshore (Issue);
- Demand for user friendly access to the beach across 1.74km of coastline (Issue);
- Further destabilisation and erosion of dune formations (Issue);

- Drainage and stormwater runoff within the foreshore from future residential and commercial development (Issue);
- The potential presence of Threatened Ecological Communities (TECs) (Issue);
- The extent, position and “Completely Degraded” condition of vegetation on the blowout (Opportunity);
- Existing tracks along and across the foreshore (Opportunity);
- The introduction of community facilities (Opportunity);
- The presence of the Tamala Limestone (Opportunity);
- User friendly beach areas (Opportunity); and
- The Alkimos Wreck (Opportunity).

These constraints, issues and opportunities were used to inform the planning and design of the restoration and future management across the foreshore. The foreshore design section in this report discusses the integration of urban and foreshore environment through describing the structural elements, the movement network, the public facilities and protection of the environment values within the foreshore. This plan demonstrates an integrated design for public foreshore use, supporting conservation and integration of public facilities with the surrounding landscape, while maximising the amenity and opportunities for passive recreational uses of a foreshore area adjacent to a significant urban development.

The second component of this report uses the existing environmental condition and foreshore design to set objectives for dune stabilisation, weed control and rehabilitation within the foreshore. Stabilisation of the foreshore includes the use of a fenced network of pathways, controlled vehicle access, fencing and barriers, signage, stabilisation of degraded dunes and the blowout and suitable drainage. Rehabilitation will include targeted revegetation of degraded dunes with suitable native plant species and ongoing protection and conservation of fauna species.

The FMP provides the implementation schedule for the Foreshore Design and Stabilisation and Rehabilitation Plan.

In conclusion, this FMP aims to provide a guiding framework for the protection, future management and integration of the foreshore reserve with the Coastal Village Precinct. The successful implementation of this plan will guide the long term management and protection of the Shorehaven foreshore.

Table of Contents

Executive Summary	ii
1 Introduction.....	1
1.1 Background	1
1.2 Location and Site Description	1
1.3 Overarching Objectives and Philosophy	2
2 Legislation and Policy Context.....	4
2.1 Current Zoning	4
2.2 Approvals under the Metropolitan Region Scheme	5
2.3 Alkimos-Eglinton District Structure Plan	5
2.4 North Alkimos Local Structure Plan	6
2.5 Conditions set by the Ministerial Statement 722.....	7
2.6 State Planning Policy No. 2.6.....	7
2.7 State Planning Policy No. 2.9.....	8
2.8 Liveable Neighbourhoods	9
2.9 Directions 2031	10
2.10 Draft Perth Coastal Planning Strategy	10
2.11 State Planning Policy No. 2.8.....	11
2.12 Bush Forever.....	11
2.13 City of Wanneroo Local Biodiversity Strategy.....	12
2.14 Management Principles and Objectives.....	13
3 Environmental Context.....	14
3.1 Climate	14
3.2 Land Use Context	14
3.2.1 Historical Land Use	14
3.2.2 Current Land Use	15
3.2.3 Future Adjoining Land Uses.....	15
3.3 Landform, Geology, Soils and Topography	16
3.3.1 Geology	16
3.3.2 Geomorphology.....	16

3.3.3	Soils.....	18
3.3.4	Landform and Dune Stability.....	18
3.4	Coastal Processes and Marine Interface.....	19
3.5	Acid Sulfate Soils.....	20
3.6	Hydrology.....	20
3.7	Flora and Vegetation.....	20
3.7.1	Plant Communities.....	21
3.7.2	Vegetation Condition.....	21
3.7.3	Threatened Ecological Communities.....	24
3.7.4	Significant vegetation.....	25
3.7.5	Weed Mapping.....	26
3.8	Fauna.....	26
3.9	Heritage.....	28
3.9.1	Indigenous Heritage.....	28
3.9.2	Non-Indigenous Heritage.....	28
3.10	Recreation and Aesthetic Value.....	28
4	Constraints, Issues and Opportunities.....	30
4.1	Constraints.....	30
4.2	Issues.....	30
4.3	Opportunities.....	32
5	Foreshore Design.....	34
5.1	Design Philosophy.....	34
5.2	Integration of Urban and Foreshore Environment.....	34
5.2.1	Structural Elements.....	34
5.2.1.1	Village Foreshore Park.....	35
5.2.1.2	Foreshore Road.....	37
5.2.1.3	Small Coastal Nodes.....	39
5.2.1.4	Major and minor nodes.....	39
5.2.1.5	Lookout Nodes.....	40
5.2.2	Accessibility.....	41
5.2.2.1	Fencing.....	41

5.2.2.2	Coastal promenade	42
5.2.2.3	Beach Access.....	42
5.2.2.4	Walking Trails.....	43
5.2.2.5	Vehicle Access	43
5.2.3	Awareness of Environment	43
5.2.4	Public Facilities.....	45
5.2.5	Infrastructure	46
5.3	Protection and Conservation Areas	48
5.4	Continuity with adjacent landholdings.....	48
6	Rehabilitation and Stabilisation Plan: Technical specifications	49
6.1	Weed Control	49
6.2	Dune Stabilisation	49
6.2.1	Managing uncontrolled access.....	50
6.2.2	Pedestrian pathways.....	50
6.2.3	Vehicle Access	53
6.2.4	Fencing/Barriers.....	53
6.2.5	Signage	55
6.2.6	Stabilisation for degraded dunes.....	56
6.2.7	Stabilisation of the blowout	58
6.2.8	Drainage.....	58
6.3	Rehabilitation.....	61
6.3.1	Timing.....	61
6.3.2	Revegetation	62
6.3.3	Vegetation Salvaging	66
6.3.4	Seed Collection	66
6.3.5	Tubestock, Direct Seeding and Tree Guards.....	66
6.4	Fauna	66
6.5	Plant Disease Management.....	67
6.5.1	<i>Phytophthora cinnamomi</i> – Dieback	67
6.5.2	<i>Armillaria luteobubalina</i> – Honey Fungus	68
6.5.3	<i>Zythiostroma</i> - Aerial Canker	68

6.6	Monitoring of Stabilisation and Rehabilitation	68
6.6.1	Monitoring, Maintenance and Reporting	68
6.6.2	Completion Criteria.....	69
6.6.3	Ongoing Maintenance	69
6.7	Specifications for stabilisation and rehabilitation	70
6.7.1	The Blowout	70
6.7.2	Batter Slopes.....	72
6.7.3	Degraded Tracks.....	74
6.7.4	Coastal Heath – LmMs.....	75
6.7.5	Primary Dune Ridgeline – LmMsOa.....	76
6.7.6	Patch of Acacia – AsSg.....	78
6.7.7	Primary Foredune – ScOaSg.....	79
6.7.8	Mobile Foredune – ShTd.....	80
6.7.9	Acacia Shrubland – ArEt	82
7	Implementation Schedule.....	84
7.1	Planting of Tubestock for Revegetation	85
7.2	Works and Construction Schedule.....	85
7.3	Stabilisation and Rehabilitation Schedule.....	85
8	Management Structure.....	100
8.1	Village Foreshore Park.....	100
8.2	Involvement of local community.....	100
9	References	101

List of Tables

Table 1: Vegetation Condition Scale (Keighery 1994)

Table 2: Categories of Priority Ecological Communities

Table 3: Weed Species

Table 4: Environmental Awareness objectives included in the Foreshore

Table 5: Public Facilities included in the Foreshore

Table 6: Infrastructure included in the Foreshore

Table 7: Stabilisation of pedestrian pathways

Table 8: Stabilisation methods for degraded dunes

Table 9: Revegetation Species

Table 10: Tubestock to be planted in LmMs

Table 11: Tubestock to be planted in LmMsOa

Table 12: Tubestock to be planted in AsSg

Table 13: Tubestock to be planted in ScOaSg

Table 14: Tubestock to be planted in ShTd

Table 15: Tubestock to be planted in ArEt

List of Plates

Plate 1: The Stratigraphical relationship of Safety Bay Sands (Semeniuk *et al.* 1989) 17

Plate 2: 360° Panorama view of the blowout (April 2010) 18

Plate 3: Exposed cementation within the blowout 19

Plate 4: ‘Excellent’ condition vegetation..... 23

Plate 5: ‘Degraded’ and ‘Completely Degraded’ condition vegetation..... 23

Plate 6: Extensive views available from high points adjacent to the foreshore 29

Plate 7: Viewshed towards the Indian Ocean through the blowout 36

Plate 8: Typical section through road with sloping downward grade on conservation area 38

Plate 9: Car park access road through Foreshore Reserve 38

Plate 10: Road Section – retaining wall 38

Plate 11: Typical Seating at Small Coastal Node with Sculptural Element (EPCAD) 39

Plate 12: Large View Deck with associated seating area (EPCAD) 40

Plate 13: Small View Deck (EPCAD) 41

Plate 14: Typical Beach Access Section (EPCAD)..... 42

Plate 15: Example of pedestrian pathway options..... 51

Plate 16: Raised Board Walk Typical Section (EPCAD)..... 52

Plate 17: Detail of Beach Access Section (EPCAD) 52

Plate 18: Typical Footpath Section (EPCAD) 52

Plate 19: Example of fencing used for stabilisation 54

Plate 20: Typical Fence Detail (EPCAD)	54
Plate 21: Typical Entry and Node Feature Fence (EPCAD)	55
Plate 22: Typical Fence to Footpath Corridors and Reserve Boundary (EPCAD)	55
Plate 23: Examples of stabilisation methods	56
Plate 24: Primary Path Section with Drainage	59
Plate 25: Drainage and Erosion examples.....	60
Plate 26: Typical Sections for Batters (EPCAD)	73

List of Figures

Figure 1: Locality Plan
Figure 2: Foreshore Reserve
Figure 3: Historical Aerial Photographs 1953 > 1988
Figure 4: Historical Aerial Photographs 1998 > 2008
Figure 5: Historical Blowout Vegetation Alignment
Figure 6: Topography
Figure 7: Soils
Figure 8: Regional Vegetation Mapping
Figure 9: Plant Communities
Figure 10: Vegetation Condition
Figure 11: Location of Village Foreshore Park
Figure 12: Foreshore Movement Network
Figure 13: Foreshore Boundaries and Reserves
Figure 14: Village Foreshore Park Viewsheds
Figure 15: Concept design of beach club
Figure 16: Staging concept for stabilisation of the blow out
Figure 17: Staging of Rehabilitation and Restoration
Figure 18: Shorehaven Drainage Concept Plan
Figure 19: Revegetation Plan

Appendices

- Appendix A Wind Roses
- Appendix B TEC Cluster Analysis
- Appendix C Weed Management

1 Introduction

1.1 Background

The Alkimos North development (Shorehaven) (Lots 1005 and 1006 Marmion Avenue) is comprised of 234 ha of undeveloped land with 1.74 km of coastal frontage approximately 42 kilometres north west of Perth CBD (**Figure 1**). This land is to be developed as a Coastal Village Precinct for residential purposes by Peet Limited (Peet). The development of a vibrant residential and commercial precinct at Alkimos will bring life to the 1.74 km stretch of coastal frontage.

As a requirement of the planning and approvals process, a Foreshore Management Plan (FMP) is required for the foreshore reserve. This is compliant with the recently approved North Alkimos Local Structure Plan (LSP) and with the approvals for the Alkimos District Structure Plan (DSP) (Landcorp 2009) which specify that an FMP is required for each foreshore in the DSP area.

This FMP addresses the design, rehabilitation and stabilisation of the 28.38ha foreshore reserve at Shorehaven, referred to in this report as the “Subject Site” (**Figure 2**). The plan focuses on the design of public facilities and access as well as on rehabilitation, restoration and stabilisation across the entire foreshore. The FMP guides restoration of the large blowout adjoining the Alkimos wreck as well as numerous degraded vehicle tracks through the foreshore. The blowout formed gradually over the past 50 years from vehicle access and erosion (**Figure 3** and **Figure 4**) and is now roughly 4 ha in size and highly mobile, creating a significant challenge for the future management and safe use of the foreshore.

The purpose of this FMP is to provide a guiding framework for the restoration, protection, future management and integration of the foreshore reserve with the future Coastal Village Precinct. This is particularly important to maintain the long term sustainability of the foreshore despite increased usage and pressures. The FMP implementation costs have not been detailed within this report as they are likely to vary significantly over the 2012-2020 implementation period. However, exact implementation costs shall be provided as part of the Development Application to be approved prior to the commencement of implementation works for each stage. These costs will accurately reflect current pricing and costings at the time of implementation. It is anticipated that this FMP will set the standard for the appropriate management of the foreshore within the DSP area. Further, it is expected that there will be continuity of management effort across the foreshores within the DSP area, with continuous north south pedestrian access as well as linkages in primary infrastructure.

1.2 Location and Site Description

The subject site is located within the locality of Alkimos, in the City of Wanneroo, approximately 18 km north of Joondalup business centre. The foreshore reserve is 1.74 km in length, is 28.38 ha in area and varies in width from 120 to over 230 metres. The foreshore reserve forms part of Bush Forever (BF) Site No. 397 (coastal strip from Wilbinga to Mindarie). Adjacent to the southern area of foreshore reserve, and as a continuation of BF Site No. 397, is an area reserved under the Metropolitan Region Scheme (MRS) for “Parks and Recreation”. The reserve is a triangular parcel of land (referred to in this report as “the green link”) within Lot 1006 of 8.87 ha in size and was reserved as part of the MRS amendment (1029/33) (WAPC 2005) in order to provide a green link to the buffer to the Alkimos Waste Water Treatment Plant (**Figure 2**). This reserve is subject to future planning assessment and as such is excluded from the current FMP.

1.3 Overarching Objectives and Philosophy

The objective and overarching philosophy for this FMP is to develop a management framework that will guide best practice foreshore management. The Alkimos foreshore provides an opportunity to showcase innovation in foreshore design through providing for conservation and integration of recreational uses with the surrounding landscape. The design aims to maximise the amenity and passive recreation use of the foreshore area adjacent to a significant urban development. In line with this philosophy, the LSP specifies that the foreshore reserve will:

'be carefully managed, limiting access to designated routes and providing interpretive material to ensure that it is valued by the community for passive recreation, and avoids being degraded by uncontrolled access. Walking tracks through the reserve will utilise informal trails that are already present in order to avoid clearing of new tracks, and to provide a network that is already proven as preferred routes by users of the area.' (TBB 2009, p. 114).

Reflecting the designation of north Alkimos in the Perth Coastal Planning Strategy as an open space precinct, this FMP guides the foreshore restoration, design and provision of public facilities in the foreshore to support recreation associated with the Alkimos wreck, public access to the beach and conservation. The foreshore design combines improved community access and amenities with restoration of extensive degraded areas, as well as recognition of the landforms and environmental values of the site. The foreshore design (see **Figure 11**) features:

- The Village Foreshore Park which provides community and commercial opportunities whilst also stabilising the large degraded area in the centre of the site including the blowout;
- A comprehensive movement network that accommodates access for a diversity of beach and foreshore users. This network uses the existing pathways and landform to minimise the impact on the environment;
- A number of lookouts throughout the reserve to enable enjoyment of expansive views towards the ocean, up and down the coast, the Alkimos wreck and back towards the development;
- A number of small coastal nodes that provide facilities including shade and seating;
- Additional facilities such as parking, toilets, barbeques and showers and stairs to the beach to support access to the beach across steep dunes; and
- Rehabilitation and stabilisation of the foreshore including revegetation, batters, and strategic pathways. This is discussed in more detail in **Section 6**.

This plan is subject to further detailed design and in particular, the details of public amenities to be provided in the Village Foreshore Park are presented here as concept designs. The FMP guides management actions and outlines the proposed design responses to the following constraints and issues within the foreshore reserve:

- Coastal set back;
- Pedestrian access to the beach;
- Pedestrian (dual use) and emergency access along and through the foreshore reserve;
- Dune stabilising, rehabilitation and restoration;
- Erosion, drainage, weed and fire control;
- Fencing, signage, public art, seating, lookouts, shelters, toilets, car parking and landscaping;
- Commercial opportunities (e.g. provision of facilities such as a surf lifesaving outpost, cafes and tourism opportunities); and
- Development – foreshore interface (e.g. drainage, batters, retaining walls and fencing).

To address these, the FMP has been subdivided into eight main sections:

- Legislation and Policy Context (**Section 2**);
- Environmental Context (**Section 3**);
- Opportunities, Issues and Constraints (**Section 4**);
- Foreshore Design (**Section 5**);
- Rehabilitation and Stabilisation Plan (**Section 6**);
- Implementation Schedule (**Section 7**); and
- Management Structure (**Section 8**).

2 Legislation and Policy Context

2.1 Current Zoning

The subject site is currently reserved for “Parks and Recreation” under the Metropolitan Regional Scheme (MRS) and adjoins regionally significant vegetation to the south and north. The Peet Alkimos Shorehaven development area is zoned “Urban” under the MRS. Peet’s landholding at Shorehaven includes the coastal foreshore and extends from around 60 metres behind the frontal dunes to east of Marmion Avenue.

The 28.38ha coastal foreshore includes a Crown Reserve adjacent to the ocean that varies in width from 35m to around 100m. The Crown Reserve is vested in City of Wanneroo and together with the whole foreshore reserve forms part of Bush Forever (BF) Site No. 397 (Coastal strip from Wilbinga to Mindarie). The Crown Reserve and adjacent portion of freehold title land owned by Peet are reserved under the MRS for “Parks and Recreation” and are referred to in this report as the foreshore reserve.

The current MRS zoning within the Alkimos-Eglinton area has been subject to a number of planning amendments since the first coastal planning strategy for Alkimos-Eglinton was prepared in 1993. The most recent amendment (MRS Amendment 1029/33) was submitted to the Western Australian Planning Commission (WAPC) in 2000 and referred to the Environmental Protection Authority (EPA) as the proposed land use changes had the potential to cause significant impacts on a number of environmental factors. The EPA decided the amendment would be subject to a formal Environmental Review (ER).

An ER was prepared by ATA Environmental (now Coffey Environments) in 2003 (ATA 2003b). The ER was subject to a number of modifications before the EPA formally assessed Amendment No. 1029/33 and released Bulletin 1207. Environmentally significant areas identified through the ER and EPA Bulletin 1207 were reserved for “Parks and Recreation” on formal gazettal of the MRS Amendment 1029/33 in 2006.

The green link, reserved for “Parks and Recreation” in the southern portion of Lot 1006, was identified and reserved through the MRS Amendment 1029/33 process. The conservation significance of this bushland was identified as being:

- the presence of Priority Flora (PF) species;
- the presence of Threatened Ecological Community (TEC) 26a: and
- part of a regional linkage.

The green link is subject to future planning assessment and is excluded from the current FMP.

The MRS coastal foreshore reserve was not modified during the 1029/33 amendment. The original coastal foreshore mapping was undertaken by the Department of Land Administration (DOLA) (now Landgate) and Alan Tingay and Associates on behalf of the Department of Planning and Urban Development (now Department of Planning). DOLA established the western (seaward) edge from digital cadastre in 1991. Alan Tingay and Associates determined the eastern (leeward) edge for the Alkimos Eglinton Coastal Planning Strategy in 1993.

Under the City of Wanneroo District Planning Scheme (2010) No. 2 the subject site is zoned “Parks and Recreation” to reflect the MRS zoning.

2.2 Approvals under the Metropolitan Region Scheme

The FMP proposes the rehabilitation and restoration of the coastal foreshore, along with the provision of recreational amenities across the foreshore and in particular recreational facilities within the restored blow out. These proposed management outcomes accord with Section 16 (1) (a) of the Metropolitan Region Scheme Text (MRS Text) (WAPC 2006a) whereby “reserved land may be used without the written approval of the Commission if the land is used for the purpose for which it is reserved under the Scheme”.

The purpose of the foreshore reserve under the MRS is for Parks and Recreation, therefore the activities proposed and detailed in this FMP accord with the purpose of the reserve.

The foreshore reserve also forms part of Bush Forever Site No.397. Under Section 16 (1) (a) “Development on reserved land owned by or vested in a public authority may be commenced or carried out without the written approval of the Commission if the development is – (a) permitted development that does not involve the clearing of regionally significant vegetation on a site specified as a *Bush Forever* site”. The activities proposed and detailed in this FMP provide for the restoration of extensively degraded areas of Bush Forever Site No.397 and are therefore permitted development.

Clause 16 (3) of the MRS Text further defines “permitted development” as “(e) works on land reserved for Parks and Recreation where the works are in accordance with a management plan endorsed by the Commission”.

The process proposed for approval of this FMP is in accordance with Section 16 as the activities proposed accord with the purpose of vesting, the Bush Forever site will be restored through the activities proposed and the works proposed are in accordance with this FMP and are therefore permitted development. Therefore the WAPC endorsement of this FMP is sought under Clause 16 (2) of the MRS.

2.3 Alkimos-Eglinton District Structure Plan

The Alkimos Eglinton District Structure Plan (DSP) was developed to guide development of the Alkimos Eglinton area. The DSP indicates that Shorehaven will form part of a coastal community accommodating more than 57,000 residents. As part of the approval of DSP, EMPs are to be prepared in consultation with the local authority and the WAPC, and submitted as supporting documentation to the subdivision application for any land adjacent to the foreshore reserve.

The DSP was supported by a Coastal Strategy (RPS Bowman Bishaw Gorham 2006) which amalgamated and updated previous work to compliment the DSP and guide development of detailed FMPs for specific sections of the coast as part of the planning process. The DSP required that the portion of the foreshore reserve adjacent to the Coastal Village Precinct at North Alkimos be indicatively identified as part of the Coastal Village Precinct centre as management of the reserve in that area would reflect access and recreation rather than conservation.

The changes to zoning proposed in the DSP were subject to a formal environmental assessment through referral of MRS amendment 1029/33 to the EPA as described in **Section 2.1**. As part of the approval process the Minister for Environment set environmental management conditions that must be met (see Minister’s Statement 722). These included the preparation and implementation of environmental management plans (EMPs) for land reserved as “Parks and Recreation”. The EMP for the foreshore in the Alkimos-Eglinton Project Area has been incorporated into this FMP and as such includes all items in the excerpt from the Minister for Environment’s Statement 722 (discussed in **Section 2.5**)

The FMP is to be prepared and implemented to the satisfaction of the WAPC prior to commencement of any site works.

The DSP was approved by the WAPC in 2009. Formal environmental consideration of the DSP was undertaken as part of the approval process. The extent of land reserved for “Parks and Recreation” took into account Bush Forever sites, TECs and coastal setback requirements (discussed further in **Section 2.6**). The conditions of Ministerial Statement 722 were carried through to the Local Structure Plan (LSP) stage. These included management planning for the coastal foreshore reserve along with finer scale details of proposed uses and facilities to support these.

The management principles and objectives for the Alkimos-Eglinton foreshore reserve established through the DSP are as follows:

- Foreshore reserve to be developed in accordance with the Minister for Environment Statement 722 (2006) and the State Coastal Policy (Statement of Planning Policy No. 2.6) (WAPC 2003a).
- Places of unique landscape, scientific and cultural significance to be managed appropriately.
- Natural habitats, particularly areas of high ecological value, to be protected.
- Public places and facilities and public access to the beach in the foreshore reserve to be developed in a manner that does not compromise the ecological values of the area.
- Development in the foreshore reserve is to be concentrated in nodes.

2.4 North Alkimos Local Structure Plan

The North Alkimos LSP (TBB 2009) was developed to guide the subdivision and development of the Shorehaven area.

The overall objectives of the LSP were to progress the planning, design and development of the site in the context of a wider Sustainability Strategy (GHD 2006) and other key supporting documentation such as a Local Water Management Strategy (LWMS). Key objectives in LSP relevant to this FMP aimed to:

- retain and respect significant vegetation in land reserved as “Parks and Recreation”;
- reflect the geo-heritage of the parabolic dune system;
- establish east-west green linkages;
- establish a sustainable dynamic Coastal Village Precinct that generates a distinct sense of place capitalising on the land’s coastal setting;
- create a balanced distribution of and access to active, passive and conservation open space; and
- create a highly connected road network with shared use pathways for pedestrian and cyclists within and between precincts.

The foreshore areas were addressed in the LSP under the Statutory Environmental Context with a summary of environmental condition responses (to Ministerial Environmental Conditions) to be addressed. Further detail was provided in sections addressing Public Open Space (POS).

The LSP was approved by the WAPC on 11 November 2009. This approval included the delineation of a coastal foreshore with setbacks as required by Schedule One of the State Coastal Policy. This policy distinguishes between physical processes setback requirement and setbacks required to provide for public access and retention of ecological values. **Figure 1** shows the foreshore boundary and coastal processes setback line established through the MRS amendment process.

2.5 Conditions set by the Ministerial Statement 722

MRS Amendment 1029/33 has been subject to a formal environmental assessment. After being referred to the EPA, a formal environmental review (Bulletin 1207) was prepared in response to the environmental assessment. From this the Minister for Environment set environmental management conditions within Ministerial Statement 722, including the requirement that before subdivision of areas zoned urban an Environmental Management Plan (EMP) be prepared for:

- land reserved as “Parks and Recreation”; and
- bushland that may be part of an ecological linkage.

As the subject site is both reserved as “Parks and Recreation” and forms part of a wider ecological linkage, an EMP, or in this case a FMP is required to be prepared (as is also required by SPP 2.6). As part of the Ministerial Statement 722, the FMP is required to include:

- A description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of the EMP;
- Clear delineation of boundaries or significant areas to be protected
- Management of construction, access and rehabilitation;
- Vegetation mitigation strategies;
- Allocation of responsibilities and identification of timing and duration of implementation;
- Provision for routine monitoring and environmental values; and
- Provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact on environmental values.

In addition, if any environmental issues are identified that fall under the following Acts, then these may also require assessments:

- Any Flora/Fauna issues that come under the Wildlife Conservation Act 1950 (Government of Western Australia 1950);
- Any Flora/Fauna issues that come under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act 1999) (DEWHA 1999); and
- Any issues under the EP Act 1989.

2.6 State Planning Policy No. 2.6

The State Planning Policy 2.6 – *State Coastal Planning Policy* (WAPC 2003a) identifies a requirement for establishing coastal reserves in Western Australia to be determined by a site specific assessment. The policy requires the area of a foreshore reserve be sufficient to provide a setback for coastal processes, protection of ecological values, landscape, visual amenity, indigenous and cultural heritage, public access, recreation and safety.

Schedule One of the SPP provides guidelines for assessment of coastal processes affecting a sandy beach through consideration of three components:

- S1: distance for absorbing acute erosion (an extreme storm sequence);
- S2: distance to allow for the historic trend affecting the site; and
- S3: distance to allow for sea level rise.

These distances are calculated from a horizontal setback datum which on a sandy beach indicates the landward limit of annual beach change identified through aerial imagery or by survey.

At the time of gazettal of the SPP (June 2003), the distance to allow for sea level rise was determined based on the mean of the median model of the 3rd Assessment Report (January 2001) of the Intergovernmental Panel on Climate Change (IPCC). Since gazettal of the SPP, a number of more

recent estimates of sea level rise have been published and adopted for use in planning policy; for example in NSW a sea level rise of 90 cm (by 2100) has been adopted (DECCW 2009).

In response to the more recent scientific information, the WAPC has convened a technical working group to review the provisions in the SSP for sea level rise. A report has been provided to the WAPC recommending the SPP be changed to allow for .9 m for sea level rise (Bassett *pers. comms.* April 2010) and in response the WAPC has issued a Statement advising that a revision of the setback requirement for sea level rise to .9 m is to be adopted for new developments.

The current foreshore reserve at north Alkimos was determined through the MRS process by broad scale studies. The area to be reserved was reaffirmed most recently by WAPC on approval of the LSP in 2009. However the area of the foreshore was determined prior to gazettal of SPP 2.6 and hence assessment of the width of the coastal foreshore was not based on the guidelines to accommodate coastal processes as set out in Schedule One of SPP 2.6.

To refine and review previous district level reporting and define a coastal foreshore area consistent with the State Coastal Policy, M.P. Rogers and Associates were appointed to review the coastal processes and setback requirements based on Schedule One of the SPP 2.6. The broad scale MRS setback and the coastal setback line (Rogers 2010) are illustrated on **Figure 2**. Detail of the review undertaken is provided in Section 3.4 Coastal Processes.

2.7 State Planning Policy No. 2.9

In recognition that water is the means by which life is sustained, the State Planning Policy 2.9 – Water Resources (WAPC 2006b) provides guidance for development abutting water resources or potentially impacting on water resources. The SPP provides guidance concerning the protection of water resources that should be taken into account in planning decision making.

The objectives of the Water Resources Policy are to:

1. protect, conserve and enhance water resources that have been identified as having significant economic, social, cultural and/or environmental values;
2. assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources; and
3. promote and assist in the management and sustainable use of water resources.

The Policy provides specific advice regarding implementation so that where water resources are a consideration, they are considered first in a strategic context that reflects wider sustainability principles. In particular, the policy details considerations to be given to incorporating relevant goals and outcomes for water quality, natural water balance, water efficiency, vegetation conservation, flood risk management, stormwater management and erosion and sediment control.

This FMP includes design principles and management measures to be applied to meet goals relevant to the State Water Resources Policy including:

- measures to manage and restore vegetation cover;
- measures to manage site constraints and hazards including slope stability and erosion hazards; and
- measures proposed to achieve effective total water cycle management and integrated urban water management.

Of particular relevance to the minimum requirements recommended by the Water Resources Policy are principles adopted throughout this FMP to identify and protect a public open space network and to

reduce the use of potable drinking water for irrigation of grassed and landscaped areas. The design approach aims to integrate the use of stormwater to conserve potable water, the use of vegetation for filtering purposes, and water-efficient landscaping.

Water sensitive urban design principles have been included in the total water cycle management measures adopted throughout the design for both the residential development at Shorehaven and the adjoining foreshore area. The water sensitive design measures proposed for stormwater management are responsive to site conditions and, acknowledging the steep topography of the land adjoining the foreshore area, propose infiltration along drainage lines, the use of swale drainage and the capture of stormwater for irrigation purposes. Stormwater treatments are integrated into multiple use corridors connecting the residential area to the foreshore, maximising the visual and recreational amenity provided and linking the developed area to the recreational amenity of the foreshore.

Replanting for restoration of the foreshore and landscaping in recreational parkland areas will use native plants that require minimal water once established. Where areas of grass are proposed for open parkland, stormwater is proposed to be captured and reused to supplement the need for irrigation using potable water supplies.

2.8 Liveable Neighbourhoods

Liveable Neighbourhoods (WAPC 2007) is an operational policy developed by the WAPC for use during the design and assessment of structure plans and subdivision. Element 5 – Urban water management seeks to promote integration of water management with the urban built form with the integration of water supply, wastewater and stormwater being the fundamental principle for urban water management. This integrated approach regards stormwater as a resource with solutions to stormwater run-off being site specific based on the local soils, climate, topography and land uses.

This FMP proposes measures to integrate stormwater treatment into the landscape in accordance with mechanisms recognised in Liveable Neighbourhoods for this purpose, including multiple use corridors, swales, and bubble up pits, along with water efficiency measures to minimise the use of scheme water thereby reducing irrigation requirements.

Urban water management objectives from Liveable Neighbourhoods, that have been considered during the design of the foreshore and adjacent areas of the coastal precinct include:

- 01** to encourage best practice in the use and management of land and water resources, reduce reliance on potable water wherever practicable and improve source protection of water quality;
- 02** to encourage water conservation by maximising the retention, detention and re-use of stormwater, by maximising local recharge of groundwater and by wastewater re-use and water harvesting;
- 04** to maintain and where possible improve the surface and groundwater quality;
- 06** to integrate appropriate water management measures in an efficient urban structure and range of parkland types; and
- 08** to provide an urban water management system that is sustainable and arrangements are in place for on-going maintenance and management. (WAPC 2007)

Guidance from the requirements in Liveable Neighbourhoods for integration of stormwater into the landscape has resulted in the design of public open spaces that promote the detention and retention of run-off through the use of swales and other measures that do not compromise the functions of foreshore

areas for conservation, landscape or recreational purposes. Similarly, design of the adjoining street network links to the open space design with features to facilitate natural stormwater flows, along with the retention, detention, low velocity flows and treatment of stormwater.

2.9 Directions 2031

Directions 2031 (WAPC 2010a) provided a high level spatial framework and strategic plan that established a vision for growth in metropolitan Perth. The framework is to guide detailed planning and delivery of housing infrastructure and services to accommodate growth of the population.

Recognising the need to protect our natural areas and in particular the value of biodiversity in the SW of Australia, Directions 2031 seeks to mitigate the impact of growth on the environment and for planning to protect and manage areas that have high conservation and biodiversity value.

Initiatives flagged to achieve sustainable city outcomes include finalising and implementing Perth Coastal Planning Strategy.

The draft Outer Metropolitan Perth and Peel Sub-regional Strategy (WAPC 2010b) develops more fully actions and strategies to implement directions 2031 at the sub-regional level. The draft strategy provides guidance at the local level and addresses issues that extend beyond local government boundaries.

The Sub-regional Strategy identifies the Alkimos district as a planned urban growth area with an expected population of 22,000+ (over the area within the Alkimos-Eglinton DSP). Key actions to achieve this vision include the implementation of the Alkimos-Eglinton DSP.

2.10 Draft Perth Coastal Planning Strategy

The draft Perth Coastal Planning Strategy (WAPC 2008) was released for public comment in December 2008, with the submissions period closing in March 2009.

The draft strategy is intended to provide a framework for sustainable planning of metropolitan coastal areas in a manner that appropriately provides for conservation, recreation, infrastructure and development. It builds on the principles of Network City and represents a means to implement SPP 2.6.

The following principles in the draft Strategy have been applied as Guiding Principles during development of this FMP:

- *General*: provide for public foreshore areas and access to these; locate facilities safely through taking into account coastal processes (erosion, accretion, storm surges, tides, wave conditions, sea level change and biophysical criteria);
- *Land use and development*: recognise and enhance the unique characteristics of specific coastal precincts; use contemporary and sustainable design principles that complement the coastal environment;
- *Environment, conservation and biodiversity principles*: protect and rehabilitate coastal areas;
- *Tourism and recreation use*: provide the right level of service access and amenity; and
- *Visual landscape*: key viewsheds and viewing locations should be retained, protected and enhanced; minimise degradation of dunes when providing elevated viewpoints.

The draft strategy identifies the North Alkimos area as a precinct that will consist primarily of marine-based recreation – snorkelling, diving – associated with the Alkimos wreck. Designated beach access

and dune conservation related activities are recommended. Measures to control dune erosion are also recognised as being desirable.

WAPC has considered public submissions on the draft strategy and requested the Department of Planning to implement the Perth Coastal Planning Strategy. The final strategy is expected to be released in mid-2010.

2.11 State Planning Policy No. 2.8

The State Planning Policy No. 2.8 is a Bushland Policy for the Perth Metropolitan Region which provides a statutory policy and implementation framework for addressing bushland protection and management issues in the Perth Metropolitan Region. The policy recognises the protection and management of significant bushland areas as a fundamental consideration in the planning process.

Regionally significant bushland areas to which the framework applies have been identified for protection through an endorsed strategy, Bush Forever (Government of Western Australia 2000a, 2000b and 2000c). The WAPC (2010) define the following objectives of the policy:

The aim of the policy is to provide a policy and implementation framework that will ensure bushland protection and management issues in the Perth Metropolitan Region are appropriately addressed and integrated with broader land use planning and decision-making. This will secure long-term protection of biodiversity and associated environmental values. The policy recognises the protection and management of significant bushland areas as a fundamental consideration in the planning process, while also seeking to integrate and balance wider environmental, social and economic considerations. In general terms, the policy does not prevent development where it is consistent with the policy measures in this policy and other planning and environmental considerations.

2.12 Bush Forever

Bush Forever is a Western Australian Government initiative that identifies regionally significant vegetation for protection within the Perth metropolitan region. Regionally significant vegetation has been identified on the basis of criteria relating to its conservation value.

The foreshore reserve at Alkimos is recognised as regionally significant, due to the importance of foreshore vegetation for the stability of the coastline and high variation amongst coastal plant communities. The foreshore reserve is identified as Bush Forever Site No. 397 (Coastal Strip from Wilbinga to Mindarie) with vegetation representative of the Quindalup Vegetation Complex.

Since the foreshore reserve is contained within an existing “Parks and Recreation Reserve” under the MRS, the planning and implementation of the FMP needs to be consistent with the Bush Forever Practice Note 14 (Government of Western Australia 2000b).

This Practice Note applies to Bush Forever sites currently reserved in the MRS for “Parks and Recreation”. In selecting sites for protection, Bush Forever’s starting position was that vegetation in “Parks and Recreation” reserves was to be regarded as regionally significant and included as protected sites (Government of Western Australia 2000a). Practice Note 14 acknowledges that future recreation, servicing or community objectives may be appropriate in cleared or degraded portions of existing reserved lands forming part of a Bush Forever Site as determined through management planning but subject to a comprehensive vegetation assessment and justification.

This approach has been undertaken in defining areas for rehabilitation of native vegetation and in designing the location of recreational access, nodes and the Coastal Village Precinct within the Alkimos foreshore and is documented further in Section 5. Additional information regarding the regional

significance of the vegetation on the Alkimos site and specifically within the foreshore reserve is contained within Section 3.

2.13 City of Wanneroo Local Biodiversity Strategy

The City of Wanneroo Local Biodiversity Strategy (2011 – the Strategy) was released for public comment in October 2008 and adopted by Council in May 2011. Implementation of the Local Biodiversity Strategy will help integrate biodiversity protection into land use planning, commit to ongoing action and support new projects to improve biodiversity conservation in the City of Wanneroo.

Within the Local Biodiversity Strategy the coastal foreshore reserve at north Alkimos is considered to be a “protected natural area” as it is comprised of Crown Land and freehold land reserved for Parks and Recreation under the MRS. The Strategy acknowledges that the City has limited opportunity to influence the protection of the foreshore reserve as this is enforced through planning decisions by the WAPC (such as through the WAPC’s approval of this FMP).

The Local Biodiversity Strategy seeks to:

- Improve biodiversity protection with a focus on Local Natural Areas;
- identify locally significant natural areas in the ecological assessment of an area, prior to development; and
- Implement the Strategy through protecting a representative sample of each of the vegetation complexes (or ecological communities) characteristic of the City of Wanneroo.

The Strategy proposes a number of targets for biodiversity conservation and specifies that the biodiversity retention target (including land for conservation/passive recreation outside of land reserved for Parks and Recreation) for the Alkimos Eglinton Precinct is 3% of the total development area (in addition to the foreshore reserve). The Local Biodiversity Strategy also specifies a target to:

- Retain and protect 80% of coastal vegetation on foredunes and secondary dunes and preferentially locate parks and infrastructure on cleared or poor condition areas.

The target for protection of the Quindalup vegetation complex is a further 331 ha (in addition to the natural areas which are already protected). In the Alkimos-Eglinton precinct, the City anticipates that, through the implementation of the Local Biodiversity Strategy, protection of the Quindalup vegetation complexes will be improved by:

- Increasing protection of natural areas within existing public open space;
- Effectively managing existing POS for conservation of biodiversity value;
- Where possible, reducing threats to biodiversity;
- Increasing reservation of natural areas in new urban development’s to protect up to or a minimum of three percent of the subdivisible area in the overall precinct to protect Local Natural Areas in public open space vested for a purpose that includes conservation;
- Successful application of the District Structure Plan to later planning stages; and
- Formalising the requirements of biodiversity protection by updating the City’s public open space policy.

A core aspect of the Strategy is to utilise the WA Planning System to maintain and protect the City’s key biodiversity assets. Provisions to achieve this are included in the District Planning Scheme No.2 (through the provision of Reserves) and further development of planning policies to provide guidance on improvements to conservation of biodiversity. The Strategy proposes that the City amend District Planning Scheme No.2 to include a local reserve classification of ‘Conservation and Passive Recreation’.

The Strategy notes the need for the City to maintain and enhance reserves and flags a requirement for the City to undertake a strategic assessment of existing coastal reserves and foreshore management plans to ensure a holistic approval to coastal reserve management. The key action to achieve this is for the City to develop a Management Plan for its Coastal Foreshore, to encourage biodiversity retention and protection whilst also planning for the impact of recreation and a larger number of visitors to the coast, to guide local management plans and future land use. To achieve this, in June 2011 the City released for comment a draft Coastal Management Plan (Part 1) which proposes areas along the City's coastline for use by dogs and horses.

2.14 Management Principles and Objectives

In accordance with the policies and approvals processes described above, the following management principles and objectives apply to the North Alkimos foreshore:

- Development of the foreshore will be in accordance with the Minister for the Environment's Statement 722 and with the State Coastal Planning Policy;
- Protect areas of unique landscape, scientific and cultural significance by management of uncontrolled access, rehabilitation and stabilisation;
- Identify areas of natural habitats and of conservation value and develop a Rehabilitation and Stabilisation Plan that protects, restores and enhances the biodiversity values of the whole foreshore;
- Provide a clear delineation between the public and private areas through construction of a local coastal road along the eastern edge of the foreshore reserve;
- Provide adequate and appropriate public access to the foreshore for recreational users and protect the ecological values from uncontrolled access by providing fenced pathways to the beach that also link to the continuous path network running north south along the entire 7.5km coastline of the Alkimos-Eglinton DSP area;
- Design public places, facilities and access to the beach in the foreshore that take advantage of the identified opportunities and does not compromise ecological values;
- Development in the foreshore reserve is to be in nodes to facilitate user friendly beach access and foreshore use; and
- Develop a management strategy for the ongoing monitoring of areas of dune stabilisation and areas of revegetation to protect environmental values.

3 Environmental Context

The description of the existing condition of the foreshore was obtained from the environmental studies undertaken in conjunction with the LSP and MRS Amendment. In preparation for the FMP, detailed environmental assessments and analyses were undertaken to identify the natural and human induced modifications in the environment (specifically the variations in the volume of the central blowout) as well as to broadly map condition of the vegetation in order to prepare for restoration planning

The following detailed environmental assessments were undertaken:

- Broadscale vegetation and condition mapping of the foreshore (2009);
- Two additional site visits (2009) to set up monitoring plots, reference sites and compile data on species composition, vegetation condition and plant communities; and
- A number of additional site visits (2010) to examine the deflation in the blowout and expansion of the sand sheet and to determine workable solutions to the challenging scale of effort required for stabilisation of both the blow out and the network of tracks.

3.1 Climate

The Perth area experiences a Mediterranean climate with warm dry summers and mild wet winters. The major synoptic systems influencing the weather during summer are high pressure systems. In winter the passage of low pressure systems to the south brings the majority of the annual rainfall. Cold fronts associated with winter low pressure systems can bring storms to the Perth region. Summer afternoon sea breezes bring relief during hot weather.

Mean temperatures vary from minimums of 8°C in winter to maximums of 30°C during summer. Most of the rainfall occurs as cold fronts pass with an annual average at Perth of 800mm per year. Average annual rainfall in the Perth region has declined by about 10% since the mid-1970s (IOCI 2009).

Wind has been an important influence on the site with the major landform features (the parabolic dune system and large dune blowout) being of Aeolian origin and subsequently strongly affected by human influences. Active deflation has been observed on the blow out during periods of strong dry easterly winds as well as sea breeze conditions. Summer weather is dominated by winds from the east to south east during the morning followed by south-westerly winds (sea breeze) in the afternoon. Winter winds in contrast are characterised by storm events which begin with a north-westerly storm or gale before backing to the west and south-west (refer to **Appendix A** for wind roses).

3.2 Land Use Context

3.2.1 Historical Land Use

From historic aerial photos (**Figure 3 and Figure 4**), it is evident that the land has not been used for any intensive agricultural purposes recently (in the last 50 years). The shape of the property boundary indicates that the land was once used as a cattle run and therefore the site may have been lightly grazed. However no clearing for agriculture or intense grazing was ever conducted on the site.

No tracks or access ways through the property are visible on aerial imagery of the property that is older than 1953. After the Alkimos was wrecked on the coast (first visible in the 1969 aerial), a number of informal tracks appeared, providing access to the beach opposite the wreck. From this time, the area was used more and more heavily for recreational purposes such as fishing, four-wheel driving and diving, creating an increasing numbers of tracks and disturbance areas. This increased disturbance and

uncontrolled access resulted in mobilisation of sand, creating the large blowout that is now a central feature of the foreshore. The development of the blowout is shown in **Figure 5**.

3.2.2 Current Land Use

Lots 1005 and 1006 Marmion Ave are vacant and undeveloped remnant bushland. There are residences along Wanneroo Road to the east (more than 4 kilometres from the foreshore area); however they are sparse and semi-rural in nature (associated with market gardens). The nearest developed land to the subject site is currently around 6kms to the southeast at Butler.

Abutting Lots 1005 and 1006 is a Foreshore Reserve that is currently used for fishing and recreation purposes through uncontrolled vehicular access. Increased use of four wheel drives, motorbikes and trail bikes has degraded many tracks in the foreshore causing increased erosion and mobilisation of sand around the large blowout and elsewhere.

Aerial photography from 1969 shows the proliferation in tracks with accompanying degradation of vegetation within the foreshore over the last 41 years. The greatest change has occurred over the past 10 years. As a result of this uncontrolled access around 24% of the subject site is classed as 'Completely Degraded'

3.2.3 Future Adjoining Land Uses

The adjoining sites - Eglinton to the north and Alkimos to the south of the subject site - are currently undeveloped land with a Waste Water Treatment Plant (WWTP) under construction on the Alkimos site. Both of the neighbouring sites are zoned "Urban" in the MRS, with the coastal foreshore reserved for "Parks and Recreation" and "Public Purposes" Reserve over the WWTP.

Both adjoining sites were addressed in the Alkimos Eglinton District Structure Plan which provided guidance on broad land use matters such as residential densities to be implemented through local structure planning and subdivision.

To the south, the area reserved for "Parks and Recreation" includes both continuation of the coastal foreshore reserve and a green link connecting from the North Alkimos land to the buffer around the Waste Water Treatment Plant (WWTP). The Alkimos activity centre has been identified as a high intensity regional activity centre directly south of the area reserved for "Parks and Recreation" with mixed use and high access in addition to the WWTP. Development of the first stage, comprising 224 ha of land at Alkimos, is expected to start in 2011 and will include approximately 2,500 homes with the first residential land to be released for sale in the same year. The first stage will take up to seven years to complete and up to 20 years to develop the entire 710 ha community.

The Alkimos WWTP is currently being constructed to the immediate south and proposed residential developments are planned for sites to the north and east on the opposite side of Marmion Ave. The coastal foreshore reserve to the south includes a regional beach identified in the DSP just south of the outfall from the WWTP.

The foreshore area to the north of the subject site includes a possible dog beach (identified in the DSP) as well as the proposed Eglinton Marina and Coastal Village Precinct. This coastal precinct has been designated as medium intensity activity centre and a major tourism and recreation centre. It is anticipated that master planning for the Eglinton Activity Centre will commence during 2010.

3.3 Landform, Geology, Soils and Topography

3.3.1 Geology

The Foreshore Reserve is located on the central portion of the Perth Basin, a geological unit that extends from the southern end of the Carnarvon Basin in the north to the south at Cape Leeuwin.

The Swan Coastal Plain lies within the Perth Basin, a sedimentary basin of accumulated sediments up to 20kms in depth, with surface landforms along the western portions of the Plain consisting of a series of rolling dune systems. The eastern boundary is formed by the Darling Scarp.

3.3.2 Geomorphology

The Swan Coastal Plain is a sedimentary basin 20 to 30 km wide stretches from north of Geraldton to south of Busselton and consisting of two main belts of differing origin (Beard 1990). On the eastern side of the plain adjoining the Darling Scarp is the Pinjarra Plain which has been formed from the deposition of alluvial material washed down from the scarp (Seddon 2004). The western side is dominated by three dune systems that occur roughly parallel to the coast and have been formed by the accumulation of dunal and shoreline deposits (Lemmon *et al.* 1979).

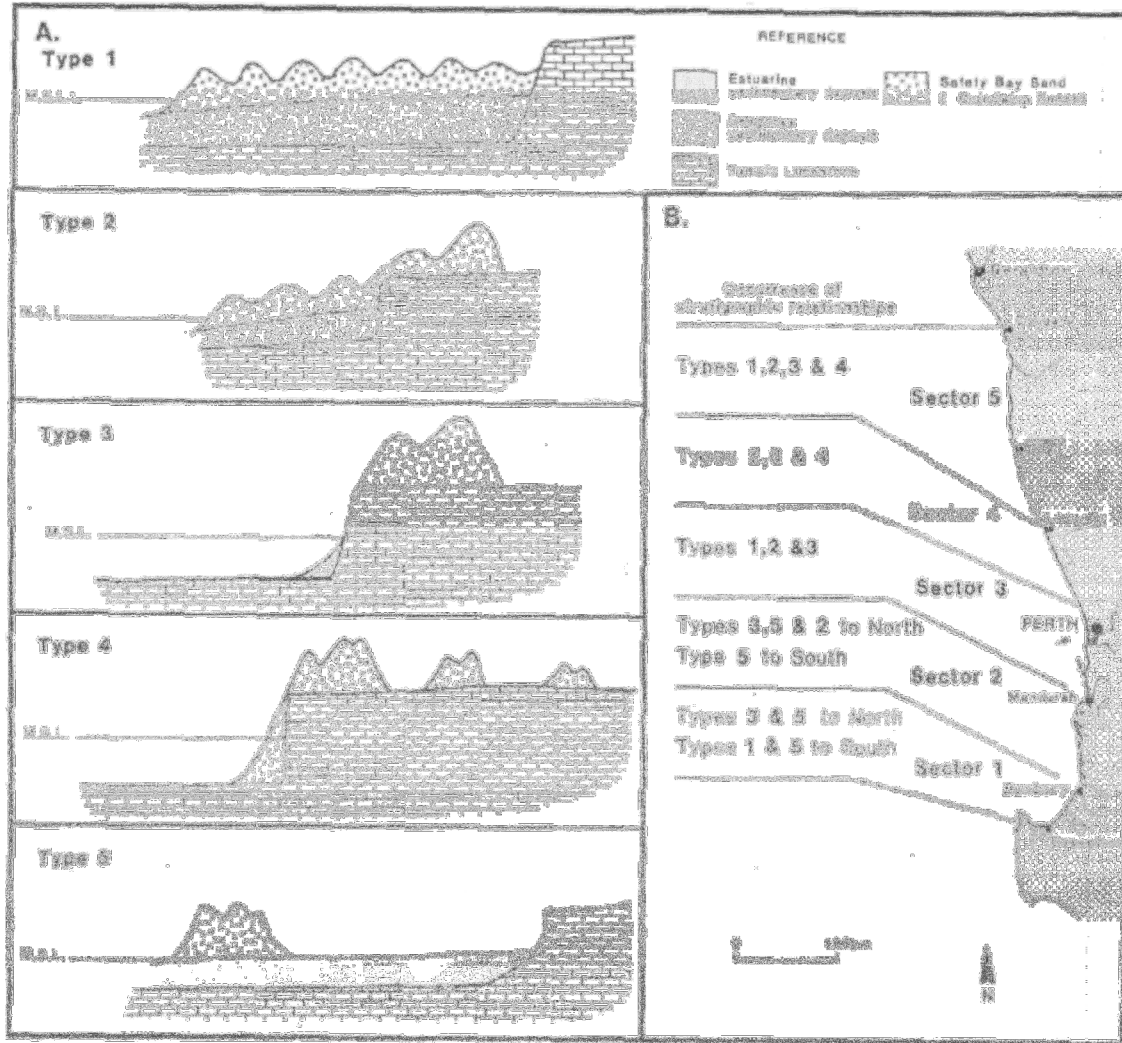
The position of these ancient dune systems reflect migrations of the shoreline in response to a falling trend in global sea level over the past 300,000 years overlaid with pronounced periods of sea level fluctuations due to glacial and interglacial periods.

The dunes in the east are older and higher (Bassendean or Spearwood systems), while the dunes in the west are lower and younger, so that the system basically records a marine recession away from the Darling Scarp (Lemmon *et al.* 1979).

The geomorphic element that characterises the north Alkimos Foreshore Reserve is the Quindalup Dune System, which is the youngest and most westerly of the dune systems. The Quindalup Dunes developed during the Holocene (the last 10,000 years) and are composed of calcareous sand known as the Safety Bay Sands. The Quindalup Dune system is characterised by a series of parabolic dunes, as well as small beach ridges and blowouts (Lemmon *et al.* 1979). Tamala limestone, a relatively hard aeolianite limestone, underlies the Safety Bay Sands.

Within the Alkimos area, the stratigraphic relationship between the Safety Bay Sands and the underlying Tamala Limestone forms a Type 2 relationship as shown in Plate 1 (Semeniuk *et al.* 1989). Type 2 can be described as a ribbon or shoestring of Safety Bay Sands that is perched upon and overlies the Tamala limestone in a near coastal setting (Semeniuk *et al.* 1989). This has resulted in the formation of small areas of rocky shoreline where the Tamala limestone is outcropping along with some intertidal exposures of reef platforms.

Plate 1: The Stratigraphical relationship of Safety Bay Sands (Semeniuk *et al.* 1989)



The following description of the dunes within the foreshore at north Alkimos site is based on the Semeniuk *et al.* (1989) system of dune classification.

Apart from one major dune blowout, the main feature within the foreshore is a fretted parabolic dune, which extends up to 500 metres inland with conical surface erosion. At the immediate coastline is a parallel dune/foredune feature of approximately 50 m in width which represents the frontal slope of the hinterland parabolic dune system. The angle of this seaward facing slope is approximately 30 to 40 degrees. The leeward edge of the foredune shows signs of parallel dunes, juvenile parabolic and conical dunes on a scale of 10 to 15 metres.

The topography of the dunes is shown in **Figure 6**.

3.3.3 Soils

Soils across the site are fine to medium grained calcareous sands of the Quindalup Association. The Quindalup soils are often high in lime but low in soluble salts, and show no profile differentiation other than some slight cementation in lower layers.

Soil types have been mapped across the site by the Geological Survey of Western Australia (GSWA) (**Figure 7**). The dominant soils associated with the Quindalup Dune systems that have been mapped within the foreshore area are:

- Q1: Quindalup Oldest Dune Phase is the most extensive but much of this landform has been overlaid by subsequent dune building. The Q1 landforms tend to be low relief with some cementation occurring at depths below one metre. Q1 land forms extend up to 6 km inland;
- Q2: Quindalup Second Dune Phase presents as a complex pattern of dunes of moderate relief with some cementation at depths below one metre;
- Q3: Quindalup Third Dune Phase landforms are steeply irregular dunes with high relief and incipient cementation; and
- Q4: Quindalup Youngest Dune Phase landforms are the extensive steep and irregular dunes with no developed soil profile. These dunes face the coastal processes and hence areas of erosion and landform instability occur intermittently along the seaward side of this landform.

From **Figure 7** it can be seen that Q4 is mapped as extending into the development area. However within the blowout some cementation has been observed and following deflation, sections of Tamala Limestone.

3.3.4 Landform and Dune Stability

The coastal landforms are dominated by dunes, with a narrow beach backed by a steep foredune of between 10 to 20 metres Australian Height Datum (mAHD) high with chaotic dunes (Q4) behind reaching heights of up to 20 - 30 mAHD. These dunes are relatively unstable especially where uncontrolled vehicle access has removed vegetation and created tracks, some of which are now deeply cut into the dune forms.

The majority of the dune formations behind the foredunes are stable except for the large blowout located along the centre of the foreshore. The erosion of the blowout has largely been caused by the use of four wheel drives and subsequent loss of vegetation (refer to **Figure 3, Figure 4, Figure 5 and Plate 2**). The blowout was created by human pressure (visitors to the Alkimos wreck) and further activated by the strong winds (sea breezes and easterlies). The dynamic nature of the blowout means it is likely to remain unstable unless significant works are undertaken to stabilise the sand.

Plate 2: 360° Panorama view of the blowout (April 2010)



A survey was recently undertaken (April 2010) of the blowout to recalculate the relative levels. The survey identified that the blowout has grown by roughly 30 000 cubic metres in the past 12 months - equivalent to the movement of, on average, 82 cubic metres per day. Over the 2009 - 2010 summer during which no rain fell, active deflation across the blowout has exposed areas of cementation (see **Plate 3**). Small outcrops of limestone are also exposed in back dune swales in the foreshore.

A parabolic dune with elevations up to RL45-50m lies immediately to the east of the foreshore.

Plate 3: Exposed cementation within the blowout



3.4 Coastal Processes and Marine Interface

The Perth metropolitan coast experiences a mainly diurnal tidal regime with a range of approximately 0.5 m. These tidal ranges are often smaller than the local waves, especially during storm events.

The wave climate across the region is dominated by the persistent long period south to south westerly swell with low to moderate energy waves. Waves generated by the sea breeze, mid latitude lows and infrequently, tropical cyclones, superimpose on deep-water swells with a mean annual deep-water wave height of two to three metres. Short period waves are generated by local wind conditions and superimpose on the swell. Sea breezes can cause south westerly or westerly seas of up to 1.5m. Wave conditions and direction vary seasonally, with sea breezes building on summer south westerly swells, in contrast to the higher energy storm waves from the north-west or west during winter.

Along the Alkimos north coast, a series of offshore reefs influence the wave energy and sediment transport along the shoreline, affecting the beach shape. The reef provides protection from storm waves. The north Alkimos site has been identified as part of a major sediment cell between Mindarie and Two Rocks (Eliot *et al.* 2005). The shoreline is a long sandy beach that is reflective and affected by northwards littoral drift. Some intertidal reef platforms are exposed from time to time along the shoreline.

The beach width along the Alkimos foreshore is varied. The southern portion of the foreshore has a stable 15-25 metre wide beach subject to natural variability. The central section of the shoreline has a stable 20-30 metre wide beach and provides for safer, more user friendly beach use. Just to the north of the blowout is a section of beach that is wide enough to accommodate recreational beach users such as swimming, walking and fishing. The northern portion (600 metres from the northern boundary) of the shoreline has a 20-30 metre wide beach and is subject to erosion with a constant recession rate (**Figure 3** and **Figure 4**).

Shoreline movement mapping undertaken for this project (Rogers 2010) identified two distinct regions of historic shoreline movement: a northern section which has undergone recession between 1954 and 2007, and the remainder of the shoreline across the site which has undergone accretion between 1954 and 1993, followed by some minor shoreline recession from 1993 to 2007 (Rogers 2010 p.16). The accretion experienced from 1954 to 2007 was far greater than the extent of erosion.

The total coastal setback recommended (Rogers 2010) for the coastal foreshore is between 93 to 150 metres to account for erosion, historical trend of the shoreline movement and potential recession of the shoreline due to climate change. This setback has been calculated in accordance with provisions for a sandy beach in the Schedule One of SPP 2.6 – State Coastal Planning Policy and is described more fully in the report undertaken by Rogers (2010). However the actual total setbacks to development are greater (see for example the detail in **Figure 13**) as a result of MRS amendment processes and accompanying studies in 1993 (see **Section 2.1**). The total width of the foreshore ranges from around 210 metres at the widest to around 130 metres at the narrowest.

3.5 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils or sediments that contains iron sulphide (iron pyrite) minerals (WAPC 2009). In their natural state ASS are present in waterlogged anoxic conditions and do not present a risk to the environment. They become an issue when oxidised, producing sulphuric acid, which can convey a range of impacts on the surrounding environment, infrastructure and human health.

The WAPC mapping indicates that ASS are not known or expected to occur within the subject site. ASS are commonly recorded from natural wetland and mangrove coastal areas, which is not consistent with the conditions over the subject site.

3.6 Hydrology

There is no surface water found within the subject site. The groundwater found on site fluctuates seasonally. The shallowest depth to groundwater from the natural surface over the entirety of Peet's landholdings is 24 metres from the highest groundwater level. The hydrological monitoring for the development determined that the groundwater levels will not impact on the dune stabilisation within the foreshore reserve. The Perth Groundwater Atlas indicates that groundwater flows from east to west (8m AHD to less than 1m AHD) (DoW 2009).

3.7 Flora and Vegetation

The foreshore reserve lies on the Swan Coastal Plain Subregion of the Drummond Botanical Subdistrict within the South West Botanical Province as described by Beard (1990). Flora composition of the Swan Coastal Plain Subregion has been described by Beard (1990) as predominantly consisting of Banksia Low Woodlands on leached sands with Melaleuca swamps where ill drained, and woodlands of Eucalyptus species on less leached soils.

Regional vegetation complex mapping undertaken by Heddle *et al.* (1986) as part of study undertaken of the South West indicates that the vegetation on the subject site is primarily the Quindalup complex (**Figure 8**), a coastal dune complex. The description given for the Quindalup complex is:

“Coastal dunes consisting mainly of two alliances, the strand and fore dune alliance and the mobile and stable dune alliance. Local variations include low closed forest of *Melaleuca lanceolata* – *Callitris preissii* and closed scrub of *Acacia rostellifera*.” (Heddle *et al.* 1986).

Previously, flora and vegetation surveys of the site have been undertaken by Trudgen and Keighery (1990), Armstrong (1996), ATA (2003a and 2005) and ENV (2008). These surveys did not identify any Declared Rare Flora (DRF) or species protected under the Commonwealth EPBC Act on site. It was however found that the subject site contained a number of Priority Flora species (discussed in Section 3.7.4)

3.7.1 Plant Communities

Eight broad plant communities have been described for the subject site, which are:

- **LmMs** – Low shrubland of *Lomandra maritima*, *Melaleuca systema*, *Acacia lasiocarpa*, *Lepidosperma pubisquameum*, *Desmocladius asper* and *Conostylis pauciflora* subsp. *Pauciflora/euryrhipis*;
- **LmMsOa** – Shrubland of *Lomandra maritima*, *Melaleuca systema*, *Olearia axillaris*, *Scaevola nitida*, *Santalum accuminatum*, *Myoporum insulare* and *Acacia rostellifera* over *Rhagodia baccata*, *Phyllanthus calycinus*, *Conostylis pauciflora* subsp. *Pauciflora/euryrhipis* and **Lagurus ovatus*;
- **AsSg** – Patch of *Acacia saligna* over *Spyridium globulosum*, *Rhagodia baccata* and *Exocarpos sparteus* over *Melaleuca systema*, *Lomandra maritima* and *Poa porphyroclados*;
- **ArMiMt** – Shrubland of *Acacia rostellifera*, *Myoporum insulare* and *Acanthocarpus preissii* over *Melaleuca thymoides*, *Melaleuca cardiophylla* and *Anthocercis littorea* over *Lomandra maritima*, **Ehrharta longifolia*, **Briza maxima*, **Pelargonium capitatum* and **Asteraceae* sp. (Recently Burnt)
- **ScOaSg** – Shrubland of *Scaevola crassifolia*, *Olearia axillaris*, *Spyridium globulosum* and *Acanthocarpus preissii* over *Acacia truncate*, *Lepidosperma gladiatum*, *Carpobrotus virescens*, **Tetragonia decumbens* and **Trachyandra divaricata*.
- **ShTd** – Mobile foredune of *Spinifex hirsutus*, *Spinifex longifolius*, **Thinopyrum distichum*, **Trachyandra divaricata* and **Tetragonia decumbens*
- **ArEt** - Shrubland of *Acacia rostellifera* over *Acanthocarpus preissii*, *Rhagodia baccata*, **Euphorbia terracina*, **Ehrharta longiflora*, **Trachyandra divaricata*, **Sonchus oleraceus* and **Lupinus cosentinii*
- **MhMsBs** - Shrubland of *Melaleuca huegelii*, *Melaleuca systema*, *Banksia sessilis* var. *cygnorum*, *Hakea lissocarpa* and *Scaevola nitida* over *Leucopogon parviflorus*, *Hibbertia subvaginata*, *Grevillea preissii* subsp. *preissii* over **Sonchus oleraceus*, **Trachyandra divaricata* and **Ehrharta longiflora*.

* Refers to species that are known weeds

The spatial distribution of these communities is shown in **Figure 9**.

3.7.2 Vegetation Condition

The condition of the vegetation was assessed in more detail to determine the conservation values of the site to map vegetation condition and target areas for revegetation. The vegetation condition was rated according to the method described in Keighery (1994), a vegetation condition scale commonly used in the Perth Metropolitan Region. The categories are defined in **Table 1**.

Table 1: Vegetation Condition Scale (Keighery 1994)

Vegetation Condition	Definition
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

The vegetation condition across the site is shown in **Figure 10**. Vegetation condition across the site ranged from “Excellent” to “Completely Degraded” (see **Plate 4** and **Plate 5**). The dominant feature of the site is the sand blowout located halfway along the foreshore alongside the Alkimos wreck (see **Plate 1**).

Areas of “Completely Degraded” condition largely consist of smaller sand blowouts along foredunes, or cleared patches behind the foredunes and tracks. In total the subject site contains 24% “Completely Degraded” vegetation. The majority of the vegetation retained within the foreshore design is in either “Excellent”, “Very Good” or “Good” condition.

The following images demonstrate the variation in vegetation condition.

Plate 4: 'Excellent' condition vegetation



Plate 5: 'Degraded' and 'Completely Degraded' condition vegetation



3.7.3 Threatened Ecological Communities

In Western Australia, ‘Threatened Ecological Communities’ (TECs) are defined by the Western Australian TEC Scientific Advisory Committee (within the DEC) and are assigned to a category of Priority 1 to Priority 5. While TECs are not afforded direct statutory protection at a State level (unlike DRF under the *Wildlife Conservation Act 1950*) their significance is acknowledged through other State environmental approval processes (specifically in Environmental Impact Assessment pursuant to Section 38 of the *Environment Protection Act 1986*).

Selected TECs are also afforded statutory protection at a federal level pursuant to the EPBC Act. The EPBC Act provides for the strong protection of TECs, which are listed under Section 181 of the Act, and are defined as “Critically Endangered”, “Endangered” or “Vulnerable” under Section 182.

As well as TEC listing, a community may be listed as a Priority Ecological Community (PEC). An ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been fully defined, is listed as a PEC in Category 1, 2 or 3 (see **Table 2**). Ecological communities that are adequately known and rare but not threatened, or meet criteria for Near Threatened, or are removed from the threatened list, are placed in Priority 4 and require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (DEC 2007).

Table 2: Categories of Priority Ecological Communities

Priority Categories	Description
Priority 1	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
Priority 5	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

One TEC (Floristic Community Type (FCT) 26a – *Melaleuca huegelii* – *Melaleuca acerosa* (now *Melaleuca systema*) shrublands of limestone ridges (Gibson *et al.* 1994)) has been inferred to occur within the site (ENV 2005, ATA and Bennett 2004). This TEC is not recognised as a federally listed TEC pursuant to the EPBC Act, however is recognised at a state level.

The presence of this community type was inferred by ENV (2005) from vegetation descriptions given in ATA and Bennett (2004) with reference to Gibson *et al.* (1994) and Bush Forever (Government of Western Australia 2000). To determine or otherwise the presence of FCT 26a, ENV undertook a targeted survey in the areas of suspected TEC in 2008, and established four quadrats within these areas. The data was run through the statistical analysis package PRIMER, the results of which were inconclusive. Therefore, the presence of this FCT has never confirmed or disproved. At the time of the survey, three of the four quadrats were recently burnt, which is likely to have had a major influence on the outcome of the data analysis.

Of the areas identified as potentially containing FCT 26a in previous studies (**Figure 2**), only Site 106 was identified as having similar plant species to that of FCT 26a in the Cardno 2009 survey. Site 106 has been described as plant community **MhMsBs** – Shrubland of *Melaleuca huegelii*, *Melaleuca systema*, *Banksia sessilis* var. *cygnorum* and *Hakea lissocarpha* and is shown on **Figure 9**. The other areas originally identified as suspected FCT 26a have been described as plant community **ArEt** – Shrubland of *Acacia rostellifera* over *Acanthocarpus preissii* and *Rhagodia baccata* and are not considered to have similar species composition to FCT 26a.

For this FMP, Cardno undertook a FCT analysis on the data collected from Site 106. The Site 106 data was reconciled with the SCP dataset of Gibson *et al.* (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded while some infraspecies that have been identified since 1994 were reduced to species level. The combined dataset was then classified into groups using a Bray-Curtis Association and a UPGMA fusion (beta level = -0.1) within the analysis package PATN (Belbin 2006).

The resulting dendrogram grouped Site 106 in close association with FCT 29b (**Appendix B**). FCT 29b is described as Acacia shrublands on taller dunes (Gibson *et al.* 1994). Therefore it is considered that Site 106 is not the TEC FCT 26a. FCT 29b is however classified as a Priority 3 Ecological Community by the DEC and should be given priority for retention.

3.7.4 Significant vegetation

Species of flora are given “Declared Rare” or “Priority” conservation status where populations are restricted geographically or threatened by local processes. The DEC recognises these threats and subsequently applies regulations towards population protection and species conservation. The DEC enforces regulations under the Wildlife Conservation Act 1950 to conserve DRF and to protect significant populations. Priority flora species are potentially rare or threatened and are classified in order of threat. A number of DRF and Priority flora species are found within the Alkimos region.

During Cardno’s 2009 survey no DRF species were recorded within the subject site, however a Priority Flora species was recorded, this being *Conostylis pauciflora* subsp. *euryrhipis/pauciflora*. The exact sub-species of *Conostylis pauciflora* could not be determined at the time of the survey due to lack of floral material available. The floral material is required to identify this species to sub-species level. Both sub species of *Conostylis pauciflora* (*Conostylis pauciflora* subsp. *pauciflora* and *Conostylis pauciflora* subsp. *euryrhipis*), are listed as Priority 4 (P4) species and are known to occur in plant communities similar to those present on site. Therefore, given the conservation significance of the sub species is the same, the exact identification of the sub species is not of vital importance at this stage. However collection of flora material and identification to sub species level is recommended for future work.

Priority 4 Flora species are listed as rare taxa; taxa which are considered to have been adequately surveyed and which, whilst being rare, are not currently threatened by any identifiable factors. These taxa require monitoring every 5 to 10 years.

3.7.5 Weed Mapping

A number of introduced (or weed) species were identified in the mapping of vegetation communities. Weeds often invade the native vegetation and subsequently have negative impacts on the biodiversity of flora and fauna, fire management regimes, dune stability and erosion. A list of the weeds found on site is provided in **Table 3**.

Table 3: Weed Species

Scientific Name	Common Name
<i>Asteraceae</i> sp. (unidentifiable)	Annual Daisy
<i>Briza maxima</i>	Blowfly Grass
<i>Ehrharta longiflora</i>	Annual Veldgrass
<i>Lagurus ovatus</i>	Hare's Tail Grass
<i>Lupinus cosentinii</i>	Sand Plain Lupin
<i>Pelargonium capitatum</i>	Rose Pelargonium
<i>Sonchus oleraceus</i>	Sowthistle
<i>Tetragonia decumbens</i>	Sea spinach
<i>Thinopyrum distichum</i>	Sea wheat
<i>Trachyandra divaricata</i>	Dune Onion Weed

None of these weeds are listed as Declared Plants by the Department of Agriculture and Food (DAFWA 2009) or listed as Weeds of National Significance (DAFWA 2010). These weeds are indicated in **Figure 9** marked with asterisks.

Asteraceae was identified on site however the species of *Asteraceae* was unidentifiable. Although a number of *Asteraceae* species are native to the region, a number are also known weeds.

3.8 Fauna

The fauna assessment over the Peet's landholdings at Shorehaven determined the presence of five fauna species of special significance (i.e. listed under the EPBC Act or *Wildlife Conservation Act* 1950) including Carnaby's Black Cockatoo, Peregrine Falcon, Southern Carpet Python, Southern Brown Bandicoot and Western Brush Wallaby. Migratory species that potentially use the subject site include the White-bellied Sea-eagle, Rainbow Bee-eater, Great Egret, Cattle Egret and Fork-tailed Swift.

The fauna survey undertaken determined that it was unlikely that any species of special significance are found within the foreshore area. Additional fauna species found within the Shorehaven development site (ATA 2005) include:

- *Macropus fuliginosus* (Western Grey Kangaroo);
- *Oryctolagus cuniculus* (Rabbit);
- *Dromaius novaehollandiae* (Emu);
- *Aquila audax* (Wedge-tail Eagle);
- *Falco berigora* (Brown Falcon);
- *Falco cenchroides* (Australian Kestrel);
- *Columba livia* (Domestic Pigeon);
- *Phaps chalcoptera* (Common Bronzewing);
- *Ocyphaps lophotes* (Crested Pigeon);
- *Cacatua roseicapilla* (Galah);
- *Platycercus zonarius* (Australian Ringneck);
- *Chrysococcyx basalus* (Horsfield's Bronze Cuckoo);
- *Dacelo novaeguineae* (Laughing Kookaburra);
- *Malurus splendens* (Splendid Fairy-wren);
- *Pardalotus striatus* (Striated Pardalote);
- *Sericornis frontalis* (White-browed Scrubwren);
- *Gerygone fusca* (Western Gerygone);
- *Lichmera indistincta* (Brown Honeyeater);
- *Lichenostomus virescens* (Singing Honeyeater);
- *Phylidonyris novaehollandiae* (New Holland Honeyeater);
- *Anthochaera lunulata* (Western Little Wattlebird);
- *Anthochaera carunculata* (Red Wattlebird);
- *Petroica multicolour* (Scarlet Robin);
- *Pachycephala rufiventris* (Rufous Whistler);
- *Rhipidura fuliginosa* (Grey Fantail);
- *Grallina cyanoleuca* (Magpie-lark);
- *Coracina novaehollandiae* (Black-faced Cuckoo-shrike);
- *Artamus cinereus* (Black-faced Woodswallow);
- *Cracticus torquatus* (Grey Butcherbird);
- *Cracticus tibicen* (Australian Magpie);
- *Corbus coronoides* (Australian Raven);
- *Pogona minor* (Bearded Dragon);
- *Tiliqua occipitalis* (Western Blue-tongue);
- *Tiliqua rugosa* (Bobtail); and
- *Pseudonaja affinis* (Dugite).

The vegetation communities (in particular **AsSg**, **ArMiMt** and **ArEt** – **Figure 9**) on site are important in terms of species richness and abundance. The DSP states that:

The Alkimos-Eglinton Project area is expected to support relatively high species diversity due to the range of habitats and general quality of the habitats within the site, combined with the connectivity of the area to other extensive vegetated areas. The foreshore reserve functions as a linkage along the coast (RPS Bowman Bishaw Gorham 2006).

A significant portion of the subject site has been degraded from off-road use of vehicles and bushfires. Nonetheless once restored the foreshore reserve will provide valuable habitat and a north south linkage for fauna.

3.9 Heritage

3.9.1 Indigenous Heritage

An online search of relevant Aboriginal heritage information was undertaken using the Department of Indigenous Affairs (DIA) Aboriginal Inquiry System (DIA 2010) that incorporates both the heritage site register and the heritage survey database. No sites were listed as registered on the database. In addition a heritage survey of the land undertaken in 2006 did not identify any sites of significance.

3.9.2 Non-Indigenous Heritage

Adjacent to the shoreline of the subject site is the well-known Alkimos wreck. The Alkimos was a merchant ship that was wrecked off the coastline in 1963, given the locality of Alkimos its name. The wreck is listed as a Category 4 heritage site under the City of Wanneroo Heritage Places Local Planning Policy (City of Wanneroo 2006). Category 4 is listed as:

Historic Site or Natural Place

- *Recognise* – Historic site without built features or natural place.
- *Interpret* – for example with a plaque, place name, or reflection in urban or architectural design.

The wreck is breaking up and is unlikely to have any structures remaining above water in 10 years.

3.10 Recreation and Aesthetic Value

The subject site, which is in private ownership, is currently and increasingly used (illegally) for recreational purposes such as four wheel driving and trail bike riding. The presence of the Alkimos wreck offshore initially attracted visitors to the subject site. The growth in four wheel driving over the last 20 years has led to the decline in vegetation from erosion and exacerbated erosion of sand dunes or blowouts particularly in the centre of the site and along the foredunes (discussed in **Section 3.3.4**). The wreck provides both recreational and aesthetic value to the shoreline.

The topography of the site features a number of significant dune forms in the coastal precinct including a remnant parabolic dune which will be retained where possible in the Viggo Trail as a feature of the Coastal Village Precinct. Dunes in the foreshore area vary from stable vegetated dunes to mobile, degraded and unvegetated dunes and blowouts. The site slopes towards the coast so that views of the coast are provided over or through the dunes from higher points inland (see **Plate 6**). Due to the topography, extensive views up and down the coast are available from a number of high points in or adjacent to the foreshore.

Community engagement undertaken during the preparation of the Perth Coastal Planning Strategy recommended predominantly of marine-based passive recreation associated with the Alkimos wreck for the North Alkimos precinct. Designated beach access and conservation related activities were recommended along with dune restoration and management of 4WD access.

Plate 6: Extensive views available from high points adjacent to the foreshore



The site also features some relatively safe and user-friendly beaches (discussed in **Section 3.4**). These are currently used by a number of recreational fishers as well as four wheel drives. It is anticipated that the provision of access and supporting recreational facilities in the foreshore will enhance the recreational uses of the beach for all beach uses including access for people with disabilities, emergency vehicles, dog owners and families.

4 Constraints, Issues and Opportunities

Environmental constraints, issues and opportunities associated with the foreshore were derived from assessment of the legislative and policy context, the existing information about the environment and from assessment of the condition of the foreshore. The constraints, issues and opportunities were defined as follows:

- Constraints are those factors where there is government policy guiding development for a particular environmental feature, which is preclusive of development. Constraints are also those factors where additional environmental approvals may need to be sought;
- Issues reflect environmental features which should influence development, including lot boundary, orientation, size and density; and
- Opportunities represent areas where the environmental features are particularly advantageous for the development.

4.1 Constraints

The key constraint associated with the subject site is the coastal processes set back.

Coastal processes set back

A review of the setback for coastal processes provided for in the foreshore reserve at Alkimos was undertaken by MP Rogers (Rogers 2010). This study recommended a coastal setback of between 93 to 150 metres to allow for coastal processes and determined therefore that the existing foreshore width of between 130 – 210 metres exceeds the requirements of the State Coastal Policy for setbacks for coastal processes (see **Section 3.4**).

Exemptions to the setback required by the State Coastal Policy include public purpose buildings and nodes that provide a range of facilities to benefit the broader public. Such development nodes may be developed within the setback where ancillary coastal protection structures would not result in erosion or destabilisation of the adjacent coast. Design should ensure that the majority of public facilities are located beyond the coastal setback line to minimise the risk from coastal erosion.

4.2 Issues

The key issues associated with development of the subject site include:

- Potential damage of “Excellent” or “Very Good” condition vegetation;
- Spread or introduction of weed species;
- Impact of strong coastal winds on dune stability and community uses within the foreshore;
- Demand for user friendly access to the beach across 1.74km of coastline;
- Further destabilisation and erosion of dune formation;
- Drainage and stormwater runoff within the foreshore from future residential and commercial development; and
- The potential presence of TECs.

The design of the development and foreshore has been modified accordingly to achieve best practice responses to the issues identified for the site.

“Excellent” or “Very Good” condition vegetation

Over the foreshore are several areas of “Excellent” and “Very Good” condition vegetation. This vegetation provides a significant habitat value as well as stabilising dunes and should be protected where possible. Design of facilities in the foreshore therefore considered the need for stabilising dunes and ongoing management needs to reduce the potential impacts on the quality of vegetation and landforms from use of the site by the community, particularly through uncontrolled access.

Weed species

The construction of the community and commercial precinct along with the expected intensification of use within the foreshore could lead to the spread or introduction of weed species. Weed species are often transported by vehicles or pedestrians through the movement of seeds or spores. Weeds often invade the native vegetation and subsequently negatively affect the biodiversity of flora and fauna, fire management regimes, dune stability and erosion.

Strong coastal winds

The impact of strong winds and blowing sand on the coastal frontage of the community and commercial precinct could potentially become an issue for construction, ongoing maintenance and ongoing community use. The precinct should be designed so that the buildings and pathways are protected from strong coastal winds (in particular the afternoon south westerly winds) and managed accordingly. Design should ensure wind scouring and sand build up is avoided or minimised.

User friendly access to the beach

Development of the Village Foreshore Park and creation of a network of beach access routes will support the expected demand for user friendly access to the beach. At present the foreshore width and steep dune formation (particularly the high, cliffed primary dunes to the north of the foreshore) does not make the beach easily accessible. Given the intensification of use within the adjacent development the foreshore management requires access for all pedestrians (including disabled access) and emergency vehicles (including surf lifesaving). The commercial and community precinct within the foreshore should provide access for bicycles, prams, wheelchairs, pedestrians and emergency vehicles.

Destabilisation and erosion of the dune formation

Further destabilisation and/or erosion of the dune formation, as result of a natural process or human induced erosion, is likely to change current relative levels and require special design and treatment for the development of community infrastructure within the foreshore. During construction degraded dunes may erode further and therefore require an extensive stabilisation plan through dune rehabilitation and revegetation. Ongoing management costs for removal of blown sand (from parking areas and roads) should be reduced through stabilisation, restoration of dune vegetation and design.

Drainage and stormwater runoff

The adjacent development will increase the quantity of stormwater runoff due to the increase of permeable surfaces. Drainage and runoff within the foreshore reserve could threaten the ecological integrity of the subject site and requires appropriate management to ensure any runoff is treated, contained and used appropriately.

Threatened Ecological Communities

Analysis of the potential presence of TECs at the subject site determined that the FCT 26a was not consistent with the species identified in the Flora and Vegetation Survey. Site 106 contains FCT 29b which is classified as a Priority 3 Ecological Community by the DEC and should be given priority for retention. However Site 106, where FCT 29b may occur (see **Figure 9**), is within the green link to the buffer around the Alkimos Waste Water Treatment Plan and is excluded from this FMP.

4.3 Opportunities

The key opportunities associated with the subject site include:

- The location and extent of the blow out and the “Completely Degraded” condition of vegetation within it;
- Existing pathways along and across the foreshore;
- The introduction of community facilities;
- The presence of the Tamala Limestone;
- User friendly beach; and
- The Alkimos Wreck.

The blowout

The blowout provides an opportunity to repair human induced damage, rehabilitate the foreshore, stabilise adjoining areas of eroding dune, provide community and commercial facilities and manage beach access. The blowout has developed onshore from the well-known Alkimos wreck. Development of this site as a community precinct will encourage tourism at Shorehaven, support improved beach access and provide economic benefit. As the blowout is heavily degraded from uncontrolled access by four wheel drives and further natural erosion, creation of the Village Foreshore Park will repair human induced degradation as well as supporting recreational users and a community and commercial precinct. In addition the ridge line surrounding the blowout will provide shelter from strong coastal winds for the future community facilities within the blowout.

Existing pathways

Previous uncontrolled use of the site by four wheel drives has created a network of tracks throughout the foreshore reserve. There is an opportunity to use the existing tracks for beach access as well as the north south pedestrian link and to rationalise the number of tracks. This will minimise the impact of beach access on the existing vegetation and allow for rehabilitation.

Community facilities

At present the main recreational use of the foreshore is by four wheel drives. As a consequence there is constant erosion of the dune formations as well as instances of vandalism and security concerns. The introduction of community facilities at the site will provide managed access, safe pedestrian access and points of interest such as lookouts. The provision of community facilities in the foreshore will include community art work, information about the natural environment and rehabilitation initiatives, seats, lookouts, showers etc.

Tamala Limestone

The presence of the Tamala Limestone within the subject site and in the adjacent development will be beneficial to the rehabilitation and landscaping processes. Limestone sourced from site is suitable for use in pathway surfaces and retaining walls and is visually sympathetic to the setting.

Tamala limestone also provides some resistance to coastal erosion processes. Coastal sites with intermittent Tamala limestone outcrops may require a smaller set back distance for development than a sandy coast, as acknowledged in the Report on Submissions for the Jindee MRS Amendment (MRS Amendment 1152/41 Jindalee (Jindee) Foreshore Rationalisation).

User friendly beach

The central and southern portion of the beach at Shorehaven is relatively wide (up to 30m) in comparison to other beaches within close proximity. The offshore reef protects the shoreline from large waves and areas of wider sandy beach are suitable for some water based recreational activities. The areas of user friendly beach can provide for a wide variety of beach uses including people with disabilities, dog owners, fishers, walkers and swimmers.

The Alkimos Wreck

The offshore wreck is a key distinguishing feature of the site. There is an opportunity to incorporate the wreck within the design of the foreshore to reflect the cultural history of the site in art works and design elements across the Shorehaven development area. In particular, lookouts will be provided for viewing the wreck as well as appreciating the extensive views available from the foreshore and these will be designed to echo the remaining visible structures of the wreck. Signage will also be provided to describe the history of the wreck.

5 Foreshore Design

5.1 Design Philosophy

The foreshore design aims to reflect the overarching design philosophy to achieve best practice foreshore management (discussed in **Section 1.3**). The design aims to showcase innovation in foreshore design through providing for conservation and integration with the surrounding landscape. Further provision of public facilities within the foreshore reserve will maximise the amenity and passive recreation use of the foreshore area adjacent to a significant urban development.

Figure 11 and **Figure 12** provide illustrations of the indicative foreshore design. This layout combines improved community access and innovative design with restoration of degraded areas, as well as recognition of the landforms and environmental values of the site. The foreshore design is subject to further detailed design and in particular, details of the public amenities to be provided in the Village Foreshore Park (see **Figure 15**) are presented here as concept designs.

This section details the specific design parameters of the foreshore. Further technical specifications (i.e. of fencing and drainage) are detailed in **Section 6**.

5.2 Integration of Urban and Foreshore Environment

Integration of the adjoining Coastal Village Precinct with the foreshore environment was an important consideration during the planning process. The goal is for the natural integrity of the coast, dune formations and vegetation to be restored and maintained whilst providing community access and lifestyle opportunities. This outcome has been designed in accordance with the coastal processes setback. The delineation between the legislative boundaries is shown in **Figure 13**.

The early provision of well-planned and designed beach access, parks, recreation and commercial amenity along the Shorehaven foreshore will significantly enhance the formation of a vibrant community and economy within the Coastal Village Precinct. The facilities and infrastructure will also attract visitors which design of the foreshore seeks to accommodate. The Alkimos-Eglinton district is expected to be developed to support a total population of around 45,000 people. From beach user surveys undertaken for the Perth Coastal Planning Strategy it is expected that the majority of future beach users will be from within this district catchment.

The foreshore design will provide a high standard district 'community hub' for local residents and visitors. As identified in **Section 4.3** the foreshore will be instrumental in creating local social capital, supporting the development of a strong local economy, and establishing a 'sense of place' at Shorehaven. The key design outcomes that aim to integrate the urban and foreshore environment are the structural elements, view sheds, accessibility, and awareness of environment and public facilities.

5.2.1 Structural Elements

The structural elements of the foreshore design include a Village Foreshore Park with a Beach Club, movement network, small coastal nodes, POS nodes and lookout nodes. The pathways, parking areas, and each node are included in the Foreshore Movement Network (**Figure 12**).

5.2.1.1 Village Foreshore Park

The early provision of well-planned and designed beach access, parks, recreation and commercial amenity along the Shorehaven foreshore will significantly enhance the formation of a vibrant community and economy. The goal is to provide sufficient infrastructure early on in the development so the community can enjoy the foreshore and recreate at the beach. However the details of the buildings and area of recreational facilities to be provided will be determined during the detailed design phase. The figures included here to illustrate the type of amenities proposed to be provided within the Village Foreshore Park and in the Club Lot (around the buildings associated with the beach club) are therefore conceptual and indicative at this point.

The Village Foreshore Park and its integration with the urban development will form the heart of the Coastal Village Precinct, creating a destination that will benefit and attract both local residents and visitors from within the region (**Figure 15**). Design of the foreshore has been directed towards restoring the blow out and providing within the restored area the services, amenities, access and infrastructure appropriate to the characterisation of the beach as a local beach.

Restoration of the blowout is designed to support recreational uses around the beach club area. The restoration and construction across the foreshore areas will be staged as will development of buildings in the Club Lot, on an area of residual title. It is proposed that the Club Lot will have a lease area within it, however definition of this area will be further refined as subdivision proceeds.

Consideration of the usage patterns reported in the Perth Coastal Planning Strategy has informed the design considerations regarding the types of amenities to be provided at Alkimos. This is particularly relevant in relation to the following considerations:

- *Beach users:* beach users are likely to live between 5 to 10km of the beach, arrive by car or walk;
- *Tourism:* coastal activities are seen as an iconic visitor experience with the benefits of organised beach activities such as volley ball being increasingly important along with access to coastal amenities and facilities;
- *Recreational users:* beach user numbers vary with distinct peaks of early use followed by mid-morning, mid-afternoon and early evening peaks. Each peak reflects a different recreational niche, and there are generally higher numbers of people on beaches on summer weekends and considerably lower numbers of weekdays;
- *Infrastructure:* Safe swimming areas and grassy landscaped areas with barbecues and shade are highly valued and additional facilities such as toilets, change rooms, showers, kiosks, cafes, shade and shelters, car parking and bicycle pathways are also sought;
- *Public transport and access:* Use of public transport to the beach will be supported by a secondary public transit network, most likely based on high frequency buses linking the coastal village to the rail line. Safe and efficient pedestrian and cycle networks are provided. Preparation of a 4WD management plan is in discussion between landowners at the district level; and
- *Indicative design guidelines:* the community engagement undertaken as part of Perth Coastal Planning Strategy nominated the North Alkimos Sector as having predominantly the character of an open space, passive recreation area. Facilities provided for this type of beach include an average of one parking bay for every 100m² of the net recreational area (represented by the total grassed areas across the foreshore).

The design of the Village Foreshore Park public open space includes passive park spaces, zones for active sport and play, event spaces, beach look outs, picnic and BBQ areas, a promenade and walking paths (see **Figure 11**). Collectively, this amenity provides for a range of leisure and recreation options adjacent to the Coastal Village Precinct with links through to the beach, creating a major attractor that will promote economic and social interaction.

The Shorehaven Beach Club will be established within the Club Lot on the southern side of the Village Foreshore Park, providing a key community facility for both local residents and visitors (see **Section 5.2.4**). When fully developed, it will be a focal point for sport and recreation, health and fitness, youth activities, community events and local information. Facilities proposed include a clubhouse building with a fitness gymnasium, indoor climbing wall, activity studio, function hall, meeting room, games room, lounge, tele-kiosk and crèche. Commercial elements could include a café, beauty clinic, and physiotherapist, while external facilities may consist of toilet change rooms, beach volleyball courts and a bocce lawn.

Proposed to be managed through an innovative public/ private/ community partnership and subsidised through a Special Area Rate (SAR), this facility will activate the Village Foreshore Park, the beach and the Coastal Village Precinct. Beach Club staff will be responsible for providing a range of centre-based and outdoor programmed activities that may include:

- Personal fitness training;
- Group fitness, dance, yoga and martial arts classes;
- Outdoor concerts and movie nights;
- Community markets;
- Health and business seminars;
- Beach volleyball competitions;
- Community groups; and
- Water sports.

Together, the Beach Club and the Village Foreshore Park will provide a high standard district 'community hub' for local residents and visitors. This will be instrumental in creating local social capital early in the development of Shorehaven, supporting the development of a strong local economy, and establishing a 'sense of place' for the community.

The Village Foreshore Park will connect the Coastal Village Precinct with the Indian Ocean. The Village Foreshore Park is oriented to take advantage of a view of the Alkimos wreck and the ocean through a low point where the blowout opens to the beach (see **Plate 7**). Retaining this important viewshed will connect the Coastal Village with the Foreshore Park, forming a strong visual link with the ocean. The view through the Village Foreshore Park will display the recreational amenity and facilities that are close to the Coastal Village Precinct core, with a gradual loss of formality closer to the beach itself. A full suite of indicative viewsheds are provided in **Figure 14**.

Plate 7: Viewshed towards the Indian Ocean through the blowout



The Village Foreshore Park consists of a landscaped area located near the Coastal Village Precinct which will be passively irrigated by drainage water from the village. This area will be at a lower level to

the Coastal Village Precinct and gradually step down towards the beach. The grassed area in the Village Foreshore Park provides a total area of approximately 7,000sqm for active recreational uses.

Pathways will lead from promenades on either side of the Village Foreshore Park to the highpoints on the foredunes on either side of the opening to the beach. Lookouts at high points on both dunes will provide destinations for viewing the expansive views to the north and south. Outside these paths, rehabilitated, stabilised and landscaped dune vegetation will form the boundaries between the more formal areas of the Village Foreshore Park and the restored foreshore dunes and native vegetation.

A beach volleyball court is under consideration close to the beach, providing a multi-purpose open space venue as a site for community activities. This will add to the diversity of recreational choices and promote night time and 'off-peak' use outside the summer months. The design of this feature will be subject to the detailed design of the Village Foreshore Park.

A series of picnic and barbecue spaces will be provided within sheltered nooks to protect from strong south-westerly winds. These small enclosures will be suitable for groups of family or friends, equipped with shade structures, barbecues, tables and seating, and sited so as to overlook activity in the body of the Village Foreshore Park.

Access to the beach through the Village Foreshore Park has been designed to maximise the accessibility to the beach as well as preserving views of the ocean. The beach club discussed in **Section 5.2.4** will include toilets and change rooms, supporting the user friendly beach access, identified as an opportunity in **Section 4.3**. For further discussion of the facilities provided within the Village Foreshore Park refer to **Section 5.2.2** and **Section 5.2.4**.

The Village Foreshore Park is strategically located within the central blowout discussed in **Section 3.3.4** providing restoration of "Completely Degraded" areas. The central position of the Village Foreshore Park also provides views towards the historic Alkimos wreck encouraging tourism within the area. These design features take on board the opportunities identified in **Section 4.3**.

The impact of strong coastal winds on dune stability and community use within the foreshore was identified as an issue in **Section 4.2**. The ridgeline of the blowout will provide shelter in the Village Foreshore Park from coastal winds. These ridgelines will be stabilised and landscaped to minimise further erosion and create visual amenity. Paths and lookouts will be constructed on these ridgelines providing additional vistas and recreational opportunities for beach users. Buildings within the foreshore will be protected from strong coastal winds (in particular the south westerly, and westerly afternoon winds – **Section 3.1**).

5.2.1.2 Foreshore Road

A north-south coastal road will provide a boundary to the coastal foreshore (see **Figure 12**). The alignment of the road has taken into account the location of inferred TEC's and significant landforms. Construction of this road will be coordinated with the future residential development in the adjacent properties to the south. For further discussion of the timing of this road alignment see **Section 5.4**.

The north-south coastal road with the adjacent pedestrian and bike path (or coastal promenade) defines the separation of the public foreshore area from the privately owned residential development. The promenade allows views of the coast to be enjoyed as well as providing for safe pedestrian access along the foreshore. Parking parallel to the road is provided for residents and visitors.

A network of carefully located and fenced paths provides controlled access across the foreshore from the road to the beach as well as through the foreshore from north to south and linkages to parking areas. Steps will be provided where the path to the beach crosses step dunes. The movement network

connects nodes within the foreshore as well as linking the foreshore to the residential area, the Viggo trail and the Coastal Village Precinct.

Plate 8: Typical section through road with sloping downward grade on conservation area

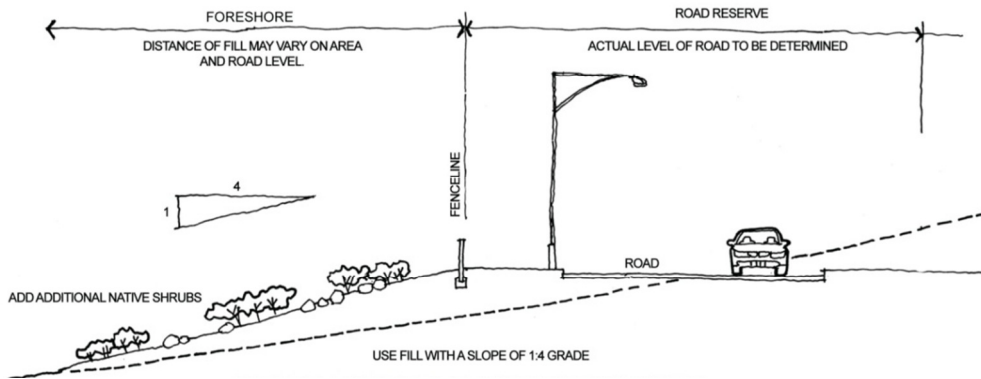


Plate 9: Car park access road through Foreshore Reserve

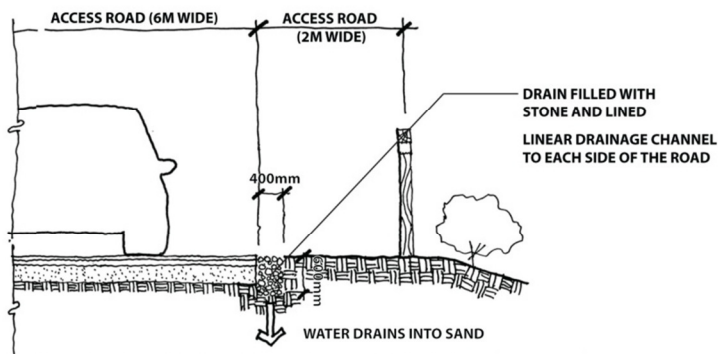
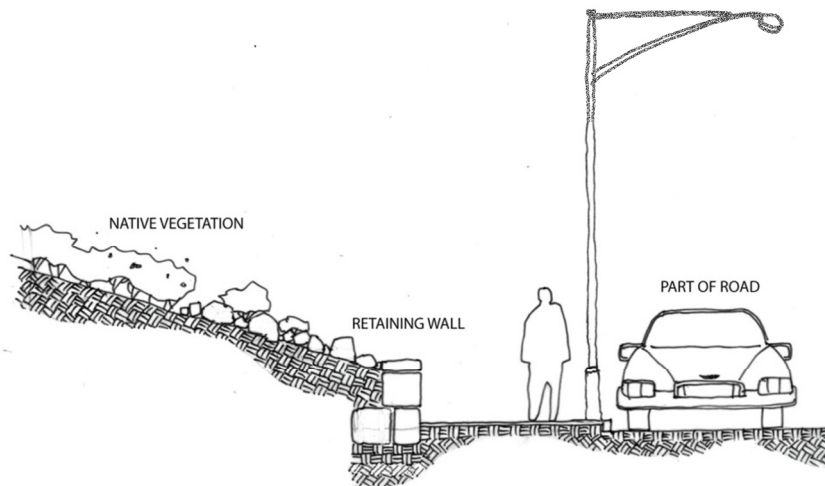


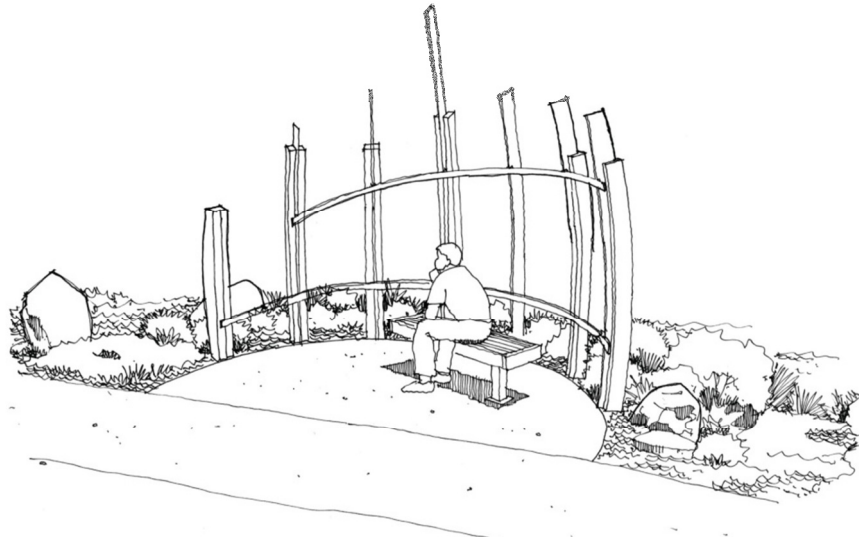
Plate 10: Road Section – retaining wall



5.2.1.3 Small Coastal Nodes

Throughout the foreshore reserve a number of small coastal nodes have been designated at the intersection of pathways. These nodes will provide seating and shading facilities for the community. The small coastal nodes are designed to provide a rest opportunity along the pathways, with educational signage on taking care of the dunes.

Plate 11: Typical Seating at Small Coastal Node with Sculptural Element (EPCAD)



5.2.1.4 Major and minor nodes

The major nodes (including the Northern Coastal Park) provide grassed open space for passive and active recreational activities such as picnics, barbecues, informal sports and other community activities. This will allow for tourism and outdoor recreation activities to occur within the foreshore without damage to the native vegetation of the dunes. Similar turfed areas have been provided along foreshore reserves in the northern coastal corridor at sites at Burns Beach and Trigg Beach, and have become valued community assets. It is expected that the Village Foreshore Park and Northern Coastal Park will encourage outdoor activity, appreciation of views and biodiversity and promote community interaction and tourism within the foreshore.

The major nodes will include:

- Adjacent car parking
- Street furniture and public artwork
- Shade and seating
- Showers and barbecues
- Rubbish bins

Northern Coastal Park

The Northern Coastal Park provides open space that incorporates the natural environment with active play opportunities, as well as more formal urban spaces and drainage integration.

A natural depression in the park provides an opportunity for passive irrigation of turf through drainage, and it is intended that the area will be terraced, with playground and barbecue facilities provided nearby. The areas of grass and modified environment will be separated from the indigenous landscape through changes in levels, use of pathways or other structural devices to ensure management integrity of the coastal heath.

The natural high point of the park provides an opportunity for a lookout; a focal point of the parabolic dune walk trail. A large sculptural element will be installed at this point to lead trail users into the park.

The formal area of this large space is located 250m from the beach, and therefore needs to be connected to the beach through obvious walkways to allow for and encourage community **access to** the ocean. There is also need for vehicle access closer to the beach to support access for people with disabilities, picnic and beach equipment, small children and strollers. This is facilitated by the provision of 20 car bays at the end of an access road at the northern side of the park down to the beach.

A dog beach with a car park to provide easy access for dog owners has been proposed adjacent to the Northern Coastal Park. This is to be confirmed with City of Wanneroo who is undertaking a review of dog beaches within the City's area. The proposed land use is designed to provide unconstrained dog exercise areas and reflects the objective of the DSP (**discussed in Section 3.2.3**). Pathways within the foreshore reserve will be fenced to minimise any detrimental impact to native fauna and flora. Further information on dog management is detailed in **Section 6.4**.

5.2.1.5 Lookout Nodes

Lookout nodes allow for enjoyment of the extensive views up and down the coast, over the ocean, towards the Alkimos wreck (identified as an opportunity in **Section 4.3**) and back towards the development of Shorehaven. Within the foreshore there will be five lookout nodes spaced along ridgelines and peaks of the foreshore. The lookouts utilise the existing high points in the foreshore and will be integrated with the network of paths.

A lookout node will be constructed on either side of the existing blowout. These natural peaks have been made more prominent with the erosion of the blowout. The two lookout nodes (see **Plate 12** and **Plate 13**) will provide direct views towards the Alkimos wreck as well as up and down the coast with views to Perth. The design of these lookouts will reflect the theme of the Alkimos wreck, adding to the visual amenity and character of the foreshore. These nodes will be accessible by secondary paths from the Village Foreshore Park.

Plate 12: Large View Deck with associated seating area (EPCAD)

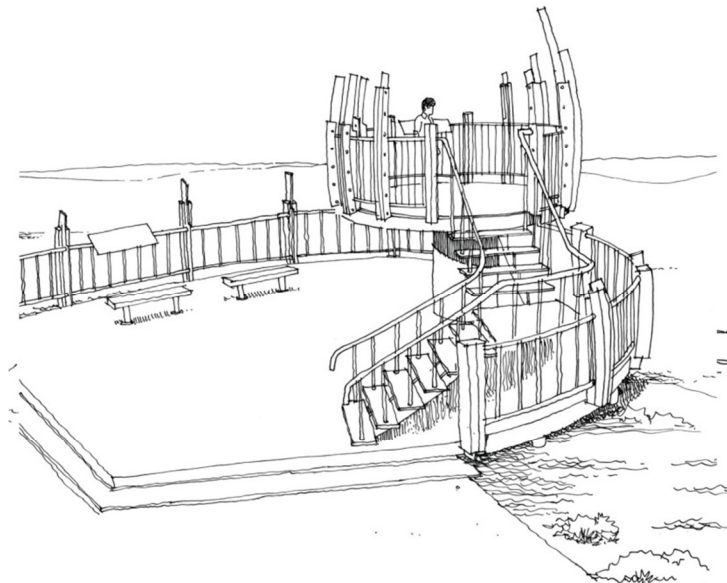
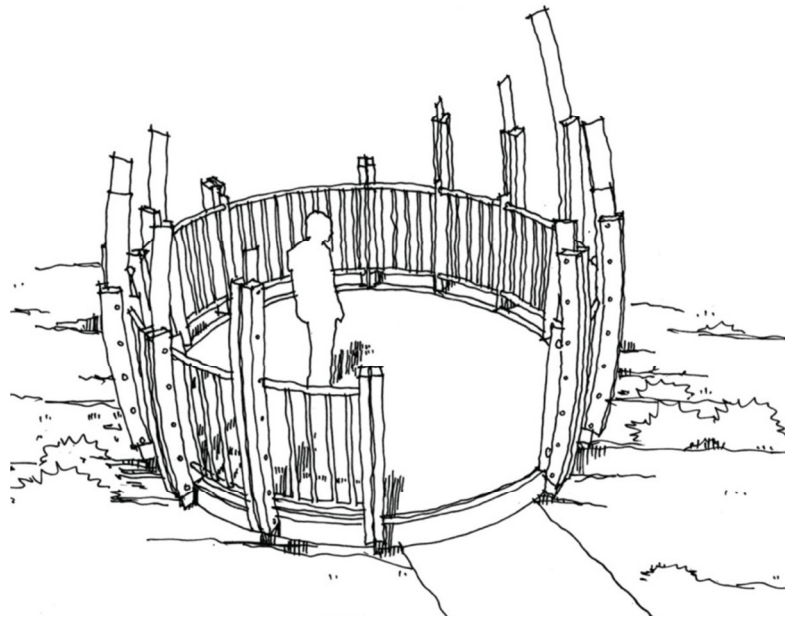


Plate 13: Small View Deck (EPCAD)



5.2.2 Accessibility

Safe, user-friendly and controlled access will be constructed on existing tracks within the reserve and to the beach, with provision for both emergency and disabled access. The movement network provides pedestrian pathways, beach access and walking trails throughout the reserve as well as a beach promenade (in the form of a dual use path) alongside the foreshore road.

Pathways have been located along the route of existing tracks to minimise damage to the native vegetation. The existing network of tracks will be rationalised to support rehabilitation and restoration of the landforms and vegetation. Additional existing pathways within the reserve that are not required for pedestrian access will be rehabilitated to return the areas to a stable vegetation community.

From experience in managing beach access at Burns Beach, the distance between beach access tracks is no more than 200m as any greater separation between tracks can result in uncontrolled access. Steps and a disabled access ramp are provided for ease of access to the beach over the steep foredune areas in the northern sections of the foreshore.

5.2.2.1 Fencing

Fencing will be installed around foreshore vegetation and along each side of each pathway within the movement network. Fencing is an important facet in dune stabilisation (further discussed in **Section 6.2.4**) and in controlling access. Fencing specifications will follow current City of Wanneroo requirements. The primary aim of the fencing is to restrict pedestrian access to pathways. Fences also provide an opportunity for fauna movement and sand trapping. In some areas of the site fencing will be supported by a low limestone wall to add to the artistic features of the foreshore design.

5.2.2.2 Coastal promenade

A coastal promenade in the form of a dual use pathway will follow the road (on the foreshore reserve side) on the eastern perimeter of the foreshore reserve, providing the main north south link to the adjoining estates. The pathway is designed for use by pedestrians, wheelchairs, bicycles, prams and for emergency access.

The pathway acts as an interface between the urban environment and the foreshore environment and aims to guide pedestrians towards beach access routes. The dual use pathway will link the residential development to the Village Foreshore Park as well as additional lookout nodes, beach access trails and public facilities. A technical specification of the dual use path is discussed in **Section 6.2.2**.

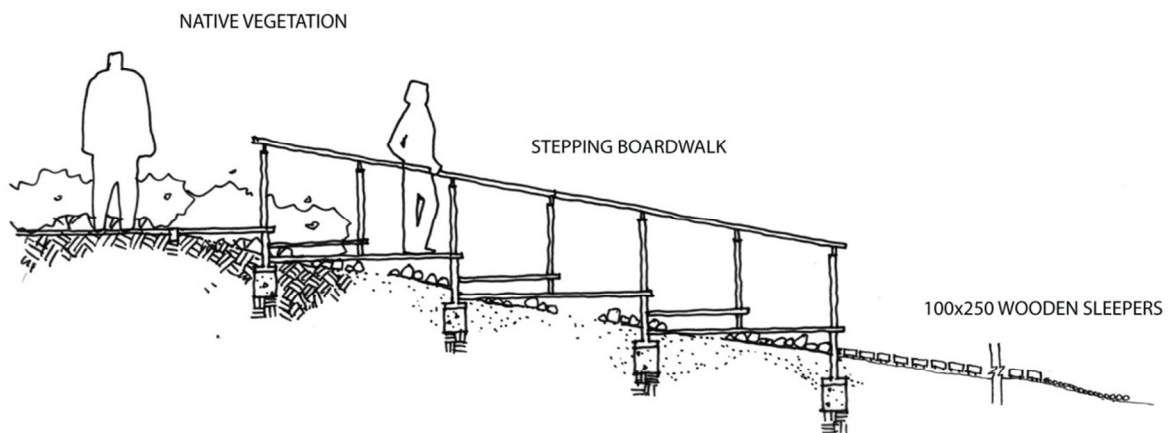
5.2.2.3 Beach Access

Beach access pathways provide access for pedestrians (including people of all ages and those with disabilities) to the beach. The majority of the beach access routes will be constructed on existing tracks. Along the full length of the foreshore (1.7km), eight access routes are proposed (**Figure 12**). These have been spaced to achieve a maximum distance of 250 metres (at the northern end of the foreshore) between beach access pathways. This addresses the demand for user friendly access to the beach identified in **Section 4.2**.

Construction material for each beach access pathway will vary, however the majority will utilise crushed limestone sourced on site. Boardwalks (ramps and staircases) are provided to traverse the steep slope of the foredunes down to the beach. Technical specifications of the beach access paths are discussed in **Section 6.2.2**.

Along the beach access pathways, shade and seating will be provided, often at intersections of the walking trail. These small coastal nodes will incorporate public art (**Section 5.2.4**).

Plate 14: Typical Beach Access Section (EPCAD)



The Viggo Trail

The Viggo Trail is a path that follows the arc of a parabolic dune form and curves around the coastal precinct of the residential development of Shorehaven, offering opportunities to learn more about the area's rich heritage and providing a central pathway that links the eastern portion of the coastal precinct to the beach. This pathway was named after Viggo Hansteen, the name of the ship before it was renamed as the Alkimos. The Viggo Trail enters the foreshore just north of the Village Foreshore Park and utilises the existing pathways of the foreshore to connect to the beach. This beach access route also provides disabled access to the beach. Educational signage will be included within the Viggo Trail.

5.2.2.4 Walking Trails

The primary foreshore pedestrian access route is a walking trail running north south through the foreshore. The trail will meander along the dune ridgeline, with connections to foreshore paths and paths to the beach. The majority of the walking trail will be constructed on existing tracks to minimise disturbance to surrounding vegetation (identified as an opportunity in **Section 4.3**).

Unlike the coastal promenade, this trail aims to provide recreational pathways accessed primarily by foot. The trail will be surfaced with crushed limestone (**discussed further in Section 6.2.2**). The primary function of this trail is to provide walkable links between the Village Foreshore Park and smaller coastal nodes along the foreshore.

Along the walking trail, shade and seating will be provided, often at intersections of beach access routes. These small coastal nodes will incorporate public art (**Section 5.2.4**).

5.2.2.5 Vehicle Access

Vehicle access will be controlled within the foreshore and limited to maintenance vehicles and emergency access. Emergency access has been provided in the design of the Village Foreshore Park to allow for easy access to the beach in emergency situations. These roadways have been appropriately stabilised and can be used by emergency service vehicles such as the State Emergency Services, Surf Life Saving or Ambulance.

To support and focus public access in a safe manner, a small car park (of 20 car bays) will be located at the northern end of the foreshore nearby the Northern Coastal Park. The provision of parking at this location within the foreshore reserve has been included to allow for easy beach access within 100 metres of the shoreline. This car park will be located in a degraded area behind the primary dune.

Any vehicle access separate from car parking within the site will require authorisation. All vehicle access routes will require appropriate drainage design.

5.2.3 Awareness of Environment

The coastal environment is a fragile system. The adjacent development of Shorehaven is anticipated to create an influx of regular visitors, recreational users and tourists to the foreshore area. While the foreshore will provide recreational opportunities for the community, the natural environment will ultimately provide amenity, biodiversity and natural stability of the foreshore system.

The degradation of higher condition vegetation has been identified as an issue in **Section 4.2**. The innovative design and use of interactive areas and educational signage will promote awareness of the natural environment at Shorehaven, foster stewardship and minimise any detrimental impact on the foreshore. Interactive areas have been strategically located in areas of lower condition vegetation (i.e. vegetation in Completely Degraded condition) to minimise disturbance to higher condition vegetation and areas where it is likely that people will seek to admire the view will be provided with suitable access and lookouts.

To further prevent people straying from paths, access paths to the beach will be fenced and located no less than 200 metres apart, with a maximum distance of 250 m between paths, on existing tracks to minimise further disturbance to the landform and vegetation. Educational signage will support the ongoing stabilisation and management of the foreshore environment. Ongoing benefits from providing coastal nodes, infrastructure and managed access include support for restoration of degraded areas and opportunities for education about environmental values.

Additional methods used to raise environmental awareness are listed in Table 4.

Table 4: Environmental Awareness objectives included in the Foreshore

Public Facility	Description
Educational Signage	<p>Signage can aid foreshore management and in particular assist in dune stabilisation by educating beach users about the fragile nature and values of the foreshore. The WAPC (2003b) advises of three types of signs applicable to the coastal area. Signage will be used to:</p> <ul style="list-style-type: none"> › Direct pedestrians and vehicles to inform foreshore users on where they can park and walk; › Inform pedestrians about the regulations associated with the restricted access to rehabilitation sites; and › Interpret the reasoning behind the regulations and rehabilitation pertaining to the natural features of the site. <p>Educational signage will be incorporated within the foreshore predominantly at nodes along pathways and surrounding areas of revegetation. Signage will educate the community of the importance of using assigned pathways and the appropriate management of the foreshore. The signage will also inform the community of the extensive rehabilitation and stabilisation undertaken by the developer. In addition a range of directional and interpretative signage will provide information and directions to features within the foreshore and adjacent development such as information about the Viggo Trail or history of the Alkimos wreck.</p>
Interactive Areas	<p>A number of interactive areas designed for community and recreation use are located in the foreshore. These open space areas will be a focal point for outdoor recreation and tourism within the coastal strip. The provision of these interactive areas reflects the design philosophy of the foreshore.</p> <p>The primary of purpose of these interactive areas is to provide opportunities for passive and active recreation that avoids damage to the native vegetation. The grassed areas will provide open space ideal for passive and active recreation and include innovative Water Sensitive Urban Design (WSUD) to minimise the need for reticulation (discussed in Section 6.2.8). Vegetation on the fringes of these areas will reflect the natural environment within the foreshore whilst complementing the built environment colour palate with native foliage and flowers (discussed in Section 6.3.2).</p>
Viewsheds	<p>Awareness of the environment also requires acknowledgement of the landscape and seascape features. Lookouts will be constructed at high points on either side of dunes at the Village Foreshore Park to provide for appreciation of the views up and down the coast, and additional lookouts with seating, shade and interpretation signage are provided in the northern portion of the foreshore.</p> <p>Viewsheds of the beach club area and associated locations in the Village Foreshore Park have been prepared to ensure the design reflects the visual landscape amenity. These images are shown in Figure 14.</p> <p>Levels from the Coastal Village Precinct through the Village Foreshore Park have been carefully designed to maintain views of the ocean from the Village Precinct.</p>

5.2.4 Public Facilities

A number of public amenities are proposed in and adjacent to the foreshore reserve. The need to setback public facilities from coastal processes was identified as a constraint in **Section 4.1** and has been addressed accordingly. Buildings within the Village Foreshore Park will be located in the Club Lot behind the coastal processes setback to minimise the risk of coastal erosion (**see Section 3.4**).

The small portion of public facilities (such as access paths and terracing) that are located seaward of the coastal setback line are exempt from the State Coastal Policy as they provide public purpose facilities that benefit the broader public use of the foreshore. All public facilities are located at least 100 metres from the shoreline in the area of the foreshore that is in private title and reserved for Parks and Recreation. In addition public facilities are sited in an area underpinned by Tamala limestone (identified as an opportunity in **Section 4.3**). Public facilities located within the Village Foreshore Park are therefore sited in accordance with the State Coastal Policy. The public facilities are described further in **Table 5**, and include:

- A Beach Club;
- A Surf Lifesaving Outpost (supported by a trailer or manned tent on the beach during summer)
- Food Outlets/Cafe;
- Car Parking;
- Street Furniture and Public Art;
- Toilets;
- Showers; and
- Shade, signage and rubbish bins.

Table 5: Public Facilities included in the Foreshore

Public Facility	Description
Beach Club	<p>The beach club will be located on the southern side of the Village Foreshore Park, providing a key community facility for both local residents and visitors. When fully developed, it will be a focal point for sport and recreation, health and fitness, youth activities, community events and local information. It is proposed to comprise a clubhouse building with a fitness gymnasium, activity studio, function hall, meeting room, first aid facilities, a surf lifesaving outpost, lounge and a City of Wanneroo community space. Commercial elements may include uses such as a cafe, beauty clinic, physiotherapist and a restaurant with a proposed liquor license. Proposed external facilities consist of toilet change rooms, beach volleyball courts and a bocce lawn. The beach club will be the focus of the Village Foreshore Park utilising passive solar design and complementing the natural setting of the foreshore.</p> <p>Proposed to be managed through an innovative public/private/community partnership and subsidised through a Special Area Rate (discussed in Section 8.1), this facility will activate the foreshore park, the beach and the Coastal Village Precinct. Beach Club staff will be responsible for providing a range of centre-based and outdoor programmed activities including:</p> <ul style="list-style-type: none"> › Personal fitness training; › Group fitness, dance, yoga and martial arts classes; › Outdoor concerts and movie nights; › Community markets; › Health and business seminars; › Beach volleyball competitions; › Community groups; and › Water sports. <p>The location of the beach club in the Village Foreshore Park and indicative design of buildings in the Club Lot can be seen in Figure 15.</p>

Public Facility	Description
Food Outlets/Cafe	Within the Village Foreshore Park in the area adjoining the Coastal Village Precinct it is proposed to provide facilities for food outlets and cafes. These will provide services to the community as well as passive surveillance over the Village Foreshore Park.
Car Parking	<p>Car parking has been provided within and adjacent to the foreshore to allow for easy access to the beach. The road adjacent to the foreshore boundary will provide parallel parking for 241 vehicles to accommodate parking requirements for Shorehaven residents as well as for tourism and commercial uses. Based on an analysis of the likely demand for parking, 138 bays are provided for the central area of POS and Beach Club.</p> <p>The provision of parking within the foreshore reserve at both the Northern Coastal Park and Village Foreshore Park allows for easy beach access within 100 metres of the shoreline. A further 20 bays are provided adjacent to the Northern Coastal Park and beach access from this car parking facility includes both steps and a ramp to the beach to allow for disabled beach access.</p> <p>Technical specifications are detailed in Section 6.</p>
Street Furniture and Public Art	<p>Bench seating will be installed throughout the foreshore at lookout nodes and at various intersections of pathways. Shade structures will be included where required.</p> <p>In line with the Shorehaven LSP, public art will be incorporated within the foreshore design and will be considered an integral component of civic design.</p>
Toilets	Toilet facilities will be provided where practical and in consultation with the City of Wanneroo. The current foreshore design has identified possible locations for toilets within the foreshore reserve. Toilet facilities are likely to be constructed within the major POS node, the Village Foreshore Park and in the northern car parking facilities. The location of toilet facilities is subject to consultation with the City of Wanneroo.
Showers and foot washes	Shower facilities and foot washes will be provided where practical and in consultation with the City of Wanneroo. The current foreshore design has identified two possible locations for showers within the foreshore reserve. Shower facilities and foot washes are likely to be constructed within the major POS node and in the northern car parking facilities.
Rubbish Bins	Rubbish bins will be provided and maintained by the City of Wanneroo within the POS around the beach club. Within the foreshore reserve itself, no bins are proposed due to limitations on access for service vehicle. Signage throughout the foreshore reserve will encourage the 'Leave nothing but footprints' philosophy to minimise littering.
Dog beach	A dog beach has been proposed in the northern section of the foreshore (to be confirmed with City of Wanneroo). This will allow for unconstrained dog exercise areas within the foreshore and minimise any impact from dogs on the natural environment elsewhere in the foreshore.

5.2.5 Infrastructure

Provision of infrastructure within the foreshore aims to service the public facilities, support the community use of the Village Foreshore Park and enhances the controlled access routes throughout the Foreshore Reserve. This infrastructure is detailed in **Table 6**.

Table 6: Infrastructure included in the Foreshore

Public Facility	Description
Lighting	<p>Lighting will allow for safe access along the main movement linkages and nodes. Lighting will be installed along the pathways within the Village Foreshore Park. Lighting along the dual use pathway will utilise the adjacent street lighting. Where possible solar lighting will be utilised to minimise energy use and maximise solar efficiency.</p>
Drainage	<p>Drainage will be integrated within the foreshore design to minimise any erosion, ensure public safety and to assist in the landscaping and revegetation of the foreshore.</p> <p>The drainage design will reflect the high water wise standards of Shorehaven. Shorehaven have received UDIA recognition of their water wise initiatives and have been awarded the Water Element of Enviro Development for improved water efficiency.</p> <p>Stormwater disposal via soak wells, grassed swales and drainage basins will maximise recharge of the shallow groundwater aquifer. Drainage basins for capture and disposal of the 1: 100 year event are designed to be located within Peet’s property boundary and to minimise impacts on ecological values of the foreshore reserve. Technical specifications for drainage are detailed further in Section 6.2.8 and will be subject to detailed design.</p>
Emergency Sewer Overflow	<p>To service Shorehaven at Alkimos development, Water Corporation wastewater planning requires the construction of a wastewater pumping station in the Coastal Village Precinct. Wastewater pump stations are generally located in the lowest areas of development.</p> <p>Current planning for the Shorehaven Coastal Precinct indicates the proposed pump station site will be located adjacent to the Northern Foreshore POS. This location is outside the MRS foreshore reserve with a physical barrier between the pump station and the foreshore being provided by the main north south coastal promenade and bike trail.</p> <p>The site will house a Type 40 pump station, pressure main and emergency storage facility to serve part of the development.</p> <p>Emergency storage facilities are provided at all pumping stations to prevent indiscriminate surface flooding in the catchment as a result of equipment breakdown or power failure. As the system is designed to protect public health, in an emergency situation wastewater will overflow to the environment so that it does not back up in pipes and flow into streets or people’s homes.</p> <p>A minimum detention time of three hours at gravity sewer design flow conditions is provided before any overflow occurs. If the trapped emergency overflow discharges into an environmentally sensitive area, the detention time is increased to six hours. This detention time may be reduced from six hours to three hours if it is possible to provide a buffer between the emergency overflow and the area.</p> <p>Emergency storage is usually provided in large diameter sealed concrete pipes laid below ground adjacent to the pump station site.</p> <p>Where possible the trapped emergency overflow is connected to a stormwater drain or drainage swale/basin. Should the emergency overflow be located in a sensitive environment, treatment of the drainage swale can be provided to prevent any negative impacts should any breakdowns/power failures persist for longer than six hours. This can include an impermeable lining to restrict overflow into sensitive environments.</p>

5.3 Protection and Conservation Areas

The majority of the foreshore will be protected for conservation. Under the SPP 2.6 the foreshore reserve is required to provide sufficient setback for coastal processes, protection of ecological values, landscape, visual amenity, indigenous and cultural heritage, public access, recreation and safety. The foreshore reserve is reserved for “Parks and Recreation” under the MRS. This will ensure that the natural integrity of the foreshore is maintained in perpetuity.

The green link located in the southern portion of the Shorehaven Development Site has been identified as being of conservation value and is excluded from this FMP. It is anticipated that in the future this land will be retained as bushland and managed for conservation, potentially by the DEC. .

Access and continuity of the dual use pathway through this green link will follow the road linkage to the south. Peet Limited will install fencing and signage (**Section 6.2.4** and **Section 6.2.5**) to minimise uncontrolled access through the area, limiting any negative impact on the potential FCTs identified as an issue in **Section 4.2**.

The road interface with this reserve will be designed with batters suitable for interfacing with the conservation area as well as protecting views, supported by rock pitching and low walls as necessary. The design of the road and buffers will focus on reducing disturbance to the green link. The interface of the green link with the road and dual use pathway will be subject to detailed design.

5.4 Continuity with adjacent landholdings

The design of the foreshore facilities and movement network aims to provide for the continuity of primary infrastructure along the foreshore in adjacent landholdings. The DSP specifies that each site located in the DSP area must prepare a FMP. It is anticipated that the Alkimos FMP will set the standard for the appropriate management of the foreshore within the DSP area and that complimentary management planning will be undertaken for the adjoining sites.

In the long term the dual use path will serve as primary pedestrian and cyclist linkage along the coastline, connecting as far south as Perth’s main beaches such as Cottesloe. Design of the foreshore infrastructure and in particular roads, services and the controlled access will link to infrastructure in adjacent land holdings.

6 Rehabilitation and Stabilisation Plan: Technical specifications

The rehabilitation and stabilisation plan uses the existing environmental condition and foreshore design to set objectives for dune stabilisation, weed control and rehabilitation within the foreshore. Stabilisation of the foreshore includes the use of pedestrian pathways, controlled vehicle access, fencing and barriers, signage, stabilisation of degraded dunes and the blowout and suitable drainage. Rehabilitation will include targeted revegetation with suitable native plant species and ongoing protection and conservation of fauna species.

6.1 Weed Control

A number of introduced (or weed) species were identified in the flora and vegetation survey (Cardno 2010). Weeds often invade the native vegetation and subsequently have a negative impact on the biodiversity of flora and fauna, fire management regimes, dune stability and erosion. Weed species identified on site are indicated in **Figure 9** marked with asterisks on the legend.

The invasion of weed species was identified as an issue for the management of the foreshore in **Section 4.2**. Areas that contain weed infestation will require treatment. It is important to note that weed treatment will not be applied across the entire subject site, but only in areas in where they are deemed to be required. Weeds will be controlled manually or chemically. The *Coastal Planning and Management Manual* (WAPC 2003b) or *Bushland Weeds* (Brown and Brooks 2002) provide specific management and control methods for the weeds (listed in **Appendix C**).

Manual control of weeds is hand collecting and hand pulling of weeds from the ground surface. This can cause disturbance of the ground surface as it removes the anchor that binds the soil together. Manual control should only be used for large weeds such as established *Lupinus cosentinii* or introduced trees and large shrubs. Manual control of weeds should take place when required.

Chemical control is the use of herbicides to control exotic plants. It can sometimes be more efficient than manual control as large areas can be covered in a smaller amount of time and without disturbing the soil structure by pulling out the root system. Chemical control should be used for both the broadleaf perennial herbs and any grass species present and can be used in all management zones. Weeds will be sprayed with either *Glyphosate* and/or *Metsulfurin* or grass selective herbicides (e.g. Fusilade). The use of herbicide is dependent on the type of weed and its position within the existing vegetation. Chemical control of weeds should take place prior to tubestock planting and where required during the revegetation monitoring period.

6.2 Dune Stabilisation

Natural processes such as waves, rain and wind can result in the natural destabilisation or erosion of dune systems. These processes can be exacerbated by the destruction of stabilising plants by human activity such as vehicle movement. At present the dune formation within the subject site is largely stable with a number of unstable areas, largely foredunes, generally as a result of human activity. The intensification of activity within the foreshore has the potential to create additional issues of instability. The WAPC (2003b) define stabilisation as:

'Stabilisation is ensuring that sediment contained in a system is maintained and that loss caused by human activity is minimised'

It is imperative that the dunal system is stabilised to minimise transportation of sand, loss of vegetation and erosion. This section addresses the issue of further destabilisation and erosion of the dune formation identified in **Section 4.2**. The key method used for stabilisation across the foreshore will be the rehabilitation of disturbed areas with matting, brushing and planting of locally endemic vegetation species (discussed in **Section 6.3**). However a number of stabilisation methods are required in addition to rehabilitation works including stabilisation of pedestrian pathways and vehicle access, use of fencing/barriers and signage and stabilisation of open dunes batters and vegetated areas. The large blow out adjacent to the Alkimos wreck is proposed to be extensively rehabilitated providing a focus for a variety of recreational uses.

6.2.1 Managing uncontrolled access

At present the uncontrolled vehicle access at Alkimos has caused extensive erosion of the dunes within and surrounding the foreshore reserve. The management of this uncontrolled access early on in the stabilisation and rehabilitation plan will prevent damage to areas of stabilisation and rehabilitation. It is anticipated that a management framework will be developed along the foreshore (including adjacent properties) to manage the uncontrolled access in the district.

Peet will restrict vehicle access to existing tracks and ensure that further damage is avoided. This can be achieved through restricting access through the placement of large limestone blocks, fencing (**Section 6.2.4**) and bollards, advising users of the negative environmental impacts of uncontrolled access through use of signage (**Section 6.2.5**) and restoring landforms through using brushing on closed tracks (**Section 6.2.6**).

6.2.2 Pedestrian pathways

The pedestrian pathways will support recreational access following construction of the residential and commercial precinct adjacent to the subject site. Suitable beach access is an important consideration in design of the foreshore reserve to support access by all recreational users. The pedestrian pathways in the foreshore include a dual use pathway (suitable for use by wheelchairs, bicycles, prams, emergency access etc), a low key walking trail along the ridgeline and beach access. Access will be controlled along pathways through fencing and appropriate educational signage. The movement network is illustrated in **Figure 12** and the stabilisation methods proposed for each type of pathway are shown in **Table 7**.

Table 7: Stabilisation of pedestrian pathways

Pathway Type	Description	Issue	Stabilisation method (WAPC 2003b)
Dual use pathway	Hard surface utilised by pedestrians, bicycles, prams, wheelchairs, emergency vehicles	Runoff the non-porous surface may cause erosion on the sides of pathways without suitable drainage (see Plate 15.1)	Concrete and asphalt paths: these paths generally used in urban situations and for dual use paths. Their visual impact can be reduced by adding colour or texture. Requires drainage (see Plate 14.2).
Walking trail	Moderately hard surface accessed by pedestrians and bmx bicycles	Possible erosion on steep slopes and subsequent loss of secure footing	Crushed limestone*: crushed, water-compacted or cement stabilised limestone will provide a firm surface and is visually compatible with coastal landscapes (see Plate 14.3 and Plate 18). Requires drainage.
Beach Access	Secure surface accessed by all beach users (including disabled access)	Steep slopes directly along the shoreline may lead to erosion	Timber boardwalks: timber boardwalks enable the natural ground surface to be protected, an vegetation to grow under and close to the path. They are especially useful in fragile areas, or where surface drainage is a problem, and they provide disabled access (see Plate 14.4 , Plate 16 and Plate 17).

*Crushed limestone will be recovered from the adjacent development area for use in the foreshore area.

Plate 15: Example of pedestrian pathway options



Plate 15.1: Example of poor drainage



Plate 15.2: Concrete path and limestone drainage



Plate 15.3: Crushed limestone path



Plate 15.4: Timber boardwalks to beach

Plate 16: Raised Board Walk Typical Section (EPCAD)

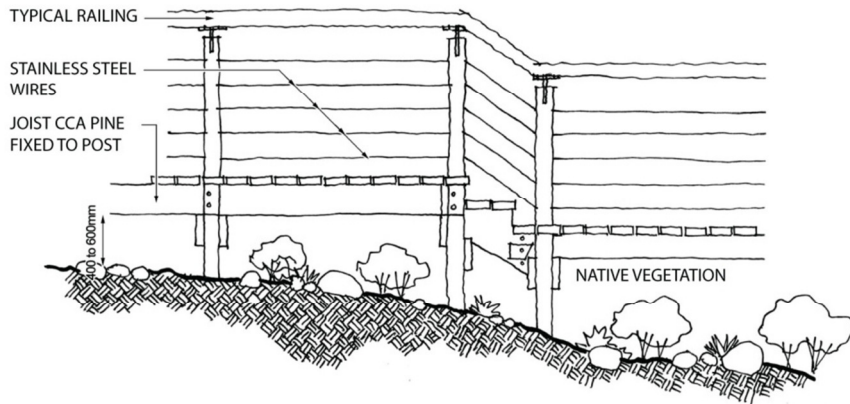


Plate 17: Detail of Beach Access Section (EPCAD)

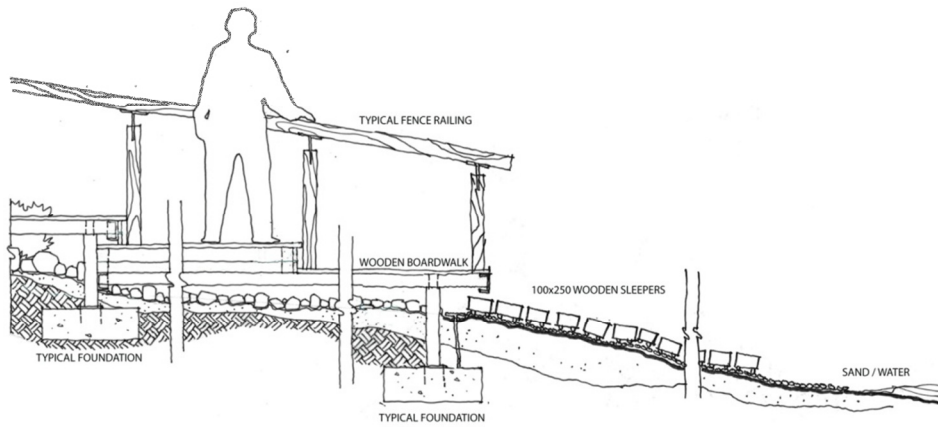
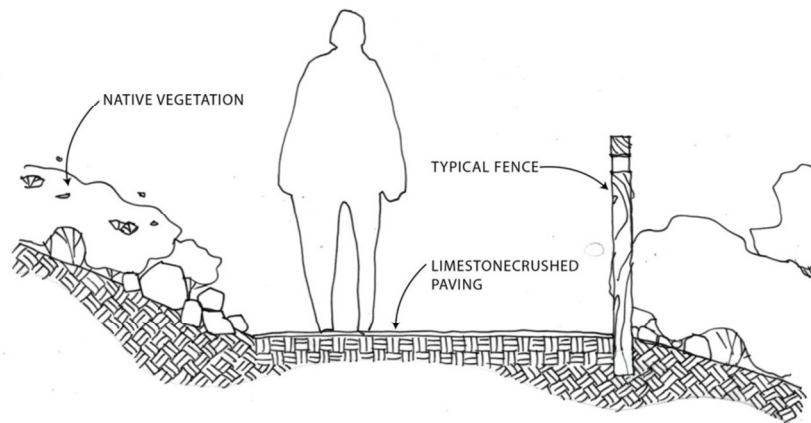


Plate 18: Typical Footpath Section (EPCAD)



6.2.3 Vehicle Access

Vehicle access will be relatively limited within the foreshore with provision for maintenance vehicles and emergency access to the beach from the beach club. In addition a small car park will be located at the northern end of the foreshore to provide easy access to the beach. Stabilisation of vehicle access will be achieved through the following methods:

- Use of generic road base materials for vehicle access into the car park, ensuring that appropriate drainage is included and pedestrian movement is separate for safety;
- Vehicle access within the community and commercial precinct will rely on existing pathways with prescribed speed limits to improve safety. These will primarily be used by maintenance vehicles and emergency vehicles. These access routes are detailed in **Figure 11**;
- Emergency access to the beach will be stabilised with the use of crushed limestone tracks (**Section 6.2.2**). Vehicle access for this purpose will only require a short connection from the beach club to the beach.
- Crushed limestone walking trails will be an appropriate width to allow for maintenance vehicle access.
- Car parking areas that are separated from the main coastal promenade will be stabilised with crushed limestone tracks (similar to the crushed limestone paths discussed in **Section 6.2.2**). Parking located along the promenade and within the Village Coastal Precinct will comprise of a bitumen surface. Car parking facilities will include appropriate drainage (further discussed in **Section 6.2.8**).

Dual use paths will be consistent with the requirements of the City of Wanneroo.

6.2.4 Fencing/Barriers

Fencing is an important facet in dune stabilisation and control of access. Appropriate fencing can enforce barriers to restrict access and allow for wind speed reduction and sand trapping. Fencing will be placed according to the environmental condition of the site. Fencing will be used within the subject site for the following purposes:

- Sand trapping on steep slopes (**Plate 19.1**) to reduce the movement of sand and to assist with revegetation;
- Sand trapping on less steep slopes (**Plate 19.2**) to reduce the movement of sand and to assist with revegetation. This type of sand trapping uses wider mesh to reduce the build-up of sand on just one side of the fence;
- Fencing on the edge of pathways (**Plate 19.3**). This encourages pedestrians to stay on the paths and keep from entering the dune revegetation areas. This fence type consist of a post and wire fence with either 1 or 2 single wire strands ringlocked at the top with 5 to 7 strand ringlock at the base; and
- Fencing along the edge of lookouts or along pathways with a steep decent adjacent (**Plate 19.4**). Used for safety and to keep pedestrians off steep, fragile slopes.

Fencing will be durable in differing weather conditions and reflect the surrounding natural environment. All wood will be treated. Fencing will be consistent with the requirements of City of Wanneroo.

Plate 19: Example of fencing used for stabilisation



Plate 19.1: Sand trapping on steep slopes



Plate 19.2: Sand trapping on mild slopes



Plate 19.3: Fencing along pathways



Plate 19.4: Strong fencing for safety

Plate 20: Typical Fence Detail (EPCAD)

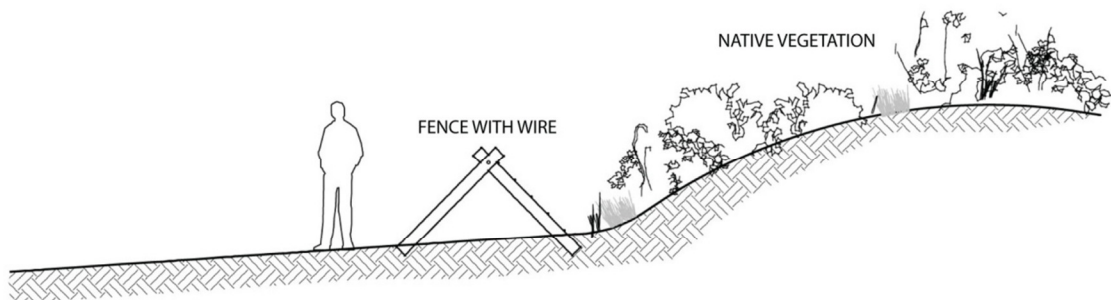


Plate 21: Typical Entry and Node Feature Fence (EPCAD)

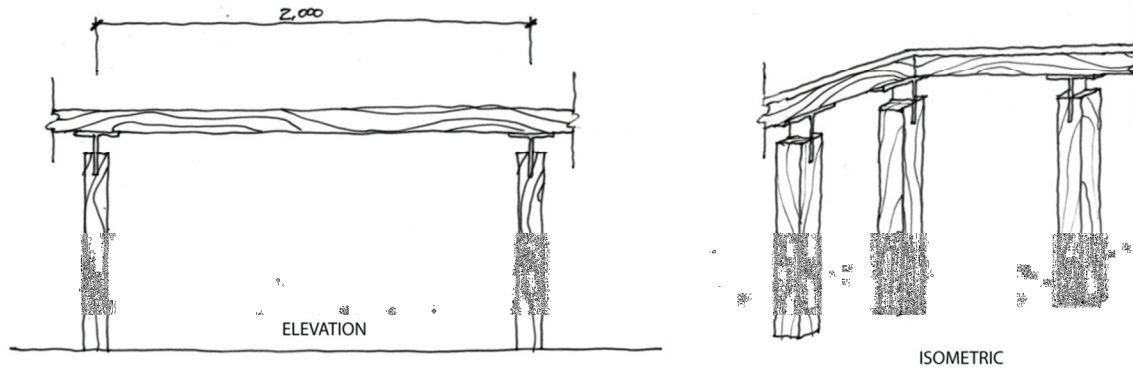
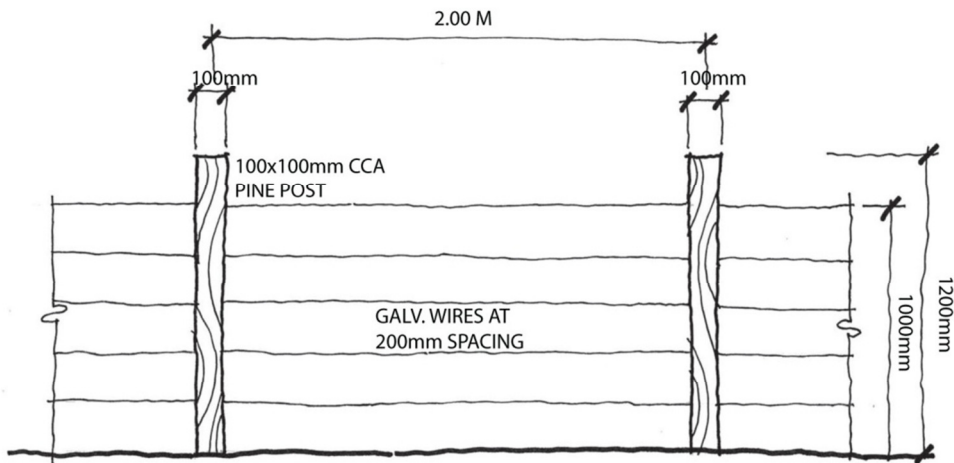


Plate 22: Typical Fence to Footpath Corridors and Reserve Boundary (EPCAD)



6.2.5 Signage

Signage can assist with dune stabilisation by educating beach users about the fragile nature of the foreshore. Signage will be used to:

- Direct pedestrians and vehicles to inform foreshore users on where they can park and walk;
- Inform pedestrians about the regulations associated with the restricted access to rehabilitation sites; and
- Interpret the reasoning behind the regulations and rehabilitation pertaining to the natural features of the site.

Signage will be designed for exposure to coastal weather conditions and reflect the surrounding natural environment. All signage will follow current City of Wanneroo specifications for design, placement and materials. Placement of and materials used for signage will be determined at the detailed design stage.

6.2.6 Stabilisation for degraded dunes

Stabilisation for degraded dunes is a temporary mechanism to halt sand movement that should be undertaken in conjunction with rehabilitation and revegetation efforts. Stabilisation methods (including mulch, matting, brushing fencing and sand trapping) will target areas that contain degraded vegetation (refer to **Figure 10**) and will be placed according to the environmental condition of the area. **Table 8** details the difference in stabilisation methods for degraded dunes. Visual examples are shown in **Plate 23**. Use of these stabilisation methods will minimise the scouring and movement of sand from strong coastal winds.

Plate 23: Examples of stabilisation methods



Table 8: Stabilisation methods for degraded dunes

Stabilisation Method	Description	Benefits	Constraints	Implementation
Brushing	Use of branches from native plants as ground cover. Ideal plants for brushing include those with tight stem arrangements such as <i>Melaleuca lanceolata</i> , <i>Acacia rostellifera</i> or <i>Banksia sessilis</i> .	<ul style="list-style-type: none"> › Biodegrades in the long term providing a natural mulch › Minimises erosion of sand › Provides a microclimate for seedlings › Can be applied to steep slopes › Can use stockpiled plant material from clearing of the Shorehaven development area 	<ul style="list-style-type: none"> › Can be labour intensive to lay brushing down › Potential to contain weed species and non-native plants › Can detract from visual amenity › Can be used for illegal fires › Increased fire risk 	<ul style="list-style-type: none"> › Brush should be laid with the stems facing to the prevailing wind, starting at the top of the dune › Successive layers of brush are to overlap the stem of the preceding rows
Fibre matting	Use of fibre matting to cover ground. Fibre matting is generally made from jute and coconut fibre.	<ul style="list-style-type: none"> › Biodegrades in the long term providing a natural mulch (2 years) › Suppresses weed growth › Moulds to the existing land formation › Minimises erosion of sand 	<ul style="list-style-type: none"> › Does not deter pedestrian access on the dunes › Can detract from visual amenity 	<ul style="list-style-type: none"> › Fibre matting will be fixed to slopes with metal or biodegradable fastener pins. › Matting can be cut to plant seedlings.
Coarse mulch	Use of coarsely shredded plant material.	<ul style="list-style-type: none"> › Provides moisture for seedlings › Can be used on steep slopes › Visually aesthetic 	<ul style="list-style-type: none"> › Potential to contain weed species and non-native plants › Can inhibit growth if applied too thickly 	<ul style="list-style-type: none"> › Course Mulch will be applied on gentle slopes at the appropriate thickness. Mulch will inhibit growth of revegetation if it is applied too thickly. Mulch will blow away if applied too thinly.
Sand trapping (discussed in Section 6.2.4)	Use of mesh on fence to trap sand	<ul style="list-style-type: none"> › Effective in minimising erosion of sand › Restricts pedestrian access 	<ul style="list-style-type: none"> › Should be used in conjunction with other stabilisation methods › High maintenance costs › Can detract from visual amenity 	<ul style="list-style-type: none"> › Fencing will use standard 90 mm diameter, 1.8 m long treated pine posts with a two to four line ring-lock mesh fence attached with galvanised staples › Posts will be installed into the ground to a depth of 90 cm, with the remaining 90cm above the ground. › A 6x6 mm aperture black Nylex mesh will then be attached to the windward facing side of the ringlock mesh fence using 'C-clips' or tie wires.

6.2.7 Stabilisation of the blowout

Stabilisation of the blowout will be undertaken in several stages during construction of the proposed Village Foreshore Park, with stabilisation and levelling of the surface being required prior to construction. At present the blow out is constantly expanding, deflating and moving in response to seasonally strong winds, with large volumes of sand being mobilised. For this reason the process of stabilisation of the blow out requires careful staging to prevent sand blowing during construction. **Figure 16** illustrates the staging sequence proposed for the stabilisation of the blowout.

The first step proposed (2.0 Closure) is to restrict the extent of influence of coastal winds (from the southwest and west) on the blowout through closing the opening to the beach. This will commence by moving sand from the northern ridgeline of the blowout down into the basin to block the mouth/inlet. The sand embankment will be supported by rock pitching on the ocean side and brushing to prevent sand blowing off the surface of the temporary bund.

Once the mouth/inlet of the blowout has been closed, the basic levels will be constructed across the area of the Village Foreshore Park grading up to the levels required for the Coastal Village Precinct (3.0 Basic grading). This grading will allow for the further sculpting of levels during the preliminary stages of development (4.0 Development) which will refine the levels to achieve final development levels across the blowout. This stage includes smoothing of levels on the landward side of the bund across the mouth of the blowout and placement of rock pitching to create a stable landform, as well as earthworks for construction of beach access roads and building platforms.

The revegetation and construction phase (5.0 Revegetation and Construction) will entail revegetation of eroded dunescape from the beach to the periphery of the Village Foreshore Park, allowing for finer grading and construction of the beach club. Revegetation of the final landforms abutting the beach club site will commence to prevent sand blowing during construction. The final stage (6.0 Completion) will complete the revegetation, construction and landscaping across the Village Foreshore Park.

The staging of the stabilisation of the blowout will require detailed design that is responsive to the size and volume of the blow out as well as to seasonal conditions. Given the highly mobile nature of the blowout, the stabilisation methods and staging to be undertaken may be adjusted accordingly.

6.2.8 Drainage

Effective management of drainage off pathways, car parks and roadsides is a critical factor in maintaining coastal infrastructure, protecting stabilised dunes and minimising erosion following construction. Water sensitive design measures for stormwater management have been developed in response to site conditions and, acknowledging the steep topography of the land adjoining the foreshore area, propose infiltration along drainage lines, the use of swale drainage and the capture of stormwater for irrigation purposes.

Without suitable provision for drainage, excess runoff from stormwater can lead to erosion along pathways. Erosion can also damage the structural integrity of pathways, car parks and roadways, adding to maintenance costs and safety risks. Measures to direct the flow of stormwater also assist with management of pollutant loads in stormwater.

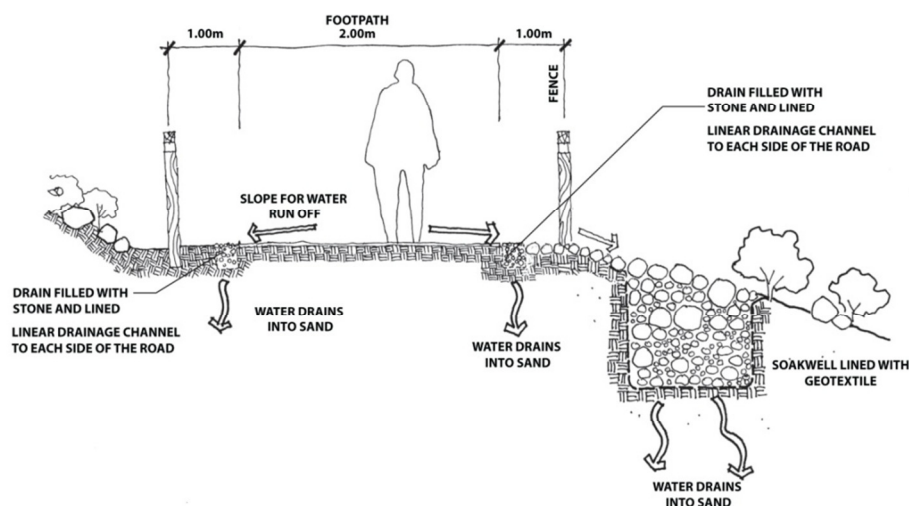
A number of drainage design elements will be used throughout the site based on principles including:

- The use of Water Sensitive Urban Design (WSUD) along pathways and roadsides to support local recharge, slow the flow of stormwater and manage the discharge;
- Use of swale drainage in areas of POS with the direction of drainage towards these areas to supplement irrigation of grassed areas; and
- Capture of stormwater and use of waterwise principles to reduce reliance on potable water for irrigation of open space areas.

Drainage management requirements within the foreshore reserve will be minimal due to the limited extent of impermeable and semi permeable surfacing proposed. Drainage treatment measures will be focused on paths, car parks and access located within the reserve.

Footpaths will be constructed of crushed limestone, which is semi permeable, therefore reducing/minimizing run off in small rain events. In large events run off will be directed into drainage channels running alongside the footpath (see **Plate 24**). These channels will be approximately 200mm wide and 400mm deep filled with single sized gravel and lined with geotextile. These will act as linear soak wells as well as providing erosion control to the edge of the path. In the event of very large run off event any excess water in the channels will be directed off the path into larger concrete lined soak wells at low points.

Plate 24: Primary Path Section with Drainage



At the Village Foreshore Park, the access road and car park will have a sealed asphalt surface and will therefore have 100% run off requiring appropriately sized drainage to match. The road drainage solution for the road and car park will similar to those used on footpaths but with larger sized drainage channels of approximately 400mm wide and 600mm deep combined with concrete lined soak wells to support local recharge.

Drainage across the broader foreshore area and adjacent POS will be designed on strict waterwise principles utilising the following measures:

- Use of sub surface irrigation where possible to minimise evaporation and wastage;
- Maximise use of passive irrigation including flush beams to road edges enabling water flow into grassed areas of POS and use of permeable paving within POS and road reserve areas;
- Underground cell systems beneath turf areas to retain sub surface moisture;
- Underground stormwater storage to supplement irrigation;
- Careful planning of planting and implementation focussing on wetter winter months to reduce irrigation volumes needed during establishment;
- Native plantings which require minimal establishment watering and no long term irrigation;
- Maximise use of dry planted un irrigated native tubestock planted during winter months;
- Minimal areas of turf installation;
- Use of agricultural polymers in soil mix to reduce water demand; and
- Use of enzyme based soil improvers to promote soil micro biotic health for increased establishment rates and reduce the need for longer establishment watering.

Drainage and stormwater runoff from the future residential development and commercial development will be located adjacent to the foreshore road (**Figure 18**) with a physical barrier provided by pathways between the stormwater basins and the seaward side of the foreshore.

Locating stormwater basins close to the development area addresses the issue of drainage and stormwater runoff in the foreshore identified in **Section 4.2**. The stormwater basins are designed for 1:100 year Inundation areas with the 1:1 year extent also shown in **Figure 18** however the actual locations and shapes of each inundation area will vary to optimise POS design. Runoff will be striped of nutrients to minimise any negative impacts of pollutants on the environment.

Plate 25: Drainage and Erosion examples





Plate 25.3



Plate 25.4

6.3 Rehabilitation

The vegetation of coastal areas of the Swan Coastal Plain plays an important role in dune stabilisation however it can be readily disturbed by human activities and natural processes (such as strong winds). The native vegetation present within the subject site is suited to the harsh conditions within the foreshore. The variety of plant communities shown in **Figure 9** demonstrates the diversity of plants along this section of coastline.

Rehabilitation will be undertaken within the foreshore to maintain dune stability and contribute to the diversity of vegetation (see **Figure 19**). The WAPC (2003b) define rehabilitation as:

‘Rehabilitation is the restoration, repair or stabilisation of a degraded system to as natural a state as possible’

Rehabilitation techniques proposed for the foreshore reserve are track rationalisation, dune blow stabilisation, weed control and revegetation. Stabilisation will be one of the main mechanisms for rehabilitation methods (discussed in **Section 6.2**).

It is anticipated that the rehabilitation of the foreshore will be undertaken in three major stages that align with the staged development of commercial and residential uses at Shorehaven, to minimise any disturbance to rehabilitation from uncontrolled access and also limit sand blowing. Detailed rehabilitation plans will be prepared for each stage, with flexibility to adjust to any revision of staging for construction.

6.3.1 Timing

Rehabilitation will be staged to occur at the appropriate time of year to ensure successful establishment of revegetation. The Mediterranean climate provides challenging conditions for revegetation. Therefore, revegetation when there has been sufficient rainfall to ensure that the soil profile is wet and stable enough to facilitate growth of the seedlings. The WAPC (2003b) advise that rehabilitation should be undertaken between April and September (preferably from May to June depending on the annual rainfall patterns).

6.3.2 Revegetation

Revegetation is effective in stabilising dunes, as the roots of the plants create a natural stabiliser in the sand. Native plants are well adapted to the coastal environment and can survive on little water and nutrients. A number of coastal plant species have a strong network of roots which grow leaves along numerous nodes (i.e. *Spinifex*). These plants act as a natural stabiliser for the dunes and provide habitat for local fauna species.

Revegetation will target areas of vegetation which are currently classed as degraded (**Figure 10**) as well as tracks to be rationalised, batter slopes and any areas disturbed or restored construction.

Provision of irrigation will support establishment of grassed areas for active recreation. Irrigation will comply with CoW requirements. The strategy for irrigation will be to minimize water use by restricting grass areas to the core activity area, drip irrigation to all permanent planting that is not dune rehab planting (no irrigation there). Other measures for irrigation include the use of passive irrigation integrated with drainage management wherever possible; and through the use of species that are site suitable low water demand (such as the coastal species currently going on site).

For the purposes of management, the foreshore has been divided into 9 management areas depending on the flora species present, the plant communities and the physical conditions affecting the site (e.g. aspect, wind direction and dune instability) detailed in **Figure 11**.

The management zones include:

1. The Blowout;
2. Batter Slopes;
3. Degraded Tracks;
4. Coastal Heath – LmMs;
5. Primary Dune Ridgeline – LmMsOa;
6. Patch of Acacia – AgSg;
7. Primary Foredune – ScOaAg;
8. Mobile Foredune – ShTd;
9. Acacia Shrubland – ArEt.

Management of each zone is discussed in **Section 6.7**.

Revegetation will reflect the existing plant communities within the localised area and the density of revegetation will be based on vegetation condition. Revegetation of the subject site aims to:

- Rehabilitate, maintain and enhance the natural biodiversity;
- Contribute to stability of the landform;
- Contribute to the natural amenity;
- Provide habitat and food for native fauna species; and
- Contribute to the nutrient cycle of the area.

Revegetation will utilise local native plant species, which are adapted to the coastal environment and require minimal watering, fertiliser and soil preparation. The key methods for planting and establishment will be direct seedling, transplants and nursery-raised seedlings (tubestock). Given the variety of plant communities (**Figure 9**) over the subject site the following list has been developed to detail plant species for suitable propagation.

Table 9 provides details of suitable revegetation species and quantities for each management zone. These numbers are indicative and will be refined at a later stage.

Prior to revegetation, stabilisation will be undertaken to minimise erosion, maintain nutrient quality in the soil and maintain moisture content. Stabilisation methods that are suitable for minimising erosion are detailed in **Section 6.2.6**.

Revegetation will be undertaken in the wetter winter months to reduce the demand for irrigation and to maximise water savings. Revegetation will maximise the use of dry planted un-irrigated native tubestock planted during winter. Tree Guards will be used where required to protect exposed tubestock. Revegetation areas that require reticulation will utilise low water use irrigation systems. Sub surface irrigation will be used where possible to minimise evaporation and wastage.

Revegetation methods for areas that require limited revegetation

Some areas of the foreshore require limited revegetation as vegetation is currently in 'Excellent', 'Excellent-Very Good' and 'Very Good' condition. These areas make up over **48%** of the site (refer to **Figure 10**) and will be fenced off to avoid further disturbance. Revegetation may be required in small pockets of these areas which will be revegetated with plants associated with the relevant plant community at a rate of approximately 2000 seedlings per hectare or 2 seedlings every 10 square metres.

Revegetation methods for areas that require moderate revegetation

A number of small areas throughout the foreshore require a moderate amount of revegetation. Across the site areas currently in 'Very Good-Good', 'Good' and 'Good-Degraded' condition, cover approximately **26%** of the site (refer to **Figure 10**). These areas will be revegetated at a rate of 4000 seedling per hectare or 4 seedlings every 10 square metres. Plant species used will be associated with the relevant plant community for the area. Revegetation will take into consideration the localised condition of the area as some areas may require less or more revegetation.

Revegetation methods for areas that require considerable revegetation

The remainder of the site requires considerable revegetation as these areas are currently in 'Degraded' or 'Completely Degraded' condition. These areas cover approximately **26%** of the site (refer to **Figure 10**) and will be revegetated at a rate of 10000 seedlings per hectare or 1 seedling per square metre. Plant species used will be associated with the relevant plant community for the area. Revegetation will take into consideration the localised condition of the area as some areas may require less or more revegetation. This area does not include any revegetation or landscaping undertaken within the blow out.

Given the variety of plant communities (**Figure 9**) over the subject site the following list has been developed to detail plant species for suitable propagation.

Table 9: Revegetation Species

Species Name	Vegetation Communities								Indicative Numbers
	Batters	Blowout	Coastal Heath	Primary Dune Ridgeline	Patch of Acacia	Primary Foredune	Mobile Foredune	Acacia Shrubland	
<i>Acacia cochlearis</i>	X	X	X		X				827
<i>Acacia lasiocarpa</i>		X	X						2459
<i>Acacia rostellifera</i>	X	X		X				X	2789
<i>Acacia saligna</i>					X				26
<i>Acacia truncate</i>						X			3451
<i>Acanthocarpus preissii</i>					X			X	7
<i>Anigozanthos flavescens</i>		X							0
<i>Anigozanthos manglessii</i>		X							0
<i>Atriplex Isatidea*</i>	X	X	X			X			2053
<i>Carpobrotus vierascens</i>						X			1725
<i>Conostylis candicans</i>	X	X	X		X	X			2552
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>			X	X	X			X	4325
<i>Eremophila nivea</i>	X	X							0
<i>Hardenbergia comptoniana</i>		X	X		X			X	1646
<i>Kennedia coccinea</i>		X							0
<i>Kennedia prostrata</i>	X	X	X						1311
<i>Lepidosperma gladiatum*</i>	X	X		X		X			2655
<i>Leucophyta brownie*</i>	X	X				X			3451
<i>Melaleuca systema</i>			X	X	X			X	6080

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Species Name	Vegetation Communities								Indicative Numbers
	Batters	Blowout	Coastal Heath	Primary Dune Ridgeline	Patch of Acacia	Primary Fore-dune	Mobile Fore-dune	Acacia Shrubland	
<i>Myoporium insulare</i>				X				X	558
<i>Olearia axillaris*</i>	X	X	X	X	X	X		X	9587
<i>Phyllanthus calycinus</i>				X				X	930
<i>Rhagodia baccata</i>			X	X	X			X	3629
<i>Santalum accuminatum</i>				X					372
<i>Scaevola crassifolia</i>	X	X	X	X	X	X			9477
<i>Scaevola nitida</i>				X					1859
<i>Spinifex hirsutus*</i>	X	X					X		801
<i>Spinifex longifolia*</i>	X	X			X	X	X		3213
<i>Spryidium globulosum</i>				X	X	X		X	6132
<i>Threlkeldia diffusa</i>								X	
<i>Xanthorrhoea preissii.*</i>		X							0
								TOTAL	71616

*These species complement the colour palate discussed in **Section 6.7.1**

6.3.3 Vegetation Salvaging

Salvaging of vegetation throughout the entire Shorehaven Development site will assist in the revegetation of the foreshore. Before construction Peet will salvage the site's grass trees (*Xanthorrhoea preissii*) and zamia palms (*Zamiaceae*) for use in landscaping after development. Brushing has been stockpiled during clearing of the development area for use during rehabilitation of the foreshore, and in particular for use during stabilisation of the blow out. Collection of seeds, brushing and plant clippings from the site for use in landscaping, dune stabilisation and revegetation will be undertaken before construction.

6.3.4 Seed Collection

Seed collection has been identified as an opportunity to assist revegetation works. Seed collection across the foreshore will assist in the propagation of native vegetation for revegetation purposes. Whether seed collection will be undertaken is to be determined at a later stage.

6.3.5 Tubestock, Direct Seeding and Tree Guards

For each management zone a specific list of tubestock has been compiled along with specific planting densities, determined by information collected during the flora and vegetation survey. Tubestock will be in the form of either forestry tubes (50x50x120mm) or squat pots (70x70x100mm). No cell trays will be used within the foreshore, as the seedlings are too small to survive.

Peet's nursery Ngulla Community Nursery will supply the tubestock where possible for the foreshore revegetation. Should seed collection be undertaken prior to construction of the foreshore, direct seeding should occur in spring to provide adequate rainfall for the seeds to establish.

Once the tubestock are planted, tree guards will be installed around the tubestock within the blowout management area and along the public interface. Tree guards will increase the survival rate of tubestock by protecting plants from wind, salt damage and predation from animals such as rabbits and kangaroos. At present 20,000 tree guards have been ordered for the foreshore revegetation. The placement of these tree guards will be subject to the detailed revegetation plans for each stage.

6.4 Fauna

Rehabilitation will incorporate the conservation and ongoing protection of native fauna species found within the foreshore reserve. A number of stabilisation methods could create obstructions or damage suitable habitat for the existing fauna found on site. One function of the foreshore reserve is to maintain high quality vegetation and species diversity for native fauna species and to restrict any negative impacts of feral or domestic animals.

The following measures will be undertaken to minimise any negative impact on fauna during stabilisation, rehabilitation and ongoing use of the foreshore:

- Use of appropriately designed culverts under roads to allow for movement of ground dwelling species within the foreshore area and along the east-west green corridor
- Identifying nests and burrows when stabilisation and rehabilitation is undertaken;
- Retaining and enhancing vegetation condition and plant diversity through revegetation and minimising plant stress;
- Controlling numbers of feral animals (particularly rabbits and feral cats). This can be achieved through strategic trapping and baiting programs; and

- Monitoring the revegetation efforts to identify any disturbance from introduced species particularly rabbits. Should the monitoring program identify disturbance from introduced species, ongoing pest management will be undertaken.

Dogs will be restricted within the foreshore to a specific 'dog beach' the northern section of the foreshore reserve, where there is provision for unrestrained exercise for dogs. Unrestrained dogs can have an impact on the native fauna and flora and disturb other recreational users. Methods to control dog access in the foreshore include:

- Installation of signage indicating to dog owners restricted access areas and where the 'dog beach' is located; and
- Installation of facilities for the removal of dog faeces. The removal of faeces by dog owners is a requirement under council by-laws.

6.5 Plant Disease Management

6.5.1 *Phytophthora cinnamomi* – Dieback

The plant disease *Phytophthora cinnamomi* is most commonly known as "Dieback". *Phytophthora* is a water mould that was introduced to Western Australia shortly after European settlement. Dieback spends its entire life within the soil and plant tissue, it attacks the roots of plants and causes them to rot, thus starving the plant of nutrients and water necessary for survival. It is generally confined to areas which receive above 600mm of rainfall annually. Over 40% of native Western Australian plant species are susceptible to dieback (Kilgour 2009).

Due to the site's well drained and alkaline soils, it is unlikely that this pathogen is present. However management measures against *P. cinnamomi* are advisable to reduce the risk of infestation. These management mechanisms are also useful in restricting the introduction of weeds and other diseases. The following management actions will be implemented within the foreshore reserve to minimise infestation of *P. cinnamomi*:

- Vehicles, tools, equipment and machinery should be free of all mud and soil on entry and exit from the foreshore. This can be achieved through the use of high pressure cleaners, stiff brushes, use of disinfectant or Phytoclean (a fungicide) and collection of the residual soil;
- Ensure that additional offsite soil, gravel or sand required for construction and rehabilitation is free of *P. cinnamomi* by selecting appropriate providers and discussing concerns with each provider;
- Minimise construction activity when soil or sand is either wet or muddy; and
- Ensure that vehicle tracks are well drained.

P. cinnamomi management procedures will be in accordance with the Dieback Management Provisions of the North Alkimos Construction Environmental Management Plan (refer to Section 3.2.6, page 18, ENV 2009a) and the Dieback Management Objectives of the Shorehaven Environmental Management Plan (refer to Section 9.1, page 19, ENV 2009b).

6.5.2 *Armillaria luteobubalina* – Honey Fungus

The plant disease *Armillaria luteobubalina* is most commonly known as “Honey Fungus”. Similar to *P. cinnamomi*, *A. luteobubalina* is a fungus that causes root rot. The preferred soil conditions for *A. luteobubalina* are largely unknown. *A. luteobubalina* is commonly found in *Eucalyptus marginata* forests.

Due to the undefined soil type preference it is possible that this pathogen could occur anywhere along the foreshore. At present there is no known cure for the disease. The following management objectives will be implemented within the foreshore reserve to minimise infestation of *A. luteobubalina*:

- Minimising potential spread of infected plant material during any dune stabilisation operations and other earthmoving activities;
- Reducing plant stress to enable plants to resist and combat a potential fungal attack by *A. luteobubalina*. Reducing plant stress can be achieved by:
 - Creating a microclimate for seedlings that provides shelter from wind stress and sand blasting. This can be achieved through use of brushing, mulch or tree guards;
 - Providing fertiliser and reticulation for seedlings; and
 - Managing weed infestation to prevent competition with seedlings.

6.5.3 *Zythiostroma* - Aerial Canker

Zythiostroma is a genus of canker fungus known as Aerial Canker or Gall. At present there is no known mechanism to control the spread and infestation of Aerial Canker. The best method to control the infestation of Aerial Canker is to remove any infected species and reduce plant stress to enable plants to resist and combat any infection.

6.6 Monitoring of Stabilisation and Rehabilitation

6.6.1 Monitoring, Maintenance and Reporting

The purpose of monitoring is to provide regular reporting on the outcomes of rehabilitation and stabilisation works at Alkimos and to adjust the way in which the rehabilitation is undertaken if the current management measures are unsuccessful or require additional effort.

Monitoring of drainage, pathways, steps and fencing will be undertaken in conjunction with vegetation monitoring. This will identify any damage or degradation to these facilities and identify appropriate maintenance requirements to the foreshore.

Vegetation monitoring will involve establishing monitoring quadrats within the foreshore to adequately monitor the rehabilitation area. From extensive revegetation work undertaken by ALCOA on bauxite mine rehabilitation it was concluded that to provide adequate data on rehabilitation success, 3 to 5% of the total area must be sampled. Less than 3% provides too little data, while over 5% provides too much (Grant 2006). Therefore monitoring quadrats will be set up within each management zone to cover approximately 4% of the total area within each management area. In addition to monitoring quadrats within the rehabilitation area, control-monitoring pilots will be established within surrounding undisturbed/natural coastal vegetation (i.e. Excellent Condition vegetation) to provide a mechanism for comparison.

Monitoring quadrats will be established before rehabilitation works begin so initial baseline data can be recorded. The number of the monitoring quadrats within each management zone will be dependent on the area of that management zone and will cover 4% of the area to provide adequate

data. All quadrats must be the same dimensions so that comparison between plots and across data can be made. 5 x 5m monitoring plots will be used within all management zones except in Batter Slopes. Batter Slopes will not have monitoring plots installed, as each area is too small. Specific monitoring will have to be undertaken within these zones, which will include a visual inspection and a visual representation (e.g. photograph).

Once the quadrats have been established the following data will be recorded for each plot:

- Quadrat Number;
- Name of Management Zone;
- Dimensions of the plot as determined by the area of the management zone;
- Visual representation e.g. photo, from a set point;
- List all vascular plants present;
- Number of individuals of each native plant species;
- Number of individuals of each exotic plant species;
- After tubestock have been planted, record species and number of tubestock; and
- After seed have been sown, record species and densities sown.

The quadrats should be established before rehabilitation work begins and the initial data recorded. Monitoring should be undertaken every year for at least 3 years following establishment of revegetation. The information gathered from the monitoring will indicate the success of the current practices and the most successful methods of rehabilitation. Monitoring is required to determine if the completion criteria is fulfilled and if extra work is required. It will provide a depth of information to future stage to assist in the planning of rehabilitation.

6.6.2 Completion Criteria

At the end of the monitoring period inspection will check that the following completion criteria have been met:

- Tubestock are healthy in appearance, diverse with no mass losses or species dominance;
- The average seedling height has increased between assessments;
- More than 75% of tubestock (from original and replacement plants) plants are alive;
- Weed presence is minimal and not inhibiting native plant survival and growth;
- Wind break fencing is intact and functioning appropriately; and
- Brushing is intact and functioning appropriately.

These expectations are for outcomes following a period of normal weather conditions and limited access to the site. Access should be controlled to minimise human disturbance to the revegetation. Control of access is detail in **Section 6** of the Alkimos FMP. In addition to these access constraints, temporary signage will be erected around the rehabilitation area to alert the community of the rehabilitation works underway.

6.6.3 Ongoing Maintenance

Maintenance will need to address weed control, infill planting, the integrity of fencing, the integrity and functioning of brushing, and the integrity and functioning of jute matting. A maintenance budget will be provided to meet completion criteria.

6.7 Specifications for stabilisation and rehabilitation

This section specifies the requirements for the revegetation and management of the Alkimos foreshore at Shorehaven. It covers weed control, dune stabilisation, tubestock planting, and monitoring maintenance and reporting requirements. This section refers to previous sections of the Rehabilitation and Stabilisation Plan and will guide the staged stabilisation and rehabilitation plans.

The foreshore revegetation, rehabilitation and stabilisation will be staged and undertaken in coordination with the staged development of the Shorehaven Coastal Precinct.

For the purposes of management, the foreshore has been divided into 7 management areas depending on the flora species present, the plant communities and the physical conditions affecting the site (e.g. aspect, wind direction and dune instability) detailed in **Figure 19**. These management areas were determined from analysis of the site investigations. All flora species (exotic and native) were recorded; vegetation communities were determined and mapped, human disturbance was noted and areas of extreme instability caused by loss of vegetation and wind erosion (the blowout) were also mapped.

From the site investigations the following management areas were devised:

1. The Blowout;
2. Batter Slopes;
3. Degraded Tracks.
4. Coastal Heath – LmMs;
5. Primary Dune Ridgeline – LmMsOa;
6. Patch of Acacia – AgSg;
7. Primary Foredune – ScOaAg;
8. Mobile Foredune – ShTd;
9. Acacia Shrubland – ArEt;

These eight management zones have different native flora, different introduced species and infestation levels and are impacted by differing levels of disturbance from human and environmental sources (e.g. erosion). For this reason each management zone will be dealt with individually and specific management actions have been formulated for each zone.

6.7.1 The Blowout

The blowout is currently (May 2010) around 38,170m² in area and highly mobile with an average movement of 82 cubic metres of sand per day. Erosion of the blowout was initiated by uncontrolled access by four wheel drive vehicles as the loss of vegetation altered the beach sand cycle, contributing to large scale sand mobilisation and deflation of the landform.

The blowout has been shaped by the summer afternoon sea breezes from the west and south west as well as by strong easterly winds. These have created a circular bowl shape open to the west and building in height to approximately 25mAHD along the north eastern lip (see **Figure 16**).

The site of the blowout is to be the focus of recreational facilities in the Village Foreshore Park. The blowout will require extensive stabilisation (discussed in **Section 6.2.7**) terracing and revegetation. As present the vegetation within the blowout is in “Completely Degraded” condition as the area is almost completely devoid of native species.

The majority of the blowout will form the hub of the Village Foreshore Park (**Figure 11**) and will be landscaped with plant species as highlighted in **Table 9**. A large central area within the Village

Foreshore Park will be turfed and given the high evaporation rate of the coastal climate, this turfed area is likely to require extensive irrigation. Drainage from the adjacent Coastal Village Precinct will supplement watering this area.

In order to develop the Village Foreshore Park, the sand around the inland margins of the blowout will be pushed into the deflated area, the area terraced and dunes either side of the opening to the ocean stabilised and revegetated (see further detail in **Section 6.2.7**).

Weed Control

Minimal weed control will be required in the blowout as the newly earth worked surface will be free of weeds. Only chemical control should be employed in the main body of the blowout due to the instability of the landform. Chemical control will allow the retention of the weed root system in situ, to maintain dune stability.

The weed species found in adjacent plant communities to be controlled within the blowout include:

- **Lagurus ovatus*;
- **Trachyandra divericata*;
- **Thinopyrum distichum*; and
- **Tetragonia divericata*.

The current weed concentration in the blowout is relatively low given the sparseness of vegetation. The chemical Glyphosate should be applied to any weeds they may establish in the blowout during construction. Weed control should be in accordance with **Section 6.1** of the Alkimos FMP.

Stabilisation

Stabilisation of the blowout will be in accordance with the staging and processes as described in **Section 6.2.7**. Additional stabilisation techniques will include the use of fencing, fibre matting and brushing. Detailed requirements for stabilisation methods of the blowout will be determined at the detailed design stage

Revegetation

- Revegetation will be undertaken at a rate of one (1) seedling per square metre. This density will be applied to the revegetation zone within the blowout.
- The rehabilitation of the remainder of the blowout will be subject to the stabilisation methods discussed in **Section 6.2.7**.
- Seeding will occur in conjunction with Stage 5 of the Foreshore Erosion Treatment Staging Plan.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.
- The following plant species will be used for revegetation and landscaping within the blowout:
 - *Acacia cochlearis*;
 - *Acacia lasiocarpa*
 - *Acacia rostellifera*
 - *Anigozanthos flavescens*
 - *Anigozanthos manglesii*
 - *Atriplex Isatidea**
 - *Conostylis candicans*
 - *Eremophila nivea*
 - *Hardenbergia comptoniana*
 - *Kennedia coccinea*
 - *Kennedia prostrata*

- *Lepidosperma gladiatum**
- *Leucophyta brownie**
- *Olearia axillaris**
- *Scaevola crassifolia*
- *Spinifex hirsutus**
- *Spinifex longifolia**
- *Xanthorrhoea preissii*.*

As the blowout will be mainly used for the Village Foreshore Park, the entire blowout will be reshaped, with some areas also being landscaped and the remaining areas (particularly along dunal ridges) will be revegetated. Detailed landscaping of the Village Foreshore Park (located within the blow out) will be subject to further more detailed design.

Revegetation within the blowout aims to reflect both the local vegetation communities and the colour palate utilised within the building materials for the commercial and residential precinct at Shorehaven. The colour palate used within the foreshore (detailed on Page 10 of the Building Design Guidelines, Peet 2010) aims to reflect the natural colours within the foreshore. Abrasive colours such as black, bright orange or red (other than on signage) are prohibited where as more natural colours such as surf mist, greys and sandy colours are encouraged. The species highlighted with an asterisk (*) in the plant species list will contribute to the colour palate of the surrounding buildings as well as provide some natural colours through flowers.

6.7.2 Batter Slopes

Batter slopes and areas disturbed by construction includes areas where construction (either for the development, pathways, fences etc.) has significantly disturbed the natural vegetation and landforms. The revegetation of batter slopes and disturbed areas will minimise any further erosion and stabilise the dune formation, preventing the movement of sand.

Batters will be developed alongside the foreshore road where dunes have been cut to provide a level road surface. In most cases batters will achieve a 1 in 3 gradient, with batters no steeper than a 1 in 2 slope without rock stabilisation. Batter slopes will aim to be irregular in appearance to reflect the natural landform and avoid any artificial looking landscape. It is required that batters and areas disturbed by construction are promptly stabilised (see methods discussed in **Section 6.2.6**) and revegetated after disturbance to minimise sand blowing and any further erosion. **Section 6.2.6** also provides details of the typical sections for batters at gradients 1:1, 1:3 and 1:6.

Typical Section for 1:1 Cut Batter

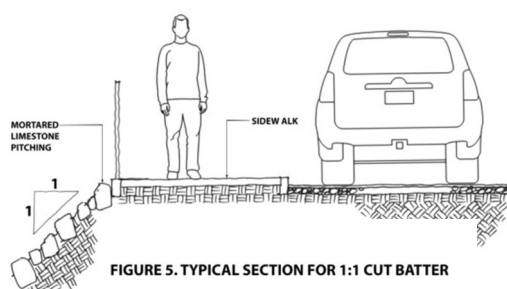
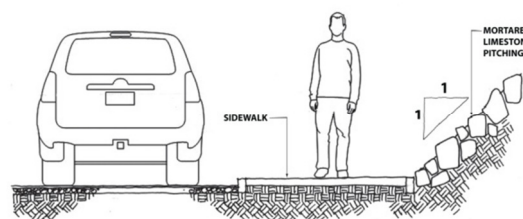
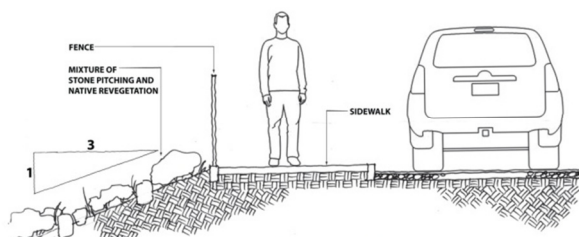


FIGURE 5. TYPICAL SECTION FOR 1:1 CUT BATTER

Typical Section for 1:1 Fill Batter



Typical Section for 1:3 Cut Batter



Typical Section 1:3 Fill Batter

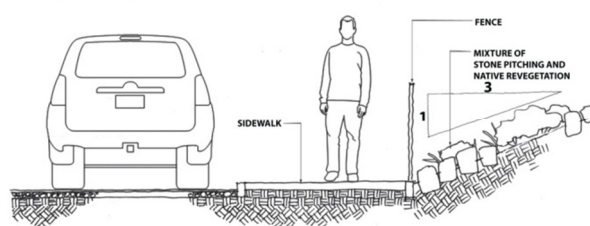
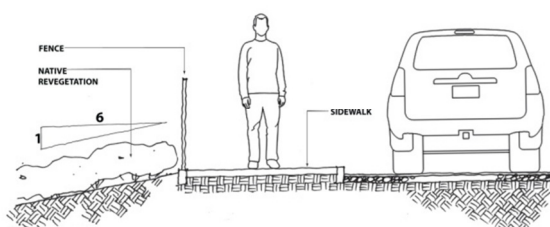
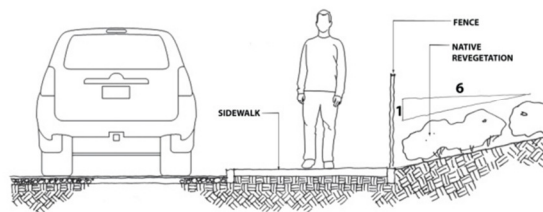


Plate 26: Typical Sections for Batters (EPCAD)

Typical Section 1:6 Cut Batter



Typical Section for 1:6 Fill Batter



Weed Control

No weed control is required on the batter slopes as the newly earthworked surface will be free of weeds. Weed monitoring will be undertaken during the monitoring period to guarantee weeds have not been introduced on batters.

Stabilisation

Different stabilisation mechanisms will be used on the different batter ratios. A 1:1 Cut/Fill Batter will require stabilisation with limestone blocks. Any batters with a ratio between 1:2 and 1:4 will require fibre matting for stabilisation. Batters at a 1:5 or 1:6 ratio will require brushing or coarse mulch for stabilisation. Detailed requirements for stabilisation methods of batters across the foreshore will be determined at the detailed design stage.

Revegetation

- Batter slopes and areas will be revegetated with seedlings (tubestock) at a rate of one (1) plant per square metre.
- Planting will be coordinated and staged to follow construction of roads along the foreshore. Revegetation and stabilisation of these batters will be undertaken immediately to minimise any erosion of exposed sand.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.
- Batter slopes will require watering from the road to hasten plant growth and provide stability to the slope. The batter slopes adjacent to the road will provide the interface between the foreshore and the development area and need to be visually less intrusive and well vegetated.

- The following plant species will be used for batter slopes:
 - *Acacia cochlearis*
 - *Acacia rostellifera*
 - *Atriplex Isatidea*
 - *Conostylis candidans*
 - *Eremophila nivea*
 - *Kennedia prostrata*
 - *Lepidosperma gladiatum*
 - *Leucophyta brownie*
 - *Olearia axillaris*
 - *Scaevola crassifolia*
 - *Spinifex hirsutus*
 - *Spinifex longifolia*

These species are native to the area and are adapted to survive the tough soil and climatic conditions. Revegetation along batters should also reflect the existing plant communities nearby where possible.

Due to the small size and instability of this management zone, no monitoring plots will be required. A visual inspection of the area is required to determine the species present and visual representation (photographs) from a fixed point is also required.

6.7.3 Degraded Tracks

Detailed assessment of the subject site determined that specific rehabilitation and stabilisation was required for degraded tracks. The aerial photography from 1969 shows the proliferation in tracks accompanying degradation of vegetation within the foreshore over the past 41 years. The greatest change has occurred over the past 10 years due to uncontrolled access within the foreshore reserve. The extent of degradation is such that some tracks are now substantially lower than the surrounding land surface (see **Plate 5**).

Impacts have generally been greatest around the foreshore adjoining the wreck of the Alkimos with large areas denuded in swales behind the foredunes, mobilisation of the large blowout and erosion of frontal dunes where access into the site from the beach has been popular. A predominantly north south network of tracks has resulted from this uncontrolled access. As a result a large area within the foreshore has been classed as being in “Completed Degraded” condition.

Weed Control

Minimal weed control will be required along degraded tracks as the disturbed surface will be free of weeds. Only chemical control should be employed along the degraded tracks due to the instability of the landform. Chemical control will allow the retention of the weed root system in situ, to maintain dune stability. The current weed concentration along degraded tracks is relatively low given the sparseness of vegetation. The chemical Glyphosate should be applied to any weeds that may establish during rehabilitation. Weed control should be conducted in accordance with **Section 6.1** and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation.

Stabilisation

Degraded tracks will require extensive stabilisation to restore the landform. Along some tracks and particularly along ridgelines, degradation has significantly lowered the level of tracks, in some places by up to several metres. Earthworks are required along the degraded tracks to restore the landform. Degraded tracks will be stabilised following restoration of levels primarily through brushing and matting. Management of uncontrolled access will be important to preserve the restoration effort.

Revegetation

- Revegetation will be undertaken at a rate of one (1) additional seedling per square metre. This density will be applied to all tracks to be closed off within the foreshore reserve.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.
- No seeding will be undertaken.
- Plant species used for revegetation will reflect the adjacent plant communities. These species are native to the area and are adapted to survive the tough soil and climatic conditions.

6.7.4 Coastal Heath – LmMs

The Coastal Heath area consists of plant community LmMs classed as:

LmMs – Low shrubland of *Lomandra maritima*, *Melaleuca systema*, *Acacia lasiocarpa*, *Lepidosperma pubisquamum*, *Desmocladius asper* and *Conostylis pauciflora* subsp. *Pauciflora/euryrhipis*;

This plant community is found behind the primary dune system in the northern and southern sections of the foreshore. The majority of the vegetation within this plant community is in Excellent condition with some small areas of Very Good-Good, Very Good, Good, Degraded and Completely Degraded condition vegetation. The specific management approach to the revegetation of plant community LmMs is as follows:

Weed Control

Both chemical and manual weed control will be undertaken within this management zone.

The Flora and Vegetation Survey determined that there were no weeds present in this plant community. Should any weeds be found during revegetation, weed control should be conducted in accordance with **Section 6.1** and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation. Unstable slopes within the LmMs that are only held together by weed species should be treated with chemical control only to prevent increased instability to the surface and the surface must be stabilised (e.g. with brushing or fibre matting) immediately after weed control.

Stabilisation

Stabilisation of the Coastal Heath will include brushing of the bare surface throughout the management zone (dependant on the supply available of brushing). Brushing should focus on areas of higher elevation where wind velocities cause the most erosion. Stabilisation within the Coastal Heath will be subject to the localised area in accordance with the guidelines provided in **Section 6.2.5**.

Revegetation

- Due to the vegetation condition rating within this area, this management zone will require limited revegetation, moderate revegetation and considerable revegetation. Refer to **Section 6.3.2** for the revegetation densities.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.

Table 10 lists the species to be planted and the percentages required.

Table 10: Tubestock to be planted in LmMs

Species Name	% of Plants
<i>Acacia cochlearis</i>	5
<i>Acacia lasiocarpa</i>	15
<i>Atriplex Isatidea</i>	2
<i>Conostylis candicans</i>	5
<i>Conostylis pauciflora</i> subsp. <i>Pauciflora</i>	15
<i>Hardenbergia comptoniana</i>	10
<i>Kennedia prostrata</i>	8
<i>Melaleuca systema</i>	20
<i>Olearia axillaris</i>	5
<i>Rhagodia baccata</i>	5
<i>Scaevola crassifolia</i>	10
TOTAL	100

These species are native to the area and are adapted to survive the tough soil and climatic conditions.

6.7.5 Primary Dune Ridgeline – LmMsOa

The Primary Dune Ridgeline area consists of plant community LmMsOa classed as:

LmMsOa – Shrubland of *Lomandra maritima*, *Melaleuca systema*, *Olearia axillaris*, *Scaevola nitida*, *Santalum acuminatum*, *Myoporum insulare* and *Acacia rostellifera* over *Rhagodia baccata*, *Phyllanthus calycinus*, *Conostylis pauciflora* subsp. *Pauciflora/euryrhipis* and **Lagurus ovatus*;

This plant community is in Very Good condition with some areas of Very Good- Good, Excellent and Completely Degraded condition vegetation. The specific management approach to the revegetation of plant community LmMsOa is as follows:

Weed Control

Both chemical and manual weed control will be undertaken within this management zone.

The weeds to be controlled within the primary dune ridgeline include:

- **Lagurus ovatus*

Appendix C suggests that Fusilade should be used to control *Lagurus ovatus* plus additional spray oil at 2-8 leaf stage before stem elongation. Weed control should be conducted in accordance with **Section 6.1** and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation. Unstable slopes within the primary dune ridgeline that are currently held together by weed species should be treated with chemical control only to prevent increased instability to the surface. The surface must be stabilised (e.g. with brushing or fibre matting) immediately after weed control.

Stabilisation

Stabilisation within the Primary Dune Ridgeline will be subject to the localised area in accordance with the guidelines provided in **Section 6.2.5**. The primary stabilisation method for the Primary Dune Ridgeline will be brushing.

Revegetation

- Due to the vegetation condition rating within this area, this management zone will require limited revegetation, moderate revegetation and considerable revegetation. Refer to **Section 6.3.2** (and **Figure 19**) for the revegetation densities.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area. This will utilise approximately 4500 tree guards.

Table 11 lists the species to be planted and the percentages required.

Table 11: Tubestock to be planted in LmMsOa

Species Name	% of Plants
<i>Acacia rostellifera</i>	15
<i>Conostylis pauciflora</i> subsp. <i>Pauciflora</i>	10
<i>Lepidosperma gladiatum</i>	5
<i>Melaleuca systema</i>	15
<i>Myoporum insulare</i>	3
<i>Olearia axillaris</i>	10
<i>Phyllanthus calycinus</i>	5
<i>Rhagodia baccata</i>	15
<i>Santalum accuminatum</i>	2
<i>Scaevola crassifolia</i>	5
<i>Scaevola nitida</i>	10
<i>Spryidium globulosum</i>	5
TOTAL	100

These species are native to the area and are adapted to survive the tough soil and climatic conditions.

6.7.6 Patch of Acacia – AsSg

The patch of Acacia area consists of plant community AsSg classed as:

AsSg – Patch of *Acacia saligna* over *Spyridium globulosum*, *Rhagodia baccata* and *Exocarpos sparteus* over *Melaleuca systema*, *Lomandra maritima* and *Poa porphyroclados*;

This plant community is located in a small patch behind the primary dune at the northern end of the foreshore. The majority of the vegetation within this plant community is in Good condition. The specific management approach to the revegetation of plant community AsSg is as follows:

Weed Control

Both chemical and manual weed control will be undertaken within this management zone.

The Flora and Vegetation Survey determined that there were no weeds present in this plant community. Should any weeds be found during revegetation, weed control should be conducted in accordance with **Section 6.1** and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation. Unstable slopes within the AsSg that are only held together by weed species should be treated with chemical control only to prevent increased instability to the surface and the surface must be stabilised (e.g. with brushing or fibre matting) immediately after weed control.

Stabilisation

Stabilisation within the patch of Acacia will be subject to the localised area in accordance with the guidelines provided in **Section 6.2.5**. Given the small size of this management zone it is unlikely that extensive stabilisation will be required. The primary stabilisation used in the patch of Acacia method will be brushing.

Revegetation

- Due to the vegetation condition rating within this area, this management zone will require moderate revegetation. Refer to Section 6.3.2 for the revegetation densities.
- No tree guards will be used within this management zone.

Table 12 lists the species to be planted and the percentages required.

Table 12: Tubestock to be planted in AsSg

Species Name	% of Plants
<i>Acacia cochlearis</i>	5
<i>Acacia saligna</i>	20
<i>Acanthocarpus preissii</i>	5
<i>Conostylis candicans</i>	5
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>	5
<i>Hardenbergia comptoniana</i>	5
<i>Melaleuca systema</i>	10
<i>Olearia axillaris</i>	5
<i>Rhagodia baccata</i>	15
<i>Scaevola crassifolia</i>	5
<i>Spyridium globulosum</i>	20
TOTAL	100

These species are native to the area and are adapted to survive the tough soil and climatic conditions.

6.7.7 Primary Fore dune – ScOaSg

The Primary Fore dune area consists of plant community ScOaSg classed as:

ScOaSg – Shrubland of *Scaevola crassifolia*, *Olearia axillaris*, *Spyridium globulosum* and *Acanthocarpus preissii* over *Acacia truncate*, *Lepidosperma gladiatum*, *Carpobrotus virescens*, **Tetragonia decumbens* and **Trachyandra divaricata*.

This plant community extends the length of the foreshore along steep foredunes. The majority of the vegetation within this plant community is in Very Good-Good condition with some areas of Very Good, Good, Excellent-Very Good and Completely Degraded condition vegetation. The specific management approach to the revegetation of plant community ScOaSg is as follows:

Weed Control

Both chemical and manual weed control will be undertaken within this management zone. The weeds to be controlled in primary fore dune include:

- *Tetragonia decumbens*; and
- *Trachyandra divaricata*.

Appendix C recommends that manual removal or foliar spray using Glyphosate is used to manage *Trachyandra divaricata*. *Tetragonia decumbens* should be removed manually.

Weed control should be conducted in accordance with **Section 6.1** and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation. Unstable slopes within the ScOaSg that are only held together by weed species should be treated with chemical control only to prevent increased instability to the surface and the surface must be stabilised (e.g. with brushing or fibre matting) immediately after weed control.

Stabilisation

Stabilisation within the Primary Fore-dune will be subject to the localised condition of the landform and undertaken in accordance with the guidelines provided in **Section 6.2.5**. The primary stabilisation within the Primary Fore-dune methods will be brushing and management of uncontrolled access.

Revegetation

- Due to the vegetation condition rating within this area, this management zone will require limited revegetation, moderate revegetation and considerable revegetation. Refer to **Section 6.3.2** for the revegetation densities.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.

Table 13 lists the species to be planted and the percentages required.

Table 13: Tubestock to be planted in ScOaSg

Species Name	% of Plants
<i>Acacia truncate</i>	10
<i>Atriplex Isatidea</i>	5
<i>Carpobrotus virescens</i>	5
<i>Conostylis candidans</i>	5
<i>Lepidosperma gladiatum</i>	5
<i>Leucophyta brownie</i>	10
<i>Olearia axillaris</i>	20
<i>Scaevola crassifolia</i>	20
<i>Spinifex longifolia</i>	5
<i>Spyridium globulosum</i>	15
TOTAL	100

These species are native to the area and are adapted to survive the tough soil and climatic conditions.

6.7.8 Mobile Fore-dune – ShTd

The Mobile Fore-dune area consists of plant community ShTd classed as:

ShTd – Mobile fore-dune of *Spinifex hirsutus*, *Spinifex longifolius*, **Thinopyrum distichum*, **Trachyandra divaricata* and **Tetragonia decumbens*

This plant community is in an area of fore-dune south of the blowout. The majority of the vegetation within this plant community is in Completely Degraded condition with some areas of Very Good-Good condition vegetation. The specific management approach to the revegetation of plant community ShTd is as follows:

Weed Control

Both chemical and manual weed control will be undertaken within this management zone.

The weeds to be controlled in ShTd include:

- *Tetragonia decumbens*;
- *Thinopyrum distichum*; and
- *Trachyandra divaricata*.

Appendix C recommends that manual removal or foliar spray using Glyphosate is used to manage *Trachyandra divaricata*. *Tetragonia decumbens* should be removed manually. *Thinopyrum distichum* should be managed with Fulisade at the 3-5 leaf stage.

Weed control should be conducted in accordance with Section 6.1 and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation. Unstable slopes within the ScOaSg that are only held together by weed species should be treated with chemical control only to prevent increased instability to the surface and the surface must be stabilised (e.g. with brushing or fibre matting) immediately after weed control.

Stabilisation

Stabilisation within the Mobile Foredune will be subject to the localised condition of the landform and undertaken in accordance with the guidelines provided in **Section 6.2.5**. As the Mobile Foredune contains steep slopes rising from the beach, the primary stabilisation method will be brushing.

Revegetation

- Due to the vegetation condition rating within this area, this management zone will require limited revegetation, moderate revegetation and considerable revegetation. Refer to **Section 6.3.2** for the revegetation densities.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.

Table 14 lists the species to be planted and the percentages required.

Table 14: Tubestock to be planted in ShTd

Species Name	% of Plants
<i>Spinifex longifolia</i>	65
<i>Spinifex hirsutus</i>	35
TOTAL	100

These species are native to the area and are adapted to survive the tough soil and climatic conditions.

6.7.9 Acacia Shrubland – ArEt

The Acacia Shrubland area consists of plant community ArEt classed as:

ArEt – Shrubland of *Acacia rostellifera* over *Acanthocarpus preissii*, *Rhagodia baccata*, **Euphorbia terracina*, **Ehrharta longiflora*, **Trachyandra divaricata*, **Sonchus oleraceus* and **Lupinus cosentinii*

This plant community is in Degraded condition with some areas of Very Good condition vegetation. The specific management approach to the revegetation of plant community ArEt is as follows:

Weed Control

Both chemical and manual weed control will be undertaken within this management zone.

The weeds to be controlled in ArEt include:

- *Euphorbia terracina*;
- *Ehrharta longiflora*
- *Trachyandra divaricata*;
- *Sonchus oleraceus*; and
- *Lupinus cosentinii*.

Appendix C recommends that foliar spray using Glyphosate is used to manage *Trachyandra divaricata* and *Ehrharta longiflora*. *Euphorbia terracina* and *Lupinus cosentinii* should be treated with Metsulfuron methyl. *Sonchus oleraceus* should be treated with Lontrel.

Weed control should be conducted in accordance with **Section 6.1** and be undertaken in a manner that avoids any further dune instability or disturbance to the remnant revegetation. Unstable slopes within the ArEt that are only held together by weed species should be treated with chemical control only to prevent increased instability to the surface and the surface must be stabilised (e.g. with brushing or fibre matting) immediately after weed control.

Stabilisation

Stabilisation within the Acacia Shrubland will be subject to the localised area in accordance with the guidelines provided in **Section 6.2.5**. As the Acacia shrubland appears relatively stable, the primary stabilisation method will be brushing.

Revegetation

- Due to the vegetation condition rating within this area, this management zone will require limited revegetation, moderate revegetation and considerable revegetation. Refer to **Section 6.3.2** for the revegetation densities.
- Tree guards will be used along the public interface to provide visual evidence for the community to recognise that revegetation is occurring in the area.

Table 15 lists the species to be planted and the percentages required.

Table 15: Tubestock to be planted in ArEt

Species Name	% of Plants
<i>Acacia rostellifera</i>	35
<i>Acanthocarpus preissii</i>	10
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>	2
<i>Hardenbergia comptoniana</i>	2
<i>Melaleuca systema</i>	10
<i>Myoporum insulare</i>	2
<i>Olearia axillaris</i>	5
<i>Phyllanthus calycinus</i>	7
<i>Rhagodia baccata</i>	15
<i>Spyridium globulosum</i>	10
<i>Threlkeldia diffusa</i>	2
TOTAL	

These species are native to the area and are adapted to survive the tough soil and climatic conditions.

7 Implementation Schedule

While **Section 5** and **Section 6** provide details of the foreshore design, stabilisation and rehabilitation, the effective implementation of these will be managed so as to minimise or avoid any disturbance or impact to the foreshore reserve. This Implementation Schedule is indicative as details of staging are to be confirmed and discussion with City of Wanneroo and relevant state agencies is required prior to finalising other details.

The Foreshore Management Plan (FMP) has been written specifically as a framework and guideline for future works within the 1.7 km stretch of coastline and 283,000m² foreshore reserve. The purpose of the plan is to outline the intended function of the foreshore reserve area and to provide a basis for all future development works in that area. However, because of its conceptual nature, the FMP cannot and does not include detailed, site specific designs, or life-cycle/asset management costings for the works it proposes (including restoration works, physical infrastructure and facilities). Whilst the proponent intends to undertake works in the foreshore area generally in accordance with the FMP, the plan itself does not constitute or guarantee development approval (where required) for those works. Equally, the plan is not intended to preclude consideration of additional or alternative works from being approved and constructed in future, where considered reasonable and appropriate by the proponent, the City and the WAPC.

The proponent acknowledges that many of the works proposed under the FMP may ultimately exist on Crown land under the management of the City. As such, those works will constitute ‘assets’ which the City may ultimately be responsible for maintaining for perpetuity, for the benefit of the community at large. The proponent therefore undertakes to provide (at the development application stage) detailed life-cycle/asset management costings for any works proposed for the foreshore that will ultimately be the responsibility of the City to manage. On the basis of those costings, some of the works proposed may or may not be approved. Alternatively, subject to agreement between the parties, prior to the City accepting handover of any reserved land upon which works are proposed, then approved or constructed, the City may (having regard to the life-cycle/asset management costings of those works) require such works to be removed or modified to its satisfaction.

Notwithstanding the above and whilst it is the City’s current intention to maintain all approved future rehabilitated and delivered assets located in the foreshore reserve, it is without prejudice to any negotiations the City may have with the State regarding future maintenance, obligations and land tenure.

Table 16 provides a summary of the main objectives of this FMP, the actions proposed to achieve these and the authority or body who will be responsible for these actions.

7.1 Planting of Tubestock for Revegetation

The successful implementation of the Revegetation Works Specification (to be developed following discussion with City of Wanneroo) requires adequate tubestock from a local provenance source. The Revegetation Works Specification will detail the tubestock required for each management zone. Tubestock will be purchased from Peet's Ngulla Community Nursery where possible or from a NIASA (Nursery Industry Accreditation Scheme Australia) accredited nursery. Tubestock will be ordered for planting in 2012 wet season. As discussed in **Section 6.3.2** seed collection, brushing and vegetation salvaging may be undertaken prior to development. This will be coordinated with the implementation of the Revegetation Works Specification.

This will commence in 2012 and continue for the life of the project to ensure the ongoing availability of the necessary seed and tubestock supplies.

7.2 Works and Construction Schedule

Construction of the Village Foreshore Park and remaining infrastructure of the foreshore will be undertaken in coordination with the staged development of the Coastal Village Precinct. Works within the blow out will follow a Staging Plan as illustrated in **Figure 16**. It is expected that Stage 5 will be completed in mid-2012 with the completion of the Village Foreshore Park expected in mid-2013. Additional building within the Club Lot will be constructed at a later stage.

Monitoring of the revegetation and stabilisation methods (including any infrastructure) will be carried out on a regular basis. This will occur throughout the lifetime of the project and be extended for an additional 3 years following the project's completion. Any maintenance issues will be addressed by the developer within this timeframe and will receive the appropriate level of either maintenance or repair, and will be in accordance with similar provisions for other areas of Public Open Space.

7.3 Stabilisation and Rehabilitation Schedule

Stabilisation and rehabilitation of the foreshore will be undertaken during the staged construction of the Coastal Village Precinct and residential lots. The stabilisation and rehabilitation program is anticipated to commence in 2012 with further staging to coincide with the development of the adjoining residential areas (see **Figure 17**). A Restoration and Revegetation Works Specification will be prepared and implemented to guide the different stages of the foreshore's rehabilitation and restoration.

Successful stabilisation and rehabilitation will be largely dependent on the seasonal variations. Planting of seedlings will be undertaken between May and June, depending on rainfall. Earthworks and brushing can be undertaken throughout the year.

Fire management techniques will be employed during the stabilisation and revegetation process. This management will include minimising fuel loads and implementing a low fuel area around buildings and public facilities. Management of bushfire safety is important for the foreshore reserve particularly in areas where brushing has been used to stabilise the landform.

The Restoration and Revegetation Works Specification will include guidance and protocols for the appropriate management of any Aboriginal artefacts or sites which may be found during the works, as required by the Aboriginal Heritage Act (1972).

Weed control will be undertaken, where required, usually in autumn and spring during the rehabilitation program. Weeds should be sprayed with Glyphosate. **Appendix C** details specific management and control methods for the weeds listed as occurring within the site.

From the initial rehabilitation budget, 20% will be set aside for maintenance of the project including repair of brush cover, fencing and replacement of seedlings/reseeding over the maintenance period.

Ongoing monitoring of the stabilisation and rehabilitation will occur throughout the lifetime of the project and will continue to be provided by Peet for an additional 3 years until handover to City of Wanneroo. This monitoring will occur on annual basis by an experienced botanist or rehabilitation professional. An annual report will be provided to the City of Wanneroo detailing the extent of maintenance or remedial actions required. Any maintenance issues identified during this time will be addressed.

Details of management actions and the responsibility for these are provided below in **Table 16**.

Table 16: Implementation schedule

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
Legislation and Policy Context					
Comply with the purpose of the reserve under the MRS	› Reflect the objectives of the Parks and Recreation Reserve under the MRS	› Preparation of a detailed FMP that reflects these objectives	FMP approved by WAPC 2011	Peet and Cardno	› N/A
Comply with objectives of the Alkimos Eglinton District Structure Plan (DSP)	› Reflect the objectives of the DSP and associated Coastal Strategy (RPS Bowman Bishaw Gorham 2006)	› Preparation of a detailed FMP that reflects these objectives	FMP approved by WAPC 2011	Peet and Cardno Consultation with CoW and WAPC	› N/A
Comply with objectives of the North Alkimos Local Structure Plan (LSP)	› Reflect the objectives of the LSP and associated Sustainability Strategies (GHD 2006) and LWMS.	› Preparation of a detailed FMP that reflects these objectives	FMP approved by WAPC 2011	Peet, Cardno and TBB; consultation with CoW and WAPC	› N/A
Comply with the conditions set by the Ministerial Statement 722	› Include the conditions set by the Ministerial Statement within the FMP	› Preparation of a detailed FMP that reflects these conditions	FMP approved by WAPC 2011	Peet and Cardno	› N/A
Comply with the requirements of the State Coastal Policy, SPP 2.6	› Implement horizontal setback line as per the existing Parks and Recreation reserve and as determined by Rogers (2010)	› Provide a foreshore road to define the boundary between the foreshore reserve and the development area › Restrict development to the eastern side of the Coastal Processes Setback line (Rogers 2010)	FMP approved by WAPC 2011	Peet and Cardno; consultation with DoP and WAPC	› N/A
Comply with the requirements of the SPP 2.9 Water Resources	› Reflect the objectives of the SPP 2.9 Water Resources Policy to ensure the protection of water resources	› Preparation of a detailed FMP that reflects these objectives	FMP approved by WAPC 2011	Peet and Cardno	› N/A
Comply with the objectives of Liveable Neighbourhoods	› Reflect the objectives of Liveable Neighbourhoods specifically the guidance on stormwater treatment	› Preparation of a detailed FMP that reflects these objectives	FMP approved by WAPC 2011	Peet and Cardno	› N/A

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
Comply with the objectives of Directions 2031	<ul style="list-style-type: none"> Reflect the objects of the Directions 2031 framework to help achieve the vision for growth in Metropolitan Perth 	<ul style="list-style-type: none"> Prioritise the protection of natural areas and mitigate the impact of growth on the environment. 	FMP approved by WAPC 2011	Peet and Cardno	<ul style="list-style-type: none"> Successful implementation of the rehabilitation program.
Comply with the objectives of the draft Perth Coastal Planning Strategy	<ul style="list-style-type: none"> Reflect the objects of the draft Perth Coastal Planning Strategy to help achieve ongoing sustainable planning of metropolitan coastal areas. 	<ul style="list-style-type: none"> Reflect the guiding principles of the strategy in the provision of public foreshore areas and access to these, location of facilities safely through taking into account coastal processes. 	FMP approved by WAPC 2011	Peet and Cardno	<ul style="list-style-type: none"> N/A
Comply with the requirements of the State Bushland Policy	<ul style="list-style-type: none"> Reflect the objectives of the State Bushland Policy to secure long-term protection of biodiversity and associated values 	<ul style="list-style-type: none"> Conserve and protect remnant bushland areas Restore areas of degraded vegetation and landforms 	FMP approved by WAPC 2011	Peet and Cardno in consultation with DoP	<ul style="list-style-type: none"> N/A
Reserve designated Bush Forever	<ul style="list-style-type: none"> Reserve designated Bush Forever land to provide regional linkages and preserve remnant vegetation 	<ul style="list-style-type: none"> Conserve and protect remnant bushland areas Restore areas of degraded vegetation and landforms 	FMP approved by WAPC 2011	Peet and Cardno in consultation with DoP (Bush Forever office)	<ul style="list-style-type: none"> N/A
Reflect the targets of the City of Wanneroo Biodiversity Strategy	<ul style="list-style-type: none"> Reflect the objectives of the City of Wanneroo's Biodiversity Strategy 	<ul style="list-style-type: none"> Conserve and protect remnant bushland areas Restore areas of degraded vegetation and landforms 	As per FMP approved by WAPC 2011	Peet and Cardno in consultation with the City of Wanneroo	<ul style="list-style-type: none"> N/A
Additional management principles and objectives in accordance with the policies and approvals described above	<ul style="list-style-type: none"> Reflect the requirements and guidelines of the policies and legislation. 	<ul style="list-style-type: none"> Protect areas of unique landscape, scientific and cultural significance by management of uncontrolled access, rehabilitation and stabilisation; Identify areas of natural habitats and of conservation value and develop a Stabilisation and Rehabilitation Plan that protects, restores and enhances the biodiversity values of the whole 	<p>FMP approved by WAPC 2011:</p> <ul style="list-style-type: none"> Rehabilitation and Stabilisation Plan described in Section 6 of FMP; 	Peet and the project team in collaboration with City of Wanneroo and DoP	<ul style="list-style-type: none"> As per Sections 6.6 and 7.3 of FMP

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
		<p>foreshore;</p> <ul style="list-style-type: none"> › Provide a clear delineation between the public and private areas through construction of a local coastal road along the eastern edge of the foreshore reserve; › Provide adequate and appropriate public access to the foreshore for recreational users; protect the ecological values from uncontrolled access by providing fenced pathways to the beach that link to the continuous path network running north south along the length of coastline adjoining the Alkimos-Eglinton DSP area; › Design public places, facilities and access to the beach in the foreshore that take advantage of the identified opportunities and does not compromise ecological values; › Development in the foreshore reserve is to be in nodes to facilitate user friendly beach access and foreshore use; and › Develop a management strategy for the ongoing monitoring of areas of dune stabilisation and areas of revegetation to protect environmental values. 	<ul style="list-style-type: none"> › See Section 5.2.2.2 and Figure 12 of FMP › See Section 5.2.2 and Figure 12 of FMP › See Section 5.2.4 and Figure 12 of FMP › See Figure 12 of FMP › See Sections 6.6 and 7.3 of FMP 		
Environmental Context					
Design responsive to strong coastal winds	› Design so that buildings, paths and community infrastructure are protected	› Design public places and paths so that they are protected from strong coastal winds yet retain important	› See Section 5.2.1.1 and Figures 11 & 12 of FMP	Peet and project team	› N/A

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
	from strong coastal winds.	viewsheds			
Utilise availability of Tamala limestone for rehabilitation and landscape purposes	<ul style="list-style-type: none"> › Design to accommodate the use and stability of Tamala limestone areas. 	<ul style="list-style-type: none"> › Utilise limestone as a feature in foreshore landscaping and design 	<ul style="list-style-type: none"> › See Section 5.2.2.3 and Figure 11 of FMP 	EPCAD and Peet	<ul style="list-style-type: none"> › N/A
Protect and restore remnant vegetation with high species abundance and vegetation structure	<ul style="list-style-type: none"> › Retain areas of remnant vegetation; rehabilitate and revegetate degraded areas. 	<ul style="list-style-type: none"> › Prepare and implement a Revegetation and Restoration Works Specification 	Revegetation and Restoration Works Specification to be prepared for each stage of foreshore rehabilitation for years 2012 to 2020 (as per Figure 17).	Cardno and Peet to work together with City of Wanneroo and DEC	<ul style="list-style-type: none"> › Monitoring will be undertaken by Cardno until completion criteria for revegetation are achieved. Ongoing monitoring responsibility will be transferred to the CoW.
Retention of Priority 3 Ecological Community FCT 29b	<ul style="list-style-type: none"> › Address the management of this community in the future management plan prepared for the green link. 	<ul style="list-style-type: none"> › Plan to conserve and protect the Priority 3 Ecological Community FCT 29b in line with DEC advice 	Site 106, where FCT 29b may occur, is within the green link to the buffer around the Alkimos Waste Water Treatment Plan and is excluded from the FMP.	DEC	N/A
Retain existing landform within the foreshore reserve	<ul style="list-style-type: none"> › Utilise the existing landform to support recreation and aesthetic value 	<ul style="list-style-type: none"> › Undertake viewshed analysis on foreshore pathways to maximise views for pedestrians and other foreshore users. This should extend into the commercial and residential areas. 	See design of access and amenity in Coastal Foreshore Park as shown in Figures 11 & 12 of the FMP	Peet and project team	<ul style="list-style-type: none"> › N/A
Foreshore Design					
Integration of the adjoining Coastal Village Precinct and urban areas with the	<ul style="list-style-type: none"> › Maintain visual links from the Coastal Village through to the ocean › Support pedestrian 	<ul style="list-style-type: none"> › Design the Coastal Foreshore Park to protect and maintain visual links through to the beach › Link the Viggo Trail to the 	Design of Coastal Foreshore Park and adjoining urban area to be completed in 2012. Visual links,	Peet and project team	<ul style="list-style-type: none"> › N/A

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
foreshore environment	<ul style="list-style-type: none"> movement to the foreshore › Provide parking for visitors and residents 	<ul style="list-style-type: none"> movement network within the foreshore › Design for parking adjacent to the Beach Club, alongside the foreshore road and within the foreshore where the foreshore width is greatest (at the northern end) 	linking the Viggo trail and provision of parking are included.		
Support public recreational uses of the foreshore, through the design of a Village Foreshore Park	<ul style="list-style-type: none"> › The design of the Village Foreshore Park will provide public open space, passive park spaces, zones for active sport and play, event spaces, beach lookouts, picnic and BBQ areas, a promenade and walking paths. 	<ul style="list-style-type: none"> › Design and construct a Village Foreshore Park inclusive of a Beach Club that provides a range of leisure and recreation options adjacent to the Coastal Village Precinct. › Design for facilities within the beach club for sport and recreation, health and fitness, youth activities, community, community events and local information. 	Addressed in the FMP approved by WAPC 2011; design of Coastal Foreshore Park to be completed in 2012.	Peet and project team	<ul style="list-style-type: none"> › Monitoring of the stabilisation and landscaping is required to maintain public amenity › Information to be provided to landowners regarding the Village Foreshore Park facilities and expected date of completion.
Creation of a distinct foreshore promenade	<ul style="list-style-type: none"> › Construction of a north-south road along the boundary of the foreshore. This road will define the separation of the public foreshore area from the privately owned residential development. 	<ul style="list-style-type: none"> › Construct the foreshore promenade inclusive of pedestrian and bike path facilities, sufficient drainage and opportunity for passive surveillance. 	Foreshore promenade to be constructed in Stages starting in 2012 (see Figure 17).	Peet and project team	<ul style="list-style-type: none"> › Monitoring of drainage and revegetation of batters to the promenade is required. This will occur in association with the revegetation monitoring. › Ongoing monitoring responsibility will be transferred to the CoW.
Establish small coastal nodes at the	<ul style="list-style-type: none"> › Small coastal nodes will 	<ul style="list-style-type: none"> › Identify appropriate locations for 	<ul style="list-style-type: none"> › See Figure 12 of 	Peet, EPCAD and	<ul style="list-style-type: none"> › Maintenance of

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
intersection of pathways	provide seating and shading facilities for community.	<p>small coastal nodes</p> <ul style="list-style-type: none"> › Construct seating and shading facilities at each node 	<p>FMP</p> <ul style="list-style-type: none"> › Construction of seating and shading in Stages starting in 2012 (see Figure 17) 	Cardno	facilities where required. Ongoing monitoring responsibility will be transferred to the CoW.
Establish major and minor nodes within the foreshore reserve.	<ul style="list-style-type: none"> › Nodes will provide areas for passive and active open space. These nodes will allow for tourism and outdoor recreation activities to occur within the foreshore without damage to the native gestation of the dunes. 	<ul style="list-style-type: none"> › Identify appropriate locations for major and minor nodes › Construct the Northern Coastal Park that incorporates the natural environment with active play opportunities, as well as more formal urban spaces and drainage integration › Construct lookout nodes to allow for enjoyment of the views from the foreshore 	<ul style="list-style-type: none"> › See Figure 12 of FMP <p>Construction of seating and shading in Stages starting in 2012 (Figure 17)</p> <ul style="list-style-type: none"> › Construction of lookout nodes in Stages starting in 2012 (Figure 17). 	Peet, EPCAD and Cardno	<ul style="list-style-type: none"> › Maintenance of facilities where required. Ongoing monitoring responsibility will be transferred to the CoW.
Provide safe, user-friendly and controlled accessibility within the foreshore reserve	<ul style="list-style-type: none"> › The movement network within the foreshore will provide pedestrian pathways, beach access and walking trails throughout the reserve as well as a beach promenade alongside the foreshore promenade. 	<ul style="list-style-type: none"> › Construct fencing to control access and assist stabilisation objectives › Construct a dual use pathway following the foreshore promenade. This pathway is designed for use by pedestrians, wheelchairs, bicycles, prams and for emergency access. › Construct beach access pathways that provide access for pedestrians to the beach. Beach access should include disabled access and paths should be spaced 200m apart. › Construct a primary north south foreshore pedestrian access route along the dune ridgeline, locate these tracks in existing degraded 4WD tracks. <p>Limit vehicle access within the</p>	<ul style="list-style-type: none"> › Construction of fencing and access to occur in Stages starting in 2012 (Figure 17). › Figure 12 of FMP shows the movement network, including the north south access, beach access and dual use pathways. <ul style="list-style-type: none"> › Peet and CoW to 	Peet and project team CoW (ongoing maintenance)	<ul style="list-style-type: none"> › Maintenance of facilities where required. Ongoing monitoring responsibility will be transferred to the CoW.

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
		foreshore (discussed below). › Create user-friendly beach access.	determine course of action prior to commencement of Revegetation and Restoration Works.		
Create awareness of the coastal environment	› Create awareness of the fragile coastal environment. While the foreshore will provide recreational opportunities for the community, the natural environment will ultimately provide amenity, biodiversity and natural stability to the foreshore	› Install educational signage that educates beach users about the fragile nature of the foreshore. › Create interactive areas that are designed for community and recreation use. › Create viewsheds to promote the values of the foreshore landscape and seascape features.	› Signage to be installed in Stages starting in 2012 (Figure 17). › Design of Coastal Foreshore Park to be completed in 2012. › See FMP, design of Coastal Foreshore Park to be completed in 2012.	Peet and project team Relevant government agencies (ongoing maintenance)	› Monitoring and maintenance of signs required. Ongoing monitoring responsibility will be transferred to the CoW.
Provide public facilities within the foreshore reserve	› Provision of public facilities that will support the recreational and conservational use of the foreshore › Restore the blow out and stabilise the area to support the provision of public recreational uses	› Provision of public facilities including a beach club, food outlets/cafes, car parking, street furniture and public art, toilets, showers, shade, signage and rubbish bins	See FMP, design of Coastal Foreshore Park to be completed in 2012.	Peet and project team Relevant government agencies (ongoing maintenance)	› Maintenance of facilities where required located.
Provide necessary infrastructure within the foreshore reserve.	› Provision of public facilities that will support the recreational and conservational use of the foreshore	› Provision of infrastructure will include lighting, drainage, water and sewer connections.	See Section 5.2.5 of FMP, installation of infrastructure to be staged as per Figure 17.	Peet and project team Consultation with CoW and DoW	› Maintenance of facilities where required. Ongoing monitoring responsibility will be transferred to the CoW.
Protect and conserve significant remnant	› Retain areas of remnant vegetation; rehabilitate and	› Rehabilitation and Stabilisation	› See Sections 6 & 7 of the FMP;	N/A	› N/A

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
vegetation within the foreshore	revegetate degraded vegetation and landforms	actions discussed below	rehabilitation and stabilisation to occur in Stages starting in 2012 (Figure 17).		
Establish a continuity with adjacent landholdings	<ul style="list-style-type: none"> Establish linkages with movement networks in adjacent landholdings 	<ul style="list-style-type: none"> Preparation of a FMP to set the standard for the appropriate management of the foreshore within the DSP area; establish the design of the movement network. 	See Figure 12 of FMP.	Peet, adjacent landowners and CoW	<ul style="list-style-type: none"> Through District Owners discussion group.
Rehabilitation and Stabilisation					
Weed Control	<ul style="list-style-type: none"> Manage the introduction, spread and concentration of weed species through manual and chemical control 	<ul style="list-style-type: none"> Determine priority weed control areas. Commence weed management detailed in Revegetation and Restoration Works Specification to be prepared and implemented by Cardno. 	Weed control to occur in Stages starting in 2012 (Figure 17).	Cardno (interim) Relevant government agencies (ongoing) Metro North Coast Care Group (ongoing)	<ul style="list-style-type: none"> Weed management will use monitoring quadrats as detailed in the Revegetation and Restoration Works Specification Monitoring will be undertaken by Cardno until required. Ongoing monitoring responsibility will be transferred to the CoW.
Manage uncontrolled access	<ul style="list-style-type: none"> Management of uncontrolled access will prevent damage to areas of stabilisation and rehabilitation Coordination of management across adjacent property boundaries 	<ul style="list-style-type: none"> Close all tracks not required for access Restrict vehicle access within the site through security and surveillance Place large limestone blocks, fencing, bollards and signage. Develop a communication plan to inform current users of the plan to 	Program of access management to be agreed with CoW and district landowners prior to commencing foreshore stabilisation and rehabilitation in 2012	Peet in association with adjacent landowners. Relevant government agencies	<ul style="list-style-type: none"> Monitoring of the damage of uncontrolled access will occur throughout the construction period. Any uncontrolled access will be referred to site security.

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
Establish pedestrian pathways	<ul style="list-style-type: none"> › Utilise existing pathways to minimise degradation of remnant vegetation › Ensure pathways have sufficient drainage to avoid further erosion of the foreshore 	<p>control access.</p> <ul style="list-style-type: none"> › Construct fenced pedestrian pathways that support recreational use of the foreshore. The primary pathways will consist of: <ul style="list-style-type: none"> ○ Asphalt Dual Use Pathway ○ Crushed limestone walking trail ○ Timber boardwalks for beach access 	Construction of fenced pedestrian paths to occur in Stages starting in 2012 (Figure 17).	Peet (construction) Relevant government agencies (maintenance)	<ul style="list-style-type: none"> › Monitoring will be undertaken to ensure there is no damage to pathways or erosion caused by runoff. Monitoring will be undertaken by Peet and project team until required. Ongoing monitoring responsibility will be transferred to the CoW.
Controlled foreshore vehicle access	<ul style="list-style-type: none"> › Limit foreshore vehicle access to maintenance vehicles and emergency access to the beach 	<ul style="list-style-type: none"> › Close all tracks not required for access › Construct an emergency beach access pathway within the Village Foreshore Park › Ensure that the width of the limestone track allows for access for maintenance vehicles › Restrict car parking to key parking areas within the foreshore. 	<ul style="list-style-type: none"> › Program of access management to be agreed with CoW and district landowners prior to commencing foreshore stabilisation and rehabilitation in 2012 › Construction of vehicle access to occur in Stages starting in 2012 (Figure 17). 	Peet (construction) CoW (maintenance)	<ul style="list-style-type: none"> › Monitoring will be undertaken to ensure there is no unauthorised use of these access routes and that no erosion is caused by runoff. Monitoring will be undertaken by Peet and project team until required. Ongoing monitoring responsibility will be transferred to the CoW.
Use of fencing and barriers to control access and support rehabilitation	<ul style="list-style-type: none"> › Fencing will be used to restrict access and provide wind speed reduction and sand trapping › Fencing will be durable and 	<ul style="list-style-type: none"> › Construct sand trap fencing on slopes in areas that are undergoing revegetation and stabilisation › Construct fencing along the edge of 	<ul style="list-style-type: none"> › Construction of sand trapping and fencing to occur in Stages starting in 2012 (Figure 17). 	<i>Sand trap fencing</i> Peet (construction and maintenance) <i>Pathway/lookout</i>	<ul style="list-style-type: none"> › Monitoring of sand trap fencing will occur in conjunction with revegetation works as specified

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
	comply with CoW standards.	pathways and at lookouts.		<i>fencing</i> Peet (construction) CoW (maintenance)	in the Revegetation and Restoration Works Specification. Sand trap fencing will be removed prior to hand over to CoW. › Monitoring of pathway/lookout fencing will be undertaken by Peet and project team until required to monitor damage and maintenance requirements. Ongoing monitoring responsibility will be transferred to the CoW.
Strategic use of signage	<ul style="list-style-type: none"> › Signage will be used to provide direction, information and interpretation material. › All signage will follow current CoW specifications for design, placement and materials. 	› Design signage to predominantly be placed in key areas (i.e. dog beach access, revegetation areas etc.). The placement of and materials used for signage will be determined at the detailed design stage.	› Installation of signage to occur in Stages starting in 2012 (Figure 17).	Peet (construction) CoW (maintenance)	› Monitoring of the site will occur to identify areas which require interpretive and educational signage. Peet will be responsible for the construction and maintenance of signage until required. Ongoing monitoring responsibility will be transferred to the CoW.
Stabilisation of degraded dune	› Stabilisation methods will be determined according to the	› Undertake stabilisation in conjunction with rehabilitation and	› Stabilisation to occur in Stages	Peet (construction and maintenance)	› Stabilisation will be monitored in

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
formations	<p>environmental condition of the area.</p> <ul style="list-style-type: none"> › Manage further destabilisation and erosion of dunes. 	<p>revegetation efforts and will include:</p> <ul style="list-style-type: none"> ○ Brushing (use of branches for ground cover) ○ Fibre matting (biodegradable matting) ○ Coarse mulch (coarsely shredded plant material) ○ Sand trapping (mesh on fence to trap sand) 	starting with the Coastal Village Park in 2012 (Figure 17).		<p>conjunction with the Revegetation and Restoration Works Specification. Degraded dune formations will be stabilised prior to hand over to CoW.</p>
Stabilisation of the blowout	<ul style="list-style-type: none"> › Stabilisation of the blowout will be undertaken in several stages. This will require detailed design that is responsive to the size and volume of the blowout as well as to seasonal conditions. 	<ul style="list-style-type: none"> › Stabilise the blowout using the proposed staging sequence including closure, basic grading, development, revegetation and construction and completion. 	<ul style="list-style-type: none"> › Stabilisation of blow out in the Coastal Village Park to commence in 2012 (Figure 17). 	Peet and project team	<ul style="list-style-type: none"> › Stabilisation will be monitored in conjunction with the Revegetation and Restoration Works Specification. The blowout will be stabilised and recreational facilities constructed prior to hand over to CoW.
Management of drainage and stormwater runoff	<ul style="list-style-type: none"> › Implement appropriate management of drainage and stormwater runoff to ensure any runoff is treated, contained and used appropriately. 	<ul style="list-style-type: none"> › Implement WSUD measures along pathways and roadsides to support local recharge, slow the flow of stormwater and manage disposal of the discharge › Reuse of stormwater to supplement irrigation of grassed recreational areas. 	<ul style="list-style-type: none"> › Installation of drainage to occur in Stages starting with the Coastal Village Park in 2012 (Figure 17). 	Peet, EPCAD, Cardno CoW	<ul style="list-style-type: none"> › Drainage measures will be monitoring for erosion and functionality. Key monitoring objectives will assess subsurface irrigation, underground storage pipes and stormwater management.
Rehabilitation through appropriate timing,	<ul style="list-style-type: none"> › Rehabilitation will be undertaken to restore, repair 	<ul style="list-style-type: none"> › Target areas of vegetation which are currently classed as degraded. 	<ul style="list-style-type: none"> › Revegetation to occur in Stages 	Cardno (interim) Relevant government	<ul style="list-style-type: none"> › Revegetation areas must meet the

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
revegetation, vegetation salvaging, seed collection and use of tree guards	or stabilise the degraded systems to as natural a state as possible. Rehabilitation will be undertaken in stages which align with development of the adjacent residential development.	<p>Stage revegetation in line with the nine management areas. Detailed Revegetation and Restoration Works Specifications will be prepared for each stage.</p> <ul style="list-style-type: none"> › Undertake revegetation during April to September, depending on seasonal patterns › Salvage Zamia palms and grass trees › Seed collection may be undertaken to assist in the propagation of native vegetation › Use tree guards to increase the survival rate of tubestock 	starting with the Coastal Village Park in 2012 (Figure 17).	agencies Coast Care Group	<p>completion criteria detailed in the Revegetation and Restoration Works Specification. Monitoring objectives include:</p> <ul style="list-style-type: none"> ○ Evaluation of the success of dune stabilisation, track restoration and revegetation; and ○ Collection of data and photographic records from designated quadrats.
Conservation and ongoing protection of native fauna	<ul style="list-style-type: none"> › Design to conserve and protect native fauna › Control of the numbers of feral animals › Restrictions for dog access 	<ul style="list-style-type: none"> › Construct fauna friendly culverts › Identify nests and burrows when stabilisation and rehabilitation is undertaken › Prepare a Pest Management Strategy › Investigate suitable locations for a Dog Beach including informative signage and facilities (with CoW) 		Cardno (interim) CoW DEC (ongoing)	<ul style="list-style-type: none"> › Monitoring of numbers of pests/feral animals during rehabilitation monitoring. › Potential to establish an education campaign to raise awareness of dangers of roaming cats at night as well as dog access to the foreshore area.

North Alkimos – Foreshore Management Plan

Prepared for Peet Limited

Objectives	Recommendations	Action	Stage	Responsible Body	Monitoring
Plant disease management	<ul style="list-style-type: none"> › Removal of soil on vehicles/equipment prior to entry into the foreshore › Screening of offsite soil, gravel or sand required for construction and rehabilitation › Minimise construction in wet weather › Ensure all vehicle tracks are well drained › Reducing plant stress 	<ul style="list-style-type: none"> › Application of the Shorehaven Construction Environmental Management Plan 		Cardno and Peet Relevant government agencies	<ul style="list-style-type: none"> › Monitoring for signs of plant stress and pathogens. This will be undertaken in conjunction with other rehabilitation monitoring.
Monitoring of stabilisation and rehabilitation	<ul style="list-style-type: none"> › Ensure that the above recommendations for the Rehabilitation and Stabilisation of the foreshore, are implemented in an effective and successful manner 	<ul style="list-style-type: none"> › Comply with monitoring requirements detailed in the Revegetation and Restoration Works Specification. › Report areas which require particular attention or further maintenance. › Establish quadrats and photographic records throughout the foreshore. › Monitor compliance with Completion Criteria prior to handover to CoW. 	<ul style="list-style-type: none"> › Restoration to occur in Stages starting with the Coastal Village Park in 2012 (Figure 17) and be monitored. 	Cardno and Peet Relevant government agencies	<ul style="list-style-type: none"> › Address monitoring requirements as above. › Monitoring of the site by Cardno and Peet until completion criteria are achieved. › Ongoing monitoring responsibility will be transferred to the CoW.

8 Management Structure

8.1 Village Foreshore Park

The Village Foreshore Park is proposed to be managed by a through an innovative public/private/community partnership and subsidised through a Special Area Rate to be levied on landowners across the Coastal Precinct. These proposals are currently being discussed with the City of Wanneroo. Further details will be determined during the detailed design phase regarding:

- Area of land to be excised from the currently private titled area of the foreshore for the Club Lot;
- Management body (as per discussions with CoW); and
- Special Area Rating and its application to the ongoing management of the Village Foreshore Park and Beach Club.

8.2 Involvement of local community

It is anticipated that the future management of the foreshore will involve at least advice and guidance from coast care groups and conservation groups within the local or regional community. Active involvement with the community will help foster community identity within Shorehaven and help the conservation and future protection of the foreshore environment. It is anticipated that there will be involvement with the Perth Region Natural Resource Management's North Metro Coastal Facilitators. Initiation of involvement of the local community will be identified through discussion with the City of Wanneroo.

9 References

Alan Tingay and Associates (ATA) 2003a *Alkimos-Eglinton Coastal Planning Strategy*, Unpublished Report prepared for Landcorp.

Alan Tingay and Associates (ATA) 2003b *Environmental Review: MRS Amendment 1029/33*, Unpublished Report prepared for the Western Australian Planning Commission.

Alan Tingay and Associates (ATA) 2005 *Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information*, prepared for the Metropolitan Region Scheme Amendment 1029/33

Alan Tingay and Associates (ATA) and Bennett 2004 *Metropolitan Regional Scheme Amendment 1029.33 Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information*. Report No. 2004/253

Armstrong, P. 1996 *Vegetation Condition and Conservation values for Lots 8 and 11 Eglinton*, City of Wanneroo. Unpublished report for Landcorp and ATA

Beard J. S. 1990 *Plant life of Western Australia*, Kangaroo Press, Perth.

Belbin, L 2006, *PATN*, v3.11, statistical program, CSIRO-Division of Wildlife and Ecology, Perth.

Brown, K. And Brooks, K. 2002 *Bushland Weeds: A Practical Guide to their Management*, Environmental Weeds Action Network, Greenwood, Western Australia.

Cardno 2010 *Flora and Vegetation Survey*, Unpublished report prepared for Peet Limited.

City of Wanneroo 2006 *Heritage Places Local Planning Policy*, Available Online: <http://www.wanneroo.wa.gov.au/cproot/1688/3/HeritagePlacesLocalPlanningPolicy.pdf> [Accessed April 2010]

City of Wanneroo 2008 *Draft Local Biodiversity Strategy 2008-2013: A Draft for Discussion*, Available Online: http://www.wanneroo.wa.gov.au/3/609/1/local_biodiversity_strategy_-_draft_for_discussion.pm [Accessed May 2010]

City of Wanneroo 2010 *District Planning Scheme* (as amended), Available Online: http://www.wanneroo.wa.gov.au/3/494/1/district_planning_scheme_.pm [Accessed May 2010].

Commonwealth of Australia 2008 *Wind Roses* prepared by the National Climate Centre of the Bureau of Meteorology. Available Online: www.bom.gov.au/ [Accessed February 2010].

Department of Agriculture and Food (DAF) 2009 *Declared Plants*, 'Agriculture and Related Resources Protection Act 1976', Agriculture Protection Board, Available Online: http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/dec_plants_list.pdf [Accessed: April 2010]

Department of Agriculture, Fisheries and Forestry (DAFF) 2010 *Weeds of National Significance*, Available Online: <http://www.daff.gov.au/brs/land/weeds/national-significance> [Accessed August 2010].

Department of Environment and Conservation (DEC) 2007 *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, Department of Environment and Conservation December 2007.

Department of Environment, Climate Change and Water (NSW) (DECCW) 2009 *NSW Sea Level Rise Policy Statement*, New South Wales Government, October 2009.

Department of Indigenous Affairs (DIA) 2010 *Aboriginal Heritage Register* (Online) Available Online: <http://www.dia.wa.gov.au/> [Accessed January 2010]

Department of the Environment, Water, Heritage and the Arts (DEWHA) 1999 *Environmental Protection and Biodiversity Act* (Online). Available Online: www.environment.gov.au/ [Accessed April 2010].

Department of Water (DoW) 2009 *Perth Groundwater Atlas* (Online) Available World Wide Web: URL: <http://portal.water.wa.gov.au/portal/page/portal/MapsDataAtlases/PerthGroundwaterAtlas> (Accessed October 2009)

Eliot I. G. and Tonts M. 2005 *Recreational Beach Use in the Perth Metropolitan Area*, Report for the Western Australian Planning Commission, July 2005.

ENV 2005 *Flora and Vegetation Survey of the Proposed Parks and Recreation Area within Lot M1482*, Alkimos.

ENV 2008 *Local Structure Plan Environmental assessment*, Unpublished Report prepared for Peet Limited.

ENV 2009a *North Alkimos Construction Environmental Management Plan*, Unpublished Report prepared for Peet Limited.

ENV 2009b *Shorehaven Environmental Management Plan*, Unpublished Report prepared for Peet Limited.

GHD 2006 *Alkimos-Eglinton District Structure Plan Appendix 1 Sustainability Strategy*, Unpublished Report prepared for the Alkimos-Eglinton District Structure Plan.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. 1994 *A Floristic Survey of the Southern Swan Coastal Plain*. Unpublished Report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)

Government of Western Australia 1950 *Wildlife Conservation Act*, Available Online: http://www.austlii.edu.au/au/legis/wa/consol_act/wca1950236/ [Accessed May 2010]

Government of Western Australia 2000a *Bush Forever Volume 1*. Western Australian Planning Commission, Perth, Western Australia.

Government of Western Australia 2000b *Bush Forever Volume 1*, 'Appendix 3, Site Implementation Guidelines Practice Notes', Western Australian Planning Commission, Perth, Western Australia.

Government of Western Australia 2000c *Bush Forever Volume 2*. Department of Environmental Protection, Perth, Western Australia.

Grant, C. D. 2006 State-and-transition successional model for bauxite mining rehabilitation in the Jarrah forest of Western Australia. *Restoration Ecology* 14: 28-37.

Heddlle, E.M., Lonerragan, O.W. and Havel, J.J. 1980 Vegetation Complexes of the Darling System Western Australia. IN Atlas of Natural Resources Darling System of W.A. Department of Conservation and Environment. Perth: UWA Press.

Indian Ocean Climate Initiative (IOCI) 2009 '*Observed changes in our climate*', Accessed Online: http://www.ioci.org.au/index.php?menu_id=0 [Accessed May 2010]

Keighery, B.J. 1994 Bushland plant survey: A guide to plant community survey for the community, Nedlands: Wildflower Society of WA (Inc).

Kilgour, S., 2009. *Managing Phytophthora Dieback in Bushland. A guide for landholders and community conservation groups*, Dieback Working Group Western Australia.

Landcorp *et. al.* 2009 *District Structure Plan*, Unpublished Report prepared for the City of Wanneroo.

Lemmon, T.C., Gee, R.D., Morgan, W.R. and Elkington, C.R. 1979 *Important Geological Sites in the Perth and Southwestern Area of Western Australia: A Report on their Scientific Significance and Future Protection*. Western Australia: Geological Society of Australia Incorporated.

Peet Limited (Peet) 2010 *Shorehaven Building Design Guidelines*, Available Online: <http://www.shorehavenrise.com.au/Shorehaven%20Rise/Building%20at%20Shorehaven%20Rise.aspx> [Accessed August 2010]

Rogers, M.P. & Associates 2010 *Alkimos-Eglinton Coastal Engineering Study*. Perth: Landcorp.

RPS Bowman Bishaw Gorham 2006 *Alkimos Eglinton Coastal Strategy*, Unpublished Report prepared for the City of Wanneroo.

Seddon, G. 2004 *Sense of Place: A response to an environment*, Bloomings Books (Facsimile edition), Melbourne, Victoria.

Semeniuk, V., Cresswell, I.D. and Wurm, P.A. 1989 The Quindalup Dunes: the regional system, physical framework and vegetation habitats. *Journal of the Royal Society of Western Australia* Vol 71 Pt 2 & 3 p23-47.

Taylor Burrell Barnett (TBB) 2009 *North Alkimos Local Structure Plan*, Unpublished Report prepared for Peet Limited.

Trudgen, M. & Keighery, B.J. 1990 A report on the flora and vegetation of the Alkimos Area and Conservation Issues Affecting it. Unpublished Report for Landcorp.

Western Australian Planning Commission (WAPC) 2003a *State Planning Policy 2.6: State Coastal Planning*. Available Online: <http://www.planning.wa.gov.au/Publications/139.aspx> [Accessed May 2010].

Western Australian Planning Commission (WAPC) 2003b *Coastal Planning and Management Manual*, Western Australian Planning Commission, Perth, Western Australia.

Western Australian Planning Commission (WAPC) 2005 *Metropolitan Region Scheme Amendment No. 1029/33*. Western Australian Planning Commission, Perth, Western Australia.

Western Australian Planning Commission (WAPC) 2006a *Metropolitan Region Scheme – Scheme Text*, Available Online: <http://www.planning.wa.gov.au/Publications/45.aspx> [Accessed December 2010].

Western Australian Planning Commission (WAPC) 2006b *State Planning Policy 2.9: Water Resources*, Gazetted in December 2006, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2007 *Liveable Neighbourhoods: A Western Australian Government sustainable cities initiative*, Western Australian Planning Commission and Department for Planning and Infrastructure, Perth, Western Australia.

Western Australian Planning Commission (WAPC) 2008 *Draft Perth Coastal Planning Strategy*, Western Australian Planning Commission, Perth, Western Australia.

Western Australian Planning Commission (WAPC) 2009 *Planning Bulletin No. 64 Acid Sulfate Soils*, Western Australian Planning Commission, Perth, Western Australia.

Western Australian Planning Commission (WAPC) 2010 *State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region*. Available Online: <http://www.planning.wa.gov.au/Plans+and+policies/Publications/2195.aspx> [Accessed August 2010].

Figure 1: Locality Plan

Figure 2: Foreshore Reserve

Figure 3: Historical Aerial Photographs 1953 > 1988

Figure 4: Historical Aerial Photographs 1998 > 2008

Figure 5: Historical Blowout Vegetation Alignment

Figure 6: Topography

Figure 7: Soils

Figure 8: Regional Vegetation Mapping

Figure 9: Plant Communities

Figure 10: Vegetation Condition

Figure 11: Location of Village Foreshore Park

Figure 12: Foreshore Movement Network

Figure 13: Foreshore Boundaries and Reserves

Figure 14: Village Foreshore Park Viewsheds

Figure 15: Concept design of beach club

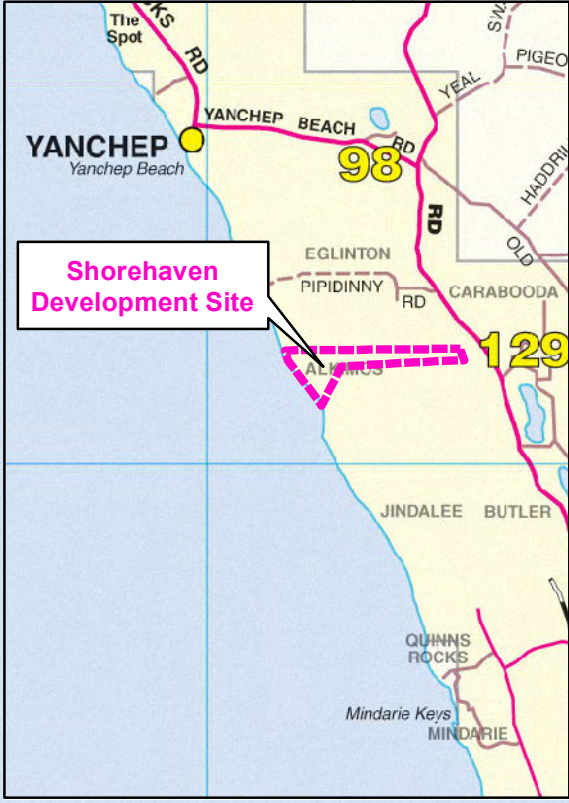
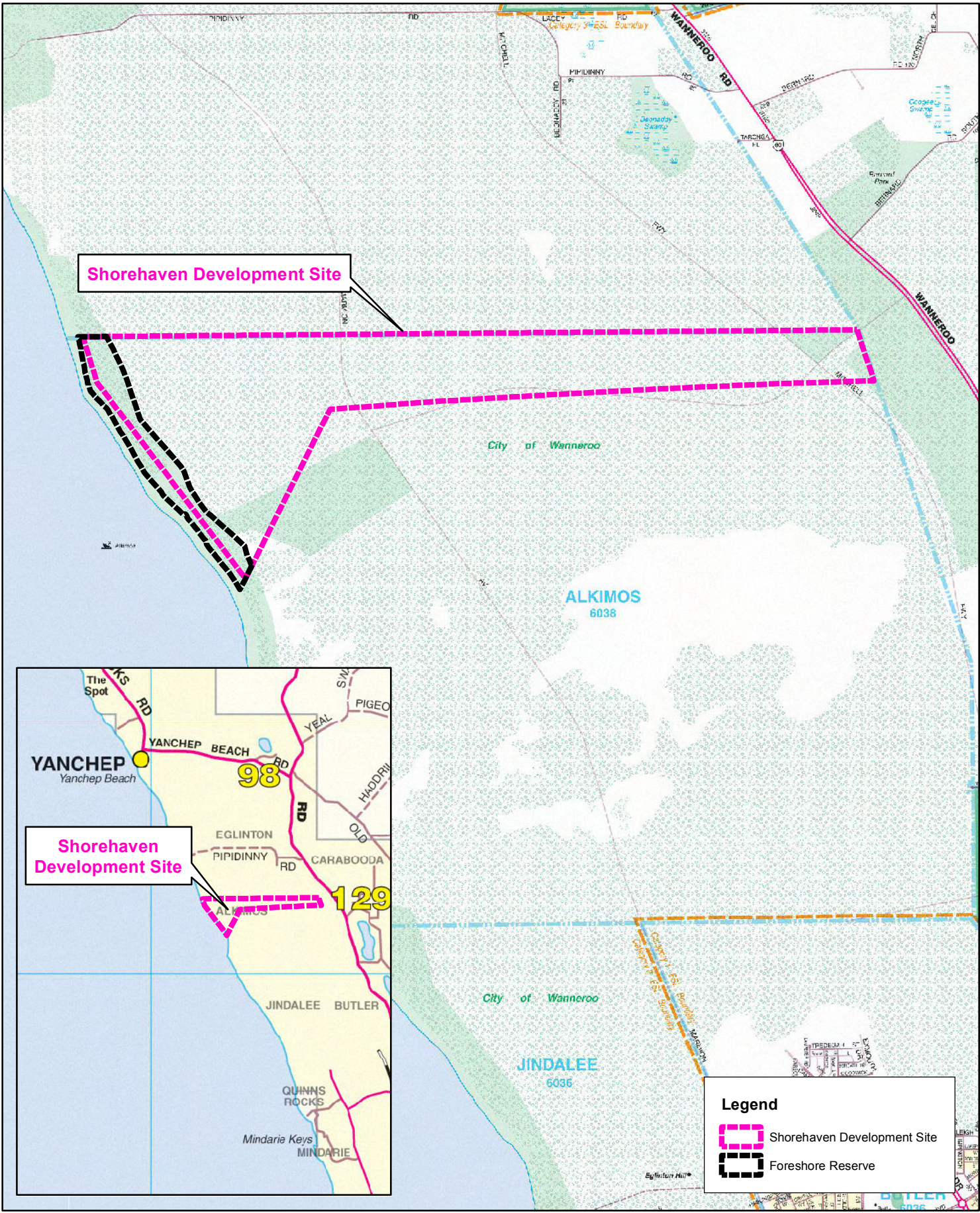
Figure 16: Staging concept for stabilisation of the blow out

Figure 17: Staging of Rehabilitation and Restoration

Figure 18: Shorehaven Drainage Concept Plan

Figure 19: Revegetation Plan

Figures



Legend

- Shorehaven Development Site
- Foreshore Reserve

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD

**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

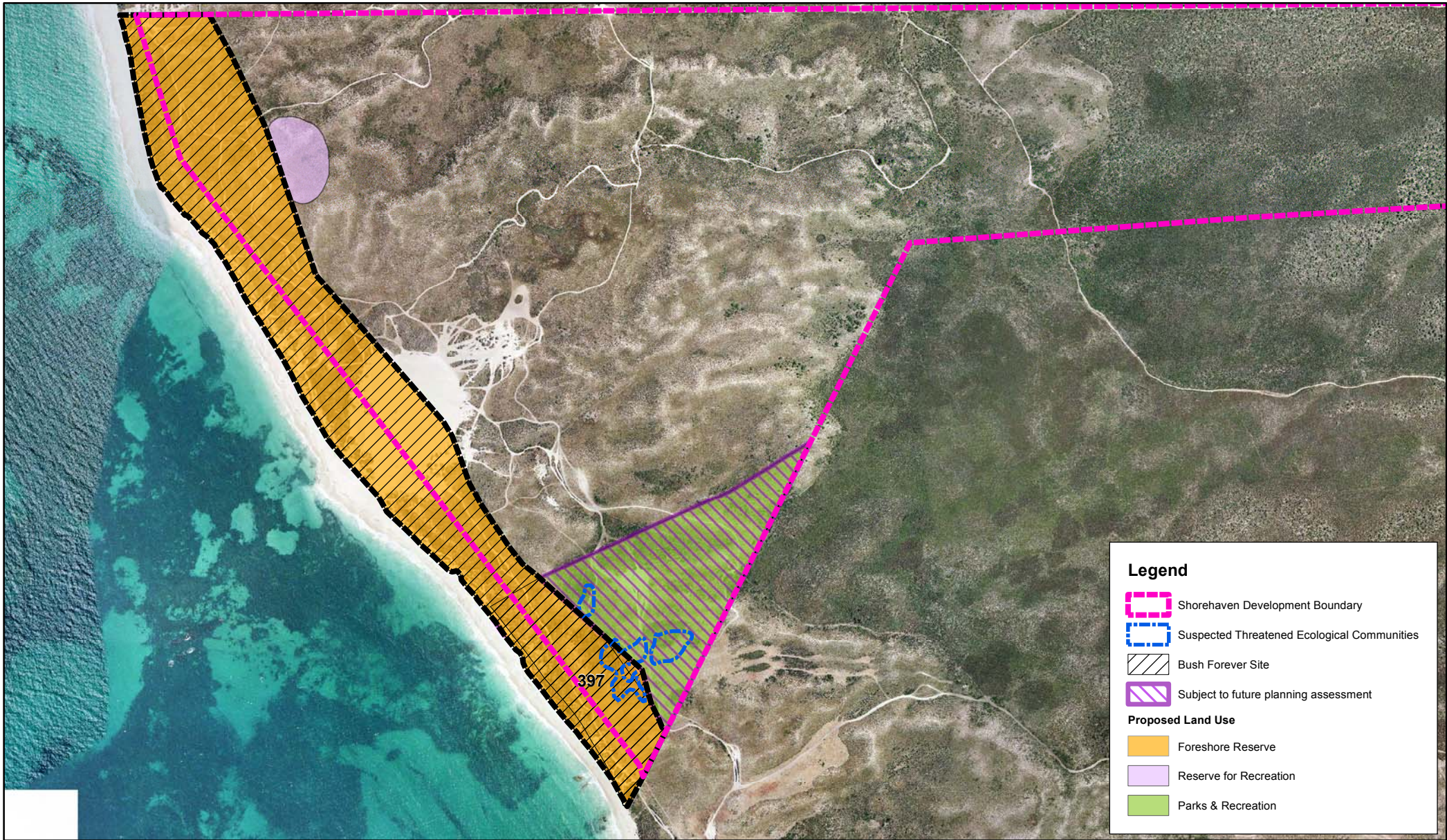
Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **1:30,000**

PROJECT	Alkimos Foreshore Management Plan	Project Number	V9034	Original	A4
DRAWING TITLE	FIGURE 1 : Locality Plan	Drawing Number	SK01	Revision	
PRINCIPAL	Peet Ltd.	Designed DM	Checked JL		
		Drawn JKM	Approved BP		
		Local Authority	City of Wanneroo		
		Sheet 1 of 1			Date 23/12/10

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



Legend

- Shorehaven Development Boundary
- Suspected Threatened Ecological Communities
- Bush Forever Site
- Subject to future planning assessment

Proposed Land Use

- Foreshore Reserve
- Reserve for Recreation
- Parks & Recreation

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------

PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 2 : Foreshore Reserve**

PRINCIPAL **Peet Ltd.**



Scale: **1:10,000**

<p>Cardno CONSULTING ENGINEERS TOWN PLANNERS PROJECT MANAGERS ENVIRONMENTAL CONSULTANTS</p>	<p>Cardno Centre 2 Bagot Road P.O. Box 155 Subiaco Western Australia 6904 Telephone (08) 9273 3888 Facsimile (08) 9388 3831</p>	<p>Project Number V9034</p> <p>Designed GT Drawn JKM</p>	<p>Drawing Number SK02</p> <p>Checked JL Approved BP</p>	<p>Revision 00</p> <p>Date: 23/12/2010</p>	<p>Original A4</p> <p>Local Authority City of Wanneroo</p>
	<p>Sheet 1 of 1</p>				

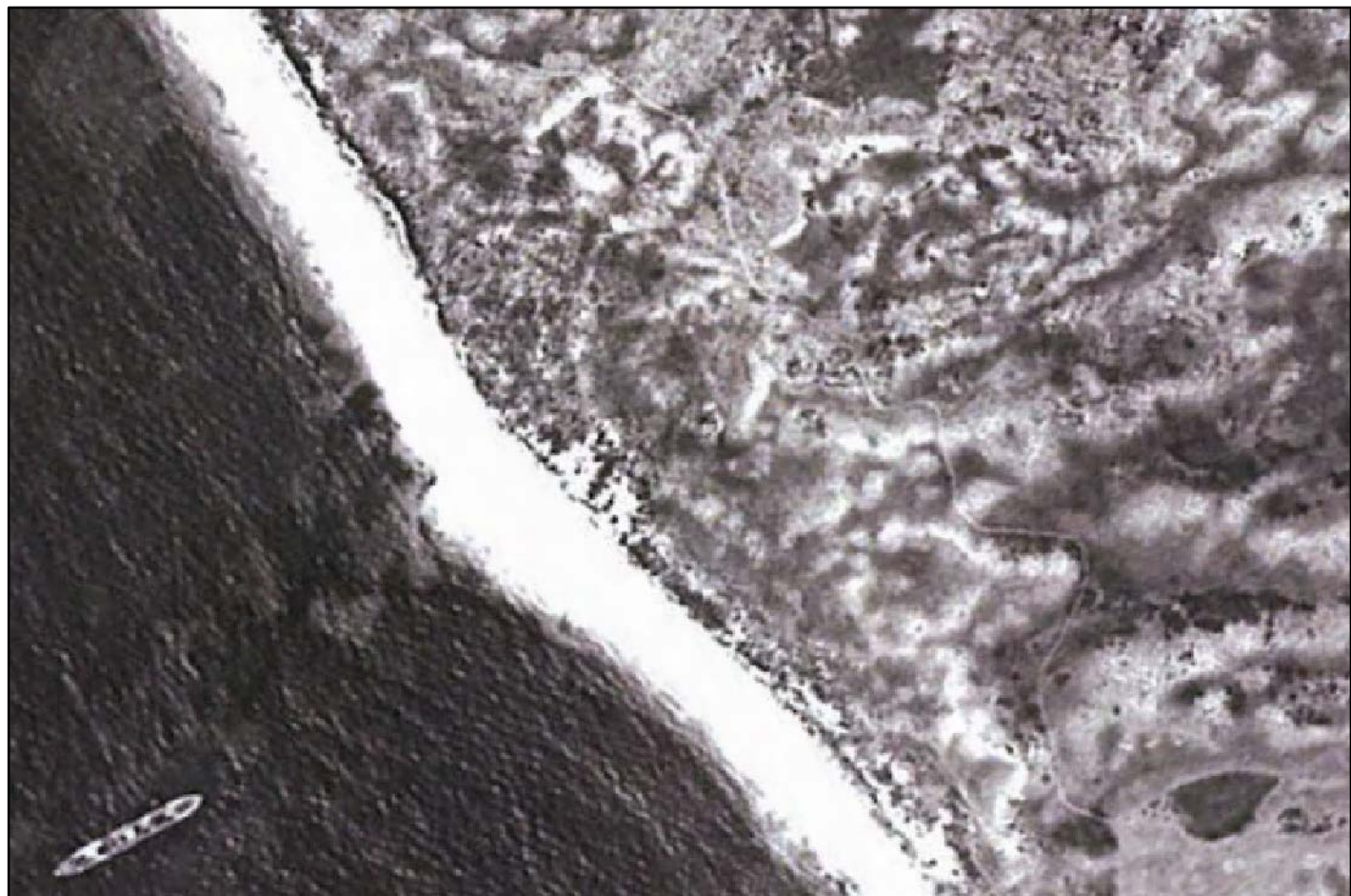
This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



Date 1/04/1988



Date 14/8/1978



Date 28/10/1969



Date 15/12/1953

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------

PROJECT **Alkimos Foreshore Management Plan**
 DRAWING TITLE **FIGURE 3 : Historical Aerial Photography - Sand Blowout 1953 -1988**
 PRINCIPAL **Peet Ltd.**

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.

Scale: **1:6,000**

Cardno CONSULTING ENGINEERS
 TOWN PLANNERS
 PROJECT MANAGERS
 ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
 P.O. Box 155 Subiaco
 Western Australia 6904
 Telephone (08) 9273 3888
 Facsimile (08) 9388 3831

Project Number V9034	Drawing Number SK04	Revision 00	Original A3
Designed GT	Checked JL	Date 23/12/10	
Drawn JKM	Approved BP		
Local Authority City of Wanneroo		Sheet 2 of 2	



Date 13/12/2008



Date 13/12/2006



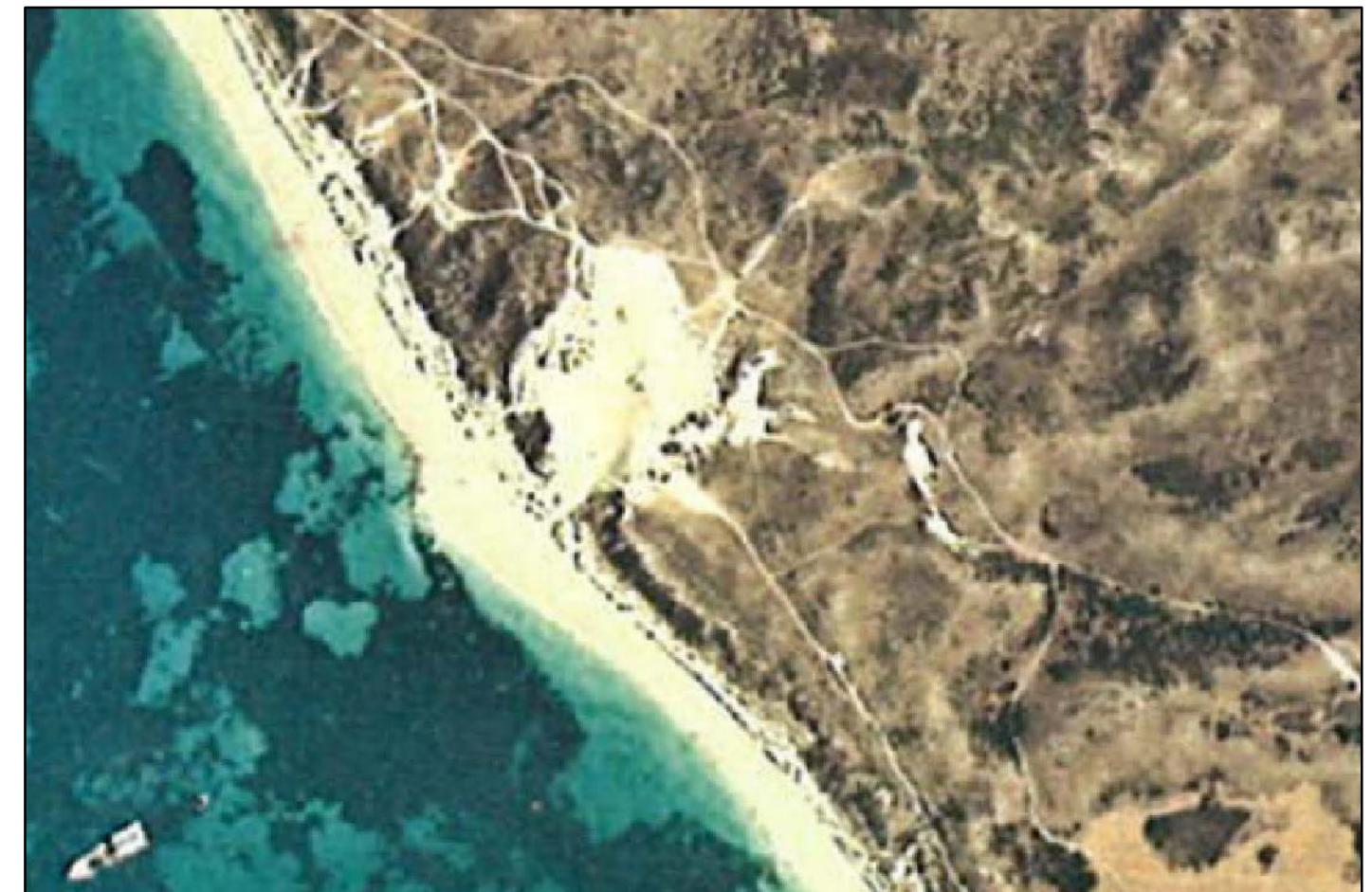
Date 7/12/2004



Date 1/01/2003



Date 14/12/2000



Date 4/01/1998

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	

PROJECT **Alkimos Foreshore Management Plan**
 DRAWING TITLE **FIGURE 4 : Historical Aerial Photography - Sand Blowout 1998 - 2008**
 PRINCIPAL **Peet Ltd**

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.

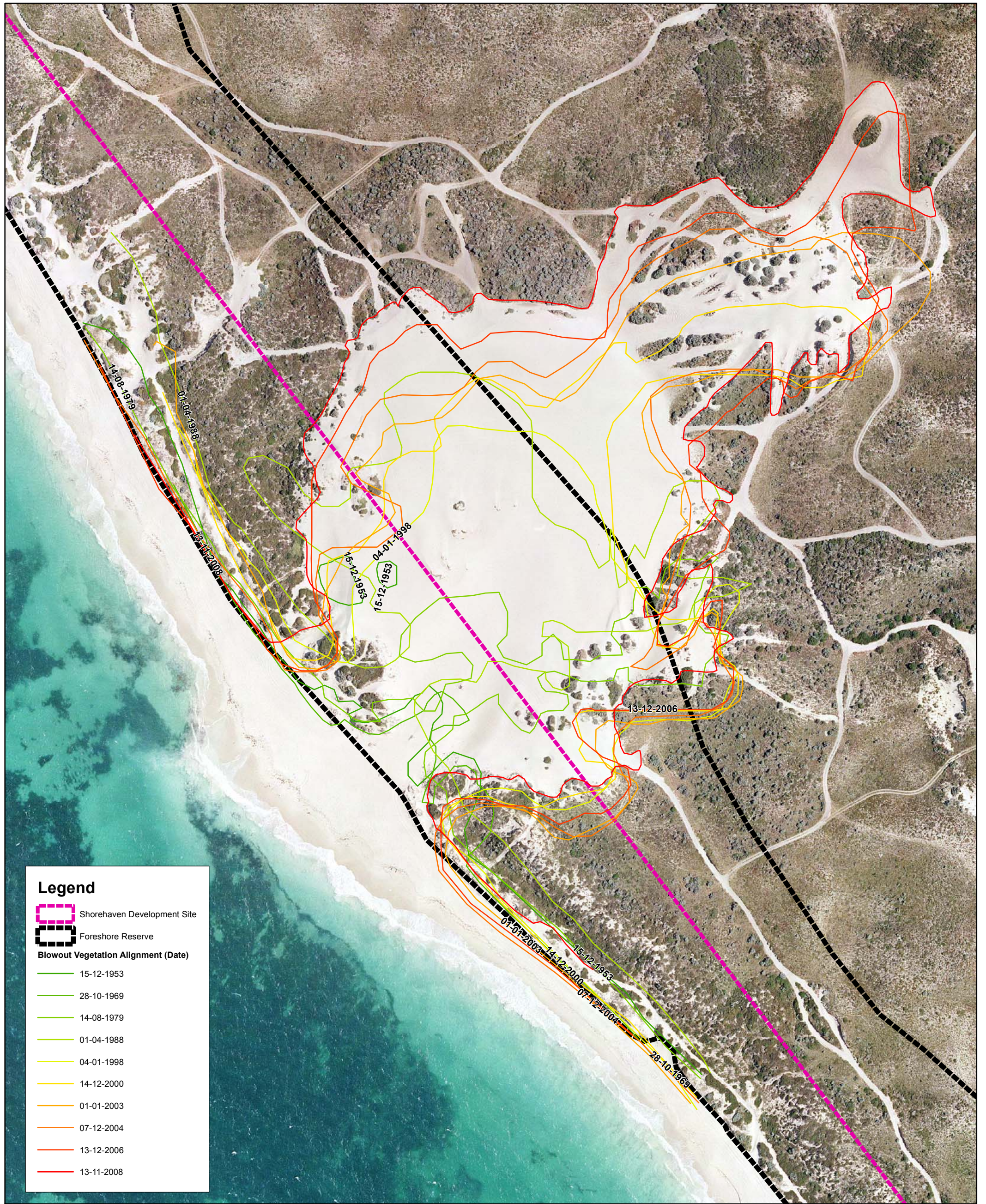
Scale: **1:6,000**

Cardno CONSULTING ENGINEERS
 TOWN PLANNERS
 PROJECT MANAGERS
 ENVIRONMENTAL CONSULTANTS













Cardno Centre 2 Bagot Road
 P.O. Box 155 Subiaco
 Western Australia 6904
 Telephone (08) 9273 3888
 Facsimile (08) 9388 3831

Project Number	Drawing Number	Revision	Original
V9034	SK03	00	A3

Designed GT Checked JL Date 24/12/10
 Drawn JKM Approved BP
 Local Authority City of Wanneroo Sheet 1 of 2



Legend

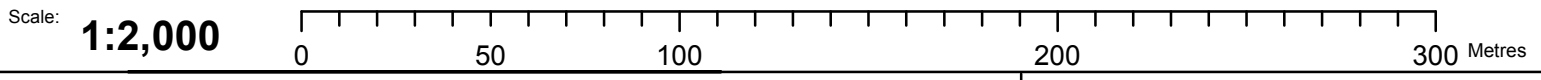
-  Shorehaven Development Site
-  Foreshore Reserve
- Blowout Vegetation Alignment (Date)**
-  15-12-1953
-  28-10-1969
-  14-08-1979
-  01-04-1988
-  04-01-1998
-  14-12-2000
-  01-01-2003
-  07-12-2004
-  13-12-2006
-  13-11-2008

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD



**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904
Telephone (08) 9273 3888
Facsimile (08) 9388 3831

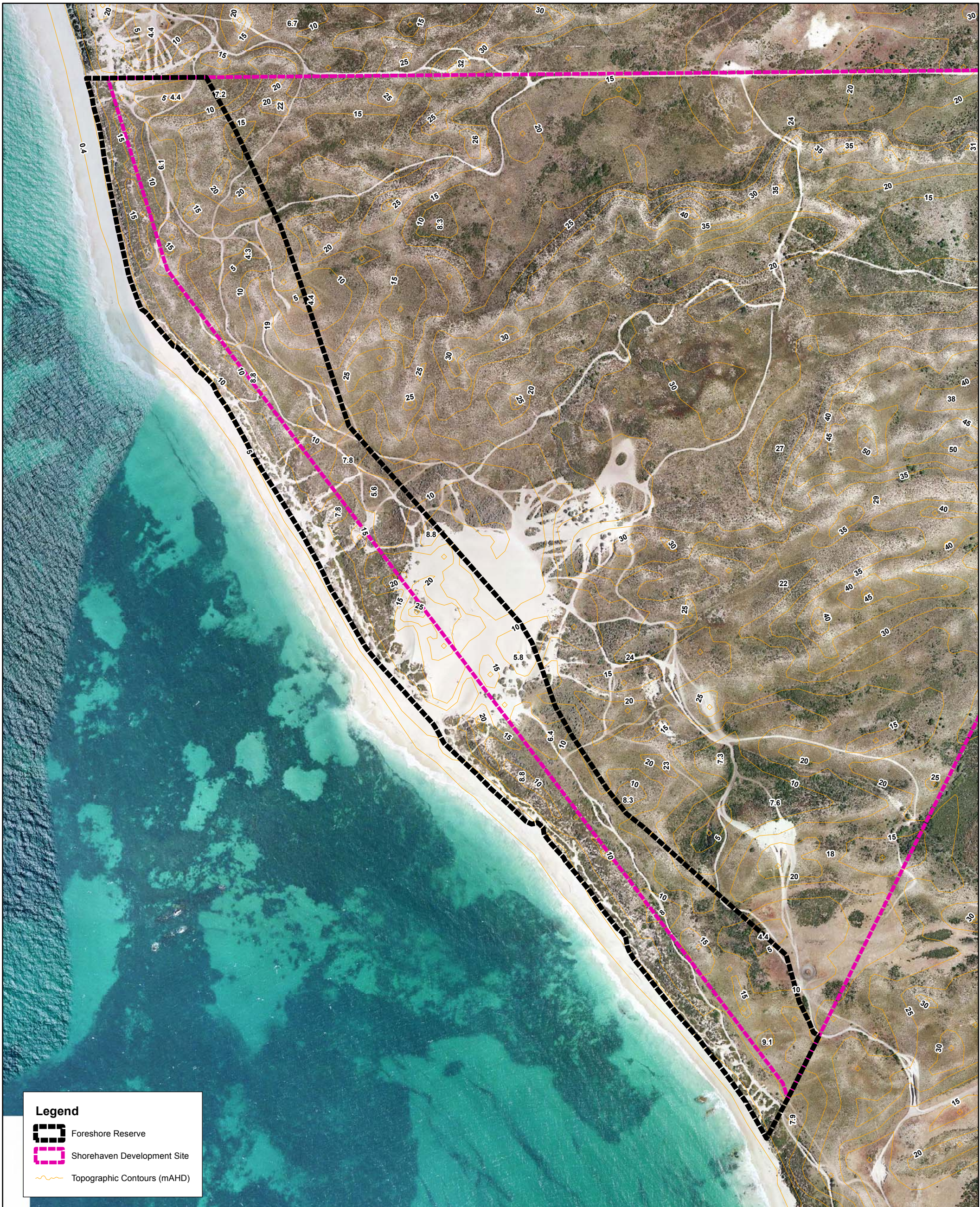


PROJECT **Alkimos Foreshore Management Plan**
DRAWING TITLE **FIGURE 5 : Historical Blowout Vegetation Alignment**
PRINCIPAL **Peet Ltd.**



Project Number **V9034** Original **A3**
Drawing Number **SK05** Revision
Designed GT Checked JL
Drawn JKM Approved BP
Local Authority City of Wanneroo
Sheet 1 of 1 Date 23/12/10

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



Legend

- Foreshore Reserve
- Shorehaven Development Site
- Topographic Contours (mAH)

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

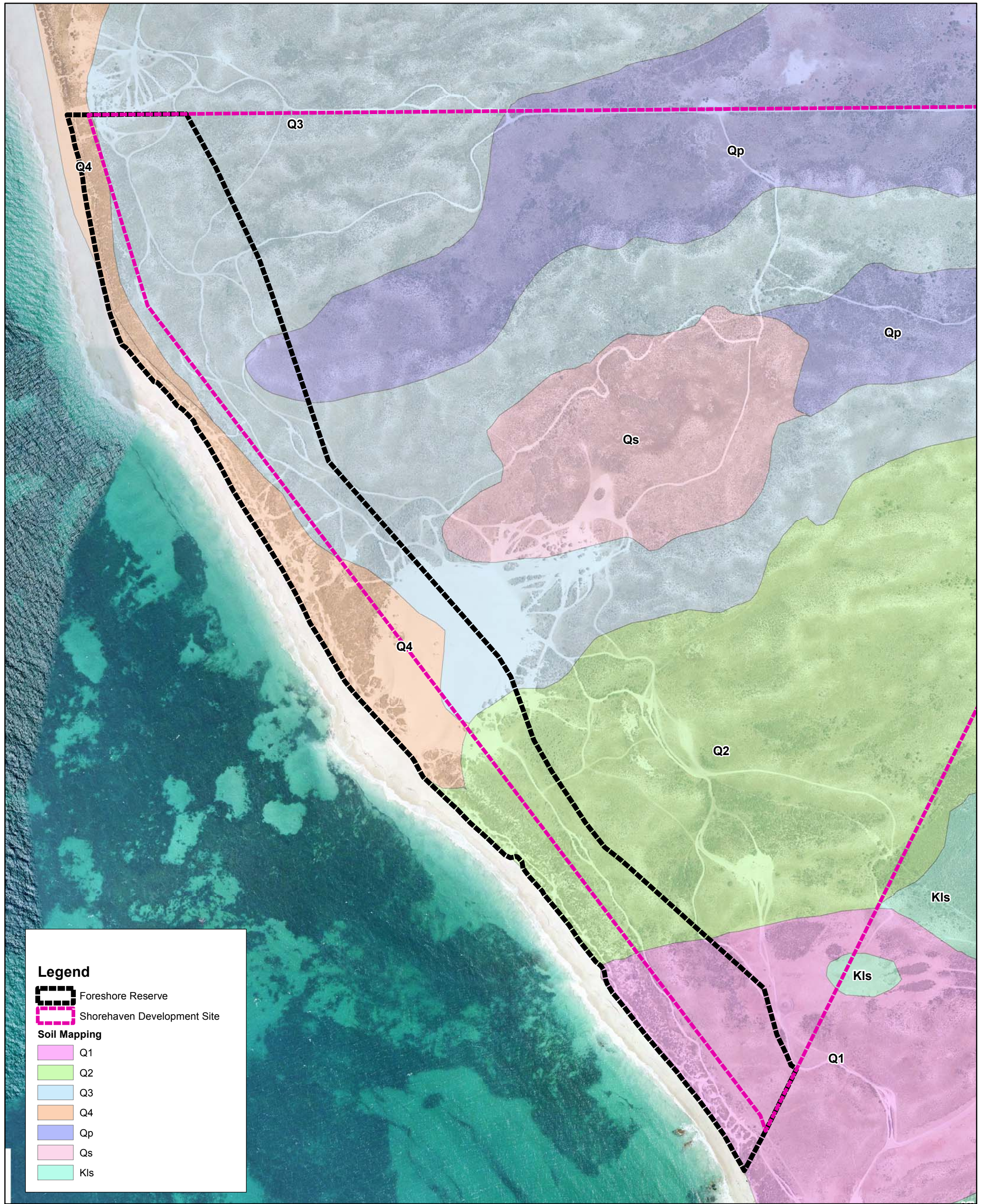
Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **1:5,000**

<p>PROJECT Alkimos Foreshore Management Plan</p> <p>DRAWING TITLE FIGURE 6 : Topography</p> <p>PRINCIPAL Peet Ltd.</p>	<p>Project Number V9034 Original A3</p> <p>Drawing Number SK06 Revision</p> <p>Designed GT Checked JL</p> <p>Drawn JKM Approved BP</p> <p>Local Authority City of Wanneroo</p> <p>Sheet 1 of 1 Date 07/05/10</p>
---	---

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



Legend

Foreshore Reserve

Shorehaven Development Site

Soil Mapping

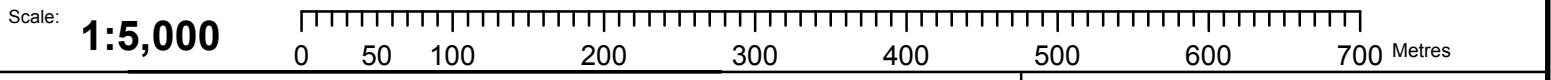
- Q1
- Q2
- Q3
- Q4
- Qp
- Qs
- Kls

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831



PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 7 : Soils**

PRINCIPAL **Peet Ltd.**

Project Number **V9034** Original **A3**

Drawing Number **SK07** Revision

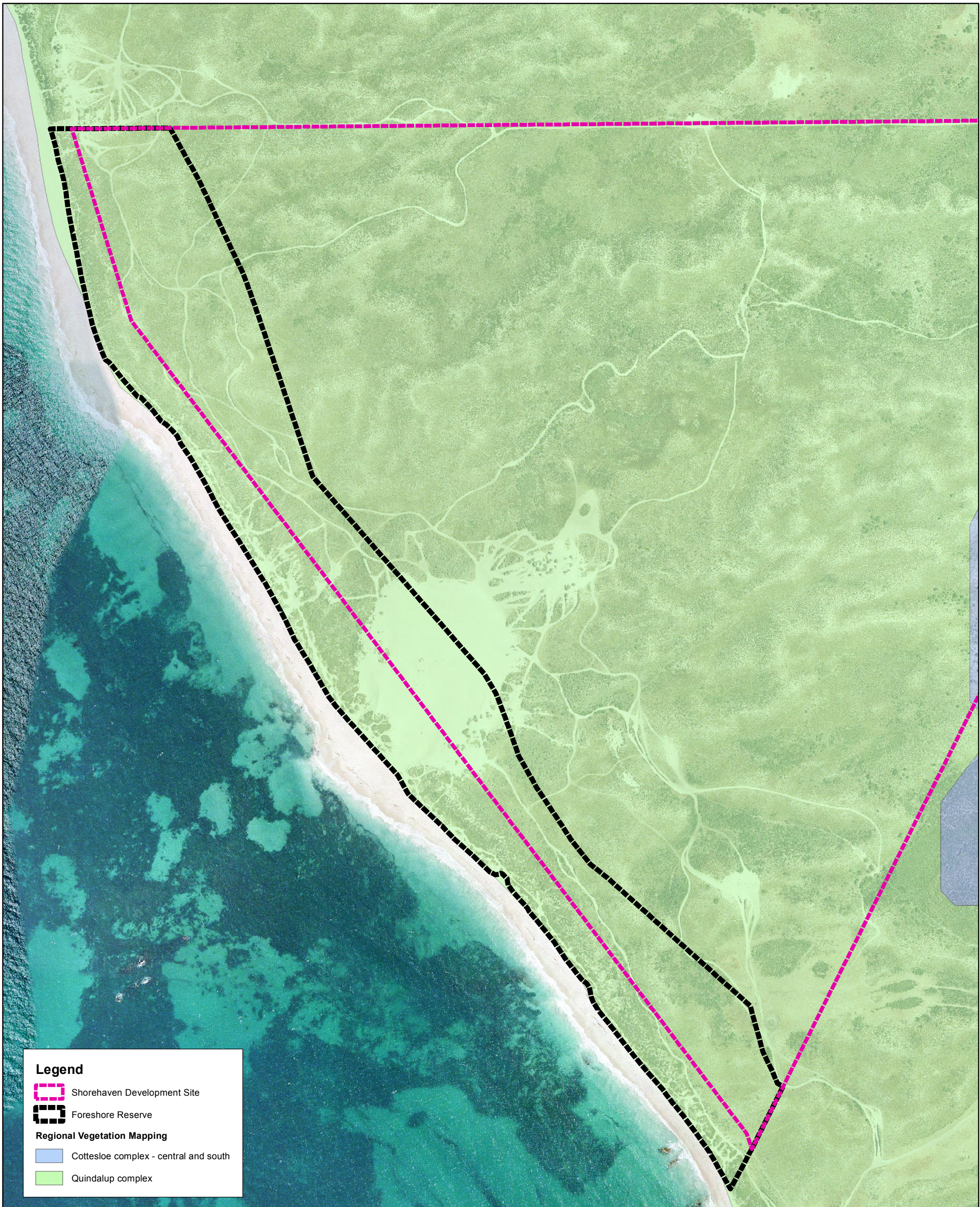
Designed GT Checked JL

Drawn JKM Approved BP



Local Authority City of Wanneroo

Sheet 1 of 1 Date 23/12/10



This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



Legend

-  Shorehaven Development Site
-  Foreshore Reserve

Regional Vegetation Mapping

-  Cottesloe complex - central and south
-  Quindalup complex

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

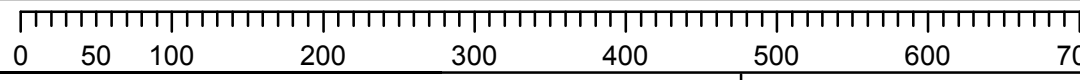


**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **1:5,000**



PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 8 : Regional Vegetation Mapping**

PRINCIPAL **Peet Ltd.**

Project Number **V9034** Original **A3**


Drawing Number **SK08** Revision

Designed GT Checked JL

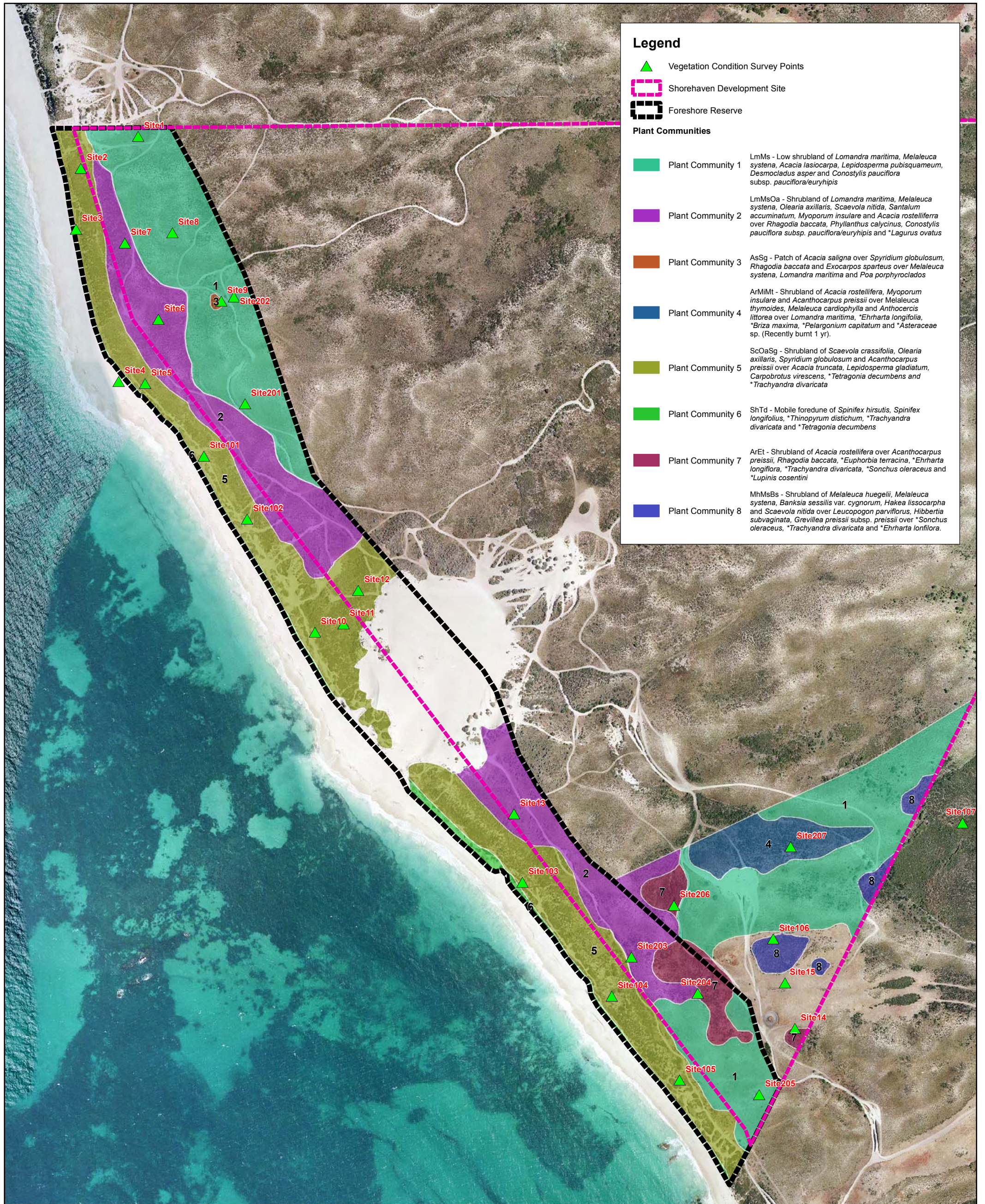
Drawn JKM Approved BP

Local Authority City of Wanneroo

Sheet 1 of 1 Date 07/05/10



This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

Cardno
CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **1:5,000**

0 50 100 200 300 400 500 600 700 Metres

PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 9 : Plant Communities**

PRINCIPAL **Peet Ltd.**

Project Number **V9034** Original **A3**

Drawing Number **SK09** Revision

Designed GT Checked JL

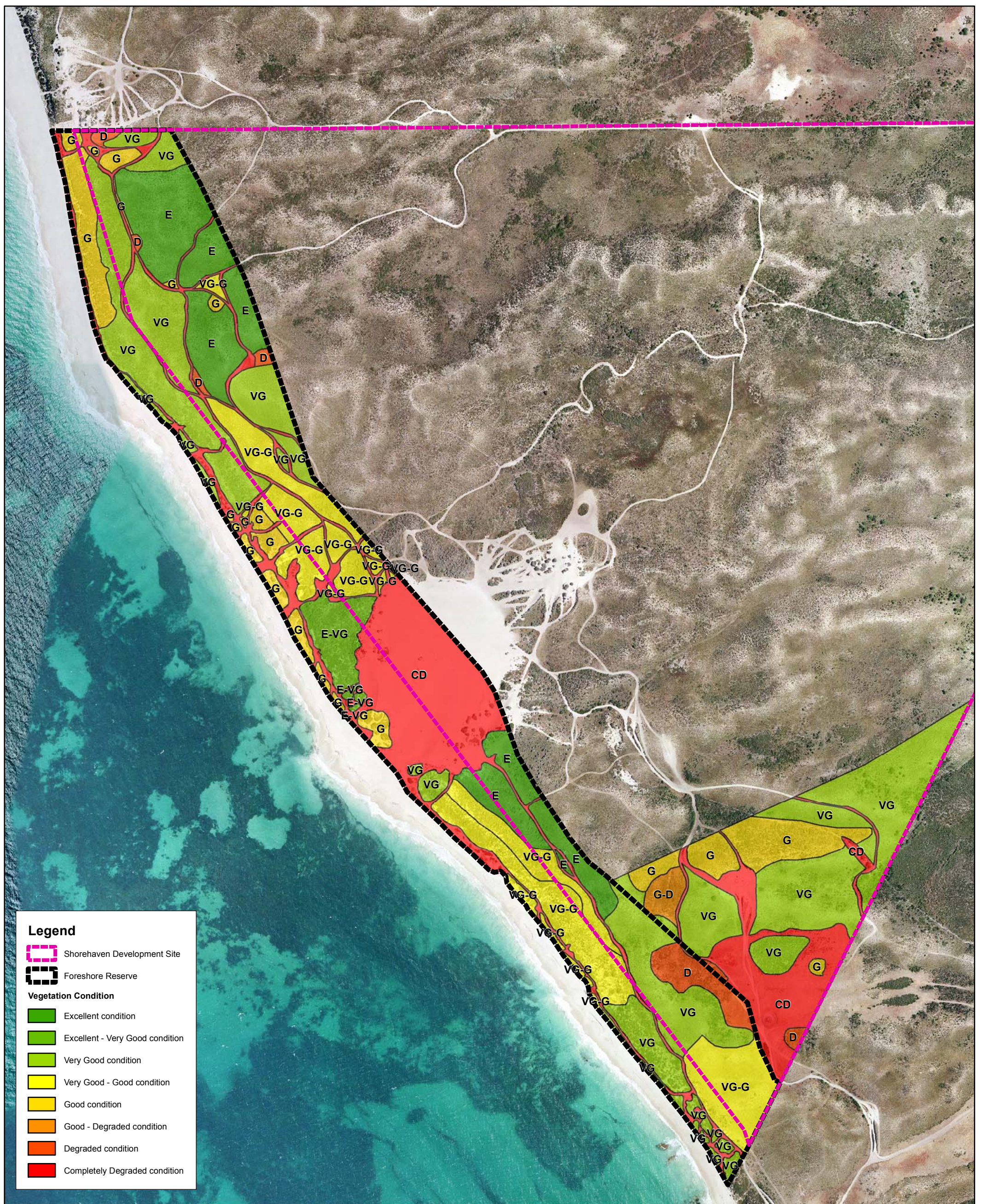
Drawn JKM Approved BP

Local Authority City of Wanneroo

Sheet 1 of 1 Date 23/12/10



This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



Legend

- Shorehaven Development Site
- Foreshore Reserve

Vegetation Condition

- Excellent condition
- Excellent - Very Good condition
- Very Good condition
- Very Good - Good condition
- Good condition
- Good - Degraded condition
- Degraded condition
- Completely Degraded condition

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD

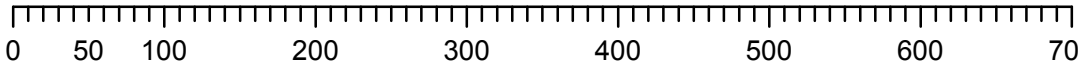


**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **1:5,000**



PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 10 : Vegetation Condition**

PRINCIPAL **Peet Ltd.**

Project Number **V9034** Original **A3**


Drawing Number **SK10** Revision

Designed GT Checked JL

Drawn JKM Approved BP

Local Authority City of Wanneroo

Sheet 1 of 1 Date 23/12/10



This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



- LEGEND**
- GRASS TREES
 - MATURE TRANSPARENT
 - 600 LITRE TREES
 - 200 LITRE TREES
 - 100 LITRE TREES
 - 75 LITRE TREES
 - 22.00 FINISHED LEVELS
 - COASTAL PROCESSES SETBACK LINE
- 1 Sand volleyball courts with spectator terracing overlooked by the beach club above
 - 2 Large grass recreational area provide scope for informal active play and relaxation. This area is large enough to allow kite flying or an informal kick about
 - 3 Beach permeates through into the main POS area to provide linkage from the grass to the ocean. This area to be used for beach huts and beach activity preparation such as kayaking, kite surfing etc
 - 4 Vehicular access ramp down to the beach provides emergency vehicle access and the potential for controlled boat access to the beach
 - 5 Major play facility for all ages
 - 6 Sculptural shade structure with associated BBQ facilities and seating
 - 7 Access steps down to the beach with landing area containing showers
 - 8 Rock revelements provide stabilisation and support to the base of the dune
 - 9 Rock groynes provide shelter from the south easterly winds. The shapes aim to re-create the dunal face and direct wind direction north along the base of the dune
 - 10 Main lookout point. This is a potential location for a sculptural leading light structure
 - 11 Beach Club building
 - 12 Trees planting to provide form, shade and character
 - 13 BBQ area with picnic benches and associated sculptural shade structures
 - 14 Lookout point with sculptural shade structure
 - 15 Grass terraces provide spectator seating for the volleyball courts as well as informal 'Cottlesoe' style sunbathing areas. Shade to be provided
 - 16 Car parking area for Beach Club and foreshore POS. 100 parking bays in total
 - 17 Access path down from promenade to beach Club
 - 18 Grassed terrace provides informal active play space
 - 19 Car parking area for the play area and foreshore. 38 parking bays in total
 - 20 Car parking along foreshore side of road. 22 parking bays in total
 - 21 Drop of and turning area for cars
 - 22 Lookout platform situated on high point of dunes. Sculptural structure to be provided with interpretation and seating
 - 23 Access steps up to footpath leading to lookout points
 - 24 Main north south foreshore dual use path
 - 25 Nodal points along foreshore footpath network provide opportunities for seating, interpretation, shade etc
 - 26 Interface nodal point on promenade highlights intersection of the Viggo trail and the Foreshore footpath network. Nodes to include seating, shade and interpretation with foreshore mapping
 - 27 'The Promenade'. Reminiscent of famous beach walks such as the Copacabana Promenade will create a strong designed pedestrian walkway along the entire foreshore/development interface. It provides opportunity for sculpture, interpretation etc as well as typical public realm provisions such as seating, shade etc. the Promenade will be formed using a strong paving pattern easily recognised and followed.
 - 28 Main access steps and ramp from the main street down to the beach Club will enforce this strong axis and create a grand entry into the foreshore POS.
 - 29 Sculptural shade structures will be used around the foreshore POS to strengthen and highlight the form and provide opportunities for seating etc. the shade structures will be 'organic' in form to contrast with the geometric layout of the POS.
 - 30 Drainage basin created using the natural topography of the dune and completed with limestone retaining walls adjacent to the POS development area. Basins to be planted with typical coastal wetland vegetation.
 - 31 Footbridge across the drainage basin provides and opportunity for a raised walkway over the dunal wetland vegetation in the basin. Interpretation can be provided.
 - 32 Ramps are provided around the POS to ensure disabled access is available all the way down to the beach.
 - 33 Foreshore POS lookout point. This raised platform at the end of the main street provides a good opportunity to look out over the POS to the ocean beyond. A flagpole or iconic tall sculpture could be provided here as a focus.
 - 34 Bands of native foreshore planting to create a strong visual layout.
 - 35 Native tree and shrub planting supplemented with other species such as Norfolk Island Pines to create a strong visual landscape
 - 36 Strong paving patterns will help enforce spatial arrangement and create an iconic public space. Colour and texture differences in the paving will help this
 - 37 Street tree planting to provide legibility, character and foraging for native bird species.
 - 38 Walls create terraces within the POS and resolve level changes across the site. The walls enforce the strong patterning in the POS as well as providing informal seating.
 - 39 Grass embankment



DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------

PROJECT	Alkimos Foreshore Management Plan	Scale:	
DRAWING TITLE	FIGURE 11 : Foreshore Landscape Plan	Cardno CONSULTING ENGINEERS TOWN PLANNERS PROJECT MANAGERS ENVIRONMENTAL CONSULTANTS	Cardno Centre 2 Bagot Road P.O. Box 155 Subiaco Western Australia 6904 Telephone (08) 9273 3888 Facsimile (08) 9388 3831
PRINCIPAL	Peet Ltd		
		Project Number	Drawing Number
		V9034	SK12
		Revision	Original
		00	A3
		Designed	Checked
		JG	MGW
		Drawn	Approved
		Local Authority	City of Wanneroo
		Date:	2/08/2011
		Sheet	1 of 1

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



- LEGEND**
- DEVELOPMENT AREAS (RESIDENTIAL AND COMMERCIAL)
 - PROPOSED DRAINAGE BASIN LOCATION (SIZE AND LOCATION INDICATIVE), REFER TO ENGINEERS SITE DRAINAGE STRATEGY DIAGRAM
 - SEWER PUMP STATION
 - REGIONAL OPEN SPACE
 - VILLAGE FORESHORE PARK REFER TO SKETCH PLAN FOR DETAILS
 - FORESHORE RESERVE AREAS TO BE FENCED OFF AND RE-VEGETATION CARRIED OUT AS NECESSARY TO DEGRADED AREAS
 - DEVELOPMENT AREA PUBLIC OPEN SPACE RESERVES
 - MAJOR NODE
 1. MAIN NORTHERN PEDESTRIAN AND VEHICULAR INTERFACE AND ACCESS POINT TO THE FORESHORE RESERVE. TO INCLUDE SHOWERS, BBQ, SEATING AND SHADE
 2. NORTHERN FORESHORE PEDESTRIAN AND CARPARK NODE. TO INCLUDE 20 CAR BAYS, SEATING AND SHADE. PROVIDES ACCESS POINT TO MAIN NORTH/SOUTH PEDESTRIAN PATH AND BEACH
 - 3 + 4. PEDESTRIAN INTERFACE NODE WITH VIGGO TRAIL, PROMENADE AND FORESHORE RESERVE. INCLUDES SEATING, DRINKING FOUNTAIN AND SHADE.
 - LOOKOUT POINTS TO INCLUDE VIEWING DECK WITH SEATING, SHADE AND INTERPRETATION REFER TO TYPICAL DETAILS
 - MINOR PEDESTRIAN NODES MINOR NODES TO BE LOCATED AT MAIN PATH INTERSECTIONS. THEY WILL PROVIDE REST POINTS WITH ASSOCIATED SEATING, SHADE AND SIGNAGE
 - VEHICLE ACCESS ROAD TO BEACH ACCESS CARPARK
 - MAIN NORTH/SOUTH COASTAL PROMENADE AND BIKE TRAIL
 - VIGGO TRAIL (PRIMARY PEDESTRIAN ROUTE)
 - VIGGO TRAIL (SECONDARY PEDESTRIAN ROUTE)
 - PRIMARY NORTH/SOUTH FORESHORE PEDESTRIAN ACCESS ROUTE
 - SECONDARY PEDESTRIAN FORESHORE ACCESS
 - FORESHORE PEDESTRIAN RAMP
 - FORESHORE PEDESTRIAN STEPS
 - PEET OWNERSHIP BOUNDARY
 - MRS FORESHORE RESERVE BOUNDARY
 - PROPOSED BOUNDARY OF ROAD CORRIDOR WITHIN FORESHORE RESERVE
 - COASTAL PROCESSES SETBACK LINE (ROGERS 2010)

NOTES:

- FOR TYPICAL DETAILS OF ROAD/FORESHORE INTERFACETREATMENTS REFER TO TYPICAL SECTIONS
- PLEASE REFER TO EPCAD SKETCH PLAN FOR DETAILS OF THE VILLAGE FORESHORE PARK
- PLEASE REFER TO TYPICAL DETAILS FOR DRAINAGE MANAGEMENT SOLUTIONS

NOT TO SCALE
REV G - 20.03.12

shorehaven
ALKIMOS

FORESHORE MASTERPLAN

MAY 2010 **PEET** **EPCAD**

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APP'D	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APP'D

Cardno
CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
P.O. Box 155 S ubiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **Not To Scale**

PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 12: Foreshore Movement Network**

PRINCIPAL **Peet Ltd.**

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno VVA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.

Project Number **V9034** Original **A3**

Drawing Number **SK12** Revision

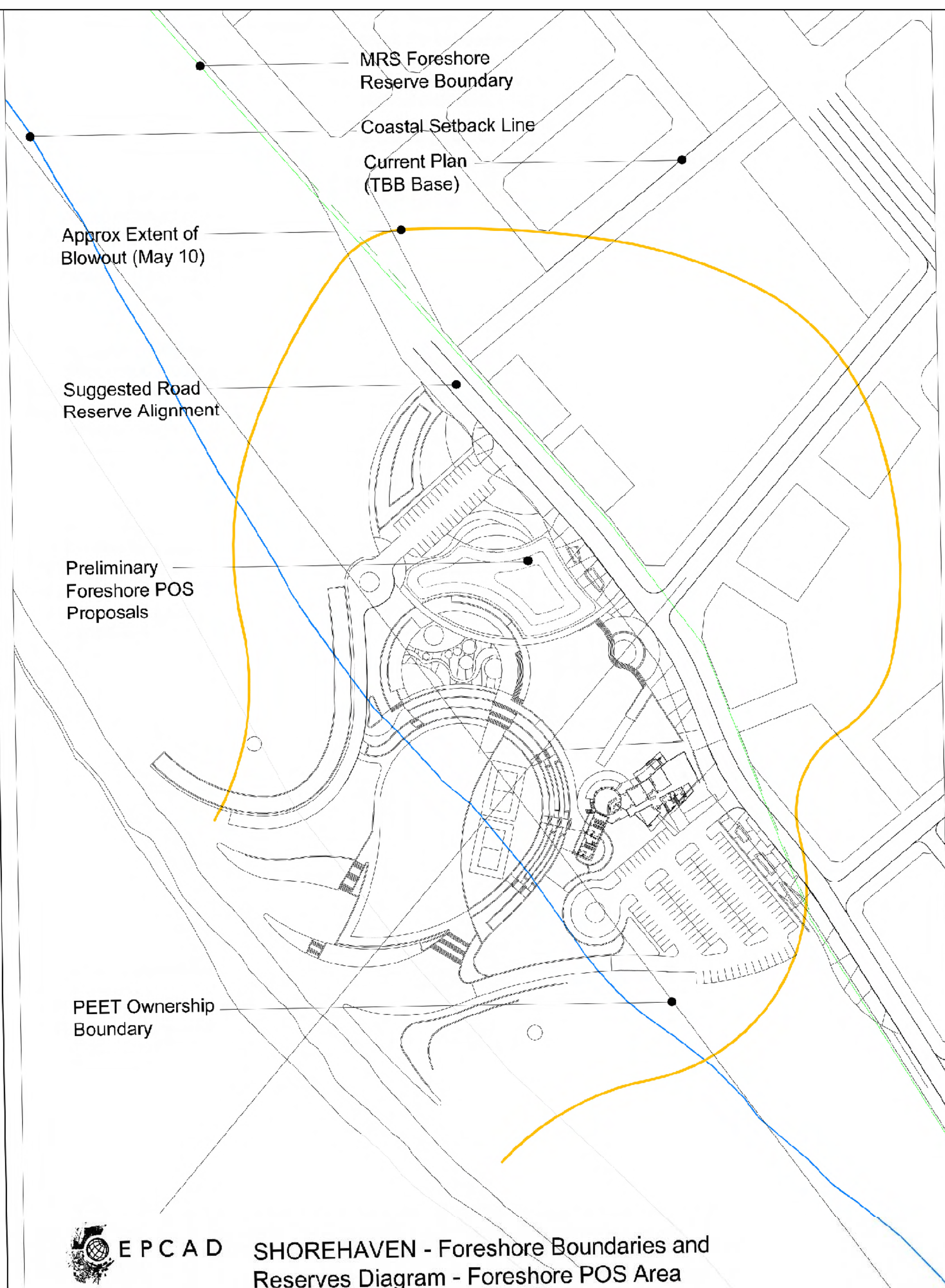
Designed **DCD** Checked **BP**

Drawn **DCD** Approved **BP**

Local Authority **City of Wanneroo**

Sheet 1 of 1 Date **20.03.12**





E P C A D

SHOREHAVEN - Foreshore Boundaries and Reserves Diagram - Foreshore POS Area

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------



**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904
Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale: **1:1,500** 0 25 50 100 150 200 Metres

PROJECT **Alkimos Foreshore Management Plan**
DRAWING TITLE **FIGURE 13 : Foreshore Boundaries & Reserves**
PRINCIPAL **Peet Ltd.**

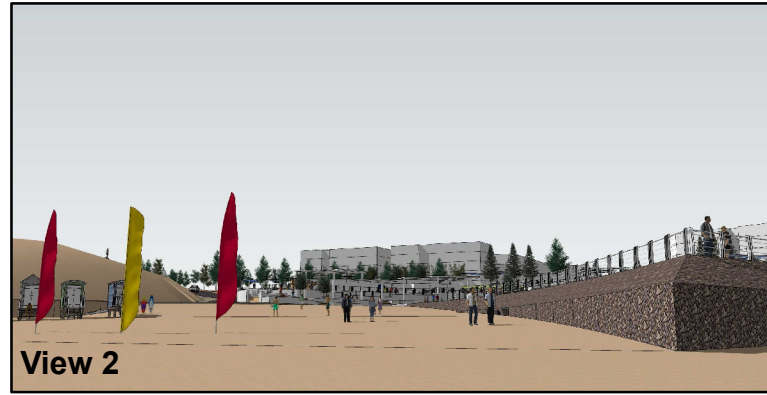
Project Number **V9034** Original **A3**
Drawing Number **SK14** Revision
Designed GT Checked JL
Drawn JKM Approved BP
Local Authority City of Wanneroo
Sheet 1 of 1 Date 23/12/10



This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



View 1



View 2



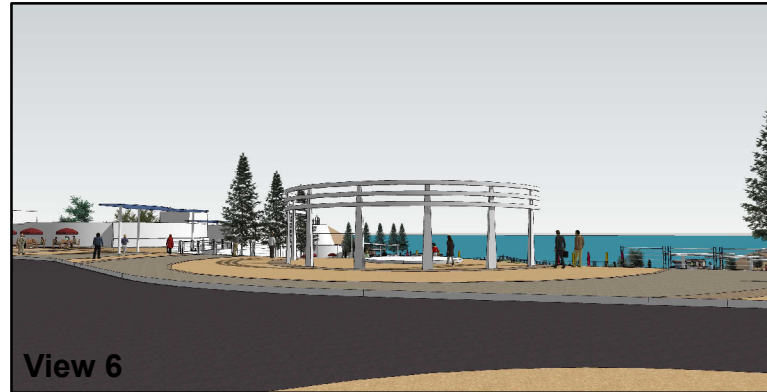
View 3



View 4



View 5



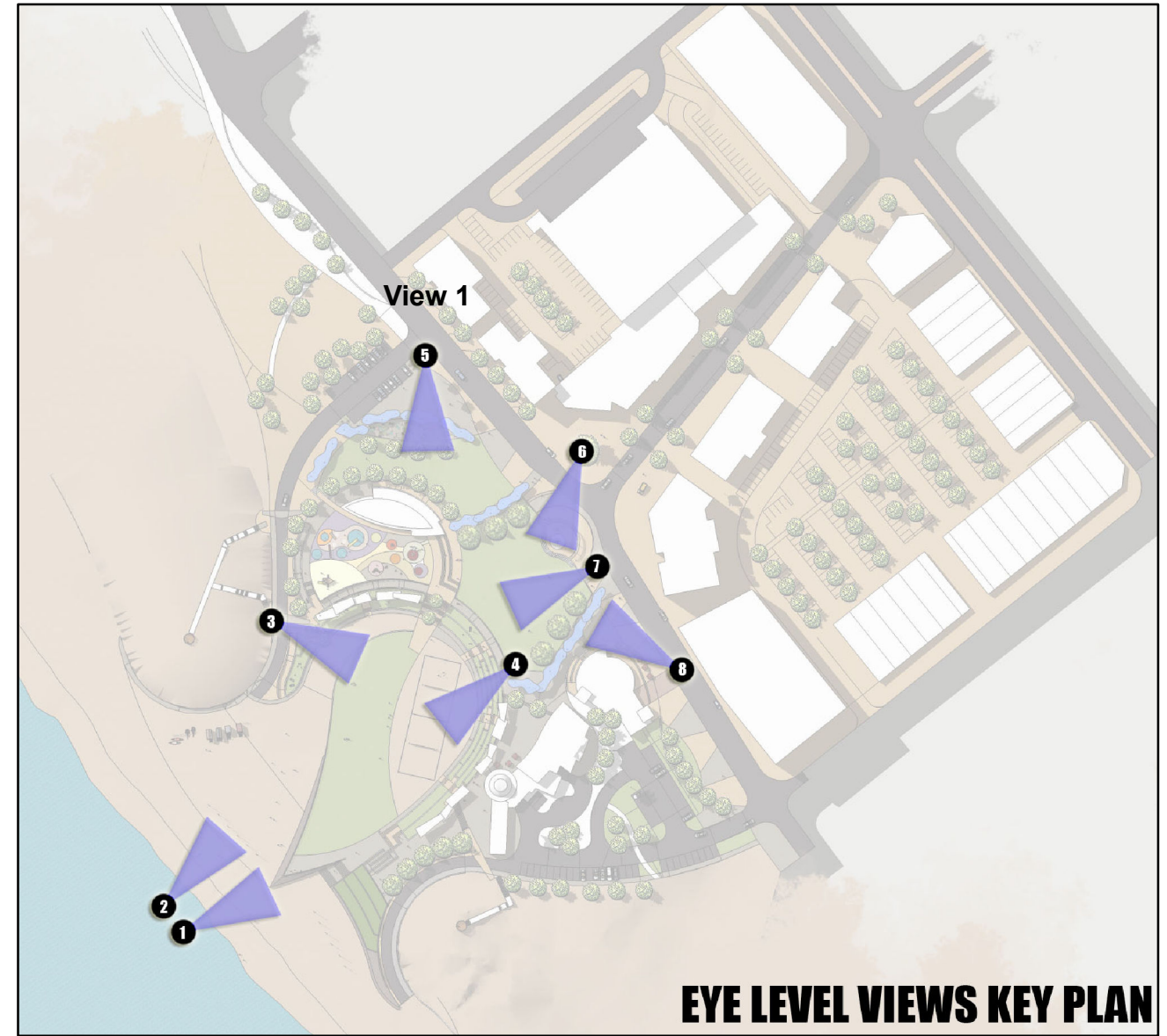
View 6



View 7



View 8



EYE LEVEL VIEWS KEY PLAN



DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	

PROJECT **Alkimos Foreshore Management Plan**
 DRAWING TITLE **FIGURE 14 : Village Foreshore Park Viewsheds**
 PRINCIPAL **Peet Ltd**

Scale:

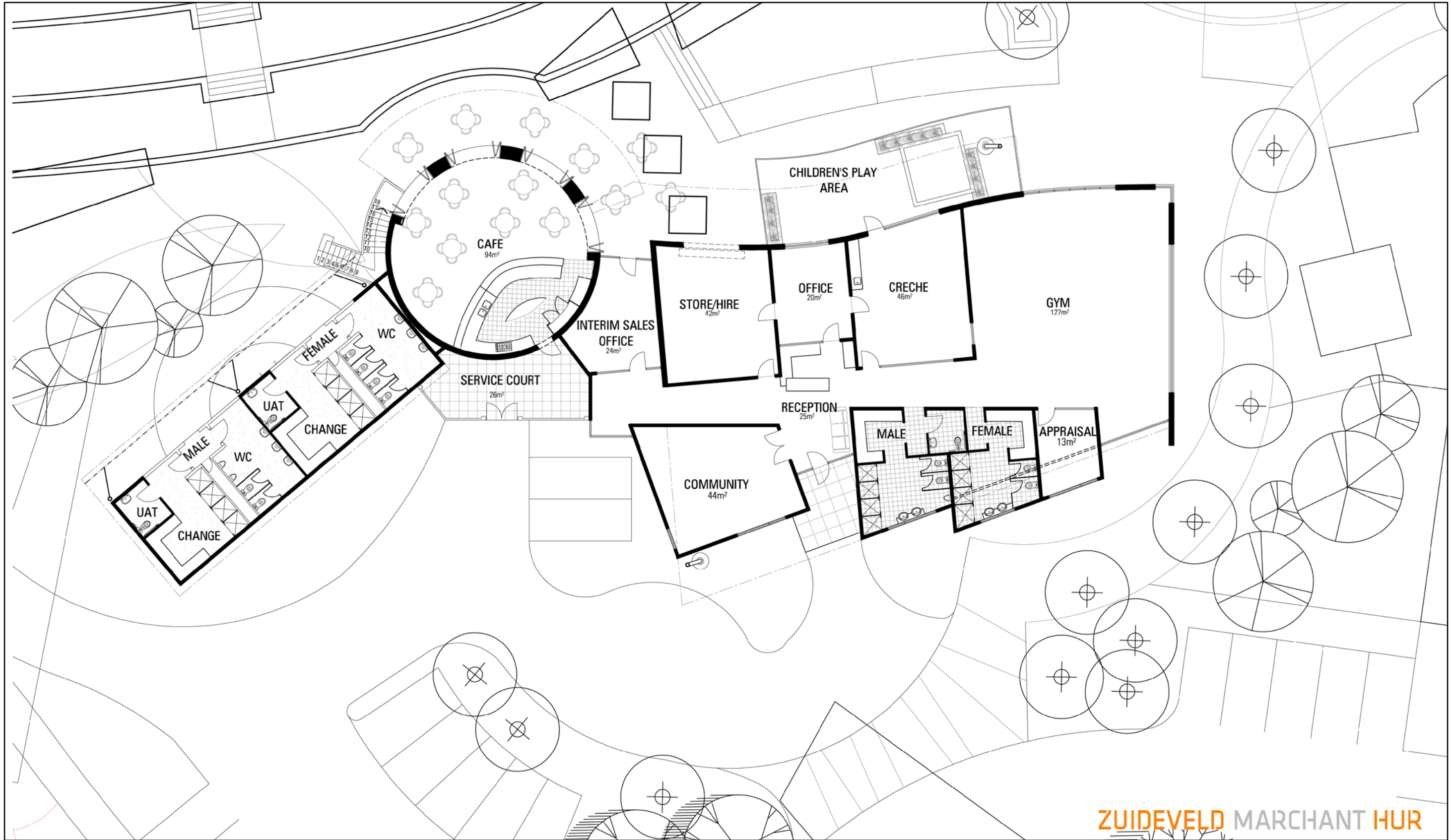


**CONSULTING ENGINEERS
 TOWN PLANNERS
 PROJECT MANAGERS
 ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
 P.O. Box 155 Subiaco
 Western Australia 6904
 Telephone (08) 9273 3888
 Facsimile (08) 9388 3831

Project Number V9034	Drawing Number SK16	Revision 00	Original A3
Designed JL	Checked JL	Date: 23/12/2010	
Drawn MGW	Approved BP		
Local Authority City of Wanneroo			Sheet 1 of 1

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



ZUIDEVELD MERCHANT HUR

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------

PROJECT **Alkimos Foreshore Management Plan**
 DRAWING TITLE **FIGURE 15: Indicative Concept design of Beach Club**
 PRINCIPAL **Peet Ltd**



Scale:

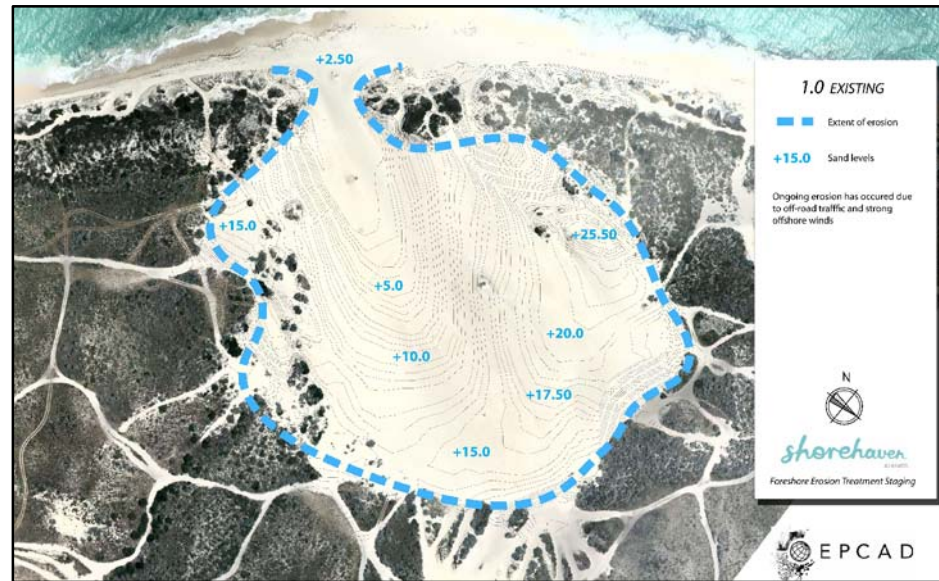


**CONSULTING ENGINEERS
 TOWN PLANNERS
 PROJECT MANAGERS
 ENVIRONMENTAL CONSULTANTS**

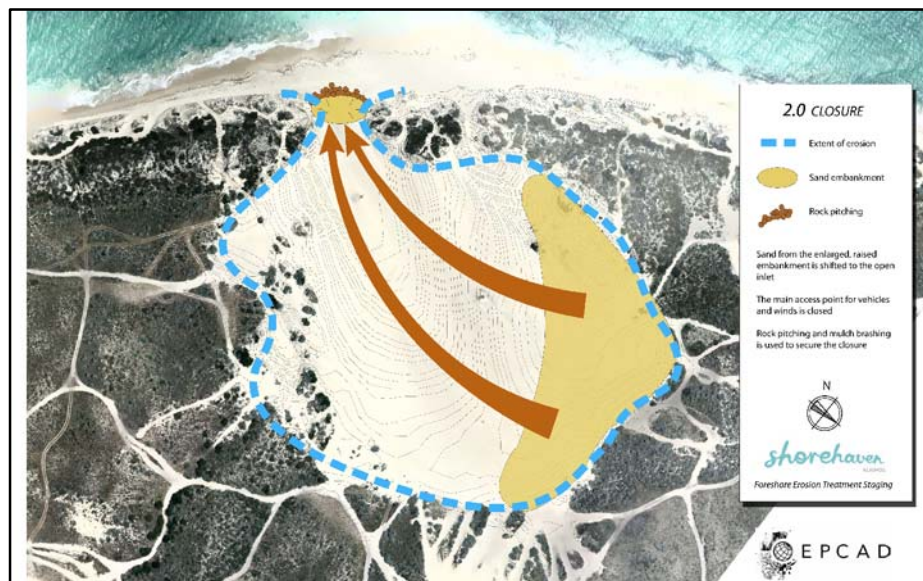
Cardno Centre 2 Bagot Road
 P.O. Box 155 Subiaco
 Western Australia 6904
 Telephone (08) 9273 3888
 Facsimile (08) 9388 3831

Project Number V9034	Drawing Number SK13	Revision 00	Original A3
Designed JL	Checked JL	Date: 23/12/2010	
Drawn MGW	Approved BP	Sheet 1 of 1	
Local Authority City of Wanneroo			

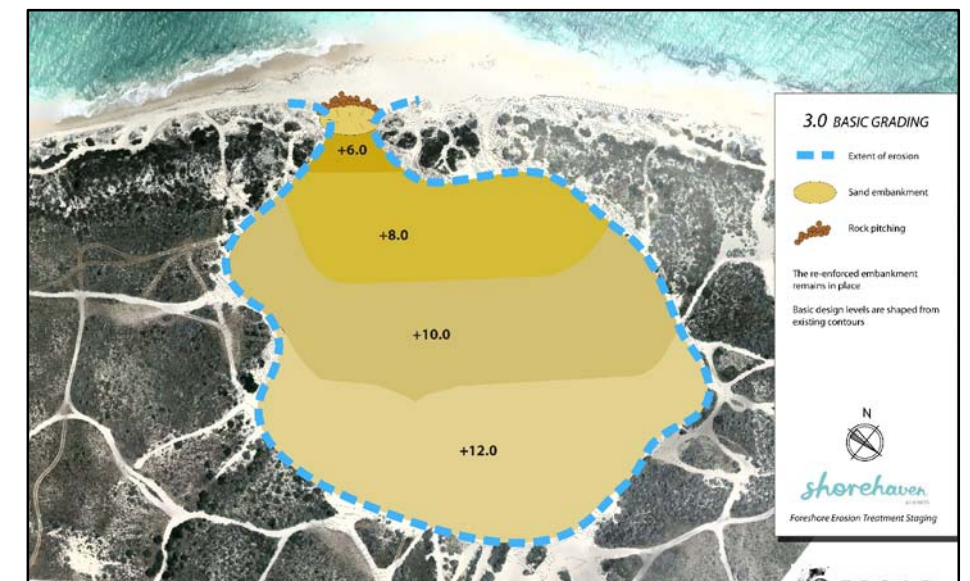
This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



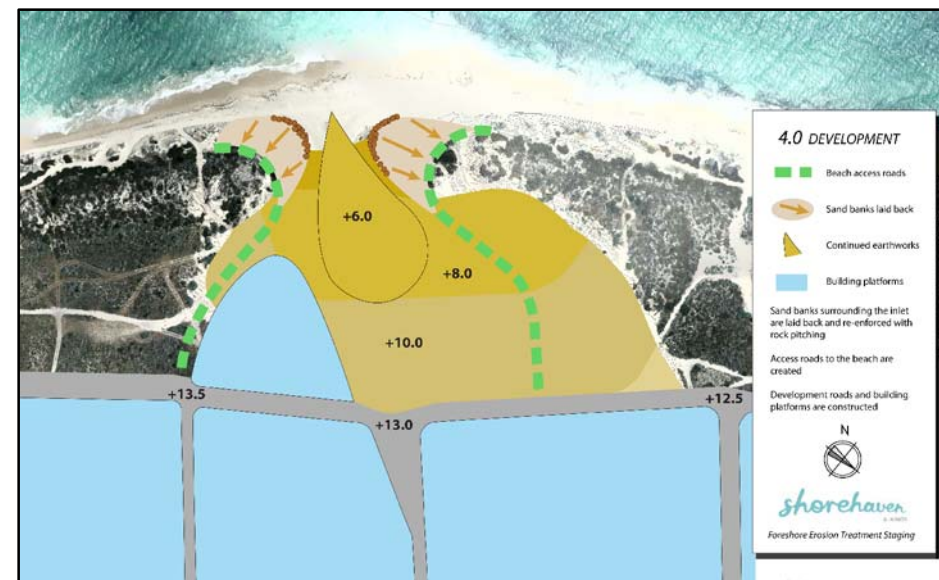
Stage 1



Stage 2



Stage 3



Stage 4



Stage 5



Stage 6

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	

PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 16 : Staging concept for Stabilisation of the blow out**

PRINCIPAL **Peet Ltd**

Scale:

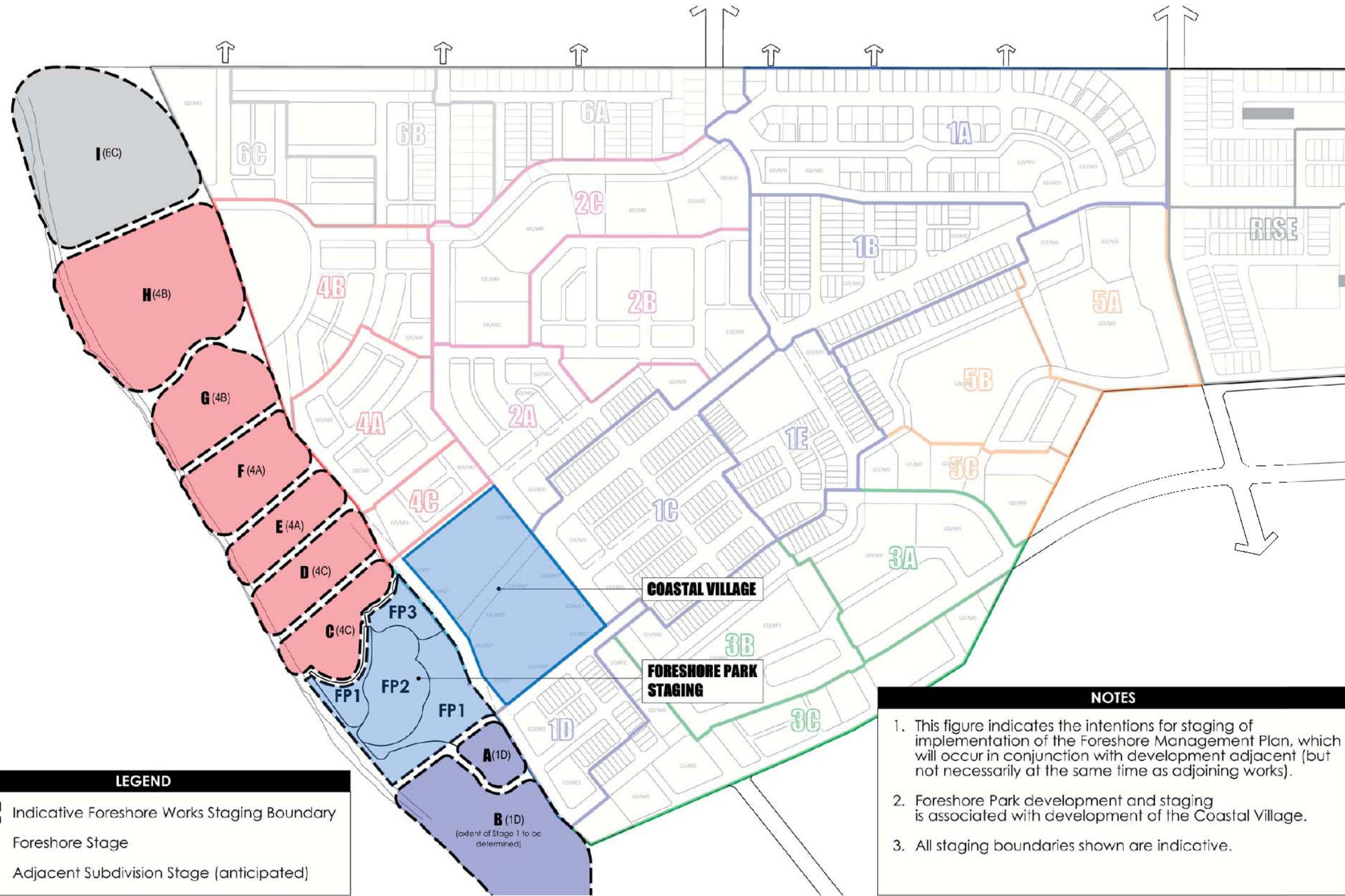


CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904
Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Project Number V9034	Drawing Number SK17	Revision 00	Original A3
Designed JL	Checked JL	Date: 23/12/2010	
Drawn MGW	Approved BP		
Local Authority City of Wanneroo		Sheet 1 of 1	

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



LEGEND

Indicative Foreshore Works Staging Boundary

C Foreshore Stage

(4C) Adjacent Subdivision Stage (anticipated)

NOTES

1. This figure indicates the intentions for staging of implementation of the Foreshore Management Plan, which will occur in conjunction with development adjacent (but not necessarily at the same time as adjoining works).
2. Foreshore Park development and staging is associated with development of the Coastal Village.
3. All staging boundaries shown are indicative.

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------

PROJECT **Alkimos Foreshore Management Plan**

DRAWING TITLE **FIGURE 17: Staging of Restoration and Rehabilitation**

PRINCIPAL **Peet Ltd**



Scale:

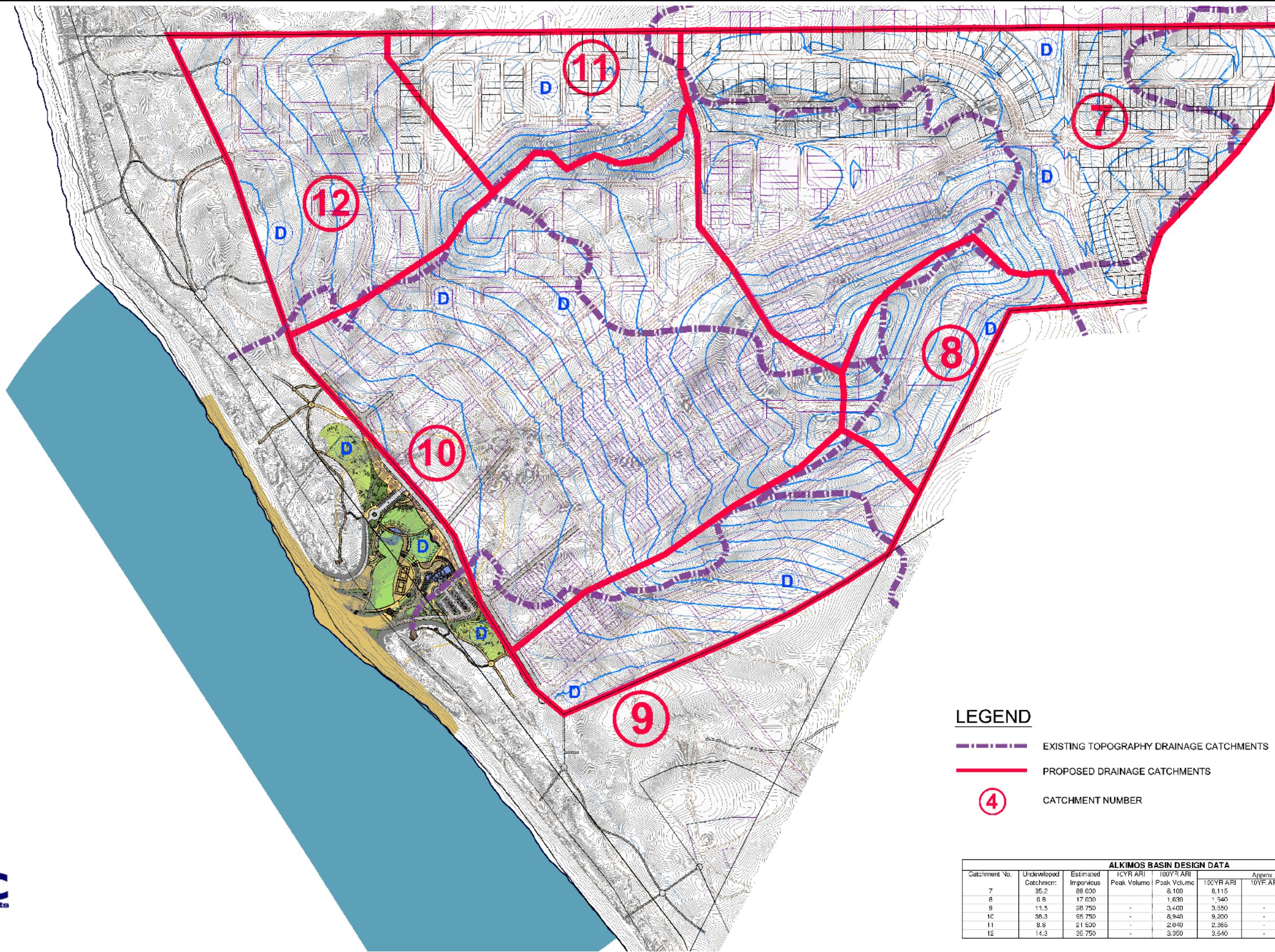


**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904
Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Project Number V9034	Drawing Number SK17	Revision 00	Original A3
Designed GB	Checked MGW	Date: 18/07/2011	
Drawn MGW	Approved	Sheet 1 of 1	
Local Authority City of Wanneroo			

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



LEGEND

- EXISTING TOPOGRAPHY DRAINAGE CATCHMENTS
- PROPOSED DRAINAGE CATCHMENTS
- CATCHMENT NUMBER

Catchment No.	Undeveloped Catchment	Estimated Impervious	1CYR ARI		10CYR ARI		Average Basin Area (m ²)	
			Peak Volume	Peak Volume	10CYR ARI	10CYR ARI	1CYR ARI	1CYR ARI
7	35.2	88 000	8,100	8,115	8,115	6,745	6,320	
8	0.8	17 000	1,630	1,340	-	1,375	1,180	
9	11.5	28 750	-	3,400	3,550	-	2,640	
10	38.3	95 750	8,940	9,200	-	7,350	6,755	
11	8.6	21 500	2,040	2,365	-	1,720	1,905	
12	14.3	35 750	-	3,350	3,540	-	2,790	

TABEC
Civil Engineering Consultants
TABEC Pty Ltd ACN 090 706 204
14 Wickham Street, East Perth WA 6004
Telephone 9225 4100, Fax 9225 4199
Email info@tabec.com.au

DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD
------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------	------	-----	---------------------------------	-----	-----	-------	------

PROJECT **Alkimos Foreshore Management Plan**
DRAWING TITLE **FIGURE 18 : Shorehaven Drainage Concept Plan**
PRINCIPAL **Peet Ltd**



Scale:

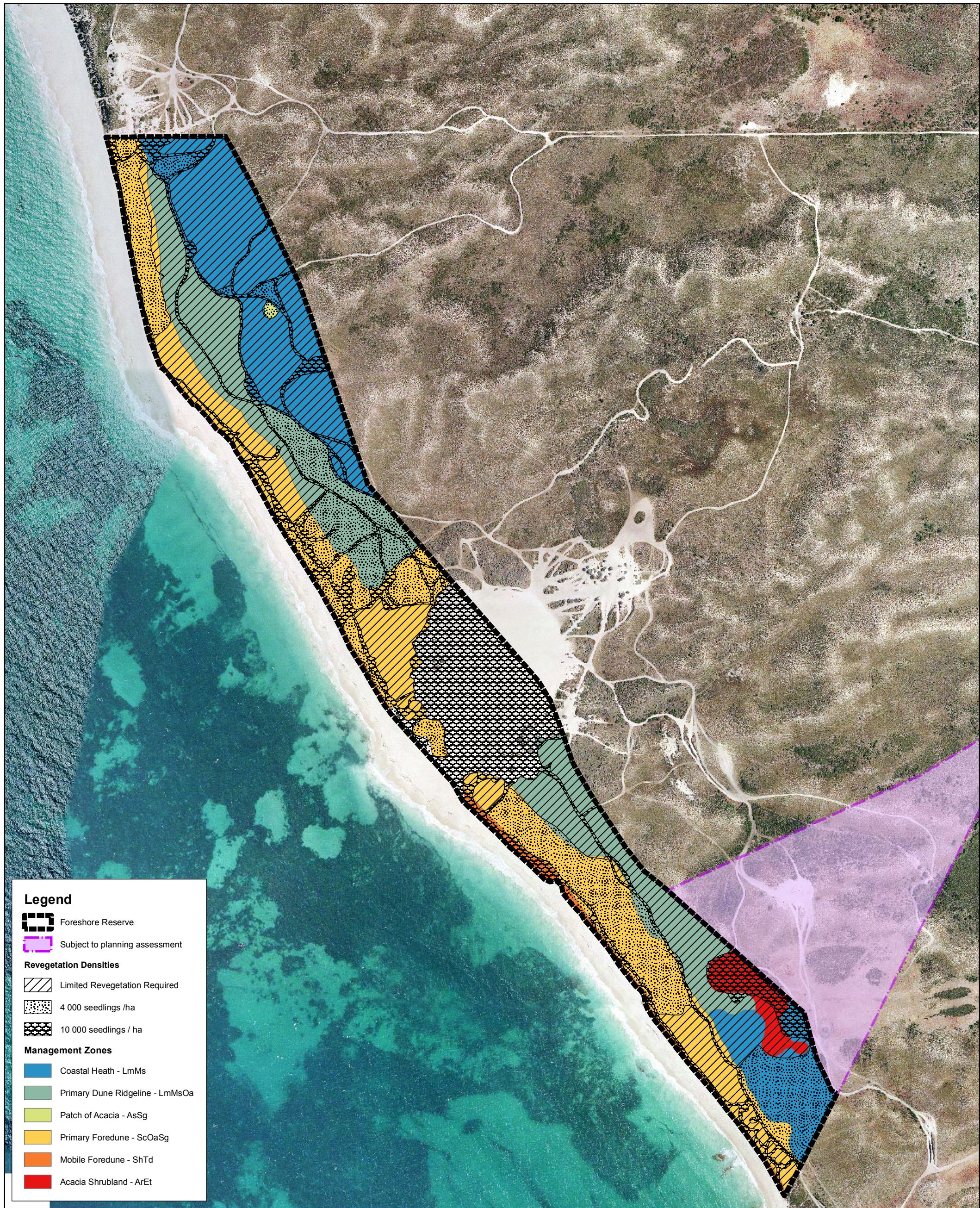


**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904
Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Project Number V9034	Drawing Number SK19	Revision 00	Original A3
Designed JL	Checked MGW	Approved MGW	Date: 2/08/2011
Local Authority City of Wanneroo			Sheet 1 of 1

This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.



DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD	DATE	No.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHK'D	APPD



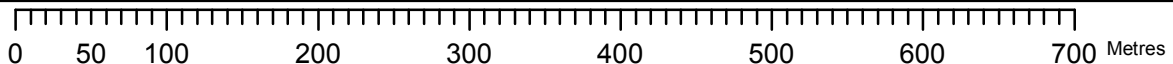
**CONSULTING ENGINEERS
TOWN PLANNERS
PROJECT MANAGERS
ENVIRONMENTAL CONSULTANTS**

Cardno Centre 2 Bagot Road
P.O. Box 155 Subiaco
Western Australia 6904

Telephone (08) 9273 3888
Facsimile (08) 9388 3831

Scale:

1:5,000



PROJECT **Alkimos Foreshore Management Plan**
DRAWING TITLE **FIGURE 19: Revegetation Plan**
PRINCIPAL **Peet Ltd.**

Project Number V9034	Original A3
Drawing Number SK11	Revision
Designed GT	Checked JL
Drawn JKM	Approved BP
Local Authority City of Wanneroo	
Sheet 1 of 1	Date 23/12/10



This drawing has been prepared in accordance to Cardno Quality Management System. It remains the property of Cardno WA Pty. Ltd. and shall not be used without permission. The drawing shall be preliminary only and/or not for construction until signed approved.

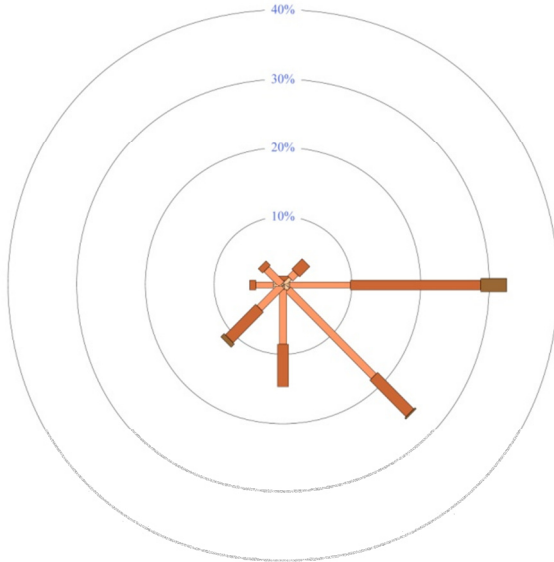
Appendix A

Wind Roses

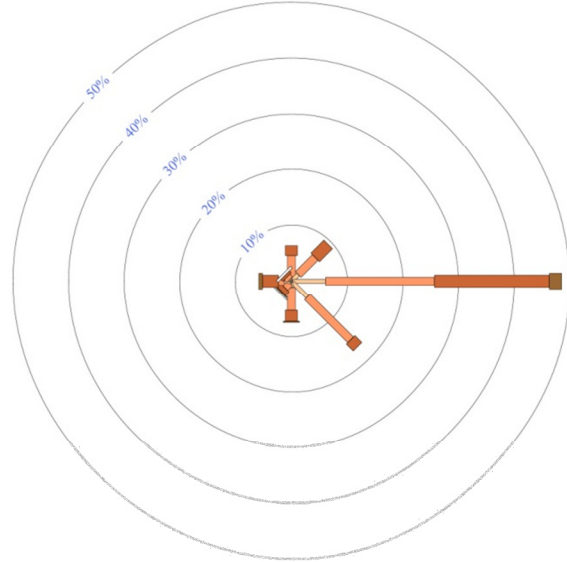
Morning Wind Roses

(Source Commonwealth of Australia 2008)

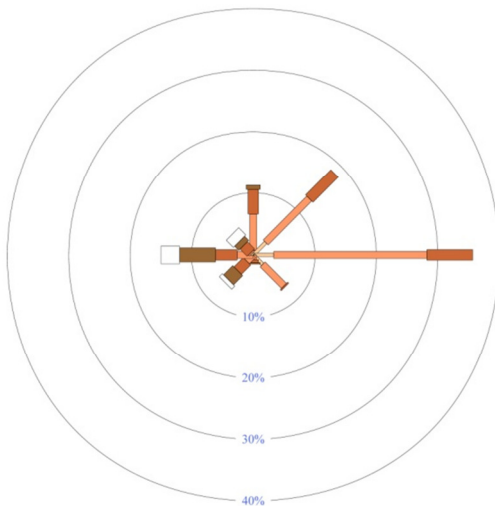
Summer



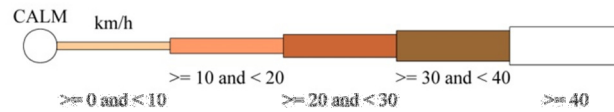
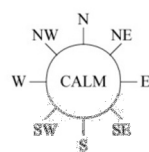
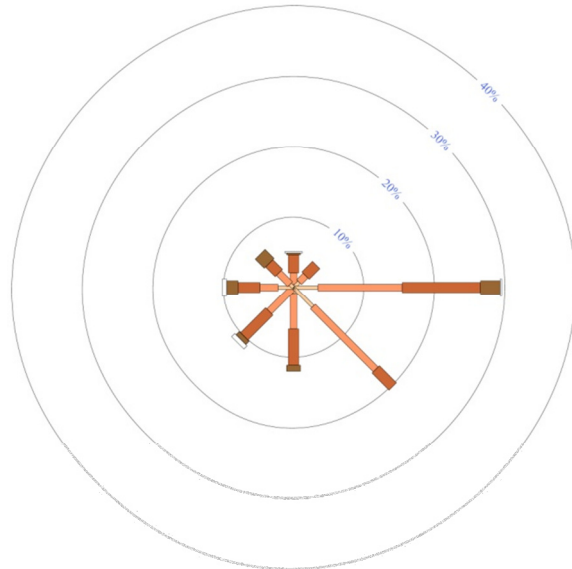
Autumn



Winter

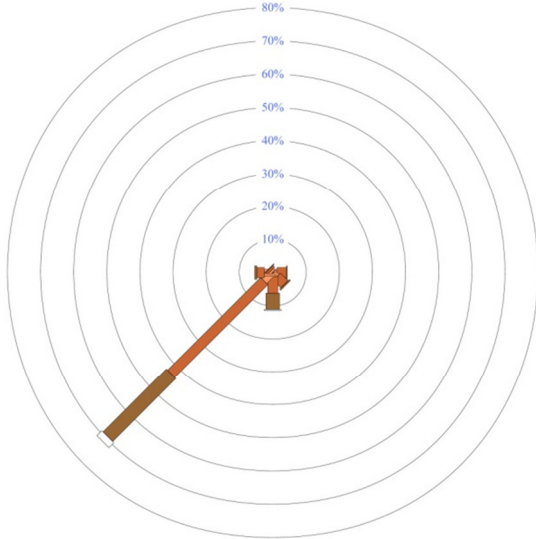


Spring

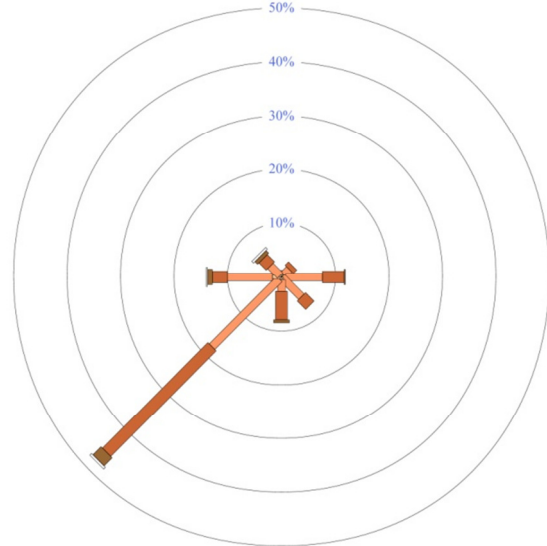


Afternoon Wind Roses

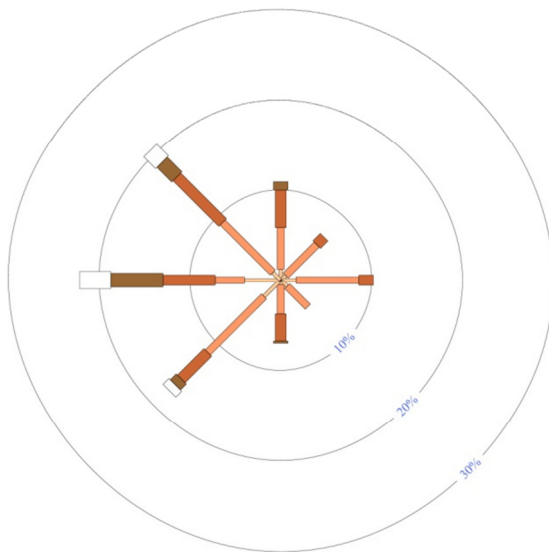
Summer



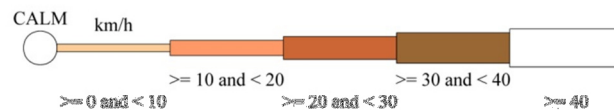
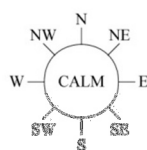
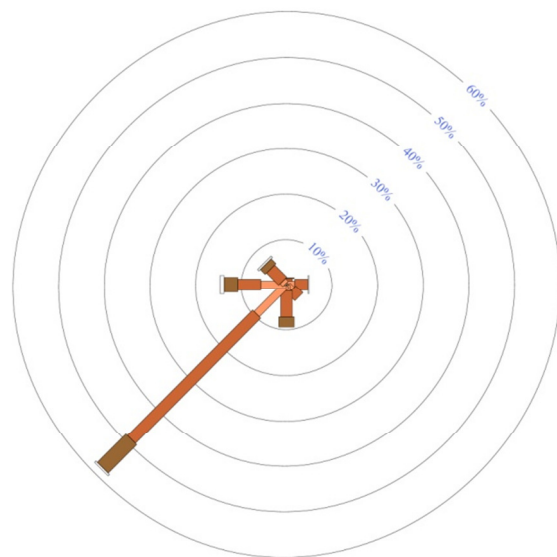
Autumn



Winter



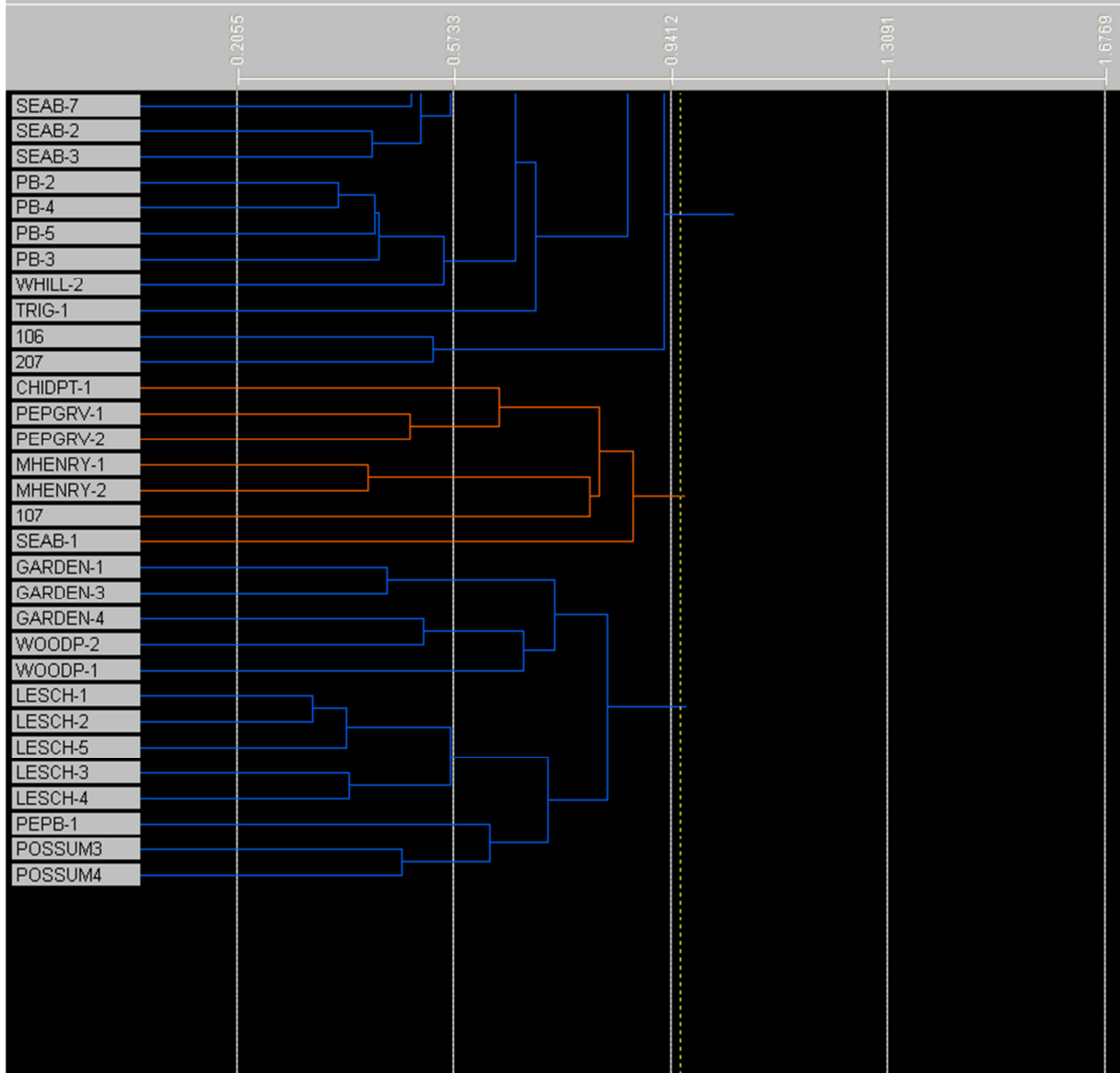
Spring



Appendix B

TEC Cluster Analysis

Column Fusion Dendrogram



Appendix C

Weed Management

Weed Management (Brown and Brooks 2002; WAPC 2003b)

Scientific Name	Common Name	Growing Season	Flowering	Reproductive unit	Dispersal agent	Seedbank persistence	Suggested methods of management and control
<i>Briza maxima</i>	Blowfly Grass	Late aut-winter	Spr	seed	Water, wind, mammal, slash	3 years	Prevent seed set – hand pull or spray at 3-5 leaf stage with Fusilade® 10mL/10L (500mL/ha) + wetting agent; repeat for 2-3 years.
<i>Euphorbia terracina</i>	Geraldton Carnation Weed		Aug-Dec	seed	Explosive, birds, ants, limestone, machinery	3-5 years	Large infestations – spot spray – with herbicide metsulfuron methyl 0.1g/15L or metsulfuron methyl +1% glyphosate before flowering. Follow-up with hand removal for at least five years.
<i>Ehrharta longiflora</i>	Annual Veldgrass	Aut-spr	Win-spr	seed	Water, wind, mammal, slash	1+ years	Hand pull; spray with Fusilade® 20mL/10L + wetting agent before flowering stem emerges; or 10mL/10L (500mL/ha) at 3-5 leaf stage – secondary seedling flush occurs – repeat if necessary.
<i>Lagurus ovatus</i>	Hare's Tail Grass	Win-spr	Spr-sum	seed	Mammal, wind	2-3 years	Prevent seed set – spray with Fusilade® + spray oil at 2-8 leaf stage before stem elongation
<i>Lupinus cosentini</i>	Sand Plain Lupin	Win/spr	Aug-Nov	seed	-	Some dormancy	Hand remove scattered plants. Spray dense infestations metsulfuron-methyl 0.1g/15L 92-3g/ha) + wetting agent
<i>Pelargonium capitatum</i>	Rose Pelargonium	-	Feb-Dec	-	-	-	Large infestations can be sprayed initially with 2,4-D anime (10mL in 10L of water + 25% wetting agent) followed up with hand removal of new seedlings. Manual removal of larger plants is rarely successful as stems and underground parts readily regenerate.
<i>Sonchus oleraceus</i>	Sowthistle	Win/spr	Sep-Dec	seed	Wind	1-2 years	Slashing often ineffective as flowers continue to be produced. Rosette stage preferred time for effective chemical control. Lontrel® at 10mL in 10L of water + 25mL wetting agent
<i>Tetragonia decumbens</i>	Sea Spinach	-	-	-	-	-	Hand pull isolated plants taking care to remove entire stem – will reshoot from below ground level.
<i>Thinopyrum distichum</i>	Sea Wheat	-	-	-	-	-	Spray at 3-5 leaf stage with Fusilade 10mL/10L (500mL/ha) + wetting agent; repeat over following two years
<i>Trachyantra divaricata</i>	Dune Onion Weed	-	Aug-Nov	-	-	-	Hand pull, foliar spray using Glyphosate. This species may naturally decline with the planting of native vegetation.

