Appendix G
Foreshore Management Plan

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COCKBURN COAST
FORESHORE MANAGEMENT PLAN

Prepared for Landcorp
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HASSELL

LANDCORP

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Section

Appendices

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EXECUTIVE SUMMARY

The Cockburn Coast Foreshore Management Plan provides a vision for the Foreshore that ensures the protection and enhancement of the natural values of the site, whilst providing a vibrant and community activated space aligned with the principals laid down in the District Structure Plan Part 2.

A key consideration of this process has been providing flexible and robust solutions to planning for the future of a constantly dynamic site due to the influence of coastal movement process.

The Foreshore Management Plan has been developed in accordance with State and Local Government guidelines, as well as an ongoing direct consultation with the City of Cockburn and the Department of Planning.

The key considerations and provisions addressed in the Foreshore Management Plan (FMP) include; existing environmental conditions, management plans for weeds, pest fauna, fire and rehabilitation, along with a landscape and infrastructure plan. In addition to these base requirements a central consideration has been the development plan outlined in the Cockburn Coast District Structure Plan Part 2.

Prior to the formulation of the Foreshore Concept a list of 'Opportunities and Constraints' for the site was developed that summarised the existing conditions. These opportunities and constraints, along with comprehensive modelling of mitigation options for coastal erosion and consideration of the proposed access, transportation and development planning outlined in the DSP part2, directed the development of the foreshore concept.

The result is a concept that is sufficiently robust to adapt to a range of coastal protection solutions. Graphics representing how the concept adapts to the three (3) most viable coastal protection options have been included within this document. While the FMP does not present a preferred coastal protection solution, it does incorporate all the necessary information required by authorities/stakeholders to weight the outcomes of each solution against its estimated cost. There is currently no clearly superior choice of option and thereby remains the need for the concept to provide a flexible approach.

Key features of the Foreshore Concept include;

_Two (2) major activity nodes associated with commercial and /or residential development along the foreshore, these being Robb Jetty and Power Station nodes. The character and function of both 'major' and 'minor' activity nodes have been based on previous work in the DSP part 2 and the Place Making Strategy and more recently influenced by constraints highlighted by the Coastal Vulnerability Assessment.

_ Three (3) minor activity nodes based at Catherine Point, McTaggart Cove and at the 'Green Corridor' connection, that provide recreational facilities but without direct interface with significant built development.

_A movement network hierarchy that builds on the existing north-south running shared path, to provide a range of movement options and experiences for pedestrians and cyclists as well as accommodating horses access to the beach.

_A foredune boardwalk between Robb Jetty and the Power Station offers uninterrupted view of the beach and ocean along with opportunities for education and interpretive elements.

_Retention of some of the unsealed beach access paths in less intensively used zones. Vegetation protection fencing would be maintained and if necessary upgraded adjacent to these pathways.

_Provision of facilities and infrastructure including toilets, beach showers, shelters, bbq facilities, seating, fish cleaning tables, interpretive signage and artworks, and areas of irrigated lawn to provide 'kick about' spaces and picnic areas.

_Carparks are to be retained at Catherine Point and McTaggart cove, with the McTaggart cove parking area relocated closer to Robb Road following development of the Power Station Precinct. The existing carpark at Robb Jetty will be lost as part of a proposed development site. The car parking provision for the site has been developed as part of the 'Local Transport and Traffic Management Strategy'.

Concept Image indicating Infrastructure and vegetation treatments for the Seawall Coastal Protection Option

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1.0____INTRODUCTION

1.1 Background

It has long been acknowledged that the Cockburn Coast presents a unique opportunity to create an exciting mixed use community that celebrates the best of Western Australia's coastal lifestyle. This belief was solidified with the adoption of the Cockburn Coast District Structure Plan 2. Henceforth, the framework for development has commenced to establish the advancement of the Cockburn Coast Area.

The development of a Foreshore Management Plan for the Cockburn Coast, that works within the framework and principals laid down in the District Structure Plan 2, whilst ensuring protection and enhancement of the natural values of the site is key to the success of the new development.

Key considerations will be balancing the emphasis on conservation and rehabilitation with the provision of a vibrant and activated community space within the constraints of coastal erosion and movement.

1.1.1 Vision

The Cockburn Coast District Structure Plan established a Vision which remains relevant to the ongoing planning of Cockburn Coast, including the Foreshore Management Plan.

"To create a vibrant, landmark destination that is connected, integrated, diverse and accessible."

This Vision was presented to the stakeholders through a workshop process which has ensured that key stakeholders have been part of the journey in building upon this vision.

The following objectives outlined in the DSP set the high level aspirations for the project:
_Responsive to the context – regionally and the immediate environment
_Establish a sustainability framework for future detailed planning and design
_Transit orientated development with appropriate density
_Establish an urban development framework that provides guidance for implementation
_Inclusive / participatory planning and consultation process
_Create a place with a mix of people, housing, uses, experience and lifestyle

In July 2010, LandCorp facilitated a workshop to further explore the Vision for Cockburn Coast where the following key drivers were established:
1. Use infrastructure as a catalyst for Development Oriented Transit
2. "Public Based" transport system to promote Land value capture (benefits from longer permanent investment)
3. Use best practice place making to create a socially inclusive environment
4. Create a sustainable development around the cultural and industrial stories of the site

The Foreshore Management Plan has been guided by this overall vision for the Cockburn Coast, while ensuring the development planned for the Cockburn coast responds sensitively to the marine and terrestrial environmental conditions of this section of coast. The rich cultural history of the foreshore provides this site with unique opportunities for enrichment of the foreshore experience.

1.2 Report Scope

In preliminary proposed scope of the FMP was been developed cognisant of current State and Local Government guidelines and was to consider the following;

a) Be informed by the Coastal Vulnerability Assessment and shall demonstrate that proposed development will not be adversely impacted by coastal processes including climate change induced sea level rise.

b) Address the matters contained within the Cockburn Coast Coastal Planning Strategy, and State Planning Policy No 2.6.

c) Address but not be limited to the following matters;
1. Existing Environment
2. Weed Management Plan
3. Pest Fauna Management Plan
4. Fire Management Plan
5. Infrastructure and Landscape Plan

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The Scope of the report was further developed through direct consultation with the City of Cockburn (CofC) and the Department of Planning (DOP) particularly in relation to the approach to Coastal Vulnerability Assessment.

Issues that the City of Cockburn specifically sort to see addressed included the strategic consideration of access to the foreshore, car parking and traffic management, 'Crime Prevention though Design' principals and social equity issues. These issues have either been addressed within the Foreshore Management Plan or as part of the broader planning processes for the foreshore and wider Cockburn Coast project.

1.2.1 Document Structure

In order to respond the requirements for the Foreshore Management Plan the document is structure in the following way;

Section 1 (this section) outlines the background and requirements of the Foreshore Management Plan.

Section 2 builds upon the introduction to outline how the Foreshore Management Plan fits within the planning processes for Cockburn Coast and is informed by other strategic documents developed for the area.

Section 3 places the site within context of Cockburn Coast and the broader region.

Section 4 describes the existing conditions and character of the site, relating to its cultural heritage, natural features and amenity.

Section 5 summarises the opportunities and constraints that arise from the existing site conditions and develops a conceptual strategy for the site, at the whole foreshore level and the detail for the individual precincts. The proposals for the site respond to a range of possible scenarios for the coastal protection and present robust treatments that will work across the range of coastal protection solutions.

Section 6 contains the detailed management plans covering vegetation and fauna management.

Foreshore Rehabilitation works

Masterplan vision for Main Street and Robb Jetty plaza

1.0____INTRODUCTION

1.3 Stakeholder Process

The Stakeholder consultation process has included a series of meetings involving representatives of the City of Cockburn, Landcorp and the consultant team. Three meetings with representatives from the City of Cockburn were scheduled to coincide with the following project milestones;

1) Site Analysis
2) Opportunities and Constraints Analysis
3) Preliminary Concept Development

The meetings covered the scope of environmental impacts, infrastructure development and coastal process modelling. As well as this feedback from City of Cockburn representatives, direct contact was made with specific city staff when seeking information regarding their specific areas of responsibility.

Following the development of a Preliminary Concept for the foreshore, more formal presentations where made to larger audiences including a broader audience of representatives from Landcorp, City of Cockburn and the Department of Planning .

2.0____POLICY AND PLANNING CONTEXT

2.1 Planning Documentation Context

2.1.1 Regional Zoning and Reservations

In August 2009, the Metropolitan Region Planning Committee (MRPC) acting under delegated authority from the Western Australian Planning Commission (WAPC) resolved to proceed with Amendment 1180/41 to the Metropolitan Region Scheme. The amendment proposes to rezone the North Coogee industrial area to an Urban Deferred zone, and to rationalise and realign the Parks and Recreation and Primary Regional Roads reservations to reflect the strategic planning intent and land use planning proposals within Cockburn Coast District Structure Plan.

The amendment proposed the following changes to the MRS:
_Rezone approximately 91.55ha of Industrial zone land to the Urban Deferred zone.
_Minor rationalisation of the Parks and Recreation reservations to the west of the Primary Regional Roads reservation and within the coastal Parks and Recreation reserve to the Urban Deferred zone, totalling 5.15ha.
_Realignment and rationalisation of Primary Regional Road reservations between Rockingham Road and the Fremantle Port freight rail line; and
_Rezoning of part of the South Fremantle Power Station Site to 'Urban Deferred'.

The Foreshore Management Plan corresponds with the proposed Parks and Recreation Reservation as indicated by the amended Metropolitan Regional Scheme, as shown in the Figure 2.1.

2.1.2 Town Planning Scheme No. 3

The Foreshore Management Plan area forms part of the larger Cockburn Coast redevolpment area. In response to the amendment to the Metropolitan Region Scheme, Amendment 89 to the City of Cockburn Town Planning Scheme No. 3 sets out to ensure alignment of the City's Scheme with the Urban zone under the MRS. Amendment 89 rezones much of the Cockburn Coast redevelopment area to a 'Development Zone', with the balance being reserved under the MRS (regional roads, parks and recreations and public purpose). By definition, the City's Development Zone requires approval of a Local Structure Plan prior to development approval being issued.

2.1.2 Cockburn Coast District Structure Plan 2009

The Cockburn Coast District Structure Plan (CCDSP) was endorsed in September 2009 and sets out to provide a statutory and land use framework intended to inform future detailed planning and the preparation of local structure plans. The Cockburn Coast District Structure Plan 2 further builds upon this with greater detail.

2.1.3 Cockburn Coast District Structure Plan 2

The Cockburn Coast District Structure Plan 2 (CCDSP2) serves as a key guiding document, which builds upon the core principles of the 2009 District Structure Plan and enables greater certainty going forward into the local planning phase. As part of the intended Local Planning Phase, the CCDSP2 identifies that the design and development of the foreshore reserve will be the subject of a Foreshore Management Plan and as such sets the context for its requirement.

Of relevance to the preparation of the Foreshore Management Plan, the CCDSP2 identifies a number of key drivers and opportunities that underpin its vision and intent. These ideologies include:
_Create a sub regional economy
_Develop an integrated transport plan
_Embed green infrastructure into the development
_Create key physical links which bring people to the coast; and
_Maximise the coastal, cultural and regional amenity.

In order to implement the principles of the CCDSP2 Local Structure Plans and Design Guidelines will be created for each of the three identified precincts; being Robb Jetty, Hilltop, and the Power Station precincts. The Foreshore Management Plan will however be considered and implemented through the Local Structure Plans.

2.1.4 State Planning Policy 2.6 - Coastal Planning Policy

State Coastal Planning Policy 2.6 (SPP2.6) is particularly relevant to the Cockburn Coast project and has informed the preparation of the Foreshore Management Plan.

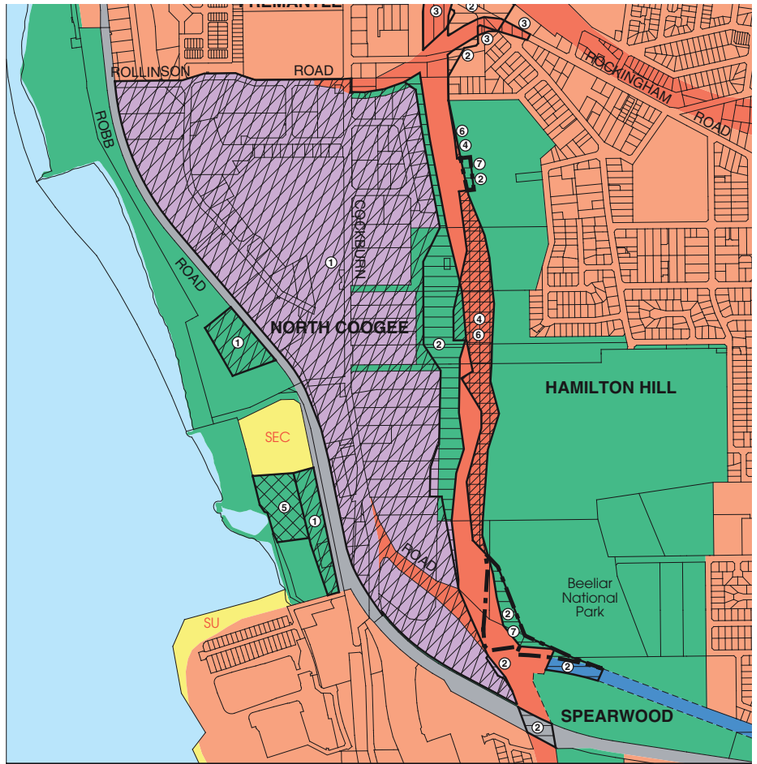

Figure 2.1: Cockburn Coast District Structure Plan

It should be noted that the coastal physical setback line has previously been defined in a study prepared by Oceania in 2007 to inform the preparation of the CCDSP. This setback line and coastal erosion has been endorsed by the Department of Planning and is further examined later on within the report (Section 5.3.1)

2.1.5 State Planning Policy 3.6 Development Contributions for Infrastructure

State Planning Policy 3.6 Development Contributions for Infrastructure sets out development contribution provisions for standard infrastructure items applied by the Western Australian Planning Commission (WAPC) on the subdivision, strata subdivision, or development of land; and provides a consistent, accountable and transparent system for local governments to plan and charge for community

Open space concept image form the District Structure Plan Part 2

Main Street Plaza concept image form the District Structure Plan Part 2

Main Street streetscape concept image form the District Structure Plan Part 2

2.0____POLICY AND PLANNING CONTEXT

infrastructure items which are not included in the standard provisions through development contribution plans.

2.1.6 State Planning Policy 4.2 Activity Centres for Peel and Perth

The Robb Jetty Structure Plan area, which abuts and intercts with the land within the Foreshore Management Plan contains a Neighbourhood Centre in the form of the Main Street Plaza. The development of this centre has been guided by the requirements of State Planning Policy 4.2 and is therefore relevant to the interaction of the Foreshore and the planned plaza area.

2.2 Other Relevant Documentation

2.2.1 Improvement Plan 33

Improvement Plan 33 (IP33) was prepared for the Cockburn Coast project area under the provisions of Part 8 of the Planning and Development Act 2005.

The purpose of IP33 was to prevent inappropriate development within Cockburn Coast whilst the District Structure Plan was being prepared and subject to additional appropriate statutory and governance arrangements being put in place.

IP33 recognises that Cockburn Coast has been identified for future urban development, moving away from its historical industrial use, and also recognises that Cockburn Coast is subject to intense development pressure. Therefore, IP33 provides the mechanism to 'halt' inappropriate development until such time that a robust statutory and governance framework has been implemented to guide future development.

IP33 also enable the WA Planning Commission to acquire land by agreement or compulsory acquisition for future redevelopment, if necessary.

The Improvement Plan came into effect on the 6 June 2006.

2.2.2 Place Making and Public Art Strategies

As part of the District Structure Plan a Place Making Strategy has been developed to ensure the delivery of the proposed character across the site. These strategies are focussed on the Local Structure Plan Precincts identified within the District Structure Plan and provide detailed strategies across the social, environmental, economic and cultural sectors for the activation of public spaces across the Cockburn Coast. The Place Making Strategy emphasis the need for flexible spaces that have the capacity to change and evolve over time. The FMP seeks to respond to this goal but also balance this with the need to provide clear direction regarding the types of activities and development appropriate to different foreshore locations.

The Place Making strategy was developed in consultation with the City of Cockburn and the Department of Planning. Since the development of the Place Making Strategy the constraints and parameters for foreshore development have been furthered through the completion of Traffic Management Strategies, the Coastal Vulnerability Assessment as well as the feedback received through the consultation process for the Foreshore Management Plan.

In conjunction with Place Making Strategy, Place Partners have developed a Public Art Strategy for the Cockburn Coast that sets up the framework for an Public Art and Interpretive Heritage Trail along the foreshore. Section 5.3.4 builds on the Public Art Strategy in relation to the proposed foreshore infrastructure

2.2.3 Local Transport and Traffic Management Strategy

A Traffic, Parking and Transport Strategy has been developed as part of the Local Structure Planting process for the Cockburn Coast. The parking and access strategies for the foreshore have been developed as part of this process and the results of this strategy are summarised in the Access and Circulation section of concept plan.

2.2.4 Cultural Heritage Strategy

The Cultural Heritage Strategy, which builds on the heritage studies prepared for Landcorp in 2008 for the CCDSP, was commissioned to ensure the next level of detailed planning for the redevelopment of Cockburn Coast area respects and enhances this significant collection of sites. The Strategy identifies places of cultural heritage value in the entire Cockburn Coast study area. However, the management and interpretation strategies are focused on the places located in the area south of Rollinson Avenue, which encompasses the three precinct areas identified by District Structure Plan 2. The foreshore area, which has not been included in any precinct, is considered in conjunction with the Robb Jetty Precinct area.

In summary, the guiding principles for the foreshore management plan are:

- The management of heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on them
- The management of heritage places should respect all heritage values of the place and seek to integrate the input of agencies with responsibilities for those places
- The management of heritage places should ensure that their use and presentation is consistent with the conservation of their heritage values
- The management of heritage places should make appropriate provision for community involvement, especially by people who have a particular interest in, or associations with, the place.

The Cultural Heritage Strategy was developed in consultation with the State Heritage Office, the City of Cockburn, the Department of Planning and the Department of Indigenous Affairs. In addition, the study team arranged to video interview some of the local Aboriginal people familiar with the Cockburn Coast project area, who were able to offer valuable insight into what the area used to like and how it has changed over time.

2.3 Planning Approvals Process

The Foreshore Management Plan forms part of the Local Structure Plans being prepared for the Cockburn Coast Area. It will operate as a non statutory appendix to the Local Structure Plan and will therefore be advertised and approved as part of the Local Structure Plan process. This will involve a 21 day advertising period and referral to the Western Australian Planning Commission.

3.0___SITE LOCATION AND CONTEXT

3.1 Regional Context

Cockburn Coast is a 330 hectare area located approximately 18 kilometres south-west of the Perth CBD and 4 kilometres south of Fremantle between the recent developments of South Beach and Port Coogee (Figure 3.1).

The area is bound by the Indian Ocean to the west and is afforded spectacular views across the ocean for the length of the site, including magnificent views to Carnac, Garden and Rottnest Islands. Beeliar Regional Park is located to the east of the Cockburn Coast site, and includes Manning Lake, Azelia Homestead and provides a wilderness experience in the natural bushland and sand dunes within the reserve.

This area has historically accommodated a range of industrial businesses and including the South Fremantle Power Station and switchyard. While there are a number of industrial uses still operating, the majority of Cockburn Coast land is now ripe for redevelopment.

Cockburn Road runs through the project area and currently functions as the primary north-south route for road freight and regional traffic. The freight rail line is a significant barrier to east-west connectivity between the high amenity of the regional park and coastline

3.2 Local Context

The Cockburn Coast Foreshore is located within the larger Cockburn Coast project area (Figure 3.2). The Foreshore site is divided from the main part of the Cockburn Coast area by the north-south running freight rail line. The extent of the site coincides with the extent of parks and recreation reserve as defined in the original District Structure plan, with the exclusion of 2 rezoned urban development sites, one near the Robb Jetty and the other is the Power Station redevelopment precinct.

While the portion of the foreshore in front of the Power station precinct is included with the FMP site, much of the final 'shape' of the coastline in this location will be determined as part of the planning and design processes for this precinct, although guided by the principals and strategies set out in this document.

Figure 3.1: Regional Context

The coastline is unique in its own right and an integral feature of the locality

Cafe at South Beach, located to the north of the project area

New development at South Beach

South Fremantle Power Station is a monolithic and historically an important structure

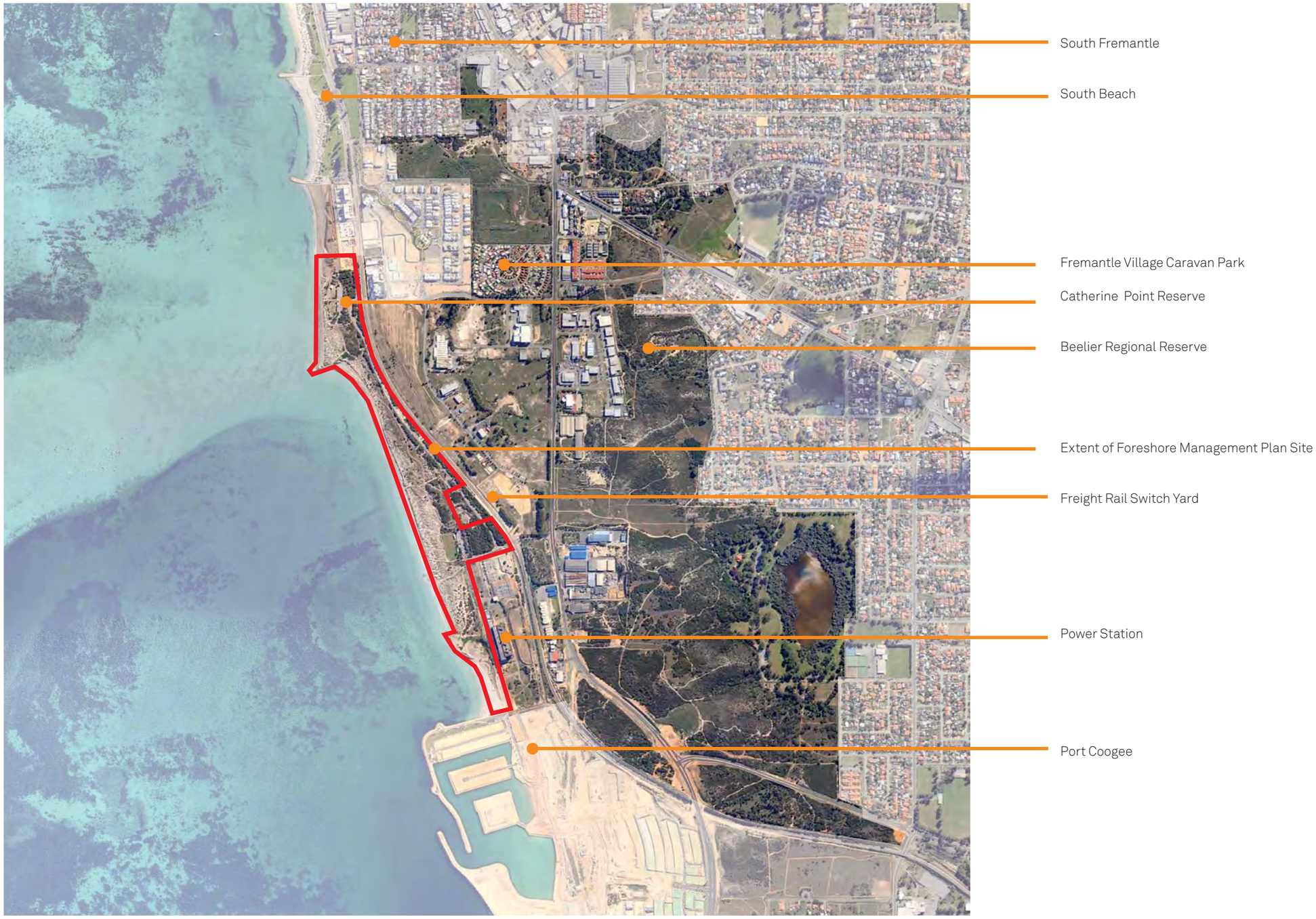

Figure 3.2: Study Site within the Local Context

4.0____EXISTING ENVIRONMENT

4.1 Topography and Surface Water

The Topography of the Cockburn Coast area is dominated by a north - south running ridge line approximately 1.5km east of the coastline. This ridge line forms the eastern boundary of the catchment for the Cockburn Coast area, with surface water flowing westward from the ridge line. There are four parallel east-west running valleys running from the ridge line westward down to a coastal plain east of the foreshore. The coastal plain starts near the alignment of Cockburn Road and extends west to the freight rail line.

The freight line is slightly raised above the plain, creating a barrier to the westward flow of surface water into the foreshore. The only impermeable surfaces within the foreshore apart from a coastal dual use path, are Robb Road running roughly parallel to the rail line and 3 existing carparks servicing the Beach users. The remainder of the site consists of coastal dune formations largely undisturbed by recent development apart from the clearing and earthworks associated with establishment of the road and rail.

Figure 4.2 identifies primary, secondary and tertiary dune systems within the foreshore site. The highest points of the foreshore are at approx 8m above sea level. The levels along Robb road are consistently around 7m. The crest of the primary dune varies but is generally between 4-5m. A narrow beach west of the primary dune forms the western edge of the site. The very flat topography immediately to the east of the foreshore means there are very limited views of the beach and ocean from the main Cockburn Coast project area, until you climb the ridgeline 1.5km to the east of the coast. The same topography contributes to the sense of isolation of the beach from the inland. The north - south running dunal structure inhibits the westerly flow of surface water, with water gathering in local low points between dunes. The high infiltration rates of the dunal sands however mean surface runoff is a rare event.

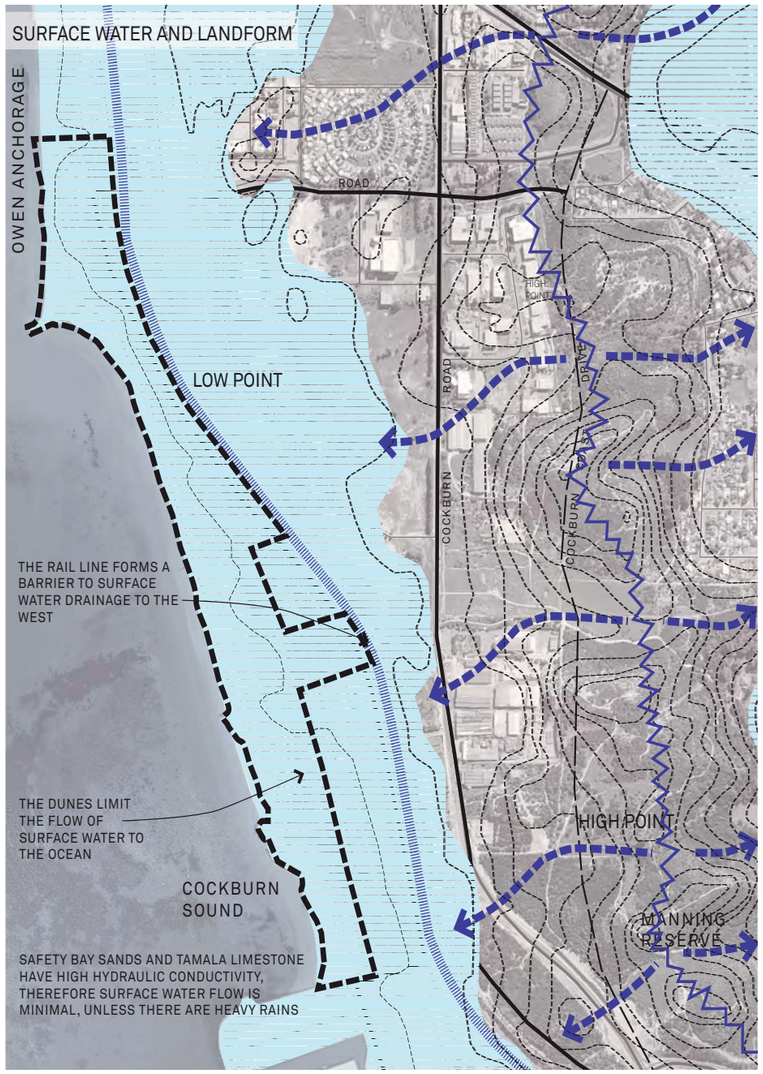

Figure 4.1 Cockburn Coast Topography and Surface Water

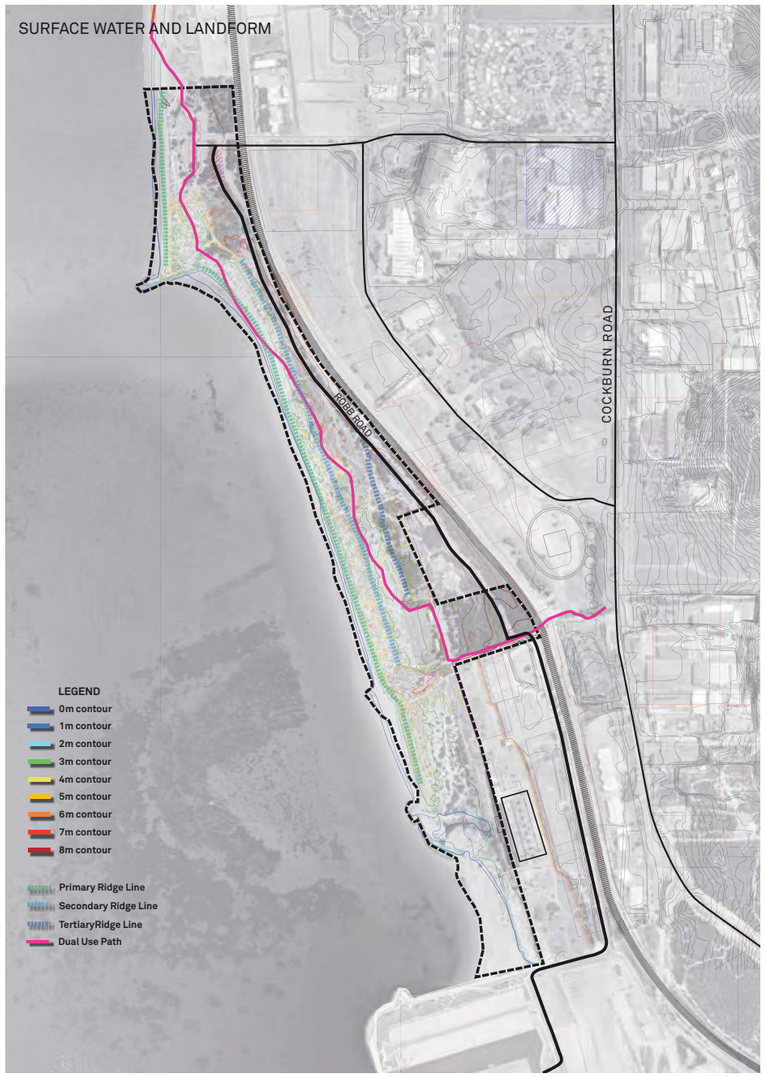

Figure 4.2 Foreshore Topography

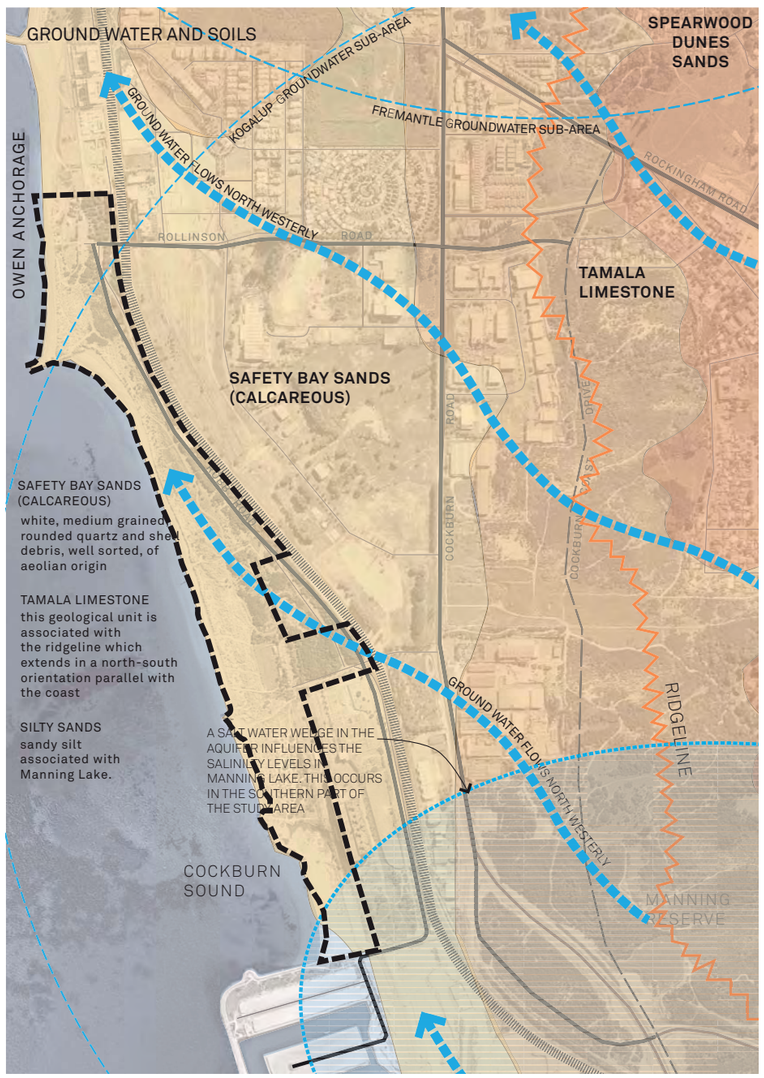

Figure 4.3 Soils and Groundwater

04____EXISTING ENVIRONMENT

4.2 Ground Water

Groundwater on the site is generally deep and therefore is not a constraint to development. However, the use of groundwater on the site has its risks, primarily the risk of salt water incursion and the historical contamination that has occurred from previous land uses such as landfills and industrial sites.

A Local Water Management Strategy has been developed in conjunction with Local Structure Planning processes. This report outlines the projected water demands along with the options for supply of that demand. A review of groundwater resources for the area found that as the Leederville and Yarragadee aquifers are fully allocated, thus any groundwater for irrigation for the site would need to be supplied by the superficial aquifer. The water available from the superficial aquifer has been monitored and found to have elevated levels of salinity and nutrients, however this has not been seen as precluding its use as a primary source of irrigation water. Irrigation demand for the foreshore areas in the Local Water Management Strategy have been based on the landscape concepts developed in the FMP. Refer to the Robb Jetty; Local Water Managment Strategy (GHD 2012) for further detail on water supply options.

4.3 Geology

The Cockburn Coast soils consists largely of safety bay sands which has a high rate of hydraulic conductivity, meaning that there is limited surface water runoff as the sandy soil is very porous.

Tamala limestone follows the ridge line in a north-south direction along Beelier Reserve and Safety Bay Sands adjacent to the coastline. Refer Figure 4.3

The soils within the foreshore site are reported to comprise of shallow Calcareous Sand (S13) of the Safety Bay Sand (Qhs) formation overlying Tamala Limestone (LS1, Qtl) (Gozzard 1983 as cited in GHD 2011). This is described by the Geological Survey of Western Australia (Gozzard 1983 as cited in GHD 2011) as:

- S13 – Calcareous Sand , white, medium-grained, rounded quartz and shell debris, well sorted, of eolian origin.
- LS1 – Limestone, pale yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface karkar, of eolian origin.

4.4 Climate

The site is subject to the 'Mediterranean' climate that dominates the south-west corner of Western Australia and produces hot, dry summers and cool, wet winters.

The closest official Bureau of Meteorology (BoM) weather recording station is at Jandakot Airport (Station No. 009172), where climate data has been collected since 1972 (BoM 2012). Temperature and rainfall averages from this location are:

- Mean daily maximum temperature: 31.5°C (Feb) – 17.8°C (July)
- Mean daily minimum temperature: 17°C (Feb) – 6.8°C (July)
- Mean annual rainfall: 825.3 mm
- Mean annual rain days (≥1 mm): 84.1 days

During winter, cold fronts bring strong westerly, north-westerly and south-westerly winds. Summer winds tend to form an east to south-east wind pattern associated with frequent high pressure systems. Strong sea breezes are also experienced in the afternoons during summer.

4.5 Visual amenity and Security

While there are a number of vantage points with views to the coast from the ridge line on the eastern edge of Cockburn Coast, views to the coast from the low lying land directly east of the foreshore are limited by both topography and the dense re-vegetated corridor along the freight rail line.

Within the foreshore area itself the narrow beach with steep foredune, combined with areas of dense vegetation adjacent Robb Road, mean the views to the coast are limited to a few high points along the DUP, or where breaks in the vegetation allow longer views from the higher land along Robb Road. While east-views are often restricted, the broad foreshore reserve offers extensive views north-south both along the beach and DUP. The power station creates a visual focus that can be seen from the very northern end of the site. While views to the sea need to be capitalised on within the foreshore plan it is important also to minimise interrupting the north-south views within the reserve.

The restricted view lines created by the topography and vegetation create security issues for users of the beach and its associated recreational facilities. The City of Cockburn has raised concerns regarding personal and property security within the foreshore as a result of; the availability of hiding places, the quick access and egress along Robb Road and the low user numbers which contribute further to poor

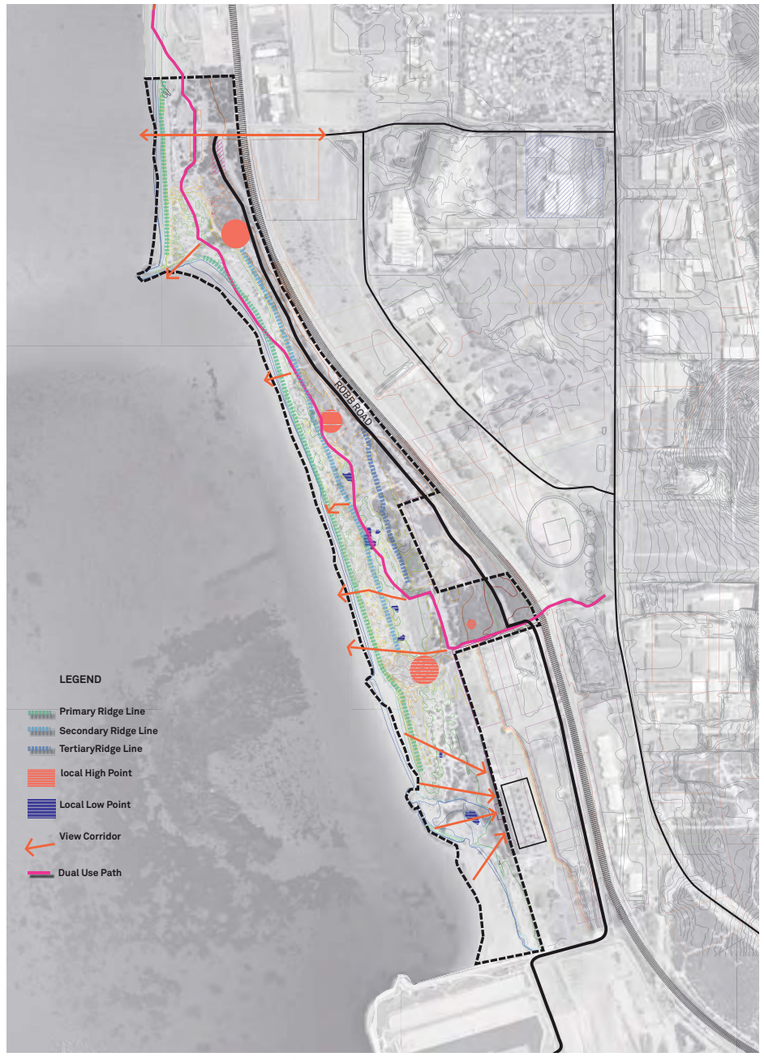

Figure 4.4 Visual analysis and Landform for the Foreshore

View from Foredune at Catherine Point

View from foredune at Robb Jetty

Restricted View from DUP at Catherine Point

View to Power Station from Robb Jetty

Dense vegetation in rail reserve restricting view lines

McTaggart Cove POS with restricted view behind foredune

Intermittent and restricted views from foreshore DUP

View from McTaggart Cove foredune

surveillance. Section 4.11.2 'Recreational facilities' further discusses security issues at the existing recreational sites.

4.6 Vegetation, Flora and Fauna

Several environmental studies covering the Cockburn Coast and adjacent areas have been conducted since 2000. The vegetation associations, vegetation condition and use of Point Catherine/CY O'Connor Reserve were documented in the City of Cockburn Coastal Works Plan in 2000 (Regeneration Technology 2000). In 2007 ENV Australia (ENV) undertook an Environmental Assessment of Cockburn Coast to inform the preparation of a District Structure Plan for the area, which included a desktop study of all available ecological information. GHD conducted a Supplementary Flora and Vegetation Spring Survey and Level 2 Fauna Survey of the Cockburn Coast and surrounding areas in 2009 to support the Cockburn Coast District Structure Plan (GHD 2009). The results of these surveys were aimed at supplementing the flora and vegetation desktop study results provided by ENV (2007). Most recently, Eco Logical Australia (ELA) conducted a site visit to verify the results of these studies and to ascertain any additional environmental values of the site.

Brief summaries of the information relevant to the site are provided in the following sections.

4.6.1 Vegetation Communities and Flora

The foreshore of Cockburn Coast has undergone extensive changes over the course of the last century owing to the use of the surrounding land for industrial purposes. The original vegetation has been gradually cleared leaving some areas completely disturbed, with only scattered weeds and others with planted re-vegetation, which has established successfully. Weeds are common throughout the site. A list of flora species recorded at the site by GHD (2009) and ELA during the recent site visits support this plan, and are provided as Appendix 2 .

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) have been recorded within the site and no Declared Rare Flora (DRF) or Priority Flora species have been recorded within the site. The vegetation types of the site were mapped by GHD (2009) from the northern boundary of the site to McTaggart Cove in the south. The vegetation types of the remainder of the site (south of McTaggart Cove) were extrapolated by ELA using information gathered during the site visit and contained in GHD (2009). The vegetation types recorded have been combined and are shown on Figure 4.5 and are listed as follows:

- Open Grassland of *Spinifex longifolius* over weed dominated herb layer with areas of planted vegetation on the dunes
- Cleared area now dominated by weed grassland
- Low Open Woodland of *Eucalyptus gomphocephala* over *Acacia rostellifera*, *Melaleuca huegelii, Calicium glaucellum* and *Rhagodia baccata* over weed dominated understorey
- Tall Shrubland of *Melaleuca huegelii, Acacia rostellifera* and *Dryandra sessilis var. cygnorum* over *Spyridium globulosum* over a weed dominated understorey
- Open Shrubland of *Leptospermum laevigatum,* over weed dominated herb layer

The foredune is dominated by Beach Spinifex *(Spinifex longifolius)* and various weed species. The vegetation diversifies into shrubland east of the foredune where the dominant species include *Acacia rostellifera, Melaleuca huegelii* and *Melaleuca lanceolata*. Dense areas of woodland vegetation representing established planted vegetation from previous re-vegetation efforts are present along the eastern boundary of the site. Dominant species include *Eucalyptus gomphocephala, Acacia rostellifera, Melaleuca huegelii* with *Agonis flexuosa*.

4.6.2 Vegetation Condition

The Bush Forever vegetation condition rating scale (Government of WA 2000) was used by ELA to rate the condition of vegetation at the site (Figure 4.6). The majority of vegetation at the site is considered to be in a Degraded Condition, with some Completely Degraded areas occurring where parks and car parks have been established, as well as the area in front of the old power station building. Areas of Good condition vegetation exist along the western edge of the site corresponding to the areas of established re-vegetation .

Figure 4.5 Vegetation Communities

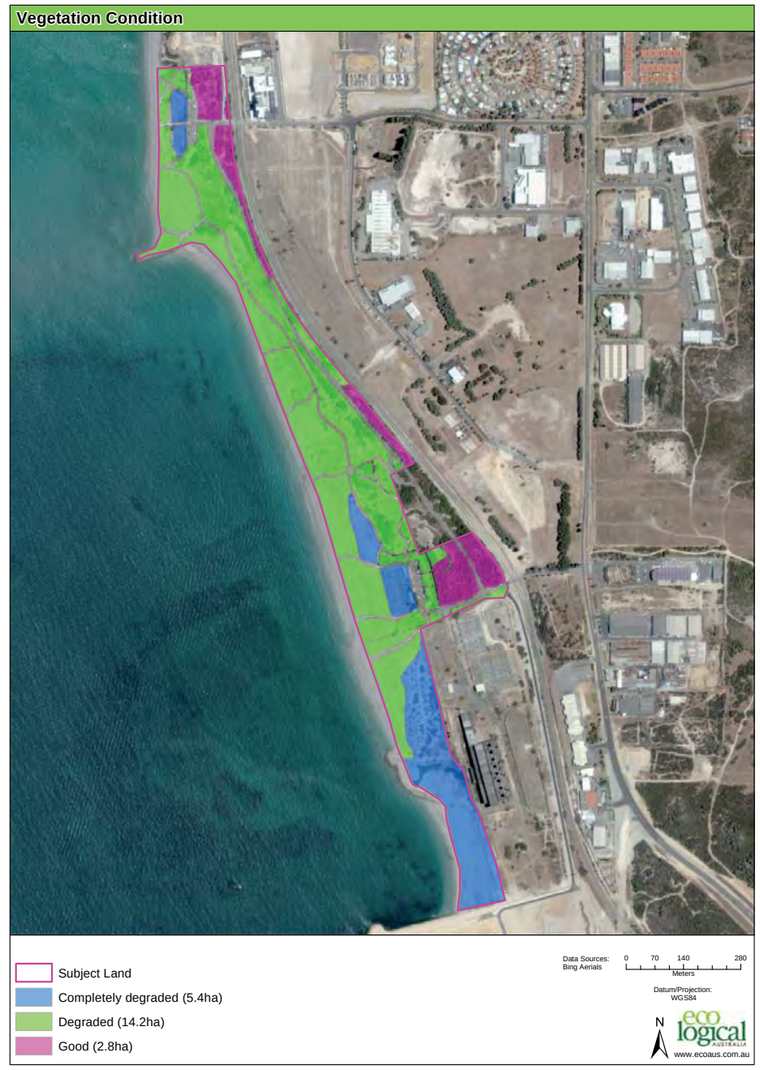

Figure 4.6 Vegetation Condition

4.6.3 Weeds

A total of 19 weed species have been recorded at the site. GHD (2009) recorded 17 of these, most of which are exotic species that are naturalised and/or widespread throughout the southwest region of WA (GHD 2009).

ELA recorded an additional two species during the site visit to support this plan; the introduced Coastal Teatree *Leptospermum laevigatum* which has spread widely through the vegetation in front of the old power station building (where it forms the dominant plant species) and Bridal Creeper (*Asparagus asparagoides*) which is listed as a Declared Plant (P1) under the Agriculture and Related Resources Protection Act 1976.

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4.6.4 Existing dune rehabilitation

The City of Cockburn (CoC) are currently undertaking dune rehabilitation works on the dunes within the site, predominantly in the area just south of Catherine Point groyne. A variety of native species have been planted and some stabilisation techniques utalised, including mulching and brushing, to encourage dune stabilisation and establishment of planted vegetation.

4.6.5 Fauna Habitats

The site is considered to represent good fauna habitat value despite large areas of vegetation being in Degraded to Completely Degraded condition (GHD 2009). The coastal reserve has a number of microhabitats that would be utilised by reptile species, such as areas of plant debris and loose sand (GHD 2009). The open grassland of Spinifex grassland of the dunes could provide habitat for a number of coastal species such as seabirds, including the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 (Marine) listed Silver Gull (*Larus novaehollandiae*), skinks, and the Dugite (*Pseudonaja affinis affinis*).

4.6.6 Fauna Assemblages

The Level 2 fauna survey conducted as part of the GHD (2009) survey observed and trapped a number of species across the site. A total of 21 species of birds were observed. These included native species such as Eagles and Honey-eaters and some introduced species including Doves and Pigeons. No native mammals were recorded within the site however four introduced mammal species were recorded. Twelve reptile species were recorded comprising of Dragons, Snakes and Skinks. The Priority 3 species ***Lerista lineata*** (Lined Skink) was recorded in high numbers.

4.6.7 Conservation Significant Fauna

A total of 27 individuals of the Lined Skink were recorded by GHD (2009) within the site. The patchy Spinifex grassland of the dunes within the site provides favourable habitat for this species. Development within the site may result in a loss of both individuals and habitat for the species to utilise, therefore retention and enhancement of this habitat where possible will be important for maintaining refuge areas for the Lined Skink.

One avifauna species listed as Migratory under the EPBC Act was observed during the GHD (2009) survey; *Merops ornatus* (Rainbow Bee-eater). Three avifauna species listed as Marine under the EPBC Act were also recorded; *Zosterops lateralis* (Silvereye), *Larus novaehollandiae* (Silvergull) and *Falco cenchroides* (Nankeen Kestrel) and are considered to be common on the Perth coastline.

The Rainbow Bee-eater is common throughout most of Australia and is a highly migratory species, wintering in the north of Australia, and offshore islands, including New Guinea. No nests were recorded within the site. This species is not restricted to nesting habitat in the Perth region, as they will build nesting tunnels in sandy slopes in a variety of areas, including disturbed sites (GHD 2009).

4.6.8 Feral Animals

A total of eight introduced fauna species were recorded within the site comprising; four birds and four mammals including *Canidae Canus sp.* (Domestic Dog), *Oryctolagus cuniculus* (Rabbit), Mus musculus (House Mouse) and *Rattus norvegicus* (Norwegian Rat). Feral animals, in particular the Rabbit, can cause adverse impacts to vegetation rehabilitation efforts. Control measures for feral animals are recommended to be implemented and are outlined as part of the Fauna Management Plan (Section 6).

[1] Although the planted vegetation (re-vegetation) areas are not remnant vegetation they have been assessed as a vegetation community, rather than Completely Degraded vegetation, for the purpose of assessing foreshore condition and function. The Good condition rating of these areas is indicative of the level of cover, health of vegetation, and extent of WA native species versus exotic weed species.

4.7 Bushfire

4.7.1 History

The site has historically had a low frequency of fire. Historical information of fire occurrence has not been collated for the area; however, the local Fire Emergency Services Authority (FESA) representative suggests that fires have been of low frequency over relatively small scales that have not posed risks to homes or infrastructure. Ignition sources have been from road verge fires (likely to be cigarette butts ejected from vehicles) and occasional open ("camp") fires from visitors to the area.

4.7.2 Bushfire assessment

A bushfire hazard assessment has been completed for the site in accordance with the Planning for Bush Fire Protection Guidelines edition 2, May 2010 (FESA/WAPC 2010). The aim of the bush fire hazard assessment was to determine the vegetation types, fuels and slopes on the site and derive a bushfire hazard classification. The hazard classification is a 'broad brush' approach to identify the spatial pattern of bushfire hazard and is typically a trigger requiring the development of site specific bushfire mitigation measures for buildings.

Vegetation types in the site ranged from Recreational Sown Grassland and Open Hummock Grassland on the fore dunes to Closed Scrub near the Robb Jetty carpark (Figure 6.1). Under the classification scheme of 'Planning for Bush Fire Protection Guidelines' (PBP), the resultant fire hazard assessment for these vegetation types identifies the areas of Closed Scrub as having an 'extreme' fire hazard assessment, with other open shrublands being 'moderate' hazard and the Open Hummock Grasslands and Recreational Sown Grassland receiving a hazard rating of 'low' (Figure 6.2). In this instance the classification system overstates the fire hazard as the size of the reserve and the potential length of fire run directly toward buildings is small. For example, the thin strip of Closed Scrub along the north-eastern boundary of the Site is classified an 'extreme' hazard, however its narrow width would not enable the full development of bushfire typical of the more expansive areas of Closed Scrub that the classification system that PBP is based upon .

Fuels in the Recreational Sown Grassland are not considered a hazard due to their greenness and maintenance as a passive recreation area throughout the year. Fuels in the Open Hummock Grassland consist of fine material (principally Spinifex longifolia and annual weeds) with large areas of open sand, and are a low fire hazard. The Low Shrubland and Tall Open Shrubland are a 'moderate' fire hazard with woody fuels interspersed with annual grasses and perennial weeds such as Pelargonium capitatum.

The spatial pattern (including extent and continuity) of bushfire fuel within the site is considered as important an influence on fire behaviour and bushfire risk as the fuel classification under PBP. In this case, the risk associated with the fuel hazard rating is significantly reduced by the spatial pattern of these fuels.

4.7.3 Bushfire risk

Risk is measured in terms of consequence and likelihood, and arises from the interaction of hazards, communities and the environment (FESA/WAPC 2010).

The likelihood of bushfires starting on or impacting the foreshore area is relatively low. Currently, the visitation to the area is low and likely to be by locals who are less likely to purposefully set the bush alight than non-locals who may visit the site infrequently. Nonetheless, there is a low risk of arson or accidental ignitions from people using the area or driving along neighbouring roads (via cigarette butts). It is therefore expected that occasional accidental or deliberate fires will continue to pose an infrequent bushfire risk.

The potential consequence resulting from a bushfire in the site ranges from very minor damage to infrastructure and the environment, through to significant impacts on people and the environment, including the potential for fatalities.

A bushfire management plan has been developed for the site to minimise the bushfire risk to lives, properties and assets, preserve conservation values of the foreshore, and preserve ecological and evolutionary processes (Eco Logical Australia 2012). This plan has been summarised in Section 6.4.

Lined Skink

Fire `Hazard Vegetation

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4.8 Coastal Processes and Stability

The shoreline of the site has been influenced by a long history of development since European settlement in the 1800's and has been used historically for various purposes including horse racing, recreation, a variety of industrial and maritime uses, power generation, and more recently for urban development. The natural coastal processes of the area have been interrupted during the last 70 years by the groynes at Island Street, Catherine Point, Robb Road and the South Fremantle Power Station.

The marine structures constructed in the 1940's to protect the South Fremantle Power Station have encouraged significant accretion of the coast, resulting in the seawalls both north and south of the cooling water pond being covered by sand accumulation. The construction of the main breakwaters at Port Coogee in 2006 have also changed the coastal processes. The developer of Port Coogee is responsible for ongoing beach monitoring and management to mitigate the impacts of the development on coastal processes, which has included bypassing sand from the northern side of Port Coogee to the beaches to the south.

In 2010, LandCorp engaged M P Rogers and Associates (MRA) to complete coastal / maritime engineering investigations to support the preparation of the District Structure Plan Part 2 (DSP2). This included a coastal vulnerability assessment based on the State Planning Policy 2.6 - State Coastal Planning Policy (SPP2.6) (WAPC 2003). That assessment (Rogers 2011b) utilised the results of Oceanic's 2007 assessment of coastal processes (Oceanica 2007). In July 2013, The SPP2.6 was revised (WAPC 2013). LandCorp has since re-engaged MRA to complete an assessment of the requirements of the new policy and calculate a revised coastal setback allowance (figure 4.7) in order to confirm the proposed development would be safe from potential coastal erosion. The new Coastal Processes Setback has resulted in the need to revise the location of development on the west side of the freight rail line where it is not protected by sea walls. Any minor changes to lot boundaries resulting as part of this process is not expected to impact on the concepts and strategies outlined in this report.

Historical Information about the coastline from the Island Street Groyne to Port Coogee was collated by Rogers (2011a,2014a)from studies of the coastline; MRA (2005) and Oceanica (2007). This information indicates that the foreshore in front of the site has been influenced by the various groynes, seawalls and breakwaters as well as the dynamics of the offshore Success Bank. In general there has been net accretion along the coast due to the onshore feed of sand from Success Bank and the trapping action of the various groynes and breakwaters. Nevertheless there have been periods of erosion on some areas of the shoreline.

MP Rogers and Associates (MRA) has produced a series of reports on Coastal Vulnerability Assessment (Rogers 2011a, 2011b , 2014a, 2014b) as part of the investigations for the development of the coastal land comprising the Cockburn Coast. The coastal vulnerability assessment involved the assessment of setback distances to account for coastal erosion processes, including climate change, and minimum Finished Floor Level to account for coastal flooding and climate change. Section 5.3 summarises the MRA results of modelling a range of coastal protection measures. The results of this modelling has guided the development strategies for the management plan. A full report of the coastal process modelling methodology and results has also been completed in parallel with this management plan (Rogers 2014b).

4.9 Water Quality and Contamination

A Detailed Site Investigation (DSI) was undertaken of 24787R McTaggart Cove and 2110L Bennett Avenue by GHD in November 2011 to support proposed upgrades to the land in accordance with the Metropolitan Region Scheme Amendment. Given the known presence of contamination at surrounding sites and industrial development history of the area, the DSI was undertaken to determine if contamination is present on the site that may pose an unacceptable risk to human health or the environment, and hence assess the area's suitability for the proposed land uses.
Several occurrences of soil and potential groundwater contamination were recorded in the site during the GHD (2011) study. The locations of the contaminated sites are shown on Figure 5 and include:

_Lead contamination in soil approximately 40m north-east of the car park at Catherine Point

Figure 4.7 Coastal Setback allowance, Rogers (2014a)

_Contamination in soil in the vicinity of the old power station building including Mercury, asbestos and Polychlorinated biphenyls (PCBs)
_Levels of Escherichia coli (E. Coli) exceeding DEC (2010) Assessment Levels for Soil, Sediment and Water criteria of <1 CFU/100mL detected in groundwater sample at one location within the site, along the eastern edge of Robb Road approximately 300m south-east of Catherine Point

The source of E. Coli in groundwater and its degree of persistence at the site is yet to be determined. GHD (2011) identified the following as potential sources of E. coli in the groundwater sample:

_Groundwater from the Port Coogee Development re-injected via bores along the eastern boundary of the site
_Faults in the integrity of local urban waste water infrastructure (e.g. leaking or broken pipes)
_Former South Fremantle Landfill Site, although this appears unlikely due to the distance from the site (approximately 500 m north-east), the short half-life of E. Coli, and the time since the landfill was decommissioned in 1991 (DEC 2010 as cited in GHD 2011)

Further confirmatory testing is likely to be undertaken to determine if the recording of E. coli was an isolated instance or if a recurring trend.

In terms of water quality, no exceedences in criteria for levels of heavy metals, dissolved organics, major ions or physio-chemical parameters were recorded in groundwater samples from the site. Concentrations of nitrate-nitrogen exceeded Marine Water criteria (0.005 mg/L) in six groundwater samples across the site and concentrations of total phosphorous also exceeded Marine Water criteria (0.02 mg/L) in six samples across the site.

Leachable concentrations of heavy metals were not apparent in groundwater indicating heavy metals are either not being mobilised or that this is on a sufficiently limited scale that no significant impacts are occurring, therefore the potential risks to ecological receptors are considered to be low (GHD 2011). However, elevated nutrient concentrations (nitrate-nitrogen and phosphorous) in groundwater present a potential risk to the Indian Ocean marine environment (discharge point) as it does more broadly along the Cockburn Sound coast.

The status of the site under the Contaminated Sites Act 2003 and any requirements for addressing issues identified in the DSI need to be endorsed by the Contaminated Sites Auditor appointed by the City of Cockburn.

Lead Contamination site at Catherine Point

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4.10 History; European and Indigenous

A Cultural Heritage Strategy has been developed for the Cockburn Coast (TPG 2012), which not only documents the rich heritage of the foreshore and inland areas but sets up a framework for the management of historical sites and guidelines for interpretation of the this history through signage and artworks.

4.10.1 Historical Industrial Activity

Figure 4.8 details the industrial and settlement infrastructure associated with this section of the coast. It details a long association of activity with the coast and outlines the degree of physical modification that this section of coastline has been subject to.

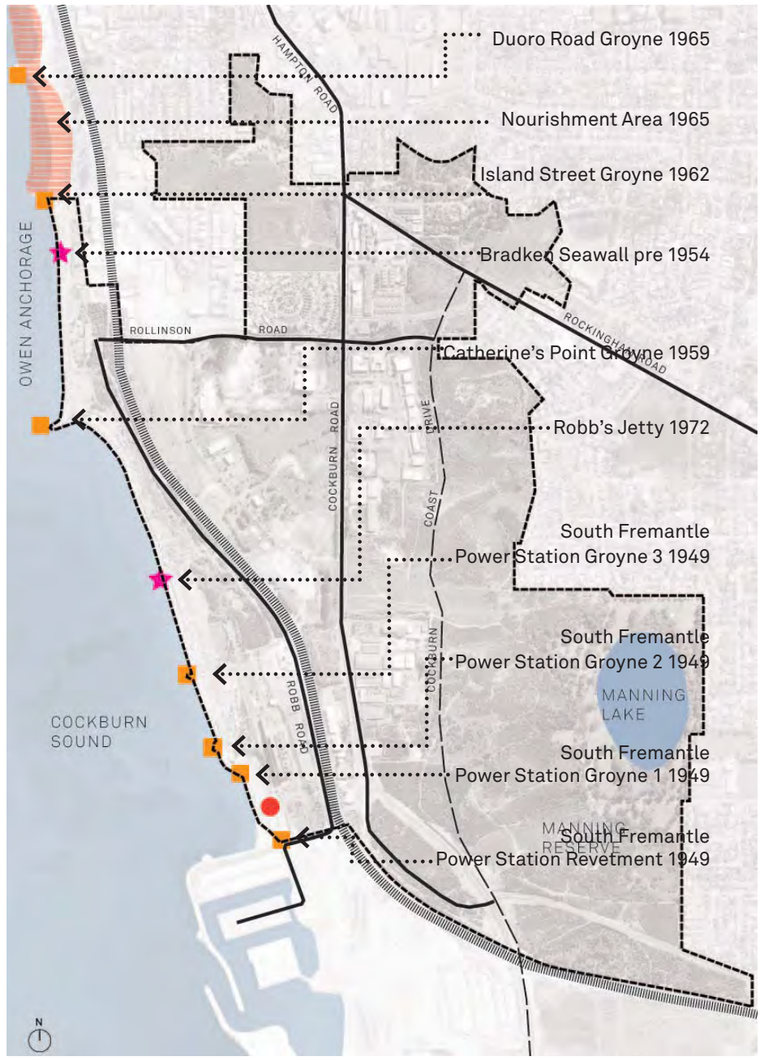


Figure 4.8 Industrial history of Foreshore

These modifications include 6 groynes, 4 seawall, jetty and infrastructure associated with the power station.

4.10.2 Cultural Heritage

Figure 4.9 summarises the range of known European and aboriginal heritage sites located within the foreshore. The Cultural Heritage Strategy (TPG 2012) provides a project wide strategy aimed at appropriatel integration of heritage into the development. Key findings and management recommendations of the Heritage strategy that impact on the foreshore include;

_Maintain, conserve and adapt the South Fremantle Power Station.
_Retain in-situ and do not disturb the 'James' and 'Diana' wreck site.
_Interpret the indigenous mythological story regarding the separation of the islands from the mainland.
_Interpret the Robb Jetty Camp site and stories associated with it
_Archaelogical investigations should be undertaken prior to any development of the foreshore area.
_Ensure the beach remains accessible to horse training and provide associated facilities to enable this ongoing use.
_Remnants of Robb Jetty should be retained and undisturbed
_Interpret the importance of Robb Jetty as an integral part of the industrial history and development of the area

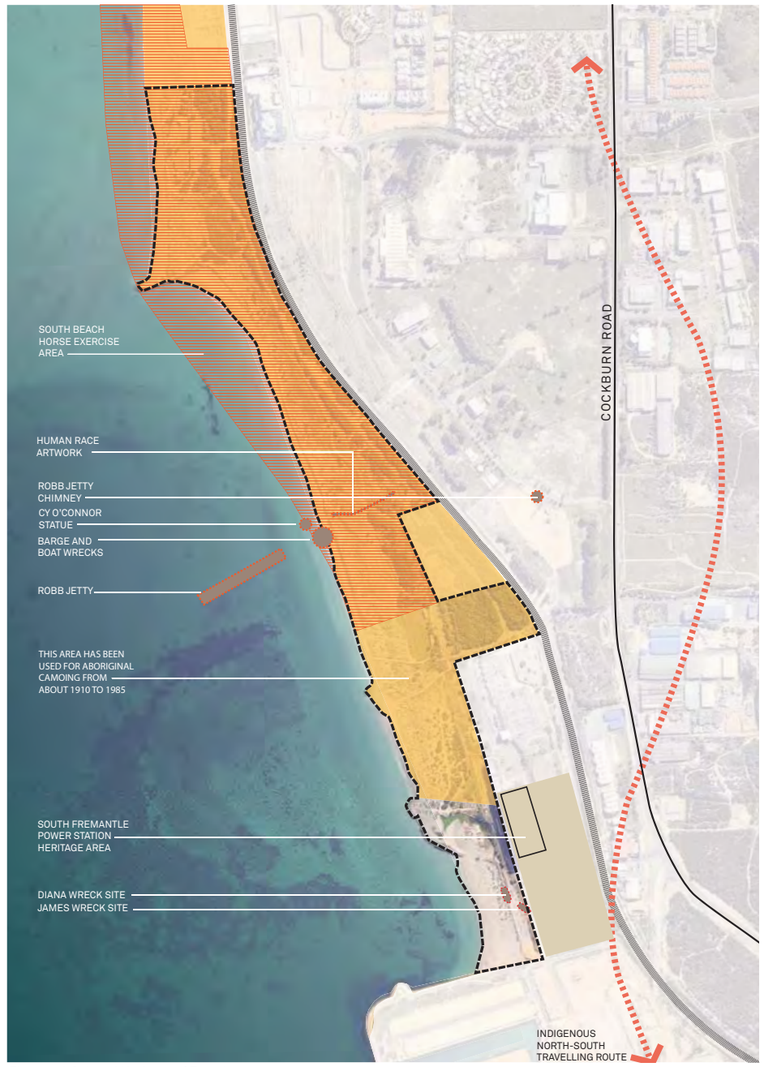


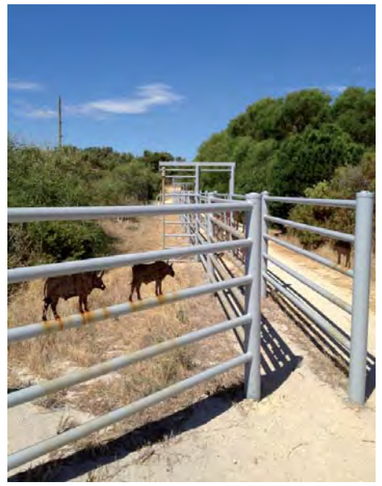
Figure 4.9 Cultural Heritage of Foreshore

CY O'Connor Statue at in ocean adjacent Robb Jetty

South Fremantle Power Station

Wyola Wreck

Long stretch of uninterrupted beach allows horse training



'Human Race' artwork by Tony Jones

'Human Race' artwork by Tony Jones

_ Any potential new jetty development should be offset from the original alignment to ensure the original structure is not damaged or obscured.
_Investigate the heritage value of the Wyola and Barge Wrecks
_Interpret the story of the wreck and wreck event.
_Retain and conserve the public art element 'CY O'connor' statue and 'Human Race' both by artist Tony Jones.

Since the development of the Cultural Heritage Strategy, some conflicts have arisen between existing features and users e.g. the retention of the wrecks within the beach and horse exercising. This has lead to the recent decision to remove the Wyola wreck. This and other future conflicts concerning the management of heritage elements will need to be resolved through consultation between the City of Cockburn and the Heritage Council WA.

The Place Making Strategy (Place Partners 2012) further utilizes the heritage themes to ensure the unique cultural heritage and place qualities are celebrated throughout the public realm. Preserving the history of the site allows the development to have its own unique identity and ensures the stories and remnants of the past are there to be discovered and to continue to live on.

Section 5.3.4 'Artwork, Signage and Education' discusses opportunities for integration and interpretation of these heritage elements within the foreshore infrastructure.

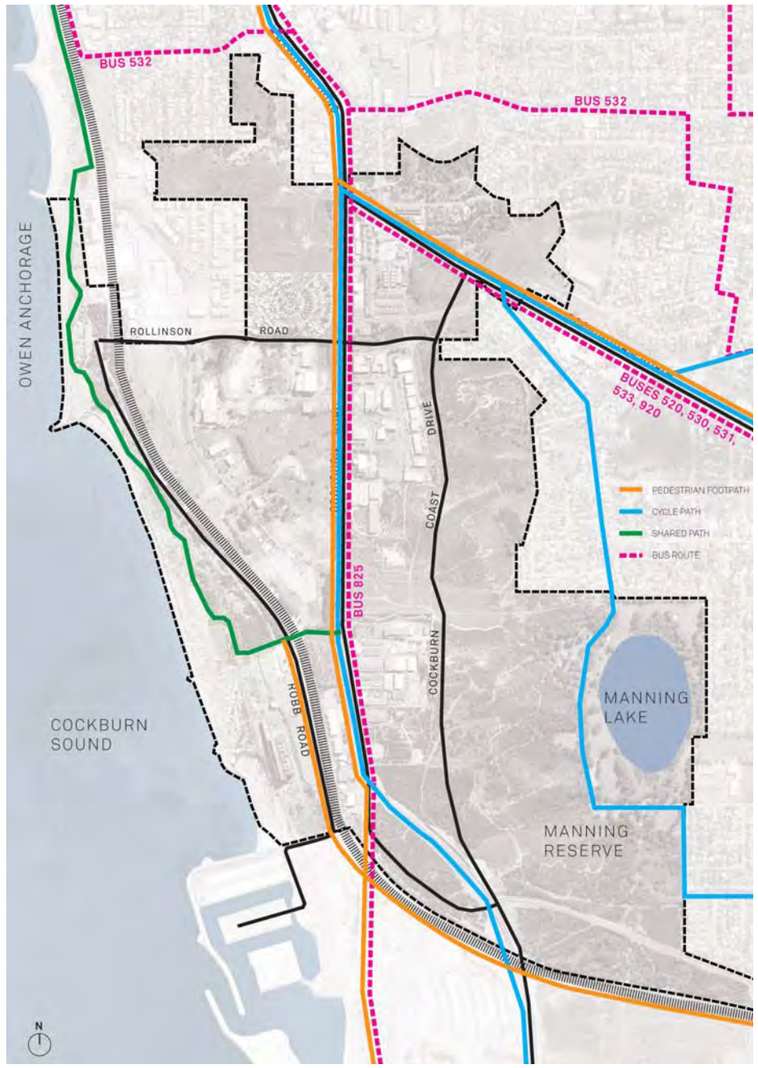


Figure 4.10 Existing circulation network within Cockburn Coast

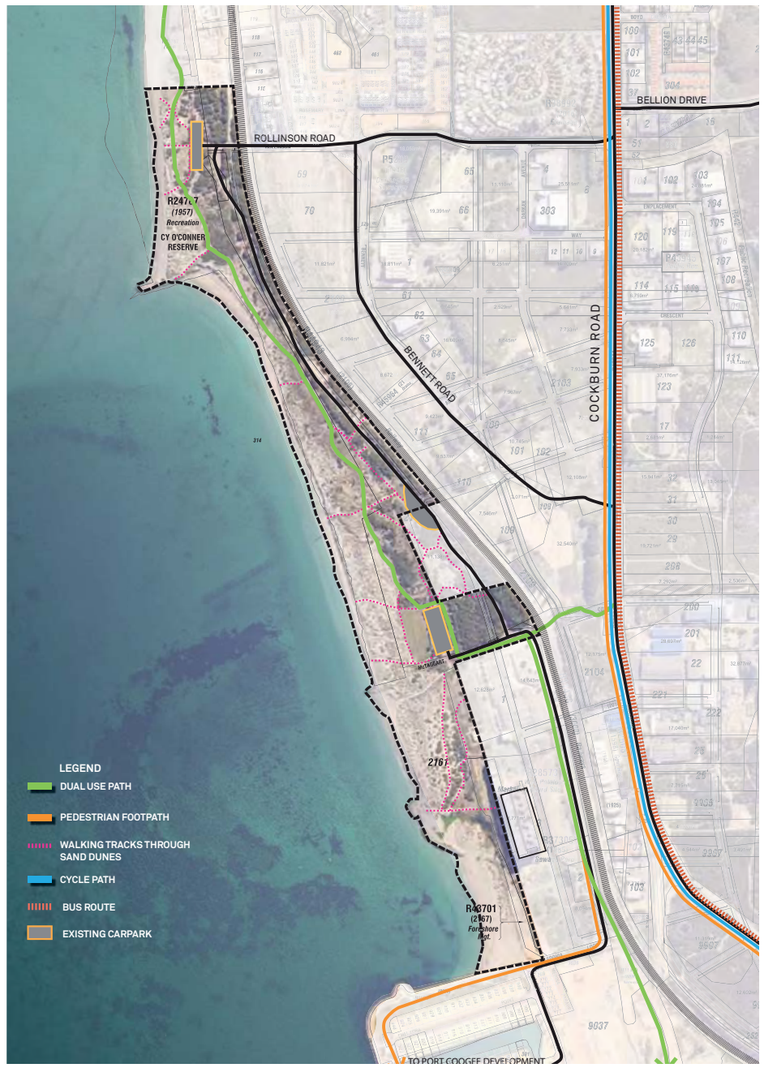


Figure 4.11 Existing access infrastructure for foreshore.

4.11 Recreation and Access

4.11.1 Access and Circulation

Movement through the wider Cockburn Coast area is currently defined by the existing transport network. North-south movements are generally well catered for within Cockburn Road, Bennet Avenue, Robb Road and the freight rail alignment. However, these also provide barriers to efficient east-west movement through the site due to a lack of east-west connectivity. Rollinson Road is the sole east-west access through the project area in the north of the site, while McTaggart Cove provides a connection at grade across the rail in the south. Refer Figure 4.10.

Vehicular access with the foreshore is limited to Robb Road which runs north-south through the site and has three public carparks located at the Catherine Point, Robb Jetty and McTaggart Cove (Figure 4.11). Access to the beach is via informal sand tracks over the dunes connecting to carpark locations and the Dual Use Path (DUP) which runs north-south through the site. The DUP currently connects back to Cockburn Road at the southern end of the site. Establishing a connection with the Port Coogee movement network is an import priority of the foreshore development.

Horse float parking is currently provided within the McTaggart Cove Carpark and the hours for beach use for horses restricted to the early morning.

4.11.2 Recreational Activities and Facilities

Existing facilities for recreation are concentrated at Catherine Point and McTaggart Cove. The facilities development for Catherine point have been the planned via the North Coogee Foreshore Management Plan (Ecoscape 2009). The concept image for this area (reproduced on page 15) outlines the facilities planned for the site as well as the management of flora and fauna. This plan is currently part way through implementation by the City of Cockburn). Facilities planned for the site include;

Completed (status as of July 2012);
_Formal and informal path networks (mostly complete)
_Shallow gradient beach access suitable for disable users
_Shelters and bbq facilities (one shelter installed, no bbq facilities)
_Rehabilitation and planting (mostly complete)

Ongoing;
_Shelters and bbq facilities (one shelter installed, no bbq facilities)
_Groyne upgrade (currently in construction)

Not yet initiated;
_Toilets
_Expansion of the Carpark and lighting
_Playground
_Interpretive signage
_Beach showers
_Drinking fountains
_Fishing shelter and cleaning tables
_Jetty
_Pontoon

Visitor use of this site is currently limited in part due to the lack of facilities compared to the South Beach park immediately to the north and part due to the lack of adjacent development and infrastructure. There is currently a lack of shade in the area, and

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un-irrigated grass and dense shrubs/trees create a sense of isolation and lack of personal security.

McTaggart cove in the south of the site, adjacent the Power Station, has more developed and established facilities and increased user numbers. The increased level of use contributes to an improved sense of security. Facilities include;
_Car parking
_Toilets
_Shelters and bbq facilities
_Seating
_Irrigated 'kick about' space
_Horse float parking
_Planting of shade trees

The foreshore currently caters for the following range of activities
_Walking, including dog walking
_Cycling
_Fishing
_Horse exercise
_Diving on Robb Jetty wrecks
_General beach recreation and swimming

To the south of the study area is the Port Coogee development. The Port Coogee foreshore very different in character to the coastal foreshore to the north and south as it is predominantly a marina created by groynes. The foreshore open space within Port Coogee are developed behind coastal protection infrastructure and have been designed for very intensive use with loss need to interface with a natural coastline. Connection and integration of the Port Coogee foreshore with the Power Station precinct will be an important focus for the design process for this precinct and will be considered within the access and circulation proposals for this FMP.

Further to the south the 'Coogee Beach Managment Plan' (Ecoscape 2009) outlines plans for the future development of Coogee Beach. This section of coastline south of Port Coogee is less intensively developed in comparison to the Port Coogee and proposed Cockburn Coast developments. Thus the facilties proposed are less intensive. There is an existing cafe and surf life saving club at this site along with parking, toilets, picnic and bbq facilties, similar to facilties at south beach and those proposed in the 'North Coogee Beach Management Plan'.


Existing shade shelters at Catherine Point


Dense vegetation blocking surveliance at Catherine Point


Carpark at McTaggart Cove


Shad and irrigated lawn provided at McTaggart Cove

Toilet facilities at McTaggart Cove

Horse float parking provided at McTaggart Cove

Beach Access Stair

Shelters & BBQs

Parkland Within Dune Planting

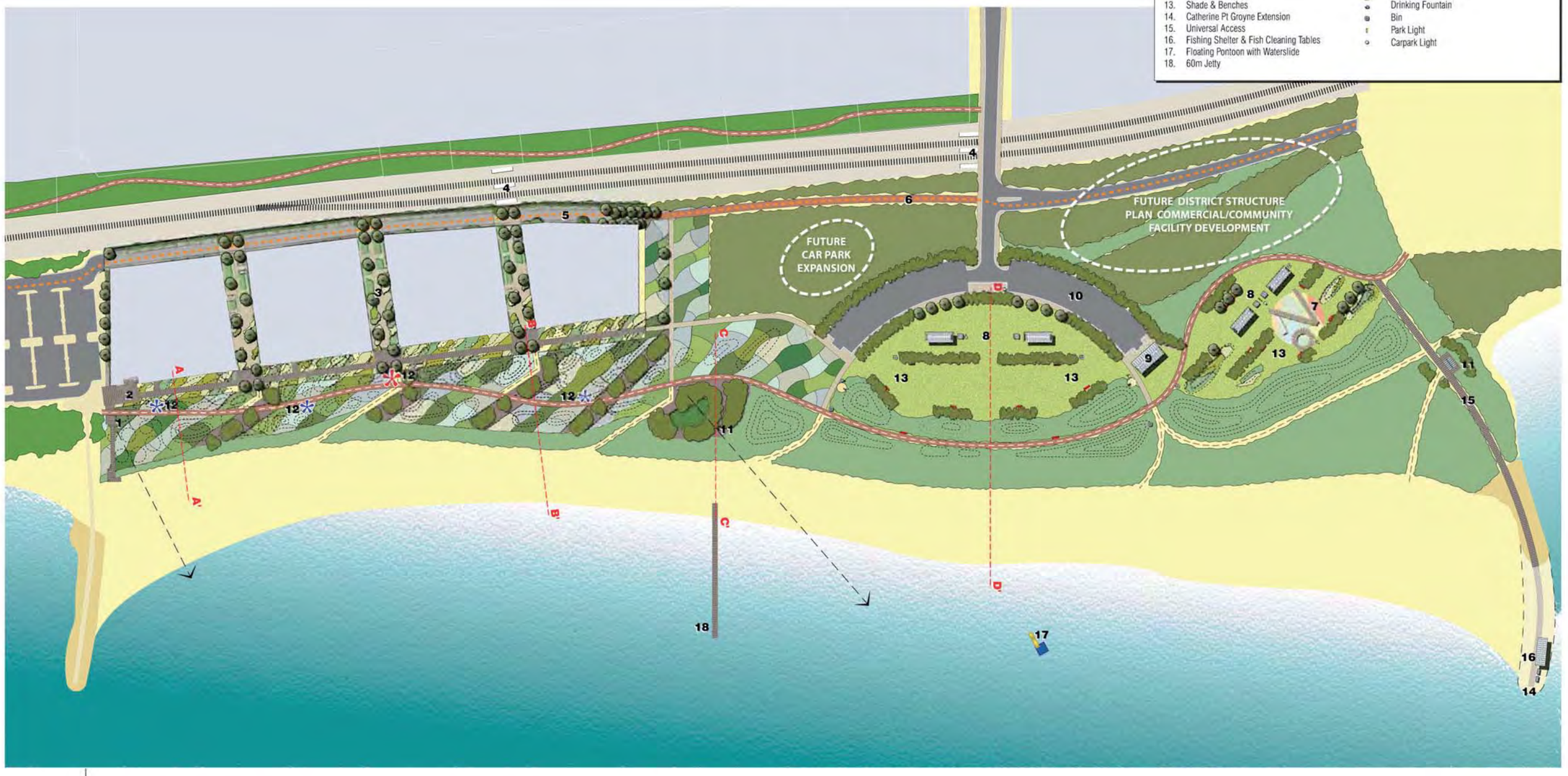
Fish Cleaning Table

Themed Accessible Playground

KEY/LEGEND

1. Beach Access Lookout & Stair
2. Boardwalk
3. Public Access Ways (POS)
4. Pedestrian Rail Crossing (requires WAGR approval)
5. Road & Carparking
6. Emergency Access Way
7. Themed Accessible Playground
8. Shelters & BBQs
9. Toilets & Showers
10. Expanded Carpark
11. Picnic Table
12. Interpretive Signage/Artwork (Major/Minor)
13. Shade & Benches
14. Catherine Pt Groyne Extension
15. Universal Access
16. Fishing Shelter & Fish Cleaning Tables
17. Floating Pontoon with Waterslide
18. 60m Jetty

- Concrete Path for Universal Access to DUP
- Sand Paths
- Commuter Cycle Path
- Dual Use Path
- New Dune Formation For Wind Protection
- Norfolk Island Pines
- Rottnest Island Tea Tree
- Turf
- Long View
- Existing Rail Line
- Dune Rehabilitation
- Development Lots
- Shower on Concrete Pad
- Drinking Fountain
- Bin
- Park Light
- Carpark Light



Rev M
SK-01

North Coogee Foreshore Concept Plan

FEB 2009

City of Cockburn

Scale 1 : 2000 @ A3

ecoscape

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5.0____CONCEPT PLAN

5.1 Summary of Opportunities and Constraints

The table below summarises the main Opportunities and Constraints identified through site analysis and stakeholder consultation.

Issue	Constraint	Opportunity
Heritage and Art	Current location of horse float parking at McTaggart cove may not be suitable in the future context of the site	The most suitable location for the horse float parking to be reviewed at an appropriate time in the future.
	Retaining the 'Human Race' Artwork at Robb Jetty may cause clashs with other planned facilities	Opportunity to integrate 'human race' with public plaza space and reinforce more visibly the alignment of the original jetty
	Need to protect the 'Diana' and 'James' wrecks from disturbance	Opportunity to reinterpret the wrecks in the above ground landscape
Access	East-west access points constrained to proposed railway crossings	Creating east-west connections will increase visual access to the site as well as physical
	Potential clash between high level of pedestrian users and bike riders particularly at key nodes along foreshore	Opportunity to separate Bike and pedestrian flows along the foreshore by providing a hierarchy of path structures.
	Horse access to beach can present an erosion risk when/where the foredune becomes very steep	Opportunity to create a suitable beach access point in a relatively stable section of the foredune i.e. adjacent Catherine Pt groyne
	Beach access paths over fore dunes are currently very steep and provide limited visual 'access' to beach. Providing shallow grade access will require significant regrading of the fore dune and associated rehabilitation works.	Multiple beach access paths spreads impact and allows more flexibility if some access routes need to be closed due to storm erosion
		DUP could provide edge to protect dune vegetation for development of small 'pocket parks
		At key locations eg Robb Jetty activity node, opportunity to create universally accessible shallow grade beach access stairs/ramps
Visual Impact and Security	Combination of high fore dune and dense north-south alignment of re-vegetation restricts visual access to beach as well as impacting on passive surveillance/security.	Some reconstructing of retained vegetation combined with a limited amount of clearing at at key locations would assist both visual connectivity and security.
		Provision of pedestrian and cycle access along Robb road will open up road corridor and Improve passive surveillance, decreasing security concerns. Overlooking from nearby developments combined with vegetation restructuring will assist security of foreshore users.
		Due to steep fore dune north-south views along beach remain relatively undisturbed by development and allow a continuation of relatively undisturbed feel of coastline with appropriate location of foreshore facilities

'Human Race' artwork at Robb Jetty

Horse Float Parking at McTaggart Cove

Masterplan vision for shallow grade beach access

Dense vegetation restricting visibility and personal security

5.0____CONCEPT PLAN

Issue	Constraint	Opportunity
		A lighting strategy focused around carparks, POS and Activity 'nodes' will contribute along with strategic removal of tall dense vegetation to improved security. Lighting along roads, pathways and cycleways address pedestrian security between 'nodes'
		Isolated high points along DUP alignment that allow views over fore dune, could be developed into 'stopping points' incorporating shelters and viewing platforms and a potential focus for interpretive elements.
Development and Community facilities	Some Sections of the foreshore are more vulnerable to coastal erosion process, eg section north of Robb Jetty and South of Catherine pt.	Concentration of facilities at nodes allows conservation of 'natural elements' along other stretches of foreshore. Section of foreshore north of Robb Jetty and South of Catherine pt to be receive very limited development due to fragile nature of shoreline and quality of existing vegetation/landscape qualities.
	Facility nodes may conflict with north-south movement paths	Provide cyclists with a fast movement corridor so that they can move around rather than through pedestrian nodes as busy times
	The high steeply sloping foredune make both physical and visual connection with the beach at 'nodes' more difficult.	Keeping facilities higher up the slope level with Robb road will afford views of the ocean. Beach views can be restricted along alignment with main street.
		Commercial-Beach interface with facilities such as café and urban plaza to be provided at Robb Jetty/Main street interface
		Each focal point or activity 'node' along the foreshore has an opportunity to develop a distinct character (refer Place Making Strategy 2012) and cater to a differ type of user
Environmental (See Figures 5.1 and 5.2 for locations of environmental issues)	'The status of the site under the Contaminated Sites Act 2003 and any requirements for remediation in light of the findings of the DSI need to be clarified with the DEC	
	The elevated levels of lead recorded in soil at Catherine Point present an environmental constraint in that there is a potential risk of exposure to the public and to any contractors working in the vicinity. Disturbance of the soil at the contaminated location should be avoided or minimised and access to the area be restricted by fencing (already in place). Any proposal to disturb would require a specific management plan to be approved by the DEC. Alternatively, the area should be isolated by permanent restricted access or given a hard surface treatment, such as a car park, as recommended in GHD (2011), would be a suitable solution to avoid potential for further disturbance. The agreed approach to treating this area should be endorsed by the Contaminated Sites Auditor appointed by the City of Cockburn.	
	The contamination in soil surrounding the old powerstation building (Mercury, asbestos and PCBs) poses a health risk to the public and any contractors working in the area. In addition, there may be the potential for Mercury and PCBs to become mobile in the soil profile which could result in their introduction into groundwater at the site. Site management plans are likely to be required to address treatment/handling of these issues.	

Existing Carpark at McTaggart Cove

Steep and eroded beach access at Catherine Pt

Masterplan vision for Robb Jetty Plaza

Lead Contamination site at Catherine Pt

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Issue	Constraint	Opportunity
	E. Coli in groundwater could present a limitation to utilising groundwater as an irrigation source at the site and could also pose a constraint to public use of the beach west of the contaminated location as potential exists for E. Coli to contaminate near shore coastal waters through groundwater discharge. Further sampling should be undertaken to assess if there is an ongoing source of E. Coli contamination and whether use of groundwater in this area for irrigation should be restricted.	The water from the Port Coogee development currently being injected into groundwater at the site could potentially be used for irrigation of POS areas, if nutrient levels are suitable. Certain levels of nutrients in this water may provide an appropriate substitute for fertiliser application to lawn areas
	Weeds are prevalent throughout the site and will need to be treated and controlled on an ongoing basis	Further dune rehabilitation and re-vegetation could be undertaken within the site, including treating weeds and managing to prevent further colonisation of invasive species. The rehabilitation already being undertaken on the dunes provides a great base to build on for further dune stabilisation and re-vegetation across the site
	The invasive Coastal Teatree species *Leptospermum laevigatum* poses the risk of affecting rehabilitation areas by establishing along the dunes and may also spread into proposed areas of POS if not controlled. The control and gradual removal of this species from the site is recommended	
	Extensive areas of areas of the foreshore vegetation are rated 'Extreme Bushfire Hazard' and some of this vegetation is in close proximity to the proposed development sites. Areas of the site considered to have a fire hazard rating of extreme will need to be considered when finalising placement of buildings/nodes in the design of the foreshore	The structural diversity of areas of dense vegetation could be increased by removing species less suited to the area (e.g. *Eucalyptus platypus*), retaining or planting Tuart, Peppermint, and WA *Melaleuca* species, eradicating weeds and returning area to more mid-level species dominated. This would provide several benefits; decrease fire hazard rating, increase habitat suitability for native fauna and improve the general condition of the vegetation
	Pest fauna including rabbits, mice and potentially cats and dogs are present at the site and will need to be addressed under the pest fauna management plan. Pest fauna may inhibit the success of rehabilitation at the site and also impact upon native fauna	
	The Lined Skink has been recorded in high numbers within the site. Earthworks should be kept to a minimum within the site to avoid individual mortalities and other adverse impacts to this species	Further re-vegetation to enhance fauna habitat values could be undertaken through creating fauna corridors and planting flowering species that will attract native birds. Restructuring of vegetation and further planting will promote habitat for the Lined Skink, which prefers coastal heath and scrublands, with intermittent bare areas of sand
	Erosion is evident particularly in the north of the site near Catherine Point. This area appears to be eroding faster than the remainder of the coast and should be prioritised for rehabilitation works	Existing pathways within the site could be formalised and those no longer in use/or needed rehabilitated to minimise dune vegetation disturbance and erosion risk.
	A steep dune face containing visible pieces of buried material is present immediately north of Catherine Point groyne and poses a public safety risk. It is suggested that this area be fenced off	
		Sound waste management procedures should be implemented to discourage/prevent dumping of rubbish within the site

Invasive Tea Tree species in front of the Power Station

Mercury Contamination in front of the Power Station

Weed species and lack of diversity within the foreshore

Lined Skink

5.0___CONCEPT PLAN

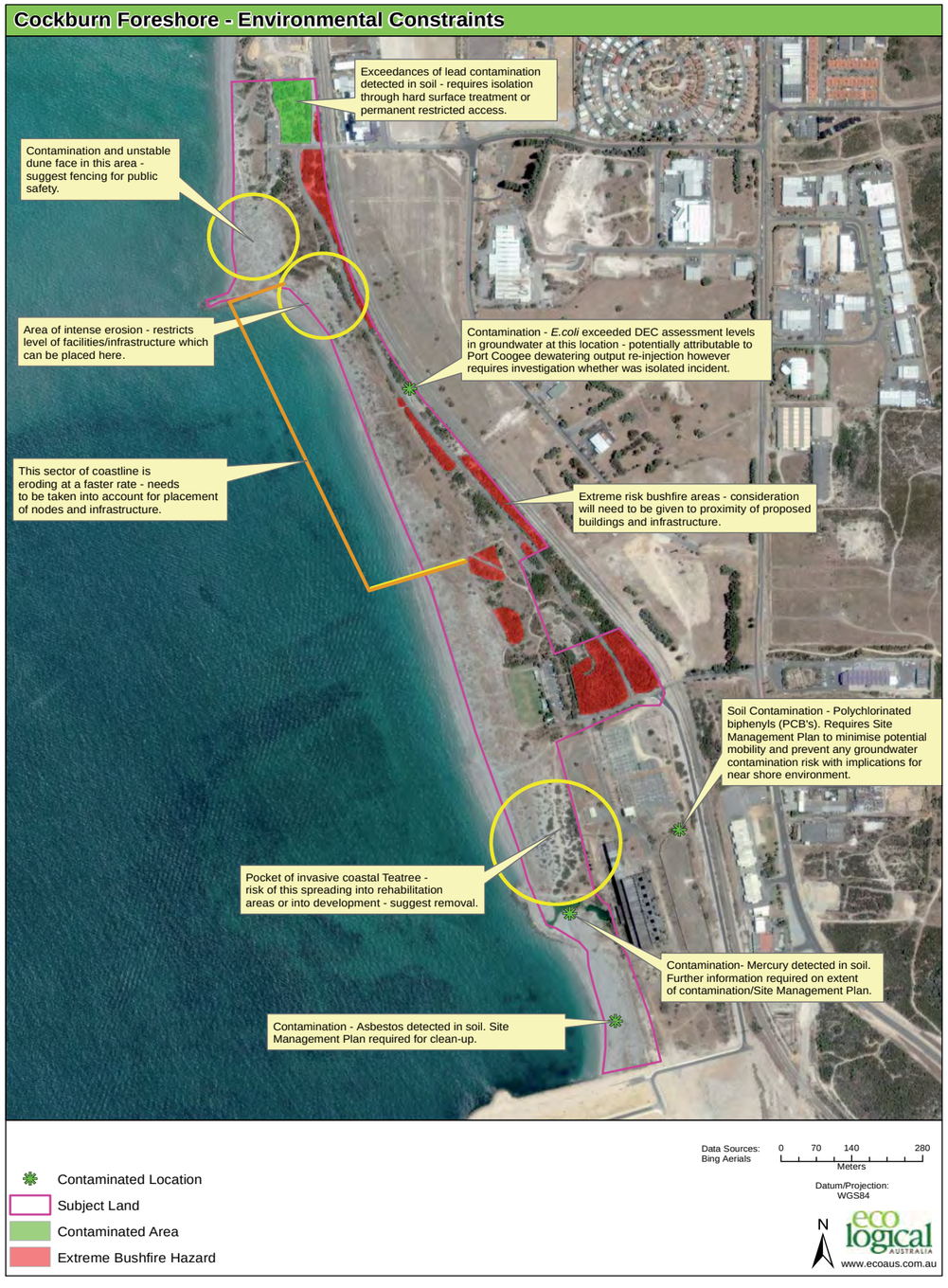


Figure 5.1 Environment Constraints

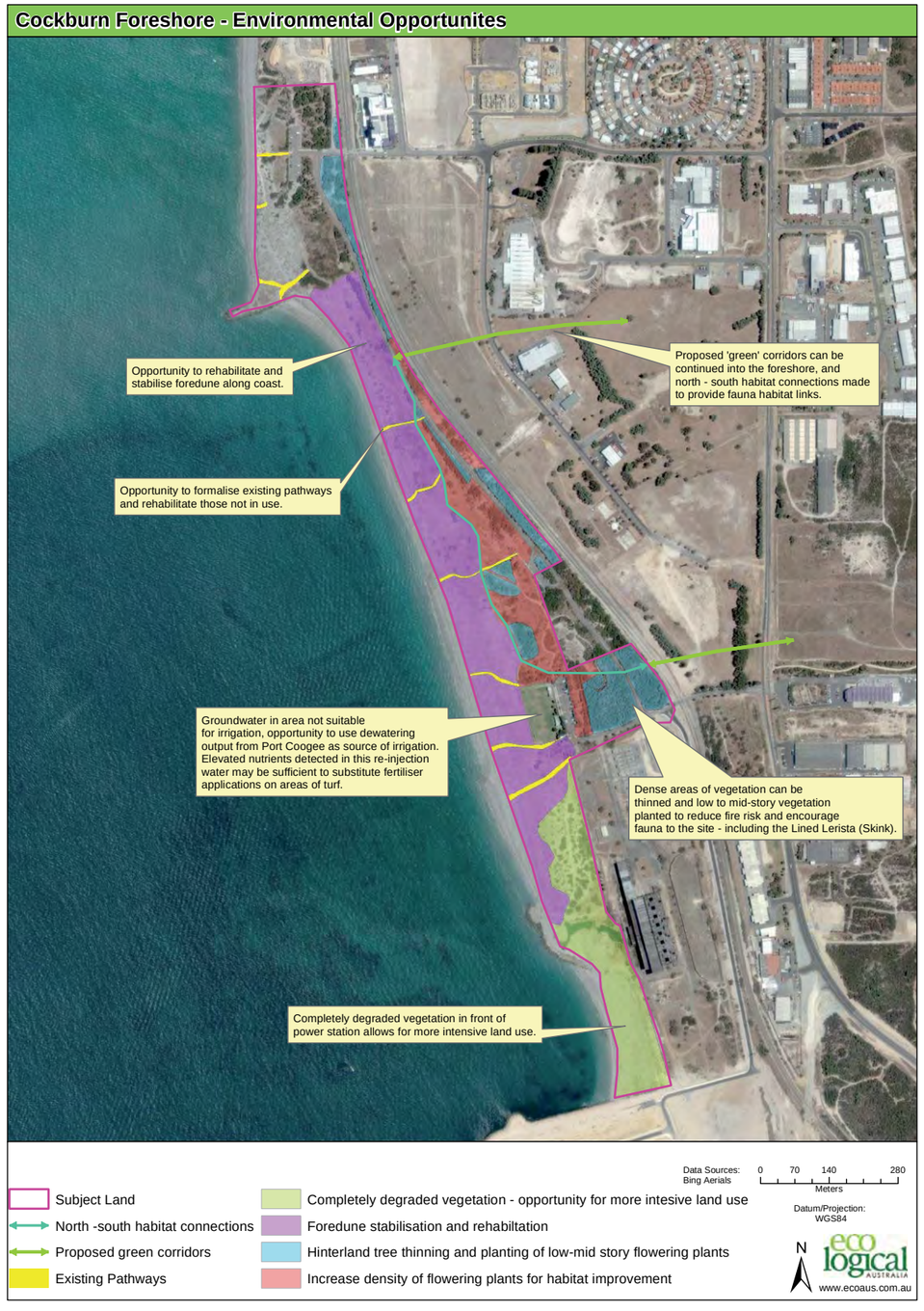


Figure 5.2 Environental Opportunities

5.0____CONCEPT PLAN

5.2 Planned Future Development

The Cockburn Coast redevelopment is a significant urban regeneration project located south of Fremantle and overlooking the Indian Ocean. The project will involve the remediation and redevelopment of former industrial land as a new ocean side community with an estimated population of 10,800 in accordance with the principles of Directions 2031. In conjunction with the Cities of Cockburn and Fremantle, LandCorp and other stakeholders, the Department of Planning has initiated the appropriate statutory framework to provide for development in accordance with the intent of the district structure plan 2.

To accommodate such a significant scale of development the District Structure Plan 2 identifies a number of development targets and development strategies within Cockburn Coast. Figure 5.1, provides a summary of the proposed development

Of note is the creation of two activity centres, being the Robb Jetty Main Street and the Power Station Activity Centres. Both centres will affect the development and management of the Foreshore. The Robb Jetty Activity Centre will be characterised by an urban plaza on the beach side of the railway line and will focus on the daily shopping needs for residents. The Power Station Activity Centre is a longer term project and will ultimately develop into an activity hub that will draw people from around the Perth metropolitan area through the provision of opportunities relating to recreation, entertainment and tourism.

Planned features of the open space network include a series of east-west running parklands, creating both movement corridors and ecological links between the foreshore and the Beeliar Regional Park. The most generous and continuous of these linear spaces has been referred to the 'Green Corridor', and meets the foreshore south of Catherine Point.

The success of the Cockburn Coast development will rely in part on the success of the foreshore as a focus of community activity and recreation. The foreshore needs to balance emphasis on the conservation of its natural elements with the provision of a vibrant and activated community space.

A primary driver for the facilities and character of the spaces along the foreshore has been the Place Making Strategy (Place Partners 2012), which developed preliminary concepts for precincts within the foreshore and development area in consultation with the stakeholder group. Figures 5.2 to 5.5 demonstrate the ideas generated for the foreshore spaces from this process.

Findings from other studies and reports developed in parallel or since the Place Making Strategy; including the Cultural Heritage Strategy and Coastal Vulnerability Assessment, along with City of Cockburn's input regarding its preferences for siting of community buildings, has meant that not all of the suggestions from the Place Making Strategy have been implemented.

Figure 5.1 Cockburn Coast Master Plan (District Structure Plan Part 2)

5.0____CONCEPT PLAN

SOCIAL
Catherine Point provides for low key local activities such as checking the conditions at South Beach. In addition, it provides for both local and district horse and dog exercisers and will attract residents from the region who share these common interests. The Community Hall for hire provides opportunities for these groups to gather and connect with each other based on these shared interests.

ECONOMIC
There is significant existing car parking infrastructure which is currently working and should be retained. A community hall that is low maintenance and management for hire in conjunction with a small cafe or kiosk would serve the local population, every day users and visitors alike. Horse related facilities and associated businesses could be considered as an attractor for equine related audiences as the population grows and activity intensifies.

ENVIRONMENTAL
Ensure Catherine Point retains its 'rawness' by revegetating and protecting areas of coastal vegetation. Aim for a seamless transition from the natural and more rugged vegetation to selected more formal green space that will facilitate community use. Built form should be modest, low maintenance and respectful of the environment. Natural materiality and soft surfaces should dominate. The view corridor through the car park provides a clear invitation marked by a lookout art work beyond the carpark.

CULTURAL
Program the Community Hall with small scale community activities as well as hire for one off events and common interest community groups. Look for opportunities for events that would suit specific user groups attracted to this location such as horse riders and dog users. Pony rides could attract tourism diversifying the equine activity at Catherine Point. Heritage markers provide a starting point for history trails throughout the Cockburn Coast.

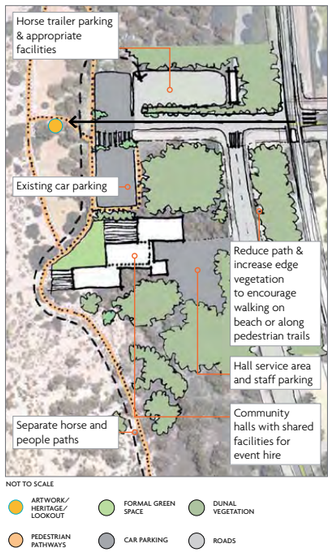


Figure 5.2 Placemaking Recommendations for Catherine Point (Place Partners 2012)

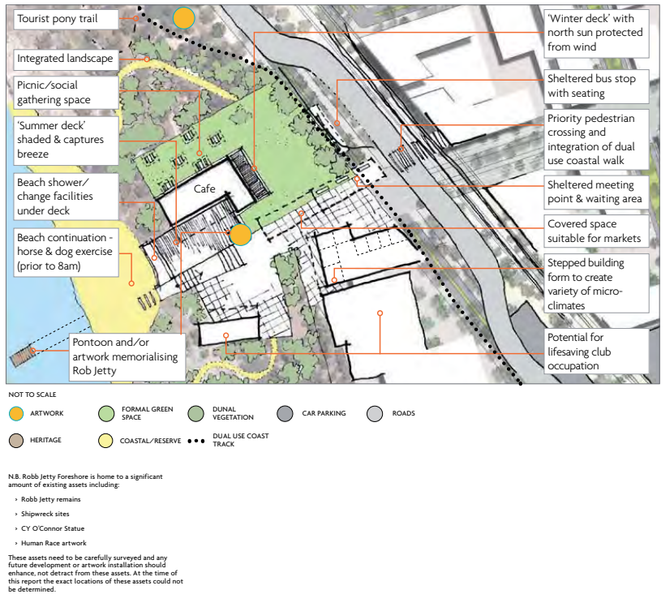
SOCIAL
Provide a series of 'rooms' with different experiential qualities that will suite various user groups. Create sheltered meeting points with view lines up into the main street in proximity to the bus stop. Providing opportunity for existing user groups such as dog walkers will ensure the development does not disenfranchise existing users and the local resident population.

ECONOMIC
Quality public amenities and public transport will encourage visitation by a broader catchment than the local Cockburn Coast. Residents from other surrounding local areas are likely to frequent this location, supplementing the customer base for local retailers. Temporary vendors, micro business and market stalls support day trippers and regional visitation on summer weekends.

ENVIRONMENTAL
The 'Summer & Winter Decks' are an example of using micro-climates to provide comfortable spaces year round. The summer deck is a shaded area that captures cooler afternoon breezes, whilst the winter deck faces the north sun and is sheltered from strong westerly winds.

Providing a choice of pathways or journeys through the site, from the rugged to more formalised will provide for the variety of user groups that will frequent this location.

CULTURAL
Public art and integrated landscapes provide opportunities to tell the story of Robb Jetty, its history and the future stories of the community as the place evolves. Attractions such as the market stalls and pony rides (starting at Catherine Point) provide tourist activities for day trippers. The Robb Jetty pontoon provides for a future 'rite of passage', when one is old enough, confident enough or a strong enough swimmer to visit the pontoon.



N.B. Robb Jetty Foreshore is home to a significant amount of existing assets including:

- Robb Jetty remains
- Shipwreck sites
- CY O'Connor Statue
- Human Race artwork

These assets need to be carefully surveyed and any future development or artwork installation should enhance, not detract from these assets. At the time of this report the exact locations of these assets could not be determined.

Figure 5.4 Placemaking Recommendations for Robb Jetty (Place Partners 2012)

SOCIAL
Create a place for the local residential community by supporting group outdoor lifestyles and ritual visitors such as the 'train watchers', usually families with young children. Various outdoor rooms cater for a broad range of community groups and local residents, from young couples and the elderly to neighbourhood and family groups.

ECONOMIC
BBQ and pavilion hire will provide low cost spaces for community groups and family functions. Other shelters and tables as well as areas for picnicing on the grass provide a no cost alternative for family outings.

The pavilion can be hired through a community portal that like with share cars gives residents the opportunity to share local resources.

ENVIRONMENTAL
Open grassed areas with perimeter planting and shade trees will provide a kick about space as well as more private gathering spaces. Use gravel and shade trees to create informal paths along desire lines and across rail tracks protected from the heat of summer. Safety screens at the rail crossing should be designed to de-risk the area for children and could incorporate aspects of the local rail story.

CULTURAL
Groups of picnic tables and chairs (some sheltered) allow visitors to play, talk, meet picnic relax, in a group or as an individual or walk the dog on a lead. Screening of the rail crossing may provide opportunity for public art integration that would speak to local stories of the Robb Jetty precinct and/ or be playful and engaging to children who 'train watch'. Most activity occurs here with adjacent green spaces providing a passive retreat and link to the rest of the precinct.

Figure 5.3 Placemaking Recommendations for the Green Corridor connection (Place Partners 2012)

SOCIAL
Collocating a variety of sporting facilities will cater to a broader range of family activities. As they age in place, brothers and sisters will be able to attend this sporting hub together. Integration with the school who will use the oval will support its activation. There is potential for use by seniors clubs, AFL and cricket, local residents, visitors as well as national memorial to the north of the site associated with the Robb Jetty Chimney.

ECONOMIC
Recreation hub for in dependant sporting and community clubs as well as a shared use with the school ensures that this is a well utilised community asset that will have the potential to raise revenue and reinvest in the community assets. It will help to concentrate pedestrian activity as users access the mainstreet and recreation facilities to the rear in consolidated carparking.

ENVIRONMENTAL
Fig trees provide a stunning backdrop to the sporting ground and create shade a micro-climates ideal for bbq and picnic use. Landscaping should encourage and retain connections through to the beach and to the primary school. Avoid fencing off areas where possible. The orientation of the club house should consider wind implications. Provide an earthen bund to create a viewing area for local games. Maximise the open space around the oval by centralising car parking to the east which will serve the beach, oval and shops.

CULTURAL
This place will allow for informal place (kick about) as well as formal play as children of all ages that engage in active recreation age in place. There is opportunity for a mix of recreation including basketball, netball, cricket etc. In addition, it can be a place of ceremony and memorial, for school fetes and carols associated with the school. As sporting clubs establish themselves, they will start to develop their legacy as an organisation building pride and making their mark on the evolution of the place.

Figure 5.5 Placemaking Recommendations for Active space east of McTaggart Cove (Place Partners 2012)

5.0___CONCEPT PLAN

5.3 Concept Plan Overview

The Concept Plan for the Cockburn Coast foreshore builds on the Opportunities and Constraints analysis, the District Structure Plan 2, the Place Making and the Cultural Heritage Strategy to direct the location and type of development suitable for the site. A big part however of the considerations for development of the site which is not adequately covered in the site analysis is consideration of coastal erosion and accretion patterns for the future of the site and how that informs development decisions. Previous Coastal Vulnerability reports by Oceania (2007) and Rogers(2011b), Rogers (2013) have identified setback requirements for coastal development and these studies have indicated areas of foreshore infrastructure that are vulnerable to erosion in the short to medium term. In conjunction with the FMP process, MP Rogers and Associates have been engaged by Landcorp to model a range of coastal protection scenarios and their impact on beach geometry. We have summarised and presented three (3) of the most viable scenarios within this report and looked at the implications on the foreshore infrastructure for each. While each protection approach has different strengths, weaknesses and costs, no one coastal protection solution has been chosen, rather the infrastructure, facilities and management strategies have been designed to by sufficiently robust to suit any of the protection solutions with minor adjustments. For a full discussion of the Coastal Vulnerability Assessment modelling for Cockburn Coast can Refer to Rogers (2014b)

5.3.1 Erosion and Coastal Protection

5.3.1.1 Coastal Dynamics

History & Current Day Coastal Dynamics

The proposed setback to development has been investigated in accord with the requirements of the State Coastal Planning Policy (WAPC 2003, WAPC 2013). The full 0.9m rise in mean sea level by 2110 was used in this assessment. LandCorp originally adjusted the District Structure Plan to locate all of the freehold development behind the setback allowance (Oceanic 2007), but have since had to update the extent of development lots to accommodate the updated development setback allowance (Rogers 2014a) generated as a result of recent changes in the State Coastal Planning Policy (WAPC 2013).

The shoreline in the Cockburn Coast project area has a long history of accretion. The recent history and current day coastal dynamics are outlined below. The information has been obtained from a number of relevant studies and monitoring data. These include Oceanica (2007), Rogers (1994), Rogers (2011b), Rogers (2014a).

- In the 1940s there was large scale dredging of Success Bank to improve the shipping channel. It is believed that a very large quantity of sand was discharged directly onto the eastern half of Success Bank.
- It is believed that this very large quantity of sand smothered the sea grass on Success Bank and formed "slugs" of sand that under the action of swell waves eventually reached the shore near Catherine Point.
- The onshore feed of sand and subsequent movement of sand along the shore created siltation problems at the South Fremantle Power Station. Various groynes and coastal structures were constructed over the decades to better manage the siltation issues at the Power Station.
- There was very large scale accretion of the coast because of the large onshore feed of sand at Catherine Point.
- In the decades from the 1940s to the 1980s the onshore feed was estimated to be about 40,000 m^3/year.
- There has been about 0.1 m rise in the mean sea level at Fremantle and Cockburn since the middle of the twentieth century.
- Since the 1990s the shoreline monitoring indicates that the rate of sand feed from Success Bank has decreased and is presently around 10,000 m^3/year.
- In addition the location of the crest of Success Bank appears to be gradually moving to the south.
- The action of waves breaking along the shore results in movement of sand generally from north to south during the winter months and south to north during the summer months.
- The net movement of sand caused by longshore drift is estimated to be presently about 15,000 m^3/year from Catherine Point towards Port Coogee.
- The reduction in the feed of sand from Success Bank on shore at Catherine Point has resulted in changes to the beach alignment. This beach immediately south of Catherine Point Groyne is receding at about 1 to 3 m/year. This is a clockwise rotation in the beach alignment.
- The sand that accumulates north of the Port Coogee Breakwaters is forming a sheltered beach.
- The proponent for the Port Coogee development has a legally binding environmental commitment to monitor and manage the beaches so there is no net erosion of the beaches to the south of the project. The proponent has committed to complete periodic bypassing about 5,000 m^3/year from the north to the south of the project.

Conceptual Model of Future Coastal Dynamics

The following is a summary of the anticipated future coastal dynamics of the Cockburn Coast project area. This conceptual model has been developed using the information on the coastal processes and engineering judgement.

- The long term onshore feed of sand from Success Bank to the shore near Catherine Point is estimated to be about 5,000 to 10,000 m3/year which is significantly less than historical rates.
- The position of the crest of Success Bank is likely to migrate slowly to the south.
- The reduced feed from Success Bank will result in continued erosion of the coast south of Catherine Point and it will recede typically about 1 to 3 m/year. This recession will result in continued clockwise rotation of the beach between Catherine Point Groyne and Robb Road Groyne.
- Ongoing bypassing of about 5,000 m^3/year will be needed to maintain Coogee Beach to the south of Port Coogee.
- The rate of sea level rise will increase in the coming century and is estimated to be about 0.1 m by 2030; 0.4 m by 2070 and 0.9 m by 2110.
- The rising sea level will result in movement of sand from the beach and dunes to the nearshore areas to maintain stable inshore seabed slopes. This will cause recession of the shoreline at an increasing rate over the coming century.

5.3.1.2 Initial Options for Coastal Management

Areas Under Threat from Coastal Erosion

Using the above conceptual model of future coastal processes, it was assessed that should no intervention take place the northern portion of the beach between Catherine Point Groyne and Robb Road Groyne would continue to erode. The beach compartment would continue to rotate clockwise (refer Figure 5.6).

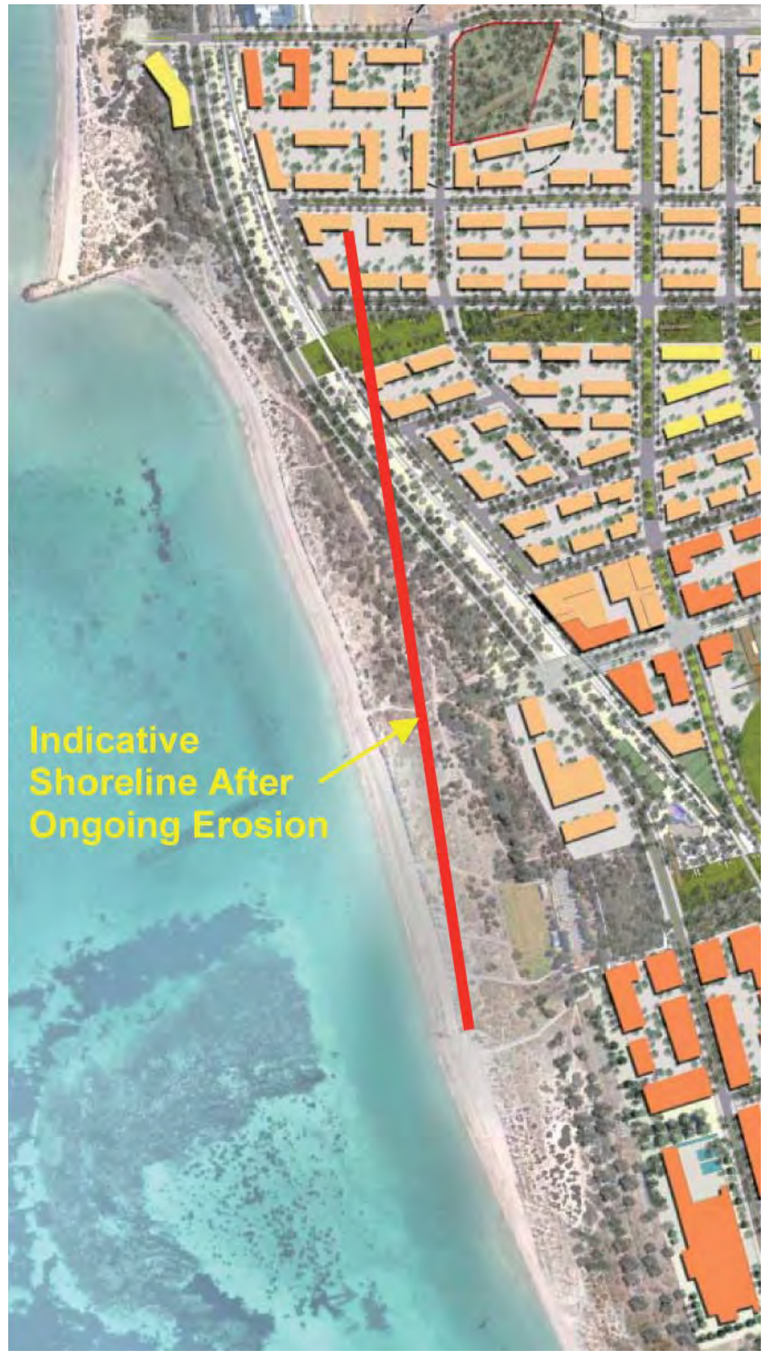


Figure 5.6 Coastal Protection - Indicative Shoreline alignment with no protection measures

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This would affect government infrastructure in the area. Rogers (2011b) predicted that in the coming 5 years the dual use path in the foreshore reserve is likely to be damaged by erosion. This has since occurred and the dual use path immediately south of Catherine Point groyne has been relocated further east from the 2012 alignment shown below. In the coming 1 to 2 decades the road reserved for Robb Road is likely to suffer erosion should nothing be done. Eventually, the railway would be threatened. None of these areas of land are owned or controlled by LandCorp. However, as part of the development of the Foreshore Management Plan, LandCorp has separately briefed the Department of Planning, the City of Cockburn, and the Public Transport Authority concerning the future coastal erosion. Officers from Fremantle Ports and Brookfield Rail attended the briefing session with the PTA. In these consultation sessions, LandCorp encouraged these various agencies to investigate the situation and develop the appropriate approach to managing the threat to their property of coastal erosion over the future decades. This should include evaluation of coastal management options and funding arrangements.

Initial Options for Coastal Management

As part of the Foreshore Management Plan, a range of options for coastal management were developed to the initial concept stage. These included:
_Ongoing Beach Nourishment.
_Seawall.
_Initial Beach Nourishment, Groyne and Ongoing Backpassing.
_Initial Beach Nourishment, Headland and Ongoing Backpassing.
Each of these options has been developed to the concept design level to identify the main features and provide an indicative cost estimate. These options are outlined below.
The three most cost effective coastal protection options; Seawall, Groyne and nourishment and Headland and nourishment have been graphically represented in figure 5.7, 5.8 and 5.9. The three scenarios have formed the basis for locating infrastructure and facilities in sections for the foreshore.

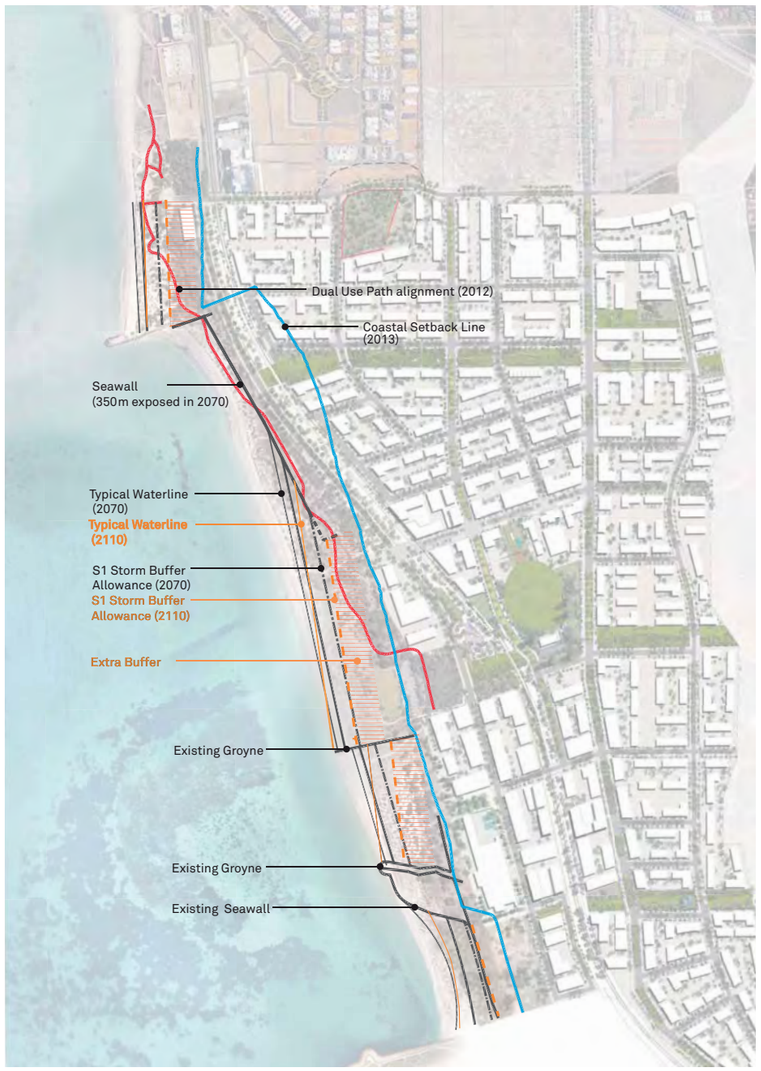

Figure 5.7 Coastal Protection - Seawall Option (2070), overlaid on DSP2 plan

Figure 5.8 Coastal Protection - Groyne and Nourishment Option (2070), overlaid on DSP2 plan

Figure 5.9 Coastal Protection - Headland and Nourishment Option (2070) , overlaid on DSP2 plan

5.0____CONCEPT PLAN

1) Ongoing Beach Nourishment
The City of Cockburn requested that the option of managing erosion using beach nourishment be examined. There are two causes of the anticipated beach erosion. The first is the reduced sand feed from Success Bank and the second is the impacts of rising sea level due to Climate Change.
To counter the impacts of the reduced sand feed from Success Bank there would need to be about 10,000 m^3/year of beach nourishment. This could be by backpassing from the sheltered beach between the Power Station and Port Coogee.
To counter the impacts of sea level rise due to Climate Change there would need to be about 567,000 m^3 of beach nourishment placed to 2110. The amount would be about 63,000 m^3 to 2030, a further 189,000 m^3 between 2030 and 2070, and a further 315,000 m^3 between 2070 and 2110.
Using normal commercial rates for backpassing and beach nourishment, the total cost of this beach nourishment option could be more than $20 million over the coming century.
If this option was to be pursued, then it would be wise for the proponent to fully explore opportunities to obtain suitable sand for free or at reduced cost. This could be by using dredge spoil should it be suitable and provided at no cost or greatly reduced cost. Fremantle Ports may be completing large scale dredging associated with the shipping channels in the coming decades (pers comm Lyle Banks, FP).

2) Seawall
It would be possible to protect the public infrastructure near Catherine Point Groyne from coastal erosion using a rubble mound seawall. The Dual Use Path was recently relocated closer to Robb Road. A seawall could be constructed to protect both the path and the road.
The initial concept is for a 520 m seawall. It would be largely buried behind the sandy beach at the time of construction. As the impacts of the ongoing coastal processes and sea level rise occurs, the rock seawall would become progressively exposed. It is estimated that by 2030 typically about 230 m of seawall would be exposed. This would increase progressively to about 350 m by 2070 and 450 m exposed by 2110.
The initial and approximate estimate of the capital cost of this option is $2.4 million.
This option would require only modest ongoing maintenance costs as properly designed rubble mound structures are reasonably resilient.
The beaches to the south of the seawall would progressively rotate clockwise in response to the reduced sand feed from Success Bank. In addition, these southern beaches would erode in response to sea level rise due to Climate Change. The anticipated position and alignment of these beaches in 2070 is shown in Figure 5.7.

3) Initial Beach Nourishment, Groyne & Ongoing Backpassing
This option aims to maintain a sandy beach for the full length of the shore from Catherine Point Groyne to Port Coogee. A new groyne would be built about 300 m south of Catherine Point Groyne and the compartment would initially be nourished with 115,000 m^3 of sand. This would protect Robb Road.
To maintain the beach alignment with the reduced sand feed from Success Bank, there would need to be ongoing backpassing. About 10,000 m^3/year of sand would need to be taken from the sheltered beach between the Power Station and Port Coogee and moved to the beach immediately south of Catherine Point. The longshore transport regime would move this back to the sheltered beach each year. The anticipated position and alignment of these beaches in 2070 is shown in Figure 5.8.
The initial and approximate estimate of the capital cost of this option is $4.0 million and the ongoing cost of the backpassing is estimated to be about $0.1 million / year.

4) Initial Beach Nourishment, Headland & Ongoing Backpassing
A variation on the groyne option would be to use a headland to form the beach compartment immediately south of Catherine Point. This scheme would require the same 115,000 m^3 of initial beach nourishment and the ongoing 10,000 m^3/year of backpassing.
The headland (figure 5.9) would provide less of an impediment to walking and horse access along the beach. The disadvantage of the headland compared to the groyne is that any adjustment to the scheme would be more difficult.
The initial and approximate estimate of the capital cost of this option is $4.5 million and the ongoing backpassing of sand is estimated to be about $0.1 million /year.

Consultation during development of Coastal Protection Options
During the development of Coastal Protection options for the Foreshore Management Plan, LandCorp has consulted with the various stakeholders. This has included the Department of Planning, the City of Cockburn, and the Public Transport Authority. These parties have been briefed on the present day coastal processes, the existing erosion trends and the extent likely future erosion.

Interactively, with the stakeholders, LandCorp and its consultant team has developed a range of options for coastal management of the Cockburn Coast shoreline. Initial details of these options have been provided together with initial and indicative cost estimates. In these consultation sessions, LandCorp has encouraged these various agencies to investigate the situation and develop the appropriate approach to managing the threat to their property of coastal erosion over the future decades. This should include evaluation of coastal management options and funding arrangements. The evaluation of proposed options need to consider beach amenity for both active and passive users of the foreshore including pedestrians, cyclists, and horses.

5.0____CONCEPT PLAN

5.3.2 Access and Circulation

Figure 5.10, 5.11, and 5.12 demonstrate the proposed circulation hierarchy throughout the foreshore for the three coastal protection solutions. The proposed open spaces, circulation and parking network for the wider Cockburn Coast development (established in the District Structure Plan 2 and updated as part of the Local Structure Planning process) is also shown, demonstrating where the main development is linking across the rail corridor to the foreshore, creating five activity 'nodes' one at each of the vehicle and/or pedestrian connections.

The final configuration of at-grade vehicular access connections across the freight rail line are currently the subject of negotiations with the Public Transport Authority. Depending on the outcomes of this process, the FMP may require updating to reflect the final agreed configurations of access routes. It is not envisaged however that changes to the status of these connections will significantly impact on the Foreshore Concept. The parking on the foreshore is supplemented by on-street parking and multi-storey car parks within the main development.

The access infrastructure currently proposed for connecting the foreshore and the main Cockburn Coast development across the freight rail line includes;
_At grade vehicle and pedestrian crossings at Rollinson Road, 'Main Street' and another within the Power Station Precinct.
_Pedestrian bridges connecting across the rail line at the 'Green Link', McTaggart Road (following closure of the vehicle access at this location when 'Main Street' is open) and a third pedestrian bridge in the Power Station Precinct.
The exact location and structure of rail crossings within the Power Station Precinct will be further resolved during the Local Structure Planning process for this precinct.

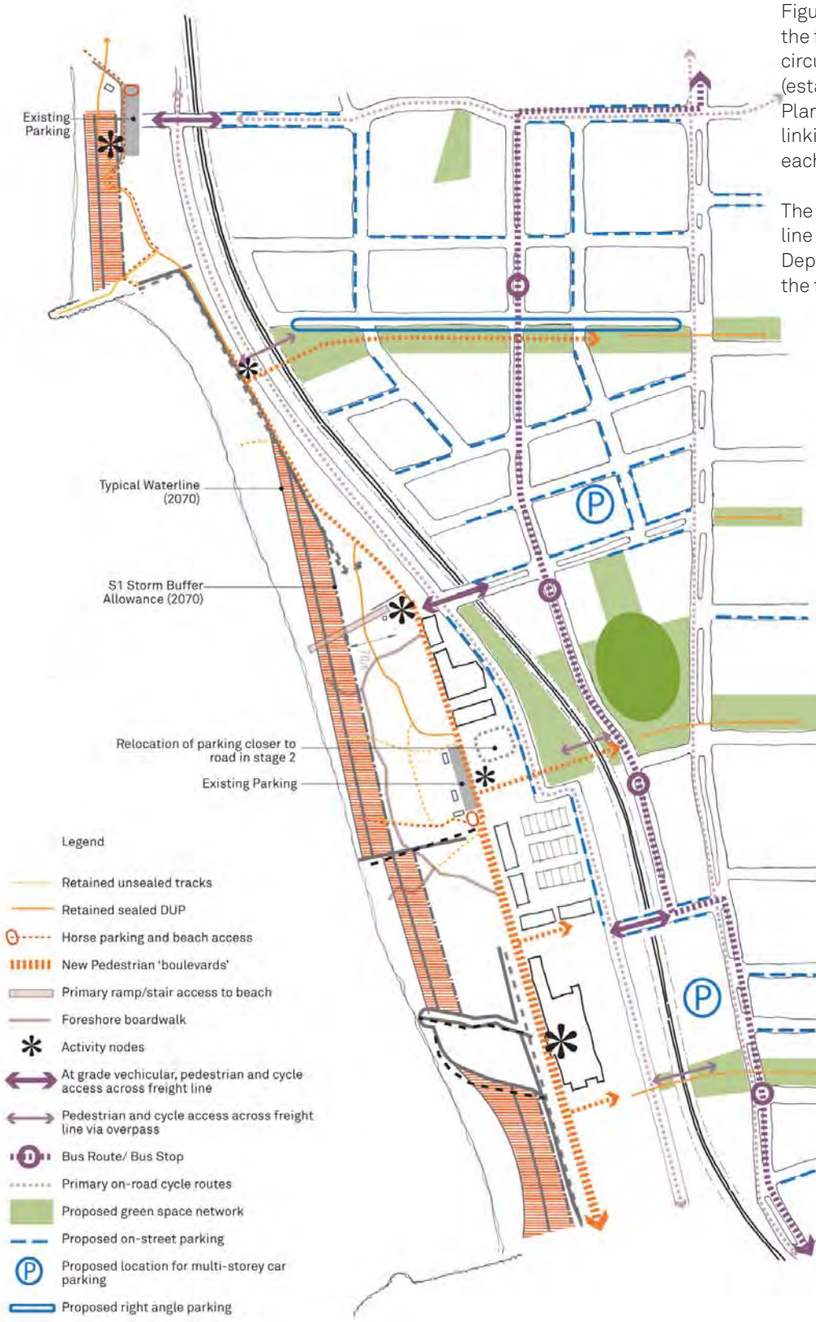

Figure 5.10 Access and Circulation - Seawall Option

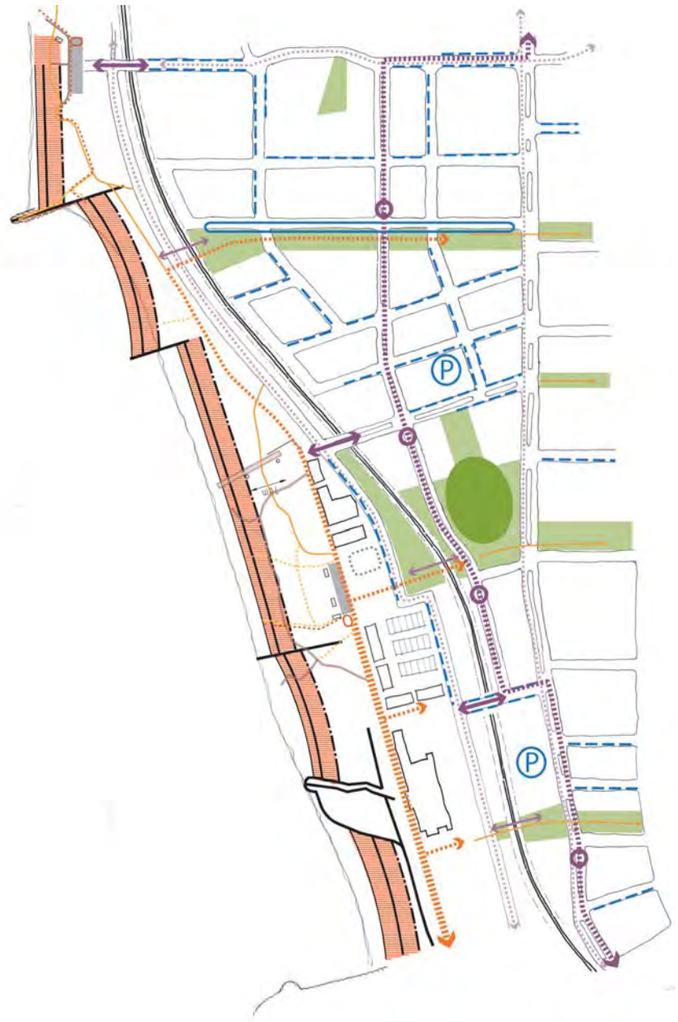

Figure 5.11 Access and Circulation - Groyne and Nourishment Option

Figure 5.12 Access and Circulation - Headland and Nourishment Option

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The character of the north-south movement network along the foreshore responds to the character of the activity nodes. The character of the nodes established through the DSP2 and Place Making Strategy establishes two urban character nodes on the southern end of the site at the Power Station and Robb Jetty. Both these locations are juxtaposed to retail and commercial activities and expected to see the concentration of pedestrian users. Catherine point and McTaggart Cove provide more space for active beach users providing lawns, playgrounds and car parking, while the Green Corridor link between Catherine Point and Robb Jetty is located on a narrow section of vulnerable foreshore well away from commercial centres.

All these factors suggest the southern section of the foreshore is likely to experience a greater density of pedestrian users many of whom may not utilise the beach other than for the views. With this in mind as you go south from Catherine Point the path width becomes incrementally wider as it handles greater user numbers. Between Robb Jetty and the Power Station it becomes a wide boulevard (5-10m width). In order to create movement options for both pedestrian and cycle users the path breaks up into a hierarchy of different path types and experiences including;

_A wide boulevard along the eastern edge of the foreshore, with a consistent elevation, will provide broken views depending on the height of the foredune to the west.
_The DUP remaining for the most part on its existing alignment, undulating with the topography and allowing cyclists or pedestrians to remove themselves from the 'high traffic' Boulevard path.
_A foredune boardwalk designed to provide uninterrupted views of the beach and ocean, while also providing the best opportunity to establish a universally accessible route to the beach for disabled users (The feasibility of providing this opportunity and location of a suitable route will need to be resolved as part of detailed design process). These boardwalks will also provide key opportunities for interpretation of maritime education themes.
_Informal sand tracks to the beach. The existing networks of tracks will be retained in some locations while others will be removed and re-vegetated.
_The beach itself is a north-south movement path.

This access scheme remains relatively consistent across the 3 coastal protection scenarios, with the exception that in the seawall option a shared path and deck would run along the top edge of the seawall providing access for both pedestrians and cyclists, however in the groyne and headland options this section of the path is a deck only, floating above unmodified dunes, and not as suitable a surface for cycle users. Thus the DUP in these two scenarios connects to Robb Road north and south of the green corridor link providing an alternative route for cyclists avoiding the decked surface.

The 3 coastal protection scenarios do have different impacts on pedestrian and horse movement along the beach. The Seawall and Groyne protection options will both result in a shorter length of continuous beach. This effect would be immediate in the case of the Groyne options whereas the usable length of beach will shorten over time with the seawall. This shortening of the beach could significantly effect the utility of the beach for horse exercise and will impact on the amenity of other users. This outcome will need to be considered in the final choice shoreline protection measure.

5.3.3 Infrastructure and facilities

General Approach

The strategy for built elements across the foreshore is to keep elements developed on retained fill away from the areas of coastal vulnerability with infrastructure built close to or within vulnerable zones to utilise pile footings (i.e. decking), as this construction methodology can accommodate some sand movement. Within the most vulnerable zones (likely to erode within the next 50 years) build only minor infrastructure. All infrastructure apart from stair and deck connections down to the beach sit behind 2070 storm buffer.

The new spaces, structures and facilities within the foreshore will require detailed design and documentation prior to construction. Some deviation from the concept plans shown is likely due to requirements to deal with levels and local conditions, however the general structure and principals of the infrastructure strategy should be maintained.

Section 5.3.8 provides a guide to the types of materials and finishes expected for each of the types of spaces i.e. streetscapes, plazas, parklands and boardwalks to provide a guide during the detail design process. Indicative costing for the foreshore infrastructure (excluding coastal protection infrastructure) will be incorporated within the Development Contribution Plan for the Cockburn Coast. This process will provide an indicative budget for design and construction of the proposed works.

Figures 5.13 to 5.15 layout the proposed infrastructure from Catherine point in the north to McTaggart cove in the south. The power station redevelopment has been the subject of an conceptual design and approval process considering a range of options from a relatively undisturbed foreshore to a marina development enclosed by seawalls. Currently, LandCorp and relevant stakeholders are in the process of preparing a Master Plan report for the Western Australian Planning Commission. The Master Plan is expected to provide guidance for the adaptive reuse of the South Fremantle Power Station and surrounding land. The Master Plan will guide development within the future Power Station Local Structure Plan. The infrastructure shown in the concept diagrams in the vicinity of the Power Station is indicative only as the design for the foreshore id yet to progress through comprehensive client and stakeholder consultation. The design and construction of the foreshore environment for this precinct will be part of the power station works but subject to the management and guidelines of this document.

Catherine Point

The development of facilities at Catherine point has been the subject of the 'North Coogee Foreshore Management Plan (Ecoscape 2009) and the graphic plan from this report is reproduced in Section 4.11. The planned works for this site are partly complete and the current concept plan does not seek to change significantly the plans for this site. The Place Making Strategy (Place Partners 2012) suggested the inclusion of a community building on this site, though City of Cockburn has since determined that this is not an appropriate location for community facilities. A site for built elements is still nominated on the infrastructure plan allowing for the establishment of a suitable cafe or restaurant in this location. Feasibility of establishing commercial facilities in this location particularly with regard to serving will require further investigation.

The Place Making Strategy had also nominated horse exercise facilities in this location. The horse float parking is currently located at McTaggart cove as this provides better access to the long stretch of beach south of the Catherine Point groyne. This southern end of Robb Road is likely to become much busier and more urbanised as the Cockburn Coast development takes shape and it may be desirable to relocate the horse float parking back to Catherine Point in the future. The most suitable location for the horse float parking and beach access needs to be reviewed once the final plans for the Power Station Precinct, McTaggart Cove and Beach Protection have been resolved, as these will all impact the best location for continued horse access.

The North Coogee FMP proposed an extension of the facilities with a playground. User numbers would not currently justify this extension, however as user numbers increase and if commercial activities where established at the site, this expansion would be justified. The other points of difference between the Cockburn Coast FMP and the pre-existing North Coogee FMP recommendations is the inclusion of;

- more shade trees in the parkland,
- the provision of stair access to the currently very steep and eroded access path
- and restriction of access to the unstable dune faces immediately north of Catherine Point Groyne .

Refer to section 5.4.1 for a detailed plan and section of the area.

Graphic of proposed Robb Jetty/Main Street interface from District Structure Plan Part 2

Existing facilities at McTaggart Cove

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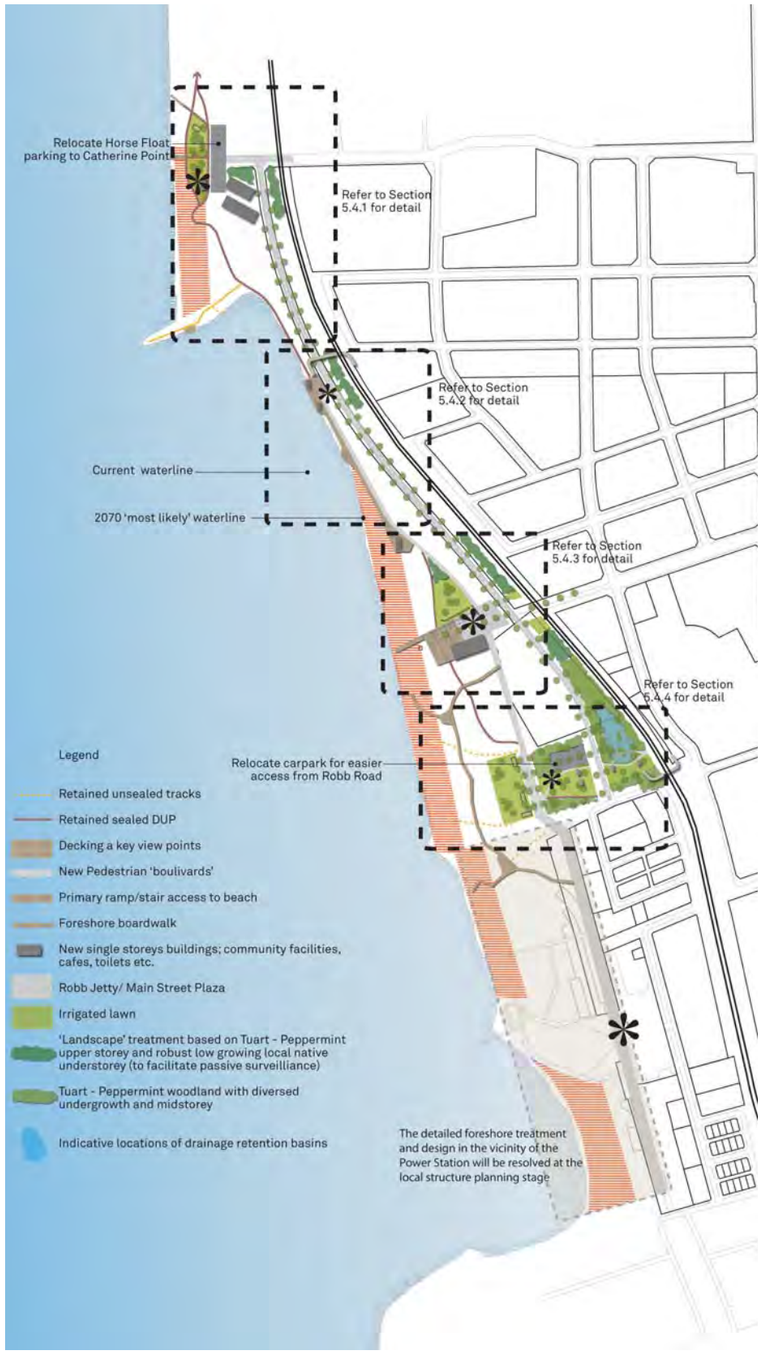

Figure 5.13 Infrastructure and Facilities - Seawall Option

Green Corridor Link

A dual use path (DUP) connects Catherine Point to the next activity node, the 'green corridor link'. This location connects the main green spine east-west through the development via a pedestrian overpass over the rail corridor, terminating in a wide platform at the northern end of the foreshore boardwalk. In the case of the seawall coastal protection option, this boardwalk would sit on top of the seawall providing expansive ocean views. The seawall would initially be built behind the fore dune, but with time the fore dune would be lost to erosion and the water would come up to the base of the seawall. In the groyne and headland options the decking structure would sit above the existing dunes providing more restricted views over the foredune which would be protected by the groyne/headland and beach nourishment. In the groyne/ headland options the boardwalk has been located further west and in the case of the groyne option will link with the groyne structure to provide access for fishing. The facilities provided along this boardwalk will include shelters, furniture and interpretive signage elements focused on themes relating to coastal processes and indigenous heritage. Refer to section 5.4.1 for detail plans of this location for the different coastal protection options.

Figure 5.14 Infrastructure and Facillties - Groyne and Nourishment Option

Robb Jetty Plaza

Robb Jetty Foreshore Plaza will provide a central focus for the foreshore as well the strongest visual link to the foreshore and the beach from the main development east of the rail corridor. The foreshore plaza needs to be a destination while not interrupting views down main street to the ocean. The eastern end of the plaza is a paved area level with Robb Road incorporating trees, furniture and shelter. A potential commercial site on the southern side of the plaza also houses toilet and shower facilities. On the north is a less formal parkland picnic area with shade bbq and picnic facilities. The western end of the plaza is a tiered deck sitting above the dune structure providing seating and interpretative signage elements that don't interrupt coastal views. An east - west

Figure 5.15 Infrastructure and Facilities - Hedland and Nourishment Option

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Figure 5.16 Artworkks, Signage and Education - Headland and Nourishment Option

aligned shade structure and interpretative elements have been proposed along the northern edge of the plaza adjacent the retained 'human race' artwork (likely to require lifting to suit new plaza levels). The artwork and adjacent shade structure would reinforce the alignment of the original jetty and provide an opportunity for interpretation of this story. The three coastal protection options have only minimal influence on beach erosion predictions for this location and therefore the proposal for all three is the same. Refer to Section 5.4.3 for a detailed plan and section for this location.

McTaggart Cove

A wide pedestrian boulevard connects the plaza with the McTaggart Cove parklands. A coastal boardwalk linked to the boulevard and the DUP will provide pedestrian and wheelchair access to the beach along this section of beach. The McTaggart cove parkland currently incorporates a carpark which sits on a retained platform above the picnic and 'kick about' space to the west. In the short term it is recommended to retain this carpark in its current location, however once the Power Station Redevelopment to the south is constructed the boulevard link will be extended to the Power Station through the current alignment of the carpark. Ground levels in the current location of the carpark may need to be lifted further to maintain a consistent level connection along this spine and maximise view opportunities. 'Stage 2' of the of the development in this location relocates the carpark further west along Robb Road. A network of pedestrian paths, cycle paths and boardwalks through an east-west running parkland connect the foreshore park to Robb Road, a 'dampland' retention basin and the sporting oval and club rooms within the main development. Current facilities within the parkland include toilets, shelters and bbq facilities. Additional shelters, seating and bbq facilities will be provided along with a suggested location for a playground. The three coastal protection options have only minimal influence on beach erosion predictions for this location and therefore the proposal for all three is the same. Refer to Section 5.4.4 for a detail plan and section of this location.

5.3.4 Artworks, Signage and Education

The Cultural Heritage Strategy (TGP 2012) has thoroughly documented the heritage elements and stories of the Cockburn Coast and set up the following interpretative themes relevant to the development of interpretive art an signage for Cockburn Coast;

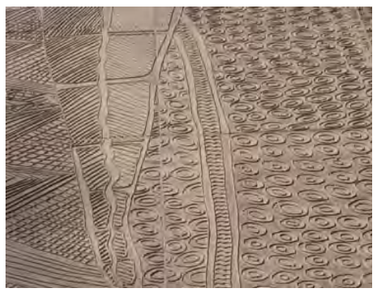
Human Race artwork located at Robb Jetty (artist Tony Jones) inspired by history of cattle yards and shipping

Unloading cattle at Robb Jetty (date unknown) image reproduced from Cultural Heritage Strategy

Public art focal pieces for plaza spaces

Interpretative elements/art as furniture

Historical image of the functioning power station



Interpretation on indigenous heritage in surface finishes

Public art utilizing site materials

Art elements interpreting natural processes

Interpretive elements incorporated into shelters at Catherine Point

CY O'Connor statue at Robb Jetty (artist Tony Jones)

Interpretive elements/art as furniture

Interpretive elements/art as infrastructure

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_Tracing Climatic and Topographical change
_Living as Australia's earliest inhabitants
_Exploring the coastline
_Moving Goods and Feeding People
_Supplying Urban Services
_Surviving as Indigenous People in a White-Dominated Economy
_Organising Recreation and Going to the Beach
_Defending Australia

The Public Art Strategy for Cockburn Coast (Place Partners 2012) builds on the Cultural Heritage Strategy; suggesting themes and locations for artworks, interpretative elements and other art based activities. The proposals for the foreshore include the development of a coast art and heritage trail, including;
- Developing an artwork at Catherine Point (horse riding theme) that would act as a the northern gateway to coast art and heritage trail
- Interpretation of the former Robb Jetty site through both landbased and water based interpretive artworks at this location
- retention and protection of the CY O'Connor statue
- art and lighting programs for the Power Station Site
- A land/sea based major artwork for the Power Station foreshore
- and a water based playground at the Power Station Site

There are existing artworks within the site at Robb Jetty; the 'human race' cattle grid, 2 wind veins and the CY O'Connor statue (in the ocean). All these elements should be retained, with minor changes to location or levels associated with the development of Robb Jetty. There is potential for major artworks as suggested in the Public Art Strategy at Catherine Point, Robb Jetty and the Power Station precinct. However, there are many more opportunities for incorporating interpretive themes within the furniture, paving, shelter elements of the development. The images on the previous page provide examples of integrating interpretive themes within the landscape elements allowing for learning though exploration and play, and complementing text based information.

Figure 5.16 builds on the Public Art strategy to provide potential locations for both tradition art works as well as for interpretive elements that inform and interpret historical and cultural themes through landscape/ furniture and signage elements. Specific interpretive themes that could be developed along the foreshore include;
_ Coastal process from both ancient indigenous narratives to predictions of future coastal movements
_ Wreck sites at Robb Jetty and the Power station
_Robb Jetty and cattle loading, already the subject of an interpretative work
_Horse training and exercise
_Industrial heritage

5.3.5 Landscape Finishes and Materials

The Section is aimed at providing some guidelines for the expectations for each type of space along the foreshore during the process of design resolution. The images provided for each type of space guide either the material choices or the design style of elements.

As a general recommendation material and fittings should be utilise sustainable materials where possible as well as being low maintenance and durable. Issues such as ultilising local materials, energy use in manufacture and use, ability to be recycled,

Public Plazas - typical finishes and furniture


Natural Stone Paving


In-situ Exposed Aggregate Concrete


Shelters and Furniture


Furniture of Robust Contemporary Design

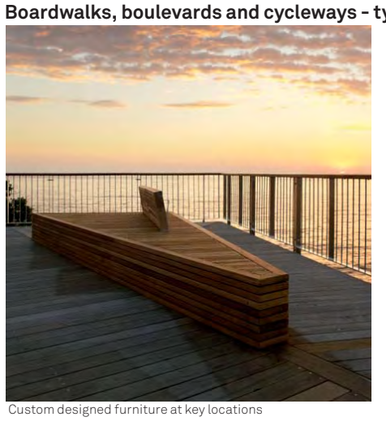

High quality finishes and detailing


Teared Decking


Drinking Fountain

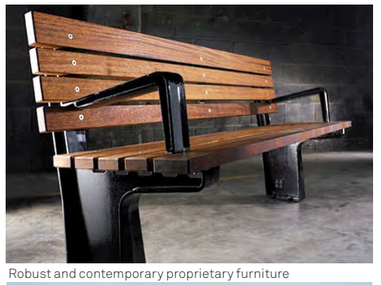

Catenary Lighting

Boardwalks, boulevards and cycleways - typical finishes and furniture


Custom designed furniture at key locations


Exposed aggregate concrete pavers


Bollard and overhead lighting


Robust and contemporary proprietary furniture


Boardwalks through dunal vegetation


Stair access linked to decks and boardwalks


Boardwalk with integrated furniture, shelters and lighting


Red asphalt DUP


Bike Parking

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recycled content and ease of repair will need to be considered during the detailed design and specification process.
Public Plazas - relates to Robb Jetty and the Power Station. These areas require the highest quality finishes and the most attention to design detailing.

_Paving surfaces are to be either natural stone, in-situ exposed aggregate concrete or exposed aggregate concrete pavers
_Robust and durable furniture of contemporary design utilising solid timber/ precast concrete/ steel work
_Mature tree transplants within the plaza area
_Lighting elements to utilise catenary or pavement lights rather than flood lights, in order to complement night time activation of the space via restaurants/cafes. Refer lighting strategy section 5.3.6.
_Include water fountains (utilize fittings and fixtures to minimise water wastage), bins and bike racks
-Bins are to include provision for dog waste bags and water points are to be provided for dogs, potentially in conjunction with toilet or shower facilities.

Boardwalks, Boulevards, Pedestrian Paths and Cycleways - these areas require a variety of finish quality levels depending on application.

_The boulevard link between Robb Jetty and the Power station should utilise high quality finishes; either an-situ exposed aggregate concrete or exposed aggregate concrete pavers (in-situ concrete preferable surface for cycleways).
_Pedestrian and shared paths indicated in grey on the plans will be a minimum of broom finished concrete whereas the retained and realigned DUP indicated as red will remain as red asphalt.
_The furniture provided will vary with location, with custom designed elements at key nodes, on the major boardwalk and boulevard, and robust and durable proprietary elements for less high profile locations.
_Bagged tree stock
_Lighting; refer lighting strategy section 5.3.6
_Shelters will be a custom design adapted and utilised across the foreshore.
_Include water fountains (utilize fittings and fixtures to minimise water wastage), bins, bike racks

Parklands - this applies to Catherine Point, Robb Jetty parkland and McTaggart cove, as well as any parkland areas proposed as part of the Power Station development.
_Irrigated native planting (see planting palette section 5.3.7)
_Some non-irrigated or temporarily irrigated restructure remnant vegetation
_Irrigated roll-on turf
_Pedestrian and shared paths indicated in grey on the plans will be broom finished concrete whereas the retained and realigned DUP indicated as red will remain red asphalt.
_The furniture provided will be robust and durable proprietary elements incorporated with the custom designed shelter design.
_Bagged tree stock
_Lighting; refer lighting strategy section 5.3.6
_Include water fountains (utilize fittings and fixtures to minimise water wastage), large capacity bins to fit consistent aesthetic across the site
_Bins are to include provision for dog waste bags and water points are to be provided for dogs, potentially in conjunction with toilet or shower facilities.

Streetscape - Robb Road and main street connection.

Parklands - typical finishes and furniture


Large Capacity Bins


Robust Proprietary furniture


BBQ facilities integrated into custom designed shelter


Pole top lighting


Custom designed shelter


Native Planting Palette


Gravel mulch as surface finish


Broom finished concrete paths

Streetscapes - typical finishes and furniture


Tree Grates


Exposed Aggregate Concrete Pavers


Robust Contemporary Bollards


Smaller bins for streetscapes

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_Irrigated native planting (see planting palette section 5.3.7)
_Some non-irrigated or temporarily irrigated restructure remnant vegetation
_Irrigated roll-on turf
_Pedestrian paths to be exposed aggregate concrete pavers or exposed aggregate in-situ concrete.
_Shared paths behind the kerb to be exposed aggregate in-situ concrete (avoid the use of segmental paving in cycle paths).
_The furniture provided will be robust and durable proprietary elements consistent with other public spaces.
_Bagged tree stock, except along main street connection
_Lighting; refer lighting strategy section 5.3.6
_Large capacity bins to fit consistent aesthetic across the site
_

5.3.6 Lighting Strategy

Public security issues have been identified by the City of Cockburn as a significant management issue for the current foreshore facilities. Lighting public spaces contributes to the safety of the foreshore spaces by encouraging more users into the space and improving surveillance generally. Figure 5.16 indicates the various types of spaces requiring lighting and the list below are suggested lighting solutions for these spaces.

Illumination levels for the different types of spaces can be guided by AS/NZS 1158.3 'Lighting for Roads and Public Spaces' and the City of Cockburn's own lighting policies.

The City's requirements for lighting in these spaces are;
_Sufficient to provide illumination for CCTV around council facilities and high use areas such as toilets, bbq and shelters, carparks, high use pedestrian paths, and around business premises .
_Areas outside the high activity sites along the foreshore should be minimised to reduce visual impact, but still enable the community to traverse walkways safely, albeit without CCTV surveillance.
_Energy efficient lighting that meets the Australian Standard and (for road lighting) meets Western Power's requirements.
_Lighting to be of a design and material suitable to exposed coastal environments and with a low maintenance requirement.

The specification of light fittings and their levels of illumination to achieve these outcomes will involve a lighting consultant and be resolved during the detailed design phase. The following is a list of suggested lighting types for different foreshore locations.

1_ Roadway Lighting
Pole top area lighting

2_ Boardwalks, Boulevards and Cycleway Lighting
Bollard lights (Bollard lighting may require supplementing with pole lighting in order to achieve sufficient illumination in higher use areas eg. boulevards)

3_ Plaza / Feature Area Lighting
Catenary, in-ground or pole top feature lighting. Dispersed 'soft' lighting to encourage restaurant and cafe establishments to activate the space at night

4_ Public Open Space / Area Lighting
Structures/shelters with integrated lighting in conjunction with overhead area lighting around bbq areas.

5_ Car Park Lighting
Pole top lighting, can be shorter than street poles

6_ Beach Access Lighting
Lower level lighting that may include path wash and handrail lights.

7_ Beach Activity Area Lighting
Provision of overhead area lighting for night time activities such as fishing.

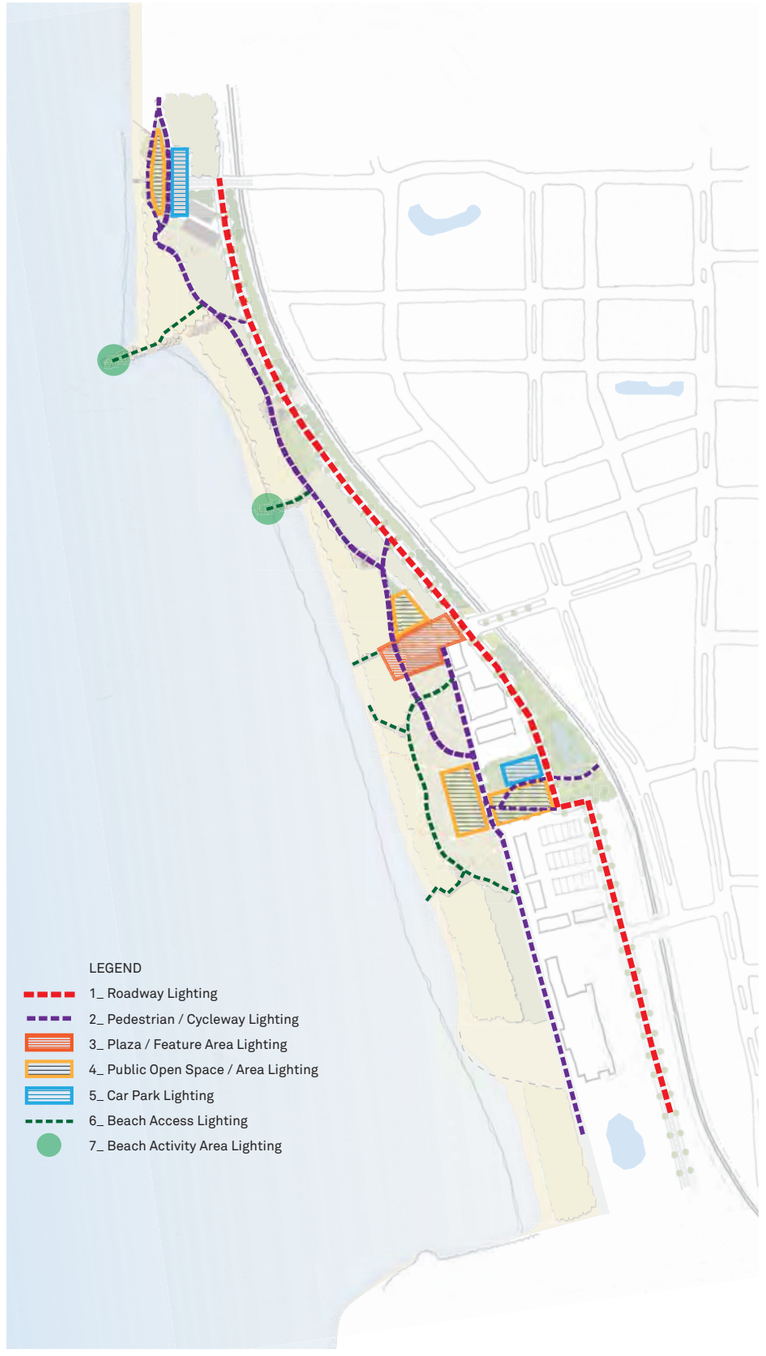

Figure 5.17 Lighting Strategy

5.0____CONCEPT PLAN

5.3.7 Rehabilitation, Re-vegetation and Planting

Section 6 deals with the detail of re-vegetation, rehabilitation and weed control for the foreshore, whereas this section deals with the broad vegetation types planned for the site, both non-irrigated re-vegetation and irrigated landscape planting.

Figure 5.18 shows three different non-irrigated (or temporarily irrigated) vegetation types and an extent of irrigated landscape planting. The non-irrigated re-vegetation treatments and their species mixes are guided by the existing remnant vegetation of the foreshore. There are three (3) proposed re-vegetation communities;

- A **Tuart-Peppermint Woodland** with diverse mid storey and under storey planting; locations indicated as suitable for this treatment already support existing re-vegetation which in many cases will require some restructuring including removal of unsuitable plants and addition of under and mid storey plants in order to promote diversity and habitat values These densely vegetated communities are generally associated with a high fire hazard rating (see section 6.4 Fire Management) as well as creating security concerns when in proximity to public infrastructure. Section 6.2 'Rehabilitation and Re-vegetation Plan' provides some guidance to restructuring these communities for ecological objective and section 6.4 provides guidance on thinning to reduce bushfire risk. Appendix 4 includes a list of suitable rehabilitation species.

- **Acacia rostellifera - Melaleuca lanceolata/heugleii shubland;** this community is based on the existing communities east of the foredune, incorporating removal of weed species and improvements to species diversity. Similar to the Tuart-Peppermint communities, these shrubland communities are associated with a moderate to high fire hazard rating. Sections 6.1, 6.2 and Appendix 4 provide guidance on rehabilitating these communities.

- An **Open grassland of Spinifex longifolius mixed with coastal dune species**; again this community is based on the existing species in these foredune locations , with proposed improvements through increased species diversity and weed control (refer sections 6.1, 6.2 and Appendix 4).

The irrigated 'landscape Planting' treatment is proposed for locations where visual surveillance and quality of planting are priorities. In locations where existing vegetation coincides with the 'landscape planting' treatment, existing trees will be selectively retained and underplanted with a predominantly local native palette of groundcovers and low shrubs (Refer to the Landscape Planting Palette on the following page).

Planting and landscape elements to reduce fire hazard

Section 6.4 'Fire Management' discusses the fire hazard rating for the existing foreshore condition as well as some discussion of the likely impacts of the proposed foreshore and Cockburn Coast development on the fire risk assessment. A separate Bush Fire Management Plan (Eco logical Australia 2012) provides a full report for managing the current fire hazard conditions existing on the foreshore.

Managing the interface between high to moderate hazard vegetation and development sites within close proximity to the foreshore reserve (i.e. urban development lots west of the rail alignment) will require compliance with Australian Standard AS3959 'Construction of buildings in bushfire prone areas' and 'Planning for Bush Fire Protection Guidelines' (WAPC/FESA 2010). The standards/guidelines require the separation of buildings from bush fire prone vegetation via a Building Protection Zone (BPZ). The extent of these zones can be determined with reference to AS3959. Under AS 3959 Bushfire Attack Levels (BAL) can be calculated based on fuel types and slope with building construction standards corresponding to the calculated BAL i.e there is a minimum requirement to provide a BPZ of 15m between buildings and moderate-high hazard vegetation to achieve a BAL of less than 29 kw/m^2.

With this in mind the re-vegetation and landscape treatments adjacant to development sites (see Figure 5.19) may need to be managed and designed to permanently reduce fuel loads around development in circumstances where it is not feasible to establish the entire required BPZ within the development lot. In these circumstances there will the need for a combined approach of reserve management and building and lot design. The City of Cockburn in consultation with FESA and the Developer could consider a combination of the following approaches to reduce bush fire risk within and adjacent development sites;

- Restructuring of existing vegetation (if necessary this may include removal of more fire prone species);
- utilizing roads, pavements and carparks surrounding the development as firebreaks between the building and hazard vegetation.
- establishing low fuel landscape planting treatments in proximity to the development lots
- incorporating barriers to radiant heat, such as low limestone walls or pathways adjacent to vegetation

The Bush Fire Management Plan (Eco Logical 2012) discusses further the requirements for development in proximity of fire prone vegetation.

Figure 5.18 Vegetation treatment types

Figure 5.19 Locations where reduction of fire hazard adjacent development lots may need to be addressed

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Planting Palette

The proposed planting palette for irrigated 'Landscape Planting' is to be predominately plant species endemic to the area. Endemic plants are well adapted to the soil types climatic and watering conditions whilst providing habitat and food supplies to native fauna and contribute to the unique character that is Cockburn Coast. This palette includes native to South-West WA as well as exotic feature trees which are adapted to the climatic conditions of Cockburn Coast.

Swales and retention basins which capture stormwater runoff are to be planted with native plantings which are suited to both wet and dry conditions to cleanse water before it reaches the ocean and ground water aquifer. Swale locations will be determined as part of the Local Water Management Strategy for the Cockburn Coast.

WA Native Trees for Robb Road (RR), Robb Jetty Plaza(RJ), Parkland Areas(PA) and Drainage Retention Areas (DR)


Agonis flexuosa (RR)


Banksia littoralis (DR)


Banksia Menziesii (PA)


Corymbia calophylla (PA)


Eucalyptus gomphocephala (PA)


Casuarina equisetifolia (RJ)


Eucalyptus marginata (PA)


Eucalyptus rudis (DR)


Melaleuca lanceolata (PA)


Melaleuca rhaphiophylla (DR)

Exotic Trees for Robb Jetty Plaza(RJ) and Parkland Areas(PA)

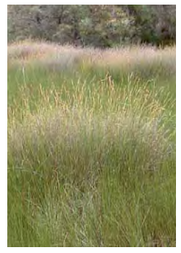

Araucaria heterophylla (RJ)


Metrosideros excelsus (RJ)

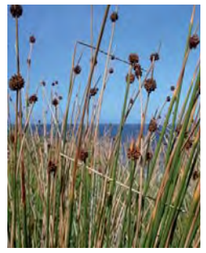

Erythrina indica (RJ, PA)

Swale and Retention Basin Planting


Baumea articulata


Baumea vaginalis


Bolboschoenus caldwelli


Ficinia nodosa


Gahnia trifida


Juncus kraussii


Juncus pallidus

WA Native Groundcovers and Shrubs for irrigated planting in Streetcapes and Parklands


Acacia lasiocarpa


Adenanthos cuneatus

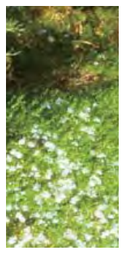

Beaufortia


Agonis flexuosa "nana"


Ficinia nodosa


Olearia axillaris


Eremophila "Kalbarri Carpet"


Hemiandra pungens "Snakebush"


Patersonia occidentalis


Calothamnus quadrifidus 'little ripper'


Calothamnus sanguineus


Hypocalymma robustrum


Melaleuca 'little nessie'


Westringia fruticosa

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5.4 Precinct Plans and Facilities

5.4.1 Catherine Point

The planning for facilities development at Catherine point has previously been the subject of the 'North Coogee Foreshore Management Plan (Ecoscape 2009) and the graphic plan from this report is reproduced in Section 4.11. The planned works for this site are partly complete and the Cockburn Coast FMP plan does not seek to change significantly the plans for this site.

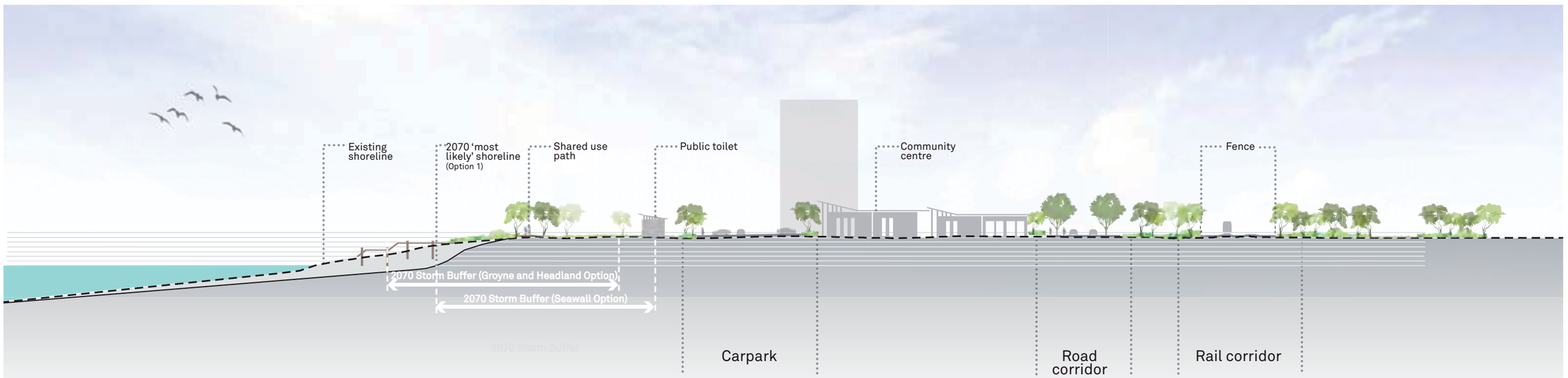
The North Coogee FMP proposed a 'stage 2' extension of the facilities which would include a playground. User numbers for the site would not currently justify this extension, however as users increase and if commercial activities where established at the site this expansion would be justified.

The Place Making Strategy (Place Partners 2012) suggested the inclusion of a community building on this site, though City of Cockburn has since expressed the preference for a different location for these facilities. A site for a built element is still nominated on the infrastructure plan allowing for the establishment of a suitable cafe or restaurant in this location.

The points of difference between the Cockburn Coast FMP and the pre-existing North Coogee FMP recommendations is the inclusion of
- more shade trees in the parkland;
- and the provision of stair access to the currently very steep and eroded access path;
- restricting access to the steep and eroded fore dune directly north of the Catherine Pt groyne through removal of access tracks and fencing if required;
- and the possible relocation of horse float parking to this site as McTaggart cove becomes busier.

The section below indicates the predicted waterline locations in this zone for 2070 and the storm buffer zones. Only minor infrastructure such as stairs, paths and shelters and likely to be under treat in this time frame.

Catherine Point Detail Plan



Section through Catherine Point

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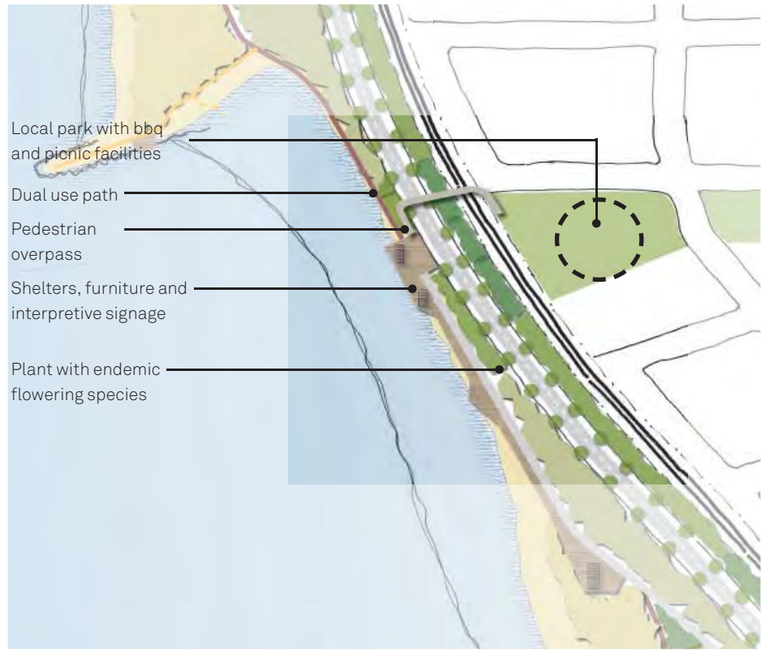
5.4.2 Green Corridor Link - Seawall Option

The 'Green Corridor Link' is a minor activity node along the foreshore created by connection between the foreshore reserve and the and east - west linear POS referred to as the 'Green Corridor'. This POS will have a function as an ecological link to the Beeliar Regional Park as well as functioning as a drainage retention and infiltration site and the inclusion of small scale neighbourhood parklands.

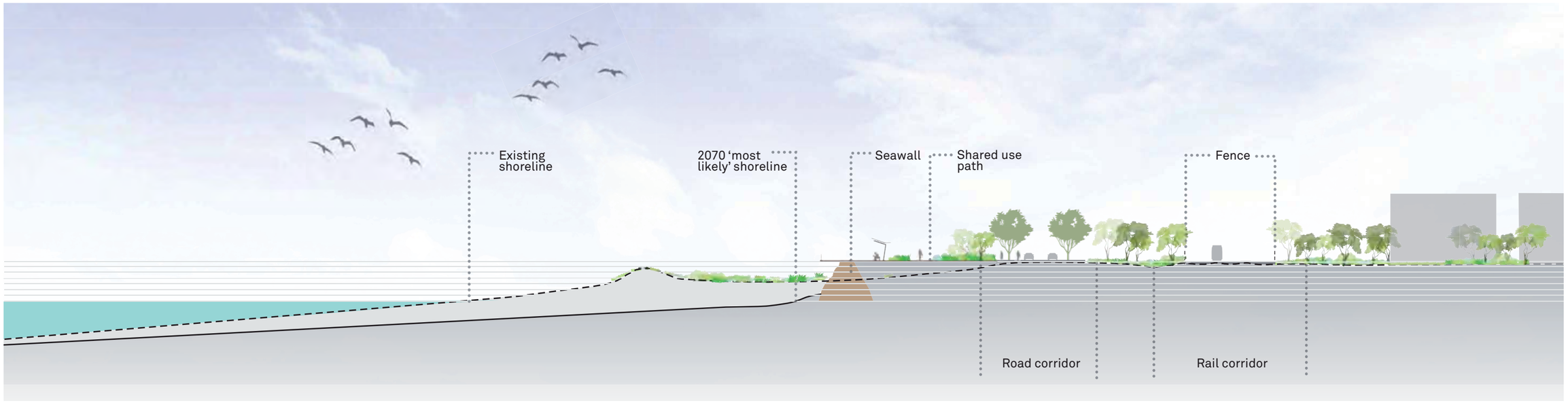
The dual use path (DUP) connects Catherine Point south to the 'green corridor link'. The red asphalt DUP terminates at the 'Green Corridor Link' where are decked viewing node marks the northern most extent of the coastal boardwalk.

In the case of the seawall coastal protection option, a boardwalk and cycle path would sit on top of the seawall, cantilevered in key locations, providing expansive ocean views. The seawall would initially be built back behind the fore dune, but with time, the fore dune would be lost to erosion and the water would come up to the base of the seawall.

The facilities provided along this boardwalk will include shelters, furniture and interpretive signage elements focused on themes relating to coastal processes and indigenous heritage. A shared use would connect across the rail corridor into the 'Green Corridor' with a local pocket park developed near the foreshore. Local endemic flowering plants would be established both with the foreshore and the Green Corridor to encourage movement of avifauna.



Detail Plan of the 'Green Corridor' Link - Seawall Option



Section through the 'Green Corridor' Link - Seawall Option

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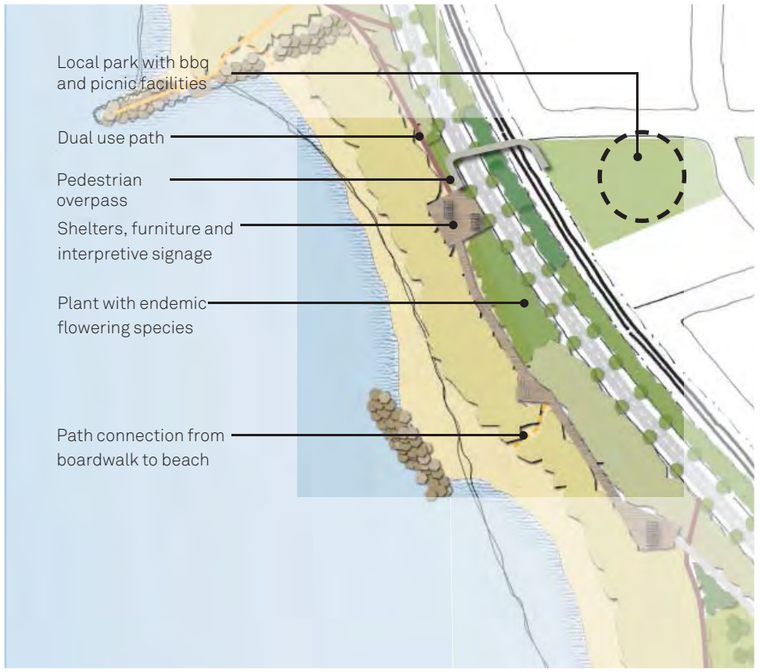
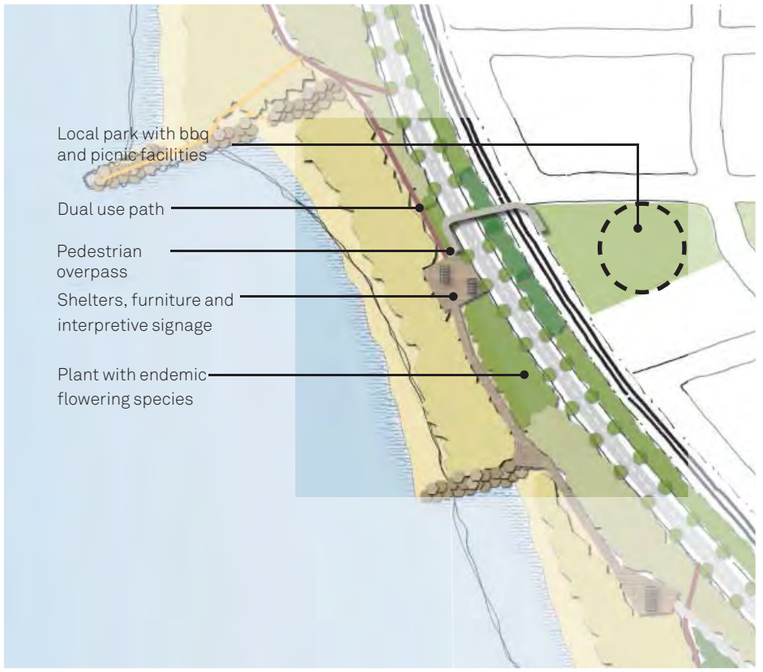
5.4.3 Green Corridor Link - Groyne and Headland Options

As the groyne and headland (with beach nourishment) protection options result in very similar beach geometry the concepts for these have been covered in the same detail. A pile mounted decking structure in these scenarios would sit above the existing dunes. As the elevated decking structure is less comfortable as a riding surface than the paved pathways established in retained fill, the DUP has been linked to Robb road north and south of the viewing deck to allow an alternative cycle route.

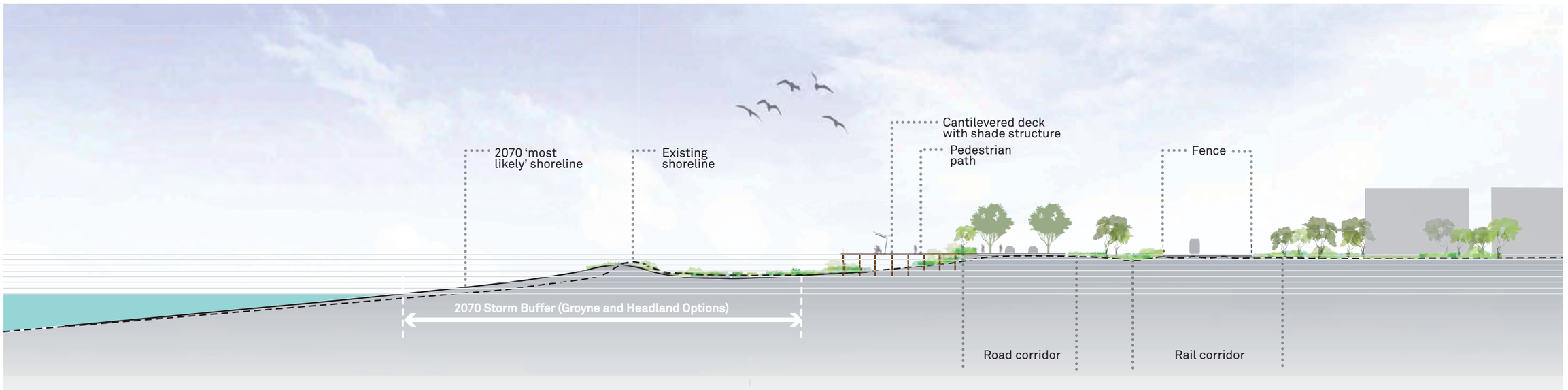
As the views are likely to be more restricted due the broad retained foreshore, in these options the boardwalk has been located further west, and in the case of the groyne option will link with the groyne structure to provide access for fishing. The section below demonstrates that the decking structure is well back from predicted waterline movements and storm surge zones for 2070.



Detail Plan of the 'Green Corridor' Link - Headland Option



Detail Plan of the 'Green Corridor' Link - Groyne Option



Section through the 'Green Corridor' Link - Groyne and Hedland Options

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5.4.4 Robb Jetty

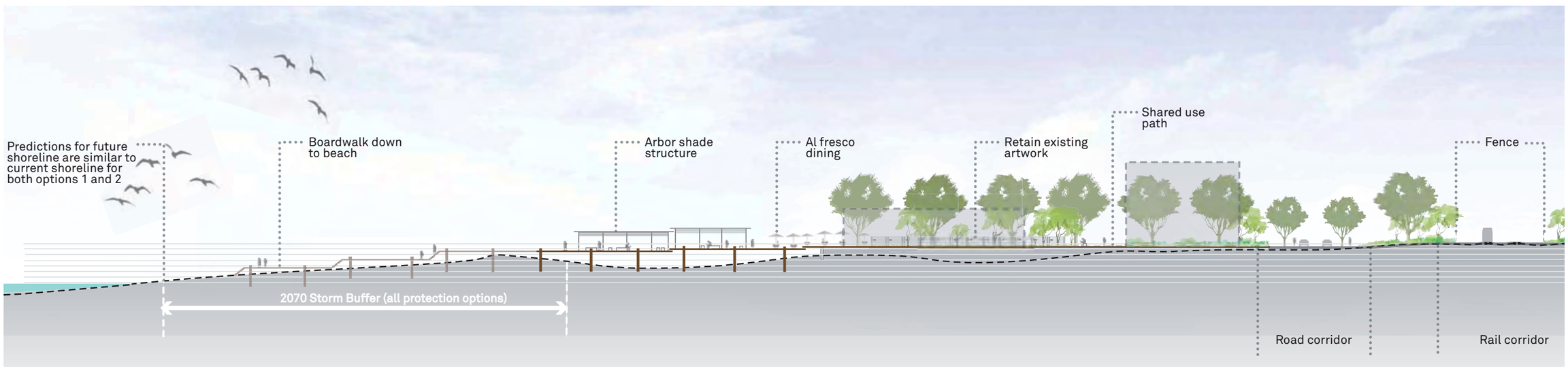
Robb Jetty Foreshore Plaza will provide a central focus for the foreshore as well the strongest visual link to the foreshore and the beach from the main development east of the rail corridor. The foreshore plaza needs to be a destination while not interrupting views down main street to the ocean.

The proposed treatment for the eastern end of the Robb Jetty Plaza is a paved area, level with Robb Road, incorporating trees, furniture and shelter. A potential commercial site on the southern side of the plaza also houses toilet and shower facilities. On the north is a less formal parkland picnic area with shaded bbq and picnic facilities. The western end of the plaza is a tiered deck sitting above the dune structure providing seating and interpretative signage elements that don't interrupt coastal views. An east - west aligned shade structure and interpretative element has been proposed along the northern edge of the plaza adjacent to the retained 'human race' artwork .

The three coastal protection options have only minimal influence on beach erosion predictions for this location and therefore the proposal for all three is the same. The section below indicates the 2070 storm surge buffer just comes within the decked zone. The stepped beach access will be the most vulnerable element to erosion and will need its alignment updated through time. Similarly the universal beach access south of the main plaza will be in a zone vulnerable to erosion and will require realignment with time.

Other facilities that need to be accommodated in this location during detail design include beach showers, bins and drinking fountains.

Detail of Robb Jetty Plaza - all scenarios



Section through Robb Jetty Plaza - all scenarios

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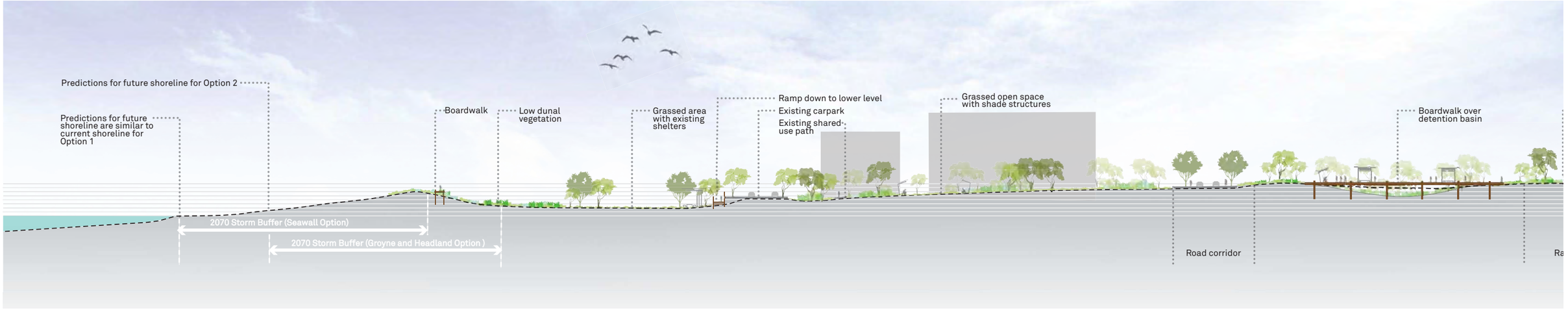
5.4.5 McTaggart Cove - Stage 1

The McTaggart cove parkland currently incorporates a carpark which sits on a retained platform above the picnic and 'kick about' space to the west. In the short term it is recommended to retain this carpark in its current location, however once the Power Station Redevelopment to the south is constructed a wide boulevard link between the Power Station and Robb Jetty will be developed along the current alignment of the carpark. Ground levels in the current location of the carpark may need to be lifted further to maintain and consistent level connection along this spine and maximise view opportunities.

A foredune boardwalk has been indicated behind the foredune on this southern end of the foreshore. This infrastructure provides the opportunity for pedestrians to experience un-interrupted ocean and beach views as well as offering unique opportunities for interpretative and educational elements. Locating the boardwalk inland of the dune crest provides the best compromise between view opportunites while minimising visual impact and risk of damage through storm erosion. It will be very difficult to keep the full extent of this boardwalk out of storm buffer zone, particular if stair of ramp connections are established linking the boardwalk and beach. Periodic realignment of the boardwalk infrastructure may be required in the medium term.

'Stage 2' of the of the development in this location relocates the carpark further west along Robb Road. A network of pedestrian paths, cycle paths and boardwalks through an east-west running parkland connect the foreshore park to Robb Road, a 'dampland' retention basin and the sporting oval and club rooms within the main development. Current facilities within the parkland include toilets, shelters and bbq facilities. Additional shelters, seating and bbq facilities will be provided along with a suggested location for a playground. The three coastal protection options have only minimal influence on beach erosion predictions for this location and therefore the proposal for all three is the same.

Detail of McTaggart Cove Stage 1 - all scenarios



Section through McTaggart Cove Stage 1- all scenarios

5.0____CONCEPT PLAN

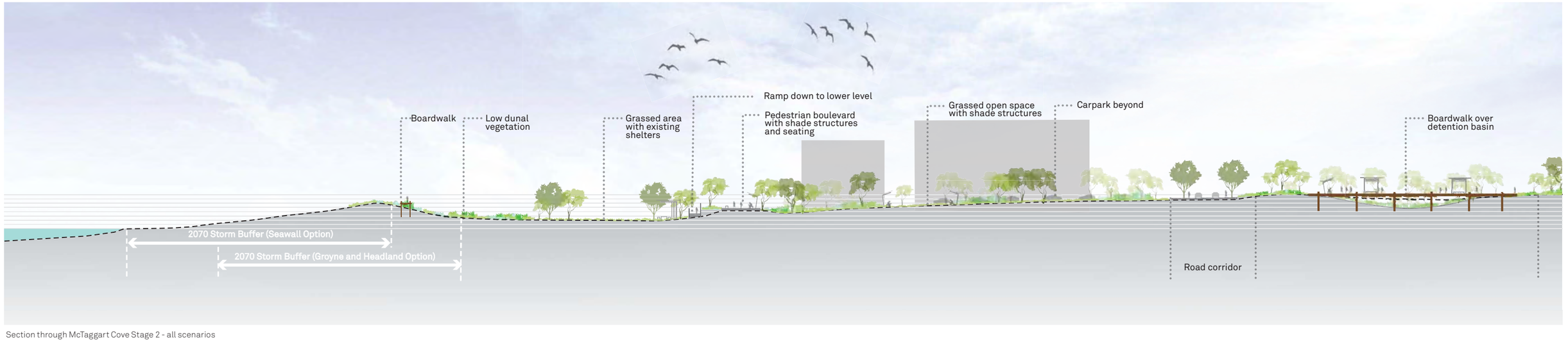
5.4.6 McTaggart Cove - Stage 2

Once the Power Station redevelopment is realised,'Stage 2' of the of the development of McTaggart Cove relocates the carpark further west along Robb Road and establishes a wider pedestrian boulevard linking Robb Jetty Plaza and the Power Station precinct in its place. Levels at the old carpark location may need to be lifted to accommodate a consistent level along the boulevard and facilitate ocean views.

All infrastructure, excepting the foredune boardwalk, are well away from coastal erosion zones at this southern end of the foreshore.

Refer to section 5.3.7 for discussion regarding the possible requirements for reducing the fire hazard of landscape elements in proximity to the development sites both north and south of this parkland. The detail design will likely need to consider alignment and location of hardscape elements such a boulevards and carkparks in contributing to fire hazard reduction as well as reducing fuel loads within vegetated areas.

Detail of McTaggart Cove Stage 2 - all scenarios



Section through McTaggart Cove Stage 2 - all scenarios

6.0 MANAGEMENT PLANS

6.1 Weed Management Plan

6.1.1 Objectives

The objectives for weed control are to:

_Control and minimise established weed populations, focusing on those of highest environmental concern
_Minimise the spread of existing weed species and the introduction of new weeds
_Mitigate competition between native flora and weed species
_Avoid or minimise adverse impacts to native flora and fauna and the public from weed control measures

6.1.2 Potential Impacts and Threatening Processes

Invasive weed species can dominate a landscape if left untreated, resulting in intense competition for native flora. This is a particularly threatening process in coastal dunes as it promotes de-stabilisation of the dune leading to increased erosion. Certain weed species can also increase the fire hazard rating of vegetated areas.

Weeds can spread and also be introduced into an area of vegetation through a number of means including fire, vehicles and pedestrians, which are key issues in foreshore areas. The proposed residential development area east of the site poses the risk of residents dumping garden waste within the site which could introduce new weeds and also increase the spread of weeds.

6.1.3 Opportunities

The proposed concept plan for the site (Section 5) presents opportunities to minimise the potential impacts of weed species at the site, which include opportunities to:

_Treat and control weed species through proposed rehabilitation works vegetation
_Manage the potential spread and introduction of new weed species
_Minimise vegetation disturbance (and therefore the spread of weeds) by formalising existing pathways within the site and rehabilitating those no longer in use
_Reduce number of weed species in denser areas of vegetation through restructuring and increasing the diversity of species

6.1.4 Recommendations

_Control access through the site through formalisation of paths and fencing off of dune areas
_Monitor for the presence of new weed populations and extension of existing weed species
_Develop and undertake a weed control program using herbicide application and manual control methods where deemed appropriate and safe to apply
_Ensure residents and the community are aware of where and when weed control measures will be carried out

6.1.5 Strategy and method statements

In conjunction with the implementation of a weed control program, controlling access to and through the site is important for minimising the spread of weeds. The formalisation of informal pathways and rehabilitation of disused tracks will act to minimise the spread of weeds by visitors to the site.

The weed control program should be undertaken on an ongoing basis concurrently with the rehabilitation program. The Western Australian Planning Commission's Coastal Planning and Management Manual (WAPC 2003) outlines the following as key concepts for development of weed control programs on the coast:

_An understanding that weed control is only one aspect of the rehabilitation and conservation of a site
_Identification of the priority weeds in the system and controlling them first
_Complementary rehabilitation techniques to prevent other weeds occupying the vacated niche
_Dedication and monitoring to ensure quick action is taken to tackle the weed before it becomes a problem
_Focus on the invaded ecosystem rather than the invader. Surrounding activities that may be encouraging the spread of weeds such as the use of weed infested fill for construction or nutrient runoff
_Education is important as people need to be aware of how their actions and presence at a site may impact on the natural environment by the introduction or spread of weeds
_Weed control should be a hierarchy of targeting highest threat weeds first, followed by a gradual decrease in the cover of others

Development of Weed Management Strategy

Key considerations for developing a weed management strategy for an area are provided in WAPC (2003). Some of these have already been addressed by information provided in this management plan, however some further action will need to be taken to allow for specific on-ground management of weeds:

_Identify and map weeds at the site: a total of 19 weed species have been recorded at the site (Appendix 1) and a vegetation condition map has been provided as part of this plan (Figure 4.6). A weed map will need to be prepared to develop a framework for selection of species to target for control, and to select target locations. The weeds already recorded on site and vegetation condition mapping will provide a suitable basis for the weed map to be prepared.
_Determine the weed species that represent the most serious threat: a list of the key weeds present at the site in terms of the level of threat posed to biodiversity is provided in the section 'Key weeds' below. Once a weed map has been prepared, in conjunction with this list of key weeds the final list of species to be controlled at the site (and over what time period) will be determined. When determining species for control, it is also sometimes appropriate to control small local infestations that will facilitate complete removal of the weed from the site and then working on more widespread populations.
_Method: specific recommended methods of removal for individual weeds at the site are provided in Appendix 3. It may be beneficial to draw up a calendar for the timing of weeding events. Recommended methods are described further below.

Weed Control Methods

In development of the weed control program a number of techniques should be considered for weed removal and control. The recommended techniques for coastal areas are outlined in WAPC (2003) and those that are suitable for the site (dependent on a weed inspection and assessment) include physical/manual control (e.g. cultivating, hand pulling and slashing) and chemical control (e.g. herbicide application).

There are four key types of herbicides: residual, contact, translocated, and selective. The attributes of these are described in WAPC (2003) and summarised below:

Residual
_These herbicides remain active in the soil and are absorbed into the plant by the roots. They are not recommended for areas to be planted or direct seeded.

Contact
_These herbicides only kill the plant material they come into contact with. Not effective for plants with underground propagules such as bulbs, rhizomes or stems.

Translocated
_The most commonly used herbicide, this chemical is translocated into the roots of the plant killing the above and below ground parts. An example is Roundup ® or glyphosate

Selective
_Selective herbicides are very useful especially for targeting grasses in native vegetation. Low concentrations of some of the hormone-based herbicides containing 2,4-D amide can also be safely sprayed amongst native vegetation without killing it. The key coastal weeds these herbicides target are Bridal Creeper and Pelargonium. As a precaution native vegetation, especially seedlings, should be guarded from direct spray

The recommended methods to use for removal of individual weed species recorded at the site are outlined in Appendix 3.

Key Weeds

One introduced species recorded within the site, Bridal Creeper is listed as a Declared Plant (P1) under the Agriculture and Related Resources Protection Act 1976. Weeds that are declared under this Act are identified as being, or have the potential to become, a problem to agriculture or the environment. The Department of Agriculture and Food Western Australia (DAFWA) and the Agriculture Protection Board maintains the list of Declared Plants for Western Australia and if a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to control that plant on their properties. Occurrences of Declared Plants should be controlled using the recommended methods outlined by the DAFWA.

The recommended method for removal of Bridal Creeper as outlined in Department of Agriculture and Food (2012), is via application of Metsulfuron and/or Glyphosate herbicide during mid – June to late August with a follow up treatment required for a couple of seasons. Further details of the recommended methods are outlined in (Department of Agriculture and Food 2012).

Based on WAPC (2003) and the Environmental Weed Strategy for Western Australia (DEC 1999), additional weeds present at the site that pose the greatest threat to biodiversity in Western Australia include:

_*Pelargonium capitatum*
_*Lupinus cosentinii*
_*Euphorbia terracina*
_*Bromus diandrus*

Relatively common on the dunes is the introduced herb Cakile maritima (Sea Rocket). WAPC (2003) highlights this species is considered beneficial in some situations as the roots bind sand dunes therefore the control of this species is usually dependent upon the immediate replacement with local species. This weed is of a low priority for control given its dune stabilisation role.

6.1.6 Monitoring and Maintenance

The site should be regularly monitored during the management and maintenance period to ensure the objectives for weed management are met and early detection of any potential problems, if they arise (Table .61). Visual monitoring of areas identified as

06____MANAGEMENT PLANS

weed infested, and those areas treated for weeds will allow the progress of the weed control strategy to be ascertained, and allow early detection of any failed methods. The vegetation of the site, in particular the rehabilitated areas, should be monitored for new weed emergence on a regular basis to allow for early detection and removal.

6.1.7 Indicative Costs

Weed management costs will depend on the type of weed species being removed and therefore the method of weed removal to be used. Indicative costs for manual and chemical removal of weeds are provided below.

Method	Indicative cost
Manual removal	A qualified contractor would cost approximately between $45.00 to $85.00 per hour for labour. Disposal fees would be charged based on amount of weeds removed.
Herbicide treatment	Approximately $980.00/ha spot spraying (including labour and chemicals)

6.2 Rehabilitation and Re-vegetation Plan

6.2.1 Objectives

The objectives for rehabilitation and re-vegetation of the site are to:

_Restore indigenous flora and vegetation communities, where they have been disturbed and/or depleted
_Minimise the impact of activities at the site that could result in degradation to vegetation communities through the use of appropriate management strategies
_Improve the overall condition of vegetation communities within the site
_Ensure vegetation communities are self-sustaining and capable of natural restoration

6.2.2 Potential impacts and threatening processes

Although highly resilient to damaging natural processes such as strong winds, salt transport and associated aridity, foreshore dune environments tend to have very low resistance to anthropogenic disturbances such as trampling and invasion by aggressive weeds. The key threatening process to natural dune vegetation and/or rehabilitated areas of dunes and their associated potential impacts are as follows:

_Coastal processes (wind and wave) – can result in loss of dune vegetation, covering of vegetation due to sand deposition and blow outs
_Trampling – human influence on dune vegetation by trampling can result in erosion of the vegetation profile and encourages the spread of weeds
_Weeds – can begin to dominate the dune environment when left untreated, which can promote de-stabilisation of the dunes

6.2.2 Opportunities

The proposed concept plan for the site (Section 5) presents opportunities to maximise and enhance the environmental values of the area, which include opportunities to:

_Rehabilitate vegetation within the site, including treating weeds and managing to prevent further colonisation of invasive species
_Approach re-vegetation with a view to mimicking the natural vegetation sequences of the Quindalup dune systems as far as possible
_Increase the structural diversity of areas of dense vegetation by removing species less suited to the area (e.g. Eucalyptus platypus), retaining Tuart, Peppermint, and Melaleuca species, eradicating weeds and returning area to more mid-level species dominated. This would provide several benefits; decrease fire hazard rating, increase habitat suitability for native fauna and improve the general condition of the vegetation
_Opportunity to minimise vegetation disturbance by formalising existing pathways within the site and rehabilitating those no longer in use.

6.2.3 Recommendations

_Prioritise and undertake re-vegetation activities along the foredune and primary dune
_Use wind fencing, brushing, matting materials and intensive planting of dune stabilising species along the front of the foredune to stabilise more exposed, erosion prone areas
_Use only species sourced from local propagation stocks (seeds, cuttings, divisions) from the Cockburn foreshore dune or hinterland vegetation communities where possible
_Install signage to inform the public of rehabilitation works (to be appropriate in location, size and level of information)
_Monitor rehabilitated areas for stability and growth of vegetation, and for evidence of pest fauna (i.e. rabbit grazing)

6.2.4 Strategy and method statements

The key areas proposed for rehabilitation/re-vegetation within the site are those associated with the primary dune system and degraded areas of vegetation eastwards of the primary dune. Additionally, unsealed tracks/pathways that are not going to be stabilised and re-established as pedestrian access, or form part of the dual-use pathway, are also proposed for rehabilitation. Areas to be rehabilitated will be flagged to ensure minimal disturbance during construction within the site.

Some key actions to be undertaken as part of the rehabilitation/re-vegetation works include:
_Take particular care to minimise disturbance to areas of vegetation in better condition
_Use local native vegetation in re-vegetation/rehabilitation
_Retain and enhance linkages between areas of native vegetation
_Ensure appropriate training of contractors and ensuring environmental awareness

In order to ensure appropriate species are used for rehabilitation, the stock will be collected from existing vegetation within the site and surrounding Quindalup and Spearwood landforms as near as possible to the site. Additional plant material supplied from outside this area may be used in the rehabilitation program when extra stock is required, however where possible, the use of stock from the site and surrounds is preferable.

Seed and Brush Collection

Seed collection and storage/propagation will be undertaken by a rehabilitation contractor specialising in native vegetation rehabilitation. An indicative planting list based on suitable species for the site and those selected for use in the North Coogee Foreshore Management Plan (Ecoscape 2009), has been provided as Appendix 4. The list presents examples of species which will be used in the seed collection and dune re-vegetation on the site.

Dune Stabilisation

Brushing is the most commonly used method of stabilisation and is recommended for the site to promote dune stabilisation and to assist re-vegetation and rehabilitation. Brushing is considered to be more effective than finer mulches because it lies slightly prominent of the sand surface and creates a shaded microclimate where seedlings are protected from the sun and wind (WAPC 2003).

Brushing is recommended at the site to accelerate stabilisation of bare dune surfaces, prevent wind and sand erosion and further damage to encourage growth of newly planted vegetation. Brushing will also be applied to existing tracks that have no planned use as future paths or strategic fire breaks. This will encourage plant regeneration and restrict access.

Ideally, brushing material should consist of cut tree or shrub branches of native coastal plants which display a tight stem arrangement. Examples include Melaleuca lanceolata, Acacia rostellifera, and Eucalyptus platypus (WAPC 2003). As these species are available within the site, brushing material may be obtainable from cuttings within the site where any clearing is required for construction of infrastructure or firebreaks.

Vegetation Establishment
The rehabilitation program will involve replanting in degraded areas with endemic plant species typical of the Quindalup dune landform and other suitable species native to WA. Rehabilitation will aim to mimic the typical transition of vegetation across this landform from west to east as follows:

_Tuart, Peppermint open-closed woodland with diverse undergrowth/mid-story
_*Acacia rostellifera – Melaleuca lanceolata/huegelli shrubland*
_Open grassland of *Spinifex longifolius* mixed with coastal dune species

WAPC (2003) illustrates direct seeding of perennial species along coastal areas in WA has had limited success. Annual herbs may produce a good stabilising cover when direct seeded over moderately large areas. Direct transplanting of rooted cuttings of grasses (e.g. *Spinifex hirsutus* and *Sporobulus virginicus*) and creepers (*Carpobrotus* species) that grow on the seaward slope of foredunes tend to give good results. Nursery-raised seedlings provide the most reliable method of establishment for the majority of coastal plants (WAPC 2003).

In order to maximise the density, diversity and resilience of re-vegetated areas of the site, a combination of seedling planting and direct seeding of species is recommended for degraded areas which are relatively protected from wind erosion. In highly degraded and exposed areas, planting of seedlings is recommended as this would allow easier establishment and provide an immediate visual sign of re-vegetation works being undertaken.

Planting activities should also take into account species selection/seed viability and the timing of planting to maximise survival rates.

Weed control
The most important factor in a successful re-vegetation program is weed control. The strategy and recommendations for weed control will be outlined in Section 6.1 . Key recommendations include; early detection and eradication of new weeds, monitoring for the presence of new weed populations and control of access through the site.

Pest control
Rabbits have been recorded within the site. The strategy and recommendations for pest fauna will be outlined in Section 6.3 . In terms of the threats to re-vegetation posed by rabbits, it is recommended that tree guards or rabbit proof fencing (for large revegetation areas) be implemented in areas where rabbit activity is evident. Tree guards offer several functions including reducing the frequency of grazing on seedlings by rabbits, offering protection from wind and sand erosion and assisting with reducing moisture loss during drier months.

6.2.5 Monitoring and Maintenance of the Site
The Cockburn foreshore should be regularly monitored during the management and maintenance period to ensure the objectives are met and early detection of potential problems is achieved (Table 6.1). Visual monitoring of re-vegetated areas will allow the progress of the re-vegetation and rehabilitation to be ascertained, including the status of weed control, establishment of species, success of brush matting and erosion control, maintenance of tree guards and allow early detection of pest activity. The survival rate of plantings in the first year should be monitored and the results used to determine the level of additional planting required for the subsequent year. Monitoring should also include signage and flagging/fencing of re-vegetated areas. Monitoring during the restructuring of dense vegetation should be undertaken using photo analysis to monitor any events of over-clearing.
Rehabilitation/Revegetation

6.2.6 Indicative Costs
Full cost of rehabilitation/revegetation can vary between $40,000.00 and $60,000.00 per ha, inclusive of labour, plants, weed management within rehabilitation areas and fencing. This estimated cost will vary depending on amount and type of fencing required, species selection and contractor selected to undertake the work. Tubestock for coastal species generally average approximately $1.80 per seedling and seed stock ranges from $70.00/kg for species such as Spinifex longifolius and $480.00/kg for shrub species such as Olearia axillaris.

6.3 Fauna Management Plan

6.3.1 Objectives
The objectives for fauna management at the site are to:
• Minimise the impact of feral animals on native fauna and flora at the site while avoiding adverse impacts to native flora and fauna and the public from feral animal control measures
• Maintain and enhance existing native fauna habitat and create additional areas of good quality habitat to support local native fauna species
• Maintain and enhance existing habitat connections where possible, and create new linkages between vegetated areas
• Control and restrict the areas in which dogs can be walked within the study area

6.3.2 Potential Impacts and Threatening Processes
Potential threats to native fauna at the site include predation by feral animals, fatality from vehicle strike, bushfire and potential indirect impacts from the construction and establishment of the adjacent proposed development.

A total of eight introduced fauna species were recorded within the site comprising; four birds and four mammals including ***Canidae Canus sp***. (Domestic Dog), ***Oryctolagus cuniculus*** (Rabbit), ***Mus musculus*** (House Mouse) and ***Rattus norvegicus*** (Norwegian Rat). Feral cats (potentially present at the site) and dogs in particular pose a threat of predation at the site and rabbits can adversely affect vegetation rehabilitation efforts by consuming plantings.

The proposed development adjacent to the site and resulting increase in activity is likely to increase the risk of certain threats to native fauna, in particular fatality from vehicle strike.

6.3.2 Opportunities
The re-vegetation efforts proposed will allow provision for creating quality fauna habitat and fauna corridors, and planting flowering species which will attract native birds. Furthermore, the restructuring of vegetation in the denser areas will promote habitat for the Lined Skink which prefers coastal heath and scrublands, with intermittent bare areas of sand.
The development of the site allows for the retention and development of fauna corridors and habitat linkages to allow for safe movement of native fauna.

6.3.3 Recommendations
• Incorporate the creation of fauna habitat, habitat corridors and linkages into design of the foreshore
• Control feral animals where possible
• Designate dog recreation areas and erect signage preventing access to areas of high value fauna habitat
• Use tree guards and establish fencing around areas of rehabilitation particularly on the dunes
• Advise local residents of the adjacent development about the implications of uninhibited domestic pets

6.3.4 Strategy and method statements
Fauna habitat
Rehabilitation of vegetation at the site will indirectly provide for native fauna species by creating more suitable habitat than was previously present. The facilitation of habitat linkages can occur through a number of means including strategic placement of

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pathways and infrastructure to ensure a continuous band of vegetation is retained throughout the site. Furthermore, the use of elevated pathways such as boardwalks and decking should be considered as they can allow access through habitat linkages whilst still allowing movement of fauna.

Maintaining and enhancing habitat for the Lined Skink is particularly important at the site. The favoured habitat of this species consists of coastal heath scrublands with intermittent patches of sand, the majority of which occurs east of the foredune. This area should be prioritised for rehabilitation.

Flowering endemic plant species should be planted at the site to encourage native bird species to utilise the site, and should be incorporated into landscape plantings where possible. A proposed species planting list is included in Appendix 4.

The creation of suitable fauna habitat for a range of species should be kept in mind when restructuring the denser areas of vegetation. Removing some of the taller tree species and replacing with low-mid story species will create a suitable diversity and 'open up' these areas for birds and reptiles. Fallen logs should not be removed as they provide suitable shelter for native fauna.

Feral animal control

Domestic cats which are able to wander in the night time pose a significant threat to native fauna. They key to approaching this problem should be to raise awareness through education of local residents via pamphlets in the mail and signage at the site if appropriate. If feral cats are found to be a significant problem at the site, the trapping and removal of individuals may be required and should be implemented where necessary. Note that the introduction of the WA Cat Act 2011 provides for stricter control of cats, particular in regard to their ability to roam at night.

Rabbits have been recorded within the site (GHD 2009) however the extent of the local population is not known. If rabbits are found to be a significant problem at the site, it is recommended tree guards or rabbit proof fencing be installed around key areas of re-vegetation. It is not likely the use of baiting will be appropriate given this could harm native fauna or domestic dogs.

The beach at the site is frequently used for dog recreation and exercise. The movement of dogs between car parks and the beach should continue to be controlled by fencing and designated pathways to minimise the occurrence of dogs entering the dunes and other areas of rehabilitation. Signage should also be erected where necessary advising visitors to the site where the designated areas for dog access are located.

6.3.5 Monitoring and Maintenance

The site should be regularly monitored during the management and maintenance period to ensure the objectives for fauna management are met and early detection of potential problems is achieved (Table 6.1). Visual monitoring for evidence of feral fauna activity, particularly rabbits and cats should be undertaken on a regular basis during and post construction, within the site, to determine whether feral animal control measures are required (e.g trapping and relocation). Tree guards within and fencing surrounding rehabilitated areas of vegetation should be regularly inspected to ensure these are still in place.

6.4 Fire Management Plan

6.4.1 Objectives

The objectives of the Fire Management Plan for the site are to:
- Minimise the bushfire risk to lives, properties and assets
- Preserve conservation values of the foreshore
- Preserve ecological and evolutionary processes

6.4.2 Potential Impacts and Threatening Processes

With regard to fire in the site, potential impacts can be defined as physical consequences resulting from the occurrence of fire within the site. These may be direct impacts (such as the burning of vegetation), or indirect impacts (such as wind erosion on coastal dunes denuded of vegetation).

Potential direct impacts from fire occurrence at the site include:
_Loss of biomass (vegetation) consumed by fire
_Loss of fauna habitat (such as coastal "thicket" style vegetation that may provide important bird habitat or coastal shrubland which supports the Lined Skink)
_Damage to fences, pathways, boardwalks, structures and signage
_Damage to electrical infrastructure (power poles and other items)
_Death or injury to people, dogs and native fauna

Figure 6.1 Bushfire Hazard Vegetation

Figure 6.2 6.4 FIRE MANAGEMENT PLAN
6.4.1 Objectives
The objectives of the Fire Management Plan for the site are to:

_Smoke, respiratory health and visibility issues on neighbouring roads and in nearby residential areas.

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Potential indirect impacts from fire occurrence at the site include:

- Destabilisation of soils (particularly dunes from loss of vegetation), resulting in increased wind and water erosion
- Opening up of areas to weed invasion
- Opening up of areas to increased pedestrian traffic
- Medium – long term reduction in potential food sources for native fauna while vegetation re-establishes

6.4.3 Opportunities

The key opportunity relating to fire at the site is the potential to decrease the fire hazard rating in areas adjoining proposed development. This would require a restructuring of dense areas of vegetation where it adjoins proposed development, a process that would also provide other benefits including increasing habitat suitability for native fauna and improving the overall condition of the vegetation.

6.4.4 Recommendations

- Actively reduce bushfire hazard by implementing hazard mitigation as per 'Strategy and method statements' in Section 6.4.5)
- Respond to, contain and control fires within the site as early as possible and keep records of the date, time, duration, personnel attending and cause (if known) of fires within the site.
- Implement fire mop-up procedures to reduce the potential for re-ignition
- Ensure FESA and fire response personnel are aware of the management strategies for the site to allow protection of ecological values during fire suppression
- Facilitate liaison between FESA and the CoC to allow efficient and effective response in the event of a fire and ensure effective post-fire management, reporting and recovery
- Reduce number of fires occurring through bushfire risk management and community education
- Create and maintain access and strategic fire breaks
- Ensure community awareness of the risk of fire at the site through public education and signage
- Delineate fire safer areas
- Develop and implement a post-fire recovery/restoration works plan
- Assess fire management strategies after the occurrence of a fire, or after a period of five years (whichever occurs sooner)

6.4.5 Strategy and method statements

Hazard reduction

Bushfire hazard can be mitigated by:

_Reducing fuel loads in vegetated areas

_Maintaining existing fire breaks (see below)

_Providing adequate separation distances between buildings and bush fire fuels (Asset Protection Zones) (see Appendix 2)

_Ensuring that new buildings in bushfire prone areas are built to Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS-3959; Standards Australia 2009)

Fuel reduction is not considered an essential component of the bushfire management plan for the foreshore, and is not proposed within the life of this Plan. Weed management for conservation objectives is likely to have a flow-on effect by reducing fine fuel loads from grassy fuels, but is not considered as an essential component to mitigate bushfire hazard. Prescribed burning is not considered a viable option due to the risk planned fire may represent to the public using and adjoining the foreshore, the strong link between fire occurrence and weed invasion, and the health and safety issues regarding smoke in urban areas.

Bush fire risk management

Bush fire risk management relates to previous fire causes and likely fire causes, with an aim to reduce the number of fires occurring and to reduce the impact of those that do occur.

Bush fire risk management within the site should include:

_Restrictions on the use of machinery and tools that have the potential to ignite fires, such as angle grinders and welders, during periods of extreme fire danger or greater (e.g. during any construction works)

_Requirements to have fire extinguishers on site during construction or maintenance operations that have the potential to start a fire (such as angle grinders or welders)

_Installation and maintenance of gas barbecues

_Public education/community awareness program highlighting the dangers of lighting fires and the penalties that apply if caught

Access and strategic fire breaks

Key considerations for access to the site is to ensure there are two access routes connecting to the public road network to provide access/egress for members of the public and fire emergency vehicles. Currently, the area complies with this requirement with McTaggart Cove and Rollinson Road providing access to the site from Cockburn Road, which is a major public road. These two roads are joined by Robb Road, permitting dual access. Future development must take into account the requirement for two access routes.

Existing pathways act as strategic fire breaks within the site; hence there is no requirement for additional fire breaks to be constructed. However, future development may need to consider the placement of pathways and/or fire breaks in those areas that are close to buildings or other infrastructure. Considerations for including pathways, roads and carparks within the foreshore reserve adjacent to development areas will reduce bushfire hazard to buildings.

Public education and community awareness

At the location of car parks, signage should be erected providing instructions in the event of a fire. Incorporated into these signs should also be a warning of penalties applying to those caught lighting open fires. Signage should be designed in consultation with the local FESA representative.

Fire safer areas

Fire safer areas within the site must be designated on the signage within car parks. These would likely be the grassed oval at McTaggart Road, and the beach. However, in the event of a bushfire, relocation of users of the site to another area is the safest option.

Recovery/restoration after a fire event

Following a bushfire in the site, a recovery action plan is required. This plan needs to be devised on a case by case basis, depending on where the fire has occurred, the size of the fire, the intensity of fire, assets affected, environmental impacts and whether or not people and/or communities have been affected (i.e. injuries or deaths). Some aspects of bushfire recovery for lands managed by the City of Cockburn are covered in detail in the Local Emergency Management Arrangements (City of Cockburn 2011), available at:
http://www.cockburn.wa.gov.au/Your_Council/Acts_and_Information/Public_Documents/2368-lemp-2012-update.pdf.

Effective rehabilitation of the environment is crucial for the foreshore area owing to the high likelihood of weed invasion and wind erosion degrading the site. The following steps are required in preparing the specific rehabilitation plan:

- Map the area affected by fire
- Assess the level of mortality
- Reduce the chance of wind erosion through covering bare sand with matting or brush
- Determine the vegetation type affected and the objectives for rehabilitation, such as:
- Desired vegetation community to re-establish
- Density of vegetation to be replanted
- Standards and techniques for weed control
- Undertake site works to prepare for rehabilitation in the appropriate season (usually autumn). This may include soil preparation, weed suppression, fencing
- Plant seedlings for rehabilitation in appropriate season (late autumn/early winter depending on rains)
- Monitor plant establishment and replace with late winter tubestock if required
- Monitor through summer and prepare for supplementary planting in late autumn/early winter in the second year (if required)

Assessment of fire management strategies

The fire management strategies must be assessed for their social, financial and environmental impact and effectiveness before they are implemented and again after they have been in place for some time. After the occurrence of a bushfire, or after five years (whichever occurs first), a review of the fire management plan is required with an annual works program assessed prior to each fire season.

6.4.6 Monitoring and Maintenance

Monitoring of bushfire hazard at the site is an annual requirement to ensure all bushfire risks are being managed effectively. Monitoring should occur in spring prior to the fire season and should include a visual assessment of the potential fire hazard across the site (cover of weeds and woody fuels). Mitigation measures should also be assessed (such as weed spraying or removal, the quality of firebreaks and adequate signage). Maintenance on any mitigation measures should be completed prior to the commencement of the fire season, and monitoring of these should be ongoing throughout the fire season.

6.4.6 Bushfire and development of the foreshore

The concept design for the foreshore has been developed to complement the proposed 'Cockburn Coast' development to the east. The concept design includes a number of proposed precincts within the foreshore which allow for facilities such as car parking, community green space, boardwalks and decking, pathways and other community facilities. The implementation of the concept design will alter the existing vegetation and the fire hazard and risk in the reserve. This may include reductions in the fire hazard in the vicinity of proposed precincts; Catherine Point, Green Corridor Connection, Rob Jetty and McTaggart Cove. Detailed bushfire risk measures should be

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considered as part of the concept design and prior to construction. It is probable that this will result in a reduction in the fire hazard ratings of the site and the final concept design and building construction standards will need to reflect the final bushfire hazard and risk.

It is possible that development proposed to adjoin the site may not comply with the acceptable solutions in PBP, as application of the standard assessment process in PBP results in over-ranking of the bushfire hazard on the site. In these situations it is important that a combination of reserve management and building design be used to minimise the bushfire risk.

The development site immediately south of the proposed Rob Jetty beach front urban plaza is bordered by moderate-extreme bushfire hazard along its north, west and sourthern boundaries (Figure 4). Under the requirements of PBP, bushfire risk must be reduced to an acceptable level through measures such as Building Protection Zones (BPZs), Hazard Separation Zones (HSZs) and construction to an appropriate standard as specified under Australian Standard AS3959 Construction of Buildings in Bushfire Prone Areas (Standards Australia 2009).

An acceptable solution for the development site requires a 100 m wide asset protection zone (BPZ and HSZ), however this is not a realistic risk assessment or a feasible protection measure. It is possible, however, to prepare a performance solution during the detailed planning phase of the development site to create a BPZ and HSZ within the site so that the PBP required Bushfire Attack Level (BAL) of 29 kW/m2 or less is achieved (BAL-29). Through careful planning of the foreshore reserve, the BPZ/HSZ can be incorporated into the foreshore design to minimise the impact on the development area. This BPZ/HSZ can consist of a combination of:

- Restructuring of vegetation (if necessary, this may include removal of more fire-prone species)
- Non-combustible pathways
- Low, non-combustible retaining walls that reduce radiant heat load
- Mounded earth or rock (e.g. berms) in a manner in keeping with the aesthetics of the foreshore
- Access roads and/or car parks

The use of the above treatments will reduce the bushfire risk and allow an appropriate mix of building design and ‘landscaping’ within the reserve so that compliance with the performance criteria within PBP are achieved.

In the absence of these performance solutions the minimum setback between bushfire hazard (vegetation) and a building is 15 m, based on calculations for BAL-29 (Eco Logical Australia 2012). A performance solution is therefore essential if the current design is to remain viable. A performance solution is beyond the scope of this plan as it requires considerable design work by architects and landscape designers in conjunction with a bushfire expert. This Plan has ‘flagged’ this issue and indicates that the landscaping of the reserve within at least 30 m of the proposed buildings requires considerable care and design in conjunction with protection measures for the proposed buildings.

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6.5 Monitoring and Maintenance

Table 6.1 below outlines the recommended monitoring and maintenance program to be undertaken during and post construction within the site.

Monitoring Action	Method	Frequency	Performance Criteria	Location	Responsibility
Fencing	Visual inspection	On a regular basis during and post construction.	Fencing is still in place, and in the correct location (e.g. not removed or vandalised)	Fencing around key areas of rehabilitation and re-vegetation and fencing around dunes and along pathways.	Construction Supervisor (the Contractor) Construction Supervisor (for landowner)
Signage	Visual inspection	On a regular basis during and post construction.	No damage to surface or damage from vandalism.	All signage including warning/restrictive signs and informative signs (e.g. signs indicating dog recreation restrictions and identification of areas of rehabilitation).	Landowner and City of Cockburn
Fixed-photo monitoring of vegetation restructuring	Photos to be taken using GPS recorded fixed locations.	Prior to, during and following vegetation restructuring works.	No incidents of over-clearing or unnecessary clearing of extra vegetation.	Where restructuring is recommended to take place in the dense areas of vegetation.	Construction Supervisor (the Contractor) Construction Supervisor (for landowner)
Rehabilitation areas	Fixed-photo monitoring and visual inspection	On a daily basis during any clearing of adjacent areas and ongoing through development	Increase in vegetation cover on degraded areas. No damage to rehabilitated areas from adjacent construction, feral animals or trampling.	Areas to be designated for rehabilitation/ re-vegetation	Construction Supervisor (the Contractor) Construction Supervisor (for landowner)
Weed management	Monitoring of weed infestations and emergence of new weeds	Ongoing during clearing and development.	No introductions of new species to the site and no spread of existing weeds	Areas of native vegetation	Environmental Advisor (to landowner) Construction Supervisor (for landowner)
Community awareness site	Erect signage around areas of native vegetation and areas undergoing rehabilitation, and distribute pamphlets advising local residents and visitors on restricted areas of the foreshore and importance of ecological values of the site.	Following implementation of rehabilitation program, on an ongoing basis.	Signage remains intact and educational materials continue to be supplied.	Within areas of native vegetation and rehabilitated areas	Developer and City of Cockburn
Bushfire	Visual assessment of the potential fire hazard across the site (cover of weeds and woody fuels). Monitoring of mitigation efforts should also be assessed (such as success of weed spraying or removal, the quality of firebreaks, ease of access and adequate signage).	Maintenance on any mitigation measures should be completed in spring prior to the commencement of the fire season, and monitoring of these should be ongoing throughout the fire season annually.	Fire hazard is kept to a minimum across the site through minimised weed cover and woody fuels. Signage is intact and free from vandalism, firebreaks and access is clear.	Throughout the site and at the locations of firebreaks and access.	Developer and City of Cockburn

Table 6.1 Monitoring and Maintenance

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6.6 Implementation Recommendations

Table 7.1 summarises the FMP recommendations, with assigned responsibilties and indicative timing

Recommendations	Timing	Responsibility
Weed Management		
Control access through the site through formalisation of paths and fencing off of dune areas	Fencing to be undertaken during stage 1 of construction of landscape elements (see 'Access and Recreational Infrastructure' section below). Formalisation of paths to be undertaken during stages 1,2 and /or 3.	City of Cockburn
Monitor for the presence of new weed populations and extension of existing weed species	During and post-construction of elements within the foreshore and on an ongoing basis post-construction.	City of Cockburn
Develop and undertake a weed control program using herbicide application and manual control methods where deemed appropriate and safe to apply	Annually (late summer early autumn, at least four weeks after first rains) during and post-construction of elements within the foreshore and on an on-going basis post-construction.	City of Cockburn
Ensure residents and the community are aware of where and when weed control measures will be carried out	During implementation of weed control program and ongoing during any proposed weed control actions.	City of Cockburn
Rehabilitation and Re-vegetation		
Prioritise and undertake re-vegetation activities along the foredune and primary dune	Commence during stage 1 of construction of landscape elements and continue through subsequent stages and ongoing post-construction where required.	City of Cockburn
Use wind fencing, brushing, matting materials and intensive planting of dune stabilising species along the front of the foredune to stabilise more exposed, erosion prone areas	During rehabilitation works	City of Cockburn
Use only species sourced from local propagation stocks (seeds, cuttings, divisions) from the Cockburn foreshore dune or hinterland vegetation communities where possible	During rehabilititaion works	City of Cockburn
Install signage to inform the public of rehabilitation works (to be appropriate in location, size and level of information)	During rehabilititaion works	City of Cockburn
Monitor rehabilitated areas for stability and growth of vegetation, and for evidence of pest fauna (i.e. rabbit grazing)	During rehabilititaion works, continue post-construction on an ongoing basis.	City of Cockburn

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Recommendations	Timing	Responsibility
Fauna Management		
Incorporate the creation of fauna habitat, habitat corridors and linkages into design of the foreshore	Commence during stage 1 of construction of landscape elements and continue throughout construction	City of Cockburn
Implementation of tree guards or rabbit proof fencing where required.	Commence during stage 1 of construction of landscape elements and continue throughout construction and post-construction on an ongoing basis	City of Cockburn
Designate dog recreation areas and erect signage preventing access to areas of high value fauna habitat	During stage 1 and/or 2 of construction of landscape elements	City of Cockburn
Use tree guards and establish fencing around areas of rehabilitation particularly on the dunes	During rehabilitation works	City of Cockburn
Advise local residents of the adjacent development about the implications of uninhibited domestic pets	Post-construction, on an annual basis	City of Cockburn
Fire Management		
Respond to, contain and control fires within the site as early as possible and keep records of the date, time, duration, personnel attending and cause (if known) of fires within the site.	In the wake of a bushfire event	City of Cockburn
Implement fire mop-up procedures to reduce the potential for re-ignition • Ensure FESA and fire response personnel are aware of the management strategies for the site to allow protection of ecological values during fire suppression	Post - fire	City of Cockburn
Facilitate liaison between FESA and the CoC to allow efficient and effective response in the event of a fire and ensure effective post-fire management, reporting and recovery	Prior to stage 1 of construction of landscape elements	City of Cockburn
Actively reduce bushfire hazard by implementing hazard mitigation as per ‘Strategy and method statements’)	Annually during and post-construction on an ongoing basis.	City of Cockburn
Reduce number of fires occurring through bushfire risk management and community education	Annual hazard mitigation and community education where possible during and post-construction.	City of Cockburn
Create and maintain access and strategic fire breaks	Prior, during and post-construction on an ongoing basis	City of Cockburn

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Recommendations	Timing	Responsibility
Develop and implement a post-fire recovery/restoration works plan	To be prepared in the wake of a bushfire event	City of Cockburn
Assess fire management strategies after the occurrence of a fire, or after a period of five years (whichever occurs sooner)	In the wake of a fire or after a period of five years, whichever occurs sooner.	City of Cockburn
Coastal Protection		
Choose preferred coastal protection solution in consultation with DoP and stakeholders and resolve funding arrangements.	2012 -2013	City of Cockburn/ Department of Planning/Public Transport Authority
Detailed design and construction of protection measures in consultation with landscape and infrastructure design	Coastal Protection infrastructure required in the next ten (10) years to protect Road and Rail Infrastructure, design to commence within next five (5) years	City of Cockburn
Access and Recreational Infrastructure		
Some relocation of access infrastructure may need to occur prior to coastal protection, depending on timing of implementation of protection measures	Within 2-3 years if coastal protection is not fast tracked.	Department of Planning/ City of Cockburn
Development Contribution Plan to include indicative costing for foreshore infrastructure works (including design development and documentation) and to review specifications for landscape finishes and furniture.	Mid 2012	City of Cockburn
Use the FMP concept to develop detailed design and construction documentation for landscape infrastructure	In conjunction with detailed design of coastal protection infrastructure (within next 5 years)	City of Cockburn
Staged construction of landscape elements:	Stage 1: Relocation of DUP South of Catherine Point Groyne required in the next fire years if Coastal protection infrastructure is not yet in place.	City of Cockburn
	Stage 2: Establishment of primary north-south movement network excluding connection to power station (following establishment of coastal protection infrastructure)	City of Cockburn
	Stage 3: Development of Robb Jetty Plaza and McTaggart Cove Parklands (in conjunction with construction of streetscape and open spaces links to the east of the rail line. The foredune boardwalk would also be constructed at this stage.	City of Cockburn
	Stage 4: Finalisation of Boulevard Connection between Robb Jetty and the power station precincts (in conjunction with construction of the power station precinct) This work will require relocation of car and horsefloat car parking and finalisation of foredune boardwalk connection to southern end of boulevard.	City of Cockburn

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APPENDIX _____**1: Foreshore Concepts Plans**

COASTAL PROTECTION USING SEAWALL

APPENDIX 1**: Foreshore Concepts Plans**

COASTAL PROTECTION USING GROYNE AND BEACH NOURISHMENT

APPENDIX 1**: Foreshore Concepts Plans**

COASTAL PROTECTION USING HEADLAND AND BEACH NOURISHMENT

Species List (including species recorded by GHD (2009) and by ELA during the recent site visit

Note: species marked with a * indicate weed species.

Family	Species
Aizoaceae	**Tetragonia decumbens*
Asparagaceae	**Asparagus asparagoides*
Asphodelaceae	**Asphodelus fistulosus*
Asteraceae	**Senecio diaschides*
Asteraceae	**Sonchus oleraceus*
Brassicaceae	**Cakile maritima*
Brassicaceae	**Raphanus raphanistrum*
Crassulaceae	**Crassula glomerata*
Euphorbiaceae	**Euphorbia terracina*
Geraniaceae	**Pelargonium capitatum*
Goodeniaceae	*Scaevola crassifolia*
Mimosaceae	*Acacia rostellifera*
Myrtaceae	*Agonis flexuosa*
Myrtaceae	*Eucalyptus platypus*
Myrtaceae	**Leptospermum laevigatum*
Myrtaceae	*Melaleuca lanceolata*
Nitrariaceae	*Nitraria billardierei*
Oxalidaceae	**Oxalis pes-caprae*
Papilionaceae	**Lupinus cosentinii*
Papilionaceae	**Trifolium angustifolium var. Angustifolium*
Papilionaceae	**Trifolium campestre var. campestre*
Poaceae	**Avena barbata*
Poaceae	**Bromus diandrus*
Poaceae	**Cynodon dactylon*
Poaceae	**Lolium rigidum*
Poaceae	*Spinifex longifolius*

Appendix 3: Recommended methods for control of individual weeds at the site as per Florabase (DEC 2012) and Brown and Brooks (nd)

Species	Common Name	Recommended control
**Tetragonia decumbens*	Sea Spinach	Consult weed control specialist.
**Asparagus asparagoides*	Bridal Creeper	Spray 0.2 g metsulfuron methyl + Pulse® in 15 L water (or 2.5 - 5g /ha + Pulse®). Best results achieved when flowering.
**Asphodelus fistulosus*	Onion Weed	Hand pull small infestations. Apply metsulfuron-methyl at 0.1 g /10 L + 100 ml spray oil when flowering.
**Senecio diaschides*	-	Consult weed control specialist.
**Sonchus oleraceus*	Common Sowthistle	Remove small and/or isolated populations manually prior to seed set. Slashing is often ineffective as flowers continue to be produced. Spot spray Lontrel® 10 ml/10 L + wetting agent preferably at the rosette stage.
**Cakile maritima*	Sea Rocket	Low priority for control given its dune stabilisation role. However if removal is pursued manual removal is effective but must be done at least every 8-10 weeks. Ensure material is removed off-site, as once pods are formed, seed will often mature if plants have been uprooted. Fairly selective control can be achieved by spot spraying Logran® at 0.5 g/10 L. Wick application with 50% glyphosate or foliar spraying with 1% glyphosate provides reasonable control and can be used at flowering to reduce seed set.
**Raphanus raphanistrum*	Wild Radish	Hand remove isolated plants several times throughout the year. Spot spray 1% glyphosate before flowering. A combination of approaches is usually most successful.
**Crassula glomerata*	-	Consult weed control specialist.
**Euphorbia terracina*	Geraldton Carnation Weed	Spot spray large infestations with metsulfuron methyl 0.1 g/15 L before flowering. Follow-up with hand removal for at least five years. Logran® at 12.5 g/100L + the penetrant Pulse ® has been found to be very effective on adults and juveniles in coastal heathlands. Ensure adequate personal protective clothing is worn to avoid contact with sap.
**Pelargonium capitatum*	Rose Pelargonium	Hand pull isolated plants taking care to remove the entire stem as it can reshoot from below ground level. Spot spray metsulfuron methyl 5 g/ha + Pulse®. Easily controlled after fire.
**Leptospermum laevigatum*	Coast Teatree	Hand pull seedlings. Fell mature plants. Resprouting has been recorded in some areas. Where resprouting has been observed, apply 250 ml Access® in 15 L of diesel to bottom 50 cm of trunk (basal bark). Seeds released *en masse* when plants are damaged or stressed, including herbicide application, mechanical damage or fire
**Oxalis pes-caprae*	Soursob	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse®, or 1% glyphosate. Apply at bulb exhaustion, generally just on flowering. Exercise care if manually removing as physical removal can result in spread of bulbils.
**Lupinus cosentinii*	Western Australian Blue Lupin	Hand remove scattered plants prior to flowering. Spray dense infestations with metsulfuron methyl 0.1g/15 L (2-3 g/ha) + wetting agent. Larger areas can be treated with more selective herbicides such as 200 g/ha Lontrel® or 50 g/ha Logran® (based on 500 L of water/ha). For spot spraying use 4 g Lontrel® or 1 g Logran® in 10 L of water + wetting agent. Glyphosate is relatively ineffective.
**Trifolium angustifolium var. Angustifolium*	-	*Hand remove isolated plants before flowering. Spot spray* Lontrel® 10 Ml/10 L + wetting agent in early winter before flowering provides effective control.
**Trifolium campestre var. campestre*	Hop Clover	*Hand remove isolated plants before flowering. Spot spray* Lontrel® 10 Ml/10 L + wetting agent in early winter before flowering provides effective control.
**Avena barbata*	Bearded Oat	Spray at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L + wetting agent. Repeat over the following 2 years. Aim to prevent seed production.
**Bromus diandrus*	Great Brome	Prevent seed set. Hand pull plants. In degraded areas use 1% glyphosate on seedlings, young plants or when flowering. Alternatively spray plants at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L or 800 ml/ha (based on 500 L water/ha) + wetting agent. An early and late application may be required where two *Bromus*species are present. Repeat the following year if required.
**Cynodon dactylon*	Couch	Small infestations may be dug out, ensuring removal of all rhizomes and stolons, however it is difficult to eradicate without herbicides. Spray Fusilade® Forte at 8 ml/L + wetting agent when plants are small and beginning new growth, or 1% glyphosate in late spring/summer and autumn when rhizomes are actively growing. In sensitive areas try painting runners or crowns with 50% glyphosate. Follow-up is nearly

Appendix 4: Suggested plant species for use in rehabilitation and landscaping works (adapted from Ecoscape 2009)

The following suggested species list for use in rehabilitation and revegetation at the site has been adapted from the list provided in Ecoscape (2009). This is to allow for a level of consistency across both the North Coogee Foreshore Management Plan (Ecoscape 2009) and this Foreshore Management Plan due to the overlap of areas covered by these plans at Point Catherine. Some additional species have been suggested, based on amenity species for the foreshore as listed in WAPC (2003) and also key species of the Quindalup Dune shrublands and herblands as described in Government of Western Australia (2000). Some of these species are identified as being suitable for provision of shade and/or windbreak functions or would assist in adding value to fauna habitat at the site.

Species	Locations suitable for species planting			Comments
	Dunes	East of foredune (central corridor)	Eastern boundary of site (dense woodland)	
Acacia cochlearis		x	x	
Acacia cyclops			x	
Acacia lasiocarpa			x	Flowering shrub
Acacia rostellifera			x	Provides shade and/or windbreak functions
Acacia sclerosperma subsp. sclerosperma		x	x	
Acanthocarpus preissii		x	x	
Agonis flexuosa			x	Provides shade and/or windbreak functions
Allocasuarina lehmanniana			x	Provides shade and/or windbreak functions
Alyxia buxifolia			x	
Angianthus cunninghamii	x	x		
Anthocercis littorea			x	
Atriplex cinerea	x	x		
Atriplex isatidea		x	x	
Baumea preissii		x		
Callitris preissii			x	Medium tree, provides shade and windbreak functions (Note: invasive roots, care to be taken around sewers)
Calothamnus quadrifidus			x	
Carpobrotus virescens		x	x	
Clematis linearifolia			x	
Conostylis candicans		x	x	
Diplolaena dampieri			x	
Eremophila glabra		x	x	
Ficinia nodosa		x	x	
Gastrolobium nervosum		x		Small flowering shrub (attract birds)
Grevillea crithmifolia			x	
Grevillea preissii			x	
Hakea prostrata			x	
Hardenbergia comptoniana			x	
Hemiandra pungens		x		
Lepidosperma gladiatum		x	x	
Lepidosperma pubisquameum		x	x	
Leucophyta brownii		x	x	
Melaleuca huegelii			x	
Melaleuca lanceolata			x	Tall shrub or medium tree, provides shade and windbreak functions (Note: best grown in groves, single plants blow over in strong winds and roots can be invasive)
Melaleuca systena syn. *Melaleuca acerosa*			x	Medium shrub, provides shade and windbreak functions. Flowering species to attract birds.
Myoporum insulare			x	
Olearia axillaris	x	x	x	
Ozothamnus cordatus		x	x	
Phyllanthus calycinus		x	x	Erect flowering shrub (attract birds)
Rhagodia baccata			x	
Santalum acuminatum			x	
Scaevola crassifolia		x	x	Erect flowering shrub
Scaevola nitida		x	x	Erect flowering shrub
Spinifex hirsutus	x	x		
Spinifex longifolius	x	x		
Sporobolus virginicus	x	x		
Spyridium globulosum			x	Erect flowering shrub, provides windbreak function.
Templetonia retusa		x	x	Medium flowering shrub, provides shade and windbreak functions
Threlkeldia diffusa	x			