Strategic Environmental Review

Cape Peron Tourist Precinct Project

Prepared for
Cape Peron Tourist Precinct Steering Committee
by Strategen

February 2006

Strategic Environmental Review

Cape Peron Tourist Precinct Project

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Client: Cape Peron Tourist Precinct Steering Committee

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Preliminary Draft Report	V1	LC/JN/MT	CW		
Draft Report	V2	LC/JN		1 cd	4/11/05
Draft Report	V3	LC/JN/KH		1cd	9/12/05
Final Draft Report	V4	LC/JN/KH	CW	1cd, 1 hard copy	22/12/05
Final Draft Report	V5	LC/JN/KH		30 hard copy	6/01/06
Final report	Final	LC	CW		27/02/06

INVITATION

The Environmental Protection Authority (EPA) invites people to comment on this project.

The Cape Peron Tourist Precinct Steering Committee has developed a Strategic Environmental Review (SER) document on the Cape Peron Tourist Precinct Project. The document has been submitted to the EPA in order for the EPA to provide strategic advice to the Minister for the Environment on the potential environmental impacts associated with the Cape Peron Tourism Precinct Project. This process is in accordance with Section 16e of the *Environmental Protection Act 1986*. The SER describes the project and its likely effects on the environment at a strategic level. The SER is available for public comment from 6 March 2006, closing on 4 April 2006.

Section 16 advice provided by the EPA does not result in environmental approval. The process is intended to allow the EPA to examine the key environmental issues associated with the project, including providing advice on potential fatal flaws of the project at a relatively early stage. The level of investigation undertaken is not as detailed as the Environmental Impact Assessment process.

Comments from Government agencies and from the public will assist the EPA to prepare a report in which it will provide advice to Government.

If Government decides to proceed with further consideration of a detailed proposal, then it would be subject to the formal Environmental Impact Assessment process.

If you are able to, the EPA would welcome electronic submissions in particular, emailed to the project assessment officer or via the EPA's Website (see address below).

Where to get copies of this document

Printed copies of this document may be obtained from Rockingham Development Office, Suite 12 The Boardwalk, cnr Val and Harrison Sts, ROCKINGHAM WA 6168, at a cost of $10.

Copies may also be obtained from www.rdo.wa.gov.au and from the EPA website at www.epa.wa.gov.au.

Why write a submission?

Providing comment on this strategic environmental review is a way to express your views on the broad concepts for development and the potential environmental issues that these concepts may raise.

All comments received by the EPA will be acknowledged. Comments will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in each report.

Points to keep in mind.

By keeping the following points in mind, you will make it easier for your comment to be analysed:

- attempt to list points so that issues raised are clear
- refer each point to the appropriate section, chapter or recommendation in the SER

- if you discuss different sections of the SER, keep them distinct and separate, so there is no confusion as to which section you are considering
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name
- address
- date
- whether you want your submission to be confidential.

The closing date for submissions is: Tuesday, 4 April 2006.

The EPA prefers submissions to be sent in electronically. You can either e-mail the submission to the project officer at the following address:

emma.glencross@environment.wa.gov.au

OR use the submission form on the EPA's website:

www.epa.gov.au/submissions.asp and click on the EIA Assessment Submission option

OR if you do not have access to e-mail then please post your submission to:

The Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842
Attention: Emma Glencross

EXECUTIVE SUMMARY

INTRODUCTION

The Mangles Bay area of Cape Peron, Rockingham (approximately 47 km south of Perth), is the focus for the development of a concept plan for a marina-based tourist precinct. The proposed development area is predominately east of the Garden Island Causeway and is bounded by Hymus Street to the east and the proposed Garden Island Highway to the south.

The concept is a tourist based marina built into the land which will accommodate more than 500 boats and will incorporate local boating clubs, commercial areas and boat pens for public use (both short and long-term). The surrounding land use will be 'mixed-use' with recreational, commercial and residential components for both locals and visitors.

The project is under the auspices of the Premier's Rockingham Planning and Development Taskforce and being managed by the Cape Peron Tourist Precinct Project Steering Committee, chaired by the Mayor of the City of Rockingham.

STRATEGIC ENVIRONMENTAL REVIEW

This document is a strategic environmental review (SER) for the Cape Peron Tourist Precinct Project for the consideration of the Environmental Protection Authority (EPA) to enable it to give advice requested by the Minister for the Environment under section 16(e) of the *Environmental Protection Act 1986* (EP Act). The EPA provides written and public advice to the Minister under this strategic assessment process. At this early stage, three concept options have been developed and addressed by this SER but these options do not constitute a formal proposal.

Section 16 advice provided by the EPA will not result in environmental approval by the Minister for the Environment. The strategic assessment process enables the EPA to examine the key environmental issues associated with the project, including providing advice on potential fatal flaws of the project at a relatively early stage in project development. The level of investigation undertaken for this assessment is not as detailed as that undertaken when a formal proposal is developed and assessed by the EPA under Part IV of the EP Act.

A formal proposal will be developed and more detailed environmental investigations will be undertaken if the project receives Cabinet endorsement to proceed to the next phase of detailed planning, design and environmental assessment.

The objectives of the SER are similar to other environmental reviews but at a strategic level in that they:

- place the project in a local and regional environmental context
- describe all key components of the project
- identify key issues and provide information on the potential environmental impacts of the project, and their significance
- outline management and mitigation measures as part of the project that would be designed to avoid, minimise and offset any potentially significant adverse impacts

- The SER is not intended to address all project impacts in detail, or to propose management strategies for addressing all impacts.

ENVIRONMENTAL SETTING

The Cape Peron area includes areas of upland coastal vegetation communities on Quindalup Dunes interspersed with cleared land associated with roads and informal tracks. There are no wetlands within the development areas. All land within the project area south of Point Peron Road is within Bush Forever Protection Area (BFPA) 355 and Rockingham Lakes Regional Park. Lake Richmond, adjoining but outside the project area, is also a BFPA (358) and within the Regional Park.

The Cape Peron shoreline consists of sandy beaches and limestone rocky shores and headlands and the seabed consists of extensive sandy areas and limestone reefs. The shallow sheltered waters of Cockburn Sound (and Mangles Bay) support extensive seagrass meadows and a wide range of marine fauna. The Shoalwater Islands Marine Park comprises the chain of islands that run parallel to the coastline between Cape Peron and Becher Point to the south. The Marine Park borders Mangles Bay at the Garden Island Causeway and contains the waters of Shoalwater Bay, Warnbro Sound and a part of Cockburn Sound off Cape Peron.

PREVIOUS PROPOSALS

The redevelopment of the Mangles Bay area has been the subject of a number of previous proposals since the 1970's that have included both sea-based marinas (i.e. built out into the bay) and land-based marinas (i.e. built into the land). Early project proposals were abandoned due to high costs and downturns in the real estate market. A proposal in 1993 involved a loss of about 30 ha of seagrass and was considered unacceptable by the EPA because of this loss, and seagrass rehabilitation was not a proven technology at the time.

The most recent proposal, in 1998, was a concept for the development of an inland marina in Mangles Bay. The concept plan was never formally assessed but advice from the EPA indicated that the proposal would not be environmentally acceptable due to seagrass loss. Processes for rehabilitation of seagrass were not considered reliable at the time.

STAKEHOLDER CONSULTATION

The stakeholder consultation process for this project commenced in April 2005, focusing on active community engagement in the development of the project concept. A high level of interest was shown in the project with more than 800 community members from a broad range of stakeholder groups participating in the process.

Project stakeholders consulted include local residents, Cape Peron users, representatives of Federal, State and local governments, local businesses, boating clubs, the local Chamber of Commerce, environmental organisations and Aboriginal groups.

The key components of the stakeholder consultation process were:

- Public forums: Two public forums, attended by approximately 350 people were held in May/June 2005 to engage the wider community in the development of the project.
- Public telephone survey of 100 randomly selected Rockingham residents.

- Stakeholder Reference Group comprising over 40 members, this group met on four occasions to discuss concerns and opportunities, and to provide input into development of concept plans.
- Public advertising and display of the concept plan: comprising a newspaper advertisement and a public display at the Rockingham City Shopping Centre attended by project team members followed by a further two weeks in the foyer of the offices of the City of Rockingham
- Project website: regularly updated with progress reports and investigation results
- Telephone information line
- Individual stakeholder meetings: Over 30 meetings were held with individual stakeholders to discuss specific issues
- Aboriginal representatives: were contacted and provided input to the project.

Stakeholder input contributed to the development and assessment of the concept options and assisted the project team to identify the opportunities and, where possible, address community issues and community concerns.

The themes identified from particular community stakeholder groups may be summarised as follows:

- Groups with a long term affiliation with Cape Peron through private recreational leases were concerned at possible impacts on their tenure and were looking for opportunities to retain their leases, or if this was not possible, to relocate within the Cape. These groups did not want to see the area over developed.
- Boating clubs and education groups could see advantages in developing a marine education and recreational facility that would attract visitors and provide educational and employment opportunities.
- Environmental groups and agencies were concerned or opposed the marina concept due to potential terrestrial and marine impacts, but could see possible benefits from modifications to the Garden Island causeway and offset packages.
- Local Aboriginal representatives identified the opportunities to build cultural awareness and capacity, and provide educational and employment opportunities.
- Local residents were concerned about anti-social behaviour and under-utilisation of the already developed areas of the Cape supported some change, but did not want to see the area over developed and were concerned by the impact of greater traffic volumes and lack of access. Local residents also supported the opportunities and facilities proposed for improve access for the general public to both the project area and the balance of Cape Peron.

The main environmental issues identified by stakeholders were Mangles Bay water quality and seagrass protection, and the preservation of the natural environment of Cape Peron and Lake Richmond. Lake Richmond is considered by the local community to be a major environmental icon and any proposal must not have any adverse impacts on the lake.

Other issues identified included traffic, site selection, club accommodation, the extent of the development, construction and ongoing operational costs and affordability of facilities.

PROJECT DESCRIPTION

REVIEW OF MARINA LOCATION

In response to community interest, the costs, benefits and constraints of Mangles Bay and other potential sites along the City of Rockingham coastline were reviewed.

The review concluded that for a marina-based development, when assessed against the project sustainability objectives, Mangles Bay presents the least constraints (not withstanding that the Mangles Bay site has some major environmental constraints) and most opportunities when compared with the other sections of the coastline in the City of Rockingham.

CAPE PERON CONCEPT OPTIONS

Five development concept options were developed in consultation with key stakeholders and the community. These options all involved an inland marina (to minimise seagrass loss) and differ in layout and the extent of the land footprint. It was felt that an offshore marina involving the loss of a substantial proportion of seagrass in Mangles would not be found environmentally acceptable even with rehabilitation of seagrass. The initial Options 1.1 and 2.0 are briefly described in this SER to show the evolution of the options but were discarded as they do not meet the environmental objectives of the project.

The minimisation of potential adverse environmental impacts from the development was one of the aims of the project. This resulted in the development of Option 2.2 to minimise seagrass loss and then the development of Option 2.3 and 2.4 to also minimise terrestrial impacts.

Option 2.2 was developed in consultation with the Stakeholder Reference Group (SRG) and was the preferred option for both the SRG and the Steering Committee in comparison to Option 1.1 and 2.0. However, community feedback also indicated that a smaller development with a lesser impact on the Cape Peron bushland was preferred to Option 2.2. Options 2.3 and 2.4 were developed in response to this feedback and are now the options preferred by the Steering Committee and are addressed in this SER. Option 2.2 is not a preferred option because of the extent of its land footprint but has been presented in this SER for comparison.

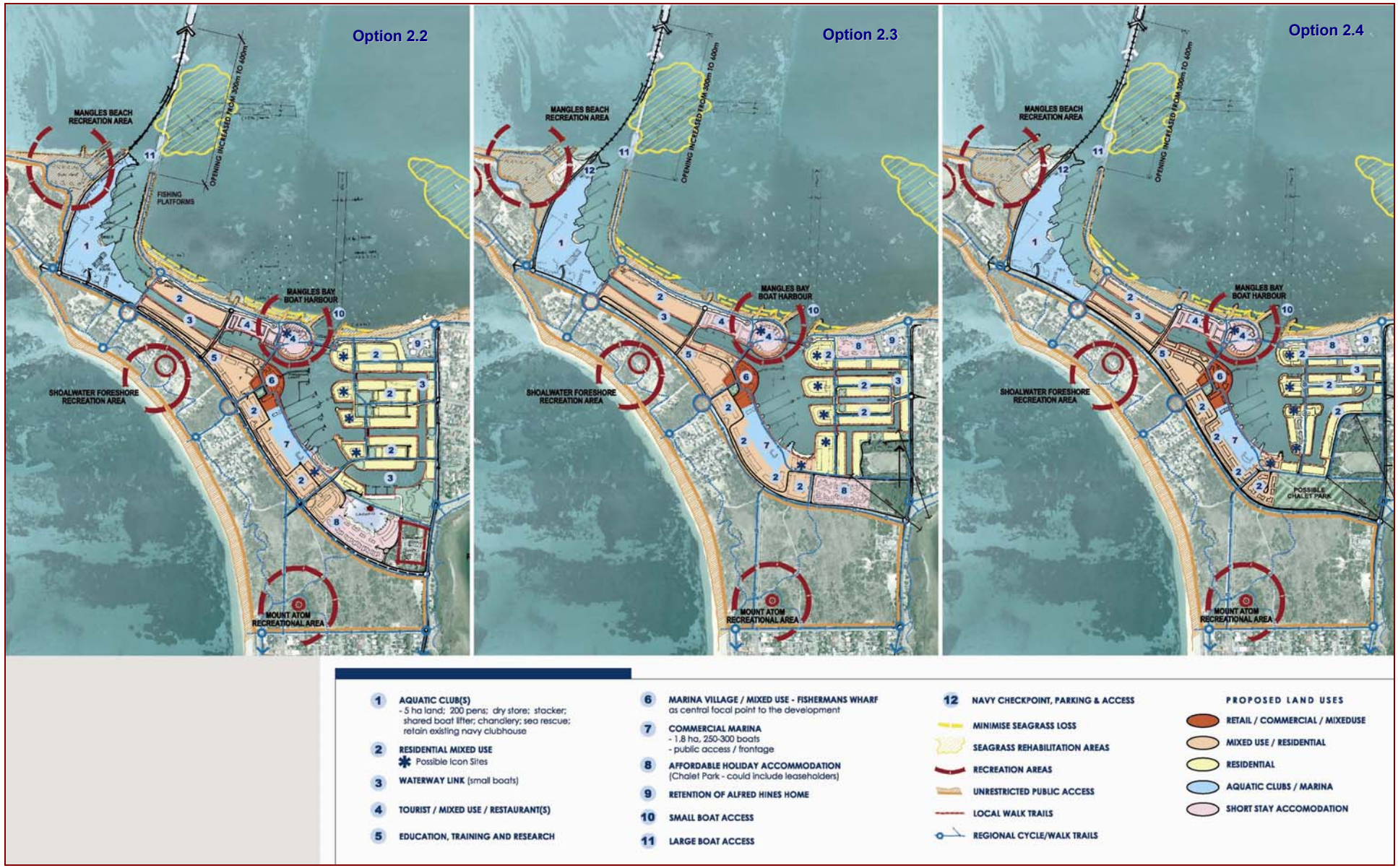


Figure 1 Concept Options 2.2, 2.3, 2.4

Table 1 Summary of the proposed development concept

Aspect	Key facilities
Marine recreation / industry facilities	Two marina entrances; one deep for very large boats and keeled craft, one medium depth suitable for most boats of trailerable size.
	Aquatic club(s) secure area comprising boat pens, dry boat store and boat stacker.
	Commercial marina secure facility with deep water access.
	Re-fuelling and sullage pumping facilities.
	Public marina for short and long-term boat stay with direct access to Mangles Bay
	Internal waterways (canals).
Accommodation	Affordable chalet style accommodation.
	Boutique resort hotel at the main (east) entrance to the marina.
	Apartment style short stay accommodation.
Education and training	A site for a marine education and research facility with marina access and boat pen.
Tourist attractions	Marina village with mixed use 'Fisherman's Wharf' (Fremantle Fisherman's Harbour style) area with restaurants, cafes, public open space and shops.
	Shop front sites and pens for Rockingham's existing marine eco-tourism operators (eg dolphin watch tours and dive operators etc)
	Mangles Bay beach with grassed public open space and a beach facing café and short-stay accommodation strip.
	Tourism focal site with boutique resort hotel and restaurants.
	Public open space and public art at icon sites throughout development.
	Continuous public access to and around the Mangles Bay foreshore and marina waterways (canals) with improved access to the balance of Cape Peron.
Residential	Residential areas along canals and part of the Mangles Bay foreshore.
Garden Island Causeway	Re-alignment and lengthening of the southern causeway trestle to facilitate flushing and improved water quality in Mangles Bay.
Environmental and social improvements external to development area	New facilities for recreation and access to Cape Peron to enhance visitor experiences and to protect the environment (walk and cycle paths, picnic shelters, lookouts, public toilets etc).
	Rehabilitation and restoration of native vegetation outside of the immediate development footprint.
	Provide environmental/ educational awareness opportunities (e.g. interpretative nature trail, Aboriginal interpretative site).

Comparison of Options 2.2, 2.3 and 2.4

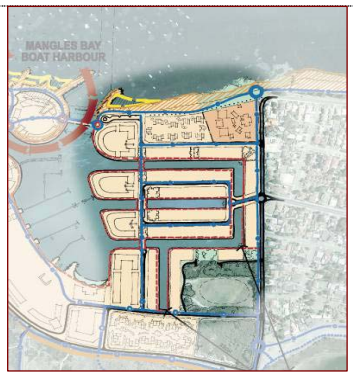
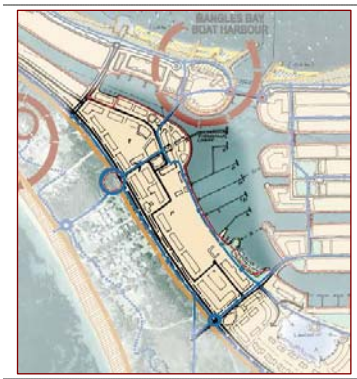
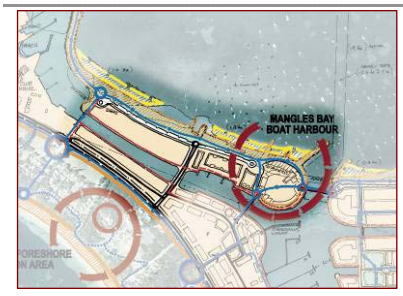
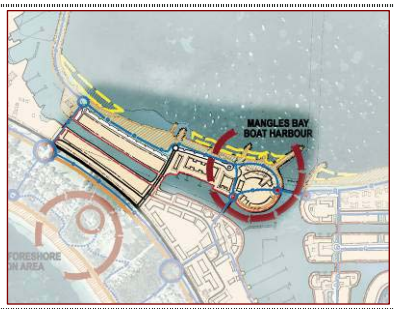
Table 2 provides a summary comparison of the key environmental impact of Option 2.2, Option 2.3 and 2.4 and Table 3 briefly compares the key design elements of these options.

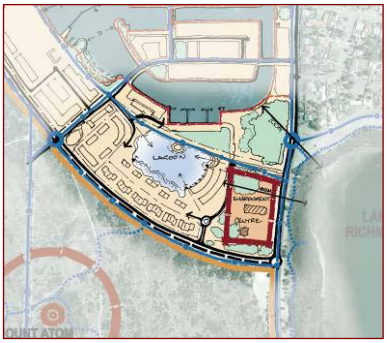
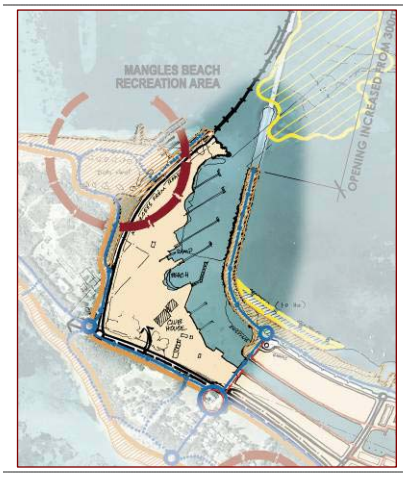
The key environmental characteristics and considerations of each option are summarised below.

Table 2 Broad environmental comparison of options

Parameter	Option 2.2	Option 2.3	Option 2.4
Direct seagrass loss	5.9 ha	5.9 ha	5.3 ha
Potential indirect seagrass loss	2 ha in Cockburn Sound 1-2 ha west of Causeway	2 ha in Cockburn Sound 1-2 ha west of Causeway	2 ha in Cockburn Sound 1-2 ha west of Causeway
Clearing within BFPA 355	43.9 ha	36.3 ha	30.9
Clearing of probable TEC	Totally cleared	Almost fully retained	Completely retained with a buffer
Distance to Lake Richmond	200 m	330 m	350 m

Table 3 Comparison of key design elements of option 2.2, 2.3 and 2.4

Option 2.2	Option 2.3	Option 2.4
Precinct 1		
		
Eastern residential waterway precinct located adjacent to Hymus Road. Full public access would be available around the perimeter of all of the waterways. Buffer sitance to lake Richmond is about 200 m.	Same as Option 2.2 but precinct, is smaller than in Option 2.2. Buffer distance to lake Richmond is increased to about 330 m	Same as Option 2.3 but with even smaller residential precinct supplemented by a village green and increased area for vegetation retention. Buffer distance to Lake Richmond about 350 m.
Precinct 2		
	Same as Option 2.2	Same as Option 2.2
Central marina precinct – A marina village with boardwalks, cafes, restaurants and shops around a public marina that would include 250-300 boat pens and 1.8 ha including hard stand. Boat clubs, chandlery and other areas have been incorporated in the western end of the marina, The main marina has a public edge.		
Precinct 3		
	Same as Option 2.2	
Mangles Bay Precinct, This area would comprise a mix of accommodation types connected to the Marina Village via a pedestrian bridge.		One row of lots has been removed. the beach reclamation is not needed along this section of Mangles Bay. Reduces the impact on seagrass by 0.6 ha.

Precinct 4		
		
Short stay/affordable accommodation precinct	The chalet park precinct has been reduced. A significant area of remnant vegetation immediately to the east of the site has been retained. Buffer to Lake Richmond ranging between 330 m and 350 m.	This precinct is left as an optional future development but would subject to a separate approval process and discussions with CALM and key stakeholders. This area would remain within the Regional Park and native vegetation retained within the chalet park.
Precinct 5		
	Same as Option 2.2	Same as Option 2.2
Combined boating clubs – this precinct would include a purpose built boating club facility that could accommodate all of the current clubs and associated facilities within the one secure site.		

SOCIAL CONTEXT (RECREATION)

Cape Peron has long been a popular holiday and day use recreation destination. Increases in population and per capita boat ownership have seen the use of Cape Peron escalate rapidly in recent years.

Cape Peron is popular for:

- **Water based activities:** boating, swimming, snorkelling, fishing and crabbing.
- **Land based activities:** walking, scenic driving, enjoying the scenery (lookout) and nature appreciation and study.

Infrastructure available to support the increased use of the Cape has however, not kept pace with the increased use. For example, there are no public toilet facilities on Point Peron to support the use of the beaches, walking trails and snorkelling trails.

Evidence of the imbalance between use and facilities/management that currently exists in the Cape Peron area can be seen in the number of informal paths and tracks through the vegetation, anchor drag scars in the seagrass of Mangles Bay, anecdotal evidence of sullage dumping and informal re-fuelling in Mangles Bay, and the common anti-social behaviour, including vandalism and car break-ins that occur on Cape Peron.

Although Cape Peron is a popular destination for recreation, much of the Mangles Bay and Shoalwater Bay beach is backed by Crown land leased to private recreation groups. This limits access to the beach in these areas.

Boating requirements

Cockburn Sound is an important destination for boating, providing a large area of protected water for yachting and powerboat use. Rockingham is one of the fastest growing population centres in the south west corridor. As a result, boat ownership and the demand for boating facilities are also rapidly increasing in the area.

Currently, boats larger than trailerable size are confined to moorings in Mangles Bay. The existing 261 swing moorings in Mangles Bay provide little protection to vessels from winter storms which approach from the north-west. Regular damage to vessels occurs during these storms, and currently there are no other options for these boat owners within the City of Rockingham.

There are no opportunities for boat owners to secure mooring pen space within the vicinity of Rockingham and this problem will intensify as the population increases.

The project's primary aim is to meet the high demand for boating facilities in the Rockingham area.

Other design considerations

The concept has also been designed to provide the following:

- provision of a range of public recreation and tourist facilities
- improved public access to Shoalwater Bay and Mangles Bay
- provision of a secure marina area specifically designed for commercial and recreational boating and yachting clubs
- increased management and regulation of boating activity
- increased management presence, lighting, traffic management and increased public use of Cape Peron will help discourage anti-social behaviour
- improved pedestrian and cycle linkages between Rockingham Beach, Point Peron and Shoalwater Bay
- acknowledgement of local heritage and cultural aspects of the Cape Peron area with the potential being investigated for provision of an Aboriginal meeting place in the Regional Park.

ECONOMIC IMPACT OF OPTIONS

A detailed analysis of the economic impacts of the various options has not been undertaken. A simple comparison based on more detailed economic analyses undertaken for similar projects (eg Mandurah Ocean Marina) indicates the infrastructure expenditure and subsequent construction of this project will generate a significant economic impact in excess of $500 million. Approximately half of this figure is from indirect flow-on economic impacts. This includes both direct and indirect spending. Option 2.3 is likely to generate $560 million whereas Option 2.4 is likely to generate $515 million.

The development will have at least one boutique hotel/resort (maximum height; five storeys), likely to employ 50 to 100 full time equivalent positions. Overall the retail, tourist and commercial businesses are expected to create direct employment of 620 to 650 full time equivalent positions. The indirect job creation in the surrounding areas during the operational phase of the project would be significant but is difficult to quantify.

The construction of the project would provide employment for at least ten years and would provide approximately 1500 jobs at its peak.

ENVIRONMENTAL STUDIES UNDERTAKEN

A number of environmental studies suitable for a strategic level of assessment were undertaken to address key environmental aspects of the development including:

- vegetation and flora survey
- statistical analysis to determine floristic community types using PATN analysis
- reconnaissance level fauna study
- hydrodynamic and water quality assessment.
- water exchange/flushing assessment
- hydrological study of canal/groundwater interaction
- seagrass rehabilitation/ transplanting analysis
- traffic and transport studies.

KEY ENVIRONMENTAL FACTORS ADDRESSED

The following key environmental factors relevant to this project were identified through the scoping process with the EPA and community:

Terrestrial environment

- flora and vegetation
- fauna
- Bush Forever Protection Area
- Rockingham Lakes Regional Park
- Lake Richmond

Marine environment

- water quality
- marine ecosystems (e.g. seagrass, fish, ecological function, Shoalwater Islands Marine Park)
- boat traffic

Social environment

- cultural heritage (Aboriginal and European)
- road traffic.

FLORA AND VEGETATION

Development will result in the removal of a total of 53 ha, 45.5 ha or 40.1 ha (development Option 2.2, 2.3 and 2.4 respectively) of remnant vegetation within Cape Peron (most of which is within Bush Forever Protection Area 355). Although disturbed, some of the vegetation lost is considered regionally significant. An area of species poor vegetation that is a probable Threatened Ecological Community (TEC) would be cleared under development Option 2.2 only. No other TECs will be affected by the project.

The clearing required for the project would not result in any vegetation complexes being cleared to less than 10% of the original extent and no Declared Rare Flora (DRF) will be affected based on flora and vegetation surveys conducted to date. Possibly one Priority Flora species (*Dodonaea hackettiana*) may occur in the area, although it was not recorded during the most recent vegetation and flora survey.

The development will provide offsets that involve support for the management, protection and rehabilitation of vegetation in the Cape Peron area of Rockingham Lakes Regional Park thereby enhancing the biodiversity including botanical values in those sections of Regional Park and improving the ecological linkage between Lake Richmond and Point Peron. A further offset is proposed through securing a parcel of land that is currently not protected, with similar or greater conservation value. The rehabilitation and land acquisition offsets will be determined in accordance with the EPA Position Statement No. 9 on environmental offsets. The project has made a provision of about $4-5m to give effect to these offsets.

The offset package and accordingly the financial provision to give effect to the offsets will defined in detail as part of any subsequent environmental assessment required by the EPA.

FAUNA

The area affected by the proposed development will result in a loss of habitat that is locally significant to fauna but is unlikely to be rich in fauna. The loss of habitat is not expected to adversely affect the conservation status or regional abundance of any faunal species.

Mitigation of the clearing will include the rehabilitation and enhancement of habitat adjoining degraded areas in the Regional Park to improve faunal habitat values and ecological linkages.

BUSH FOREVER PROTECTION AREA

The development will require clearing within the Bush Forever Protection Area 355. The clearing requirements of each option are:

1. Option 2.2 (not preferred) will result in the removal of approximately 43.9 ha (41%) of remnant vegetation within Bush Forever Protection Area 355. Most of this vegetation is considered regionally significant (including a degraded probable TEC).
2. Option 2.3 will result in the removal of approximately 36.3 ha (34%) of remnant vegetation within BFPA 355 but retains almost all of the probable TEC.
3. Option 2.4 will result in the removal of approximately 30.9 ha (29%) of remnant vegetation within BFPA 355 and retains all of the probable TEC with an appropriate buffer.

An additional 10 ha of clearing will be required outside of the Bush Forever Protection Area.

As indicated above, the project includes an offset provision of about $4-5m to support the rehabilitation of vegetation within the Bush Forever area and the acquisition of a parcel of land of similar or greater conservation value. The rehabilitation would include replanting, weed management, habitat material for fauna, dune stabilisation and monitoring. Greater than 70 ha of bushland exists within the immediate Cape Peron area outside of the project area.

The proposed mitigation measures (including offsets) are also designed to meet the requirements of the Statement of Planning Policy (SPP) 2.8, which addresses the protection and management of regionally significant bushland.

ROCKINGHAM LAKES REGIONAL PARK

The development will require the development site to be excised from the Rockingham Lakes Regional Park as follows:

- Development Option 2.2: approximately 51 ha or 1.2% of the total area of the Regional Park.
- Development Option 2.3: approximately 44 ha or 1.0% of the total area of the Regional Park.
- Development Option 2.4: approximately 39 ha or <1.0% of the total area of the Regional Park.

It is expected that the proposed development will not significantly alter current Park management regimes. The offset measure described above is expected to positively contribute to CALM's management of the conservation values of the Cape Peron area of the Rockingham Lakes Regional Park. In addition, the project will also provide new recreation facilities and funds for their ongoing management. The recreation facilities will include public toilets, lighting, parking, walk trails, board walks in sensitive areas, a lookout, cycle path and fishing platform.

The project has included provision for $0.8M to be put in a trust for CALM to use for the ongoing management of the area and these facilities.

LAKE RICHMOND

Lake Richmond has national conservation significance and iconic value to the Rockingham Community. The lake is currently fresh, although prior to the discharge of Rockingham's stormwater into Lake Richmond since the 1960's, it was saline.

Preliminary modelling indicates that it is unlikely that the underground saltwater wedge would reach Lake Richmond and that there is a low likelihood of an adverse impact on Lake Richmond water levels and nutrient status as a result of Option 2.2 (with canals 200 m from Lake Richmond). Options 2.3 and 2.4 are even further away from Lake Richmond (330 m and 350 m respectively) and would reduce this low risk even further. More detailed investigations of saltwater intrusion and groundwater drawdown will be conducted during any subsequent environmental assessment phase to confirm or otherwise these preliminary results.

The proposed mitigation measures (rehabilitation and increased support for management) for the Cape Peron area aim to enhance ecological linkages between the lake to Cape Peron and the wetland buffer between Lake Richmond and the proposed development.

MARINE ENVIRONMENT

Cockburn Sound has a history of poor water quality and large-scale loss of seagrass meadows in the 1960s and '70s. Although environmental conditions have improved markedly since the 1970s, a legacy of this past is that water quality and seagrass meadows remain key environmental concerns. The State Environmental Policy (SEP) for Cockburn Sound sets specific objectives for water quality and seagrass health, while EPA guidance for Benthic Primary Producer Habitat Protection requires that proposals must not cause any *net* loss of seagrass in Cockburn Sound.

The proposed development is located in Mangles Bay at the southern end of Cockburn Sound, an area which has the following characteristics:

- is sheltered by the Garden Island Causeway and Cape Peron, and therefore relatively calm and poorly 'flushed' by marine waters under most circumstances, but exposed to storms from the north-west
- has approximately 100 hectares of seagrass, comprising the main area of seagrass meadow along the shore between the Causeway and Woodman Point, in Cockburn Sound
- is an important fish nursery habitat
- is a popular departure point for boat-based recreation
- is currently degraded and under continuing pressure, because the level of human use exceeds that catered for by the present minimal level of management and provision of facilities.

WATER QUALITY

The proposed widening of the southern opening of the causeway is expected to provide localised improvements to the flushing of Mangles Bay and is expected to be a greater benefit than the adverse impacts of the marina construction and operation on water quality. More detailed assessment of these impacts will be conducted as part of any subsequent environmental assessment of a formal proposal required by the EPA.

Breakwater construction and dredging of boating access channels are expected to be the main causes of turbidity during construction, and have the potential to cause localised short-term impacts on water quality (and potentially on seagrasses) in Mangles Bay. Turbidity caused by construction activities are not expected to cause any long-term impacts on seagrasses, as this area has survived much longer construction activities (i.e. construction of the Causeway) during periods of far worse water quality (1971–1973). However, all construction activities will be managed under a comprehensive Construction Management Plan to ensure the turbidity in sensitive areas is prevent or minimised.

The proposed development is not expected to cause significant impacts on contaminant-related water quality in Mangles Bay and adjacent waters. Although boat numbers in the area will increase, these will be accommodated in the marina, and while a slight accumulation of contaminants (e.g. anti-foulants leaching from boat hulls) may occur in sediments over time, this will occur in the marina rather than Mangles Bay or adjacent areas. There are also opportunities for water quality benefits via the relocation into pens of some of the boats presently moored in Mangles Bay, the conversion to sewerage of all properties in the Cape presently still on septic tanks, improved capabilities (e.g. appropriate management of stormwater runoff) to manage boat hardstand activities, and better management of stormwater drains entering Mangles Bay.

The management objectives for the Shoalwater Islands Marine Park include conservation of biological, physical, cultural and landscape values and protection of wildlife (especially the Australian Sea-lion, Little Penguin and other sea birds) and reefs, intertidal platforms and other marine communities. These objectives are not expected to be adversely affected by the development.

COASTAL PROCESSES

The proposed development will not result in any additional detrimental impacts due to the interruption of longshore sediment movement, but it will provide an opportunity for a long-term solution to the accretion and erosion problems caused by Cape Peron boat ramp and Causeway, as it will include a properly engineered sediment bypass system similar to those that operate at Mandurah and the Dawesville Cut.

The development will result in more swell wave energy from the west reaching the shore in Mangles Bay, potentially causing erosion of the beach. These impacts will be very carefully monitored but should also be readily manageable with an appropriate sediment bypass system.

MARINE ECOSYSTEM

Seagrass loss and rehabilitation

Direct seagrass losses in Cockburn Sound due to the development footprint are expected to be 5.9 ha for development Options 2.2 and 2.3, and 5.3 ha for development Option 2.4. All three options involve minor losses (0.1 ha) in Shoalwater Islands Marine Park. Potential indirect losses associated with increased current velocities/sediment movement are expected to amount to approximately 2 ha in Cockburn Sound and 1–2 ha in Shoalwater Islands Marine Park. The Marine Parks and Reserves Authority has advised that small losses of seagrass (as bound by the EPA guidance for Benthic Primary Producer Habitat Protection) may be acceptable in a marine park if a proposal offers considerable public benefit.

No indirect losses of seagrass are anticipated due to changes in water quality with any marina option.

Small localised increases in current velocities in Mangles Bay arising from the development could help reduce the loads of epiphytes on seagrass and lessen accumulations of detritus within the meadows, and so improve seagrass health. In addition, widening the Causeway will also improve conditions for seagrass growth in other areas of Cockburn Sound (e.g. Southern Flats, and the eastern end of Mangles Bay) by lessening current velocities and/or sediment movement. Localised improvements in water quality due to improved flushing with lengthening the Causeway trestle may also be beneficial to seagrass health in Mangles Bay, on Southern Flats and seagrass health and reef health in Shoalwater Islands Marine Park.

Any loss (7.3-7.9 ha) of seagrass in Cockburn Sound will be offset by rehabilitation of at least an equal area. The project has made a provision of about $1m at this stage for the rehabilitation of seagrass on the basis of a cost of about $100 000 per hectare for the rehabilitation of seagrass. This would provide for the initial planting effort, monitoring and any supplementary planting required.

To date, large-scale seagrass rehabilitation (areas > 1 ha) in Western Australia has been carried out in Owen Anchorage, Albany and, most recently (between November 2004 and February 2005), in Cockburn Sound. Long-term rehabilitation of seagrass (>10 years) in Cockburn Sound has yet to be demonstrated, but research and trials to date strongly indicate it is readily achievable, providing conditions are suitable as they are in Cockburn Sound. Rehabilitation criteria will be developed as part of the detailed environmental assessment process. It is currently believed that all ecological functions will be present within rehabilitated seagrass areas within 5-10 years.

Potential sites for seagrass rehabilitation that are sufficient to provide the necessary area of offset have been identified in Mangles Bay and adjoining areas.

To demonstrate the effectiveness of seagrass rehabilitation in Mangles Bay, 2 ha of seagrass will be replanted within Mangles Bay immediately following any Cabinet approval of the project proceeding to the detailed design and environmental assessment phase. The monitoring of this demonstration site is expected to demonstrate that the replanting of seagrass is a feasible option for offsetting seagrass loss in Mangles Bay.

In conjunction with the seagrass rehabilitation demonstration, it is proposed to develop and commence a trial incentive scheme to replace a selection of swing moorings in Mangles Bay with 'seagrass friendly' fixed moorings. This will commence as soon as possible in the second half of 2006.

Recreational boating

The proposed development will indirectly result in increased tourism, recreational use and boating activity in Mangles Bay and adjacent waters.

The proposed development also offers the opportunity for decreased stress on the marine ecosystem in a broader sense, by supporting better management of impacts due to tourist, recreational use and boating activity. This can be achieved by using marina facilities to:

- promote/display information about natural and cultural values, and appropriate behaviour in the marine environment, including sustainable fishing practices
- provide a base for surveillance, monitoring and research in the marine environment, including the impacts of recreational use and management activities.

The proposed development also offers a means and support to allow improvement in fisheries management in the area.

The calm, slightly enriched waters and seagrass meadows of Mangles Bay make this area an important fish nursery habitat. The proposed development will not significantly alter these conditions.

SOCIAL ENVIRONMENT

Cultural heritage

The proposed development area is within the boundaries of two listed Aboriginal heritage sites that are based around Lake Richmond and Mangles Bay / Rotary Park. These sites have mythological significance based on the origin of the waterbodies.

The public Mangles Bay foreshore is currently used by the local Aboriginal community to meet for cultural and learning purposes. The foreshore will remain public but the environment will be modified, potentially reducing the attraction of this area as an Aboriginal meeting place.

In consultation with the local Aboriginal community and CALM, it is proposed that an appropriate site for a meeting place be established and leased to the local Aboriginal community. Aboriginal art and an 'interpretive site' will be incorporated into the development to recognise the Aboriginal heritage values of the area and their connection with the Cape Peron environment.

The project developers will also consult with the relevant Government heritage agencies, community groups and the City of Rockingham to determine the best outcome for the State Heritage listed Turtle Factory building.

Road traffic

The realignment of the causeway will improve the management of traffic to and from HMAS Stirling which currently banks up considerably at peak times. The re-alignment of the causeway will allow the base entrance to be redesigned to remove the bottleneck effect that currently occurs during peak hour Navy traffic.

The proposal will increase traffic flow on some of the main roads within the vicinity of the development, however, flows will be within the current capacity of the roads. The increased traffic flows will not pose an additional significant traffic hazard. A number of mechanisms to reduce any loss of amenity to affected residents will be considered. These may include the instalment of medians where pedestrians cross the roads to decrease the risk to public safety. The traffic increases on the minor residential roads are not expected to be noticeable.

There will be an increase in noise generated by the increased traffic flows along the roads affected, however, traffic management measures will be implemented to ensure this nuisance is minimised by all means practicable (eg. appropriate design guidelines).

SUMMARY OF KEY MITIGATION MEASURES

Mitigation measures have been developed to offset any potential adverse environmental impacts that may result from the proposed development. In summary, the key elements of the mitigation include:

- rehabilitation of the natural environment of the Cape Peron and Lake Richmond area to enhance the ecological linkage between the lake and Point Peron
- acquisition of an area of land of similar or greater conservation value and secure it for conservation purposes
- rehabilitation of seagrass meadows in and around Mangles Bay

- provision of recreation facilities and the funds for ongoing management of the facilities in the regional park by CALM
- provision of environmental/educational opportunities (eg. interpretive nature trail, Aboriginal interpretive centre, a site for a marine education and training facility).

Table 4 Summary of the environmental assessment of different concept options against project environmental objectives

Objectives	Development concept option			
	Do Nothing	2.2	2.3	2.4
ENVIRONMENTAL				
• Contributes positively to the natural terrestrial environment • Contributes positively to the marine environment	**Terrestrial environment** • No direct vegetation clearing • Further degradation of vegetation in areas with uncontrolled access • Minimal improvements in weed control, dune stabilization, vegetation rehabilitation and access management • No further improvements at the Cape other than implementation of the current CALM plan **Lake Richmond** • No further improvements at the lake other than implementation of the current CALM plan **Marine environment** • Boating numbers will increase • Current unmanaged boating activities will increase; unrestricted access through Mangles Bay and no managed re-fuelling or sullage facilities • No direct seagrass loss from infrastructure • No rehabilitation of seagrass and ongoing seagrass scarring from unmanaged boat access and anchor chains • No improvement in water quality in Mangles Bay • Management of coastal erosion and accretion continued to be managed through infrequent road transport of sand from one side of the causeway to the other.	**Terrestrial environment** • Total clearing: 53.0 ha • Clearing within Bush Forever and Regional Park: 43.9 ha • Probable TEC: almost all will be cleared • Regional Park: 51 ha to be excised • Weed control, dune stabilisation, vegetation rehabilitation and access management from Lake Richmond to Cape Peron • Acquisition of an of area of similar or greater conservation value and secure it for conservation **Lake Richmond** • 200 m from canal development **Marine environment** • Boating management: improved • Direct seagrass loss: 5.9 ha (reduced impact on seagrass by realigning sewer) • seagrass rehabilitation • Water quality in Mangles Bay improved by widening the causeway opening • Sand bypass installed	**Terrestrial environment** • Total clearing: 45.5 ha • Clearing within Bush Forever and Regional Park: 36.3 ha • Probable TEC: minimal clearing with no buffer provided • Regional Park: 44 ha will be excised • Mitigation: similar to Option 2.2 **Lake Richmond** • 330 m from canal development **Marine environment** • As for Option 2.2	**Terrestrial environment** • Total clearing: 40.1 ha • Clearing within Bush Forever and Regional Park: 30.9 ha • Probable TEC: no clearing and buffer provided • Regional Park: 39 ha will be excised • Mitigation: similar to Option 2.2 **Lake Richmond** • 350 m from canal development **Marine Environment** • As for Option 2.2 with the exception of direct seagrass loss which is reduced to 5.3 ha.

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1. INTRODUCTION

This document is a strategic environmental review (SER) for the Cape Peron Tourist Precinct Project to enable the Environmental Protection Authority (EPA) to give strategic advice under section 16(e) of the *Environmental Protection Act 1986* (EP Act). The EPA provides written and public advice to the Minister under this strategic assessment process. At this early stage, three concept options have been developed and addressed by this SER but these options do not constitute a formal proposal.

The three concept options, 2.2, 2.3 and 2.4 (described in Section 4.2.2) are being presented for review by the EPA in this SER. Option 2.3 and Option 2.4 are the preferred options.

1.1 PROJECT OVERVIEW

The Mangles Bay area of Cape Peron, Rockingham (approximately 47 km south of Perth), is the focus for the development of a marina-based tourist and residential precinct. The proposed development area is primarily immediately east of the Garden Island Causeway and is bounded by Hymus Street to the east and the proposed Garden Island Highway to the south (Figure 1). The precinct is up to 86 ha in area depending on the development option.

Mangles Bay

A number of previous proposals have been developed for the area that have included both sea-based marinas (i.e. built out into the bay) and land-based marinas (i.e. built into the land). The main components of each proposal have been:

- marina with permanent boat pens
- associated land development (e.g. residential, tourism and marine services)
- inclusion/retention of large areas of conservation and recreation areas
- rationalisation and/ or relocation (within Cape Peron) of some or all of the existing camp-sites.

Early projects were abandoned due to high costs and downturns in the real estate market. A proposal in 1992/3 involved about 30 ha of seagrass loss was found unacceptable by the EPA because of this loss and at that time seagrass rehabilitation was not a proven technology.

The Cape Peron Tourist Precinct Project Steering Committee has been established to oversee the progress of revised concept plans for the sustainable redevelopment of the area. Funding has been acquired from Commonwealth, State and Local Government for the development of the concept plans.

The concept is for a tourist based marina that is predominately land-based. The marina will accommodate more than 500 boats) and will incorporate the local Cruising Yacht Club of WA, Mangles Bay Fishing Club, commercial areas and pens for public use (both short and long-term). The surrounding land development will be 'mixed-use' including tourism, accommodation, commercial, public open space and residential areas. The project also aims to enhance the environmental and social values of the Cape Peron and Mangles Bay area outside of the immediate development area.

Figure 1 Location of the Cape Peron Tourist Precinct Project area

1.2 PROJECT STEERING COMMITTEE

The project is under the auspices of the Premier's Rockingham Planning and Development Taskforce and being managed by a Steering Committee chaired by the Mayor of the City of Rockingham.

The Steering Committee has been established to oversee the interests of the three tiers of government that have provided funding; Commonwealth, State and Local Governments. The Steering Committee comprises representatives from:

- City of Rockingham
- Department for Planning and Infrastructure (DPI)
- Department of Conservation and Land Management
- South West Corridor Development and Employment Foundation (SWCDEF)
- LandCorp
- Rockingham Development Office
- Peel Area Consultative Committee
- Royal Australian Navy
- Australian Department of Defence - Corporate Support Infrastructure Group.

Mr Simon Proud of the Rockingham Development Office has provided support to the Steering Committee and is the main contact for the project. His contact details are:

Mr Simon Proud
Rockingham Development Office
Suite 12, The Boardwalk
ROCKINHAM WA 6168
Telephone: (08) 9550-7201 Facsimile: (08) 9528-7288
Email: Simon.Proud@landcorp.com.au

A project team, comprising professionals from environmental, public consultation, planning, engineering and economic fields, was assembled to assist the proponent with the development of the concept options presented in this SER.

The Steering Committee's mandate is to develop a concept plan only at this stage. Should the State Government support the project proceeding further it is likely that LandCorp would become the proponent and undertake detailed planning, secure statutory approvals and undertake the development. Ongoing management of the precinct is likely to be undertaken by DPI or the City of Rockingham.

1.3 NEED FOR PROJECT

The need for boating and marine facilities in the south of Cockburn Sound has been identified in several tourism and recreational studies of the area (LandCorp 1998).

Cockburn Sound is an important destination for boating, providing a large area of protected water for yachting and powerboat use. Its shoreline currently supports both yacht and power boat clubs. The

existing 261 swing moorings on the southern shoreline provide little protection for vessels in winter storms which approach from the north west. Regular damage to vessels occurs during these storms, and provision of a marina would provide an alternative option for mooring of these vessels.

There is little opportunity for boat owners to secure mooring pen space within the vicinity of Rockingham and this problem will intensify as the population increases. Rockingham is one of the fastest growing areas in the south west corridor and levels of disposable income have increased with expanded employment opportunities and comparatively lower housing mortgage rates.

The projected population increase for the Cockburn, Kwinana and Rockingham areas between 1996 and 2011 is 77 800 from the 1996 level of 138 800, an increase of 56%. The primary source of demand for moorings in the proposed Mangles Bay marina will be from the localised Rockingham region and this demand will increase with population growth. The availability of pens will also allow current boat owners to upgrade beyond trailerable vessels. Boat owners from other areas of metropolitan Perth will add to the demand as mooring space in existing metropolitan clubs and marinas reach capacity. Room for expansion of existing facilities is limited, resulting in long waiting periods for pens.

1.3.1 Social and economic benefits of the project

Social benefits

- provision of a range of public recreation and tourist facilities to enhance Cape Peron as a destination for local and international visitors
- improved public access to Shoalwater Bay and Mangles Bay and pedestrian and cycle linkages between Rockingham Beach, Point Peron and Shoalwater Bay
- provision of a secure marina area specifically designed for commercial and recreational boating and yachting clubs
- increased management and regulation of boating activity with associated improvements in public safety
- increased management presence, lighting, traffic management and increased public use of Cape Peron will help discourage anti-social behaviour
- effective traffic management in the local area
- provision of low cost, family holiday accommodation for a wide cross section of the community.

Economic benefits

A detailed analysis of the economic impacts of the various options has not been undertaken. A simple comparison based on more detailed economic analyses undertaken for similar projects (eg Mandurah Ocean Marina) indicates the infrastructure expenditure and subsequent construction of this project will generate a significant economic impact in excess of $500 million. Approximately half of this figure is from indirect flow-on economic impacts. This includes both direct and indirect spending. Option 2.3 is likely to generate $560 million whereas Option 2.4 is likely to generate $515 million.

The development will have at least one boutique hotel/resort (maximum height; five storeys), likely to employ 50 to 100 full time equivalent positions. Overall the retail, tourist and commercial businesses are expected to create direct employment of 620 to 650 full time equivalent positions. The indirect job

creation in the surrounding areas during the operational phase of the project would be significant but is difficult to quantify.

The construction of the project would provide employment for at least ten years and would provide approximately 1500 jobs at its peak.

1.4 RELEVANT LEGISLATION

The project is being developed in accordance with the requirements of the EP Act and will take into consideration all applicable State legislation and regulations. Current State legislation applicable to the project includes the following:

- *Aboriginal Heritage Act 1972*
- *Building Regulations 1989*
- *Bush Fires Act 1954*
- *Conservation and Land Management Act 1984*
- *Environmental Protection Regulations 1987*
- *Health Act (and Regulations) 1911*
- *Heritage of Western Australia Act 1990*
- *Land Administration Act 1997*
- *Local Government Act 1995*
- *Wildlife Conservation Act 1950*
- *Metropolitan Region Town Planning Scheme Act 1959*
- *Town Planning and Development Act 1928*.

Relevant Western Australian policies and strategies

In addition to existing legislation, the following State Government agency strategies and policies are of relevance to the environmental assessment and management of this project:

- Western Australian State Sustainability Strategy 2003
- Conservation Policy for Western Australia 1997
- EPA Red Book recommendations for Conservation Reserves of Western Australia
- Bush Forever Protection Policy 2000
- Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (currently under review)
- Revised Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 2004 (currently in development)
- Environmental Protection Authority Position Statements
- Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment, Guidance Statement no. 29, 2004
- State Environmental (Cockburn Sound) Policy 2005

- DoE Environmental Management Plan for Cockburn Sound and its Catchment 2005
- Rockingham Lakes Regional Park Draft Management Plan 2003-2013.

Commonwealth legislation and policies

Commonwealth polices and legislation applicable to the project includes:

- *Aboriginal and Torres Straight Islander Heritage Protection Act 1984* (which operates concurrently with any existing State laws in so far as those laws would not be consistent with this Act)
- *Australian Heritage Commission Act 1975*
- *Native Title Act 1993*
- *Environment Protection and Biodiversity Conservation Act 1999*
- National Strategy for Ecologically Sustainable Development 1992
- Intergovernmental Agreement on the Environment 1992
- National Strategy for Conservation of Australia's Biological Diversity 1996.

1.5 PURPOSE AND SCOPE OF THIS DOCUMENT

The purpose of this document is to present a strategic level environmental review of the proposed Cape Peron Tourist Precinct Project based on the concept plans that have been developed for the project. The scope includes the direct project development area and the immediate surrounding environs (e.g. Cape Peron, Lake Richmond and Cockburn Sound) that may be affected by the project.

The SER also details the proposed mitigation that will be implemented within and around the Cape Peron and Lake Richmond area to mitigate (including offsets) any potential environmental and social impacts associated with the proposed development.

1.6 STRUCTURE OF THIS DOCUMENT

The SER document is structured as follows:

Introduction and background

- background of the project
- the need and social and economic benefits of the project
- relevant legislation, policies and strategies

Strategic Environmental Review process

- stakeholder consultation
- environmental review approach

Overview of existing environment

- social and biophysical environments

Description of project

- history of the project
- alternative sites and development concepts considered
- preferred development concept options

Environmental review of the project

- description of relevant factors
- identification of potential impacts
- consequences and management of potential environmental impacts

Mitigation measures

- Cape Peron and Lake Richmond rehabilitation and enhancement conceptual approach
- Recreational facilities and funds for management
- Mangles Bay seagrass rehabilitation conceptual approach

2. STRATEGIC ENVIRONMENTAL REVIEW PROCESS

2.1 SECTION 16(E) PROCESS

Under section 16(e) of the EP Act, the EPA may be requested by the Minister to advise on environmental protection aspects of a project. This process enables the EPA to evaluate whether a project has any 'fatal flaws' at an early stage in proposal development and to provide written and public advice. The EPA section 16(e) review is based on the evaluation of proponent submitted information.

Similar to other environmental reviews, the objectives of an SER are to:

- place the project in a local and regional environmental context
- describe all key components of the project
- provide the basis of the proponent's environmental management program, which shows that the environment impacts resulting from the project are likely to be able to be adequately managed
- communicate clearly with the public so that the EPA can obtain informed public comment to assist in providing advice to Government.

It should be noted that the project is not a strategic proposal as defined under section 37B of the EP Act.

2.2 REVIEW PROCESS

The Minister for the Environment initiated the SER process to review the development concept plan in May 2005. The EPA considered the section 16(e) strategic environmental review (SER) process appropriate to allow the EPA to provide advice on potential fatal flaws in the project at a relatively early stage. The SER process does not result in an environmental approval from the Minister for the Environment or otherwise for the project.

The EPA agreed to a section 16(e) process timeline with comprehensive and targeted consultation during the preparation of the SER. The timeline was extended to account for extra public consultation and development of options.

The EPA confirmed the scope of issues to be addressed in the SER at it's meeting of the 11 August 2005.

The Steering Committee, through the Premier's Rockingham Planning and Development Taskforce, will submit the concept plan, the SER and the EPA advice to Cabinet for consideration. A decision will then be made as to whether to progress the project to the next level of design and assessment. If the project proceeds to the next phase, it will develop and undergo a detailed environmental assessment pursuant to Part IV of the EP Act with detailed designs, investigations and consultation being undertaken. Town Planning Scheme and Metropolitan Regional Scheme amendments to enable the project to be implemented will also need to be considered by the EPA in accordance with the normal approval processes.

2.3 KEY ENVIRONMENTAL STUDIES

The following environmental studies as indicated in the agreed scope for the assessment addressed the key areas of interest at the strategic level:

- **Vegetation, flora and fauna studies:** to enhance the level of knowledge regarding biodiversity at a local scale within and surrounding the project area to enable an assessment of the likely impacts that development in this area will have on biodiversity values in a local and regional context.
- **Hydrodynamic and water quality assessment:** to investigate the potential impacts of the marina on water quality and flows in Mangles Bay and Cockburn Sound
- **Water exchange/flushing assessment**: to assess the residence time of water in the marina in a worst case scenario (autumn)
- **Hydrological studies of canal/groundwater interaction:** to investigate the potential impacts of the development on Lake Richmond resulting from the inland movement of the saltwater-freshwater interface and groundwater levels during dewatering.
- **Seagrass rehabilitation/ transplanting analysis:** to review previous seagrass rehabilitation work in Cockburn Sound to assess seagrass rehabilitation methodology and feasibility, and to identify areas in Cockburn Sound suitable for seagrass transplanting.
- **Traffic and transport studies:** to investigate local traffic impacts from the proposed development.

2.4 STAKEHOLDER CONSULTATION

Estill and Associates Pty Ltd was appointed to the project to provide community consultation services and to develop and implement a community consultation and communications strategy for the project. The consultation process commenced in April 2005 with the main focus being on active community engagement in the development of the project concept. Stakeholder input contributed to the development and assessment of the concept options and assisted the Project Team to identify the opportunities and, where possible, address community issues and community concerns.

2.4.1 Identification of stakeholders

Stakeholders were identified including Commonwealth and State Government agencies, non-government organisations (NGOs) and individual private citizens. Key agencies, NGOs and other stakeholder groups consulted included:

- Royal Australian Navy and Corporate Support Infrastructure Group (CSIG)
- Environmental Protection Authority Services Unit (EPASU)
- Department of Environment (DoE)
- Department of Conservation and Land Management (CALM)
- Cockburn Sound Management Council (CSMC)
- Department for Planning and Infrastructure and the WA Planning Commission
- LandCorp
- Public Transport Authority

- Main Roads WA
- Water Corporation
- City of Rockingham
- Naragebup Rockingham Regional Environment Centre
- Recreation camp lessees (e.g. RSL, Apex)
- Mangles Bay foreshore user groups (e.g. Mangles Bay Fishing Club)
- Aboriginal groups
- Local residents and interest groups
- Local business operators
- Local sport and recreation groups
- Boat owners and mooring owners
- Recreational beach users.

2.4.2 Objectives of consultation

Stakeholders were engaged during the preparation of the SER to ensure representative stakeholder input to the development of the concept plan (Figure 2). The main objectives of the consultation process were to:

- *encourage the involvement of all stakeholders*
- *promote open communication with clear and consistent messages*
- *provide participative mechanisms for stakeholder input*
- *provide accurate and timely information to stakeholders to ensure informed decisions*
- *consolidate representative stakeholder input in the development of a preferred and endorsed concept plan*.

2.4.3 Consultation program

In addition to meetings with key stakeholder groups (over 30 meetings), the following mechanisms were employed to engage stakeholders:

- **Public survey:** a telephone survey was conducted in June 2005 with Rockingham community members to obtain feedback regarding the project. A total of 100 random sample interviews were conducted with 71% of those surveyed either supporting or strongly supporting the concept providing identified concerns are satisfactorily addressed.
- **Public forums:** two public forums were held over two nights on 31 May 2005 and 1 June 2005 and were attended by approximately 350 people in total. Information was presented on constraints and opportunities (environmental, social and economic) for the project and included a presentation of the environmental issues. The evening also gave the public an opportunity to comment on their concerns, opportunities and preferred land uses within a marina development. Public comment forms were provided to encourage more comprehensive feedback (182 feedback forms were received) and attendees were asked to nominate for a stakeholder reference group.

- **Stakeholder reference group (SRG):** comprising over 40 members, the SRG met on four occasions to provide input into the concept plan development. SRG members also provided written submissions on environmental issues and other issues associated with the resulting concept plan. Members of the SRG were provided with feedback forms and were encouraged to distribute these among other interested community members to facilitate public submission. Sixteen feedback forms and a further 37 submissions were received during this process; responses to submissions are included in Appendix 1.
- **Public advertising and display of [previously] preferred option**: comprising a newspaper advertisement and a public display at the Rockingham City Shopping Centre on 27 August 2005. The public display then moved to the City of Rockingham for the next two weeks. Community members were encouraged to provide feedback on the then preferred option concept plan (Option 2.2). The displays and associated feedback period saw 790 surveys returned. There was an almost even split for those who supporting and opposing the Cape Peron development (48% in support and 49% in opposition 3 % undecided). The feedback received showed a high level of concern for the environment and this led to the development of Options 2.3 and 2.4 that both have a smaller environmental footprint.
- **Project website:** was maintained and regularly updated throughout the duration of the public consultation process. This website was hosted on the Rockingham Development Office website (www.rdo.wa.gov.au) and included a public feedback page.
- **Telephone information line:** A dedicated Information line was set up and managed by Estill and Associates to provide direct contact with project team personnel. This enabled stakeholders and members of the community to obtain further information and provide additional feedback, this telephone line was available throughout the consultation process. More than 300 community members contacted the Information line. Most callers requested information or were registering to attend Forums or as observers at SRG meetings.
- **Aboriginal representatives:** were contacted and invited to provide comment on the project. Representatives were also involved with ethnographic investigations to update and verify the earlier ethnographic findings on the area.

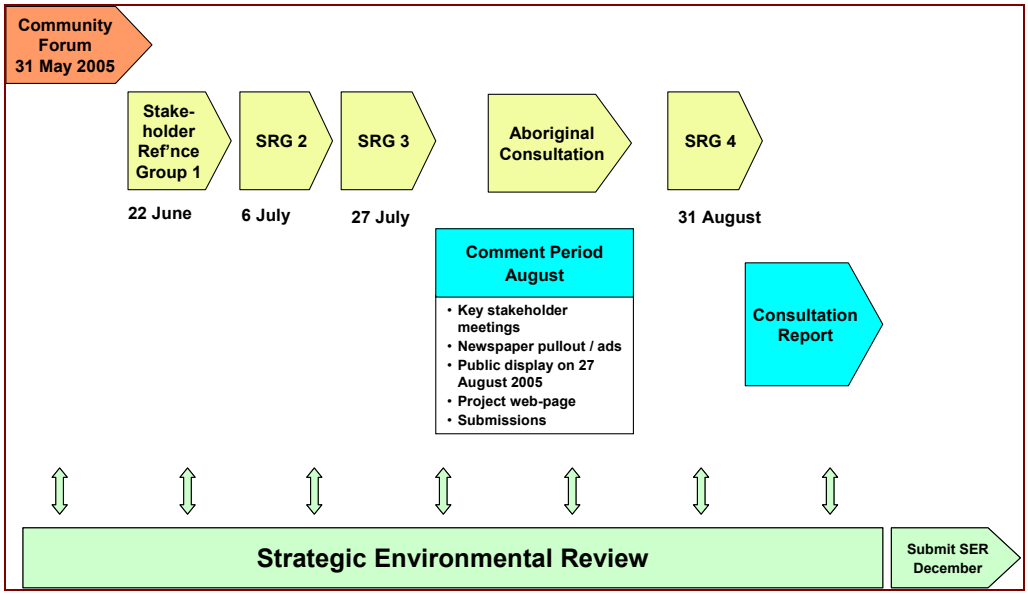


Figure 2 Stakeholder consultation process and timeline

2.4.4 Key environmental issues identified

A detailed description of the stakeholder consultation process and its outcomes is contained in Estill (2005).

The main environmental issues identified during the consultation process were:

- water quality in Mangles Bay
- seagrass protection
- preservation of the natural environment of Cape Peron and Lake Richmond
- Lake Richmond is considered by the local community to be a major environmental icon and any proposal must not have any adverse impacts on the lake.

Environmental issues raised by stakeholders during consultation sessions were recorded and responses to these issues were made (Table 1). Appendix 1 outlines proponent responses to written submissions received during the consultation process.

Table 1 Key environmental issues raised by stakeholders and proponent responses

Key environmental issues	Responses
Marine environment	
Mangles Bay water quality (including antifouling and boat fuel)	The dual entrance marina option is unlikely to adversely affect marine water quality in Mangles Bay. Opening of the causeway is expected to lead to an improvement locally in the water quality of Mangles Bay. Flushing modelling of the dual entrance marina indicates less potential for adverse impact on the water quality in Mangles Bay compared to the single entrance marina option. Addressed in Section 6.1.
Marina flushing	Flushing modelling of the dual entrance marina indicates the main body of the canals will be flushed in approximately two days and will flow mainly to the west of the causeway. This has less potential for adverse impact on water quality in Mangles Bay compared to the single entrance marina option and is not expected to adversely affect water quality. Addressed in Section 6.1.
Seagrass protection	An area of seagrass will be removed/ disturbed for the construction of the development, facilities, however the loss will be offset through the planting/ rehabilitation of seagrass meadows within Mangles Bay on a greater than 1:1 basis. Addressed in Section 8.
Regional fishing impacts and overfishing	The development may lead to an increase in fishing pressure in the local area, however the overall effect of fishing pressure at a regional scale is less certain. The development does provide an opportunity to increase fishing awareness through education. Addressed in Section 6.2.4
Fauna habitat	Within Mangles Bay, the value of marine fauna habitat is based on the presence of seagrass meadows; the development is not expected to have a significant impact in the longer term as all seagrass loss will be offset through replanting degraded areas. Addressed in Section 6.2.4
Coastal processes (e.g. water flow and siltation)	The development will not result in any additional impacts due to interruption of longshore sediment movement, but will provide a benefit in the form of a long-term solution to the accretion and erosion problems caused by the Cape Peron boat ramp and Causeway. Addressed in Section 6.2.4

Key environmental issues	Responses
Terrestrial environment	
Bushland preservation	The development will require the removal of remnant vegetation with some areas of remnant vegetation being retained within the development. Some of this vegetation is of conservation significance and there is a probable Threatened Ecological Community within the vicinity of the development. Addressed in Section 5.1. The proposed mitigation package will positively contribute to enhancing the ecological values of the vegetation in and around Cape Peron and Lake Richmond and may involve the transfer of another area of remnant vegetation to the CALM managed conservation estate. Addressed in Section 8.
Fauna habitat	The development will result in the removal of remnant vegetation that may provide habitat for fauna. Addressed in Section 5.2. The proposed mitigation package will positively contribute to enhancing the fauna habitat in and around Cape Peron and Lake Richmond and may involve the transfer of an area of remnant vegetation to the CALM managed conservation estate. Addressed in Section 8.
Maintaining naturalness of Cape Peron	The development has been designed with consideration of the surrounding landscape to ensure the design is sympathetic and/or complimentary to the local landscape character to reduce adverse visual impacts. See also responses above for 'bushland preservation' and 'fauna habitat'.
Protection and preservation of Lake Richmond	The development is not expected to have any adverse impacts on Lake Richmond's terrestrial and aquatic environments. Addressed in Section 5.5. The proposed mitigation package will positively contribute to enhancing the ecological values of Lake Richmond and the linkage between the lake and Point Peron. Addressed in Section 8.
Rehabilitation and management of Cape Peron area	The proposed mitigation package will positively contribute to enhancing the ecological values of the natural environment in and around Cape Peron and Lake Richmond. Addressed in Section 8.
Social environment (where these may be applicable to environmental issues)	
Traffic management (land and water)	The development will increase traffic flow on the main local thoroughfare roads within the vicinity of the development. This increase will be within the current capacity of these existing roads and roads within the development will be designed to safely carry predicted traffic flows. Installation of pedestrian crossing facilities will also reduce risk to the public. Addressed in Section 7.2. The development will increase boating traffic in Mangles Bay but provides an opportunity for the better boating management through provision of refuelling and sullage facilities, properly marked access channels and boating education. Addressed in Section 6.2.4.
Public accessibility to marina and beach frontage	The development will improve public access to the Mangles Bay foreshore, providing access and amenities similar to those already existing along the Rockingham Beach foreshore. Most areas of the marina facility will be open to public access and will also encourage public access and use and facilities. Addressed in Section 4.
Access and safety	See responses above for 'traffic management' and 'public accessibility to marina and beach frontage'.

Key environmental issues	Responses
Existing social uses	Existing social uses of Cape Peron are varied in location and activity. Social uses of Cape Peron outside of the development area will not be adversely affected and the proposed mitigation package will enhance the opportunities for various social uses. Addressed in Section 8. Most existing social facilities within the development area (e.g. Yacht club) will be accommodated within the development with improved facilities. Addressed in Section 4. Some existing social uses of the Mangles Bay foreshore may be precluded during construction activities however, in most instances, there will be no restriction in the resumption of these uses subsequent to construction. Addressed in Section 5.4.

2.5 ENVIRONMENTAL REVIEW APPROACH

2.5.1 Scoping of relevant factors

The scoping process involved preliminary identification of environmental aspects and associated key environmental issues and factors for the concept Options 2.2, 2.3 and 2.4. The scoping process utilised EPA guidelines and stakeholder consultation to confirm factors and those key aspects that affect environmental factors.

2.5.2 Key environmental factors addressed

The following key environmental factors relevant to this project were identified through the process described above as requiring detailed assessment in the SER:

1. **Terrestrial environment**
   - flora and vegetation
   - fauna
   - Bush Forever Protection Area
   - Rockingham Lakes Regional Park
   - Lake Richmond
2. **Marine environment**
   - water quality
   - ecosystems (e.g. seagrass, fish, ecological function, Shoalwater Islands Marine Park)
   - boat traffic
3. **Social surrounds**
   - cultural heritage (Aboriginal and European)
   - traffic.

These factors have been addressed in detail in Sections 5, 6 and 7 respectively.

3. OVERVIEW OF EXISTING ENVIRONMENT

3.1 SOCIAL ENVIRONMENT

3.1.1 City of Rockingham

The project area is within the City of Rockingham (proclaimed a city in 1988), which has a population of almost 85 000. Historically, Rockingham was a seaside holiday town, however it is now one of fastest growing cities in Western Australia with an annual population growth rate of approximately 6.9%. Rockingham has undergone significant development, with increased industry, large residential developments (e.g. Port Kennedy and Secret Harbour) and redevelopment of the old Rockingham town centre foreshore and surrounds and the Rockingham City centre. Rockingham is also one of the most popular coastal destinations south of Perth.

The Royal Australian Navy has a strong presence in the area, with its base on Garden Island and a significant amount of residential requirement being filled in and around Rockingham.

Main industries and employment sectors in the City of Rockingham include:

- defence (Navy)
- heavy industry (Kwinana Industrial Area)
- light general industry (including boat building, structural engineering, ceramics)
- commercial fishing (crayfish, fish, mussels)
- land-based agriculture, horticulture, viticulture, market gardens, forestry
- grain export
- building and construction
- entertainment and leisure
- retail and commerce
- marine ecotourism.

3.1.2 Land tenure and zoning

The main project area is currently vested in the Recreation Camps and Reserve Board and managed by the Department of Conservation and Land Management (CALM). This Board is soon to be dissolved and the land is in the process of being transferred to the Conservation Commission of Western Australia and will continue to be managed by CALM.

The area to the south of Point Peron Road is zoned as 'Parks and Recreation' and the area to the north of Point Peron Road, along the Mangles Bay foreshore, is reserved 'Port Installations' under the Metropolitan Region Scheme. There are other small areas within the project area that are reserved for parking, drainage, special use (e.g. wastewater treatment plant) and the future road connection to the Garden Island Causeway. The land tenure is described fully in TBB (2005).

3.1.3 Conservation areas

Bush Forever

All land within the project area south of Point Peron Road is within Bush Forever Protection Area (BFPA) 355 (Government of Western Australia 2000). The purpose of the BFPA is to protect regionally significant vegetation within the site. Lake Richmond, which is located to the south east of the project area, is also a Bush Forever site (BFPA 358). Sections 5.3 and 5.5 contain more detailed description of BFPA 355 and BFPA 358 respectively.

Regional Park

In 1997, the State Government announced that Rockingham Lakes would be established as a regional park. Cape Peron and Lake Richmond are within the boundaries of the Rockingham Lakes Regional Park (the Park).

Regional parks are areas of regional open space that have been identified through planning processes as having regionally significant conservation, landscape and recreation values (CALM 2003). The Park is one of eight regional parks in the Perth metropolitan area.

The Park covers an area of 4 270 hectares (ha), which consists of coastal areas, wetlands, remnant bushland areas, private leases and recreation areas. The Park is valued for its natural environment, recreation, cultural heritage, landscape, and research and education values. The *Rockingham Lakes Regional Park Draft Management Plan* provides a broad direction for the protection and enhancement of these values (CALM 2003). Section 5.4 contains a more detailed description of the Park.

3.1.4 Land use

The Cape Peron area is the focus for the pursuit of many recreational activities, including:

- **Water based activities:** boating, swimming, snorkelling, fishing and crabbing.
- **Land based activities:** walking, scenic driving, enjoying the scenery (lookout) and nature appreciation and study. These activities are restricted (for the general public) by limited public access and facilities.

Recreation camp at Cape Peron

Most of the Mangles Bay foreshore and some of the Shoalwater Bay foreshore are designated dog beaches. An area directly to the east of the Garden Island Causeway is designated a power water craft and water ski area.

Visitor facilities on Cape Peron include numerous recreation camps located on CALM managed land. CALM currently manages ten recreation camp leases, leased to private groups, which are mainly located to the west of Memorial Drive along the Shoalwater Bay foreshore.

CALM also manages one educational camp lease (leased by the Department of Education), which is located to the west of the Garden Island Causeway (Section 3.1.2).

To the north of Point Peron Road along the Mangles Bay foreshore is a yacht club, fishing club and several other private holiday camps. Other visitor facilities on Cape Peron include day-use carparks, for accessing beaches and lookouts, and a public boat ramp directly to the west of the Garden Island Causeway.

The Naragebup Rockingham Regional Environment Centre is located on the southwest corner of the Memorial Drive / Safety Bay Road intersection, opposite Lake Richmond. The centre is a community run non-profit organisation that is actively involved in conservation activities in the Rockingham area and also provides a role in environmental education.

The Water Corporation Point Peron Wastewater Treatment Plant is located to the west of the Garden Island Causeway and a Water Corporation drain dissects the landscape from Lake Richmond to Mangles Bay.

Residential areas are located to the east and south of the project area.

3.1.5 Aboriginal heritage

The Rockingham area has significance to Aboriginal people although there is little documented information available about their association and use of the area. Traditional Aboriginal family groups would have traversed the area seasonally utilising areas such as Lake Richmond for food gathering and camping.

Two listed Aboriginal heritage sites lie partly within the project area; Cockburn Sound (site no. S02169) and parts of the foreshore that encompasses Rotary Park (site no. S02625). Both these sites are of mythological significance being part of Dreaming stories; the Waugal created the water bodies (e.g. Lake Richmond and Rotary Park pond) and other topographic features (e.g. dunal depressions) through its movement across the land and water.

Recent consultation with the local Aboriginal community identified several additional sites on Cape Peron of significance to the local Aboriginal community, including a meeting/ learning place, burial area, ceremonial/ dancing area and a former holiday camp for Sister Kate's orphanage.

Section 7.1 contains a more detailed description of the Aboriginal heritage values associated with the project area.

3.1.6 European heritage

The first European exploration of the Rockingham area occurred in the early 1800's by French explorer Commodore Nicolas Baudin. Baudin named several features along the coast including Cape Peron. Farmers first settled the eastern parts of Rockingham in the 1830's and a port was established to the east of Mangles Bay for the shipment of timber in the 1870's. However, the port ceased to exist in the early 1900's due to the appeal of Bunbury port.

HMAS Stirling Naval Base was commissioned on Garden Island in 1978 (Royal Australian Navy 2000) and gun emplacements built on Cape Peron in 1942. The Cape Peron Battery Complex is now listed on the Rockingham Municipal Heritage Inventory and the Register of the National Estate.

Other buildings that are listed on the State heritage database and the Rockingham Municipal Heritage Inventory within the Cape Peron area include:

- The Cape Peron Recreation Camp buildings: located to the west of the Garden Island Causeway and currently leased to the Education Department. These buildings were constructed in 1942 for use as military barracks.
- The 'Turtle Factory' building: constructed in 1923 initially to farm turtles for food production. This venture was unsuccessful and the building was later used to operate a boarding facility and then used by the Sisters of Notre Dame des Missions as a convent school (City of Rockingham 2004). The building is located on the Mangles Bay foreshore and is now used by the Cruising Yacht Club.

3.2 TERRESTRIAL ENVIRONMENT

The terrestrial component of the project area includes areas of upland coastal vegetation communities on Quindalup Dunes interspersed with cleared land associated with roads and informal tracks over the low lying dunes between the headland of Point Peron to the west and Lake Richmond to the south east.

Headland environment at Cape Peron

3.2.1 Geology

Cape Peron is a cuspate (sharp headland with adjacent smooth shoreline) foreland, formed where sand has been trapped and deposited in the lee of offshore islands including Garden Island. Cape Peron was once an island that became connected to the mainland as sand accumulated.

The site is underlain by approximately 30 m of superficial formations, comprising Safety Bay Sands and Tamala Limestone. These formations are in turn underlain by an approximately 100 m thick sequence of Rockingham Sand (WorleyParsons 2005a).

The Safety Bay Sand formation which blankets the surface of the Cape Peron project area overlies Tamala Limestone, which consists of cream, unlithified, calcareous fine-grained to medium-grained quartz sand and shell fragments.

The Tamala Limestone unit is a calcareous eolianite (rock formed by cementation of calcareous dune sands) that unconformably overlies the deeper Rockingham Sand formation. It contains various proportions of quartz sand, fine-grained to medium-grained shell fragments and minor clay lenses. The limestone typically exhibits secondary porosity in the form of numerous solution voids, channels and cavities. The average base elevation of the Tamala Limestone in the project area is estimated to be -30 m AHD (Department of Environment 2004).

The Rockingham Sand formation occupies what is thought to be a palaeo-channel (erosional channel) incised into the bedrock Cretaceous sediments, which extend offshore from Rockingham to beneath the southern end of Garden Island. The unit comprises mainly slightly silty, medium-grained to coarse-grained sand of shallow marine origin. The maximum thickness of the Rockingham Sand is approximately 110 m at the southern end of Cockburn Sound in the Rockingham area.

3.2.2 Hydrogeology

Groundwater occurs in two main aquifer systems at the Cape Peron project area:

- superficial aquifer: collectively made up of the Safety Bay Sands and Tamala Limestone
- underlying Rockingham aquifer: made up of the Rockingham Sand formation.

Groundwater in the superficial aquifer (top 30 m of profile) generally flows in a westerly direction. As this aquifer is the surface aquifer and is relatively shallow, flows tend to discharge to the near shore marine environment along the coastline.

The flow in the underlying Rockingham aquifer is generally in a westerly direction and discharges freshwater into the ocean well below sea level. The aquifer extends to a depth of about -65m AHD, and the top 40 m contains groundwater of salinity less than 1000 mg/L (Smith & Hick 2001).

3.2.3 Flora and fauna

The vegetation of the project area consists mostly of coastal shrublands dominated by common species of coastal areas on the Swan Coastal Plain over a series of low lying dunes between the rocky headland of Point Peron and Lake Richmond (Keating & Trudgen 1986). There are no wetland vegetation communities within the project area; Lake Richmond is to the south east of the project area.

The species composition of the vegetation varies from one place to another due to edaphic and topographical factors and the amount of shelter from the salt laden winds. There are three main vegetation groups, related to geology:

- shoreline
- fore dune
- stable dune.

The project area is expected to support species of most faunal groups, however the area is not likely to be rich in fauna because it is substantially degraded and provides a limited range of habitats. As the project area is an isolated patch of coastal and near-coastal habitat it is likely to support a suite of fauna not likely to be present in surrounding suburbs. Sections 5.1 and 5.2 contain more detailed descriptions of the flora and fauna of the project area and surrounds.

3.2.4 Lake Richmond

Lake Richmond is located to the south east of the project area and is separated from the project area by Safety Bay Road.

Lake Richmond is a perennial freshwater lake covering approximately 40 ha that is about one metre above sea level and is up to 15 m deep (CALM 2003). In the 1960's, stormwater drains were installed that discharged into Lake Richmond, resulting in a decrease in the lake's salinity concentrations. Currently, there are three main drains into Lake Richmond and one outlet that discharges to Mangles Bay (this drain traverses the project area).

Lake Richmond is significant as habitat for the critically endangered threatened ecological community (TEC) of thrombolites, which is protected under the Commonwealth *Environment Protection and*

Biodiversity Conservation Act 1999 (EPBC Act). Lake Richmond is further described in Section 5.4.1.

3.3 MARINE ENVIRONMENT

The Cape Peron headland extends westward into the Indian Ocean and defines the southern extent of Cockburn Sound. The Mangles Bay foreshore (within Cockburn Sound) forms most of the northern shoreline of the Cape and the Shoalwater Bay foreshore forms most of the southern shoreline of the Cape (Figure 1).

The Cape Peron shoreline consists of sandy beaches and limestone rocky shores and headlands and the seabed consists of extensive sandy areas and limestone reefs.

Rocky limestone shores of Cape Peron

3.3.1 Cockburn Sound

Cockburn Sound is the most intensively used marine embayment in Western Australia. Historically it has suffered poor water quality and contaminated sediment due to industrial discharge, but with increasing improvements to industrial practice in the region, discharge of contaminants has decreased substantially. Subsequently, water quality has improved considerably since the 1970's but still remains the focus of current management attention. Marine water quality is further described in Section 6.1.

3.3.2 Mangles Bay

Mangles Bay is sheltered by the Garden Island Causeway and Cape Peron, and is therefore relatively calm and poorly 'flushed' by marine waters under most circumstances. Natural patterns of sediment movement have been disrupted by the Causeway and the Cape Peron boat ramp, which has resulted in sediment accumulation and erosion problems along the Mangles Bay foreshore. Shoreline processes are further described in Section 6.2.

3.3.3 Marine biota

Seagrasses

The shallow sheltered waters of Cockburn Sound (and Mangles Bay) support extensive seagrass meadows. Widespread loss of seagrass on the eastern margin of the Sound occurred during the 1970's; the loss attributed to shading caused by nutrient-stimulated growth of epiphytes (algae that grow on seagrass leaves) and phytoplankton (microscopic algae in the water).

The seagrass meadows in Mangles Bay show evidence of nutrient enrichment in the form of heavy epiphyte loads in summer and some areas of seagrass are partially exposed at low tide and experience desiccation and heat stress. The seagrass meadows are also damaged by numerous mooring scars.

Marine fauna

Cockburn Sound supports a wide range of fauna and has significant fauna values because of its utilisation by dolphins, a large range of seabirds, protected migratory birds, and Little Penguins. The whole of Cockburn Sound is considered significant as a fish nursery/habitat. About 130 species of fish and 14 large crustacean and mollusc species are estimated to exist in Cockburn Sound, and the Sound is a significant fisheries resource.

Although the seagrass meadows that Mangles Bay supports are degraded, the shallow, sheltered, slightly nutrient-enriched waters of Mangles Bay are also recognised as an important fish nursery habitat.

The marine biota of Cockburn Sound (and Mangles Bay) is further described in Section 6.2

3.3.4 Shoalwater Islands Marine Park

The Shoalwater Islands Marine Park comprises the chain of islands that run parallel to the coastline between Cape Peron and Becher Point to the south. The Marine Park borders Mangles Bay at the Garden Island Causeway and contains the waters of Shoalwater Bay, Warnbro Sound and a part of Cockburn Sound off Cape Peron.

The islands are important for a diversity of wildlife, particularly the Little Penguin, other sea birds and the Australian Sea-lion. The islands also make a significant contribution to the conservation value of Western Australia's islands estate.

Little Penguin

4. PROJECT DESCRIPTION

4.1 HISTORY OF MARINA PROPOSALS

Redevelopment of the Mangles Bay area of Cape Peron has been the subject of several marina-type proposals since the early 1970's. A summary of these proposals is provided below:

- 1971: The Fremantle Port Authority adopted a plan for the development of a container port in Mangles Bay.
- 1975: The Metropolitan Region Scheme was amended to provide for connection of the site to the regional road and rail network.
- 1982: A Cabinet Sub-Committee and Departmental Technical Committee was established to review the Mangles Bay site and compare it with other sites.
- 1984: The proposed container port facility for the area was rejected on the basis that Catherine Point and North Mole would be more suitable and cheaper alternative sites for a port.
- 1985: The John Holland Group put forward a proposal for a small marina built out into Mangles Bay, which was found to be environmentally acceptable. The proposal was never pursued due to the downturn in the real estate market.
- 1992: The Department of Marine and Harbours proposed a 500 pen marine-based marina built out into Mangles Bay close to the Garden Island causeway. The proposal was formally assessed by the EPA at the level of a Public Environmental Review. The subsequent EPA report and recommendations, Bulletin 693, recommended against the proposal primarily due to seagrass loss. At this time, seagrass rehabilitation was not considered possible.
- 1998: Following a request by Cabinet in May 1997, the Mangles Bay Boat Harbour Steering Committee developed a concept plan for the development of an inland marina in Mangles Bay. The concept plan was never formally assessed but advice from the EPA indicated that the proposal would not be acceptable due to seagrass loss. Rehabilitation of seagrass was not considered reliable at the time.
- Early 2005 (current project): The Cape Peron Tourist Precinct Steering Committee commenced a feasibility study to consider the possible redevelopment of the Mangles Bay area of Cape Peron to include a marina facility.

4.2 SITE AND DEVELOPMENT CONCEPT OPTION ASSESSMENT

Sustainability objectives and associated criterion were established for a triple bottom line approach to the development of project (Table 2).

The proposed development concept options were developed with consideration for mitigating or offsetting negative impacts and enhancing the positive impacts with the aim of achieving a sustainable outcome with a net benefit for each of the social, environmental and economic objectives.

Table 2 Project objectives and criteria

Objective	Detailed criterion
SOCIAL	
Realises the shared vision and reflects local heritage, culture and sense of place	Manages competing or potentially conflicting land uses to ensure a safe community environment
	Preserves Aboriginal heritage
	Respects local heritage and history
	Provides for improved boating and marine activities in the long term
	Uses public art and historic references to create a strong sense of place
	Provides a complementary mix of marine and dry land facilities and uses
Creates an integrated solution offering sound community access to the wider area as a regional asset	Attracts people to the area
	Improves public linkages to the area
	Offers improved regional and local traffic flows
	Provides for disabled access to all facilities and marine based activities
	Provides a range of tourist accommodation including affordable holiday options and activities
	Offers a place for everybody
	Involves and promotes the Navy as a platform for community development
	Strengthens and reinforces the existing maritime theme
	Provides a family friendly development concept
	Ensures the activation of street frontages
	Provides public and pedestrian friendly access to all waterways and features
	Maintains or improves existing marine facilities including boat ramps
Creates a world class community asset that is different from all others	Offers clear points of difference from a land use and develop potential perspective
	Provides training, personal and professional development opportunities
	Provides a built form that is suitable for accommodating long and short term community needs
	Offers a visually pleasing and unique location
Responds to community values and promotes a sense of ownership amongst all stakeholders	Enjoys community ownership of the concept
	Provides high quality public spaces including streets, boardwalks, squares and marine facilities
	Promotes a sense of belonging that reflects community values
	Offers a mix of recreational opportunities for all age groups
ENVIRONMENT	
Contributes positively to the natural terrestrial environment	Offers outcomes that are consistent with CALM's regional park management strategies
	Addresses the environmental policies, plans and values of the area
	Provides for sound water management including inland waterways
	Retains and protects local flora and fauna
	Ensure sound recreation and environmental management
Contributes positively to the marine environment	Provides better offshore boating management
	Addresses the environmental policies, plans and value of the area
	Provides for a mix of boats and boating facilities
	Ensures the long term viability of Mangles Bay seagrass
	Provides improved conditions for the growth of marine life
	Re-nourishes and enhances existing beaches
ECONOMIC	
Increased activity, visitation and commercial activation	Satisfying unmet demand and economic growth opportunities
	Increasing visitation and activation of the area by tourists and tourist operators (commercial)
	Complementing existing and planned commercial centres accentuate points of difference
Commercial opportunities and impacts	Dive wrecks use and develop potential of marine resource
	Actively seeking new and innovative commercial outcomes as a centre of excellence
	Protected environment for boating and marine activities
	Connect to Wanliss St development by extending the Rockingham Transit System to Cape Peron
Creation of sustainable employment opportunities	Boat chartering
	Capitalise on passing traffic e.g. navy
	Marine related events boat shows, eco tourism
	beads on a string cafes shops and small business
	Compatible marine industry opportunities
Financial viability of the project	Centre of excellence for job creation and training
	Active working small harbour comprehensive mixed used
	Feasibility
	Linking of traditional foreshore development

Objective	Detailed criterion
	Proving local employment and community development opportunities
	Development helping to fund long term infrastructure requirements
	Financial break even for initial project
	No ongoing impost on ratepayers

4.2.1 Site history

In the initial consultation for this project, the community expressed interest in the evaluation of other potential sites for the marina development. Wanliss Street was identified by the community as a desirable alternative site. In response to this concern, a review of the benefits and constraints of Mangles Bay and other potential sites along the City of Rockingham coastline was conducted (ed. NS Projects 2005). The coastline was segmented into a series of defined sections for the purpose of the review (Figure 3):

- Coastline section 1: City of Rockingham southern boundary to start of Rockingham Lakes Regional Park boundary
- Coastline section 2: southern boundary of Rockingham Lakes Regional Park boundary to north of Becher Point
- Coastline section 3: Becher Point north to start of coastal development
- Coastline section 4: Safety Bay
- Coastline section 5: Shoalwater Bay Marine Park
- Coastline section 6: Mangles Bay
- Coastline section 7: Mangles Bay to CBH grain terminal (including Wanliss Street)
- Coastline section 7.1: Wanliss Street
- Coastline section 8: CBH grain terminal to Woodman Point

The constraints and opportunities for each coastline section were compared having regard to the project objectives (Table 2) to determine the potential for a marina-based development site.

In summary, the review identified some potential locations where a marina-based development of some type could be considered in the future.

The review concluded that for a marina-based development, Mangles Bay presents the least constraints and most opportunities when compared with the other sections of the coastline in the City of Rockingham.

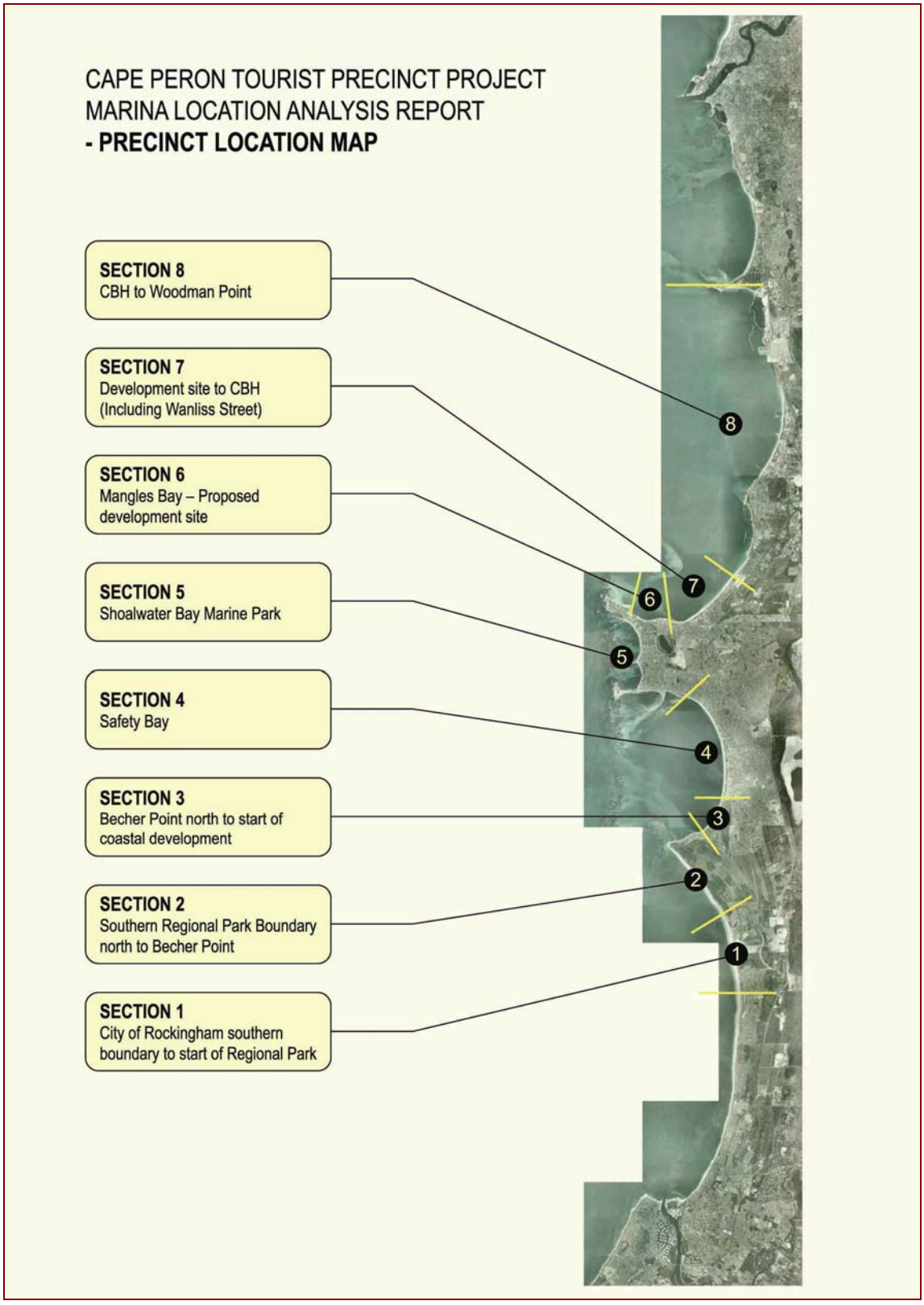


Figure 3 Coastline sections in the City of Rockingham assessed for a marina-based development

4.2.2 Comparison of Cape Peron development concept options

Five development concept options were designed (Figure 4 to Figure 8) in consultation with key stakeholders and the community and with consideration of the social, environmental and economic objectives developed for the project (Table 2). The initial Options 1.1 and 2.0 are described below for comparison but have been discarded as they would most likely not meet the environmental objectives for the project.

The proposed development concept options were developed with consideration for minimising potential negative environmental impacts. This resulted in the development of Option 2.2 to minimise seagrass loss and then the development of Option 2.3 and 2.4 to minimise terrestrial impacts.

Options, 2.2, 2.3 and 2.4 are addressed in detail in this SER for consideration by the EPA. The latter two options are preferred by the Steering Committee.

The key environmental characteristics and considerations of each option are summarised below.

Option 1.1

Development concept Option 1.1 presents a one entrance marina (Figure 4). This option would result in:

- clearing/disturbance of:
  - approximately 8.2 ha of seagrass (direct loss)
  - approximately 48.5 ha of vegetation within BFPA 355
  - a probable TEC
- canal development 150 m from Lake Richmond
- 16.3 ha of internal open waters with capacity for approximately 450 boats
- no change to the alignment and/or design of the Garden Island Causeway.

Three dimensional numerical modelling of the flushing potential of this option indicated that the 'flushing time' of the main area of the marina water body is approximately 6 days (flushing time is defined in engineering terms, and means that the concentration of the dye is below 37% within the 6 days). The water flushed from the marina flows into Mangles Bay and may cause some localised adverse water quality impacts.

Due to the potential negative contribution to water quality issues in Mangles Bay and proximity to Lake Richmond, the one entrance marina was viewed as inferior to the two entrance marina options (see below). This option also offered a limited social benefit as much of the marina would need to be privatised to cater for clubs and commercial boating areas. Therefore, this design was not considered acceptable and was rejected.

Option 2.0

To overcome the potential water quality issues identified for Option 1.1 and to improve the social benefits of the project, a two entrance marina was investigated (Figure 5). Development concept Option 2.0 would result in:

- clearing/disturbance of:
  - approximately 9.9 ha of seagrass (direct loss)
  - approximately 48.1 ha of terrestrial vegetation within BFPA 355
  - a probable TEC
- canal development 150 m from Lake Richmond
- 21.7 ha of internal open waters accommodating approximately 510 boats
- one fully public marina area with full public access around its boundaries and a second marina area near the western entrance that would cater for clubs and commercial uses with the required secure facilities
- realignment and redesign of the Garden Island Causeway to facilitate improved flushing in Mangles Bay.

Although the two entrance marina option would provide positive water quality outcomes in Mangles Bay, the extent of seagrass loss was considered excessive and the buffer to lake Richmond was inadequate. Therefore, this design was not considered acceptable and was rejected.

Option 2.2

Development concept Option 2.2 was developed to reduce seagrass loss with the additional benefit of an increased separation from Lake Richmond and a reduction in terrestrial vegetation clearing requirements (Figure 6). This option is based on the dual entrance marina concept presented in Option 2.0 and would result in:

- clearing/disturbance of:
  - approximately 5.9 ha of seagrass (direct loss)
  - approximately 43.9 ha of terrestrial vegetation within BFPA 355
  - a probable TEC
- canal development 200 m from Lake Richmond
- 22.5 ha of internal open waters accommodating approximately 560 boats
- one fully public marina area with full public access around its boundaries and a second marina area near the western entrance that would cater for clubs and commercial uses with the required secure facilities
- realignment and redesign of the Garden Island Causeway to facilitate improved flushing in Mangles Bay.

With this option, the 'flushing time' of the main area of the marina water body is approximately 2 days, which means it would have better water quality than Option 1.1. The water flushed from the marina also tends to flow mainly to the west of the causeway during autumn, with less potential for impact on

the water quality in Mangles Bay than Option 1.1. Nonetheless, this option was of concern to some stakeholders because of the extent of the land footprint.

Compared to Options 1.1 and 2.0, this option:

- reduces area of seagrass clearing/disturbance
- reduces terrestrial vegetation clearing requirements
- improves marina flushing and water quality in Mangles Bay
- increases the distance between the development and Lake Richmond.

Option 2.3

Development concept Option 2.3 (Figure 7) was developed as a refinement of Option 2.2 in response to community concern about the extent of the development footprint and the identification of a potential TEC (Section 5.1.1) in the development footprint of Option 2.2. This option would result in:

- clearing/disturbance of:
    - approximately 5.9 ha of seagrass (direct loss)
    - approximately 36.3 ha of terrestrial vegetation within BFPA 355
- canal development 330 m from Lake Richmond
- 19.7 ha of internal open waters accommodating approximately 520 boats
- one fully public marina area with full public access around its boundaries and a second marina area near the western entrance that would cater for clubs and commercial uses with the required secure facilities
- realignment and redesign of the Garden Island Causeway to facilitate improved flushing in Mangles Bay.

Compared to Option 2.2, this option:

- reduces terrestrial vegetation clearing requirements by 7.6 ha, including retaining almost all of the probable TEC
- includes an additional chalet park (affordable family holiday accommodation) on the Mangles Bay foreshore
- increases the distance between the canal development and Lake Richmond by 65% from 200 m to 330 m.

Option 2.4

Development concept Option 2.4 (Figure 8) was developed to further explore reduction of the development footprint and enhance the protection of the probable TEC. This option would result in:

- clearing/ disturbance of:
    - approximately 5.3 ha of seagrass (direct loss)
    - approximately 30.9 ha of terrestrial vegetation within BFPA 355
- 20.2 ha of internal open waters for approximately 520 boats

- one fully public marina area with full public access around the boundaries and a second area near the western entrance that would cater for clubs and commercial uses with the required secure facilities
- realignment and redesign of the Garden Island Causeway to facilitate improved flushing in Mangles Bay
- canal development 350 m from Lake Richmond.

Compared to Option 2.2, this option:

- increases the distance between the development and Lake Richmond by 75% to 350 m
- reduces terrestrial vegetation clearing requirements by 13 ha
- reduces seagrass loss by 0.6 ha
- retains all of the probable TEC, including an adequate buffer
- includes chalet park (affordable accommodation) on the Mangles Bay foreshore.

Option 2.4 also recognised that a chalet park, if developed in a sustainable way, may be consistent with the objectives of a Regional Park. In Option 2.4, the development of the chalet park with affordable family holiday accommodation adjoining the southern boundary of the project area is left as an optional development but would only be developed subject to a separate approval and discussions with CALM and other relevant stakeholders. For this option, this area would remain as is within the Regional Park. If developed at some future time it is likely that native vegetation would be retained within the chalet park.

Assessment of viable development options

An assessment of development Options 2.2, 2.3 and 2.4, as well as the 'do nothing' scenario, was undertaken, assessing each option against the sustainability criteria (Table 2). The 'do nothing' scenario is included for comparison purposes only. The assessment took into consideration the mitigation and offsetting of potential environmental impacts of the proposed development (Section 8). The results of the environmental assessment are contained in Table 3.

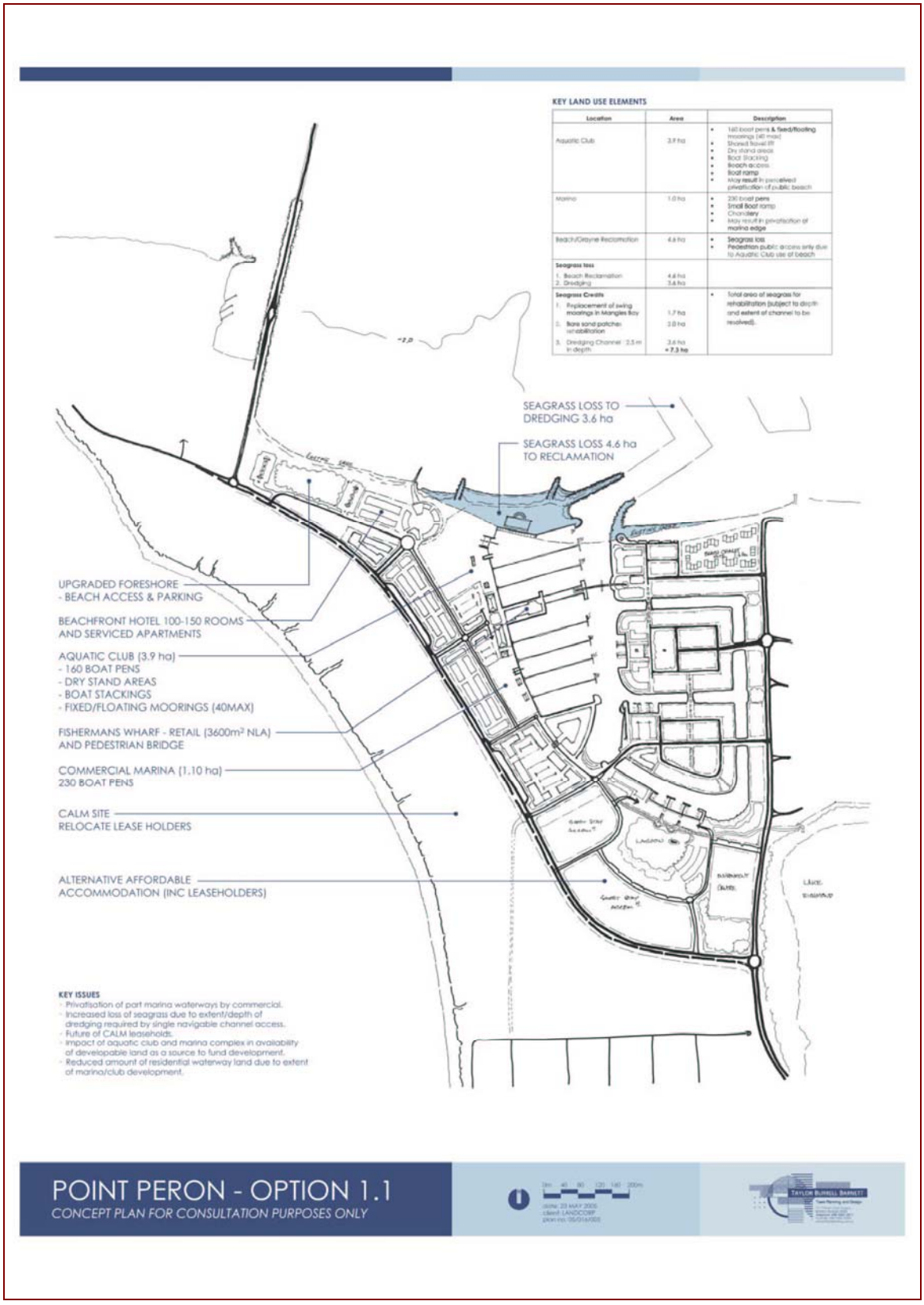


Figure 4 Development concept Option 1.1

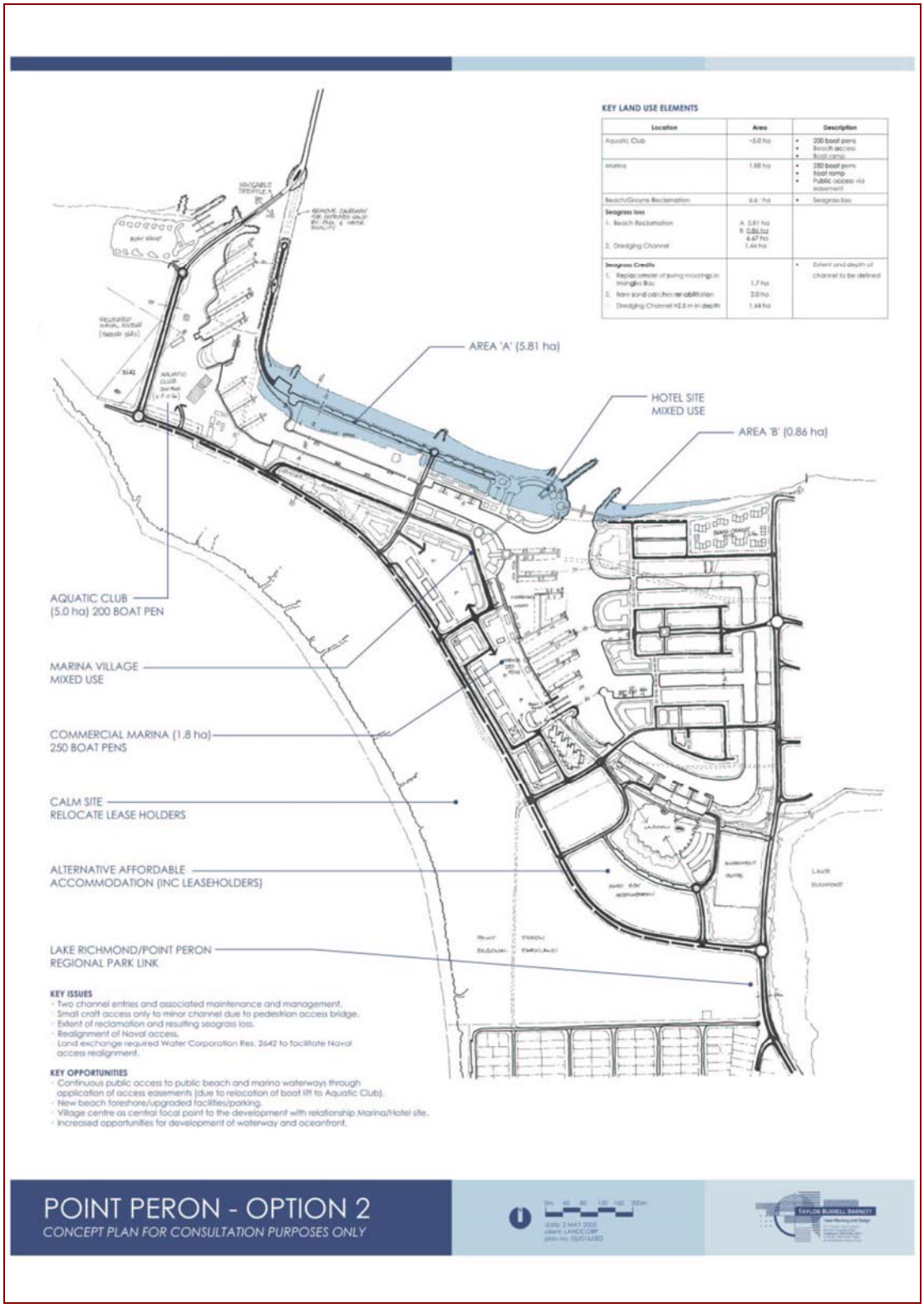


Figure 5 Development concept Option 2.0

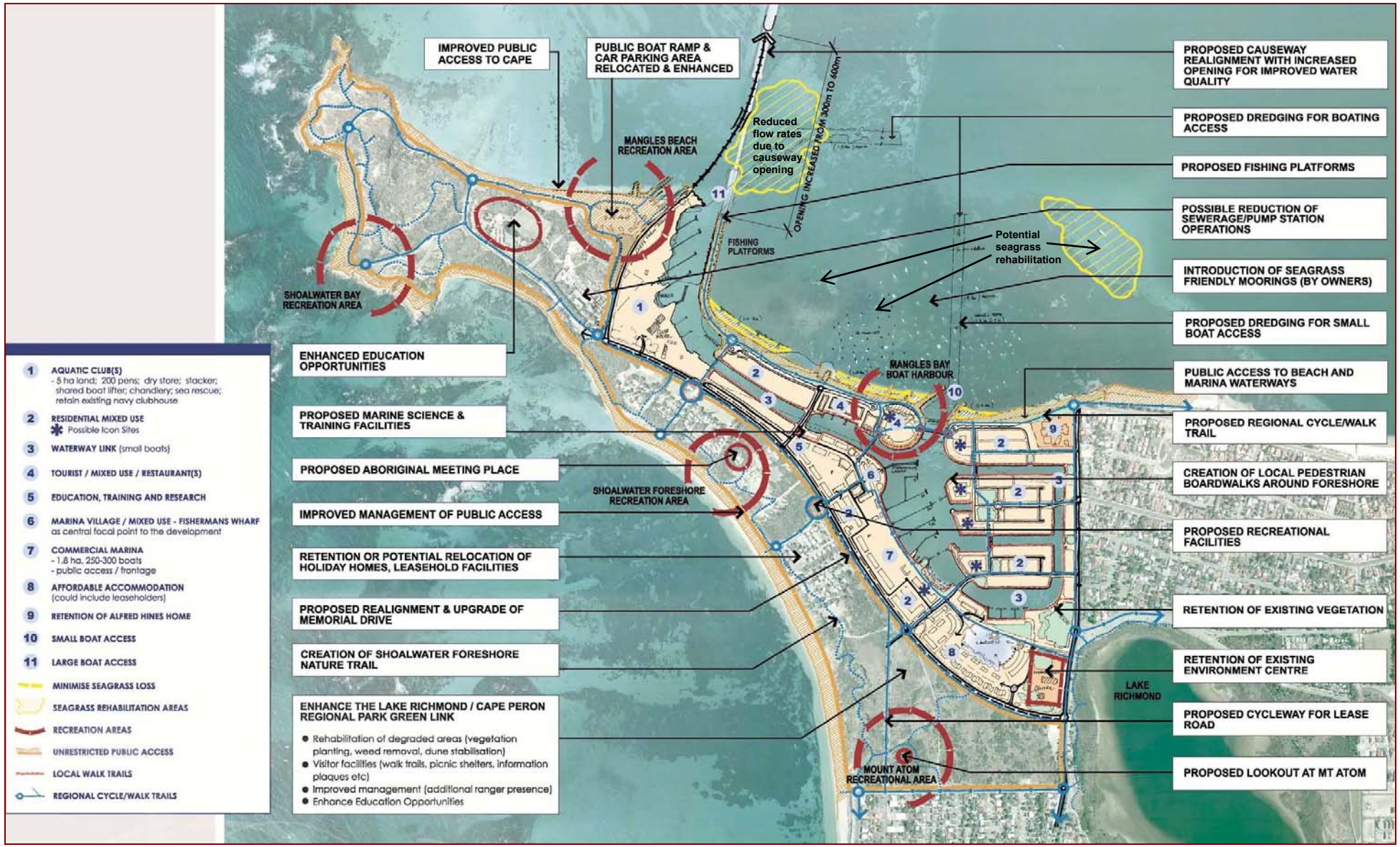


Figure 6 Development concept Option 2.2

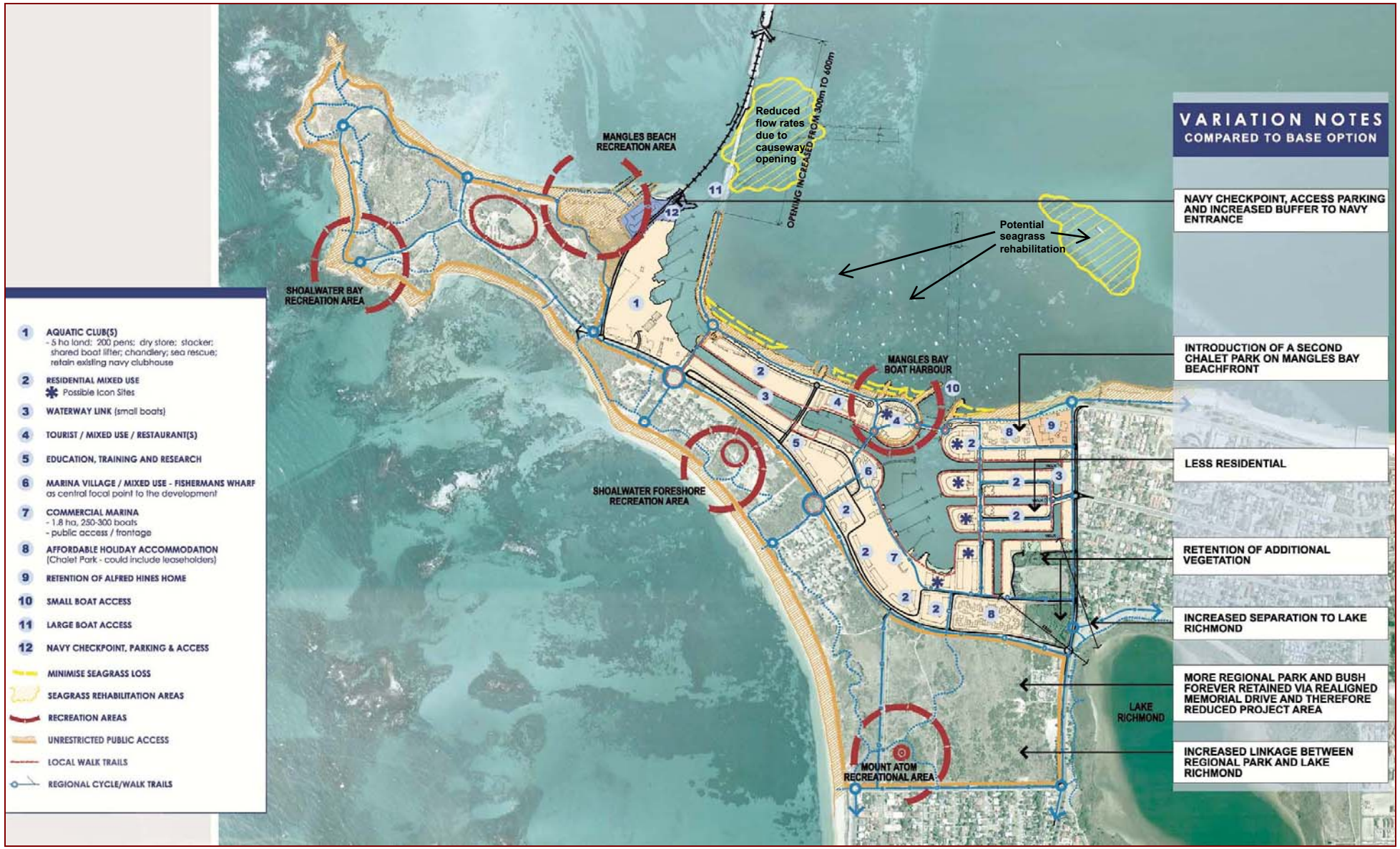


Figure 7 Development concept Option 2.3

Figure 8 Development concept Option 2.4

Table 3 Environmental, social and economic assessment of development concept options

Objectives	Development concept option			
	Do Nothing	2.2	2.3	2.4
ENVIRONMENTAL				
• Contributes positively to the natural terrestrial environment • Contributes positively to the marine environment	**Terrestrial environment** • No direct vegetation clearing • Further degradation of vegetation in areas with uncontrolled access • Minimal improvements in weed control, dune stabilization, vegetation rehabilitation and access management • No further improvements at the Cape other than implementation of the current CALM plan **Lake Richmond** • No further improvements at the lake other than implementation of the current CALM plan **Marine environment** • Boating numbers will increase • Current unmanaged boating activities will increase; unrestricted access through Mangles Bay and no managed re-fuelling or sullage facilities • No direct seagrass loss from infrastructure • No rehabilitation of seagrass and ongoing seagrass scarring from unmanaged boat access and anchor chains • No improvement in water quality in Mangles Bay • Management of coastal erosion and accretion continued to be managed through infrequent road transport of sand from one side of the causeway to the other.	**Terrestrial environment** • Total clearing: 53.0 ha • Clearing within Bush Forever and Regional Park: 43.9 ha • Probable TEC: almost all will be cleared • Regional Park: 51 ha to be excised • Mitigation: weed control, dune stabilisation, vegetation rehabilitation and access management from Lake Richmond to Cape Peron **Lake Richmond** • 200 m from canal development **Marine environment** • Boating management: improved • Direct seagrass loss: 5.9 ha (reduced impact on seagrass by realigning sewer) • seagrass rehabilitation • Water quality in Mangles Bay improved by widening the causeway opening • Sand bypass installed	**Terrestrial environment** • Total clearing: 45.5 ha • Clearing within Bush Forever and Regional Park: 36.3 ha • Probable TEC: minimal clearing with no buffer provided • Regional Park: 44 ha will be excised • Mitigation: similar to Option 2.2 **Lake Richmond** • 330 m from canal development **Marine environment** • As for Option 2.2	**Terrestrial environment** • Total clearing: 40.1 ha • Clearing within Bush Forever and Regional Park: 30.9 ha • Probable TEC: no clearing and buffer provided • Regional Park: 39 ha will be excised • Mitigation: similar to Option 2.2 **Lake Richmond** • 350 m from canal development **Marine Environment** • As for Option 2.2 with the exception of direct seagrass loss which is reduced to 5.3 ha.

4.3 DEVELOPMENT OF THE CONCEPT OPTIONS

Option 2.2 was presented to the Stakeholder Reference Group (SRG) and was the first option initially chosen by the Steering Committee as the preferred option at that time. Community consultation at the third SRG meeting (Section 2.4) confirmed that Option 2.2, when compared with Option 1.1 and Option 2.0, best met the project objectives for a marina based tourist project.

Options 2.3 and 2.4 are variations of Option 2.2 that were developed in response to community concerns. These options reduce the footprint of the project and reduce the environmental impacts identified for Option 2.2. Option 2.3 was presented at the fourth SRG meeting and was generally supported as an acceptable option. Option 2.4 was developed after the fourth SRG meeting to further improve the environmental outcomes of the development in response to community concerns and the results of the project's environmental investigations (i.e. identification of probable TEC). A letter was sent to all SRG members describing this option and the option has been made publicly available.

Options 2.3 and 2.4 have both been endorsed by the Steering Committee as preferred options. The two options each provide a slightly different mix of outcomes but both achieve the social, economic and environmental project objectives.

Options 2.2, 2.3 and 2.4 are all being addressed in this SER.

Development concept Options 2.2, 2.3 and 2.4 are described in full in TBB (2005) and the key characteristics summarised below. Some adverse impacts would be anticipated as part of all three options and a comprehensive mitigation package has been designed to achieve a net environmental benefit (Section 8).

4.3.1 Key characteristics for options 2.3 and 2.4

Development concept Option 2.3 is approximately 76.6 ha in area and Option 2.4 is approximately 76.3 ha. Both options provide for the following opportunities (see also Figure 6 to Figure 8):

Marine recreation / industry facilities

- two marina entrances; one deep at the western end for very large boats and keeled craft, one medium depth at the eastern end suitable for most boats of trailerable size
- aquatic club(s) secure area with dry boat store and boat stacker available for further demand increases
- commercial marina secure facility with deep water access
- provision for a total of 520 and 520 boat pens (Option 2.3 and 2.4 respectively)
- re-fuelling and sullage pumping facilities
- public marina for short and long-term boat stay with direct access to Mangles Bay
- internal waterways (canals)

Accommodation

- affordable family holiday chalet style accommodation with access to the marina (Option 2.3 only)[1]
- affordable family holiday chalet style accommodation on Mangles Bay foreshore (Options 2.3 and 2.4)
- boutique resort hotel at the main (east) entrance to the marina
- apartment style short stay accommodation in the mixed use areas adjacent to the marina and Mangles Bay

Education and training

- marine education and research facility with marina access and boat pen

Tourism developments

- marina village with mixed use 'Fisherman's Wharf' (village style) area with restaurants, cafes, bars, public open space and shops
- Mangles Bay beach with grassed public open space and a beach facing café and short-stay accommodation strip
- tourism focal site with boutique resort hotel and restaurants overlooking Mangles Bay and the marina entrance
- public open space and public art at icon sites throughout development
- continuous public access to and around the Mangles Bay foreshore and marina waterways (canals)
- walkways, cycleways, signage and facilities for passive enjoyment of the other beaches, conservation areas and heritage attractions of Cape Peron.

Residential

- mixed use residential areas along canals and Mangles Bay foreshore

Garden Island Causeway

- realignment and lengthening of the southern causeway trestle to facilitate flushing and improved water quality in Mangles Bay

[1] Southern chalet park (affordable accommodation) not included in option 2.4, but the area has been earmarked for possible future development by CALM of a chalet park as part of the Regional Park; it has been negotiated that should CALM progress development of the chalet park at this location it would be funded by the marina project.

4.3.2 Environmental and social mitigation

The project will provide environmental and social offsets outside of the immediate development footprint through support for the enhancement of environmental and social values on Cape Peron. Part of this will be achieved through the proposed comprehensive mitigation measures including provision for:

- rehabilitation of natural environments in and around Cape Peron, Lake Richmond and Mangles Bay
- acquisition of land with similar or greater conservation to that lost through the project and secure it for conservation
- improving facilities for recreation and access to Cape Peron to enhance the enjoyment of visitors and protect the environment
- assisting with the ongoing management of the natural and social environments of Cape Peron.

Section 8 contains details of the proposed mitigation.

5. TERRESTRIAL ENVIRONMENT

5.1 VEGETATION AND FLORA

Example of the vegetation of Cape Peron

Bennett Environmental Consulting Pty Ltd conducted a flora and vegetation survey of the Cape Peron study area in June 2005 in accordance with EPA Guidance Statement 51 (Bennett 2005). By June most native annual species and weed species had germinated, although not all species of native annuals may have been in flower at the time of the survey. The germination of the weed species allowed the vegetation condition assessment to be undertaken with confidence.

Bennett (2005) surveyed the area using temporary 10 m x 10 m quadrants, or relevees[2] where the environment was fragile (e.g. limestone outcrops) or where the vegetation unit was less than 10 m wide. The area outside the quadrants and relevees was also surveyed for additional/ opportunistic species for that vegetation unit.

These surveys are believed to provide sufficient information to support a strategic level of assessment. A spring survey of the area will be conducted if Cabinet decides that the project should proceed to detailed design and assessment.

The following description of the flora and vegetation for Cape Peron is from the Bennett (2005) survey, unless otherwise stated.

5.1.1 Description of vegetation and flora

Vegetation

Cape Peron is within the Drummond Botanical Subdistrict of the Southwest Botanical province as defined by Beard (1981). Beard (1981) mapped Cape Peron as:

- Scrub heath, mixed shrubs and heathland, mainly Proteaceous and Myrtaceous.

Approximately 9.5% of the pre-European area of this vegetation remains. Of the remaining vegetated area, 28.5% (or 2.7% of the pre-European area) is protected in International Union for the Conservation of Nature (IUCN) Reserves (Shepherd et al. 2002).

All vegetation of Cape Peron is representative of the Quindalup Complex, as described by Heddle et al. (1980), of which approximately 48% of its pre-European extent in the metropolitan area remains. Approximately 5.2% of the pre-European extent is within reserves that meet IUCN criteria. The complex is described as a coastal dune complex consisting mainly of two alliances – the strand and

[2] A relevee records all flora within a 5 m radius or within a 10 m transect.

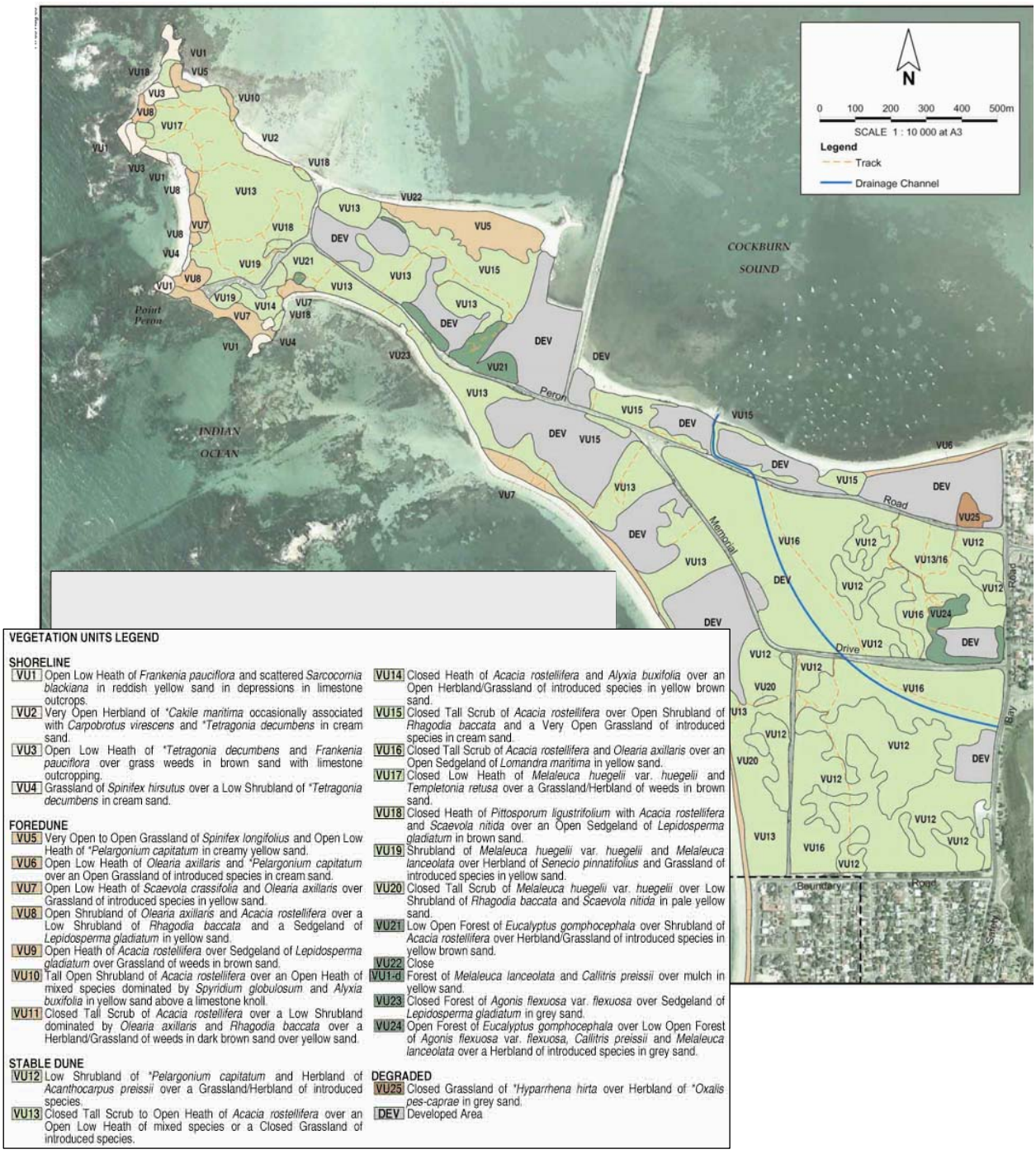
foredune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata-Callitris preisii* and the closed scrub of *A. rostellifera*.

Bennett (2005) recorded 25 different vegetation units (Figure 9 and Table 4). More detailed descriptions of these units are provided in Appendix 2.

Table 4 Vegetation unit descriptions and area affected by development

Vegetation unit	Description	Total area mapped	Area affected by options (ha)		
			2.2	2.3	2.4
Shoreline					
1	Open Low Heath of *Frankenia pauciflora* and scattered *Sarcocornia blackiana*	1.2	-	-	-
2	Very Open Herbland of **Cakile maritima* occasionally associated with *Carpobrotus virescens* and *Tetragonia decumbens*	0.3	-	-	-
3	Open Low Heath of *Tetragonia decumbens* and *Frankenia pauciflora* over grass weeds	0.7	-	-	-
4	Grassland of *Spinifex hirsutus* over a Low Shrubland of *Tetragonia decumbens*	0.4	-	-	-
Fore Dune					
5	Very Open to Open Grassland of *Spinifex longifolius* and Open Low Heath of **Pelargonium capitatum*	3.8	2.1	2.7	2.7
6	Open Low Heath of *Olearia axillaris* and **Pelargonium capitatum* over an Open Grassland	10.5	0.5	0.5	0.5
7	Open Low Heath of *Scaevola crassifolia* and *Olearia axillaris* over Grassland of introduced species	3.3	-	-	-
8	Open Shrubland of *Olearia axillaris* and *Acacia* rostellifera over a Low Shrubland of *Rhagodia baccata* and a Sedgeland of *Lepidosperma gladiatum*	1.1	-	-	-
9	Open Heath of *Acacia rostellifera* over Sedgeland of *Lepidosperma gladiatum* over Grassland				
10	Tall Open Shrubland of *Acacia rostellifera* over an Open Heath of mixed species dominated by *Spyridium globulosum* and *Alyxia buxifolia*	0.2	-	-	-
11	Closed Tall Scrub of *Acacia rostellifera* over a Low Shrubland dominated by *Olearia axillaris* and *Rhagodia baccata* over a Herbland/Grassland of weeds	5.2	-	-	-
Stable Dune					
12	Low Shrubland of **Pelargonium capitatum* and Herbland of *Acanthocarpus preissii* over a Grassland/Herbland of introduced species	17.1	10.1	6.0	5.3
13	Closed Tall Scrub to Open Heath of *Acacia rostellifera* over an Open Low Heath of mixed species or a Closed Grassland of introduced species	39.3	1.3	1.3	1.3
13/16		4.9	4.9	4.1	2.8
14	Closed Heath of *Acacia rostellifera* and *Alyxia buxifolia* over an Open Herbland/Grassland of introduced species	0.8	-	-	-
15	Closed Tall Scrub of *Acacia rostellifera* over Open Shrubland of *Rhagodia baccata* and a Very Open Grassland of introduced species	8.2	5.6	6.8	6.8
16	Closed Tall Scrub of *Acacia rostellifera* and *Olearia* axillaris over an Open Sedgeland of *Lomandra maritima*	41.6	28.0	24.6	20.7
17	Closed Low Heath of *Melaleuca* huegelii var. *huegelii* and *Templetonia retusa* over a Grassland/Herbland of weeds	0.2	-	-	-
18	Closed Heath of *Pittosporum ligustrifolium* with *Acacia* rostellifera and *Scaevola nitida* over an Open Sedgeland of *Lepidosperma gladiatum*	0.7	-	-	-
19	Shrubland of *Melaleuca huegelii* var. *huegelii* and *Melaleuca lanceolata* over Herbland of *Senecio pinnatifolius* and Grassland of introduced species	0.7	-	-	-
20	Closed Tall Scrub of Melaleuca *huegelii* var. *huegelii* over Low Shrubland of *Rhagodia baccata* and *Scaevola nitida*	0.4	-	-	-
21	Low Open Forest of *Eucalyptus* gomphocephala over Shrubland of *Acacia rostellifera* over Herbland/Grassland of introduced species	1.7	1.1	1.1	1.1
22	Closed Forest of Melaleuca lanceolata and *Callitris preissii* over mulch	0.08	-	-	-
23	Closed Forest of *Agonis flexuosa* var. *flexuosa* over Sedgeland of *Lepidosperma gladiatum*	0.5	-	-	-
24 (probable TEC)	Open Forest of *Eucalyptus gomphocephala* over Low Open Forest of *Agonis flexuosa* var. *flexuosa*, *Callitris preissii* and *Melaleuca lanceolata* over a Herbland of introduced species	1.5	1.5	0.3	0
Degraded area					
25	Closed Grassland of **Hyparrhena hirta* over Herbland of **Oxalis pes-caprae*	0.6	0.6	0.6	0.6

Abbreviations: subsp. = subspecies var. = variety
* = introduced species, weed ? = thought to be the correct species name
sp. = species – used where the genus but not the species is known



Source: Bennett (2005)

Figure 9 Vegetation units mapped at Cape Peron

A previous flora and vegetation survey of Cape Peron, by Keating & Trudgen (1986), recorded 16 vegetation units. Bennett (2005) recorded all except one of these vegetation units; *Olearia axillaris* shrubland. Keating & Trudgen (1986) did not record any of the taller units recorded by Bennett (2005), vegetation units 19, 21 – 24, nor a completely degraded unit, vegetation unit 25.

Floristic community types

Bennett (2005) inferred the Floristic Community Types (FCTs) for each vegetation unit (Table 5) using Gibson et al. (1994). A PATN numerical analysis[3] was also undertaken by EA Griffin and Associates (Griffin 2005) to confirm the inferences for the vegetation units that occurred within the proposed development area (Table 5). The PATN analysis was limited in its application due to the relatively small number of flora species recorded from the study quadrats on Cape Peron (due to the mostly degraded condition of the vegetation).

Table 5 Floristic community types for vegetation units mapped

Floristic community type	Inferred vegetation units mapped by Bennett (2005)	PATN confirmation
FCT 16 Highly saline seasonal wetlands	1 and 3	-
FCT 29a Coastal shrublands on shallow sands	2, 8, 9, 10, 11, 12, 15	Vegetation Unit 12: probably 29b, but may be 29a Vegetation Unit 15: possibly 29b or 30b or 30c
FCT 29b Acacia shrublands on taller dunes	13, 14, 16, 17, 18 and 20	Vegetation Unit 16: Probably 29b
FCT S13 Northern *Olearia axillaris – Scaevola crassifolia* shrublands	6 and 7	-
FCT S14 *Spinifex longifolius* grasslands and low shrublands	4 and 5	-
FCT 30a *Callitris preissii* (or *Melaleuca lanceolata*) forest and woodlands	19?, 22 and 24	Vegetation Unit 24: Probably FCT 30a (TEC)
FCT 30b Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands	21 and 23	-
FCT S15 Weed group	25	-

Vegetation of conservation significance

FCT 30a (Table 5) is listed as a Threatened Ecological Community (TEC) by CALM within the 'Vulnerable'[4] conservation category. Vegetation Units 22, 24 and possibly 19 were inferred as being representative of FCT 30a. The PATN analysis indicated that the vegetation unit 24 was probably the TEC, FCT 30a. However, there were insufficient species present at the survey site for the statistical analysis to confirm this assessment.

[3] PATN is a software package that extracts and displays patterns in complex data. PATN generates estimates of association (resemblance, affinity, distance) between any set of objects described by a suite of variables or attributes. PATN then classifies the objects into groups (Blatant Fabrications 2004).

[4] 'Vulnerable' conservation category for TECs: An ecological community that is declining or has declined in distribution and/or condition and whose ultimate security has not been secured OR still widespread but will become increasingly endangered in the near future if threatening processes continue or begin to operate.

Vegetation Unit 22 was mapped in the Education Department lease area and was highly degraded, being completely devoid of all understorey vegetation. Vegetation Unit 19 was mapped from several small areas on the point and Vegetation Unit 24 was mapped as occurring on the corner of Safety Bay Road and Memorial Drive (Figure 9).

No other vegetation units occurring on Cape Peron are listed or are probable TECs.

The reservation and conservation status of several other FCTs occurring on Cape Peron were described by Gibson et al. (1994):

- FCT 16: poorly reserved and vulnerable (a community likely to move into the endangered category in the near future if the causal factors continue operating)
- FCT 29a and 29b (Priority 3): poorly reserved and susceptible (a community of concern because there is evidence that it can be modified or destroyed by human activities, or would be vulnerable to new threatening processes)
- FCT 30b (Priority 3): well reserved and susceptible.

Vegetation condition

The vegetation condition of Cape Peron was mapped by Bennett (2005) (Figure 10). The dominant problem weed throughout the whole area was *Euphorbia terracina* (Geraldton carnation weed) being recorded from nearly every site. This species was common and the vegetation in most areas was disturbed but retained the basic vegetation structure, giving a vegetation condition rating of 'good' east of the causeway and 'very good' west of the causeway according to the Bush Forever method of condition rating. Several areas associated with development were 'degraded' or 'completely degraded'[5].

The project area, which in the 1986 survey was regarded as 'degraded' (Keating & Trudgen 1986), is recovering well. The basics of the vegetation units are developing and several species were recorded in the area that were not recorded elsewhere (e.g. *Calothamnus quadrifidus*). It is anticipated that with time, the vegetation will continue to recover and develop into a dense shrubland.

The completely degraded sites were those where there are holiday homes and other infrastructure.

CALM are implementing targeted restoration projects at Cape Peron with reasonable success. When plantings do occur it is essential that local vegetation species are used. In some areas this has not been the case.

[5] Vegetation condition rating (Department of Environmental Protection 2000):

Pristine = Pristine or nearly so, no obvious signs of disturbance.

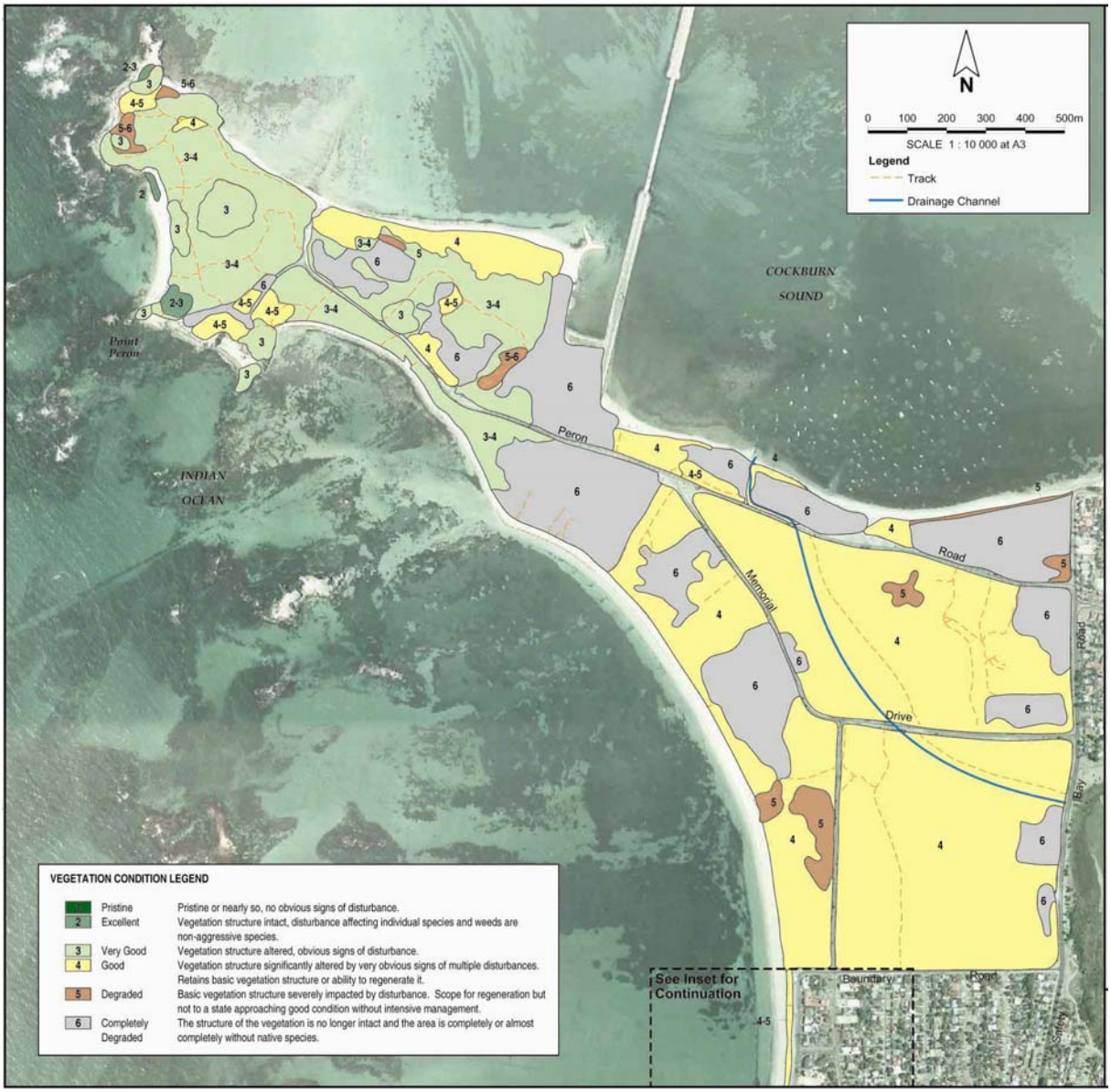
Excellent = Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very good = Vegetation structure altered, obvious signs of disturbance.

Good = Vegetation structure significantly altered by very obvious signs of multiple disturbances; retains basic vegetation structure or ability to regenerate it.

Degraded = Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good condition without intensive management.

Completely degraded = The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.



Source: Bennett (2005)

Figure 10 Vegetation condition mapped at Cape Peron

Flora

A total of 59 vascular plant families, 104 genera and 121 taxa, of which 66 are endemic and 53 are weeds etc, were recorded by Bennett (2005). The dominant families were Poaceae (grass family), Asteraceae (daisy family), Myrtaceae (myrtle family) and Papilionaceae (pea family). The survey was undertaken after the annual species had commenced germination. However, many species were still too small for positive identification, and a spring survey would be required for completion of a more comprehensive species list.

Flora of conservation significance

While no Declared Rare Flora (DRF) or Priority Flora were recorded in the Bennett (2005) survey, one species, *Dodonaea hackettiana* (Priority 4), has been previously recorded from the vicinity of Cape Peron outside the development area. This taxon would have been visible at the time of the survey. No annual DRF or Priority Flora were recorded on the CALM Rare Flora Database for the Cape Peron area (Bennett 2005), so a spring survey would not be expected to locate additional species of conservation significance.

Six flora species considered by Bush Forever (Department of Environmental Protection 2000) to be of significance for the Quindalup dune system in the Perth metropolitan area were recorded during the Bennett (2005) survey (Table 6).

Table 6 Significant species identified by Bush Forever recorded at Cape Peron

Species	Significance category	Floristic Community Type (FCT)
Agonis flexuosa var. *flexuosa*	At northern extension of known range Significant population	FCT 30b
Allocasuarina lehmanniana	Significant population	FCT 29a
Callitris preissii	Significant population Endemic to Swan Coastal Plain in Perth metropolitan area	FCT 30a
Diplolaena dampieri	At northern extension of known range Significant population	FCT 29a
Hibbertia cuneiformis	At northern extension of known range Significant population	FCT 29a
Melaleuca lanceolata	Disjunct population (geographically or ecologically isolated from other populations of the same species) Significant population	FCT 30a

Introduced flora (weeds and cultivated species)

A total of 53 weed species (45% of the total number of taxa) were recorded during the Bennett (2005) survey (weed species are listed in Appendix 3), all of which have been determined as weeds by CALM (1999a). In addition, four cultivated species and a group of unidentifiable grasses were also recorded.

Some weed species recorded had been planted as part of rehabilitation, mainly within lease areas. Cultivated species planted for ornamental purposes were not recorded by the survey.

Seven of the weed species were rated by CALM (1999a) as 'High'[6]. Three of these species were widespread throughout the study area:

- *Eurphorbia terracina*: Geraldton carnation weed
- *Pelargonium capitatum*: Rose pelargonium
- *Romulea rosea*: Guildford grass.

[6] Ratings based on three criteria; invasiveness, distribution and environmental impacts. 'High' rating indicates weed is prioritised for control and/or research.

Lagurus ovatus (Hare's tail grass), rated as 'High', is possibly dominant in the area; most of the grass seedlings were too small for identification but the old flowering heads of this species were still visible at one site.

Another common weed species in the area was *Trachyandra divaricata* (Onion weed), which is rated as 'Mild'[7]. This species is known to be aggressive in interdunal beach heathland (Hussey et al. 1997). No *Asparagus asparagoides* (Bridal creeper) was recorded during the survey (confirmed Bob Goodale, Naragebup Rockingham Regional Environment Centre, pers. comm. 2005).

5.1.2 Assessment framework or policy context

EPA objectives

The EPA objective relevant to this assessment is:

- *Maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*

The following overriding EPA objective addressing biodiversity is also relevant to this factor:

- *Maintain biological diversity where it represents the different plants, animals and micro-organism, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

National Strategy for Conservation of Australian Biodiversity

The State and Commonwealth Governments have endorsed the *National Strategy for Conservation of Australia Biodiversity* and the *National Strategy for Ecologically Sustainable Development* that protects biodiversity. The strategies address the conservation of Australia's biological diversity by defining guiding principles.

EPA Position Statement No 2

EPA Position Statement No 2, *Environmental Protection of Native Vegetation in Western Australia*, provides an overview of the EPA position on the clearing of native vegetation in Western Australia. Principles and related objectives and actions have been adopted from the abovementioned national strategies in the formation of this Position Statement. In assessing a proposal, the EPA consideration of biological diversity will include the following basic elements:

- comparison of development scenarios or options of biodiversity at the species and ecosystems level
- no known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable
- no association or community of indigenous plants or animals ceases to exist as a result of the proposal

[7] 'Mild' rating indicates monitoring of the weed and control where appropriate.

- there is a comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves
- if the project is large (in the order of 10 ha to 100 ha or more, depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected
- the on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

EPA Position Statement No 3

EPA Position Statement No 3, *Terrestrial Biological Surveys as an Element of Biodiversity Protection*, discusses the principles that the EPA would apply when assessing proposals that may impact on biodiversity values in Western Australia. The outcomes sought by this Position Statement are intended to:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and therefore the need to develop and implement best practice in terrestrial biological surveys
- enable greater certainty for proponents in the EIA process by defining the principles the EPA will use when assessing proposals which may impact on biodiversity values.

EPA Position Statement No 9

Environmental offsets are recognised by the Environmental Protection Authority (EPA) Preliminary (version 2) Position Statement No. 9, 'Environmental Offsets', as one tool that can provide alternative beneficial environmental outcomes in situations where social and economic growth is sought at some detriment to the environment. The aim of environmental offsets is to achieve a 'no net environmental loss' or 'net environmental benefit' outcome (EPA 2005).

Preliminary (version 2) Position Statement No. 9 recognises Bush Forever reserves as 'critical assets'[8]. Preliminary (version 2) Position Statement No. 9 does not consider it appropriate to validate or endorse the use of environmental offsets where projects are predicted to have significant adverse impacts to critical assets. However, with regard to Bush Forever reserves, the Position Statement does state:

> "*not including those* [Bush Forever] *areas subject to negotiated planning solutions or complementary mechanisms and for which agreement has been reached that such areas fall outside the conservation requirements*" (EPA 2005, pg 14).

EPA Guidance Statement No 51

EPA Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, provides guidance on standards and protocols for terrestrial flora and vegetation surveys, particularly those undertaken for the environmental impact assessment of proposals.

[8] 'Critical assets' represent the most important environmental assets in the State that must be fully protected and conserved (EPA 2005).

EPA Guidance Statement No 10

EPA Guidance Statement No. 10, *Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region*, outlines the EPA's approach to environmental assessment of proposals involving the clearing of natural vegetation within these areas.

Significance of vegetation and flora

The assessment framework for assessing the significance of vegetation and flora are contained in Appendix 4.

Threatened Ecological Communities

Unlike threatened flora and fauna, there is currently no legislation or formal policy covering TECs at the State level. However, an informal, non-statutory process, including advice from a scientific advisory committee, the establishment of the TEC database and steps for assigning ecological communities to categories of threat is in place and is coordinated by CALM (CALM 1999b).

Under the Commonwealth EPBC Act, some TECs are recognised as matters of national environmental significance. Any proposals that are likely to have a significant impact on such matters are subject to approval by the Commonwealth Minister for the Environment.

5.1.3 Potential impacts and mitigation

The following aspects of the proposed Cape Peron Tourist Precinct Project may potentially affect vegetation and flora values:

- **Direct loss of vegetation and flora** through clearing requirements for the development, including conservation significant vegetation.
- **Increased level of vegetation disturbance** due to increased public usage of the area.
- **Introduction of weeds** from increased vehicle movements and public usage.
- **Restoration of degraded vegetation** through improved management and rehabilitation of vegetation.
- **Increased protection of vegetation** through improved management of access.

All construction impacts will be restricted to within the development area. Existing access routes will be used and all excavation spoil will be redistributed on site, disposed of (or sold if possible) offsite as required to create the appropriate levels.

Vegetation clearing

Clearing requirements for the three development options under consideration are contained in Table 4 and summarised below:

- Development Option 2.2 (not preferred): will result in the loss of a total of 53.0 ha of remnant vegetation, with 43.9 ha of that clearing occurring within Bush Forever Protection Area 355.
- Development Option 2.3: will result in the removal of a total of 45.5 ha of remnant vegetation, with 36.3 ha of that clearing occurring within Bush Forever Protection Area 355.

- Development Option 2.4: will result in the removal of a total of 40.1 ha of remnant vegetation, with 30.9 ha of that clearing occurring within Bush Forever Protection Area 355.

Infrastructure development inside the perimeter of the proposed development area will remove the plant community structure, although some small areas of vegetation will remain as part of the development design (Section 4.3.1) but will not pose a threat to nearby vegetation.

The proposed development would affect vegetation communities as follows (see also Table 4):

1. Development concept Options 2.2, 2.3 and 2.4 would affect 10.1 ha, 6.0 ha and 5.3 ha respectively of Vegetation Unit 12, which is not restricted to the proposed development area but is probably an example of FCT 29a which is poorly reserved and susceptible, as determined by Gibson et al. (1994). Based on the assessment by Gibson et al. (1994), this floristic community is considered regionally significant.
2. Development concept Options 2.2, 2.3 and 2.4 would affect 28.0 ha, 24.6 ha and 20.7 ha respectively of Vegetation Unit 16, which is not restricted to the proposed development area but is probably an example of FCT 29b which is poorly reserved and susceptible, as determined by Gibson et al. (1994). Based on the assessment by Gibson et al. (1994), this floristic community is considered regionally significant.
3. Development concept Options 2.2, 2.3 and 2.4 will result in the loss of all of the variation of Vegetation Unit 15 located on the Mangles Bay foreshore. This variation of Vegetation Unit 15 is restricted to the proposed development area. Although Vegetation Unit 15 was recorded in several areas outside of the proposed development area (Figure 9), the faunal habitat of this particular example in the proposed development area was considered locally unique (Bamford 2005).
4. Development concept Option 2.2 will result in the loss of 1.5 ha of Vegetation Unit 24 from the Cape Peron area, Option 2.3 will potentially affect only 0.3 ha of this vegetation unit and Option 2.4 will retain all of this vegetation unit with an appropriate buffer. Vegetation Unit 24 is regionally significant as:

    a) It is possibly a depauperate[9] example of FCT 30a (a TEC listed by CALM) and was only mapped from the one location on Cape Peron (Figure 9). The best example of FCT 30a is found on Garden Island (Gibson et al. 1994) due to the no burn policy and a native tammar population that have reduced the impact of weeds. Vegetation Units19 and 22 are also possible examples of FCT 30a and were recorded outside of the development area.

    b) Three of the dominant species of this vegetation unit (*Agonis flexuosa* var. *flexuosa, Callitris preissii* and *Melaleuca lanceolata*) are of significance for the Quindalup Dunes (Table 6).

Within the project area, Vegetation Unit 24 (Tuart woodland) was found to be quite degraded, being mapped as mostly being in 'good' condition according to the Bush Forever condition categories, with some areas being of 'completely degraded' condition, and lacking a significant understorey structure. While other Tuart woodlands have been recorded within the region (CALM 2004), these are all further inland than the study area (e.g. within the Rockingham Lakes Regional Park, east of Patterson Road).

Several parts of the proposed development area are currently developed (e.g. caravan park, fishing club) and these areas are 'completely degraded'. The remnant vegetation of the proposed development area (excluding already developed areas) was assessed to be in 'good' vegetation condition with small areas of 'degraded' vegetation due to public access, clearing for infrastructure,

[9] Species deficient

road and track edges (Bennett 2005). The edges of these tracks were typically in poorer condition than the vegetation further away. The vegetation along the drain that bisects the area blended with the surrounding vegetation and in some sections included weedy areas, but mostly was in 'good' vegetation condition.

Indirect disturbance and spread of weeds

The proposed marina development will most likely result in increased public usage of the Cape Peron area. Uncontrolled and unmanaged access to vegetated areas can lead to:

- introduction and/or spread of weeds
- direct disturbance of vegetation and flora (e.g. from trampling and erosion of existing sandy tracks).

Currently there is evidence of degradation of bushland, some of which is due to uncontrolled access at Cape Peron owing to the network of sandy tracks through vegetated areas and the associated invasion by weeds along track edges and degradation of vegetation adjacent to the tracks. Improving visitor access facilities as part of the project will improve the protection of native vegetation through the provision of hard paths, board walks in sensitive areas, increased management presence in the area and the removal and rehabilitation of unnecessary paths. Therefore, increased visitor access to the area is not expected to result in the impacts listed above.

Mitigation

In addition to reducing the footprint of the development during the design process, comprehensive mitigation measures are proposed to offset the potential impacts of the proposed development, including impacts on vegetation and flora values. These measures are described in detail in Section 8.

Proposed vegetation and flora mitigation measures, also address the impact on the Bush Forever Protection Area and include the protection and rehabilitation of the remnant vegetation of Cape Peron within the Bush Forever Protection Area to enhance the conservation values and ecological linkage with Lake Richmond. The rehabilitation would be carried out by undertaking:

- a strategic weed control program with the aim of a net decrease in weeds in the area
- planting and/or seeding disturbed areas with local provenance species where appropriate
- consolidating and formalising walking tracks and provision of board walks in sensitive areas to reduce disturbance to vegetation
- fencing where required to protect vegetation
- stabilisation of disturbed dune areas
- provision of funding to CALM for ongoing management of the area
- establish a monitoring program to evaluate the rehabilitation performance.

A provision of $4-5m has been made in the project for the combination of rehabilitation within the Bush Forever Protection Area and the acquisition of land with comparable or greater conservation value to secure the land for conservation. A cost of the order of $50,000 per hectare is believed to be sufficient for the initial rehabilitation effort, monitoring and ongoing management for five years.

Specific rehabilitation prescriptions for the final proposal will be identified in consultation with CALM and detailed in a Rehabilitation Management Plan.

The final form and extent of the above offsets will be determined in accordance with EPA Position Statement No 9.

5.1.4 Expected outcome

Development will result in the clearing of 45.5 ha or 40.1 ha (development Options 2.3 and 2.4 respectively) of remnant vegetation which has suffered varying degrees of disturbance including extensive weed invasion. Notwithstanding these disturbances, some of the vegetation lost is considered regionally significant on the basis of floristic communities, as defined by Gibson et al. (1994).

Vegetation Unit 24 is a 1.5 ha area that is a probable depauperate example of a TEC. Option 2.3 results in the clearing of 0.3 ha and Option 2.4 avoids any clearing of this unit and leaves a buffer of at least 15 m around the vegetation unit to protect the vegetation from edge effects.

The project will not result in any vegetation complexes being cleared to less than 10% of the original extent. Approximately 48% of the pre-European extent Quindalup Vegetation Complex remains in the metropolitan area. No Declared Rare Flora (DRF) will be affected and possibly one Priority Flora species (*Dodonaea hackettiana*) may occur in the area, although it was not recorded during the vegetation and flora survey.

The development will provide offsets in accordance with EPA Position Statement No 9 and will include land acquisition with similar or greater conservation value and support for the management, protection and rehabilitation of vegetation in the Regional Park to enhance the biodiversity, including botanical values in the Regional Park and improving the ecological linkage between Lake Richmond and Point Peron.

5.2 FAUNA

Bamford Consulting Ecologists conducted a fauna assessment of the Cape Peron study area in July 2005 (Bamford 2005). The fauna assessment was undertaken as a Level 1 survey (a background research or 'desk-top' study) in accordance with EPA Guidance Statement 56. This approach involved a site visit and a review of the available published and unpublished information.

The following description of the fauna of Cape Peron is from the Bamford (2005) study, unless otherwise stated.

Quenda (Bandicoot) – *Isoodon obesulus*

5.2.1 Description of fauna

A total of 53 vertebrate fauna species may occur within the Cape Peron study area (Table 7 and Appendix 5).

Table 7 Vertebrates that may occur in the Cape Peron study area

	Amphibians	Reptiles	Birds[1]	Mammals[2]	Total
Total number of species	7	42	121	17	187
Native	7	42	114	11	174
Introduced	0	0	7	6	13
Conservation significant	1	9	40	3	53

[1] Compilation of bird species includes those species that may be regular visitors to the area by does not include species considered vagrants that can be recorded almost anywhere.

[2] Excludes marine species and species now confined to Garden Island.

Bamford (2005) recognises three levels of conservation significance for native fauna species:

- *Conservation significance level 1*: Species listed under State or Commonwealth Acts.
- *Conservation significance level 2*: Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by CALM.
- *Conservation significance level 3*: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

See Section 5.2.2 for discussion on conservation significance categories.

Invertebrates

There is limited published information pertaining to invertebrates likely to occur in the study area, however, there are some species of conservation significance that have been recorded on the coastal plain immediately east of the search area. The following significant species may occur in the Cape Peron area.

Conservation significance level 3

Vanessa itea (Yellow Admiral Butterfly): This species is considered of local conservation significance due to its decline in the Perth area, mainly due to the loss of its primary food plant, *Parietaria debilis* (Native Pellitory). *Parietaria debilis* was recorded from Vegetation Unit 13, as described and mapped by Bennett (2005) (Table 4). The Cape Peron area is considered to be a location where the species gathers to mate, before females disperse to search for food plants on which to lay their eggs (B. Goodale, *pers. comm.*). High points in the landscape (e.g. the extremity of Point Peron and Mount Atom) are important for mating gatherings.

Amphibians

Seven species of frogs may be present in the Cape Peron area. Most would breed in the drain or in seasonal freshwater pools around Lake Richmond, but would be expected to range widely outside the breeding season.

Conservation significance level 3

Myobatrachus gouldii (Turtle Frog): This species is considered of local conservation significance as it is close to the southern limit of its range on the coastal plain south of Perth. This species is not recorded on the WA Museum database as potentially occurring in the study area and was included by Bamford (2005) as being potentially present only on the basis of general patterns of distribution.

Reptiles

General patterns of species distribution indicate around 42 reptile species may be present in the Cape Peron area. The area provides a range of fauna (reptile) habitats, from coastal limestone to heathlands, shrublands and low forest, to the margins of a drain. However, the study area lacks *Banksia* woodlands so some of the species listed may not occur. The reptile assemblage may be substantially complete, as in the Perth area reptiles generally display a high degree of persistence even in small remnants of native vegetation.

The following significant species are likely or could occur in the Cape Peron area.

Conservation significance level 2

Lerista lineata (Bold-striped Lerista): This skink has a restricted distribution with a core range on the coastal plain between the Swan River and Mandurah. It persists even in small remnants of native vegetation, including gardens, so is likely to be common in the study area where there are sandy soils and at least some vegetation cover.

Conservation significance level 3

The following species are considered locally significant due to being at the limit of their range in the study area:

- *Varanus rosenbergi* (Rosenberg's Goanna)
- *Varanus tristis* (Tree Goanna)
- *Egernia luctuosa* (Glossy Swamp Egernia)

- *Lerista praepedita* (Worm Lerista)
- *Tiliqua occipitalis* (Western Blue-tongue)
- *Brachyurophis semifasciata* (Southern Shovel-nosed Snake).

Only *Lerista praepedita* and *Brachyurophis semifasciata* have been recorded in the area.

Birds

The Cape Peron study area may support 121 bird species, including species that may be regular visitors but excluding species that may occur as vagrants. The actual number of species that may be present at any one time is likely to be much less than the 121.

The list includes some ducks and other wetland birds that may visit the drain or nest in the Tuarts (*Eucalyptus gomphocephala*), and a number of shorebirds and seabirds likely to roost and/or forage along the shoreline. Many of the shorebirds and seabirds are likely to be more abundant on the islands of Shoalwater Bay than on the mainland of the study area. Other species likely to be present are:

- land birds: including occasional visitors, such as some birds of prey
- regular visitors: for example, the honeyeaters
- species that are probably resident or at least present at all times: including *Malurus splendens* (Splendid Fairy-wren) and *Anthus novaeseelamdiae* (Richard's Pipit).

A number of the bird species are of conservation significance, as discussed below (see Appendix 5 for complete listing).

Conservation significance level 1

Falco peregrinus (Peregrine Falcon): This species is reported to occur in the Cape Peron area (B. Goodale *pers. comm*.) and breeds in the region, with a nest believed to be in a large tree on nearby private property. Although a widespread species, it occurs at low densities and birds in urban areas are at risk from road-kill and secondary poisoning.

Calyptorhyynchus latirostris (Carnaby's (Short-billed) Black Cockatoo): This species is abundant in the Perth area where loss of habitat is a threatening process, but it is probably only an occasional visitor to the study area as it forages primarily on Proteaceae, such as *Banksia*, that are absent from the site. There are anecdotal reports of this species nesting in Tuarts in the general region but there have been no reports of the species frequenting the Tuarts on the site.

Eighteen species, listed as migratory under the *Environment Protection and Biodiversity Act 1992*, may occur at the site. These include:

- *Pandion haliaetus* (Osprey)
- *Haliaeetus leucogaster* (White-bellied Sea-eagle)
- *Merops ornatus* (Rainbow Bee-eater)
- *Apus pacificus* (Fork-tailed Swift)
- shorebirds, including *Tringa brevipes* (Grey-tailed Tattler) and *Arenaria interpres* (Ruddy Turnstone).

In general, these species are likely to occur in low numbers in the study area and in littoral or shallow water habitats, although the bee-eater may nest in sandy soils and forage over terrestrial areas. The Swift is an aerial species likely to occur only occasionally and then only to overfly the site. The Osprey is known to nest on Garden Island (Naturalists Club 1988).

Conservation significance level 2

Thinornis (Charadrius) rubricollis (Hooded Plover): The Hooded Plover is probably a vagrant in the study area and has not been recorded by the Naturalists Club (1988), but is included because of its significance. There is a well-studied population on salt lakes south of Mandurah and there is suitable habitat in the sandy beaches of the study area. If the species did move onto these beaches, disturbance, such as by people and dogs, would be a concern.

Conservation significance level 3

Eighteen bird species are listed as being locally significant, including:

- *Lophoictinia (Hamirostra) isura* (Square-tailed Kite) and *Haliastur sphenurus* (Whistling Kite)
- *Turnix varia* (Painted Button-quail)
- *Acanthiza apicalis* (Inland Thornbill), *Acanthiza inornata* (Western Thornbill) and *Acanthiza chrysorrhoa* (Yellow-rumped Thornbill)
- *Artamus cyanopterus* (Dusky Woodswallow) and *Artamus cinereus* (Black-faced Woodswallow).

Most of these species are listed by Dell & Banyard (2000) as having declined in the Perth area, and most are dependent upon remnant native vegetation. At least some of these species also require linkage between areas of suitable habitat in order to be able to move across the landscape, and the juxtaposition of the study area and remnant vegetation around Lake Richmond may be important for such movements. Loss of habitat may affect some Conservation significance level 3 species, but there may be some benefit from an increase in linkage through the study area.

Mammals

Seventeen mammal species are listed as expected to occur in the Cape Peron area but few have been confirmed. This list excludes marine species and species now confined to Garden Island. The mammal fauna is poor, with six introduced species. Eight bat species that have been included because they are known from the general area and there is nothing to suggest that they are not present. Only one native species, *Isoodon obesulus* (Quenda), is known to occur in Cape Peron. The CALM threatened species database contains a record of *Phascogale tapoatafa* (Brush-tailed Phascogale), but this is reported to have been a specimen inadvertently brought into the area in a vehicle (B. Goodale *pers. comm.*).

Conservation significance level 2

Isoodon obesulus (Quenda): This species is reported to now be common in the study area (B Goodale *pers. comm.*). It favours dense, low vegetation and probably crosses roads in the area, making it vulnerable to roadkill. It is therefore a species that could benefit from revegetation but be adversely affected by increased traffic volume.

Hydromys chrysogaster (Rakali or Water-Rat): This species has not actually been recorded in the study area, but it is known from some wetlands in the region, including Spectacle Swamp, and is known from a number of wetlands in urban areas around Perth, such as Lake Goollelal, Herdsman Lake and Alfred Cove on the Swan River (M. Bamford personal database). It therefore may be present at Lake Richmond and occasionally along the drain in the study area, while it does use rocky marine coastlines elsewhere. If present, it would be vulnerable to roadkill.

Falsistrellus mackenzei (Western False Pipistrelle): This species has been recorded in Harry Waring Marsupial Reserve, near Jandakot (Hosken & O'Shea 1994), and therefore the possibility that it is present in the Cape Peron area cannot be discounted. If present, it would probably roost in the Tuarts, although some small bats will roost in limestone crevices.

Conservation significance level 3

At least some of the bat species could be considered of local significance as they have declined in the Perth area, with only *Tadarida australis* (White-striped Bat) and *Chalinolobus gouldii* (Gould's Wattled Bat) regularly persisting in urban areas. All are tree-roosting species that could shelter anywhere trees provide hollows or crevices in which they can hide. *Tadarida australis* (White-striped Bat), *Chalinolobus gouldii* (Gould's Wattled Bat), *Vesadelus (Eptesicus) regulus* (Southern Forest Bat) and *nyctophilus timoriensis* (Lesser Long-eared Bat) were recently (January 2005) recorded at Little Rush Lake in Beeliar Regional Park (M. Bamford personal database).

Introduced species

Six introduced mammal species may occur in the study area:

- *Mus musculus* (House Mouse)
- *Rattus norvegicus* (Brown Rat)
- *Rattus rattus* (Black Rat)
- *Oryctolagus cuniculus* (Rabbit)
- *Vulpes vulpes* (European Red Fox)
- *Felis catus* (Feral Cat).

Seven introduced bird species may also occur in the study area:

- *Columba livia* (Rock Dove (feral pigeon))
- *Streptopelia chinensis* (Spotted Turtle-dove)
- *Streptopelia senegalensis* (Laughing Turtle-dove)
- *Cacatua tenuirostris* (Long-billed Corella)
- *Cacatua sanguinea* (Little Corella)
- *Trichoglossus haematodus* (Rainbow Lorikeet)
- *Dacelo novaeguineae* (Laughing Kookaburra).

5.2.2 Assessment framework or policy context

EPA objectives

The EPA objective relevant to this assessment is:

- *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystems levels through the avoidance or management of adverse impacts and improvement in knowledge.*

The following overriding EPA objective addressing biodiversity is also relevant:

- *Maintain biological diversity where that represents the different plants, animals and micro-organism, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

EPA Guidance Statement No 56

EPA Guidance Statement No. 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, provides guidance on standards and protocols for terrestrial fauna surveys, particularly those undertaken for the environmental impact assessment of proposals.

EPA Guidance Statement No 10

EPA Guidance Statement No. 10, *Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region*, outlines the EPA's approach to environmental assessment of proposals involving the clearing of natural vegetation within these areas.

State protection

In Western Australia, rare or endangered species are protected by the *Wildlife Conservation (Specially Protected Fauna) Notice 2003*, under the *Wildlife Conservation Act 1950.* Schedules 1 and 4 in the Notice are relevant to this assessment, providing a listing of those species protected by the Notice. The EPA would expect the proposal to have a low likelihood of affecting fauna species that would meet the criteria for special legal protection as a threatened species under the Act.

The CALM Priority Fauna List also nominates conservation species from Priority level one to four as described for flora in Section 5.2.1. The Priority Fauna List does not confer any additional legal protection apart from the normal protection afforded to most native fauna. It is expected however, that the potential impacts from a proposal on these Priority listed species should be managed so that the species do not meet the International Union for Conservation of Nature and Natural Resources (IUCN) criteria for threatened species.

Commonwealth protection

In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora. As a result, an official list of endangered species was prepared and is regularly updated. The listing is administered through the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The current list differs from the various State lists but there are some species that are common to both.

International agreements

A range of shorebirds are listed under the Japan–Australia (JAMBA) and China–Australia (CAMBA) Migratory Bird Agreements. Most of these are associated with saline wetlands or coastal shorelines and have little relevance to the project area. However, some migratory birds not associated with water are also listed on these international treaties.

Significance of fauna

On the basis of the above discussion relating to mechanisms for the protection of fauna, three levels of conservation significance, developed by Bamford (2005), are recognised in this assessment:

- *Conservation significance level 1*: Species listed under State or Commonwealth Acts
- *Conservation significance level 2*: Species not listed under State or Commonwealth Acts, but listed in publications on Threatened Fauna[10] or as Priority species by CALM
- *Conservation significance level 3*: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

5.2.3 Potential impacts and mitigation

The following main aspect of the proposed Cape Peron Tourist Precinct Project may potentially impact on fauna values:

- **Loss of habitat** due to:
  - terrestrial vegetation clearing
  - disturbance of littoral and inshore marine environments (e.g. seagrass meadows).
- **Restoration of habitat** through
  - improved management
  - rehabilitation of vegetation.

Other potential but minor adverse impacts include:

- **Increased levels of habitat disturbance** from increased public usage of the area.
- **Increased mortality through traffic movements** due to a potential increase in traffic volumes.
- **Increase predation** from feral species or domestic pets.

Loss of Habitat

Development concept Option 2.2 will require a total of 53.0 ha of vegetation to be cleared, Option 2.3 approximately 45.5 ha and Option 2.4 approximately 40.1 ha. Infrastructure development inside the

[10] The Department of the Environment and Heritage (formerly Environment Australia) has supported the publication of reports on the conservation status of most vertebrate fauna species, for example reptiles (Cogger et al. 1993), birds (Garnett & Crowley 2000), monotremes and marsupials (Maxwell et al. 1996), rodents (Lee 1995) and bats (Duncan et al. 1999). These publications also use the IUCN categories, although those used by Cogger et al. (1993) differ in some respects as this report pre-dates the review by Mace & Stuart (1994).

perimeter of the proposed development area will remove fauna habitat but will not pose a threat to nearby fauna habitat.

Habitat potentially significant to fauna that will be affected by the development (Table 4) include:

1. Tuart (*Eucalyptus gomphocephala*) and Peppermint (*Agonis flexuosa* var. *flexuosa*) in Vegetation Unit 24; only 0.3 ha of this habitat would be affected by Option 2.3 and none by Option 2.4. Option 2.2 would result in the clearing of all 1.5 ha of this unit.
2. Tuart (*Eucalyptus gomphocephala*) in Vegetation Units 21 and 23. All options result in the clearing 1.1 ha of Vegetation Unit 21 (total 1.7 ha) with no clearing of Vegetation Unit 23 (total 0.5 ha).
3. Dense stand of tall *Melaleuca huegelii* subsp. *huegelii* at the water's edge where the drain enters the ocean at Mangles Bay in Variation of Vegetation Unit 15. The habitat of the variation of Vegetation Unit 15 found within the proposed development area was considered unique as it differed from the other occurrences of the unit as it was tall and was recorded on the vegetated beach edge. This vegetation may provide habitat for several fauna species, although such fauna are probably not restricted to this habitat. All options result in the clearing of this habitat.

Tuarts in particular are likely to be locally significant for fauna that uses tree hollows (e.g. bats and possibly the Brush-tailed Possum), and for species that forage in eucalypt foliage, such as the Weebill and Striated Pardalote. There are scattered Tuarts outside the study area, but those within the study area do represent a locally rare habitat important for a number of species.

Native Pellitory (*Parietaria debilis*), the foodplant of Yellow Admiral Butterfly (*Vanessa itea*), only occurred in Vegetation Unit 13. The majority of this vegetation unit occurred outside the proposed development area and *P. debilis* may also be present in other vegetation types.

Rhagodia baccata, a seasonally important foodplant for some birds, was found in 20 vegetation units and was not restricted to the development area on Cape Peron.

The existing Water Corporation drain may provide habitat for several fauna species. The proposed development will result in the loss of most of this drain habitat but such fauna species are probably not restricted to the drain as there are large wetland areas available very close by (e.g. Lake Richmond).

Other impacts

As previously described in Section 5.1.3, the proposed marina development will result in increased public usage of the Cape Peron area. Uncontrolled access of vegetated areas could lead to the disturbance of fauna habitat through:

- introduction and/or spread of weeds
- direct disturbance of habitat (e.g. from trampling and erosion of existing sandy tracks).

Improved management of visitor access facilities is expected to result in improved protection of native vegetation through the provision of hard paths, board walks in sensitive areas, increased management presence in the area and the removal and rehabilitation of unnecessary paths. Therefore, increased visitor access to the area is not expected to result in the impacts listed above.

Increased public usage of the area could decrease avian fauna numbers due to noise impacts and increased risk of fauna deaths on roads due to increased vehicle movements. The proposed residential

component of the development could also increase the risk of predation from domestic animals. These impacts will be minor and are not expected to significantly impact fauna.

Mitigation

Refer also to mitigation for flora and vegetation (Section 5.1.3).

The proposed rehabilitation of the Cape Peron environment through weed control, revegetation, dune stabilisation and access management will improve the fauna habitat on Cape Peron outside of the development area. Specific provision of fauna habitat such as logs, nesting boxes and planting of tuarts will be included in the rehabilitation according to the requirements of the fauna that occur in the area.

A relocation program for significant fauna will be undertaken prior to the clearing of the development area. Mitigation measures are described in detail in Section 8.

5.2.4 Expected outcome

The proposed development area is unlikely to be rich in fauna species. However, the area affected by the proposed marina development will result in a loss of habitat that is locally significant to fauna. Mitigation of this impact will include the restoration of adjoining degraded areas in the regional park to improve faunal habitat values (including planting, provision of habitat logs, etc). The development is not expected to adversely affect the conservation status or regional abundance of any faunal species.

The development will lead to the rehabilitation and enhancement of habitat in the Cape Peron area and improve ecological linkages between Lake Richmond and Point Peron. Therefore, although the project will result in the loss of some habitat, it will improve the quality of habitat throughout the rest of the Cape.

5.3 BUSH FOREVER PROTECTION AREA

All the land within the Cape Peron Tourist Precinct project area south of Point Peron Road is within Bush Forever Protection Area (BFPA) 355; *Point Peron and Adjacent Bushland, Peron/Shoalwater Bay* (Government of Western Australia 2000). The strip of land to the north of Point Peron Road (e.g. Mangles Bay foreshore area) is not included in BFPA 355.

Bush Forever aims

Bush Forever aims, within the limits of the natural areas available, to identify a comprehensive, adequate and representative system of reserved and protected areas in the Perth Metropolitan Region portion of the Swan Coastal Plain (Government of Western Australia 2000), where:

- *comprehensive*: the degree to which the full range of ecological communities and their biological diversity are incorporated within reserves
- *adequate*: the ability of the reserve to maintain the ecological viability and integrity of populations, species and communities
- *representative*: the extent to which areas selected for inclusion in the national reserve system are capable of reflecting the known biological diversity and ecological community or ecosystem concerned.

Criteria for selection

The seven criteria for determining the significance of bushland areas for inclusion in Bush Forever are listed below. BFPA 355 meets five of these criteria (Government of Western Australia 2000); these are italicised:

- *representation of ecological communities*
- diversity
- *rarity*
- maintaining ecological processes or natural systems
- *scientific or evolutionary importance*
- *general criteria for the protection of wetlands, streamline and estuarine fringing vegetation and coastal vegetation*
- *criteria not relevant to determination of regional significance, but which may be applied when evaluating areas having similar values.*

5.3.1 Description of Bush Forever Protection Area

Bush Forever Protection Area 355 is 174.5 ha in area of which approximately 107.1 ha is vegetated. Cleared areas within BFPAs were not identified for protection unless they are required to control significant indirect impacts on adjacent bushland (e.g. weed infestation or drainage discharge).

The Cape Peron site features rocky headlands displaying excellent exposures of the aeolian phase of Tamala Limestone, connected to the mainland by a series of Holocene beach-sand and dune-sand

ridges of the Safety Bay Sands (Government of Western Australia 2000). The vegetation and flora, and fauna values of the site are described in Sections 5.1 and 5.2 respectively.

The Cape Peron site is recognised as forming a linkage with BFPA 358, *Lake Richmond* (29 ha total area; approximately 27 ha vegetated), which is to the east (Section 5.5); Safety Bay Road separates the two areas. The Cape Peron site is also part of Greenways[11] 1, 93 and 97 (Tingay & Associates 1998).

5.3.2 Assessment framework or policy context

Bush Forever

Bush Forever is a non-statutory regional policy endorsed by the Government of Western Australia. It identifies 51 200 ha of regionally significant bushland (and any associated wetlands) on the Swan Coastal Plain within the Perth Metropolitan Region for protection and management in 287 Bush Forever sites. The majority of bushland areas are within Government ownership, with about 9% owned by private landowners. Areas of bushland outside Bush Forever sites may have regional values, but were not identified for protection and management in Bush Forever because of wider social and economic considerations.

Bush Forever is used as a basis for decision-making and an agreed framework for the protection and management of Bush Forever sites.

EPA Guidance Statement No 10

EPA Guidance Statement No. 10, *Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region*, outlines the EPA's approach to environmental assessment of proposals involving the clearing of natural vegetation within these areas.

Bushland Policy for the Perth Metropolitan Region Statement of Planning Policy 2.8 (Draft)

Statement of Planning Policy (SPP) 2.8 addresses the protection and management of regionally significant bushland identified for protection in Bush Forever. This SPP provides the policy and implementation framework for Bush Forever Protection Areas (BFPAs); these measures combined give statutory planning effect to Bush Forever.

The SPP requires that proposals impacting on BFPAs should, amongst others, ensure that all reasonable steps have been taken to avoid, minimise or mitigate any likely adverse impacts (direct or indirect) on regionally significant bushland, consistent with the SPP. Requirements of the SPP include:

- focus development within cleared, degraded and less intact areas of bushland and where possible avoid fragmentation of the bushland area and provide for ecological linkages
- protect bushland with the highest conservation value

[11] The term 'greenways' is a generic term that has been used to describe ecological linkages in the landscape that connect natural areas, preferably with continuous corridors of native vegetation, in ways that allow both fauna and flora to move between these areas to access resources and suitable habitat for survival and reproduction. A study of Perth's greenways by Tingay and Associates (1998) identified proposed greenway corridors linking the Park internally and to external areas.

- seek to avoid unacceptable losses, which includes a general presumption against clearing regionally significant bushland containing:
    - Threatened Ecological Communities
    - threatened and poorly reserved plant communities[12]
    - Declared Rare Flora
    - Specially Protected Fauna
    - Environmental Protection Policy wetlands
    - vegetation complexes where less than 10% of the original extent currently remains on the Swan Coastal Plain
    - wetland dependent vegetation fringing creeks, rivers and estuaries.

Details of long term protection, management and measures to minimise impact must be provided in a Statement of Environmental Effects and Environment Management Plan with any planning proposal.

Environmental offsets

Environmental offsets are recognised by the Environmental Protection Authority (EPA) Preliminary (version 2) Position Statement No. 9, 'Environmental Offsets', as one tool that can provide alternative beneficial environmental outcomes in situations where social and economic growth is sought at some detriment to the environment. The aim of environmental offsets is to achieve a 'no net environmental loss' or 'net environmental benefit' outcome (EPA 2005).

Preliminary (version 2) Position Statement No. 9 recognises Bush Forever reserves as 'critical assets'[13]. Preliminary (version 2) Position Statement No. 9 does not consider it appropriate to validate or endorse the use of environmental offsets where projects are predicted to have significant adverse impacts to critical assets. However, with regard to Bush Forever reserves, the Position Statement does state:

> "*not including those* [Bush Forever] *areas subject to negotiated planning solutions or complementary mechanisms and for which agreement has been reached that such areas fall outside the conservation requirements*" (EPA 2005, pg 14).

5.3.3 Potential impacts and mitigation

The primary potential impact of the Cape Peron Tourist Precinct on Bush Forever values is a decrease in the representation of regionally significant bushland in the Swan Coastal Plain portion of the Perth Metropolitan Region.

[12] It should be noted that SPP 2.8 is currently in draft form and that discussions with Bush Forever officers have indicated that it is not Bush Forever policy to expect poorly reserved plant communities to be precluded from clearing. Threatened Ecological Communities and Declared Rare Flora are the primary reasons for a presumption against clearing (Carissa Lloyd, Bush Forever, pers. comm. 6 September 2005).

[13] 'Critical assets' represent the most important environmental assets in the State that must be fully protected and conserved (EPA 2005).

The potential impacts on vegetation and flora, and fauna values have been described in Section 5.1.3 and Section 5.2.3 respectively. In summary, the development will result in the following disturbance to BFPA 355:

- Development Option 2.2: approximately 43.9 ha of BFPA 355 to be cleared, or 41% of the total area of BFPA 355.
- Development Option 2.3: approximately 36.3 ha of BFPA 355 to be cleared, or 34% of the total area of BFPA 355.
- Development Option 2.4: approximately 30.9 ha of BFPA 355 to be cleared, or 29% of the total area of BFPA 355.

Options 2.3 and 2.4 were developed specifically to reduce the amount of clearing required within the Bush Forever site while still providing adequate marina space.

Refer Section 5.1.3 for an assessment of the potential impacts of the proposed development on vegetation and flora values, including vegetation and flora of local and regional significance.

The development will have no adverse impacts on the vegetation and flora values of BFPA 358 (Lake Richmond) as the development will be at least 330 m from the BFPA and separated by a road, which will minimise any indirect impacts.

The clearing requirement for the project was assessed against the requirements of SPP 2.8 (Table 8).

Table 8 Consistency with Statement of Planning Policy 2.8 requirements

Statement of Planning Policy 2.8 requirement	Development Option 2.2 (base but not preferred option)	Development Options 2.3 and 2.4 (preferred options)
1. Focus development within cleared, degraded and less intact areas of bushland	Vegetation within the development footprint was assessed as being of Good to Completely Degraded condition and included areas already cleared. No areas of a condition ranking better than Good will be affected by the development. Areas of vegetation in better condition (Very Good to Excellent) were recorded at distance to the west of the proposed development site and will not be affected by the development (Section 5.1.1 and 5.1.3).	As for Option 2.2.
2. Seek to avoid fragmentation of the bushland area	The development will not interrupt the corridor between Lake Richmond and Point Peron but will reduce its areal extent. The proposed mitigation will contribute to the rehabilitation and enhancement of this corridor (Section 8).	As for Option 2.2.
3. Protect bushland with the highest conservation value	See 1 above.	As for Option 2.2.
4. Seek to avoid unacceptable losses of (presumption exists against clearing): a. Threatened Ecological Communities b. Threatened and poorly reserved plant communities c. Declared Rare Flora d. Vegetation complexes where less than 10% of the original extent currently remains on the Swan Coastal Plain	a. A probable depauperate example of a TEC (Floristic Community Type 30a, as defined by Gibson et al 1994) is located within the development footprint. The development will result in the removal of this probable TEC (Section 5.1.1). The proposed mitigation will contribute to the rehabilitation of the natural environment in and around Cape Peron and Lake Richmond. An area of vegetation of similar conservation value will be acquired and protected for conservation (Section 8).	Option 2.3 will retain almost all of the probable TEC (Section 5.1.1). Option 2.4 will retain all of the probable TEC, including an appropriate buffer (Section 5.1.1). Same mitigation approach as for Option 2.2
	b. The development will result in some clearing of possible Floristic Community Types 29a and 29b (threatened and poorly reserved plant communities as defined by Gibson et al. 1994). FCTs 29a and 29b were not restricted to the proposed development area. The condition of these floristic communities was assessed as being Good, indicating the vegetation structure had been significantly altered by obvious signs of multiple disturbances (Section 5.1.1). The proposed mitigation will as for a above (Section 8).	As for Option 2.2 but with reduced clearing requirements.
	c. No known Declared Rare Flora will be disturbed by the proposed development (Section 5.1.1).	As for Option 2.2.

Statement of Planning Policy 2.8 requirement	Development Option 2.2 (base but not preferred option)	Development Options 2.3 and 2.4 (preferred options)
	d. All of the vegetation of Cape Peron is within the Quindalup Vegetation Complex, of which approximately 48% remains in the Perth metropolitan area. The clearing requirement of the project (43.9 ha) would result in a reduction in the representation of this complex by approximately 0.2% (Section 5.1.1). The proposed mitigation as described in a above will contribute to the rehabilitation of vegetation on Cape Peron, which would increase the conservation values of the vegetation this area (Section 8).	As for Option 2.2. The clearing requirement for Option 2.3 is smaller (36.3 ha) The clearing requirement for Option 2.4 is smaller again (30.9 ha).
5. Wetland buffers	A minimum 200 m wetland buffer will be maintained between Lake Richmond and the proposed development (Section 5.5). The proposed mitigation package will contribute to the rehabilitation of this wetland buffer, which would increase the conservation values of the vegetation in this area (Section 8).	Option 2.3: a minimum 330 m wetland buffer will be maintained. Option 2.4: a minimum 350 m buffer will be maintained. (Section 5.5) Mitigation package as for Option 2.2.
6. Adopt bushland sensitive design measures (as published by Department of Planning and Infrastructure)	The bushland sensitive design measures aim to retain the conservation values of bushland by minimising the occurrence and impact of actions on adjacent land that disturb the soil, water or nutrient regime. The measures also aim to encourage conservation planning in the urban environment. The bushland sensitive design measures have been considered in the development design and will continue to do so. It is proposed that an Environmental Management Plan will be developed for the development to ensure the bushland sensitive design measures are fully considered and incorporated into the development design where appropriate.	As for Option 2.2.
7. Consider mitigation and offset measures (both on-site and off-site) for impacts to vegetation	Comprehensive mitigation is proposed (Section 8).	As for Option 2.2.
8. Management measures for significant fauna	Comprehensive mitigation package is proposed (Section 8), which included rehabilitation of flora species and vegetation communities and development of habitat of significance to fauna within and around the Cape Peron and Lake Richmond area.	As for Option 2.2.

Mitigation

Refer also to mitigation for flora and vegetation (Section 5.1.3).

It is proposed that an Environmental Management Plan will be developed for the proposed development which will incorporate the bushland sensitive design measures as described in *Bush Forever* (Government of Western Australia 2000). This management plan will address, but not be limited to, the following:

- bushland/ development interface issues
- providing for bushland sensitive public access
- landscaping to compliment the local natural environment
- future management regimes.

As indicated earlier, a provision of $4-5m has been made in the project for the combination of rehabilitation within the Bush Forever Protection Area and the acquisition of land with comparable or greater conservation value to secure the land for conservation. A cost of the order of $50,000 per hectare is believed to be sufficient for the initial rehabilitation effort, monitoring and ongoing management for five years.

Specific rehabilitation prescriptions for the final proposal will be identified in consultation with CALM and detailed in a Rehabilitation Management Plan.

The final form and extent of the above offsets will be determined in accordance with EPA Position Statement No 9.

The measures for the protection and rehabilitation of vegetation, flora and fauna values described in Section 5.1.3 and Section 5.2.3 respectively also directly relate to Bush Forever values. The proposed rehabilitation plan is described in Section 8.3.1. Section 5.5.2 describes the provision for wetland buffers between Lake Richmond and the proposed development.

5.3.4 Expected outcome

Development Option 2.3 will result in the removal of approximately 36.3 ha (34%) of remnant vegetation within BFPA 355 but retains almost all of the probable TEC. Development Option 2.4 will result in the removal of approximately 30.9 ha (29%) of remnant vegetation within BFPA 355 and retains all of the probable TEC with an appropriate buffer.

The proposed mitigation measures (including offsets) address and will be designed to meet the requirements of the EPA Position Statement No 9 and Statement of Planning Policy (SPP) 2.8 which addresses the protection and management of regionally significant bushland.

The proposed mitigation package will enhance and protect the conservation values of the remaining vegetation in BFPA 355 and the adjacent BFPA 358 (Lake Richmond).

5.4 ROCKINGHAM LAKES REGIONAL PARK

All of the Cape Peron Tourist Precinct project area south of Point Peron Road is within the Rockingham Lakes Regional Park (the Park). Regional parks are areas of regional open space that have been identified through planning processes as having regionally significant conservation, landscape and recreation values (CALM 2003). Rockingham Lakes Regional Park is one of eight regional parks in the Perth metropolitan area. A draft management plan has been developed for the park to provide broad direction for the protection and enhancement of the conservation, recreation and landscape values of the park (CALM 2003). The following description of the park is from this management plan unless otherwise stated.

5.4.1 Description of the Regional Park

Location

The Park covers an area of 4 270 hectares (ha), which consists of coastal areas, wetlands, remnant bushland areas, private leaseholds and public recreation areas. The park is wholly within the City of Rockingham. The main areas of the Park are (see also Figure 11):

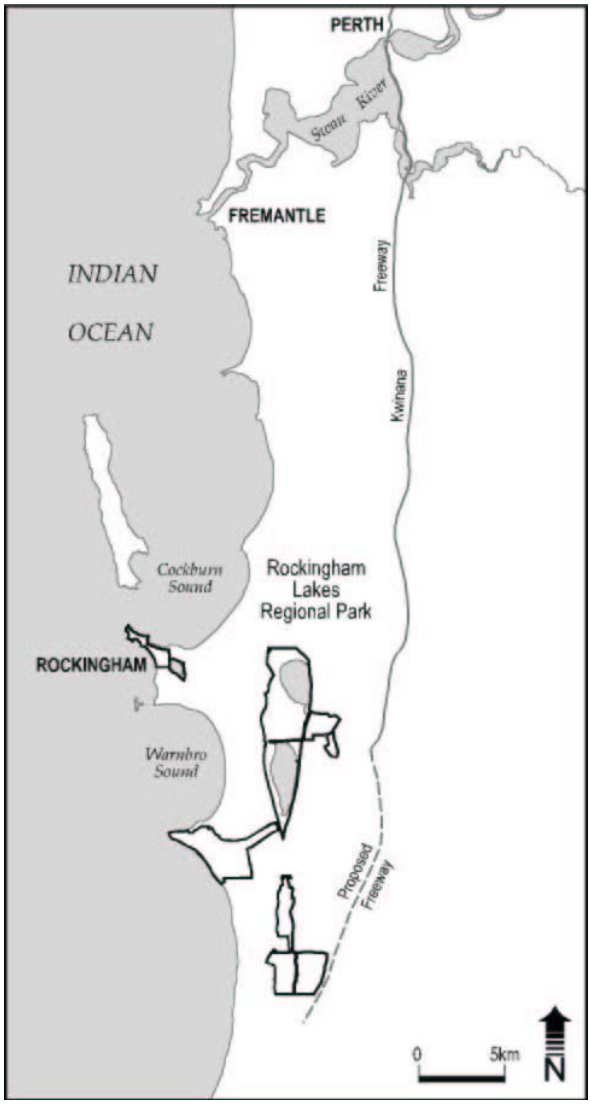
- Cape Peron
- Lake Richmond
- Lark Hill
- Lake Cooloongup
- Lake Walyungup
- Tamworth Hill
- Tamworth Hill Swamp
- Anstey Swamp
- Paganoni Swamp
- Port Kennedy Scientific Park

The Park is a significant feature of the Rockingham area, occupying approximately 16% of the area of the City of Rockingham. The Park is surrounded mainly by residential and commercial land uses, with some rural areas to the south east of the park.

Park values

The Park is valued for:

- *Natural environment*: the Park has significant conservation value owing to its geomorphic features, the presence of diverse wetland types, habitat, flora and fauna. The location of the park in relation to other conservation reserves also enhances its value in a regional context.
- *Recreation*: the Park provides for a range of active and passive recreation opportunities. Most visitors to the eastern part of the park are local residents, whilst Cape Peron and Lake Richmond have a greater profile and attract visitors from across the Perth metropolitan area.
- *Cultural heritage*: traditionally, Aboriginal family groups travelled the Rockingham area throughout the seasons. Wetlands and woodlands would hold high cultural significance due their importance for food and shelter. Various aspects of European heritage are linked to the Park, for example, the Second World War gun batteries on Cape Peron.
- *Landscape*: the diverse landscapes of the Park, including wetlands, woodlands and coastal areas, contribute to its scenic values.
- *Research and education values*: the unique and diverse environmental features of the Park provide many educational opportunities.



Source: CALM (2003)

Figure 11 Location of Rockingham Lakes Regional Park

The long term vision for the Park is:

> *"The Rockingham Lakes Regional Park will be a well managed park supporting a diversity of habitats in a sustainable manner. The park will provide for the conservation and preservation of ecological and heritage values, research and education, as well as providing for the recreational needs of the community in a visually harmonious way."*

Consideration of development proposals

The draft management plan acknowledges the possible development of a boat harbour at Mangles Bay and that the site is likely to be the subject of further planning. In recognition of prior planning for the development, the area of the Park that may be potentially affected has been classified within an '*Area subject to further planning*' management zone. This management zone recognises that the long term

management of the Cape Peron area "may depend on the outcomes of further planning and Government decisions on the proposed boat harbour at Mangles Bay" (CALM 2003; Table 1, pg. 15)

With respect to the proposed boat harbour, the draft management plan also acknowledges:

- "Should the boat harbour proposal proceed it will require land to be excised from the Park. An excision would require an amendment to the Metropolitan Region Scheme to change the land from 'Parks and Recreation', to an appropriate zoning" (CALM 2003, pg. 8).
- "The resources required by CALM to manage issues resulting from a harbour development would be considerable and ongoing. In the case that the harbour proceeds, adequate compensation for the loss of Regional Park estate would be sought and appropriate mitigation to minimise environmental impacts would be required" (CALM 2003, pg. 56).

5.4.2 Assessment framework or policy context

Regional Parks

In 1997, the State Government announced a commitment to introduce legislation to give regional parks legal standing. Regional parks are vested in the Conservation Commission of Western Australia. The coordination and management of the eight metropolitan regional parks is to be progressively transferred to CALM, the Government's primary agency for conservation and recreation land management.

The current land tenure arrangements within defined regional park areas are complex with a number of different landholders of both Crown land and private land. The Western Australian Planning Commission has proceeded to, and will continue to, acquire the land that is required to consolidate the parks.

Planning for regional parks occurs at a number of levels (Figure 12).

Source: CALM (2003)

Figure 12 Regional park planning hierarchy

Rockingham Lakes Regional Park Draft Management Plan 2003-2013

The key environmental and social objectives from this plan (CALM 2003) that are relevant to the proposed Cape Peron Tourist Precinct project include:

Environmental

- *Maintain and improve the ecological condition of the coast adjoining the Park.*
- *Protect and enhance wetland environments.*
- *Protect, conserve, rehabilitate and restore locally and regionally significant flora and vegetation communities.*
- *Maintain and improve the overall condition of the Threatened Ecological Communities.*
- *Maintain the diversity of the indigenous fauna species in the Park and if possible reintroduce species lost from the Park.*
- *Maintain the impact of environmental weeds on biodiversity within the Park using methods compatible with the conservation of the natural environment.*
- *Restore degraded areas of the Park to a condition resembling the natural environment.*
- *Minimise the environmental and social impact of pets and domestic animals in the Park.*
- *Encourage appropriate management of corridors and linkages between the Park and other conservation or recreation areas.*

Social

- *Maintain and enhance the natural and cultural landscape qualities.*
- *Identify, protect and appropriately manage sites with Aboriginal and non-Aboriginal cultural heritage value.*
- *Ensure that the level of visitor use and behaviour is sustainable and minimises conflict with other Park visitors and values.*
- *Provide and manage a range of quality recreation sites, facilities and uses that allow for a diversity of recreation opportunities without conflicting other Park values.*
- *Provide safe, convenient and structured access to and within the Park.*

Development proposals

- *Ensure that developments do not adversely affect values of the Park.*

Environmental offsets

See Section 5.3.2 for description of Environmental Protection Authority (EPA) Preliminary (version 2) Position Statement No. 9, 'Environmental Offsets'.

Preliminary (version 2) Position Statement No. 9 recognises Regional Parks as 'critical assets' and does not consider it appropriate to validate or endorse the use of environmental offsets where projects are predicted to have significant adverse impacts to critical assets.

5.4.3 Potential impacts and mitigation

The Cape Peron Tourist Precinct has the potential to affect the five values identified for the Park:

- **Natural environment:**
  - disturbance to vegetation and flora, and fauna values
  - improvement in vegetation condition through rehabilitation
- **Recreation:** potential to increase recreational activity and opportunity to better manage recreation
- **Cultural heritage:**
  - potential disturbance of cultural heritage sites
  - enhancement of these values through recognition and restoration of cultural values.
- **Landscape:** potential loss of visual amenity associated with the natural coastal environment through the development. Visual amenity may also be enhanced through rehabilitation measures.
- **Research and education:** creation of new research and education opportunities.

Natural environment

Potential impacts of the development on flora and vegetation, and fauna values have been described in Section 5.1.3 and Section 5.2.3 respectively and Lake Richmond in Section 5.5.3. The development will require a proportionally small area of land to be excised from the Park (including cleared areas) as follows:

- Development Option 2.2: approximately 51 ha or 1.2% of the total area of the Park.
- Development Option 2.3: approximately 44 ha or 1.0% of the total area of the Park.
- Development Option 2.4: approximately 39 ha or <1.0% of the total area of the Park.

BFPA 355 has the same boundaries as the Cape Peron section of the Regional Park and the actual clearing within this section of the Regional Park is:

- Development Option 2.2: approximately 43.9 ha of BFPA 355 to be cleared, or 41% of the total area of BFPA 355.
- Development Option 2.3: approximately 36.3 ha of BFPA 355 to be cleared, or 34% of the total area of BFPA 355.
- Development Option 2.4: approximately 30.9 ha of BFPA 355 to be cleared, or 29% of the total area of BFPA 355.

Mitigation measures to improve the environmental values of the balance of Cape Peron are described below.

Recreation

Cape Peron is a popular sightseeing destination and is also a popular location for activities such as fishing, walking, excising dogs, diving, swimming, picnicking and windsurfing (Section 3.1.4). Most of these activities are pursued at locations outside of the proposed development area. The recreation masterplan for the Cape Peron area of the Park identifies the point and Lake Richmond as providing

the focus for visitor use and facilities (CALM 2003). The Park will continue to provide opportunity for these activities at the point in the presence of the proposed development and is expected to compliment the visitor experience at these sites.

There is some current use of the Mangles Bay foreshore for walking, snorkelling and boat launching. In the short term, the pursuit of these activities may be affected in the immediate area of the proposed development during all or part of the construction phase. Opportunities for these activities will be improved in the area subsequent to development. See Section 4.3.1 for details of the proposed development plan. The development will result in increased recreational activity in the regional park but the development will also provide an opportunity to better manage this activity in the park and the adjoining marine areas.

Cultural heritage

Two European heritage sites were identified on Cape Peron; Cape Peron Battery Complex and Turtle Factory (Section 3.1.6). The Cape Peron Battery Complex is located outside of the development footprint and will not be affected by the proposed development. Mitigation measures are likely to enhance values associated with this site. The Turtle Factory building is located to the north of Point Peron Road within the Cruising Yacht Club complex and is therefore, not within the Park. Potential impacts on this site and Aboriginal heritage values are described in Section 7.1.3.

Landscape

The current landscape character of the proposed development area is a combination of natural areas (e.g. vegetation, foreshore and marine waters) and developed areas (e.g. roads, power transmission lines, boat yards, caravan parks and other buildings).

The proposed development will result in a change in the landscape values of the Cape Peron area. These changes may be perceived by some as detracting from the current landscape character of the area, whilst others may perceive the change in landscape as enhancing the landscape character of the area. The development has been designed with consideration of the surrounding landscape to ensure the design is sympathetic and/or complimentary to the local landscape character to reduce adverse visual impacts.

Research and education

The proposed development is expected to contribute positively to research and education opportunities. An educational facility that contributes to the research and training for marine related sciences is proposed within the development.

Mitigation

Consistent with the environmental and social objectives for the park, comprehensive mitigation is proposed to offset the potential impacts of the proposed development, including those impacts on Regional Park values. Mitigation measures are described in detail in Section 8.

The measures for the protection and rehabilitation of vegetation and flora, and fauna values described in Section 5.1.3 and Section 5.2.3 respectively also directly relate to Regional Park values. Section 5.5.2 describes the provision for wetland buffers between Lake Richmond and the proposed development.

In addition, within the Cape Peron and Lake Richmond area of the Park, it is also proposed to:

- improve recreational opportunities by providing hard walking and cycling paths without creating additional disturbance to the natural environment
- provision of board walks in sensitive areas with a lookout over Shoalwater Bay
- provision of public toilet facilities on Point Peron
- formalise beach access points and remove unnecessary paths to minimise dune erosion
- recognise cultural heritage (Aboriginal and European) links with the area (e.g. providing interpretative signage at sites of significance and contributing to the maintenance of these sites)
- contribute to research and educational opportunities through the provision of facilities within the marina and interpretative walk trails/ signage
- provide $0.8 million funding to CALM for ongoing management of the proposed facilities and the natural environment within the Cape Peron and Lake Richmond area of the Park.

5.4.4 Expected outcome

The development will result in the excision of about 44 ha for Option 2.3 and 39 ha for Option 2.4 or 1.0% and <1.0% of the total area of the Park respectively. The proposed development is expected to improve Park management regimes and will positively contribute to CALM's management of the Cape Peron area of the Park, including management of natural areas and visitor facilities.

The development will present an opportunity to contribute to Park values, through the provision of additional recreational opportunities, enhancing the biodiversity values of the remaining natural environment and providing research and educational opportunities.

5.5 LAKE RICHMOND

5.5.1 Description of Lake Richmond

Lake Richmond is a perennial freshwater lake covering approximately 40 ha that is about one metre above sea level and is up to 15 metres deep (CALM 2005). It is located across Safety Bay Road, near, but outside, the proposed tourist precinct development and is bounded by residential development on most sides (Figure 6). The lake is of iconic value to the Rockingham community.

Lake Richmond evolved from a marine embayment and historically (prior to the 1960's) contained saline water (English et al. 2003). Cape Peron was once an island that became connected to the mainland as sand accumulated on the leeward side. Lake Richmond was cut off from the marine environment by this process (CALM 2005).

Water quality and hydrology

Historically, Lake Richmond was saline as it was once connected to the marine environment. Water quality in the lake in the mid 1960's was brackish to saline[14] with 2000 to 3500 mg/L total dissolved salts recorded (English et al. 2003). In the 1960's drains were installed to drain Rockingham's stormwater into Lake Richmond, resulting in a decrease in the lake salinity concentrations, which have stabilised in the range 300 to 400 mg/L total dissolved solids (Bowman Bishaw Gorham 1997).

Lake Richmond is a throughflow lake receiving groundwater discharge from the Safety Bay aquifer in a southerly arc spanning the lake from east to west. The lake leaks water to the north where it becomes part of the groundwater flow system that eventually discharges into Cockburn Sound (English et al. 2003). The lake also receives stormwater runoff from drains receiving much of the stormwater from Rockingham, Shoalwater and Safety Bay. Currently, there are three main drains into Lake Richmond and one outlet drain that traverses the project area and discharges to Mangles Bay.

Water levels vary seasonally, ranging from 0.2 to 1.2 m AHD with a long term average water level of 0.75 m AHD (WorleyParsons 2005a).

A saltwater-groundwater (freshwater) interface[15] currently intrudes approximately 150 m inland to the base of the Safety Bay aquifer at a depth of approximately 65 m below ground level (English et al. 2003).

Vegetation and flora

Lake Richmond is bordered by flats devoid of permanent vegetation that pass into sedges at the base of surrounding coastal dunes. The flats are up to 70 m wide and bare except for clumps of *Juncus*

[14] Water is defined as fresh/marginal if the electrical conductivity is <1000 mg/L, brackish from 1000 to 3000 mg/L and saline if >3000 mg/L. The salinity of seawater is approximately 35 000 mg/L.

[15] As the groundwater underlying the ocean is saline, a wedge shaped boundary or interface is formed between the higher density ocean water and the lower density fresh groundwater beneath the land. The shape and movement of the saltwater-groundwater interface depends on factors such as the direction and gradient in groundwater flow, density difference between the salt and freshwater, aquifer permeability and tidal and storm surge heights and gradients (WorleyParsons 2005).

kraussii and *Schoenus nitens*. The sedgeland is several metres wide and is dominated by *Baumea juncea, Scirpus validus* and clumpos of the bulrush *Typha orientalis*. The dunes are up to four metres high and support low coastal scrub of *Acacia cyclops* and *A. saligna* over shrubs of *Adriana quadripartite, Olearia axillaris, Scirpus nodosus* and *Acanthocarpus preissii* (DEH 2004).

Conservation significance

Lake Richmond supports two TECs identified by CALM as 'critically endangered'[16]:

- Floristic Community Type 19a (as identified by Gibson et al. 1994); 'Sedgelands in Holocene dune swales'.
- Stromatolite-like microbialite community of coastal freshwater lakes (Lake Richmond).

Both TECs are also listed as 'endangered' under the EPBC Act. The Lake Richmond thrombolite community is the only known occurrence of this community. Lake Richmond is also listed on the Register of the National Estate due in part to the presence of the thrombolite community.

The Holocene dune swale community occurs in linear damplands, and occasionally sumplands, between Holocene dunes. Their present distribution is almost entirely located within swales (linear wetland depression) occurring between parallel sand ridges of the Rockingham-Beecher Plain. The Holocene dune swale community is also of geomorphological significance due to the information it provides about the evolutionary record of sea-level history and climatic changes (English et al. 2002).

Thrombolites are microbial structures, which represent one of the oldest living organisms on earth. Lake Richmond is one of the few places in the world where thrombolites are found. Thrombolites are organo-sedimentary structures that are produced by the growth and metabolic activity of benthic communities. The structures are formed by a complex association of bacteria and micro-algae.

Thrombolites of Lake Richmond

Thrombolites occur in a 15 m wide band around the edge of Lake Richmond, with the best developed structures occurring on the eastern side of the lake. Sunlight and fresh water rich in calcium, carbonate and bicarbonate are likely to be essential for their survival. Calcium is probably supplied by groundwater that has passed through the calcium-rich dunes around the lake. The thrombolites appear to be adapted to freshwater and would be unlikely to survive a return to saline conditions (DEH 2004).

Other biological values

Lake Richmond is utilised by a range of fauna, including:

- waterbirds (e.g. various species of grebes, cormorants, egrets and ducks)
- reptiles (e.g. Gould's monitor dragons)

[16] An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range but capable of being substantially restored or rehabilitated (DEH 2004).

- amphibians (e.g. Motorbike and Moaning Frogs)
- fish.

The lake supports the Long-necked Tortoise (*Chelodina oblonga*), which lives and feeds in the lake laying its eggs in the dunes nearby, and an unnamed species of mollusc (Bowman Bishaw Gorham 1997).

Bird species protected by the Japan Australia Migratory Bird Agreement (JAMBA) and the China Australia Migratory Bird Agreement (CAMBA) are known to inhabit Lake Richmond. These species are also protected under the EPBC Act.

5.5.2 Assessment framework or policy context

EPA Objectives

The EPA objective relevant to this assessment is:

- *To maintain the integrity, ecological functions and environmental values of wetlands.*

The following overriding EPA objective addressing biodiversity is also relevant:

- *Maintain biological diversity where that represents the different plants, animals and micro-organism, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

Wetland policies

Several environmental protection policies provide specifically for the protection of significant wetlands on the Swan Coastal Plain and the south-west region of the State:

- *Environmental Protection of Wetlands Preliminary Position Statement* (Position Statement No. 4)
- *Wetlands Conservation Policy for Western Australia 1997*.

Statutory Environmental Protection Policies (EPPs) include:

- *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*,
- *Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 2004.*

The EPPs prohibit disturbance to any registered EPP wetland (Lake Richmond is a registered wetland under the EPP) without an assessment by the EPA.

The EPA has also previously reported on strategies for the protection and management of wetlands in several bulletins, including:

- Bulletin 685: *Strategy for the protection of lakes and wetlands of the Swan Coastal Plain*.
- Bulletin 686: *A guide to wetland management in the Perth and near Perth Swan Coastal Plain Area*.

In addition, the Water and Rivers Commission (WRC) (now Department of Environment) position on buffer requirements for wetlands has been outlined in the *Wetlands Position Statement* (WRC 2001) and *Advisory Notes for Land Managers on Rivers and Wetland Restoration* (WRC 2000).

Wetland buffers

As a general guide, the EPA normally recommends a minimum distance between intensive land uses and wetlands of 50 m from the point one metre higher in elevation than the furthest extent of the wetland vegetation (minimum dryland buffer).

The Department of Environment *Wetland Position Statement* recommends buffer distances between various land uses and wetlands in absence of management to address potential threats (Table 9). The buffer[17] width recommended for a particular wetland is dependent upon the conservation significance of the wetland and the purpose of the buffer.

The Department for Planning and Infrastructure has also developed a *Land Use Planning Guideline for the Determination of Wetland Buffer Requirements* to assist land owners, developers and architects in identifying appropriate buffering between wetlands and existing or proposed land uses that will enhance or maintain the significant attributes and values of the wetland (Essential Environmental Services 2004; Welker Environmental Consultancy 2002).

Table 9 Water and Rivers Commission recommended widths for wetland buffers on the Swan Coastal Plain

Purpose of Buffer	Land Use Example	Buffer Width*	Implications
Reduction of impact of nuisance insects on residents (e.g. midges)	Residential housing	800-1000 m depending on orientation of wetland#	Existing and proposed housing within 100 m of wetland. Midges not considered significant issue in area. City of Rockingham issue
Protection from nutrient inputs	Market garden	200 m on transmissive soils, 100 m on non-transmissive soils	Avoid inclusion of large garden areas requiring fertiliser application Direct stormwater away from wetland
Protection from pollution (e.g. petroleum hydrocarbons, surfactants)	Mechanical workshop	200 m	Restrict landuses within 200 m of wetland to activities with little potential to pollute surface water and groundwater draining to a wetland.
Protection from heavy metal contamination	Mineral processing operation	200 m	Not Applicable
Protection from pesticide drift	Orchard	200 m	Not Applicable
Reduction of sedimentation	Timber harvesting operation	100 m	Not Applicable
Protection of groundwater quality	Agricultural composting facility	2000 m in direction of groundwater flow for transmissive soils	Not Applicable
Protection of avifauna nesting and roosting sites	Residential housing	200-800 m	Housing at least 200 m from Lake Richmond. Control access from project area to wetland Fauna Management Plan

[17] The term buffer in the June 2001 draft *Wetlands Position Statement* (WRC 2001) refers to a distance required between a wetland and another use. The statement does not refer to a requirement for vegetation within this buffer distance.

Purpose of Buffer	Land Use Example	Buffer Width*	Implications
Protection from weed infestation	Residential housing	50-100 m	Housing at least 50 m from Lake Richmond
Maintenance of natural water levels	Vineyard	200 m but dependent on water extraction	Addressed by WRC bore application process

Source: Wetlands Position Statement (WRC 2001)

*Buffer width recommendations may be varied at the discretion of the Commission as new data becomes available. Guidance on the Commission's buffer recommendations is received from the State Wetlands Coordinating Committee working group on wetland buffers.

Current practice for insect nuisance buffering is 500 m. It is understood that distances in excess of this have not yet been applied in practice.

Threatened Ecological Communities

Unlike threatened flora and fauna, there is currently no specific legislation formally protecting TECs at the State level. However, an informal, non-statutory process, including advice from a scientific advisory committee, the establishment of the TEC database, and steps for assigning ecological communities to categories of threat, is in place and is coordinated by CALM (CALM 1999b).

The two Lake Richmond TECs (thrombolites and the 'sedgelands in Holocene dune swales' are recognised as matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any proposals that are likely to have a significant impact on such matters are subject to approval by the Commonwealth Minister for the Environment.

Other

See Sections 5.1.2 and 5.2.2 for relevant assessment frameworks and/or policies relating to vegetation and flora, and fauna, including migratory fauna.

5.5.3 Potential impacts and mitigation

The following aspects of the proposed Cape Peron Tourist Precinct Project may potentially impact on the values of Lake Richmond:

- **Dewatering to allow construction of canals** will lead to temporary groundwater drawdown which may lead to:
  - exposure of acid sulphate soils if they exist around Lake Richmond
  - lowering of water levels in Lake Richmond.
- **Saltwater intrusion** caused by the inland movement of the saltwater-groundwater (fresh) interface due to canals
- **Buffer establishment** between the development and the lake including the rehabilitation of vegetation within the buffer

Nutrient inputs to the lake from the proposed development are not anticipated because groundwater under the development flows away from Lake Richmond to Mangles Bay.

WorleyParsons Services Pty Ltd (WorleyParsons 2005a) conducted a preliminary assessment of the potential impacts (e.g. dewatering and saltwater intrusion) that the proposed Cape Peron Tourist

Precinct development (based on development Option 2.2) could have on the hydrology of Lake Richmond (Appendix 9). The following discussion is based on the assessment unless otherwise stated.

Dewatering

Water levels

WorsleyParsons constructed an analytical computer model using aquifer geometry and properties obtained from the Department of Environment AQWABase database and the Coffey Partners Geotechnical Report (Coffey Partners International Pty Ltd 1997) to determine the potential impact of lowering groundwater levels to -2.4 m AHD during canal construction from development Option 2.2 on water levels in Lake Richmond 200 m away from the canals.

The analytical model was developed using the HOTSPOTS modelling system, which was developed by the University of Technology Sydney and the NSW Department of Infrastructure, Planning and Natural Resources for assessing water allocation and trading applications, and for management of localised declines in groundwater levels due to over-abstraction (Merrick et al. 2002; Ross et al. 2004).

Modelling indicates that lowering groundwater levels to -2.4 m AHD during canal construction could potentially result in a drawdown of the watertable of approximately 15 cm at Lake Richmond in the absence of management controls. This would cause an associated drawdown of the lake water level although the surface water level will also be influenced by rainfall or evaporation at the time. Any impact will be restricted to the construction phase only. This result is based on Option 2.2. Options 2.3 and 2.4 are expected to have less (if any) of an impact on the water levels of Lake Richmond as the canal development in each case is 130 m and 150 m further away respectively from Lake Richmond than in Option 2.2.

This preliminary assessment suggests that Option 2.3 and 2.4 are unlikely to adversely affect lake water levels as the predicted impacts from dewatering are well within recorded seasonal variations (up to 1 m). However, as tidal variations and local variations in aquifer properties are likely to influence drawdown during canal construction more detailed modelling is required to better quantify the potential impacts and develop management measures to avoid such impacts if required.

Acid sulphate soils

Acid sulphate soils are naturally occurring soils that contain iron sulphide minerals, predominantly as the mineral pyrite. These naturally occurring iron sulphides are generally found in a layer of permanently waterlogged soil or sediment. Acid sulphate soils are most likely to occur in the coastal regions, in low-lying areas containing estuarine sediments, peaty sediments underlying wetlands and in mineral sands deposits along former shorelines.

The DoE and Western Australian Planning Commission (WAPC) have produced preliminary maps that indicate acid sulphate risk areas of the Swan Coastal Plain (WAPC 2003). All wetlands on the Swan Coastal Plain including Lake Richmond were included in the high risk category. In Australia, the acid sulphate soils of most concern are those that formed following the last major sea level rise, in the Holocene geological period (the last 10 000 years). Soil sampling is required to determine whether acid sulphate soils occur at Lake Richmond.

Acid sulphate soils only become a problem when the pyrite is exposed to air (oxidation[18]) by lowering of the watertable below where these soils occur in the profile. Wetlands underlain by pyritic sediments may become acidic if the watertable is lowered substantially by groundwater pumping or an extensive period of low rainfall.

The groundwater drawdown from Option 2.2 at the lake is predicted to be 15 cm for the construction period of the south east canals. Water levels will return to normal when dewatering ceases and the canals are filled with water. As the watertables fluctuate each year with rainfall and evaporation, it is highly unlikely that a temporary small change will cause acid conditions to develop as result of dewatering for construction.

Options 2.3 and 2.4 have canal development 330 m and 350 m respectively from Lake Richmond (130 m and 150 m respectively further away than Option 2.2) and based on the preliminary groundwater modelling of Option 2.2, it is highly unlikely that there would be any impact from Options 2.3 and 2.4 on Lake Richmond.

There is "low to no risk" of acid sulphate soils occurring beyond Lake Richmond (WAPC 2003) although this would be confirmed through onsite sampling as part of an acid sulphate soils investigation program in a detailed environmental assessment.

Saltwater intrusion

Preliminary modelling has been undertaken by WorleyParsons of the risk of saltwater intrusion. At the time, only Option 2.2 had been developed so the following results relate to that option. As Option 2.3 and Option 2.4 are further away from the lake, the risks associated with these options will be lower.

WorleyParsons predicted the shape of the saltwater-groundwater (freshwater) interface using the Ghyben-Herzberg equation, an accepted approach for approximating interfaces in urban areas south of Perth where the superficial aquifer consists mainly of sands (Davidson 1995). The predicted position of the saltwater-groundwater interface relative to Lake Richmond, under both existing and post-development conditions, is presented schematically in Figure 13. In predicting the locations of the interface the following assumptions were adopted:

- the superficial aquifer is homogeneous (i.e. the hydraulic conductivity of the Safety Bay Sand is the same as that of the underlying Tamala Limestone)
- the thickness of the superficial aquifer is 30 m
- no tidal variations (sea level held constant at 0 m AHD)
- no 'zone of diffusion'[19].

Groundwater monitoring of the superficial aquifer has shown that the saltwater-groundwater interface actually currently intrudes up to 2 km inland from the coast through solution cavities in the Tamala Limestone (Smith & Hick 2001). This results in an almost flat saltwater-groundwater interface within this aquifer and a thin layer of saline water at the base of the superficial aquifer within the Tamala

[18] Oxidation generally means the addition of oxygen or the removing of hydrogen to a substance in a chemical reaction.

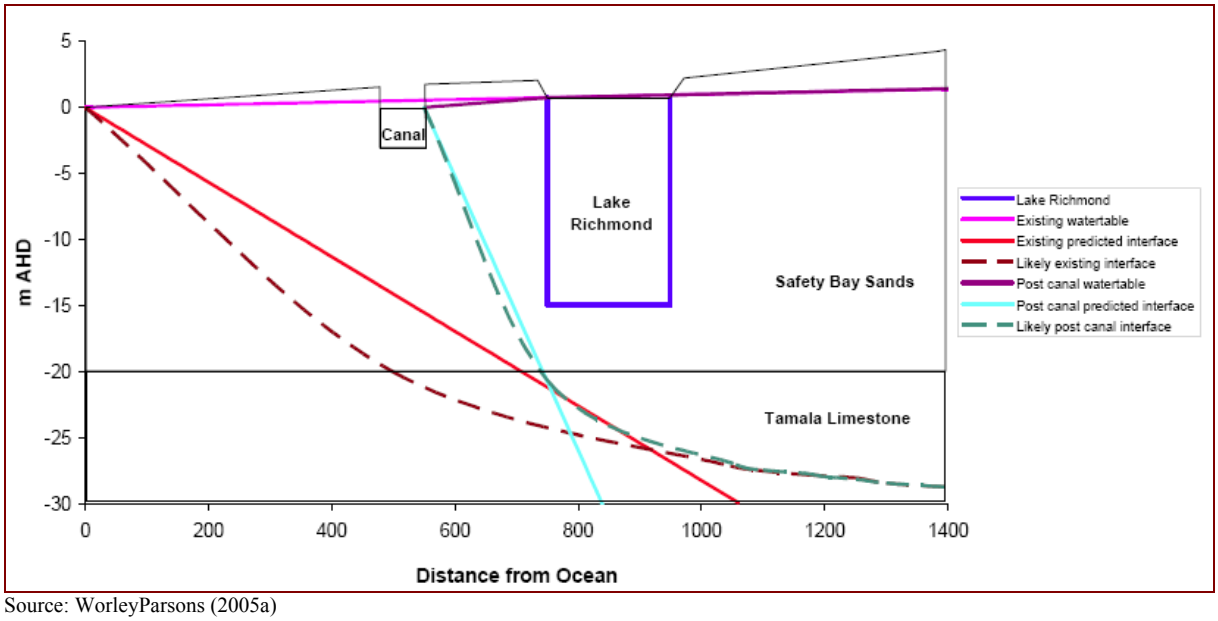
[19] In coastal areas, there is a 'zone of diffusion' at the interface where the fresh and saline groundwater mixes.

Limestone. The shape and position of a new saltwater-groundwater interface is likely to be similar to current situation (Figure 13).

Construction of the proposed development will result in both a steepening and lateral inland movement of the saltwater-groundwater interface (Figure 13). The anticipated distance between the saltwater-groundwater interface and the base of Lake Richmond under current conditions is approximately 200 m. The preliminary assessment indicated that this may be reduced to approximately 50 m for Option 2.2 following canal construction. However, there is a low risk that this distance would not be maintained in all conditions as the interface could be affected by tidal fluctuations, diffusion and local variations in aquifer properties. These processes would need to be taken into account in further detailed investigations and modelling.

As the canals in Options 2.3 and 2.4 are further from Lake Richmond (330 m and 350 m respectively, as opposed to 200 m in Option 2.2), the risk of salt water intrusion is likely to be substantially lower for these options. Detailed modelling of the groundwater system and the potential impact of the final design will be undertaken as part of any environmental assessment required by the EPA.

Should a more detailed investigation indicate that there is a significant risk of salt water ingress into Lake Richmond as a result of construction of the proposed canal development, engineering solutions will be investigated to eliminate the potential risk (e.g. impermeable cut off walls installed during construction).



Source: WorleyParsons (2005a)

Figure 13 Schematic representation of saltwater-groundwater interface for Option 2.2

Management and mitigation

The following mitigation measures are proposed to improve the natural values of Lake Richmond:

- maintaining and rehabilitating a predominately vegetated wetland buffer between Lake Richmond and the proposed development to enhance the wetland buffer values (consistent with the *Wetland Position Statement* [WRC 2001])

- supporting the rehabilitation of the ecological linkage between Lake Richmond and Point Peron
- contributing to the rehabilitation of the natural vegetation around Lake Richmond.

This is described in detail in Section 8.

5.5.4 Expected outcome

The development is not expected to have any significant direct or indirect adverse impacts on Lake Richmond. Due to the proximity of the lake to the development and its high conservation value, the proposed mitigation will aim to improve the conservation values of the lake. The proposed mitigation measures for the Cape Peron area include enhancing the conservation values of the ecological link from the lake to Point Peron and rehabilitation within the wetland buffer between Lake Richmond and the proposed development.

The risk of saltwater intrusion affecting Lake Richmond in Option 2.2 is low and there is a low likelihood of an adverse impact on Lake Richmond water levels as a result of the proposed development. Options 2.3 and 2.4 will reduce this low risk even further due to the increased distance between Lake Richmond and the development. More detailed investigations of saltwater intrusion and groundwater drawdown will be conducted if the project proceeds to an environmental assessment required by the EPA.

6. MARINE ENVIRONMENT

The Marine Environment section of this SER is based on information supplied by by Oceanica Pty Ltd.

6.1 MARINE WATER QUALITY

6.1.1 Description

Cockburn Sound

The water quality of Cockburn Sound has been the focus of considerable study since late 1970s, when it was found that the discharge of industrial waste and domestic wastewater (sewage) into Cockburn Sound had caused widespread contamination of sediments and biota, poor water quality and widespread loss of seagrass on the eastern margin of the Sound. The loss of seagrass was attributed to shading caused by nutrient-stimulated growth of epiphytes (algae that grow on seagrass leaves) and phytoplankton (microscopic algae in the water). Water quality has improved considerably since the 1970s, but remains the focus of management attention today due to the intensive level of multiple uses in the Sound (Fremantle Port outer harbour, discharge of industrial effluent and cooling water, power station cooling water, a strategic naval base, commercial fishing, and intensive recreational use).

Water quality monitoring presently focuses on nutrient-related effects, especially the growth of phytoplankton (measured as 'chlorophyll a' levels) as this provides a good indication of the available nutrient supply. Water clarity (measured as 'light attenuation') is also a useful measure, as it is affected by phytoplankton levels.

Nutrient related water quality depends mainly on two factors:

1. Nitrogen inputs to the area (nitrogen is the main nutrient determining marine plant growth).
2. How well the area is 'flushed' with marine water.

The water quality of Cockburn Sound is due in part to its enclosed nature (by Parmelia Bank to the north, Garden Island to the west, and the Garden Island Causeway to the south), which reduces exchange (flushing) with the water of Owen Anchorage to the north and the open ocean to the west and south. Flushing times affect the dilution of nutrient and contaminant inputs, and therefore a variety of ecological processes (e.g. plant growth rates, toxicity responses) that depend on the concentrations of these substances.

Median summer chlorophyll levels throughout Cockburn Sound presently vary from 0.5 µg/L in well flushed areas that are far away from nutrient inputs (e.g. the northern end of the Sound) to >4.0 µg/L in poorly flushed areas close to major nutrient inputs (e.g. Jervoise Bay Northern Harbour).

There is also water quality monitoring for indicators of faecal contamination (measured as 'enterococci' levels, in colony forming units (cfu) per 100 ml) to ensure marine waters are safe for recreation. The levels in Cockburn Sound are generally well below recreational use guidelines, but exceedences occur in some areas of the Rockingham foreshore and Mangles Bay, especially after stormwater discharge into the Sound.

Flushing of waters in Cockburn Sound

Current speeds and circulation patterns determine the flushing of Cockburn Sound, and these in turn are mainly determined by wind and horizontal pressure gradients. The latter are the result of differences in water pressure between two areas, and may be grouped into those driven by wind, tides, waves, seiches and atmospheric pressure (which cause differences in water level between areas) and those driven by horizontal differences in water density (cold, salty water is more dense than warm, fresh water).

Waves and currents in Cockburn Sound are primarily wind-generated. Wind is also the main driving mechanism of circulation within the Sound when the wind speed is above 5 m/s. During calm periods (wind speed <5 m/s), however, circulation becomes complex and is driven by a combination of wind and horizontal pressure gradients.

Three distinct hydrodynamic regimes have been identified in Cockburn Sound based on the relative importance of wind and pressure gradients in determining circulation patterns and flushing: 'summer', 'autumn' and 'winter-spring' (DEP 1996). The key characteristics of the three seasons are as follows:

- **Summer**. During summer, winds are the most important factor controlling hydrodynamics. Circulation is wind-driven and the waters within both the Sound and adjacent waters are vertically well mixed (and therefore well oxygenated).
- **Autumn**. During autumn the wind subsides and pressure gradients determine the circulation. The waters in the Sound are of greater density (cooler and more salty) compared to adjacent water due to evaporation that has occurred during the summer and rapid cooling during autumn. The gradient between the denser waters of Cockburn Sound and the lighter adjacent water controls the flushing of Cockburn Sound to the greatest extent. 'Stratification' (distinct vertical layering of water) also occurs due to movement of lighter water into the Sound. Flushing of the bottom waters of Cockburn Sound during autumn depends on wind events that vertically mix the whole water column (generally requiring wind speeds >5 m/s for 2-3 days or more), followed by re-establishment of density gradients. Such wind events are rare in autumn, and so the deep basin waters of the Sound are particularly poorly flushed in autumn.
- **Winter-spring**. Circulation is primarily driven by pressure gradients, punctuated by periods of wind-driven circulation due to storm activity. The waters within the Cockburn Sound become progressively lighter than waters further offshore due to the relative lowering of salinity by freshwater inflow, particularly from rivers. The relatively rapid response of the shallow waters of Cockburn Sound to heating (compared to offshore waters) as spring progresses also contributes to the relative decrease in density. Denser water moves into the lower depths of Cockburn Sound during calm periods (wind speeds typically less than 5 m/s), and stratification persists until broken down by the passage of winter low pressure systems about every 7-10 days (D'Adamo & Mills 1995).

There are many ways to measure the time over which Cockburn Sound is flushed. To be consistent with previous modelling of Cockburn Sound (DEP 1996) the 'e-folding' time is used in this report, which estimates the time taken for 63% of Cockburn Sound to be flushed. The e-folding time for Cockburn Sound is roughly a month: 37 days in autumn, 22 days in winter and 44 days in summer (highest in summer because the prevailing winds set up circulation gyres that tend to confine water within the Sound). These are flushing times for Cockburn Sound as a whole: flushing times for localised areas within the Sound are much less (e.g. about a day along the eastern margins of the Sound).

Nutrient inputs to Cockburn Sound

About 300 tonnes/year of nitrogen enter Cockburn Sound from industrial outfalls, groundwater discharge, surface drainage (stormwater runoff) and the atmosphere. Of these, groundwater discharge is the largest contributor (about 75%) (DAL 2001).

The cycling of nutrients between sediments and the water column also plays an important role in determining water quality, particularly under conditions of low oxygen. The waters of the Sound are generally well oxygenated, although if calm weather persists for more than a week (which occurs most often in autumn), the deep waters at the southern end of the Sound may become low in oxygen. This is due to stratification and bacteria in the organic-rich sediments that use up oxygen faster than that supplied by diffusion down the water column. Oxygen levels in the bottom waters sometimes become so low that the release of nutrients from sediments to the water column increases.

Water movement plays a major role in determining sediment characteristics (including nutrient cycling) within Cockburn Sound. In calmer and/or deeper areas the sediments tend to be finer and siltier, while shallower/more exposed areas experience more wave and current action and so have sandier sediments (the finer particles are easily suspended and swept away). Calmer/deeper areas accumulate fine organic particles (e.g. dead plankton, faecal material), and so are more organically enriched than shallower/more exposed areas. Contaminants discharged to marine environments—and any increased production of organic matter due to nutrient enrichment—typically accumulate in the sediments, especially in sheltered, relatively deep areas.

Mangles Bay

Mangles Bay is sheltered by the Garden Island Causeway and Cape Peron, and therefore is relatively calm and poorly 'flushed' by marine waters under most circumstances, but is exposed to storms from the north. Chlorophyll levels in Mangles Bay have varied between 1.3 and 1.7 µg/L over the past four years (and were even higher prior to summer 2000/2001, when nutrient inputs to the Sound were also higher). The relatively high chlorophyll values in Mangles Bay are believed to be largely due to the reduction in flushing of the area by the construction of the Garden Island Causeway in 1971–73, although the area would also have been naturally calm and sheltered before this time.

Nutrient inputs to Mangles Bay are from groundwater discharge (which occurs all year round) and stormwater drainage (which occurs mainly in winter and early spring). Appleyard (1994) has estimated groundwater discharge to the Mangles Bay area to be 53 ML/year/km, and to contribute between 0.048 to 0.573 tonnes nitrogen/year/km along the 4 km of coast east of the Causeway. The variation in estimated loads is due to the variation in groundwater flows and nitrogen concentrations in groundwater bores in the region (Table 10). The total load of groundwater nitrogen to Mangles Bay from the 4 km of coast east of the Causeway is estimated to be 0.814 t/year and is largely in forms readily available for aquatic plant growth (ammonium, nitrate). Little groundwater discharge is expected west of the Causeway, as the groundwater flow path to Mangles Bay or Shoalwater Bay is much shorter.

Table 10 Concentrations of nitrogen in groundwater entering Mangles Bay

Nutrient	Bore 125601	Bore 125609	Bore 125602	Bore 125608
Nitrogen (mg/L)				
Total nitrogen	0.90	1.08	3.58	0.85
Ammonium	0.86	0.83	0.28	0.80
Nitrate-plus nitrite	0.04	0.25	3.30	0.05

There are seven stormwater drains entering Mangles Bay, but by far the largest stormwater flow is from the Lake Richmond drain (R. Mort, City of Rockingham, *pers. comm*.). There are no data for volumes of stormwater outflow from the minor drains, but outflow from Lake Richmond drain was measured between 1978 and 1986 and found to be highly variable, averaging 2,270 ML/year (DMH 1992). Based on water quality data for stormwater, DMH (1992) estimated the Lake Richmond drain contributed 0.25–8.3 tonnes/year total nitrogen, 32 kg/year copper, 98 kg/year lead and 104 kg/year zinc. More recent estimates indicate a lesser load of 0.122 tonnes nitrogen/year in the three months of winter 2002 (Water and Rivers Commission, cited Natural Resource Management Office, Naragebup Rockingham Regional Environment Centre [Inc.] 2003a), possibly due to rainfall in recent years has been below the historical long-term average.

Groundwater inputs are important as discharge occurs all year round, and nitrogen is largely in forms readily available for aquatic plant uptake. Unlike groundwater, stormwater flows mainly in the winter months, and the majority of nitrogen in stormwater is present as organic nitrogen, and therefore not readily available for plant uptake. Recent water quality data for Lake Richmond drain and the minor drains (Table 11) suggest that in years of low to average rainfall the major input of nitrogen to Mangles Bay is from groundwater.

Table 11 Concentrations of contaminants in stormwater draining into Mangles Bay

Statement of Planning Policy 2.8 requirement	Lake Richmond Drain*	Minor drains**
Total nitrogen	0.65–1.00 mg/L	0.400–0.780 mg/L
Kjeldahl nitrogen (organic nitrogen)	> 90% of total nitrogen	53–85% of total nitrogen
Nitrate-plus-nitrite	0.012–0.043 mg/L	0.100–0.380 mg/L
Ammonium	No data	0.093–0.110 mg/L
Total phosphorus	0.012–0.200 mg/L	0.051–0.800
Orthophosphate	0.005–0.028 mg/L	0.036–0.047
Total suspended solids	No data	3–8 mg/L
Copper	0.001 mg/L	0.006 mg/L
Lead	0.001 mg/L	0.010 mg/L
Zinc	0.016– 0.062 mg/L	0.021 mg/L

* Natural Resource Management Office, Naragebup Rockingham Regional Environment Centre (Inc.) (2003a, b) for routine monitoring in winter 2002 and winter2003.

** Snapshot survey data provided courtesy of D. Mort, City of Rockingham, for Bell Park and Hymus St drains for winter 2005.

There are no data to compare the relative importance of groundwater and stormwater in contributing other contaminants such as metals and hydrocarbons to Mangles Bay, but these types of contaminants are more common in road runoff and so it is likely that stormwater is the major source. There does not appear to be significant amounts of herbicides or pesticides entering Mangles Bay from stormwater (Natural Resource Management Office, Naragebup Rockingham Regional Environment Centre [Inc.] 2003a, b).

Stormwater drains also discharge high loads of faecal bacteria, with winter 2005 data (R. Mort, City of Rockingham, *pers. comm.*) indicating enterococci levels of 450–3,550 cfu/100 ml, well above health guidelines. As the Cape Peron area west of Hymus St is on septic system, there is also the possibility that groundwater is carrying faecal bacteria into Mangles Bay from the various leasehold sites.

In addition to groundwater and stormwater inputs of nutrients and contaminants to Mangles Bay, anecdotal evidence of inputs from boats moored in Mangles Bay was provided during the community consultation for this project. These included fuel spillage during informal refuelling, illegal sullage disposal and rubbish disposal. There would also be some contaminant input from leaching of anti-foulant from the hulls of moored boats (probably dominated by copper-based biocides, and herbicides).

6.1.2 Assessment framework or policy context

State Environmental (Cockburn Sound) Policy

The State Environmental (Cockburn Sound) Policy (SEP) has been released by the Minister for the Environment to declare, protect and maintain the environmental values (EVs) of Cockburn Sound (Government of Western Australia 2005). To ensure the EVs are protected, environmental quality objectives (EQOs) must be met (Table 12), and environmental quality criteria have been specifically developed for Cockburn Sound to provide the quantitative benchmarks for measuring success in achieving the EQOs set in the SEP (EPA 2005).

Table 12 Environmental quality values and environmental quality objectives for Cockburn Sound

Environmental values	Environmental quality objectives
Ecosystem health	Maintenance of ecosystem integrity in terms of structure (e.g. biodiversity, biomass and abundance of biota) and function e.g. food chains and nutrient cycles).
Seafood safe for eating	Maintenance of aquatic life for human consumption, such that seafood is safe for human consumption when collected or grown.
Aquaculture	Maintenance of aquaculture, such that water is of a suitable quality for aquaculture purposes.
Recreation and aesthetics	Maintenance of primary contact recreation values, such that primary contact recreation (e.g. swimming) is safe. Maintenance of secondary contact recreation values, such that secondary contact recreation (e.g. boating) is safe. Maintenance of aesthetic values, such that the aesthetic values are protected.
Industrial water supply	Maintenance of industrial water supply values, such that water is of suitable quality for industrial water supply purposes.

Two forms of environmental quality criteria have been developed:

1. Environmental quality guidelines (EQGs): environmental quality guidelines are threshold numerical values which, if met, indicate a high degree of certainty that the associated environmental quality objective has been achieved. If the guideline value is not met then a more detailed assessment process against an environmental quality standard is triggered.
2. Environmental quality standards (EQSs). Environmental quality standards are threshold numerical values that indicate a level beyond which there is a significant risk that the associated environment quality objective has not been achieved and a management response is triggered (EPA 2005).

The environmental value of ecosystem health has different environmental quality criteria for zones of high, moderate and low ecological protection, whereas environmental values for safe seafood, aquaculture, recreation and aesthetics, and industrial water supply have the same criteria applied throughout Cockburn Sound.

Should this project proceed to detailed environmental impact assessment pursuant to Part IV of the EP Act, any resultant impact on water quality will be assessed by comparison with environmental quality criteria for the relevant environmental values.

Shoalwater Islands Marine Park

Shoalwater Islands Marine Park borders Mangles Bay at the Garden Island Causeway. The Park covers an area of approximately 6545 hectares and contains the waters of Shoalwater Bay, Warnbro Sound and a part of Cockburn Sound off Cape Peron. Shoalwater Islands Marine Park is presently unzoned, and as no sanctuary zones, recreation zones or special purpose zones are presently defined but the purposes of a general use zone have been applied as a default. The conservation of natural resources is a priority purpose but activities such as commercial fishing are allowed (and already occur) provided they do not compromise the conservation values.

The Park is vested to the Marine Parks and Reserves Authority, and managed on a day-to-day basis by CALM, apart from recreational fishing which is managed by the Department of Fisheries in close cooperation with CALM.

The Shoalwater Islands (the terrestrial portion) are presently managed under the 1992 Shoalwater Islands Management Plan. A management plan has yet to be developed for the Shoalwater Islands Marine Park, but the Shoalwater Islands Management Plan makes reference to the marine component due to the close interrelationship between the land and water components. The management goals of the Shoalwater Islands Management Plan are:

1. Conservation: Conserve the biological, physical, cultural and landscape values.
2. Recreation: Facilitate recreation in a manner compatible with conservation and other values.
3. Information-Education: Promote informed appreciation of natural and cultural values.
4. Research-Monitoring: Seek a better understanding of natural and cultural environments and the impacts of visitor use and management activities.

Key issues for the Shoalwater Islands Management Plan include:

- protection of the wildlife (especially the Australian Sea-lion, Little Penguin and other sea birds)

- promotion of visitor awareness, appreciation and understanding of the Islands' natural resources and recreation opportunities
- protection of the reefs, inter-tidal platforms and other marine communities that surround the Islands and which are an integral part of their attraction.

Any impact on water quality in Shoalwater Islands Marine Park is assessed relative to the management goal of conservation, and the key issues of protection of wildlife, reefs, inter-tidal platforms and other marine communities. The Marine Park is characterised by high water quality. Sites monitored in Warnbro Sound presently provide the 'reference' data used to generate nutrient-related water quality criteria for Cockburn Sound. This high water quality will need to be maintained to demonstrate that the Marine Park's management goal of conservation is met.

6.1.3 Potential impacts and mitigation

Three main aspects of the proposed development that may have potential impacts on water quality in Mangles Bay have been identified, as follows:

- **Construction and maintenance of the marina** will cause localised, temporary increases in turbidity.
- **Poor quality water from within the marina** could lower the water quality in Mangles Bay and adjacent waters on an ongoing basis.
- **Increased boat numbers** increase the potential for pollution.

Aspects arising from the development that may result in minor water quality impacts in Mangles Bay include increased stormwater runoff from the land-based development and contamination of groundwater (garden fertilisers, pesticides, detergents) with the residential/commercial development of land that presently carries only vegetation.

The provision of a deep sewer to the proposed development will ensure that there is no groundwater contamination from sewerage and provide opportunities for existing buildings to connect to this infrastructure.

Increased turbidity due to marina construction and maintenance activities

Temporary, localised impacts on turbidity in Mangles Bay may potentially occur due to construction and maintenance activities.

Breakwater construction and dredging of boating access channels are expected to be the main causes of turbidity during construction, and have the potential to cause localised short-term impacts on water quality (and therefore seagrasses) in Mangles Bay. Construction activities are not expected to cause any long-term impacts on seagrasses, as this area has survived much longer construction activities (i.e. construction of the Garden Island Causeway) during periods of far worse water quality (1971–1973). However, all construction activities will be managed under a comprehensive Construction Management Plan that includes:

- baseline monitoring of water quality and seagrass health at agreed sites
- ongoing monitoring of water quality and seagrass health at agreed sites

- agreed reporting requirements, management triggers for water quality and seagrass health, and required actions if management triggers are exceeded (eg deployment of silt curtain, temporary cessation of construction activities
- post-construction monitoring of seagrass health.

Impacts on water quality in Mangles Bay (and adjacent waters) due to outflow of lesser quality water from the marina

Marinas are, by necessity, calm, sheltered environments, and therefore are less well flushed than adjacent waters. Due to reduced flushing and the concentration of boats, there is usually a build up of nutrients and contaminants in marina sediments with some nutrients recycling back into the water column (other contaminants tend to stay associated with the sediments).

Any marina associated with the proposed development will have lesser water quality than in Mangles Bay (Perth's existing marinas typically have chlorophyll levels 1.5 to 4 times higher than adjacent waters), and therefore outflow of marina water has the potential to affect water quality in Mangles Bay and adjacent waters in Cockburn Sound and the Shoalwater Islands Marine Park. The environmental quality criteria of the Cockburn Sound SEP provide the basis to assess impacts on water quality in Cockburn Sound (Mangles Bay is within the High Protection Zone and marinas/harbours are classified as Moderate Protection Zones), but there are no formal criteria or targets presently defined for the Shoalwater Islands Marine Park.

Sources of potential contamination

Any place where boats are permanently moored, such as a mooring area like Mangles Bay or a marina, are generally not major 'non-point' sources of contamination to water bodies compared with groundwater and stormwater runoff from industrial, commercial and urban areas (or agricultural areas), but can potentially be locally significant sources of:

1. Fuel and oil (spills during re-fuelling; bilge discharge; stormwater runoff from areas where launching, maintenance and repair of boats takes place).
2. Copper and tin in anti-foulants; aluminium, iron and chromium in the boats themselves; arsenic in pesticides, paint pigments and wood preservatives; zinc in boat anodes, oil and tyres; and mercury in float switches for bilge pumps and, shower water storage tank pumps and air-conditioning/heating thermostats; nickel in brake linings and pavements; cadmium in brake linings and batteries. There is some leaching while the boats are moored, but most metal is dislodged during boat cleaning either directly during 'in-water' cleaning, or indirectly if washing/maintenance occurs onshore and wash water is not directed to appropriate stormwater treatment areas.
3. Solvents such as tetrachloroethane, trichloroethene and trichloroethylene (in degreasing agents, varnishes, paint removers and lacquers) in stormwater runoff from areas where launching, maintenance and repair of boats takes place.
4. Acid from batteries (often also containing high levels of lead) or cleaning compounds.
5. Surfactants (detergents), either directly from 'in-water' cleaning, or indirectly if cleaning occurs onshore and wash water is not directed to appropriate stormwater treatment areas.
6. Sewerage and other waste discharges (including fish cleaning waste, debris and litter).

All of these impacts are already expected to be occurring in Mangles Bay at present, due to the 260 boats moored there and are possibly occurring within the two lease areas of the Cruising Yacht Club and Mangles Bay Fishing Club.

Altered water circulation patterns

The marina development proposes removal of part of the Causeway, so there is the potential for alterations to water circulation patterns, surface current velocities and the degree of exchange with oceanic waters. These changes could, in turn, directly or indirectly positively influence water quality in localised areas as follows due to:

- improved flushing times and therefore degree of exchange/dilution with oceanic waters
- a reduction in the amount of organic matter settling out to sediments from changes in water quality, and changes in current velocities), and therefore sediment/water column nutrient cycling and sediment oxygen demand.

In deep harbours or marinas (water depth >10 m), vertical mixing due to wind may also be insufficient to replenish oxygen supplies in bottom waters during calm periods, and this can lead to increased rates of nutrient release from sediments. However, this is not anticipated to any significant degree in the proposed development, as the marina is relatively shallow (water depths 4 m or less), and oriented to take maximum advantage of mixing due to prevailing winds.

Nutrient related impacts

Under the Cockburn Sound SEP, the chlorophyll environmental quality guideline for the High Protection Zone is 0.8 micrograms/litre (µg/L), and 1.3 µg/L for Moderate Protection Zones. The sheltered waters of Mangles Bay (in the High Protection Zone) do not presently comply with either Environmental Quality Guidelines, and as any marina (a Moderate Protection Zone) will have lesser water quality than Mangles Bay it will not comply with the Moderate Protection Zone guideline.

The potential impact of marina waters on Mangles Bay and the adjacent waters was roughly assessed using simple tidal prism calculations. A daily exchange of about 60,000–70,000 m^3/day is expected due to tides (tidal variation 0.4 m, marina depth 4 m), which is about 1.4% of the 4,520,000 m^3 of shallow waters (i.e. <10 m deep) in Mangles Bay out to the Causeway, and insignificant compared to the much larger volume of water in Cockburn Sound. Should marina waters flow to the west of the Causeway a similar level of dilution would occur because a similar area and water volume is encompassed by the shallow waters from the Causeway to Cape Peron.

A screening level hydrodynamic numerical study was also conducted for the two-fold purpose of identification/selection of a preferred marina option, and examination of potential impacts on water quality in Mangles Bay and adjacent waters (WorleyParsons 2005b). Initially, hydrodynamic modelling of autumn conditions was used to examine the flushing times of marina development options 1.1 (marine opening into Mangles Bay only) and 2.2, and the influence of each marina on water circulation patterns and flushing times in Mangles Bay and adjacent waters. Autumn was chosen as the calmest time of year, and therefore likely to represent the 'worst case' scenario in terms of flushing. Subsequently, modelling of marina development Option 2.2 under summer conditions was undertaken to examine effects on water circulation patterns and flushing times in Mangles Bay and adjacent waters. Results were compared to the existing situation in Mangles Bay and adjacent waters to provide a qualitative interpretation of likely effects ("much worse, slightly worse, no significant change, slight improvement, much better") relative to the existing situation. The results for development Option 2.2 are also applicable to Options 2.3 and 2.4.

The hydrodynamic model used was Danish Hydraulic Institute's (DHI) Mike3 Flexible Mesh model (Appendix 6) a state-of-the-art model of proven performance worldwide. The model was not calibrated at the Causeway, and in common with all modelling undertaken in Cockburn Sound to the present, it has access to limited data on winds and currents in the region. Although this approach is considered appropriate for this SER document as a screening level exercise to identify major water quality issues, there is some low risk that subsequent, more rigorous modelling might identify a major water quality issue.

Simple 'box model' calculations were also used to estimate chlorophyll levels in the main body of the marina (i.e. excluding the side canals on the eastern side of the marina, but representing ~ 85% of total marina water volume). Modelling was undertaken for marina development Option 1.1 in autumn conditions and for both autumn and summer conditions for development Option 2.2. The hydrodynamic modelling approach is described in full in Appendix 6, and the box model calculations in Appendix 7.

The results are summarized in Table 13 and Table 14. Examples of circulation and flushing patterns are shown in Figure 14 (autumn conditions) and Figure 15 (summer conditions) depict modelled concentrations of red tracer dye remaining 10–11 days after having originally filled the entire southern third of Cockburn Sound. Figure 14 and Figure 15 also illustrate the far more rapid flushing of the Mangles Bay area in summer compared to autumn.

Table 13 Summary of hydrodynamic and "box" water quality modelling results in autumn

Factor	Marina development Option 1.1	Marina development Option 2.2
Flushing time of main body of marina	4–5 days	<2 days
Estimated average chlorophyll level in main body of marina	2.9–4.0 µg/L. (1.9 to 2.8-fold increase)	2.7–3.4 µg/L. (1.8 to 2.3-fold increase)
Effects on water quality in Mangles Bay	- Marina outflow confined to Mangles Bay. - Slight, localised impact on water quality due to outflow from marina entrance, extending several hundred metres offshore, and alongshore west to Causeway and several hundred metres east. - No significant impact on overall water quality in Mangles Bay due to direct effects or indirect effects.*	- Marina outflow west of Causeway (western entrance) and in Mangles Bay (eastern entrance). - Slight, localised impact on water quality due to outflow from eastern and western marina entrances, extending up to 200 m offshore, and several hundred metres west alongshore. Impacts offset by localised improvements in water quality in Mangles Bay due to improved flushing with wider Causeway entrance, and diversion of groundwater nutrient inputs to waters west of Causeway. - Lesser impact on water quality in Mangles Bay than development Option 1.1. - No significant impact on overall water quality in Mangles Bay due to direct effects or indirect effects*. Possible slight improvement.
Regional effects on water quality in Cockburn Sound	No significant change due to direct effects or indirect effects*.	No significant change in most areas, possible slight improvements in localised areas due to direct effects and indirect effects.*
Regional effects on water quality in Shoalwater Islands Marine Park	No significant change due to direct effects or indirect effects* .	No significant change in most areas, possible slight improvements in localised areas due to direct effects and indirect effects.*

* Direct effects: outflow of marina water, and/or changes in flushing times and degree of exchange with oceanic waters.
Indirect effects: changes in the amount of organic matter settling out to sediments (due in turn to changes in water quality, and changes in current velocities), and therefore sediment/water column nutrient cycling and sediment oxygen demand.

Table 14 Summary of modelling results hydrodynamic and "box" water quality in summer

Factor	Marina development Option 2.2
Flushing time of main body of marina	Estimated as <1.5 days*
Estimated average chlorophyll level in main body of marina	2.6–3.2 µg/L. (1.75 to 2.1-fold increase)
Effects on water quality in Mangles Bay	- Marina outflow into Mangles Bay (eastern entrance) and to a lesser extent west of Causeway (western entrance). - Slight, localised impacts on water quality due to outflow from eastern and western marina entrances: impacts difficult to discern due to 3-fold faster flushing of dye evident in summer compared to autumn. Impacts offset by localised improvements in water quality in Mangles Bay due to improved flushing with wider Causeway entrance, and diversion of groundwater nutrient inputs to waters west of Causeway. - No significant impact on overall water quality in Mangles Bay due to direct effects or indirect effects**. Possible slight improvement.
Regional effects on water quality in Cockburn Sound	No significant change in most areas, possible slight improvements in localised areas due to direct effects and indirect effects.**
Regional effects on water quality in Shoalwater Islands Marine Park	No significant change in most areas, possible slight improvements in localised areas due to direct effects and indirect effects.**

* e-folding time not calculated directly, but based on improved flushing (relative to autumn conditions) in modelling results.

** Direct effects: outflow of marina water, and/or changes in flushing times and degree of exchange with oceanic waters.
Indirect effects: changes in the amount of organic matter settling out to sediments (due in turn to changes in water quality, and changes in current velocities), and therefore sediment/water column nutrient cycling and sediment oxygen demand.

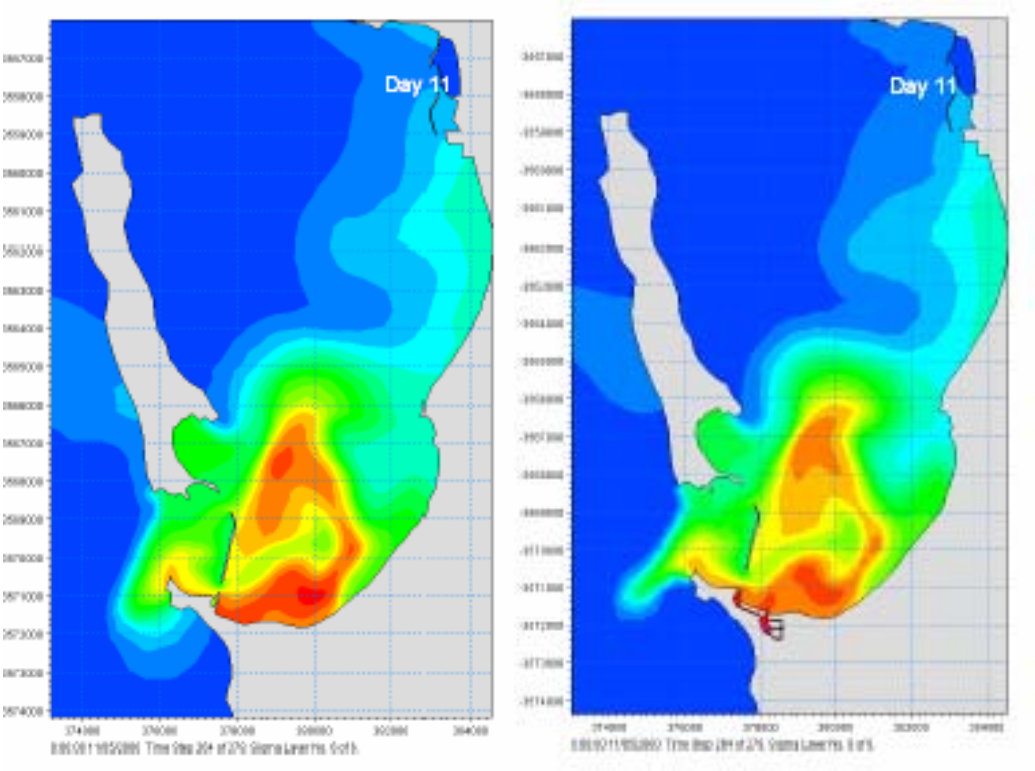


Figure 14 Dye circulation and flushing with (right) and without (left) marina development Option 2.2 in autumn

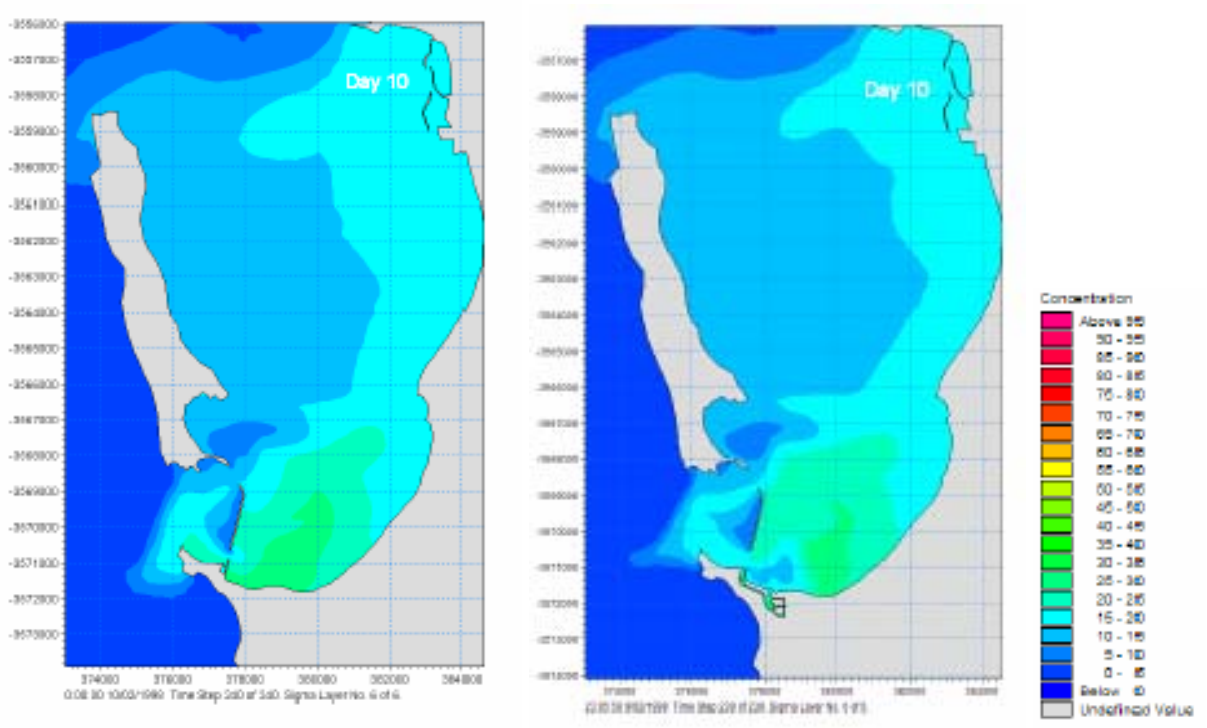


Figure 15 Dye circulation and flushing with (right) and without (left) marina development Option 2.2 in summer

Marina development Options 2.3 and 2.4 are variations on Option 2.2 and involve no change to the main body of the marina, but a reduction in the extent of the eastern side canals. Consequently, water quality for these options is expected to be very similar to Option 2.2. Indeed, Options 2.3 and 2.4 is likely to have slightly better water quality than Option 2.2, as they have a lesser volume of water in their eastern part of the marina (the most poorly flushed).

Rigorous modelling will be conducted using regionally-representative wind forcing data, a comprehensive set of current measurements for the area around the Causeway and Mangles Bay, and a model that has been fully validated and calibrated should this project proceed to detailed environmental impact assessment.

The proposed development is not expected to cause significant impacts on contaminant-related water quality in Mangles Bay and adjacent waters based on the preliminary modelling. Although boat numbers in the area will increase these will be located in the marina, and contaminants will tend to accumulate in marina sediments rather than Mangles Bay or adjacent waters. There are also opportunities for water quality benefits through the relocation of boats presently moored in Mangles Bay, the conversion to sewerage of properties presently still on septic tanks, improved capabilities (e.g. appropriate management of stormwater runoff) to manage boat hardstand activities, and better management of stormwater drains entering Mangles Bay.

Marina activities would be managed under an Operational Management Plan that includes:

- a fuel spill management plan
- maintenance and management plan for marina facilities (including maintenance dredging)
- codes of conduct for, and surveillance of, users of the marina

- ongoing monitoring of water quality and sediment quality within the marina, and water quality and seagrass health at agreed sites outside the marina.

Potential impacts due to increased numbers of boats in the area

The marina will result in an increased number of boats traversing Mangles Bay and adjacent waters, although this is inevitable with or without the marina due to population growth and increased levels of boat ownership in the region.

Boating activities can affect water quality via:

- sediment re-suspension (propeller wash, dragging of boat hulls and/or anchors on the seabed), causing turbidity and (if sediments have high levels of contaminants) release of contaminants
- release of hydrocarbons and heavy metals from engine emissions and accidental fuel spills (such contaminants eventually tend to accumulate in sediments)
- anti-foulant paint leaching (generally minimal compared to inputs from boat maintenance areas, and these contaminants also tend to accumulate in sediments)
- sewerage and other waste discharges (including fish cleaning waste, debris and litter).

Water quality may be affected by sediment re-suspension but will be minimised by provision of well marked access channels with appropriately sign-posted speed limits. The development will also offset impacts due to increased boat traffic as it will manage the presently uncontrolled movement of boats in Mangles Bay. The release of hydrocarbons and heavy metals from engine emissions will increase in proportion to boating traffic, but this is expected to be offset by management of the presently uncontrolled refuelling activities and sullage disposal (via provision of refuelling facilities and sullage pump out facilities in the marina).

6.1.4 Expected outcome

No significant adverse impact on overall water quality is expected in Mangles Bay, adjacent waters in Cockburn Sound or the Shoalwater Islands Marine Park from project options. The proposed development is expected to cause some slight, localised impact on nutrient-related water quality close to the marina entrances, but opening up the Causeway is expected to slightly improve the nutrient-related water quality in Mangles Bay and adjacent waters overall.

The proposed development is not expected to cause any significant contaminant-related water quality (including bacteria) adverse impacts on Mangles Bay because boating activity will be better managed than currently is the case. There is also the potential for water quality improvements by conversion of properties presently on septic systems in the area to sewerage, and better management of stormwater entering Mangles Bay.

6.2 MARINE ECOSYSTEM

6.2.1 Overview description

Physical environment

Shoreline processes

The present Perth metropolitan coastal region was formed by a sea level rise that took place about 10 000 years ago. At that time, the sea-level was approximately 27 m below present, but rose rapidly over a period of about 3 600 years to reach 3 m above its present level. Sea level then dropped slightly to reach the present level, about 1 500 years ago, and has stayed relatively constant ever since.

The present shoreline was formed when the sea spilled over the Garden Island Ridge into lower land known as the Warnbro-Cockburn Depression. This depression is bounded on its eastern side by the Spearwood Ridge that forms the basis of the mainland shore today. Only the high points of the Garden Island Ridge remain, and form the offshore chain of islands (Penguin Island, Garden Island, Carnac Island) and reefs seen today. Further west another ridge, the Five Fathom Bank Ridge, is completely submerged. These two lines of islands and reefs protect Perth's southern coastal waters from ocean swell to varying degrees.

Today's shoreline consists of sandy beaches and limestone rocky shores and headlands, while the seabed consists of extensive sandy areas and limestone reefs. In some areas, the pattern of wave action has deposited sand at right angles to the shore, forming shallow sandy banks that separate deeper areas (for example, Rockingham Bank and Parmelia Bank). This process also forms the tombolo feature at Penguin Island and has resulted in the reconnection of an offshore island to form Cape Peron.

Erosion/accretion of the shoreline occurs as sand is moved by waves breaking on the shore. If the waves are approaching the beach at an angle, this creates a longshore current that can move sand suspended by wave action, or rolled along the seabed by the force of the breaking waves. Waves, near-shore currents, the weather (winds, barometric pressure) and changes in water level are important factors determining erosion/accretion patterns at the shoreline.

Two forces have generated the present coastal morphology of Cockburn Sound and Shoalwater Islands Marine Park:

1. Southerly wind systems that set-up longshore sediment transport through local wind waves and longshore currents during the spring and summer months.
2. North-west storm systems consisting of swell waves, local wind waves and wind-driven currents.

The sheltered nature of Cockburn Sound results in less wave energy to move sediment compared to other metropolitan beaches, and changes in the Sound's coastline evolve relatively slowly. Artificial structures such as groynes, harbours and offshore breakwaters have altered natural patterns of longshore sediment movement in some places, and changes to the coastline due to development are occurring more quickly than adjustment of sand movement patterns to those developments.

Ecology

Seagrass 'meadows' and reef 'gardens'

Perth's coastal waters are characterised by seagrass 'meadows' on the shallow sandy areas (which contribute both seagrass and epiphyte production) and seaweed 'gardens' on the reefs, both of which are important habitats for many species of fauna. The coastal waters generally have low levels of plankton (microscopic plants and animals) and so marine fauna (including commercially important fish, crabs and lobsters) also depend on the production of the reefs and seagrass meadows rather than plankton-based food chains.

The densest stands of seagrass occur in shallow, sheltered areas and consist of meadows of the large strap-like species *Posidonia sinuosa* or *P. australis*. Cockburn Sound had extensive areas of these species before the massive seagrass loss that occurred in the late 1960s/early 1970s. Less sheltered areas (e.g. Owen Anchorage, and off Becher Point in Shoalwater Islands Marine Park) tend to have patchy meadows of *Amphibolis griffithii* and *P. coriacea*; species that can tolerate greater wave and current action than *P. sinuosa* and *P. australis*. Of the estimated 2 820 ha of seagrass within the Cockburn Sound Management Council boundary in Cockburn Sound in 1965/67, only 630 ha remained in 1999. Cockburn Sound has little sub-tidal reef.

In the Shoalwater Islands Marine Park there are about 600 ha of seagrass. The Marine Park also has extensive areas of sub-tidal reefs , usually dominated in the summer period by larger brown algae such as kelp (*Ecklonia*) or *Sargassum*, or mixed assemblages of red, brown and green algae.

Marine fauna

The diversity and abundance of marine fauna is highest in and around the reefs, followed by seagrass meadows. The deep basins of Cockburn Sound and Warnbro Sound also support a rich seabed community dominated by species that feed on detritus (dead and decaying organic material). Cockburn and Warnbro Sounds present unique and regionally significant environments, with deep silty basins containing a distinctive mixture of temperate and tropical invertebrates surrounded by shallow, sandy areas with extensive seagrass beds.

Cockburn Sound is home to a resident population of bottlenose dolphins that have become a popular tourist attraction. About 180 animals have been identified as using Cockburn Sound, and approximately a quarter of these are adult females with calves, which is unusually high for dolphin populations.

The Shoalwater Islands Marine Park is characterised by a chain of islands (Penguin Island, Shag Rock, Seal Island, Gull Island, Bird Island, White Rock, The Sisters, Passage Rock, Third Rocks, First Rock and Second Rock) and reefs close to the mainland, and these islands and reefs are of particular importance for breeding colonies of Little Penguins and other seabirds and as resting places for the Australian Sea-lion, a species gazetted as in need of special protection. About 50 species of birds use the islands, including migratory species that are covered by international treaties.

Penguin Island supports the largest breeding population of Little Penguins on the west coast of Australia, and there is also a small colony of Little Penguins in Cockburn Sound, in limestone walling at Careening Bay (Garden Island).

Recreational use and other social values

Cockburn Sound is particularly unusual due to its degree of shelter from ocean swell, and its depth. The waters of Shoalwater Bay and Warnbro Sound have also long been recognized as an area of high environmental significance and recreational potential as acknowledged by the creation of Shoalwater Islands Marine Park.

Cockburn Sound and Shoalwater Islands Marine Park are very popular for recreational fishing, sailing, windsurfing, skiing, jet-skiing, diving, snorkelling, swimming, or just relaxing on the beach and enjoying the ocean view.

The main species sought by recreational fishers are whiting (especially King George whiting), crabs, Australian herring, squid, garfish, trevally, dhufish, tailor and pink snapper (Sumner and Williamson 1999). These are many of the species targeted by commercial fishers. Cockburn Sound is particularly popular for family/small boat use due to its sheltered nature.

Based on predicted population increases for the region (DOT 1999), recreational fishing pressure will increase by about 30% in the next 10 years, and by more than 50% in the next 20 years. An indication of the intensity of recreational boat use was obtained from a 1999 Department of Transport (DOT) survey of public boat ramps in the area (Table 15).

Table 15 Estimated boat use at public boat ramps in Cockburn Sound and Warnbro Sound

Boat ramp	Estimated number of boats used per year (power boats and yachts)		
	1999	2011	2021
Cockburn Sound			
- Woodman Point	16,520	21,375	24,673
- Challenger Beach, Naval Base	1,980	2,601	3,030
- Kwinana Beach (Wells Park), Kwinana	3,300	6,406	8,622
- Palm Beach, Rockingham	9,250	12,600	15,162
- Cape Peron, Rockingham	13,220	20,298	25,964
- SUBTOTAL	44,270	63,280	77,451
Warnbro Sound			
- Carlisle St, Safety Bay	1,980	3,004	3,899
- Bent St, Safety Bay	6,610	9,872	12,895
- Donald Drive, Safety Bay	2,640	3,981	5,176
- SUBTOTAL	11,230	16,857	21,970
TOTAL	55,500	80,137	99,421

Education/Scientific Study

Cockburn Sound and Shoalwater Islands Marine Park are within easy access of the schools, tertiary institutions and natural history clubs of the Perth Metropolitan Region. This, in combination with the special features of the area offers many opportunities for education on marine ecology and coastal processes, and so is frequently used by scientific researchers, school students and nature study groups.

Commercial (including tourism) use

Cockburn Sound is extensively fished for blue manna crabs (the most valuable fishery in dollar terms), baitfish and table fish (mainly whiting, pink snapper, Australian herring, shark, garfish, squid and octopus). Mussel aquaculture also takes place in the Sound in three lease areas at Kwinana Grain jetty, Southern Flats and north Garden Island. The aquaculture industry requires relatively deep water (>10 m), good circulation, excellent water quality (i.e. low levels of faecal bacteria, contaminants, and toxic species of phytoplankton) and slightly nutrient-enriched conditions so that there is sufficient phytoplankton for the mussels to feed on. Some areas of Shoalwater Islands Marine Park are also used extensively for commercial fishing.

The levels of tourism based on marine values in Cockburn Sound and Shoalwater Islands Marine Park are rapidly increasing. Tourist activities include marine charters (involved in diving, deep-sea fishing, sailing, sea-lion and dolphin watching and sight seeing), diving, dolphin tours, sea-lion watching and bird watching. Most tourist activities occur predominantly in the summer months from September/October to March/April, and most boat tourist operators pass through Cockburn Sound to the more scenic islands and reefs of the Shoalwater Islands Marine Park.

6.2.2 Mangles Bay

Physical environment

The Cape Peron boat ramp and Garden Island Causeway prevent the natural pattern of longshore sediment movement from Cape Peron into Mangles Bay (DMH 1992), which has led to an accumulation of sand on the western side of the Causeway (Figure 16) and erosion on the eastern side as far as Palm Street jetty (Figure 17).

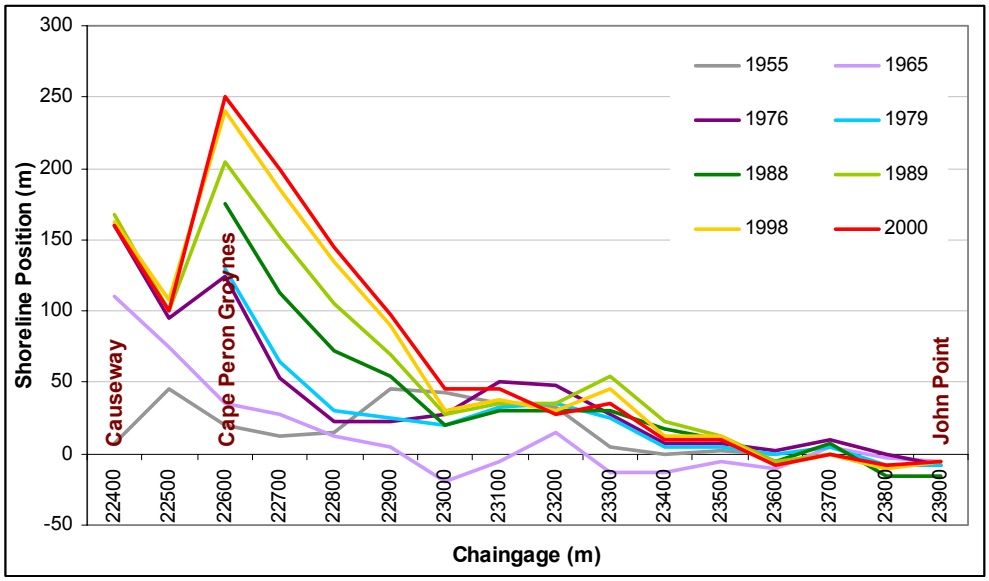
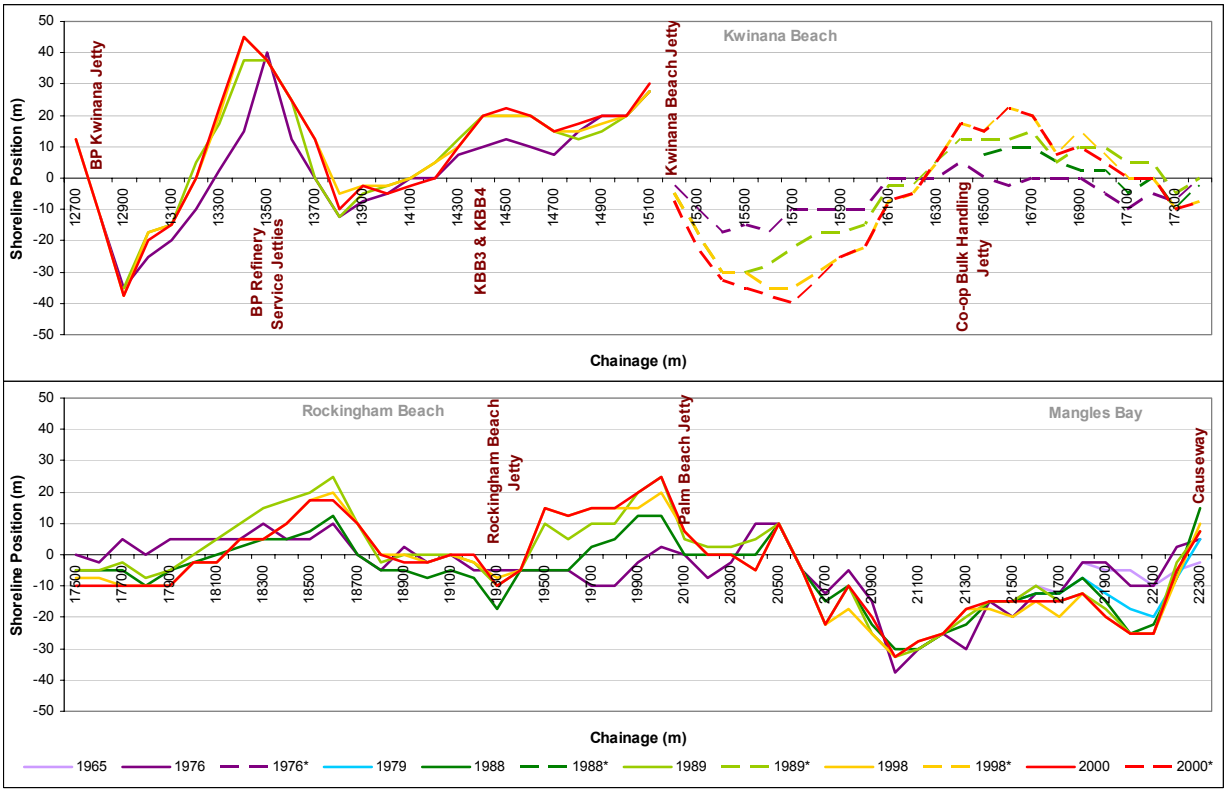


Figure 16 Historical changes in shoreline position between the Causeway and John Point (Cape Peron)

The large build up of sand west of the Causeway is attributed to the construction of the Causeway itself between 1971 and 1973 disrupting the natural eastward flow of sediment into Cockburn Sound.

However, this eastward sediment flux is now solely restricted by the Point Peron groynes built during the early nineties in response to the sedimentation occurring within the Point Peron boat ramp facilities. The ongoing problem with accumulation/erosion is managed on an *ad hoc* basis by transport (by truck) of sediment from the western side of the Causeway to renourish beaches on the eastern side.



* Dashed lines are relative to the 1955 vegetation line

Figure 17 Historical changes in shoreline position between the Causeway and James Point

A seagrass site in Mangles Bay is one of a number of sites in Cockburn Sound routinely monitored by Edith Cowan University for comparison against environmental quality criteria for seagrass health (measured as shoot density) as defined under the Cockburn Sound SEP (Section 6.2.3). Due to the sheltered, slightly nutrient-enriched nature of the site, on some occasions a layer of loose organic matter can accumulate around the seagrass leaves to the extent that the meadows are shaded to a considerable degree. This site has shown no evidence of long-term decline in health, but is very close to, and occasionally falls below, the seagrass environmental quality criteria for shoot density.

Despite the degraded nature of the seagrass meadow, the shallow, sheltered, slightly nutrient-enriched waters of Mangles Bay are an important fish nursery habitat (Hyndes 2004). It is also a habitat type (highly sheltered, with dense seagrass meadows close to shore) for which some species of fish (King George Whiting and Small Tooth Flounder) have a marked affinity, and is only found elsewhere in Perth's coastal waters in parts of the Shoalwater Islands Marine Park, and north of Woodman Point, (Valesini et al. 2004).

Recreational use

The Mangles Bay area adjacent to the Causeway is not as popular for swimming as beaches further east (it is very shallow and full of seagrass), but is heavily used for boat moorings. The area also has

private boat ramps (including Mangles Bay Fishing Club, and The Cruising Yacht Club), a dog beach, a jet-ski and water-ski area. The area is used extensively for yachting and boating, and is popular for recreational fishing of squid, crabs, whiting, herring, garfish skipjack, tailor, snapper and samsonfish.

Commercial use

The main commercial use of the Mangles Bay area is jet-ski hire. The Mangles Bay Fishing Club also serves as a base for the commercial fisheries and mussel farming enterprises in the Sound.

6.2.3 Assessment framework or policy context

State Environmental (Cockburn Sound) Policy

See Section 6.1.2.

EPA Guidance Statement No 29

EPA Guidance Statement No. 29, *Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment*, provides a set of principles to be applied by proponents and the EPA when considering development proposals that may result in removal or destruction of, or damage to, marine benthic primary producer communities (e.g. seagrasses, coral reefs) or the habitats which support them. A series of six categories of marine ecosystem protection are defined in the guidelines and used to define the cumulative percentage loss threshold for benthic primary producer habitat within any defined management unit.

The guidelines require:

- the natural ecosystem boundary to be defined (i.e. the 'management unit')
- the quantity of previous habitat loss or damage to be determined
- the additional loss or damage as a result of the proposal to be calculated.

The proposed loss and previous habitat loss are totalled to determine a cumulative impact that is assessed in light of the ecosystem's level of protection. Management units are of the order of 50 square kilometres in area, and are defined taking into account key physical and biological ecosystem attributes, such bathymetry, position of offshore reefs/islands, water circulation patterns, and habitat/substrate types.

The management unit for Cockburn Sound is the marine portion of the Cockburn Sound Management Council (CSMC) management area (CSMC 2002). Cockburn Sound is designated 'Category F', and so proposals must not cause any net loss of seagrass.

Shoalwater Islands Marine Park qualifies as a Category B area, and so cumulative loss of seagrass within any defined management unit must not exceed 1% of the total area of seagrass. For the purpose of this document, the management unit for seagrass protection within the Shoalwater Islands Marine Park has been taken as the area inshore of the Garden Island reef chain from the southern end of Garden Island to the southern end of Warnbro Sound, an area of roughly 30 square kilometres.

Shoalwater Islands Marine Park

The management goals of the Shoalwater Islands Management Plan (Section 6.1.2) are:

- Conservation: Conserve the biological, physical, cultural and landscape values.
- Recreation: Facilitate recreation in a manner compatible with conservation and other values.
- Information-Education: Promote informed appreciation of natural and cultural values.
- Research-Monitoring: Seek a better understanding of natural and cultural environments and the impacts of visitor use and management activities.

Key issues for the Shoalwater Islands Management Plan include:

- Protection of the wildlife (especially the Australian Sea-lion, Little Penguin and other sea birds).
- Promotion of visitor awareness, appreciation and understanding of the Islands' natural resources and recreation opportunities.
- Protection of the reefs, intertidal platforms and other marine communities that surround the Islands and which are an integral part of their attraction.

It is also noted that, depending on the marina development option chosen, the proposed development may require either:

- A change to the boundary of the Shoalwater Islands Marine Park. This is a major administrative procedure, requiring approval of both Houses of Parliament, and will take some considerable time to achieve.

  OR

- A change to the zoning of the existing Marine Park, which is a lesser procedure, but still involves public consultation and sign-off by three Ministers (for Environment, Fisheries, and State Development).

6.2.4 Potential impacts and mitigation

Coastal processes

The proposed development is not expected to have additional adverse effects on the longshore movement of sediment from Cape Peron into Mangles Bay because this process is already interrupted by the Cape Peron boat ramp and Causeway.

The narrowness of the southern entrance to Cockburn Sound, the presence of submerged reefs and the broad shallow Southern Flats sand shoal all combine to cause a significant natural attenuation of offshore wave energy to inshore of Cockburn Sound, but the Causeway provides a significant further barrier. The proposed development will involve widening the southern trestle of the causeway, and this will result in increased swell wave energy from the west reaching the shore in Mangles Bay. Under both south westerly and north westerly swell there would be an increase in swell-wave energy in the Mangles Bay area, and therefore an increase in the eastward longshore current along the shoreline in this area. While this represents a return to more natural (i.e. pre-Causeway) conditions, it could potentially cause erosion of the beach. These impacts will be very carefully monitored but should also be readily manageable with sediment bypass systems similar to those that operate at the Dawesville Cut and Mandurah.

Widening the southern Causeway opening will also result in a slight increase in wind-wave energy on the northern beaches of Cape Peron, but this effect would be minor compared to the westerly swell wave energy that dominates this area.

The proposed development will not result in any additional adverse impacts due to interruption of longshore sediment movement, but it will provide a benefit in the form of a long-term solution to the accretion and erosion problems caused by the Cape Peron boat ramp and the Causeway, as it will include a properly engineered sediment bypass system.

Seagrass

Aspects of the development that could impact on seagrass include:

- the **development footprint** (principally construction of boating channels to the marina) will cause a direct loss of seagrass
- **water quality changes** due to the marina could potentially cause indirect losses of seagrasses and on the other hand facilitate vegetation natural expansion and improved health of seagrass
- **changes in current speed/sediment movement** for those marina options that involve lengthening the southern opening of the Causeway could potentially cause indirect losses of seagrass.

Changes in current speed can cause:

- changes in the degree of erosion or 'scour' on existing seagrasses (either via the currents themselves, or sand mobilised by the currents
- changes in seedling re-establishment (both the settling out of seedlings, and their ability to remain anchored in the area)
- changes in the amount of 'drag' on—and therefore erosion of—seagrass epiphytes (epiphytes can grow to a larger size in calmer waters)
- changes in the degree of accumulation of organic matter in and around seagrass meadows.

Extremely low currents can be almost as bad for seagrass meadows (in some situations) as currents that are too fast. A potential benefit of any marina development option that involves lengthening of the southern opening of the Causeway may be slight increases in current speeds in areas of Mangles Bay where seagrass meadows are presently adversely affected by accumulations of organic matter.

Direct loss

Direct seagrass losses due to the development footprint are expected to be:

- 5.9 ha in Cockburn Sound and 0.1 ha in Shoalwater Islands Marine Park due to development Options 2.2 and 2.3
- 5.3 ha in Cockburn Sound and 0.1 ha in Shoalwater Islands Marine Park due to development Option 2.4.

Indirect loss

Indirect losses associated with increased current velocities/sediment movement due to the development are estimated as approximately up to 2 ha in Cockburn Sound and 1–2 ha in Shoalwater Islands Marine Park. These estimates are based on empirical observations of the changes in current velocity associated with seagrass loss due to the construction of the Causeway (DALSE 2003).

No indirect losses of seagrass are anticipated due to changes in water quality with any marina option for the following reasons:

1. There is presently little opportunity for phytoplankton blooms in the Mangles Bay area, due to competition for nutrients by seagrass epiphytes and microscopic algae on and in the sediments. However, with a marina, a proportion of groundwater nutrients that presently fuel epiphyte growth will be taken up by phytoplankton growth in marina waters. Therefore, the slight, localised changes in water quality expected with the marina will be offset by reduced epiphyte growth on seagrasses. The phytoplankton will also be far more readily flushed from Mangles Bay than epiphytes and/or loose organic matter.
2. The seagrasses most likely to be affected by the slight, localised changes in water quality that may occur with a marina are in extremely shallow waters close to the shore, and therefore much less vulnerable to changes in water quality than seagrasses at their depth limit.

Potential indirect benefits

Localised improvements in water quality due to improved flushing with lengthening the Causeway opening may also be beneficial to seagrass health in Mangles Bay, on Southern Flats and seagrass health and reef health in Shoalwater Islands Marine Park. In addition, small localised increases in current speeds in Mangles Bay arising from the development could help reduce the loads of epiphytes on seagrass and lessen accumulations of detritus within the meadows, and so improve seagrass health. In other areas of Cockburn Sound (e.g. Southern Flats, and the eastern end of Mangles Bay) lengthening the southern Causeway opening will improve conditions for seagrass growth by lessening current velocities and/or sediment movement.

The reduction in flow velocity in the currently scoured areas may also facilitate natural vegetative expansion of seagrass into these areas. However, this natural expansion would be slow.

Offsets for seagrass losses

Seagrass rehabilitation

Any loss (direct or indirect) of seagrass in Cockburn Sound will be offset by rehabilitation of at least an equal area. The project has made a provision of $1m based on accost of $100 000 per hectare for the rehabilitation of seagrass. This is considered a generous amount and would provide for the initial planting effort, monitoring and any supplementary planting required.

To date, large-scale seagrass rehabilitation in Western Australia has been carried out in Owen Anchorage, Albany and more recently (November 2004 to February 2005) in Cockburn Sound, with survival rates of transplanting ‘units’ varying from 40% to >90% depending on the environment and the ability of the ‘unit’ to remain in place (e.g. small units are successful in calm environments, but larger units are needed in more exposed areas because they are less likely to be eroded in storms). Some of these transplanted areas have only been established for less than a year (1.4 ha in Cockburn

Sound), but others have been actively growing and expanding for two to eight years (0.3 ha in Owen Anchorage for over four years, 0.8 ha in Albany for two years and smaller trials for eight years).

Successful long-term (greater than 10 years) rehabilitation of seagrass in Cockburn Sound has yet to be demonstrated, but research and trials to date strongly indicates it is feasible providing conditions are suitable (Appendix 8). Some degree of natural colonisation of seagrasses may also be expected with improved conditions that will result with the proposed development, based on patterns of seagrass loss and growth that have occurred at the southern end of Cockburn Sound in recent years (DALSE 2002).

In Shoalwater Islands Marine Park, EPA guidance for benthic primary producer habitat does not require seagrass rehabilitation to offset seagrass loss, but indicates that cumulative loss of seagrass must be less than 1% of the total area of seagrass. The present position of the Marine Parks and Reserves Authority is also that small losses of seagrass (as bound by the EPA guidance for benthic primary producer habitat) may be acceptable in a marine park if a proposal offers considerable public benefit. Given the public benefit that the proposed development provides, plus the fact that there is over 600 hectares of seagrass in Shoalwater Islands Marine Park, both EPA and Marine Parks and Reserves Authority objectives are considered achievable.

Potential rehabilitation sites

Potential sites for seagrass rehabilitation that have been identified (Figure 18) include:

- 1.7 ha in mooring scars in Mangles Bay (requiring the removal of the moorings or their replacement with environmentally friendly moorings
- approximately 2 ha in old barge scars in Mangles Bay
- approximately 1 ha along the shallow edges of the marina's boating access channel(s)
- several hectares on Southern Flats
- approximately 2 ha on the eastern edge of Mangles Bay shallows.

Rehabilitation of Southern Flats and eastern edge of Mangles Bay should benefit from the improvements in water quality and current velocity expected with the widened Causeway opening.

Should the proposed development be approved by Cabinet, to proceed to the next stage of detailed design and environmental assessment, it is proposed to commence seagrass rehabilitation trials in the Mangles Bay area immediately. It is recognised that demonstration of the ability to rehabilitate seagrasses would add significant confidence to any final proposal submitted to the EPA for detailed environmental impact assessment. The intention is to plant seagrass in selected areas as soon as possible, with the goal of successfully establishing an appreciable area of seagrass during the period of the detailed environmental impact assessment process (expected duration of approximately 2 years).

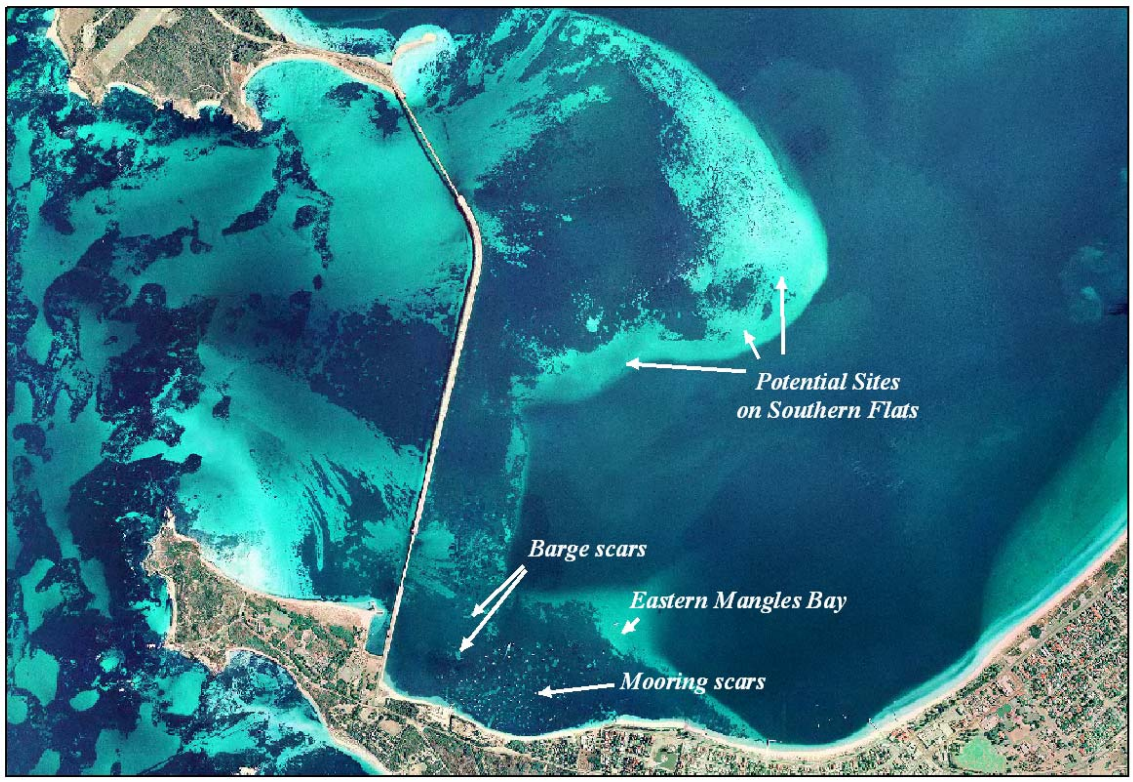


Figure 18 Aerial photograph showing potential sites for seagrass rehabilitation

Demonstration site of seagrass rehabilitation

To demonstrate the effectiveness of seagrass rehabilitation in Mangles Bay, 2 ha of seagrass will be replanted within Mangles Bay at the very start of the detailed environmental impact assessment phase. The replanted seagrass will then have been growing for approximately two years by the time there is a Ministerial decision on the project. The monitoring of this demonstration site is expected to provide added evidence that the replanting of seagrass is a feasible option for offsetting seagrass loss in Mangles Bay.

In conjunction with the seagrass rehabilitation demonstration, it is proposed to develop and commence a trial incentive scheme to replace a selection of swing moorings in Mangles Bay with 'seagrass friendly' fixed moorings. This will commence as soon as possible in the second half of 2006.

Completion criteria for seagrass rehabilitation

Rehabilitation criteria will be developed as part of the detailed environmental assessment process. It is proposed that completion criteria for any seagrass rehabilitation program be linked to a specific percentage survival of planting units for at least two years, with ongoing monitoring of indicators of ecological function (e.g. shoot density, seagrass production, fauna production, habitat function; Appendix 8) for four years. Implicit in this approach is that planting units are spaced at intervals that allow attainment of shoot densities similar to adjacent natural meadows within five to ten years.

Research presently underway (Appendix 8) will provide modelling tools that will allow definition of planting unit spacing and percentage survival that achieves the required outcome.

Marine ecosystem

Within Mangles Bay, the value of the marine ecosystem is based on the presence of seagrass meadows and the calm, existing slightly nutrient enriched conditions. The marina has the potential to affect these components (i.e. seagrass loss and rehabilitation, changes to water quality, and changes in current velocity).

The proposed development will also lead to increased recreational use of the area, and potential indirect impacts on the marine ecosystem in Mangles Bay and adjacent water (including Shoalwater Islands Marine Park) may occur due to the following aspects:

- **increased boat traffic**, causing:
    - disturbance to marine life (especially sea birds and sea-lions) due to noise, crowding and physical disturbance (note that studies have found yachts can be just as intrusive as powerboats), and including undesirable practices such as feeding of wild dolphins
    - damage to the seabed (seagrass meadows, reef) due to propeller wash, anchor drag and hull drag
    - impacts on water quality (see also Section 6.1.2) including turbidity (due to propeller wash, anchor drag and hull drag), engine emissions, anti-foulant paint leaching and sewerage and other waste discharges (including fish cleaning waste, debris and litter)
    - killing or damaging marine fauna, and the eggs and larvae of fish and invertebrates by propellers and propeller wash. (Note: at a cruising speed of ~50 km/hour, the blades of a 30 cm diameter propeller pass through ~4,250 cubic metres of water an hour, and shear stresses of the magnitudes typical of such forces have been shown to be lethal to eggs and larvae)
- **increased people access** causing direct habitat damage or littering
- **increased fishing**.

However, increased recreational pressure is inevitable due to increased population and levels of boat ownership, while the marina itself will only provide for a proportion of the total number of boats using the Mangles Bay and adjacent waters.

Within Mangles Bay, the proposed marina is not expected to significantly change the calm, slightly nutrient enriched conditions that exist, while any seagrass loss will be offset, as per the requirements of the EPA's guidance for benthic primary producer habitat protection. As the value of the marine ecosystem in Mangles Bay depends on these two key features, its values should not be significantly affected.

For the Shoalwater Islands Marine Park, there is the requirement for conservation of biological, physical, cultural and landscape values, and protection of wildlife (especially the Australian Sea-lion, Little Penguin and other sea birds) and reefs, intertidal platforms and other marine communities. Changes in water quality due to the marina are not expected to prevent these requirements being met.

Mitigation

Some of the impacts due to increased boating activity in Mangles Bay will be offset by better management of boating. Properly marked access channels will help control boat movements. It is also intended that fewer boats will be moored within the seagrass areas and will have environmentally friendly moorings that don't damage seagrass. Marina facilities will ensure that informal refuelling practices and illegal sullage disposal no longer occur. Provision of facilities at Mangles Bay may also reduce the pressure on other facilities, such as the boat ramps in Safety Bay.

The proposed development also offers the opportunity for decreased stress on the marine ecosystem in a broader sense, by supporting better management of impacts due to tourism, recreational use and boating activity. This can be achieved by using marina facilities to:

- promote/display information about natural and cultural values, and appropriate behaviour in the marine environment, including sustainable fishing practices
- provide a base for surveillance of, and monitoring and research in the marine environment, including the impacts of recreational use and management activities.

The management of recreational fishing pressure depends on:

1. The level of public awareness about minimum fish size and bag limits for different fish species.
2. Surveillance of recreational fishing activities.
3. Ongoing research to ensure that minimum size limits for different species are biologically sound, and the level of fishing effort is sustainable.

The proposed development offers a means and support to allow improvement in all three areas.

6.2.5 Expected outcome

The proposed development is expected to result in:

- changes in coastal processes that are manageable by an appropriately engineered sediment bypass system, and that will provide an on-going management solution to existing accretion/erosion problems caused by the Cape Peron boat ramp and the Garden Island Causeway
- a level of seagrass loss that is acceptable in Shoalwater Islands Marine Park given the public benefit associated with the facilities provided,
- a level of seagrass loss in Cockburn Sound that is acceptable given that it will be offset by rehabilitation of a greater area, and potentially favourable conditions for natural vegetative expansion of seagrass.
- impacts on the marine ecosystem due to marina water quality/Causeway configurations that should not significantly affect their existing values and may result in some small, localised improvements. More detailed water quality modelling will be conducted during any detailed environmental impact assessment required by the EPA.
- impacts on the marine ecosystem due to the small additional increases in tourism, recreational use, boating activity and fishing pressure due directly to the marina (as opposed to increases that would occur anyway due to increases in population and the level of boat ownership in the region) can be offset by better management and facilities, as most of these activities are largely unregulated at present or under-resourced.

7. SOCIAL ENVIRONMENT

7.1 CULTURAL HERITAGE

7.1.1 Description of cultural heritage

Aboriginal heritage

The Rockingham area has significance to Aboriginal people although there is little information available about their association and use of the area. Traditional Aboriginal family groups would have traversed the area seasonally utilising areas such as Lake Richmond for food gathering and camping. Lake Richmond is listed on the Aboriginal Sites Register with the Department of Indigenous Affairs as a site with ceremonial and artefact significance (site no. S02223).

A previous Aboriginal heritage assessment undertaken for the project area by McDonald Hale & Associates (1997) identified two additional listed Aboriginal heritage sites within the vicinity of the project area; Cockburn Sound (site no. S02169) and parts of the foreshore that encompasses Rotary Park and Mangles Bay (site no. S02625). Both these sites are of mythological significance being part of Dreaming stories; the Waugal created the various water bodies (e.g. Lake Richmond and Rotary Park pond) and other topographic features (e.g. dunal depressions) through its movement across the land and water. Rotary Park and Lake Richmond will not be affected by the project, however the project area does occur within the boundaries of their heritage site boundaries.

The Aboriginal spokespeople consulted indicated that although there were mythological associations with the area, the area was not a sacred site and the Dreaming associated with this area is *mootch* – dead or finished (McDonald Hale & Associates 1997).

Subsequent to the McDonald Hale & Associates (1997) study, additional Aboriginal heritage areas have been identified through the stakeholder consultation process for this project. These sites include:

- dancing/ceremonial ground near the existing RSL hall
- burial ground in the vicinity of the public carpark at the point.

The local Aboriginal community utilise an area on the Mangles Bay foreshore, just to the east of the Garden Island Causeway, as a meeting and learning place. The Sister Kate's former orphanage holiday camp has been identified as having emotional significance as part of recent Aboriginal history in the area. These two sites are not heritage sites but have significance to the local Aboriginal community.

European heritage

Two European heritage sites were identified on Cape Peron; Cape Peron Battery Complex and the Turtle Factory building (Section 3.1.6). The Cape Peron Battery Complex is located at the point (outside the project area) and the Turtle Factory is located to the north of Point Peron Road within the Cruising Yacht Club complex.

Turtle Factory

7.1.2 Assessment framework or policy context

EPA Objectives

The EPA objective considered relevant to this project is:

- *To ensure that changes to the biological and physical environment resulting from the proposal development do not adversely affect historical and cultural associations of the area.*

Statutory requirements

The Minister for Indigenous Affairs is responsible for the administration of the *Aboriginal Heritage Act 1972*. Under section 17 of the Aboriginal Heritage Act, it is an offence to disturb any Aboriginal site without consent under section 18 of that Act.

The Minister considers recommendations from the Aboriginal Cultural Material Committee (ACMC) and the general interests of the community when making a decision on disturbance to a site and may also impose conditions on the approval.

The Registrar of Aboriginal Sites is responsible for maintaining the Register of Aboriginal Sites. The Department of Indigenous Affairs (DIA) has a database of all recorded sites.

Sites listed with National Trust, Heritage Council, or Australian Heritage Commission would have some level of protection against development.

EPA Guidance Statement No 41

EPA Guidance Statement No. 41, "*Assessment of Aboriginal Heritage*", provides guidance on the process for the assessment of Aboriginal heritage as an environmental factor. This guidance statement also details those actions that may be pertinent to the factor of Aboriginal heritage, including:

- consultation with DIA staff and desktop review of sites
- undertaking an Aboriginal heritage and/or archaeological survey in consultation with relevant Aboriginal representatives
- inform relevant Aboriginal people of the proposal and conduct appropriate consultation
- demonstrate that any concerns raised by the Aboriginal people have been considered in the environmental management of the factor and that this is made known to the relevant Aboriginal people.

7.1.3 Potential impacts and mitigation

The main aspect of the proposed Cape Peron Tourist Precinct Project that may potentially impact on Aboriginal heritage values is:

- **Disturbance to heritage sites,** including mythological associations and meeting places and Turtle Factory building, through the development of infrastructure and the alteration of the landscape.

Disturbance to heritage sites

Aboriginal heritage

The two listed ethnographic sites (Lake Richmond and Rotary Park / Mangles Bay) encompass features including the sea, seabed and onshore manifestations. The construction of sea and land based infrastructure for the proposed development will affect all of these features through:

- dredging activities
- sea based infrastructure (e.g. breakwaters)
- land based infrastructure
- creation of artificial inland canals.

The site at Lake Richmond (site no. S02223) will not be affected by the development.

The other sites identified will not be affected by the proposed development as they are located outside of the development footprint.

European heritage

The Battery Complex is located outside of the development footprint and will not be affected by the proposed development and mitigation measures are likely to enhance values associated with this site.

The Turtle Factory building will require removal as part of the development. As this site is of cultural significance, consideration will be given to relocating the building, however, this may not be plausible given the building is constructed of asbestos material. The project developers will consult with the relevant government heritage agencies, community groups and the City of Rockingham to determine the best outcome for this building.

Consultation with Aboriginal people

The Aboriginal meeting place on the Mangles Bay foreshore may be affected by the proposed development. Although this area will remain as public open space subsequent to marina construction, the proposed development may alter the natural features of the meeting place area, possibly detracting from the values this site holds for the local Aboriginal community that utilise it as a meeting place.

As the disturbance of the two listed ethnographic sites is unavoidable (site numbers S02169 and S02625)[20], the project developers will seek consent to disturb the sites from the Minister for Indigenous Affairs through a section 18 application under the *Aboriginal Heritage Act 1972*. Close consultation with the local Aboriginal community will be maintained during this process.

Through discussions with Aboriginal representatives, it is proposed to recognise the Aboriginal heritage values of the Cape Peron area through the creation of an Aboriginal 'interpretive site' at or near the site of the former Sister Kate's orphanage holiday camp lease. In consultation with the local

[20] It should be noted that listed Aboriginal heritage site locations provided by the *Aboriginal Heritage Site Database* (maintained by the Department of Indigenous Affairs) are not precise and are represented as shapes ranging in diameter/ width from 100 m to 2 km. This may mean that these sites may actually fall some distance from the project area but for the purpose of this assessment it will be assumed that the broad site location is in close proximity to the project area.

Aboriginal communities and CALM, it is proposed to create a site that can be used by Aboriginal persons as a meeting and learning place for the continued teaching of their customs and to also serve as an Aboriginal heritage educational site for the wider community. The site would include, amongst other features, educational signage, integrated artwork and interpretative walk trails.

There is also opportunity to incorporate some of these features (e.g. artwork) in other areas of the proposed development area, for example, at the public icon sites (see Section 4.3.1 for details of the proposed precinct plan). The natural environment around this meeting place will also be maintained and enhanced as part of the mitigation package, which will contribute positively to the Aboriginal heritage values of the site (Section 8).

7.1.4 Expected outcome

The proposed development will potentially affect some of the cultural heritage values associated with the Cape Peron area, including the two listed ethnographic sites (site numbers S02169 and S02625) and a European heritage site. Approval will be sought to disturb the Aboriginal heritage sites under the Aboriginal Heritage Act. The proposed development may also reduce the opportunity for local Aboriginal people to meet for cultural and learning purposes on the Mangles Bay foreshore, as is done presently.

In consultation with the local Aboriginal community, an appropriate 'interpretative site' will be established at or near the former Sister Kate's orphanage site to recognise the Aboriginal heritage values of the area whilst providing for use by the local Aboriginal community as a meeting place. There are also other opportunities to recognise the Aboriginal connections with Cape Peron within the development (e.g. public art, information). The project developers will also consult with the relevant Government heritage agencies, community groups and the City of Rockingham to determine the best outcome for the Turtle Factory building.

7.2 ROAD TRAFFIC

7.2.1 Description of road traffic

Esplanade, Palm Beach, Rockingham

Local roads of significance within proximity to the Cape Peron project area include:

- **Safety Bay Road** (which runs in Hymus Street at the Parkin Street intersection): the road runs north- south to form the eastern side of the project area; current traffic flow is between 8000 to 9000 vehicles per day.
- **Parkin Street:** joins Safety Bay Road from the east; current traffic flow is around 6200 vehicles per day.
- **Esplanade:** provides a continuation of Hymus Street eastwards along the foreshore; only historical traffic flow data is available (around 3000 vehicles per day in 1992) however, traffic flow is expected to be higher now.
- **Memorial Drive:** is a local access road within the project area that connects to Safety Bay Road; current traffic flow is around 1300 vehicles per day.
- **Point Peron Road:** is a local access road within the project area that connects to Hymus Street; current traffic flow is around 4600 vehicles per day.

HMAS Stirling Naval Base is located on Garden Island and a causeway links Cape Peron to the island for naval personnel access requirements. Access to Garden Island via the causeway is restricted and is not available to the general public. It is estimated that up to 3000 vehicles per day access Garden Island with peak traffic flow times occurring between 0600 – 0800 hours and 1500 – 1700 hours Monday to Friday. Point Peron Road provides the only entry point to the causeway. Although the traffic loads in the area are within the design limitations for an entire day, significant problems do occur due to car stacking on local distributor roads during the peak morning and afternoon periods resulting in existing community concern about the amount of traffic on these roads.

7.2.2 Objectives

The following objective is considered relevant to this project:

- *To ensure that the increase in traffic resulting from the proposal does not adversely impact on social surroundings or increase the risk to local public safety.*

7.2.3 Potential impacts and mitigation

The proposed Cape Peron Tourist Precinct Project will increase the volume of traffic flow along roads in proximity to the development. The increase in traffic may impact on residents and users of the area with regard to:

- **Public safety issues** (e.g. road traffic and pedestrian safety).
- **Loss of amenity** (e.g. increase in noise emissions from vehicles).

Riley Consulting undertook a traffic and transport study relating to the proposed Cape Peron project based on development Option 2.2 (Riley Consulting 2005). The discussion below is derived from this study unless otherwise stated.

Public safety

Riley Consulting used the Saturn traffic model to estimate the future traffic flows along key roads within and in proximity to the project area as a result of the proposed development. The local road network was modified to reflect the possible road layout of the development. Overall, during a typical weekday, the development could generate up to 6220 new vehicle movements on the local road network. During the weekend with the higher use of boat pens and tourist facilities, traffic flows could increase by up to 7700 new vehicle movements per day. Table 16 provides a comparison of the existing and future traffic volumes resulting from the proposed development on local streets. These traffic estimates were modelled based on Option 2.2 but similar traffic flows are expected for Option 2.3 and Option 2.4.

Table 16 Existing and future traffic volumes on the local road network

Street	Traffic volume			Comments
	Existing	Future	Increase (%)	
Esplanade	4 990	6 100	22	The expected traffic increase can be accommodated by the existing carriageway.
Parkin Street	6 253	9 093	45	The expected increase along this road is quite large as it is the main distributor between Rockingham and the localities of Peron and Shoalwater. Traffic flow is within the capacity of the road. Medians would be required to allow pedestrians to cross.
Lake Street	1 160	1 200	3	The modelling indicates that traffic is unlikely to use Lake Street or other residential streets. The expected increase is unlikely to be noticeable.
Hymus Street	8 187	9 927	21	Existing carriageway would be sufficient to cater for the increased flow, although traffic speeds are expected to reduce due to higher volumes during peak periods.
Safety Bay Road (south of Boundary Rd)	8 130	10 350	27	
Memorial Drive	1 275	3 595	181	This road may be realigned as a result of the development and would be designed to meet current urban road standards and expected traffic volumes.

Source: Riley Consulting (2005)

Although the forecast traffic flows associated with the proposed Cape Peron development are quite high on some roads, the increase can be accommodated by the existing road network and will not represent a significant increase in road traffic hazard.

The estimated increase in traffic volume on the local road network may pose a risk to pedestrians trying to cross roads. Below a flow of one vehicle every six pedestrians have the opportunity of crossing the road. Most of the local roads will not exceed this flow of vehicles, with the exception of Parkin Street. During peak hours, a flow of 900 vehicles can be expected on Parkin Street, which would require medians (road islands) to be provided at locations where pedestrians are expected to cross. This would enable pedestrians to cross one flow direction of vehicles at a time.

Amenity

An increase in traffic volumes on the local road network will result in a cumulative increase in noise emissions from vehicles, which could be of nuisance value to local residents. Road traffic noise is already anecdotally reported as being of nuisance to residents in the area. The popularity of the Rockingham foreshore area as a weekend (and weekday during school holiday periods) destination is increasing even in the absence of the proposed marina development.

This issue is not unique to the proposed development and is common in urban centres experiencing urban growth. The issue is accentuated even more so in areas that are popular tourist destinations, such as coastal areas that provide for visitor usage (e.g. Rockingham foreshore).

Traffic Management Plan

It is proposed that a Traffic Management Plan will be developed for the proposed development in consultation with the local community. The plan will address mitigation measures for traffic to reduce risks to public safety, road traffic hazards and noise impacts, including:

- appropriate traffic control measures at main intersections
- speed control measures
- pedestrian crossings or provisions for medians.

7.2.4 Expected outcome

The proposed development will increase traffic flow on some of the main roads within the vicinity of the development, however flows will be within the current capacity of the roads. The increased traffic flows will not pose a significant traffic hazard. An upgrade of local distributor roads is planned including the installation of medians where pedestrians cross the roads to decrease the risk to public safety and turning lanes to minimise banking and improve efficiency. The traffic increases on the smaller residential roads are not expected to be noticeable. Current peak traffic loading issues will be significantly minimised through the implementation of traffic management strategies (e.g. improved security checkpoint efficiency and stacking of vehicles in carparks at the Causeway entrance).

There will be an increase in noise generated by the increased traffic flows and this is expected to be of some nuisance to those residents along the roads affected, however, traffic management measures and property design guidelines will be implemented to ensure this nuisance is minimised.

8. MITIGATION MEASURES

8.1 INTRODUCTION

Environmental offsets are used as a means to counter adverse environmental impacts often encountered through social and/or economic growth (EPA 2005). The aim of environmental offsets is to achieve a 'no net environmental loss' or a 'net environmental benefit' outcome, as the environment has historically been compromised through development and the halting or reversal of this decline of the environment is now a priority (EPA 2005).

This chapter will address the environmental offsets process and how potentially adverse environmental impacts from the proposed marina development may be addressed through the provision of offsets such as rehabilitation in the remainder of Bush Forever Protection Area 355, which are consistent with the Environmental Protection Authority (EPA) Preliminary (Version 2) Position Statement No. 9, 'Environmental Offsets' (EPA 2005).

8.2 OFFSET PRINCIPLES

When considering proposed environmental offsets, the EPA is guided by the following principles:

- environmental offsets should only be considered after all other reasonable attempts to avoid and minimise adverse impacts have been exhausted
- an environmental offset package should address both direct offsets and contributing offsets
- environmental offset and impact should ideally be "like for like or better"
- positive environmental offset ratios should apply where risk of failure is apparent
- environmental offsets must entail a robust and consistent assessment process
- environmental offsets must meet all statutory requirements
- environmental offsets must be clearly defined, transparent and enforceable
- environmental offset must ensure a long lasting benefit.

8.3 OFFSETS FOR CAPE PERON TOURIST PRECINCT PROJECT

The design process for the development of the proposed concept options (Section 4.2) included consideration of avoidance and minimising potential negative environmental impacts. This resulted the development of Options 2.3 and 2.4 to reduce seagrass loss and terrestrial impacts through redesign of earlier options. The following offsets are proposed with the aim of mitigating the environmental impacts of the project and achieving a net environmental benefit for the project and also to enhance the social outcomes.

The offsets strategy is described in this section. However, if the project progresses to a detailed environmental assessment, more comprehensive assessment of impacts and consultation will result in the refinement of the proposed offsets in accordance with EPA Position Statement No 9. The proposed offsets strategy includes at this stage:

1. A provision of about $4-5m for offsets to redress the direct impact and reduce threatening processes on the Bush Forever Protection Area and terrestrial flora, vegetation and fauna:
    - rehabilitation of the natural environment of the Cape Peron and Lake Richmond area to enhance the conservation values of the area and the ecological linkage between the lake and Point Peron
    - acquisition of land with similar or greater conservation value to secure it for conservation
2. Rehabilitation of the buffer area between Lake Richmond and the development to enhance conservation value of the lake.
3. Reduction of threatening process from the indirect effect of the development through increased usage of the area:
    - provision of about $0.8m to a trust for CALM to use for ongoing management and provision of facilities of the Cape Peron area
    - provision of environmental/educational opportunities (eg. Marine Science Centre site, interpretive nature trail and Aboriginal cultural site)
4. A provision of about $1m for offsetting the impact on seagrass by rehabilitation of areas of seagrass meadows in and around Mangles Bay at least equal to the area lost through the construction of the development
5. Enhanced management of boating in the locality to reduce risks to water quality and seagrasses

These key elements of the above are discussed in the following sections.

8.3.1 Rehabilitation of the natural environment

Offset principle

Rehabilitation will be undertaken within the Cape Peron area to offset vegetation clearing requirements within the Bush Forever Protection Area 355 and the Rockingham Lakes Regional Park. Each option has a different rehabilitation requirement as follows related to the extent of impact, depending on the multiplier applied and value of the land acquired for conservation as an offset:

- **Option 2.3**: Total vegetation clearing 45.5 ha, with a potential to rehabilitate up to 91 ha of vegetation within the Cape Peron and Lake Richmond area .
- **Option 2.4:** Total vegetation clearing 40.1 ha, with a potential to rehabilitate up to 80 ha of vegetation within the Cape Peron and Lake Richmond area.

The project has estimated that about $50,000 per hectare is required for rehabilitation, to allow for the initial rehabilitation effort, monitoring and ongoing management for five years.

The rehabilitation works would be commenced before the construction of the project and would be monitored for five years after the completion of the initial rehabilitation phase. If any opportunity for rehabilitation within the Shoalwater Bay lease areas arises, these completely degraded areas will be targeted for rehabilitation with local native vegetation.

Cape Peron rehabilitation

The majority of vegetation surrounding the proposed development area has been surveyed and classified as 'Good' (Bennett 2005) according to the scale used in Bush Forever (Government of Western Australia 2000). The full description of this category is "Vegetation structure significantly altered by obvious signs of multiple disturbances however retains basic vegetation structure or ability to regenerate it." There are also some areas where vegetation condition ranges between 'Completely Degraded' and 'Degraded' and these areas will be targeted for intensive rehabilitation. The better condition areas require less intensive works but will still benefit from weed control and supplementary planting in some areas.

A Rehabilitation Management Plan for Cape Peron will be developed as part of any detailed environmental assessment. This Cape Peron area has been divided into six rehabilitation categories and associated preliminary rehabilitation measures developed based on the vegetation condition assessment and site assessment (Figure 19 and Table 17).

In general, the Rehabilitation Management Plan will aim to:

- protect and rehabilitate the remnant vegetation of the Cape Peron area to enhance the conservation values by:
    - implementing a strategic weed control program with the aim of a net decrease in weeds in the area
    - planting and/or seeding disturbed areas with local provenance species where appropriate
    - consolidating and formalising walking tracks and cycle paths to reduce disturbance to vegetation
    - providing fencing where required to protect vegetation
    - stabilising disturbed dune areas
    - providing ongoing management assistance to CALM.
    - establish a monitoring program to evaluate the rehabilitation performance
- protect native fauna within the proposed development area (through fauna trapping and relocation) and enhance fauna habitat within the rehabilitation area.

Specific rehabilitation prescriptions will be identified in the Rehabilitation Management Plan and will be tailored to best suit the final proposal. Performance monitoring of the Cape Peron rehabilitation will include assessment parameters and criteria (Table 18). Specific criteria will be determined through the detailed environmental assessment process and detailed in a Rehabilitation Management Plan.

Funding for contingencies will be provided for in the rehabilitation and monitoring program. Contingency funds would be set aside in the advent of fire within a specified period (eg 5 years) of the implementation of the rehabilitation program. Sufficient funding would be allocated to allow replanting/reseeding and weed control in the event of fire. These contingencies will be further detailed in the Rehabilitation Management Plan.

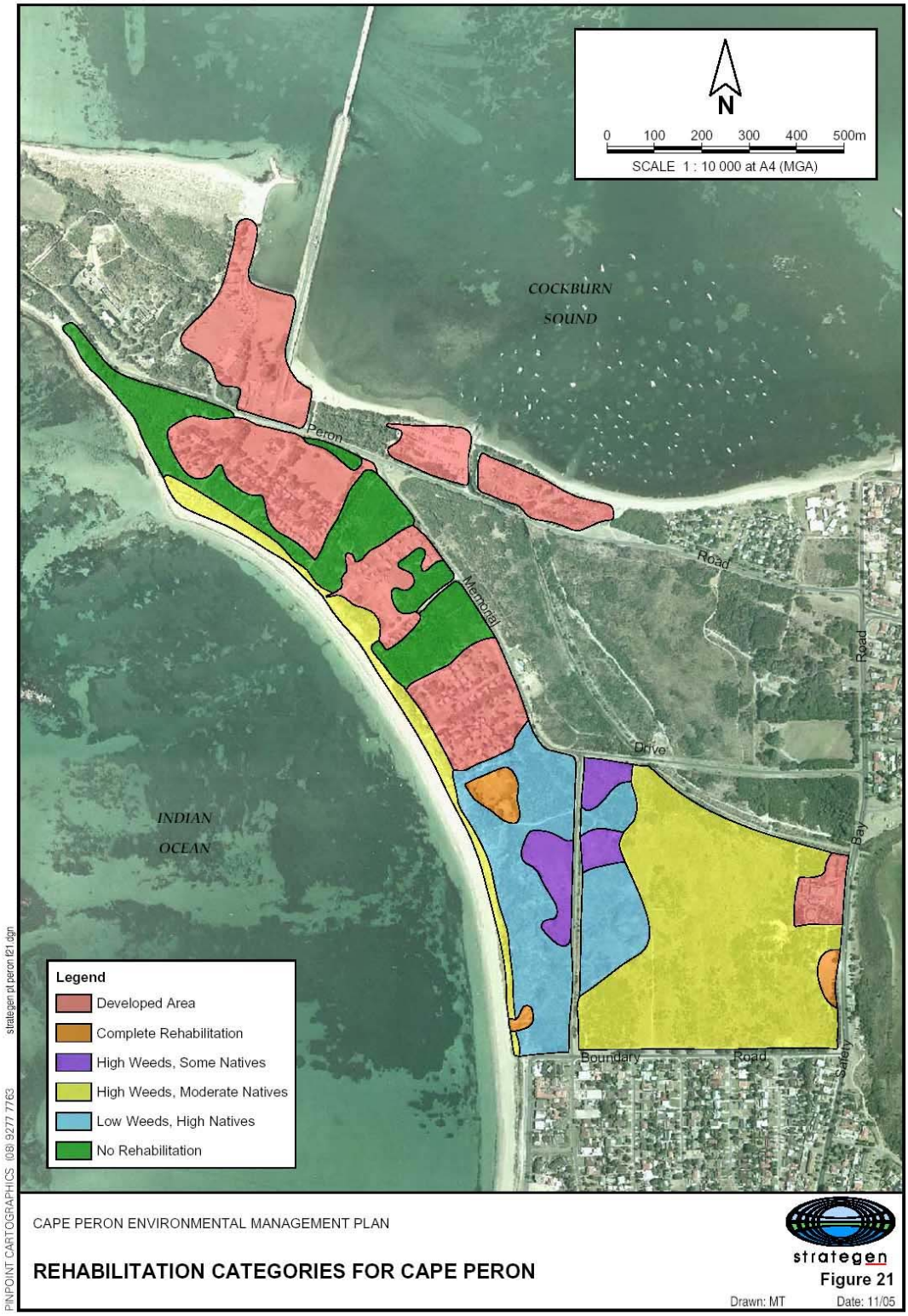


Figure 19 Rehabilitation categories within Cape Peron

Table 17 Rehabilitation Categories for Cape Peron

Category	Description	Rehabilitation required (preliminary)
Total Rehabilitation	Areas that are completely degraded with minimal representation of native species, poor diversity and highly weed infested ('Developed Area', Figure 19).	Preliminary site preparation required. Weeds to be controlled through physical and/or chemical removal as appropriate and areas to be supplementary planted or seeded with native species (species type, diversity and density to be determined).
Total Rehabilitation – Removal of infrastructure	Areas associated with infrastructure (eg. buildings, houses, ovals etc) that are completely degraded with minimal representation of native species, poor diversity and highly weed infested ('Complete Rehabilitation', Figure 19).	Preliminary site preparation required once infrastructure is removed. Weeds to be controlled through physical and/or chemical removal as appropriate and areas to be supplementary planted or seeded with native species (species type, diversity and density to be determined).
Moderate Rehabilitation – Highly weed infested areas with some natives	Areas that are degraded to poor condition with low representation of native species, low diversity and highly weed infested ('High Weeds, Some Natives', Figure 19).	Preliminary site preparation required as appropriate. Weeds to be controlled through physical and/or chemical removal as appropriate and areas to be supplementary planted or seeded with native species (species type, diversity and density to be determined).
Moderate Rehabilitation – Highly weed infested areas with moderate natives	Areas that are poor condition with moderate representation of native species, low diversity and highly weed infested ('High Weeds, Moderate Natives', Figure 19).	Preliminary site preparation required as appropriate. Weeds to be controlled through physical and/or chemical removal as appropriate and areas to be supplementary planted or seeded with native species (species type, diversity and density to be determined).
Minimal Rehabilitation – Some weed infestation with high natives	Areas that are good condition with high representation of native species, high diversity and moderately weed infested ('Low Weeds, High Natives', Figure 19).	Minimal site preparation required. Weeds to be controlled through physical and/or chemical removal as appropriate and areas to be supplementary planted or seeded with native species (species type, diversity and density to be determined).
No Rehabilitation – Very good condition remnant vegetation	Areas that are excellent condition with high representation of native species, high diversity and a low level of weed infestation ('No Rehabilitation', Figure 19).	No rehabilitation required

Table 18 Proposed method of assessment to measure rehabilitation performance

Assessment Parameter	Assessment Method (preliminary) (based on 5 replicates, 10m x 10m)	Specific Performance Criteria to be addressed in the Rehabilitation Management Plan (preliminary)
Germination of native species	Require baseline data on seed viability and germination rate. Need to calculate the estimated number of germinable seeds/m^2 for the seed mix. Count established seedlings in all replicates. Calculation of seedling emergence rate (seedlings present as a proportion of the estimated number of germinable seeds per square metre).	Germination is evident and occurring uniformly with no completely bare areas. Seedling emergence rate measured in mid-Spring.
Seedling survival	Require seedling health to be measured.	Survival rate of planted tube stock measured 3 months after planting.
Foliage cover	As per the Australian Soil and Land Survey Handbook (McDonald et al. 1998)	Species cover (excluding weeds) measured 3 years after the implementation of the rehabilitation.
Species representation	Species present in each replicate recorded. Number of species present calculated as a % of number of species in the seed mix.	Species representation over a given area at any time after rehabilitation.
Presence of weeds	Identification of any declared plants and significant environmental weed species within the replicates.	No declared weeds within the rehabilitation area 3 years after implementation and environmental weeds controlled to an extent where their impacts on new plant growth are of decreasing significance.
Overall success of plant establishment	Subjective measure based on a visual assessment of species composition, plant density and plant condition in all replicate plots. Five categories used (Excellent, Good, Satisfactory, Poor and Unacceptable). Photographic record of plant growth in each replicate. Overall assessment of the ability of the revegetated area to attain a final required vegetation structure and composition.	Species composition and projected plant growth (size, form) likely to achieve foliage cover target (excluding weeds) 3 years after implementation.

Lake Richmond

Lake Richmond is adjacent to the proposed development area and is a perennial freshwater lake covering approximately 40 ha (CALM 2005). Lake Richmond supports two Threatened Ecological Communities (TECs) including a thrombolite community that is listed as "Critically Endangered". The thrombolites occur in a 15m wide band around the lake with the best developed features occurring on the eastern side of the lake. The lake is not expected to be affected by the proposed development but the lake environment is of high value ecologically and to the local community and rehabilitation of the area where beneficial will be included in the offsets package subject to consultation with the City of Rockingham and local residents. Enhancing the ecological linkage between Lake Richmond and Point Peron will be a focus for the Rehabilitation Management Plan.

8.3.2 Land contribution to the conservation estate

To contribute to the project mitigation, offsets outside of the immediate Cape Peron/Lake Richmond area would be included in an offsets package for the development options. This would be done through the use of those funds to purchase appropriate land and protect it for conservation.

This acquisition and the rehabilitation of areas within the Bush Forever Protection Area will be finalised in accordance with the EPA Position Statement No 9 during the preparation of any detailed environmental assessment required by the EPA.

8.3.3 Rehabilitation of the sea grass meadows

Any loss (direct or indirect) of seagrass in Cockburn Sound will be offset by rehabilitation of at least an equal area. The project has made a provision of about $1m for the rehabilitation of seagrass and expect that $100 000 per hectare will be required for the rehabilitation of seagrass. This is considered a generous amount and would provide for the initial planting effort, monitoring and any supplementary planting required. The rehabilitation will be carried out within the following areas as described in Section 6.2.4:

- 1.7 ha in mooring scars in Mangles Bay (requiring the removal of the moorings or their replacement with environmentally friendly moorings)
- approximately 2 ha in old barge scars in Mangles Bay
- approximately 1 ha along the shallow edges of the marina's boating access channel(s)
- several hectares on Southern Flats
- approximately 2 ha on the eastern edge of Mangles Bay shallows.

Rehabilitation criteria will be developed during the preparation of a detailed environmental assessment. It is proposed that completion criteria for any seagrass rehabilitation program be linked to a specific percentage survival of planting units for at least two years, with ongoing monitoring of indicators of ecological function (e.g. shoot density, seagrass production, fauna production, habitat function) for four years. Implicit in this approach is that planting units are spaced at intervals that allow attainment of shoot densities similar to adjacent natural meadows within five to ten years. Research presently underway (Appendix 8) will provide modelling tools that will allow definition of planting unit spacing and percentage survival that achieves the required outcome.

To demonstrate the effectiveness of seagrass rehabilitation in Mangles Bay, 2 ha of seagrass will be replanted within Mangles Bay if Cabinet decides that the project should proceed to detailed design and assessment. The replanted seagrass will then have been growing for approximately two years by the time there is a Ministerial decision on the project. The monitoring of this demonstration site is expected to provide added evidence that the replanting of seagrass is a feasible option for offsetting seagrass loss in Mangles Bay.

In conjunction with the seagrass rehabilitation demonstration, it is proposed to develop and commence a trial incentive scheme to replace a selection of swing moorings in Mangles Bay with 'seagrass friendly' fixed moorings. This will commence as soon as possible in the second half of 2006.

8.3.4 Enhancement of recreational opportunities and public facilities

The proposed marina development is primarily a public boating and tourist facility proposed in order to cope with the high demand for boating facilities in the City of Rockingham area.

Within the Cape Peron and Lake Richmond area of the Rockingham Lakes Regional Park, it is proposed to:

- improve recreational opportunities by providing hard walking and cycling paths without creating additional disturbance to the natural environment
- provision of board walks in sensitive areas with a lookout over Shoalwater Bay
- provision of public toilet facilities at Point Peron
- formalise beach access points, provide parking and remove unnecessary paths to minimise dune erosion
- recognise cultural heritage (Aboriginal and European) links with the area (e.g. providing interpretative signage at sites of significance and contributing to the maintenance of these sites)
- contribute to research and educational opportunities through the provision of facilities within the marina and interpretative walk trails/ signage
- provide funding to CALM for ongoing management of the proposed facilities and the natural environment within the Cape Peron and Lake Richmond area of the Park.

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9. SHORT TITLES AND ACRONYMS

Table 19 sets out the short titles and acronyms used in this report.

Table 19 Short titles and acronyms

Short Title or Acronym	Long Title
BFPA	Bush Forever Protection Area
CALM	Department of Conservation and Land Management
DALSE	DAL Science and Engineering Pty Ltd
DEH	Department of Environment and Heritage
DEP	Department of Environmental Protection (former)
DMH	Department of Marine and Harbours (former)
DoE	Department of Environment
DPI	Department for Planning and Infrastructure
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPP	Environmental Protection Policy
EQG	Environmental quality guideline
EQO	Environmental quality objective
EQS	Environmental quality standard
EV	Environmental value
FCT	Floristic community type
SEP	State Environmental (Cockburn Sound) Policy
SRG	Stakeholder Reference Group
WAPC	Western Australian Planning Commission
WRC	Water and Rivers Commission (within DoE)