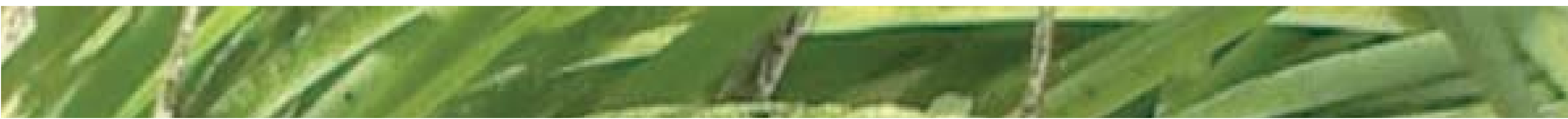
cape jaffa anchorage

environmental impact statement february 2005



eis

cape jaffa anchorage

environmental impact statement february 2005

prepared for

Kingston District Council

and

Cape Jaffa Development Company Pty Ltd

by

Masterplan SA Pty Ltd

and

Tonkin Consulting

Also see Authors & Contributors

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SUMMARY

Introduction Section 1.0

Cape Jaffa is one of the five designated Southern Ports in the South East of South Australia. Its fishing fleet and associated industry and community are well established, and in recent times, aquaculture opportunities have been recognised with the commencement of commercial operations. Tourism and recreational boating are important contributors to the economy and activity at Cape Jaffa. The population centres at Kingston and Robe have experienced growth in recent years and the stock of available vacant residential land is extremely limited.

In recognition of the growth in the district and the specific pressures and activities at Cape Jaffa, Kingston District Council, through a committee established in early 2000, sought to investigate infrastructure and development requirements at Cape Jaffa. Following these investigations, Kingston District Council and the Cape Jaffa Development Company (CJDC) then prepared an application to the Government for the establishment of an enhanced range of facilities to serve the fishing, aquaculture, tourism, recreational boating and resident communities with safe, environmentally sensitive and well planned services and facilities.

The Minister for Urban Development & Planning declared the Cape Jaffa Anchorage proposal as a Major Development on 19th December 2002. Guidelines for the preparation of an Environmental Impact Statement (EIS) were issued by the Major Developments Panel in June 2003.

The EIS has been prepared in accordance with the Guidelines determined by the Major Developments Panel, as required under Section 46B (3) of the *Development Act* 1993, and provides statements as to the expected environmental, social and economic effects of the development. It also provides statements as to the extent to which the expected effects are consistent with the Development Plan and the Planning Strategy, as required in Section 46B (4) of the *Development Act* 1993.

The EIS documentation incorporates three volumes, the first being the substantive EIS report, the second and third being the supporting Appendices. Volume 1 comprises:

- Summary;
- Background to the proposal, the proponent and the EIS process;
- Statement as to the need for the proposal, including discussion of the objectives, relevant government strategies, benefits, costs, project rationale and consequences of not proceeding;
- Description of the proposal;
- Description of the existing physical, social and economic environment;
- Response to the specific questions raised in the Guidelines;
- Glossary;
- References; and
- Authors and Contributors.

The investigations have been thorough and the mechanisms required for the management of all identified effects have been considered to allow relevant commitments to conditions for the betterment of the social, economic and physical environment at Cape Jaffa.

The study concludes that the proposal is one that is readily accommodated in this environment. It reinforces and builds upon the existing settlement and is supported and encouraged by numerous Government policies and strategies relevant to the locality. Further, at its peak it is estimated that there will be 222 full time equivalent jobs, peak value added contribution to the local economy of $21.3 million and an ongoing contribution of $12.4 million per annum.

Need for the Proposal Section 2.0

The need for the development of Cape Jaffa is well established in numerous strategic plans, policies and studies applicable to this area. These strategies and policies were produced prior to consideration of this proposal and clearly recognise the special features of Cape Jaffa, its current function and the future possibilities to enhance and grow the community, the local industries and the broader economy.

The need is expressed in the current Development Plan, which sets out areas for Residential, Local Centre and Industrial development at Cape Jaffa. The State Regional Planning Strategy and the Kingston District Council Strategic Plan both support the intention for further development at Cape Jaffa.

The South East Coastal Management Strategy reinforces the planning policy for further development at Cape Jaffa and acknowledges the communities aspirations for appropriately located port, marina and coastal development.

The Lacepede Bay Aquaculture Management Policy acknowledges the area of Lacepede Bay close to Cape Jaffa as being appropriate and suited to the development of the aquaculture industry.

These identified policies reflect the community needs, expectations and well known demand for facilities, services and living environments on or close to the coast. The existing infrastructure at Cape Jaffa does not meet current expectations. There is no reticulated water, no effluent treatment, only single wire earth return power and the facilities for the existing fishing and aquaculture industries causes inefficiencies and limits the capacity for growth. There is therefore the need to significantly enhance the infrastructure.

Description of the Proposal Section 3.0

The proposed Cape Jaffa Anchorage development is a multi-component commercial/recreational marina, together with waterfront residential development, located on land immediately south and east of the Cape Jaffa township. The proposal incorporates features typical of a fishing/aquaculture port, recreational boat haven and marina, including:

- Breakwaters;
- Channel;
- Main harbour basin;
- Boat ramp;

- Fishing and aquaculture industries service area;
- Fuel and waste management facilities;
- Boat washing and hull cleaning;
- Commercial areas for maintaining and repairing vessels;
- Public marina berths;
- Commercial berths;
- Commercial wharf;
- Retail;
- Residential allotments;
- Private marina berths;
- Apartment, motel and cabin accommodation;
- Motor repair station – marine servicing and hard stand;
- Recreation facilities and open space;
- Landscape buffers;
- Reticulated mains water supply;
- Effluent treatment and water reuse;
- Stormwater management;
- Reticulated power;
- Telecommunications; and
- Land division to accommodate these uses.

To enable the development of a safe harbour, a channel will be created through the beach into Lacepede Bay along the Cape Jaffa Road reserve. The channel opens into a basin area where boats can be moored. The basin is edged by private and public spaces, commercial wharfs and recreational frontages. The main activity area comprises tourist accommodation, retail, commercial and public facilities, a recreational boat ramp, commercial wharf and associated facilities. Running east and west of the main basin are waterways for recreational vessels to be moored, together with residential allotments and public reserves.

The proposal includes the dedication of coastal foredune from private ownership to public ownership to ensure its protection. The dune vegetation will be rehabilitated and accessways provided.

The Kingston District Council and the CJDC have entered into an agreement to ensure the appropriate management of construction and operation of the facilities. The agreement establishes maintenance funds to provide for the ongoing maintenance of the marine infrastructure and defines maintenance responsibilities. The agreement also provides for the preparation of an amendment to the Development Plan policies which guide development in terms of land use, design and function.

Assessment of Environmental, Social and Economic Effects Section 5.0

Section 5 of the EIS sets out responses to the issues identified by the Major Developments Panel and provides assessment of the proposal in terms of its environmental, social and economic effects. These issues are identified under the following headings:

- Need for the Proposal;
- Environmental Issues including Groundwater, Coastal, Water, Management and General;
- Effects on Communities;
- Economic Issues;

- Construction and Operational Effects;
- Risk/Hazard Management;
- Effects on Infrastructure Requirements;
- Native Title and Aboriginal Heritage; and
- Planning and Environmental Legislation and Policies.

Need for the Proposal   Section 5.1

The investigations into the effects of the proposal conclude that established needs can be addressed by this proposal:

- There is a well established need for the development in the studies and strategies prepared relevant to the locality, the district and the State. These works have resulted from consultative processes in which the role of Cape Jaffa has been identified by the community, agencies and authorities as a focus to serve the resident, fishing, aquaculture, tourist and recreational boating communities.

- There is a shortage of residential land for development purposes and more-so a lack of coastal residential land, a phenomenon well documented around the coastal areas of Australia. The demand in this locality can be in part met by the creation of additional waterfront land without the creation of a linear coastal development. The demand is reinforced by the interest shown in the proposal and the formal registrations of interest.

- In economic terms, the need for the proposal is linked to the current limitations placed on the fishing, aquaculture and tourist industries. The current infrastructure at Cape Jaffa is substandard and is inadequate to cater for the advancement, efficient or safe operation of the fishing and aquaculture activities.

Environmental Issues   Section 5.2

The environmental issues investigated reveal that the land to a large extent is degraded as it has been used for many years for grazing and cropping and possesses few natural features. There will be significant environmental and community benefits flowing from the development of the proposal in its current form. A reticulated water supply will be established and an effluent and waste water reclamation scheme thereby providing greater protection to the local groundwater. The vegetated foredune will be enhanced and transferred to public ownership, there will be a number of attractive reserves, parks and walkways created as part of the scheme, there will be reduced traffic effects on the beach and the roadside vegetation will be rejuvenated. Water quality will be maintained in the marina by the tidal flow combined with the natural flow of groundwater out to sea. The adaptive coastal management plan will ensure that the prevailing longshore sand drift and the existing coastal alignment are maintained thereby protecting the dunes and the coast.

Effects on Communities   Section 5.3

The proposal will facilitate the growth of the township and associated community facilities in a form that utilises the unique and special qualities of the locality and the local industry. This growth will be in a different form and the spacial arrangement differs from the current zoning. This extends the range of facilities and services available to a greater population, providing new opportunities and choices not otherwise available. This will reinforce the role and function of Kingston as the main service town for the district.

Economic Issues Section 5.4

Economic benefits are numerous as there will be significant job opportunities and increased expenditure and hence income to the district as a result of the development as follows:

• During Establishment	Up to 222 jobs and $21 million per annum over 15 years
• During Ongoing Operations	215 jobs and $12.4 million per annum ongoing
• Once off	311 jobs and $21.4 million

The rate revenue will benefit the wider community and provision has been made for maintenance funds provided directly from the developer and rate revenue of residents at the marina.

Construction and Operation Effects Section 5.5

Construction of the sea channel, breakwaters, main basin, waterways and land-based infrastructure will be appropriately managed to minimise potential effects on the local environment. The Site Construction Management Plan is an integrated management plan that covers all aspects of construction, including marine construction and incorporates measures to protect the marine environment, terrestrial environment and the general amenity at Cape Jaffa.

The operational management of the facilities is defined in an agreement between Kingston District Council and CJDC which sets out the roles and responsibilities for operation, monitoring and maintenance of facilities. In addition to existing statutory requirements, Marina Rules, encumbrances and by-laws will be created to provide mechanisms for the management and control of the marina.

Risk/Hazard Management Section 5.6

Strategies and procedures for the management of various potential hazards have been assessed, including: public safety during construction, acid sulphate soils, pollution spills, sewage leaks, fire, explosion, marine pest organisms, weeds, hazardous materials, boat maintenance activities, flooding, sea level rise, groundwater effects, marine environment, coastal hazards and public safety on the waterways. The management of these hazards is set out in Section 5.6.

Effects on Infrastructure Requirements Section 5.7

The Cape Jaffa settlement is seriously deficient in service infrastructure and the proposal will result in increased demand for services. A significant part of the service infrastructure will be provided by the proponent and contributions from government will be sought to assist in enabling the existing community to connect to these services.

Native Title and Aboriginal Heritage Section 5.8

Surveys, investigations and consultation with Aboriginal representatives revealed no recorded Native Title, anthropological or archaeological sites at Cape Jaffa. The recent investigations have located a limited number of artefacts which have been determined by the Minister under Section 12 of the *Aboriginal Heritage Act* 1998. An application made under Section 23 of the Act to collect the artefacts for their protection and preservation has been approved by the Minister for Aboriginal Affairs and Reconciliation..

Planning and Environmental Legislation and Policies Section 5.9

The proposal is consistent with the intent of the Development Plan which encourages the development of Cape Jaffa into a substantial coastal community. The proposal rearranges the functional areas to create an efficient operating fishing port, recreational marina and township development. These intentions are also acknowledged and supported in State, regional and local policies for the development of the area.

The facilities will be established in accordance with relevant environmental legislation and management policies including stormwater management, wastewater management, construction management, in water maintenance and other similar management practices to protect the marine and terrestrial environment.

Avoidance Mitigation Management and Control of Adverse Effects

The assessment and management of potential adverse effects is set out in Section 5.0, together with responses to the issues identified by the Major Developments Panel.

There are limited adverse effects resulting from the development of the proposal. The current zoning allows the urban development of the majority of the land, however very little provision has been made for infrastructure and facilities to support environmentally balanced development. The proposed development provides for an orderly and economic, comprehensively planned development incorporating the necessary measures for the control and management of potential effects.

The proposed safe haven enhances the operating environment and safety for the commercial fishers, the aquaculture enterprises and the recreational boating public. The breakwaters result in the interruption of the flow of sand from west to east along the coast.

As the quantity of movement is limited and the adaptive sand management program will readily accommodate the variations in movement in order to mitigate and manage the adverse effect of interruption to sand movement. Periodic sand bypass pumping will be employed to match the natural longshore sand drift to manage the coastal profile, protect the existing dunes and maintain safe navigation. The adaptive sand management is the responsibility of the proponent and is provided for by a maintenance fund to be established as part of this proposal.

The other key issue for consideration is the effect of the development on groundwater within the existing Cape Jaffa settlement. The investigations reveal that although the groundwater level changes are small and changes to productivity of existing wells will be minimal, the later stages result in increased risk of seawater intrusion whilst extracting groundwater. The effects are limited to the immediate vicinity of the waterways and ongoing monitoring will confirm the extent of potential effects. It is proposed to extend the reticulated water supply to the existing settlement, thereby mitigating any potential effects of the later stages well in advance of their possible occurrence.

The proposal creates a better managed environment that satisfies a greater variety of social needs and is therefore of significant value to the community at large. Numerous opportunities are created for jobs, housing choice, recreation and work type opportunities that enhance the overall quality of life at Cape Jaffa and the region. Arising from the proposal is also the prospect of greater interpretation and education about Aboriginal and European heritage, increased tourism experiences and interest in the area.

There are no adverse social effects identified through these investigations. Individual perceptions and opinions regarding the resulting changes to the size and nature of Cape Jaffa may be seen as either a positive or an adverse social effect. It is important to note that the existing zoning allows for growth of Cape Jaffa and hence a change in the extent and nature of the township.

The increase in rate revenue to Kingston District Council is significant and the whole of the community stands to benefit from the greater capacity of the Council. There will be additional maintenance and management costs associated with the operation of the marina and the management of coastal processes. These costs are to be managed through the creation of funds to ensure the long term management and maintenance of the marine infrastructure. In this way users of the facilities are assured that these activities are adequately funded and the community is not prejudiced by the development.

The proposal makes allowance for modification to ensure the most appropriate outcomes. There are seven stages proposed with a review and design process between stages to ensure the design is responsive to community needs.

In addition to the mitigation, management and control of effects, the proponent has taken a proactive approach to development. Commitment has been made to long term funding of works, and incorporation of design guidelines into agreements and the Development Plan to provide greater certainty as to the form and nature of development.

Conclusion

The proposed development provides for industrial, business, residential, recreational and tourist accommodation activities in a form and manner that cannot be developed within the current infrastructure, policy constraints and arrangements at Cape Jaffa. The State's Regional Strategy and the regional review of the Development Plan are in unison in their encouragement of improved facilities at Cape Jaffa for the overall economic betterment of the region. This consistency is logical given the geography and suitability of the locality as evidenced by the long term establishment of the fishing fleet and the more recent development of the aquaculture industry.

Council's current Development Plan recognises a significant area suited to residential, tourist and industry growth, however does not contemplate the prospects of a safe harbour and marina facilities which inevitably increase the area required to be zoned. The proposal is therefore consistent with the strategic directions and the more detailed policy for the development of this area.

This proposal provides the impetus for improvements and enhancements of infrastructure and services as sought in the various Strategic Plans for the State and the district.

The greater efficiency in the fishing and aquaculture industries will reinforce and enhance their market position and improve the local economy. The creation of additional residential and tourist accommodation opportunities will go towards satisfying the longer term demands for coastal housing associated with retirement trends and recreation pursuits. There are few opportunities in the South East of South Australia where a comprehensive planned approach can be accommodated.

The key features and benefits of the proposal are listed below.

- Provision of appropriate safe access and service infrastructure;
- Enhanced economic opportunities for the existing industries at Cape Jaffa and the region including fishing, aquaculture, recreation, tourism and wine making;
- Creation of up to 222 full time equivalent jobs;
- Peak value added contribution to the local economy of $21.3 million and an ongoing contribution of $12.4 million per annum;
- Investigations into the terrestrial and marine coastal environment as part of this Major Development process provides an excellent understanding of the characteristics of the area and highlights improvements that can be made through this development;
- The vegetated dunes can be considerably enhanced;
- Public facilities, access, parking, reserves and boating facilities will all be enhanced;
- The land can be appropriately and readily protected from floods, erosion and sand drift;
- The proposal incorporates design characteristics and is located such as to allow for sea level rise;
- The physical and economic resources of the coast have been identified and the effects of development assessed as part of the Major Development process;
- Cape Jaffa has been a defined settlement for many years serving a resident, tourist and fishing community. The proposal reinforces this settlement in a location suited to a protected harbour for an existing fishing fleet consistent with the strategic directions for aquaculture and the provision of safe and environmentally appropriate facilities;
- The proposal redesigns and expands on the earlier expectations for the development of Cape Jaffa, and in so doing, significantly reduces the risk of environmental degradation by the provision of safe mooring, service infrastructure, including pump out facilities, waste and refuelling facilities; and
- Provides enhanced safety and public access to the beach with the development of footpaths and car parks close to the beach as well as public boat launching facilities.

The proposed development provides a comprehensive and planned approach to the development of the Cape Jaffa settlement by accommodating the existing demands of the fishing and aquaculture industries, tourists and residents. The development builds on the existing infrastructure and improves the service level to the community in various ways. By expanding on the existing infrastructure, the varied social, cultural, employment, economic and recreational needs of the communities at Cape Jaffa can be satisfied.

For these reasons, the proposal is orderly and economic and satisfies good planning principles for the development of facilities in a coordinated manner in order to satisfy the varied needs of the community.

1.0 INTRODUCTION

1.1 Background to and Objectives of the Proposal

The Kingston District Council comprises an area of about 3,336 square kilometres extending from the southern Coorong to just north of Robe and eastward toward Naracoorte in the South East of South Australia. Council has a significant frontage to the coast of approximately 140 kilometres. The Council area is predominantly used for rural pursuits, however the coastal association is strong and significant in terms of its economic environment and development. There are two zoned urban settlements established in the Council area, the primary focus being at Kingston and the other at Cape Jaffa, a long established fishing port. The Kingston District is shown on **Figure 1.1**.

The Kingston District Council formed a committee in January 2000 to investigate future development requirements at Cape Jaffa in relation to the Southern Rock Lobster fishing industry, the aquaculture industry, tourist interests, recreational boating facilities and the settlement growth. With the demands of these industries and activities requiring significant upgrades to onshore infrastructure and growth in the district generally, the committee was established to plan for all infrastructure requirements to meet the varied needs of the community for the future of the existing port at Cape Jaffa.

Figure 1.1: Kingston District

Council investigations involved discussion with interest groups including the fishing and aquaculture industries to determine future infrastructure needs. Discussions were also held with recreational boating users, tourist facility operators and tourists to determine requirements for an adequate recreational boating facility at Cape Jaffa. The committee conferred with adjoining landowners to identify their requirements or visions for future development of their land, as without a cooperative approach the future directions would be difficult to determine.

These discussions were held with a view to investigating areas to be set aside for commercial and industrial development in association with the fishing and aquaculture industries as well as the tourism industry and residential development.

Council also undertook a rezoning of land to expand the development area of the Cape Jaffa settlement. Since May 2001, the investigations into the development of improved service facilities at Cape Jaffa gained momentum with discussions between Council and the principals of CJDC who approached Council with ideas consistent with Council's intentions. As a result, a concept which could accommodate the fishing and tourism industries and the possibility of future residential development was viewed favourably by the Council. These investigations and discussions lead to the purchase of private land adjacent and contiguous with the Cape Jaffa settlement.

As part of performing preliminary investigations into the future planned development of Cape Jaffa, test digs were conducted on the land to ensure its general suitability for construction of canals, wharfs, ramps and other related infrastructure.

The trial test digs proved that the site is generally suitable and subsequently a preliminary concept plan for the development was prepared. Further, the circumstances of the existing fishing port and its location as the base for an aquaculture industry, its geographical location and orientation all indicated that Cape Jaffa would be suitable as a site for creating a more protected facility for the fishing industry and also presented an opportunity to create a settlement that would accommodate the growing tourism, holiday and residential community. From these preliminary investigations and following early consultation with the community, the Kingston District Council and CJDC identified the following objectives:

Objective 1	An enhanced range of facilities and services to support and grow the local fishing, aquaculture, tourism, recreational boating activities and residents;
Objective 2	Provision of safe, convenient and orderly services and facilities for business, tourism, recreation and residential purposes.
Objective 3	Well planned and integrated facilities for residents, tourists and the fishing and aquaculture enterprises of the district.
Objective 4	Facilities established in an environmentally sensitive and balanced manner to ensure an enduring environment for the community.

1.2 The Proponent

The proponent for the development is the Kingston District Council and the Cape Jaffa Development Company Pty Ltd (CJDC).

Kingston District Council and CJDC have an agreement which specifies the roles and responsibilities of both parties in the proposed development. Kingston District Council's role is to facilitate the development without exposing Kingston District Council and its community to the financial risks associated with the development and without placing a financial burden on Kingston District Council.

CJDC's role is to execute the development and to accept the financial risks associated with the development. CJDC's involvement incorporates the provision of bank guarantees to ensure that Kingston District Council and hence the community it serves is not at risk as a result of the project. CJDC comprises interests from the private sector well versed in the land development, quarrying, earthworks, environmental management, waste management, engineering and construction areas. Other projects designed, developed, constructed or operated by the principals of CJDC include:

- Southern Waste Depot: a fully engineered and lined major metropolitan Adelaide landfill incorporating contaminated soils bioremediation treatment, management and disposal;
- a joint venture with Flinders Bioremediation Pty Ltd, a wholly owned subsidiary of the Flinders University of South Australia for the research, development and management of contaminated soil remediation projects including Harbourside Quays, various Council depot and Transport SA depot sites, Catchment Water Management Board trash rack wastes, ETSA sites, and lead contaminated mine tailings;
- Southern Expressway Stage 2, earthworks and blasting;
- long term quarrying and mining on behalf of Penrice Soda Products at Angaston, McLaren Vale Quarries, One Steel at Ardrossan, and various other quarrying and mining activities;
- operation of Southern Region of Council's landfill at Pedler Creek;
- rehabilitation and residential land development of a former Council depot at Port Adelaide;
- residential land development including civil works;
- commercial and industrial site development works throughout metropolitan Adelaide;
- rehabilitation and residential development of a former Transport SA depot at Grange; and
- infrastructure development, land reclamation and earthworks for the Commercial Precinct at Adelaide Airport.

1.3 Staging and Timing

The development is proposed to be undertaken in seven main stages, however these stages will be refined as the project progresses. Stage 1 will comprise the major infrastructure and hence the highest cost phase of the project. It is intended to provide, as part of this stage of the project, the public boat ramp and associated facilities which directly rely on the channel and breakwater works, and form an integral part of Stage 1.

Table 1.1 and **Section 3.0**, 'Description of the Proposal', sets out the proposed staging arrangements and expected timing for each stage. It is expected that the full development will be undertaken over a nine to ten year phase, however this will depend on commercial interests, particularly the demand for allotments. As there are secondary stages within each primary stage there is overlapping construction and operation phases. It is also evident that the stages comprise different elements of the project to satisfy different needs of the community, and hence offers choice in housing location, additional tourist accommodation areas, and commercial activities associated with the fishing fleet and marina.

Table 1.1: Staging

Stage	Construction Phase	Operation
1	Spring 2005 to Autumn 2006	Autumn 2006
2	Autumn 2006 to Spring 2006	Spring 2006
3	Autumn 2008 to Winter 2008	Winter 2008
4	Autumn 2010 to Winter 2010	Winter 2010
5	Autumn 2012 to Winter 2012	Winter 2012
6	Autumn 2014 to Winter 2014	Winter 2014
7	Autumn 2016 to Winter 2016	Winter 2016

1.4 EIS Process

1.4.1 Purpose and Description of the EIS Process

EIS means Environmental Impact Statement. This term is established in Section 46B of the *Development Act* 1993. The purpose of the EIS as set out in the *Development Act* 1993 is to:

- provide a clear description and analysis of the existing environment, the proposal, issues relevant to the development and the means by which these can be addressed;
- detail the expected environmental, social and economic effects of the development;
- consider the extent to which the expected effects of the development are consistent with the provisions of any Development Plan, the Planning Strategy and any matter prescribed by the Regulations under the *Development Act* 1993;
- set out the proponent's commitments to meet conditions (if any) placed on any approval that may be given to avoid, mitigate or satisfactorily control and manage any potential adverse impacts of the development on the environment; and
- address any other information required by the Minister.

The aims of the EIS and the public consultation and review are to provide:

- a source of information from which interested individuals and groups may gain an understanding of the proposal, the need for the proposal, the consequences of not proceeding, the environment which would be affected, the effects that may occur and the measures to be taken to minimise these effects;
- a forum for public consultation and informed comment on the proposal; and
- a framework in which decision-makers may consider the environmental aspects of the proposal in parallel with social, economic, technical and other factors.

Following an application by the proponent, the Minister declared the proposal to be a Major Development and Guidelines were issues by the Major Development Panel requiring the proponent to prepare an EIS. The process continues as follows:

- the **EIS** is referred to any prescribed authority or body, and to other relevant authorities or bodies for comment;
- public exhibition of the **EIS** document by advertisement is undertaken for 30 business days during which time written submissions are invited;
- a public meeting is held in the locality by Planning SA during the period for making submissions to provide information on the development or project, to explain the EIS document and processes, and to assist interested persons making submissions under the *Development Act* 1993;
- copies of any submissions from the public and agencies will be given to the proponent, being the Kingston District Council and CJDC soon after the public comment period has closed;
- the proponent then prepares a written response in a '**Response Document**' to the matters raised by the Minister or any prescribed or specified authority or body and the public;
- the Minister then prepares an **Assessment Report** taking into account any submissions, the proponent's response to those submissions, and comments from any other authority or body considered as the Minister thinks fit;
- the **Response Document** and the **Assessment Report** are to be kept available for inspection and purchase at a place and period determined by the Minister;
- availability of each of these documents will be notified by advertisements in The Advertiser newspaper and local press;
- under Section 48 of the *Development Act* 1993, the Governor is the decision maker; and
- in arriving at a decision, the Governor must have regard to:
  - provisions of the appropriate Development Plan and Regulations;
  - if relevant, the Building Rules;
  - the Planning Strategy;
  - EIS and Assessment Report;
  - if relevant, the *Environment Protection Act* 1993.

1.4.2 Approval Processes and Legislation

The following table sets out more formally the main steps in the process from its commencement according to the Major Development provisions pursuant to Sections 46 and 48 of the *Development Act* 1993 as amended, together with comments relevant to each step in the process:

Table 1.2: Major Development Process

Section	Main Steps In Procedure	Comments
46	Declaration as a Major Development.	The Minister made a declaration on 19 December 2002 that the development is of major environmental, social or economic importance.
2	An application was lodged by the proponent in March 2003.	Proponent is a person or company that proposes to undertake development. The proponent in this case is a cross sectorial collaboration between Local Government and the private sector. This application formalised the proposal to the government to assist in identifying the main issues.
3	The Major Developments Panel prepared an issues paper.	The issues paper was prepared and subsequently advertised on 13 March 2003 and written submissions received.
4	The Major Developments Panel determined the level of assessment as an EIS (Environmental Impact Statement) in accordance with Section 46B of the *Development Act 1993* and prepared guidelines.	These guidelines were released in June 2003. They require a description and analysis of issues relevant to the development and the means of addressing those issues.
5	The proponent has prepared this EIS in accordance with the requirements of the guidelines.	The EIS details the relevant expected environmental, social and economic effects. It also analyses the proposal in terms of its consistency with State Planning Strategy, the Development Plan and other regulatory requirements under the *Development Act* 1993. It also sets out the commitments to the management of issues and effects arising from the project.
6	The EIS is now released for public and agency comment.	The EIS is released to the public and Government agencies for 30 business days. A public hearing is held during the expiation of that period.
7	Proponent response and possible EIS amendment.	The proponent responds to submissions and all matters raised by the public and Government agencies. The proposal may be amended as a result of the submissions received.
8	Assessment Report	The Minister prepares an Assessment Report which is released to the public. The assessment report clarifies matters related to the proposed development to assist in the decision making process. The proponent does not have a role in its preparation.
9	Decision making by the Governor.	The application (with any amendments) is forwarded for decision making by the Governor. The Governor determines all applications for Major Developments which are subject to an EIS. The Governor may delegate authority to the Development Assessment Commission for further decisions and review.

The following legislation is most relevant to the project for approvals and management purposes (please note (F) denotes federal legislation while (S) denotes South Australian State legislation):

- *Aboriginal Heritage Act*, 1988; (S)
- *Aboriginal and Torres Strait Islander Commission Act*, 1989; (F)
- *Aboriginal Sacred Sites Act*, 1989; (F)
- *Animal and Plant Control (Agricultural Protection and Other Purposes) Act*, 1986 and Regulations, 2002; (S)
- Australian Code for the Transport of Dangerous Goods by Road and Rail, 1992; (F)
- *Australian Heritage Commission Act*, 1975; (F)
- *Coast Protection Act*, 1972, and Coast Protection (South East) Regulations, 2000; (S)
- *Country Fires Act* and Regulations, 1989; (S)
- *Dangerous Substances Act*, 1979 and Regulations; (S)
- *Crown Lands Act*, 1929 and Regulations, 1996; (S)
- *Dangerous Substances Act*, 1979; (S)
- *Development Act* and Regulations, 1993; (S)
- *Endangered Species Protection Act*, 1992; (F)
- *Environment Protection Act*, 1993 & Environment Protection (General) Regulations, 1994; (S)
- *Environment Protection and Biodiversity Conservation Act*, 1999; (F)
- *Environment Protection Councils Act*, 1993; (S)
- *National Environment Protection Council Act*, 1994; (F)
- *Environment Protection (Sea Dumping) Act*, 1981; (F)
- *Environment Protection (Sea Dumping) Act*, 1984; (S)
- *Explosives Act*, 1936; (S)
- *Fisheries Act*, 1982 and Regulations; (S)
- *Harbors and Navigation Act*, 1993 and Regulations, 1994; (S)
- *Heritage Act* and Regulations, 1993; (S)
- *Historic Shipwrecks Act*, 1981 and Regulations, 1999; (S)
- *Historic Shipwrecks Act*, 1976 ; (F)

- *Industrial Chemicals (Notification and Assessment) Act*, 1989; (F)
- *Local Government Act*, 1999 and Regulations; (S)
- *National Parks and Wildlife Act*, 1972 and Regulations; (S)
- *National Environment Protection Council (South Australia) Act*, 1995; (F)
- *Native Title Act*, 1993 (as amended); (F)
- *Native Title (South Australia) Act*, 1994 and Regulations, 2001; (S)
- *Native Vegetation Act*, 1991 and Regulations, 2003; (S)
- *National Environment Protection Council (South Australia) Act*, 1995; (F)
- *Protection of Marine Waters (Prevention of Pollution from Ships) Act*, 1987; (S)
- *Protection of Moveable Cultural Heritage Act*, 1986; (F)
- *Public and Environmental Health Act*, 1987 and Regulations; (S)
- *Recreation Greenways Act*, 2000; (S)
- *Sewerage Act*, 1929; (S)
- *Soil Conservation and Landcare Act*, 1989; (S)
- *South Eastern Water Conservation and Drainage Act*, 1992; (S)
- *Upper SE Dryland Salinity and Flood Management Acts* and Regulations, 2002; (S)
- *Water Resources Act*, 1997 and Regulations; (S) and
- *Wilderness Protection Act*, 1992. (S)

Related policies, guidelines and references for this type of development include:

- ANZECC Best Practice Guidelines for Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand (ANZECC, 1997);
- ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance (ANZECC, 2000);
- ANZECC Australia's Oceans Policy: Caring, Understanding, Using Wisely (Commonwealth of Australia, 1998);
- Australian Ballast Water Management Requirements (Dept of Agriculture, Fisheries and Forestry);
- Biodiversity Plan for the South East of South Australia, Dept for Environment, Heritage and Aboriginal Affairs, 1999);

- Coastal Management Strategy South East South Australia – Strategy and Action Plan (SELGA, September 2000);
- Code of Practice for Commercial Users of Transport SA Marine Facilities (Transport SA, 1998);
- Draft Aquaculture Resource Management and Ecologically Sustainable Development Policy, (PIRSA, April 2003);
- Draft Aquaculture Resource Management and Ecologically Sustainable Development Policy Report (PIRSA, April 2003);
- Draft Management Plan for Harvesting Beach-cast Seagrass and Marine Algae (PIRSA, September 2003);
- Ecotourism: A South Australian Design Guide for Sustainable Development (South Australian Tourism Commission, 1994);
- Environmental Protection (Marina) Policy 1994;
- Environmental Protection (Water Quality) Policy 2003 and Associated Codes and Guidelines;
- Environment Protection Policies for Noise and Associated Guidelines for Environmental Noise and Construction Noise;
- Guidelines for the Planning and Development of Coastal Marinas in South Australia (MAAC, Dept of Environment and Planning, 1988);
- Guidelines for Users of Transport SA Marine Facilities (Transport SA, 2003);
- Interim Marine and Coastal Regionalisation for Australia, IMCRA Technical Group (1998);
- International Convention for the Prevention of Pollution from Ships (MARPOL, 1973/1978);
- Lacepede Bay Aquaculture Management Policy (PIRSA, February 2004);
- Management Plan for the South Australian Southern Zone Rock Lobster Fishery, South Australian Fisheries Management Series Paper No 29., (Zachrin, W (ed), PIRSA, 1997);
- Management Policy for the South Australian Giant Crab Fishery, (Sloan, S, PIRSA, October 2002);
- Migratory Bird Agreements, including the Ramsar and Bonn Conventions, the China-Australia Migratory Bird Agreement (CAMBA) (Commonwealth of Australia, 1995), and the Japan-Australia Migratory Bird Agreement (JAMBA) (Commonwealth of Australia, 1995);
- National Environmental Protection (Assessment of Site Contamination) Measure 1999;
- National Strategy for the Conservation of Australia's Biological Diversity, Commonwealth of Australia, 1991;

- National Strategy for Ecologically Sustainable Development, (Ecologically Sustainable Development Steering Committee, December 1992);
- National Water Quality Management Strategy: Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000);
- Planning Strategy for Regional South Australia (Planning SA, 2003);
- South Australian Boating Advisory Committee Guidelines for Planning Design and Construction of Boat Launching Facilities, Marine Facilities Section, Department of Transport, March 1997;
- South East Development Plan Review (SELGA, July 2002);
- South East Visitors Survey, 1992, Volumes 1 and 2, (South Australian Tourism Commission, 1992);
- Tourism Means Business, (South Australian Tourism Commission, 1996); and
- Wild Fisheries with a Future: Environmental Management Plan of the Southern Fishermen's Plan (Baker, D & Pierce, BE (eds), 1998).

Under the provisions of the *Environment Protection and Biodiversity Conservation Act* (the *EPBC Act*), there are also requirements for a referral to be made to determine whether there are any actions proposed which trigger the application of the *Act*. A referral was made under the EPBC *Act* in October 2004, and the Department of Environment and Heritage has advised that:

> *… the action is not a controlled action. Approval is therefore not needed under Part 9 of the Act before the action can proceed.*

Refer **Appendix 1**.

1.5 Local Community Consultation

Since the agreement of Kingston District Council to support the Cape Jaffa Anchorage Development Proposal in June 2001, the Kingston District Council has released concept plans and information relating to the development for the community and others to comment. During this process, a formal launch of the concept plan was made at the January 2002 Cape Jaffa Seafood and Wine Festival and subsequently, a formal questionnaire was released for interested persons to make comments on the development. These documents are included in **Appendix 2**. In addition, the questionnaire was also used for interested persons to lodge an expression of interest in residential allotments, marina berths and other uses.

In July 2002, Kingston District Council undertook a key stakeholder workshop that included elected members of Council, Cape Jaffa residents, the tourist park operators, and representatives from the rock lobster industry, aquaculture industry, and recreational fishing. This group was highly supportive of the concept and the benefits that would result from the development generally. During the workshop, the stakeholders highlighted the need to consider a range of issues including existing industry requirements and poor existing infrastructure, including the jetty, water quality, beach access, safety issues, mooring and launching/retrieval facilities.

Issues were also raised concerning the continuation of the fish processing facilities and the visual amenity of the whole area. This consultation process with the key stakeholders greatly assisted in the formation of a revised concept plan that recognised the input and issues raised.

A meeting with residents of Cape Jaffa was held on 7 March 2003, which advised of the release of the issues paper for the preparation of the guidelines of the EIS as part of the development application process. The meeting was well attended by residents from Cape Jaffa and other interested persons that had direct links mainly with the professional fishing industry and recreational boating within the area. This meeting was beneficial as it provided an explanation of the process which assisted those not familiar.

In addition, on 9 April 2003 Council held a public forum at Kingston to provide information to the wider community on the Cape Jaffa Anchorage Development and the issues paper released by the Major Developments Panel. This forum was well represented by approximately sixty interested members of the public, several issues were discussed and general support for the project was evident.

Subsequently, a workshop was held with members of the professional fishing industry associations to discuss their needs and expectations, and to identify design criteria.

In January 2004, Kingston District Council and CJDC made further presentations at the Cape Jaffa Seafood and Wine Festival. Updated information about the proposal and the process was made available to the community and comments were most favourable, with most enquirers wishing to know when they could expect to purchase land. An information pamphlet was made available to the public, and representatives of Kingston District Council and CJDC were available to answer questions. A short video was also played throughout the day to supplement the maps and plans displayed. The pamphlet is contained in **Appendix 3**.

Throughout the consultation process, it has been emphasised that members of the public can provide information to the Kingston District Council, CJDC and also the Major Developments Panel in order to inform or contribute to the project and its outcomes. The proponent recognises the importance of consultation with the community to ensure that every opportunity is provided to express opinions or concerns and make any valuable contribution towards the design outcomes of the proposal.

Consultation with Planning SA has continued prior to and during the preparation of the EIS together with presentations to staff of the Coastal Management Branch, Department of Water, Land Biodiversity and Conservation, and the Office of Infrastructure Development.

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2.0 NEED FOR THE PROPOSAL

2.1 Introduction

The Guidelines require, in Section 4.5.4 titled 'Need for the Proposal', a brief description of the objectives and market requirements to be met, the benefits, costs and environmental, social and economic issues together with a statement of the consequences of not proceeding with the proposal. The following sections provide this summary and are supported by detail in the chapters of this EIS and associated reference documents.

2.2 Objectives

The relevant objectives, as set out in **Section 1.0** are:

1. *An enhanced range of facilities and services to support and grow the local fishing, aquaculture, tourism, recreational boating activities and residents.*

2. *Provision of safe, convenient and orderly services and facilities for business, tourism, recreation and residential purposes.*

3. *Well planned and integrated facilities for residents, tourists and the fishing and aquaculture enterprises of the district.*

4. *Facilities established in an environmentally sensitive and balanced manner to ensure an enduring environment for the community.*

Need and overall community expectations have been developed over many years and are represented in a number of studies and documents prepared by Federal, State and Local Governments. In addition, there has been an ongoing unequivocal demand in South Australia and Australia for coastal living, tourism and visitation together with associated facilities. This has been reinforced locally with strong demand for coastal land in the Kingston and Robe areas for several years with much of the supply in these areas exhausted or at least very limited.

There are no allotments for sale at Cape Jaffa and those that have been on the market in the past couple of years have been readily sold with significant increases in values. No other land has been released to the market in any comprehensive manner at Cape Jaffa, as it was not made available for development by the prior owner. The Kingston District Council, as part of its desire to ensure the best planned approach to the development of the area, is now in a position to prepare, with CJDC, comprehensive plans taking into account the range of interests at Cape Jaffa. These interests include the Cape Jaffa Southern Rock Lobster fishers, the aquaculture operators, tourist service providers, residents, visitors and those seeking coastal residential property.

2.3 Strategic Directions

2.3.1 Relevant Strategies

The key documents that reflect government and community need for a range of facilities are:

- South Australian Strategic Plan Creating Opportunity 2004 (SA Gov 2004);
- Kingston District Council Strategic Plan 2004 – 2007 (KDC 2004);
- South East Coastal Management Strategy September 2002 (SELGA 2000);
- State Planning Strategy for Regional South Australia 2003 (Planning SA 2003);
- South East Development Plan Review 2002 (SELGA 2002);
- Kingston District Council Development Plan 24 July 2003 (Planning SA July 2003);
- Limestone Coast 2004 to 2007 Strategic Plan (LCRDB 2004); and
- South Australian Tourism Plan 2003-2008 (SATC 2002).

Council's Recreational Boating Facilities Strategic Plan of 2000 (KDC 2000) identified the need for a safe all year round launching facility to cater for the growing demands of the recreational fishers. It is also noteworthy that the Draft South East Recreation Sport and Open Space Strategy prepared by SGL Consulting Group October 2003 (SGL 2003) is supportive of the need for recreation facilities.

2.3.2 South Australian Strategic Plan Creating Opportunity 2004

The Plan for the whole State commences with six interrelated objectives as follows:

1. Growing Prosperity.
2. Improving Wellbeing.
3. Attaining Sustainability.
4. Fostering Creativity.
5. Building Communities.
6. Expanding Opportunity.

Under these objectives are a total of 79 key targets set as benchmarks against which the progress of the strategy can be reviewed. Of these, the following selected targets, as they apply to the objectives, are most outstanding and relevant to the Cape Jaffa Anchorage proposal:

Objective 1: Growing Prosperity

Jobs: *Better the Australian average employment growth rate within 10 years. (T1.1)*

Economic Growth: *Exceed the national economic growth rate within 10 years. (T1.5)*

Investment: *Match or exceed Australia's ratio of business investment as a percentage of the economy within 10 years. (T1.6)*

Total Population: *Increase South Australia's population to 2 million by 2050, rather than the projected population decline. (T1.7)*

Exports: *Treble the value of South Australia's export income to $25 billion by 2013, with exporters assisted by the work of the industry-led Export Council which was established in 2004. Industry-agreed sectoral goals that will assist in meeting the overall target include $7.5 billion by 2013 by the food industry in meeting the Food Plan target, over $3 billion nationally by the wine industry by 2010, further developing our exports of motor vehicles, increasing the current 20% per annum sales and revenue growth of the electronics industry and further consolidating Adelaide as the defence industry capital of Australia and developing defence industry exports. Minerals will also contribute to the overall target by achieving ambitious exploration and processing targets. We will work to more than double our share of national service exports and increase our exports of elaborately transformed manufactures. (T1.12)*

Tourism Industry: *Increase visitor expenditure in South Australia's tourism industry from $3.4 billion in 2001 to $5.0 billion by 2008 by increasing visitor numbers and length of stay and, more importantly, by increasing tourist spending. (T1.13)*

Strategic Infrastructure: *Increase investment in strategic areas of infrastructure, such as transport, ports and energy to support and achieve the targets in the State Strategic Plan. (T1.16)*

The vision for the growing prosperity of our community based on an existing settlement and industries for fishing and tourism are well served at Cape Jaffa. There will be increased jobs, and economic growth in the region with increased regional investment flowing from an increased regional population.

Although small in relative terms, the population increase that may result from this type of development is valuable. The type of development proposed is highly desirable and is readily accessible from the South East region generally and western Victoria. These factors may therefore result in the reduction of out migration and an increased inward migration by providing a living environment not otherwise available in the region.

The fishing and aquaculture activities offer prospects for increased exports, and the local tourism industry that is struggling to keep pace with demands will be afforded opportunities to expand and create new markets.

Cape Jaffa is designated by Transport SA as one of the five southern ports, and the Cape Jaffa Anchorage project proposes to reinforce its role and function. The existing functions and operations at Cape Jaffa are all supported by State and local strategies, and accordingly warrant attention in terms of infrastructure development.

Objective 2: Improving Wellbeing

Quality of Life: *Improve Adelaide's quality of life ranking on the William M Mercer Quality of Life index to be in the top twenty cities in the world within 10 years. (T2.1)*

Sport and Recreation: *Exceed the Australian average for participation in sport and physical activity within 10 years. (T2.7)*

Greater Safety at Work: *Achieve the nationally agreed target of 40% reduction in injury by 2012 (National OHS Strategy 2002-2012, National Occupational Health and Safety Commission). (T2.10)*

The creation of improved living environments is part of satisfying the quality of life enjoyed by South Australians. The proposal is one such example where South Australia can make the most of its opportunity to build on an existing settlement and industries in an attractive and innovative manner satisfying a diverse range of lifestyle interests.

Apart from the formal sport and recreation interests of the Kingston and South East communities, the most significant interest at Cape Jaffa is boating and fishing. Participation is enjoyed by residents and visitors to the region, and Cape Jaffa is one of the few locations where access to the beach is generally available and relatively manageable. The proposal offers participants a quality of facilities and features not readily available along the South East coast and a greater degree of public safety.

The opportunity for a safe haven for the commercial sector significantly enhances the operational safety of the mooring, loading and unloading activities for the fishers and aquaculture operators. The wellbeing of the fishers and aquaculture operators will be enhanced when there is a safe haven for use in bad weather or an emergency. The facility also provides a location from which to facilitate sea rescue operations.

Objective 3: Attaining Sustainability

Land Biodiversity: *Have five well-established biodiversity corridors linking public and private lands across the State by 2010. (T3.4)*

Ecological Footprint: *Reduce our ecological footprint to reduce the impact of human settlements and activities within 10 years. Actions will include:*

- *increasing the use of renewable electricity so that it comprises 15% of total electricity consumption within 10 years;*
- *extending the existing Solar Schools Program so that at least 250 schools have solar power within 10 years;*
- *extending the One Million Trees program so that 3 million trees will be planted in South Australia within 10 years;*

- *increasing energy efficiency of dwellings by 10% within 10 years, by such means as the introduction of a five-star energy requirement for new houses by May 2006. (T3.10)*

Although not part of any of the five well established corridors, there is land along the coast currently in private ownership that will be transferred to public ownership for its rehabilitation and protection. In local terms, this will enhance the corridor along the coast frontage.

It is proposed that in addition to the standard Development Plan provisions for sustainable development, additional guidelines be placed on land requiring that its future development incorporate energy efficiency design and building features as well as water management features to conserve and better utilise our water resources.

Objective 4: Fostering Creativity

Creativity: *Achieve a ranking in the top three regions of Australia in Richard Florida's Creativity Index within 10 years. (T4.1)*

Investment in Science, Research and Innovation: *Exceed the national average of business expenditure on research and development (as a percentage of GSP) and approach the OECD average within 10 years. (T4.6)*

Creative Education: *Improve learning outcomes in the arts and other curriculum areas that utilise enterprise education. (T4.9) Improve the connections between educational institutions and industry to enhance creativity and innovation. (T4.10) Increase the number of families participating in the Learning Together and school community arts and recreation programs. (T4.11)*

This project has already enhanced our knowledge of the locality and the region through research in the quest of providing innovative and creative solutions to satisfy existing industrial and community needs in an environmentally appropriate manner.

Some of this research such as the tide data will be valuable to mariners as information is already being provided to the National Tidal Facility.

Investigations and discussions are continuing with TAFE particularly in relation to the rock lobster and aquaculture activities of Cape Jaffa, with a view to the provision of some industry related education facilities at the Cape or as part of the offerings at nearby venues.

Objective 5: Building Communities

State and Local Government: *Align State and Local Strategic Plans within 12 months of the release of the State Strategic Plan and agree joint initiatives from them. (T5.7)*

Regional Population Levels: *Maintain and develop viable regional population levels for sustainable communities. (T5.8)*

Infrastructure: Build and maintain infrastructure to develop and support sustainable communities in regions. (T5.11)

The proposed development at Cape Jaffa builds on the existing community at Cape Jaffa. There are several relevant strategic plans and reviews for the area at Federal, State and local level which are consistent in their acknowledgment that Cape Jaffa is the logical choice as a focus for investment in the fishing, aquaculture and tourist industries. The proposal is a joint initiative between the private sector and local government, and aims to significantly enhance the regional population, and support a sustainable community at Cape Jaffa.

Objective 6: Expanding Opportunity

Aboriginal Wellbeing: Reduce the gap between the outcomes for South Australia's Aboriginal population and those of the rest of South Australia's population, particularly in relation to health, life expectancy, employment, school retention rates and imprisonment. (T6.1)

Regional Education: Achieve a marked improvement in the percentage of regionally based students completing SACE or equivalent by 2010. (T6.14)

Employment opportunities will be created at Cape Jaffa and the district from the primary construction activities and the flow on effects of this significant development. The requirements for skilled and unskilled workers will create more opportunities in the Kingston District than presently exist.

The enhanced facilities for the fishing and aquaculture enterprises are likely to create better economies, and further opportunities for research into enhancing those industries in terms of exports, sustainability and growth.

The South Australian Strategic Plan promotes a lively, creative, innovative and growing State which recognises environmental needs and the need to accept change. Building on the existing community and facilities at Cape Jaffa which are highly suited to their fishing and aquaculture functions is orderly and efficient and consistent with the desire for the communities prosperity, wellbeing, sustainability and creativity as expressed in the South Australian Strategic Plan.

2.3.3 Kingston District Council Strategic Plan 2004 - 2007

The Kingston District Council has a strategic focus to provide adequate infrastructure to all members of the resident community and visitors to the community to improve the standard of service and facilities and that enhance the "quality of life". In 2000 Council adopted a Strategic Plan for the 2004 to 2007 years, which incorporates the following vision and mission.

Our Vision:
To continue improving quality of life in the community.

Our Mission:
Enhance and improve the quality of life, the character of our district as a vibrant coastal community that is an attractive destination with excellent business opportunities.

With the adoption of the 'vision' and 'mission', the Kingston District Council has put in place objectives and strategies to ensure that infrastructure and facilities are provided throughout the community. Included in these objectives and strategies is the continued development of recreational boating facilities to provide residents and visitors adequate access to the fishing grounds in Lacepede Bay and to use the waters of Lacepede Bay for other recreational purposes.

In addition, Kingston District Council prepared and adopted a Recreational Boating Facilities Strategic Plan which includes reference to developing recreational boating facilities within the townships of Kingston SE and Cape Jaffa. The vision of the plan is as follows:

> *To provide safe all year round boat launching facilities at Kingston SE and Cape Jaffa for recreational fishers and emergency purposes.*
>
> *The objectives adopted by the Council under the plan are:*

- *construct safe all weather and all year round recreational boat launching facilities;*
- *design and construct recreational boat launching facilities that minimise the effect of seagrass movement and build up to reduce ongoing maintenance costs;*
- *provide recreational boating facilities to complement and continue to enhance tourism activity and economic development within the area; and*
- *construct boat launching facilities to provide a safe all weather and all year round launch and retrieval for emergency vessels.*

2.3.4 South East Coastal Management Strategy September 2002

The Local Government bodies of the coastal areas of the South East of South Australia through the South East Local Government Association together with the Federal and State Governments undertook a Strategic Plan for the strip of coast from the mouth of the Murray River to the South Australian/Victorian border. This strip of 400 kilometres has few opportunities for the growth of communities and their associated employment and business activities that rely on the sea. Much of the coast is exposed or highly sensitive and therefore protected areas for the fishing fleets of the south east are highly valued.

Further in recent years, investigations have revealed that Lacepede Bay is an environmentally suitable location and habitat for the husbandry of Atlantic Salmon and, as Cape Jaffa provides a protected environment, the location has established as the service focus for this industry in addition to the well established Rock Lobster industry.

The Strategy acknowledges the communities aspirations for port, marina and coastal development generally to be appropriately located and managed as an integral part of the economic, social and cultural lifestyle of the South East as follows:

Identify suitable locations for port and marina development in terms of convenient transport and boating routes, tidal flow and minimising large scale impacts on marine habitats (both during development and through ongoing use), based on the Marina Guidelines - For the Planning and Development of Coastal Marinas in South Australia, 1991.

2.3.5 State Planning Strategy for Regional South Australia 2003

The State strategy for the development of regional South Australia, titled Planning Strategy for Regional South Australia, clearly recognises the need for the consolidation and reinforcement of services and facilities in the region. It aims to support key industry areas by providing strategies for:

- aquaculture and fishing;
- tourism;
- coastal centres and ports;
- energy;
- transport;
- environment and resources strategies;
- community development strategies; and
- infrastructure strategies.

The need has been well established and identified in the State Planning Strategy through public statements of commitment to consolidating, reinforcing and supporting the ports and the fishing industries position and opportunities for development. This is also supported by the desire to grow the tourism market and to capture more of the travelling public as they pass through the region as well as to develop new tourism ventures and products.

<u>Aquaculture and Fishing</u>

.... an important fishing industry based on the port towns in the area. The industry should consolidate its position in the area with opportunities available for development that supports value adding production initiatives (particularly for rock lobster) export and monitoring.

Cape Jaffa is a strategically located fishing port that currently accommodates approximately thirty fishing vessels, recreational vessels mainly during summer, and associated support facilities.

The proposal incorporates a safe haven and improved support facilities for the fishing industry that are necessary to continue the development and sustainability of the industry. Further, Cape Jaffa is the most proximate town to the existing Atlantic Salmon and Ocean Trout aquaculture ventures, and is the only practical location for load out, maintenance and harvesting.

Improved facilities are essential if the aquaculture objectives for the State are to be satisfied. The State has recognised the significance of this area for the Atlantic Salmon industry and this proposal will support that intent.

The safety of mariners and environmental protection can be best provided in a safe haven. Vessels have in past years broken moorings and have been beached. Risks of this nature can be avoided in a secure marina. Further, refuelling, servicing and waste management facilities can be significantly improved. In these respects, the proposal accords with the State Strategy.

Tourism

> *Its position between Adelaide and the eastern states provides opportunities to tap into a significant population base and through traffic not available to many other areas.*

The strategy also seeks to leverage off key features of the region and its position. The opportunity for a multi faceted, integrated boat haven and residential marina will be unique in the South East and is not practical elsewhere on the coastline of South Australia between Victor Harbor and the South Australia/Victoria border.

The nearby Mount Benson wine region has experienced significant development and investment in recent years of over $30 million in the establishment of facilities and these commitments reinforce the local interest and attractions for the region.

There is an existing tourism focus at Cape Jaffa with tourist accommodation facilities that cannot meet current demands. The past owners of the tourist park made public statements and submissions to Council seeking expansion of the park, however the operators were unable to make appropriate arrangements with the property owners.

The facilities are unable to cope with the current demand and the new owners and others have stated their desire to expand the extent, quality and choice of accommodation. Cape Jaffa is a proven destination for tourists from various locations but significantly western Victoria due to its proximity and access to excellent fishing, swimming and recreation waters.

In all of these respects the proposal is consistent with the strategy and will meet various needs within the community.

Coastal Centres and Ports

The coast surrounding Kingston is recognised as providing *"a unique environmental and recreational experience"*.

> *The southern ports should retain and protect their coastal features and character, and promote development in harmony with the coastal environment.*

The development of new facilities will enhance safety and minimise risk of environmental damage from fuel spills and broken moorings and other events that have the potential to damage this coastal environment.

The risk of fuel spills in a protected environment is significantly reduced and any spill within the harbour is more readily contained and treated in an orderly and efficient manner. The major part of the proposal is on the landward side of the coast and is to the greatest extent possible avoiding interference with the coastal vegetation and foredune system. There is the opportunity to create a fishing port and coastal village character unique to the South East consistent with the tourism and port industry activities already entrenched at Cape Jaffa.

The strategy also states:

> *... continue to develop service and infrastructure support for the important fishing industry ...*

The proposal provides the option of a significant service and infrastructure support to the fishing industry that is not currently available in a safe and environmentally sensitive manner. The development of services and infrastructure further supports and reinforces the fishing and aquaculture industries and strengthens the relevance and appropriateness of the proposal.

Under the heading Economic Activity Strategies the following key statements are made:

> *promote development to support established fish processing and distribution facilities;*
>
> *allow for land based infrastructure and support services for the marine fishing industry;*
>
> *develop new tourism ventures and products;*
>
> *develop tourism links with significant economic activities of the area, ie wine, wool, dairy, timber, fishing, agriculture and processed food;*
>
> *develop holiday accommodation and recreation opportunities; and*
>
> *develop and connect tourist linkages with Melbourne and Adelaide to involve interstate travellers, utilising features such as coastal roads, key towns, and natural and cultural attractions.*

A number of significant strategies listed above can be satisfied or be facilitated as part of this proposal.

<u>Energy</u>

> *Investment in power, gas and other energy infrastructure needs to be strategic to ensure maximum benefit.*

The fishing, aquaculture, horticulture and wine industries in the locality are well placed to economically utilise improved energy infrastructure as the settlement and fishing port is proposed to be developed in a coordinated and integrated manner. The proposal satisfies the needs for strategic planning of infrastructure as distinct from disparate or piecemeal services.

There is no three phase power at Cape Jaffa, although 11 kV three phase power exists six kilometres from the site. ETSA has advised that augmentation costs to service Cape Jaffa are considerable. As a consequence, alternative power supplies have been investigated and are readily capable of providing the development and the existing Cape Jaffa community with improved power. In addition, these systems provide the potential to feed electricity back into the grid during peak load periods, as further discussed in Section 3. There are numerous commercial operators capable of establishing energy generation facilities at Cape Jaffa.

Transport

The area is generally well served, however it is recognised that:

> *Upgrading of local roads and bridges is necessary to ensure local industry is better able to move its new product to processing facilities and to enable it to market its produce and compete successfully in Australian and international markets.*

The proposed development will contribute to local road improvements as set out in Section 3. Recent improvements to roads ensure excellent movement of goods regionally.

Environment and Resources Strategies

The following statements highlight the need to protect and conserve whilst improving public access to the coast:

> *…. protect areas of native vegetation and associated native fauna on both public and private lands;*
>
> *ensure land use policy recognises and protects areas of conservation significance;*
>
> *maintain and improve public access to the coast while protecting fragile areas, habitats and sites of cultural significance;*

The development proposes to protect significant areas of native vegetation and provide for its conservation whilst formalising public access to the coast in a sensitive manner. Given the existing function of Cape Jaffa as a southern port, it is entirely appropriate that the facilities provided are commensurate with the safety, environmental and service requirements of the industries and users of these facilities. These features are essential elements of a port environment which are able to be achieved in a manner sensitive to the natural and cultural features of the locality.

In summary, a number of significant strategies listed above can be satisfied or be facilitated as part of this proposal. These have been identified in the strategic plan for the South East's growth and development. The proposal satisfies or at least creates opportunities to satisfy these strategies and reinforces the provision of facilities and services identified as needs in this community.

Community Development Strategies

> *maintain the coastal townships as important tourist and local service centres and key fishing ports.*

The proposal reinforces Cape Jaffa's role as a southern port, a significant tourist destination and local service centre. The relevant community includes those residing at Cape Jaffa, those who use Cape Jaffa for business and pleasure, and those in our community who seek to live, work or recreate at Cape Jaffa in the future.

Infrastructure Strategies

investigate airport development in the Coonawarra for tourism development and at coastal airstrips for the movement of live rock lobsters to Adelaide or Melbourne for export;

ensure land use policies guide the development of alternative energy infrastructure by providing for its specific requirements and managing the visual and environmental effects on a locality;

Major improvements to serve the fishing, aquaculture and tourist industries reinforces the town of Cape Jaffa and the town of Kingston. Kingston has a high quality air strip which currently serves the local industries and the Kingston and district communities.

The Development Plan is the appropriate mechanism for the inclusion of policy to guide the land use, visual and environmental effects of development as it relates to infrastructure in the urban environment. In addition to existing control mechanisms such as the requirement for power to be underground in new residential development, it is proposed to incorporate policies into the Development Plan to provide the necessary guidance.

2.3.6 South East Development Plan Review 2002

Section 30 of the *Development Act, 1993* requires each Council to carry out a periodic review to determine the appropriateness of their Development Plans. The Kingston District Council was a participant in the South East Development Plan Review 2002 which was carried out jointly by all the South East Councils and the Coorong District Council in accordance with the requirements of Section 30. A key regional recommendation that is relevant to the proposal was to *"review requirements for marine and land based aquaculture"*.

In addition to the regional recommendations, the following localised issues of relevance were recommended for consideration:

- *include relevant Development Plan policy recommendations of the South East Coastal Management Strategy; and*
- *investigate potential marina opportunities at Cape Jaffa.*

2.3.7 Kingston District Council Development Plan 24 July 2003

Kingston District Council's Development Plan results from the democratic process of review and assessment of its land use allocation and development policies. Several years ago the Kingston District Council, as the elected body responsible for planning in the district, determined that Cape Jaffa, as an existing fishing port, settlement and aquaculture focus was the appropriate location to consolidate activities. In this way Council could best fulfil its role and responsibility as planning authority by planning for orderly managed facilities rather than being reactive to sudden and uncontrollable pressures. Council established a committee to investigate how this could be achieved and to progress the idea of improved facilities and services at Cape Jaffa.

In 2003 the Kingston District Council updated its Development Plan as it affects Cape Jaffa by expanding the settlement area significantly to allow for the creation of an expanded Residential Zone, an Industry Zone, a Local Centre Zone and an Urban Coastal Zone, all to replace a generic Cape Jaffa Zone.

Although this zoning provides better opportunities for the fishing and aquaculture industries and tourism, recreation and community facilities, it does not recognise the more specific functional requirements of the specialised activities associated with today's fishing and aquaculture fleets. Therefore, a more sophisticated approach to the zoning and hence the provision of facilities, design, layout and allocation of land use functions in the area is necessary.

2.3.8 Limestone Coast 2004 to 2007 Strategic Plan

The regional strategy for the Limestone Coast focuses on business, investment and enterprise support to strengthen delivery of products and services out of the South East. In order to achieve growth, infrastructure needs to be developed in a co-operative environment.

> *Goal 01: Support the viability, sustainability and growth of new and existing businesses.*
>
> *Strategies:*
>
> *Provide local support to assist the progression of worthy applications under Regional Partnerships or other Government programs that support new business investment, assist business expansion and aid the retention of existing businesses.*
>
> *Undertake activities to support product development, value adding to regional produce and access to new markets (including export) for regional businesses.*

New business opportunities exist to value add to the existing Rock Lobster and aquaculture industries. Expansion of the aquaculture industry is desirable to create sustainable business enterprises. Industry growth and product development relies heavily on the appropriate infrastructure being available.

> *Goal 03: Strengthen regional infrastructure and service delivery capacity to meet future industry and social growth demands.*
>
> *Strategies:*
>
> *Identify opportunities for joint private/public sector developments, for example road, rail, waste management and housing.*
>
> *Support regional cooperation and coordination to achieve best possible regional outcomes.*

Develop business cases to support prioritised regional infrastructure requirements.

The proposal is an excellent opportunity for the private and public sectors to cooperate and build together a settlement with associated infrastructure that satisfies a range of community needs with significant regional benefits.

Goal 04: Foster regional economic and community growth through marketing and promotional activities.

Strategies:

Support Limestone Coast Tourism to increase tourism product development and promote the region.

The proposal supports and enhances the regional tourism offering and promotes the region. The effect of the development in terms of employment and expenditure is significant and ensures the development of Cape Jaffa is undertaken in a coordinated manner that will promote community growth.

Goal 05: Support and strengthen local community capacity for the benefit of the region.

The capacity and strength of the local community will be enhanced through the growth and development of improved infrastructure, the reinforcement of the fishing village character, the enhancement of recreational offerings and expanded tourist facilities.

2.3.9 South Australian Tourism Plan 2003 to 2008

The need for the proposal is well established and reinforced through the State's Tourism Plan which sets out four key goals as follows:

- *enhance and grow the State's authentic experiences;*
- *be productive in marketing the State;*
- *achieve strategic tourism policy, investment and development; and*
- *develop a strong, professional and profitable industry.*

These are supported by a range of objectives each of which have strategies to achieve these goals.

Goal 1: Enhance and grow the State's authentic experiences.

Objective 1.1: Enrich the wine and food experience.

Strategies

Work in partnership with South Australia's Food SA program to optimise marketing and destination development synergies between tourism and the food industry.

Encourage and support local events and festivals that celebrate the State's wine and food.

Develop strong regional food groups that market, showcase, distribute and make accessible the quality food on offer in the State.

Value-add to the wine experience through the provision of accommodation, dining, meeting facilities and relevant merchandising at wineries and cellar doors.

Investigate the opportunity to forge links between the National Wine Centre and the State's food producers.

Position the wine industry as an interpretive and cultural experience that allows visitors to view and learn about wine processes including 'meet the winemaker', vineyard pruning, grape picking and crushing.

Encourage the development of new products designed to capitalise on the State's wine experience, lifestyle, climate and landscape (for example, Banrock Station Wine and Wetland Centre).

Explore opportunities to establish a positive marketing link between regional produce and tourism destinations.

Expand and develop further opportunities for gourmet and aquaculture trails.

Raise the profile of South Australia's fine food and wine at domestic and overseas trade shows.

Develop wine and food educational based tourism around the University of Adelaide, Centre for Tourism and Languages (Adelaide Institute of TAFE), Regency Hotel School and LeCordon Bleu.

Cape Jaffa is well known for its seafood and wine associations celebrated by an annual festival which promotes the economic development of the region and the marketing of the tourism offerings. The development will create numerous attractors and facilities for the tourist community which will enrich the wine industry experience. Greater attention to the locality creates improved opportunities for marketing, development of synergies and linkages.

Objective 1.3: Develop integrated coastal experiences.

Strategies

Encourage the development of sustainable, medium scale, high design and quality coastal accommodation in strategic locations.

Value-add to coastal tourism experiences by increasing the availability of fresh seafood through a greater range of outlets including wholesalers, fish farmers, and restaurants and cafés.

Prepare touring information that facilitates the experience of rich aquatic life found in South Australia's coastal waters.

Develop a range of focal points along the coastline of South Australia that facilitate the drive and marine trail market including places for viewing, meeting and gathering.

Improve sustainable/managed access to coastal areas of high tourism value.

Increase the profile, viewing and interpretation of the State's coastal history and heritage, scenery and wildlife including whale watching, bird life, caves, biodiversity, pristine qualities and remnant vegetation.

Develop and promote linkages between coastal touring experiences and the State's aquatic recreation activities, for example recreational fishing, scuba diving, boating and surfing.

The proposal provides a fully integrated development satisfying fishing and aquaculture industry requirements whilst enabling the development of a high quality coastal settlement incorporating a range of tourist accommodation. The development will increase the exposure and availability of seafood at a key coastal focal point where the coastal environment will be protected and the history of the area and the locality is interpreted and created as a further tourist experience. Cape Jaffa is also a significant location for recreational fishers and the proposed facilities will enhance the safety and utility of the area, thus making the area more attractive to recreational boating tourists.

Objective 1.4: Develop a balanced program of events and festivals.

Strategies

Leverage broader opportunities presented by existing successful events, for example Jacob's Creek Tour Down Under.

Increase event and festival partnerships between government and non-government businesses to achieve collective marketing and successful bidding for projects.

Encourage the events industry to move towards accreditation to assist with industry maturity and risk management.

Work collaboratively to create a festivals marketing network that supports arts ventures and promotes arts and cultural experiences.

Leverage major events by encouraging longer stays through pre- and post-touring.

The annual Cape Jaffa Seafood and Wine Festival is a highly successful local event that supports the local winery, fishing aquaculture and support enterprises. The development reinforces these industries and provides significant marketing network opportunities.

Objective 1.8: Tell the story of the State's history and heritage.

Strategies

Encourage creative/commercial use of South Australia's heritage to conserve its assets, including retaining the heritage/townscape ambience.

Build on the State's traditional historical brandings – such as its German, Cornish, mining and wine heritage – by linking individual assets and sites more closely via trails and other means.

Broaden the historical messages about South Australia with particular reference to capturing the State's rich story through interpretive material.

Combine tourism product with a variety of interpretive methods to tell the stories of South Australian places and people, including innovative approaches such as the use of oral history 'sound posts', cartoons, and fresh and contemporary design idioms.

Interpret places where visitors stop and congregate such as parks, streets, civic places, significant heritage sites, wineries, rest stops, roadhouses, key vistas and lookouts.

Improve the interpretation of Adelaide's history, including investigating the potential for a focal interpretive centre.

Establish Port Adelaide as an essential stopover for visitors with an interest in history by increasing its profile as a heritage centre with the largest cluster of museums outside of North Terrace.

Encourage school children to be more knowledgeable and proud of their State by linking educational curriculum with South Australian educational camps and excursion opportunities.

Aboriginal and European history of the locality provides a fascination to many tourists and visitors. This history is not currently interpreted or presented in a coordinated manner at Cape Jaffa, although an excellent presentation of European Heritage exists at Kingston in the Cape Jaffa Light House. A combined facility would provide a valuable education and recreation resource and attraction to tourism.

Objective 1.9: Encourage development of Aboriginal tourism.

Strategies

Empower Aboriginal operators to explore opportunities for cultural self-determination and community independence through tourism.

Participate in cultural awareness programs to develop knowledge and understanding of protocols and cultural management issues.

Encourage the participation of Aboriginal businesses in mainstream tourism.

Develop, in conjunction with traditional custodians, a coordinated approach to marketing and promoting the State's Aboriginal sites, displays, music and customs.

Develop Aboriginal experiences, particularly in regions, through linkages with nature-based and ecotourism initiatives and cooperative marketing.

The proposal creates the opportunity for Aboriginal tourism experiences as well as other tourist business ventures and investment.

Objective 1.11: Create a 'sense of place'.

Strategies

Incorporate South Australia's special places in marketing messages and imagery.

Identify opportunities through the tourism strategic planning process for redevelopment and revitalisation.

Participate in the early stages of planning for revitalisation projects and initiatives.

Support as appropriate the revitalisation of South Australia's special places, for example marketing and advice on business and product development.

The proposal will reinvigorate Cape Jaffa and the industries that create the character of this fishing port. The proposal will create a special and unique place in the South East and add to the tourism product of the State.

Objective 3.2: Strategically develop accommodation.

Strategies

Encourage strategic development consistent with our positioning and branding in appropriate locations and subject to sound performance criteria.

Encourage accredited nature-based tourism accommodation in strategic areas.

Encourage 'getaway' accommodation (rural retreats, guesthouses, health retreats) in strategic areas including Limestone Coast (South East).

Encourage wine tourism accommodation (rural retreats, health retreats, guesthouses, boutique hotels and value-adding to wineries) in strategic areas including Limestone Coast (Coonawarra).

Encourage water-based recreation holidays incorporating touring parks (caravans and cabins) in strategic areas including Limestone Coast.

Ensure effective synergies between research, policy, planning design, investment and infrastructure initiatives to achieve 'cutting edge' sustainable developments.

The South East and Cape Jaffa are well recognised as strategically well located for tourism development and variety in product. Tourist accommodation and synergies with other attractors are well placed at Cape Jaffa, thus reinforcing the investment in the wine and fishing industries and the attractions of the coast.

Objective 3.4: Ensure tourism infrastructure supports strategic development.

Strategies

Increase tourism infrastructure funding for five years to develop adequate tourism services and facilities in key communities.

Adopt a whole-of-government approach to infrastructure funding, strengthening the government packages and incentives available for infrastructure assistance.

Give priority to funding projects that demonstrate links with strategic planning initiatives, for example regional and local tourism strategies.

Ensure high-quality design expertise is used for all tourism infrastructure development.

Upgrade and develop caravan and camping areas to meet the demands of self-drive and coastal touring markets.

All festivals and events to identify infrastructure requirements prior to fund allocation and marketing.

Investigate water supply issues in key locations for new tourism ventures.

Provide incentives for sustainable, alternative generation of power and water and treatment of waste, especially in remote areas.

Increase ownership and maintenance of tourism infrastructure by communities, local Councils and local associations.

Very little input into the tourism infrastructure has been provided other than the private investment at the caravan park and some fishing charter activities. The proposal will provide a significant opportunity to advance the product and related accommodation.

The proposal reinforces the tourism strategies and helps to achieve the objectives of the plan. These objectives and strategies have been set down in recognition of a need to satisfy expectations of tourists and visitors, and hence advance the viability and experiences of tourism in the region.

2.3.10 Draft South East Recreation Sport and Open Space Strategy

The October 2003 draft of the South East Recreation Sport and Open Space Strategy (SGL 2003) specifically identified "the need for new or improved recreation facilities to attract new visitors and encourage existing visitors to stay longer", as follows:

> *Fishing and boating are two popular recreation activities for both residents and visitors. Greater emphasis can be placed on increasing the number of visitors who fish or are interested in boating.*

Actions identified include:

> *Providing more accessible boat ramps.*
>
> *Providing information on available fishing and boating facilities.*
>
> *Ensuring adequate support services are available, such as boat repairs, sale of bait, and hire of equipment.*
>
> *Conducting fishing and boating/sailing events.*
>
> *Encouraging the private sector to establish boat charters and aquatic recreation tours.*
>
> *Fishing expeditions to secluded (secret?) fishing spots.*

Cape Jaffa is located proximate to some of the most interesting coastline, areas of maritime history, fishing areas and seascapes. It is a most popular base and origin for many tourists and recreation and sports activities. There are very basic facilities at the jetty and on the beach to serve these community interests. Cape Jaffa is capable of accommodating those interests in a sensitive and practical manner.

2.4 Benefits and Costs

2.4.1 Overview

Cape Jaffa is at the extreme southern end of a long sandy beach system extending to the Murray Mouth. The coastline to the north is more open and exposed without natural protection, whilst Cape

Jaffa is more protected by its northerly orientation and the reef systems to the west, thus providing a calmer marine environment.

The land for the Major Development activities is cleared, marginal grazing and cropping area which has no natural features of attraction nor a high visual amenity. Once the channel and related facilities are created, the coastal vegetation on the foredune is to be rehabilitated and protected and that which is in private ownership will be transferred to community ownership.

Investigations into the effects of the proposal on the environment are set out in detail in Section 5 and any identified effects are manageable.

There are economic advantages and benefits as set out under the heading 'Benefits' below, which are significant in terms of employment and expenditure in three key components of the economic and social environment.

The settlement of Cape Jaffa is one of two designated urban growth centres for the Kingston District Council. A significant part of the land is currently zoned for residential centre and industrial purposes. Due to various factors including the lack of services to Cape Jaffa, the settlement has been limited in its development and growth.

The opportunity exists to develop the settlement in a comprehensive manner incorporating up to date standards and a range of facilities to satisfy the various interests of this community through a comprehensive scheme which provides a growth area with choices for the community. The Cape Jaffa area has been the subject of a number of reviews including significant input from the community wherein Cape Jaffa has been identified for additional facilities, growth and development. The benefits and costs have been identified below.

2.4.2 Benefits

The benefits to the local environment are numerous, including:

- a significant part of the coastal vegetated dune is currently in private ownership and, as part of this proposal, will be transferred to community ownership to facilitate its ongoing protection;
- the coastal vegetation on the foredune, both that which is currently in community ownership and that which is proposed to be transferred to community ownership, is to be rehabilitated for its protection;
- significant employment and expenditure results from the proposal in three key components of the economic and social environment, these are during the construction phase, the ongoing operation of the developed community, and one off benefits that result in the sphere of influence of this proposal;
- up to date facilities to satisfy the various interests of this community can be provided through a comprehensive scheme;
- greater housing choice can be accommodated in the development;
- is consistent with strategic planning directions;

- creates the necessary protected facilities to reinforce and enhance the fishing and aquaculture industries with greater efficiencies in servicing operations for these industries, thus creating jobs and potential for greater exports;
- the creation of a safe harbour in which vessels can be berthed together with the efficiencies to the operators on the water and onshore of direct servicing at a wharf;
- provides better wharf facilities, increasing efficiencies to boat operators;
- reduces risk to vessels on swing moorings in the open sea;
- reduces risk of damage to the marine environment from vessels moored in the open sea;
- creates better and safer waste management and fuel handling facilities;
- reinforces and creates new business and economic opportunities and offerings in the tourism industry;
- creates short and long term employment opportunities;
- provides for a coordinated planned growth of an existing coastal port;
- creates in the long term a greater critical mass to support community infrastructure, ie hospital and medical services, and creates greater confidence in the community for services to be provided;
- enables expansion of the tourist accommodation and services;
- creates a new exciting attraction for tourist and resident communities;
- an improved recreational amenity on the jetty;
- major savings in the short and long term to government if the jetty is converted to recreation standard and hence avoiding costs to maintain commercial status;
- mains water reticulation to residents for better quality and supply of potable water;
- new and improved wastewater treatment and reclaimed water reuse facilities;
- provision of a vehicle free beach area;
- allows regrowth of seagrass on swing mooring area;
- provides for the removal of swing moorings from the Rock Lobster Sanctuary;
- relocates industrial and commercial activities away from the coast and beach;
- provides a comprehensive integrated plan for the development of the area;
- provides more detailed design guidance for the development of the settlement;
- enhances safety of mariners by providing safe access and anchorage in all weather conditions;

- better quality habitat for native fauna in the foredune area;
- increased protection of foredune vegetation from foot and vehicular traffic; and
- increased level of weed management in foredune vegetation.

2.4.3 Costs

- Wastewater treatment.
- Power supply.
- Water supply.
- Relocation of vessels to marina berths.
- Removal of swing moorings if necessary.
- Ongoing coastal management of sand and seagrass.
- Loss of continuous/uninterrupted access along the beach.
- Loss of seagrass in the footprint of the breakwaters and channel.
- Change in the visual amenity due to the development of the breakwaters and land based development.
- Rehabilitation and revegetation of foredunes.
- Potential loss of groundwater supply to residents.
- Marine infrastructure.
- Public boat ramp.
- Public wharf.

2.5 Project Rationale and Consequences of Not Proceeding

Cape Jaffa has been identified as the most appropriate location along the South East coastline of South Australia for the establishment of port and marina facilities with numerous benefits, as set out in Section 2.4.2 above. In geographical terms, there are severe limitations on available locations for such a development. The long stretch of sandy beach from Lacepede Bay extends northward along the Coorong, backed by significant sand hills until it reaches the mouth of the Murray River. None of this coastline, with the exception of Kingston and the settlement of Cape Jaffa, have any existing infrastructure or focus upon which to base a new settlement or facility.

To the south the coastline is dominated by low platform reefs with heavy limestone rocky shores and headlands and smaller isolated beaches, except for the longer beaches at Guichen Bay north of Robe, Rivoli Bay between Beachport and Southend and Brown Bay at Port MacDonnell. Much of this coastline from the Murray Mouth to the South Australian/Victorian border is also fringed with National Parks, thus limiting the opportunity for near coastal development.

Of all these locations along about 400 kilometres of coast, the most appropriate in terms of accessibility, protection and safety is Cape Jaffa. In addition, its proximity to the Southern Rock Lobster fishery, the excellent conditions for Atlantic Salmon culture, and the ability to reinforce an existing settlement as opposed to creating a new settlement are all compelling reasons for the chosen location.

In summary, the proposed facility is appropriately and well located as:

- Cape Jaffa has a long and valued history as a fishing port and settlement;
- there is a degree of natural protection from the south westerly weather in this part of Lacepede Bay;
- local area growth in residential and particularly coastal property demand is significant;
- Cape Jaffa is an existing tourist focus;
- Cape Jaffa is an existing settlement upon which to build;
- Cape Jaffa is an existing fishing port accommodating about thirty vessels;
- Cape Jaffa accommodates the existing fledgling Atlantic Salmon industry;
- the marine environment in this locality is the preferred, desirable and logical location for the Atlantic Salmon industry;
- access to the coast and in particular to the beach is already extensive; and
- further reinforcement for the existing industries, enterprises and activities is supported in the State Strategic Plan, the Planning Strategy, the Section 30 Review pursuant to the *Development Act,* 1993 and is supported in the South East Coastal Management Strategy and the South Australian Tourism Plan 2003 to 2008.

This project provides significant environmental, economic and social benefits to the community as outlined in **Section 2.4.2** above. The environmental benefits include the reduction of risks and actual damage to the marine environment, enhanced protection and rehabilitation of coastal dunes, and its biodiversity and the provision of wastewater treatment and water supply infrastructure to mitigate existing effects on the groundwater environment.

Significant investment at Cape Jaffa will stimulate a number of industry sectors including fishing, aquaculture, tourism, tourist accommodation, construction, housing construction, retail trade and personal services. The development will bring to the district an additional 500 households and an additional 250 jobs with the associated expenditure.

Currently Cape Jaffa suffers from a lack of infrastructure. Cape Jaffa is one of the two designated towns for the whole of the Kingston district and is zoned in the Development Plan for development. There is no water supply, wastewater treatment, three phase power, and telecommunications are extremely limited. As one of the five designated southern ports, Cape Jaffa urgently needs marine infrastructure to properly serve the fishing, aquaculture and recreational boating needs of the community.

The infrastructure is inadequate for the existing community and has prevented further development, despite the fact that the current zoning allows significant expansion for residential, centre and industrial purposes.

As a result, growth at Cape Jaffa has been stifled and the local community has been disadvantaged. There are numerous strategies prepared by local, State and federal authorities that support and reinforce the appropriate growth and development of Cape Jaffa and the district. This proposal provides the opportunity to achieve many of the goals of these strategies, as set out in Section 2.3, for the benefit of the community.

Numerous social benefits arise from the development of Cape Jaffa. It creates a vibrant community, improved public access to the marine environment, housing choice, jobs, additional business opportunities, critical mass for affordable community and personal services in the district, improved quality of life, and a vibrant seaside village character by bringing together commercial fishing, aquaculture, recreational boating, tourism, seaside recreation, entertainment and living.

The following summarises the key consequences of not proceeding and are therefore general in nature:

- failure to acknowledge the needs of the fishing and aquaculture industries will stifle growth and development and associated potential value adding activities;
- the Cape Jaffa jetty will need to be significantly upgraded and maintained at government expense to continue to accommodate the existing fleet and to service the aquaculture industry if it continues under these circumstances;
- vessels will remain on swing moorings in the open sea within the Rock Lobster Sanctuary;
- coastal areas remain in private ownership;
- fuel facilities will need to remain on the jetty in a form that limits improvements and protective measures from potential environmental damage;
- will need to develop alternate, less environmentally appropriate recreation boat ramp on the beach;
- loss of significant income to the region from construction, building and ongoing service activities that are expected to result from the project;
- development pressures on existing township boundaries and coastal areas less appropriate for comprehensive development;
- no improvement to service infrastructure thus stifling growth;
- continuation of septic soakage in close proximity to the coast until growth in township demands environmentally sustainable practices;
- lost opportunity to create a comprehensively planned scheme incorporating significantly improved infrastructure;

- lost opportunity for significant jobs (220) and economic growth; and
- failure to meet stated strategies.

If this development were not to proceed there would be missed opportunity for the community to achieve the significant environmental and economic benefits as set out above. Development will occur at Cape Jaffa regardless, as it is currently zoned. This would likely occur in an ad hoc manner, to a lesser extent and benefit and without the coordinated provision of infrastructure necessary to support this community, as is enabled by the proposal.

3.0 DESCRIPTION OF THE PROPOSAL

3.1 Introduction

In accordance with the requirements of Section 4.5.5 of the guidelines, the following sets out information about the key elements and characteristics of the proposal including its location, construction and timing, operation, maintenance and monitoring. In addition to a concept layout, a description of the main elements of the physical development and a description of the proposed elevation and the general appearance of structures and buildings is provided in text and graphic forms. Service infrastructure requirements, availability and provision, as well as construction and operation management arrangements are also explained in general terms.

A comprehensive review of the natural and man-made environment in which this proposal is located is set out in Chapter 4.0 titled Existing Environment.

3.2 Location

Cape Jaffa is centrally and well located in relation to the remainder of the South East region of South Australia, Adelaide and the western part of Victoria. Figure 3.1 shows the location of Cape Jaffa relative to Adelaide and the South East region.

The Cape stands out from the remainder of the coast to the north which comprises a long sweeping beach, most of which abuts the Coorong, extending northward to the Murray Mouth. The coastline changes to the south of the Cape, exhibiting many of the characteristics of a high energy environment. Between the Murray Mouth and the State border, a distance of about 400 kilometres, there are few sheltered locations and hence Cape Jaffa's north facing protected bay is unique and appropriate as the location for a safe anchorage.

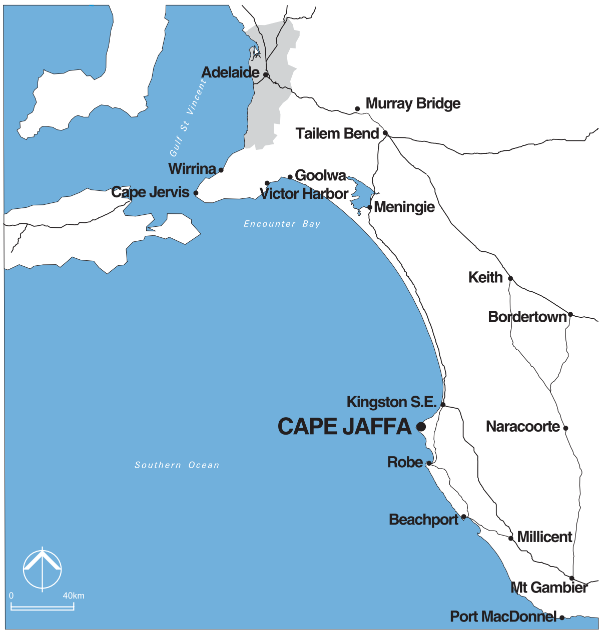


Figure 3.1: Location

Cape Jaffa is also an existing fishing port and coastal settlement in the Local Government jurisdiction of the Kingston District Council at the southern extremity of Lacepede Bay. The Southern Ports Highway is the main north/south accessway along this coastline serving Cape Jaffa, Robe and Beachport. Cape Jaffa is approximately 15 kilometres from the Southern Ports Highway via the Cape Jaffa Road, a further 8.0 kilometres from the town centre of Kingston and 39.5 kilometres north of the town centre of Robe via the Limestone Coast Road. Figure 3.2 shows Cape Jaffa's relationship to its nearest coastal towns, the Princess Highway and the district.

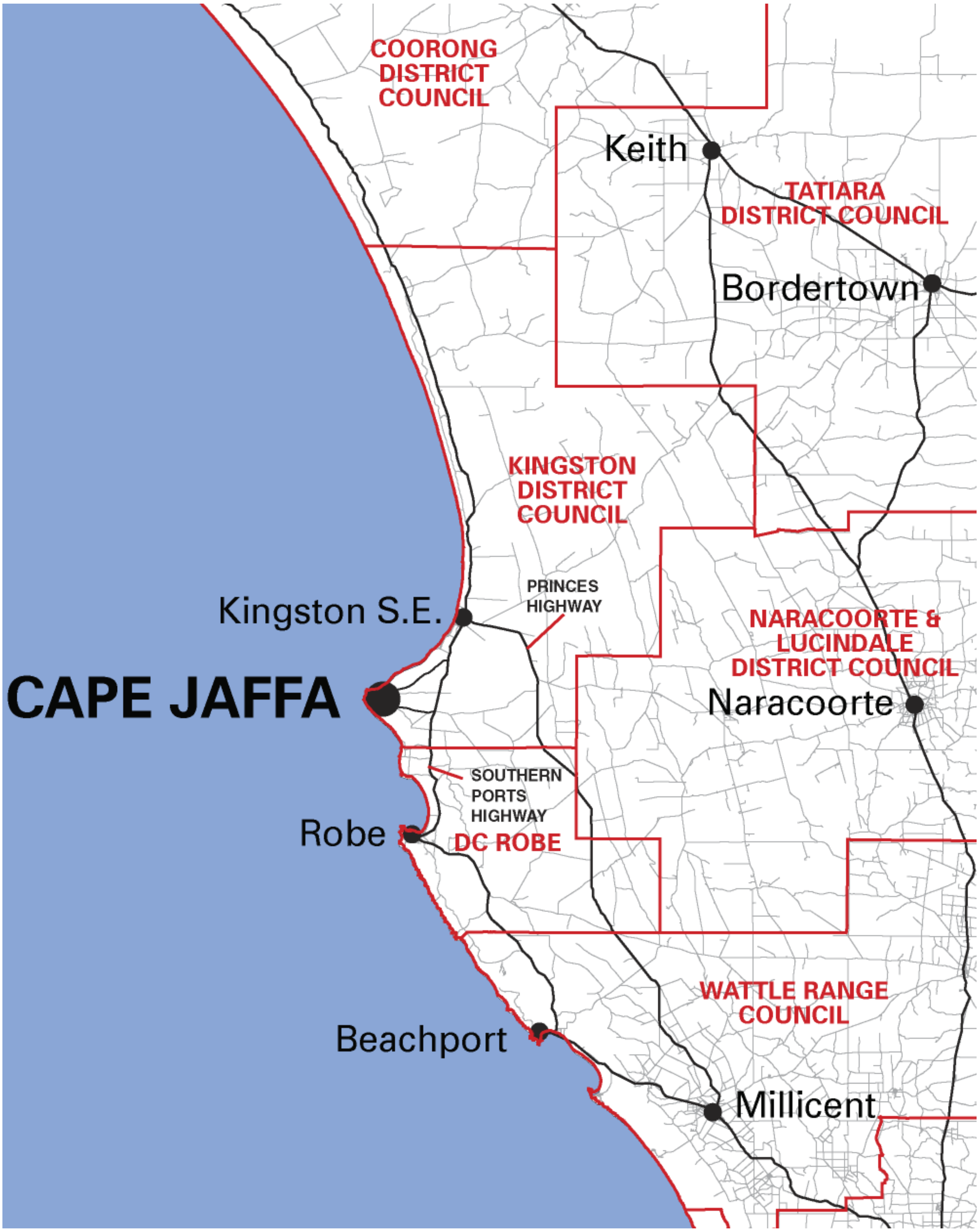
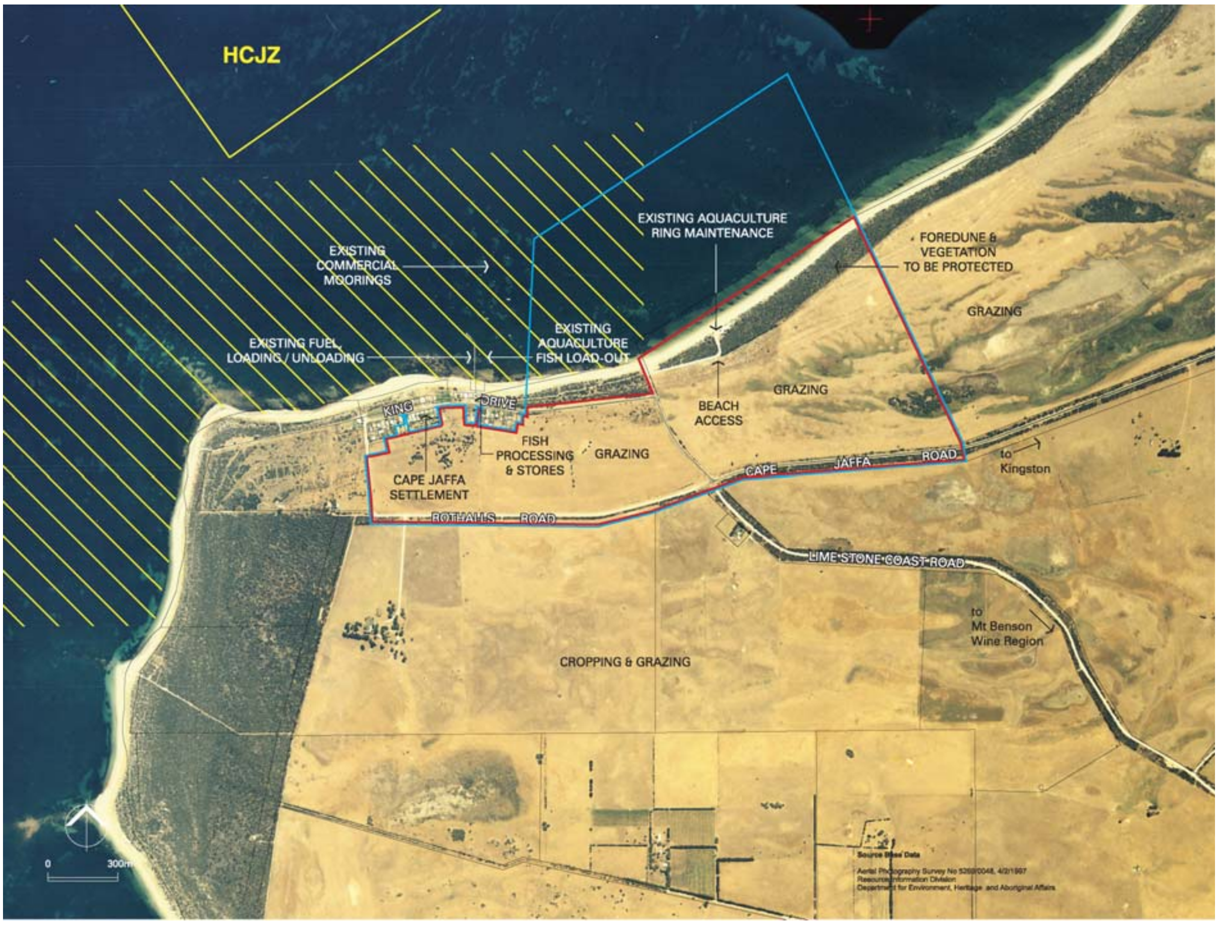


Figure 3.2: District Context

3.3 Locality

The locality comprises extensive cropping and grazing on marginal coastal lands set behind the existing Cape Jaffa settlement which accommodates the existing fishing fleet and aquaculture activities. The settlement has permanent and holiday accommodation, and storage activities associated with the fishing industry.

This is a significant development which has been located to satisfy a range of identified community needs. The environmental, social and economic conditions prevailing at Cape Jaffa provide the only practical opportunity along the whole of the South East coast of South Australia for a development of this nature. The development proposal is contiguous with the existing Cape Jaffa settlement as shown on **Figure 3.3**.



(blue outline)	Major Development Area
(red outline)	Subject Land
(hatched)	Cape Jaffa Rock Lobster Sanctuary
HCJZ	Historic Cape Jaffa Zone - Refer Lacepede Aquaculture Management Policy 2004

Figure 3.3: Locality

The land is coastal with a protected northerly aspect. Behind the sandy beach there is a low, vegetated sand dune, except in that part of the locality developed for fish receival and processing, public areas and a few dwellings forming the front of the Cape Jaffa settlement. In these urbanised areas, the vegetation and dunes are no longer a feature. Out from the area developed for fish processing are the Cape Jaffa jetty and the extensive mooring area for the fishing fleet. Closer to the jetty, the tenders to those fishing vessels are tethered. These mooring and jetty areas are within a Rock Lobster Sanctuary that extends in a southerly direction around the point at Cape Jaffa as shown on Figure 3.3 where the reef areas prevail.

The settlement of Cape Jaffa extends to the south of the beach and comprises a range of uses including:

- fish receival and associated facilities;
- a fuel storage area;
- a waste incinerator;
- waste oil storage area;
- commercial/industrial activities associated with the fishing industry activities;
- coastal reserve;
- a range of dwellings varying in style comprising single and two storey development together with a range of outbuildings and a number with storage areas for vessels and fishing equipment;
- a tourist park comprising camping areas, caravan sites and cabins, a shop and residence, storage areas, and fuel facilities; and
- vacant land.

Behind the settlement the land is undulating, cleared grazing land back to Rothalls Road. To the south of Rothalls Road the land begins to rise into the limestone layered hills of the Mt Benson wine region which is used primarily for grazing and cropping purposes, although there is an almond orchard at the southern extremity of the locality. Immediately to the west and south-west of the Cape Jaffa settlement, is an area accommodating a dwelling, surrounded by native vegetation, that extends west to the Cape proper and south along the coastline. The area beyond this private land along the coast forms the Bernouilli Conservation Reserve which extends southward a distance of about 7 kilometres.

Along the foredune to the east of the settlement is a band of coastal vegetation fronting a sandy beach, portions of which have been cleared for reserve, access and parking purposes. To the front of the property there are two significant vehicular accessways to the beach. The westernmost beach accessway extends along the existing Cape Jaffa Road reserve. The easterly accessway, which is located on the subject property, is used as the main service area for the aquaculture industry, recreational boat launching, and also beach access for pedestrians and vehicles.

For further information on the locality see Section 4.2.

3.4 The Subject Land

The subject land is depicted on **Figure 3.3** as the area contained within the Major Development area. The major part of the land is set behind the foredunes and is slightly undulating, cleared land used over many years for grazing and occasional cropping. The proposal also extends out to sea as it requires the development of breakwaters and a navigable channel and as such includes Crown land.

The land extends northward including the vegetated foredunes into the sea for that portion east of Cape Jaffa Road. To the west of Cape Jaffa Road, the property includes portion of King Drive immediately abutting the vegetated foredune. The land extends to the south, incorporating portions of King Drive, Rothalls Road, and the east/west leg of Cape Jaffa Road which commences at the Southern Ports Highway to the east.

The land is bound in the west by Rothalls Road and extends over a kilometre to the east of the north south leg of Cape Jaffa Road. The total land area measures approximately 150 hectares. **Figure 3.4** shows the general form of the land.

Figure 3.5 titled Land Tenure, depicts the subject property boundary and the particular parcels comprising the land as well as the proclaimed Major Development Boundary. The formal descriptions for the freehold land are contained in Certificate of Title Volume 5853 Folio 840 and Certificate of Title Volume 5560 Folio 348 (portion only) contained in **Appendix 4**. Portion of Certificate of Title Volume 5560 Folio 348 is the subject of a separate application for the division of land to facilitate the separation of the land depicted in the development concept. The subject land also incorporates portions of public roads as these are to be affected by the proposal. Portion of King Drive is proposed to be relocated south of its current alignment as depicted on the plan in **Appendix 5** whereas Cape Jaffa Road will be closed for the majority of its length from its current junction with Rothalls Road and Limestone Coast Road.

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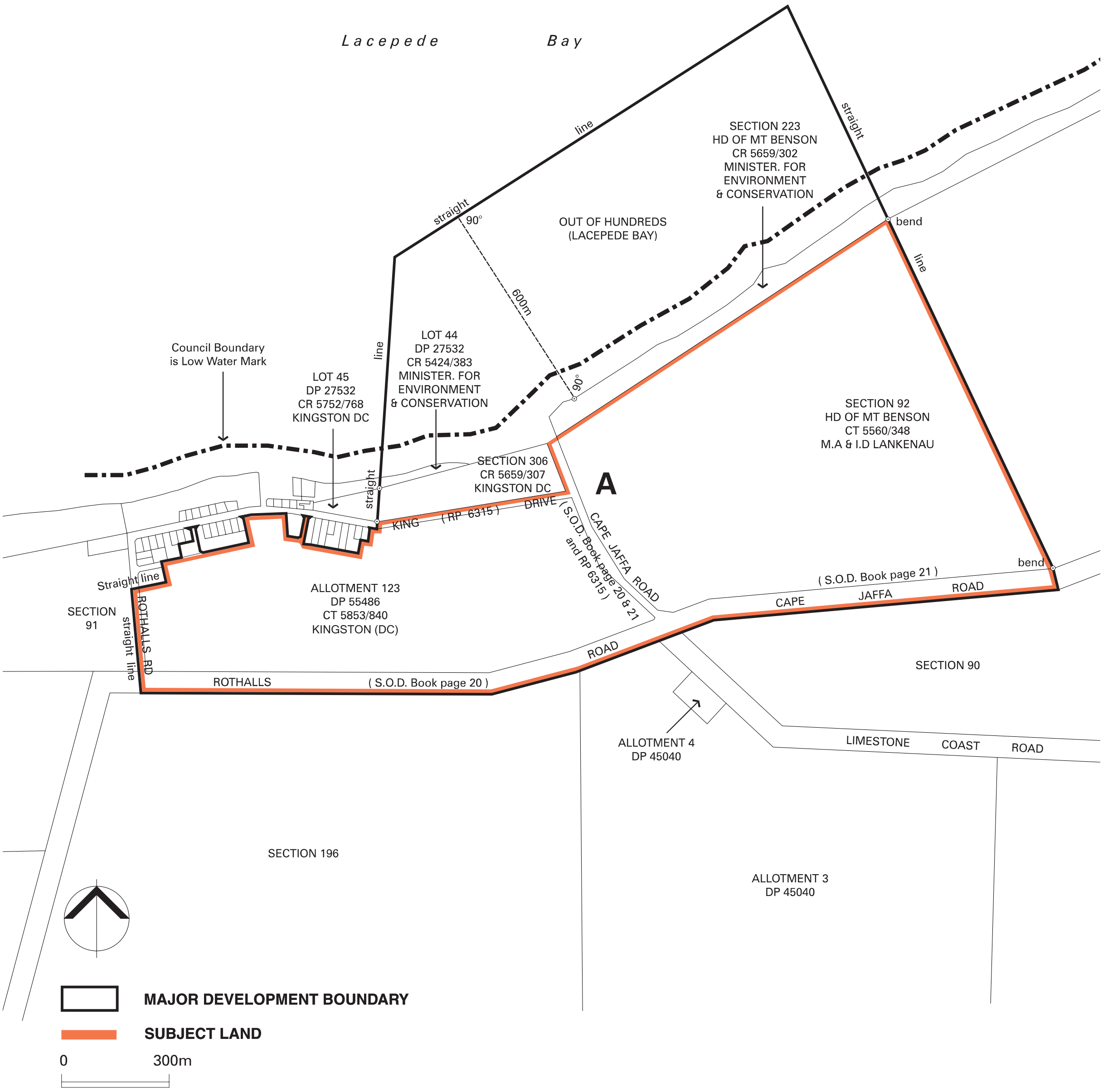


Figure 3.5: Land Tenure

3.5 Nature of the Proposal

3.5.1 Overview

The Cape Jaffa Anchorage project involves the development of a safe haven and moorings for the existing fishing fleet and aquaculture vessels, together with areas for the development of recreational boating facilities and tourist and residential accommodation. The concept is depicted on Figure 3.6.

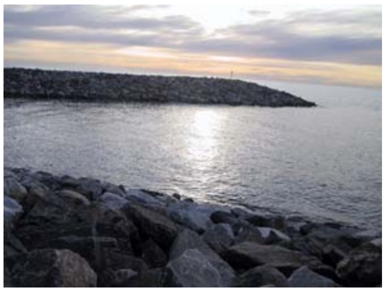
The principal features of the proposed development are summarised under the following key headings:

- Breakwaters;
- Channel;
- Main Harbour Basin;
- Boat Ramp;
- Fishing and Aquaculture Industries Service Area;
- Fuel and Waste Management Facilities;
- Boat Washing and Hull Cleaning;
- Maintaining and Repairing Vessels;
- Public Marina Berths;
- Commercial Berths;
- Commercial Wharf;
- Waterways;
- Retail;
- Residential Allotments;
- Private Marina Berths;
- Apartment, Motel and Cabin Accommodation;
- Motor Repair Station – Marine Servicing and Hardstand;
- Recreation Facilities and Open Space;
- Landscape Buffers;
- Reticulated Mains Water Supply;
- Effluent Treatment and Water Reuse;
- Stormwater Management;
- Reticulated Power;
- Telecommunications;
- Land Division; and
- Design Guidelines.

3.5.2 Breakwaters

Two breakwaters constructed of local earth and stone will extend out to sea approximately 200 metres, slightly less than the length of the Cape Jaffa jetty, to provide a protected seaway access to Lacepede Bay, as shown on Figure 3.6.


Breakwater
Breakwater
Jetty
KING DRIVE
CARAVAN PARK
ROTHALLS ROAD
CAPE JAFFA ROAD
LIME STONE COAST ROAD
Existing Residential
Proposed Residential
Proposed Commercial
Reserve



The longer western breakwater is designed to provide protected waters from the westerly through northerly weather and wave action, and is to be built to a height of 2.5 mAHD (Australian Height Datum) equivalent to the height of the highest sections of the footway on the Cape Jaffa jetty.

The eastern and shorter breakwater is designed to protect the entrance from the easterly weather and wave action, and to create an entrance to the protected waters. This breakwater is also to be developed to a minimum height of 2.0 mAHD. Refer to **Sections 5.2.11** and **5.3.2**. The breakwaters are constructed with a flat top to enable service, emergency and pedestrian access. **Figure 3.7** depicts the form of the breakwaters and the nature of the construction. Note that the breakwaters are subject to final design detail. **Figure 3.8** is a graphical representation of the proposed breakwaters at Cape Jaffa, as viewed from the east and the west.

The approximate location of the seaward end of the breakwater is 200 metres offshore and 170 metres east along the coast from the centre line of the entrance to the inland waterways. At this point the water depth is approximately 2.1 mAHD. The extent of the proposed channel for deepwater access to the sea is approximately 280 metres seaward of the breakwaters, where the water depth is 3.0 mAHD. The accompanying photographs depict various breakwaters to give an indication of the form and style of the breakwaters.

Breakwater Construction

The breakwaters will be constructed with an impermeable core and lined with locally sourced limestone rock. The core is medium to fine grained sand and silts with minimal clay content, sourced from the on-site excavations. The rock for lining is to be sourced from existing stockpiles of durable consolidated limestone excavated from drains constructed previously and located about 15 kilometres east of the site. The rock will be sorted to remove fine material and graded to achieve appropriate rock sizing at the source site prior to loading and cartage to the site. The existing breakwater at Kingston was constructed using a similar construction technique from material sourced from drain excavations.

The volume of breakwater core is approximately 19,000 m^3 and the volume of rock lining is approximately 14,000 m^3. The total area of seabed disturbed will be approximately 1.3 hectares.

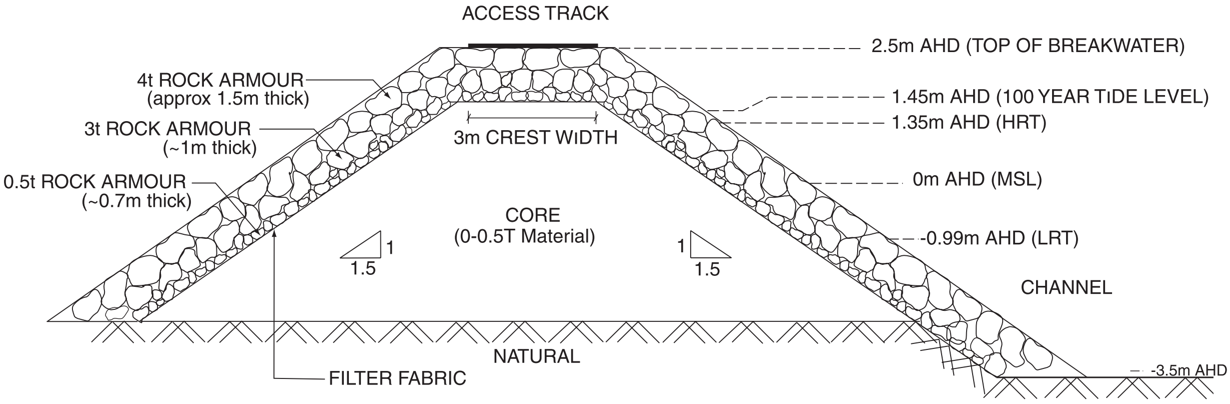


Figure 3.7: Breakwater Typical Cross Section

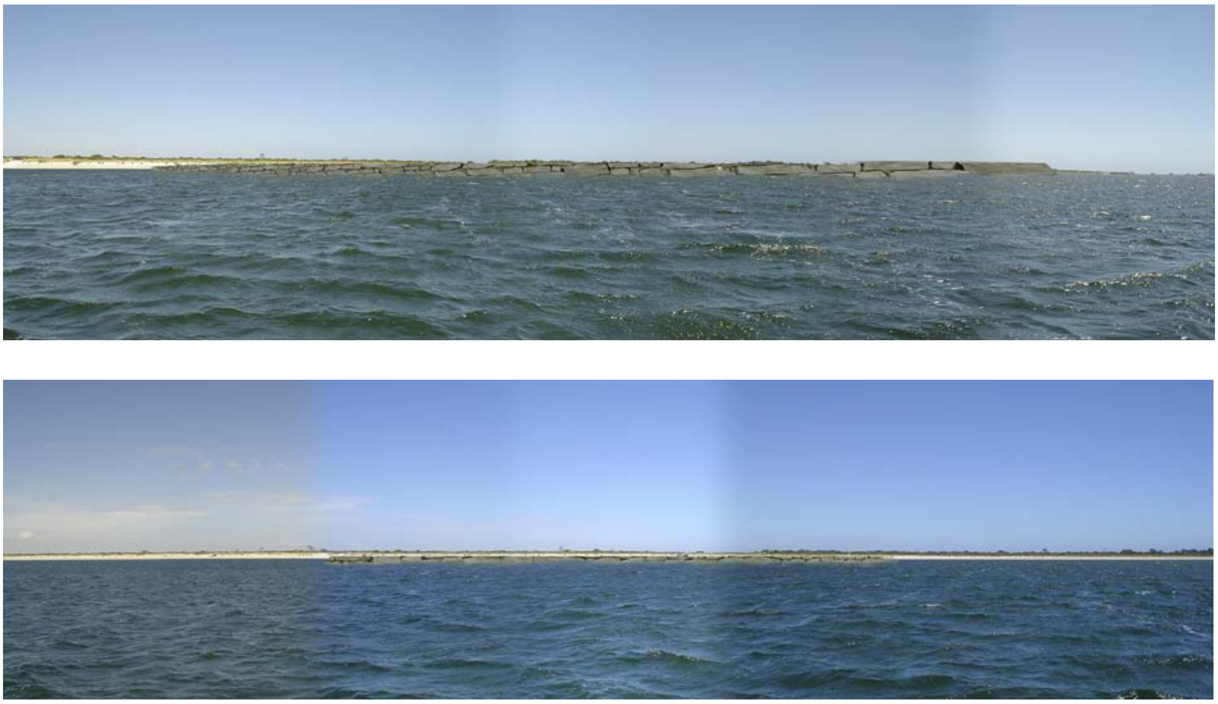


Figure 3.8: Cape Jaffa Breakwater

The limestone armour rock is a pale cream colour and is expected to darken with time as it weathers, as depicted in **Figure 3.8**. The colour and general visual appearance of the breakwater is expected to be similar to that of the Maria Creek breakwater at Kingston SE, as shown in the adjacent photograph.

3.5.3 Channel

A dredged channel with navigation markers is to be dredged approximately 200 metres from the end of the breakwater in a northerly direction as depicted on **Figure 3.6** to attain a depth of -3.0 mAHD.

The navigable channel is to continue into the protected area of the breakwaters, through the beach, the existing ramp and car park, and to the rear of the foredune to meet the main basin.

Entrance Channel Dredging

Dredging will be required to establish the navigable channel to the open sea. From the coast to the entrance between the breakwaters, approximately 300 metres of channel will be constructed to a depth of -3.5 mAHD. Seaward of the breakwaters the channel is -3.0 mAHD and extends offshore until -3.0 mAHD water depth is reached, approximately 200 metres from the breakwaters. The channel is approximately 25 metres wide plus sides with slopes of 1 in 5, so the total width varies up to about 45 metres.

The volume of excavation seaward of the breakwaters is approximately 5,000 m^3 and within the breakwaters 14,000 m^3. The total area of seabed disturbed by the channel is about 2.2 hectares.

The survey indicates that all of the 5,000 m^3 to be dredged seaward of the breakwaters is sand and will be readily dredged using a conventional suction cutter dredge. Construction of the channel within the breakwaters will involve a combination of suction cutter dredging and, where limestone is encountered, excavation.

The preferred option for excavation of the limestone is to use an extended turret excavator, whereby the track assembly runs on the seabed and the majority of the machine is elevated sufficiently to ensure it is above water and wave level. Trafficking of the seabed will be limited to the areas to be excavated in order to minimise disturbance of the seabed and seagrasses.

Excavated limestone will be loaded onto a conventional articulated truck mounted on a barge that will convey the truck to the beach in the area that will be later excavated for the channel into the main basin. The trucks will then cart the spoil for placement in mounds together with the material excavated from the land-based excavations, in the conventional manner.

Dredging discharge will be to a land-based cofferdam located within the area to be excavated as part of stage one. Overflow will occur through a chain of settling ponds, and eventual return to the marine environment occurs between the breakwaters. Sieve analysis of the sand show that it is medium to fine grained (0.125 to 0.5 millimetre diameter) with only a few percent silt and clay, thus appropriate water handling will ensure very low turbidity discharge thereby maintaining water quality.

The dredging will be performed in accordance with a Dredging Environmental Management Plan that will meet the SA EPA licensing requirements and will be undertaken in accordance with a management plan approved by the EPA. Monitoring of turbidity will be undertaken to assess the potential effects associated with increased turbidity during construction, although a number of strategies will be put in place to reduce these effects. The assessment shows that the short duration of any increase in turbidity will not cause any problems for the seagrasses in the area. Strategies to reduce turbidity will include timing dredging events to coincide with periods of low water movement, use of a cutter-suction dredge to remove soft sediments, and shields around the area being dredged where necessary.

3.5.4 Main Harbour Basin

A main basin on the landward side of the existing vegetated foredune will be developed. This will create an open waterway area of approximately 14 hectares to accommodate the safe passage of vessels, marina berths, wharf frontage and safe access to the waters of Lacepede Bay. Incorporated around the main basin are sites to enable the establishment of a public boat ramp to serve recreational fishing interests, commercial/industrial boat lift and servicing facility for the larger recreational vessels, and commercial fishing and aquaculture interests.

<u>Basin and Waterway Excavation</u>

The excavation of basins and waterways within the site covers approximately 47 hectares and totals approximately 2,568,000 m^3. Stage 1, which includes the main basin and opening to the sea, covers approximately 14 hectares and involves the excavation of about 813,000 m^3. The main basin will be excavated to a depth of -3.5 mAHD, with a shallow gradient to slightly shallower water depth at the ends of the housing development areas to the east and west.

Existing ground levels vary between 1.5 and 5.0 mAHD and therefore there is a need to fill and redistribute materials to create a more usable site. Fill will be used on-site to elevate the land around the waterways in order to provide protection against combined extreme high tide and storm surge events. Minimum building platform levels are 2.5 mAHD and minimum floor levels are 2.75 mAHD. For comparison the Development Plan specifies 2.4 mAHD and 2.65 mAHD respectively. Finished ground levels around the site will range from about 2.0 metres at the waterway wall edge to about 9.0 mAHD away from the waterways, which will require approximately 500,000 m^3 of fill.

The balance of the material excavated (2,080,000 m^3) will be used to construct noise mounds, general fill mounds, and to elevate the area that will be used for reclaimed water fodder crop irrigation immediately east of the site, and other land reclamation and rehabilitation projects such as the Council borrow pit on Limestone Coast Road. The land that has been made available for reclaimed water fodder crop irrigation is approximately 77 hectares, of which about 55 hectares is open pasture suitable for levelling and raising with material from the excavations and subsequent irrigation. Existing levels are between 2.0 mAHD and 6.0 mAHD, and it will be elevated by an average of 4.0 metres to between 6.0 and 11 metres, thus allowing the crop irrigation to occur with good vertical separation from the watertable.

In addition, salt-scalded land exists immediately to the east of the site and negotiations with the landowner to rehabilitate this area using fill excavated within the site are proceeding. Further, Council operates a rubble quarry approximately 5.0 kilometres south-east of the site and material excavated from the Cape Jaffa site may be used for rehabilitation of the mined areas of the quarry.

The frontage to the main basin also allows for the establishment of public waterfront along which can be developed the tourist, retail and commercial centre of the development overlooking the recreational and commercial fleets and the activity focus of the marina.

The main basin area is to be excavated to -3.5 mAHD to ensure that deep keeled vessels can manoeuvre within the basin at all tide conditions.

3.5.5 Boat Ramp

A public boat ramp is proposed between the retail and commercial/industrial sectors of the development. A submission to the South Australian Boating Facility Advisory Committee has been made for funding to provide this locality with a safe boat haven, ramp and breakwater for the existing and growing boating community using the Cape Jaffa beach.

To enable the creation of protected all weather access, the ramp will be located inside the breakwaters and at the innermost part of the harbour. Figure 3.9 shows the location of the proposed facilities. The ramp concept comprises four lanes and four floating fingers with associated rigging/ de-rigging, wash down and car and trailer parking areas. Space for about 64 cars and trailers is provided to the south of the ramp with overflow available on the adjacent car park area. The concept for the boat ramp is shown on Figure 3.10. The photograph depicts the Kingston Boat Ramp.

These facilities will replace the informal access and beach launch facilities that operate on the beach within the area of private land.

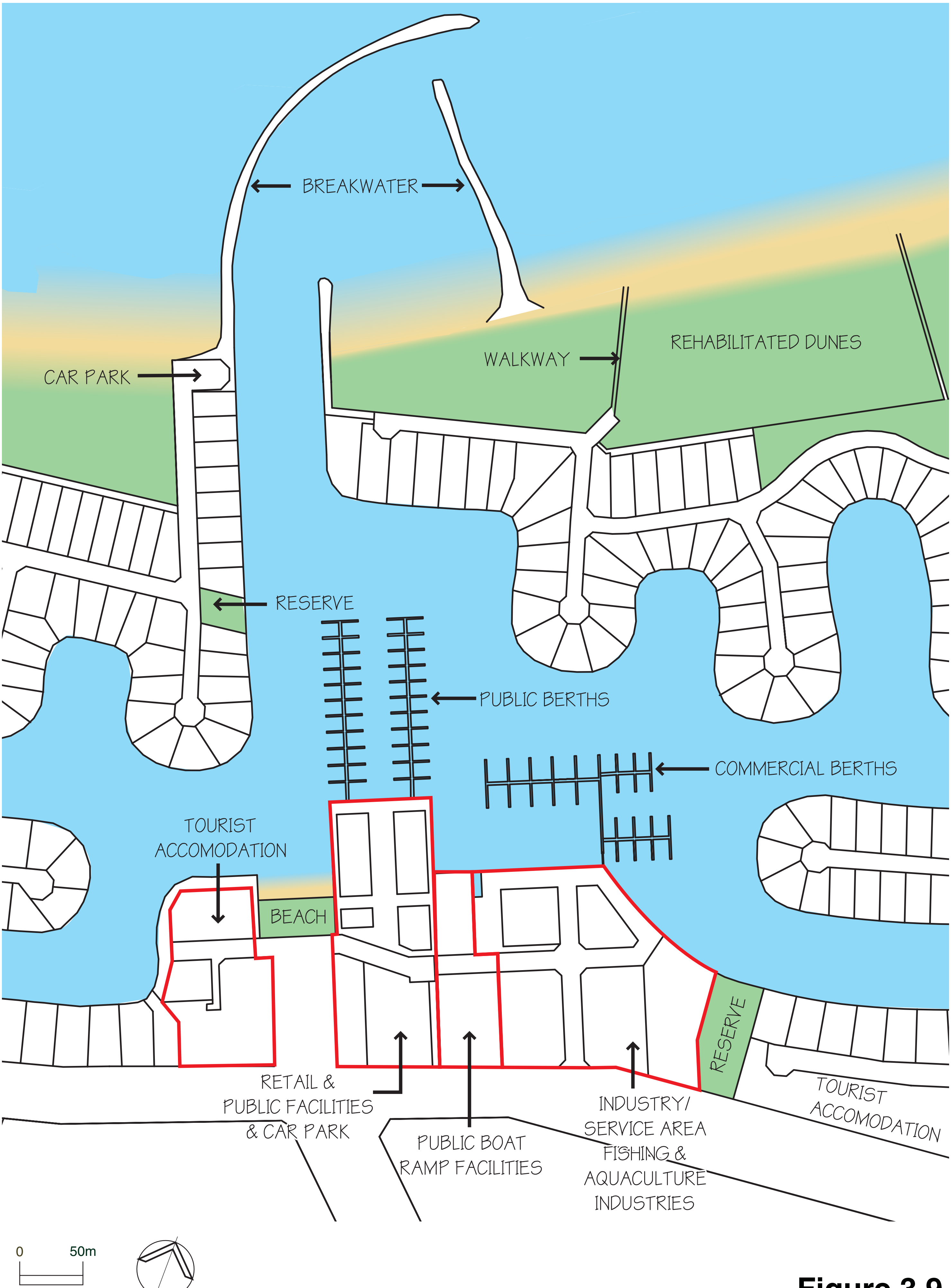


Figure 3.9

CENTRAL FACILITIES
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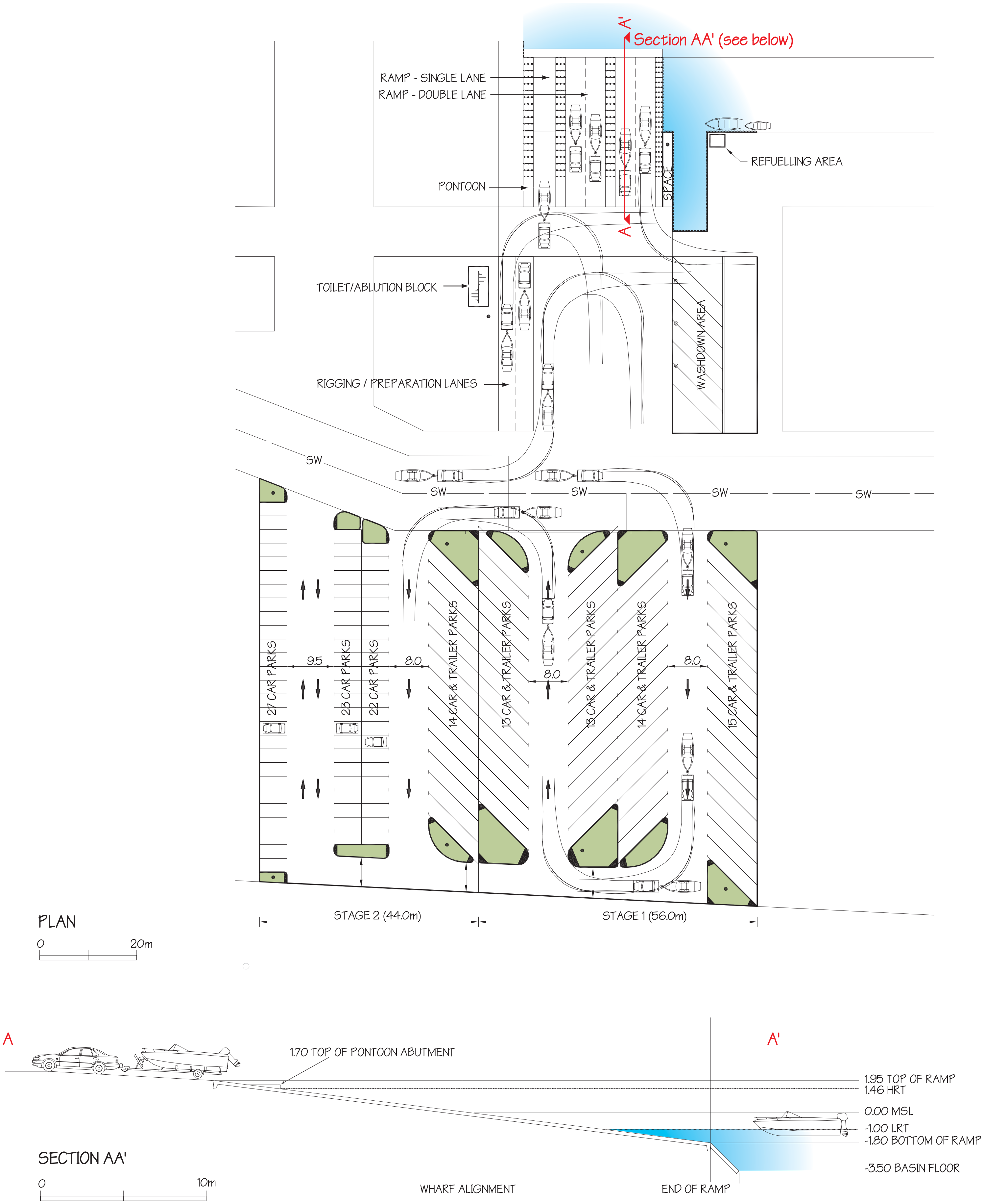


Figure 3.10

BOAT RAMP

CAPE JAFFA ANCHORAGE

Tonkin Engineering Science

3.5.6 Fishing and Aquaculture Industries Service Area

The fishing and aquaculture industries currently operate from the Cape Jaffa Jetty together with the car park and the fish processing buildings near the start of the jetty.

It is proposed to create an alternative area adjacent to a service wharf where vessels can unload directly to the receival area for weighing and transfer of catch to buyers, processors and holding facilities. This area will enable the development of purpose built facilities, incorporating where required, the necessary water handling infrastructure for cleaning and holding fish, essential in the fishing industry. This can be achieved by providing an underground reticulated fresh seawater service to this area from a location on the breakwater subject to need and licensing requirements. The accompanying photographs depict a range of facilities provided in other fishing ports.

A travel lift or similar device is proposed to be established in association with a hardstand area for off season servicing, maintenance and storage for vessels. At this time, 21 owners have registered their interest in securing a hardstand space for their commercial vessel. There is also provision for an area in excess of 3,750 square metres that can be developed for marine servicing activities. This area is separated from the residential development proposed and will incorporate all necessary waste and stormwater management facilities.

The provision of all of these services will be determined following further consultation with the fishing and aquaculture industries.

3.5.7 Fuel and Waste Management Facilities

It is proposed to establish enclosed or bunded facilities and areas according to current environmental standards to ensure the commercial and recreation fleets and the community generally are served in a manner that will protect water quality, minimise risk to the environment, and create a healthy, attractive town and port.

The relevant codes and guidelines (TSA 1998, TSA 2003) encourages best practice in terms of fuel and waste management and pollution prevention, and will be used as the guide for the development of all port related facilities. Further, the Australian Institute of Petroleum Code of Practice (AIP) will be used in conjunction with the TSA code and guidelines. The AIP code sets out the standards for the establishment of fuel facilities and their management.

The establishment of fuel facilities will also be in accordance with the relevant Australian Standards (AS 1940 1993) for fuel storage and handling. Above ground fully bunded fuel storage will be installed together with associated pipes and pumps to the dockside bowser. This service will be managed using a swipe card system. The associated photographs show the type of dispensers incorporated at Port Lincoln and Mandurah Western Australia, and waste management enclosure at Mandurah.

Waste facilities and services will be established for the appropriate collection, storage and disposal of wastes, based on the appropriate guidelines (ANZECC 1997). This will comprise sewerage pump-out from marine toilets and covered mobile garbage bins for all hard wastes from the fishing and aquaculture activities. Further, the industries on their own initiative encourage waste avoidance, reduction, segregation, and where practical, reuse.

This development will greatly assist in implementing the principles for users of TSA marine facilities contained in the TSA codes (Transport SA 1998) through the provision of appropriate facilities and services.

3.5.8 Boat Washing and Hull Cleaning

Boat wash down facilities will be incorporated adjacent the public boat ramp. This area will be clearly identified and the run-off from this site will be collected to ensure it does not enter the stormwater or waterways. This area will be sealed and bunded to prevent any liquid escaping the site and divert all uncontaminated stormwater away from the area. Further, it will be located above the 1 in 100 year high tide level to ensure that the collection system is not flooded by storm surge events. See **Figure 3.10** for the location of this facility.

The boat washing/cleaning area will be located adjacent to both the commercial slipway/travel-lift bay and the public boat ramp in order to ensure it is readily accessible to both commercial and recreational users.
The wastewater and the associated paint and hull scrapings, oil and fuel will be diverted to a trade waste collection system designed in accordance with EPA requirements for Stormwater Management for Marinas, Boat Sheds and Slipways (EPA 521/04). This system incorporates silt traps to collect gross solids and sediments. Subject to design detail, this will be located to the rear of the boat ramp area. All liquids are then discharged to sewer after passing through an oil separation unit. A licensed contractor will undertake removal and disposal of the solids on a regular basis.

Activities such as abrasive or high pressure cleaning, and wet rubbing will be limited to this area.

3.5.9 Maintaining and Repairing Vessels

Mechanical repairs of engines, fibreglass repair work and painting of vessels will be carried out in workshop areas with facilities to collect and treat solvents, degreasers and other potential contaminants.

All general boat repair work will be carried out on the land in an appropriately designated area. Activities will be restricted to ensure that no contamination of the stormwater can occur. Precluded activities include hull cleaning and wet rubbing. Areas will be regularly maintained and cleaned as part of the operation and management of the facility.

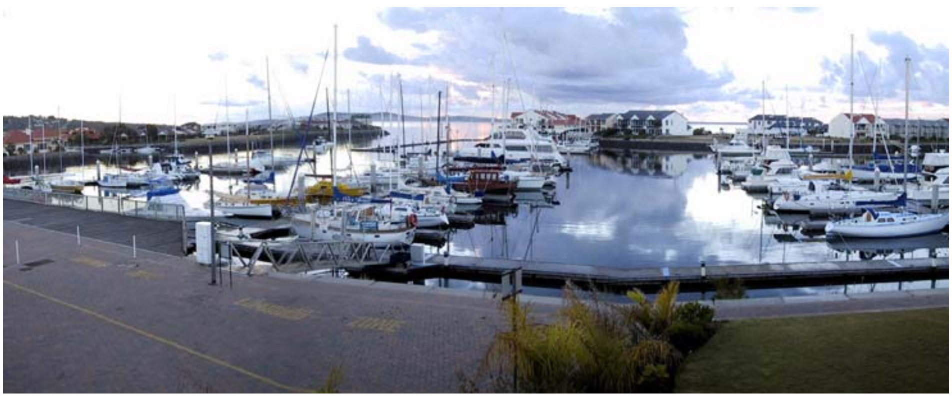
In-water hull cleaning within the marina will not be allowed without approval from the EPA. EPA approval may be given subject to satisfactory operating procedures as defined in the Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance (ANZECC undated).

3.5.10 Public Marina Berths

Berths for up to approximately 60 vessels can be accommodated in the main basin area and their development will be contingent upon demand. It is anticipated that permanent long term occupation will predominate with a significantly smaller need for short term occupancy including overnight stays for passage makers. These facilities will be a welcome addition along this coast as there are few facilities for the tourist mariner. This will also provide a service to mariners not presently satisfied or able to be accommodated in existing facilities such as at Robe.

The berths will be accessed via a gated walkway or walkways to floating pontoons secured by vertical driven piles or flexible anchoring system. The berth sizes are likely to range between 8.0 metres and 20 metres with the majority being in the 10 to 14 metre range. Some of these will be single bay berths and the majority will be double bay.

It is proposed to provide these berths on a community title basis with principles established setting out the necessary roles, responsibility and management requirements for the public marina as a whole.



3.5.11 Commercial Berths

Approximately 40 commercial vessels can be accommodated in a separate floating pontoon marina accessed via a gated walkway from the commercial wharf. As for the private berths, this floating pontoon system will be secured by vertically driven piles or flexible anchoring system. Vessel size in the fleet ranges from about 10 metres up to 18 metres with the majority around 15 metres. The berths will be created to provide the fleet with the most appropriate sizes to ensure a safe, secure facility. These berths will be made available as part of a community title arrangement including the necessary management requirements for the facility. At this time, 21 owners have registered their interest in securing a berth for their commercial vessel in addition to those interested in hardstand facilities.

3.5.12 Commercial Wharf

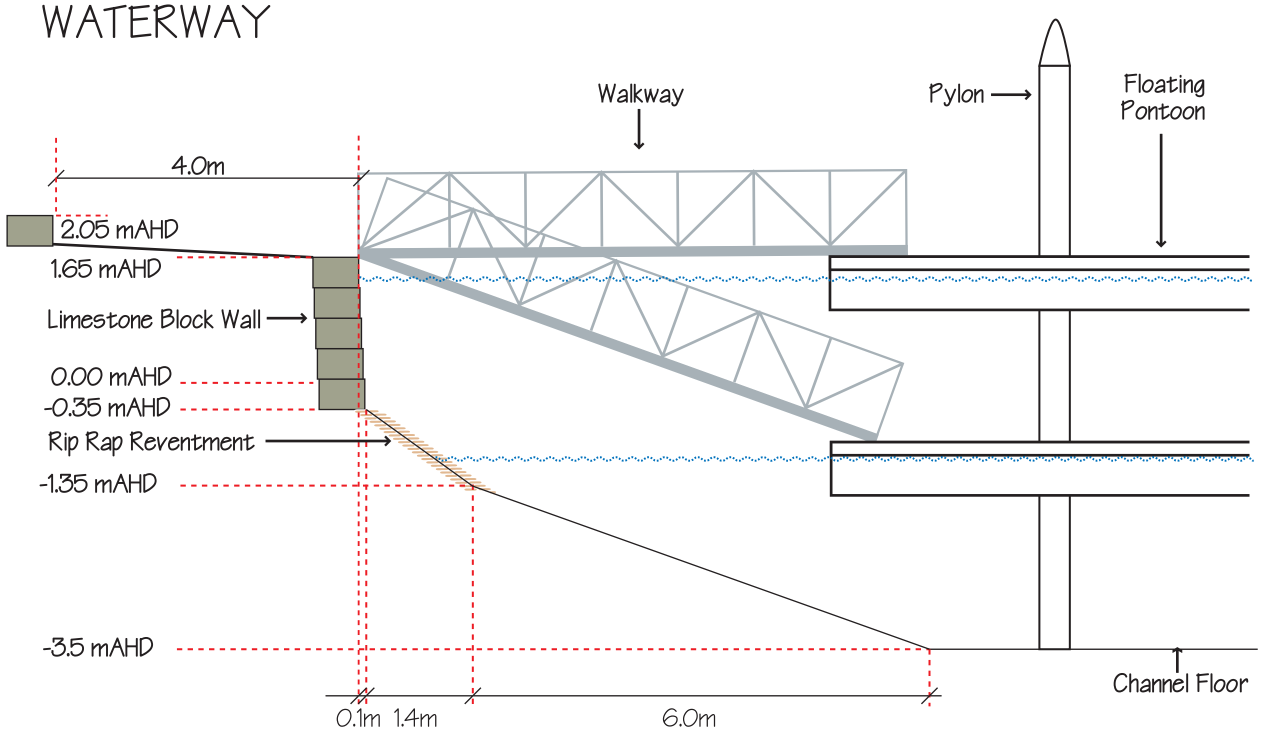
A wharf comprising two sections is proposed to be established subject to demand to accommodate refuelling, loading and unloading and short term berthing for minor servicing. As set out, the wharf in total measures approximately 160 metres and is to be constructed using a near vertical limestone block wall with timber fenders similar to the style depicted in the accompanying photograph of the Mandurah Western Australia commercial wharf.

This wharf and associated infrastructure services the rock lobster fleet comprising similar vessels and operations to the Cape Jaffa fleet. The photograph shows the commercial wharf at Mandurah where the lobster boats service, fuel and unload their catch. The commercial wharf area is to be built with an edge treatment to a height of between 1.65 and 2.05 mAHD extending near vertically to the full -3.5 AHD basin depth, thus allowing the deepest draft vessels access to the edge of the wharf. Refer **Figure 3.11**.

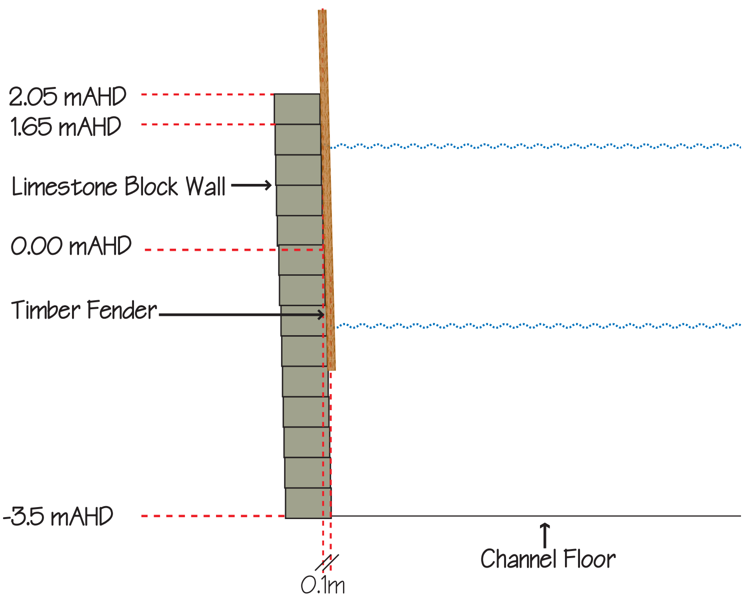
3.5.13 Waterways

The waterways are to be established as extensions to the main basin to a depth of -3.5 mAHD and rising gradually with distance away from the main basin to provide drainage. They have a minimum width of approximately 50 metres to allow for mooring and passage of vessels. The base of the waterways are to be constructed and maintained in the natural material with shallow slopes to the edge where local limestone rock will be used to tie in the waterway base with the near vertical limestone block wall. The block wall extends from -1.35 to 1.65 mAHD, backed by a 4 metre easement with a finishing wall at 2.05 mAHD. The typical arrangement is depicted on **Figure 3.11**.

WATERWAY



WHARF



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MasterPlan
Town & Country Planners

Figure 3.11

WATERWAY & WHARF EDGE TREATMENT

CAPE JAFFA ANCHORAGE

Waterway Edge Treatments

The edge of the waterways will be constructed of reconstituted limestone blocks manufactured using limestone rubble and sand won on-site. The blocks are very similar to those used in numerous similar developments around Australia including Port Lincoln Stage 2, in waterway development south-east of Melbourne, and numerous developments in Perth including Mandurah, Ascot Waters and Secret Harbour.

The main marina wall around the majority of the waterway extends from +1.65 to -0.35 mAHD, with local limestone rock revetment below, extending down to -1.35 mAHD. The 100 year ARI (Annual Return Interval) extreme high tide is 1.45 mAHD, the highest recorded tide is 1.35 mAHD and the lowest recorded tide is -1.05 mAHD, so the whole of the tide range is covered by this edge treatment. Above the main wall is another low wall up to 2.0 mAHD set back 4 metre from the main wall and incorporating a maintenance easement. Below the revetment, a batter of the natural limestone will extend down to the full depth of the waterways.

The sand and limestone for block construction will be won on-site, although limestone rubble requirements may be augmented using rubble sourced from the existing stockpiles of limestone along the same drains as the limestone used for breakwater construction. Revetment rock will also be sourced from the existing stockpiles of limestone along the drains.

The only materials being imported to the site is limestone rock used for breakwater, revetment and edge treatment block construction, and cement for the manufacture of the limestone blocks. No materials will be exported from the site other than that used for filling land immediately to the east of the site as described or, if deemed appropriate, for the rehabilitation of the disused area of quarry nearby.

For residential allotments it is proposed that the waterfront comprise a 2.0 metre high limestone block wall built using five blocks with dimensions of approximately 300 by 400 by 1,000 millimetre plus mortar and a topping block. The blocks will be laid with a minor backward slope and each block being laid slightly set back from the block below. In this way, the wall will be stable and climbable for safety around the waterway. This wall will also be secured by tieback mesh into the backfill soil behind the wall.

At the toe of this wall is a limestone rubble rip rap face set at about 33 percent for a distance of about 1.2 metres, at which point the natural material forms the sloping channel floor down to the base of the channel.

The commercial wharf is a higher vertical limestone block wall extending up to 5.15 metres close to the maximum depth of the main basin to allow vessel access to the edge. The wall will be protected using vertical timbers bolted to the wall extending marginally above the top of the wall.

3.5.14 Retail

Manager's Office

An on-site management, sales and information office will be established as a multi function facility until circumstances require the separation of these functions. Management will be responsible for the day to day operation of the marina facility including the management and administration of the community titled areas, berth rental, environmental and licence management and administration, fuel services, land sales and settlement, events coordination and marketing functions.

This office will also provide general information to visitors about the marina, Cape Jaffa generally, Kingston, the region, and the services and facilities available.

General Store/Kiosk

The requirement for these facilities is yet to be determined and will be dependent on the continuing role of similar facilities at the Cape Jaffa Caravan Park. It is intended to support these commercial activities rather than compete.

Tavern/Café/Restaurant

A waterfront facility is proposed as a tourist/visitor and possible local club focus. It is intended to establish a facility that can function as a resting place for tourists and a focal point to view the marina and its activities while being served with café style refreshments. This facility is also intended to serve the permanent population and it is hoped that a club like atmosphere can be established as a local focus for gathering, entertainment and information.

Chandlery and Boat Brokerage

These facilities are likely to be required in later stages either as a retail facility or agency, and may be operated from the manager's office.

3.5.15 Residential Allotments

Approximately 339 canal waterfront, 77 seaview and 104 township allotments are proposed as part of the development concept. This may vary over time depending on the market requirements for allotment sizes and types and final design.

The proposal currently depicts allotments averaging about 800 square metres land area as a guide only to the future arrangement and configuration of waterways, allotments and dwellings. Each waterfront allotment extends up to 20 metres into the water, however the majority extend approximately 15 metres from the main limestone block wall.

Each allotment will be constructed to engineering standards to create a building platform with a minimum height of 2.5 mAHD which is higher than the minimum 2.4 mAHD requirements of the Development Plan.

The northernmost allotments will be setback from the existing coastal vegetation a distance of 6.0 metres within which space a public walkway will be constructed of natural limestone material, thus creating a hard pavement to stop weed and non native grasses from readily migrating from garden to coastal dune. There will also be a degree of vertical separation between the allotments and the natural ground level as the allotments are to be built up for flood protection purposes as well as to create views out to sea. These allotments are to have finished levels of up to approximately 7.0 mAHD which results in the potential to view the sea, but not the beach as the dunes and vegetation prevent a beach view. Likewise, a view from the beach to development behind the dunes is not available as the dunes and vegetation screen the view.

The building platforms around the marina waterways will be at least 2.5 mAHD with slopes down to the top of the limestone block wall at 2.05 mAHD located 4.0 metres from the top of the main wall which is to be set at 1.65 mAHD. These elevations cater for the sea level rise to 2100. Should the need arise in the very long term, there is ample space and opportunity to raise the protection features further.

A building line will be established a further 4.0 metres back from the easement, thus ensuring no buildings are located within the first 8.0 metres. Fencing within this 8.0 metre area will be a combination of open style fencing to a maximum height of 1.5 metres for the first 4.0 metres and standard fencing to a maximum height of 1.5 metres to the 8.0 metre setback.

The 8.0 metre setback from the waters edge is designed to maintain openness in this area and to allow for the service and maintenance easement around the waterway edge.

Other allotments within the development area will also have minimum building envelopes established at 2.5 mAHD. At the western end of the development it is proposed to elevate the area to gently rise from the roadways toward an elevated central reserve to a height of approximately 7.5 mAHD. The area will be designed to capture stormwater locally for local infiltration rather than shedding all to the external road system.

All allotments will be subject to design criteria for the purpose of guiding and managing the development in relation to:

- building levels for habitable rooms;
- setbacks;
- height;
- energy efficiency;
- solar access;
- fencing;
- building design;
- location of service areas;
- stormwater management - stormwater retention and detention (rainwater storage);
- use of land and water areas; and
- rights of way and easements.

3.5.16 Private Marina Berths

Most waterfront residential allotments are capable of attaching an associated marina berth if desired. It is estimated that 50 percent of all waterfront properties will wish to develop a private berth. This equates to about 190 vessels for the whole of the development for residential allotments by the end of the project. Marina berths will need to be developed in accordance with the relevant Australian Standards.

These standards will be used as the basis for the preparation of a standard format for Cape Jaffa to be developed as a design requirement in order that there is total consistency in form, design and theme throughout the development. These requirements will be incorporated into deeds or agreements attached to the land and water to ensure adherence and consistency.

3.5.17 Apartment, Motel and Cabin Accommodation

When the existing tourist park is full, some camping tourists move to the dune zone and beach. In the proposal, an area of about 10,000 m^2 has been set aside for waterfront tourist accommodation in close proximity to the central facilities area, another area measuring about 6,500 m^2 of land fronting the western side of the entrance and an area off waterfront over 30,000 m^2 for possible expansion of other tourist park facilities as may be required should this area not be required for further expansion of the fishing and aquaculture activities. The feasibility of these facilities will be the subject of separate investigations and contingent upon the further development and needs of these industries. There is currently a shortfall in cabin and apartment style accommodation at Cape Jaffa and the opportunity exists to expand the options available to the travelling public.

3.5.18 Motor Repair Station - Marine Servicing and Hardstand

An area is set aside for industrial/commercial purposes to enable establishment of marine repair and maintenance operations. This area has direct access and association with the commercial fishing fleet and the service and wharf areas. This will replace the current ad-hoc arrangements that occur to some extent at Cape Jaffa and the defined area in the current Development Plan. Also, for those seeking convenient hardstand next to the harbour, within which some maintenance work can be performed, an area is available in close proximity to the berths and marine services.

3.5.19 Recreation Facilities and Open Space

Extensive areas of reserve and open space are to be provided around the development as depicted on **Figure 3.12**. The concept provides for a total reserve and open space in excess of 22 hectares excluding the waterways. These waterways function as additional open spaces within the urban area and add approximately 40 hectares to the open space amenity of the area.

A number of reserves and open spaces are created in key locations to create visual and physical access to the waterways as well as focal point and distance views. These spaces will be developed with grasses, ground covers, shrubs and trees to maintain the visibility through to the water creating attractive local spaces.

Figure 3.13 provides a concept layout for the development of one of the reserve areas to indicate the general form and nature of the landscaping and the linkage to other spaces.

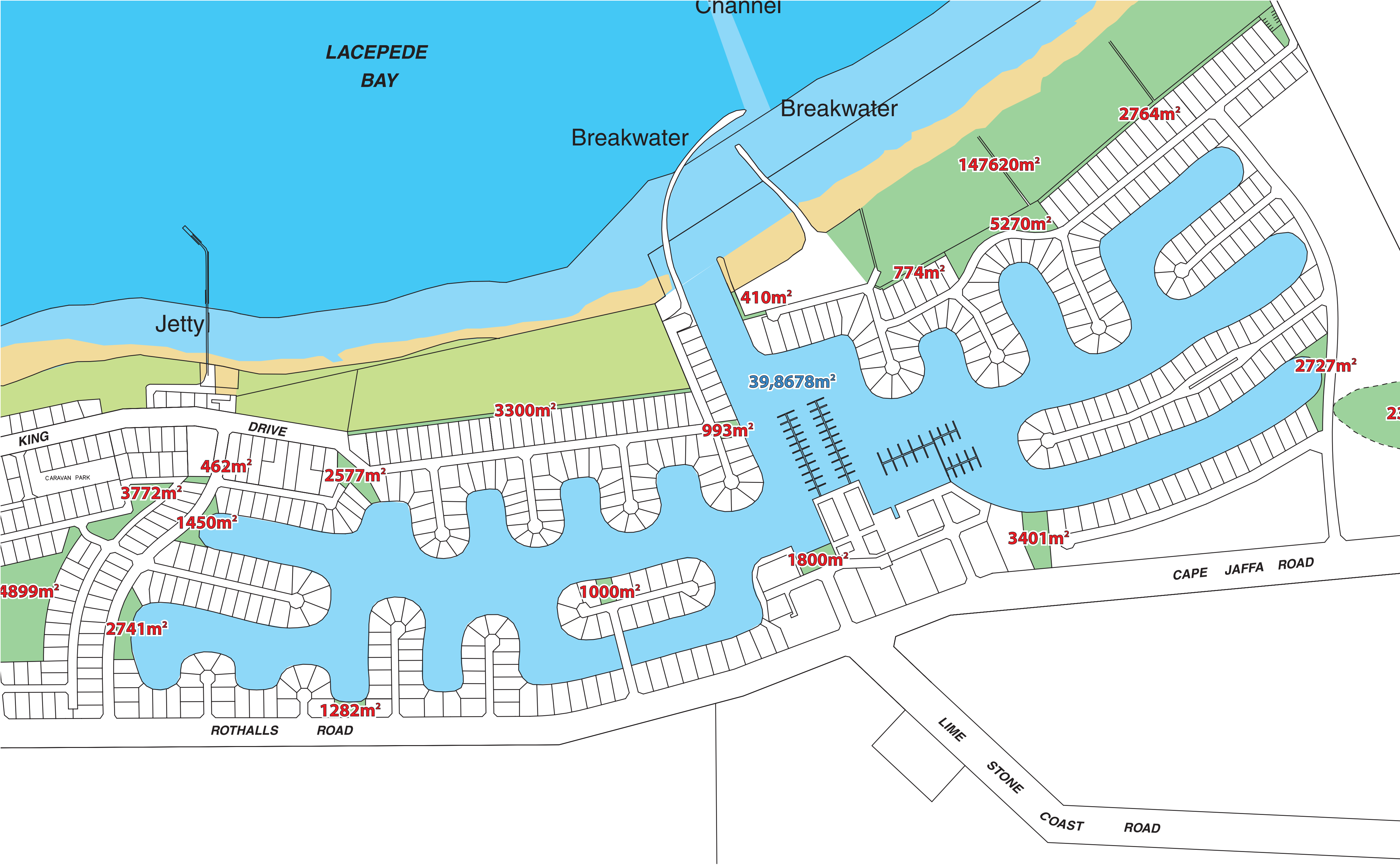
Beach access is to be enhanced with carparking and boardwalks. Removal of public vehicle access from a section of beach will create a safe bather and beach users' zone.

A combination of native vegetation and introduced species will be incorporated into the landscape for all of the reserves within the main development area. However, the walkway reserve abutting the vegetated dune areas will only be planted with native ground covers and grasses.

3.5.20 Landscape Buffers

In locations where visual or amenity buffers are required, mounded landscaped spaces will be established using native vegetation in the manner set out in **Figure 3.14** incorporating the species listed in **Appendix 6**. These landscaped spaces can be established along Cape Jaffa Road where visual access into the eastern side of the industrial/service area is less desirable and around the infrastructure service area at the south-eastern corner of the site.

The mounds are proposed to have a height up to 2.0 metres with slopes of approximately 1:2 with trees along the ridge, shrubs on either side, and the surface finished with native grasses and groundcovers.


Channel
LACEPEDE
BAY
Breakwater
Breakwater
Jetty
2764m²
147620m²
5270m²
774m²
410m²
39,8678m²
2727m²
3401m²
3300m²
993m²
1800m²
1000m²
2577m²
462m²
3772m²
1450m²
4899m²
2741m²
1282m²
KING
DRIVE
CARAVAN PARK
ROTHALLS
ROAD
CAPE JAFFA ROAD
LIME STONE COAST ROAD

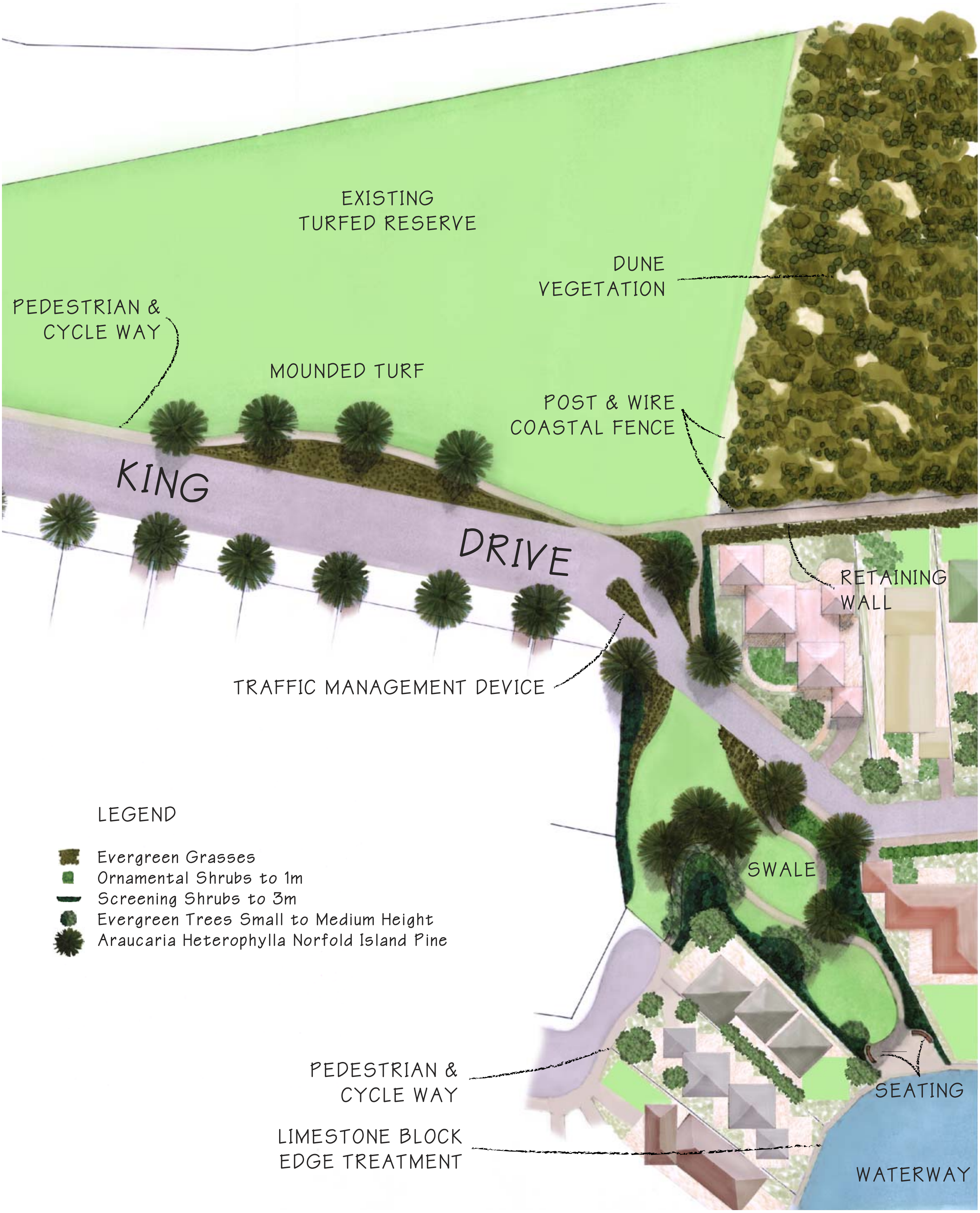
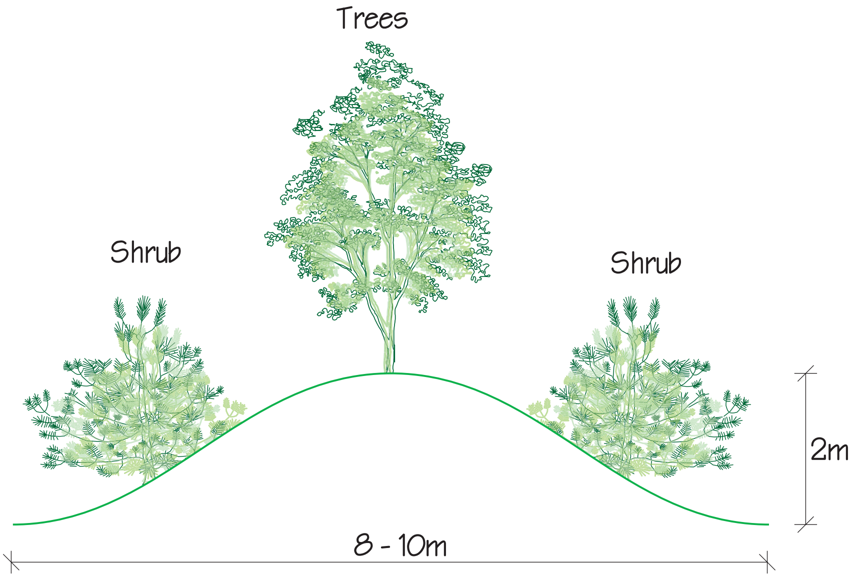


Figure 3.13

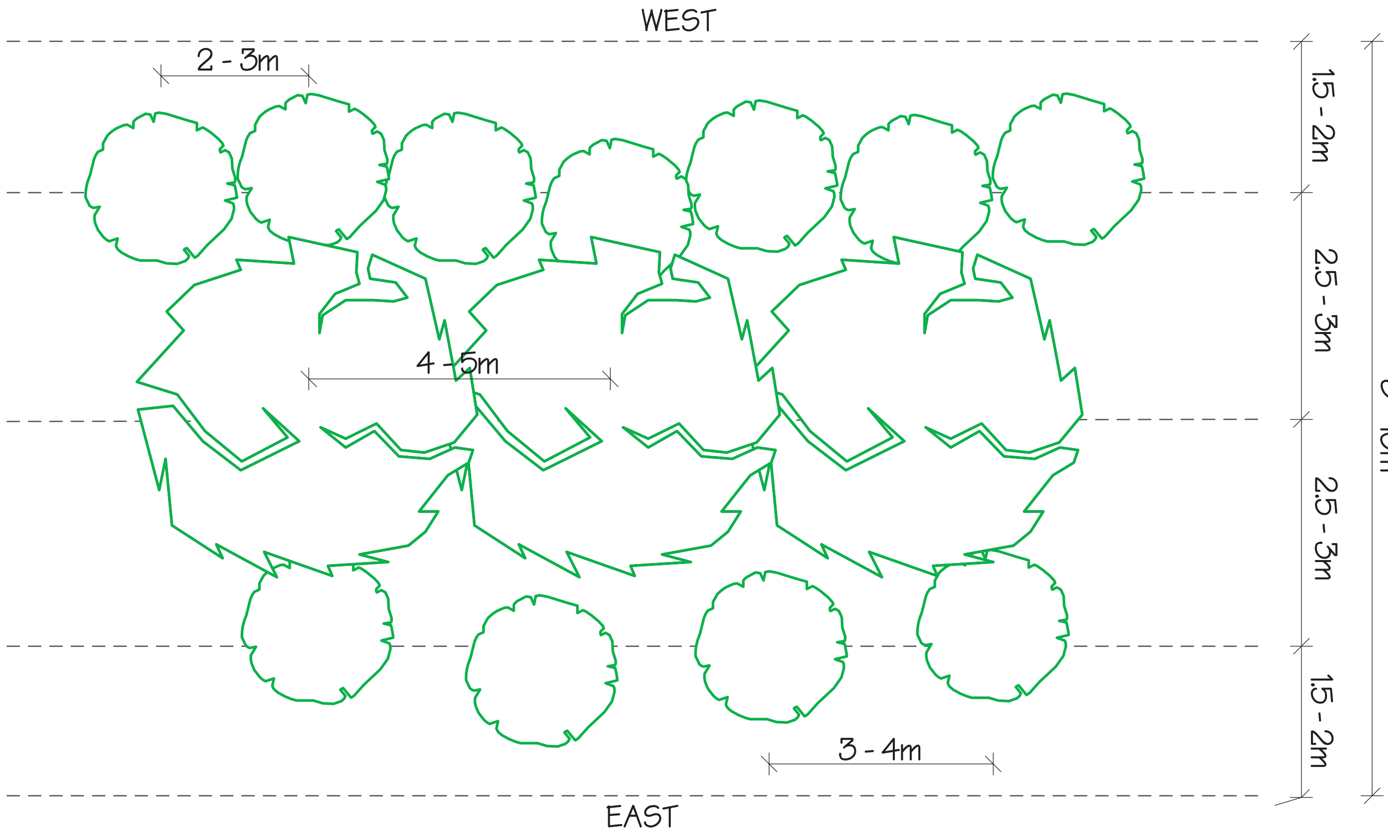
Scale:
1: 1000 @ A4
0 20m

Landscape Design Solutions

LANDSCAPE CONCEPT
CAPE JAFFA ANCHORAGE



MOUND



PLANTINGS

Native Grasses and Ground Covers to Understory

Figure 3.14

MasterPlan
Town & Country Planners

LANDSCAPE BUFFERS
CAPE JAFFA ANCHORAGE

3.5.21 Reticulated Mains Water Supply

A fully reticulated mains water supply will be provided to the development. The opportunity for existing Cape Jaffa properties to connect to the system in accordance with a staged program will be provided.

A test bore has been drilled into the confined aquifer in the south-eastern extremity of the land to determine the availability of potable water. A resource has been identified approximately 170 metres deep. Extensive sands were intersected, which, based on production from these sands elsewhere in the region, is expected to supply significant quantities of good potable water more than sufficient to meet the needs of the whole of the development and the township. Given the previous regional experience, a flow rate of about 30 to 40 litres per second is anticipated. Both Kingston and Robe also use confined aquifer water for town water supply.

The resource is within the Mepunga Formation of the Nirranda Group as depicted on **Figure 4.66**. This water is likely to be artesian, that is under pressure, and hence will flow to the surface naturally. The water nevertheless may be pumped using a submersible bore pump and will be treated to meet appropriate specifications in a similar manner to the Kingston town water supply. Approval from the Minister for Water Resources has been granted for the use of this resource for the purposes of a public water supply subject to proving up the resource. Refer **Section 5.2.21** and **Appendix 7**.

3.5.22 Effluent Treatment and Reclaimed Water Reuse

The collection system will provide a full sewer scheme for all domestic effluent wastes. Various alternatives are available including gravity sewer, vacuum sewer or pumped sewer type, and the preferred option will be submitted for approval after detailed design. A boat pump out facility for the collection of domestic sullage, ie toilet and sink waste, will also be connected when a facility is established. The sewer scheme will be designed to enable residents and others in the existing settlement to connect to the sewer in the future.

The design, construction and commissioning of the collection scheme will meet the requirements of the Department of Health (DH), including the Public and Environmental Health (Waste Control) Regulations 1995. The design of the scheme will be submitted to the DH for approval. The design will be based on accepted present day standards to minimise the potential and risk of spills. The plant will therefore incorporate dual pump systems, provision of contingency storage, and automatic fault reporting facilities. The total scheme and reuse applications will be authorised by the DH and the Environment Protection Authority (EPA).

The treatment facility will be located in the south-eastern corner of the land with buffers provided in accordance with EPA guidelines and will be designed to treat the water to a minimum of Class C as defined in the South Australian Reclaimed Water Guidelines (DH/EPA April 1999).

<u>Wastewater Treatment</u>

The type of scheme selected for the proposed development will take into account likely soil and groundwater conditions, along with ongoing operation and maintenance requirements in consultation with Kingston District Council. It is however most likely that a proprietary ‘package’ type aerated treatment plant will be selected for treatment of the collected wastewater flows. These treatment plants are in wide use throughout South Australia and allow for treatment of wastewater to specified standards, such as those required under the South Australian Reclaimed Water Guidelines DH/EPA. Maintenance and servicing of these plant facilities is readily available and supported commercially. As part of the establishment of the facility, a Waste Water Treatment Management Plan (WWTMP) will be prepared incorporating Monitoring Programme and Contingency Plan and Operations and Maintenance Manual in order to ensure the protection of the environment.

The treatment plants occupy a small area less than 5,000 square metres for this size of development, and will handle high summer peak and low mid-winter flow variations. Treatment plants can be readily extended as required to provide additional treatment capacity as the development proceeds. The treatment plant can also include additional features as required to meet changing needs such as nutrient or mineral removal or production of higher class water as necessary.

The hydraulic capacity of the treatment plant to take into account seasonal population fluctuations will be assessed in consultation with DH. The treatment plant will be designed to treat the water to a minimum of Class C as defined in the South Australian Reclaimed Water Guidelines, DH/EPA April 1999. It is proposed that reclaimed water will be reused by irrigation to one or more areas specifically designed to receive this water. The storage will be sized to accommodate flows during winter when irrigation demands are minimal with adequate allowance for consecutive 'wet' years.

The storage will be designed, constructed and located in accordance with South Australian Reclaimed Water Guidelines. Crop requirements and soil characteristics will determine the irrigation rate and frequency in order to optimise the take-up of water and nutrients by the plants to avoid adverse effects on the groundwater. Refer Section 5.2.20. Allowance for buffer distances from irrigation areas to residential development and public land will be made in accordance with the guidelines as discussed in Section 5.2.20.

Reclaimed Water Reuse - Sustainable Irrigation

The proposed irrigation area will be subject to detailed investigations to determine the hydrogeological conditions and hence the aerial requirements and application rates. Preliminary nutrient balance estimates show an ultimate requirement for crop irrigation of up to about 26 hectares. There are also areas of reserve and street landscaping available for additional irrigation. The investigations will make recommendations on irrigation practices and establish an Irrigation Management Plan (IMP) for the purposes of ensuring irrigation sustainability. The IMP will incorporate monitoring requirements for the irrigation scheme.

The details of the preliminary hydraulic balance and nutrient balance are set out in Section 5.2.20. This analysis indicates that in order to minimise effects on the environment and health risks, an area of up to 26 hectares of irrigated grazing animal feed crop is required. The reuse of the reclaimed water will be the subject of authorisations from the DH and the EPA.

3.5.23 Stormwater Management

The key components and features of the stormwater management system are:

- a system which primarily directs stormwater away from the waterways;
- grassed open swales along all roads that allow stormwater quality improvement via soakage of run-off, together with safe conveyance of extreme event flows to the stormwater retention basins. The sandy free draining soils will mean that for most rainfall events, settling of solids and filtering of stormwater will occur within the swale system, providing recharge to the groundwater system distributed around the site. The swales are designed for flows up to the 100 year ARI event;
- stormwater retention basins will allow settling of suspended solids and soakage of stormwater into the underlying sandy soils, thereby minimising discharge to the waterways. During dry weather the ponds would normally be dry, filling only during larger rainfall events. Overflow discharge to the waterway will only occur during significant extreme rainfall events. Numerous retention basins will be distributed around the development and have a dual function in that they also provide open space at strategic locations. The basins will be grassed or planted with native grasses and require maintenance similar to other reserve areas. The basins capacity is such that all run-off from a 20 millimetre rainfall event is retained and recharges the groundwater via soakage. A 20 millimetre rainfall event is equivalent to:
  - 1 year ARI, 4 hour event;
  - 5 year ARI, 1 hour event;
  - 20 year ARI, 20 minute event; and
  - 100 year ARI, 10 minute event.
- rainwater tanks will be required as part of all new residential and commercial development to capture roof run-off for on-site reuse. This will reduce off-site discharge and reduce mains water demand for high use activities such as garden watering. In these very sandy soils significant potential exists to use various on-site detention methods successfully, methods such as pebble paths, infiltration trenches and soak wells. The techniques are in accordance with the principles of Water Sensitive Urban Design (WSUD) as described in the Good Residential Design Guide. Overflow from on-site detention systems will be directed to the roadside swales;
- run-off from the commercial boat ramp and wash down areas will be diverted from the stormwater system in order to allow treatment aimed specifically at removing oil and grit and other suspended solids as discussed in **Section 5.6.11**. In addition, provision for the interception and separation of oil resulting from a spill event ensures that contamination of stormwater and hence groundwater is avoided. Run-off from areas of high risk activities will be diverted and collected separately to allow for efficient and appropriate treatment, whereas run-off from the areas of lower risk activities, once treated for oil and grit removal, will be discharged in a similar manner to the stormwater run-off from most areas; and

- the surface levels of these areas will be designed to slope away from waterway edges towards the stormwater treatment system or, where appropriate, cut off drains will be incorporated.

The design levels of internal roads are an important aspect of the stormwater management system. The open swales associated with the roads will have sufficient grade and flow capacity to carry extreme rainfall events. The roads will also be sufficiently elevated to avoid compromising access during combined extreme rainfall events, extreme high tide and extreme storm surge events, in accordance with best practice coastal management techniques and development guidelines in coastal areas. Road heights and grades will be such that run-off is directed towards the stormwater retention basins.

The Soil Erosion and Drainage Management Plan (SEDMP) as outlined in Section 5.5.1 documents strategies and procedures for effectively treating and discharging run-off during the construction phase. The SEDMP is in accordance with the Stormwater Pollution Prevention Code of Practice for Local, State and Federal Government (EPA July 1998) and a draft is provided in the Site Construction Management Plan contained in Appendix 8.

Issues of flood prevention relating to storm surge are discussed in Sections 5.2.17 and 5.6.12, which includes waterway edge treatments and height, and road and allotment levels incorporating design measures to avoid potential seawater flooding.

Conceptual stormwater arrangements are depicted on Figure 3.15.

3.5.24 Reticulated Power

A three phase power supply will be established to significantly enhance the service to the settlement area. The existing supply is an overhead, single phase, single wire earth return which is unreliable and inhibits further development of enterprises at the settlement. Generally the area and the region are poorly served and alternative supply is a practical and worthwhile proposition.

The power supply system will be modular to allow progressive growth. Further, alternative power sources are being researched incorporating renewable energy options. A small wind turbine system with a capacity to match the demand, coupled with buffer power supplied by conventional generators is being investigated. See Section 5.7. The reticulation of power throughout the development will be underground thereby ensuring the streetscape will not be cluttered with wires and stobie poles. The main generation plant will be located in the south-eastern infrastructure area along with other service plant.

Gas

Investigations are being made into the provision of reticulated gas throughout the development using bulk tanker supplies. The storage will be accommodated in the south-eastern infrastructure area along with other service plant.

CAPE JAFFA ROAD
LIME STONE COAST ROAD
ROTHALLS ROAD
KING DRIVE
CARAVAN PARK
LACEPEDE BAY

3.5.25 Telecommunications

It is proposed to extend the existing telecommunications network operating at Cape Jaffa. The advent and ready availability of the mobile telephone has significantly enhanced communications throughout the country, however it is also desirable to seek from the private sector service providers services to equal or better those available in the main settlement areas of the region. To this end, investigations into the provision of reliable internet access and telecommunications facilities are being undertaken. These investigations will also include the capability of reticulating television reception and satellite services to enhance communications and entertainment facilities to the locality.

Television reception from the transmission tower at nearby Mt Benson is good and services the area from Robe to Kingston. In order to protect the visual amenity at Cape Jaffa, it is proposed to limit TV antenna heights to within 1 metre of the highest point of the roof.

3.5.26 Land Division

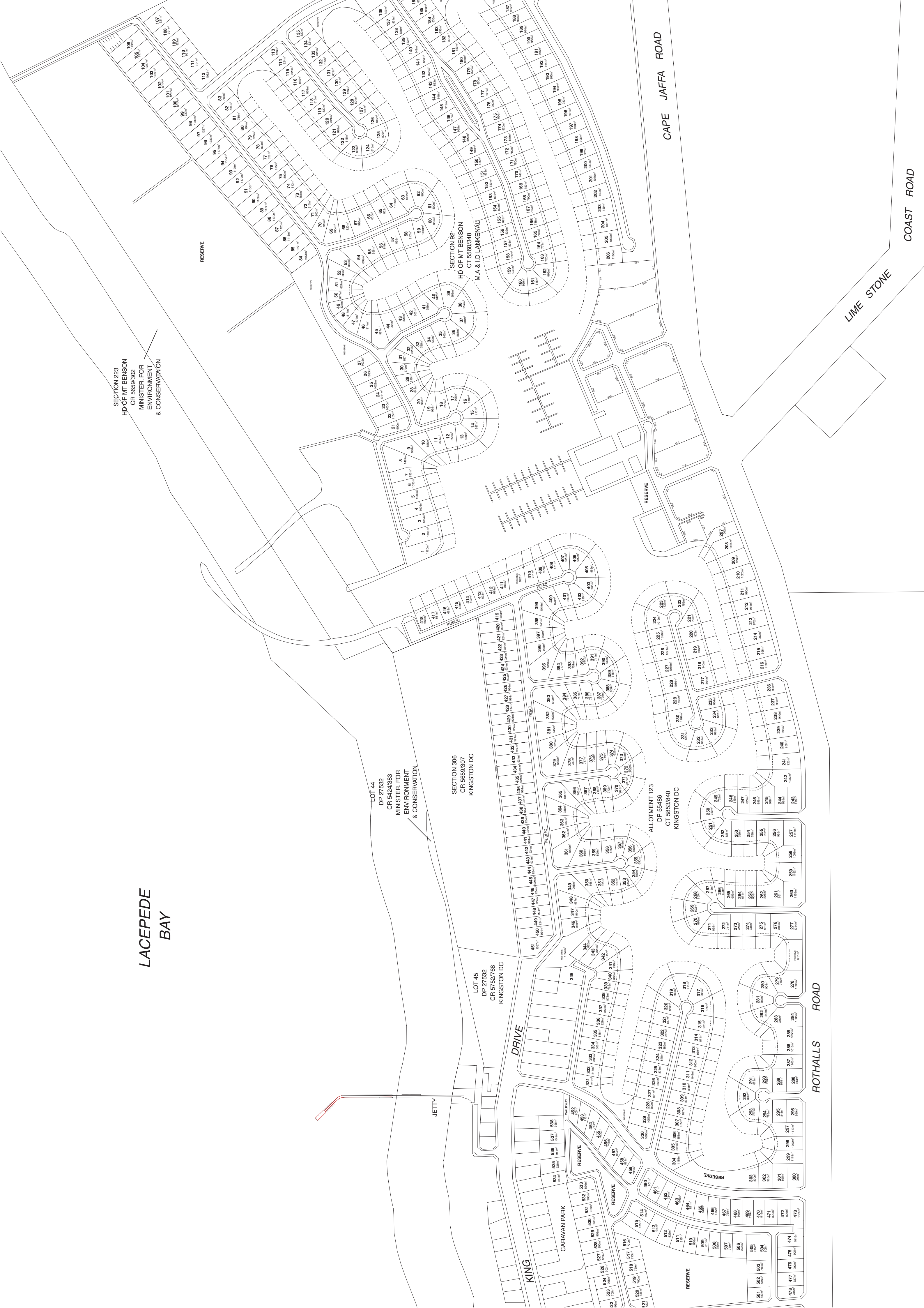
Figure 3.16 shows the proposed division of land for allotments, public spaces, commercial, service industry, service infrastructure, residential, tourist accommodation, roads and reserves. The waterways will also be divided to include the extensions to allotments for mooring of vessels as well as areas in which community titled arrangements for multiple berth facilities can be established. The remainder of the area will be defined in easements for passage rights and maintenance. There are a total of about 560 residential allotments together with about twelve retail/commercial/industrial allotments, however there is further potential for the division of these commercial allotments. The staging of the development is set out in **Section 3.7**.

It is noteworthy that a large area of vegetated foredune and beach, in excess of 14 hectares, is to be set aside as reserve for community ownership and to accommodate formal public access to the beach. Refer **Sections 5.2.15** and **5.2.16**. There are an additional 17 reserve areas totalling approximately 7.5 hectares of open space, which create and provide important linkages and/or visual connections throughout the scheme. The creation of the waterways also provides a significant area of open space totalling approximately 40 hectares. **Figure 3.16** also confirms the ability to integrate with the existing settlement of Cape Jaffa, and provide significant improvement and enhancement to the existing range of services and facilities.

As a consequence of the proposed development, various road realignments and partial closures will need to be undertaken. The portion of Cape Jaffa Road from its junction with Rothalls Road and Limestone Coast Road extending out to sea will, in its majority, be closed with a small portion remaining as the principal entry to the central activities area of the marina and a portion at the coastal extremity. The easternmost extent of King Drive will be realigned in a southward direction to accommodate a buffer walkway between the coastal dune area and residential allotments.

3.5.27 Design Guidelines

The development will be guided by a set of design parameters and principles which can be echoed in the Development Plan to protect the desired style and character of the settlement and to enhance the opportunities for energy efficient, solar access, water harvesting, setbacks, heights, other design parameters and general character. An encumbrance or management agreement on all titles is proposed to be applied requiring all development proposals to be approved by the proponent. This encumbrance will incorporate the Design Guidelines and a description of responsibilities.


LACEPEDE BAY
CAPE JAFFA ROAD
LIME STONE COAST ROAD
ROTHALLS ROAD
KING DRIVE
PUBLIC ROAD
JETTY
CARAVAN PARK
RESERVE
SECTION 92
HD OF MT BENSON
CT 5560/348
M.A & I D LANKENAU
SECTION 223
HD OF MT BENSON
CR 5659/302
MINISTER, FOR
ENVIRONMENT
& CONSERVATAION
LOT 44
DP 27532
CR 5424/383
MINISTER, FOR
ENVIRONMENT
& CONSERVATION
SECTION 306
CR 5659/307
KINGSTON DC
ALLOTMENT 123
DP 55486
CT 5853/840
KINGSTON DC
LOT 45
DP 27532
CR 5752/768
KINGSTON DC

3.6 Visual Amenity

Visual amenity of the development is a function of the relationship between the existing and future land form and built form on the land and out to sea. These will be affected by practical policy requirements such as flood protection from sea level rise as well as the type of construction and materials used for finishes such as the marina edge treatments.

The land is undulating and needs to be elevated in part to comply with the protection measures set out for sea level rise over the next 100 years. The analysis of these risk management requirements establishes a minimum building platform level of 2.5 mAHD and a minimum floor level of 2.75 mAHD. For comparison the Development Plan specifies 2.45 mAHD and 2.65 mAHD respectively.

The land rises generally from the coast southward and eastward. The foredunes are between 3.0 and 4.5 mAHD with vegetation to approximately 7.5 mAHD and the roads to the south 3.0 to 5.0 mAHD. The road levels within the existing settlement also range between about 3.0 to 5.0 mAHD. At the eastern end of the settlement several dwellings are set on elevated land above the road and at the western end several dwellings to the north of King Drive are established on the foredune above the road level.

The minimum building platform height for allotments adjacent to the waterways will be at least 2.5 mAHD at the lowest point. This results in the land being elevated 0.45 metres above the top of the protective wall height set at 2.05 mAHD, 4.0 metres from the waterway edge wall. Development will be required to be setback a minimum of 8.0 metres from the waters edge. As a consequence, the slope is shallow, averaging about 10 percent. This setback area is to be free of permanent structures such as outbuildings and the like in order to keep this area generally free and open apart from landscaping and open form fencing on the boundary. The open style fencing will extend from the 8.0 metre setback to the waters edge. This fencing will also be removable from the waterway edge wall for a distance of 4.0 metres to allow for waterway wall maintenance. This arrangement will ensure an open feel through the waterways, a proper relationship with the water and berth facilities and will avoid a canyon effect or the feeling of enclosure in or along the waterways. Examples of the form and presentation of the waterways and facilities is shown in **Figures 3.17, 3.18, 3.19, 3.20** and **3.21**.

Adjacent the existing dunes and elsewhere, where building platforms do not abut a waterway, site levels will be raised. Generally, this will create a flowing or sloping relationship from one site type to the next and down to the water, particularly as viewed from the majority of the public roads and public places around the waterway. Any dry allotment, that is where no direct waterfront exists, levels will be raised to ensure proper stormwater management, to gain benefit from views and vistas, and to create a varied and interesting urban form. **Figure 3.22** shows the flowing nature of the landform from the waterway to allotments to the dune and beach.

Figure 3.17: Main Basin Looking South

Figure 3.18: Waterway View Looking West

Figure 3.19: Beach Reserve View into Main Basin

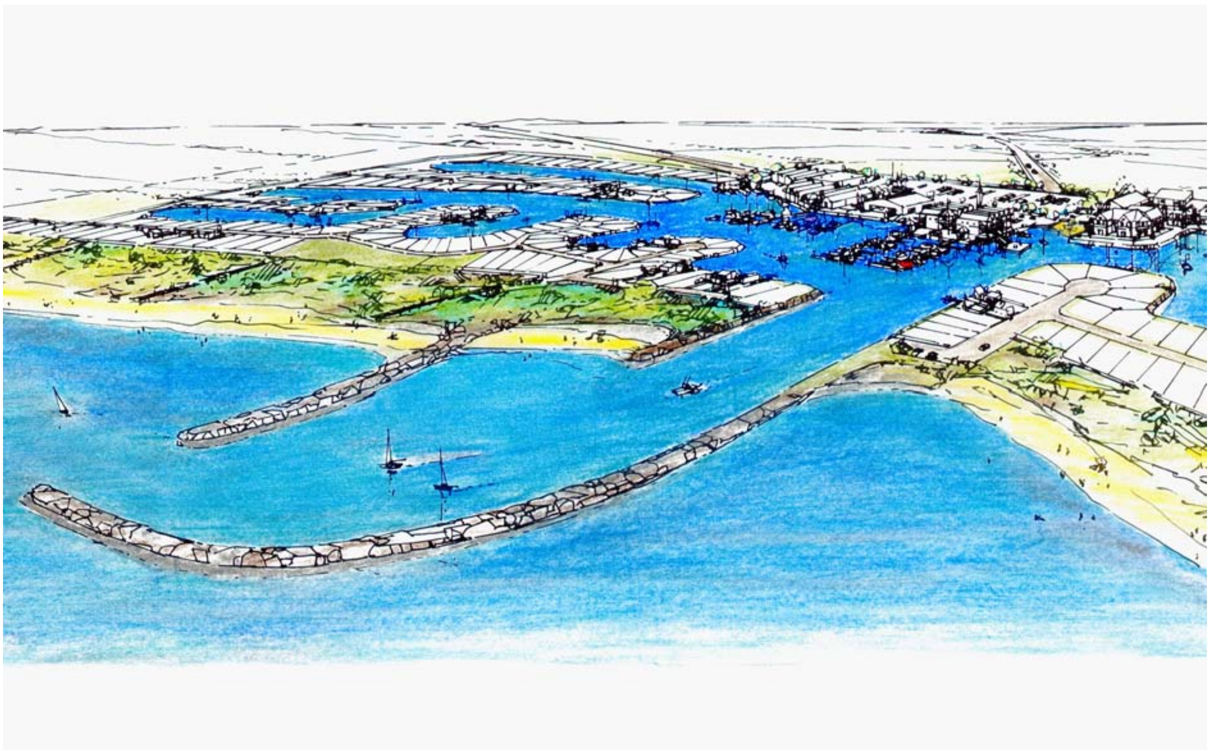


Figure 3.20: Aerial View Looking South-East

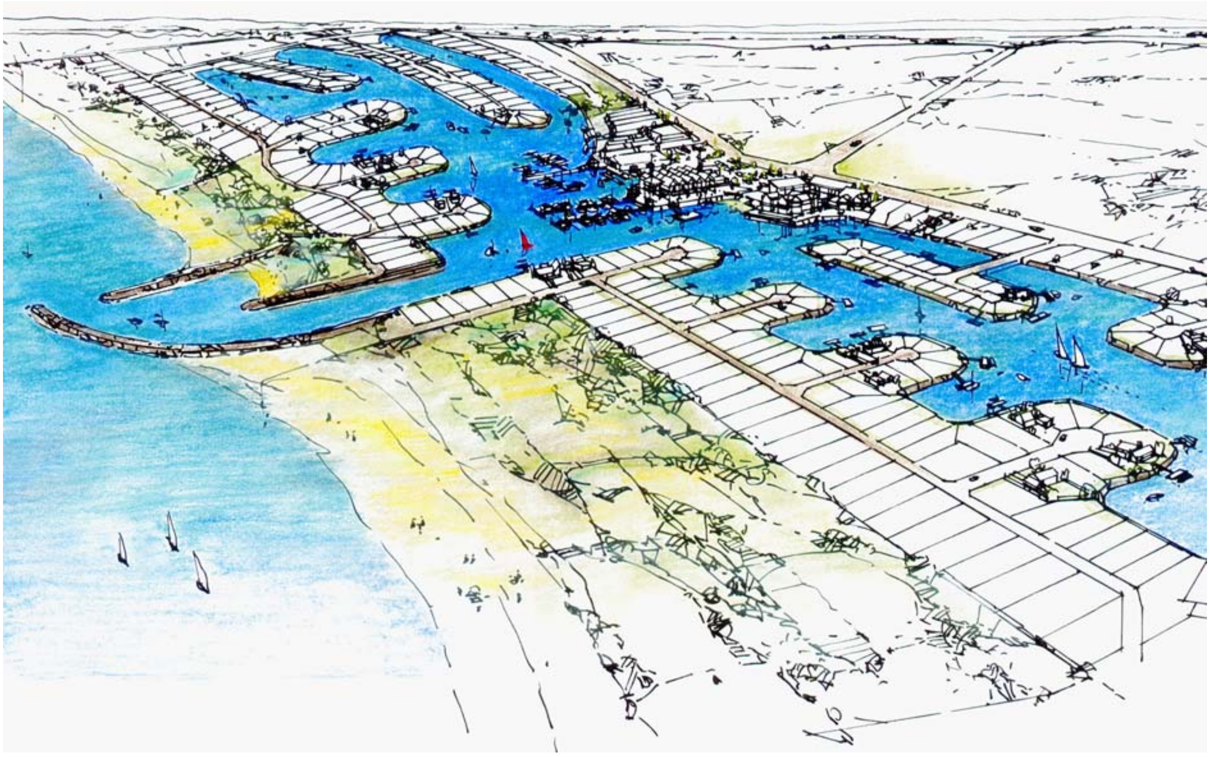
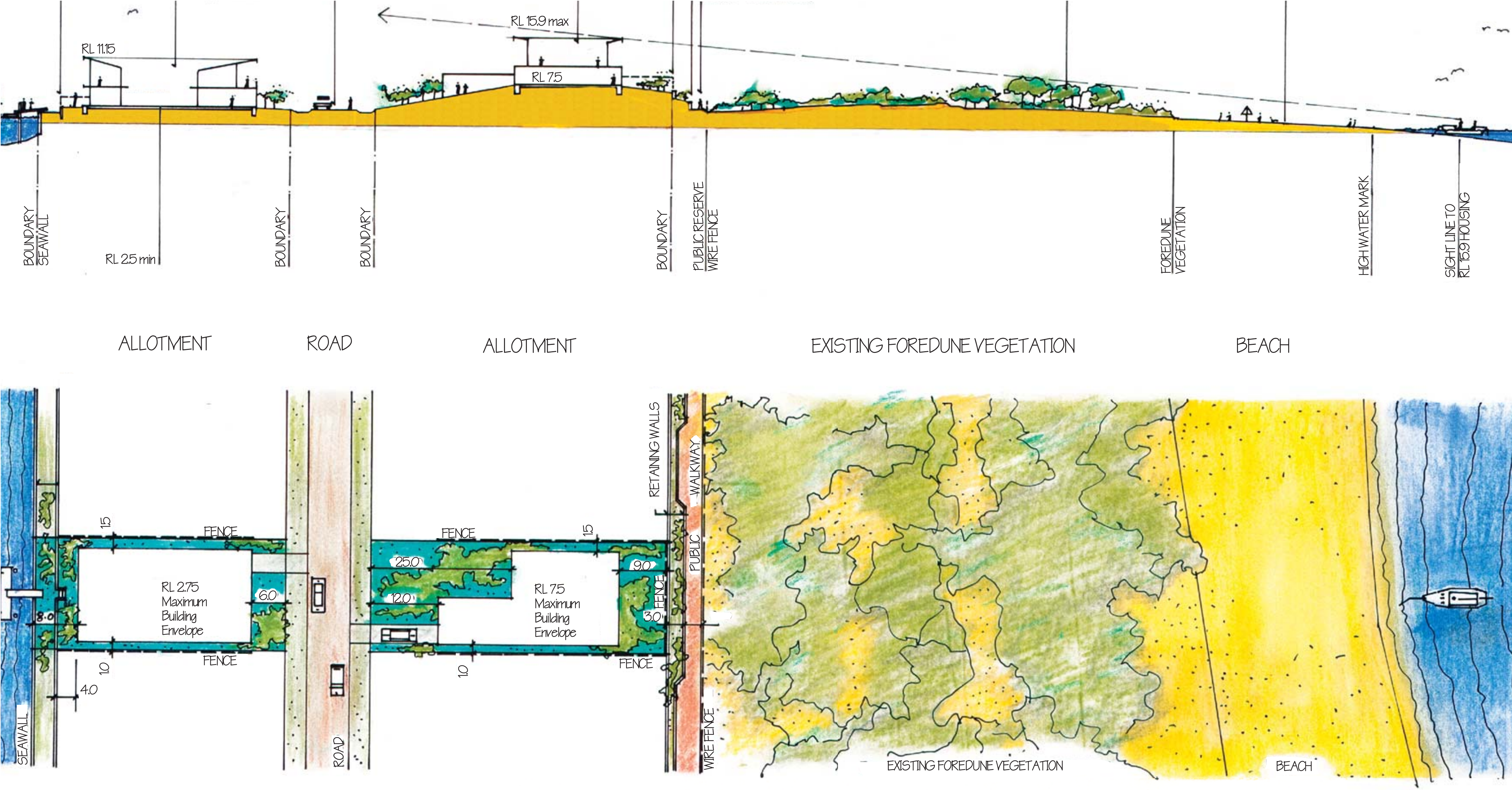


Figure 3.21: Aerial View Looking East

There is also a critical separation required between the site and the foredunes as part of the mechanism to buffer the coastal dune vegetation from the domestic activities of the land beyond. This relationship and the buffer created are shown in **Figure 3.23**.

The walkway will be fenced on the dune side and a pathway constructed using local limestone material to produce a solid impervious surface. On the landward side, a wall of about 1.0 metre in height constructed of limestone blocks using local materials will retain a planting bed 3.0 metres wide where another low retaining wall will retain and define the front of the private land. This planting area will be landscaped using groundcovers and native grasses. This will create a separation between the private lots and the vegetated dune area as well as a valuable recreation space and link.

The maximum height of built form throughout the residential areas is set at 15.9 mAHD based on maximum design building platform height of 7.5 mAHD adjacent to the coastal reserves. In all other circumstances in the residential area it is proposed to create a top of roof design level of 8.4 metres above design ground level, which varies over the site. For the commercial industrial, retail and tourist accommodation areas greater flexibility is anticipated. In general, the majority of the commercial and industrial activities will be designed to fit the needs of the fishing fleet and aquaculture needs. Therefore, the ability to service a vessel indoors and to deliver the vessel by travel lift or similar device will require buildings with clear openings of about 10 metres with roof space above. This is not significant when compared with a normal two storey dwelling that has an overall height of about 9.0 metres. These areas will not be prominent from Cape Jaffa Road as there will be buffer landscaped corridors. This can be compared with the open nature of the existing Industry Zone, which makes no provision for buffers.


RL 11.15
RL 15.9 max
RL 7.5
BOUNDARY
SEAWALL
RL 2.5 min
BOUNDARY
BOUNDARY
BOUNDARY
PUBLIC RESERVE
WIRE FENCE
FOREDUNE
VEGETATION
HIGH WATER MARK
SIGHT LINE TO
RL 15.9 HOUSING
ALLOTMENT
ROAD
ALLOTMENT
EXISTING FOREDUNE VEGETATION
BEACH
RETAINING WALLS
WALKWAY
PUBLIC
FENCE
FENCE
FENCE
FENCE
FENCE
RL 2.75
Maximum
Building
Envelope
RL 7.5
Maximum
Building
Envelope
25.0
12.0
9.0
3.0
6.0
8.0
15
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1.0
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SEAWALL
ROAD
WIRE FENCE
EXISTING FOREDUNE VEGETATION
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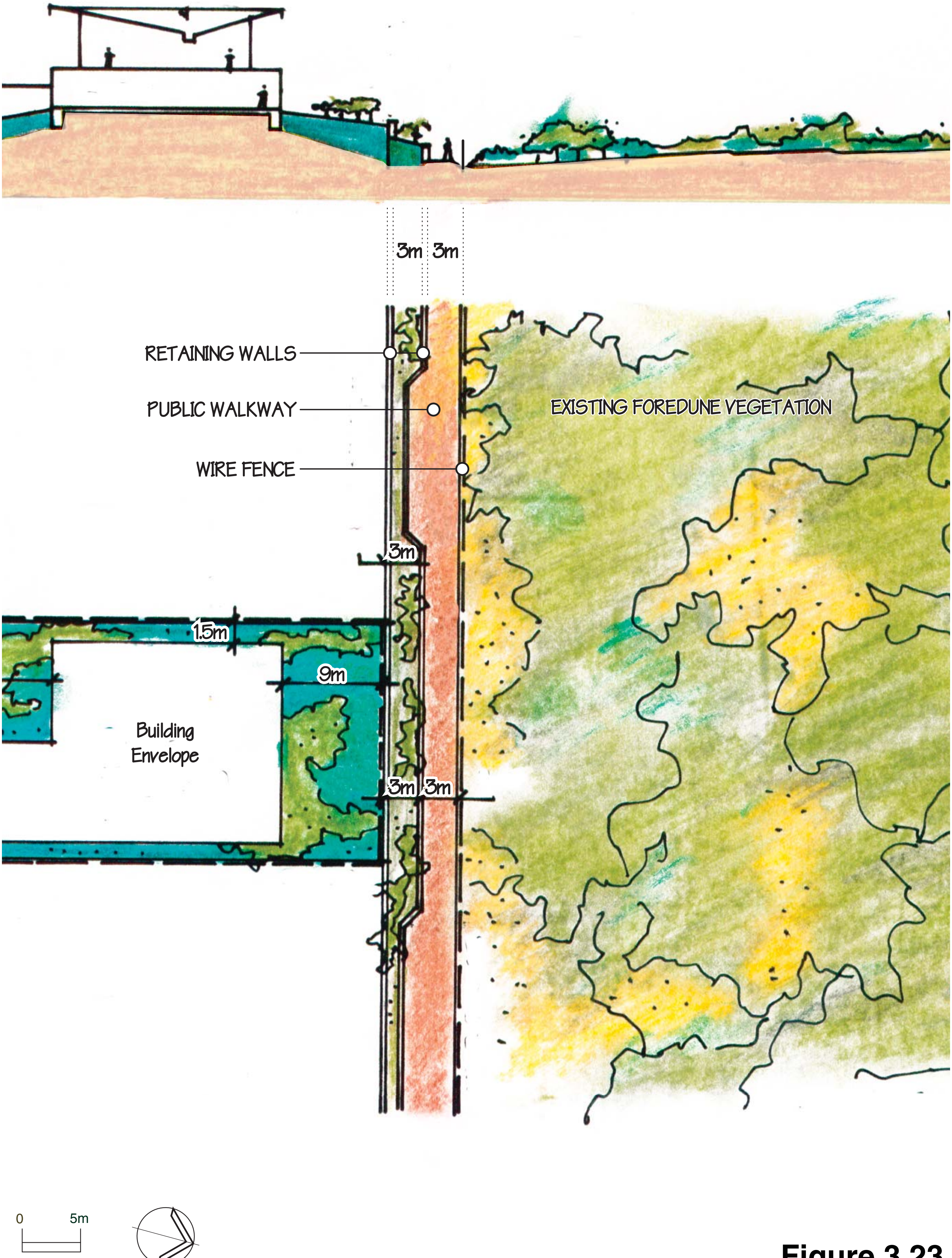

MasterPlan Town & Country Planners

Jim Lelliott DESIGN

Figure 3.23

COASTAL RESERVE WALKWAY

CAPE JAFFA ANCHORAGE

The whole of the land extending behind the Cape Jaffa settlement and eastward to the north-south extension of Cape Jaffa Road is currently zoned for residential, local centre and industrial development as depicted on Map King/29 (**Appendix 9**). This clearly indicates that the significant western area of the subject land is expected to be developed and that a significant part of this allows for commercial, storage and industrial development near the coast. The area not currently zoned is mainly Primary Production Zone. The proposal will alter the presentation and entry into Cape Jaffa. To reduce the overall effect of the enlarged development area, whilst establishing a sense of arrival and place, significant landscaping is proposed along the road reserve together with mounding where appropriate. There will however also be locations where views will be encouraged to create focal points and vistas into the development. This is particularly the case at the main public entry at the junction of Limestone Coast Road with Cape Jaffa Road.

It is proposed to create an avenue vista looking north through a reserve and into the main basin and the channel beyond. Refer **Figure 3.19**. The central facilities area however, needs to be able to accommodate higher buildings or structures to efficiently utilise the land set aside for public, tourist, visitor and related functions. Higher structures may also be used to create this centre as a focus and may include elevated viewing platforms. This type of facility may be necessary should a yacht club or sea rescue facility be established at Cape Jaffa. This view will include an activity frontage on the right where the public can walk and recreate, a beach in the front part of the view, and the main basin and channel area beyond, with the waterways and residential allotments to the left. This will be a vibrant active space and viewpoint during the summer months particularly weekends, whilst in the winter time it is expected to be a quiet space.

The breakwaters will be developed to a height of 2.5 mAHD, which is the same height as the main pedestrian platform level on the Cape Jaffa jetty. For comparison, the southern breakwater at Wallaroo reaches a height of 5.5 mAHD, significantly higher than that proposed. Refer to **Sections 3.5.2, 5.2.11** and **5.3.2** for further information.

Overall the proposal will result in change to the visual appearance of the locality. Development is anticipated by the Development Plan and supported by various strategic plans. This scheme promotes the orderly programmed approach to that development to accommodate identified needs. As needs are satisfied visual change is inevitable. Importantly, the visual effect of the development will be one which reflects the origins of Cape Jaffa as a fishing port and the vibrancy and attractiveness of a seaside village.

It is not anticipated that high density multilevel development can be justified nor is it desirable, and therefore the development will be limited to heights appropriate to their immediate locality. This will create visual interest and attraction and creates the sense of arrival.

3.7 Staging Construction and Commissioning Timeframes

An indicative Staging Plan, **Figure 3.24** shows how the development may be progressed over approximately ten years. Also shown in **Figure 3.24** is a schedule identifying the range of allotment types in each stage.

RESIDENTIAL

	Land Allotments	Waterfront Allotments	
Stage 1	7	29	36
Stage 2	16	41	57

The timing of each stage is outlined below in **Table 3.1**. **Table 3.2** outlines the various construction components and their expected staging.

Table 3.1: Staging Timeframes

Stage	Expected Completion
Stage 1	2006
Stage 2	2006
Stage 3	2008
Stage 4	20010
Stage 5	2012
Stage 6	2014
Stage 7	2016

Table 3.2: Construction and Commissioning Timeframes

Construction Activity	Construction Stage
Breakwater construction	1
Dredging of sea channel	1
Sand bypassing infrastructure for Adaptive Coastal Management	1
Excavation and dredging in the area between the breakwaters	1
Excavation of the channel from the main basin to the sea	1
Excavation of the main basin	1, 3
Excavation of the waterways	2, 3, 4, 5, 6
Dewatering associated with excavation of main basin and waterways	All Stages
Edge treatment to the waterways: limestone block wall, revetment and pathways	All Stages
Controlled filling of land in commercial, industrial and residential areas, including roads and public spaces	All Stages
Filling of mounds including noise mounds and amenity screening mounds	All Stages
Commercial fishing/aquaculture wharf	1, 3
Fish processors and aquaculture area	1, 3
Commercial berths: piling, floating berths and service distribution	1, 2
Solid waste handling and marine toilet pump-out facilities	1, 3
Boat refuelling facilities	1, 3
Travel lift bay and travel lift	1
Boat wash down bay and associated water handling facilities	1
Boat hardstand and maintenance area	1, 3
Public boat ramp, rigging/de-rigging areas, car park and associated facilities	1
Public berths: piling, floating berths and service distribution	1, 2, 3
Retail and public facilities	1
Mooring facilities associated with residential waterfront allotments: piling and floating berths	All Stages
Construction of roads	All Stages

Construction Activity	Construction Stage
Installation of services distribution infrastructure including sewer, water, stormwater swales, electrical and communications	All Stages
Services head works including wastewater treatment plant, water supply treatment facilities, stormwater retention basins and electrical power head works	1
Construction of beach access tracks, public walkways and public car parks	1, 2, 3, 4, 5
Construction and landscaping of public parks and open space areas	All Stages
Installation of marine navigation lights	1
Environmental monitoring infrastructure	1, 2, 3

3.8 Construction and Operation Management

3.8.1 Management Systems

An Integrated Management System (IMS) will be developed in accordance with the methodology and process set out in AS/NZS ISO 14001:1996, which aims to ensure the appropriate management of all aspects of activities in a coordinated and integrated manner. The process encapsulates setting targets, outcomes and objectives, identifying resources undertaking actions or works, ongoing monitoring of works and outcomes, review of actions and outcomes, and improvements flowing from the monitoring and review.

The IMS incorporates the Environmental Management System (EMS), the Quality Management System (QMS) and the Occupational Health and Safety Management System (OHSMS). The EMS is described in more detail below.

The key benefits of the EMS are:

- the system is comprehensive as it brings together all environmental issues derived from environmental risk assessment, legislative requirements, license conditions, industry codes of practice, guidelines and standards requirements;
- the system is integrated with the other management systems for the site in a uniform format and linking into the Quality Management System (QMS) for procedures and document control. Environmental management therefore becomes part of the everyday, ongoing management culture;
- the baseline environmental audits enable the creation of site specific action plans;
- the risk assessments, license conditions, standards, contractual obligations and general environmental considerations form individual action plans using the base line data and together they form the specific components of the Environmental Management Plan, for example Stormwater Management Plan, Vegetation Management Plan, Stormwater Erosion Drainage Management Plan, Hazard Management Plan and the like;
- the format of the EMP's and the comprehensive coverage of environmental considerations ensures greater identification and tracking of compliance to assist regulatory authorities and the production of data, reports and returns; and

- effective reporting on environmental matters is defined in terms of content, frequency and format.

The EMS uses established strategies in order to achieve continuous improvement in the effectiveness of the environmental management. These include:

- the use of risk assessment processes to identify and evaluate environmental issues, thus providing the impetus for developing the appropriate systems for ongoing management and mitigation of the issues;
- the development of policies to clearly communicate the environmental commitment and expectations of Kingston District Council and CJDC. Clear and concise statements allow employees, contractors, suppliers, customers and the broader community to fully understand the environmental objectives, commitment and expectations;
- the development of procedures that define the actions, roles, responsibilities, timing, monitoring, reporting and corrective action requirements for each of the issues specific to the project;
- mandatory site induction training for all personnel, in order to clearly communicate commitments, expectations, policies, procedures, roles and responsibilities. This is further enhanced by periodic training to focus on issues at hand, general awareness and duty of care; and
- monitoring, reporting and auditing requirements, including the use of independent experts to audit, assess and report on status and make recommendations for future improvement.

The EMS defines the responsibilities of management, key personnel including the designated Environmental Officer, and staff. Inherent in the development of the EMS is the definition of key roles and responsibilities, implementation of links to other management requirements, and reporting and monitoring requirements. Staff familiarity with environmental requirements is built into the system through environmental awareness training.

Expertise will be made available for specialist environmental requirements such as environmental audits, progressive rehabilitation, and revegetation programs where these lie outside the skills matrix of on-site employees.

These systems are established for the construction and operational phases of the development and are amended according to requirements of the project.

3.8.2 Management Arrangements

The development and operation of the Cape Jaffa Anchorage is the joint responsibility of the Kingston District Council and CJDC. The management of the Cape Jaffa Anchorage Marina is to be split into the “Infrastructure Development Stage” and the “Operational Stage”. Responsibility for the construction stage lies predominantly with CJDC, while responsibility for the operational stage will be shared, as determined by agreement between the Kingston District Council and CJDC. Refer Section 5.4.5.

The "Infrastructure Development" means together, the land division infrastructure and the marine infrastructure known as "The Cape Jaffa Anchorage Development". Conceptually, infrastructure that is to become the responsibility of the Council will do so after completion and the agreed maintenance period has lapsed. The maintenance period is extensive, up to eight years for some parts of the infrastructure. The agreement between Kingston District Council and CJDC defines the roles and responsibilities for various aspects of the project and is described in Sections 5.4.5, 5.5.8 and 5.5.16.

Kingston District Council and CJDC will establish a suitable structure for the construction and operation of the project. The structure will require a number of key personnel as shown in Figure 3.25, and their proposed roles and responsibilities are described below.

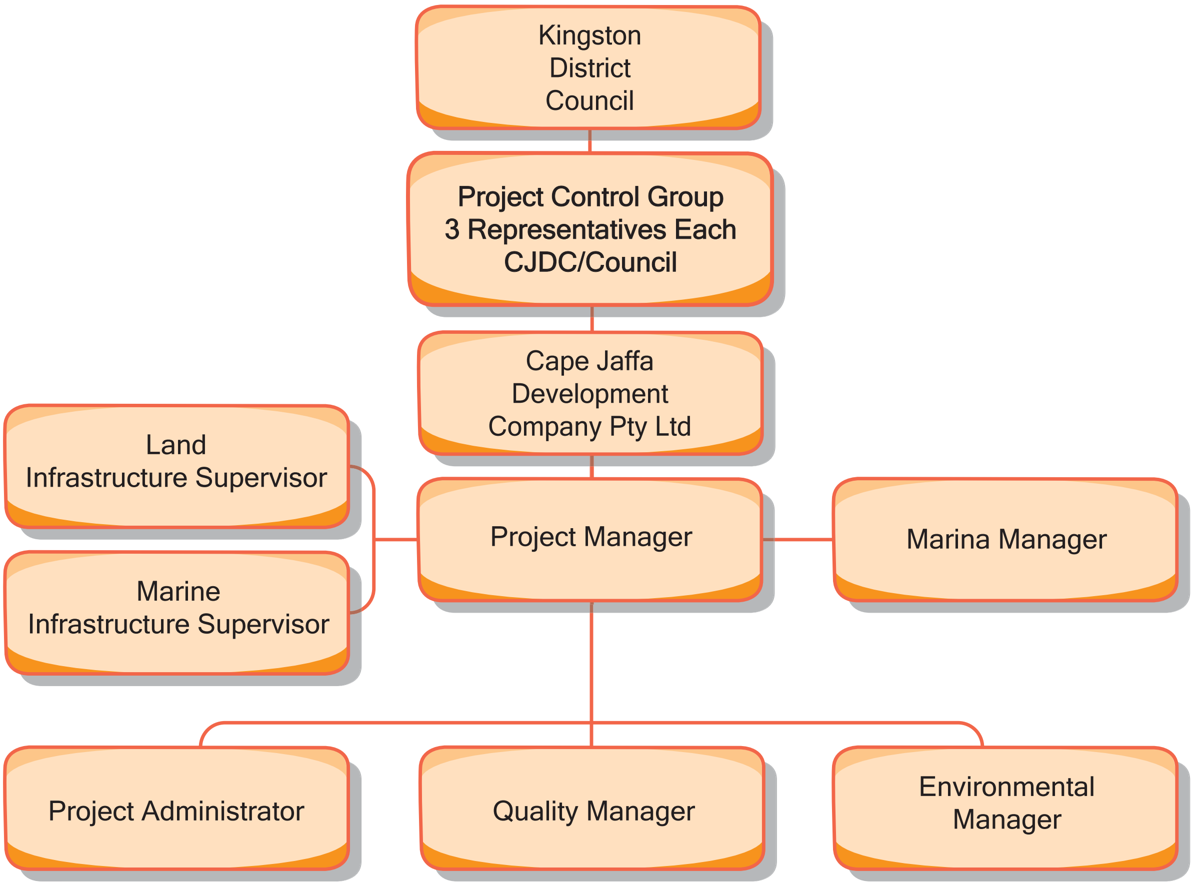

Figure 3.25: Management Structure

Project Manager

A suitably qualified, experienced Project Manager who will be responsible to the Project Control Group and the board of CJDC for all aspects of the construction stage of the project. The scope of the job will encompass all aspects of managing the construction phase of the project.

In carrying out his/her duties, the Project Manager will be assisted by the key personnel under his/her control. The Project Manager will in addition have as a resource extensive experience and know-how of the Directors of CJDC and their network of associated contacts and companies.

The Project Manager will be responsible for finalising the development of the Integrated Management Plan, with support from the Project Control Group, CJDC management, consultants and staff. He/she will be responsible for all aspects of the infrastructure development, commissioning and operation, including the following:

- the day-to-day management of the project works;
- liaison with relevant Government agencies;
- liaison with the Kingston District Council;
- liaison with the local community;
- environmental requirements of the project;
- providing relevant information, data and progress reports to the Project Control Group on behalf of CJDC;
- cost control;
- statutory requirements; and
- quality and OH&S system compliance.

Project Administrator

Reporting to the Project Manager. The Project Administrator's responsibilities will be to ensure that correct processes, documentation, reporting and systems are in place and maintained for the efficient and timely management of the project. Furthermore, the project administrator will ensure that all paperwork is processed in a timely manner.

Environmental Manager

Reporting to the Project Manager and whose role will include the following duties and responsibilities:

- assist in the development and implementation of the Environmental Management Plan (EMP);
- oversee the EMP procedures, including assisting in the development, implementation and review of the procedures;
- bring to the attention of the Project Manager, Directors of CJDC, and/or the Project Control Group any potential environmental risks or issues;
- act as the reporting point for all site staff for environmental incidents, events, accidents and occurrences on-site;

- act as the contact point for external organisations, authorities and the community in relation to the environmental matters of the project;
- maintain documentation and records of all matters of an environmental nature on-site;
- investigate and report on all environmental issues and incidents on-site;
- undertake, or ensure the effective maintenance of all environmental monitoring programs for the project in accordance with legislative and contractual requirements;
- prepare regular reports, plans and returns to management and statutory authorities in accordance with contractual, licence and legislative requirements and the EMP; and
- assist in the regular audit of environmental performance of the operation, and assist with any investigation of environmental incidents on-site.

Quality Manager

The Quality Manager is responsible to the Project Manager to ensure that the project quality system is implemented and complied with. This position will also ensure that the employees and contractors are correctly inducted to the site including the EMP induction. The responsibility for OH&S will lie with the Quality Manager.

Land Infrastructure Supervisor

Reporting to the Project Manager, responsible for the day-to-day running of the land infrastructure works.

Marine Infrastructure Supervisor

Reporting to the Project Manager, responsible for the day-to-day running of the marine infrastructure works.

Operational Structure

Management of the operational stage of the project is a staged transfer of infrastructure to Kingston District Council. Maintenance and handover periods are:

- CJDC will keep the marine infrastructure and waterways clean and navigable for eight years after completion;
- CJDC will maintain and repair each stage of the marine infrastructure and waterways for four years after completion; and
- CJDC will maintain and repair the land division infrastructure for two years after completion.

To ensure that there is consistency during and after the staged transfer of responsibility, an Operational Management Structure will ensure regular reporting to the Project Control Group and ultimately, the Operation Management Structure will require direct reporting to the Kingston District Council.

A Marina Manager will be employed by the proponent and will be responsible for ongoing management and maintenance including daily inspections and checks, floating pontoon and associated services maintenance, licence conditions compliance, cleaning, on water activity surveillance, and reporting and action protocols.

3.9 Easement and Infrastructure Requirements and Availability

Water

The Department of Water, Land and Biodiversity Conservation (DWLBC) have advised in correspondence dated 29 December 2003 (Appendix 7) that:

> *"the Minister for Environment and Conservation, John Hill, has approved a proposal that an authorisation under section 11 of the Water Resources Act 1997 be made to allow the water to be taken on a temporary basis for the purposes of public water supply. Provision can then be made in the revised water allocation plan to allow a water allocation and licence be granted for this use, around mid 2006 when the plan will be revised."*

The water supply infrastructure is to be located on the subject land at the south easternmost corner. Refer **Figure 3.6**. Water drawn from the deep confined aquifer will be treated to meet appropriate requirements including disinfection and clarification, and will be reticulated across the land and along the existing roadways where appropriate. No additional easements or infrastructure other than that being established by the proponent is required.

Effluent Collection and Treatment

Sewage is to be collected and delivered to the treatment plant near the south easternmost corner of the land. The sewer will be developed within road easements in the main in a manner typical of urban development areas. Where appropriate or necessary to achieve appropriate levels and grades, easements may be taken through private land. Any such requirement will be identified in the land division design process and therefore no unforseen requirements will arise. No additional requirements for easements outside the land will be necessary to serve the needs for effluent collection and treatment as all of these activities will occur on the subject land or on public roads. Where existing development connects to the system later, all connections can be provided without the need for easements over existing private land.

Stormwater

Stormwater will be accommodated primarily on individual allotments, roadways and reserves in accordance with normal subdivision practice without the need for any intrusion into existing private land.

Power

Various options are available for the provision of power to the settlement. Given the location of existing infrastructure 3.6 kilometres to the east of the site and the ability to extend this along the road reserve, there is no need for any additional easement for power should this be the preferred option.

An alternative is the establishment of a private system where power is generated on-site and/or alternate power sources such as wind generation is incorporated into the network. These systems also allow for connection and hence supply options back into the grid. Should a wind generation system be incorporated, easements or other arrangements for the use of land not in the control of the proponent may be necessary. These easement requirements are not a prerequisite to the development proposal and are the subject of more extensive investigations.

Breakwaters and Channel

The breakwaters and dredged channel extend out into Crown Land. It is proposed that the local government boundary be reviewed with a view to extending the boundary to include the breakwaters. The dredged channel would remain in Crown ownership with the necessary authorisation for the channel and its ongoing maintenance.

Revetment Wall

A 4.0 metre easement will be created along the top of the waterway edge to enable access for service vehicles. This easement will follow the front of all waterfront allotments and all public pathways abutting the water. This will enable regular maintenance and repairs to the limestone rock wall, the rock rip rap at the toe of the wall and the channel floor beyond. Further, access for the construction and some maintenance of the floating marina hardware may be necessary from the shore.

Waterways and Main Basin

The waterways will accommodate floating marina berths, navigation channels for the safe passage of vessels, areas for the temporary loading, unloading and servicing of vessels, and the launching and retrieval of vessels and equipment. These include the public boat ramp as well as facilities for the commercial operations. Some service infrastructure may be laid beneath the waterways and main basin, and their location will be survey recorded for easement purposes. These services will be laid in a manner that will ensure ready access and replacement.

Public Waterfront

The public waterfront areas will be established as public walkways or where appropriate shared zones with the commercial operations. These will be identified in the detailed plans of division and established accordingly as reserves or with easements for passage. These areas are generally depicted on **Figure 3.12**.

4.0 EXISTING ENVIRONMENT

4.1 Introduction

This section describes the known existing physical environment in the Cape Jaffa area. The following information has been derived from various investigations by consultants with experience in the relevant field of expertise in order to determine the local physical environment in detail and to fill any relevant 'data gaps' that exist in the available literature.

In addition, consultation has been sought with a number of government agencies including Department of Water Land and Biodiversity Conservation (DWLBC), Department of Environment and Heritage (DEH), Planning SA (PSA), South East Catchment Water Management Board (SECWMB) and Coastal Management Branch (CPB).

4.2 Setting

4.2.1 Physical Setting

The physical setting comprises the natural and manmade environments. Cape Jaffa is the cape that forms the southern end of Lacepede Bay. The site of the proposed development is located adjacent to the north-facing beach east of Cape Jaffa and is east and south of the existing Cape Jaffa settlement on the southernmost beach of Lacepede Bay. The photograph depicts an aerial view from the north-east looking towards the Cape Jaffa settlement.

Behind the sandy beach there is a low, vegetated sand dune, except that part of the locality has been developed for fish receival and processing, public areas and a few dwellings, thus forming the front of the Cape Jaffa settlement. In these urbanised areas, the vegetation and dunes are no longer a feature. Seaward of the area developed for fish processing is the Cape Jaffa jetty and the extensive mooring area for the fishing fleet. Closer to the jetty the tenders to those fishing vessels are tethered. These mooring and jetty areas are within a Rock Lobster Sanctuary that extends in a southerly direction around the point at Cape Jaffa as shown on **Figure 3.3**.

The settlement of Cape Jaffa extends to the south of the beach and comprises a range of uses including:

- fish receival and associated facilities;

- a fuel storage area;
- a waste incinerator;
- waste oil storage area;
- commercial/industrial premises associated with the fishing industry activities;
- coastal reserve;
- a range of dwellings varying in style, comprising single and two storey development, together with a range of outbuildings and a number with storage areas for vessels and fishing equipment;
- a tourist park comprising camping areas, caravan sites and cabins, a shop and residence, storage areas, and fuel facilities; and
- vacant land.

Behind the settlement the land is undulating, cleared grazing land back to Rothalls Road. To the south of Rothalls Road the land begins to rise into the limestone layered hills of the Mt Benson wine region, which is used primarily for grazing and cropping purposes, and there is an almond orchard further south. Immediately to the west and south-west of the Cape Jaffa settlement is an area accommodating a dwelling surrounded by native vegetation that extends west to the Cape proper and south along the coastline. The area beyond this private land along the coast forms the Bernouilli Conservation Reserve, which extends southward a distance of about 7.0 kilometres.

Along the foredune, ie the sand ridge adjacent to the beach, to the east of the settlement is a band of coastal vegetation fronting a sandy beach, portions of which have been cleared for reserve, access and parking purposes. To the front of the subject land there are two significant vehicular accessways to the beach. The western most beach accessway extends along the existing Cape Jaffa Road public road reserve, and the easterly accessway, which is located on the subject land, is used as the main service area for the aquaculture industry, recreational boat launching, and also beach access for pedestrians and vehicles.

4.2.2 Topography

The topography of the locality is characterised by ridges of low sandy dunes parallel to the coast and some low-lying swampy areas. The beach is a shallow sandy beach typical of Lacepede Bay. Further to the south, the topography becomes more undulating and consists of limestone ridges that rise up to approximately 30 mAHD. See **Figure 4.1** and **Figure 4.2** for the 1:250,000 and 1:50,000 topographic maps of the region.

The engineering survey for the subject land indicates that the topographic relief of the site and its immediate surrounds varies between approximately 1.5 and 5 metres Australian Height Datum (mAHD), as shown on **Figure 4.3**.

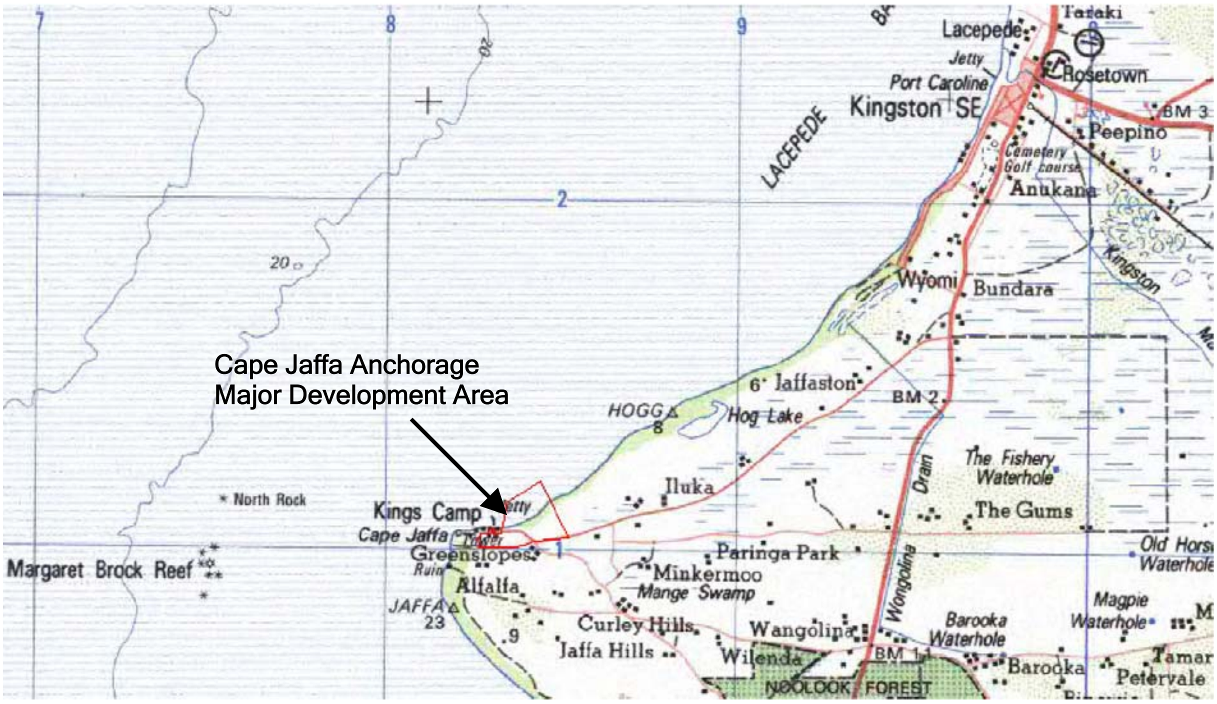

Figure 4.1: 1:250,000 Topographic Map Extract

Source: Department for Environment, Heritage and Aboriginal Affairs 1999

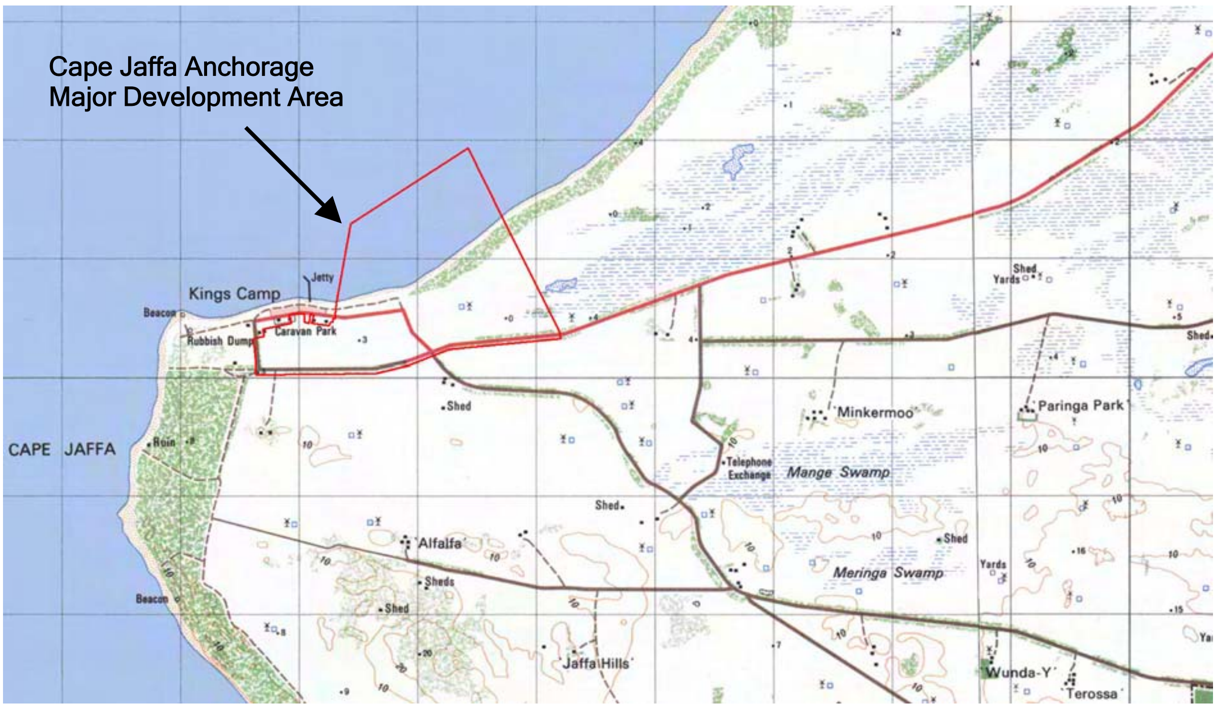

Figure 4.2: 1:50,000 Topographic Map Extract

Source: Department for Environment, Heritage and Aboriginal Affairs 1999

The locality comprises coastal land with a stable foredune of moderate relief at elevations of between 1.0 and 4.5 mAHD, which is well vegetated and 40 to 60 metres wide. The development and persistence of the foredune depends on complex interactions between waves, currents, sand supply, littoral drift, wind and vegetation. In the lee of the foredune is a flat low lying plain that, further to the east, includes swampy flats.

The Cape Jaffa foredune is mainly heavily vegetated. It is in fair condition from the eastern extent of the site to the settlement. Further west the dune has been degraded to varying degrees and removed in places by the construction of private dwellings, commercial buildings, public parks and access tracks.

The soils of the area include coastal dunes, saline swamps and shallow soils on dune limestone. All of the soils are highly calcareous, consisting almost entirely of finely divided shell fragments with some larger shell fragments. The Lacepede/ Tatiara Soil Conservation Board District Plan (DLWBC 2003) indicates that the soils are mostly well drained with a low water holding capacity and are seriously deficient in plant nutrients. The annual rainfall is about 560 millimetres (Bureau of Meteorology Jaffa Hills Automatic Weather Station).

The stable dunes support dense coastal tall scrubland vegetation with a mixed quality understorey and a large plant species list. However, Bridal Creeper (*Asparagus asparagoides*), and at the western end invasive garden escapes, are degrading the native vegetation along the coastal foredune.

Immediately adjacent to the foredune, at the back of the beach, is a 15 to 25 metre wide zone where marram grass has stabilised beach sand, allowing the establishment of sea spurge (*Euphorbia paralias*) which is an introduced plant that contributes to the stability of the dunes.

Lacepede Bay, to the north of Cape Jaffa, is a large relatively flat marine environment of near continuous seagrass meadows that generally extend to within 30 metres to 50 metres of the coast. Water depth increases very gradually from the coast. On a north-west heading from the Cape Jaffa settlement, the water depth reaches approximately 20 metres at 10 kilometres offshore, whereas in a northerly direction from Cape Jaffa the distance to 20 metres water depth is significantly greater, at approximately 16 kilometres. **Figure 4.4** shows the Marine Navigation Chart of the Cape Jaffa region.

West and south of Cape Jaffa the marine environment consists of limestone reefs and water depths close to the coast are significantly greater, resulting in higher coastal wave energy along the coast south of Cape Jaffa. The continental shelf is relatively close at approximately 80 kilometres.


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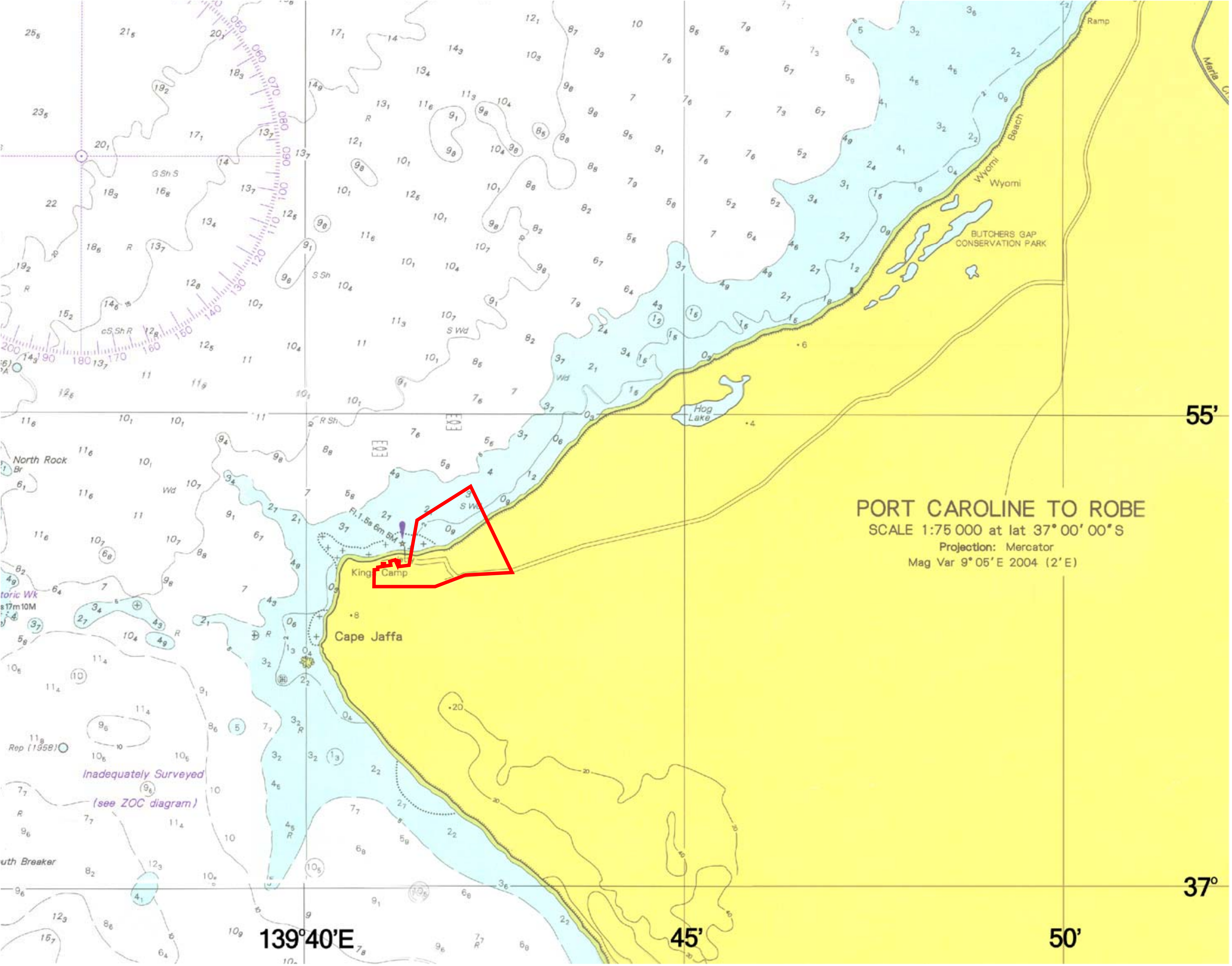

PORT CAROLINE TO ROBE
SCALE 1:75 000 at lat 37° 00′ 00″ S
Projection: Mercator
Mag Var 9° 05′ E 2004 (2′ E)
BUTCHERS GAP CONSERVATION PARK
Wyomi
Wyomi Beach
Ramp
Hog Lake
King Camp
Cape Jaffa
North Rock
Inadequately Surveyed
(see ZOC diagram)
55′
37°
139°40′E
45′
50′

Lacepede Bay in the locality of Cape Jaffa is a relatively calm port. It is protected by the Margaret Brock Reef system which extends from South Breaker 9.0 kilometres south-west of Cape Jaffa, to North Rock 9.0 kilometres west-north-west of Cape Jaffa.

During rough weather, waves break along much of the reef, thus dissipating considerable wave energy. In addition, shallow water reef systems extend from Cape Jaffa to the Margaret Brock Reef and another shallow reef extends north-west from Cape Jaffa.

The site of the proposed development is well protected from the weather. The Cape, together with the extensive reef systems, protect the north facing beach at Cape Jaffa from the southerly and south westerly weather. Seas from the north to north-west impinge more directly onto the coast at the site, as they do for much of Lacepede Bay. The relatively shallow environment of the bay attenuates the wave energy significantly through the friction effect between the seabed and the waves. This is most evident for the more northerly weather.

4.3 Social Characteristics - Demographics

The following analysis sets out Census data from the Australian Bureau of Statistics (ABS) from the 1991 to 2001 Census periods for Cape Jaffa and Environs (CJ&E), Kingston SE township (KSET), Kingston DC and South East Local Government Association (SELGA) which comprises Robe DC, Wattle Range DC and Grant DC, City of Mt Gambier, Tatiara Council, Kingston DC and Naracoorte Lucindale Council. This area is referred to as the study area. These areas are consistent with ABS defined collection areas and are shown on **Figure 4.5**. The statistical information for these areas has also been analysed in comparison to both Adelaide and South Australia as a whole.

4.3.1 Population

- With the exception of Kingston DC all study areas grew in population between 1991 and 2001, the average increase in the three defined areas that experienced growth was 4.75 percent over the ten years (CJ&E 10.64%, KSET 3.23%, SELGA areas 0.39%) (refer **Table 4.1**).
- Adelaide grew in population between 1991 and 2001 by 4.12 percent, while the South Australian population as a whole grew by 4.19 percent over the same period. On this basis, the population growth experienced in CJ&E between 1991 and 2001 is over double that experienced by the State as a whole and Adelaide.
- There was generally an increase in the proportion of older people in all study areas, both as a percentage of the whole and in whole numbers. Likewise, there was a decrease in the proportion and number of younger people in all study areas. Similar trends occurred in both Adelaide and in South Australia as a whole.
- The reduction in the younger cohorts is attributed largely to lifestyle and work opportunities outside of the region and the aging demographic structure.

Table 4.1: Population Change 1991 - 2001

Study Area	Population 1991	Population 1996	Population Change (%) 1991 - 1996	Population 2001	Population Change (%) 1996 - 2001	Population Change (%) 1991-2001
Cape Jaffa & Environs	235	253	7.66	260	2.77	10.64
Kingston SET	1,423	1,442	1.34	1,469	1.87	3.23
Kingston DC	2,258	2,211	-2.08	2,213	0.09	-1.99
SELGA	59,739	59,432	-0.51	59,969	0.9	0.39
Adelaide	1,023,278	1,041,541	1.78	1,066,103	2.36	4.12
South Australia	1,400,252	1,422,522	1.59	1,458,912	2.56	4.19

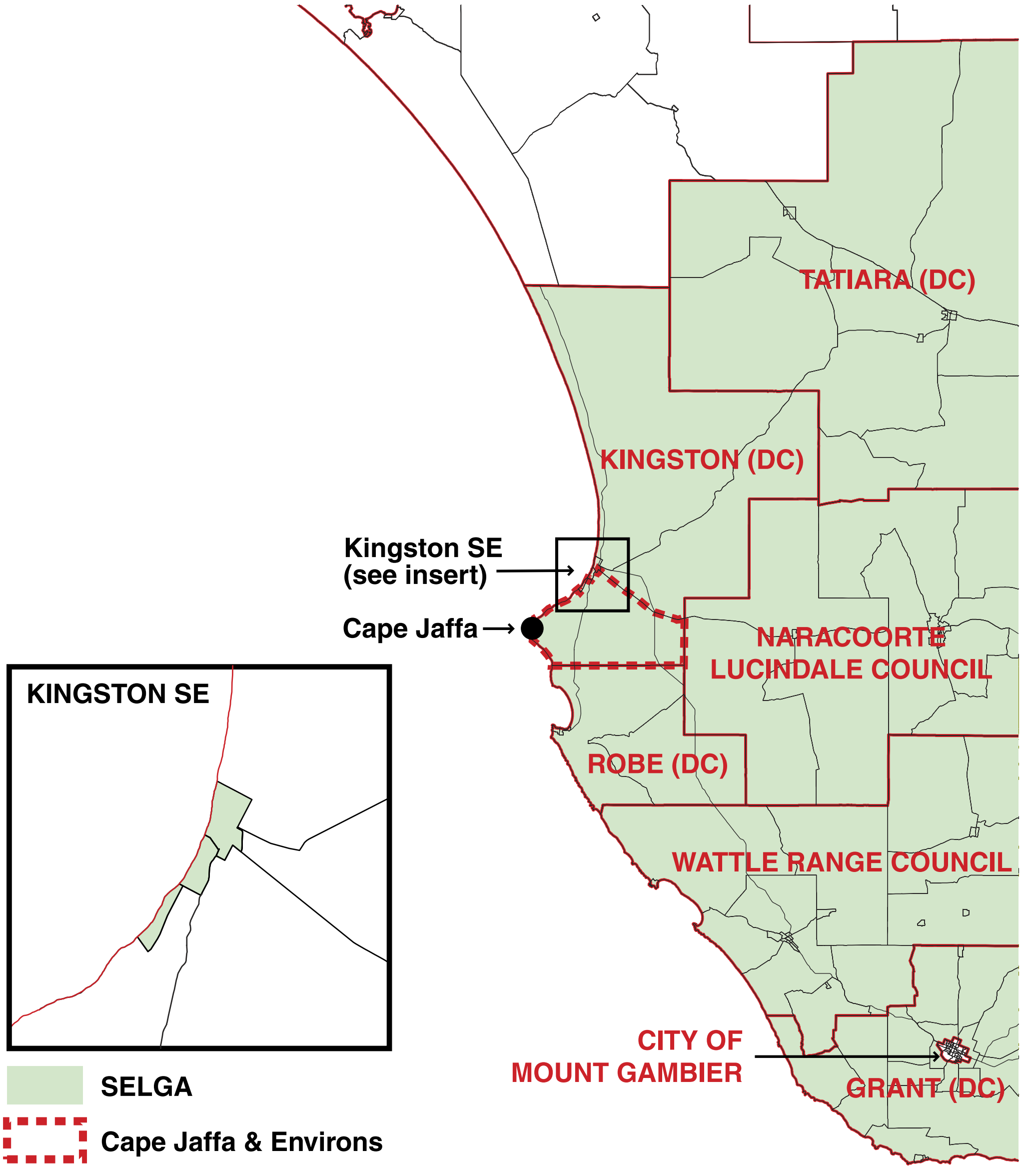


Figure 4.5: Demographic Assessment Areas

4.3.2 Income

- All study areas had a proportionate increase of persons in the higher income brackets between 1996 and 2001.
- The trends described above, namely a decrease in the lower income brackets and an increase in the higher income brackets between 1996 and 2001, are consistent with the trends exhibited in both the Adelaide Statistical Division and the State as a whole.

Figure 4.6 depicts the change in income as described above for South Australia as a whole and CJ&E.

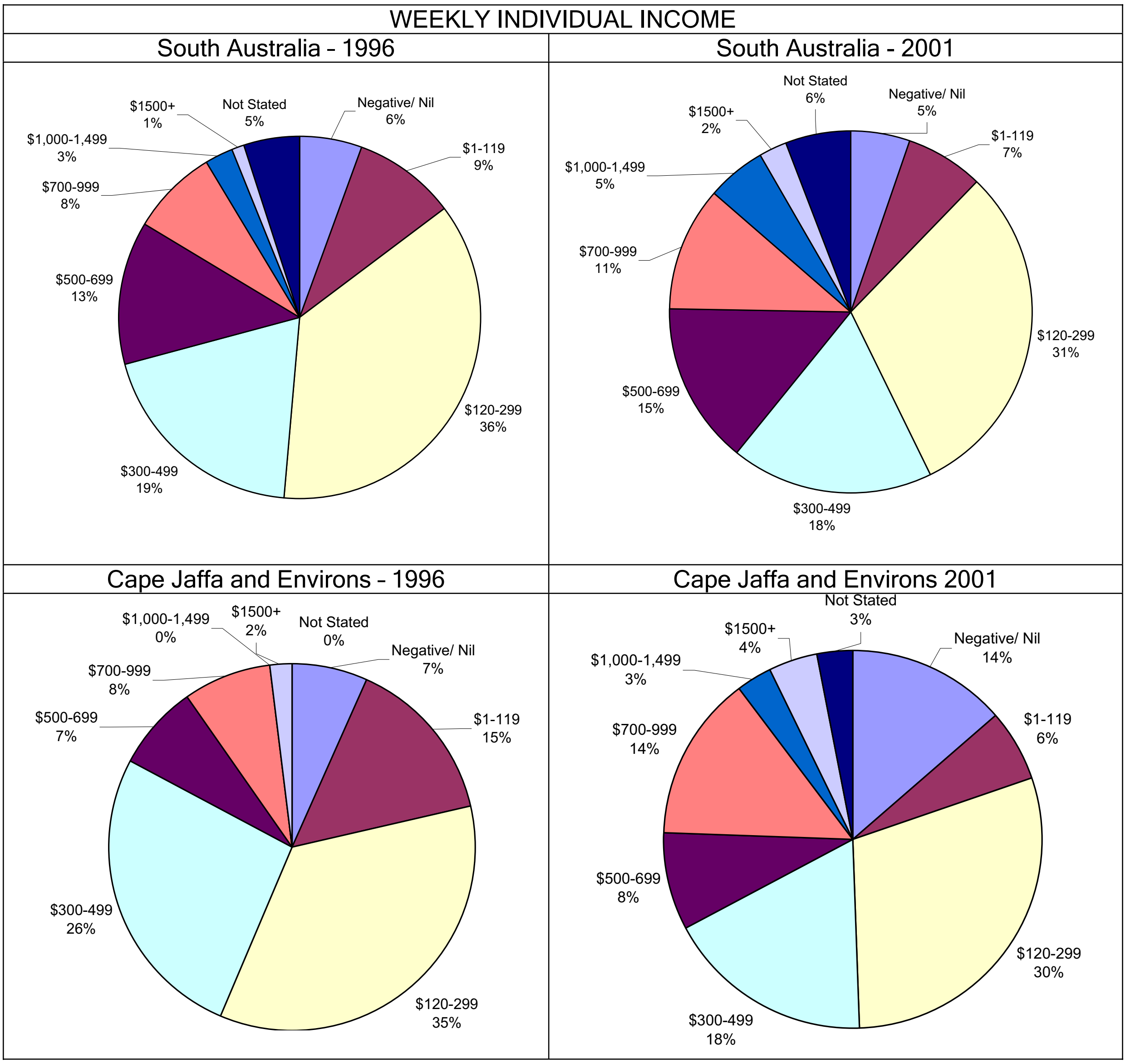


Figure 4.6: Income Change

4.3.3 Dwelling Structure and Tenure Type

Table 4.2 and **Table 4.3** set out various data in relation to dwelling characteristics and occupation rates. In summary:

- Between 90 and 100 percent of persons in the study area lived in separate houses with only marginal change between 1991 and 2001.
- There was a marginal increase in persons living in semi-detached, row or terrace houses, townhouses and flats, units and apartments in the study area between 1991 and 2001. People living in these dwelling types still only accounted for a very small portion of the total population.
- The number of dwellings fully owned in CJ&E increased marginally from approximately 58 percent to 61 percent between 1991 and 2001, and is significantly higher in proportion, approximately 20 percent, compared to the number of dwellings fully owned in SELGA, Adelaide and South Australia as a whole.
- Kingston District Council and KSET both recorded a small increase of 3 to 4 percent in fully owned dwellings between 1991 and 2001, both resulting in full ownership of dwellings just below 50 percent of total dwellings.
- Of the four areas, SELGA and KSET had the highest proportion of rented dwellings at approximately 23 percent of all private dwellings each. The lowest proportion of rented dwellings as a proportion was recorded in CJ&E at 6.25 percent in 2001.
- All areas recorded a decline in the proportion of dwellings rented between 1991 and 2001, and both SELGA and CJ&E recorded an increase in proportion of dwellings being purchased in the same period.
- KSET and Kingston District Council had a similar proportion of unoccupied private dwellings in 2001 at approximately 35 percent and 34 percent respectively, which was slightly higher than that for CJ&E at approximately 27 percent of all private dwellings.

This occupancy rate reflects the area's popularity as a holiday destination in summer, where many of the unoccupied dwellings recorded at the time of the Census would be used for tourist accommodation/holiday homes during the summer season. The rates of occupancy are similar to those of other seaside tourist destinations in South Australia such as Victor Harbor and Moonta Bay. Victor Harbor's higher level of occupancy is attributed to this town's relative proximity to the Adelaide metropolitan area. There is also a trend to greater ownership and fewer rentals whilst the range of housing types occupied remains heavily skewed to detached dwellings. These reflect regional issues with the shortage of accommodation and the small number of dwelling types other than detached dwellings.

Table 4.2: Dwelling Characteristics – Coastal Townships

Coastal Township	Total Dwellings 1991	Occupied Dwellings 1991	Total Dwellings 2001	Occupied Dwellings 2001	Total Dwellings Change (%) 1991-2001
Kingston	826	545	968	630	+17.19
Robe	675	301	845	392	+25.19
Beachport	348	179	387	186	+11.21
Port MacDonnell	410	281	425	265	+3.66
Cape Jaffa & Environs	108	76	128	93	+18.52
Total	**2,367**	**1,382**	**2,753**	**1,566**	**+16.31**
Victor Harbor	3,924	2,484	5,652	4,077	+44.04
Wallaroo	1,512	1,028	1,775	1,208	+17.39
Adelaide	403,596	379,551	458,002	430,239	+13.48
South Australia	569,163	515,623	645,944	584,042	+13.49

Table 4.3: Dwelling Occupation – Coastal Townships

Coastal Township	Proportion (%) of Occupied Dwellings 1991	Proportion (%) of Occupied Dwellings 2001
Kingston	65.98	65.08
Robe	44.59	46.39
Beachport	51.44	48.06
Port MacDonnell	68.54	62.35
Cape Jaffa & Environs	70.37	72.66
Total	**58.39**	**56.88**
Victor Harbor	63.3	72.13
Wallaroo	67.99	68.06
Adelaide	94.04	93.94
South Australia	90.59	90.42

4.3.4 Qualification and Education

- Between 23 and 28 percent of all persons in the study area held a higher qualification in 2001, this is slightly less than in South Australia as a whole and in Adelaide.
- The greatest proportion of people in the study area who held a higher qualification in 2001 held a 'certificate'. This level of qualification is similar to the levels of qualification in 1991 and 1996.
- CJ&E had a slightly greater proportion of persons holding an 'undergraduate diploma' in 2001 than the other areas including South Australia and Adelaide.
- Approximately one quarter of persons in all areas were attending an educational institution across all Census periods, and CJ&E had the highest proportion of persons attending in 2001 with 32.6 percent of persons attending an educational institution.

- Approximately 24 percent of all persons in CJ&E were attending either infant/primary or secondary schooling in 2001, slightly higher than in the other areas and all persons in CJ&E were attending government institutions. In South Australia as a whole approximately only 16 percent of all persons were attending either infant/primary or secondary schooling in 2001.
- CJ&E also had a marginally higher proportion of persons attending pre-school institutions in 2001.
- In summary, while there are some variations between the study areas the variations are minor, and the education and qualifications of persons in CJ&E varies little with the rest of the State.

4.3.5 Family Type

- Over half of all persons in all areas were part of a couple with children family. CJ&E had the highest proportion with 67 percent of all persons in a couple with children family, KSET had the lowest with 52 percent. In South Australia as a whole and in Adelaide the proportion of couples with children families was less than half at approximately 44 percent in both study areas.
- The majority of couples with children in CJ&E had children younger than 15 years of age. Likewise the majority of couples with children in South Australia and Adelaide also have children younger than 15 years of age.
- The proportion of single parent families is similar in all study areas in the South East at around 11 percent of the total population, while in South Australia and Adelaide this proportion is higher at around 16 percent.

4.3.6 Industry Sector and Labour Force Status

- The predominant industry sector in CJ&E is agriculture, forestry and fishing which accounted for 53 percent of all employed persons in 2001. This is approximately 10 percent greater than that in Kingston District Council and in the order of 30 percent greater than that in SELGA and KSET.
- The next greatest industry sector in CJ&E is retail trade which accounted for 14 percent of employed persons.
- Other notable industry sectors are manufacturing, accommodation, cafes and restaurants, education and health, and community services which accounted for between 4 and 6 percent of employed persons each in CJ&E in 2001. Refer Table 4.4.
- By comparison, the proportion of industry types in South Australia is quite evenly spread with most industry types accounting for between 0.5 and 10 percent of the workforce. Notable exceptions however include manufacturing (14.71 percent, retail trade 14.57 percent, and health and community services 11.4 percent). The same trend is evident in Adelaide with predominant industry types being manufacturing (15.32 percent), retail trade (14.95 percent), and health and community services (12.28 percent).

- All study areas had particularly high employment rates at the time of the 2001 Census in excess of 90 percent, CJ&E had the highest employment rate in 2001 with 98 percent of the labour force employed, of this 98 percent, 67 percent was employed full-time, also higher than all other study areas.

- CJ&E also has the highest proportion of persons in the labour force with 76 percent of all persons aged over 15 years in the labour force in 2001, compared to 65 percent in SELGA, 61 percent in Kingston District Council and 54 percent in KSET.

- The employment and labour force participation rates in CJ&E is also significantly higher than in Adelaide and South Australia as a whole. South Australia had an employment rate of 92.39 percent, and a labour force participation rate of 58.69 percent at the time of the 2001 Census. Adelaide had an employment rate of 92.11 percent and labour force participation rate of 58.6 percent in the same period.

Table 4.4: Industry Sector Comparison 2001 (percentages)

Industry Sector	Cape Jaffa & Environs	Kingston SET	Kingston DC	SELGA	Adelaide	South Australia
Agriculture, forestry and fishing	53.79	26.94	44.89	21.13	1.2	5.8
Mining	0.0	0.0	0.0	0.2	0.33	0.61
Manufacturing	4.14	8.59	6.13	17.48	15.32	14.71
Electricity, gas and water supply	0.0	0.51	0.0	0.46	0.71	0.73
Construction	2.07	5.56	4.6	5.29	5.72	5.74
Wholesale Trade	2.07	2.69	2.76	5.31	5.02	4.97
Retail Trade	14.48	16.84	10.12	14.32	14.95	14.57
Accommodation, cafes and restaurants	4.14	8.92	7.06	4.5	4.42	4.52
Transport and storage	0.0	3.54	1.43	3.64	3.79	3.78
Communication services	0.0	1.52	0.41	0.81	1.85	1.63
Finance and insurance	0.0	2.02	1.23	1.7	3.7	3.14
Property and business services	2.07	2.02	3.37	4.83	10.71	9.35
Govt administration and defence	0.0	5.05	2.25	2.02	4.48	4.19
Education	6.9	4.71	5.01	5.3	7.33	7.07
Health and community services	6.21	6.57	6.03	7.01	12.28	11.4
Cultural and recreation services	0.0	0.51	0.0	1.18	2.34	2.08
Personal and other services	2.07	1.01	1.94	2.91	4.03	3.85
Non-classifiable economic units	0.0	0.0	0.61	0.33	0.5	0.49
Not stated	2.07	3.03	2.15	1.58	1.32	1.39
Total	100	100	100	100	100	100

4.3.7 Motor Vehicle Ownership

- All households in CJ&E owned at least one vehicle at the time of the 2001 Census, the number of households in CJ&E with one and two vehicles grew by 16 percent and 29 percent respectively between 1996 and 2001, while the number of households with three or more vehicles declined by 3 percent in the same period.
- Nevertheless, CJ&E had the highest proportion of households with three or more vehicles at 33 percent in 2001, compared with 18 percent in SELGA and Kingston District Council, and 11 percent in KSET.
- Motor vehicle ownership in South Australia as a whole and in Adelaide was much lower at the time of the 2001 Census compared to CJ&E. Motor vehicle ownership in CJ&E was higher than in other country localities reviewed for comparative purposes including Mannum, Robe and Wallaroo. This characteristic can be attributed to the rural nature and smaller settlement of CJ&E, lack of public transport, and consequently the need for private car ownership to facilitate accessibility and manoeuvrability.

4.3.8 Supply and Demand

- The five year period between 1999 and 2003 saw a steady increase in the number of dwellings approved in Kingston District Council. The figures to date for 2004 indicate that the 24 approvals to November is greater than the number of approvals for the calendar year periods of 1999, 2000 and 2002.
- The five year period between 1999 and 2003 also saw an increase per year in the number of approved land division applications. While the 11 approvals for 2004 (to November) is less than the number of approvals in 2003, it is already more than the number of approvals for the calendar year periods of 1999, 2000, 2001 and 2002.
- With the exception of 2002 there was also a corresponding increase in the number of allotments created by land division applications.
- Sales data for the Kingston District Council shows an increase in the number of dwellings being sold between 2002 and 2003. The half year figure for 2004 suggests a similar demand for dwellings as in 2003.
- In comparing the development approvals and sales data figures for 2002 and 2003, it is evident that the demand for both dwellings and vacant residential land is much greater than that supplied by approved development applications.
- Indeed the declining sales of vacant residential land between 2002 and 2004 most likely results from the lack of supply. Despite the decline, the number of sales for the first six months of 2004 is still greater than the number of allotments created in 2004 to November Table 4.5 shows the difference between allotments created and residential land sales.
- These figures suggest that there is an inadequate supply of vacant residential land within Kingston District Council.

- This trend of inadequate supply is also evident elsewhere along the South East coast, and in particular Robe. The recently exhibited District Council of Robe Miscellaneous Plan Amendment Report contained the results of investigations into the supply and demand of residential land in Robe. These investigations illustrated that in Robe as well as in Kingston District Council supply of residential land does not meet demand.

Table 4.5: Residential Land Sales and Creation 1999 - 2004

	1999	2000	2001	2002	2003	2004	Total
Number of residential allotments created	2	14	14	9	19	13*	71
Vacant Residential Land Sales	+	+	+	99	81	18**	198
Difference for period	NA	NA	NA	-90	-62	-5	NA

* To November

**To June 30

\+ Data not available

Sources: Kingston District Council

Land Services Group of the Department for Administrative and Information Services, *Property Assist*

In summary, the area is experiencing residential growth with a diminishing supply of available land for residential development purposes. The attraction of the coast is a phenomenon well documented in all Australian States. Further, there are limited opportunities for waterfront development and it is appropriate to create these opportunities in association with port facilities thereby providing an efficient allocation of resources and infrastructure.

In real demand terms, the proponents have maintained a database of registrants for the purchase of land or other facilities which has at the time of writing about 170 signatories. This interest has resulted only from local information dissemination about the proposal and the processes for assessment, and there has been no formal marketing. There is therefore adequate demand for the type of development proposed.

4.4 Historical Development

Occupation of the South East commenced about 9,500 years ago until about 700 years ago, with the principal period of occupation 9,000 to 7,000 years ago (Fankel 1996 and Egloff *et al* 1989). This information was gathered from the excavation of three coastal caves close to the South Australian/Victorian border. The Cape Jaffa area forms part of the coastal occupation of the Kungari although it is apparent from the investigations undertaken over the past twenty years that there are no recorded or registered sites within the study area. There are however artefact sites along the coast within 15 kilometres north and 8.0 kilometres south of the study area, which are characterised by flint flakes and cores and no other raw material (Wood 1995).

The degree of integrity of this material is reported as ranging from poor to good with most described as poor to moderate. This is typical of the site pattern for the South East of South Australia.

The land has been cropped and grazed for the past 100 years, which has resulted in significant change to the pre contact landscape. It is also noteworthy that the remnant dunes and coast at Cape Jaffa has developed relatively recently, that is within the last few thousand years.

Surveys of the study area comprising four field investigations resulted in the identification of four artefact sites. Walshe and Bonell (2004) reported the sites to be surface only with no associated stratified deposit as none of the test pits revealed any indication of sub surface material, the soils being devoid of any evidence of occupation (**Appendix 10**).

The artefact sites comprise surface only shell debris, flint tools and fragments of hearth stones. It is also reported that the sites range from thin, disaggregated scatters to discrete higher density clusters, that all sites have been significantly disturbed by the farming activities, and the site integrity is extremely low. No burial sites or any indication of any burial areas were identified. It was concluded that the sites are either discrete, modest sites with medium to poor integrity, or disaggregated scatters of debris with no to poor integrity. **Figure 4.7** shows the location of investigations and aerial photograph (**Appendix 10**).

In 1802, Nicolas Baudin named the northern cape of Rivoli Bay as Cape Jaffa, after a Mediterranean port near Jerusalem. Baudin named what is now known as Cape Jaffa as Cape Bernouilli, however shortly after Matthew Flinders wrongly identified it as Cape Jaffa. The name Cape Bernouilli was used until the mid 1850s when it was replaced by Cape Jaffa (McLaren 1977).

The European settlement of Cape Jaffa commenced as Kings Camp in 1868 when a campsite was established to serve the development of a lighthouse on Margaret Brock Reef. The lighthouse was established to guide vessels from the fringing reefs after a number of shipwrecks in the area and was finally operational in 1872. At the time the lighthouse was established, family accommodations were constructed to the south of the point at Cape Jaffa and the remnants of the buildings remain within the heavily vegetated Bernouilli Conservation Reserve, which extends from Cape Jaffa for about 10 kilometres south (McLaren 1977, Nicholson 2002).

The lighthouse platform remains on the reef off Cape Jaffa and in the 1970s the lighthouse itself was decommissioned and relocated to a site along the foreshore at Kingston. The settlement at Cape Jaffa was originally named Kings Camp, after the lighthouse constructor WF King, and although generally known as Cape Jaffa, Kings Camp is sometimes still shown on maps.

Artefact Site

By the late 1950s the fishing fleet had grown together with a jetty and beachfront accommodations, which had taken over portions of the foredune. At that time the access to the Cape was via a road to the west of the settlement and southward to a road connecting eastward to what is now the Cape Jaffa Road. This connecting road is today known as Rothalls Road. Another track is also evident along the foredune through the vegetation extending eastward to what remains today as the main access ramp to the beach. In more recent times, vegetation has regenerated to some extent in this area. **Figures 4.45** to **4.50** in **Section 4.13.3** shows aerial photographs of the Cape Jaffa region taken in 1958, 1975, 1981, 1997, 2000 and 2003. Comparison of these provides an indication of the development and change that has occurred over the last fifty years.

4.5 Existing Development and Land Use

Today, the settlement of Cape Jaffa has a busy jetty serving the Southern Rock Lobster, aquaculture, charter boat and tourist industries. The extensive mooring area for the fishing fleet lies beyond the jetty within a proclaimed Rock Lobster Sanctuary which extends around the point at Cape Jaffa in a southerly direction. These vessels are served by their tenders which are accessed from the jetty. **Figure 3.3** depicts the jetty and moorings, which are also shown on the accompanying photographs.

The fleet is further supported by an existing commercial/industrial area comprising fuel and waste oil handling areas, processors and buyers, car parking, loading, unloading and fish weighing areas.

The settlement of Cape Jaffa extends to the south and west of this area and comprises a range of uses including:

- a range of dwelling types, 23 in number in 2004, varying in style comprising single and two storey development some with associated storage areas for vessels and fishing equipment;
- commercial/industrial activities associated with the fishing industry activities;
- a tourist park comprising camping areas, caravan sites and cabins, a shop and residence, storage areas and fuel facilities;
- vacant undeveloped and open land; and
- mown open foreshore reserves with public toilets and shelter.

Refer also to **Section 3.3**.

To the east of the settlement are two significant beach accessways. The most easterly is maintained as a boat ramp with a concrete base and is located within the subject property. It is used year round for beach access and during the summer months for boat launching and retrieval, with the beach being used for boat and trailer parking and camping. **Figure 4.8** shows the location of the existing ramp facilities and, as part of its ongoing commitment for safe and convenient recreational boating facilities, the Kingston District Council has a proposal to develop a four lane protected boat ramp in this location, as shown in **Figure 4.9**.

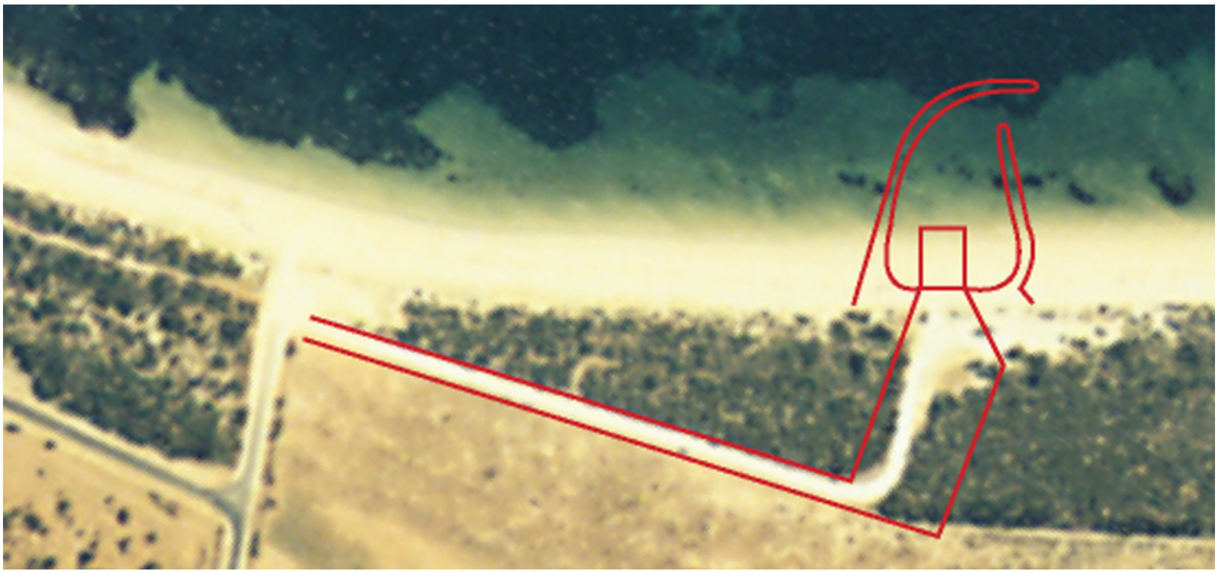


Figure 4.8: Location of Existing Ramp and Previously Proposed Ramp, Breakwaters and Car Park

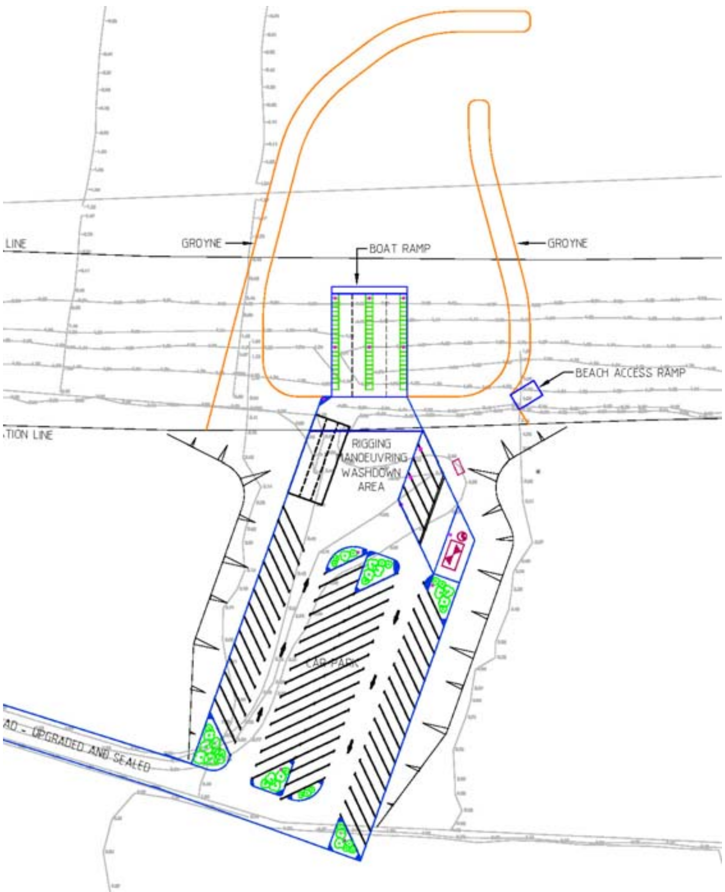


Figure 4.9: Previously Proposed Ramp and Car Park Layout

The subject land has been used by farmers in the area for grazing cattle or sheep for many years, however due to the sandy nature of the soil and the general lack of nutrient rich topsoil, the land is not highly productive. Some areas of low-lying coastal plain are subject to inundation and salt scalding is evident. The light sandy soils are susceptible to weed infestation, particularly False Caper and Horehound.

4.6 Terrestrial Flora and Fauna

Site inspections were undertaken in May 2003 by Bill Matheson and in September 2004 by Roger Playfair, Mark deJong and Steve Milne. The habitat areas were inspected on foot and observations of fauna activity, vocalisations or scats, tracks and diggings were recorded. Assessment of the terrestrial flora and fauna of the site is based on information collected on site visits, database searches, anecdotal information and review of published information. The results are discussed below and more detailed information can be found in **Appendix 11**. More detailed discussion relating to biodiversity conservation can be found in **Appendix 12**.

As part of the investigations, discussions were also held with Malcolm Lankenau, pastoralist and previous owner of some of the project area. Various professionals were consulted with regard to flora and fauna investigations, refer **Appendix 11**.

4.6.1 Flora

The majority of the land incorporated in the proposal has been used for cereal cropping and pastoralism. Most of the original vegetation has been cleared, however there is some remnant vegetated foredune of varying integrity and a small area of paperbark. On the site there are three generalised habitat/vegetation types as shown on **Figure 4.10**:

- foredune coastal heath marked A on **Figure 4.10** in three discrete patches between the beach and the development area. A narrow strip of this habitat type also lines the access road on the southern boundary of the site;
- paperbark swamp marked B on **Figure 4.10** in one small area near the south-east corner of the site; and
- open pasture marked C on **Figure 4.10** covering the majority of the site.

The extent of the Major Development Area is also shown on **Figure 4.10**. **Appendix 11** provides further information and more comprehensive plant lists for the habitat areas and similar areas nearby.

Figure 4.10: Extent of Vegetation Types
Source: **Appendix 11**.

Foredune Coastal Heath

Between the beach and the proposed development there are some narrow strips of coastal vegetation that remain on the foredune. These areas are quite dense shrubland dominated by *Leucopogon parviflorus* (coast beard heath), *Acacia longifolia* var. *sophorae* (coastal wattle), *Olearia axillaris* (coast daisy bush) over a ground layer consisting of *Isolepis nodosa* (knobby club rush), *Carpobrotis rossii* (pigface), *Lepidosperma gladiatum* (coast sword sedge) and *Tetragonia implexicoma* (brown spinach) (**Appendix 11**). Exotic grasses are common particularly around the edges and in the smaller fragmented patches, and there are serious infestations of *Asparagus asparagoides* (bridal creeper). Open areas are dominated by *Euphorbia paralias* (sea spurge) and *Euphorbia terracina* (false caper) (**Appendix 11**). **Figures 4.11** and **4.12** show photographs of these areas and additional photographs are shown in **Figure 4.17**. Note the exotic grasses and onion weed on the edge of the tall shrubland and bridal creeper infestation. A very narrow strip of degraded coastal heath habitat also runs along Cape Jaffa Road on the southern boundary of the site (**Appendix 11**).

Bernouilli Conservation Reserve to the south of Cape Jaffa and Butcher Gap Conservation Park 10 kilometres north-east are both reasonably well preserved examples of this vegetation type. **Appendix 11** has a comprehensive plant list for these reserve areas.

Figure 4.11: Western Patch of Coastal Heath Adjacent to King Drive

Figure 4.12: Inland Edge of Coastal Heath

Paperbark Swamp

A very small area of paperbark exists in the south-eastern corner of the site. This area is only inundated during the winter when the rainfall fills the soil profile and a temporary swamp is created. This creates an area of quite low biodiversity because many understorey plants do not tolerate swamp conditions (Appendix 11). The fringes of this area are dominated by *Gahnia filum* (thatching grass), *Gahnia trifida* (cutting grass), *Isolepis nodosa* (knobby club rush), *Samolus repens* (creeping brookweed) and *Tetragonia implexicoma* (brown spinach), and the central part consists of *Melaleuca halmaturorum* (swamp paperbark) over mainly bare ground or shallow water in winter (Appendix 11). Pasture grasses also form a dense sward where the pasture meets the swamp. Figures 4.13 and 4.14 show this area and additional photographs are shown in Figure 4.17.

Figure 4.13: Paperbark Area with Fringe of Thatching Grass - Open Pasture in Foreground

Figure 4.14: Paperbark Area with Thatching Grass and Knobby Club Rush in the Mid-ground

Open Pasture

Taking up approximately 90 percent of the site area is open pasture. Historically grazed and "improved by the use of pasture seed and fertiliser application". Dominated by exotic grasses, *Euphorbia terracina* (false caper) with some patches of *Marrubium vulgare* (horehound), this area is not used by most native fauna species due to its domination by exotic plants, often not attractive to them for breeding or feeding, and the low open nature provides little protection from predators (**Appendix 11**). See **Figures 4.15**, **4.16** and **4.17**.

Figure 4.15: Open Pasture with Very Dense Infestation of False Caper

Figure 4.16: Open Pasture with Moderate Infestation of False Caper

4.6.2 Fauna

Mammals

There was limited evidence of mammal presence recorded at the site during the site assessment. Rabbit warrens were noted at several locations in the coastal dunes. However, few fresh rabbit tracks, scats or diggings were observed, indicating that rabbit population size and activity was generally low (**Appendix 11**).

Mammal species recorded in SA Museum databases within 20 kilometres of the coast and at coastal DEH biological survey sites in the Cape Jaffa region are listed in **Table 4.6**.

Table 4.6: Mammals Recorded in the Region
Source: **Appendix 11**

Species	Common Name	Conservation Status	
		SA (NPW Act)	Aus (EPBC Act)
Antechinus flavipes	Yellow-footed Antechinus		
Antechinus minimus	Swamp Antechinus	Endangered	
Cercartetus concinnus	Western Pygmy-possum		
Cercartetus lepidus	Little Pygmy-possum		
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	
Chalinolobus gouldii	Gould's Wattled Bat		
Chalinolobus morio	Chocolate Wattled Bat		
**Felis catus*	Cat		
Hydromys chrysogaster	Water-rat		
Isoodon obesulus obesulus	Southern Brown Bandicoot	Vulnerable	Vulnerable
Macropus fuliginosus	Western Grey Kangaroo		
Macropus giganteus	Eastern Grey Kangaroo	Rare	
Macropus greyi	Toolache Wallaby	Extinct	Extinct
Macropus rufogriseus	Red-necked Wallaby	Rare	
Miniopterus australis	Bentwing-bat		
Miniopterus schreibersii	Large Bentwing-bat		
Mormopterus planiceps	Southern Freetail-bat		
**Mus musculus*	House Mouse		
Nyctophilus geoffroyi	Lesser Long-eared Bat		
Pseudomys apodemoides	Silky Mouse		
Pteropus poliocephalus	Grey-headed Flying-fox		
Rattus fuscipes greyi	Bush Rat		
Rattus lutreolus	Swamp Rat		
**Rattus rattus*	Black Rat		
Sminthopsis crassicaudata	Fat-tailed Dunnart		
Tachyglossus aculeatus	Short-beaked Echidna		
Trichosurus vulpecula	Common Brushtail Possum		
Vespadelus darlingtoni	Large Forest Bat		
Vespadelus regulus	Southern Forest Bat		
Vespadelus vulturnus	Little Forest Bat		
Vombatus ursinus	Common Wombat	Rare	
**Vulpes vulpes*	Fox		

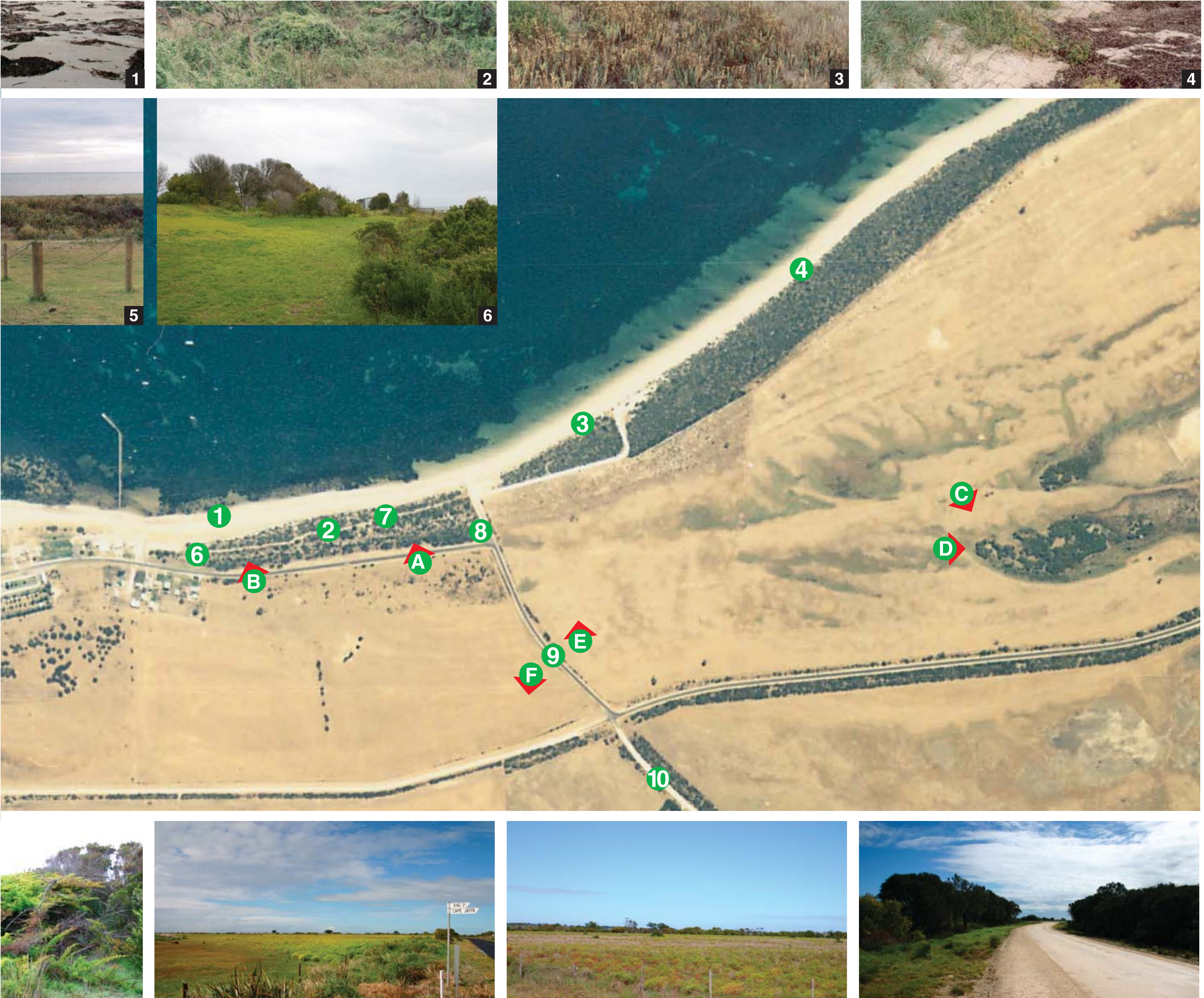


PHOTO POI

1 Dune Vege
2 Bridal Cre
3 Sea Spurg
4 Marram G
foregroun
5 Urban End
6 Buffalo an
7 Cypress P
8 False Cap
9 False Cap
10 Roadside

A Figure 4.1
B Figure 4.1
C Figure 4.1
D Figure 4.1
E Figure 4.1
F Figure 4.1

A number of these species are likely to occur in the coastal heath foredune habitat. The Common Wombat (*Vombatus ursinus*), which is considered "Rare" in South Australia, is known from coastal vegetation in nearby Bernouilli Conservation Reserve.

Evidence of wombat activity was not observed in the project area, however its presence cannot be completely discounted. The Short-beaked Echidna (*Tachyglossus aculeatus*) has also been reported from nearby coastal areas (Foulkes *et al.* 2003a), but no evidence of its presence was noted (**Appendix 11**). The Western Grey Kangaroo (*Macropus fuliginosus*) is expected in most habitats in the region and may occur at the site. The Red-necked Wallaby (*Macropus rufogriseus*) has been recorded in tall coastal shrubland (Foulkes *et al.* 2003a) although there are no database records in the vicinity of the site. Introduced species such as cats, foxes, house mice and black rats are also likely to be present at the site.

Mammals of Conservation Significance

Other species of conservation significance recorded in the region (**Table 4.6**) are not likely to be found in the habitat types present and are not expected at the site, as discussed below:

- Swamp Antechinus (*Antechinus minimus*) is associated with Silky Teatree (*Leptospermum lanigerum*) tall shrubland and Cutting Grass *(Gahnia trifida*) sedgeland (Foulkes *et al.* 2003a), which are not present or not sufficient in size or quality to support this species;
- Eastern Pygmy Possum (*Cercartetus nanus*) is an inhabitant of stringybark and manna gum open forest and woodland (Foulkes *et al.* 2003a), which are not present at or near the site; and
- Eastern Grey Kangaroo (*Macropus giganteus*) is a resident of open forest and woodland, and has not been recorded in coastal habitats in the region (Foulkes *et al.* 2003a).

<u>Reptiles and Amphibians</u>

Although weather conditions during the site inspections were suitable for reptile activity, few reptiles were observed. Several Four-toed Earless Skinks (*Hemiergis peronii*) were found under debris in the paperbark and would also occur in the coastal shrubland areas. A snake (possibly an Eastern Brown Snake, *Pseudonaja textilis*) was observed fleeing into dense vegetation in the coastal dunes. Large numbers of the Common Froglet (*Crinia signifera*) were heard calling in the paperbark (**Appendix 11**).

Reptile and amphibian species recorded in SA Museum databases within 20 kilometres of the coast and at the Department of Environment and Heritage coastal biological survey sites in the Cape Jaffa region are listed in **Table 4.7**. Most of these species are relatively common and widespread, and a number are possible inhabitants of the coastal shrubland habitat. These include the Lined Worm Lizard (*Aprasia striolata*), Eastern Three-lined Skink (*Bassiana duperreyi*), Bougainville's Skink (*Lerista bougainvillii*), Southern Grass Skink (*Pseudemoia entrecasteauxii*), Eastern Tiger Snake (*Notechis scutatus*) and Bluetongue lizards (*Tiliqua* spp.). The Sleepy Lizard (*Tiliqua rugosa*) and Adelaide Snake-eye (*Morethia adelaidensis*) have been reported from sites in Bernouilli Conservation Reserve and may also occur in the coastal shrubland. Several additional frog species including the three *Limnodynastes* species listed in **Table 4.7**, Brown Tree Frog (*Litoria ewingii*) and Painted Frog (*Neobatrachus pictus*) may also inhabit the paperbark swamp area at the northern edge of the site.

Table 4.7: Reptiles and Amphibians Recorded in the Region
Source: **Appendix 11**

Species	Common Name	Conservation Status	
		SA (NPW Act)	Aus (EPBC Act)
Reptiles			
Amphibolurus norrisi	Mallee Tree-dragon		
Aprasia striolata	Lined Worm-lizard		
Austrelaps superbus	Lowland Copperhead		
Bassiana duperreyi	Eastern Three-lined Skink		
Chelodina longicollis	Common Long-necked Tortoise		
Ctenotus orientalis	Eastern Spotted Ctenotus		
Ctenotus robustus	Eastern Striped Skink		
Drysdalia coronoides	White-lipped Snake		
Hemiergis peronii	Four-toed Earless Skink		
Lampropholis delicata	Delicate Skink		
Lampropholis guichenoti	Garden Skink		
Lerista bougainvillii	Bougainville's Skink		
Morethia adelaidensis	Adelaide Snake-eye		
Morethia obscura	Mallee Snake-eye		
Notechis scutatus	Eastern Tiger Snake		
Pogona barbata	Eastern Bearded Dragon		
Pseudemoia entrecasteauxii	Southern Grass Skink		
Pseudemoia rawlinsoni	Glossy Grass Skink	Endangered	
Pseudonaja textilis	Eastern Brown Snake		
Pygopus lepidopodus	Common Scaly-foot		
Tiliqua nigrolutea	Blotched Bluetongue		
Tiliqua rugosa	Sleepy Lizard		
Tiliqua scincoides	Eastern Bluetongue		
Varanus rosenbergi	Heath Goanna	Rare	
Amphibians			
Crinia signifera	Common Froglet		
Limnodynastes dumerilii	Bull Frog		
Limnodynastes peronii	Striped Marsh Frog		
Limnodynastes tasmaniensis	Spotted Grass Frog		
Litoria ewingii	Brown Tree Frog		
Litoria raniformis	Southern Bell Frog	Vulnerable	Vulnerable
Neobatrachus pictus	Painted Frog		
Neobatrachus sudelli	Sudell's Frog		
Pseudophryne bibronii	Brown Toadlet		
Pseudophryne semimarmorata	Marbled Toadlet		

The open pasture areas are likely to support only those species capable of exploiting heavily disturbed areas (for example, the Four Toed Earless Skink and Eastern Brown Snake) and are not expected to be used by the majority of other reptile and amphibian species (**Appendix 11**).

Reptiles and Amphibians of Conservation Significance

Three species of conservation significance have been recorded in the region (**Table 4.7**) but are not considered likely to inhabit the project area nor have they been sited within the Major Development Area (**Appendix 11**):

- the Glossy Grass Skink (*Pseudemoia rawlinsoni*) is considered "endangered" in South Australia and is a grassland/sedgeland specialist, often found on the edges of wetlands or lakes (Foulkes *et al.* 2003b).

It has been recorded from sites dominated by cutting grass (*Gahnia* spp.) within the region, the closest being at Lake Hawdon South, approximately 35 kilometres to the south-east (Stewart *et al.* 2001, Milne 2004). Although cutting grass is present in the paperbark swamp area, compared to sites where the Glossy Grass Skink has been recorded, it is more limited in extent and subject to much heavier grazing pressure and represents relatively poor quality habitat. The presence of this species cannot be completely discounted, but it is considered unlikely;

- the Southern Bell Frog (*Litoria raniformis*) is considered "vulnerable" both in South Australia and under the Commonwealth EPBC Act. Although its habitat requirements are not fully understood, it is most commonly found in or near permanent water bodies with dense fringing vegetation (Cogger 2000) and it is likely that it requires permanent or semi-permanent still water bodies for reproduction (Robertson 2000). The Southern Bell Frog is thought to have very similar biology to the closely related Green and Golden Bell Frog (*Litoria aurea*) (Pyke 2002) and studies of this species have reported that breeding is almost completely restricted to still, relatively unshaded water bodies that are low in salinity (Pyke *et al.* 2002).

  Breeding ponds are generally small (<1000m^2) and shallow (<1m deep). Significant predictors for the presence of *L. aurea* include diversity of vegetation on the banks of water bodies, presence of emergent vegetation and potential shelter provided by nearby rocks or thick, low vegetation (Hamer *et al.* 2002; Pyke *et al.* 2002). The paperbark swamp area does not contain thick, low and diverse fringing vegetation, and does not represent suitable habitat. The presence of the Southern Bell Frog is considered unlikely; and

- the Heath Goanna (*Varanus rosenbergi*), considered "rare" in South Australia, has been rarely recorded in the South East. It prefers heath shrublands, eucalypt woodland and forest, and woodland with a heath understorey (Foulkes *et al.* 2003b). There are no database records at or near the project site, and its presence is unlikely.

Birds

Of the available types of habitat on the site, the paperbark swamp whilst wet supports a far more diverse bird population than the open pasture or the coastal heath. Though small in extent, the dense cover of the paperbarks, standing water, mud and surrounding thatching grass all provide for a wide range of birds needing fruits, seeds, insects, protection from predators or nesting sites. After the standing water dries, many of those birds that rely on shallow water or mud will move elsewhere to return in winter (**Appendix 11**).

The DEH vertebrate survey site in the Bernouilli Conservation Reserve provided no bird data relevant to the project site. **Table 4.8** lists the birds observed on separate visits in May 2003 and September 2004 (**Appendix 11**). They are presented as being in a particular habitat type, but not all are habitat specific.

Table 4.8: Birds Recorded at the Site, May 2003 and September 2004

Source: Appendix 11

Common Name	Scientific Name	Habitat#		
		PS	OP	CF
Australasian Shoveler	*Anas rhynchotis*	+		
Australian Magpie	*Gymnorhina tibicen*		+	+
Australian Pelican	*Pelacanus conspicillatus*	+		
Australian Shelduck	*Tadorna tadornoides*	+		
Australian Spotted Crake	*Porzana fluminea*	+		
Beautiful Firetail	*Stagonopleura bella*	+		
Black-shouldered Kite	*Elanus axillaris*		+	+
Black-winged Stilt	*Himanotopus himantopus*	+		
Blue-winged Parrot	*Neophema chrysostoma*	+		
Brown Falcon	*Falco berigora*		+	+
Brown Thornbill	*Acanthiza pusilla*			+
Brush Bronzewing	*Phaps elegans*			+
Chestnut Teal	*Anas castanea*	+		
*Common Starling	*Sturnus vulgaris*		+	+
Crested Pigeon	*Ocyphaps lophotes*		+	+
*Eurasian Blackbird	*Turdus merula*	+		+
*Eurasian Skylark	*Alauda arvensis*		+	
*European Goldfinch	*Carduelis carduelis*	+		+
Grey Fantail	*Rhipidura albiscapa*	+		
Grey Shrike-thrush	*Colluricinchla harmonica*	+		+
*House Sparrow	*Passer domeesticus*			+
Little Pied Cormorant	*Phalacrocorax melanoleucos*			+
Little Raven	*Corvus mellori*		+	+
Magpie-lark	*Grallina cyanoleuca*	+		
Masked Lapwing	*Vanellus miles*	+	+	
Musk Duck (Rare in SA)	*Biziura lobata*	+		
Nankeen Kestrel	*Falco cenchroides*			+
Pacific Black Duck	*Anus superciliosa*	+		
Richard's Pipit	*Anthus novaeseelandiae*		+	
Rufous Bristlebird (Vulnerable in SA)	*Dasyornis broadbenti*			+
Silver Gull	*Larus novaehollandiae*	+		
Silvereye	*Zosterops lateralis*	+		+
Singing Honeyeater	*Lichenostomas virescens*			+
Spiny cheeked Honeyeater	*Acanthagenys rufogularis*	+		+
*Spotted Turtledove	*Streptopelia chinensis*	+		+
Striated Fieldwren	*Calamanthus fuliginosus*	+		
Stubble Quail	*Coturnix pectoralis*		+	
Superb Fairy Wren	*Malurus cyaneus*	+	+	+
Welcome Swallow	*Hirundo neoxana*			+
Whiskered Tern	*Chlidonias hybridus*	+		

Common Name	Scientific Name	Habitat#		
		PS	OP	CF
White-browed Babbler	*Pomatostomas superciliosus*			+
White-browed Scrubwren	*Sericornis frontalis*			+
White-fronted Chat	*Epthianura albifrons*	+		
Willie Wagtail	*Rhipidura leucophrys*	+		+

**PS** Paperbark Swamp Wetland, **OP** Open Pasture, **CF** Coastal Foredune

Whilst not observed on either site visit, it is possible that the available habitat may support Brown Quail (*Coturnix ypsilophora*) (vulnerable in South Australia) and Southern Emu-wren (*Stipiturus malachurus*) (rare in South Australia).

Migratory Species

A range of petrels and albatrosses, pelagic feeders are expected to visit this coast periodically, staying mainly over the deep water, often following fishing vessels and larger ships and rarely making landfall. Australian Painted Snipe and White-bellied Sea-Eagles may also be occasional visitors.

Birds of Conservation Significance

The Biodiversity Plan for the South East of South Australia (DEHAA 1999) highlights a number of birds of conservation significance in the region (**Table 4.9**). Of these, the Beautiful Firetail, Hooded Plover, Orange-bellied Parrot and Southern Emu-Wren are the only species that are recorded or have any mapped or predicted habitat near Cape Jaffa (**Appendix 11**). The Musk Duck (rare in South Australia) was observed at the site even though the habitat appears suboptimal. The "vulnerable" Rufous Bristlebird was also observed in its preferred habitat of dense coastal heath.

Table 4.9: Threatened Bird Species with Potential Habitat at the Site - from the SE Biodiversity Plan
Source: **Appendix 11**

Species	Status A* & SA**	Distribution
Beautiful Firetail (*Stagonopleura bella*)	A: - SA: Vulnerable	South-eastern Australia from NSW, Victoria, Tasmania, SA (SE, MLR, KI, Lower MM).
Hooded Plover (*Charadrius rubricollis*)	A: - SA: Vulnerable	Southern Australia from south-western Western Australia, and ocean beaches of Victoria, Tasmania, SA.
Orange-bellied Parrot (*Neophema chrysogaster*)	A: Endangered SA: Endangered	Breeds in south-western Tasmania. Over-winters in southern Victoria and SA (coastal SE, MM to Lake Alexandrina).
Southern Emu Wren (*Stipiturus malachurus*)	A: - SA: Vulnerable	Eastern, south-eastern from Queensland, NSW, Tasmania, Victoria, SA (SE, KI, EP, MLR) and south-western Australia.

*A = Australian status under the Environment Protection and Biodiversity Conservation Act, 1999
**SA = South Australian status under the Schedules 7, 8 and 9 of the National Parks & Wildlife Act, 1972

These species are discussed below:

- *Beautiful Firetail* – found in coastal heath communities in Tasmania and south-eastern Australia, Beautiful Firetails forage on or near the ground, feeding on grass seeds. A small group was observed in the paperbark swamp area at the western end of the site. The greatest threats are from wildfire, which could destroy small populations, and fox and cat predation.

- *Hooded Plover* – this species nests on beaches above the high water mark and its eggs and young are vulnerable to recreational activities such as off-road vehicles (Frith 1982). Population appears to be declining, and low breeding success is suspected. It has been observed in Bernouilli Conservation Reserve. Dogs, foxes and feral cats also pose threats to the Hooded Plover.

- *Orange-bellied Parrot* – the current total population is estimated at approximately 200 birds. The 2004 count only recorded one individual in South Australia and this was with one of the larger search efforts so far in terms of sites covered and included potential new areas (pers. comm. R. Green). They breed in south-west Tasmania and migrate over winter to the coastal salt marshes, samphire flats and dunes of south-eastern Australia. Up to 70 percent of the entire population concentrates at three wintering sites around Port Phillip Bay and the Bellarine Peninsula in central southern Victoria. The most used site in South Australia is considered to be Carpenter Rocks (south-west of Mount Gambier) and Orange-bellied Parrots have been recorded at other locations along the South East coast (Orange-bellied Parrot Recovery Team 1998).

  In South Australia, 10 of the 15 important areas of habitat for the Orange-bellied Parrot are protected through a combination of reservation, heritage agreements, or planning regulations (Gibbons 1984). Key feeding habitat is considered to be sheltered coastal habitats, mainly low samphire herblands (Higgins 1999), none of which exists near the site, although it is considered that in South Australia birds also feed on the seeds of colonising strandline plants, especially sea rocket (*Cakile maritima*) on ocean beaches, dune frontages and adjacent dune systems and sheltered areas along rocky foreshores (Garnett and Crowley 2000, Higgins 1999).

  There are no samphire herblands in the vicinity of the site. There is limited potential feeding habitat in strandline vegetation along the seaward edge of the coastal heath, which is very much dominated all year round by marram grass (*Ammophila arenaria*) and seasonally two-horned sea rocket (*Cakile maritima*). In 2004, over the winter, very little two-horned sea rocket existed, and in September germination of new plants began in the zone at the top of the beach immediately in front of the marram grass (**Figure 4.18**). Storms and tides over the winter may be a determining factor in the quantity of two-horned sea rocket available for orange-bellied parrots. The coastal heath on the foredune does provide roosting habitat, but it is unlikely to be used if there is no good feeding habitat nearby. Bernouilli Conservation Reserve and Butcher Gap Conservation Park (10 kilometres north-east) provide similar habitats (**Appendix 12**).

Figure 4.18: Beach Fringing Vegetation in August and September 2004
Source: **Appendix 12**

- *Southern Emu Wren* - this species is found in tea-tree shrubland, sedgeland and heaths, much of which is grazed by stock that have fragmented the habitat. None were recorded on the site. A sedentary species, the main threats being habitat loss and predation by foxes and feral cats.

- *Musk Duck* - this species is rare in South Australia and usually associated with deep permanent lakes, swamps and dams, but is sighted occasionally at sea (Frith 1982). They have been recorded at Bernouilli Conservation Reserve and were seen at the Cape Jaffa site in May 2003 and September 2004. Musk Duck usually nest in reed beds associated with permanent freshwater, none of which exist at this site.

- *Rufous Bristlebird* – this is generally a shy, elusive species that inhabits dense coastal heath thickets. It is vulnerable in South Australia but not listed in the South East Biodiversity Plan. Clearance of habitat is the major threat to this species. The linear coastal heath habitat is particularly susceptible to disturbance and fragmentation by development. Fox and feral cat predation is another serious threat, particularly near settlements (Hopton *et al.* 2003).

4.7 Marine Ecology

4.7.1 Marine Habitats in the Vicinity of Cape Jaffa

In order to assess the marine habitats of the Cape Jaffa area, a habitat map of the area has been prepared. While information is available on marine habitats around Cape Jaffa (Edyvane 1999, SKM 2001), in order to provided a more detailed assessment of the areas potentially effected by the development, it was considered appropriate to conduct additional investigations in the immediate Cape Jaffa area including additional video surveys of the marine fauna and flora.

A series of 15 seabed video surveys between 654 and 1,090 metres long were conducted using a digital underwater video camera mounted on a sled and towed by boat at relatively constant speed. A total of approximately 14,000 metres of video footage was acquired as shown in **Figure 4.19**. The video surveys were analysed and assessed to identify and locate the types of habitats and seagrass present. All visible macro fauna such as sponges and ascidians were recorded.

Video surveys indicate that the area is dominated by seagrasses in the genus *Posidonia* (54 percent), and *Amphibolis antarctica* (33 percent), with only a small amount of bare sand (9 percent). While *Posidonia* dominates inshore and *Amphibolis* is more abundant offshore, the two are intermingled over the whole of the area surveyed. Nearby (west of the site) there are areas of rocky reef and a Rock Lobster Sanctuary, which are unlikely to be affected by the proposed development (**Appendix 13**). Additional information is provided in the report prepared by South Australian Resource and Development Institute (SARDI) Aquatic Sciences titled Cape Jaffa Anchorage Marina EIS Marine Studies contained in **Appendix 13**.

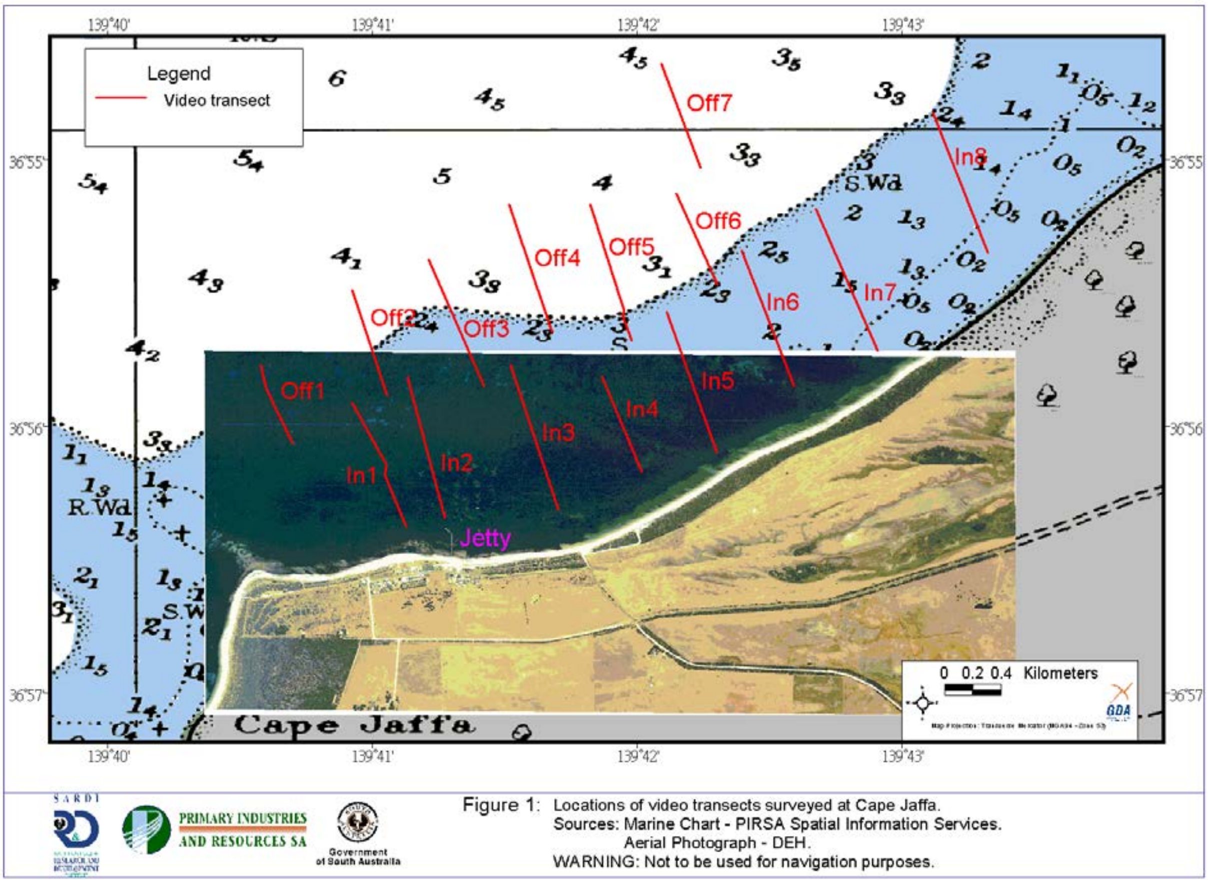


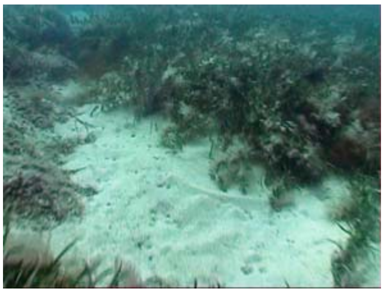
Figure 4.19: Seabed Video Survey Locations
Source: **Appendix 13**

Posidonia and *Amphibolis antarctica* are the dominant seagrasses identified in the area. *Posidonia* is more common along the inshore transects and *Amphibolis antarctica* is more common along the offshore transects (**Appendix 13**).

The entire study site is classified as mixed *Posidonia/Amphibolis* seagrasses, with 54 percent cover of *Posidonia* and 33 percent cover of *Amphibolis* seaward of the inshore seagrass line visible in **Figure 4.19**.

Inshore of the seagrass line is bare sand to the east of the jetty and bare sand with some rocky reef to the west of the jetty.

The majority of the seagrass is very healthy and forms dense beds, although the *Posidonia* often has a relatively high epiphyte load (**Appendix 13**). Bryars (2003) indicates that the area is dominated by *Posidonia angustifolia* and *Posidonia sinuosa*, with some *Posidonia coriacea*.



Bare sand makes up a relatively small proportion of the surveyed area (9 percent) and can be seen as lighter patches in **Figure 4.19**. Only a few small patches of macroalgae were recorded, predominantly *Ecklonia* and *Scaberia* with some *Cystophora* and *Sargassum*. Very few macroinvertebrates were seen, with only two sponges and two ascidians recorded in total (**Appendix 13**).

The mixed seagrasses identified occur extensively throughout Lacepede Bay to a depth of about 10 metres (Edyvane 1999, SKM 2001). Deeper waters are dominated by medium dense macroalgae, predominantly *Carpoglossum*, *Cystophora* and *Seirococcus* (SKM 2001). Edyvane (1999) reports an area of heavy limestone reef west of the jetty off Cape Jaffa and low profile platform reef beyond, as shown on the habitat map **Figure 4.20**.

The reefs are dominated by macroalgae and most likely have a diverse collection of sessile invertebrates (Edyvane 1999) and are well outside the Major Development area.

The proposed development borders on a rock lobster sanctuary, with the western breakwater to be located adjacent to the eastern border of the sanctuary. There are no reefs or likely rock lobster habitat identified within the development site.

The nearest rocky reef is greater than 1.0 kilometre from the marine sections of the proposed development, and the boundary of the sanctuary was apparently based on easily observable marks on land rather than marine habitat boundaries.

Figure 4.20 shows the reefs habitat areas and **Figure 4.21** shows the extent of the rock lobster sanctuary in relation to the development.

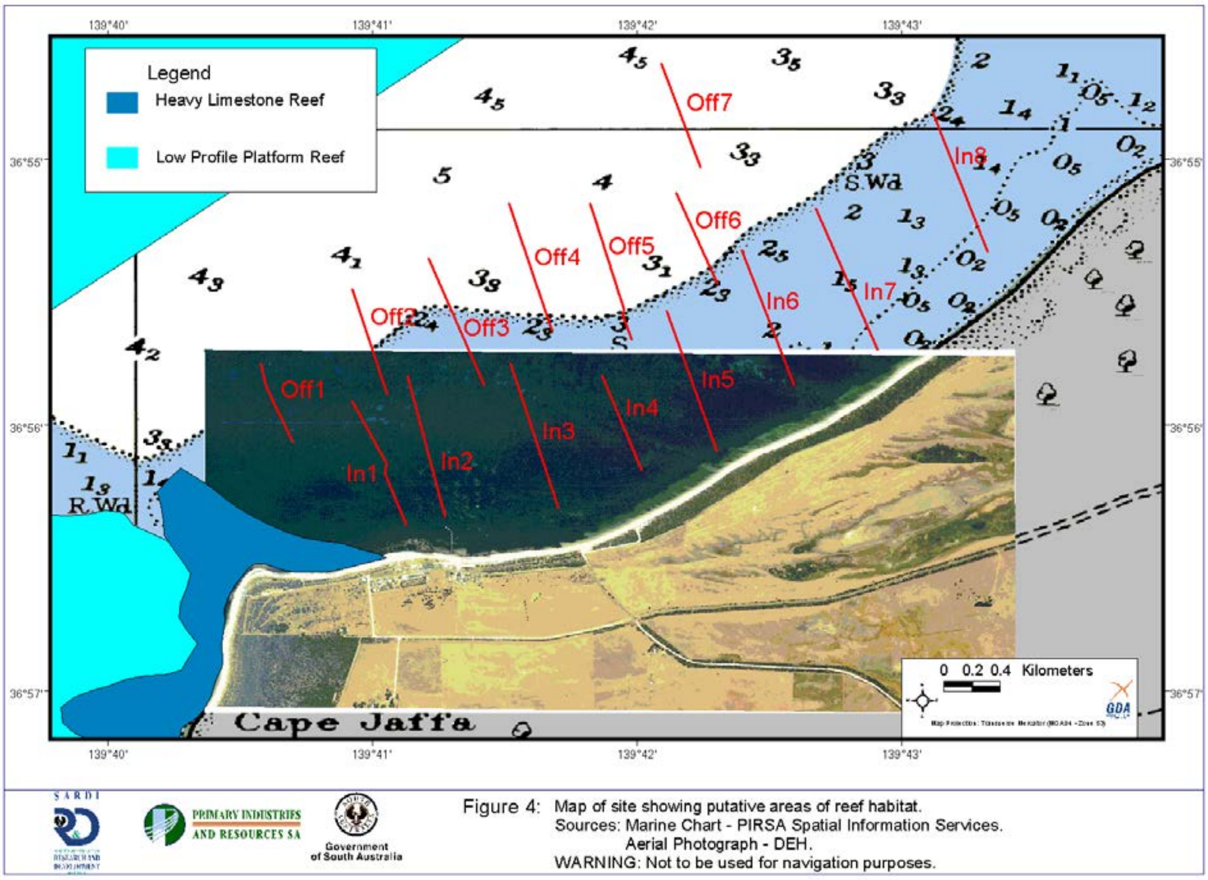
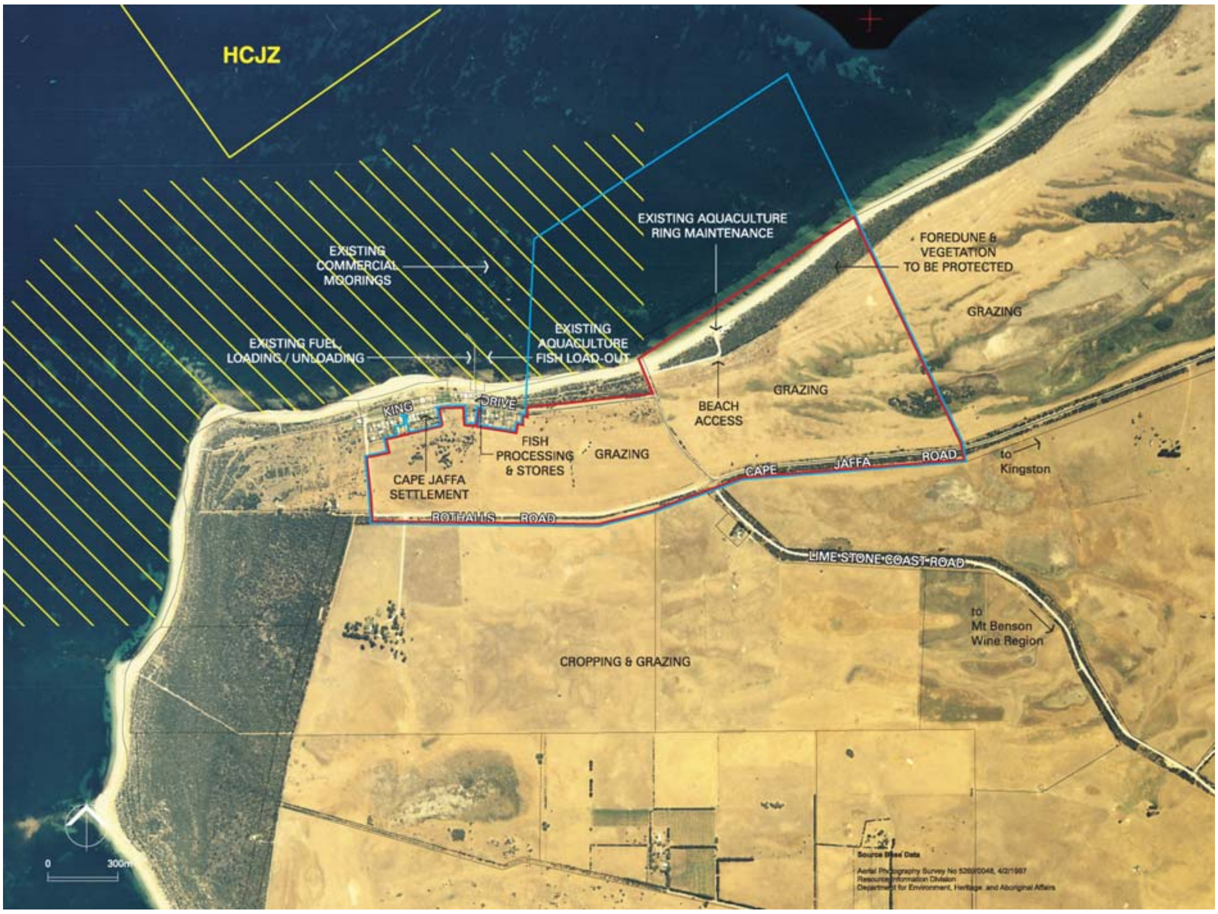


Figure 4.20: Extent of Reef Habitat

Source: **Appendix 13**



Major Development Area

Subject Land

Cape Jaffa Rock Lobster Sanctuary

HCJZ Historic Cape Jaffa Zone - Refer Lacepede Aquaculture Management Policy 2004

Figure 4.21: Location of Rock Lobster Sanctuary and Commercial Moorings

4.8 Hydrology, Geology and Soils

4.8.1 Regional Surface Hydrology

During prolonged periods of wet weather, flooding occurs in the interdunal low lying areas. The wider region is crossed by several constructed drainage channels designed to drain low lying areas, improve the usability of agricultural land, and manage dry land salinity. The closest drain to the study area is the Wongolina/Butchers Gap Drain approximately 10 kilometres to the east.

The region is an undulating coastal plain sloping towards the sea. Between Kingston and Beachport a series of parallel dune ranges trend in a north-west direction, conforming approximately to the present orientation of the coastline. The dunes form a barrier to the seaward drainage of surface waters. Salt lakes and swamps have formed in some areas between the dunes.

The Glenelg River, near the South Australian-Victorian border in the southern extremity of the wider region, is the only regional perennial stream. Watercourses have not developed because of the low topography, high permeability soils and coastal ridges, which act as a barrier to surface water flow. Surface water drains to swamps, lakes and sinkholes in the interdunal corridors (Love *et al.* 1992) and via the network of manmade drains.

4.8.2 Regional Geology

Geologically, the study area lies within the Gambier Embayment of the Otway Basin, which extends from Kingston to the Mornington Peninsula in Victoria. Basement highs outcrop in the north-west (Padthaway Ridge) and south-east (Dundas Plateau).

During the *Late Jurassic Period*, sequences of sand and silt were laid in an elongated depression now known as the Otway Basin. Following the *Jurassic Period*, the *Cretaceous Period* was predominantly a fluvial environment with some marine incursion which resulted in the formation of the Otway Group, which are sedimentary rocks often exhibiting interbedded sandstones, siltstones, mudstones and claystones.

During the subsequent *Tertiary Period*, the Dilwyn Formation was deposited and overlain unconformably by the Gambier Limestone. The Dilwyn Formation is comprised of an interbedded sequence of sand, gravel and clay of fluvial and deltaic origin. The Gambier Limestone is a bryozoal limestone formed during open marine conditions and contains some marl, chert and dolomite. The limestone is noted as dolomitised along an inferred fault zone near Cape Jaffa (Department of Mines 1951).

4.8.3 Local Surface Geology

The surface geology of the Cape Jaffa area is shown on **Figure 4.22**. The surface sediments in the area were predominantly deposited during the *Quaternary Period* and are a record of sea level change. The Bridgewater Formation is the oldest Quaternary sedimentary deposit near the site and is located to the south of Cape Jaffa. This formation is sub tidal beach and Aeolian calcarenite from stranded coastal ridges (Department of Mines and Energy 1995).

The coastal strip around Cape Jaffa is predominantly Semaphore Sands of the St Kilda Formation comprised of coastal barrier, beach ridge and dune sediments. To the east of Cape Jaffa are the older lagoonal and lacustrine (lake) sediments and shell beds of the St Kilda Formation. Further east again are the slightly older lagoonal sediments and shell beds of the Glanville Formation (Department of Mines and Energy 1995).

A total of 34 soil bores were drilled to investigate the geology across the site in further detail. These bores were later converted to groundwater monitoring wells and their location in relation to the surface geology is shown in **Figure 4.22**. The majority of the bores were drilled through the quaternary sediments and into the upper limestone unit, up to a depth of 12 metres below ground level. The bore logs generally confirm the expected geology and the results are discussed below in further detail.

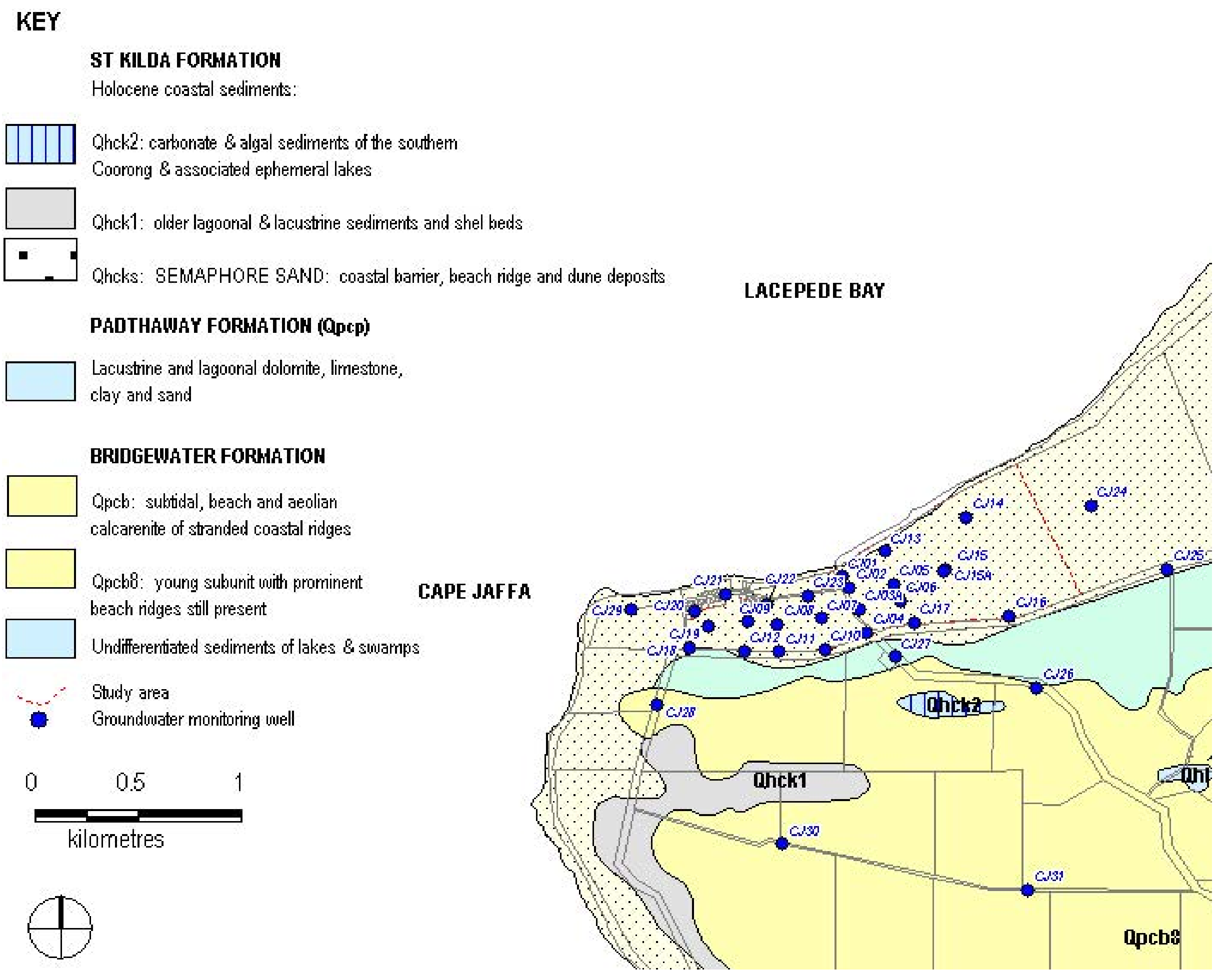


Figure 4.22: Surface Geology and Investigation Bores
Source: Appendix 14

4.8.4 Local Soil and Geological Conditions

The soil type series of the Cape Jaffa area consist of low, parallel coastal dunes alternating with swamps. The dunes are predominantly vegetated and therefore currently stable and are comprised of deep shelly calcareous or calcareous siliceous sand (PIRSA 2001).

Swamps and lunettes are also found in the Cape Jaffa area. The swamps are moderately saline, dark cracking clay, although calcareous clay on marl is also found. The lunettes are dark clay loam, often over dark clay on calcrete (PIRSA 2001).

The soil profile observed during trial excavations and monitoring well installation is summarised in Table 4.10 and the detailed bore logs are presented in Appendix 14. In addition, 12 test pits were excavated and the logs are presented in Appendix 26.

Figure 4.23 presents two geological cross sections based on the lithology observed during the drilling investigations in July 2003. Section A-A' runs perpendicular to the coast and Section B-B' runs approximately parallel to the coast.

The quaternary deposits are typically 5 to 10 metres thick. A discontinuous clay layer up to 2.2 metres thick, generally between 0.0 and -2.3 mAHD, was identified at some locations and separates the quaternary deposits from the underlying upper limestone unit.

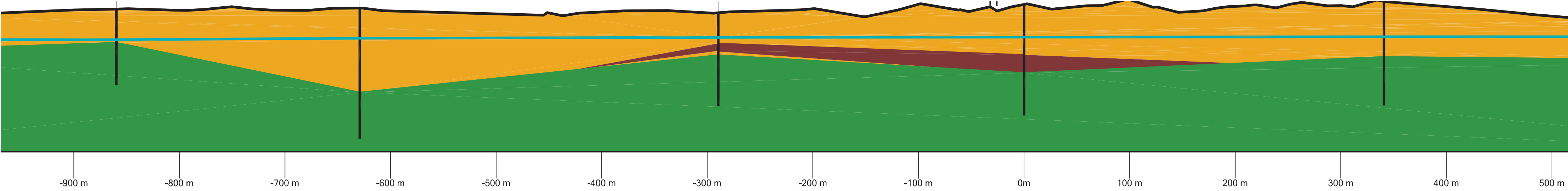
Table 4.10 - Generalised Soil Profile Encountered On-site
Source: Appendix 14

Unit	Depth to Top of Unit	Thickness of Unit	Location
Topsoil	0 m	0 - 0.5 m	All bores
Yellow brown to pale grey sands	0 - 0.5 m	2.4 - 7.6 m	All bores
Dark grey to green layer of clay of medium to high plasticity	2.4 - 5.0 m	0.2 - 2.2 m	CJ03, CJ04, CJ07, CJ10, CJ11, CJ12 and CJ22
Soft and wet limestone containing sand	2.4 - 7.6 m		All bores

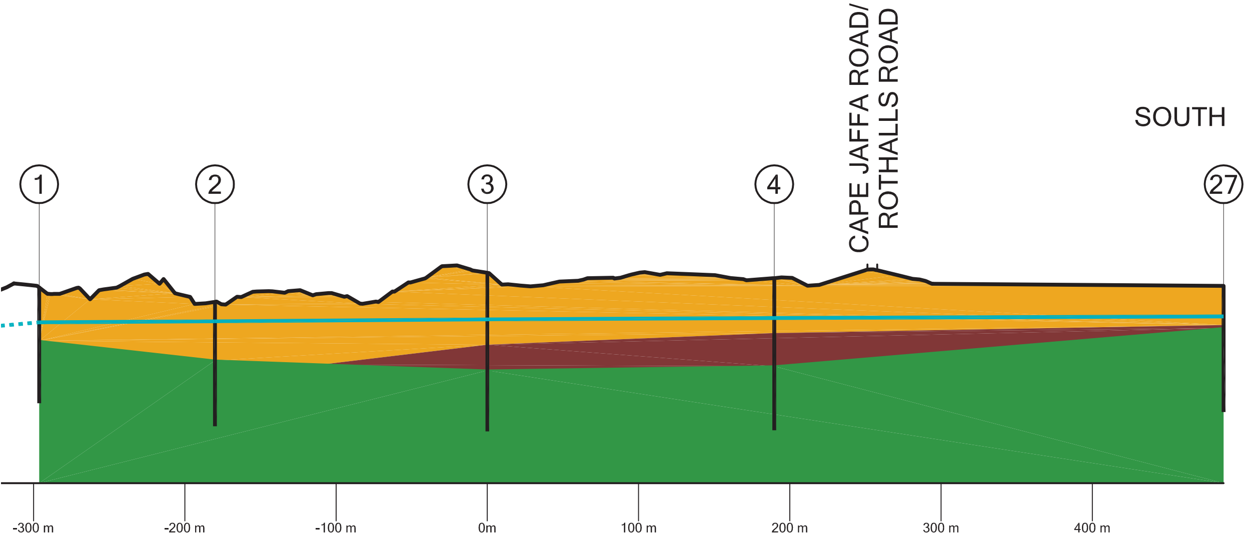
4.9 General Climate

Cape Jaffa enjoys a temperate, maritime climate consisting of warm, dry summers and cool, wet winters. The climatic conditions at Cape Jaffa are outlined below and presented in detail in Appendix 15. Climatic information from various sources has been used in assessing the general climate at Cape Jaffa, including:

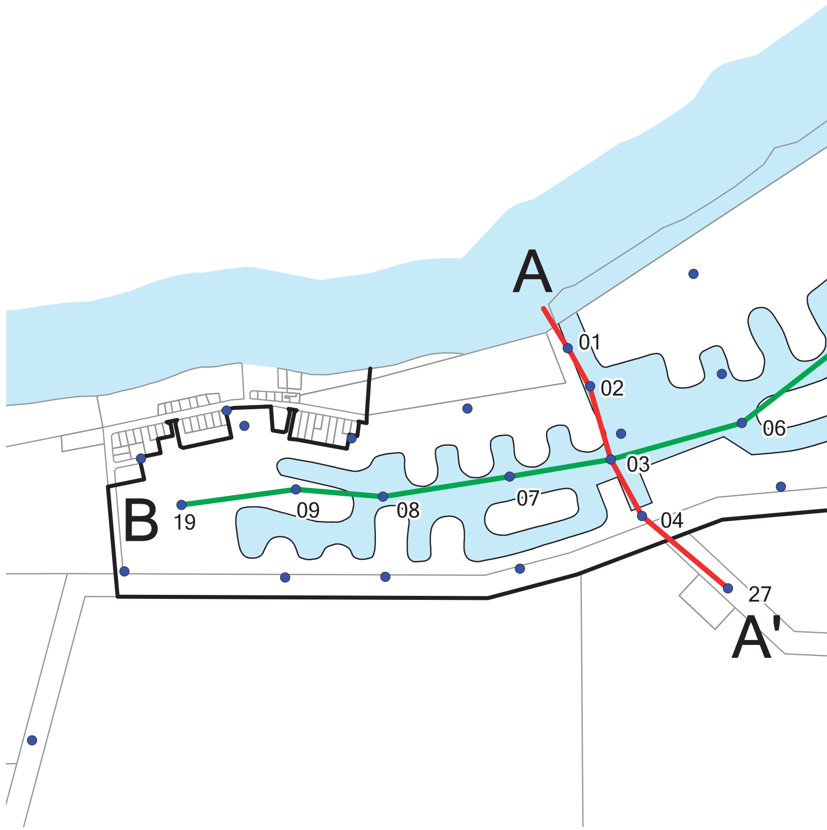
- Robe climatic observations for 9.00 am and 3.00 pm. Measurements include 43 years of temperature data, 39 years of humidity data, 44 years of cloud data, 65 years of wind data and 140 years of rainfall data. Robe is about 25 kilometres south of Cape Jaffa;
- Kingston rainfall observations over 127 years. Kingston is about 18 kilometres north-east of Cape Jaffa;
- Cape Jaffa (Jaffa Hills) rainfall observations over 45 years. Jaffa Hills is about 3.0 kilometres south-east of the site; and
- Konetta evaporation data over 10 years. Konetta is about 50 kilometres south-east of Cape Jaffa.



Cross Section B-B'



Cross Section A-A'



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03 Monitoring Well CJ03

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The nearest available station with records of both temperature and rainfall data is Robe and this is shown in **Figure 4.24**. Robe maximum temperatures in summer rarely exceed 35°C and minimum temperatures rarely drop below 2°C. The mean daily temperature range in summer months is 13°C to 23°C and during winter months is 8°C to 15°C.

The mean annual rainfall at Kingston is 589 millimetres, at Jaffa Hills is 559 millimetres and these are less than the mean annual rainfall at Robe of 633 millimetres. In summer months the Robe mean monthly rainfall is 18 to 28 millimetres per month and during winter months the mean monthly rainfall is 85 to 105 millimetres per month.

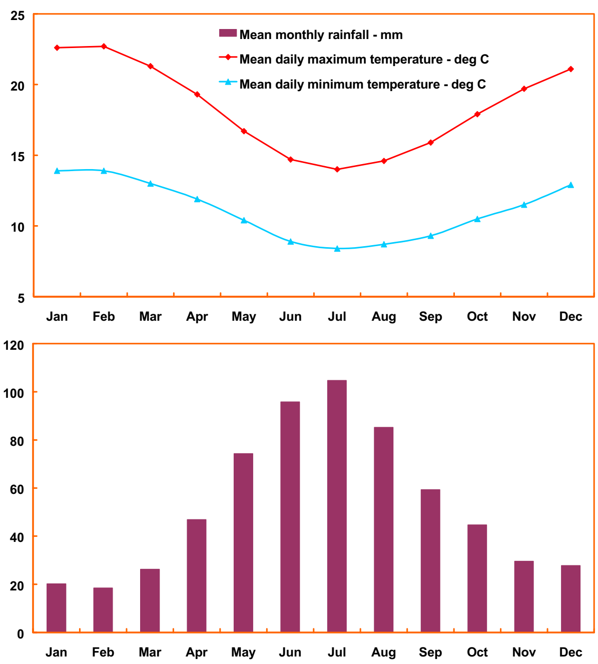


Figure 4.24: Robe mean monthly Temperatures and Rainfall
Source data: Bureau of Meteorology

The rainfall verses evaporation has particular implications for the groundwater in the study area. Aquifer recharge is seasonal, with much higher potential of recharge to the shallow unconfined aquifer during months where the rainfall exceeds evaporation. Comparison is made of the nearest readily available rainfall and evaporation records for the study area (rainfall from Jaffa Hills and evaporation from Konetta). Although Konetta is about 50 kilometres south-east of Cape Jaffa, the mean daily temperature range at Konetta in summer months is 11°C to 26°C and during winter months is 5°C to 14°C, which is similar to Robe (Robe being the nearest available temperature data). Further, evaporation at Padthaway, 80 kilometres north-east of Cape Jaffa, is similar to that from Konetta (within 10 percent) and therefore it is considered to be reasonably representative of the evaporation at Cape Jaffa.

Figure 4.25 presents the mean monthly rainfall at Cape Jaffa with the evaporation at Konetta. Rainfall occurs on about 150 days per year, typically from April to November. The mean annual pan evaporation is 1,468 millimetres with mid-summer evaporation rates up to 230 mm/month and mid-winter rates as little as about 40 mm/month. Potential evaporation exceeds rainfall for most months, however during May to August the mean monthly rainfall is greater than evaporation and groundwater recharge is more likely to occur. Further information regarding rainfall, evaporation and groundwater recharge is presented in **Appendix 14**.

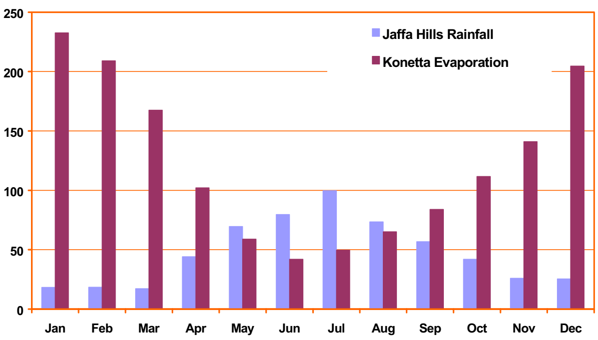


Figure 4.25: Jaffa Hills Rainfall verses Konetta Evaporation
Source data: Bureau of Meteorology

4.10 Winds

The wind climate at Cape Jaffa is outlined below and discussed in detailed in **Appendix 15**. The strongest winds are generally from the south to south-west, particularly during summer afternoons and evenings. The summer winds tend to moderate and turn to the south-east overnight, with relatively calm mornings. During winter, the stronger winds are generally more northerly and tend to ease during the late afternoon and evening, with generally calmer mornings.

4.10.1 Wind Observation Data

Instrumental wind speed and direction observations are available from 6 April 1992 to the present day (about 12 years) from the Cape Jaffa (Curley Hills) Automatic Weather Station (AWS), located approximately 3.0 kilometres south-east of Cape Jaffa. The Curley Hills AWS is adjacent to the Jaffa Hills weather station site at which rainfall data has been collected over about 45 years. Wind observations are every half hour, with occasional more frequent observations.

Wind speed and direction observations are also available for Robe for a 65 year period from 1938 to the present, consisting of manual observations at 9.00 am and 3.00 pm. Weekend observations are often missed. For much of the 65 years recorded the wind speed was estimated using the Beaufort Scale, a wind estimation method described in the Bureau of Meteorology Observers Handbook.

4.10.2 Wind Strength

An annual series analysis of the 1992 to 2003 wind data has been performed and the Average Recurrence Intervals (ARIs) of maximum wind speeds are summarised in **Table 4.11** and **Figure 4.26**. The ARIs have also been analysed for the annual maximum 1 hour, 3 hour, 6 hour and 9 hour average wind speeds.

A similar pattern is observed from wind data for Robe, which has been recorded for a longer period than at Cape Jaffa (Curley Hills). A comparison of the 1 in 100 year ARI winds between Robe and Cape Jaffa shows that Cape Jaffa has winds about 5 knots lighter than Robe (49.7 knots verses about 55 knots). Further information is provided in **Appendix 15**.

Table 4.11: Wind Speed Expected Average Recurrence Intervals

Source data: Bureau of Meteorology Cape Jaffa (Curley Hills) Automatic Weather Station April 1992 to May 2003

ARI (years)	Maximum Wind Speed (knots)	1 hr Average Wind Speed (knots)	3 hr Average Wind Speed (knots)	6 hr Average Wind Speed (knots)	9 hr Average Wind Speed (knots)
1.1	34.7	32.5	32.0	30.2	28.1
2	37.7	35.4	34.1	33.1	31.2
5	40.8	38.7	36.4	34.9	33.2
10	42.9	40.9	37.9	35.9	34.3
20	45.0	43.2	39.4	36.6	35.1
50	47.7	46.1	41.3	37.5	36.1
100	49.7	48.4	42.8	38.0	36.8

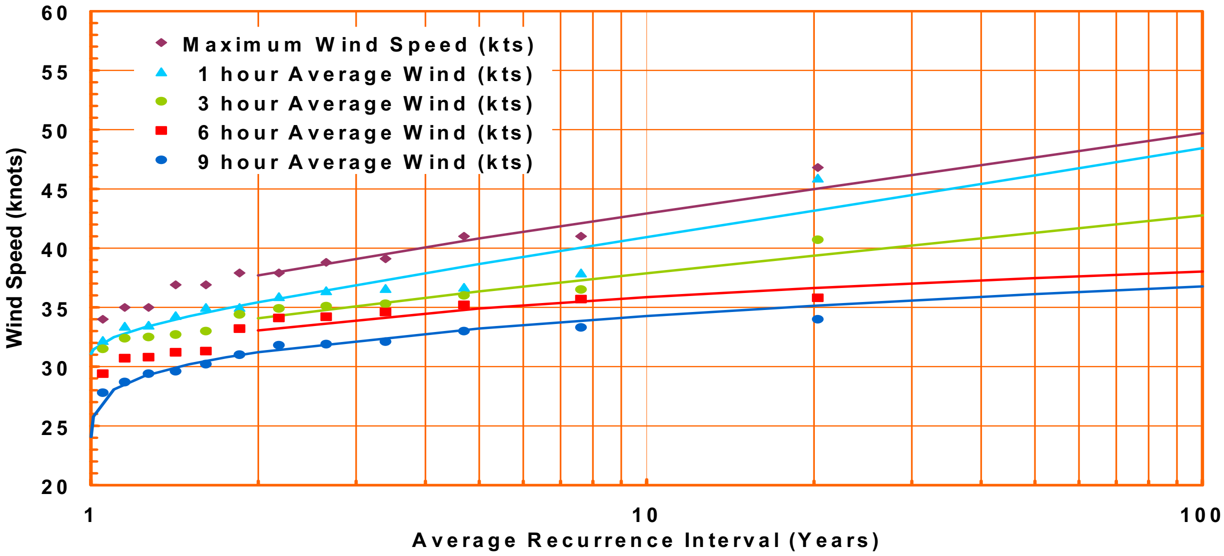


Figure 4.26: Wind Speed Annual Recurrence Intervals

Source data: Bureau of Meteorology Cape Jaffa (Curley Hills) Automatic Weather Station April 1992 to May 2003

4.10.3 Wind Direction

Detailed wind roses for Curley Hills AWS showing frequency of winds verses wind direction and speed for each month and each synoptic observation hour (12.00 am, 3.00 am, 6.00 am, 9.00 am, 12.00 pm, 3.00 pm, 6.00 pm and 9.00 pm) are given in **Appendix 15**. The prevailing southerly winds dominate over summer from November to March. Northerlies are more prominent during autumn, winter and spring, and westerlies are more common from August to October.

Figure 4.27 shows 10 degree increments of wind direction for all observations from Curley Hills AWS (**Appendix 15**). The plot shows the total number of half hourly wind observations when winds are less than the speed indicated in the legend. The figure illustrates that the most common winds are from south to approximately west (180 degrees to 260 degrees).

The direction of very strong winds is illustrated in **Figure 4.28**, which shows the number of wind observations exceeding 25 knots verses the wind direction. The figure indicates that winds greater than 25 knots are most commonly from approximately south to west (170 degrees to 290 degrees), less frequently from the north, and are rarely from north-west or north-east to south-east.

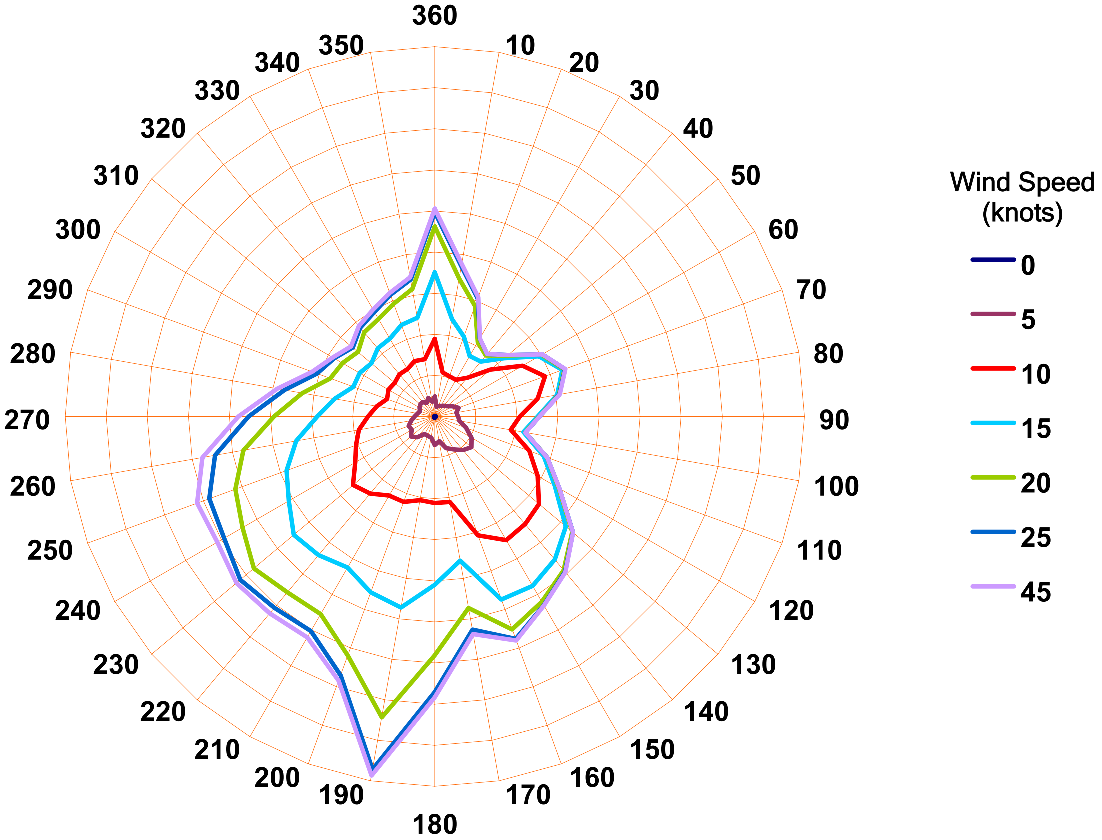


Figure 4.27: Winds by Direction and Speed
Source data: Bureau of Meteorology Cape Jaffa (Curley Hills) Automatic Weather Station April 1992 to May 2003

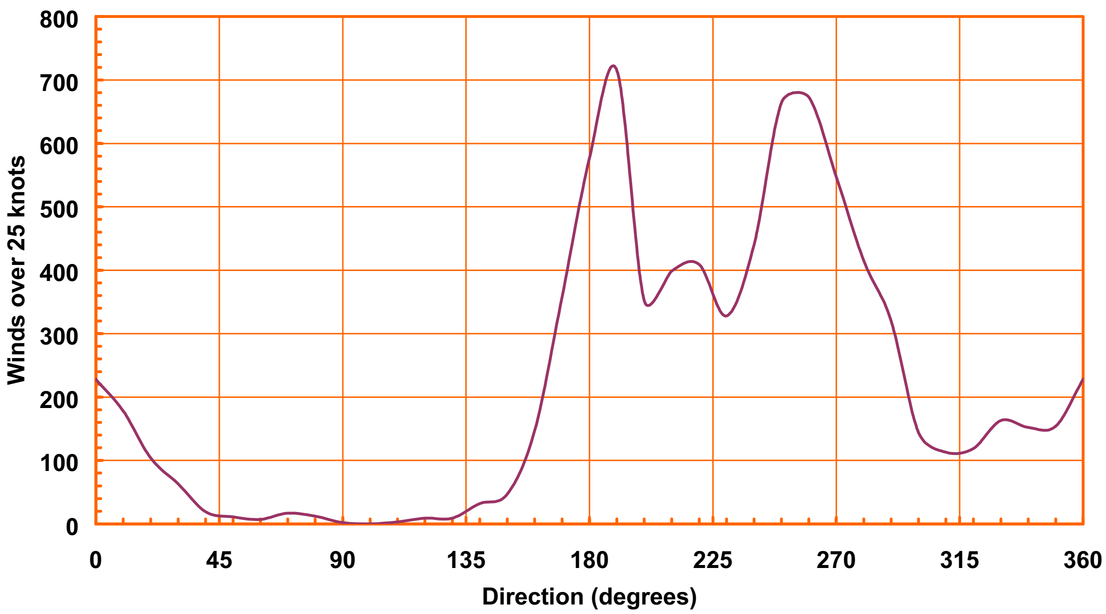


Figure 4.28: Direction of Winds over 25 Knots
Source data: Bureau of Meteorology Cape Jaffa (Curley Hills) Automatic Weather Station April 1992 to May 2003

4.11 Tides

There are generally two tides per day in the area, although periods of dodge tide and single daily tides occur periodically. The tidal cycles are characterised by near fortnightly spring/neap cycles varying in size from larger spring tides to smaller neap tides and back to spring tides. The tidal range is larger around the solstices and smaller around the equinoxes, and tides are generally higher during winter than during summer. Astronomical tide ranges in the area are typically from -0.65 mAHD to 0.9 mAHD. **Figure 4.29** and **Figure 4.30** show typical fortnightly and annual astronomical tidal cycles at Victor Harbor. Further details are provided in **Appendix 15**.

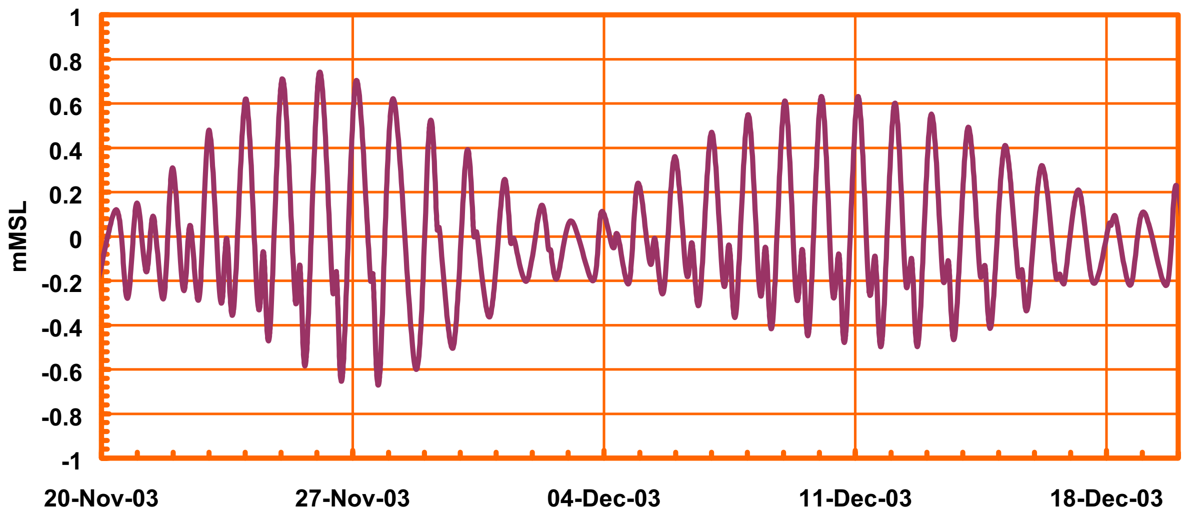


Figure 4.29: Typical Fortnightly Astronomical Tide Cycles
Source data: National Tidal Facility

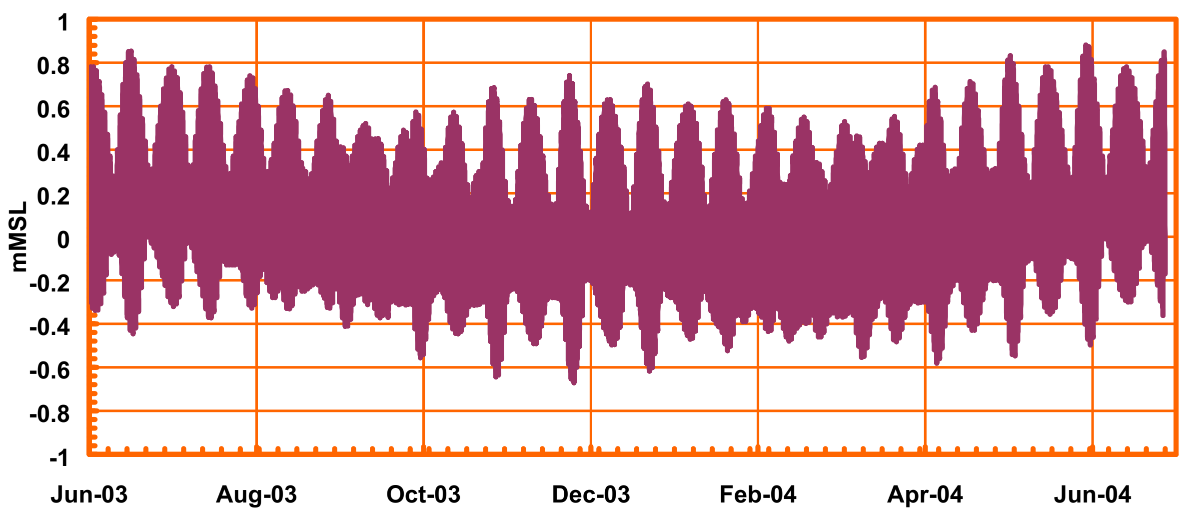


Figure 4.30: Typical Annual Astronomical Tide Cycle
Source data: National Tidal Facility

4.11.1 Meteorological Effects on Tides

Tide levels are influenced by both regional barometric pressure conditions and local wind strength and direction. Sea level rises about 0.1 metre for every 7 hectopascals fall in barometric pressure and drops an equivalent amount as barometric pressure rises. See Tidal Tables for South Australian Ports (Transport SA 2003) for further information.

Offshore winds tend to lower sea levels and onshore winds generally increase sea levels. Around Cape Jaffa, onshore winds are often associated with falling barometric pressures and higher sea levels, and are more common in winter. Offshore winds are often associated with rising barometric pressures and lower sea levels, and are more common in summer. Overall, the tidal regime of the Cape Jaffa region can be characterised by:

- highest tide generally occur during poor weather in the winter period;
- lowest tide generally occur during fair weather in the summer period; and
- the tidal range is generally larger during summer and winter than during autumn and spring.

4.11.2 Historical Tide Data at Cape Jaffa

The National Tidal Facility (NTF) have provided hourly tide level data for a four year period from April 1980 to May 1984. The data was used to determine the daily mean, maximum and minimum tide level as shown in **Figure 4.31**. In addition, the daily tidal range has been determined as the difference between the daily maximum and the daily minimum tide level.

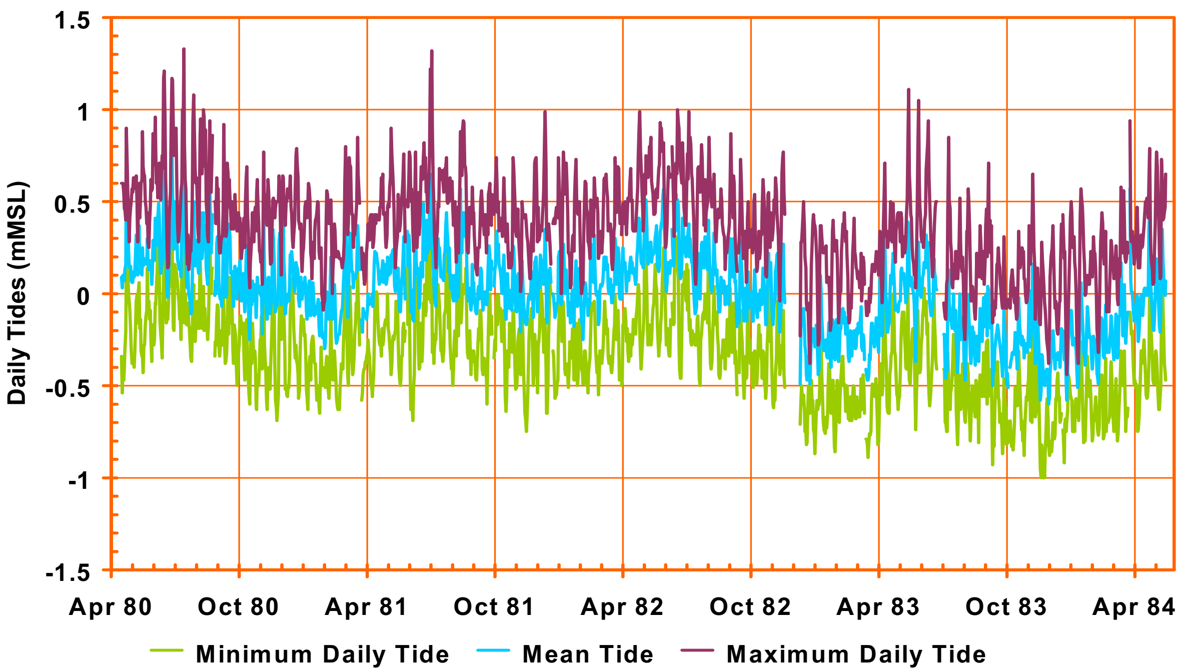


Figure 4.31: Daily Mean, Maximum and Minimum Tide Levels
Source Data: National Tidal Facility, Cape Jaffa April 1980 to May 1984

This data has been used to assess actual tidal levels referenced to Mean Sea Level (MSL) and MSL has been calculated as the mean instrument reading for the whole of the four year period. The data has not been used to assess absolute tidal levels referenced to a known height datum such as Chart Datum (CD) or Australian Height Datum (AHD) as it is referenced only to MSL. Separate analysis of tide levels referenced to AHD is presented below.

Over the four year period 1980 to 1984, the maximum observed tide level was 1.33 metres above MSL and the minimum was 1.0 metre below MSL. Approximately 99 percent of the hourly readings were within the range of -0.75 to +0.85 metres MSL and the average observed tide level was 0.002 metres MSL. The maximum observed daily tidal range during 1980 to 1984 was 1.49 metres. Approximately 99 percent of all daily tidal ranges were less than 1.17 metres and the average daily tidal range was 0.70 metres.

It is noteworthy that a data shift occurred in late 1982 and it is expected that the measured range of tide heights is greater than the actual range over that period, as detailed in Appendix 15. To provide more reliable tide predictions, a tide gauge has been installed at the Cape Jaffa jetty as discussed below.

4.11.3 Tide Reference Datum

Tide levels referenced to a known height datum such as CD or AHD have been assessed. Kingston and Robe are designated as secondary ports in the annual Tidal Tables for South Australian Ports (Transport SA 2003) publication and are referenced to the nearest primary port, that being Victor Harbor. Predicted astronomical tide levels for Kingston and Robe can be calculated from the tide tables by reference to the standard port utilising the ratio of rises and time difference data supplied.

In addition, NTF have published the harmonic constants for Kingston and Robe, thus astronomical tide level predictions can be calculated using any one of the tide calculation software packages that are available on the market.

The marine navigation charts (Australian Hydrographic Service 2001) provide some tide datum information. In addition, PortsCorp have provided historical records such as highest recorded tide, lowest recorded tide and also datum information to convert from local chart datum (CD) to AHD (pers. comm. Greg Pearce PortsCorp). A summary of tide datum information for Kingston, Robe and Victor Harbor from the tide tables (Transport SA 2003), the marine navigation chart (Australian Hydrographic Service 2001) and from PortsCorp is shown in **Table 4.12**. This data has been converted from CD to AHD based on survey and information provided by PortsCorp.

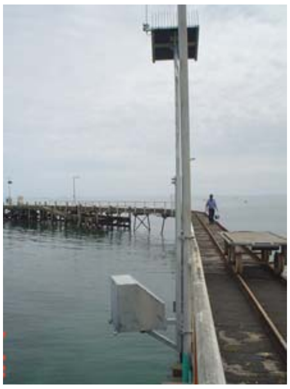
Kingston provides the most relevant point of reference for Cape Jaffa. Generally, the data for the three ports listed in **Table 4.12** are similar. The astronomical tidal information at Kingston and Victor Harbor (for example, highest astronomical tide, lowest astronomical tide and mean sea level) are quite similar. There is some difference in highest recorded tides and lowest recorded tides between the three ports as a result of the varied local meteorological affects at the three ports. Also note that the historical actual data for Kingston and Robe supplied by PortsCorp has only been recorded for approximately seven years and record dates are shown in the table.

Table 4.12 - Tide Data Referenced to AHD
Source: Appendix 15

	Kingston			Robe			Victor Harbor (Ref Port)		
	Aust. Hydro Survey Chart	TSA Tide Tables	Ports Corp 1946-52	Aust Hydro Survey Chart	TSA Tide Tables	Ports Corp 1945-52	Aust Hydro Survey Chart	TSA Tide Tables	Ports Corp 1953
Highest Recorded Tide			1.19			1.37			1.69
Highest Astronomical Tide	0.9			0.6			1.0		
Mean High Water Springs	0.4	0.3		0.5	0.3		0.6	0.2	
Mean High Water Neaps	0.1	0.0		0.2	0.1		0.3	0.0	
Mean Sea Level (MSL)	0.0	0.0		0.0	0.0		0.1	0.0	
Mean Low Water Neaps	-0.2			-0.1			-0.1		
Mean Low Water Springs	-0.5			-0.4			-0.4		
Lowest Astronomical Tide		-0.7			-0.6			-0.75	
Indian Spring Low Water		-0.7			-0.5			-0.7	
Lowest Recorded Tide			-1.16			-1.04			-0.78
Correct Chart Datum to AHD		-0.8	-0.76		-0.6	-0.58		-0.6	-0.58
PCSA Local Datum		31.85			31.97			31.88	
Ratio of Rises to Reference Port (Victor Harbor)		1			0.85				
Average Time Difference to Reference Port (Victor Harbor) (mins)		-5			-5				

4.11.4 Cape Jaffa Jetty Tide Gauge Data

In order to better assess tide levels at Cape Jaffa, a tide gauge was installed on the Cape Jaffa jetty in mid 2003. The gauge uses a solar powered high resolution acoustic sensor which measures the tide level at the jetty once a second and reports the average tide level in each five minute interval. The gauge has been surveyed to AHD and all readings are referenced to AHD. **Figure 4.32** shows the hourly moving average tide height recorded July 2003 to November 2004. In order to also collect wave data, no stilling well is installed.



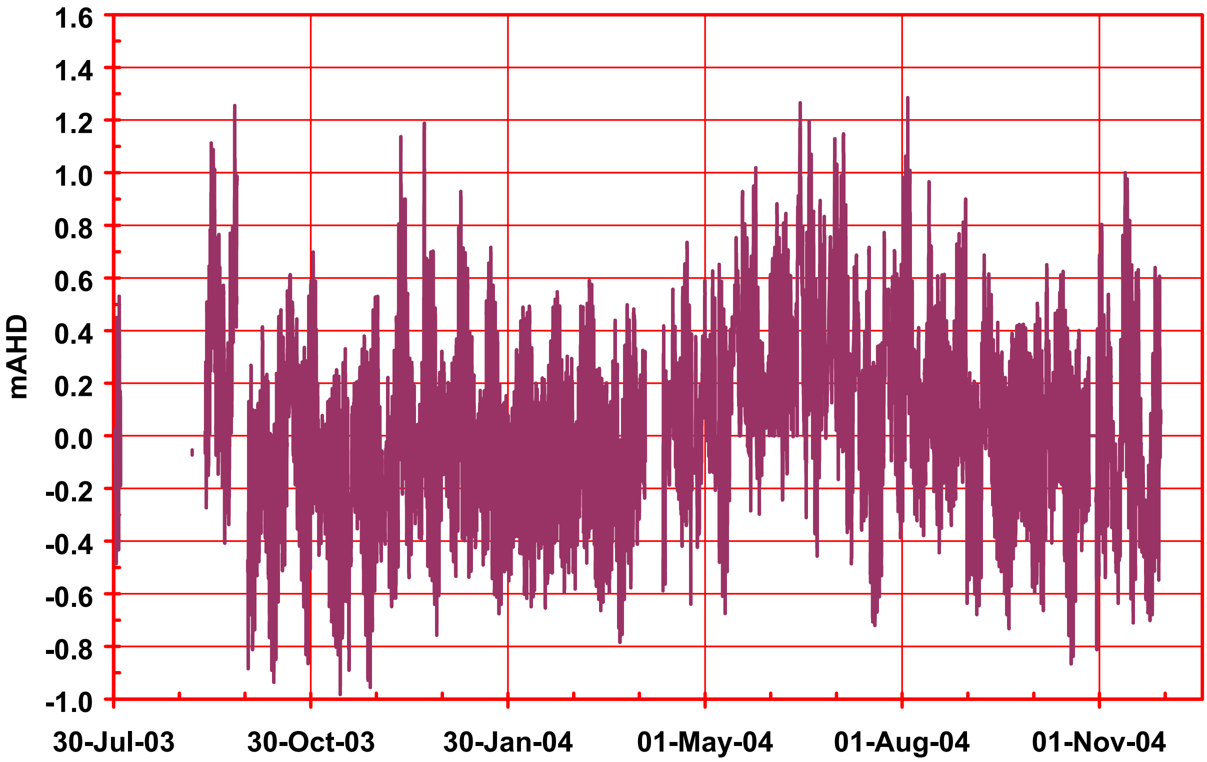


Figure 4.32: Cape Jaffa Measured Tide Data
Source: Appendix 15

Data continues to be recorded in order to provide a more definitive correlation of tide levels to AHD. As additional data is collected, greater certainty of the Cape Jaffa tidal regime and hence tidal predictions will be achieved. Over the period July 2003 to November 2004, the highest recorded tide was 1.282 mAHD and the lowest recorded tide was -0.982 mAHD.

The NTF has performed an assessment of the data collected to date and produced plots that show the residual differences between the observed and predicted tide levels. The residual differences generally result from either meteorological effects or inaccuracies in tidal predictions. These plots are used to assess the accuracy and validity of the tidal predictions and to allow more accurate calculation of the harmonic coefficients that are used to predict tides. The residuals plot for Cape Jaffa for the period September 2003 to February 2004 is shown in Figure 4.33. The meteorological effects observed for Cape Jaffa can also been seen on a similar plot for Portland Victoria, thus confirming that the residuals are predominantly a result of meteorological effects.

NTF have calculated the harmonic constants that allow tidal predictions at Cape Jaffa on the basis of the 2003 to 2004 data measured to February 2004. These predictions have been compared to predictions made by NTF previously, based on the 1983 to 1984 recorded data, which results in some minor improvements to the tidal predictions.

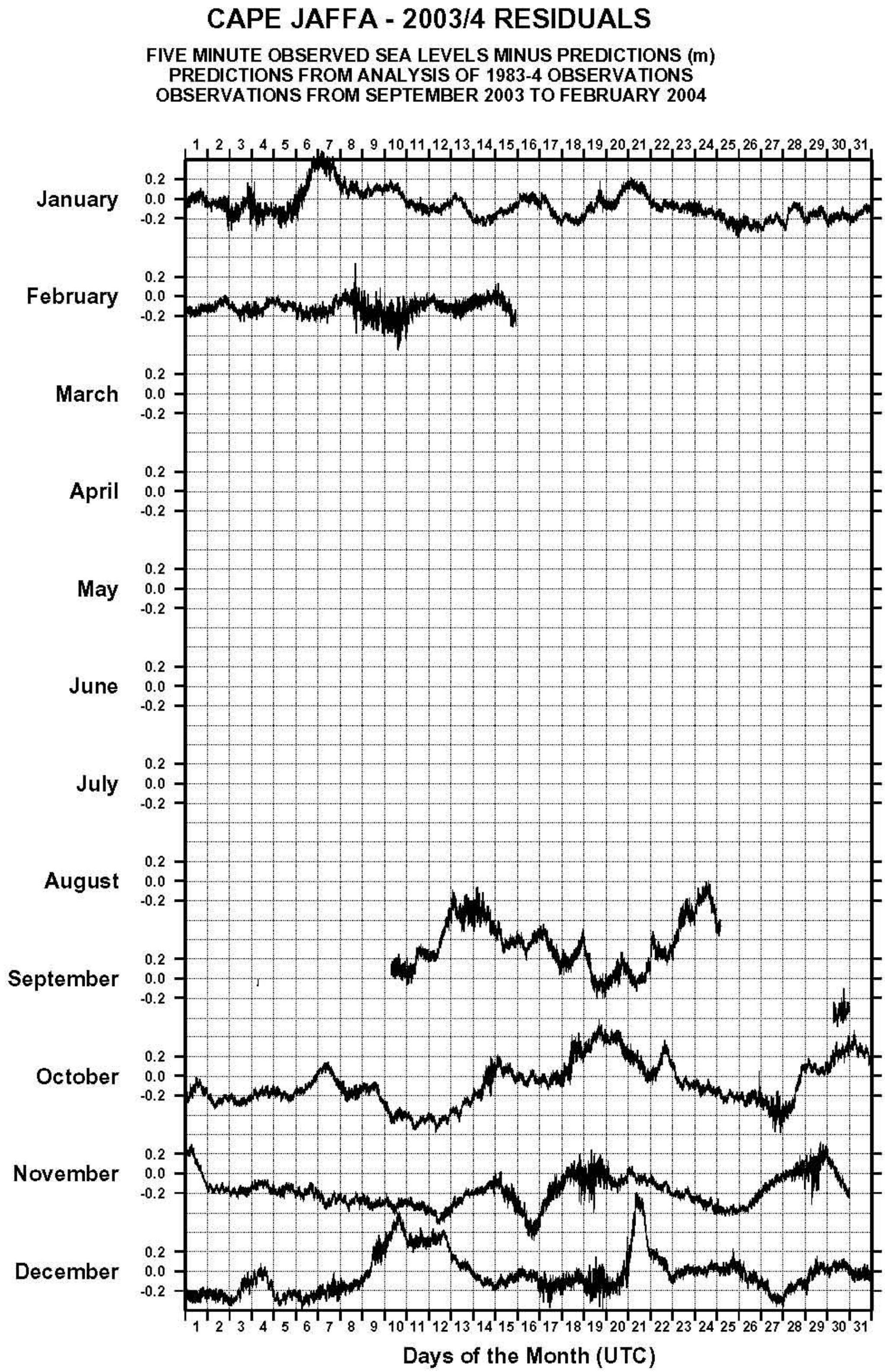


Figure 4.33: Residual Differences Between Predicted Astronomical Tides and Observed Tides
Source: National Tidal Facility

The 2003 to 2004 measured data also provides reference between the AHD and tide datum information such as mean sea level and lowest astronomical tide, which was not available accurately from the previously recorded data. The first six months of readings indicates that the Lowest Astronomical Tide (LAT) is -0.75 mAHD and Mean Sea Level (MSL) is -0.051 mAHD, compared to approximately -0.7 mAHD and +0.04 mAHD at Kingston.

Progressively improved predictions of both the harmonic constants and the correlation between MSL/LAT and AHD can be made as more data is collected. Data collection will continue for a minimum of two years.

4.11.5 Extreme High Tides

The NTF have provided an extreme event analysis of high tide levels and the results are shown in **Table 4.13**. The analysis is based on the 1980 to 1982 data and uses the techniques described in "A Spatial Analysis of Australian Extreme Sea Levels" (Tawn and Mitchell 1998).

The NTF results are referenced to MSL and conversion from MSL to AHD has been made using the NTF analysis of the 2003 to 2004 data, which indicates that MSL is -0.051 mAHD. A conservative analysis has been made using MSL elevation of +0.02 mAHD, thereby adding a 71 millimetre safety margin to the calculated extreme sea levels as shown in **Table 4.13**.

Table 4.13: Extreme High Tide Average Recurrence Intervals (ARI)

Average Recurrence Interval (Years)	Height above Local MSL (m)	Height above AHD (m)	Height Above AHD Including Safety Margin (m)
1.01	0.91	0.86	0.93
5	1.19	1.14	1.21
20	1.31	1.26	1.33
100	1.43	1.38	1.45

4.11.6 Summary of Tides at Cape Jaffa

Through a combination of the historical records (NTF 1980-1984 data), spatial extreme event analysis and recent high frequency gauge data, an assessment of tide level, tidal ranges, extreme tide events and the correlation between Chart Datum and Australian Height Datum has been performed. **Table 4.14** summarises the most relevant parameters in relation to the Cape Jaffa tidal environment.

Table 4.14: Summary of Tides
Source: Appendix 15

Predicted 1 in 100 ARI high tide level [1,2]	1.38 to 1.45 mAHD
Maximum recorded tide from Cape Jaffa 1980-1984 data [1,2]	1.28 to 1.35 mAHD
Maximum recorded tide from Cape Jaffa 2003-2004 data	1.282 mAHD
Maximum recorded tide at Kingston 1946-1952	1.192 mAHD
Lowest recorded tide from Cape Jaffa 1980-1984 data [1,2]	-1.05 to -0.98 mAHD
Lowest recorded tide from Cape Jaffa 2003-2004 data	-0.982 mAHD
Lowest recorded tide at Kingston 1946-1952	-1.158 mAHD
Elevation of Chart Datum	-0.758 mAHD

[1] Note that the 1980 to 1984 Cape Jaffa data incurred errors such that the maximum measured tide may be higher than actual tide and the lowest measured tide may be lower than the actual tide.

[2] Although Mean Sea Level based on NTF analysis is -0.051 mAHD, a safety margin of +0.02 mAHD has been adopted. The range of levels shown corresponds to a range of MSL values of -0.051 mAHD to +0.02 mAHD.

4.12 Waves

4.12.1 Background

> *It is remarkable that Lacepede Bay, although apparently exposed to the ocean swell, affords safe anchorage in all weather, there being tolerably smooth water, even at the height of a W gale. Two reasons account for this; the force of the prevailing SW swell is broken by the reefs off Cape Jaffa, and that from W and NW by traversing a long extent of undulating ground, with comparatively shallow water over it before it reaches the anchorage. There is no surf between Cape Jaffa and a position on the beach 3 miles N of Kingston Jetty, abreast the S end of the sandhills; landing should not be attempted N of this position.* Source: Australian Pilot 1973

The wave environment at Cape Jaffa has been discussed and assessed in Appendix 15 and Appendix 16, which highlight that the relatively calm waters at Cape Jaffa are a result of the significant attenuation of waves associated with the extensive shallow water and the dense seagrass cover throughout Lacepede Bay, combined with the protecting reefs, Cape and north facing beach.

4.12.2 Extreme Wave Heights

In deep water, wave height is a function of wind speed, fetch length and wind duration. In shallower waters, once the relative depth, d/L, where 'd' is the water depth and 'L' is the wavelength between wave crests, is less than about 0.5 then the wave characteristics start to be influenced by the friction losses due to interaction between the wave and the seabed.

The Shore Protection Manual (US Army Corps 1984) is often used for coastal analysis and provides a methodology for determining significant wave height for various water depths. Significant wave height (Hs) is a standard coastal engineering measure of wave height that uses statistical methods to quantify the size of a series of waves as a single figure. The Shore Protection Manual (US Army Corps 1984) enables the calculation of the height of deep water wind generated waves and the effects of bottom friction loss and percolation loss on wave heights.

Spilling waves dominate in areas with very shallow sea floor slopes (flatter than 1:50) such as near Cape Jaffa where the bottom slopes are very flat (1:200 to 1:600) up to 7.0 kilometres offshore (**Appendix 16**). Spilling waves break gradually and are characterised by white water at the crest (**Appendix 15**).

Wave heights in Lacepede Bay for extreme wind events are given in **Table 4.15** and are based on 100 year ARI winds (the maximum wind speed expected once in 100 years), using the higher wind speed from Robe and Cape Jaffa (Curley Hills), based on the methodology of the US Army Corps (1984) Shore Protection Manual (**Appendix 15**).

Table 4.15: Wave Heights from 1 in 100 Year ARI Winds
Source: Appendix 15

Water Depth (m)	Approx Distance Offshore (km)	Significant Wave Height (m)			
		100 yr ARI Max Speed 55 kts	100 yr ARI 1 Hr Ave 48 kts	100 yr ARI 3 Hr Ave 43 kts	100 yr ARI 6 Hr Ave 38 kts
10	5 to 6	1.2	1.0	1.0	0.9
5	1 to 2	1.2	1.0	0.9	0.8
3	0.6 to 1	0.9	0.8	0.8	0.7

The wave heights shown should be considered as conservative as the analysis uses the highest winds from both Robe and Cape Jaffa. Also, no allowance has been made for the protection afforded by the reef system offshore from Cape Jaffa nor from the Cape itself west of the site.

4.12.3 Wave Height Modelling

Wave heights at Cape Jaffa beach have been assessed to determine the breakwater design requirements and to assess prevailing coastal processes, including sand and seaweed movement (**Appendix 16**).

Wave information for a site in deep water off Cape Jaffa has been obtained from the British Meteorological Office (BMO) global wave model for the period 2000 to 2002. This historical deep water wave data has been used to assess the resulting wave climate at Cape Jaffa beach over that same period, ie to “hindcast” the Cape Jaffa beach wave climate. The BMO data includes wave height, direction and period, as well as wind speed and direction (**Appendix 16**).

Both sea waves and swell waves have been investigated. Sea waves are the waves generated locally as a result of the prevailing local winds. Swell waves are the waves generated in the open ocean, which then travel to Cape Jaffa. The height of swell waves arriving at Cape Jaffa is governed by:

- deep water swell wave properties including:
  - height;

- swell direction; and
- swell period (time between successive waves passing the same location).

- the nature of the transmission of waves from the open ocean to Cape Jaffa, which is governed by:
  - water depth;
  - sea bed shape and profile;
  - sea bed friction characteristics; and
  - location and orientation of coast and reefs.

4.12.4 Swell Wave Propagation

Two dimensional wave propagation modelling has been undertaken using the SWAN (Simulating Waves At Nearshore) analysis, which assesses the effects of refraction and seabed friction on the propagation of waves to the coast. The modelling has been used to determine the wave height and direction immediately offshore from Cape Jaffa in 2.5 metres of water. Further analysis is then applied to calculate the wave height at Cape Jaffa beach (**Appendix 16**).

The SWAN model of wave propagation from deep water to Cape Jaffa beach covers an area 60 kilometres x 60 kilometres, as shown on **Figure 4.34**, and extends from deep water where the BMO ocean swell data applies, to the coast. Water depths are taken from charts of the region and converted to MSL. The shallow nature of Lacepede Bay is clearly illustrated and Margaret Brock reef is modelled as a small area of zero water depth west of Cape Jaffa.

Swell waves were modelled at two wave periods (10 and 14 seconds) and two wave heights (2.0 and 4.0 metres). Sensitivity tests were run for a range of representative wave directions to identify any variations in the height and direction of waves arriving nearshore at Cape Jaffa at 2.5 metres water depth. Waves from directions north of west were treated as sea waves.

The modelling shows that the deep water waves undergo significant change in the process of propagating to water 2.5 metres deep off Cape Jaffa and **Table 4.16** below gives some examples of the modelling results. Further details are provided in **Appendix 16**.

Table 4.16: Modelled Wave Heights at 2.5 metres Water Depth Off Cape Jaffa

Deep Water Swell		Resulting Swell Waves at Cape Jaffa in 2.5 metres Water Depth	
Height	Direction	Height	Direction
2 metres	South 180°	0.36 metres	West northwest 299°
4 metres	South 180°	0.47 metres	West northwest 299°
2 metres	West 270°	0.76 metres	Northwest 316°
4 metres	West 270°	0.94 metres	Northwest 316°

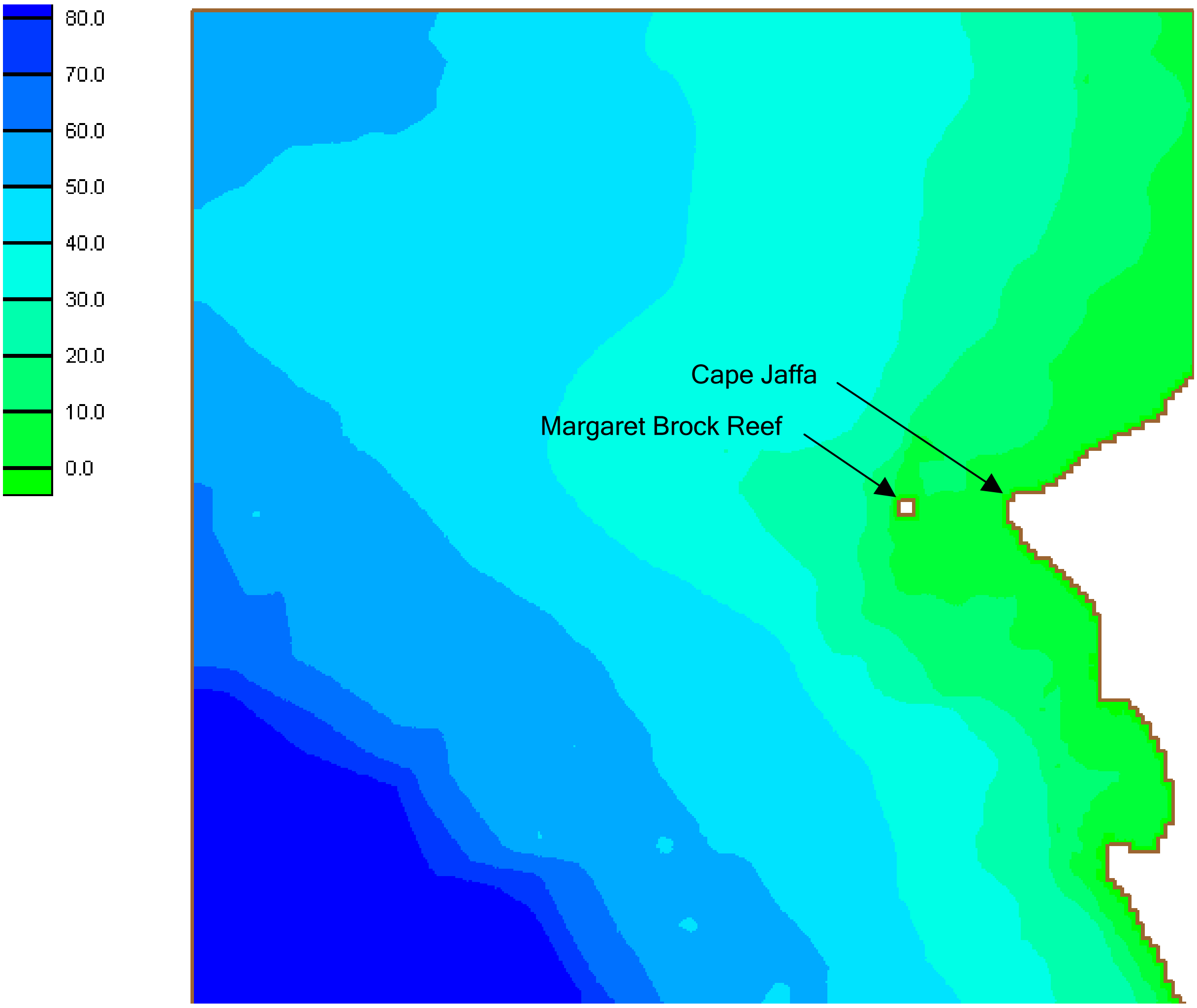


Figure 4.34: SWAN Wave Model
Source: **Appendix 16**

4.12.5 Seabed Friction Effects

As discussed previously, seabed friction plays a significant role in attenuating waves, particularly in shallow water. **Figure 4.35** shows the Cape Jaffa nearshore seabed profile and **Figure 4.36** shows offshore wave height reduction due to seabed friction over a distance of 5.0 kilometres from Cape Jaffa, clearly illustrating that the waves are reduced in height significantly as they approach the Cape Jaffa beach. It is noteworthy that the larger the wave, the greater the extent of wave height reduction, due to the increased bed friction associated with the larger waves (**Appendix 16**).

Figure 4.36 shows that waves at the shore never exceed 1.5 metres, regardless of the deep water wave height. Further, when the additional effect of refraction is also considered, the resultant wave height at Cape Jaffa beach does not exceed about 1.0 metre, regardless of the deep water swell height.

The seabed friction effect has been modelled using a conservative friction factor of 0.03 (Collins method). Sensitivity tests were undertaken with several bed friction methods and factors, noting that the seabed in the region is highly irregular where the reefs occur and is covered in dense seagrass closer to the shore. It would be expected that friction attenuation in this area would be greater than would apply for a relatively smooth seabed, as has been used in the modelling, thus the modelling is considered to be conservative.

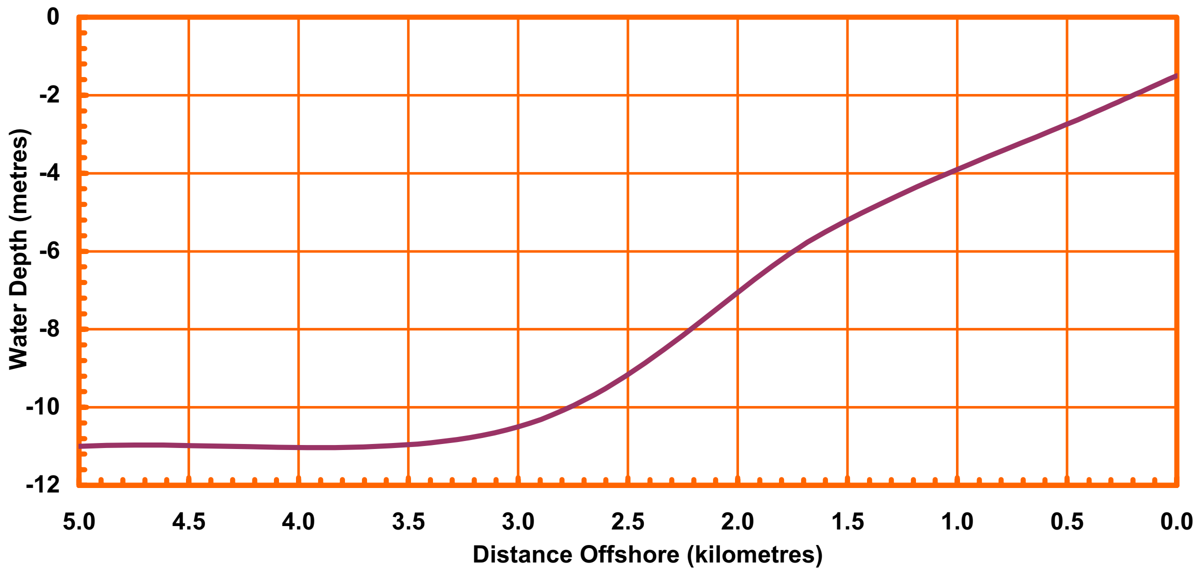


Figure 4.35: Modelled Nearshore Water Depth verses Distance Offshore from Cape Jaffa
Source: Appendix 16

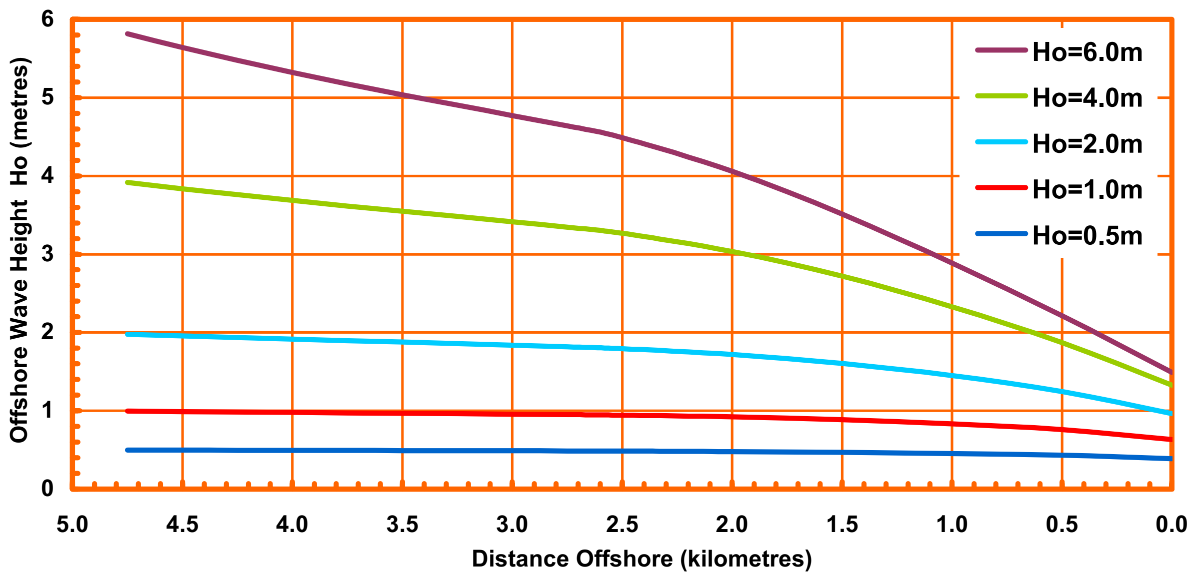


Figure 4.36: Modelled Nearshore Bed Friction Attenuation for Various Deep Water Wave Heights
Source: Appendix 16

4.12.6 Locally Generated Sea Waves

In addition to the SWAN modelling of the propagation of swell waves, locally generated sea waves have been considered. The height of sea waves is governed by the wind strength, wind direction, water depth, near shore profile, fetch length and the coastal topography and orientation. For directions from west through north east, locally generated sea waves have been calculated using hindcast techniques and the BMO wind speed, direction and period data.

4.12.7 Nearshore Wave Propagation

The propagation of sea and swell waves from nearshore onto the beach is affected by sea bed friction, refraction, shoaling and breaking. Standard coastal engineering techniques applied to the results of the wave calculations described above allow determination of the height, direction and period of waves at Cape Jaffa beach. **Table 4.17** shows examples of the resulting waves at Cape Jaffa beach for waves generated by deepwater swell.

Table 4.17: Modelled Swell Waves at Cape Jaffa Beach

Deepwater Swell		Resulting Waves at Cape Jaffa in 2.5 metres Water Depth		Resulting Waves at Cape Jaffa Beach	
Height	Direction	Height	Direction	Height	Direction
2 metres	South 180°	0.36 metres	west north-west 299°	0.32 metres	north-west 309°
4 metres	South 180°	0.47 metres	west north-west 299°	0.4 metres	north-west 311°
2 metres	West 270°	0.76 metres	north-west 316°	0.63 metres	north-west 321°
4 metres	West 270°	0.94 metres	north-west 316°	0.75 metres	north-west 321°

4.12.8 Wave Model Calibration

In order to better understand the wave climate at Cape Jaffa, a gauge was installed on the Cape Jaffa jetty in September 2003 (see **Section 4.11** for further information). The maximum wave height (Hmax) is calculated from the maximum and minimum measured water levels in each five minute interval. It should be noted that this technique results in the measured Hmax being slightly greater than the actual Hmax, as the gauge measures the difference between the highest wave crest and the lowest wave trough in each five minute interval, rather than the height of the highest individual wave.

Figure 4.37 shows the significant wave height at the gauge, calculated using conventional coastal engineering methods to convert from Hmax to Hs, for the period September 2003 to November 2003. Also shown are the corresponding heights of the waves breaking at Cape Jaffa beach, calculated using conventional wave shoaling and breaking criteria.

For comparison, **Figure 4.38** shows the deep water wave height for the period 15th to 31st September 2003 (obtained from www.buoyweather.com).

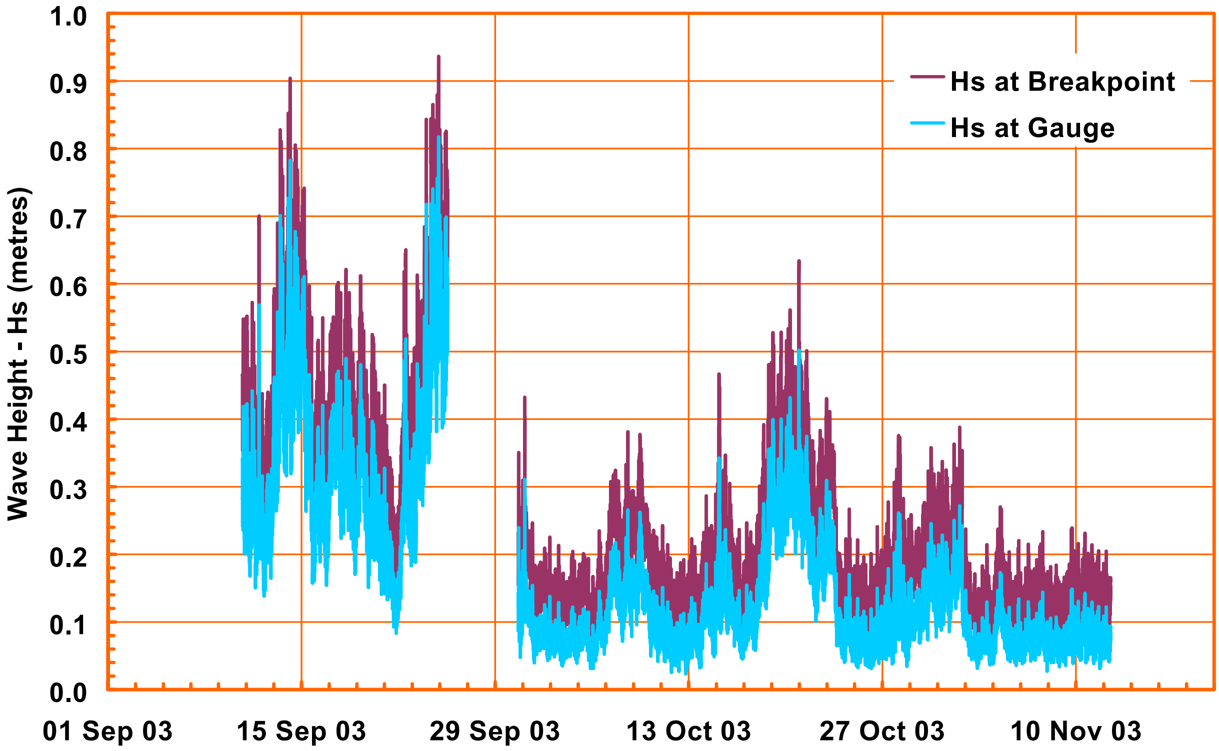


Figure 4.37: Measured Wave Heights - Cape Jaffa Jetty

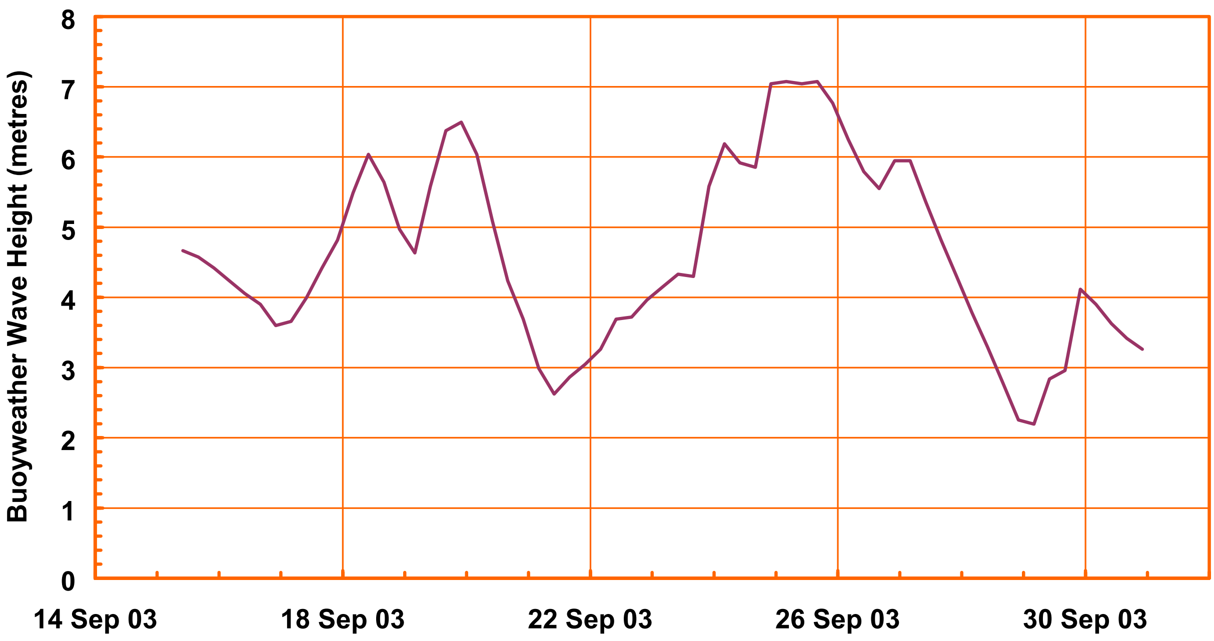


Figure 4.38: Deep Water Buoyweather Wave Heights

Comparison of **Figure 4.38** and **Figure 4.39** shows the extent of wave attenuation between deep water and Cape Jaffa. For example, during 25th to 26th September 2003, deepwater wave heights reached approximately 7.0 metres but the resulting waves arrived at Cape Jaffa jetty with a height of only about 0.7 metres.

In order to assess the accuracy of the model, the Buoyweather data for the period 15th to 26th September 2003 has been used to model waves at Cape Jaffa and the results compared to the gauge data. This comparison shows that the model wave heights are 20 percent to 30 percent higher than the actual waves. Based on this comparison, and from general observations and discussions with local fisherman it is clear that the modelled wave heights are conservatively high and as a result the modelled wave heights have been reduced by 15% and are still considered to be conservatively high.

This analysis gives confidence that the modelled and calculated wave heights are sufficiently reliable for impact assessment and planning purposes, including the assessment of sand movement that results from the waves.

4.12.9 Wave Modelling Results

Figure 4.39 shows the modelled wave heights at Cape Jaffa beach during the period 2000 to 2002. The swell waves are more frequent, however the largest waves are fetch-limited ‘sea’ waves, typically from the north to north west during June to October.

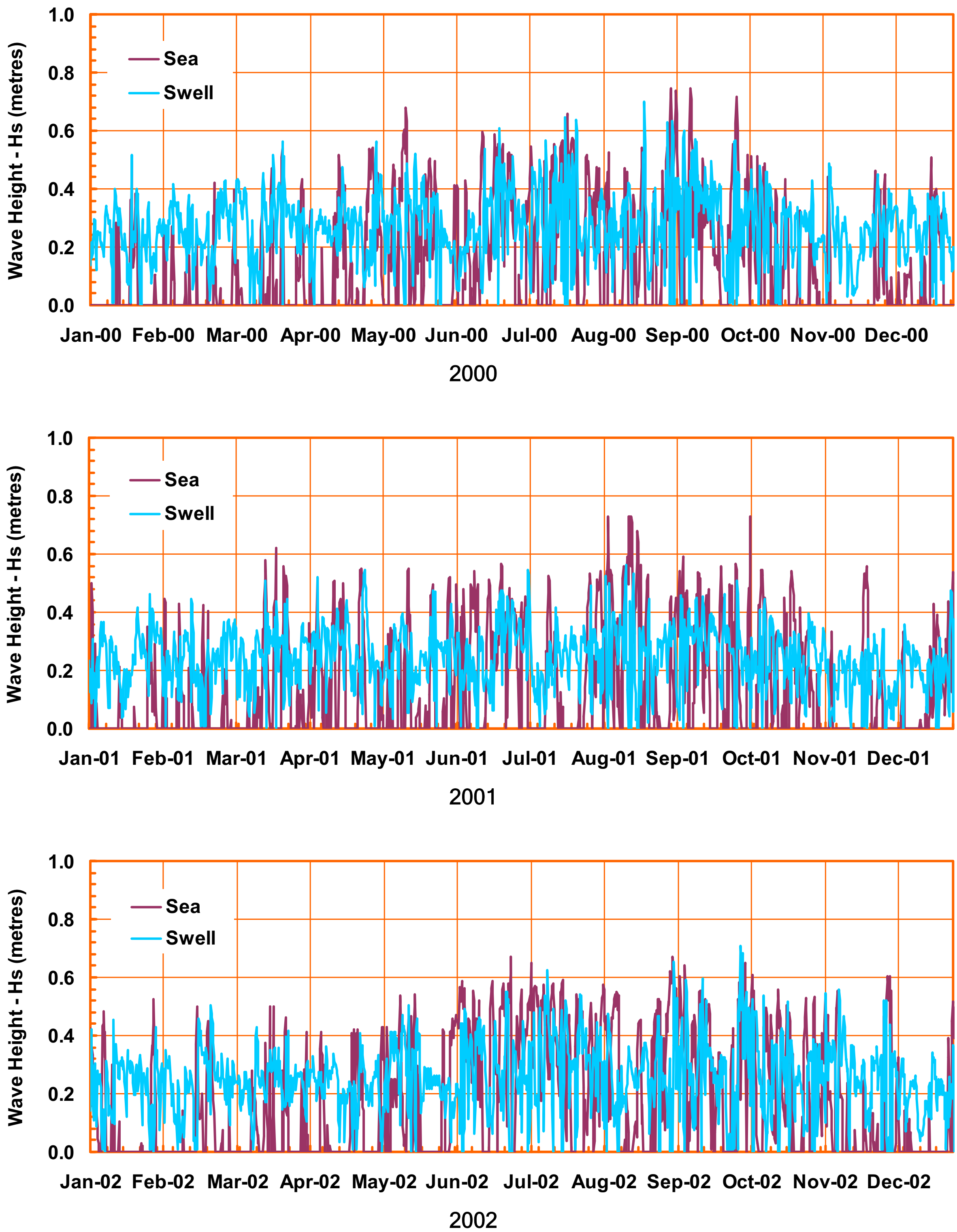


Figure 4.39: Wave Heights at Cape Jaffa Beach 2000-2002

Source: Appendix 16

4.13 Coastal Profile and Longshore Sand Drift

4.13.1 Coastal Evolution

The evolution of the coastline near Cape Jaffa has been analysed on a number of different time scales in order to gain an understanding of the processes that have, and continue to have, an effect on the coast. The timeframes investigated are:

- the 'recent' geological past since the last major sea level change approximately 7,000 years ago (**Section 4.13.2**);
- the recent contemporary past, during which survey and aerial photography data has been acquired and is available, approximately the last 100 years (**Section 4.13.3**); and
- the duration of the current investigations since June 2003 (**Section 4.13.4**).

4.13.2 Coastal Evolution Since the Last Major Sea Level Change

The evolution of the shoreline at Cape Jaffa shows clear evidence of substantial net accretion, that is accumulation of material and seaward progress of the coast over the 7,000 years since the end of the last major transgression of the sea. This is seen in the context that, between about 18,000 years and 7,000 years ago the sea level rose some 120 metres, creating a new shoreline. The present day shoreline has evolved since that time (**Appendix 16**).

Where there has been significant accretion of the coast, as at Cape Jaffa, there is indication of net long term supply of sediment at a rate greater than its removal. That is not to say that the present day pattern of sand supply and transport remains at the longer term average. Indeed, some coastal areas have accreted initially and then eroded more recently as the supply of sediment diminished relative to its removal (**Appendix 16**).

Nevertheless, the geological history of this accreting shoreline provides considerable useful information as supporting evidence in determining the contemporary coastal evolution and sand transport regime. The following information has been drawn predominantly from the referenced publication by Short and Hesp (1980).

The 190 kilometre section of curving sandy coast from the Murray Mouth to Cape Jaffa represents a classic example of spatial variation in nearshore energy and beach surf zone morphology controlling the evolution, extent and nature of the entire coastal system (Short and Hesp 1980). Two factors are paramount in the evolution of this coast:

- the gradient of the nearshore seabed profile; and
- the breaker wave energy.

10 metre water depth occurs about 2.0 kilometres offshore near the Murray Mouth, whereas it is some 18 kilometres offshore at Lacepede Bay. This wider zone of wave propagation across relatively shallow water, together with the sheltering provided by shallow offshore reefs (North Rock, Margaret Brock Reef and South Breaker), has a significant effect in attenuating wave energy at the shore at Cape Jaffa (**Appendix 16**), as indicated by the results of the wave propagation modelling present in **Section 4.12**.

Although Short & Hesp (1980) describe the wave energy in Lacepede Bay as 'zero', this is not strictly the case. Waves at the coast originating from deepwater swell do exist but are very small throughout Lacepede Bay, so the local wind generated waves become more important in influencing the beach at Cape Jaffa. Wave energy does affect the shoreline and cause sand movements, albeit at a much lower level than at the shoreline further to the north or south (**Appendix 16**). The waves climate at Cape Jaffa is presented previously in **Section 4.12**, and waves and sand movement are discussed in detail in **Appendix 16.**

Short & Hesp (1980) describe the beaches of the area as:

- low to moderate beach gradients;
- medium to coarse sand;
- 70 percent to 80 percent carbonate content; and
- relatively wide Holocene accretionary dune system of average width about 1.65 kilometres, featuring extensive recurved spits, enclosed lagoons and beach ridges.

Notably, Short & Hesp (1980) report that: "Since the Holocene rise in sea level, a tremendous amount of sediment has moved around Cape Jaffa and been deposited in Lacepede Bay."

The clear implication of this is that a significant proportion of the sand that now forms the coastal dune system at Lacepede Bay has been derived from material moving along the coast around Cape Jaffa and past the proposed development site. It is likely that this sediment has been sourced as material from the extensive shallow limestone reefs offshore from Cape Jaffa, of which Margaret Brock Reef, North Rock and South Breaker form part.

This is supported by the existence of accreted dunes at the tip of the Cape itself and the relatively high (10 metres) and extensive dune accumulation to the south east of the Cape, with no other apparent sand source. It is also consistent with the nature of the sediment, shown by petrographic analysis to contain predominantly marine calcareous minerals and also shown to be of similar particle size to that present on the current beach and coastal dune (**Appendix 16**).

Figure 4.40 shows the spatial extent of the Holocene accretion of the shoreline. It occurs predominantly along the 21 kilometres between the jetties at Cape Jaffa and Kingston, pinching down to a narrower dune system width beyond Kingston. Short & Hesp (1980) Table 2 reports a total dune system accumulation of about 184 x 10^6 cubic metres of sand in Lacepede Bay since the sea level reached its present level about 7,000 years ago and Table 3 reports a Holocene rate of sediment supply to Lacepede Bay of about 26,300 m^3/yr. Further, Short & Hesp (1980) indicate an average progradation of the coast of 1.65 kilometres, or about 0.25 m/yr, since the sea reached its present level.

In an effort to explain ridges observed on the seabed in Lacepede Bay, Short & Hesp (1980) described nearshore sand waves (submerged ridges of sand aligned obliquely transverse to the shore) and associated shoreline protrusions (where the sand waves attach to the coast) moving through the Bay, which is analogous to Geographe Bay in Western Australia. They proposed that cycles of coastal erosion/accretion of the order of 300 metres, with a period of 100 to 1,000 years, may occur as a sand wave and shoreline protrusion move northeast through the bay.

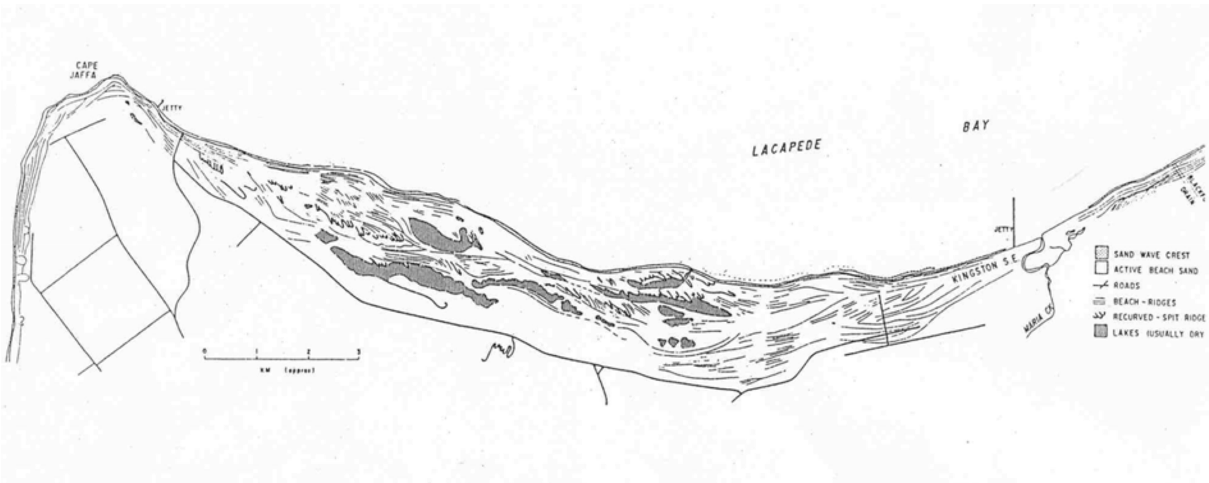


Figure 4.40: Morphologic Forms of the Cape Jaffa Holocene Coastal Plain (Recurved Spits, Beach Ridges and Lakes)
Source: Short & Hesp 1980

The presence of sand waves moving through Lacepede Bay has since been determined to be not the case (**Appendix 16**). The shallow nearshore protrusions are in fact hard limestone bedrock ridges and hence not mobile in the manner described.

Despite this, much of what Short and Hesp (1980) conclude in regard to the evolution of the coast is well supported by the evidence, albeit by different mechanisms. The shoreline protrusions do have effects on the shoreline shape through their effects on wave propagation and sand transportation along the coast. Natural embayment and erosion cycles have occurred within the overall accretionary trend, as indicated by the variable orientation and the variable, crenulate shape of the Holocene beach ridges shown in **Figure 4.40**. Recent aerial photography indicates that the current coast exhibits similar morphology (**Section 4.13.3**).

The erosion/accretion cycles are expected to be a result of the complex dynamics associated with the interaction of the ridged nearshore seabed topography, the wave orientation, the shoreline orientation/shape and the combined effect these factors have on the wave to beach angle and hence longshore transportation of sand.

The evolving wave to beach angle results in changing rates of beach accretion/erosion which is understood to change the beach orientation and in turn alter the wave to beach angle. This complex interaction between the factors governing the dynamics of the coastal processes results in complex cycles of beach orientation and embayment within the overall accretionary trend in the evolution of the coast.

It is reasonable to suppose that reworking of the overall accretionary coast to a depth similar to the amplitude of current and Holocene shoreline protrusions, as postulated by Short and Hesp (1980), will continue to occur. The geological evidence provides indications as to the extent of the cyclic reworking of the coast, however the timeframe over which these cycles occur is more difficult to assess.

4.13.3 Recent Evolution of the Coastal Profile

The evolution of the coastline over approximately the last 100 years has been analysed by comparison of aerial photography and survey of the coast in order to gain an understanding of the coastal processes effecting the coast at Cape Jaffa. Figure 4.41 below shows a portion of the marine navigation chart and depicts coastal features influencing the evolution of the coast. Figure 4.4 contains an expanded portion of the marine navigation chart. Note the reef system to the west and south of the Cape, which has a significant effect on the wave environment at Cape Jaffa, as presented in Section 4.12. Also note the shoreline protrusions near the north east extent of the image approximately 4.0 kilometres from the proposed breakwater site, backed by Hog Lake and a minor protrusion at the eastern extent of the site.

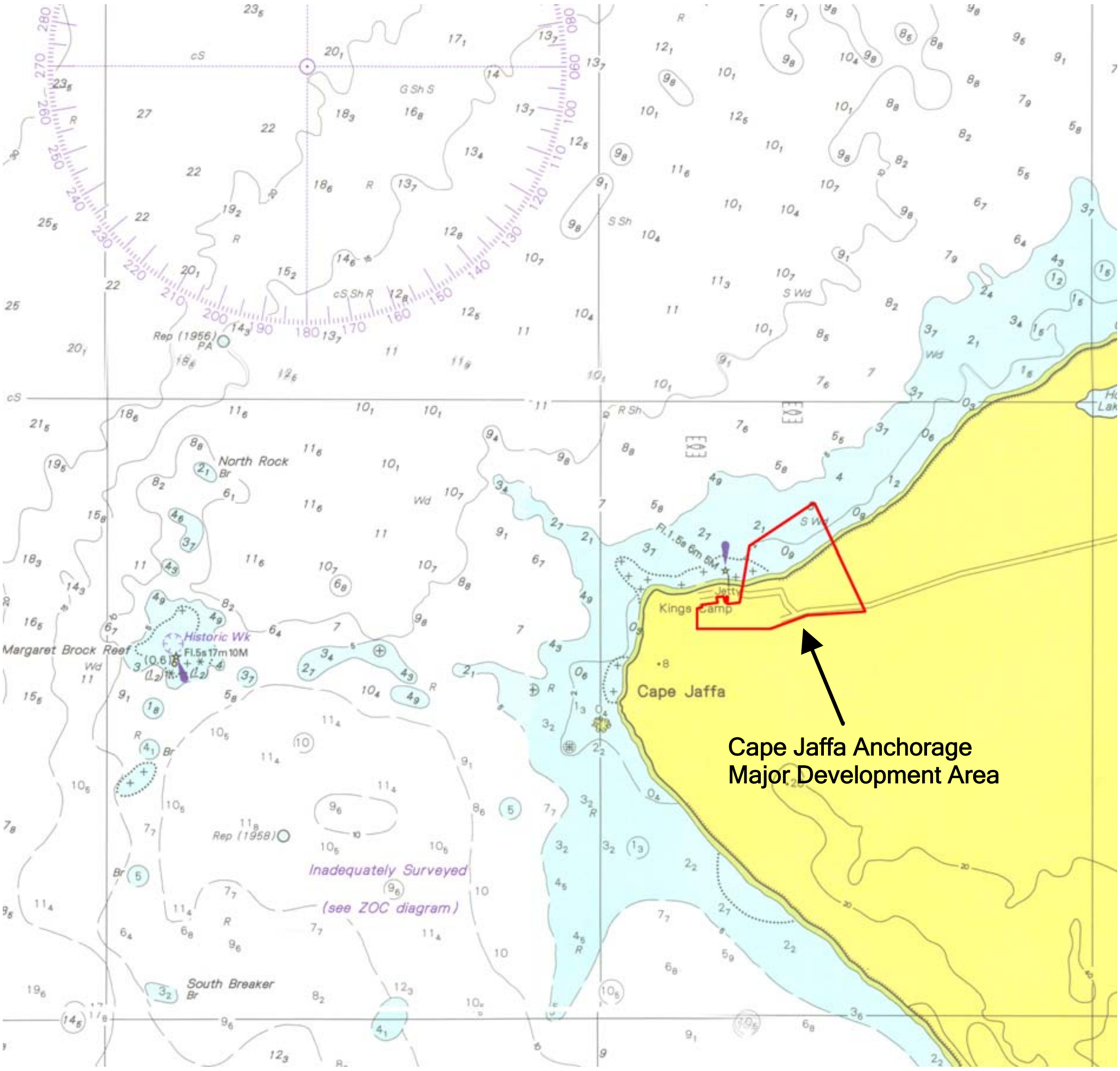


Figure 4.41: Cape Jaffa Coastal Features

Source: Australian Hydrographic Service 2001

Oblique aerial photographs of features that affect the evolution of the coast are shown as **Figure 4.42**, **Figure 4.43** and **Figure 4.44**. Also shown in the figures is the approximate extent of the Major Development area.

Figure 4.42: Oblique Aerial Photograph Looking South-West to the Cape Jaffa Settlement

Figure 4.42 shows spilling waves breaking on a shallow ridge adjacent to a shoreline protrusion in the foreground, which is visible as light coloured limestone without seagrass coverage. Note the smaller shoreline protrusion at the near (eastern) extent of the Major Development area. It also shows the numerous minor protrusions along the coast (crenulated shoreline) that result from the complex interaction between the nearshore seabed topography, wave orientation to the beach and longshore sand transportation rate.

Figure 4.43: Oblique Aerial Photograph Looking North-East from Cape Jaffa

Figure 4.43 shows waves breaking on the shallow reef west of the jetty in front of the existing settlement. It also shows waves breaking on the shallow limestone ridge in the background, as seen in the foreground of **Figure 4.42**. The shallow ridge is attached to a shoreline protrusion that is backed by Hog Lake and a second protrusion is visible beyond. Again note the smaller shoreline protrusion at the far (eastern) extent of the Major Development area. The figure also indicates the wave orientation to the beach and the effect that the undulating water depths has on wave orientation. Note that on this particular day deepwater swell was from the south-south-west and the waves landing at Cape Jaffa beach were from approximately the north-west.

Figure 4.44: Oblique Aerial View Looking South from about 3.0 kilometres North of Cape Jaffa

Figure 4.44 shows waves breaking on the multiple inner reef systems to the west of Cape Jaffa in the right of the figure. Waves breaking on the South Breaker, which is the southern extend of the outer Margaret Brock Reef, are visible in the background at the right of the figure.

Subsequent to Short & Hesp (1980) nominating areas of potential shoreline erosion and accretion along the coastline, the Coastal Protection Board performed a review of the evolution of the coastline in the Cape Jaffa area (Mavrinac 1984). This report compared the location of the edge of the coastal vegetation from aerial photography in 1945, 1975 and 1981 with 1886 survey data, in order to assess the movement of the coastline.

Mavrinac (1984) identifies areas of both accretion and erosion. Erosion is shown to be dominant from a point just west of the proposed breakwater site to approximately 1.5 kilometres north east of the proposed breakwater site over the 100 years investigated. However, Short and Hesp (1980) identified this area as one of accretion over a similar timeframe and proposed that it is likely to be subject to potential erosion over the next few decades. Mavrinac (1984) concludes that the *"Cape Jaffa vicinity is under constant active change"*.

In order to better understand the coastline movement in the area, a similar review has been recently conducted which includes the more recently available photographs and uses the more sophisticated assessment techniques that are now available (Appendix 17). Images from 1958, 1975, 1981, 1997, 2000 and 2002 were rectified to the topographical survey that was completed as part of the recent investigations. Current mapping technology was used to align notable features such as roads and buildings to the surveyed positions of these features and thus ortho-register the aerial photographs.

The edge of the coastal vegetation and the visible waterline are identified on each photo. The edge of the coastal vegetation is more easily identified than the waterline and appears to provide a more reliable and longer term indication of the movement of the coast, although similar trends are shown from both methods. This study generally supports the Mavrinac (1984) findings. Accretion is dominant in some areas and erosion in other areas. From the tip of the Cape to a point near the proposed breakwater an overall accretionary trend has occurred since 1958.

In the eastern part of the site, from the existing boat ramp/beach access to the eastern extent of the site, the coastline has experienced net erosion since 1958, however in more recent times, this eastern area is showing signs of accretion. This further strengthens the conclusion of both Mavrinac (1984) and Short & Hesp (1980) that the coastline undergoes ongoing natural cycles of erosion and accretion. Table 4.18 below summarises the coastal movement observed by comparison of aerial photography.

Table 4.18: Coastal Movement - Aerial Photography Comparison
Source: Appendix 17

	Coastal Movement					
	1958-1975	1975-1981	1981-1997	1997-2000	2000-2002	Overall
At the Cape	Accretion	Erosion	Accretion	Accretion	Erosion	Accretion ~50m
Cape to jetty	Accretion	Accretion	Accretion	Accretion with some areas of slight erosion	Accretion with some areas of slight erosion	Accretion ~50m at Cape declining to 13m at Jetty
Jetty to proposed breakwater site	Accretion at jetty, erosion toward breakwater	Accretion at jetty, erosion toward breakwater	Erosion with some areas of accretion	Accretion	Accretion with some areas of slight erosion	Accretion ~13m at jetty trending to erosion (~20m) at breakwater
At proposed breakwater	Erosion	Erosion	Erosion	Accretion	Accretion	Erosion ~20m
Proposed breakwater to site boundary	Mainly erosion	Erosion	Erosion	Accretion at breakwater, trending to erosion	Accretion	Erosion: ~20m at breakwater, increasing to ~40m at 300-800m then decreasing to ~35m at site boundary
North east of the site	Erosion with an areas of accretion	Erosion (decreasing to the north east)	Erosion (decreasing to the north east)	Erosion	Accretion	Erosion: ~35m at site boundary, decreasing to ~10m at north eastern extent of assessment

Figures 4.45 to 4.50 show the ortho-registered aerial photography and lines defining the edge of both the coastal vegetation and the visible waterline at 1958, 1975, 1981, 1997, 2000 and 2002. Also shown is the Major Development boundary (Appendix 17).

Figure 4.51 shows the edge of the coastal vegetation from each of the aerial photographs analysed together with the 2002 aerial photograph. Figure 4.52 shows an enlarged portion in the vicinity of the proposed development.

In order to better depict the coastal movement, Figure 4.53 is a plot of the movement of the coastal vegetation line (since 1958) verses distance along the coast (Appendix 17). The plot shows, for each of the photographs, the perpendicular offset from the 1958 vegetation line verses longitudinal distance along that line.

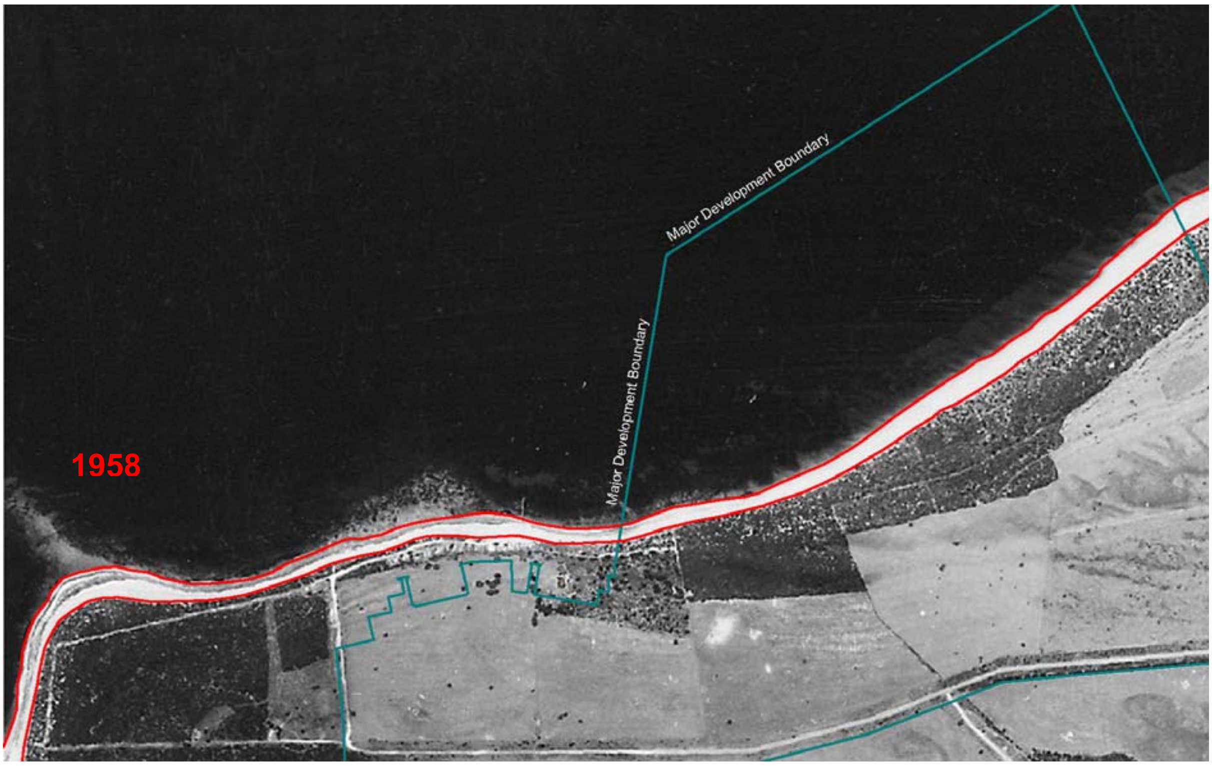


Figure 4.45: Coastal Profile – 1958, Showing the Visible Waterline and Coastal Vegetation Line

Figure 4.46: Coastal Profile – 1975, Showing the Visible Waterline and Coastal Vegetation Line

Figure 4.47: Coastal Profile – 1981, Showing the Visible Waterline and Coastal Vegetation Line

Figure 4.48: Coastal Profile – 1997, Showing the Visible Waterline and Coastal Vegetation Line

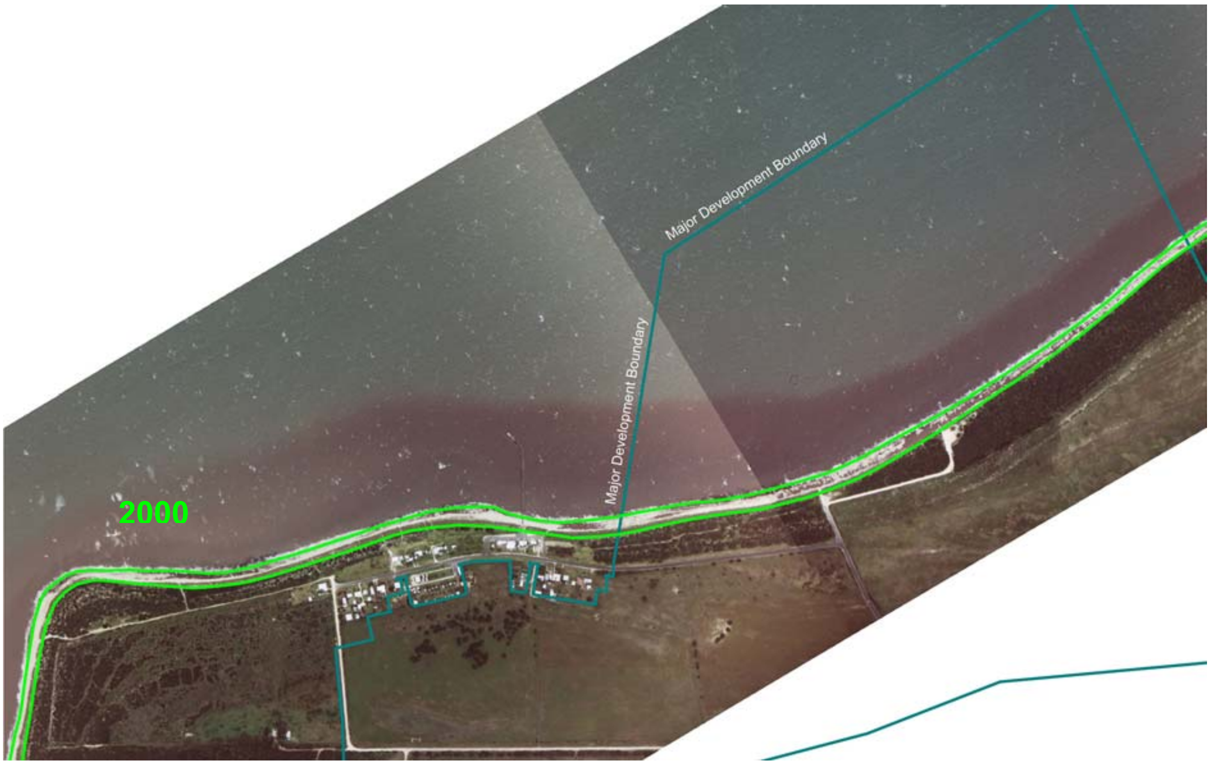


Figure 4.49: Coastal Profile – 2000, Showing the Visible Waterline and Coastal Vegetation Line

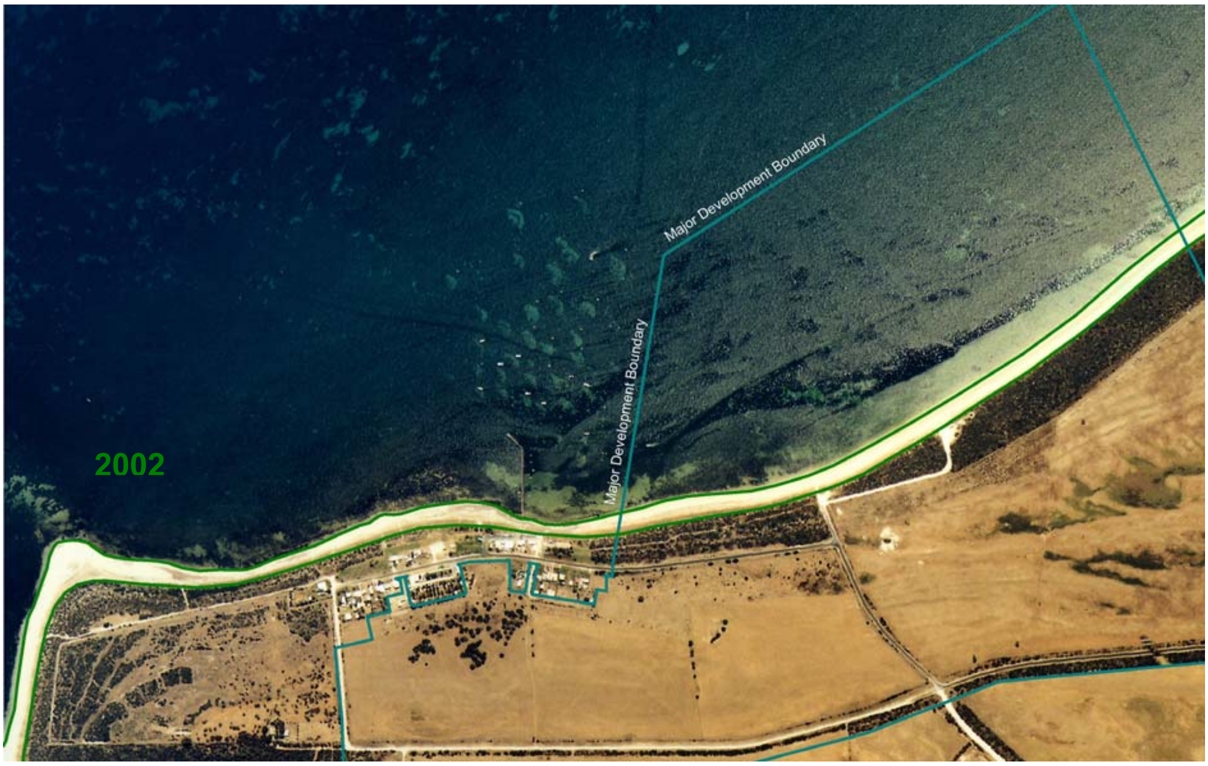


Figure 4.50: Coastal Profile - 2002, Showing the Visible Waterline and Coastal Vegetation Line

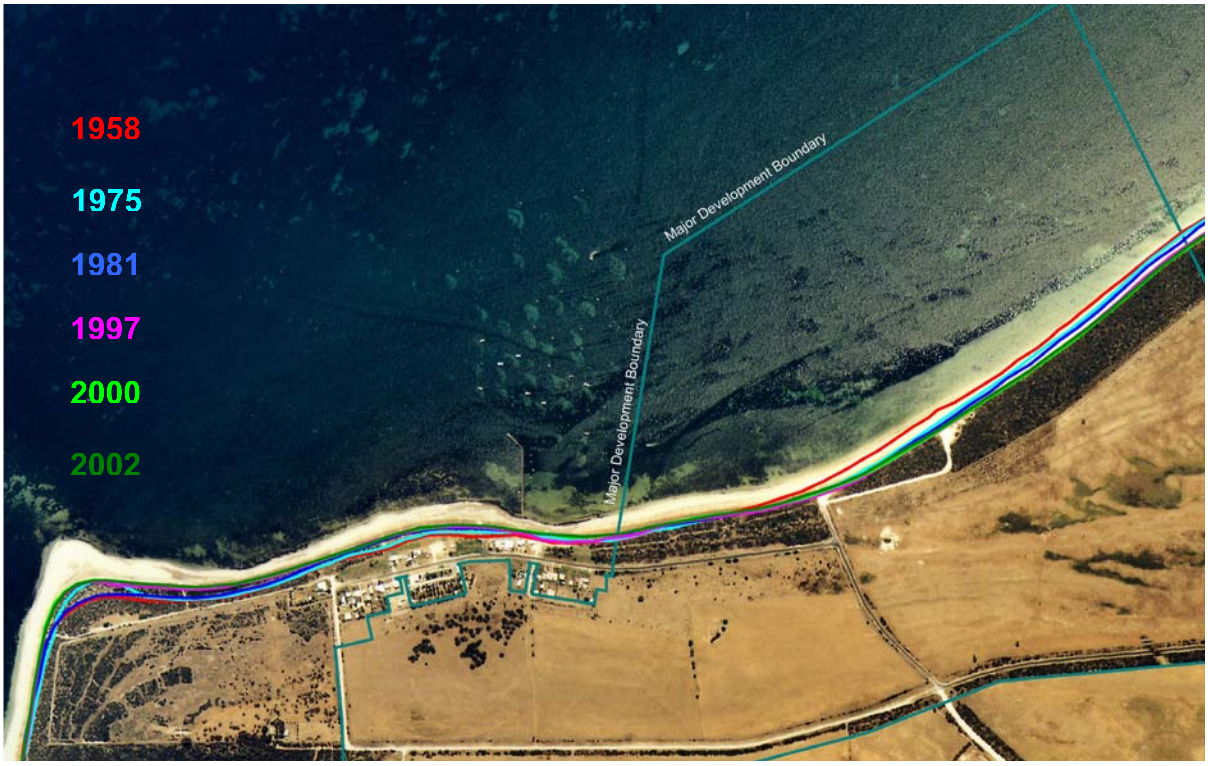


Figure 4.51: Evolution of Coastal Profile Since 1958

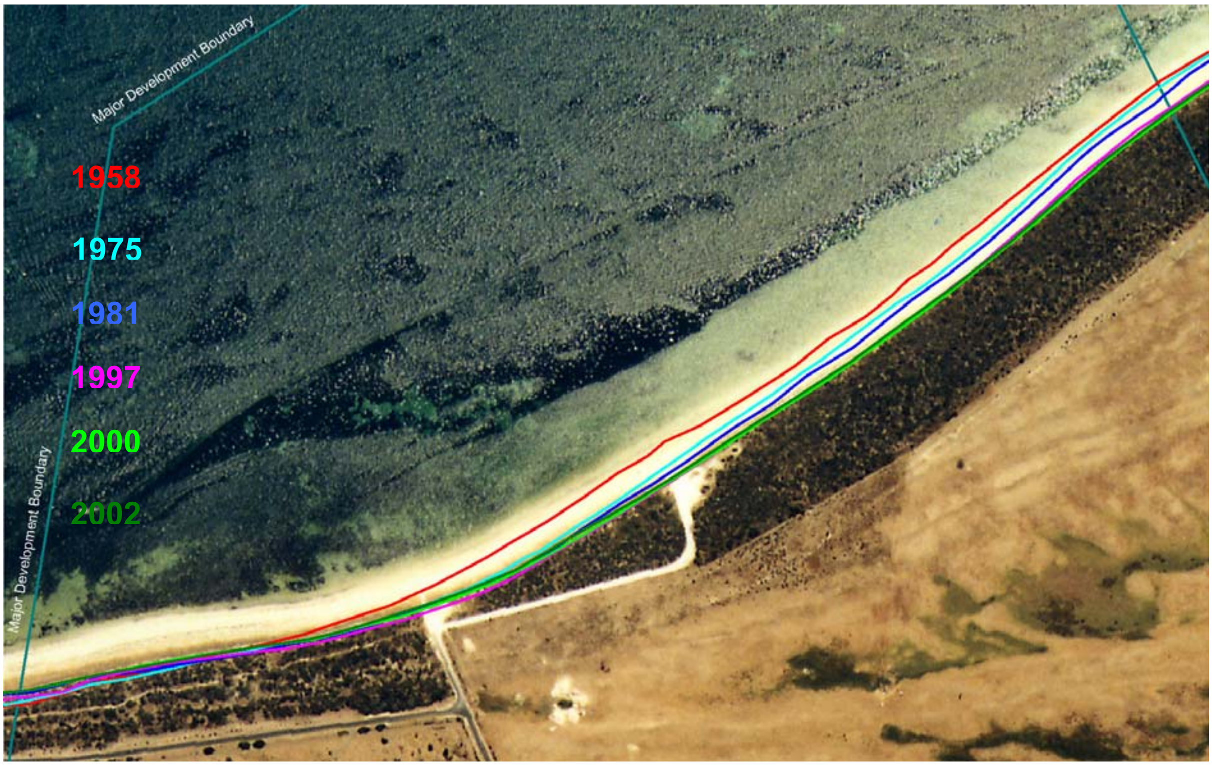


Figure 4.52: Evolution of Coastal Profile in the Eastern Portion of the Site Since 1958

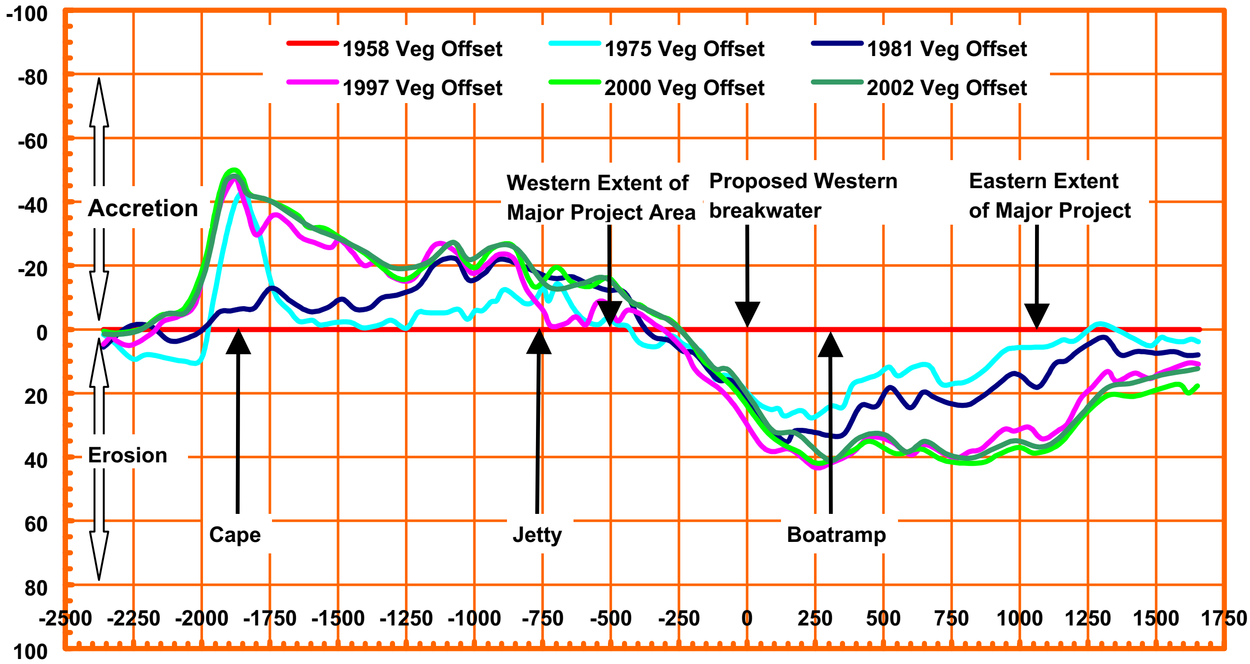


Figure 4.53: Cape Jaffa Coastal Accretion and Erosion Since 1958
Source: Appendix 17

4.13.4 Current Coastal Profile

For the duration of the current investigations, since mid 2003, the dune, beach and seabed in the vicinity of Cape Jaffa has been surveyed in order to define the existing nearshore environment. An initial survey was conducted in July 2003 and included detailed survey of the coastal dune, back-beach, beach and seabed (**Appendix 17**).

The seabed survey was conducted by Flinders Ports Pty Ltd in 2003 and covered a 2.1 kilometre wide area (centred on the proposed breakwater site) and extended between 1.0 and 1.4 kilometres from the beach. It was conducted utilising contemporary hydrographic survey methods whereby lines of high resolution depth soundings were acquired by boat. Positioning was by GPS equipment and the sounding data was referenced to AHD via a tide gauge installed on the jetty for the duration of the survey. In addition, Flinders Ports surveyed the beach and shallow water using land based techniques in order to achieve an overlap with the terrestrial survey (**Appendix 17**).

Land based survey was conducted by Allsurv Engineering Surveys Pty Ltd in 2003 and included:

- overlap survey of the beach;
- sections through the coastal dunes;
- survey of the existing roads/tracks;
- level survey over the site of the proposed development;
- an outer boundary survey of the subject land; and
- survey of various features of interest in the area (for example jetty, beach access ramp, car parks, etc).

Figure 4.54 shows seabed and coastal profiles in the vicinity and **Figure 4.55** shows detailed cross sections along the beach close to the proposed breakwater site. **Figure 4.56** shows a plan with contours of the nearby seabed and also shows the beach and coastal dune survey and the Major Development area. Note that the sections are approximately perpendicular to the coast and the section names indicate the distance 'eastward' along the coast from the proposed entrance to the waterways, such that positive distances are 'east' (more accurately north east) of the entrance and negative distances are 'west' (south west) of the entrance (**Appendix 17**).

The profiles at and 'east' of the proposed breakwater, between 50 metres and 150 metres offshore, show a deepening of water depths to much as 3.0 mAHD, whereas further offshore at 200 to 250 metres from the coast, depths shallow to approximately 2.0 mAHD. Further offshore again, at more than approximately 200 metres from the coast, the profiles are all similar, although the water is deeper toward the 'east' (**Appendix 17**).

Generally, the beach exhibits a relatively constant shallow grade of 7 percent (4 degrees or 1 in 14) over a width of about 30 metres, from about -0.8 mAHD to +1.2 mAHD.

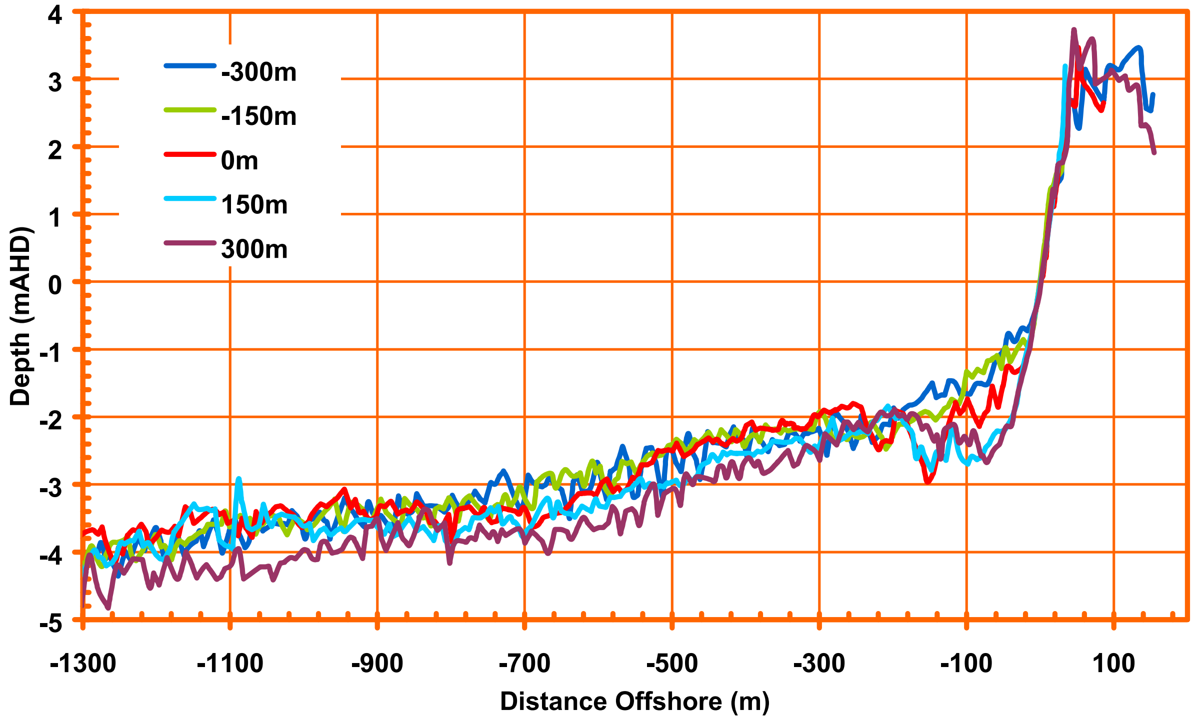


Figure 4.54: Seabed and Coastal Profiles
Source: Appendix 17

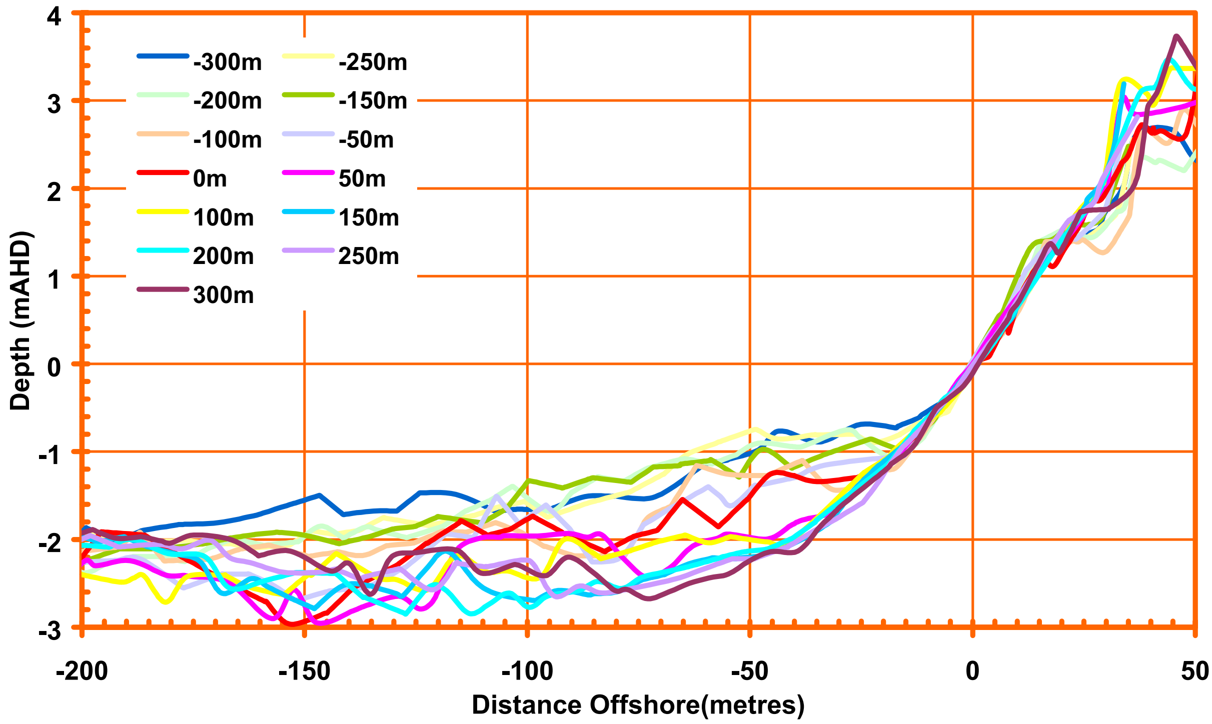


Figure 4.55: Nearshore Seabed and Coastal Profiles
Source: Appendix 17

Figure 4.56: Plan of Seabed Contours and Location of Seabed, Beach and Dune Profile Lines
Source: **Appendix 17**

Beach Profile Changes Between July 2003 and February 2004

As part of understanding the current coastal processes, the changes in beach profile that have occurred over approximately a seven month period has been made in order to assess the lateral beach shift and beach volume changes that have occurred as a result of the existing sand transportation processes. A survey has been performed at July 2003, November 2003 and February 2004 (**Appendix 17**).

The beach survey sections have been performed from approximately the low waterline to the vegetated back-beach, along profile lines that are spaced about 50 metres apart, covering approximately 300 metres along the beach either side of the proposed breakwater location. Cross sections were then generated along each profile and are shown in **Figure 4.57.**

Figure 4.58 shows lines of +1.0 mAHD elevation for each survey, which provides an indication of coastal movement over the period between surveys.

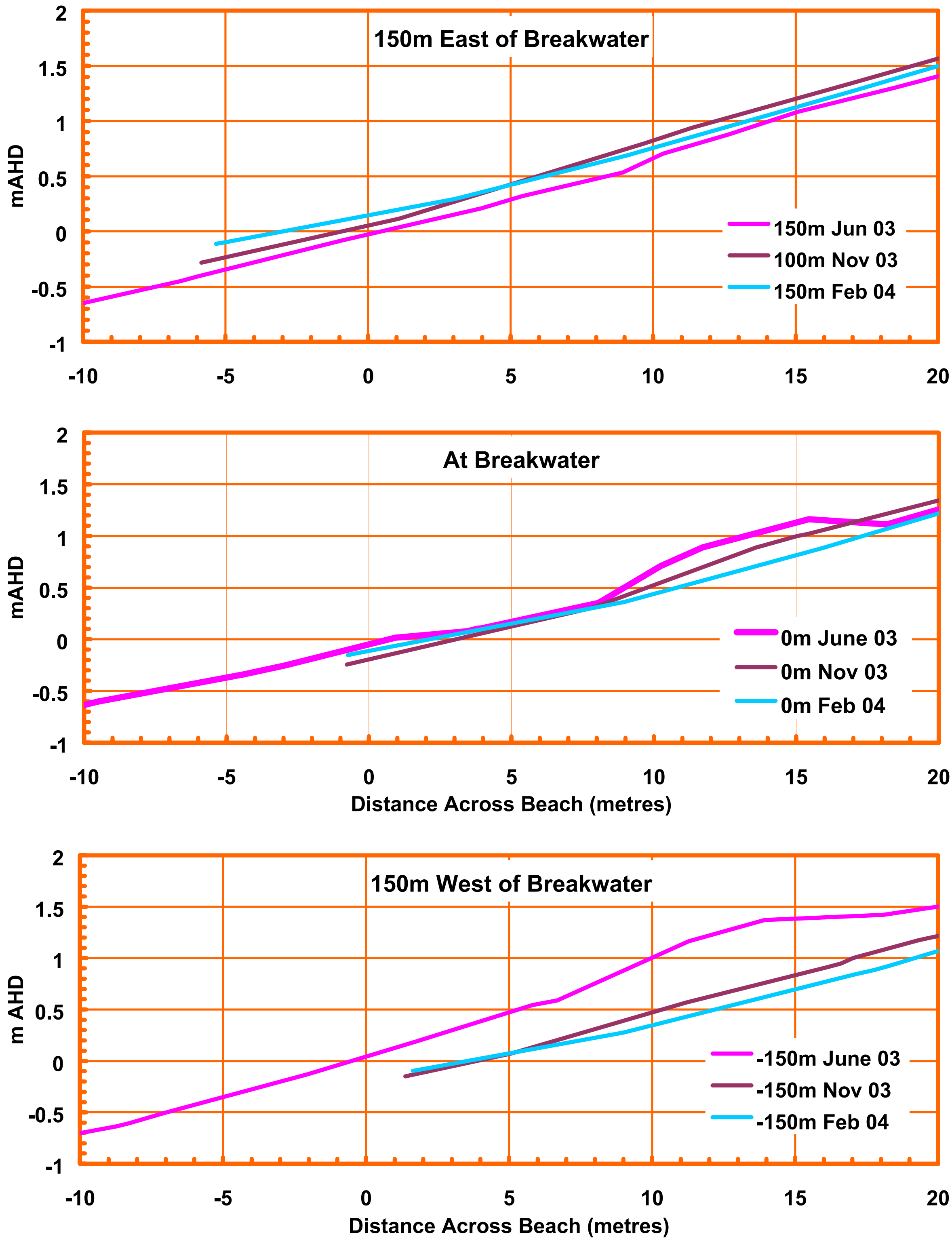
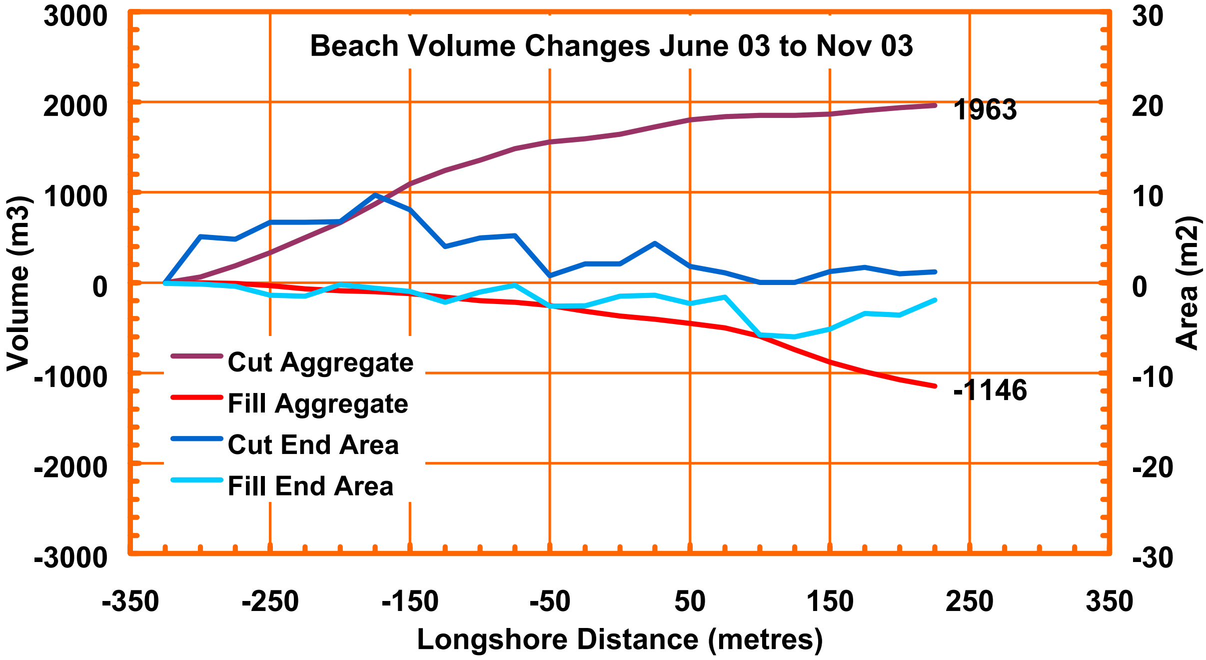


Figure 4.57: Beach Profile Changes in the Vicinity of the Proposed Breakwater
Source: Appendix 17

Figure 4.58: Beach 1.0 mAHD Location at July 2003, November 2003 and February 2004
Source: Appendix 17

In addition, comparison of digital terrain models for each of the surveys has been made in order to compute the volume changes that have occurred during the periods between the surveys. The volume changes verses distances along the beach are shown in Figure 4.59. Areas of erosion are depicted at 'cut' and areas of accretion are depicted as 'fill' and shown as negative volumes.

It should be noted that these short-term beach volume changes cannot be directly translated into long-term coastal longshore sand drift rates, as seasonal effects are large and also sand is being eroded from a section of the beach concurrently with the deposition of new sand in the same area. These surveys do however, allow an assessment of the natural changes in beach profile and provide some indication of sand movement, particularly that resulting from short term seasonal effects.



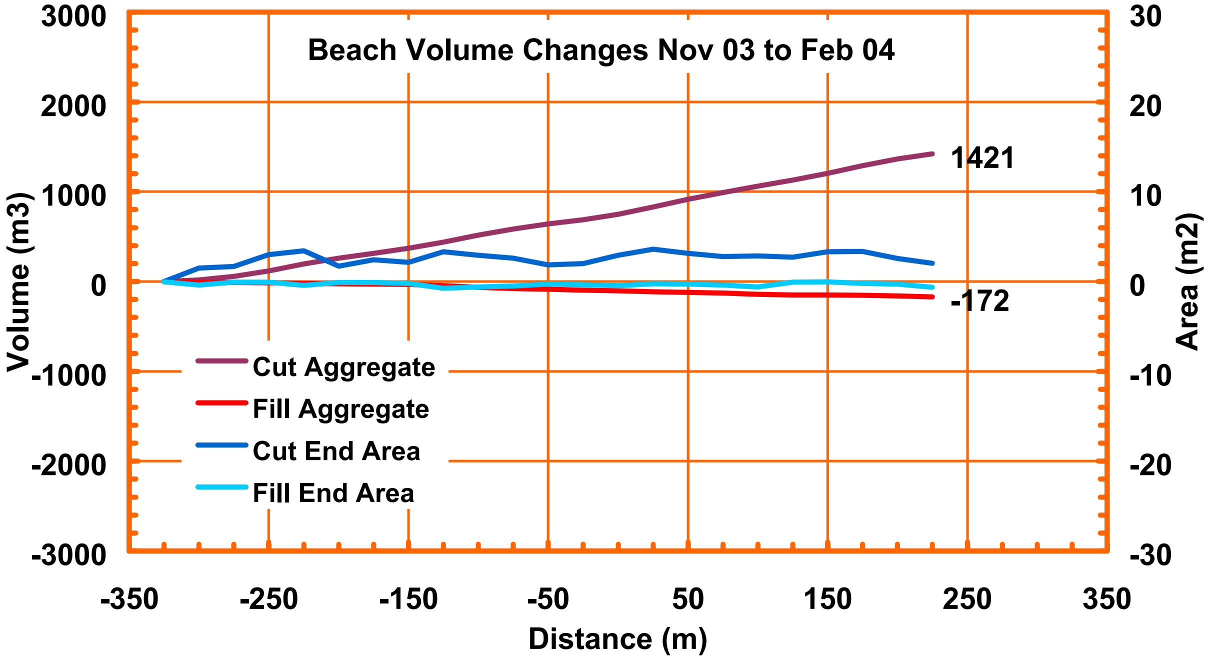


Figure 4.59: Beach Volume Changes in the Vicinity of the Proposed Breakwater
Source: Appendix 17

Beach Changes Between July 2003 and November 2003

The cross sections (**Figure 4.57**) show that generally erosion has occurred west of the breakwater with a trend to accretion to the east of the breakwater. Changes in levels of up to 500 millimetres, but more typically 150 millimetres, have occurred.

At chainage -150 (150 metres west) the beach has moved approximately 5.0 metres landward (erosion), while at chainage +150 (150 metres east) it has moved approximately 3.0 metres seaward (accretion), as shown on **Figure 4.57** and **Figure 4.58**. A reversal to erosion is observed at the far eastern extent of the survey.

Figure 4.59 shows erosion and accretion volumes verses longshore distance. There is some general redistribution of sand on the beach: 1,960 m^3 of erosion (an average of 188 millimetres over the eroded area) has occurred predominately west of the proposed breakwater and 1,150 m^3 of accretion (an average of 128 millimetres over the filled area) has occurred predominately east of the proposed breakwater. A net erosion of approximately 900 m^3 has occurred, which is an average of approximately 40 millimetres over the total area surveyed (**Appendix 17**).

Beach Changes Between November 2003 and February 2004

The cross sections (**Figure 4.57**) show generally that erosion has occurred at the top of the beach and no change to minor accretion has occurred toward the bottom of the beach. Again, there is a trend of erosion west of the proposed breakwater and accretion east of the breakwater. By using the +1 mAHD lines as shown on **Figure 4.58** as a measure of the beach location, at chainage -150 (150 metres west) the beach has moved approximately 2.0 metres landward (erosion), while at chainage +150 (150 metres east) it has moved approximately 1.0 metre seaward (accretion). In addition, the beach has a slightly flatter profile at February 2004 than either of the prior profiles.

Figure 4.59 shows beach erosion and accretion verses longshore distance. 1420 m^3 of erosion (an average of 100 millimetres over the eroded area) has occurred, predominately at the top of the beach and roughly evenly along the length of the beach. 170 m^3 of accretion (an average of 43 millimetres over the filled area) has occurred predominately east of the proposed breakwater. A net erosion of approximately 1,250 m^3 has occurred, which is an average of approximately 64 millimetres over the total area surveyed (**Appendix 17**).

4.13.5 Summary of Coastal Change and Sand Transportation

The evolution of the coast in Lacepede Bay over the past 6,000 to 7,000 years, since the last major sea level change, provides useful indications of the current coastal evolution and sand transportation processes. However, typical Holocene shoreline evolution patterns in other areas would suggest that the present day coastal evolution, sand supply and sand transport regime at Cape Jaffa is not a direct match of the average conditions over the past 6,000 to 7,000 years.

Some of the sand that now forms the onshore coastal system is expected to have been supplied directly onto the shore from adjacent nearshore areas rather than alongshore past Cape Jaffa, particularly during the initial period after the sea level stand-still and prior to extensive colonisation by seagrass. It is expected that the onshore sand supply was much stronger soon after the last major transgression of the sea than is presently occurring.

In other coastal areas it is commonly understood that the sea transgression swept large quantities of sand onto the shoreline up to about 3,000 years ago, after which the rate declined and the ongoing process shifted towards longshore redistribution of that sand (**Appendix 16**).

Lacepede Bay has significant areas of seagrass, which extends to within approximately 30 to 70 metres of the shoreline at the proposed site. The majority of the current sand transportation occurs on and very near to the coast as longshore sand drift. The aerial photography and ground survey show that at least since 1958 (and probably longer) net erosion of the shoreline at the eastern portion of the development site has occurred. More recently some of those areas previously eroding have begun to experience net accretion. This may be part of a natural pattern of erosion and accretion that has persisted for millennia, with net long-term accretion as identified, or an outcome of reduced sand supply relative to the rate of longshore removal.

Analysis of shoreline changes east of the proposed breakwaters over the 44 year period 1958 to 2002 indicates an average retreat of about 37 metres along a length of about 800 metres. This equates to an annual loss of 3,400 m^3/yr, assuming that it involved the beach berm and foredune over a vertical height of about 5.0 metres. It is expected that this loss is alongshore and a result of a differential in longshore transport and the transportation into this section is not zero during this time.

A longshore sand transportation rate can be calculated by applying an assumed ratio of inflow to outflow. On the basis that inflow is 50 to 80 percent of outflow the following sand transportation rates are indicated:

- 3,400 to 13,800 m^3/yr into the area east of the breakwaters; and
- 6,900 to 17,200 m^3/yr out of that area.

Overall it is clear that:

- longshore transport of sand (from south west to north east) continues to occur at Cape Jaffa;
- the natural coastal processes result in complex cycles of erosion and accretion within an overall accretionary trend;
- between the proposed breakwaters and the eastern extent of the Major Development area, the coast has experienced net accretion in the very long term, net erosion in the shorter term (at least since 1958) and, in places, net accretion more recently; and
- the portion of the coast within the development site that has experienced erosion is expected to revert to accretion in the future and in places this has occurred recently. It is difficult to assess when the remainder of these areas will revert to accretion.

With respect to interpretation of the historical changes as indicators of the future longshore sand transport rate, it is considered that:

- the present day rate of shoreline accretion is significantly less than the longer term average indicated by the extent of Holocene dune sand accumulation, that being approximately 26,000 m^3/yr;
- not all of the sand in the coastal dune system was sourced as longshore supply past Cape Jaffa; and
- more recently (1958 to 2002) the longshore sand transportation rate in the range 3,400 to 13,800 m^3/yr and 6,900 to 17,200 m^3/yr is indicated by sand loss of approximately 3,400 m^3/yr from the 800 metres of beach east of the breakwaters.

It is clear that monitoring and management of longshore sand drift and the natural cycles in the coastal processes will be required. In order to better define the longshore sand transportation rate analytical calculations have been conducted and this analysis is presented below.

4.13.6 Calculation of Longshore Sand Transportation Rate

Time series of longshore sand transport rates have been calculated at six hourly time increments for the three year period January 2000 to December 2002, for which deepwater wave information has been obtained from the British Meteorological Office (BMO) (**Appendix 16**). Detailed information on transport rates has been derived indicating annual average, seasonal and short term patterns.

A spreadsheet has been developed for this purpose, providing for:

- swell wave transformation algorithms (height and direction) derived from the SWAN modelling for a location immediately offshore from the Cape Jaffa site;
- calculation of locally generated sea waves using hindcast techniques and BMO wind data;
- further wave propagation to the breakpoint, accounting for the effects of refraction, bed friction and shoaling;
- calculation of equivalent daily sand transport rates for sea and swell waves using the conventional CERC relationship (US Army Corps 1984); and
- cumulative longshore sand transport for sea and swell, together with the total cumulative transport for each year period.

The 'factor K' in the CERC relationship is recommended in the range 0.125×10^6 to 0.79×10^6 by various authors for a range of circumstances (where the transport rate is in m^3/yr). This is equivalent to 340 to 1,730 for daily rates (m^3/day). It has been 'calibrated' at 1,120 for the Gold Coast beaches where the median sand grain size is 0.22 millimetres (Patterson 1985).

The sand transport method of van Rijn (1993) provides an opportunity to determine the effect of grain size on the transport rate and the likely variation of K as a function of grain size. **Figure 4.60** illustrates the effect of grain size for typical Cape Jaffa wave/current conditions, based on the van Rijn (1993) method.

Sand samples collected from a range of locations both on the beach/dune system and across the nearshore zone for grain size analysis indicate a representative median (D50) size of 0.30 millimetres, as shown on **Figure 4.61**. This suggests that a K value of about 800 is appropriate for this beach, and this has been used in the calculations of sand transport rates.

The calculated sand transport rates are presented in **Figure 4.62**, **Figure 4.63** and **Figure 4.64** as six hourly time series values of daily transport for each of the three years of available wave data respectively (**Appendix 16**).

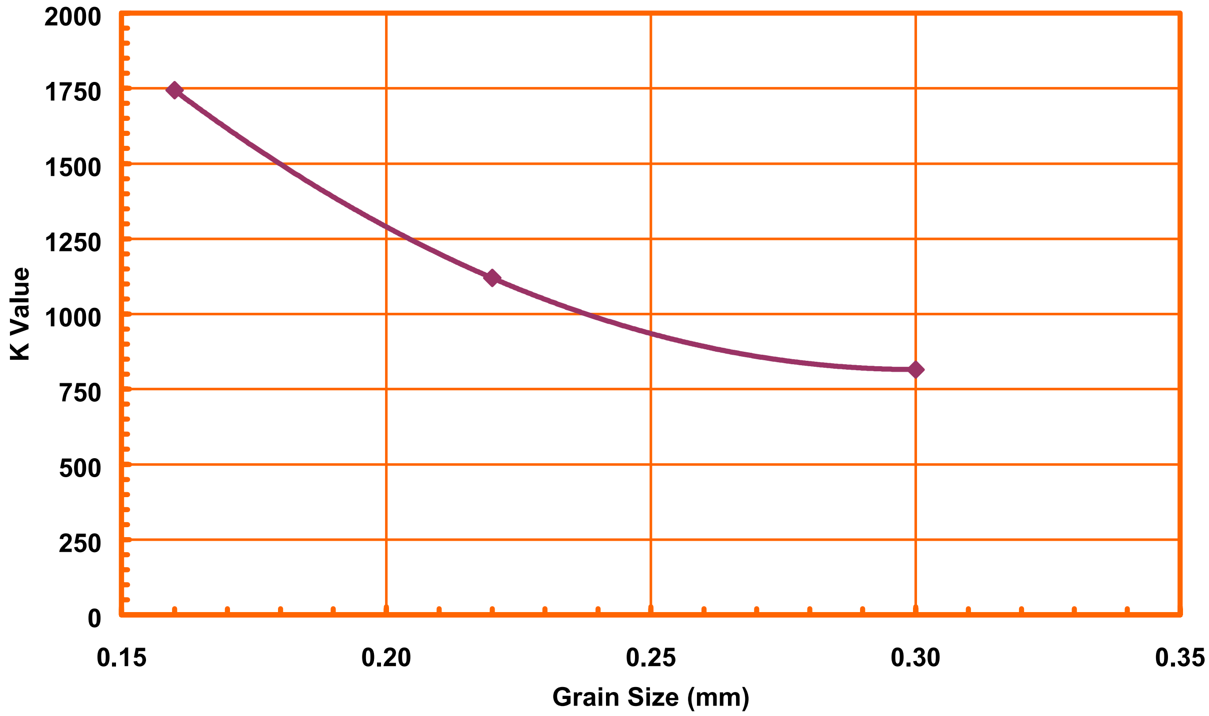


Figure 4.60: Variation of CERC K Factor with Grain Size
Source: Appendix 16

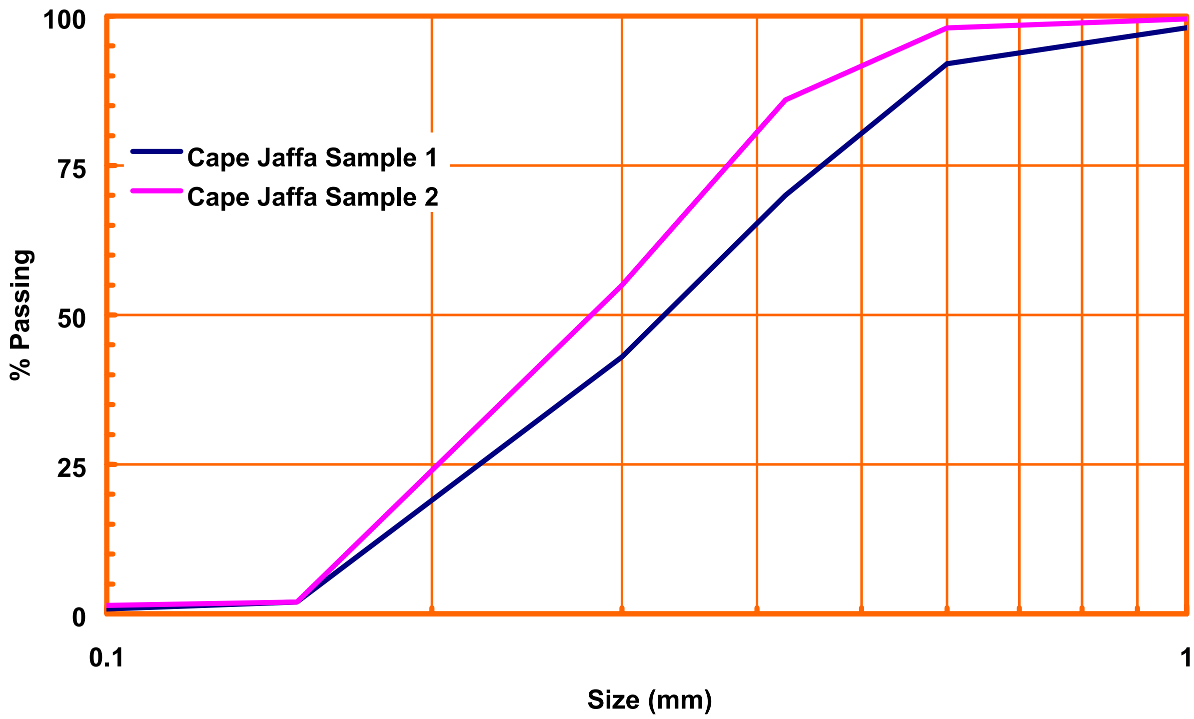


Figure 4.61: Beach System Sand Grain Size Distribution
Source: Appendix 16

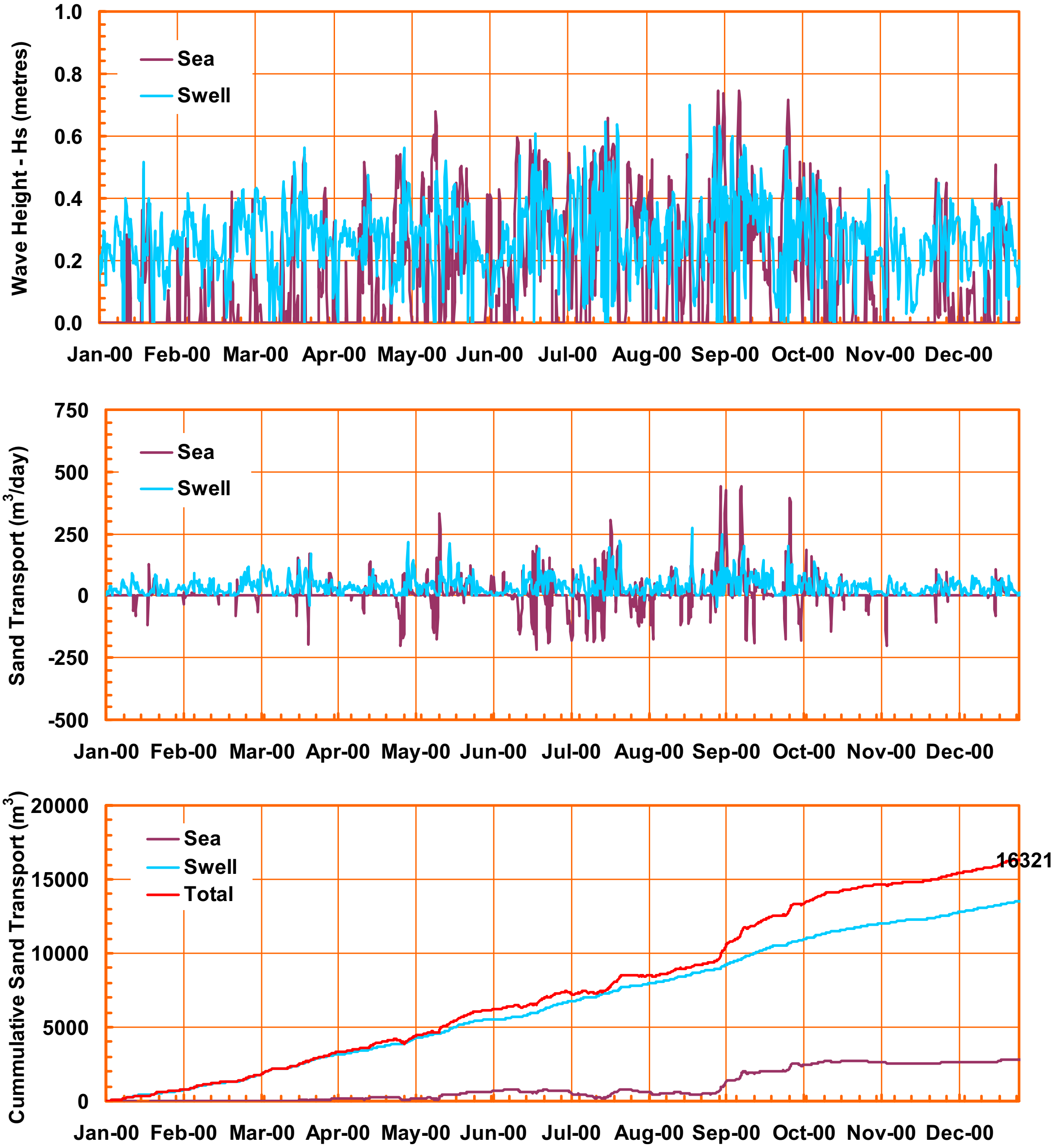


Figure 4.62: Calculated Daily Longshore Sand Transportation Rate - 2000

Source: Appendix 16

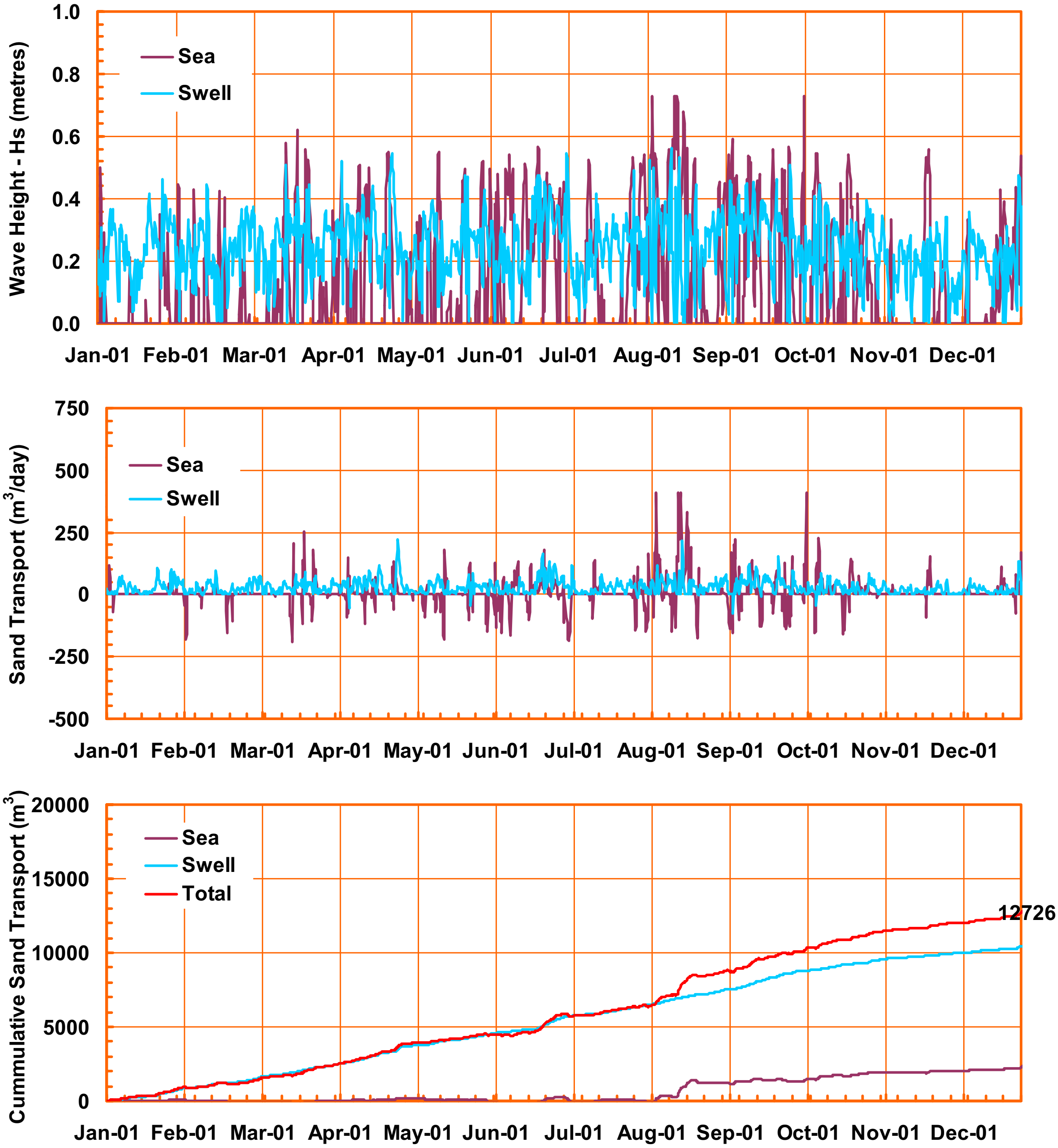


Figure 4.63: Calculated Daily Longshore Sand Transportation Rate - 2001
Source: Appendix 16

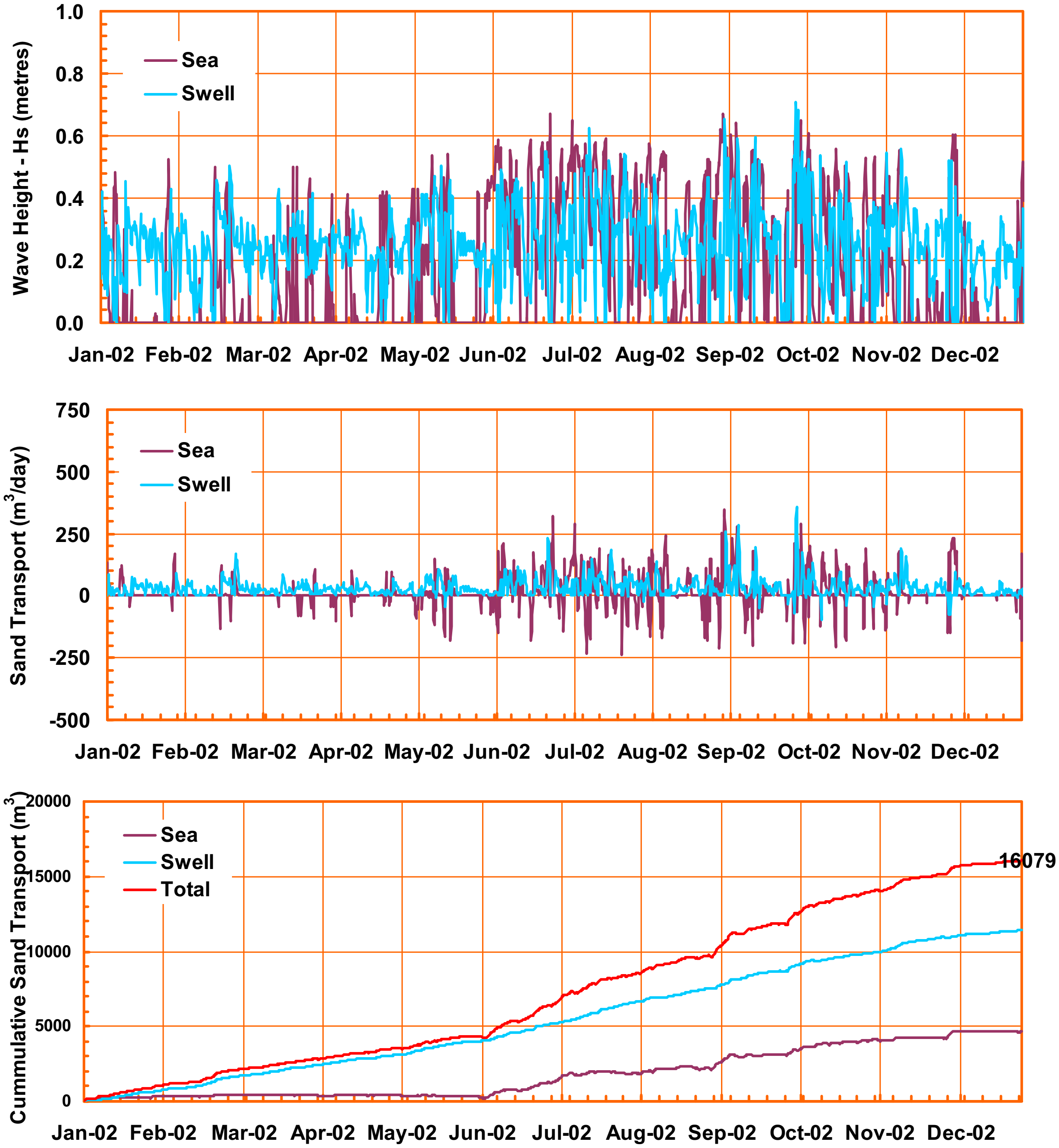


Figure 4.64: Calculated Daily Longshore Sand Transportation Rate – 2002

Source: Appendix 16

4.13.7 Summary of Sand Transportation

There is a clear seasonal pattern to the transport, with most movement occurring during winter to spring months. Short term daily transport rates of up to 500 m^3/day may occur infrequently, with more common rates being less than 200 m^3/day. While swell waves consistently cause transport north east, locally generated 'sea' waves may lead to some transport south west.

Cumulative annual transport rates for each of the three years analysed are shown in Table 4.19.

Table 4.19: Cumulative Annual Transport Rates
Source: Appendix 16

YEAR	TRANSPORT
2000	16,300 m3/yr
2001	12,800 m3/yr
2002	16,100 m3/yr
AVERAGE	about 15,000 m3/yr

The uncertainty of these calculations must be recognised. The average annual longshore sand transport rate is likely to be less than 15,000 m^3/yr, with the majority of that occurring during the months May to October and some relatively modest variation from year to year. The calculations presented above have used very conservative factors to account for seabed friction effects on the wave height and shows that the majority of the sand transportation results from deepwater swell waves rather than from locally generated wind waves. The deepwater derived breaker wave energy has been previously described as "zero" at this location and secondary sources of marine energy dominate the coastal processes. Hence, these calculations should be viewed as a conservative (high-side) estimate of the actual longshore sand transportation rate.

As expected, the conservatively calculated contemporary rate of 15,000 m^3/yr is lower than the long term Holocene average derived from geological evidence (approximately 26,000 m^3/yr). The calculated rate is consistent with the rates indicated by recent aerial photography (3,400 to 13,800 m^3/yr and 6,900 to 17,200 m^3/yr).

For comparison, the SA Coastal Protection board reported that longshore sand transportation on the northern metropolitan Adelaide beaches is approximately 150,000 m^3/yr (CPB 2000). Sand drift rates at Cape Jaffa are to be expected to be significantly smaller given the very low wave breaker energy.

The modelling performed provides a basis for planning and design of the development, involving an initial stage of monitoring and design refinement. Assessments have been based on an upper limit transport rate of 25,000 m^3/yr, in the knowledge that the actual rate and its variability is most likely to be less than 15,000 m^3/yr and will be determined more accurately through monitoring. The management action required, for example sand bypassing, needs to deal with only the rate of transport that actually occurs.

4.14 Groundwater

This section describes the existing groundwater environment at Cape Jaffa. It is divided into a number of sections that cover the various characteristics of the groundwater system and within each section there is generally a description of both regional and local characteristics.

Information has been drawn from various reports, particularly the South East Catchment Water Management Board Groundwater Monitoring Status Report 2002 (DWLBC 2002/10) and the Water Allocation Plan (WAP) for the Lacepede Kongorong Prescribed Wells Area (SECWMB 2001).

A number of additional investigations have been carried out in order to obtain more detailed information on the groundwater environment in the immediate area. The investigations performed are further described in **Section 5.2.2** and detailed reports are attached as **Appendix 14**.

4.14.1 Aquifers

Cape Jaffa is located in the Gambier Embayment of the Otway Basin (DWLBC 2002/10) and the geology of the region has been discussed previously in **Section 4.8**.

In this region, groundwater flows through two main systems, an upper unconfined aquifer (also referred to as the Tertiary Limestone Aquifer or TLA) and a deeper confined aquifer (also referred to as the Tertiary Confined Sand Aquifer or TCSA) (SECWMB 2001). The aquifers are separated by a clay sequence which forms the aquitard between the aquifers. A hydraulic basement exists below the confined aquifer (DWLBC 2002/10).

A schematic east-west cross section through approximately Cape Jaffa and Naracoorte is presented as **Figure 4.65** and illustrates the aquifers of interest (DWLBC 2002/10). It shows the confined and unconfined aquifers and the watertable (potentiometric surface) in each aquifer. As the confined aquifer does not have a free water surface, the water level is labelled as the “confined aquifer potentiometric surface”.

The unconfined aquifer is predominantly found within the Gambier Limestone, although in places it extends into the overlying Bridgewater Formation and/or Semaphore Sands, and consists mainly of calcareous sandstone and limestone deposits. Where it extends into the overlying sand, it is generally regarded as a single aquifer unit.

The confined aquifer is contained within the sand sequences of the Dilwyn Formation. This aquifer is a multi-aquifer system resulting from interbedded sands, gravels and clays. It is generally regarded as one aquifer throughout the region (DWLBC 2002/10). **Figure 4.66** presents the stratigraphic units of the region (Brown *et al.* 2001).

At Cape Jaffa the confined aquifer exists at depths greater than 100 metres, based on investigations outlined in **Section 5.2.21**. As a result, the development will not have an effect on the confined aquifer and the focus of these investigations has been on the unconfined aquifer, which is intersected by the waterways being constructed as part of the development.

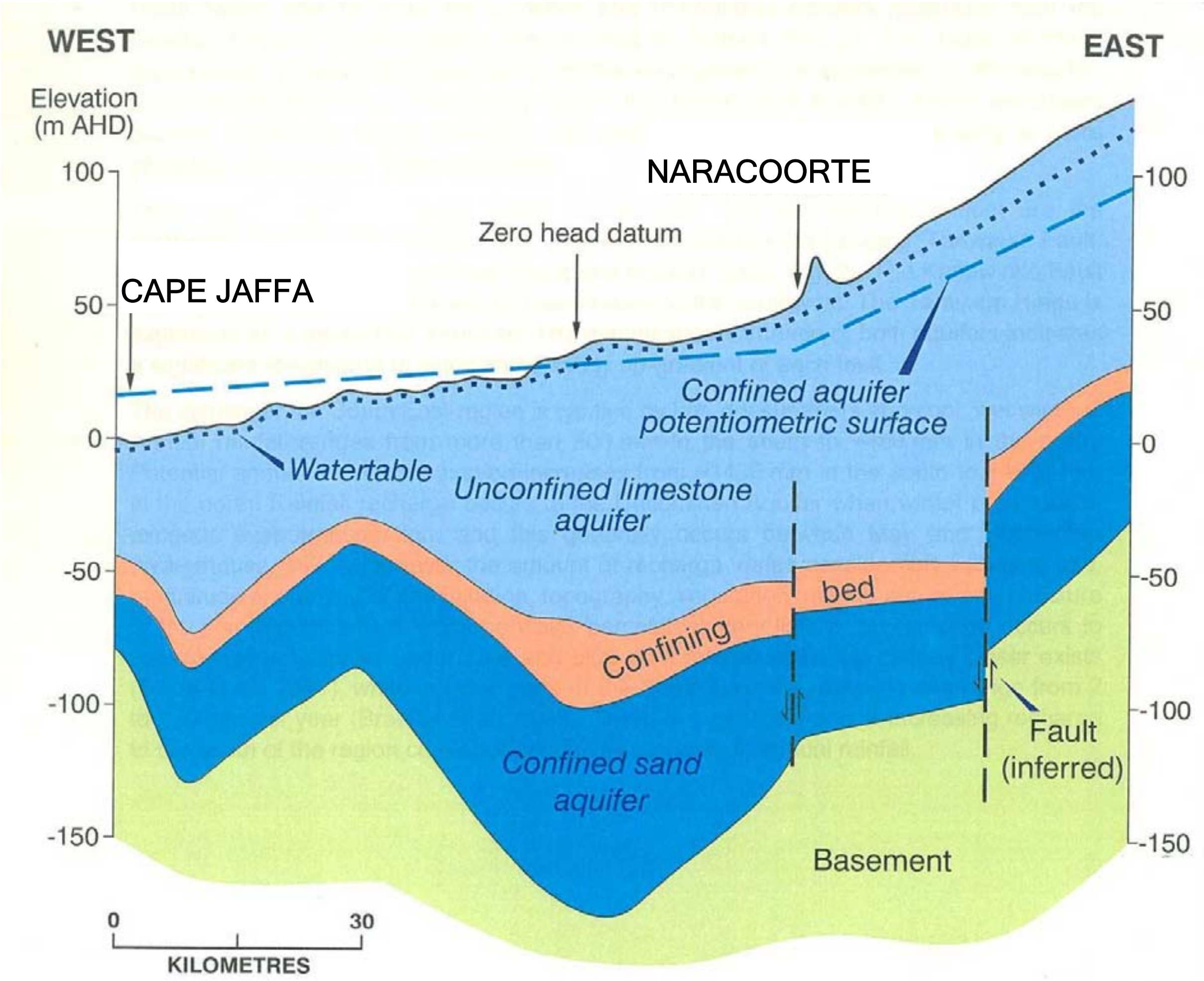


Figure 4.65: Schematic Cross Section of Aquifers of Interest
Source: DWLBC 2002/10

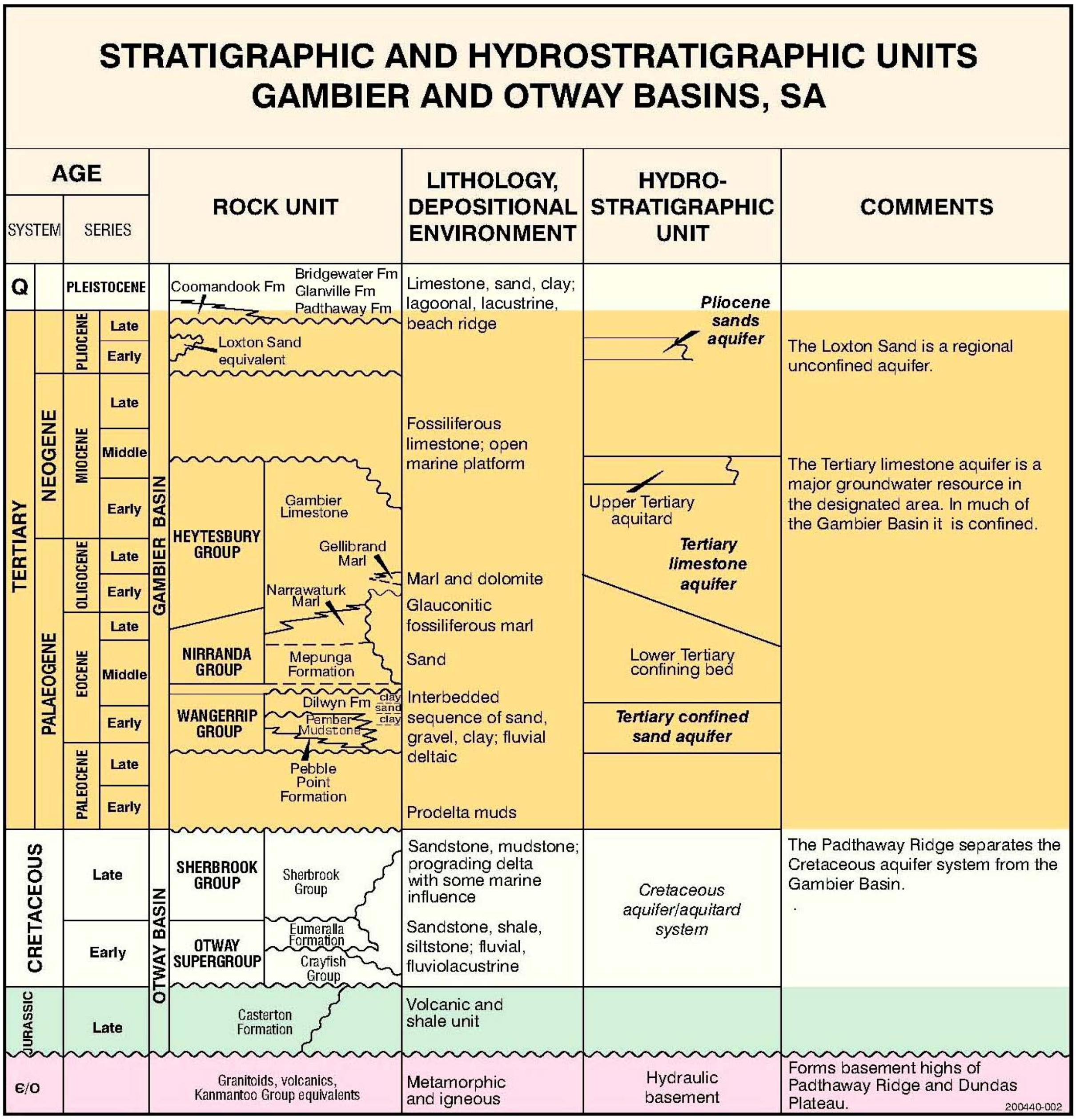


Figure 4.66: Regional Stratigraphic Profile

Source: Brown *et al.* 2001

4.14.2 Regional Monitoring Wells

Regional monitoring wells intersecting both aquifers in the vicinity of Cape Jaffa are shown in Figure 4.67. The details of these nearest regional monitoring wells are summarised in Table 4.20 and Table 4.21. Data collected from these wells has been provided by DWLBC and used to provide indications of the groundwater environment at Cape Jaffa. Level data recorded in these wells is presented in Section 4.14.9 and 4.14.15. None of the previously existing monitoring wells are located on the site itself.

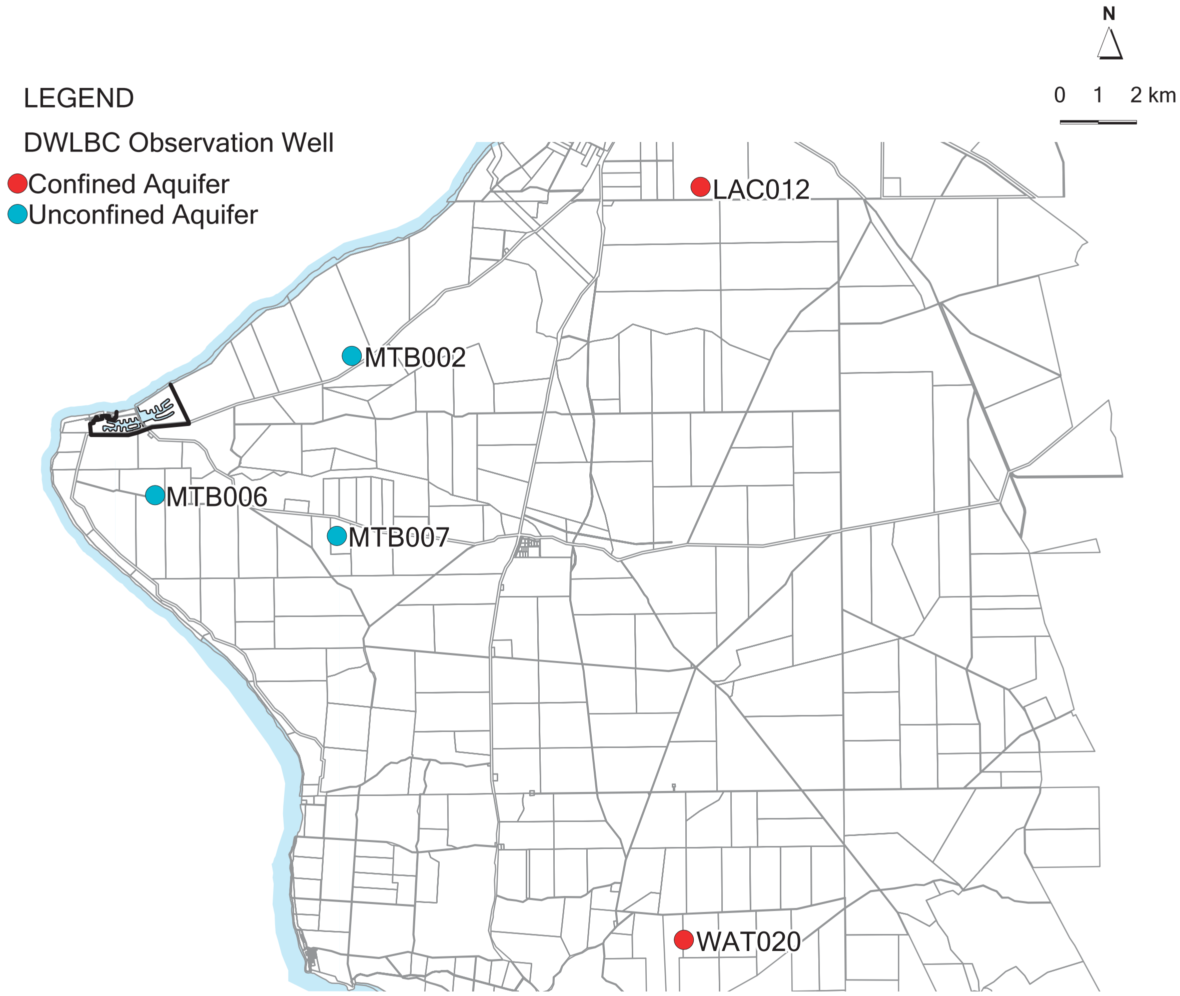


Figure 4.67: Regional Observation Wells - Unconfined and Confined Aquifers
Source Data: PIRSA Well database July 2003

Table 4.20: Regional Observation Well Details - Unconfined Aquifer
Source Data: DWLBC

Observation Well Name	Well Reference No	Ground Elevation (mAHD)	Reference Elevation (mAHD)	Formation	Total Depth of Well (mBGL)	Construction Date
MTB007	6824-00323	-	11.42	Bridgewater	12	1996
MTB002	6824-00252	3.57	3.87	St Kilda/ Holocene	6	1970
MTB006	6824-00667	5.3	5.36	Bridgewater	5.2	1996

Table 4.21: Regional Observation Well Details - Confined Aquifer
Source Data: DWLBC

Observation Well Name	Well Reference No	Ground Elevation (mAHD)	Reference Elevation (mAHD)	Formation	Total Depth of Well (mBGL)	Construction Date
WAT020	6823-00523	8.35	8.99	Dilwyn	170.38	1960
LAC012	6824-00238	2.01	2.4	Dilwyn	76.6	1974

4.14.3 Groundwater Field Investigations

In June 2003, 34 groundwater monitoring wells were constructed in order to provide detailed information on the groundwater environment at Cape Jaffa, as shown on **Figure 4.68**. Further detail is provided in **Appendix 14**.

All of the wells were constructed to intersect the unconfined aquifer. The majority of the wells intersected the upper limestone of the Gambier Formation and three wells were screened to intersect the shallower quaternary sands of the St Kilda Formation (wells CJ3A, CJ15A and CJ21A). Typical well construction details are shown in **Figure 4.69**.

The purpose of installing the groundwater monitoring wells was to:

- obtain additional information and understanding of the local hydrogeological environment;
- evaluate spatial and temporal hydrogeological trends;
- evaluate groundwater quality of the unconfined aquifer in both the St Kilda Formation and the Gambier Limestone;
- confirm that the aquifers of the St Kilda Formation and the Gambier Limestone behave as the one unconfined aquifer system; and
- obtain sufficient information in order to build a hydrogeological model and thus allow modelling of the effects of the development on the unconfined aquifer.

Wells were sited across and surrounding the site in order to characterise the groundwater environment and its spatial changes near the site. Cross sections oriented approximately north-south and east-west have been shown previously in **Figure 4.23** (**Appendix 14**).

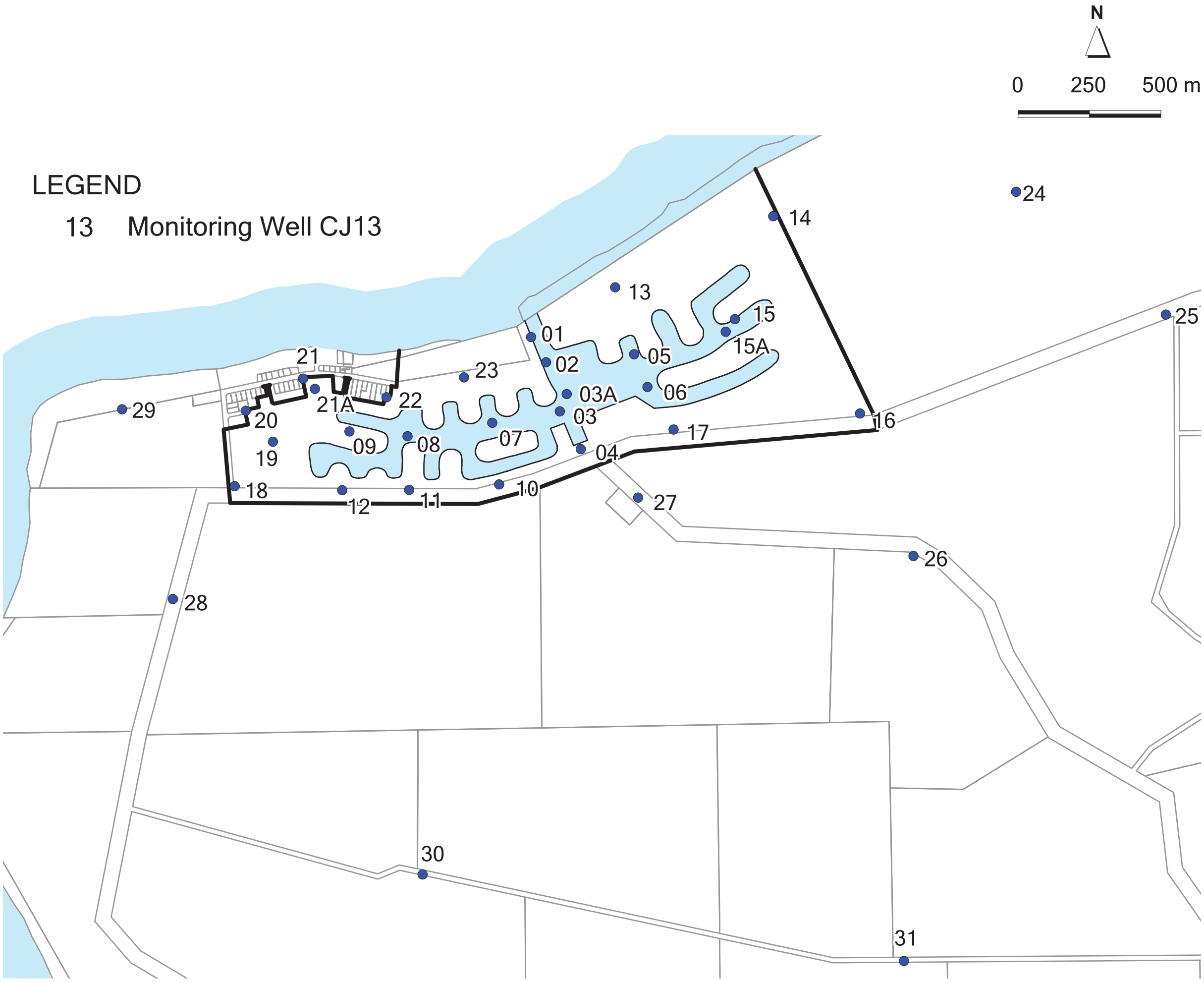


Figure 4.68: Groundwater Well Location Plan

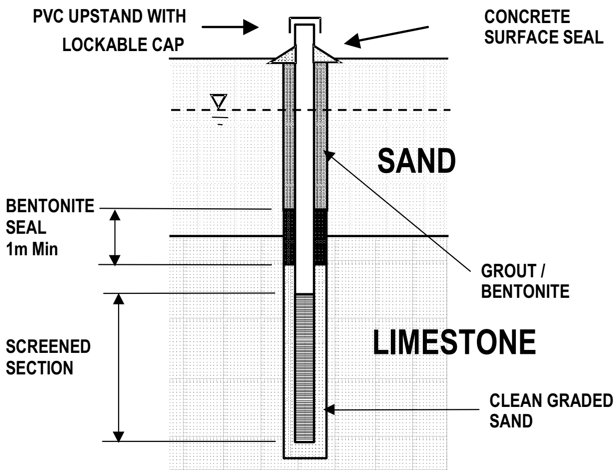


Figure 4.69: Typical Well Construction Detail

Data was collected from the monitoring wells in order to measure the following local characteristics of the unconfined aquifer:

- levels and flow direction;
- salinity;
- chemical composition;
- water quality;
- seasonal and tidal level fluctuations;
- aquifer properties (for example, hydraulic conductivity); and
- proximity of seawater and the location of the seawater – freshwater interface.

The data is presented below on a topic by topic basis, together with the corresponding regional information. Full data is presented in **Appendix 14**.

4.14.4 Aquifer Recharge

<u>Regional</u>

Regionally, the unconfined aquifer is recharged principally via precipitation (Herczeg *et al.* 1997) and is greatest when rainfall exceeds evaporation during the winter months, as discussed in **Section 4.9**. Other features, such as the topography, surface drainage features, permeability of the soils, extent of vegetation cover (which effects the rate of evapo-transpiration from the root zone) and the intensity of individual rainfall events all have an effect on the extent to which rainfall infiltrates the soil profile to recharge the groundwater (**Appendix 14**).

Recharge to the confined aquifer occurs in the east of the Otway Basin near the Victorian border, via the unconfined aquifer as a result of the downward head gradient between the aquifers. Confined aquifer recharge principally occurs in relatively small, localised areas where the aquifers are connected via fractures, faults or sinkholes which allow preferential flow between the aquifers (Brown *et al.* 2001). The degree of connectivity between the two aquifers is poorly understood and is currently the subject of research by DWLBC.

In the western portion of the basin the potential exists for additional recharge of the unconfined aquifer from the confined aquifer below. Evidence supporting this proposition is set out in the current Water Allocation Plan (SECWMB 2001) and the Groundwater Monitoring Status Report (DWLBC 2002/10), and includes:

- published potentiometric surface elevations of the aquifers indicate higher groundwater head in the confined aquifers than in the unconfined aquifer, indicating an upward hydraulic gradient. Potentiometric head in the confined and unconfined aquifers near the site are approximately 15 mAHD and 2.0 mAHD respectively. Note that this indicates that the confined aquifer is artesian such that wells flow without the need for pumping;
- published salinity maps show low salinity groundwater within the unconfined aquifer in the Cape Jaffa/Mt Benson/Robe areas;

- measured salinity on the site near the shoreline is low, which may be a result of recharge from the underlying confined aquifer, or sufficient through-flow occurring in the unconfined aquifer, or sufficient aquifer recharge from precipitation, or a combination of the above; and
- regionally, upward migration from the confined aquifer to the unconfined aquifer has been observed in leaking wells. A program to rehabilitate these wells is currently in place by DWLBC.

Local

On-site recharge of the unconfined aquifer from precipitation is expected to be occurring due to the high infiltration rates associated with the highly permeable sandy soils and the lack of surface drainage features. Recharge is likely to be highest during months when precipitation exceeds evaporation during May to August, as shown in **Figure 4.25**, but will also occur at other times, particularly following intense summer rainfall events. In addition, it is expected that there is some upward recharge from the underlying confined aquifer, however this contribution is likely to be minor.

4.14.5 Groundwater Level and Flow Direction

Regional

Potentiometric surface contours of the unconfined aquifer are shown in **Figure 4.70**. The groundwater flow direction is perpendicular to the contours toward the coast.

Local

The level data supplied by DWLBC from the nearby monitoring wells that intersect the unconfined aquifer shows:

- flow direction is approximately north west (wells MTB002 and MTB006 have very similar levels and well MTB007 has higher levels by approximately 3.0 metres); and
- the hydraulic gradient a few kilometres south east of the site is approximately 0.001 (1.0 metre head per kilometre).

Groundwater level data for the nearby monitoring wells is discussed in further detail in **Section 4.14.9**.

Gauging in the recently constructed monitoring wells has occurred at five monitoring events from July 2003 to May 2004. Elevation contours and flow directions for the unconfined aquifer for two of these events are presented as **Figure 4.71**. Generally the flow is towards the north west and the measured levels are consistent with the measured levels from the data supplied by DWLBC in the nearby monitoring wells, as described above.

The hydraulic gradient of the unconfined aquifer is moderately consistent over the majority of the study area for all of the gauging events, however a steeper hydraulic gradient was observed near the foreshore, particularly in October 2003. Based on the gauging performed, the estimated hydraulic gradient is approximately 0.0004 (0.4 metres head per kilometre). Near the foreshore a gradient of approximately 0.0007 (0.7 metres head per kilometre) was observed.

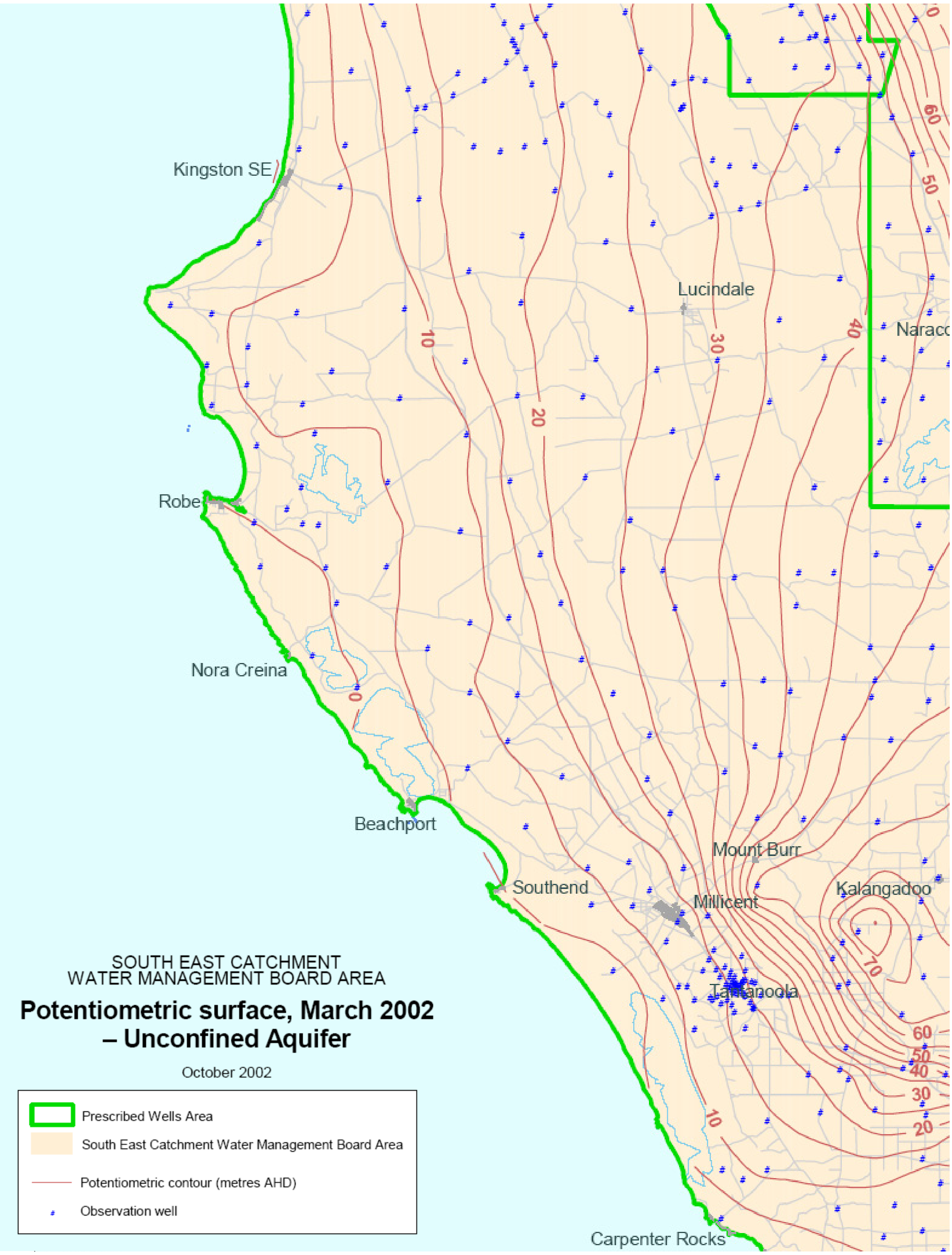


Figure 4.70: Unconfined Aquifer Potentiometric Surface
Source: DWLBC 2002/10

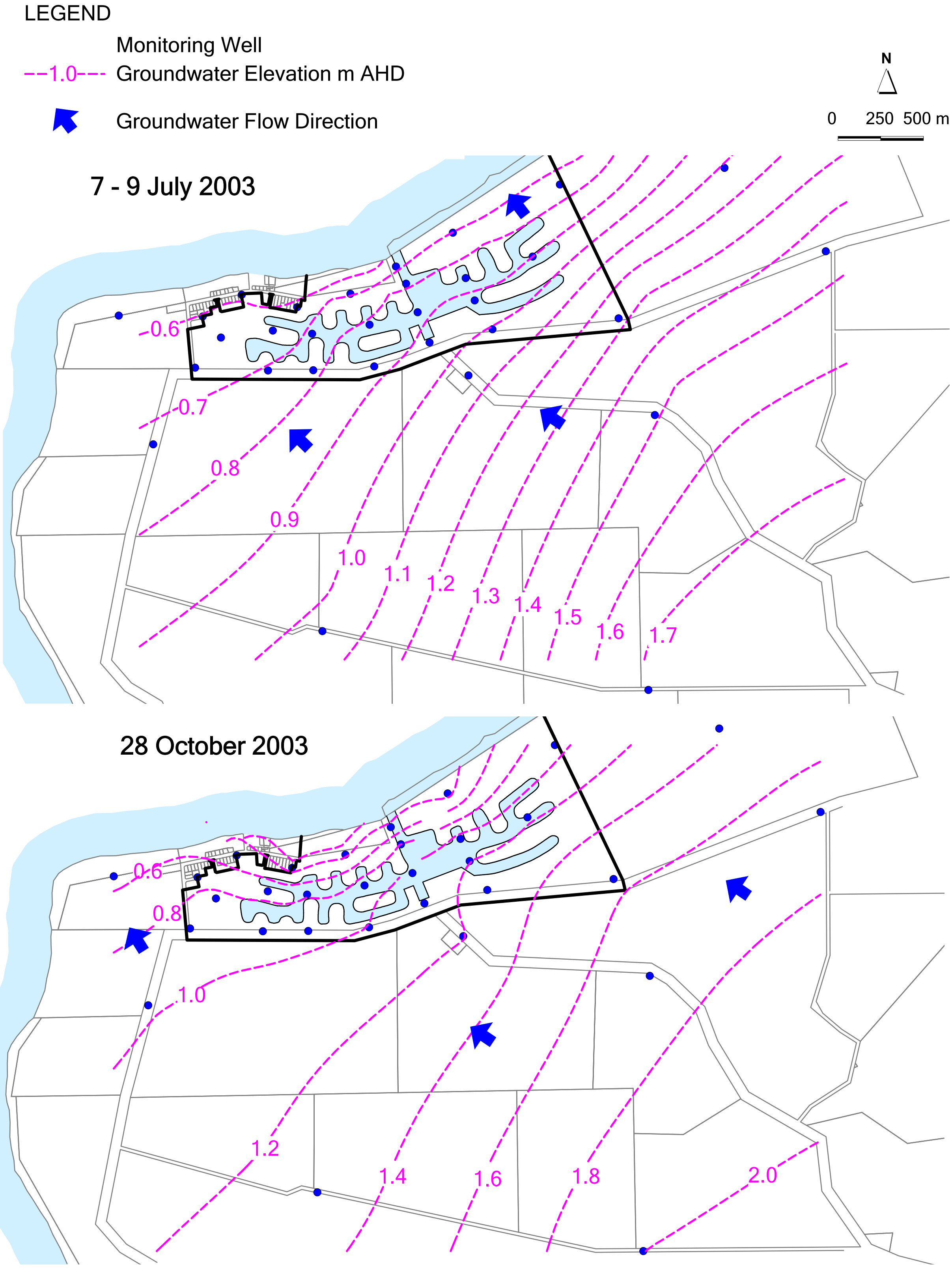


Figure 4.71: Unconfined Aquifer Elevation Contours and Flow Direction

Source: Appendix 14

4.14.6 Groundwater Salinity

Regional

Regional salinity distribution in the unconfined aquifer is shown in **Figure 4.72**.

A body of low salinity groundwater exists in the Cape Jaffa/Mt Benson/Robe regions. Salinity in this area is typically below 1,000 mg/L TDS (Total Dissolved Solids). Near surface interdunal saline water may rest on top of the main unconfined aquifer body in places as localised 'perched' watertables (Nelson 1972). Nevertheless, the unconfined aquifer is generally regarded as a single aquifer.

Local

Salinity in the vicinity of the site from the database of registered wells held by PIRSA is presented in **Figure 4.73**. Based on the registered depth, all of these wells intersect the unconfined aquifer. The registered salinity measurements for wells on and near the site range from about 400 mg/L to about 3,000 mg/L.

Salinity measurements from the monitoring wells installed as part of the recent investigations on and around the site are presented as **Figure 4.74**. During these investigations, measured salinity of the unconfined aquifer ranged between 439 mg/L TDS to 14,900 mg/L TDS.

Generally, in low lying areas within the eastern part of the site salinity was greater than 2,000 mg/L TDS and elsewhere on the site the salinity was less than 2,000 mg/L TDS. The higher salinities in the low lying areas are expected to be as a result of the effects of evaporation on the shallow watertable. Watertables less than 2.0 metres to 3.0 metres below ground level can be affected such that water is evaporated away, leaving behind the salt. Further to the south, away from the coast where the topography rises and the groundwater is deeper, the measured salinity was generally less than 1,000 mg/L TDS (**Appendix 14**). From a salinity viewpoint, groundwater with a salinity of less than 1,000 mg/L is generally considered suitable for potable supply per the Australian Drinking Water Guidelines (NHMRC 1996), as discussed further in **Section 4.14.14**.

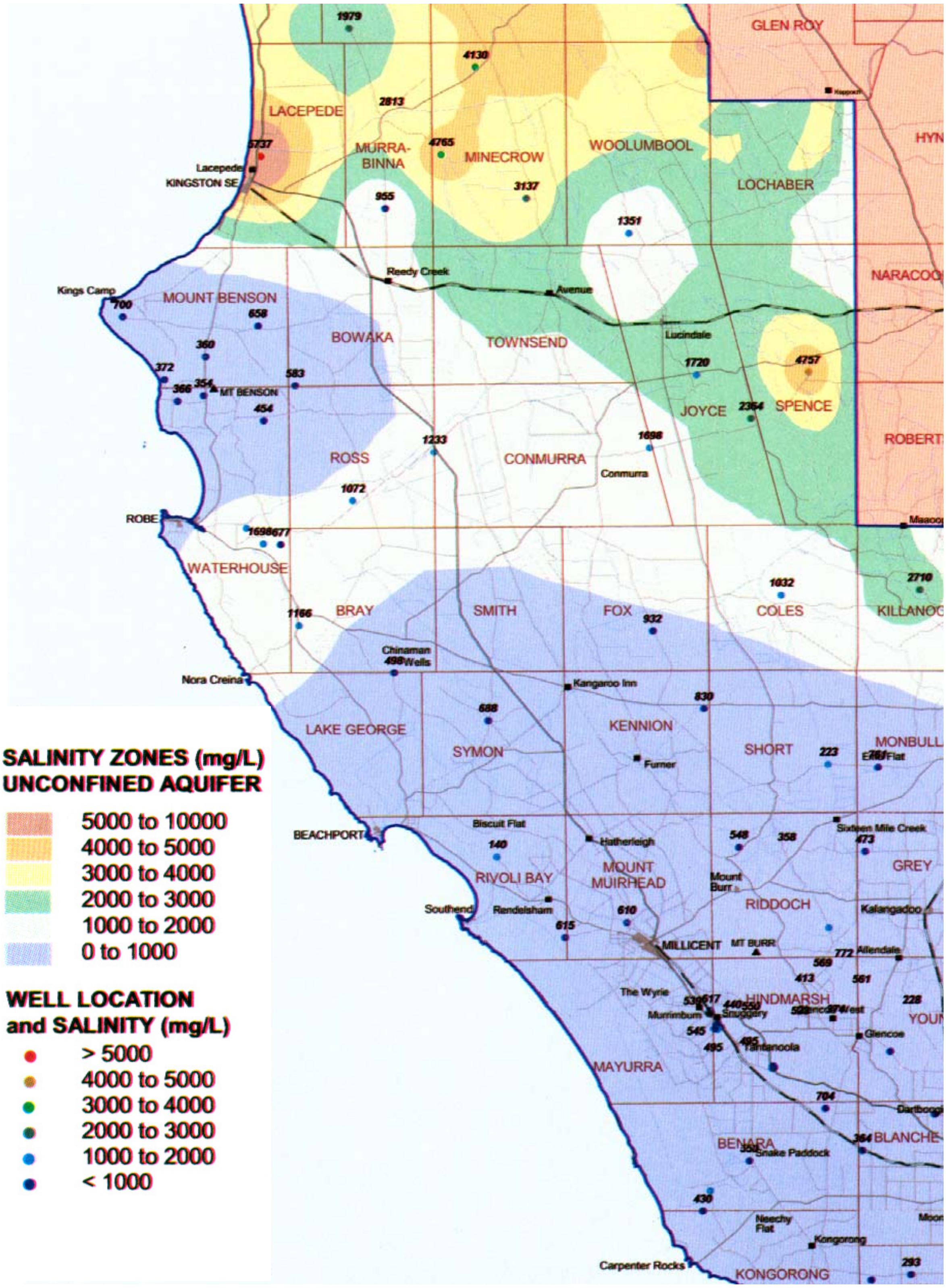


Figure 4.72: Unconfined Aquifer Salinity
Source: SECWMB 2001

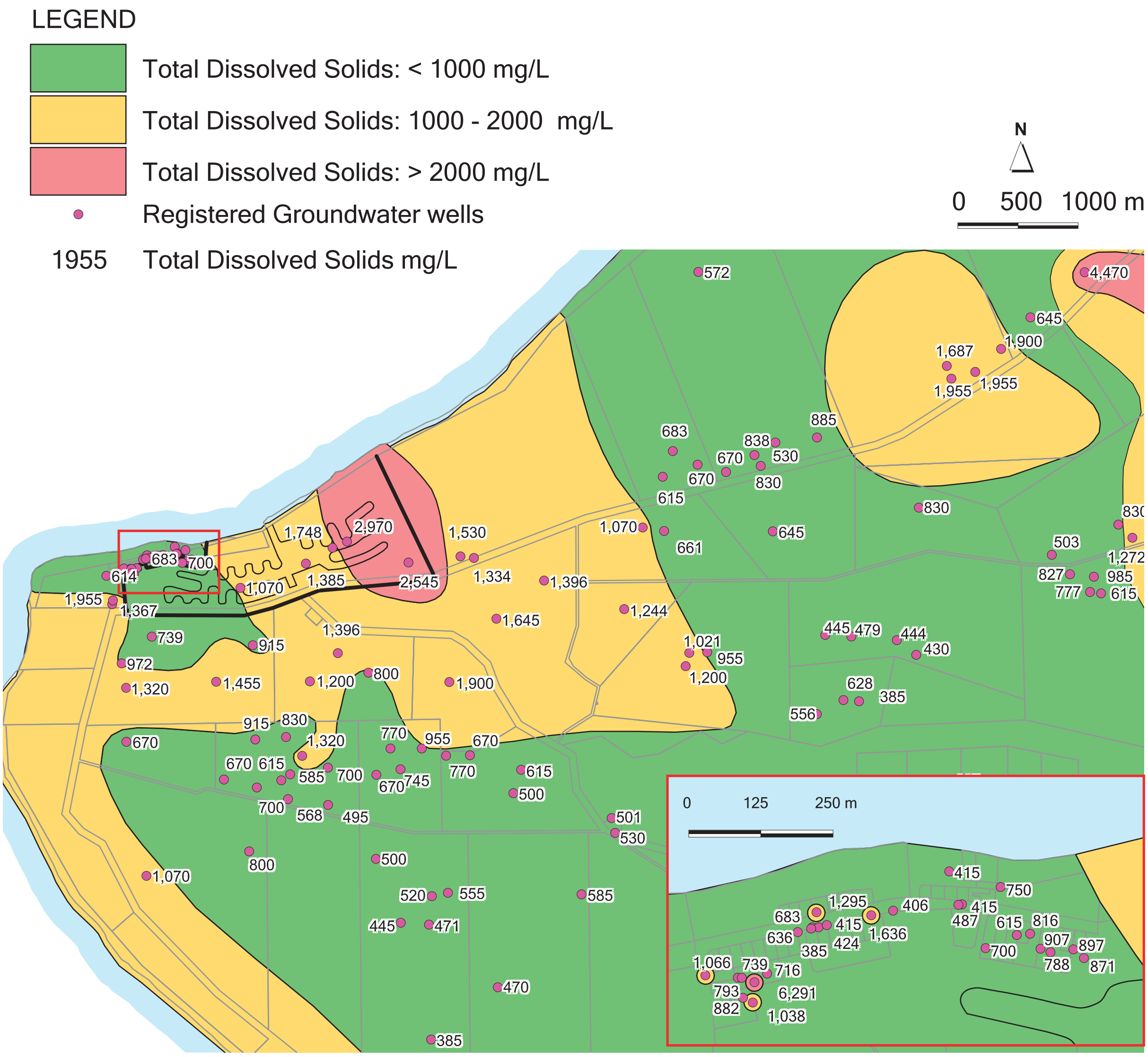


Figure 4.73: Salinity (TDS) Distribution from PIRSA Data

Source Data: PIRSA Well Database July 2003

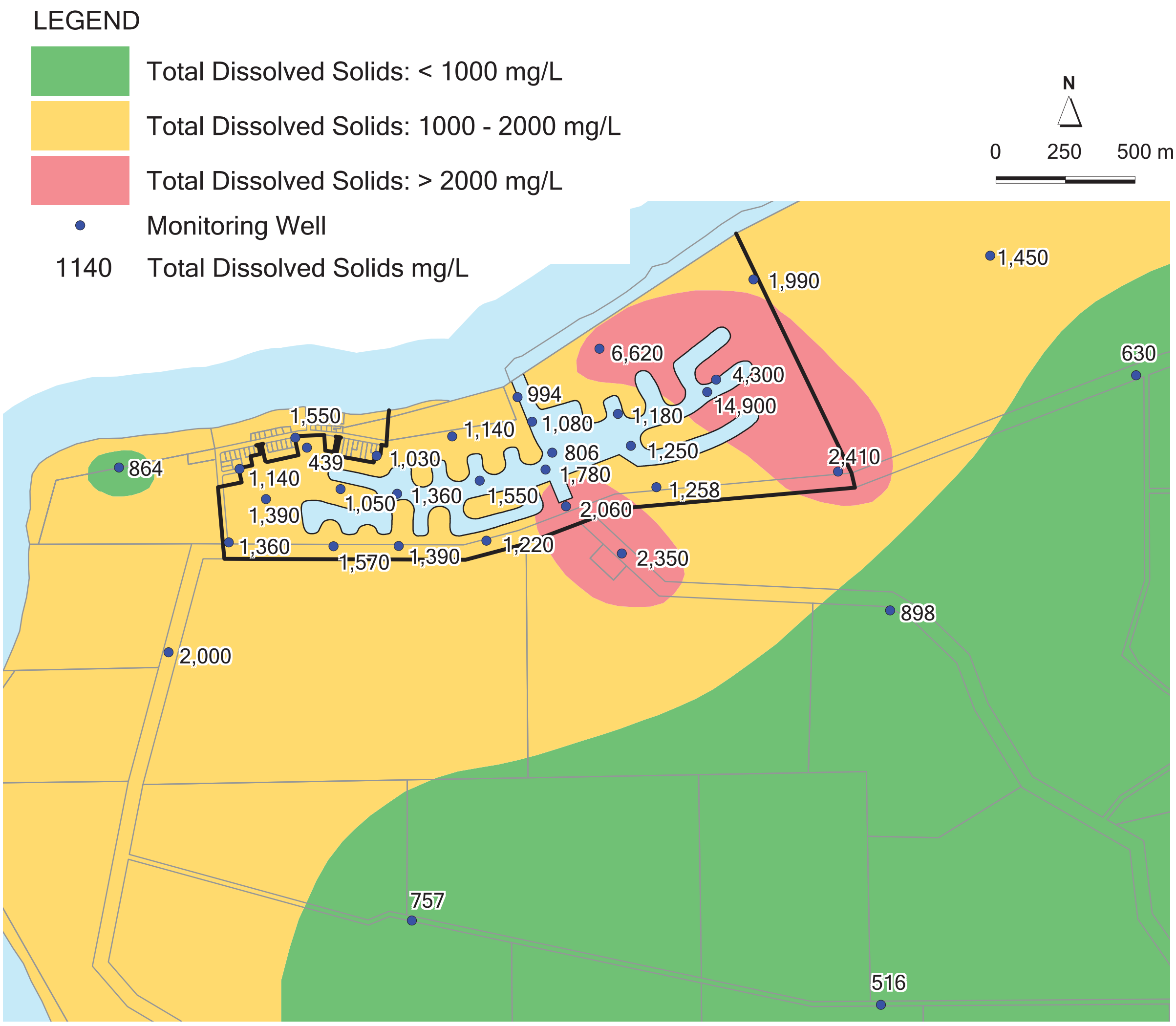


Figure 4.74: Salinity (TDS) from Field Investigations July 2003

Source: **Appendix 14**

4.14.7 Local Groundwater Chemistry

In order to assess the chemical composition of local groundwater, the ratios of major ionic species for samples from the recently installed monitoring wells have been plotted on a trilinear diagram (**Figure 4.75**). Refer to **Figure 4.68** for the location of the monitoring wells.

The results are generally grouped together, indicating that the groundwater has similar hydrochemical composition, the aquifer is continuous, and that groundwater within the sands of the St Kilda Formation and the underlying limestone are interconnected and can be considered as a single aquifer system. The diagram also indicates that the groundwater is dominated by ions of sodium, chloride, calcium and bicarbonate, with increasing dominance of sodium and chloride with increasing salinity. This chemistry is typical of limestone aquifers.

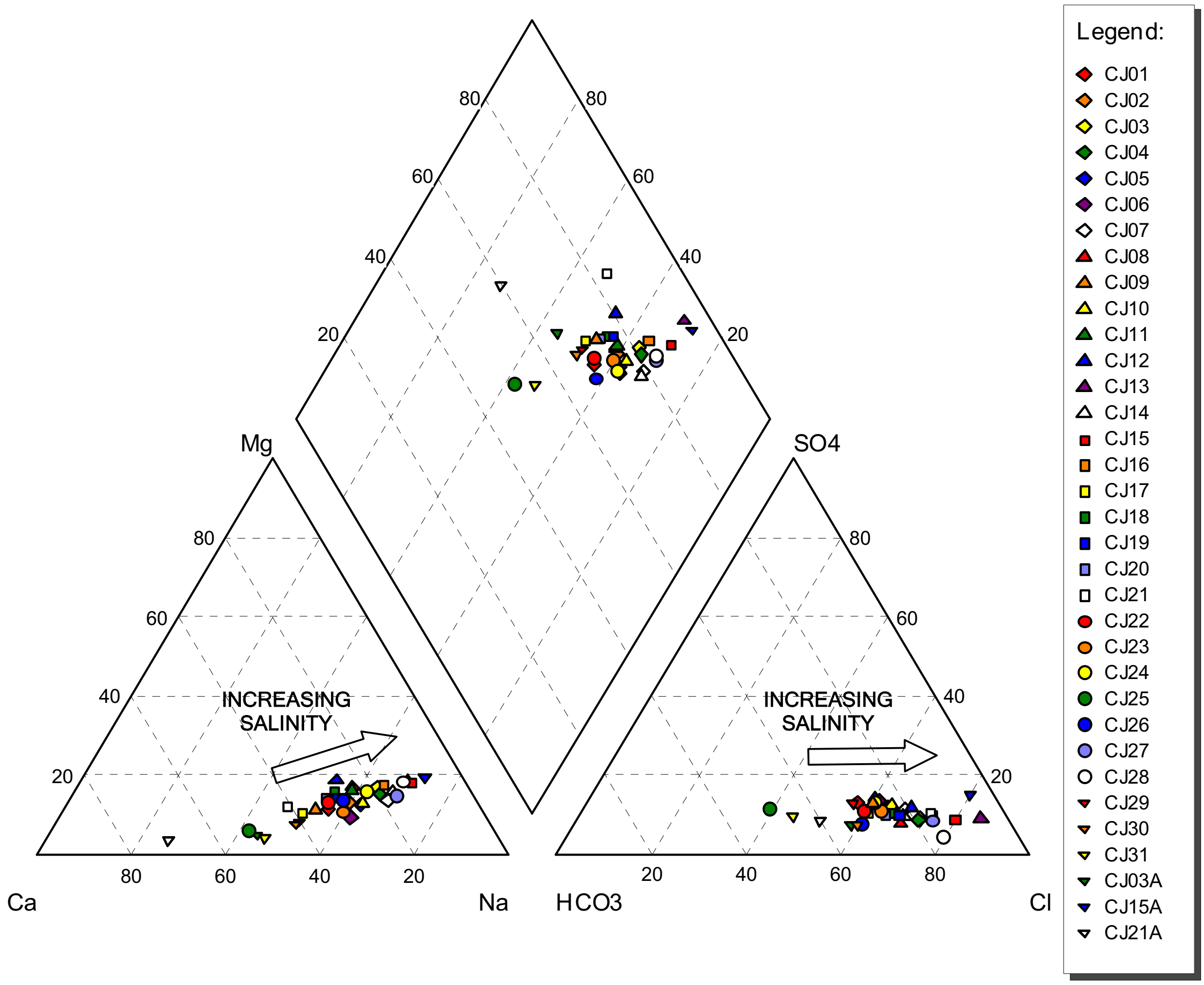


Figure 4.75: Trilinear Plot - All Wells
Source: **Appendix 14**

4.14.8 Aquifer Properties

Regional

An understanding of the aquifer properties governing groundwater flow is required for general understanding of the groundwater environment. In addition, this information is required as part of the construction of a groundwater flow model used to quantify the changes in the unconfined aquifer as a result of the proposed development.

Regional aquifer properties are summarised in **Table 4.22**.

Table 4.22: Aquifer Properties
Source: Appendix 14

Property	Unconfined Aquifer (Tertiary Limestone Aquifer)	Aquitard	Confined Aquifer (Tertiary Confined Sand Aquifer)	Reference
Flow Rate	5-50 m/year	-	1-5 m/year	Love, Armstrong and Stadter (1992)
Thickness	10-20 m (Nangwarry-Tarpeena area) Increases west and south to >300 m along coast near Carpenter Rocks	5-40 m (Nangwarry-Tarpeena area) 20-40 m (except in northwest margin)	Deepens near coast	Love, Armstrong and Stadter (1992) Cobb and Brown (2000)
Transmissivity	200 to >10,000 m^3/day/m	-	200 to 1,600 m^3/day/m 40 to >4,500m^3/day/m	Love, Armstrong and Stadter (1992) Cobb and Brown (2000)
Porosity	30-50% (estimated from logs) 50-60% (measured)	-	20-30%	Love, Armstrong and Stadter (1992)
Diffuse Recharge	47 to 270 mm/yr in southern portion of Otway Basin 2 to 40 mm/yr in northern portion	-	-	Love, Armstrong and Stadter (1992)
Vertical Permeability	-	10^{-3}-10^{-7} m/day	-	Love, Armstrong and Stadter (1992)
Depth to Watertable	Near ground level west of interdunal flats to >40 m in Mt Burr Region	-	-	Cobb and Brown (2000)

<u>Local</u>

In July 2003, aquifer tests including falling and rising head tests were carried out on the recently installed monitoring wells to assess the hydraulic conductivity of the unconfined aquifer. The average measured hydraulic conductivities are presented in **Figure 4.76** and **Figure 4.77** and range from 1 to 30 m/day, with an average of approximately 5 m/day. The figures show that the rising and falling head test methods of assessing hydraulic conductivity both indicate the same general trends and the variation between the results is due to inherent differences between the two measurement procedures. In addition, higher variations are evident for higher hydraulic conductivities as less data can be captured during these tests as they occur over a shorter period than for lower hydraulic conductivities.

There is a zone of higher conductivity running north-south within the western portion of the site. The measured hydraulic conductivities have been incorporated into the groundwater flow model in order to assess the effects of the development on the unconfined aquifer, as detailed in **Section 5.2.2**.

Figure 4.76: Unconfined Aquifer Hydraulic Conductivity - Measured by Falling Head
Source: **Appendix 14**

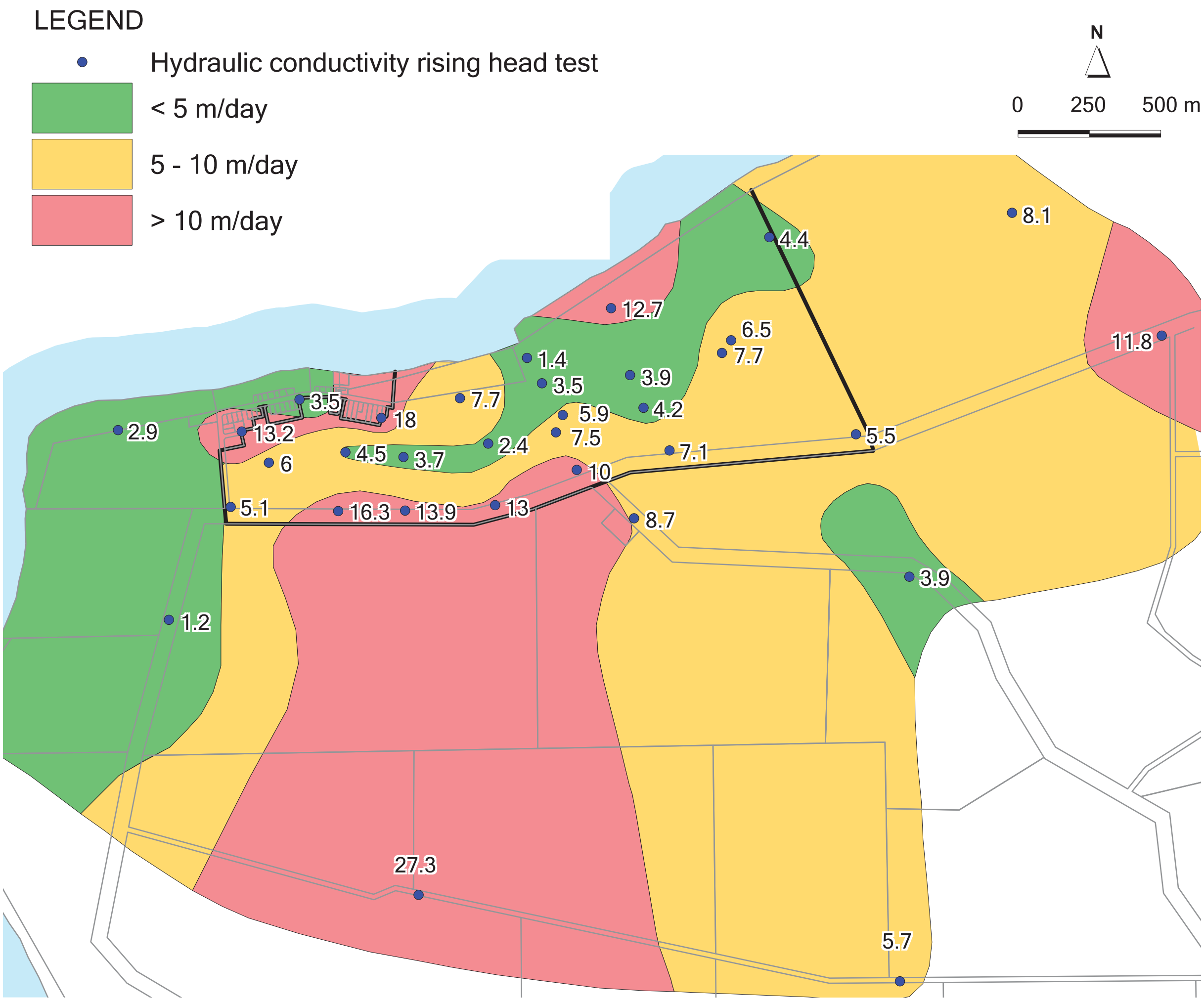


Figure 4.77: Unconfined Aquifer Hydraulic Conductivity – Measured by Rising Head
Source: Appendix 14

4.14.9 Groundwater Level Fluctuations

Regional

Seasonal water level trends in the unconfined aquifer were evaluated using data provided by DWLBC from the regional observation wells near the study area. See **Figure 4.67** and **Table 4.20** for locations and details of these wells.

The observed trends have been evaluated in order to assess external influences on the unconfined aquifer, including aquifer recharge from precipitation and seasonal water level trends. **Figure 4.78** shows hydrographs of the water level fluctuations versus time for each observation well.

Seasonal water level fluctuations of up to 1.3 metres, but generally between 0.5 to 1.0 metre are observed. Groundwater levels are higher following winter than summer. Over the last ten years or so there is a general trend of decreasing head in one of the wells within the unconfined aquifer, which may be related to groundwater use in proximity to the well.

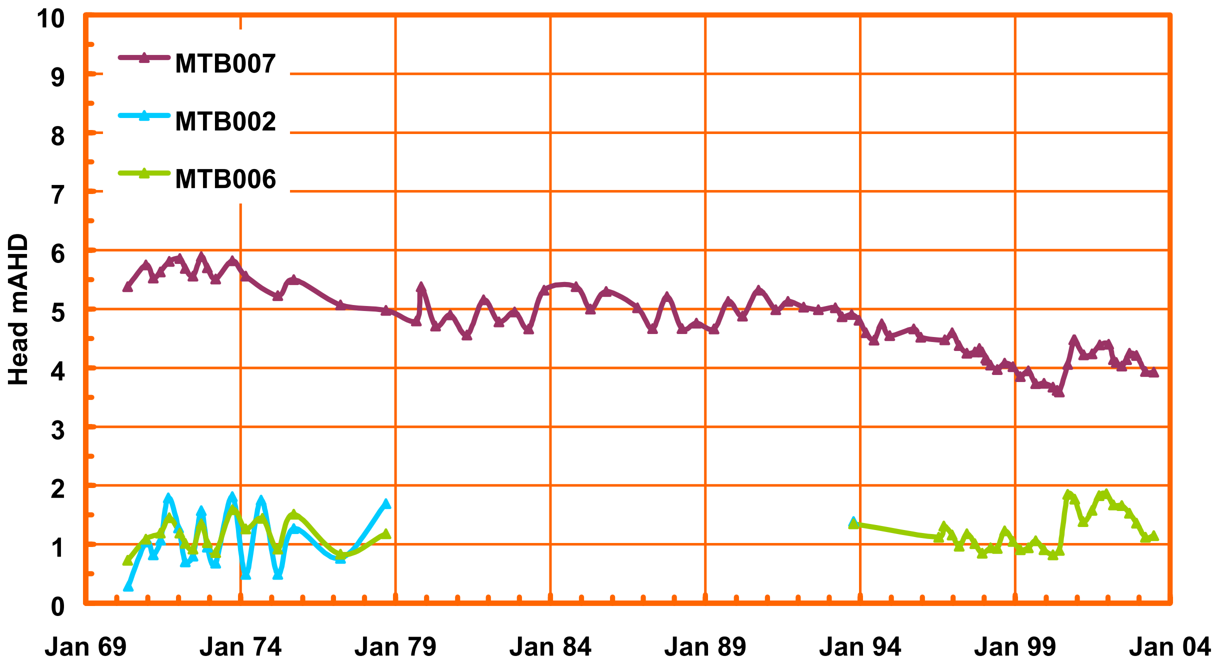


Figure 4.78: Unconfined Aquifer Regional Level Fluctuations
Source data: DWLBC

Local

Unconfined aquifer level fluctuations for the study area have been evaluated by measuring groundwater level in the recently installed monitoring wells. In addition, data loggers have been installed in some of these wells to make continuous measurements of groundwater level. Gauging has occurred at five monitoring events between July 2003 and May 2004. Regional data has also been considered, particularly the historical water level information from the nearest unconfined aquifer observation well.

Figure 4.79 to **4.82** presents the hydrographs for all of the recently installed monitoring wells. The location of these wells is shown in **Figure 4.69** and the spatial distribution of groundwater levels at July 2003 and October 2003 is shown in **Figure 4.71**. For most wells, increasing water level trends were observed for the period July 2003 to October 2003 and decreasing levels since October 2003. This is generally consistent with the expected variations as during May to August precipitation exceeds evaporation and therefore aquifer recharge from precipitation is more likely (**Appendix 14**).

The water level trends for most wells appear to be similar, except for the wells located near the foreshore where groundwater levels are most influenced by tidal fluctuations of sea level. The wells near the coast that show different trends include CJ01, CJ13, CJ21, CJ22, CJ23 and CJ29. The hydrographs for these wells are shown in **Figure 4.82** and locations are shown in red in **Figure 4.83.**

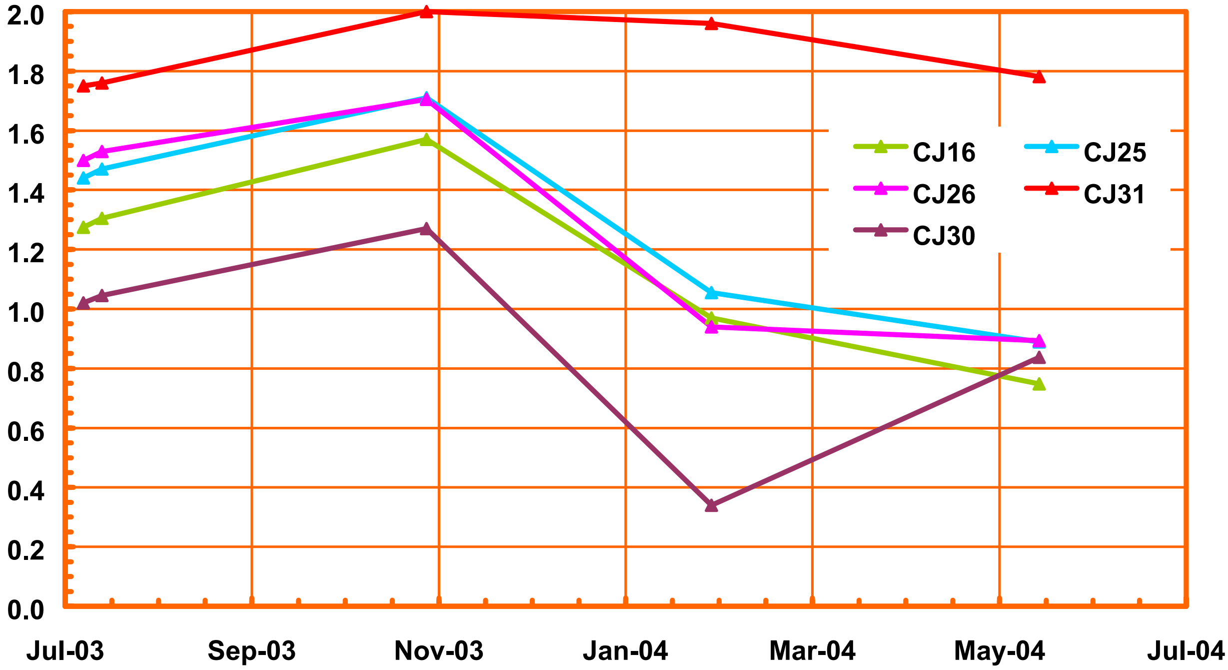


Figure 4.79: Hydrographs of Recently Installed Monitoring Wells – Inland Wells
Source: Appendix 14

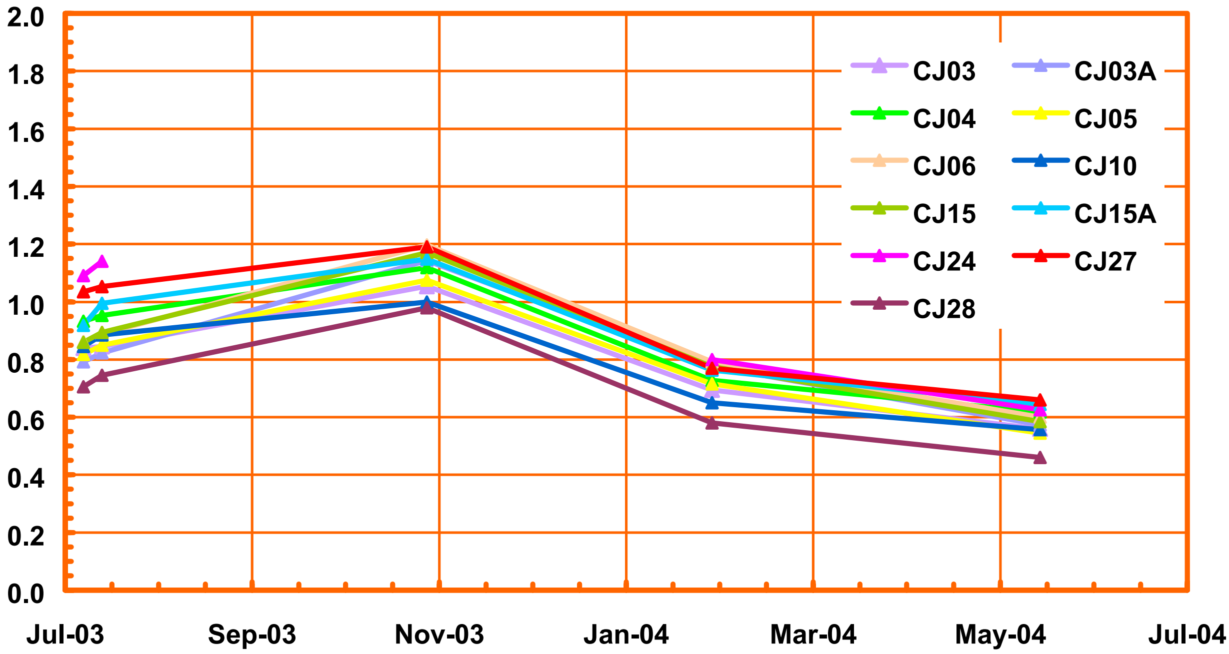


Figure 4.80: Hydrographs of Recently Installed Monitoring Wells – Middle Distance from the Coast
Source: Appendix 14

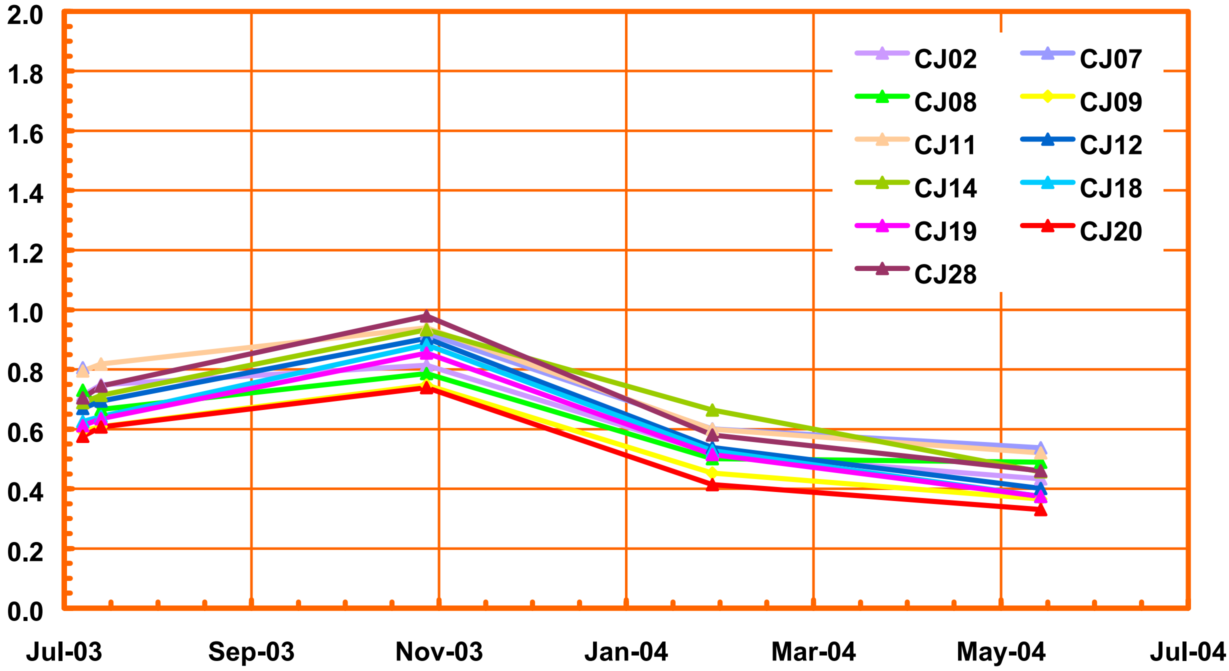


Figure 4.81: Hydrographs of Recently Installed Monitoring Wells - Middle Distance from the Coast
Source: Appendix 14

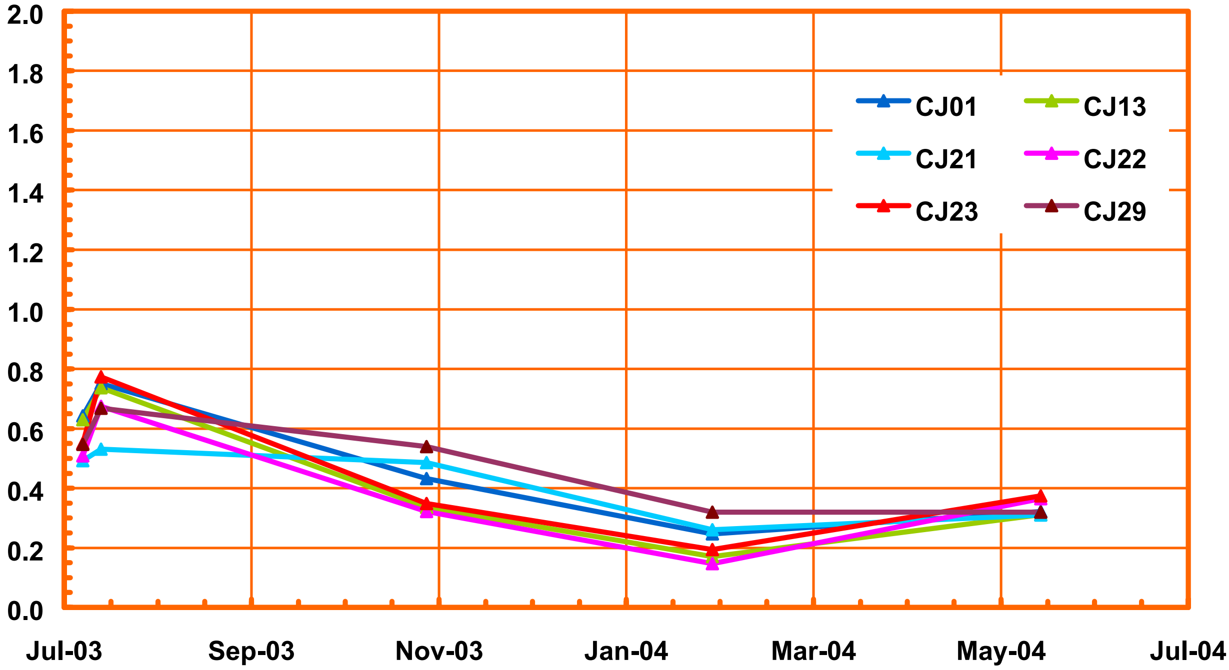


Figure 4.82: Hydrographs of Recently Installed Monitoring Wells - Foreshore Wells with Different Water Level Trends
Source: Appendix 14

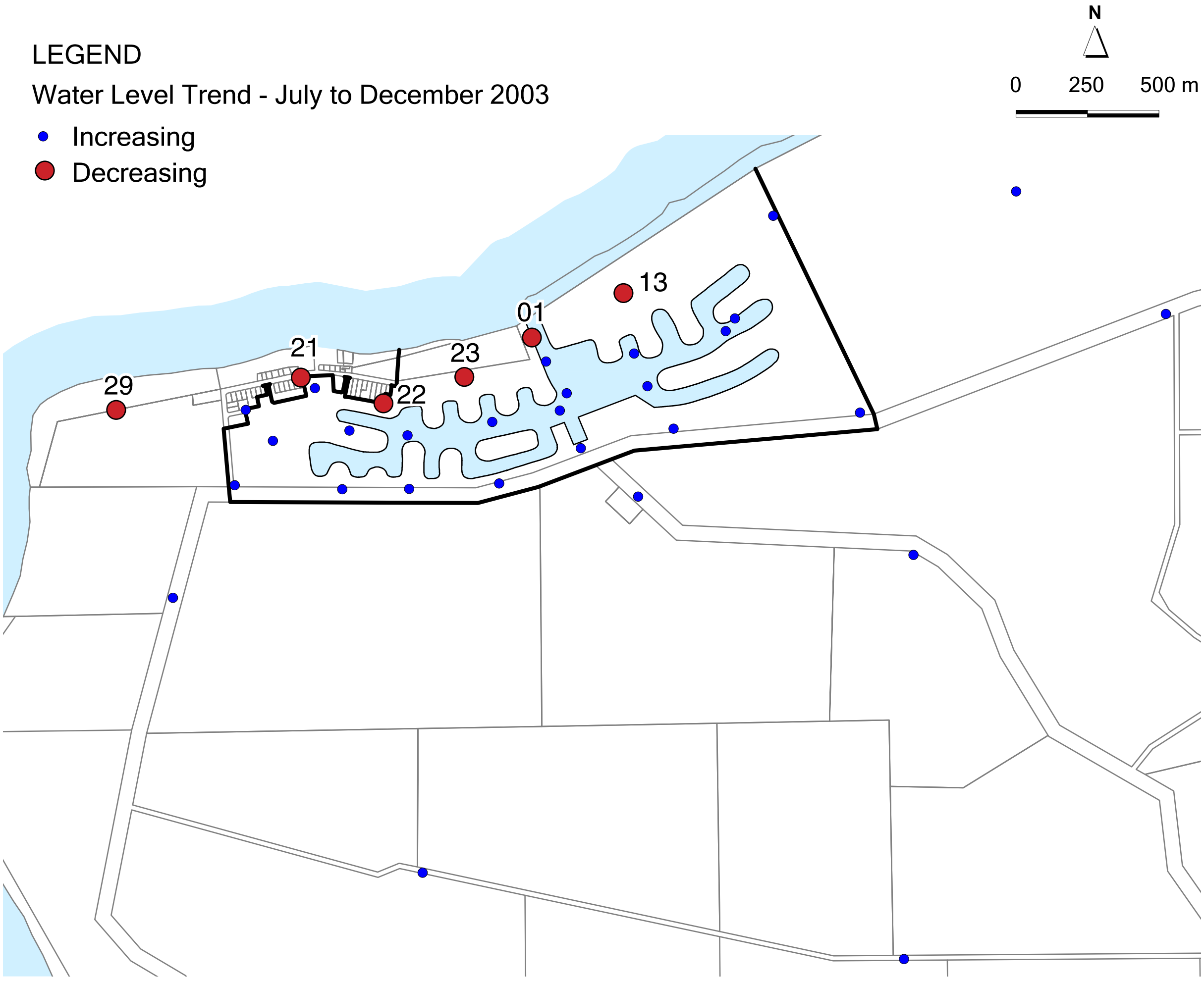


Figure 4.83: Foreshore Wells with Different Water Level Trends
Source: Appendix 14

4.14.10 Tidal Influences on Groundwater Levels

An understanding of the relationship between groundwater movement and tidal influence is important for the conceptual understanding of the groundwater system, particularly when considering the discharge potential from the unconfined aquifer to the marine environment.

The field investigations included measurement of groundwater levels versus tide levels between August and November at CJ01 (near the shoreline) and at CJ04 (located approximately 500 metres inland of CJ01) in order to assess the influence of the tides on the groundwater levels in the unconfined aquifer. The location of these wells is shown in Figure 4.68. The two wells are located on a groundwater flow path approximately perpendicular to the shoreline and are in the middle of the proposed development site. Comparison of groundwater levels at two wells along a flow line in the aquifer enables assessment of the tidal effect on groundwater levels further inland and also the change in hydraulic gradient over time.

Data loggers were set to record the groundwater levels at 30 minute intervals and the groundwater level data collected was compared with the measured tidal levels recorded by a data logger installed at Cape Jaffa jetty.

A plot of the high frequency groundwater data and the tide data for the monitored period is shown in Figure 4.84. The plot indicates that the groundwater levels at both locations are at a higher level than the tide level and hence the hydraulic gradient is towards the marine environment, as expected from regional understanding of the groundwater flow.

The response to the tidal oscillation is more dampened in the distant bore CJ04 as compared to at CJ01. Both wells appear to have a general trend of decreasing water level over the monitoring period, consistent with the tidal and seasonal recharge trend at that time of year.

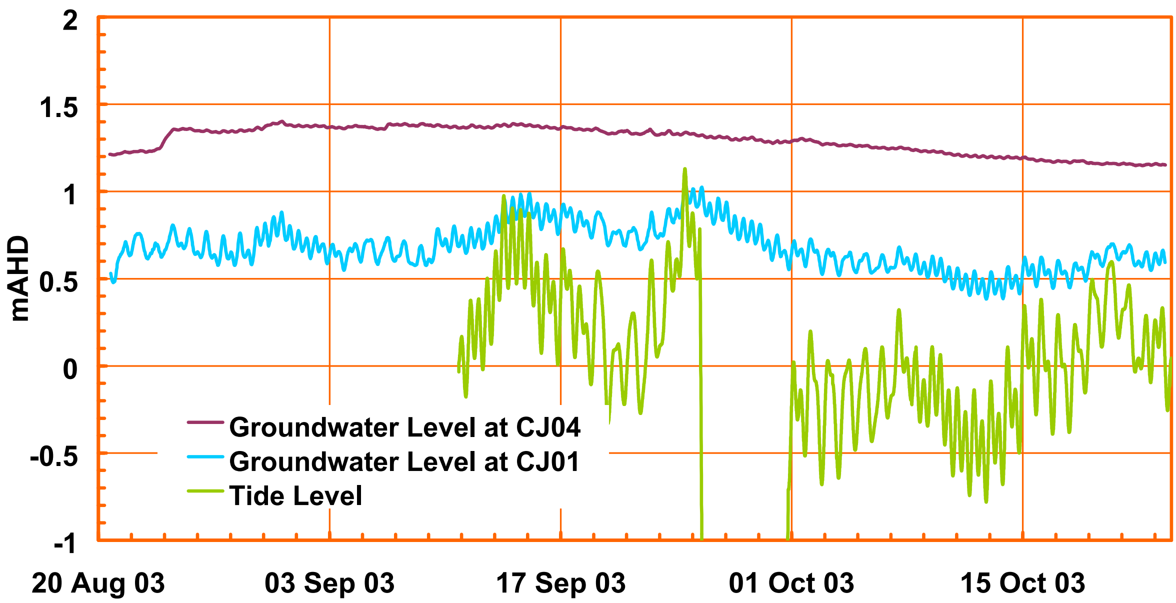


Figure 4.84: Groundwater Level Versus Tide Level
Source: Appendix 14

Figure 4.85 and 4.86 show hourly groundwater levels and the tide level over a one day interval (11 September 2003) to illustrate the phase shift between the tide levels and corresponding wave pattern established in the groundwater at CJ01 and CJ04 respectively. Note that the scales have been exaggerated for ease of interpretation.

The groundwater at CJ01 is in phase with the tidal oscillation with little or no delay in the water level fluctuation induced by the tide. It can be seen from Figure 4.86 that there is a lag of one to two hours at the more distant CJ04. This is consistent with the highly permeable sediments identified in the area.

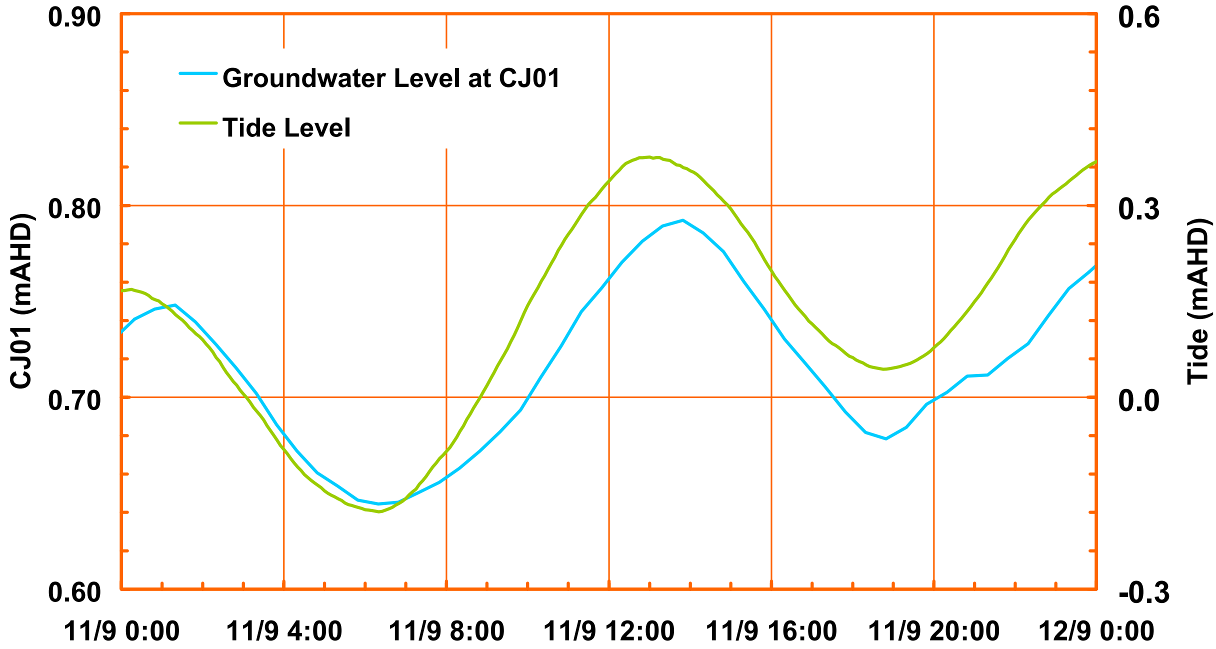


Figure 4.85: Groundwater Levels at CJ01 vs Tide Level
Source: Appendix 14

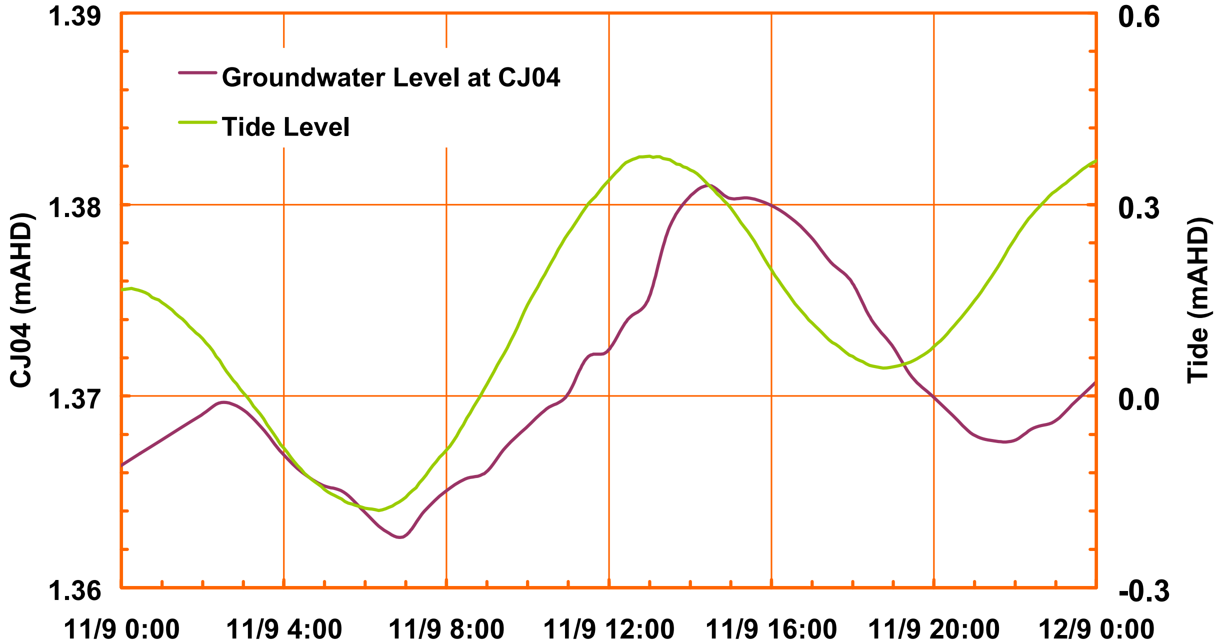
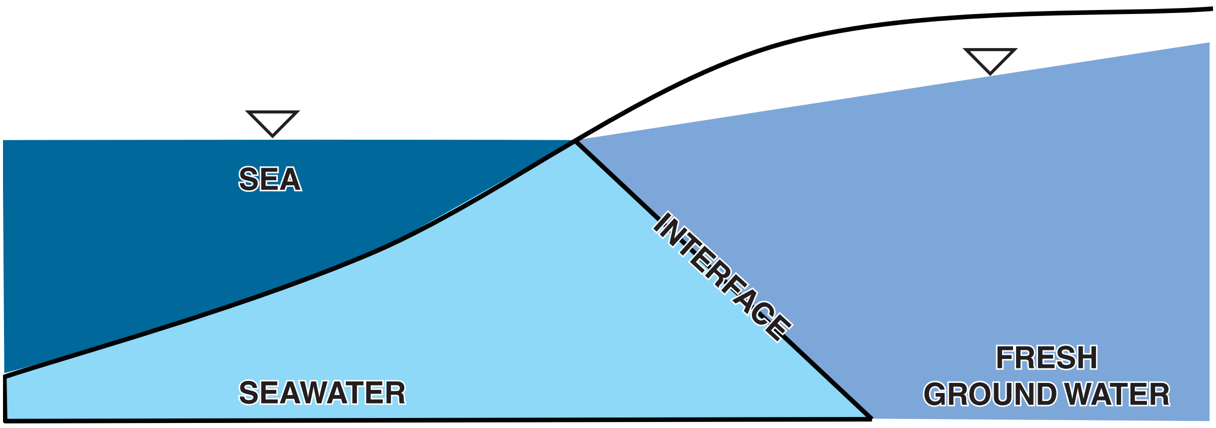


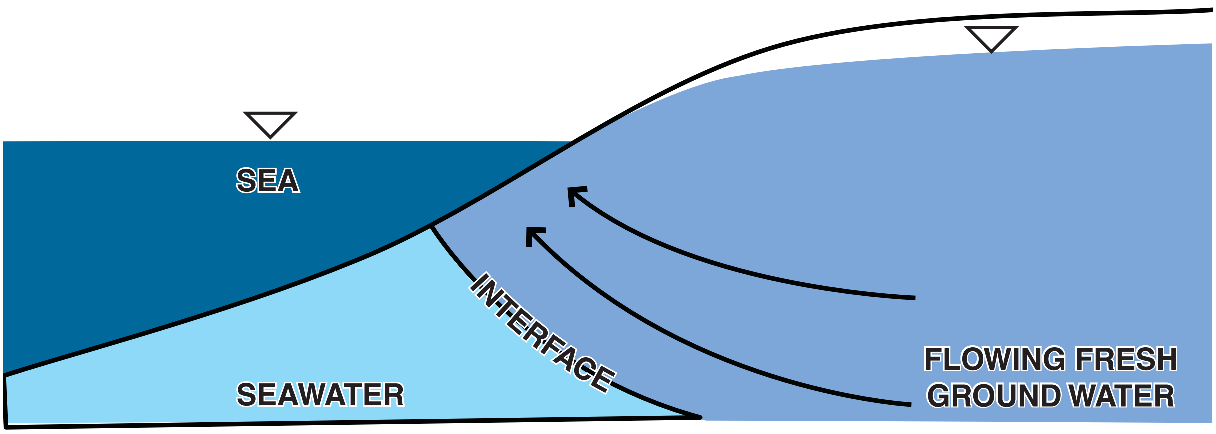
Figure 4.86: Groundwater Levels at CJ04 vs Tide Level
Source: Appendix 14

4.14.11 Freshwater-Seawater Interface

- In unconfined coastal aquifers where groundwater flows to the coast, as is the case at Cape Jaffa, a transition between the fresh groundwater and salty seawater exists within the aquifer near the coast. The transition is referred to as the seawater interface and its nature is principally a result of the density difference between seawater and fresh groundwater. The fresh groundwater is less dense and tends to ‘float’ on top of the seawater, resulting in an interface that projects inland under the aquifer (Freeze and Cherry 1979). Figure 4.87 illustrates this concept for two situations.



(a) No groundwater flow (hydrostatic) conditions

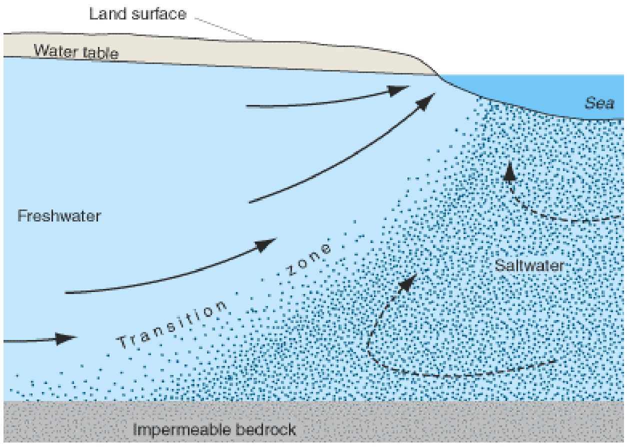


(b) Steady state seaward groundwater flow

Figure 4.87: Seawater Interface
Adapted from Freeze and Cherry 1979

The interface intersects the seabed near the shoreline and extends landward into the aquifer beneath the fresh groundwater. The angle of the interface depends on the aquifer conditions including the salinity of the fresh groundwater and seawater, the hydraulic conductivity of the aquifer, and the rate of groundwater flow toward the coast (Barlow 2003).

The flow of groundwater toward the coast tends to 'push' the seawater interface down and seaward and results in a deeper interface than would occur without groundwater flow. The fresh groundwater above the interface flows seaward and enters the marine environment through the relatively small gap between the interface and the coast, and some of the seawater becomes entrained in the groundwater flow and returns to the sea along the interface. A seawater interface does not occur as a discrete boundary, but as a transition zone between groundwater and seawater, due to mixing and diffusion effects.



Adapted from Barlow (2003)

The width of the transition zone at the interface can vary significantly depending on the extent of mixing and diffusion between the seawater and groundwater and the rate of groundwater flow to the coast. Variations in aquifer salinity can also be attributed to other factors such as evapo-transpiration, evaporation from very shallow or outcropping aquifers, sea-spray, inundation of low lying coastal land by seawater, entrapped fossil seawater that has not been completely flushed from the aquifer, the dissolving of mineral salt deposits such as halite within the aquifer or contamination by human activities.

Seawater Interface at Cape Jaffa

The seawater interface has not been encountered in any of the recently constructed monitoring wells or existing wells near the site, indicating that the seawater interface along the coast at Cape Jaffa is deeper within the unconfined aquifer below these wells. This is consistent with the behaviour of unconfined coastal aquifers within the region, as shallow domestic wells are found near the coast in many coastal towns in the South East of South Australia. At Cape Jaffa the salinity of wells near the coast is low, ie wells of about 1,000 mg/L have been recorded within 100 metres of the coast, thus the transition zone is expected to be narrow.

In order to provide a better understanding of the nature and location of the seawater interface, additional assessment has been performed. Ghyben and Herzberg investigated hydrostatic conditions as depicted in **Figure 4.87 (a)** and determined that, due to the density difference between fresh groundwater and seawater, the minimum possible depth below sea level to the seawater interface is approximately forty times the elevation of the watertable above sea level (Freeze and Cherry 1979). Thus, if groundwater levels are known, the minimum depth of the seawater interface can be determined.

This analysis is conservative as it assumes no groundwater flow to the coast and any flow to the coast, as exists at Cape Jaffa, acts to lower the interface, as illustrated in **Figure 4.87 (b)**. A sharp interface (i.e. a narrow transition zone) is assumed, consistent with site observations at Cape Jaffa.

In order to estimate a range of depths to the seawater interface at Cape Jaffa, the Ghyben/Herzberg relationship has been applied to the groundwater levels measured in July and October 2003 and the results are shown in **Figure 4.88**. For this analysis, sea level has been defined as 0 mAHD.

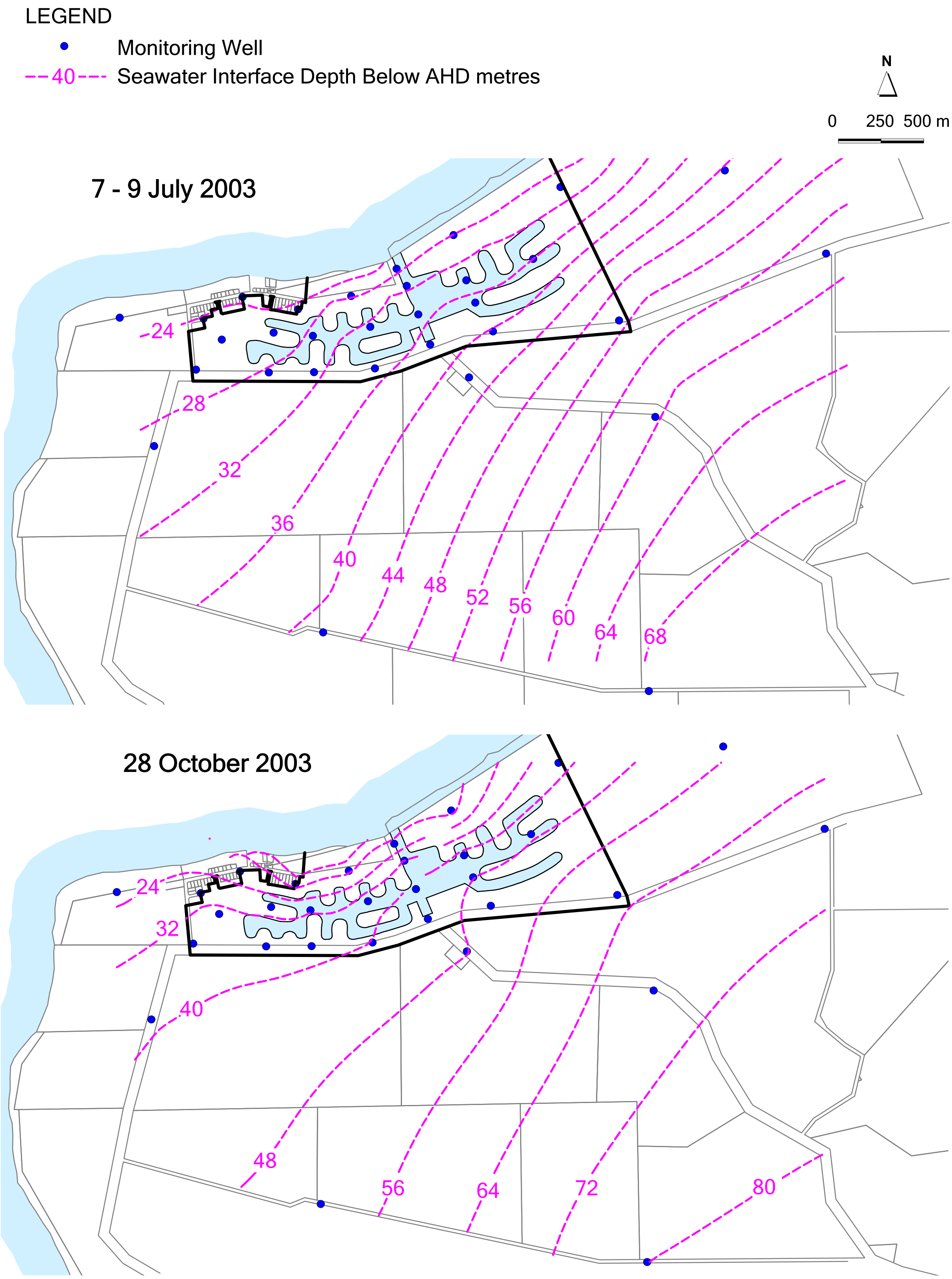


Figure 4.88: Estimated Minimum Depth of Seawater Interface

Source: Appendix 14

Table 4.23 summarises the results by listing the depth below ground level of the seawater interface at various locations. The results show the expected trend of increased depth to the seawater interface further from the coast and that the seawater interface was deeper (that is closer to the coast) in October 2003 than in July 2003. This is due to the increased groundwater flow and level in October 2003 following winter rainfall recharge and also the effect of tide levels during the groundwater level gauging.

Table 4.23: Estimated Depth to Seawater Interface
Source: Appendix 14

Location	Distance to Coast (metres)	July 2003 Interface Depth (mBGL)	Oct 2003 Interface Depth (mBGL)
Existing settlement	100 to 200 m	23 to 28 m	18 to 33 m
South-west corner of site	500 m	30 m	38 m
South-east corner of site	1,000 m	55 m	63 m

There is no evidence that any of the existing registered wells experience seawater intrusion whilst extracting groundwater and none of the monitoring wells indicate increased groundwater salinity that would be consistent with the intersection of the interface. As a result, it is not likely that the seawater interface is shallower than predicted using the Ghyben/Herzberg relationship.

Other factors can result in local or temporary changes in the location of the interface. Tidal fluctuations, storm surges, seasonal groundwater level changes, excessive groundwater extraction or variations in aquifer properties near the coast can all influence the location of the interface. An example is seawater coning, which results from the interface rising locally near a well during extraction. This is depicted in Figure 4.89 and discussed further in Section 5.2.3.

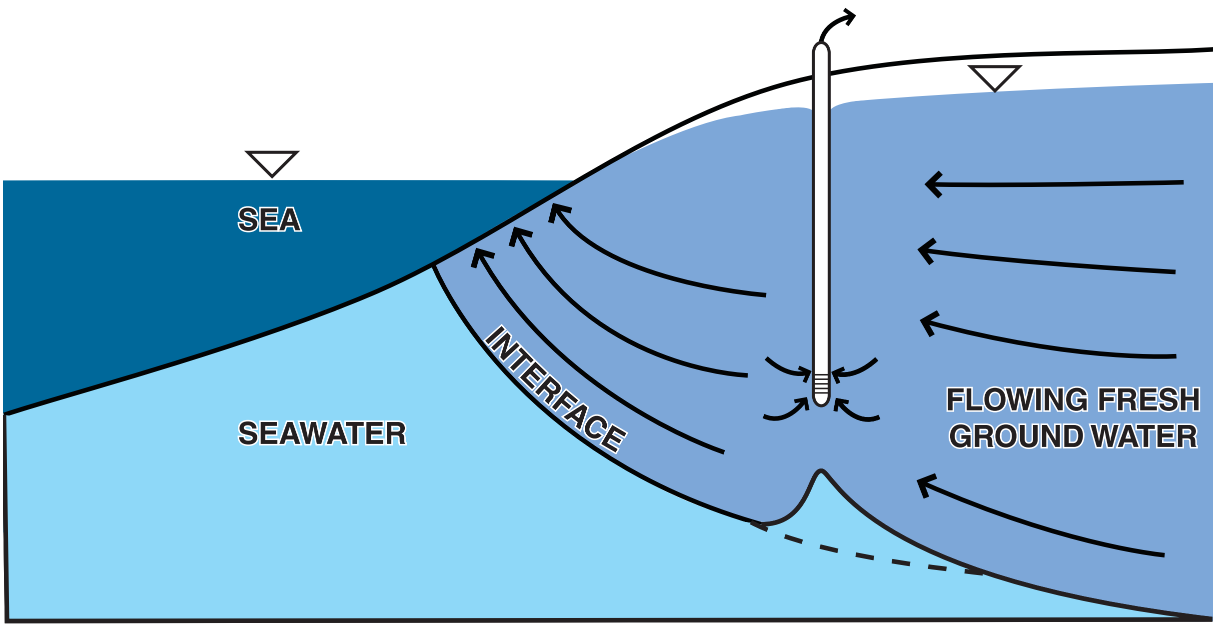


Figure 4.89: Seawater Coning
Adapted from Freeze and Cherry 1979

4.14.12 Continuity of the Unconfined Aquifer

As presented above, the depth of existing registered wells in proximity to the proposed development suggests that most of these wells are established into the Tertiary Limestone below the Quaternary Semaphore Sands. During the field investigations it was noted that groundwater extends through the shallow Quaternary Semaphore Sands in addition to the Tertiary Limestone. As the effect of the marina on registered groundwater users was the primary purpose of groundwater investigations, the upper limestone unit was targeted during the installation of groundwater monitoring wells and the subsequent groundwater flow modelling, as described in **Sections 5.2.2** and **5.2.3**. In addition to the wells established in the limestone, several wells were established in the sand layer in order to assess interconnection and any differences between the sand and limestone units.

A clay layer was observed at a number of locations on site below the water table between the sand and limestone units. The clay layer exists in varying thickness, generally between 0.0 and -2.3 mAHD, and the approximate extent and thickness of the clay is shown in **Table 4.10**, **Figure 4.23** and **Figure 4.90**.

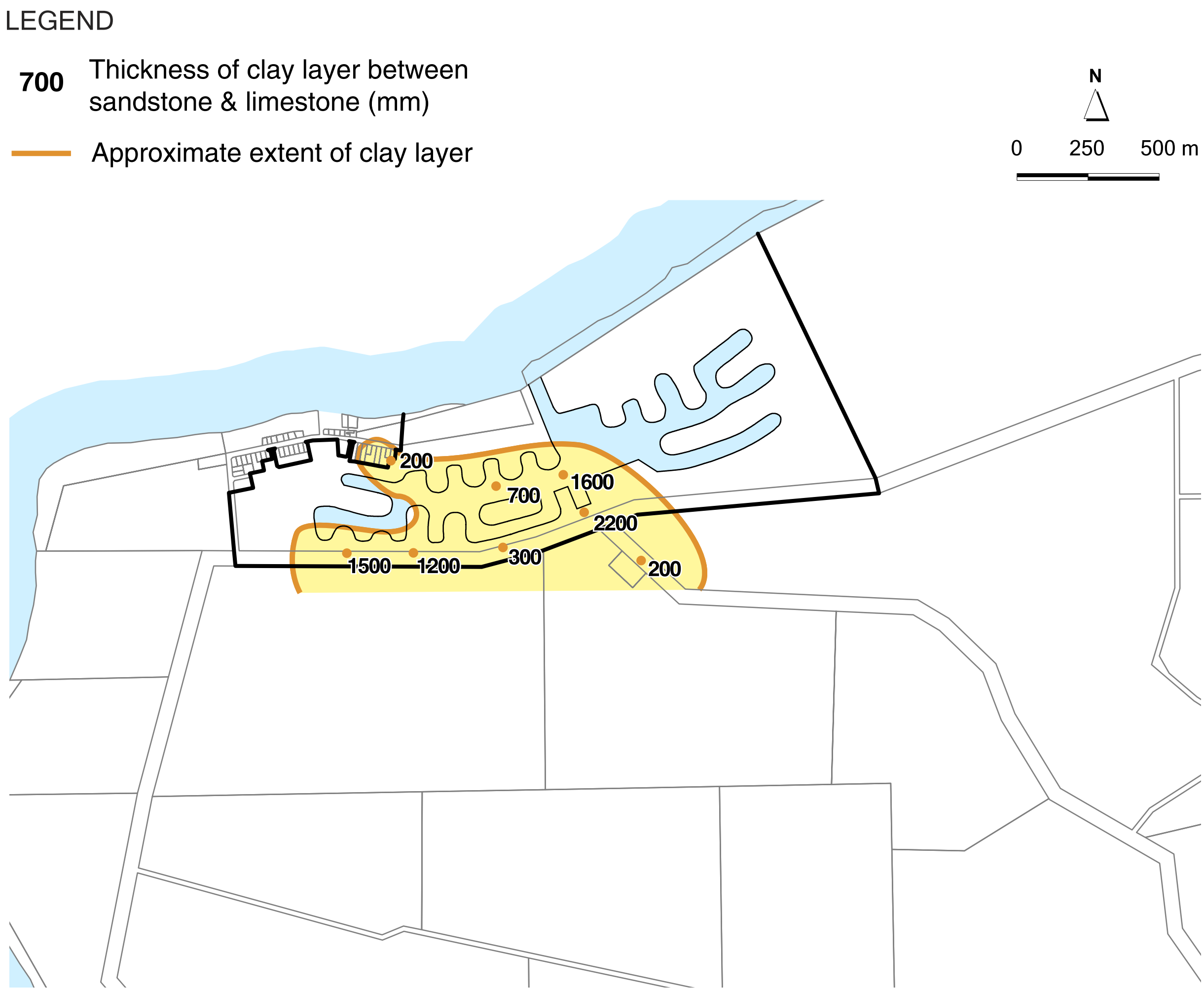


Figure 4.90: Approximate Extent of Clay Layer within the Unconfined Aquifer

One of the wells targeting the sand unit was installed above the clay unit. In order to assess any differences between the sand unit and limestone unit above and below the clay, a continuous water level data logger was installed into this well and the adjacent well that was installed into the limestone. Figure 4.91 shows the groundwater levels measured in these two wells. It also shows the tide levels for comparison, which were recorded using the continuous tide level recorder described in Section 4.11.4. The plot generally confirms hydraulic connectivity between the two geological units and shows larger tidal influence on the limestone aquifer than the shallow sands. The data indicates a downward head gradient, which is typical of unconfined aquifers.

The unconfined aquifer in the shallow Quaternary Semaphore Sands has been found to behave very similarly to that within the Tertiary Limestones, both where the clay layer was present and where it was not present. The groundwater within the two units has similar chemical analysis, as presented previously in Section 4.14.7. In addition, the measured hydraulic conductivity in the two units is similar, as presented previously in Section 4.14.8.

The waterways will be excavated into the limestone below the sand unit and, where present, below the clay layer. Due to the depth of excavation and the depth of existing registered wells, it is anticipated that the clay layer will have minimal influence in determining the effect on groundwater users as a result of the development. This hypothesis was tested by assuming a single aquifer system for the unconfined aquifer within the groundwater model, extending through the limestone and into the overlying sands. The fact that model calibration was achieved at locations where clay was and was not present is testament that the assumption of a continuous unconfined aquifer system within the sand and limestone units is appropriate for the purposes of impact assessment. See Section 5.2.2 for further information regarding the groundwater modelling and the model calibration.

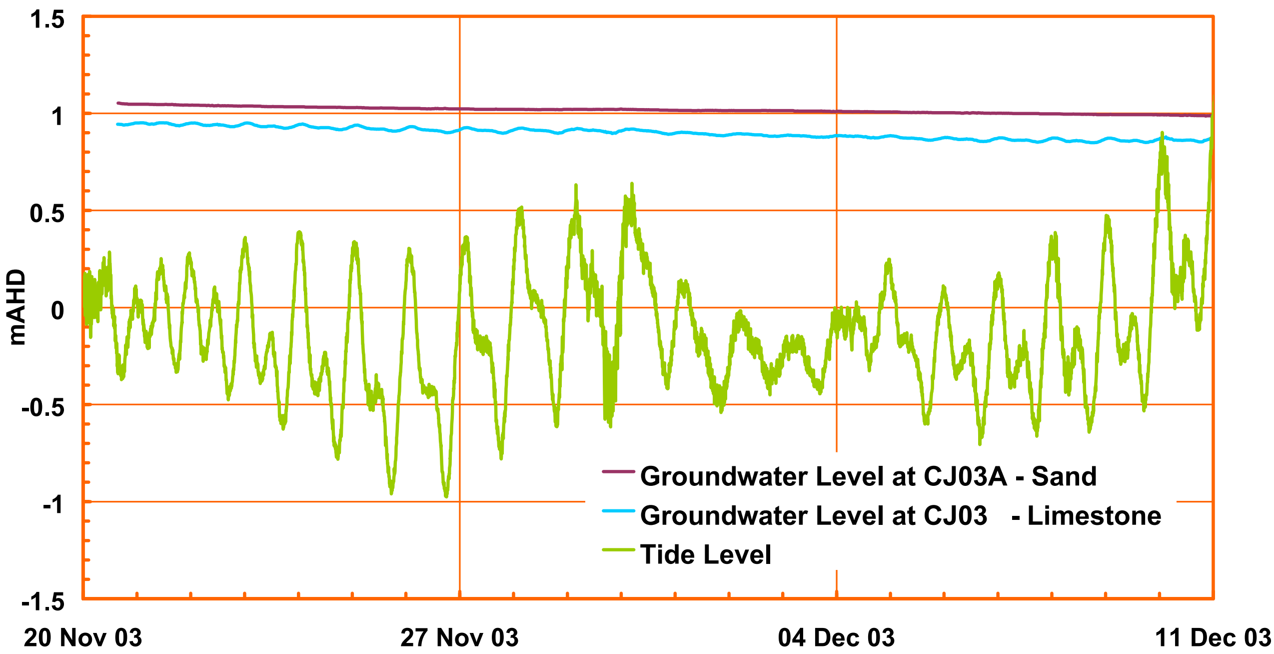


Figure 4.91: Unconfined Aquifer Levels in Tertiary Limestones and Quaternary Semaphore Sands
Source: Appendix 14

4.14.13 Groundwater Quality

Sampling from the 34 groundwater monitoring wells intersecting the unconfined aquifer on and around the site was performed in July 2003 and several wells were re-sampled in October 2004 in order to reconfirm some of the results. The samples were analysed for a range of compounds based on a review of historical land uses in the area and potential effects of the development on the environment, providing a “snap shot” of the water quality of the unconfined aquifer near the site.

In order to identify compounds that might require further assessment, the results of the analysis have been compared to criteria for the protection of marine aquatic ecosystems. Assessment of the potential effects is presented and discussed in **Section 5.2**, particularly **Section 5.2.6**.

The results of the analysis were compared to criteria defined in Environment Protection (Water Quality) Policy 2003 for marine aquatic ecosystems (EPA 2003) and these criteria are referred to as the EPP Marine Criteria. Where the EPP Marine provides no criteria for a compound (for example cyanide), reference was made to investigation levels defined for marine waters in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 1999), which are intended as a guideline to trigger further investigation. These investigation levels are referred to as the NEPM Marine Levels.

Many of the compounds analysed were not found in identifiable concentrations, however nutrients and several inorganic compounds were identified. The sampling, analysis and results are summarised below and discussed in more detail in **Appendix 14**. The range of parameters and compounds analysed and the number of samples assessed is shown in **Table 4.24**.

Table 4.24: Analysis of the Unconfined Aquifer Groundwater Quality – July 2003
Source Data: **Appendix 14**

Compound Type	Number of Parameters/Compounds Investigated	Number of Samples Assessed
Inorganics, including heavy metals	22	34
Nutrients and general chemistry	18	34
Volatile organics	6	7
Semi-volatile organics	32	7
Organochlorine pesticides	24	18
Organophosphate pesticides	22	18
Petroleum hydrocarbons	4	7
Speciated Arsenic, Cyanide & Cadmium	5	3
Total	133	37

Note: not all samples have been assessed for all compounds within each compound group

The sampling and analysis have been performed using industry standard procedures in order to ensure validity of the sampling results, as detailed in **Appendix 14**.

Organic Compounds

All of the samples had concentrations less than the EPP Marine Criteria for all of the organic compounds analysed. These compounds assessed include:

- speciated phenols;
- organochlorine pesticides;
- organophosphate pesticides;
- total petroleum hydrocarbons;
- benzene, toluene, ethylbenzene and xylenes;
- polycyclic aromatic hydrocarbons;
- volatile organic compounds; and
- semi-volatile chlorinated compounds.

Nutrients and General Chemistry

Samples were analysed for a range of nutrients and general chemical parameters, including:

- total dissolved solids;
- conductivity;
- pH;
- total alkalinity;
- calcium;
- chloride;
- magnesium;
- nitrate;
- nitrite;
- nitrate/nitrite;
- total phosphorous;
- potassium;
- sodium;
- sulphate;
- TKN (Total Kjeldahl Nitogen); and

- total organic carbon.

Figures 4.92 to **4.95** show the concentrations of total nitrogen, total organic carbon, oxidised nitrogen and phosphorous measured on-site and regionally. Where measured concentrations are greater than the EPP Marine Criteria they are highlighted in the figures. The measured concentrations of all other compounds analysed were less than the EPP Marine Criteria in all of the samples assessed.

The results indicate the presence of nutrients in the groundwater of the unconfined aquifer both on-site and in the surrounding area. This is consistent with the use of fertilisers and the application of animal effluent likely to be associated with agricultural land use in the region (**Appendix 14**).

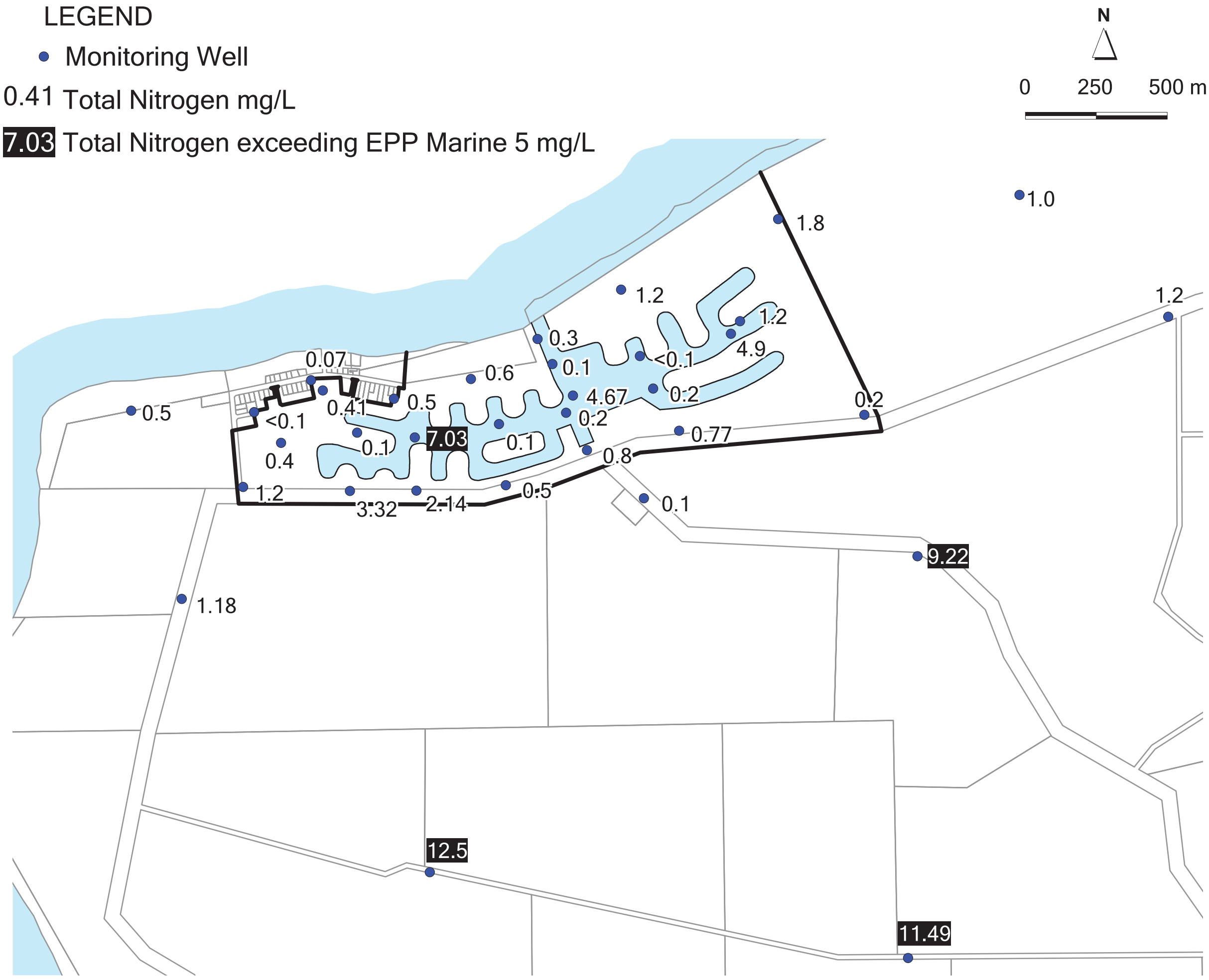


Figure 4.92: Total Nitrogen
Source: **Appendix 14**

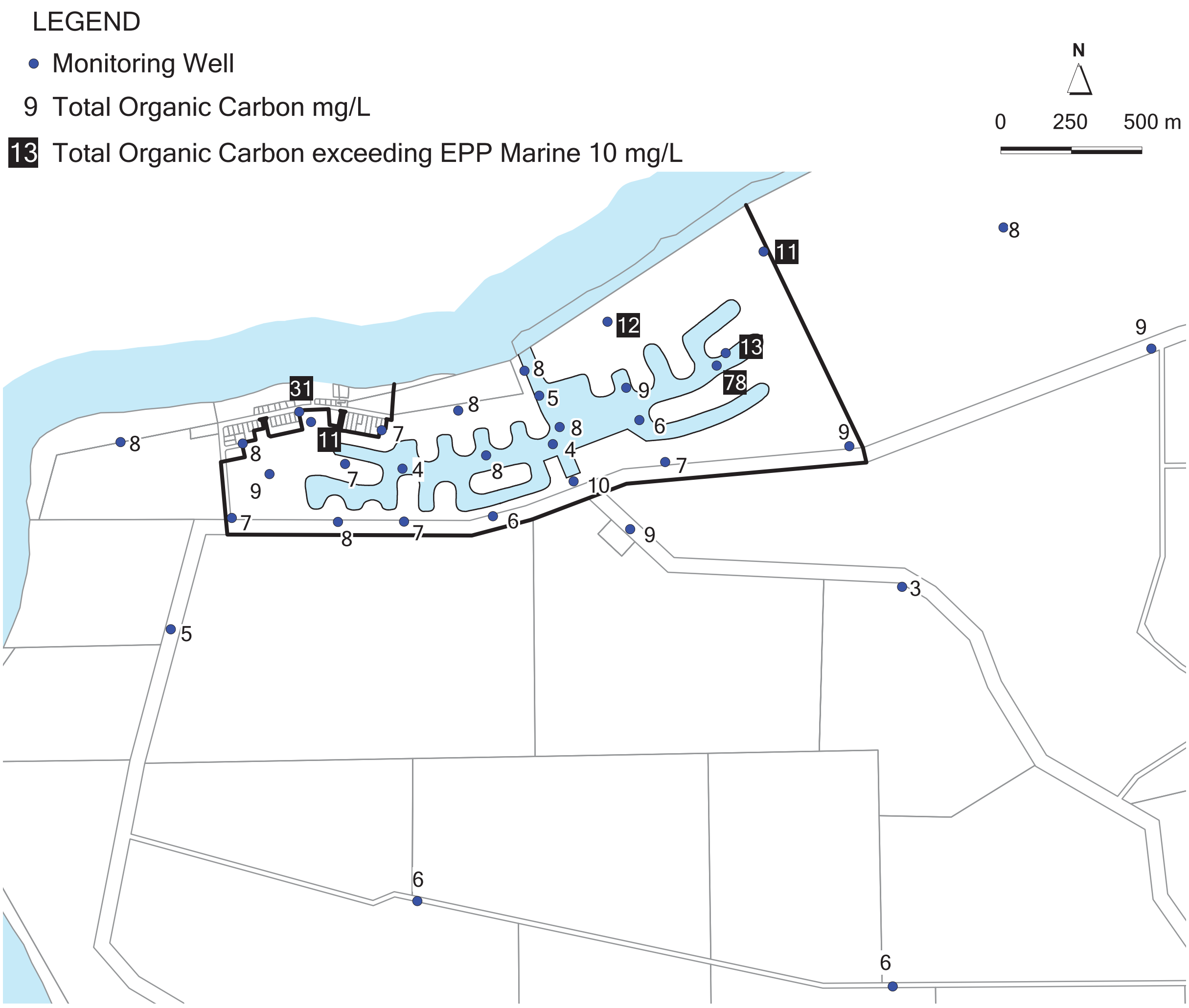


Figure 4.93: Total Organic Carbon
Source: **Appendix 14**

LEGEND

- Monitoring Well

0.01 Oxidised Nitrogen mg/L

0.58 Oxidised Nitrogen exceeding EPP Marine 0.2 mg/L

N

0 250 500 m

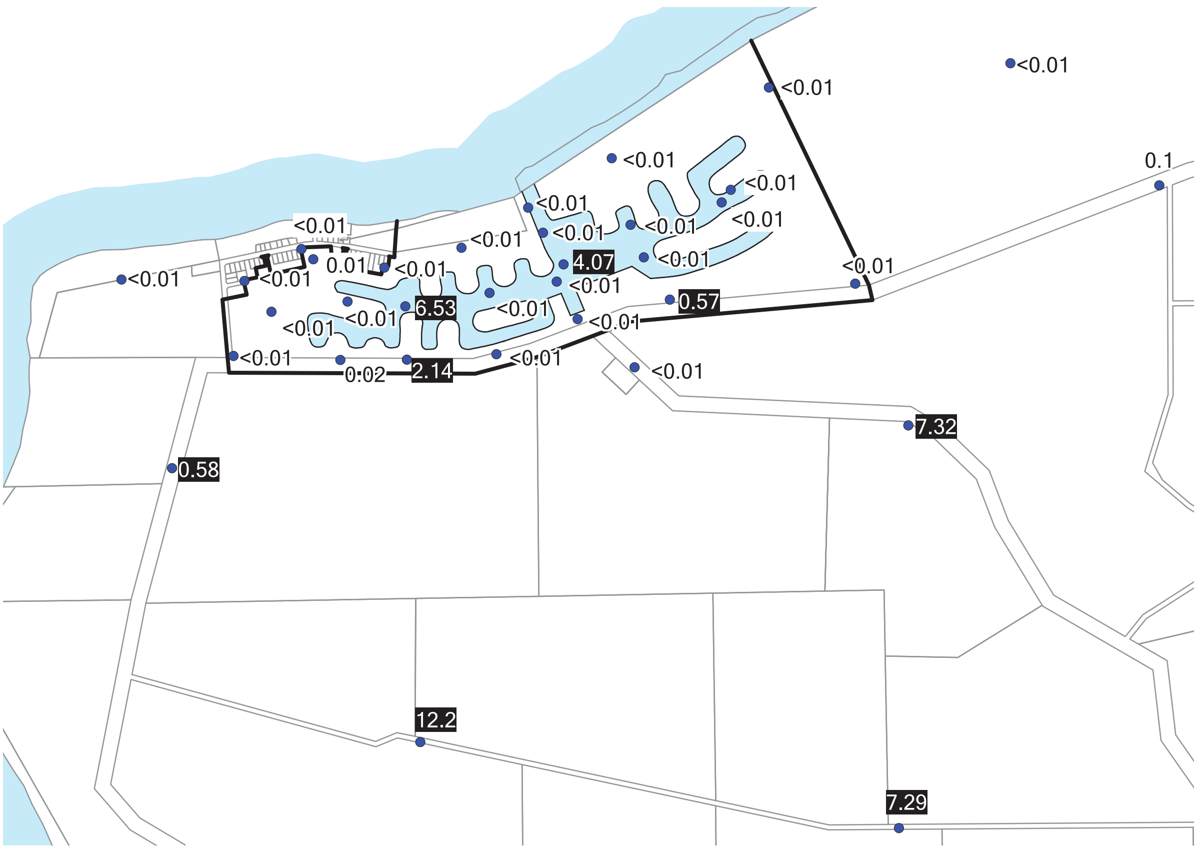


Figure 4.94: Oxidised Nitrogen

Source: Appendix 14

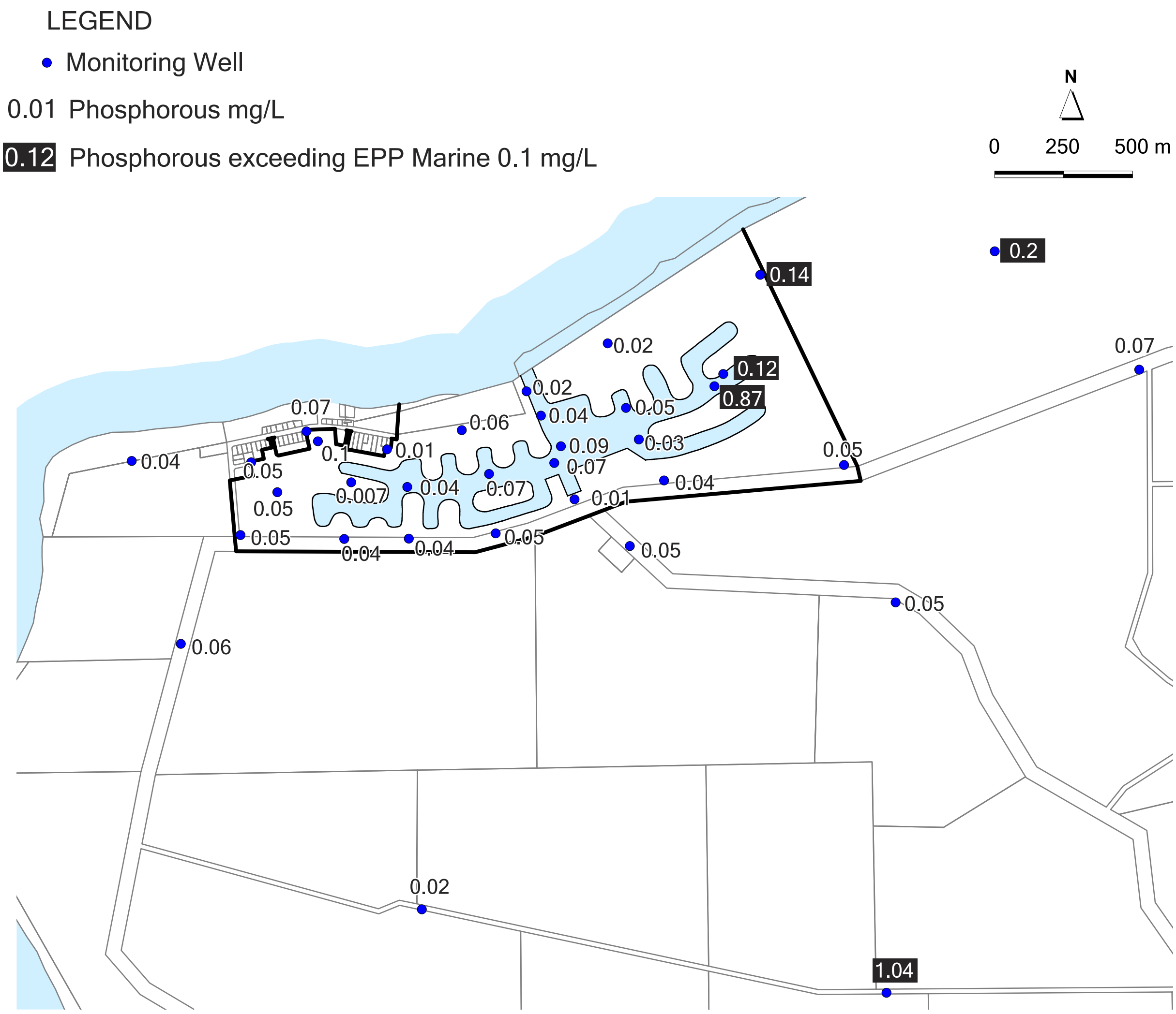


Figure 4.95: Phosphorous
Source: **Appendix 14**

<u>Inorganic Compounds</u>

Samples were also analysed for a range of inorganic compounds, including:

- heavy metals including antimony, total arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, tin, vanadium and zinc;
- total cyanide; and
- soluble fluoride.

Arsenic, cadmium and cyanide were identified at some locations, as shown in **Figures 4.96** to **4.98**. Where the measured concentrations are greater than the EPP Marine they are highlighted in the figures.

For cyanide, comparison is made to the NEPM Marine investigation level as no criteria is defined in the EPP. The measured concentrations of all other compounds were less than the EPP Marine Criteria (or where applicable, NEPM Marine investigation levels) for all of the samples.

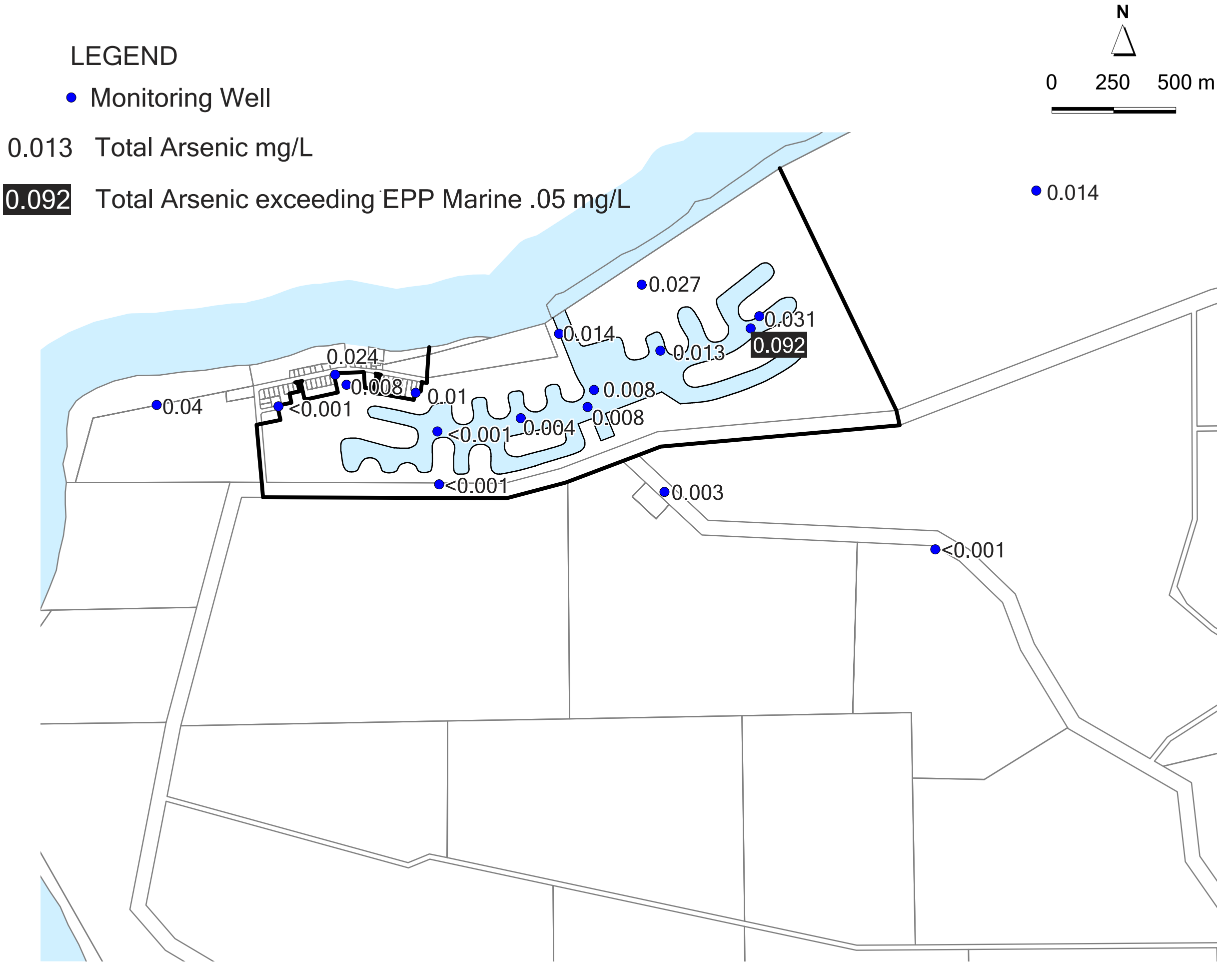


Figure 4.96: Total Arsenic
Source: **Appendix 14**

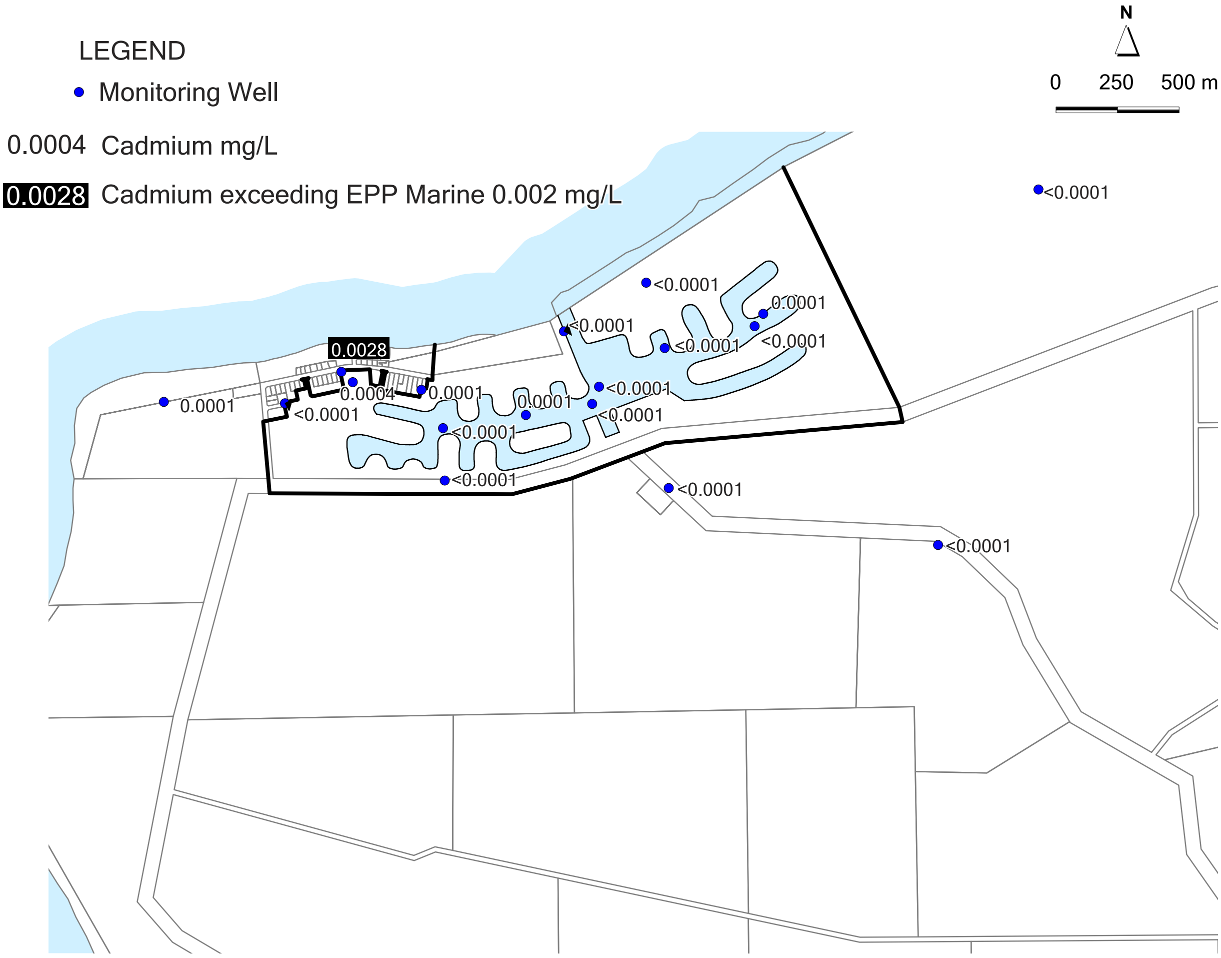


Figure 4.97: Cadmium

Source: **Appendix 14**

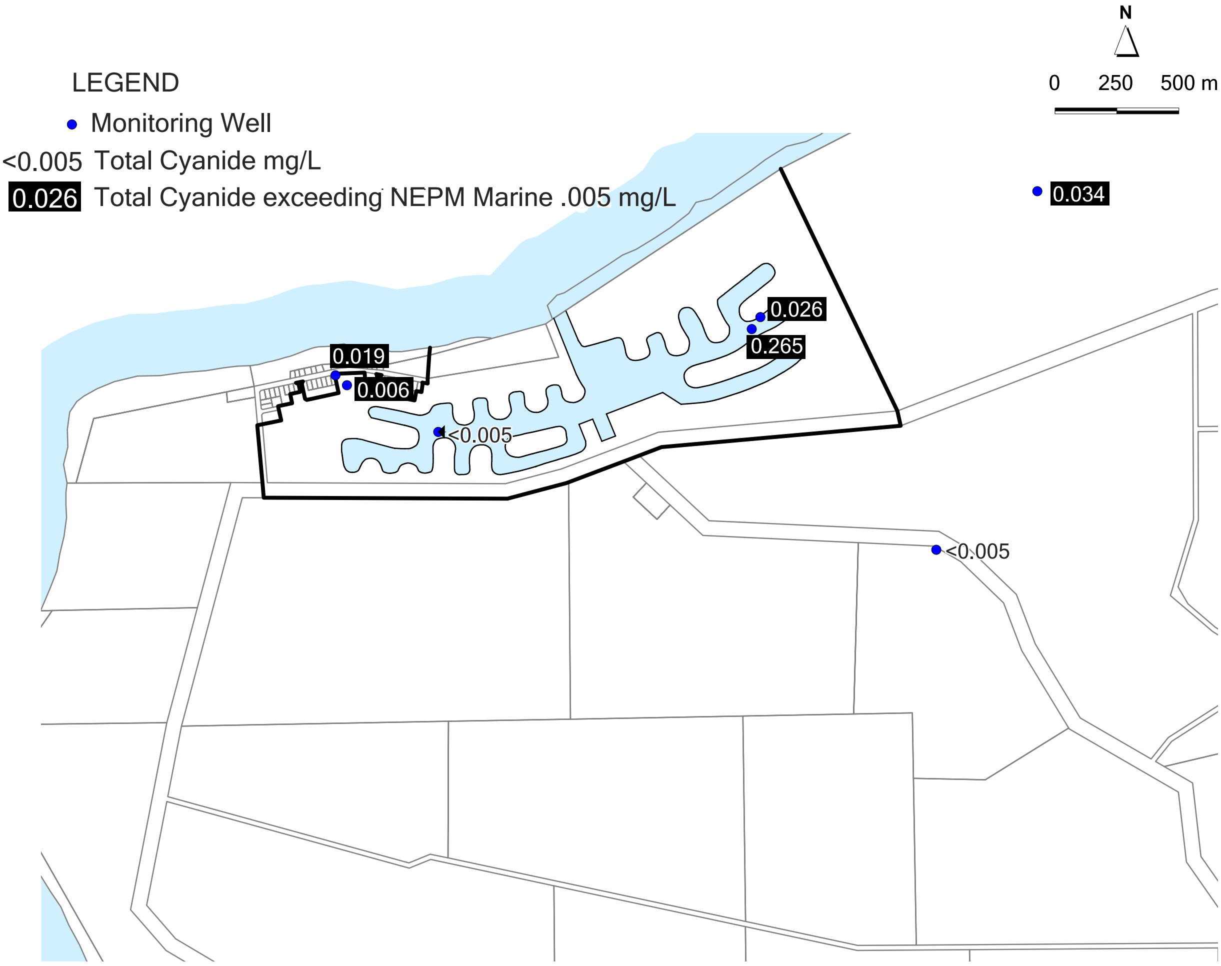


Figure 4.98: Cyanide
Source: **Appendix 14**

Additional Analysis of Inorganic Compounds

To further investigate the presence of inorganic compounds, wells within the site that exhibited concentrations above the EPP Marine Criteria (CJ15, CJ15A and CJ21, refer **Figure 4.68**) were sampled again in October 2004 and more detailed analysis was performed (**Appendix 14**). The repeat analysis was conducted for cyanide, arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

Different forms of arsenic and cyanide have different potential effects, thus the additional samples were analysed for individual species of arsenic, free cyanide and total cyanide. Another objective of the additional sampling was to investigate the accuracy of the initial analysis, as high salinity may have resulted in interference during laboratory analysis and artificially high results. The subsequent analysis was performed using saline waters techniques, which reduces this susceptibility.

The results for arsenic, cadmium and cyanide are presented in **Table 4.25**, including a comparison to the previous results. The concentration of all of the other metals reassessed remained below the EPP Marine Criteria.

Table 4.25: Re-sampling Results - October 2004
Source: Appendix 14

	EPP/NEMP Marine	CJ15		CJ15A		CJ21	
Date		July 2003	Oct 2004	July 2003	Oct 2004	July 2003	Oct 2004
Salinity (mg/L)		4,300	5,620	14,900	7,590	1,550	1,630
Total Arsenic (mg/L)	0.05	0.031	0.024	0.092	<0.002	0.024	0.005
Cadmium (mg/L)	0.002	0.0001	0.0002	<0.0001	<0.0002	0.0028	0.0005
Free Cyanide (mg/L)		[1]	<0.005	[1]	<0.005	[1]	0.006
Total Cyanide (mg/L)	0.005	0.026	0.021	0.265	0.011	0.019	0.006

[1] Not tested

The total arsenic concentrations decreased in all three wells since July 2003 and were all less than the EPP Marine Criteria. It is likely that this is a result of a combination of the removal of saline water interference during laboratory analysis and the effects of increased rainfall recharge. A significant reduction was observed for well CJ15A, which is a shallow well located within low-lying land in the eastern part of the site. The reduction is expected to be largely due to the effects of dilution from increased rainfall recharge, as indicated by the reduced salinity (Appendix 14).

The cadmium concentrations in all three wells are less than the EPP Marine Criteria, whereas in July 2003 one of the 18 wells assessed was marginally greater than the EPP Marine (0.0028 vs 0.002 mg/L).

Total cyanide concentrations have reduced, particularly in the case of CJ15A, which may also be the result of dilution from increased rainfall recharge. The measured total cyanide concentrations ranged from 0.060 to 0.021 mg/L and the free cyanide (the form cyanide that is of greatest concern) measured less than the detection limit of 0.005 mg/L in two wells and 0.006 mg/L in the other well. As the EPP does not define marine criteria for cyanide, comparison has been made to the NEMP Marine investigation level of 0.005 mg/L, which is intended as a guideline to trigger further investigation. The EPP does however define a total cyanide criterion for potable water of 0.08 mg/L and all of the ten samples from both sampling rounds except one (CJ15A in July 2003) meet the EPP potable water criteria for total cyanide concentration.

The arsenic, cadmium and cyanide identified could be from a number of sources. Both arsenic and cyanide can be found naturally in the concentrations identified, with arsenic coming from some soil/rock minerals and cyanide from plant production. These compounds can also result from non-natural sources, such as the historical application of pesticides, or in the case of arsenic, from the use of parasite treatment for stock. Low concentrations of cadmium are often associated with fertilisers such as superphosphate .

The potential effects of compounds in the groundwater are discussed in various sections of Section 5, particularly Section 5.2.6, which discusses changes in the flow out to the sea and potential effects on the marine environment. In order to be conservative, the highest of the measured concentrations of arsenic, cadmium and cyanide have been used for the assessment presented in Section 5.2.6, despite the generally reduced concentrations measured in October 2004 using the saline waters method.

4.14.14 Groundwater Use

Regional Groundwater Use

Groundwater from the confined and unconfined aquifers is a major source of water in the region. It is used for stock, domestic, irrigation, commercial (aquaculture) and town water supply purposes. Cape Jaffa is located within the Lacepede Kongorong Prescribed Wells Area (PWA), and groundwater allocations and usage are described in the Water Allocation Plan (WAP), published by the South East Catchment Water Management Board (SECWMB 2001). The groundwater salinity of both aquifers is generally suitable for potable supply, however the salinity of the unconfined aquifer is elevated at some locations, as indicated by **Figures 4.73** and **4.74**. From a salinity viewpoint, groundwater with a salinity of less than 1,000 mg/L is generally considered suitable for potable supply per the Australian Drinking Water Guidelines (NHMRC 1996).

Information on the registered groundwater wells near the study area was provided by Primary Industries and Resources SA and **Figure 4.99** shows the operational groundwater wells within approximately 20 kilometres of the site.

Unconfined Aquifer

Regionally, where the unconfined aquifer quality is good, it is used extensively for irrigation, stock and domestic purposes. There is also some industrial use of groundwater, particularly for the aquaculture industry. The unconfined aquifer is generally not used for town water supply purposes, although it is used in the lower south east at Millicent and Mount Burr.

Confined Aquifer

For the confined aquifer, Cape Jaffa is located in the Kingston Management Area and groundwater use from the confined aquifer in this area is extensive. It has good quantity and quality of water and often the wells are artesian or seasonally artesian so pumping is not required. **Figure 4.99** highlights wells greater than 60 metres deep as an indication of wells that are possibly intersecting the confined aquifer.

Groundwater from the confined aquifer in the Kingston Management Area is predominately used for irrigation, town water supply and aquiculture. Other uses include stock and domestic, particularly at locations where the salinity of the unconfined aquifer is higher. Leakage from the confined aquifer to the unconfined aquifer through poorly constructed or deteriorating wells has been a significant “use” of groundwater from the confined aquifer in the region and a program is in progress to replace, decommission or rehabilitate such wells.

Although the use of the confined aquifer in the wider region is extensive, there are no operational wells intersecting the confined aquifer in the Cape Jaffa area, as indicated in **Figure 4.99**. The nearest well deep enough to be expected to be intersecting the confined aquifer is approximately 10 kilometres south-east of Cape Jaffa.

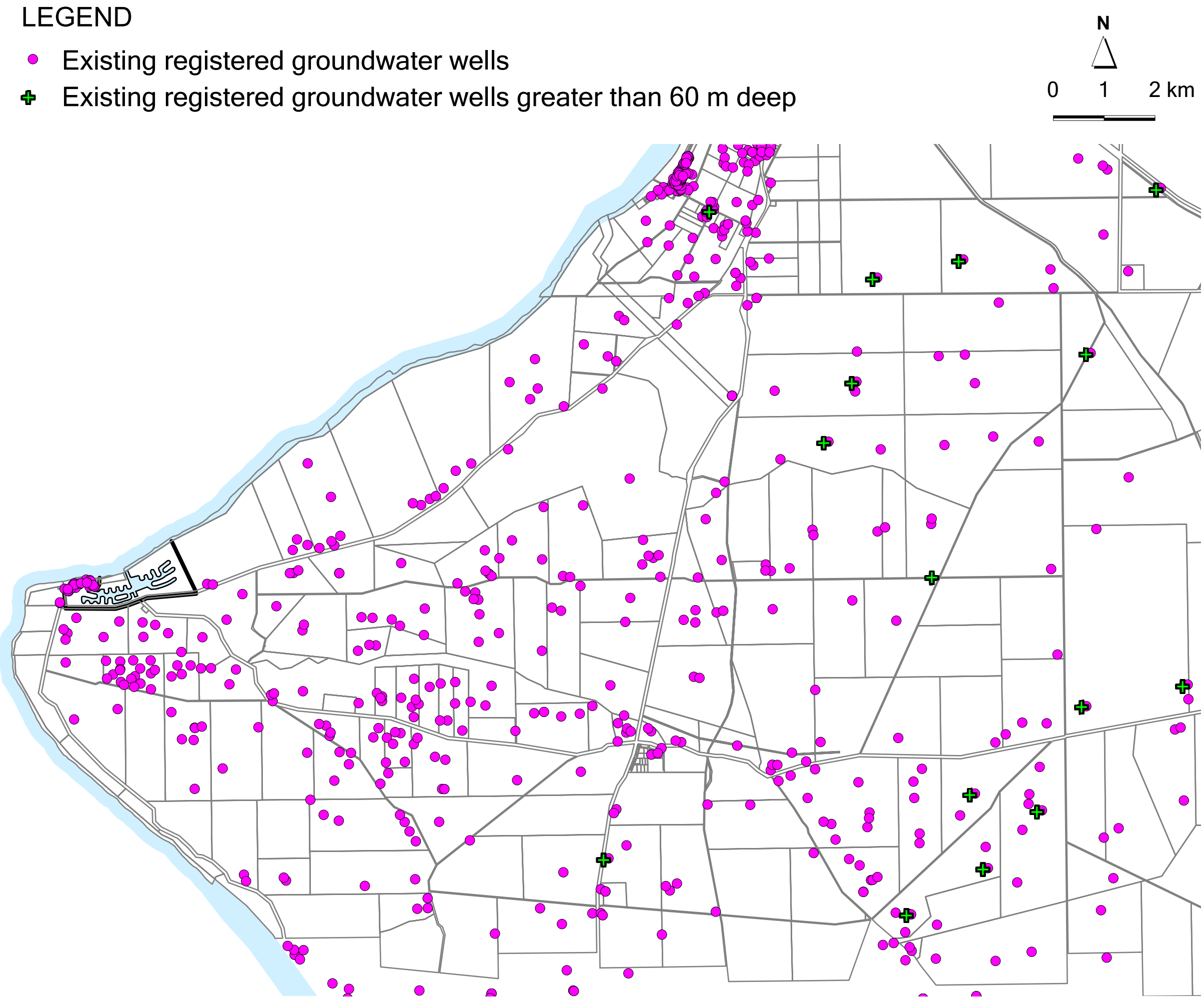


Figure 4.99: Registered Operational Groundwater Wells in the Region
Source Data: PIRSA Wells Database July 2003

Local Groundwater Use

Figure 4.100 presents the location and classified use of registered groundwater wells near the study area and the registered depth of each well is presented in **Figure 4.101**. Based on depth, all of the registered wells near the study area are expected to intersect the upper unconfined aquifer within either the Quaternary Sands or the upper Tertiary Limestone.

The recent field investigations indicate that the salinity of the unconfined aquifer is between 400 and 15,000 mg/L TDS. In the low-lying areas immediately to the south and east of the site salinity generally greater than 2,000 mg/L TDS was measured. Further south where the topography rises, salinity was typically less than 1,000 mg/L TDS, thus is potentially suitable for potable supply with respect to the salinity guidelines of the Australian Drinking Water Guidelines (NHMRC 1996).

The majority of the wells are classified as being used for stock/domestic or irrigation purposes. **Figure 4.102** shows the number of operational wells registered for each class of use within

5.0 kilometres of Cape Jaffa. One well is classified as being used for the purposes of a town water supply, although no town water supply exists at Cape Jaffa. Its registered location is shown in **Figure 4.99** and its registered depth is shown in **Figure 4.101**. This well is drilled to a depth less than 10 metres below ground level, thus it is expected to be intersecting the upper sediments of the unconfined aquifer.

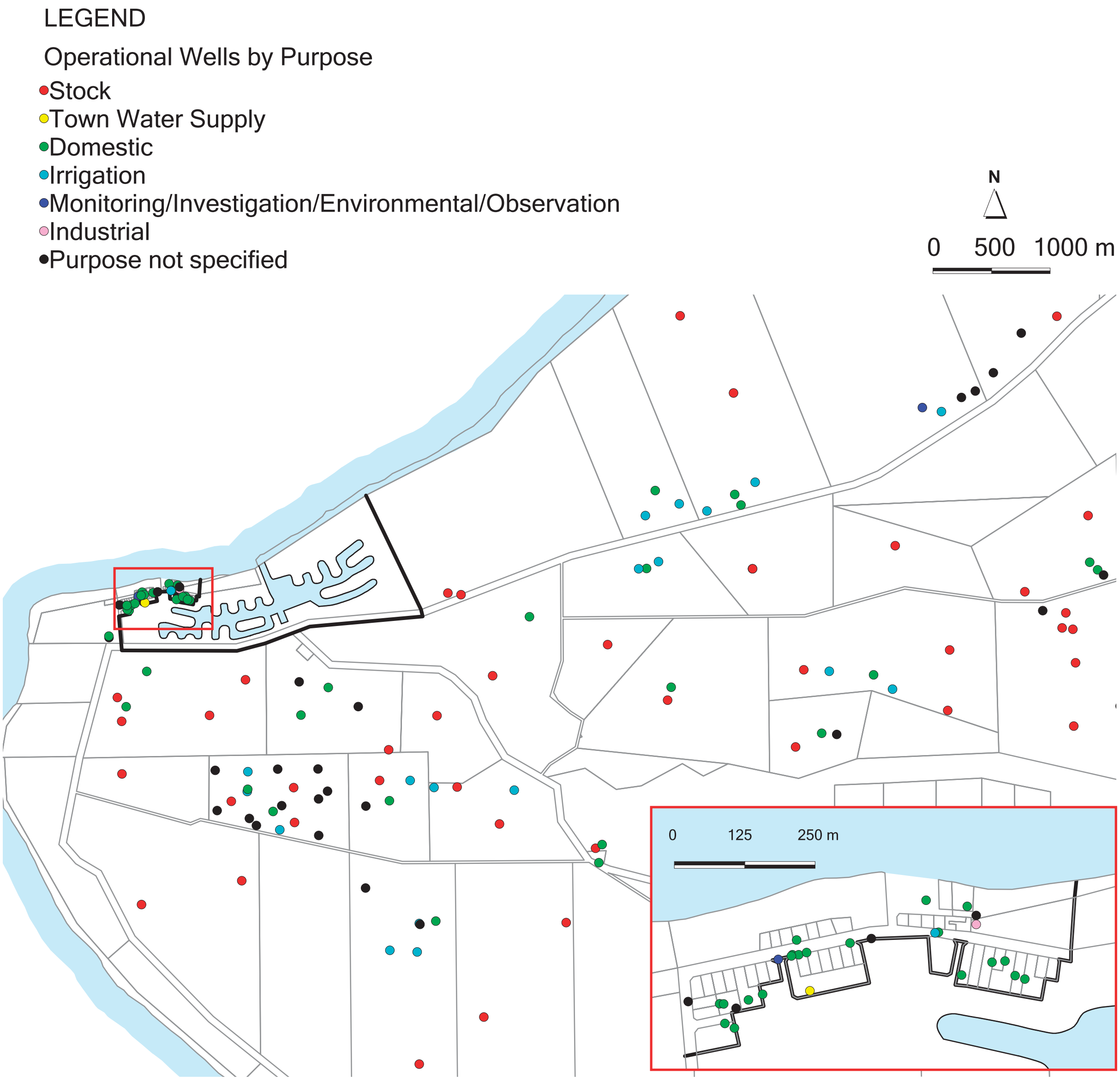


Figure 4.100: Registered Groundwater Well Use

Source Data: PIRSA Well Database July 2003

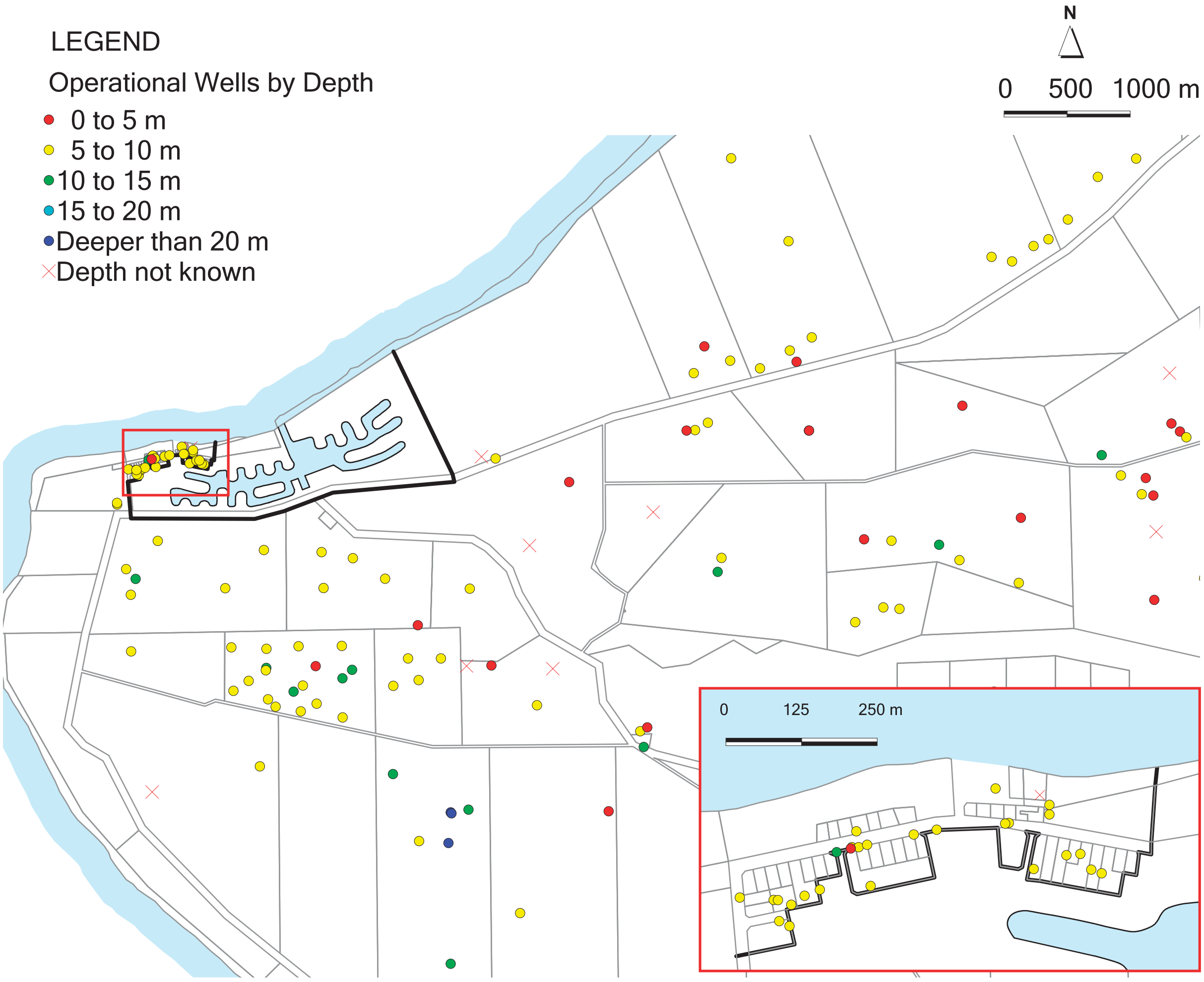


Figure 4.101: Registered Groundwater Well Depth
Source Data: PIRSA Well Database July 2003

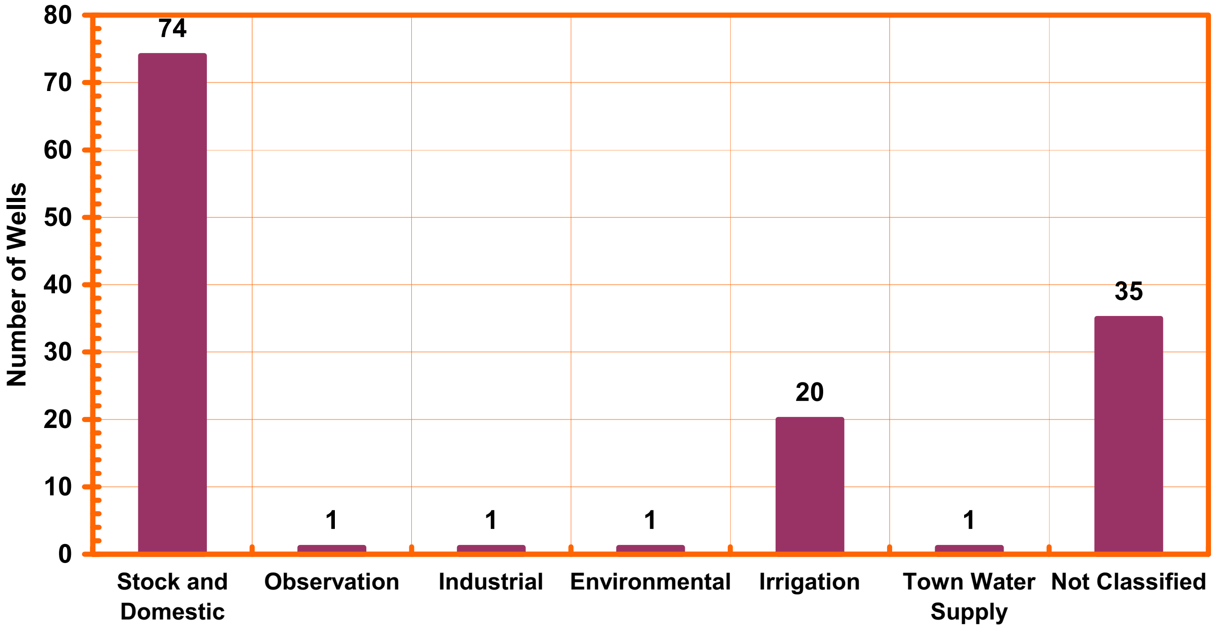


Figure 4.102: Registered Groundwater Well Use Within 5.0 kilometres
Source Data: PIRSA Well Database July 2003

4.14.15 Confined Aquifer

The investigations described above have focussed on the unconfined aquifer as the potential effects of the development relate principally to the shallow unconfined aquifer. Nevertheless, the following regional information pertaining to the confined aquifer is provided as background.

Potentiometric surface contours on the confined aquifer are shown in **Figure 4.103**. The groundwater flow direction is perpendicular to the contours shown and generally towards the coast. Based on the presented contours the hydraulic gradient near the study area is approximately 0.0002 (0.2 metres head per kilometre).

Regional salinity distribution in the confined aquifer is shown in **Figure 4.104**. Groundwater in the confined aquifer is about 10,000 years old (Love *et al.* 1994) and has low salinity, generally less than 1,000 mg/L TDS (DWLBC 2002/10).

Figure 4.105 shows hydrographs of the water level fluctuations versus time in the confined aquifer using data provided by DWLBC from nearby observation wells. See **Table 4.21** and **Figure 4.67** for details and locations of these wells. **Figure 4.105** shows that the confined aquifer displays pressure fluctuations of up to 8.0 metres recorded in the two closest monitoring wells. Seasonal variation in these wells is typically between 2.0 metres to 4.0 metres with groundwater pressures higher following winter than summer. Such variations are common in confined aquifers due to groundwater use and do not necessarily indicate significant stress on the system. It should be noted that these nearest monitoring wells are a considerable distance from the site, as shown on **Figure 4.67**. **Figure 4.105** also shows that over the last eight years there is a general trend of increasing head in the confined aquifer.

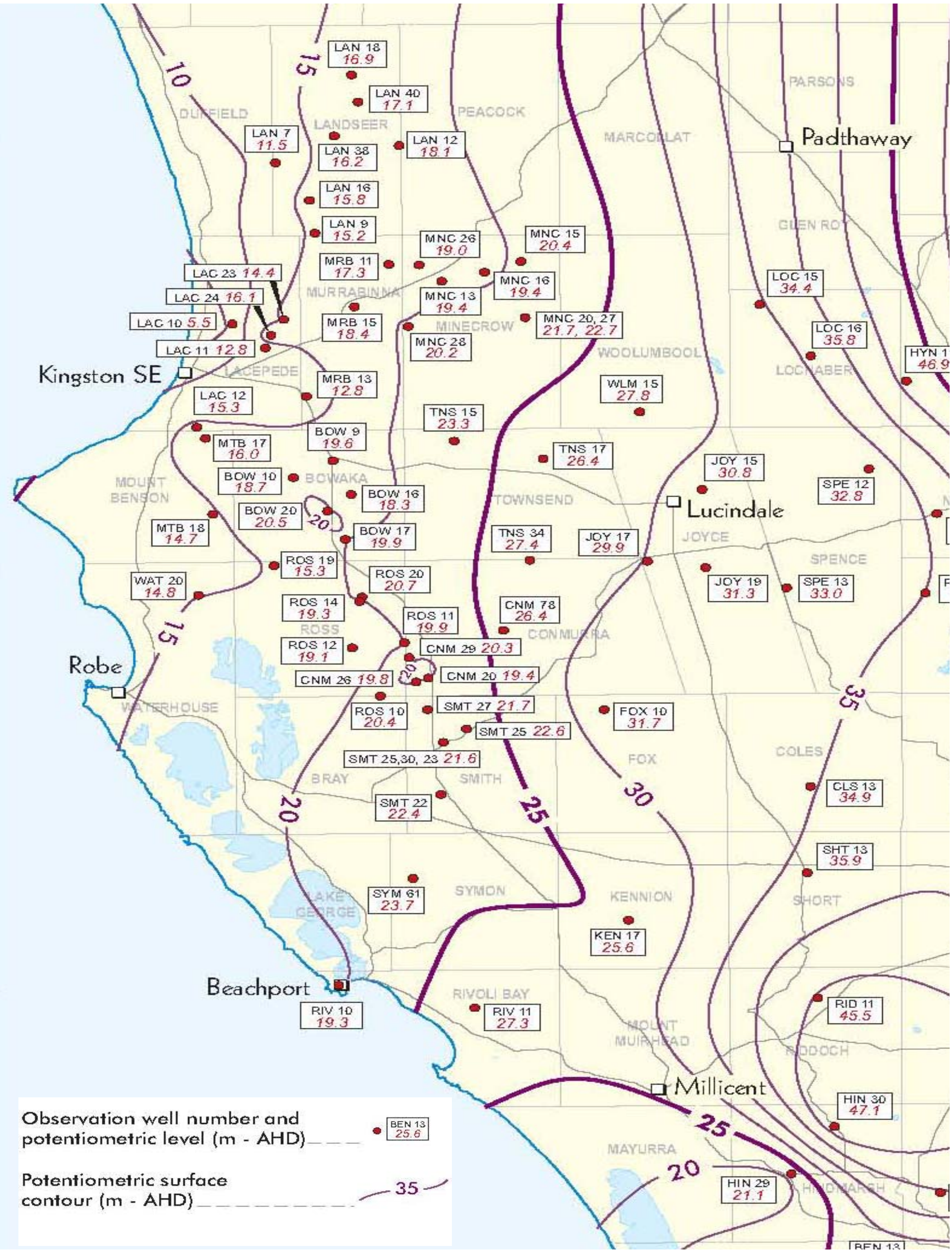


Figure 4.103: Confined Aquifer Potentiometric Surface

Source: Brown *et al.* 2001

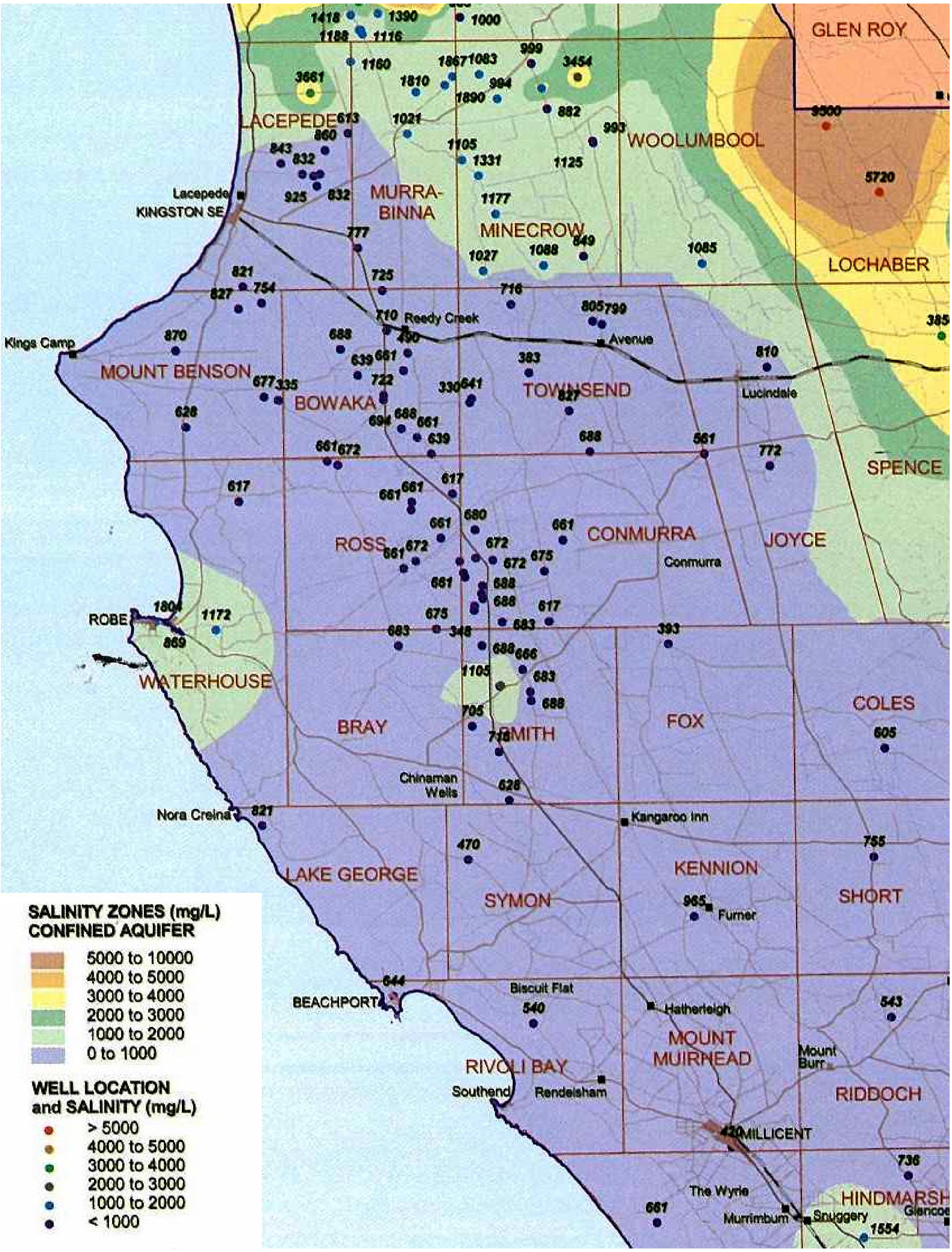


Figure 4.104: Confined Aquifer Salinity Distribution

Source: SECWMB 2001

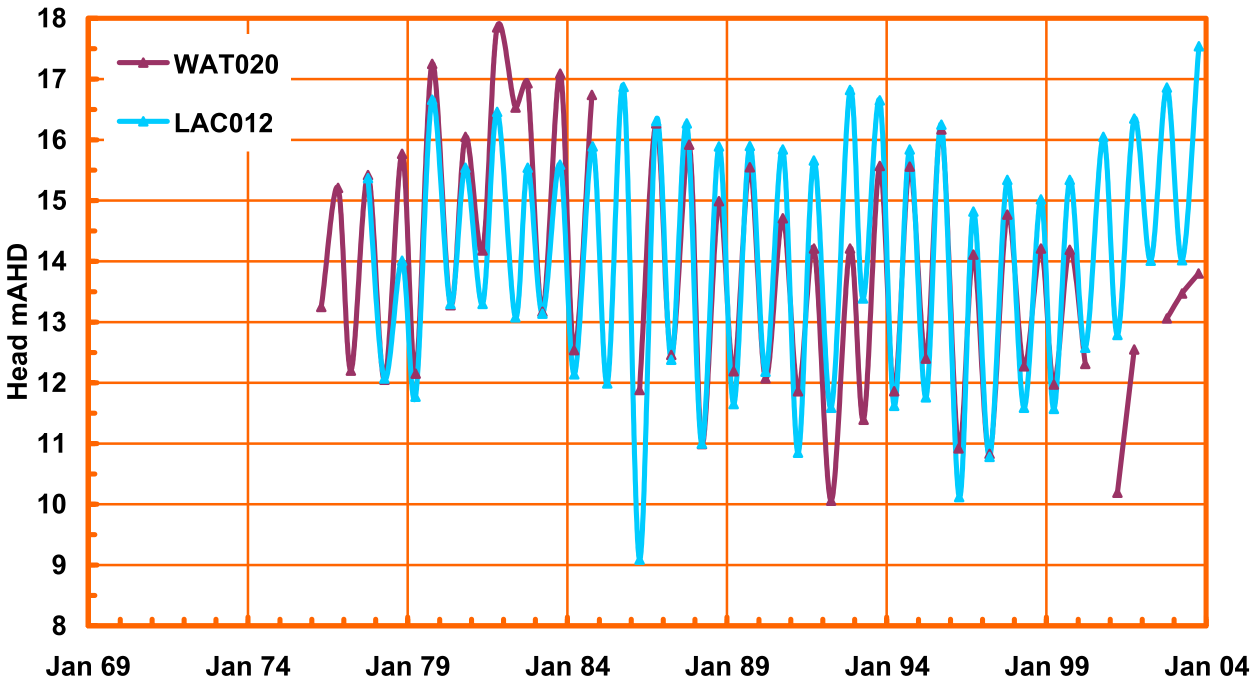


Figure 4.105: Confined Aquifer Regional Level Fluctuations
Source data: DWLBC

The seawater interface within the confined aquifer is expected to be located seaward of the coast, as groundwater flows through the aquifer beneath the seabed before discharging into the marine environment some distance offshore (Love *et al.* 1994).

The registered wells greater than 60 metres deep, hence possibly intersecting the confined aquifer, within approximately 20 kilometres of the site are highlighted in **Figure 4.98**. The closest registered operational well intersecting the confined aquifer is located approximately 10 kilometres south-east of the site. Limited data is available regarding the confined aquifer near Cape Jaffa as there is no use or monitoring in the vicinity. There is record of an abandoned 127 metre deep well located approximately 5.0 kilometres east of the site, although no additional information has been identified.

Investigations relating to the proposed use of groundwater from the confined aquifer for town water supply purposes at Cape Jaffa are discussed in **Section 5.2.21**.

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5.0 ISSUES IDENTIFIED BY THE PANEL

This chapter provides the detailed response to the issues identified by the Major Developments Panel as set out in Section 5 of the guidelines dated June 2003 on pages 11 to 18 inclusive (**Appendix 18**). The structure of this chapter follows that of the guidelines, with the general headings and issues raised highlighted in the coloured strips. Maps, figures, diagrams, the appendices and the preceding chapters containing more detailed technical investigations support the responses.

5.1 Need for the Proposal

5.1.1 Describe the need for the proposed development, including the reasons for its proposed location and staging.

Introduction

Kingston District Council has for some years recognised the pressure for services and facilities at Cape Jaffa to serve the long established fishing industry, the strong tourist interests, the more recently established aquaculture activities and general community demand for residential accommodation. Council's understanding of its local circumstances has in the past few years been reinforced by various studies and documents about the region and the locality which:

- recognise growing needs and pressures;
- identify the desire to ensure well planned communities;
- highlight the changing expectations in the community for services;
- recognise the economic growth potential in the locality; and
- reconfirms the appropriateness of the locality of Cape Jaffa as a focus for activity as it has been for many years.

These factors are recognised in a number of strategies and documents as discussed in **Section 2**. These strategies typically arise from the process of reviewing and identifying community needs and the desire to provide direction and a coordinated approach to the implementation of actions. The most significant and relevant strategies and studies to the Kingston District Council and Cape Jaffa are shown in **Figure 5.1** and are discussed below:

- Planning Strategy for Regional South Australia January 2003 (Planning SA 2003), issued by the State Government and the Premier of South Australia;
- Coastal Management Strategy South East South Australia September 2000 (SELGA 2000), prepared for the South East Local Government Association, the State Government and Environment Australia, with funding from the Federal Government's Coasts and Clean Seas program; and

- South East Development Plan Review July 2002 (SELGA 2002), prepared for the South East Local Government Association as a requirement under Section 30 of the *Development Act* 1993, undertaken as a joint review on behalf of all South East Councils and the Coorong District Council.

Figure 5.1: Strategy Documents

<u>Planning Strategy for Regional South Australia 2003</u>

The State Regional Planning Strategy (Planning SA 2003) clearly recognises the need for the consolidation and reinforcement of services and facilities in the region. These strategies aim to support key industry areas of fishing, aquaculture, tourism and recreation. Figure 5.2 depicts key features of the South East region including the aquaculture industry at Cape Jaffa.

In the text below, key components of the Regional Planning Strategy relevant to the South East are quoted in italics and accompanied by commentary as to how this development achieves these strategies. The major headings set out in the Regional Planning Strategy include Economic Activity, Environment and Resources, People Towns and Housing and Infrastructure, and discussed below.

Economic Activity

Aquaculture and Fishing

…. an important fishing industry based on the port towns in the area. The industry should consolidate its position in the area with opportunities available for development that supports value adding production initiatives (particularly for rock lobster) export and monitoring.

Review Aquaculture Management Plans and include land use policies in Development Plans.

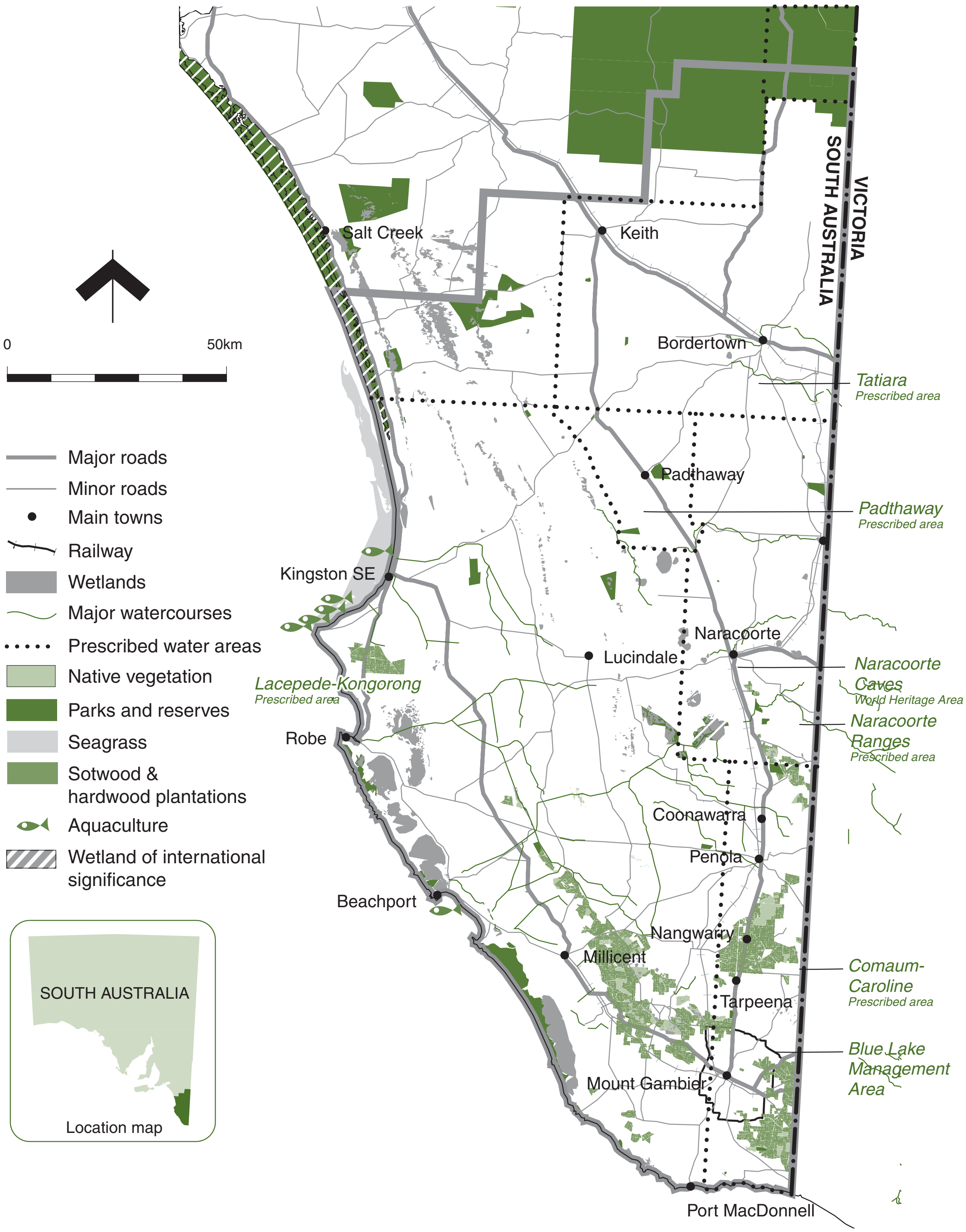


Figure 5.2: Extract from Sate Regional Planning Strategy

Source: Planning SA 2003

Exploit potential for land-based marine and freshwater aquaculture and freshwater crayfish aquaculture.

Promote development to support established fish processing and distribution facilities.

Allow for land-based infrastructure and support services for the marine fishing industry.

Identify and promote new sustainable fishing and aquaculture opportunities utilising coastal and underground water resources that are appropriately located, well managed and contribute to regional development.

Retain and attract young people through appropriate job creation and use of distant tertiary education and other knowledge/information storing techniques.

Cape Jaffa is a strategically located fishing port that currently accommodates approximately thirty fishing vessels and associated support facilities. There are other vessels working from Lake Butler at Robe that might choose Cape Jaffa if there were safe and protected mooring facilities available, given that Lake Butler is at or near capacity. At this time, there are at least 21 owners wishing to accommodate their vessels at floating pontoons and the same number wishing to secure hardstand facilities.

The proposal incorporates a safe haven and improved support facilities for the fishing industry that are highly desirable to continue the development, efficiency and sustainability of the industry. Secure wharfage also enables more efficient loading/unloading and servicing of vessels, activities which are difficult or in some cases impossible from the Cape Jaffa jetty. Further, Cape Jaffa is the most proximate town to the existing aquaculture ventures and is being used for load out, maintenance and harvesting. Improved facilities are essential if the aquaculture objectives for the State are to be satisfied. The State has recognised the significance of this area for the Atlantic Salmon industry and this proposal will support that intent. The State's policy is expressed in the Lacepede Bay Aquaculture Management Policy 23 February 2004 (PIRSA 2004), that came into operation on 12 August 2004, in which the Cape Jaffa locality is identified as a location of strategic importance to the future of aquaculture in South Australia.

The safety of mariners and environmental protection can be best provided in a safe haven. Vessels have in past years broken moorings and have been beached. Risks of this nature can be avoided in a secure marina. Further, refuelling and waste management facilities can be significantly improved.

The swing moorings are located in the proclaimed Rock Lobster Sanctuary. The removal of vessels and their associated swing moorings will result in less direct disturbance to the seabed within this area and enable the regrowth of seagrasses where disturbance or loss has occurred.

The project offers a significant number of job and substantial income to the region, which has a valuable spin-off effect as it enhances existing business and job creation.

Tourism

Its position between Adelaide and the eastern States provides opportunities to tap into a significant population base and through traffic not available to many other areas.

Develop tourism links with significant economic activities of the area including wine, wool, dairy, timber, fishing, agriculture and processed food.

Develop value-adding opportunities to wineries (cellar door sales, accommodation and restaurants).

Develop interpretive facilities and tours of major industries including wine, timber and agriculture.

Develop holiday accommodation and recreation opportunities.

Develop and connect tourist linkages with Melbourne and Adelaide to involve interstate travellers utilising features such as coastal roads, key towns, natural and cultural attractions.

The strategy seeks benefits for the region from its position and attractions. The opportunity for a multi faceted, integrated boat haven and residential marina will be unique in the South East and is not practical elsewhere on the coastline of South Australia between Victor Harbor and the South Australia/Victorian border. It would therefore be an attractive feature in a location that has ready access to the touring public between Victoria and South Australia, as also noted in the Coastal Management Strategy.

The nearby Mt Benson wine region has experienced significant development and investment in recent years, including the growth of numerous wineries, one of which has invested over $30 million in the establishment of facilities in the area, and these commitments reinforce the local interest and attractions for the region.

There is an existing tourism focus at Cape Jaffa with tourist accommodation facilities that cannot meet current demands. The past owners of the tourist park have made submissions to Council to enable the expansion of the park.

The facilities are inadequate to cope with the current demand and there is a desire to expand the extent, quality and choice of accommodation. Cape Jaffa is a proven destination for tourists, significantly western Victoria, due to its proximity and access to excellent fishing, swimming and recreation waters.

In all of these respects, the proposal provides an opportunity to implement the strategy and will meet various needs within the community.

Environment and Resources

> *Protect areas of native vegetation and associated native fauna on both public and private lands.*
>
> *Ensure land use policy recognises and protects areas of conservation significance.*
>
> *Maintain and improve public access to the coast while protecting fragile areas, habitats and sites of cultural significance.*
>
> *Conserve, restore and develop the unique landscape features and biodiversity of the area that contribute to its distinct character (including the coast, wetlands, national parks and conservation areas, remnant vegetation, volcanic lakes, caves).*
>
> *Protect areas of native vegetation and associated native fauna on both public and private lands.*
>
> *Control the spread of weeds, introduced animals, fire and other risks to biodiversity.*
>
> *Promote revegetation programs using local native species to link and enhance existing remnant areas.*
>
> *Maximise sustainable use of regional water supplies by managing demand and providing opportunities to supply future needs.*
>
> *Promote efficient water use.*
>
> *Reduce soil salinity and waterlogging in conjunction with better land and water management.*

In the context of the communities need for living, employment, industry and recreation, a sensitive balanced approach to conservation is sought. Given the existing function of Cape Jaffa as an established settlement, a recognised growth locality and one of the five Southern Ports, it is entirely appropriate that the facilities provided are commensurate with the safety, environmental and service requirements of the industries and the community in a sensitive manner. Native vegetation has in the past been neglected or at least overlooked and this proposal will ensure the long-term protection of the remnant native vegetation. To achieve this, changes in tenure and management techniques are necessary to rearrange land uses and points of access.

A number of additional measures are included in the proposal to protect the local environment, including dunes and coastal vegetation management, water sensitive urban design, wastewater management, and the removal of risks from the marine environment.

People, Towns and Housing

> *The southern ports should retain and protect their coastal features and character, and promote development in harmony with the coastal environment.*
>
> *Ensure land use policies encourage a diverse range of housing types to meet the changing needs of the community, including accommodation in town or business areas where appropriate.*
>
> *Clearly define township boundary to preserve land used for primary production and to avoid land use conflicts.*
>
> *Identify land for residential expansion based on population projections, infrastructure capacity and the protection of primary production land.*
>
> *Identify and, where possible, resolve constraints to providing infrastructure for residential expansion.*
>
> *Encourage increased private sector investment in housing in regional areas along with appropriate management structures, infrastructure and supply of land.*
>
> *Maintain the coastal townships as important tourist and local service centres and key fishing ports.*
>
> *Develop holiday accommodation and recreation opportunities at coastal townships while maintaining residential amenity.*
>
> *Address shortage of housing in parts of the South East.*

Cape Jaffa is recognised as providing a unique environmental and recreational experience.

The proposal reinforces Cape Jaffa's role as a southern port, a significant tourist destination and local service centre. The expectations of tourists and others from a local service centre are greater today than ever, and the facilities and safety features are inadequate. Therefore, to maintain its integrity as a destination, improvements and additions are essential. This development will provide new facilities, enhance safety, minimise risk of damage from fuel spills and broken moorings, and other events that have the potential to damage this coastal environment whilst providing more efficient operating conditions.

The proposal recognises the demands and changing needs of the community and allows for a range of housing types as well as alternatives for tourist accommodation. Housing investment will be primarily undertaken by the private sector to allow contiguous expansion of the existing Cape Jaffa settlement. It will also create the opportunity for comprehensive service infrastructure to be introduced to the existing community.

In this manner, the proposal reinforced the existing settlement and creates opportunities to enhance Cape Jaffa as a key tourist, local service centre and fishing port.

Infrastructure

> *… investment in power, gas and other energy infrastructure needs to be strategic to ensure maximum benefit …*
>
> *Promote innovative means of energy supply and capacity to areas that are remote from the distribution network.*
>
> *Promote opportunities to facilitate renewable energy development and its supporting infrastructure as a primary contributor in redressing greenhouse gas emissions and fossil fuel dependency.*
>
> *Upgrading of local roads and bridges is necessary to ensure local industry is better able to move its new product to processing facilities and to enable it to market its produce and compete successfully in Australian and international markets.*
>
> *Further develop road infrastructure to meet growth industry needs.*
>
> *Investigate the need to upgrade facilities at existing aerodromes in the area.*
>
> *… continue to develop service and infrastructure support for the important fishing industry …*
>
> *Identify key infrastructure development requirements to support industry growth and prepare an implementation strategy.*

The fishing, aquaculture and wine industries in the locality are well placed to economically utilise upgraded infrastructure. Investigations into a range of options for the provision of power suggests that there will be benefits to the existing occupants at Cape Jaffa and in the long-term, others on the grid in the district. Investigations are proceeding into alternate power supply systems. Land use policy will also be written encouraging the use of alternate energy/resource use on individual allotments.

The area is well served by local road networks and the proposed development will contribute to local road improvements by providing upgraded access to the existing Cape Jaffa settlement via Rothalls Road and generally an improved local road environment.

Major improvements incorporated in the proposal to serve the fishing, aquaculture and tourist industries reinforce the settlement of Cape Jaffa and the town of Kingston and its airstrip. The airstrip at Kingston is a valuable and well developed facility that could be improved to accommodate direct export.

The proposal provides a significant service and infrastructure support to the fishing industry that is not currently available in an environmentally sensitive manner. The development of services and infrastructure reinforces the fishing industry in accordance with the strategy. Due to various factors, including the lack of services to Cape Jaffa, the settlement has been limited in its development and growth.

The strategy clearly seeks the growth and development including the provision of service and infrastructure support for the fishing industry. It specifically promotes development to enhance the established fishing industry including land based infrastructure. The strategy also acknowledges the need to develop new tourism ventures and products with linkages to other activities. This proposal will provide a most significant opportunity to integrate the development with the existing wine and fishing industries with potential to expand on the number, size and nature of experiences available. In this respect, additional holiday accommodation is necessary with opportunities to link these activities with the Kingston Golf Course and other recreational pursuits.

A number of significant strategies listed above can be satisfied or be facilitated as part of this proposal. These have been identified in the strategic plan for the growth and development of the South East. The proposal satisfies or at least creates opportunities to satisfy these strategies and reinforces provision of facilities and services identified as needs in this community.

<u>South East Coastal Management Strategy</u>

The Coastal Management Strategy for South East South Australia (SELGA 2000) acknowledges the communities aspirations for port, marina and coastal development appropriately located and managed as an integral part of the economic, social and cultural lifestyle of the South East. The strategy states:

> *Marinas, ports and boat harbours that are developed and managed to minimise marine habitat impacts whilst providing appropriate services to meet commercial and recreational boating needs.*
>
> *Identify suitable locations for port and marina development in terms of convenient transport and boating routes, tidal flow and minimising large scale impacts on marine habitats (both during development and through ongoing use), based on the Marina Guidelines – For the Planning and Development of Coastal Marinas in South Australia, 1991.*
>
> *Public access to the coastal area is an important issue among the local and wider community. An increase in controlled public access is required for 2WD vehicles, however, restriction in more fragile environments from recreational vehicles (4WD, dune buggy, and motorbike) is also required.*
>
> *Maintain and improve public access to the coast, whilst protecting environmentally fragile areas, habitats and sites of cultural significance.*

The clear intention of the South East Coastal Management Strategy is for the development of coastal facilities to satisfy a range of needs, in particular marinas, ports and harbours as identified in Objective 1.

The marine and coastal infrastructure is essential to the viability of the coastal townships and the industries of the settlements. The impact of development must be assessed and managed such that there is effects on the townships and/or commercial fishing activities and aquaculture are managed and balanced.

To ensure that existing and proposed marine and coastal infrastructure is strategically managed and developed to provide viable, safe and environmentally sustainable operations into the future.

Ensure marine development projects give appropriate consideration to the safe handling of fuel and to effluent discharge issues generally.

Land use development that balances the provision of suitable living areas, viable commercial activities, coastal tourism and recreation uses with the cultural and environmental values of the area.

Apart from primary industry, the main commercial activities associated with the coast is commercial fishing and marine based aquaculture. It is important that suitable land is set aside for this industry, including land for boat yards, boat builders, fish storage, fish processing and general marine supplies. Land is also required for other commercial and industrial activities that service the area, for example engineering works and fuel depots.

Industrial and commercial land is available in the main settlements but there may be opportunities for new and emerging business activities. These activities should remain focused within township areas and suitable land should be set aside for existing and future industrial needs. It is also important that these areas are properly serviced and are easily accessible to the coast when necessary.

Commercial and industrial development located in appropriate areas sensitive to the character of the coastal environment.

Provision of appropriate infrastructure for the development of industrial and commercial activity in close proximity to the coastal environment.

Provide suitable zoned land and development for land based ancillary operations required for the marine based aquaculture industry and allowing for appropriate access to these facilities.

Enhancement of the opportunities for tourism development predominantly within the coastal townships, whilst protecting the unique environmental and cultural heritage assets and minimising the adverse impacts of tourism.

Promotion of the cultural heritage and ecotourism value of the coast and nearby national and conservation parks.

Strengthen the linkages between tourism and other economic, social and environmental attributes such as national parks, arts and culture, sport and recreation, food and wine, education and local industry.

Encourage tourism during off-peak periods to overcome the seasonal nature of the industry.

Ensure tourism infrastructure is suitable for the identified markets and provide tourism facilities and amenities in suitable locations.

Tourism in various forms is widely encouraged in the strategy and relies heavily on investment and infrastructure development to ensure the appropriate markets are captured, that local character and values are supported, and linkages between attributes are reinforced. Cape Jaffa is specifically identified as the location to satisfy a range of needs in the South East. The proposal provides the opportunity to implement these strategies in a comprehensive and practical manner.

<u>Development Plan Review</u>

Council's review of its Development Plan (SELGA 2002) undertaken as a joint review by the South East Local Government Association in July 2002, on behalf of all South East Councils and the Coorong District Council, identified Cape Jaffa specifically for development. This review considered all coastal Councils amongst others between the Murray Mouth and the South Australian-Victorian border and was subject to public scrutiny and input prior to presentation to the Minister for Planning. This review reinforced the community aspiration for improved facilities, infrastructure and appropriate development, and the Kingston District Council proceeded with further zoning of land at Cape Jaffa and investigations into the development of the settlement.

<u>Location and Staging</u>

In addition to the practical rationale set out in the strategies above, the following physical characteristics of the coastline of the south east of South Australia are relevant in the determination of appropriate location criteria.

The coastline to the north is all open or exposed beach and without natural protection as afforded by the reef system, the cape at Cape Jaffa and the northerly orientation of this part of the coastline.

A long stretch of sandy beach extends from Cape Jaffa northward along the Coorong to the mouth of the Murray River. None of this coastline with the exception of the Kingston town has any existing infrastructure or focus upon which to base a new settlement or facility.

To the south the coastline is dominated by low platform reefs with heavy limestone rocky shores and headlands and smaller isolated beaches except for the longer beaches at Guichen Bay north of Robe, Rivoli Bay between Beachport and Southend and Brown Bay at Port MacDonald.

Much of this coastline from the Murray Mouth to the South Australian/Victorian border is designated as National Park, thus limiting the opportunity for near coastal development. The main features of the coastline are depicted on **Figure 5.2**.

As can be seen, the areas not designated as park, reserve or other key feature include Cape Jaffa and Lake Butler. It is also noteworthy that Lake Butler is currently at capacity and plans are afoot to improve these facilities, however the increased capacity does not resolve the safety, convenience and strategic development opportunities offered by the Cape Jaffa location.

Of all these locations, along about 400 kilometres of coast, the most appropriate in terms of accessibility, capacity for growth and safety is Cape Jaffa. The settlement, associated jetty and protected bay provide for an existing fishing fleet of about 30 vessels. In addition, its proximity to the Southern Rock Lobster fishery, the favourable conditions for Atlantic Salmon culture, and the ability to reinforce an existing settlement as opposed to creating a new settlement, are all compelling reasons for the chosen location.

The Planning Strategy for Regional South Australia, Section 30 Review and South East Coastal Management Strategy, all acknowledge the need for facilities at Cape Jaffa. The rationale for its location is logical and compelling, and relates directly to the practical capacity to accommodate the fishing fleet, an expanded settlement, and the ability to create a protected harbour and an expanded residential development. The existing development, its linkages with other activities including the wineries, recreation facilities and the services at Kingston, make the site ideal.

The location of the channel through the beach and dune zone is based on a range of factors including:

- its minimal impact on native vegetation;
- its location on a public road reserve whereon an existing beach access, ramp and camping area have been established for many years;
- the topography of the seabed immediately seaward of this location;
- its relationship to the land at the rear;
- its location outside of the Rock Lobster Sanctuary; and
- its proximity to existing infrastructure and town development.

In terms of staging, the development needs to be progressed in an orderly and planned manner. There are key components of the first stage upon which all other stages of the development rely, including the breakwaters, the channel, the main basin, water supply, power and effluent treatment, and the rehabilitation and revegetation of the dune areas. The first stage is significant as headworks and infrastructure relevant to the whole of the settlement and the identified requirements for industry and public facilities need to be established.

The establishment of facilities already identified as much needed infrastructure, include a safe all weather boat ramp and associated facilities, improved service infrastructure and fishing, and aquaculture industry facilities will be assisted or fostered by this proposal. These elements are proposed to be incorporated into the first stage as shown on Figure 3.9.

Thereafter, there is the expectation for consolidation of the development including growth in the tourist and service/retail sectors with ongoing enhancements to the public realm following the establishment of roads and reserves. The staging will be guided by the market as this will vary from year to year and result in changes to the size of the relevant stage and the number of releases. The expected construction stages are set out in **Tables 3.1**, **Table 3.2** and **Figure 3.24**.

5.1.2 Detail the potential demand for this type of development at the proposed location.

Over the past three years, the proponents have undertaken various consultation processes and there is an overwhelming interest in the provision of a unique facility in the south east that is not considered possible elsewhere in the region (pers. comm. Kingston District Council CEO). As a consequence, there is a significant number of people who have registered their interest in a range of aspects of the development including commercial fishing berths, residential allotments, private marina berths, commercial opportunities, wharfage for aquaculture activities, areas for processing and servicing the fishing fleet, and other boating interests, tourist accommodation, public boat ramp and related facilities. In all, there is a register of about 170 persons and at this time there has been no marketing of the proposal, only the opportunity to comment on the broad concept presented at public meetings and in media reports.

Of particular note is the significant interest shown by travellers and tourists generally from the country regions of the South East and western Victoria. This is entirely consistent with the Planning Strategy's desire to make more out of the tourist linkage between Melbourne and Adelaide. As this locality is more readily accessed from the western parts of Victoria and it is a highly sought after area as evidenced in the actual demand and sales at Kingston and Robe over the past few years. It is also noteworthy that the coastal living phenomenon is not limited to the east coast of Australia or the peninsula country in South Australia. The south east of South Australia has experienced considerable growth and demand in the past five years during which period there has been no growth in the availability of coastal land in the Cape Jaffa and Kingston areas.

Robe for example has experienced significant growth but has a limited capacity to accommodate residential division in the coastal areas and these have now all but been taken up with no further opportunity to expand due to the recognised sensitive nature of the remaining coastal areas. There is also a significant interest in coastal property arising from the farming community as seaside holiday destinations and retirement residency. There are few opportunities where these demands can be satisfied.

The five year period between 1999 and 2003 saw a steady increase in the number of dwellings approved in Kingston District Council. The figures to date for 2004 indicate that the 24 approvals to November is greater than the number of approvals for the calendar year periods of 1999, 2000 and 2002.

Although there has been an increase in the number of allotments created by land division in recent years, sales data for the Kingston District Council shows an increase in the number of dwellings being sold between 2002 to 2004. It is evident from the records that the demand for both dwellings and vacant residential land is much greater than that supplied by approved development applications and the stock of residential land in Kingston has diminished significantly.

This trend of inadequate supply is also evident elsewhere along the South East,coast and in particular Robe. The recently exhibited District Council of Robe Miscellaneous PAR contained the results of investigations into the supply and demand of residential land in Robe. These investigations illustrate that in Robe as well as in Kingston District Council supply of residential land does not meet demand.

This is not an isolated phenomenon as land along our coastline is highly sought after and in short supply as many of the original shack areas have been given over to freehold title and their extensions have also been taken up.

In summary, the area is experiencing residential growth with a diminishing supply of available land for residential development purposes. The attraction of the coast is a phenomenon well evidenced in all Australian States. Further, there are limited opportunities for waterfront development and it is appropriate to create these opportunities in association with port facilities, thereby providing an efficient allocation of resources and infrastructure. The development will also facilitate achieving many of the strategic directions and intentions as established in various planning, tourism and recreation strategies. Through these public strategies the need for a focus of activity and development at Cape Jaffa, and the enhancement of facilities for economic and social benefits is well documented and established.

5.1.3 Assess the "do nothing" option.

The "do nothing" option would fail to acknowledge the strategic directions presented in the Planning Strategy for Regional South Australia, the Section 30 Review of the Development Plan, and the South East Coastal Management Strategy as set out in **Section 5.1.1** above. These documents set out the perceived needs of the wider community of interest for economic development of the region. These regional economic development strategies are based on the sustainability of Cape Jaffa as a recognised southern port and the noted fact that service and infrastructure development for the port is necessary to maintain its viability. The no-development option would place the responsibility for such support onto the Kingston District Council and eventually the State government.

The important issues relating to the Cape Jaffa port include:

- maintenance costs of the existing jetty;
- safety and impacts of boats on existing swing moorings within the Rock Lobster Sanctuary; and,
- the costs of any necessary emergency response should there be a fuel spill on the existing jetty.

Tourism and recreational fishing is a current use of the Cape Jaffa area and this has placed stress on the foredune area. Tracks have been established through the vegetated areas causing erosion and damaging the stability of the dune system, which eventually will result in serious damage to the dunes and resulting loss of the vegetation and in particular the sea rocket (*Cakile maritima)*, a strandline plant preferred as feed by the orange-bellied parrot (*Neophema chryosgaster*). This plant is already under stress along the coastal dune area and needs support to become re-established. The proposed development would enable the sand dune vegetation to be safeguarded and is committed to the regeneration of the sea rocket.

Areas are zoned for residential, local centre (retail) and industrial development, and it is therefore feasible that development will take place in the foreseeable future. However, development must take into account issues such as:

- water requirements;
- impact on groundwater quality;
- health issues if the current practice of septic disposal trenches near shallow bores continues;
- beach and shoreline health;
- further degradation of low lying rural land due to salination; and
- beach access for recreational and commercial activities over private land.

It is accepted that the proposed development is a major development proposal, but it is considered necessary to ensure that all of the above potential issues can be fully addressed. Smaller developments may be able to address some of the issues, but it would not be economical to address all of the issues.

The Kingston District Council Development Plan recognises a number of these needs and accordingly there is a significant area zoned for development purposes encompassing residential, tourism and commercial activities. There is therefore already significant recognition in the zoning that there will be change resulting from development in this locality regardless of this project. Therefore, the "do nothing" option does not result in nothing happening. Development at Cape Jaffa is inevitable as much of the land is zoned for development anyway, resulting in less controlled haphazard development which does not address various environmental and infrastructure needs. However, a comprehensive well planned, all-encompassing proposition, including a safe fishing harbour, public boat ramp and related facilities will better serve the needs of the wider community than an expansion of the land based facilities, with no improvement for the fishing fleet, aquaculture, tourism and the environment. To proceed on the "do nothing" basis flies in the face of the Planning Strategy and supporting documents and the needs of the wider community.

Further, there are a range of concerns that have been identified as follows:

- impact on groundwater quality and health issues may become more critical if the current practice of septic disposal trenches near shallow bores continues;
- impact on groundwater quality, beach and shoreline health with increased disposal of effluent via septic trenches in close proximity to the coast;
- risk of fuel spill on the existing jetty;
- maintenance costs of the existing jetty;
- safety and impacts of boats on existing swing moorings within the Rock Lobster Sanctuary;
- further degradation of low lying rural land due to salination; and
- beach access for recreational and commercial activities over private land.

Benefits that accrue from the development include:

- a significant part of the coastal vegetated dune is currently in private ownership and, as part of this proposal, will be transferred to community ownership to facilitate its ongoing protection;
- the coastal vegetation on the foredune, both that which is currently in community ownership and that which is proposed to be transferred to community ownership, is to be rehabilitated for its protection;
- significant employment and expenditure results from the proposal in three key components of the economic and social environment, these are during the construction phase, the ongoing operation of the developed community, and one off benefits that result in the sphere of influence of this proposal;
- up to date facilities to satisfy the various interests of this community can be provided through a comprehensive scheme;
- greater housing choice can be accommodated in the development;
- is consistent with strategic planning directions;
- creates the necessary protected facilities to reinforce and enhance the fishing and aquaculture industries with greater efficiencies in servicing operations for these industries, thus creating jobs and potential for greater exports;
- the creation of a safe harbour in which vessels can be berthed together with the efficiencies to the operators on the water and onshore of direct servicing at a wharf;
- provides better wharf facilities, increasing efficiencies to boat operators;
- reduces risk to vessels on swing moorings in the open sea;
- reduces risk of damage to the marine environment from vessels moored in the open sea;
- creates better and safer waste management and fuel handling facilities;
- reinforces and creates new business and economic opportunities and offerings in the tourism industry;
- creates short and long term employment opportunities;
- provides for a coordinated planned growth of an existing coastal port;
- creates in the long term a greater critical mass to support community infrastructure, ie hospital and medical services, and creates greater confidence in the community for services to be provided;
- enables expansion of the tourist accommodation and services;
- creates a new exciting attraction for tourist and resident communities;
- an improved recreational amenity on the jetty;

- major savings in the short and long term to government if the jetty is converted to recreation standard and hence avoiding costs to maintain commercial status;
- mains water reticulation to residents for better quality and supply of potable water;
- new and improved wastewater treatment and reclaimed water reuse facilities;
- provision of a vehicle free beach area;
- allows regrowth of seagrass on swing mooring area;
- provides for the removal of swing moorings from the Rock Lobster Sanctuary;
- relocates industrial and commercial activities away from the coast and beach;
- provides a comprehensive integrated plan for the development of the area;
- provides more detailed design guidance for the development of the settlement;
- enhances safety of mariners by providing safe access and anchorage in all weather conditions;
- better quality habitat for native fauna in the foredune area;
- increased protection of foredune vegetation from foot and vehicular traffic; and
- increased level of weed management in foredune vegetation.

These benefits result from the proposal satisfying a range of needs identified in various strategies and by the Kingston District Council. These benefits would not result if the proposal does not proceed.

Should the project not proceed, the significant economic benefits to the locality, the Kingston district, the South East and the State would be lost. These include jobs, income and investment as detailed in **Section 5.4**. These jobs and related economic benefits cannot be transferred elsewhere in the South East as there are no locations suited to replace the port at Cape Jaffa. Development funds for the project are primarily private funds apart from government contributions for public infrastructure. These funds are dedicated to this project and are unlikely to be applied elsewhere in an alternate project in the South East or in South Australia as there are already similar projects afoot around the coast.

5.2 Environmental Issues

Groundwater

5.2.1 Describe the known existing groundwater environmental conditions.

The existing groundwater environment has been described in **Section 4.14** and a more detailed description is provided in **Appendix 14**. The groundwater environment can be summarised as follows:

- Aquifers of Interest – confined and unconfined aquifers exist at the site and are also referred to as the Tertiary Confined Sand Aquifer (TCSA) and the Tertiary Limestone Aquifer (TLA) respectively;

- Stratigraphic Sequence – the unconfined aquifer is within the Tertiary Gambier Limestone and overlying quaternary sands. The confined aquifer is generally within the Tertiary Dilwyn Formation and the aquifers are separated by an aquitard;

- Regional Observation Wells – an assessment has been made of DWLBC data from regional observation wells intersecting the aquifers;

- Groundwater Monitoring Well Installation – 34 wells on and around the site have been installed and assessed;

- Geological Cross Sections – geological and groundwater level data from the recently installed monitoring wells has been collated into cross sections perpendicular and parallel to the coast at the site;

- Aquifer Recharge – the unconfined aquifer is recharged by local rainfall and upward leakage from the confined aquifer. The confined aquifer is recharged by downward leakage in the east of the Otway Basin;

- Groundwater Levels and Flow Direction – groundwater levels in the unconfined vary from 0.3 to 1.6 mAHD. The confined aquifer is expected to be artesian (ie; free flowing). Groundwater flows in both aquifers are generally toward the coast;

- Groundwater Salinity – regionally, the confined aquifer has low salinity and the unconfined aquifer has variable salinity. Locally, measured salinities in the unconfined aquifer range from 400 to 2,000 mg/L TDS; with salinities up to 15,000 mg/L TDS recorded in low lying areas, such as within the eastern part of the site;

- Groundwater Chemical Composition –chemical analysis of groundwater samples from the recently installed monitoring wells indicates that unconfined aquifer is continuous across the site and that the groundwater within the sands of the St. Kilda Formation and the underlying limestone are interconnected and can be considered a single aquifer;

- Aquifer Properties – the unconfined aquifer generally has moderate to high hydraulic conductivity across the site with a zone of higher conductivity running north-south in the western portion of the site;

- Seasonal Groundwater Level Fluctuations – regional information indicates that seasonal fluctuations in the unconfined aquifer are up to 1.3 metres and in the confined aquifer, up to 7.0 metres. The information collected at the site over the period July 2003 to May 2004 indicates a seasonal fluctuation in the unconfined aquifer of up to 0.8 metres. Over recent years the unconfined aquifer levels have declined and the confined aquifer levels have increased;

- Tidal Influences on Groundwater Levels – tidal influences result in groundwater level fluctuations in the unconfined aquifer near the coast and these effects are progressively reduced with distance from the coast. Tidal fluctuations do not cause the groundwater flow direction to be reversed;

- Freshwater-Seawater Interface – near the coast an interface between fresh groundwater and seawater exists within the aquifer. The interface extends inland beneath the fresh groundwater and is deeper with distance from the coast;

- Comparison of Semaphore Sands and Tertiary Limestones – the unconfined aquifer extends from the Tertiary Limestones into the overlying Quaternary Semaphore Sands and is treated as a single aquifer;

- Groundwater Quality – testing for a wide range of compounds has been undertaken and maps showing concentrations of nutrients and inorganic compounds (heavy metals and cyanide) in the unconfined aquifer at Cape Jaffa have been produced; and

- Groundwater Use – groundwater from the unconfined aquifer is used mainly for stock, domestic and irrigation purposes. There are no wells accessing the confined aquifer within 5.0 kilometres of the site.

5.2.2 Detail any groundwater investigations and modelling undertaken on the site or in the locality of the site.

Groundwater Investigations

A number of field investigations and site specific studies have been completed and are included in **Appendix 14**. The investigations are summarised below:

Desktop Study and Field Investigations (**Appendix 14 Volume 1**)

This report presents a compilation of regional and site specific reports, investigations and data, as summarised below:

- a review of regional information including geology and soils, hydrogeology, groundwater levels and flow direction, aquifer properties, groundwater quality and use, registered groundwater users, tidal level and climatic conditions;

- discussion regarding the 34 soil bores drilled in June 2003, which were then converted to groundwater monitoring wells. All of the wells were screened to intersect the shallow unconfined aquifer. The location of these wells is shown on **Figure 5.3**;

- results of five gauging events, groundwater level data was collected from June 2003 to May 2004;

- results of groundwater sampling and analysis for various compounds, in order to obtain a baseline understanding of the composition of groundwater with and near the site;

- discussion regarding the installation of data loggers for the collection of high frequency water level data in order to evaluate the daily groundwater level fluctuations and influence of the tides;

- discussion regarding the installation of a tide gauge at the jetty for the collection of high frequency tide data that has been used and compared to the groundwater levels; and

- results of aquifer tests including falling and rising head tests, to determine the hydraulic conductivity of the shallow unconfined aquifer.

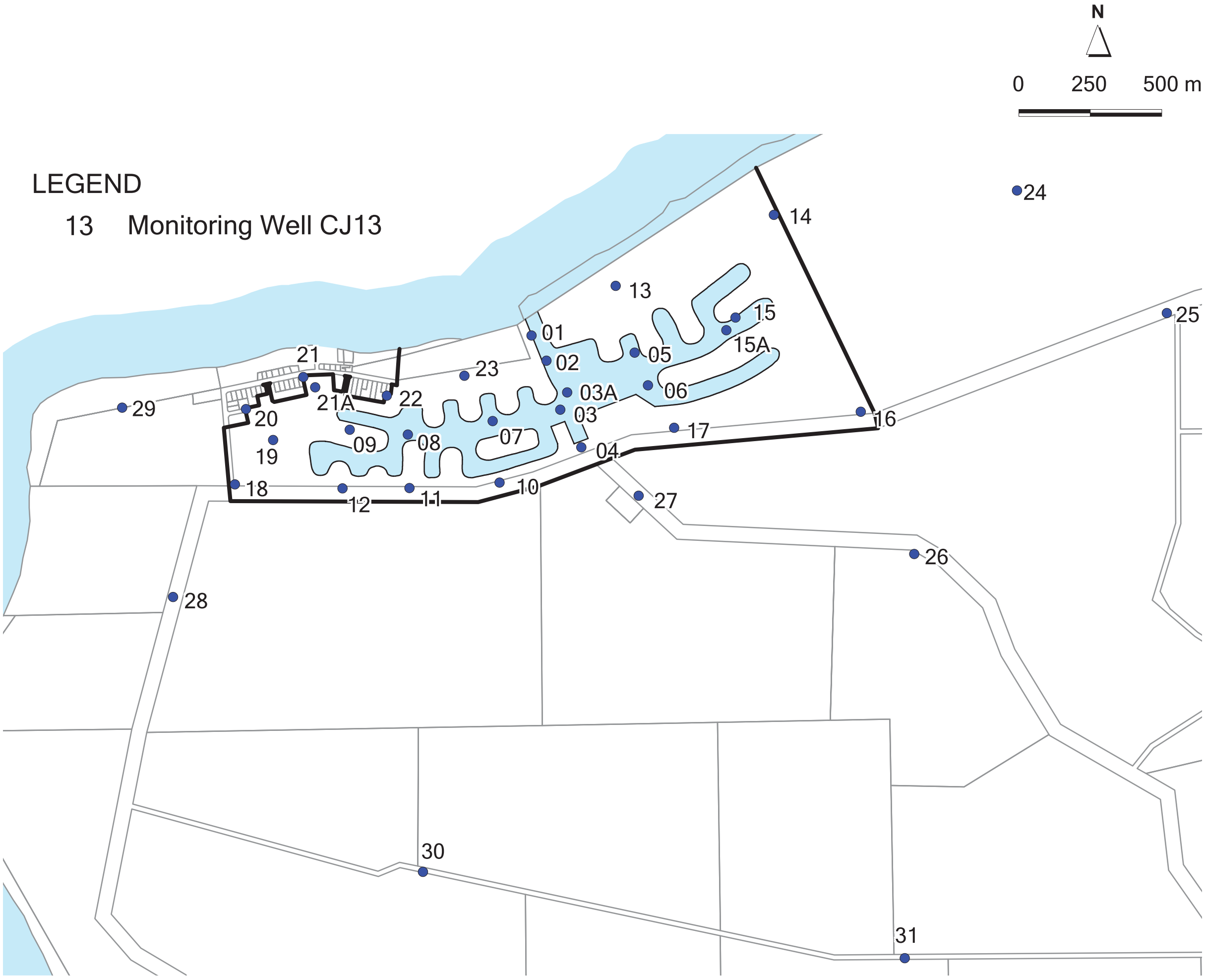


Figure 5.3: Groundwater Well Locations
Source: **Appendix 14**

Conceptual Hydrogeological Model (**Appendix 14 Volume 2**)

This report presents a collation of all regional and local information, and the development of a conceptual hydrogeological model, including:

- climate;
- geological information;
- identification of aquifers of interest;
- groundwater quality;
- identification of local groundwater users;

- description of known groundwater characteristics including:
    - flow direction;
    - level fluctuations;
    - aquifer recharge;
    - aquifer properties; and
    - saltwater/freshwater interface.

Groundwater Flow Model (**Appendix 14 Volume 3**)

This report describes the development of a site specific groundwater flow model to assess the effects of the development on the groundwater system. The following conditions have been investigated:

- modelling of existing pre-development conditions and calibration of the model against measured site data to determine the existing groundwater outflow to the marine environment over the site area;
- modelling of the effect on the groundwater environment during Stage 1 construction dewatering to determine water level changes and aerial extent of water level changes;
- modelling of the post Stage 1 effects on the groundwater environment to determine:
    - water level changes and aerial extent of water level changes; and
    - water level impact on adjacent groundwater users.
- modelling of the post-development effects on the groundwater environment to determine:
    - water level changes and aerial extent of water level changes;
    - water level impact on adjacent groundwater users; and
    - groundwater outflow to the marina waterways and the marine environment.

<u>Groundwater Modelling</u>

Introduction

A groundwater flow model of the area was developed using MODFLOW software to assess the likely effects of the Cape Jaffa Anchorage on the unconfined aquifer. This section describes the model. The results of the modelling are presented later in this report. Further details of both the model and the modelling results are documented in **Appendix 14**.

MODFLOW is a three dimensional finite difference groundwater flow model capable of modelling multi-layered groundwater flow systems in both steady state and transient flow conditions. MODFLOW models the flow through a porous medium of uniform density water and was developed by the US Geological Survey (McDonald and Harbaugh 1988).

Groundwater Model Design

The modelled area covers 100 square kilometres and is orientated to match the principal groundwater flow direction (**Appendix 14**). A finer grid is used near the study area to improve modelling accuracy in the area of interest. Vertically, the model incorporates three layers as depicted in **Figure 5.4**. The vertical extent of each layer has been taken from regional data and the modelled layers are:

- the unconfined aquifer, extending from the natural ground level to -40 mAHD;
- the aquitard, from -40 mAHD to -60 mAHD; and
- the confined aquifer, from -60 mAHD to -75 mAHD.

The groundwater modelling has been performed using steady state conditions. Thus, the model reports the long-term outcome of a change to the groundwater system and assumes that the groundwater environment is in a state of equilibrium. The steady state model was calibrated using the October 2003 gauging event.

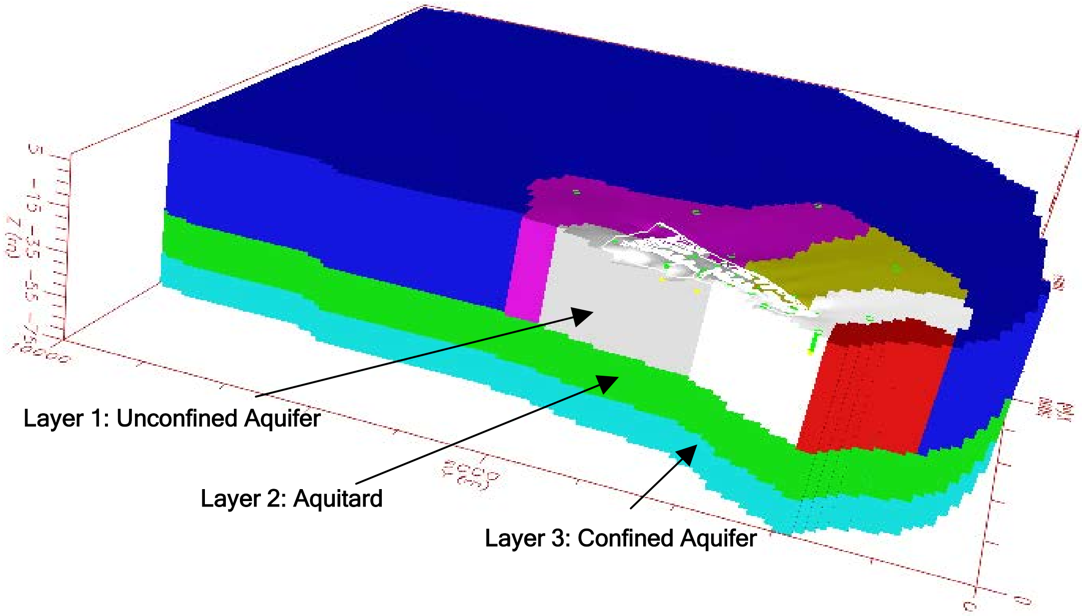
The model boundary conditions define the groundwater state at the edge of the modelled area. In the unconfined aquifer, the shoreline boundary is defined as having a constant head of 0.3 mAHD, which is representative of the average nearshore groundwater levels at the time of model calibration. In the confined aquifer, constant head boundaries have been assigned in accordance with the South East Groundwater Monitoring Status Report (DWLCB 2002/10). Refer **Appendix 14**.

The model incorporates allowance for unconfined aquifer recharge from precipitation. A uniform recharge rate of 10 percent to 15 percent of rainfall was adopted, which incorporates an allowance for the loss of water via evapotranspiration.

The unconfined aquifer properties are based on the hydraulic conductivity measurements presented in **Section 4.14.8** and the results of the model calibration. These properties were assumed to apply to the entire thickness of the unconfined aquifer, which is a valid assumption given that the model calibrated with the assigned hydraulic conductivities correlate well with measured conductivities presented in **Figures 4.76** and **4.77** and the regional published data (**Appendix 14**). The calibrated distribution of hydraulic conductivity in the unconfined aquifer is shown in **Figure 5.4**.

The following aquifer properties were taken from previous modelling exercises (PIRSA 2000) and regional data (**Appendix 14**):

- aquitard hydraulic conductivity of 1 x 10-5 m/day;
- confined aquifer hydraulic conductivity of 15 m/day;
- specific yield for all layers of 0.1; and
- specific storage for all layers of 1 x 10^{-6} /m.



Assigned Hydraulic Conductivity in Unconfined Aquifer

5 metres per day
15 metres per day
0.9 metres per day
1.0 metres per day
0.9 metres per day
25 metres per day

Figure 5.4: Model Design
Source: **Appendix 14**

Model Calibration

The modelled groundwater elevations in the unconfined aquifer were calibrated against the October 2003 measured elevations (**Appendix 14**). A plot of the observed (at October 2003) versus modelled water levels is shown in **Figure 5.5**, which illustrates the difference between the measured and modelled water levels at each well. The figure shows a good correlation between modelled and measured results (RMS less than 10 percent) and that the maximum difference is approximately 0.2 metres.

Modelled Scenarios

The model was used to assess the effects on the unconfined aquifer in the following scenarios (**Appendix 14**):

- pre-development conditions: used for validation of the model by comparison to the measured groundwater levels and also as a baseline against which the other modelled scenarios are compared;

- dewatering during Stage 1 construction: models the groundwater state once the Stage 1 excavation has been completed and the water level in the whole of the Stage 1 area is maintained at -1.0 mAHD by the dewatering program;
- post-completion of Stage 1: steady state water levels after completion of Stage 1; and
- post-development conditions: steady state water levels after the completion of all stages of the project.

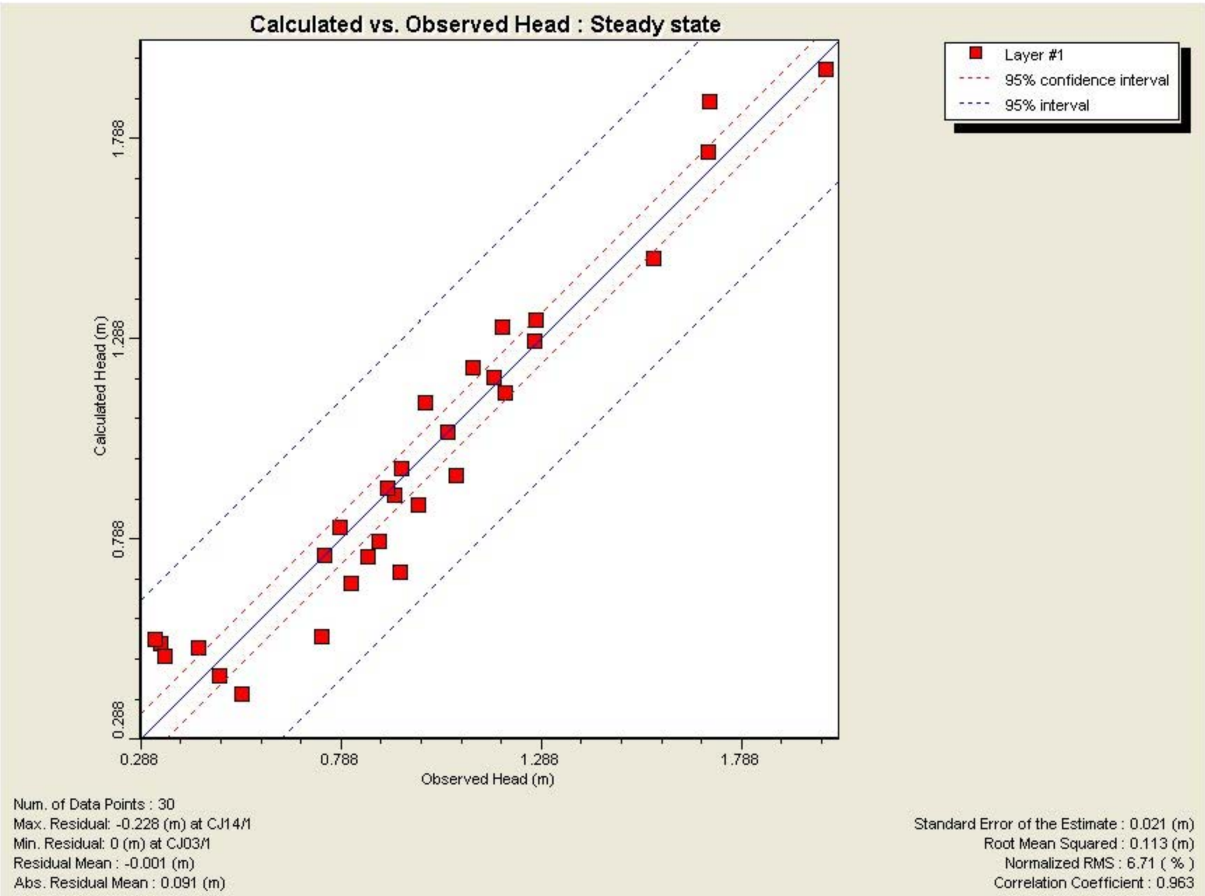


Figure 5.5: Model Calibration
Source: Appendix 14

5.2.3 Describe the short and long term effects of establishing channels and basins on groundwater quantity and quality and movement, particularly watertable drawdown or contamination from saltwater intrusion.

Introduction

Watertable drawdown in the unconfined aquifer as a result of the establishment of channels and basins has been modelled in order to determine the aerial extent and magnitude of the change in groundwater levels (**Appendix 14**). The modelling has been performed using MODFLOW and the model design, calibration and associated investigations are described in **Section 5.2.2**. This section describes the results of the modelling that has been performed.

In addition to investigating the long term effects of the completed waterways, the short term effects of dewatering during construction of the waterways and edge treatments (wharf, revetment, etc) have been investigated. The short and long term effects of establishing the waterways have been evaluated using the groundwater flow model in the following situations:

- short term effects of dewatering during Stage 1 construction;
- post-completion of Stage 1; and
- long term effects post-completion of all of the waterways.

Potential saltwater intrusion effects on groundwater as a result of establishment of the waterways have also been investigated.

Groundwater Level Changes

Groundwater Levels During Stage 1 Dewatering

Dewatering during excavation and construction will result in groundwater levels being temporarily lowered in the immediate vicinity of the excavations. **Figure 5.6** shows the modelled changes in groundwater level during dewatering of Stage 1 and the location of existing registered wells. The temporary drawdown during construction dewatering is larger than the change in groundwater levels that occurs once the waterways have been completed and opened to the sea as discussed later in this section (**Appendix 14**).

The figure illustrates the extent of influence around the works and shows that the groundwater level changes are limited to the vicinity of the excavations. The effects of changes in groundwater levels further from the excavations are very limited, for example level changes similar to the seasonal fluctuations in nearby monitoring wells of 0.6 metres (**Section 4.14.9**) are limited to about 170 metres from the waterways.

The modelled scenario is expected to be conservative as it shows the influence on water levels after long term continuous dewatering of the whole of Stage 1. In contrast, the proposed construction methodology is to dewater the excavation in substages to minimise the duration and extent of dewatering, and thus minimise the influence on groundwater levels. As a result, the level changes that occur are expected to be less than that indicated by the modelling.

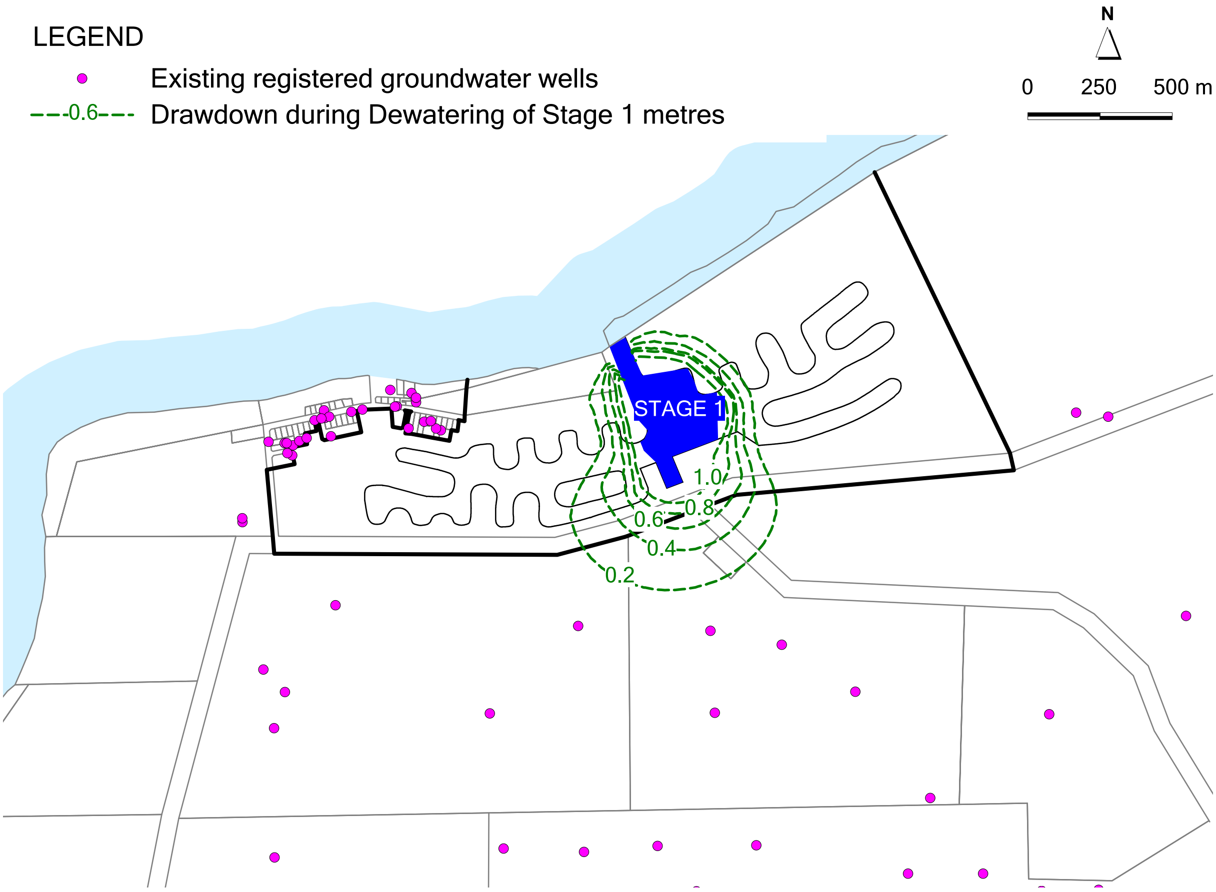


Figure 5.6: Stage 1 Dewatering Drawdown
Source: Appendix 14

Stage 1 Groundwater Levels (Post-Construction of Stage 1)

Groundwater levels at completion of Stage 1, following opening of the channel to the sea and flooding of the waterways, have also been modelled. The groundwater at the edge of the waterways will be at sea level and over time the groundwater levels near the waterways will reach a new equilibrium. **Figure 5.7** shows the modelled pre and post Stage 1 groundwater levels.

The modelling shows that the changes in groundwater level during and after Stage 1 are negligible at the location of existing groundwater wells and that Stage 1 poses no threat to existing groundwater users.

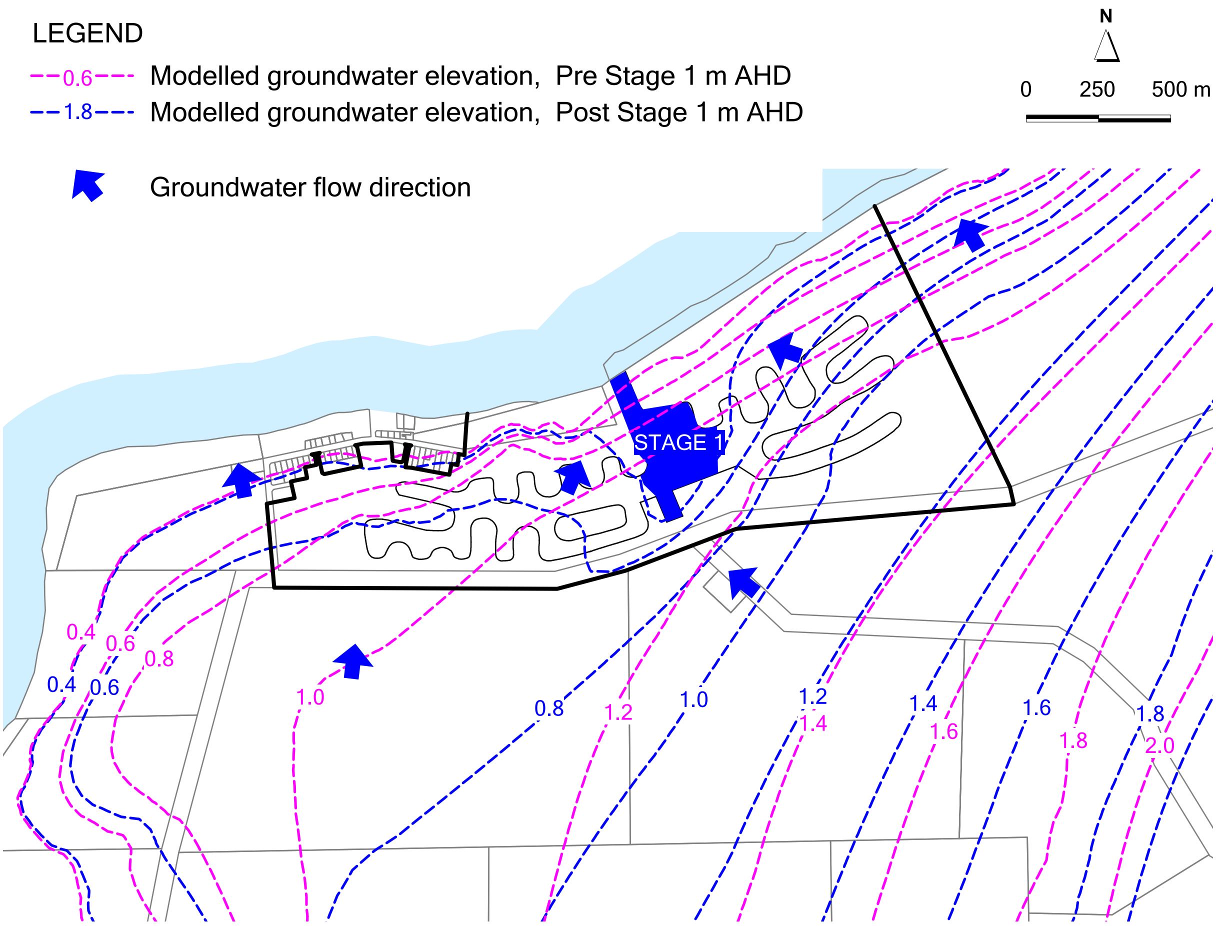


Figure 5.7: Groundwater Levels Post Stage 1
Source: **Appendix 14**

Post-Development Groundwater Levels

Figure 5.8 shows the modelled groundwater levels before and after establishment of the whole of the waterways. Further, **Figure 5.9** presents the modelled groundwater level changes (ie difference between before and after) and also shows the nearby registered groundwater wells (**Appendix 14**).

The modelled change in groundwater level at the location of existing wells is less than approximately 0.6 metres and for the wells within the existing Cape Jaffa settlement is less than about 0.2 metres. This small reduction in available head for extraction is expected to have minimal effect on yield from existing groundwater wells.

The groundwater level changes are generally small compared to the existing seasonal groundwater level changes. The seasonal changes recorded by DWLBC in the nearby regional observation wells are up to 1.3 metres and generally between 0.5 and 1.0 metre, as described in **Section 4.14.9**.

The potential effects on vegetation, land use, existing groundwater users and the proclaimed water resource are discussed later in **Sections 5.2.5**, **5.3.10**, **5.3.17**, **5.4.12** and **5.6.14**.

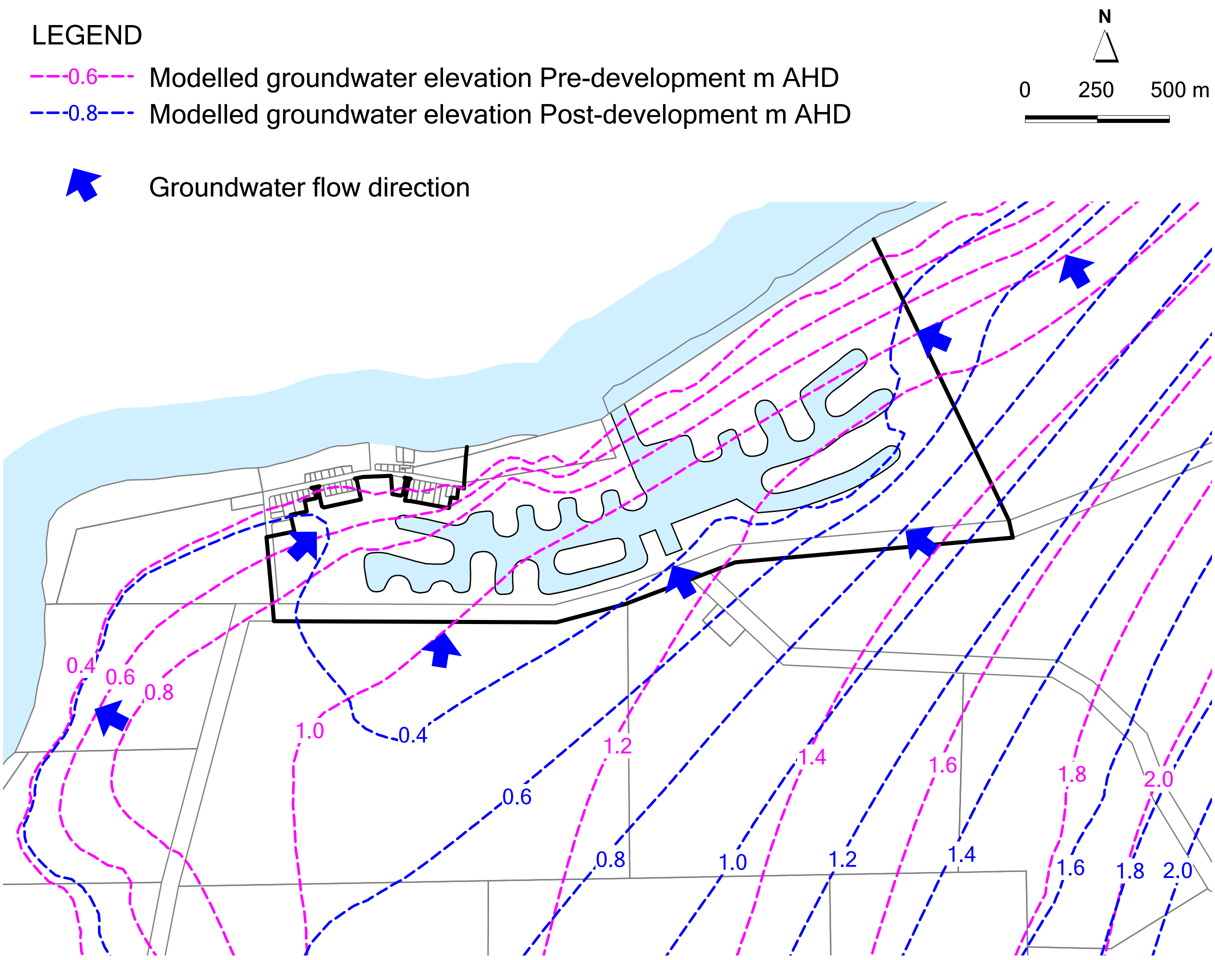


Figure 5.8: Groundwater Levels Post Development
Source: **Appendix 14**

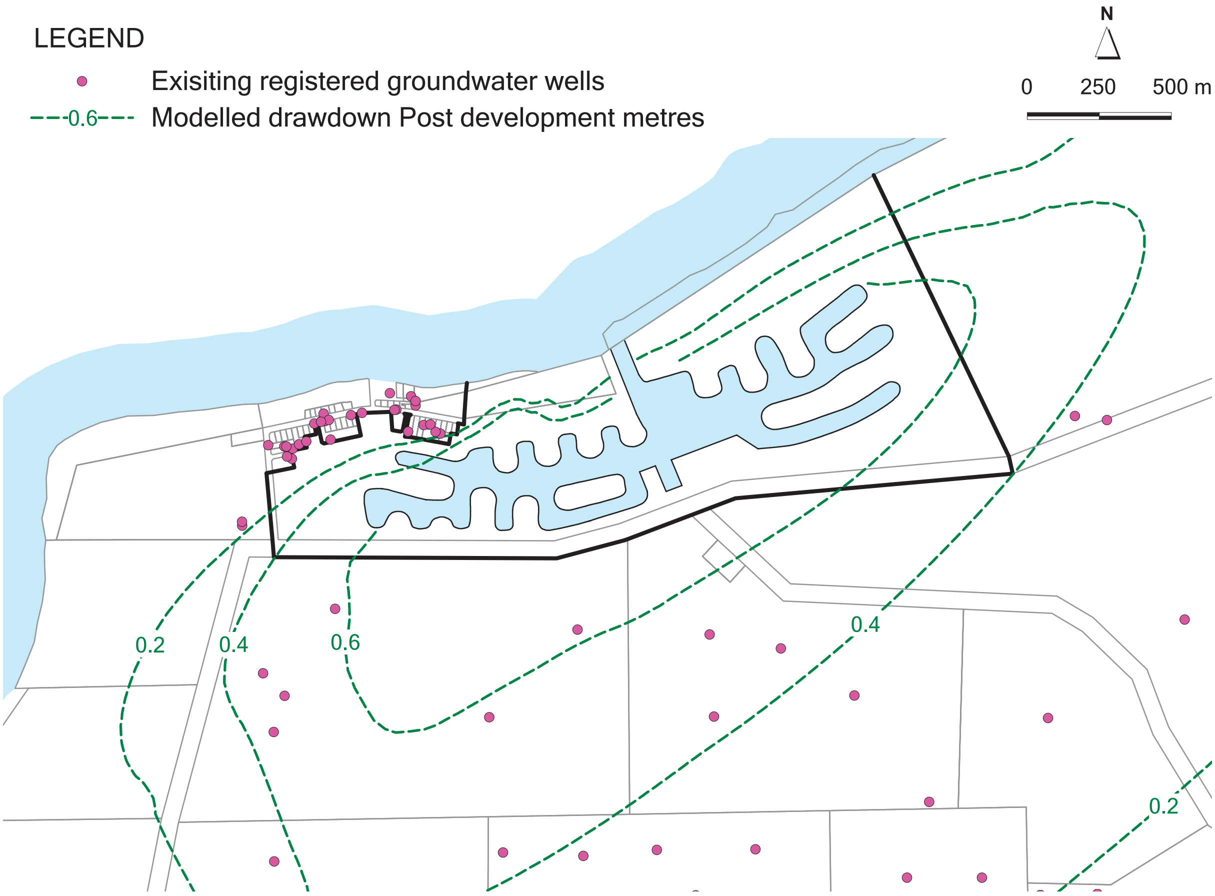


Figure 5.9: Groundwater Level Changes Post Development
Source: **Appendix 14**

<u>Ongoing Monitoring and Assessment</u>

The Groundwater Management Plan provides for ongoing monitoring and assessment, which enables determination of the actual effects of the construction of the waterways on the groundwater. Comparison between the actual and the modelled effects will allow validation and refinement of the model and provide improved understanding of the groundwater environment. The ongoing monitoring and assessment is described in **Sections 5.2.10** and **5.2.29**.

The staged construction of the waterways minimises risks to the groundwater environment and nearby groundwater uses as it limits the zone of influence around the waterways and locates early stages away from the existing groundwater uses. This allows mitigation of risks well in advance of their possible occurrence.

<u>Seawater Intrusion</u>

In unconfined aquifers where groundwater flows to the coast, as is the case at Cape Jaffa, an interface exists between the fresh groundwater and saline seawater (**Appendix 14**). The interface generally intersects the seabed a short distance offshore and extends landward beneath the fresh groundwater, as shown in **Figure 4.87**. The groundwater above the interface flows seaward and 'escapes' from the aquifer into the sea in the gap between the coast and the interface. The nature and location of the existing seawater interface at Cape Jaffa is discussed in more detail in **Section 4.14.11**.

Changes in groundwater levels near the coast can influence the location of the seawater interface and may result in intrusion of seawater into the aquifer. Notwithstanding the small groundwater level changes, investigation into the potential movement of the seawater interface has been undertaken as discussed below.

The following classifications are useful for understanding changes to the seawater interface that can result in seawater intrusion (Fetter 2001 and Barlow 2003):

- active seawater intrusion occurs when the groundwater levels are lowered to below sea level, causing seawater to flow landward from the marine environment into the aquifer toward the area of lowered groundwater level. Examples include excessive and unsustainable extraction from the aquifer or dewatering activities that reduce groundwater levels to below sea level near the coast;

- passive encroachment of the seawater interface occurs when the groundwater flow to the coast is reduced. Flow to the coast "pushes" the seawater interface down and seaward, so if flow to the coast is reduced then the interface will shift upward and extend into the aquifer at a shallower angle, as illustrated in **Figure 5.10**. In addition, the reduced groundwater flow results in reduced groundwater levels near the coast. Passive encroachment is less severe than active seawater intrusion as the resulting movement of the interface is much slower and less extensive. The encroachment is temporary as the interface stabilises at a new location rather than the ongoing intrusion associated with active seawater intrusion. An example of where this may occur include increased regional extraction from the aquifer or reduced groundwater recharge during drought periods; and

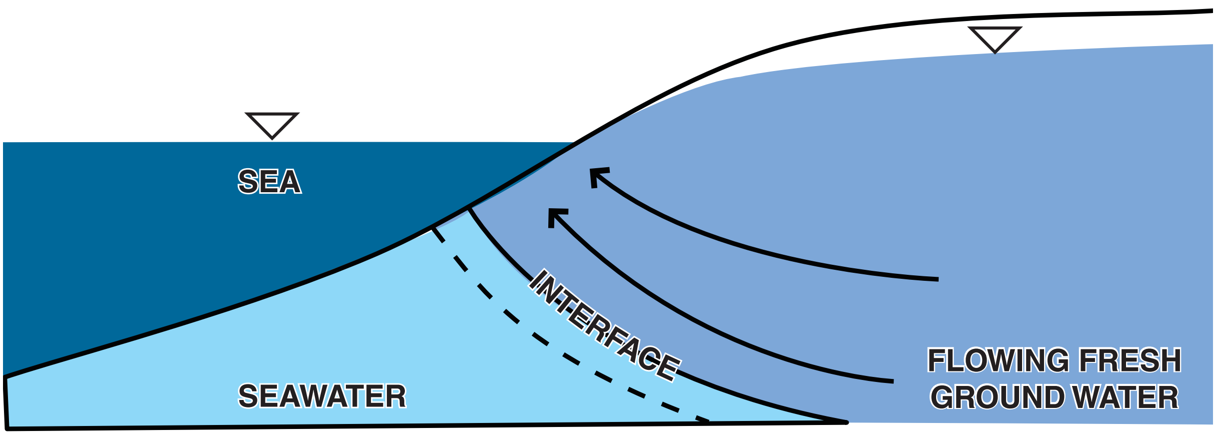


Figure 5.10: Passive Encroachment when Flow to the Coast is Reduced
Adapted from Freeze and Cherry 1979

- seawater coning occurs when groundwater is extracted from a well located above the seawater interface near the coast, particularly at high extraction rates. During extraction, the groundwater levels near the well are temporarily lowered and a cone of elevated seawater is formed, as illustrated in **Figure 5.11**. If the seawater cone is raised sufficiently to reach the well, then seawater will flow to the well and result in seawater intrusion.

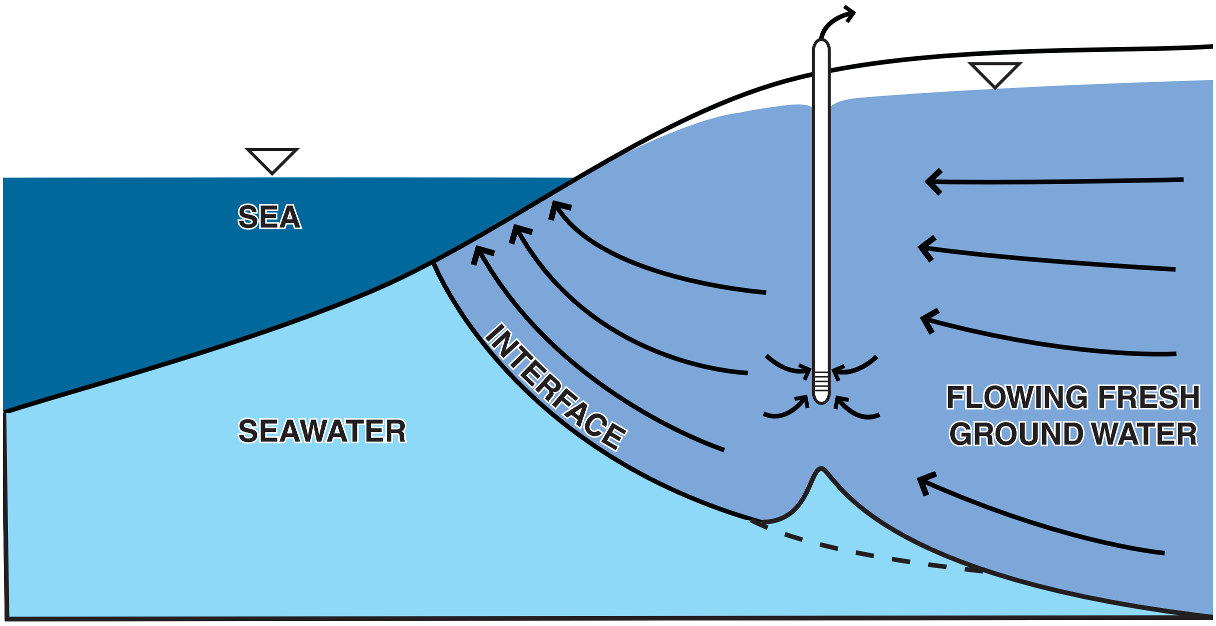


Figure 5.11: Seawater Coning During Extraction Near the Seawater Interface
Adapted from Freeze and Cherry 1979

Potential Seawater Intrusion at Cape Jaffa

None of the existing wells at Cape Jaffa or the wells drilled during the recent investigations exhibit elevated salinity levels consistent with seawater intrusion or encroachment, nor has the seawater interface been intersected by wells drilled during the recent investigations. The salinity of wells near to the coast is low compared to seawater (about 1,000 mg/L within 100 metres of the coast) and the interface is understood to exist seaward and below the influence of these wells. This is consistent with the behaviour of unconfined coastal aquifers within the region as shallow domestic wells are found near the coast in many coastal towns in the South East of South Australia. The existing location of the seawater interface is discussed in more detail in **Section 4.14.11**.

No active seawater intrusion occurs as a result of the waterways once they are established, as groundwater levels are not lowered below seawater level. In the short term, active seawater intrusion may occur temporarily during construction if dewatering of excavations is required to below sea level. The effects of active seawater intrusion will take some time to reach the dewatered zone and will only be observed on the seaward side of excavations. The effects are minimised by staging the construction of the waterways and reducing the duration, extent and depth of each dewatering event.

Once the waterways are established, the groundwater levels and flows in the vicinity of the waterways will change. Longer term effects could occur as a result of three factors:

- the groundwater of the peninsula between the waterways and the existing coastline will receive recharge from incident precipitation and only minimal groundwater through-flow. The recharge may not be sufficient to support viable long term groundwater extraction for potable use in this area;

- where groundwater flow to the coast is reduced, the interface will shift upward and extend landward beneath the fresh groundwater at a shallower angle (passive encroachment); and
- the edges of the waterways will effectively create new “coastline” inland of the existing coast and a seawater interface will be established around the waterways which will be closer to some of the existing wells.

These factors are discussed in relation to various areas adjacent to the waterways as set out below.

Eastern End of the Cape Jaffa Settlement

The eastern end of the Cape Jaffa settlement will be located on a peninsula between the waterways and the coast and groundwater extraction in this area is likely to be effected by seawater intrusion over time.

As discussed previously, the initial stages will not result in adverse effects as the development has been staged such that construction activities commence away from the existing settlement. Monitoring and mitigation measures, including the extension of the town water supply to the existing settlement, are described in Section 5.2.10, 5.2.29 and 5.4.9. This allows mitigation of any risks well in advance of their possible occurrence.

Western End of the Cape Jaffa Settlement

At the western end of the Cape Jaffa settlement it is expected that the groundwater flow to the coast will be reduced and the interface will shift upward such that it extends into the aquifer at a shallower angle (passive encroachment). Thus, existing wells located above the seawater interface are subject to increased risk of seawater coning during extraction. The extent of increased risk is dependant upon the rate of groundwater extraction, the well’s depth and the proximity of the well to the waterways and the coast. The potential effects progressively diminish to the west as the distance from the waterways increases.

Again, adverse effects of the initial stages are not expected as the development has been staged such that construction activities commence away from the existing settlement and the monitoring and mitigation measures are described in Section 5.2.10, 5.2.29 and 5.4.9.

Adjacent to the Waterway (< 750 metres)

Areas within 750 metres of the waterways effectively become closer to the new “coastline” and consequently closer to the seawater interface. Despite being closer to the new coastline, the net flow of groundwater across this area does not change and availability of the groundwater resource will not be reduced.

The existing uses, such as domestic and stock watering, are unlikely to be effected by the changes to the location of the interface because the volume of groundwater extraction associated with these uses is generally low. Within this area there are no apparent major uses such as broad scale irrigation.

Should any future major groundwater extraction be proposed in this area, it must have regard for the location of the seawater interface and be managed to prevent potential degradation of water quality. This type of management is typical of any major groundwater extraction regime in proximity to the coast, in order to avoid potential seawater intrusion.

Further from the Waterways (> 750 metres)

Areas beyond those adjacent to the waterways described above are unlikely to be effected. Within this area, the higher watertable elevation and greater distance from the waterways mitigates potential effects so that changes to the seawater interface are unlikely to cause any measurable effect.

The majority of existing registered wells located up to 3.0 kilometres south of the waterways are constructed to less than 15 metres below ground level. Based on the modelled post construction groundwater level changes, at a distance of 1.4 to 2.0 kilometres south of the waterways, the minimum depth of the interface varies from 35 to 95 metres below ground level (estimated using the groundwater monitoring data from CJ30 and CJ31 together with the methods described in Section 4.14.11) and the depth of the interface increases towards the south east. Within much of this area the interface may be below the base of the aquifer so that the aquifer consists entirely of fresh groundwater.

Summary of Potential Drawdown and Seawater Intrusion as a Result of Establishing Waterways

- The modelling and analysis discussed above shows that short term, during construction dewatering, a temporary lowering of groundwater levels will occur in the immediate vicinity of the dewatering activities. The longer term groundwater changes that result from the establishment of Stage 1 have been shown to be negligible and Stage 1 poses no threat to existing groundwater users.
- In the long term, the completed project will result in lowering of groundwater levels in the vicinity of the waterways. Nearby existing wells will experience level changes less than about 0.6 metres and wells within the settlement will experience level changes less than about 0.2 metres, which results in correspondingly reduced available head for extraction. As the changes are small compared to the natural seasonal fluctuations, minimal effect on yield from the existing wells is expected.
- None of the existing wells at Cape Jaffa or the wells drilled during the recent investigations exhibit elevated salinity levels consistent with seawater intrusion or encroachment, and the seawater interface has not been identified in nearby wells to date. The interface is understood to exist seaward and below the influence of these wells, consistent with regional observations.
- Active seawater intrusion is not expected to occur other than for short durations in localised areas during dewatering. The effects are minimised by staging the construction of the waterways to reduce the duration, extent and depth of each dewatering event.
- The wells at the eastern end of the Cape Jaffa settlement will be located on a peninsula between the waterways and the coast, and groundwater extraction in this area is likely to be effected by seawater intrusion over time.

- At the western end of the Cape Jaffa settlement the seawater interface will shift upward to extend into the aquifer at a shallower angle. Existing wells are subject to increased risk of seawater coning, depending on extraction rate, depth and location. The potential effects progressively diminish to the west as the distance from the waterways increases.

- Adverse effects of seawater intrusion on existing groundwater uses within the remainder of the locality are unlikely.

- Ongoing monitoring and assessment of changes to the groundwater environment will be undertaken as described in **Sections 5.2.10** and **5.2.29**.

- The staged construction of the waterways minimises risks to the groundwater environment and nearby groundwater uses as it limits the zone of influence around the waterways and locates early stages away from the existing groundwater uses. Monitoring and mitigation measures, including the extension of the town water supply to the existing settlement, are described in **Sections 5.2.10**, **5.2.29** and **5.4.9**. This allows mitigation of any risks well in advance of their possible occurrence.

- The modelling and analysis undertaken is sufficiently reliable to allow planning and assessment of the short and long term effects of the waterways on groundwater quantity, quality and movement, including potential groundwater level changes and seawater intrusion. The potential effects on vegetation, land use, existing groundwater users and the proclaimed water resource are further discussed in **Sections 5.2.5**, **5.3.10**, **5.3.17**, **5.4.12** and **5.6.14**.

5.2.4 Describe stormwater and wastewater management and the potential impact on groundwater.

Stormwater

Features of the proposed stormwater management system are shown in **Figure 3.15** and discussed in **Appendix 19**. These features include:

- grassed open swales along all roads that allow stormwater quality improvement via soakage of run-off, as well as provide safe conveyance of extreme event flows to the stormwater retention basins and away from the waterways. The sand free draining soils will mean that for most rainfall events, settling of solids and filtering of stormwater will occur within the swale system, providing recharge to the groundwater system distributed around the site. The swales are designed for flows up to the 100 year ARI event;

- stormwater retention basins will allow settling of suspended solids and soakage of stormwater into the underlying sandy soils, thereby minimising discharge to the waterways. During dry weather the ponds would normally be dry, filling only during larger rainfall events. Overflow discharge to the waterway would only occur during significant extreme rainfall events. Numerous retention basins will be distributed around the development and have a dual function in that they also provide open space at strategic locations. The basins will be grassed and require maintenance similar to other reserve areas. The basins capacity is such that all run-off from a 20 millimetre rainfall event is retained and recharges the groundwater via soakage. A 20 millimetre rainfall event is equivalent to:

- 1 year ARI, 4 hour event;
- 5 year ARI, 1 hour event;
- 20 year ARI, 20 minute event; and
- 100 year ARI, 10 minute event.

• rainwater tanks will be required as part of all new residential and commercial dwellings to capture roof run-off for on-site reuse. This will reduce off-site discharge and mains water demand for high use activities such as garden watering. In these very sandy soils significant potential exists to use various on-site detention methods successfully, methods such as pebble paths, infiltration trenches and soak wells. The techniques are in accordance with the principles of Water Sensitive Urban Design (WSUD) as described in the Good Residential Design Guide (Planning SA 1999). Overflow from on-site detention systems will be directed to the roadside swales;

• run-off from the commercial boat ramp and wash down areas will be diverted from the stormwater system in order to allow treatment aimed specifically at removing oil and grit and other suspended solids such as hull scraping, refer to Section 5.6.11 for further information regarding the stormwater management in the commercial areas; and

• the surface levels of these areas will be designed to slope away from waterway edges towards the stormwater treatment system or, where appropriate, cut off drains will be incorporated.

The design levels of internal roads are an important aspect of the stormwater management system. The open swales associated with the roads will have sufficient grade and flow capacity to carry extreme rainfall events. The roads will also be sufficiently elevated to avoid compromising access during combined extreme rainfall events, extreme high tide and extreme storm surge events, in accordance with best practice coastal management techniques and development guidelines in coastal areas. Road heights and grades will be such that run-off is directed towards the stormwater retention basins.

A Soil Erosion and Drainage Management Plan (SEDMP) will be prepared as part of the Environmental Management Plan to document strategies and procedures for effectively treating and discharging run-off during the construction phase. The SEDMP will be prepared in accordance with the Codes of Practice for Stormwater Pollution Prevention (EPA September 1997 and EPA July 1998) and is outlined in Section 5.5.1.

Potential Effects of Stormwater Management on Groundwater

The Stormwater Management System has been designed to minimise discharge to the marine environment, maximise stormwater soakage into the groundwater system and improve the quality of stormwater entering the groundwater. By using a large number of smaller retention basins the opportunity for soakage into the underlying soils at strategic locations will be maximised.

Further, by providing ample soakage opportunity within individual allotments, grassed swales and at strategic locations within the landscaped basins, the quantity and quality of the stormwater reaching the aquifer is maximised. Run-off from commercial areas will be diverted and treated appropriately to prevent contaminants from being discharged to the aquifer. Interception and separation of oil resulting from a spill event will be provided in order to avoid contamination of stormwater and groundwater.

Wastewater Management

This section provides information on the wastewater treatment system and the recycling of the water that is reclaimed, by reusing it for irrigation. It also discusses the implications of connecting the existing development at Cape Jaffa to a wastewater treatment system. See **Section 5.2.20** and **Appendix 20** for more details of the wastewater management and reclaimed water reuse.

Wastewater Collection and Treatment System

The wastewater management and treatment system includes the following features:

- a full sewer system is to be constructed, therefore no on-site septic tanks are required in the new development;
- the proposal allows for the existing development at Cape Jaffa to connect to the same treatment system that is to be used for the collection and treatment of raw sewage from future development, thereby eliminating the need for disposal of septic tank effluent (via soakage trenches) and the associated effects on the unconfined aquifer;
- it is proposed to provide the sewage collection infrastructure throughout the existing Cape Jaffa settlement, thereby allowing existing development the option of connection;
- options are being considered for the type of sewerage collection system. These include a combination of gravity drainage and pumping stations or the use of a vacuum collection system;
- a packaged mechanical aeration treatment plant is to be located at the south eastern extent of the development. Packaged treatment plants are readily available from various suppliers, are modular in design, easily upgraded to meet the future development needs, and are ideal for smaller communities such as Cape Jaffa. It also provides improved odour control, includes primary and secondary wastewater treatment, and is capable of producing high quality reclaimed water, which allows a range of options for the reuse of the reclaimed water; and
- a separate winter storage of the reclaimed water will be provided, as discussed later.

Reclaimed Water Use

The treatment will allow reuse of the water in accordance with the South Australian Reclaimed Water Guidelines (DHS/EPA April 1999) to achieve a minimum reclaimed water quality of Class C, which allows for a wide range of reuse of the reclaimed water. The guidelines also define management practices for the sustainable reuse of the reclaimed water.

All of the reclaimed water is to be reused in accordance with current best practices, sensitive to potential human health and environmental issues. These issues include:

- minimising the total water use associated with the development;
- protection of groundwater quality, particularly nutrient loading;
- protection of water quality within the basins and channels;
- protection of the marine environment; and
- human health.

Class C water is recommended for the following uses:

- irrigation of pasture and fodder crops for grazing animals;
- irrigation of crops for human consumption, with restrictions on type of crop, water application methods and harvesting methods;
- municipal use, including the irrigation of public parks and gardens, with restricted public access during irrigation and withholding periods; and
- passive recreational use, for example the creation of water bodies for picnicking, fishing and other activities that do not involve bodily contact with the water.

The primary reuse proposed at Cape Jaffa will be the irrigation of an agricultural pasture/fodder crop in areas of no public access. Lucerne is the preferred option, however other options including perennial grasses such as ryegrass, eucalypt woodlot or a combination of these have been considered. Compared to many reuse options, all of the options mentioned allow for significant separation between the irrigation activities and residences, waterways, the coast and other public areas. In addition, these crops pose a lower health risk than other uses such as the irrigation of crops for human consumption.

Opportunities for the irrigation of parks and gardens and other uses will be investigated as the development proceeds. Regardless of the reuse option, the quality of the groundwater, waterways, marine environment and public health must be protected. Treatment of water to higher quality through the use of additional disinfection and/or turbidity removal treatment to allow a broader range of reuse options will also be investigated. Upgrades to the package treatment plant can be incorporated at a later stage if required to implement alternate reuse options. Prescribed buffer distance requirements from waterways and residential properties may preclude a number of these potential reuse opportunities and further investigation is required before implementing alternate reuse options.

The nutrient content of the water also needs to be considered in relation to the reuse. Irrigation of pasture or crops is effective in minimising the environmental effects of the nutrients as the plants will absorb the nutrients in addition to the water, thereby protecting the groundwater and marine environments. The recycling of these resources into a fodder crop minimises the use of fertiliser and water from other sources, thereby providing the additional environmental benefit of minimising existing agricultural water and fertiliser use.

Different plant and soil types have different capacity and response to the application of water and nutrients by irrigation. As a result, the water and nutrient requirements of the crop at the irrigation site must be assessed to ensure that the irrigation practices are sustainable. This assessment is outlined in **Section 5.2.20** and will form part of the finalised Irrigation Management Plan.

Irrigation Management Plan

The purpose of the Irrigation Management Plan is to describe the irrigation and its sustainable management, taking into account the irrigation site, soil characteristics and potential effects on surface water and groundwater, public health and air quality.

It will include a description of the short and long term potential environmental effects, nutrient balance, irrigation/distribution infrastructure, system maintenance, salinity, other potential contaminants, drainage, monitoring, reporting, and the health and safety of operations personnel and the public (**Appendix 20**).

Irrigation and Storage Location

The reclaimed water storage dam will be sited and constructed in accordance with the Reclaimed Water Guidelines (DHS/EPA April 1999). See **Figure 5.12**.

The proposed storage and reuse of water is to be located on the land east of the site within Section 92, Hundred of Mt Benson. An agreement with the current landowner has been finalised which provides permanent use of the land for the purposes of ensuring the long term sustainability of the irrigation and storage of recycled water.

The proposed site for reclaimed water reuse is well removed from any existing groundwater users. The groundwater in this area exhibits elevated salinity levels, as can be seen in **Figures 4.73** and **4.74**, and the recent investigations show salinity levels at the eastern extent of the site as high as 14,900 mg/L TDS (**Section 4.14.6**). The extent of separation between the irrigation area and the existing settlement ensures there is no risk to other users of the groundwater resource, particularly in relation to the highly sensitive domestic use within the existing township.

Effects of Connecting the Existing Development

The connection of the existing development at Cape Jaffa to the wastewater treatment and reclaimed water reuse systems will have the following effects:

- reduction in effluent disposal to the groundwater environment within the existing settlement, thus reducing the risk of groundwater contamination; and
- reduced risk to human health associated with extraction of groundwater for the purposes of domestic, commercial (food processing) and irrigation use in close proximity to the disposal of septic tank effluent into the groundwater resource.

Currently, septic tank effluent disposal occurs into the unconfined aquifer and extraction from the same aquifer occurs for domestic use, commercial (food processing) and irrigation purposes. By providing wastewater treatment facilities, the effects on the aquifer can be managed more appropriately and the risk to health associated with the existing use of the groundwater can be eliminated.


Existing Swing Moorings
Proposed Breakwater
Proposed Breakwater
Recreation Berths
Existing Jetty
DRIVE
Recreation Marina
Commercial Marina
CAPE JAFFA ROAD
ROTHALLS ROAD
LIMESTONE COAST ROAD

Effects of Connecting the Existing Development

The connection of the existing development at Cape Jaffa to the wastewater treatment and reclaimed water reuse systems will have the following effects:

- reduction in effluent disposal to the groundwater environment within the existing settlement, thus reducing the risk of groundwater contamination; and
- reduced risk to human health associated with extraction of groundwater for the purposes of domestic, commercial (food processing) and irrigation use in close proximity to the disposal of septic tank effluent into the groundwater resource.

Currently, septic tank effluent disposal occurs into the unconfined aquifer and extraction from the same aquifer occurs for domestic use, commercial (food processing) and irrigation purposes. By providing wastewater treatment facilities, the effects on the aquifer can be managed more appropriately and the risk to health associated with the existing use of the groundwater can be eliminated.

5.2.5 Detail the impact on land and native vegetation of the off-site depression of the watertable and outline the extent of groundwater depression and effect on farming and horticulture and other operations within the groundwater depression zone.

Extent of Groundwater Level Changes

Changes to groundwater levels in the vicinity of the development and the expected effects on nearby groundwater wells are discussed in detail in **Section 5.2.3**, which concludes that the nearby existing wells will experience level changes less than about 0.6 metres and wells within the settlement will experience level changes less than about 0.2 metres. The level changes are small compared to the natural seasonal fluctuations in groundwater levels and no noticeable effect on yield from the existing wells is expected.

Figure 5.13 below shows the modelled groundwater level changes once the waterways are fully developed, and the nearby existing groundwater wells.

Potential Effects of Watertable Depression on Land

Regional Context

The water regime of much of South Australia's South East has been significantly altered since the arrival of Europeans. In order to improve agricultural productivity, a complex network of drains has been constructed, which has drained most of the former wetlands of the region. The State of the Environment Report for South Australia (1998) estimated that 2 percent of pre-European wetlands now remain.

The South East has also undergone significant clearance of deep rooted perennial native vegetation and replacement with shallow rooted annual crops and pasture. This has led to a significant increase in groundwater recharge rates and in many areas watertables have risen, resulting in dryland salinity and more saline higher volume surface flows. This scenario exists in the Upper South East and further inland, however, in the area immediately behind the foredunes south of Kingston, the seasonal inundation is a result more of poor drainage of surface water than of rising watertable.

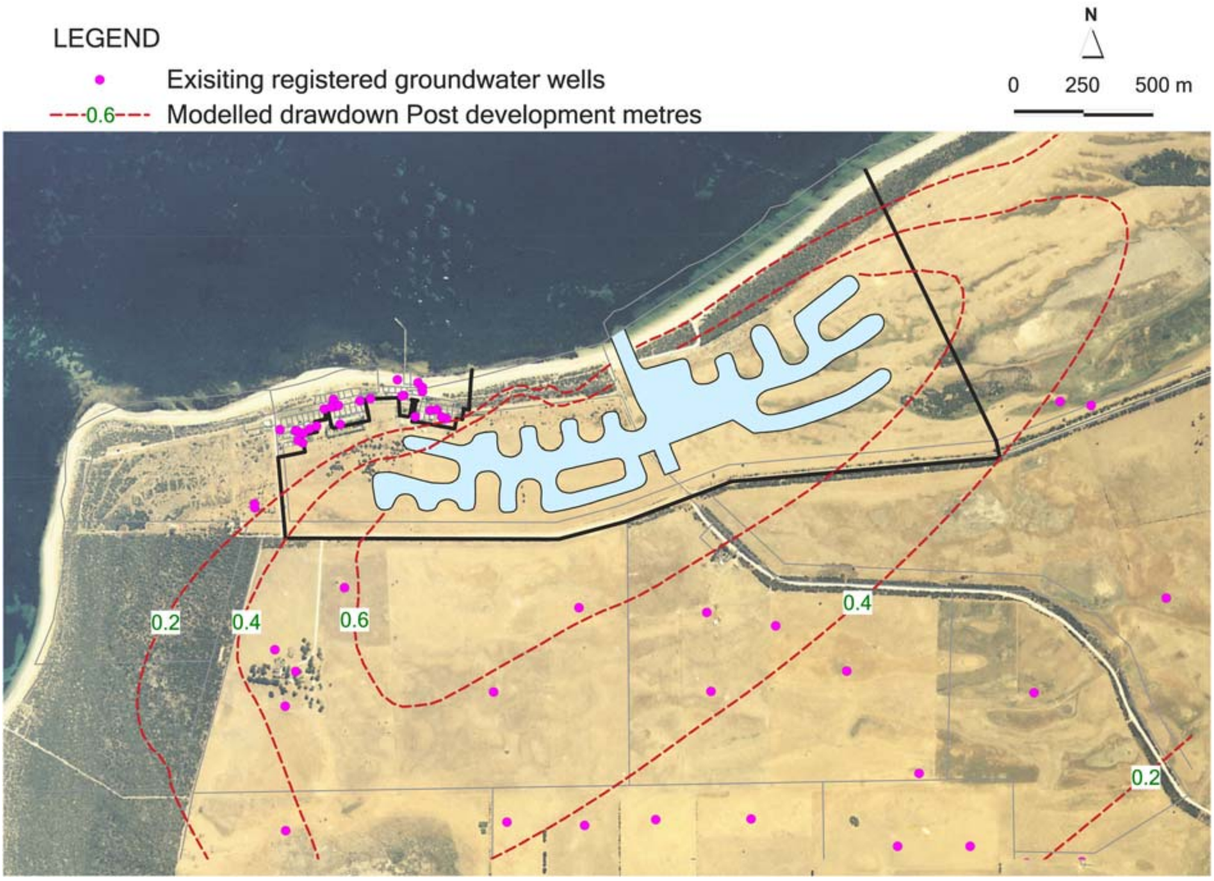


Figure 5.13 Groundwater Level Change and Land Use
Source: **Appendix 14**

Effects at Cape Jaffa

Extensive agriculture is the dominant land use in the area of potential changes to the groundwater levels as a result of the development. The land is limited in its primary production capacity due to the poor nutritional and structural characteristics of the soils and a propensity to inundation in low-lying areas. Other land uses in the region include forestry, viticulture, conservation and horticulture. Bernouilli Conservation Reserve is a vegetated area along the coast to the south of Cape Jaffa. There is an almond grove south of the Major Development Area, a number of wineries four kilometres south east, and pine forests approximately 6.0 kilometres south east.

The township area is predominantly residential. The caravan park provides tourist accommodation and the commercial activities (crayfish processors) are located immediately adjacent to the jetty.

The topography of the area around the development is depicted in **Figure 5.14**. To the east and immediately south of the site is generally low-lying and portions are seasonally inundated. Further south of the site the land rises, resulting in increased depth below ground level to the watertable. In this area, the changes in groundwater elevation are minor and become progressively smaller with increased distance from the site.

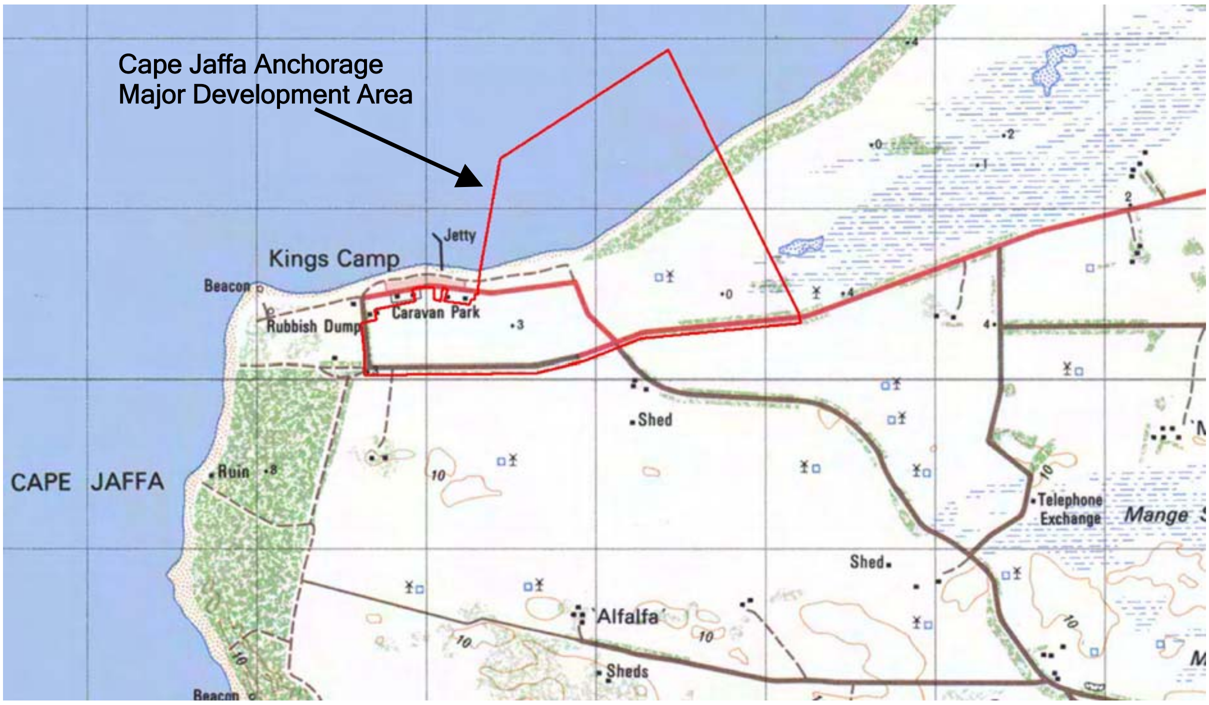


Figure 5.14: 1:50,000 Topographic Map Extract
Source: Department for Environment, Heritage and Aboriginal Affairs 1999

The most significant effect of the reduced groundwater levels is expected to be the improved drainage in seasonally inundated low-lying areas. As a result of periodic inundation or very shallow groundwater levels, some areas currently exhibit low agricultural productivity, elevated groundwater salinity or elevated soil salinity. **Section 4.14.6** presents the salinity of the unconfined aquifer measured in the recently installed monitoring wells. Generally the groundwater in low lying areas immediately to the south and east of the site exhibited salinity greater than 2,000 mg/L TDS, whilst at locations within the site, the existing settlement and further to the south where the topography rises, salinity was generally lower (**Appendix 14**).

After construction of the waterways, land currently subject to seasonal inundation within the groundwater depression zone is likely to be inundated less often or for shorter periods, thus allowing improved agricultural productivity and reduced soil salinity over time. In addition, low-lying areas within the groundwater depression zone will become more suitable for residential or commercial use. In the more elevated areas where the depth to the groundwater is greater, no noticeable effects are anticipated. See **Section 5.2.3** in relation to potential effects on groundwater wells nearby the development.

The horticultural activities are on the periphery of the zone of influence where water level changes are expected to be about 0.3 metres. This land is elevated (8.0 mAHD to 10 mAHD) and the groundwater level is generally less than 2.0 mAHD, which corresponds to more than approximately 6.0 metres below ground level. Horticultural crops in these areas are generally shallow-rooted and unlikely to be dependant on the groundwater, and in any case the level changes are small.

The potential impact on the urban activities at the Cape Jaffa settlement is expected to be minor, though poorly drained areas may benefit from reduced risk of inundation.

Viticulture and forestry areas are well outside the zone of influence of the development and no effects are anticipated.

Potential Effects of Watertable Depression on Native Vegetation

In the Bernouilli Conservation Reserve, modelled groundwater level changes post-development are less than 0.4 metres. The modelled groundwater level changes in the vegetated coastal dunes are less than 0.2 metres west of the breakwaters and up to 0.4 metres east of the breakwaters. As the construction of waterways is staged, it is expected that these level changes will occur gradually over approximately ten years or more. This subtle and gradual change is not expected to effect native vegetation, as it is not reliant on the groundwater system to be sustained (**Appendix 11**).

The construction of the basins will result in the interception of much of the local groundwater flow to the coast. Within the waterways, groundwater will mix with the seawater that enters the waterways from the sea and the salinity of the water in the waterways will be approximately the same as seawater. Thus, beneath the coastal dunes between the coast and the waterways, there will be increased salinity of the groundwater and a raising of the interface between seawater and groundwater within the aquifer.

The coastal dunes are of moderate relief (1.0 metre to 5.0 metres high and 40 metres to 60 metres wide) and are densely vegetated with a wide range of native species that are very well adapted to the coastal conditions. The extent to which the native vegetation relies on groundwater for survival will determine the likely long-term effects. Beneath the coastal dune vegetation in Bernouilli Conservation Reserve and the foredunes at Cape Jaffa, the depth from the ground surface to the watertable, even with seasonal fluctuations of 0.5 metres to 1.0 metres, is in excess of 2.0 metres and it is unlikely that this vegetation would access the watertable to survive. This vegetation type has adapted its water requirements well to surviving the salt-laden winds, the high infiltration rate of the sands and low natural rainfall, so it is not expected that there will be any effect on the coastal vegetation from either increased salinity or a lowering of the watertable in this area.

While groundwater salinities may increase and should be monitored at least in the short term, there will be some amelioration from stormwater being retained on-site by a system of retention basins and swales that will allow infiltration of stormwater into the groundwater.

The *Melaleuca halmaturorum* swamp east of the site is very reliant on a regime of flooding and drying for its survival. Populations of M*. halmaturorum*, found along the edge of wetlands, can live for 100 years. However, these populations are at risk from flooding if young seedlings are drowned. In studies at Bool Lagoon, it was found that recruitment of *M. halmaturorum* has been negatively affected by an increase in the permanence of the surface water (Denton and Ganf 1994). Young seedlings are more likely to survive if the mature trees set and drop seed in spring as the water recedes. The young trees then have sufficient time to grow and establish themselves in the mud flats before the next winter rains. The removal of grazing animals also assists this recruitment process. The health of *M. halmaturorum* juveniles suffers where floods exceed six to nine weeks. Germination does occur, but seedlings fail to become established (Denton and Ganf 1994).

The groundwater modelling suggests an overall depression after completion of the waterways of 0.6 metres to 0.8 metres from current levels in the area of the *M. halmaturorum* swamp. Construction of the waterways will take place over a number of stages, and it is expected that groundwater level changes will occur gradually over a ten to fifteen year period. The modelling used to estimate groundwater levels does not account for the seasonal fluctuations when winter rains recharge the shallow unconfined aquifer. These fluctuations are of the order of 0.5 metres to 1.0 metres.

The critical factor for the survival and regeneration of the *M. halmaturorum* is the period of seasonal inundation. Over recent years, depending on the amount of winter rainfall, the area east of the project site has standing water from about May to November. This is not expected to change significantly. It is possible that after completion of the final stage of the development (10 to 15 years), the draining of this area through the aquifer into the marina basin may bring drying on more quickly. This possible change may be offset through stormwater management involving a system of retention basins that will allow infiltration of stormwater into the groundwater and its redirection towards the swamp area.

Taking all these factors into account, it is not expected that the survival of the *M. halmaturorum* will be threatened. The removal of stock will aid regeneration. If any changes in vegetation structure do occur, it will be over an extended period and if seasonal drying of the swamp happens slightly more quickly than currently, conditions may favour the *Gahnia filum* (chaffy saw sedge). This successional shift is expected to have minimal effect on the habitat value of the swamp area.

As development progresses, the ground and surface water conditions in surrounding areas will be monitored and water regimes managed as required to ensure minimal effect on the native vegetation.

5.2.6 Describe the likely effects on marine organisms, reef communities and seagrasses, given groundwater flow out to sea is likely to increase, potentially reducing the salinity and increasing nutrients and pollutants, particularly heavy metals.

Groundwater Outflow to Sea

The construction of the waterways will change local groundwater flow as described in Section 5.2.3. As the levels in the waterways will be maintained at sea level, which is lower than existing groundwater levels, some of the existing groundwater flow to the coast nearby the development will be redirected toward the waterways and ultimately out to sea.

The establishment of the waterways will not change the total groundwater outflow to the marine environment in the Cape Jaffa area. Once the waterways have been established and the groundwater system has reached equilibrium, the outflow to the sea is equal to the recharge to the aquifer less any net removal from the aquifer. As the waterways do not change the recharge or removal quantities, there is no change to the groundwater outflow.

The waterways will result in a local redistribution of outflow to the marine environment only, not an overall increase. They will act as a conduit for groundwater flow to the marine environment and the outflow to the coast immediately adjacent to the waterways will be correspondingly reduced (Appendix 14), as illustrated in Figure 5.15.

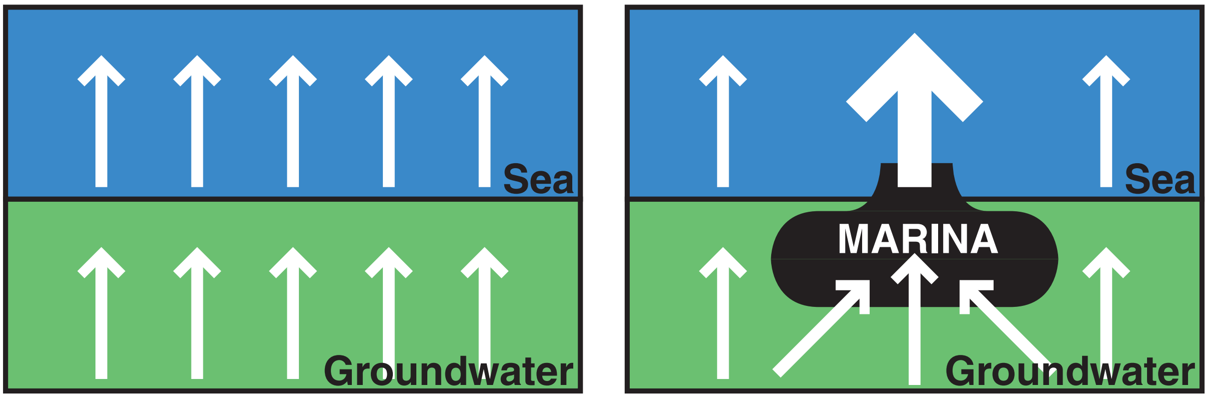


Figure 5.15: Groundwater Outflow to Sea via Waterways
Source: Appendix 14

As there is no increase in the total groundwater outflow, there is no increase in nutrients or pollutants resulting from that unchanged outflow. Similarly, there can be no reduction in seawater salinity. Nevertheless, localised redistribution of groundwater outflow to the marine environment will occur and the associated potential effects are discussed below.

The extent of coast which experiences changes to the groundwater outflow to the marine environment as a result of the development is indicated by the modelled groundwater levels presented in Figure 5.8. The groundwater flow direction is perpendicular to the groundwater level contours, thus, where the orientation of the pre and post development contours differ, the direction of groundwater flow has changed. Figure 5.8 shows that the extent of coastline from which groundwater outflow has been diverted into the waterways extends over a section of coast that is about the same as the extent of the Major Development Area.

The groundwater model has been used to calculate the quantity of groundwater flow diverted into the waterways following completion of the development. The modelling has also been used to assess the distribution of the groundwater flow into the waterways, as shown in Figure 5.16 (Appendix 14). A total of approximately 900 m^3/day discharges to the waterways and thus enters the marine environment at the mouth of the breakwaters and the effects of this outflow has been assessed below.

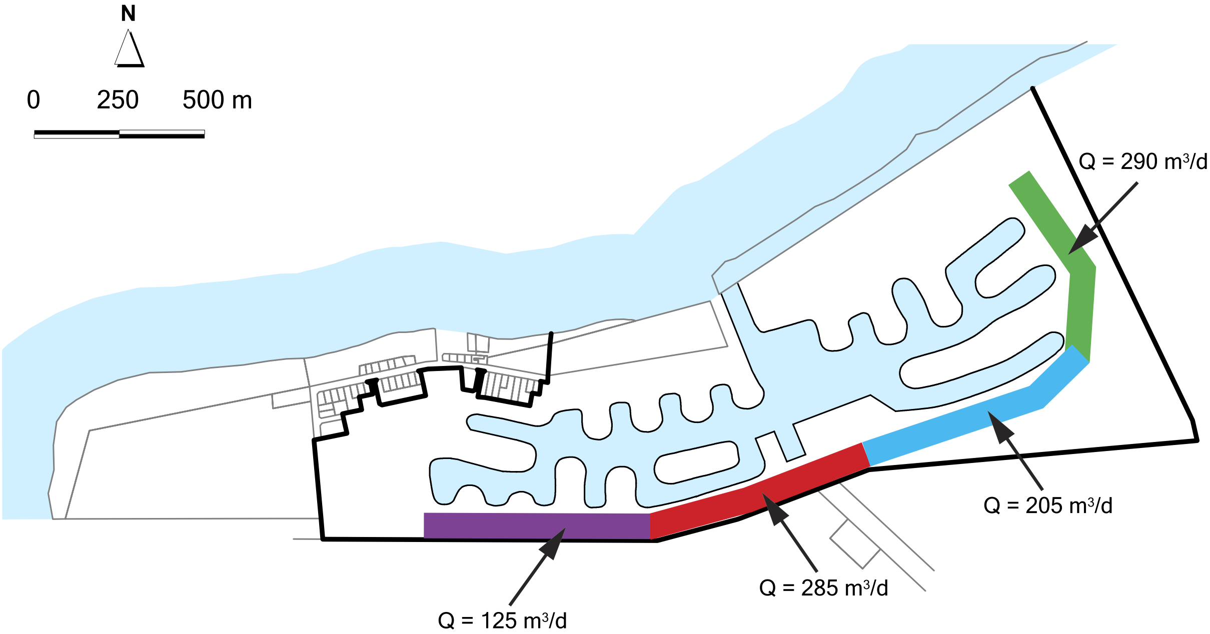


Figure 5.16 Groundwater Outflow to Waterways
Source Data: **Appendix 14**

Groundwater Quality

Groundwater currently flows to the marine environment and thus any existing nutrients, pollutants or dissolved compounds in the groundwater are also currently being transported to the marine environment. The development is not expected to result in any significant change to the concentration of any existing compounds in the groundwater. Once the waterways are constructed, a portion of the groundwater and the associated compounds that previously flowed direct to the coast will be diverted to the waterways and enter the marine environment at the mouth of the breakwaters.

In order to assess the effects of compounds in the groundwater on the marine environment in the vicinity of the mouth of the breakwaters, the following methodology has been adopted:

- sampling and analysis of the groundwater to determine the concentrations of compounds that can potentially effect the marine environment, including nutrients and heavy metals;
- assessment of the dispersion and mixing effects within the waterways to determine the concentrations of compounds entering the marine environment at the mouth on the breakwaters;
- comparison of the concentration of compounds entering the marine environment with EPP Marine Criteria, defined by the EPA for the protection of marine aquatic ecosystems, as set out in the Environmental Protection (Water Quality) Policy 2003 (EPA 2003); and
- assessment of the potential effects on marine organisms, reef communities and seagrasses.

Groundwater Sampling and Analysis

Sampling from the 34 groundwater monitoring wells located on and around the site was performed in July 2003. The samples were analysed for a range of compounds including:

- inorganics, including heavy metals and cyanide;
- nutrients;
- general chemistry;
- volatile organics;
- semi-volatile organics;
- organochlorine pesticides;
- organophosphate pesticides; and
- petroleum hydrocarbons.

Table 5.1 below presents the maximum measured concentration in groundwater of total organic carbon, oxidised nitrogen, total nitrogen, phosphorous, cyanide, arsenic and cadmium. The maximum measured concentrations presented include those measured off-site, some of which are at a significant distance from the waterways, but nevertheless these have been included in order to be conservative. In addition, some of the sampling has been repeated and the higher of the results has been adopted, again in order to be conservative.

All measured concentrations of all other compounds were well below the EPP Marine Criteria. The groundwater sampling results are discussed in more detail in Section 4.14.13, which includes maps of the measured concentrations of these compounds.

Table 5.1: Maximum Measured Concentrations in Groundwater
Source Data: **Appendix 14**

Compound	Maximum Measured Concentration (on-site and off-site)
Total Organic Carbon (mg/L)	78
Oxidised Nitrogen (mg/L)	12.2
Total Nitrogen (mg/L)	12.5
Phosphorous (mg/L)	1.04
Cyanide (mg/L)	0.265
Arsenic (mg/L)	0.092
Cadmium (mg/L)	0.0028

Dispersion and Mixing within the Waterways

Modelling has been used to evaluate dispersion, mixing and flushing within the waterways. It incorporates the effects of advection, diffusion, tidal hydrodynamics and tidal flushing, and is discussed further in **Section 5.2.22** (**Appendix 21**). This enables assessment of the quality and effects of the groundwater/seawater mixture and associated compounds entering the marine environment via the waterways at the mouth of the breakwaters. In addition, the model incorporates the effects of groundwater inflow on the hydrodynamics within the waterways.

The model shows that the exchange volume (tidal prism) per tide cycle is between 168,000 m^3 and 420,000 m^3 depending on the tide height. It also shows that the waterways have a total volume of about 1.26 million m^3 below low water. Clearly, both the tidal exchange volume and the total volume of water within the waterways are very large compared with the groundwater inflow to the waterways of 900 m^3/day. As a result of the mixing and dispersion of the small quantity of fresh groundwater, together with the action of currents, waves and wind, it is expected that complete mixing of the groundwater will occur rapidly within the waterways.

The modelling has been performed assuming a worst case tidal regime of 0.4 metre neap tides for a continuous period of 50 days. The assumed tidal regime is very conservative as the historical tidal records (**Section 4.11**) show that the actual daily tidal range averages about 0.7 metres, which provides nearly twice the modelled water exchange. Over a 50 day period it is expected that the average actual tidal range will be close to the long term historical average of 0.7 metres, however the conservative assumption of 50 days of continuous 0.4 metre tides was used in order to assess the worst case scenario.

The model results are presented in **Figure 5.17**. It shows the distribution of concentration of a compound in the waterways, referred to as the mixing factor, as a fraction of its concentration in the groundwater. At the end of the south eastern arms of the waterways the mixing factor is about 0.66 percent whilst at the mouth of the breakwaters, where a compound enters the marine environment, the mixing factor is less than about 0.3 percent. **Figure 5.17** also shows that the mixing factor is significantly less in the ocean immediately adjacent to the breakwaters and that flushing processes quickly reduce the concentration of compounds to negligible levels in the nearby ocean (**Appendix 21**).

The mixing factor at the mouth of the breakwaters can also be assessed using a simple mass balance. This method approximates the mixing factor as equal to the ratio of groundwater inflow volume to tidal exchange volume over the same period. Assuming a daily groundwater inflow of 900 m^3 and diurnal tides of 0.4 metres, ie daily tidal exchange of 336,000 m^3, gives an approximate mixing factor at the mouth of the breakwaters of 0.27 percent, very similar to the modelled mixing factor of less than 0.3 percent. The same technique using the actual average tides of about 0.7 metres gives a mixing factor at the mouth of the breakwaters of about 0.15 percent.

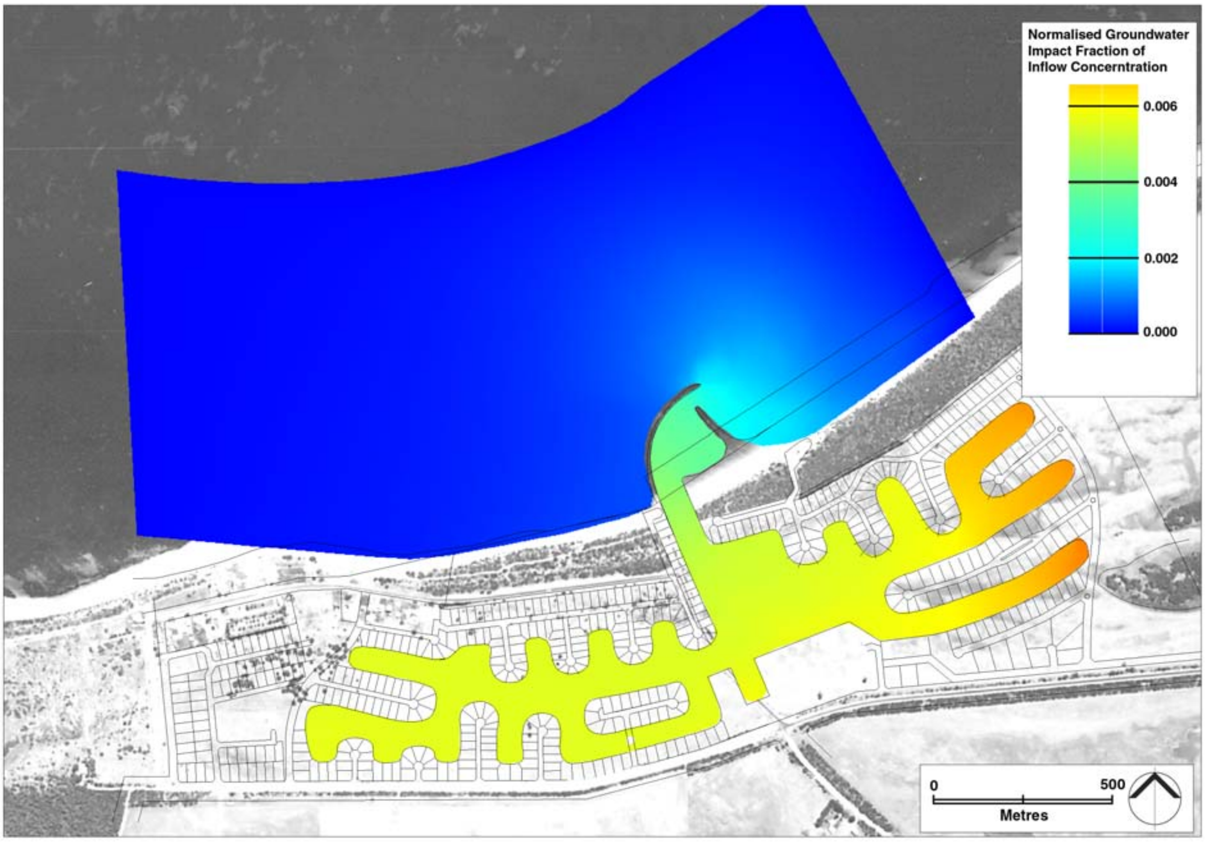


Figure 5.17: Groundwater Dispersion and Mixing (Continuous 0.4 metre Tides)
Source: Appendix 21

Outflow to Marine Environment

In order to obtain a conservative prediction of the potential effects of compounds from the groundwater on the marine environment, it has been assumed that all of the groundwater entering the waterways contains all of the compounds at the highest concentration measured anywhere during the investigations, both on and off-site, as listed previously in Table 5.1. The worst case mixing factor of 0.3 percent has been used, which corresponds to continuous 0.4 metre tides over a 50 day period. The combined effect of the conservative assumptions made is to provide a very conservative prediction of the maximum concentrations of compounds entering the marine environment via the breakwaters (Appendix 21).

Table 5.2 compares the maximum concentration of total organic carbon, oxidised nitrogen, total nitrogen, phosphorous, cyanide, arsenic and cadmium entering the marine environment with the EPP Marine Criteria (EPA 2003). As described previously, the measured concentrations of all other compounds were well below the EPP Marine Criteria in the groundwater itself, and concentrations would be even further reduced with mixing within the waterways. Table 5.2 also shows the maximum concentrations using more typical average tides of 0.7 metres.

The maximum predicted concentration of all compounds entering the marine environment are significantly below the EPP Marine Criteria, even in the worst case tidal regime of 0.4 metres. In addition, the maximum predicted concentration of all compounds is also well below the EPP Marine Criteria everywhere within the waterways.

Table 5.2: Maximum Concentrations Entering the Marine Environment
Source Data: **Appendix 14**

Compound	Maximum Concentration		EPP Marine Criteria	Maximum Concentration as % of EPP Marine Criteria	
	Worst Case (Neap) Tides	Typical Tides		Worst Case (Neap) Tides	Typical Tides
Total Organic Carbon (mg/L)	0.23	0.12	10	2.3%	1.2%
Oxidised Nitrogen (mg/L)	0.036	0.018	0.2	18%	9.2%
Total Nitrogen (mg/L)	0.037	0.019	5	0.74%	0.38%
Phosphorous (mg/L)	0.0031	0.0016	0.1	3.1%	1.6%
Cyanide (mg/L) *	0.00078	0.00040	0.005	16%	8.0%
Arsenic (mg/L)	0.00027	0.00014	0.050	0.54%	0.28%
Cadmium (mg/L)	0.0000083	0.0000042	0.002	0.41%	0.21%

* Comparison made to the NEPM Marine investigation level, as there is no defined EPP Marine Criteria

It is noteworthy that the compounds entering the marine environment via the waterways are not additional to that currently entering the marine environment. These compounds are currently entering the marine environment via the existing groundwater outflow along the coast. A portion of the groundwater and thus the associated compounds are diverted into the waterways and continue to enter the marine environment, albeit via the waterways. Nevertheless, the above analysis shows that the quality of the water entering the marine environment at the mouth of the breakwaters meets the EPP Marine Criteria in terms of nutrients, heavy metals and other potential pollutants (**Appendix 14** and **21**).

Groundwater Effects on Seawater Salinity

The groundwater that enters the waterways reaches the marine environment at the mouth of the breakwaters and results in reduced salinity at that location. The analysis shows that the effect of groundwater outflow to the waterways is to reduce the salinity at the mouth of the breakwaters by a maximum of about 0.3 percent, assuming worst case tidal conditions and worst case (zero) groundwater salinity.

This corresponds to a salinity reduction at the mouth of the breakwaters from about 35,000 mg/L to about 34,900 mg/L. The modelling also shows that this change would be significantly less in the ocean immediately adjacent to the breakwaters. Thus, the tidal flushing is very effective and the influence of groundwater outflow on salinity on the marine environment is negligible.

As discussed previously, some of the groundwater that currently flows to the coast adjacent to the breakwaters will be diverted into the waterways and there is a correspondingly reduced groundwater outflow direct to the coast. As a result, within the marine environment adjacent to the breakwaters, the salinity will be reduced to a lesser extent than occurs currently, ie salinity will be marginally increased. The combined effect of the changes at and adjacent to the breakwaters is that there is no net change to overall seawater salinity at Cape Jaffa.

Potential Effects on Marine Organisms, Reef Communities and Seagrasses

An assessment of the likely effects of groundwater contamination on marine assemblages has been undertaken based on seabed video surveys of the area and the groundwater studies discussed above. The seabed video survey results are presented in **Section 4.7** and detailed in **Appendix 13.**

The assessment concludes *"groundwater contamination will have no detectable impact on the marine environment"* (**Appendix 13**). In addition, the short term effects of construction dewatering discharging direct to the sea were investigated. Natural currents and tidal movement will rapidly disperse this water so *"it is unlikely to have any detectable impact"* (**Appendix 13**).

5.2.7 Detail management systems to control the quality and quantity of outflow from the marina given that it is likely to become a sump for groundwater or high freshwater flows that may affect marine organisms.

Quality and Quantity of Outflow from Waterways

The extent to which the waterways act as a 'sump' for groundwater, create 'freshwater flows' to the marine environment, and potentially effect marine organisms has been assessed and is presented in **Section 5.2.6** (**Appendix 13** and **14** and **21**) and summarised below.

The effect of the waterways is to divert groundwater flow from the existing coast into the waterways and then out to sea. The groundwater flow out to sea via the waterways occurs instead of the groundwater flow direct to the coast. Overall, the groundwater flow to the marine environment does not change as a result of the establishment of the waterways.

The relevant effect is the local redistribution of outflow to the marine environment via the waterways. The waterways act as a conduit for groundwater flow to the marine environment and the outflow to the coast immediately adjacent to the waterways is correspondingly reduced. This is discussed in **Section 5.2.6** and shown diagrammatically in **Figure 5.15.**

Section 5.2.6 assesses the effects of the groundwater flow on the quantity and quality of outflow from the waterways. The tidal exchange between the waterways and the sea is between 168,000 m^3 and 420,000 m^3 per tide cycle, depending on the height of the tide, and there are generally two tides per day. Groundwater flow into the waterways has been determined using the groundwater flow model and is about 900 m^3/day.

In order to determine quality of outflow from the waterways, the mixing effect under worst case tidal exchange conditions (small neap tides) for a continuous 50 day period was assessed. Under these conditions the concentration of a compound that enters the waterways together with the groundwater is reduced to less than 0.3 percent of its initial concentration in the groundwater. This mixing factor is even lower in the marine environment immediately surrounding the breakwaters due to additional mixing in the sea and is lower again if more realistic tidal exchange conditions are assumed.

The water quality of the outflow from the waterways is presented in **Table 5.2**. It has been assessed assuming that all of the groundwater inflow to the waterways contains all of the compounds that may effect marine organisms at concentrations equal to the highest concentrations of each compound measured on and around the site. Worst case tidal exchange condition as described above were also assumed. Salinity of the outflow from the waterways is also assessed in **Section 5.2.6**. Assuming worst case conditions, the salinity of the outflow from the waterways is essentially the same as that within the marine environment itself, being less than 0.3 percent fresher than seawater.

On the basis of the quantity, quality and salinity of the outflow from the waterways, the effects of the outflow from the waterways on marine organisms has been assessed to be negligible (**Appendix 13**).

<u>Management Systems for Control of Outflow from Waterways</u>

The detailed investigations undertaken as part of this report (**Appendix 14** and **21**) have resulted in significant redesign of the layout of the waterways during the course of the investigations. Initial assessment of the early designs of the waterways indicated that specific management intervention may have been required in order to maintain water quality in the outflow from the waterways and also to maintain the water quality in the waterways themselves. As a result, the early designs of the waterways incorporated flushing basins to assist in the circulation of water in the waterways and to promote mixing by enhancing tidal exchange.

The above assessment shows that the current design of the waterways is such that the outflow to the marine environment will have negligible effect on marine organisms without any management intervention. The revised design has eliminated the need for such active management intervention.

Other measures that have been incorporated to protect water quality within the marine environment and the waterways include:

- prevention of discharge from vessels by provision of appropriate waste disposal facilities for oil, bilge water, wastewater, etc;
- prevention of potential contamination entering the waterways by diversion of water collected in areas of commercial activities into separation facilities and for appropriate treatment; and
- prevention of stormwater entering the waterways by diverting it away from the waterways into retention basins.

The extent of monitoring to ensure appropriate management includes:

- monitoring for potential pest marine organisms; and
- monitoring of turbidity during construction activities.

The construction related management is discussed in more detail in **Section 5.5**.

Although it has been recommended that ongoing monitoring of salinity, potential contaminants or turbidity is not required, it is intended that these parameters be monitored initially.

This discussion deals predominantly with the management of the outflow from the waterways to the marine environment. The monitoring and management of water quality within the waterways is further described in Section 5.2.22.

5.2.8 Detail any seasonal variations of groundwater level and impact on marina design and off-site operations.

Seasonal and Other Groundwater Level Variations

Groundwater monitoring data provided by DWLBC indicates that there are seasonal groundwater level fluctuations in the unconfined aquifer near Cape Jaffa that are generally between 0.5 and 1.0 metre. This data is presented in Section 4.14.9 and indicates that the groundwater is highest in about September and lowest in about May. The fluctuations in groundwater levels are also indicated by gauging of levels in the wells that were installed as part of the groundwater investigation for the development and the high resolution levels measured in some of the wells. See Section 4.14.10 for further information. Near to the coast the seasonal variations are smaller as the groundwater levels are more closely tied to sea level and tidal fluctuations. This is illustrated by the plots shown in Section 4.14.10.

Effects on Marina Design and Off-site Operations

The groundwater level fluctuations resulting from both the seasonal and tidal effects are small and have little or no effect on the design or operation of the marina.

The minimum site levels required for flood, storm surge and sea level rise are well above the levels influenced by seasonal groundwater changes and thus the groundwater level changes have no influence on the design or operation of the facilities. Minimum allotment, road and development level requirements are discussed in Section 5.2.17 and 5.6.12. In addition, the design and maintenance of the edge treatment around the waterways is controlled by other design parameters and the seasonal groundwater variations have no significant influence on these facilities.

Construction of waterways that involve dewatering activities are influenced by seasonal groundwater variations as less dewatering is required during late summer and autumn when groundwater levels are lower.

The effect on off-site operations from seasonal groundwater level variations is not expected to change, as the development will have minimal effect on the level variations.

5.2.9 Describe the impact of housing and commercial fishing based on groundwater quality.

The main potential effects on groundwater quality are those described above in relation to the establishment of the waterways. There are also potentially both positive and negative effects of residential and commercial development in the area, as described below:

- there will be no disposal of sewage or commercial wastewater to the groundwater system from the new development. Wastewater will be treated in a packaged treatment plant and the reclaimed water will be reused for the irrigation of an agricultural fodder crop in accordance with EPA/DH requirements, thus the nutrient and water resources will be recovered and reused. See Sections 5.2.20 for further information;

- the existing effluent disposal to groundwater will be reduced. The sewerage system will be extended to the existing settlement, thus the development will result in improved groundwater quality as it provides the opportunity for the existing disposal of septic tank effluent into the unconfined aquifer to cease. See Section 5.2.4, 5.2.20 and 5.2.23 for further information;

- commercial wastewater such as that from the commercial and recreational boat washdown area, will be separated for treatment and not directed to the groundwater, stormwater or waterways. The wastewater and the associated paint and hull scrapings, oil and fuel will be diverted to a trade waste collection system designed in accordance with EPA requirements as outlined in Stormwater Management for Marinas, Boat Sheds and Slipways (EPA 521/04). This system incorporates silt traps to collect gross solids and sediments, and all liquids are then discharged to sewer after passing through an oil separation unit. A licensed contractor will undertake removal and disposal of the solids on a regular basis. Activities such as abrasive or high pressure cleaning and wet rubbing will be limited to this area. See Section 5.6.11 for further information;

- garden fertilisers - some minor nutrient loading from the use of garden fertilisers is expected, however this is not anticipated to be significantly different than the nutrient loading associated with the previous agricultural use of the land;

- stormwater will be directed into localised holding basins via open swales, thus maximising the soakage into the groundwater water system and providing rainwater infiltration in those areas in accordance with the principles of water sensitive urban design. This also minimises the potential effects on the water quality in the waterways and the marine environment. See Section 5.2.3, 5.2.19 and 5.7.2 for further information;

- providing ample stormwater soakage opportunity into the permeable sandy soils, including within individual allotments, grassed swales and at strategic locations within the landscaped basins, will allow the quality of the stormwater reaching the unconfined aquifer to be maximised. Further, the basins will be sited to afford recharge in strategic locations, for example, nearby the existing paperbark vegetation;

- rainwater tanks will be required as part of all new residential and commercial development to capture roof runoff for on-site reuse. This will reduce runoff discharged to the stormwater system and reduce mains water demand for high use activities such as garden watering. Overflow from these systems would be directed to the on-site soakage or roadside swales;

- landscape plantings - plant types and species will be selected that are suited to this coastal environment and have minimum requirement for additional watering. The climate at Cape Jaffa should allow species to be selected that thrive in these conditions with minimal watering once established. Using natives as feature plantings in public places in lieu of expansive introduced mown lawns will further minimise the potential water/nutrient loading to the groundwater;

- Water Sensitive Urban Design (WSUD) - utilising these principles, as described in the Good Residential Design Guide (Planning SA 1999), minimises the need for garden watering by maximising on-site retention of stormwater and approximating the natural water balance;
- reducing household water demand – improved water efficiency within the home will be required as part of the design guidelines, including dual flush toilets and water efficient shower heads, taps and AAA appliances; and
- improving soil water holding capacity – materials excavated on-site will be selectively recovered and reused on-site for improved topsoil quality. Various opportunities exist for soil conditioning and mulching to minimise water loading as part of the construction and landscaping activities in developing the site. Kingston District Council have a trial underway to utilise seagrass wrack, ie seaweed deposited on the beach as a soil additive, together with green organics recycling from Council's parks and gardens maintenance program.

It should also be noted that a significant portion of the development land is currently zoned for residential and commercial development, and that this residential/commercial development is likely to occur regardless of this proposal. This alternate development scenario would likely proceed in a less orderly manner and without the benefit of a sewerage system or town water supply, thus resulting in increased contamination from septic tank effluent disposal into the unconfined aquifer together with an increased dependence on it for domestic water supply. Compared to the alternative, this development proposal will result in reduced contamination of the unconfined aquifer and a reduced exposure to the health risks associated with its use for domestic water supply.

5.2.10 Detail the measures to be taken to protect and monitor groundwater resources to ensure that the development does not have a deleterious effect on them.

Kingston District Council and CJDC have invested significant effort into understanding current and post-development groundwater conditions in the vicinity, and are committed to continuing monitoring and assessment during the development phase in order to protect the groundwater resources.

Measures to protect the groundwater environment from potential adverse effects of the development are described in various sections of this report, including those related to stormwater management, reclaimed water use, commercial/industrial wastewater treatment and construction dewatering.

CJDC will implement a Groundwater Management Plan (GMP) prior, during and after construction and the construction related issues will be incorporated into the Site Construction Management Plan (**Appendix SCMP**). The purpose of the GMP is to:

- confirm CJDC's commitment to the appropriate management of groundwater issues;
- assign responsibility for the management of groundwater issues;
- identify any further investigations;
- commit to undertaking consultation and liaison with relevant statutory authorities and local groundwater users potentially impacted by the development;

- define groundwater management requirements;
- specify monitoring requirements to identify spatial and temporal changes to the groundwater system as a result of the development; and
- define environmental reporting requirements and make commitment to updating the conceptual hydrogeological understanding and numerical groundwater flow model if considered necessary as new information becomes available.

The GMP will include the following:

- details of further investigations, including additional investigation into the behaviour of the seawater interface. See **Section 5.2.29** for additional information in relation to ongoing groundwater investigations;
- management of dewatering activities, including:
  - managing dewatering disposal;
  - developing a dewatering trial; and
  - managing effects from dewatering;
- management of the effects to groundwater users and the details of alternative water supply;
- monitoring of wells developed by CJDC for the project to validate and update the conceptual and numerical models if considered necessary;
- monitoring of nominated wells used by existing groundwater users to assess impact on groundwater supplies;
- monitoring for disposal of water generated during dewatering activities; and
- monitoring of water quality in the waterways to assess groundwater outflow to the marine environment.

It is envisaged that the GMP will focus on the effects of the development on salinity and water level.

Coastal

5.2.11 Describe the visual effect of the construction of the breakwater into the bay at Cape Jaffa.

The breakwaters are to be located directly out from the area currently used for beach access and the launch and retrieval of recreational vessels. This is also the area currently used by the aquaculture industry for the occasional mooring and beaching of fish rings for maintenance. There are to be two main breakwaters, the eastern and western which are set apart a distance of approximately 200 metres. At the point where the channel passes across the beach zone a third minor breakwater is provided to create an edge and separation between the enclosed beach and the navigable channel. This feature is short and will be narrower and lower than the eastern and western breakwaters. Refer **Figure 5.18**.

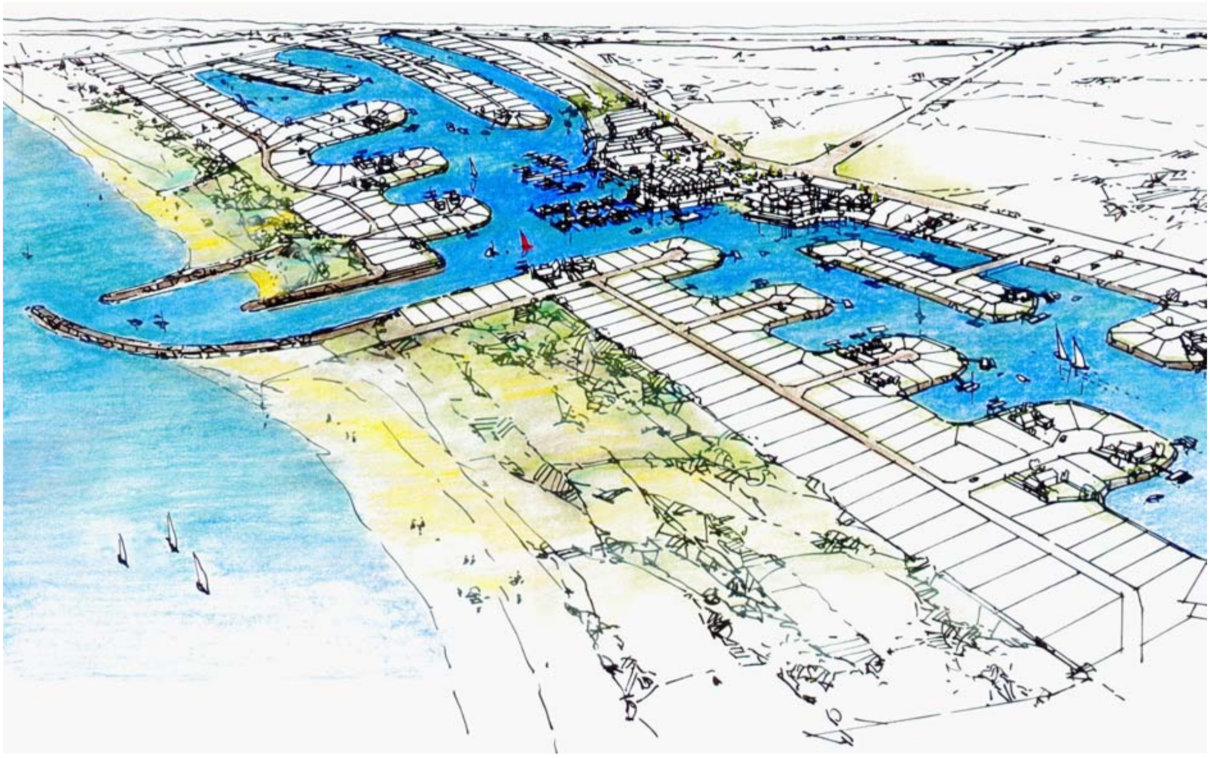


Figure 5.18: Aerial View Looking East

The main or western breakwater will be developed to a height of 2.5 mAHD, which is the same height as the main pedestrian platform level on the outer part of the Cape Jaffa jetty. For comparison, the southern breakwater at Wallaroo reaches a height of 5.5 mAHD, significantly higher than that proposed. The larger western breakwater extends approximately 200 metres from the beach to its outermost extent. This is about the same length as the Cape Jaffa jetty. The secondary or eastern breakwater is lower and is set at a minimum of 2.0 mAHD, thus smaller than the main western breakwater. The limestone armour rock proposed is a pale cream colour and is expected to darken with time as it weathers, as shown in Figure 3.8. The colour and general visual appearance of the breakwater is therefore expected to be similar to that of the Maria Creek breakwater at Kingston SE which is armoured with the same type of material from similar sources.

The effect of the breakwaters as viewed from the beach either to the east or the west of the structures will be to interrupt the continuous view along the slight curve of the beach. As a backdrop to this view will be the curve of the elevated foredune backing the beach, which is higher than the breakwaters and as this is continuous along the frontage to Lacepede Bay, it will provide a dominating continuum with the lower interruption of the breakwater in the foreground in a small part of the bay. This can be likened to the jetty as the overall length and heights are similar except that the jetty has balustrades that extend at least 1.0 metre higher than the proposed breakwater height.

A distant view of the jetty from the position of the proposed western breakwater reveals it as a thin strip on the water, and although it is an open structure, the attached platforms create a more solid presentation from a distance. It can therefore be expected that the breakwaters will have a similar but more solid presentation from this same distance and that as distance decreases, the detail of the breakwater becomes more apparent. The jetty, although an interruption in the coastline, is an attractive and valuable feature used by residents, tourists and others. Jetties, breakwaters and wharfs are very often viewed as a normal and attractive part of a coastal town or harbour, and invariably provide a positive visual and functional contribution to the community. The following **Figure 5.19** depicts two photographic views of the breakwaters.

Figure 5.19: Cape Jaffa Breakwater

The limestone armour rock is a pale cream colour and is expected to darken with time as it weathers, as depicted in **Figure 5.19**. The colour and general visual appearance of the breakwater is expected to be similar to that of the Maria Creek breakwater at Kingston SE, as shown in the adjacent photograph.

5.2.12 Outline the visual effect of the development in this locality

Visual amenity of the development is a function of the relationship between the existing and future land form and built form on the land and out to sea. These will be affected by practical policy requirements such as flood protection from sea level rise as well as the type of construction and materials used for finishes such as the marina edge treatments.

The visual effect of the breakwaters out to sea is discussed in **Section 5.2.11** whilst this section discusses the visual effects on the land.

The land is undulating and needs to be elevated in part to comply with the protection measures set out for sea level rise over the next 100 years. The analysis of these risk management requirements establishes a minimum building platform level of 2.5 mAHD and a minimum floor level of 2.75 mAHD. For comparison the Development Plan specifies 2.4 mAHD and 2.65 mAHD respectively.

The land rises generally from the coast southward and eastward. The foredunes are between 3.0 and 4.5 mAHD with vegetation to approximately 7.5 mAHD and the roads to the south 3.0 to 5.0 mAHD. The road levels within the existing settlement also range between about 3.0 to 5.0 mAHD. At the eastern end of the settlement several dwellings are set on elevated land above the road, and at the western end several dwellings to the north of King Drive are established on the foredune above the road level.

The minimum building platform height for allotments adjacent to the waterways will be at least 2.5 mAHD at the lowest point. This results in the land being elevated 0.45 metres above the top of the protective wall height set at 2.05 mAHD, 4.0 metres from the waterway edge wall. Development will be required to be setback a minimum of 8.0 metres from the waters edge. As a consequence, the slope is shallow, averaging about 10 percent. This setback area is to be free of permanent structures such as outbuildings and the like in order to keep this area generally free and open apart from landscaping and open form fencing on the boundary. The open style fencing will extend from the 4.0 metre setback to the waters edge. This fencing will also be removable from the waterway edge wall for a distance of 4.0 metres to allow for waterway wall maintenance. Figure 5.20 shows a view of the allotment water frontage.

Figure 5.20: Waterway View Looking West

This arrangement will ensure an open feel through the waterways, a proper relationship with the water and berth facilities, and will avoid a canyon effect or the feeling of enclosure in or along the waterways. The waterways will accommodate floating pontoons and associated vessels. These will create a lively, interesting and attractive waterway.

Adjacent the existing dunes and elsewhere where building platforms do not abut a waterway, site levels will be raised. Generally, this will create a flowing or sloping relationship from one site type to the next and down to the water, particularly as viewed from the majority of the public roads and public places around the waterway. Any dry allotment, that is where no direct waterfront exists, levels will be raised to ensure proper stormwater management, to gain benefit from views and vistas, and to create a varied and interesting urban form. Figure 3.22 shows the flowing nature of the landform from the waterway to allotments to the dune and beach.

There is also a critical separation required between the site and the foredunes as part of the mechanism to buffer the coastal dune vegetation from the domestic activities of the land beyond. This relationship and the buffer created are shown in **Figure 3.23**.

The walkway will be fenced on the dune side and a pathway constructed using local limestone material to produce a solid impervious surface. On the landward side, a wall of about 1.0 metre in height constructed of limestone blocks using local materials will retain a planting bed 3.0 metres wide where another low retaining wall will retain and define the front of the private land. This planting area will be landscaped using groundcovers and native grasses. This will create a separation between the private lots and the vegetated dune area as well as a valuable recreation space and link.

The maximum height of built form throughout the residential areas is set at 15.9 mAHD based on maximum design building platform height of 7.5 mAHD. In all circumstances in the residential area it is proposed to create a top of roof design level of 8.4 metres above design ground level which varies over the site. For the commercial, industrial, retail and tourist accommodation areas greater flexibility is anticipated. In general, the majority of the commercial and industrial activities will be designed to fit the needs of the fishing fleet and aquaculture needs. Therefore, the ability to service vessel in-doors and to deliver the vessel by travel lift or similar device will require buildings with clear openings of about 10 metres or possibly more with roof space above. This is not significant when compared with a normal two storey dwelling that has an overall height of about 9.0 metres. These areas will not be prominent from Cape Jaffa Road as there will be buffer mounds and landscaping corridors. This can be compared with the open nature of the existing Industry Zone in which there is no provision for buffers and mounding.

The whole of the land extending behind the Cape Jaffa settlement and eastward to the north south extension of Cape Jaffa Road is currently zoned for residential and industrial development. **Appendix 9** shows the zones. This clearly indicates that the significant western area of the subject land is expected to be developed and that a significant part of this allows for commercial, storage and industrial development near the coast. The area not currently zoned is mainly Primary Production Zone. The proposal will alter the presentation and entry into Cape Jaffa. To reduce the overall effect of the enlarged development area, whilst establishing a sense of arrival and place, significant landscaping is proposed along the road reserve together with mounding where appropriate. There will also be locations however, where views will be encouraged to create focal points and vistas into the development. This is particularly the case at the main public entry at the junction of Limestone Coast Road with Cape Jaffa Road.

It is proposed to create an avenue vista looking north through a reserve and into the main basin and the channel beyond. This vista is presented in **Figure 5.21**. The central facilities area however, needs to be able to accommodate higher buildings or structures to efficiently utilise the land set aside for public, tourist, visitor and related functions. Higher structures may also be used to create this centre as a focus and may include elevated viewing platforms or coastal towers. This type of facility may be necessary should a yacht club or sea rescue facility be established at Cape Jaffa.

Figure 5.21: Beach Reserve View into Main Basin

The breakwaters will be developed to a height of 2.5 mAHD, which is the same height as the main pedestrian platform level on the Cape Jaffa jetty. The breakwater will extend out to sea about the same distance as the Cape Jaffa jetty. For height comparison, the southern breakwater at Wallaroo reaches a height of 5.5 mAHD, significantly higher than that proposed. This is further detailed in **Section 5.2.11**.

Overall the proposal will result in change to the visual appearance of the locality. Development is anticipated by the Development Plan and supporting strategic plans. This scheme promotes the orderly programmed approach to that development to accommodate identified needs. As needs are satisfied, visual change is inevitable. Importantly, the visual effect of the development will be one which reflects the origins of Cape Jaffa as a fishing port and the vibrancy and attractiveness of a seaside village.

It is not anticipated that high density multilevel development can be justified nor is it desirable, and therefore the development will be limited to heights appropriate to their immediate locality. This will create visual interest and attraction and is the exposing or arrival view. This view will include an activity frontage on the right where the public can walk and recreate a beach in the front part of the view and the main basin and channel area beyond. To the left are the waterways and residential allotments. This will be a vibrant active space and view during the summer months particularly weekends, whilst in the winter it is expected to be a quiet space.

5.2.13 Describe the effect of the breakwater and entrance channel construction on coastal erosion and seagrass and sand movement on the coast, and outline management and rehabilitation measures.

Shoreline evolution modelling has been used to determine the likely shoreline response to breakwater and channel construction. The potential up-drift accretion and down-drift erosion and the sand management required to maintain shoreline stability has been assessed. Analysis of coastal seagrass movement is also included (**Appendix 16**). The construction related effects are discussed further in **Section 5.5**.

Existing Coastal Environment

To assist in determining the shoreline response and management requirements, investigations of the existing coastal processes have been undertaken and are presented in **Sections 4.10** to **4.13** and **Appendix 16**. The results of these investigations can be summarised as:

Sand

- The majority of the current sand transportation occurs on and very near the coast as longshore sand drift (from south west to north east).
- The natural coastal processes in Lacepede Bay result in cycles of erosion and accretion within an overall accretionary trend. Complex interactions between the coastal processes and the shape of the coast cause variations in the sand drift rate along the length of the coast and thus cycles of coastal movement.
- Portions of the coast that have experienced erosion are expected to revert to accretion in the future, consistent with the well documented long term trend throughout Lacepede Bay. In places, the reversal to accretion has recently occurred.
- Average longshore sand transport rate has been assessed using modelling techniques for the three years 2000 to 2002, which conservatively indicates 15,000 m^3/yr longshore sand drift over that period. The modelling indicates relatively modest variation from year to year and the majority of longshore drift occurs during the months May to October.
- Two longshore sand transportation rates have been adopted for assessment purposes:
  - a worst case upper limit rate of 25,000 m3/yr;
  - a conservative rate of 15,000 m3/yr, such that the actual rate is expected to be less than 15,000 m3/yr;

Seagrass

- Throughout the shallow Lacepede Bay wave action together with natural die-off detaches seagrass from the seabed. Transportation of suspended seagrass wrack onto the shore is dependant mainly upon the strength and orientation of the prevailing winds and wind generated currents.
- Seagrass wrack movement is driven by different mechanisms than sand movement. Sand movement at Cape Jaffa occurs predominantly alongshore close to the beach and is driven by the action of waves breaking at the beach. Seagrass wrack movement is driven by wind and wind generated currents. Wave refraction results in wind and wave directions that are commonly quite different at Cape Jaffa, for example, southerly deepwater swell waves results in north-westerly waves at Cape Jaffa beach, together with southerly winds.
- Although there is some alongshore component to seagrass wrack movement, the predominant action is for seagrass wrack to accumulate on the beach during periods of onshore winds and leave the beach during periods of offshore winds.
- The rate of deposit or removal of seagrass wrack at the beach is very dependant on the wind strength, ie most of the seagrass movement to and from the beach occurs during high wind (storm) events. In addition, high tides encourage the deposit and removal of seagrass wrack at the beach.
- At Cape Jaffa seagrass wrack accumulates on the beach seasonally. The strong northerlies and north-westerlies in autumn, combined with unusually high tides, result in seagrass wrack accumulation, which typically begins in April or May. In spring, as the winds tend southerly, the seagrass wrack leaves the beach, which is generally cleared of seagrass wrack during spring.
- Around Lacepede Bay to the north-east at Kingston, where the coast is oriented more north-south, seagrass wrack tends to accumulate all year, as the winds are more persistently onshore all year.

<u>Effects on Coastal Accretion, Erosion and Sand Movement</u>

GENESIS software has been used to perform one line shoreline evolution modelling in response to the breakwater and channel construction. The modelling incorporates the local beach characteristics including grain size, beach profile and shape (**Appendix 16**).

Typical shoreline profiles in the vicinity of the proposed development are illustrated in **Figure 5.22**. The shoreline profiles are labelled according to their distance north east of the proposed main breakwater location. The modelling also incorporates the time series of nearshore wave heights and angles to the shore, which have been derived from the wave and the sand transportation modelling described previously in **Sections 4.12** and **4.13** .

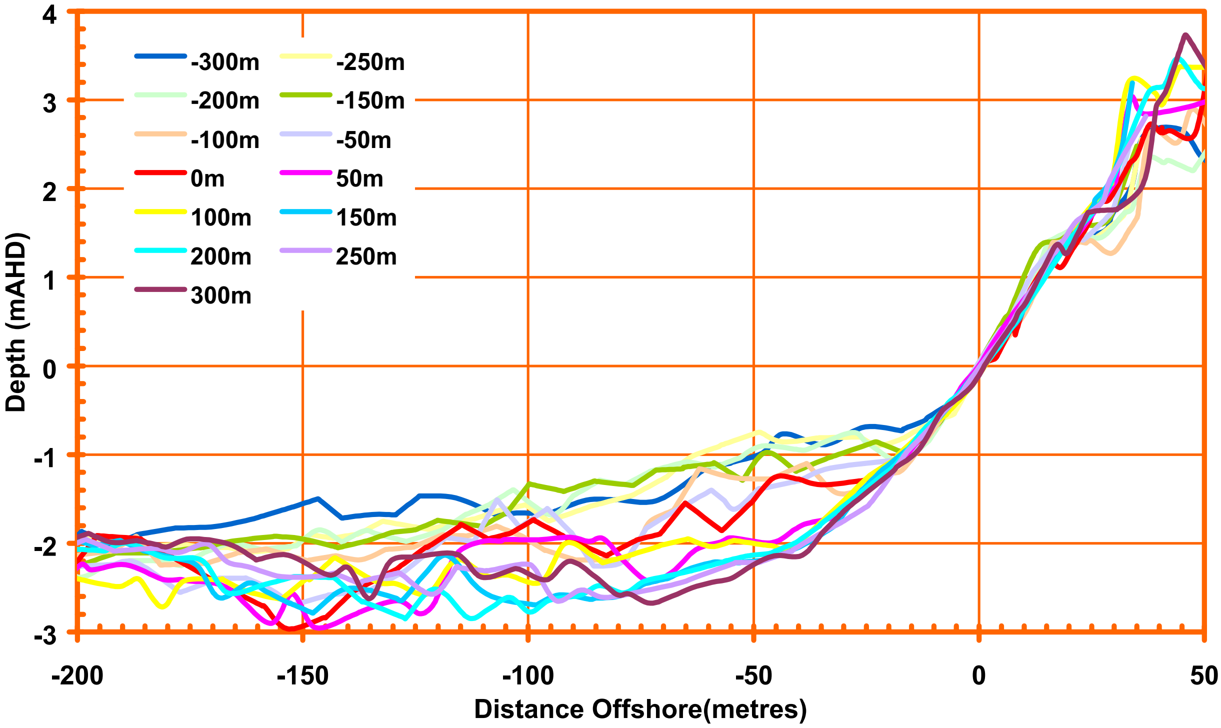


Figure 5.22: Nearshore Profiles at Development Site

Several shoreline response scenarios have been modelled based on the 'worst case' longshore drift rate of 25,000 m^3/yr in the knowledge that with reduced actual rates the responses will be proportionally reduced (**Appendix 16**). Additional scenarios using 15,000 m^3/yr, which is still considered to be conservative, have also been presented by scaling of the 'worst case' modelled responses.

GENESIS modelling of shoreline response has initially been performed as follows:

- Analysis of shoreline response without management action.
- Analysis of shoreline response with annual sand bypass to match the longshore drift rate. The bypass is modelled as occurring over four months of the year from May to August.

The modelled shoreline change relative to the existing shoreline is presented as **Figures 5.23** to **5.26**. The results indicate that:

- if no bypassing is carried out over a two year period there is potential for accretion immediately updrift and erosion downdrift of the channel entrance of:
  - up to approximately 70 metres for the worst case upper limit longshore drift rate of 25,000m^3/yr (**Figure 5.23**); or
  - up to approximately 40 metres for the conservative estimate of 15,000 m^3/yr longshore drift rate (**Figure 5.24**).

- long term shoreline stability can be achieved with acceptable beach width variability between annual bypass events, even if the longshore sand transport rate is as much as the worst case upper limit of 25,000 m^3/yr. Modelled beach width variability are:
  - up to about 30 metres for the worst case upper limit longshore drift rate of 25,000 m^3/yr (**Figure 5.25**); and
  - up to about 18 metres for the conservative longshore drift rate of 15,000 m^3/yr (**Figure 5.26**).
- bypass of the worst case upper limit of 25,000 m^3 over four months indicates that bypass infrastructure capable of up to 200 m^3/day is required; and
- the initial assessment described above is considered to be conservative. If the bypassing is undertaken at a lower rate over a longer period or at the same rate over a number of shorter periods in each year, or if the actual longshore drift rate is less than that adopted, then the resulting beach width variability will be less than that shown in the figures.

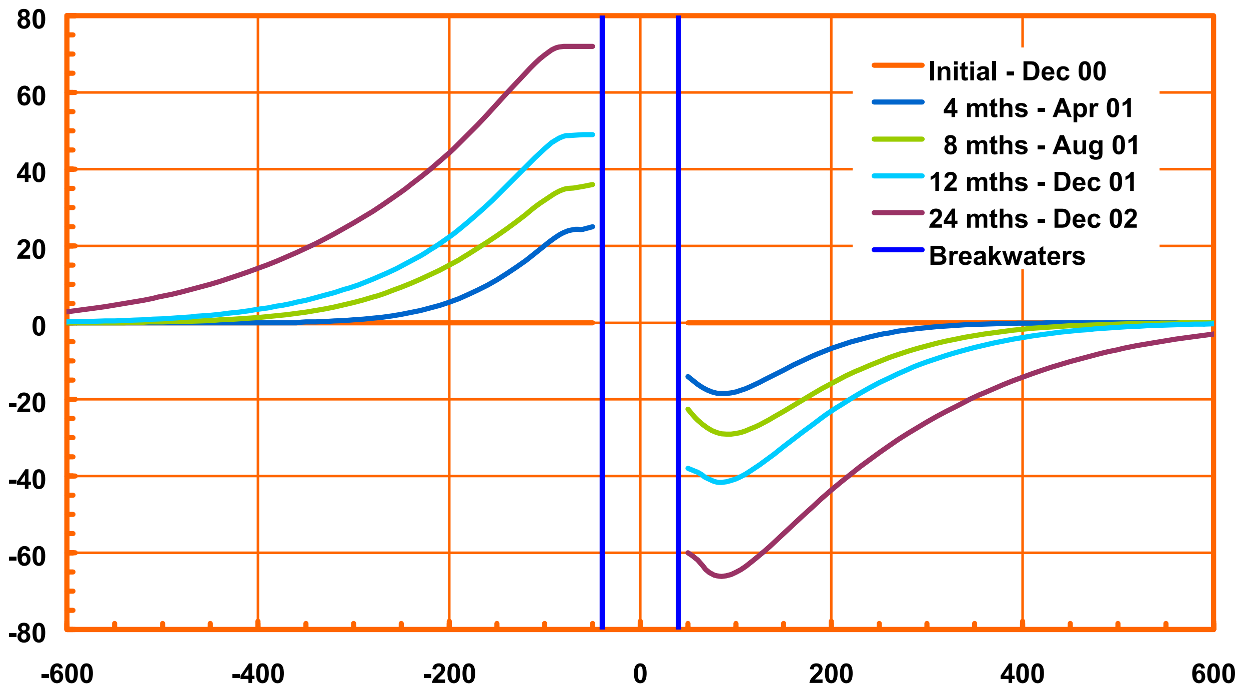


Figure 5.23: Shoreline Response – No Bypass 25,000 m^3/yr

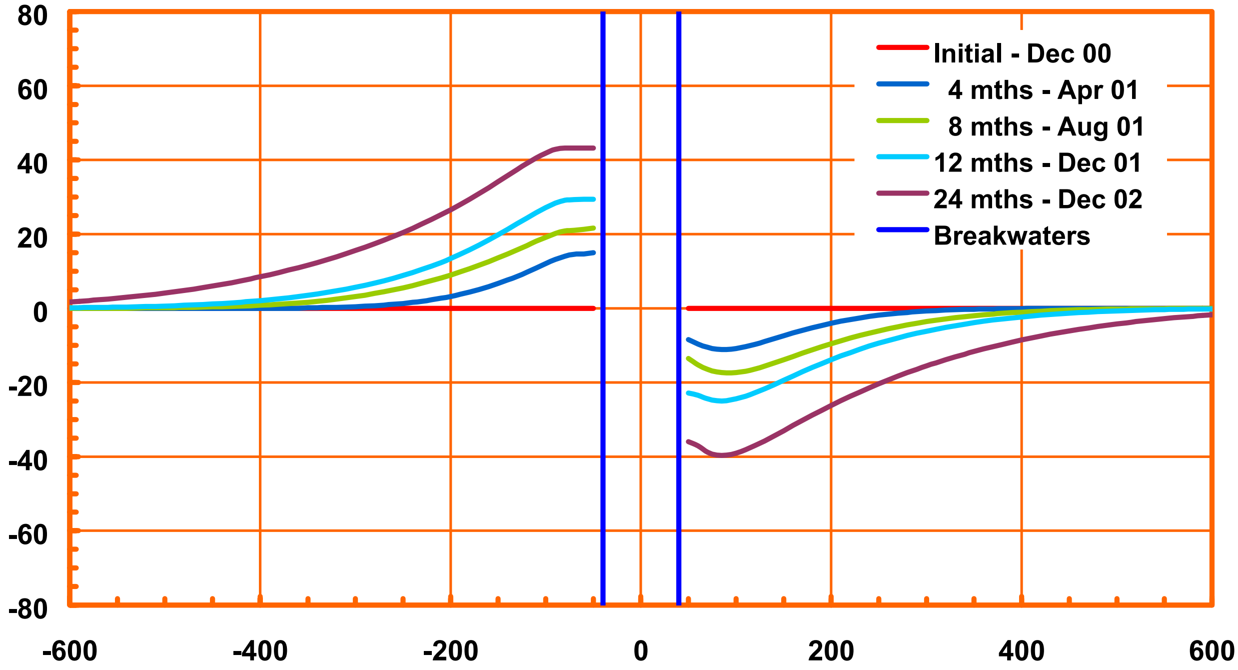


Figure 5.24: Shoreline Response - No Bypass 15,000 m3/yr

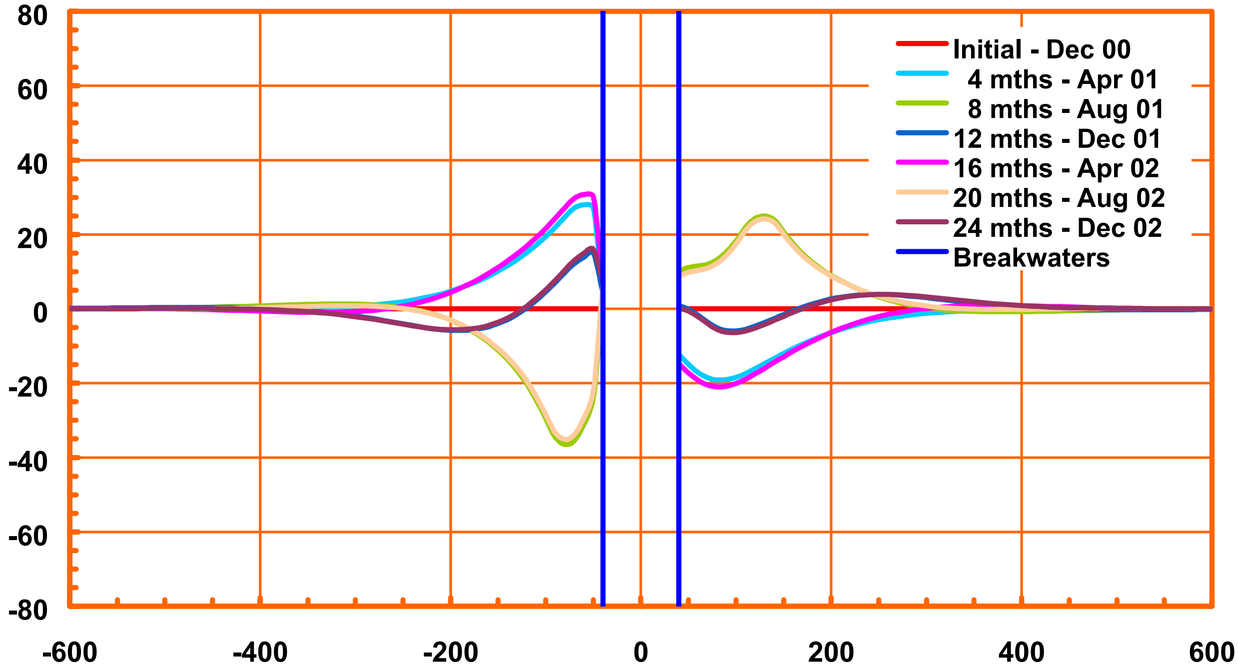


Figure 5.25: Shoreline Response - Bypass 25,000 m3/yr

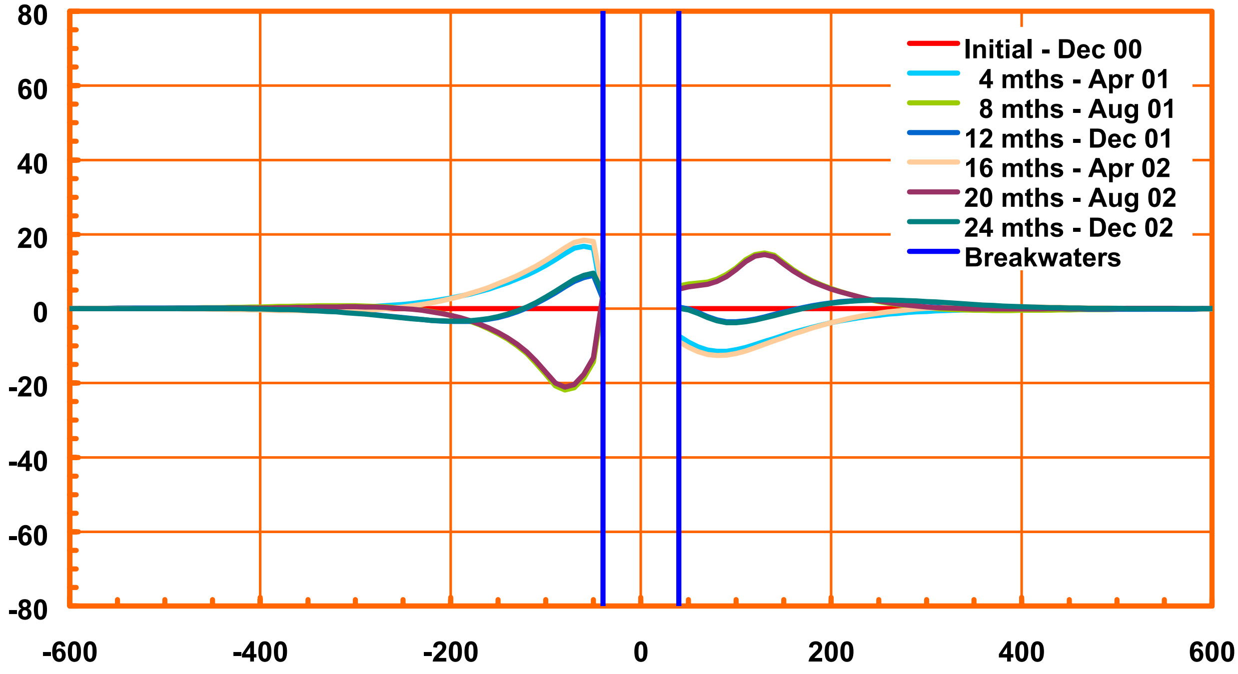


Figure 5.26: Shoreline Response - Bypass 15,000 m3/yr

The modelling presented above in **Figures 5.25 and 5.26** shows that it is feasible and practical to manage the shoreline by bypassing sand at the rates indicated above. Nevertheless, additional GENESIS modelling has been performed in order to evaluate the merits of alternate management strategies so that the best outcomes can be achieved in response to the longshore drift rate that actually occurs season by season.

Placing initial fill downdrift of the breakwaters provides a substantial buffer for the long term and accommodates any short-term downdrift erosion between bypass events. Further, it is proposed that sufficient fill be placed downdrift of the breakwaters to protect the downdrift coast from erosion while monitoring is undertaken to confirm the modelling results and determine the actual longshore drift rate in each season. The bypass can then be matched to the actual longshore drift in order to maintain the updrift shoreline by adjusting the bypass rate, duration and frequency (**Appendix 16**). This process of optimising the coastal management on the basis of ongoing monitoring and assessment is termed "adaptive coastal management".

Figures 5.27 and 5.28 show the shoreline response if initial downdrift fill is placed according to the following two scenarios:

- Scenario 1: 25,000m^3/year longshore drift rate, initial downdrift fill of about 25,000 m^3, in conjunction with 20,000 m^3 bypassed in the first year and 25,000 m^3 bypassed in subsequent years.
- Scenario 2: 15,000 m^3/year longshore drift rate, initial downdrift fill of about 15,000 m^3, in conjunction with 12,000 m^3 bypassed in the first year and 15,000 m^3 bypassed in subsequent years.

The modelled results show that the placing of initial fill can essentially eliminate coastal erosion downdrift of the breakwaters between bypass events, even if the longshore sand transport rate is as much as the worst case upper limit of 25,000 m^3/yr. Thus, the coastal movement that occurs between bypass events occurs seaward of the existing coast and does not adversely effect the coastal dune system.

Another strategy for management of the coastal processes is to perform the bypass at six monthly intervals rather than annually. Figures 5.29 and 5.30 show the shoreline response to the same two scenarios as Figures 5.27 and 5.28, with the bypass occurring during May to June and October to November, rather than May to August.

Comparison of these figures provides an indication of the effect of six monthly bypassing as compared to annual bypassing, and shows that the beach width variability is further reduced (Appendix 16).

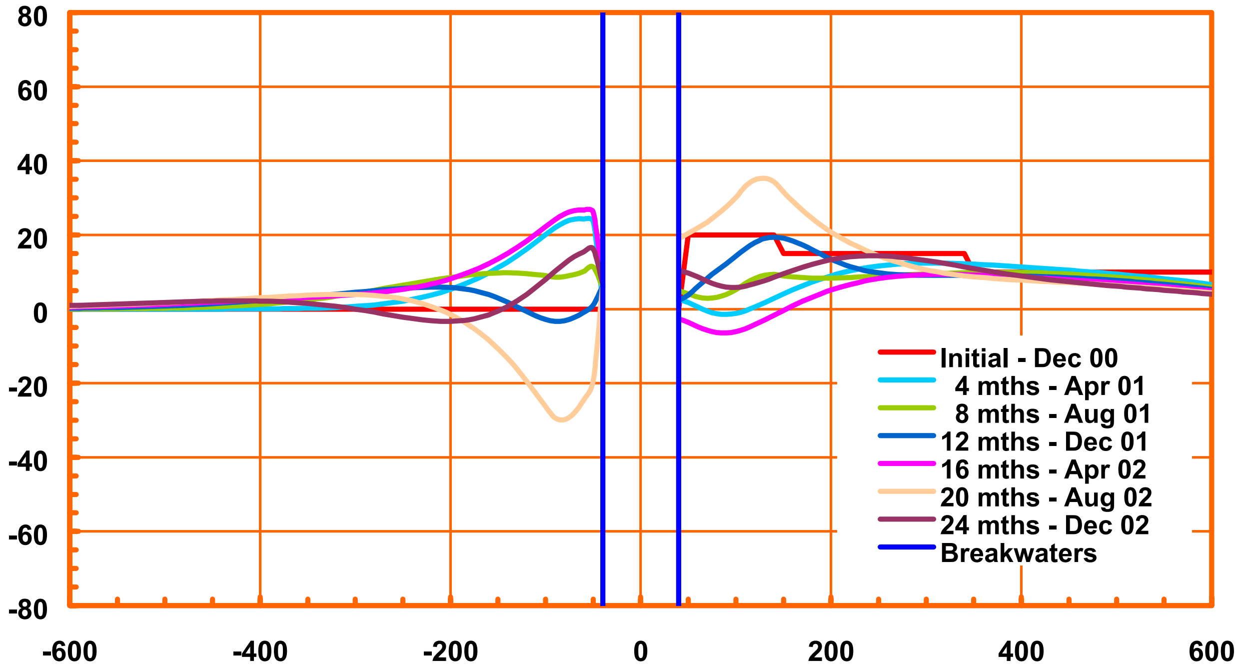


Figure 5.27: Shoreline Response – Initial Fill and Annual Bypass – 25,000 m^3/yr

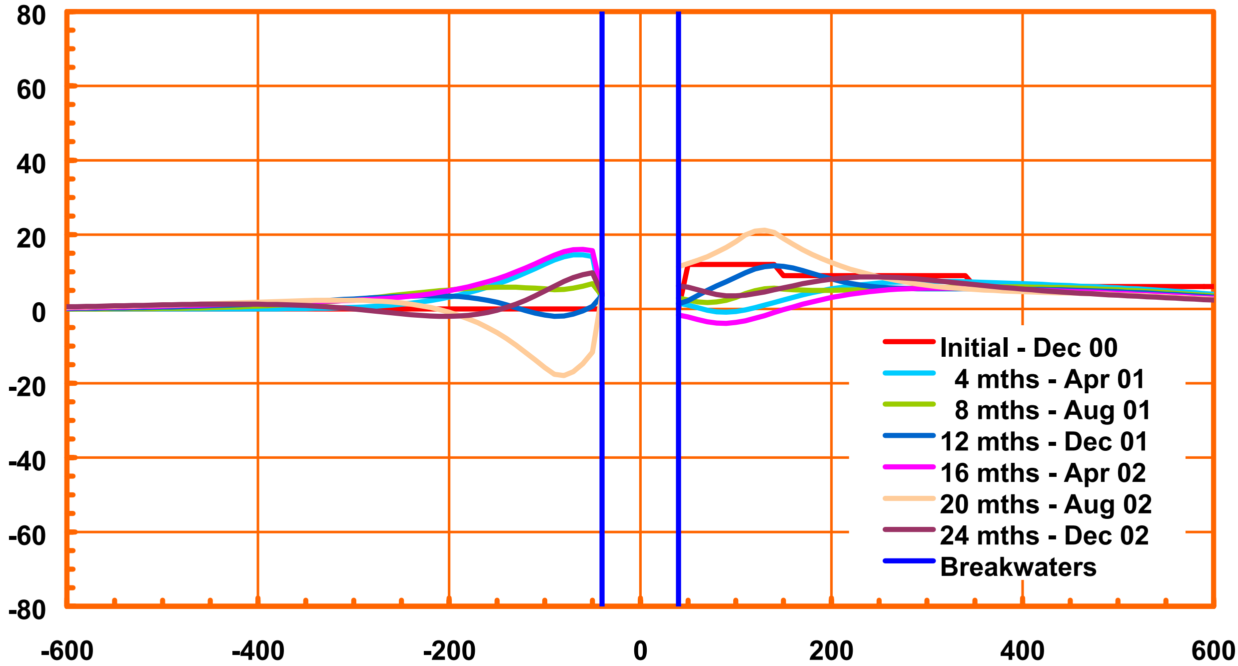


Figure 5.28: Shoreline Response - Initial Fill and Annual Bypass – 15,000 m^3/yr

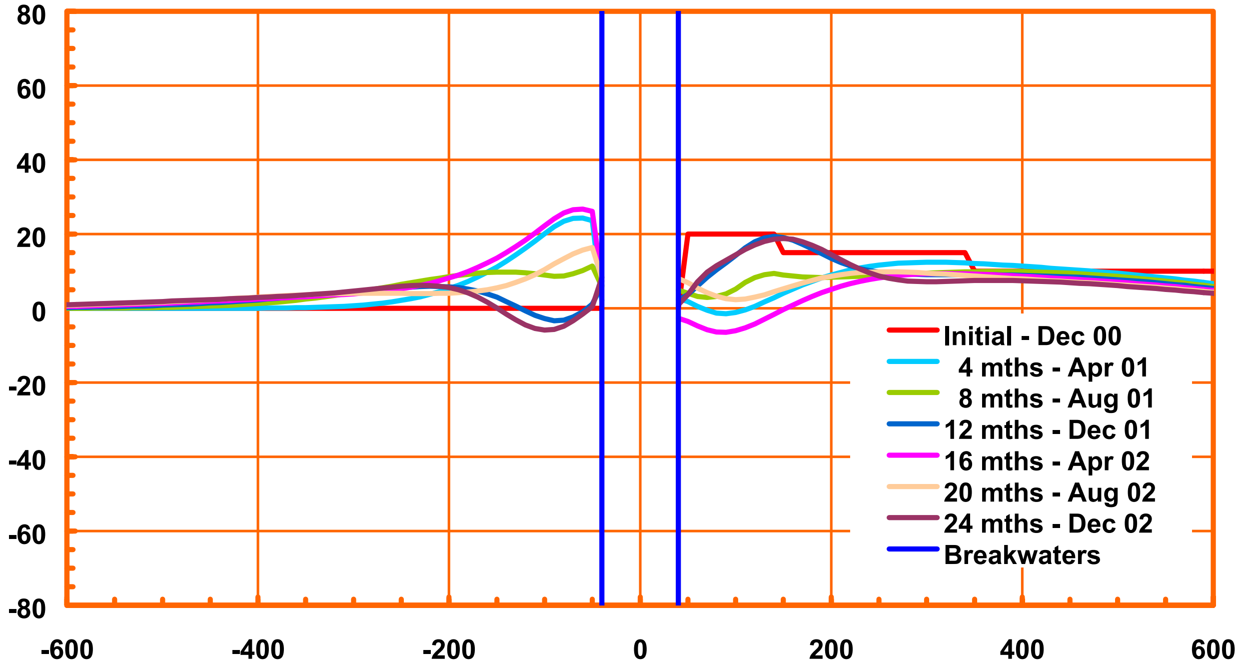


Figure 5.29: Shoreline Response - Initial Fill and Six Monthly Bypass – 25,000 m^3/yr

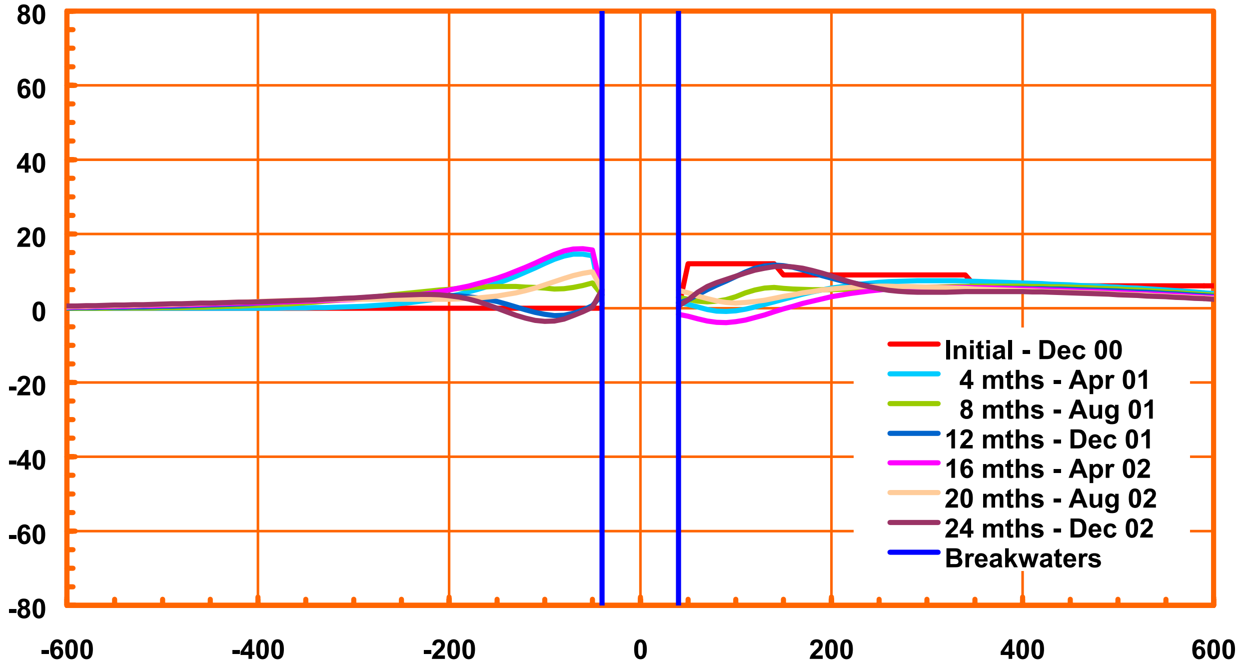


Figure 5.30: Shoreline Response - Initial Fill and Six Monthly Bypass – 15,000 m^3/yr

The presence of the breakwaters will have a significant moderating effect on the wave climate and sand transportation downdrift (east) of the breakwaters. Thus, the modelled coastal evolution that occurs downdrift of the breakwaters between periods of sand bypassing is conservatively high and the actual beach profile downdrift of the breakwaters is expected to be somewhat smoothed along the coast, as compared to the model results. As a consequence, it is expected that the breakwaters will further enhance and accelerate the existing trend of reversal to accretion downdrift of the breakwaters, provided that the sand bypass maintains the prevailing longshore drift (pers comm. D. Paterson WBM).

The modelled management strategies show that it is feasible and practicable to manage the shoreline by bypassing sand to maintain the prevailing longshore sand drift at the rates indicated. The initial placement of sand downdrift of the breakwaters is recommended to act as a buffer in maintaining long term dynamic beach stability. In addition, initial monitoring results may indicate that it is prudent to stockpile suitable sand should additional buffer be required.

Breakwater Concept and Sand Bypass Equipment

The breakwater design has allowed for significant updrift accretion and for occasional periods of reversed longshore drift, thereby avoiding potential adverse effects the navigability of the waterways. The breakwaters design is discussed in more detail in Sections 5.6.9 and 5.6.16.

The method of sand bypass proposed is to use a conventional cutter suction dredge to excavate the sand from the western side of the western breakwater and pump it to the eastern side of the eastern breakwater, thereby preserving the natural sand drift along the coast. Pipework will be installed under the breakwaters and the channel prior to construction in order to allow the sand bypass to occur without any effect on the navigability of the channel. The sand bypass activity is discussed further in Sections 5.2.28, 5.5.10 and 5.5.11.

Effects on Coastal Seagrass Movement

Seagrass wrack build-up on the beach at Cape Jaffa is an existing seasonal phenomenon that occurs during the winter with the onshore winds. During spring and summer, the more southerly winds clear the beach, and this generally occurs rather abruptly in spring during periods of high tides and southerly winds. This is expected to continue to occur in much the same manner. None of the geological evidence, soil investigation bores, testpits or trial excavations at the site indicate that seagrass wrack build-up has occurred in a persistent manner that results in long term deposition.

Further to the north east in the head of Lacepede Bay where the beach faces west, seagrass wrack does build up as the wind are more persistently onshore and the summer southerly and south-westerly winds are not able to clear the beach seasonally. Further, the head of the bay is more directly in the path of the wrack from the seagrass meadows throughout the whole of the bay. In contrast, the beach orientation, prevailing wind directions and proximity of the seagrass meadows at Cape Jaffa is such that the extent of seagrass meadows producing wrack that lands on the beach near Cape Jaffa is significantly smaller.

The breakwaters have been designed to allow the natural movement of seagrass to continue and they are curved in order to minimise a dead zone in which build-up might occur. Although seaweed management is not expected to be required, if weather conditions, particularly wind direction, result in build up, it is readily managed in this limited area. As described above, ongoing build up of seagrass wrack is not expected to occur adjacent to the breakwaters, rather it is expected to be deposited over winter and to leave again over summer, as currently occurs along the southern beaches of Lacepede Bay.

The breakwaters have been designed to minimise seagrass wrack entering the mouth between the breakwaters, as discussed in Section 5.6.9. Further, the breakwaters have been designed specifically to allow any seagrass wrack that does enter between the breakwaters to build up on the beach between the breakwaters, in preference to it entering the main basin and waterways. Again, it is unlikely that ongoing build up will occur as the prevailing summer southerly winds will tend to take it off the beach and back into Lacepede Bay. Nevertheless, if required to improve general amenity (odour, insects, etc) or water quality (nutrient loading), it will be cleared by scraping it off the beach into trucks for removal. This is a limited area and limited quantities are expected, so the potential adverse effects of this activity are expected to be minimal given the general amenity and water quality benefits will likely outweigh the potential concerns. Section 5.2.22 discusses water quality within the waterways in detail and Section 5.3.3 describes the potential odour and pest nuisance associated with long term seaweed build up.

Adaptive Management of Coastal Processes

The coastal management, including management of longshore sand transport, seaweed, beach changes, dune vegetation and channel depth are outlined in Appendix 16 and a detailed Management Plan is to be produced prior to commencement of construction.

The following outlines the objectives and elements of the Adaptive Coastal Management. The management of potential effects on coastal vegetation and seagrasses are further discussed in Section 5.2.15 and 5.2.16.

Features and Objectives

- Protect the existing coast, foredune and vegetated coastal reserve and buffer.
- Protect the seagrasses from inundation by sand and minimise the area over which sand accretion and erosion occurs.
- Maintain the existing beach profile and alignment within reasonable limits.
- Regular monitoring to determine the actual rate more reliably, particularly in the initial stage of development. Periodic survey to assess sand build up, initially on a quarterly basis, covering the nearshore seabed, beach and vegetated foredune, for the coastal extent of the Major Development Area.
- Monitoring of pre-construction natural coastal changes in order to establish baseline seasonal trends in sand and seagrass movement.
- Placing approximately 25,000m^3 of sand downdrift of the breakwaters, that being the expected worst case upper limit of one year of bypassing, to protect the downdrift beach.
- Once the breakwaters are constructed, ongoing monitoring of coastal accretion and erosion and seagrass presence adjacent to the breakwaters. Initially to be performed quarterly, with the frequency of ongoing monitoring events to be determined once a trend has been established from analysis of the results.
- Sand bypass initially at rates consistent with the measured longshore drift rates. It is expected that the first bypass event will occur once sufficient accretion has been observed on the updrift beach so that bypassing will not result in over excavation of the updrift beach. The bypass quantity will be adjusted to maintain an attractive integration of the beach with the breakwater. Although the longshore drift rate is expected to be less than about 10,000 m^3/yr, allowance has been made for the possibility of the worst case upper limit of 25,000 m^3/yr.
- Adaptive management of the sand bypass quantity and frequency to match the natural sand transport and a desirable beach profile, based on the results of ongoing monitoring. This will not be so extensive to result in over excavation of the updrift beach nor will accretion be allowed to extend such as to prejudice the channel and waterways navigability.
- Stockpile additional sand in case it is desired for future coastal management.
- If excessive seagrass wrack exists on the beach in early summer it may be necessary to remove and stockpile the wrack for later reuse as a soil conditioner.

Planning and design of coastal management action has been based on the modelled longshore sand transport rates described above and in Appendix 16. Nevertheless, the management must adapt to the prevailing coastal conditions and their variations year to year.

The actual rate and its variability can be determined accurately via monitoring during the early phases of the development and the management action (sand bypassing) should deal with only the rate of transport that actually occurs.

The modelled management strategies show that it is feasible and practicable to manage the shoreline by periodic sand bypassing. The initial placement of sand downstream of the breakwaters is recommended to act as a buffer in maintaining long term dynamic beach stability. In addition, initial monitoring results may indicate that it is prudent to stockpile more suitable sand to provide for additional buffer in the future.

5.2.14 Outline the effect of removing swing moorings from the rock lobster sanctuary and off the seagrass bed, including details of the programs for removal of the swing moorings.

The swing moorings currently in use are north of the Cape Jaffa jetty and are between about 150 and 750 metres from the coast. Review of the aerial photographs in 1997 and 2002 (**Figures 4.48** and **4.50**) identifies 42 discrete swing mooring scars of the seagrasses, with the total area effected being about 2.3 hectares, as shown on **Figure 5.31**. Also shown on **Figure 5.31** is the 2002 photograph, the boundary of the Major Development area, the proposed breakwaters and the proposed sea channel.

Of the 42 swing moorings scars identified, 30 are visible on both the 1997 and the 2002 images, 7 are visible on the 1997 image but are not visible or barely visible on the 2002 image (shown in white), and 5 are visible only on the 2002 image. As a result, it is considered likely that 7 new moorings have been installed between 1987 and 2002, and 5 have become disused, which is in general agreement with advice from fishermen in the area.

The photographs show that seagrass recolonisation has occurred in less than about five years, in the areas where swing moorings are apparently disused. Bryars (2003) conducted underwater investigations at Cape Jaffa that included the assessment of seagrass recolonisation at a disused swing mooring site at Cape Jaffa, which indicates that the primary seagrass coloniser in the short and medium term is likely to be *Amphibolis Antarctica*. Several algal species, including the green alga *Caulerpa cactoides*, were noted within the regrowth area around the disused mooring. *Posidonia* is generally recognised as taking longer to recolonise (Larkum *et al.* 1989), however there was evidence of *Posidonia* regrowth from old root mat.

The recolonisation of about 2.3 hectares of seagrass meadows within the rock lobster sanctuary is expected to occur relatively quickly once the swing moorings are disused, initially predominantly with the seagrass *Amphibolis Antarctica*.

The existing use of swing moorings in the bay poses various risks of environmental harm associated with boats breaking their moorings during a storm. This has happened and, if boats remain moored in the bay, should be expected to occur again periodically. The potential exists for fuel and oil spills, damage to reefs and coastal vegetation habitat, and damage associated with the recovery of a boat that might wash ashore. In addition, there is potential for injury or loss of life associated with the prevention of such an event or salvage of a boat that has broken its mooring. The relocation of boats into a safe anchorage eliminates these risks.

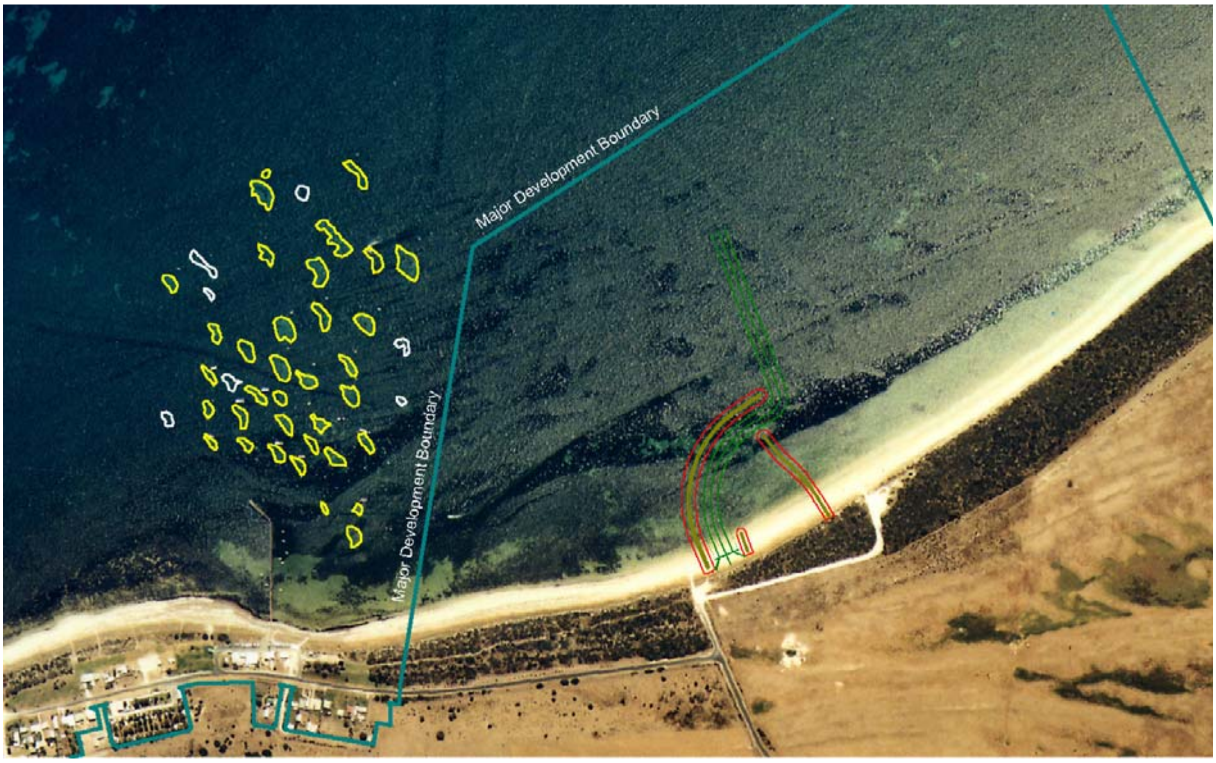


Figure 5.31: Swing Mooring Scars
Source Photo: DEH 2002

Extensive discussions have been held with the Professional Fisherman's Association and with individual operators of boats on swing moorings in the bay. These discussions clearly indicate strong support for the provision of safe moorings of vessels, and 21 of the existing fleet at Cape Jaffa have recorded their intention to relocate to a berth within the anchorage as soon as possible. As part of Stage 1, facilities will be constructed to accommodate all or any of the vessels that commit to a berth and it is expected that the whole of the fleet will relocate within a few years.

As the equipment used as part of the existing swing moorings is in private ownership and located within an area controlled by the State, the proponent has no authority to define programs or requirements for removal of the equipment, but the proponent is able to provide alternate safe anchorage such that the moorings become disused. The anticipated benefits, that is the recovery of the seagrass beds and the elimination of the risk of boats breaking moorings, are dependant upon the moorings being disused and not on the equipment being removed. It is anticipated that the owners of the mooring equipment will recover their own equipment once the moorings are no longer in use.

5.2.15 Outline the effect of the development on any native flora and fauna, including any impact on coastal and marine flora and fauna.

Introduction

The native flora and fauna that can be found on the site has been assessed and is discussed in **Section 4.6**. Further information can be found in **Appendix 11**.

Figure 5.32 presents a habitat map that identifies the types of vegetation and habitat that exist on the site. The majority of the project site has been used for cereal cropping and pastoralism. Most of the original vegetation has been cleared, however there is some remnant vegetated foredune of varying integrity and a small area of seasonally inundated paperbark swamp.

On this site there are three generalised habitat/vegetation types:

- Foredune Coastal Heath (A) in three discrete patches between the beach and the development area. A narrow strip of this habitat type also lines the access road on the southern boundary of the site;
- Paperbark Swamp (B) in one small area near the south east corner of the site; and
- Open Pasture (C) covering the majority of the site.

Figure 5.32: Terrestrial Habitat Map
Source: Appendix 11

In addition, the marine flora and fauna has been assessed and is discussed in Section 4.7. Further information can be found in Appendix 13.

The entire marine area of the site seaward of the seagrass line is mixed *Posidonia/Amphibolis* seagrasses, with 54 percent cover of *Posidonia* and 33 percent cover of *Amphibolis*. Inshore of the seagrass line is bare sand to the east of the jetty and bare sand with some rocky reef to the west. The majority of the seagrass is very healthy and forms dense beds, although the *Posidonia* often has a relatively high epiphyte load (**Appendix 13**). Bryars (2003) indicates that the area is dominated by *Posidonia angustifolia* and *Posidonia sinuosa* with some *Posidonia coriacea*.

There is relatively little bare sand (9 percent of the area surveyed). Only a few small patches of macroalgae were recorded, predominantly *Ecklonia* and *Scaberia* with some *Cystophora* and *Sargassum*. Very few macroinvertebrates were observed, with only two sponges and two ascidians recorded in a total of approximately 14 kilometres of seabed video footage (**Appendix 13**).

The nearest reef habitats are some distance from the site, west of the Cape Jaffa jetty, as shown on **Figure 5.33**. Also shown on **Figure 5.33** are the tracks of the seabed video performed as part of the recent investigations.

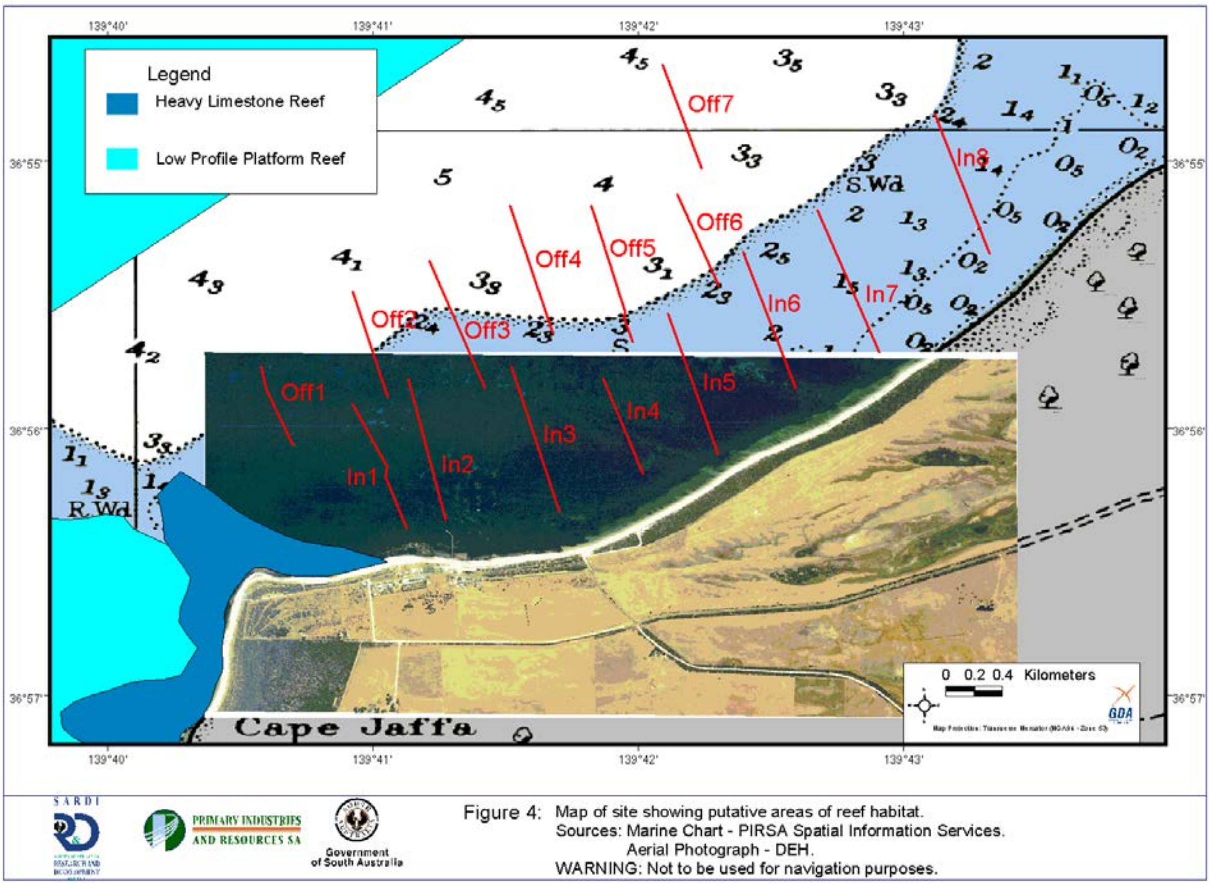


Figure 5.33: Marine Habitat Map
Source: **Appendix 13**

The potential effects of the development on native flora and fauna in each of these areas is discussed below.

Terrestrial Native Vegetation

The most serious threats to the remnant native vegetation are from further fragmentation, exotic weed invasion and wildfire. The potential effects of changes to the groundwater level are discussed separately in Section 5.2.5.

Fragmentation

Construction of access tracks, either official or unofficial, and unauthorised clearing through and in high quality native vegetation can allow access to weeds and garden escapes by facilitating seed dispersal and reducing competition for light and water.

It is vital to maintain the integrity of the existing native vegetation and to restore any areas of degraded vegetation. West of the proposed channel abutting King Drive, the coastal dune complex is within Crown Land Section 306. This area does not form part of the development proposal, however it is desirable to improve and extend the fencing and to create dedicated walkways through the dune to the beach. Currently, this vegetated dune is accessible by pedestrians and some off-road vehicles, with an existing track running east-west through the middle of the dunes, as can be seen on Figure 5.32.

The eastern foredune is wholly within private ownership and forms part of the existing cropping and grazing activities undertaken by the current landowner. The whole of the existing native vegetation within the foreshore dune complex will be protected from the development by creating fenced pathways along the interface and through the dunes consistent with normal coastal management practices. The proposed development will excise the vegetated foredune and create a coastal reserve in order to provide an appropriate level of protection for flora and fauna, as well as providing a buffer for the future protection of the coast from the effects of the prevailing natural coastal processes.

The existing public boat ramp and associated car park is located within the foredune on the land that is currently within private ownership. The development provides for the relocation of the public boat ramp facilities in order to further protect the coastal dune and its associated native vegetation and native habitat, yet allows continued access to the beach in a controlled manner. The area of paperbark near the south east corner of the site will also be protected and fenced to prevent fragmentation.

Exotic Weed Invasion

Some garden plants have the capacity to become environmental weeds because they adjust easily to low soil fertility, are prolific seed producers, or are spread by birds, people or vehicles. At the western end of King Drive, bridal creeper, gazania spp., Marguerite daisy, soursob, black-eyed Susan and kikuyu grass have all invaded native vegetation. Golden cypress is also established in dense native vegetation near Cape Jaffa Road west of the proposed breakwater location.

Lawn clippings disposed of inappropriately in the edges of native vegetation encourages the spread of grasses that reproduce vegetatively into native vegetation.

It is therefore appropriate that:

- buffer zones be established to provide a separation between the vegetated dunes and residential allotments;
- dumping of garden refuse in native vegetation be prohibited; and
- grass mowing extending into adjacent native vegetation encouraging the spread of Kikuyu, Couch and Buffalo grass be prohibited.

In order to protect the native vegetation within the coastal foredune, separation between the proposed development and vegetation will be provided. A 6.0 metre wide buffer is proposed along the majority of the vegetated dune.

In other areas, the buffer is achieved by a roadway with approximately 7.0 metres of pavement and a total road reserve width of 12.4 metres. The 6.0 metre wide buffer comprises elevated areas up to 3.0 metres wide and a pathway approximately 3.0 metres wide. The elevated area is retained by a solid limestone block wall in keeping with the character and style of the waterway edges and used throughout the development area. Native groundcovers and grasses are to be established in the elevated areas and the pathway will be constructed using natural local limestone materials to provide a hard impervious surface. The combination of the solid limestone block walls, hard impervious pathway surface, and the native groundcovers and grasses minimises the risk of garden escapees into the vegetated dunes. Figure 5.34 is a typical section that shows this buffer and accessway.

In addition, it is proposed to undertake a reseeding program in consultation with Parks and Wildlife using local seed in order to encourage the re-establishment of native species along the coastal dunes.

Wildfire

Unauthorised burning off and accidental fires all destroy habitat and can kill flora and fauna. Native flora and fauna are generally well adapted to fire and employ reproductive mechanisms that enable their survival. The vegetation on and around the site is not highly flammable and the risk of uncontrolled fire is very low.

The proposed 6.0 metre buffer zone between residential allotments and the coastal foredune vegetation will inhibit weed spread and reduce fire risk. A limited number of access tracks to the beach will be constructed and pedestrians prohibited access to the remaining areas. This will protect the overall health of the vegetation, minimise further weed spread and enhance the available habitats.

Coastal Native Fauna

With the increased population, there will inevitably come an increase in predatory pressure from domestic cats and dogs. These effects and possible habitat destruction through increased pressure from a variety of human activities are the main threats to native fauna.

The proposal does not involve significant loss of habitat for terrestrial fauna resulting from native vegetation clearance. The main potential effects on fauna are:

- fragmentation of available habitat by access tracks;
- habitat degradation due to weed invasion, increased pedestrian use or fire; and
- increased predation by domestic dogs and domestic and feral cats.

Although there are no terrestrial fauna of particular conservation significance thought to be present at the site, these effects could reduce the diversity and abundance of those native mammal and reptile species that are present, particularly in the coastal dunes.

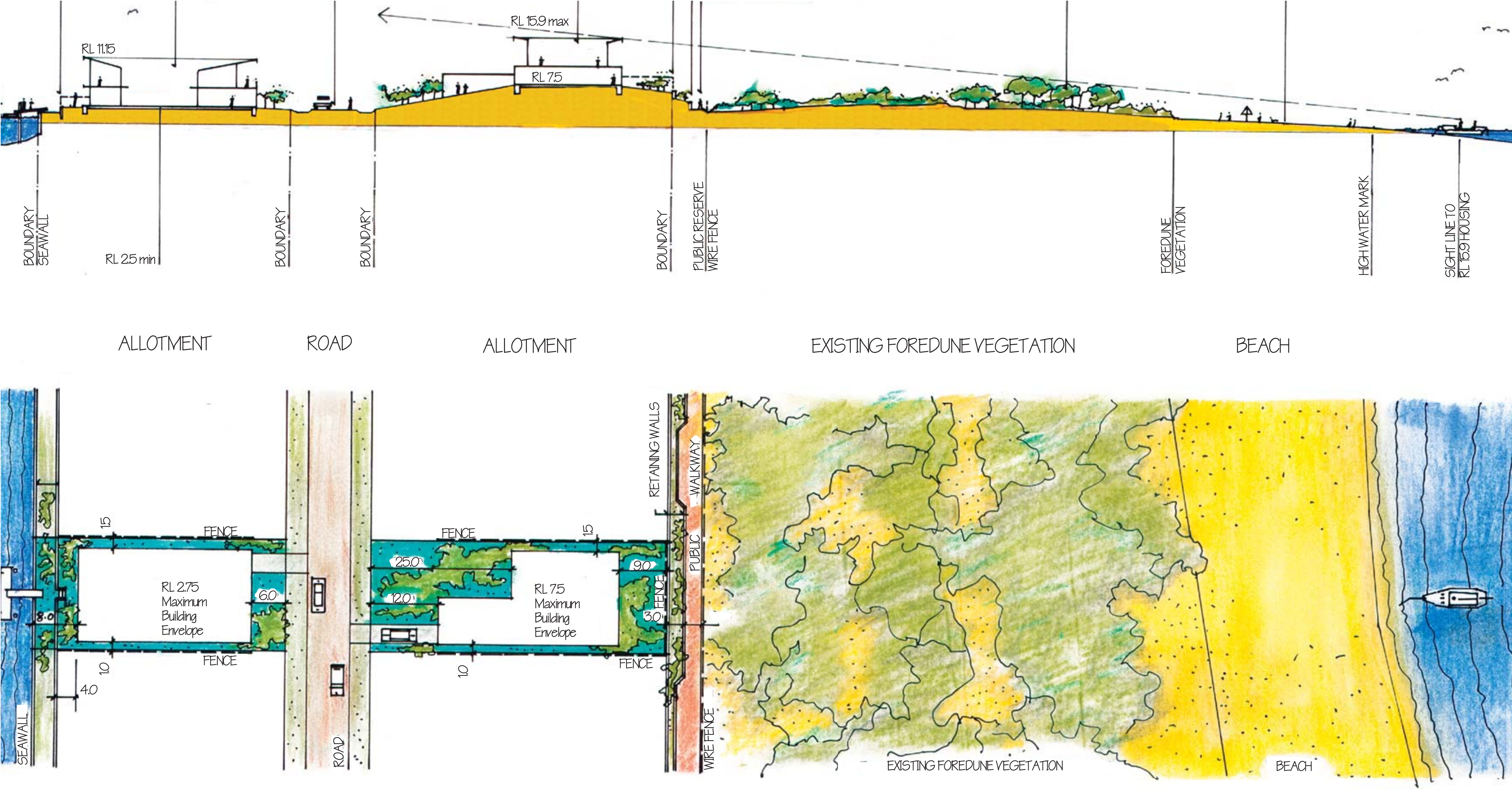
The paperbark swamp will be fenced from stock grazing, thus allowing improved habitat for native fauna.

The mitigation measures described to minimise effects on native vegetation would also minimise effects on fauna habitats. In addition, measures to mitigate effects specific to fauna include:

- the number and width of access paths through the dunes have been minimised in order to minimise fragmentation effects;
- installation of signage and fencing to prevent off-path access; and
- measures to ensure domestic dogs and cats are under control and do not access native vegetation areas.

A program to control foxes and feral cats in the region would be likely to have a beneficial effect on native fauna. It is proposed to implement such a program in conjunction with Parks and Wildlife who undertake similar programs in the Bernouilli Conservation Reserve, located south of Cape Jaffa (NPWSA November 2000).

Migratory birds, including albatrosses and petrels, may visit the area occasionally but are unlikely to show any preference for this area over much of the rest of the south east coast. Many are unlikely to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make landfall at all even if they are in the area. The proposed development is therefore unlikely to have any significant effect on any of these species.

The small numbers of orange-bellied parrots that may visit over the winter are unlikely to be affected by the slightly increased "people pressure" on 1.0 to 2.0 kilometres of the South East coastline.

Marine Flora and Fauna

Construction Effects

Effects associated with the construction phase may be direct, such as habitat removal, or indirect such as turbidity. The major, although very localised, effect will be the direct loss of habitat from the breakwater and entrance channel. Both of these features will result in the removal or burial of approximately 3.0 hectares of seagrass. This area is likely to be similar in extent to the area that has been lost around the current swing moorings within the rock lobster sanctuary to the west of the breakwaters. The moorings will be removed and are expected to recolonise with seagrasses, mainly *Amphibolis Antarctica*, as discussed in **Section 5.2.14** (**Appendix 13**).

The indirect effects of construction include increased turbidity and sedimentation related to dredging, scouring of seagrasses around the breakwater, and the potential propagation of 'blowouts' from the channel. Given the small volume of sediment to be excavated (about 4,000 m^3), the open well-flushed nature of the area, the short dredging duration (about two weeks), and the relatively coarse sediments, it is very unlikely that increased turbidity will cause problems for the seagrasses in the vicinity. Construction sources of turbidity are expected be short-lived, with the seagrasses in the area likely to experience decreased light availability for less than one month in total.

Scouring of seagrasses around the base of the breakwater could occur if increased sand movement or suspended sediment concentrations occur in this region. Any direct increase in sediment concentrations will be short-lived, and are therefore unlikely to be significant. As part of the development, provisions will be made for bypassing sand around the breakwater.

There is the potential for the excavated entrance channel to form an erosion scarp that could then propagate away from the channel.

Along the southern Adelaide metropolitan coast 'Blowouts' are common and form when wave energy erodes the sediment in a patch devoid of seagrass. Given the low wave energy at Cape

Jaffa, such effects are less likely. There has been very little erosion around Maria Creek (Kingston boat ramp) where conditions are similar, and the same is expected at Cape Jaffa.

Runoff from the dredge spoil could potentially cause problems through increasing turbidity or re-suspension of contaminants. Using a series of settlement ponds for dewatering will ameliorate turbidity problems. These ponds will be located in the marina basin, isolated from the ocean during construction by a coffer dam. Low turbidity water will then be disposed of to sea. Given the relatively undeveloped nature of the site, it is unlikely that the sediments to be excavated will contain any significant levels of contamination. To ensure that this is the case, sediments will be sampled and tested for the main problem contaminants (heavy metals) prior to any dredging activity. In order to avoid potential adverse effects, all of spoil will be placed on land rather than at sea (Appendix 13).

Operational Effects

Effects associated with the operational phase are related to groundwater/seawater interactions and the potential introduction of marine pest organisms.

There will be minimal inputs of groundwater into the marina and contaminant concentrations as a result of groundwater inputs have been shown in Section 5.2.6 to be inconsequential (Appendix 14, 21 and 13). Water quality problems could result from stormwater inputs, other discharges, or poor flushing of the marina basin. Stormwater will be diverted to a stormwater treatment facility to prevent direct discharge into the waterways, thus will not be an issue. Discharges from vessels will be minimised by providing the appropriate waste disposal facilities (for oil, bilge water, wastewater, etc), and hardstands will be equipped with pollution traps. The flushing time of the marina is expected to be rapid (six to eight days) and that water exchange will be sufficient to prevent serious water quality deterioration, with the water quality within the waterways expected to be similar to that in the nearby open sea (Appendix 21).

There are over 250 known introduced marine species in Australia. The environmental effects of marine pests associated with a coastal development such as a marina has been considered from three interrelated perspectives:

- introduction or enhancement of the distribution of a marine pest during construction;
- provision of a large expanse of new habitat for colonisation by species that may not otherwise occur in the area due to dominance of seagrass; and
- ongoing potential for introduction of pest species from other infected areas through increased boating traffic.

Disturbance created by construction of a marina is likely to favour opportunistic marine organisms. Mitigation includes ensuring that water quality is good so that local species are able to colonise, which is expected to be the case at Cape Jaffa, although even then it is likely that the marina will soon support an assemblage of introduced species.

Pleasure craft are more likely vectors for marine pests than larger vessels, particularly for hull-fouling species. Fishing vessels can also be important agents for new introductions, particularly those that use bottom trawling or dredging equipment. The risks will depend on the amount of traffic from other ports. Boats based in the marina which rarely travel to areas such as Port Adelaide and Port Phillip Bay are likely to be low risks, whereas visiting vessels from these ports will be higher risks. Similarly, local rock lobster vessels will be low risk, as they generally restrict their voyages to the south east of South Australia. Visiting trawlers operating out on the shelf will be higher risks if they use the marina, which is unlikely.

5.2.16 Detail measures to protect dunes and beach during and after construction, including buffers.

Coastal Reserves and Buffers

Coastal buffers and reserves have been provided to protect the coastal dunes and beach, as shown on **Figure 5.35**. In this context, the term 'buffers' refers to the horizontal separation between the coast and the development. Vertical separation, that is the elevation of land to protect it from combined storm surge and sea level rise is discussed in **Sections 5.2.17**.

At the western end of the development the coastal buffer is afforded by the existing settlement and its coastal reserves. Between the existing settlement and the proposed breakwaters, the coastal buffer is provided by an existing coastal reserve adjacent to the development, as shown on **Figure 5.35**. This reserve comprises two parcels, the total width of which varies from about 100 metres at the western end, adjacent to the settlement, up to about 150 metres at its eastern end, adjacent to the proposed breakwaters. It is proposed to protect the coastal vegetation within the existing coastal reserve by providing an additional buffer between the reserve and the development as outlined below. The total width of the coastal buffer from the seaward edge of the vegetated foredune varies from about 90 metres near the existing settlement to about 135 metres near the breakwaters.

East of the proposed breakwaters, the vegetated coastal dunes and portions of the beach are freehold land that is in private ownership as part of the primary production landholding to the rear of the dunes. In order to establish appropriate buffers and provide appropriate protection to this area, it is proposed to excise this land and establish a coastal reserve, as shown on **Figure 5.35**. The area to be excised is about 14 hectares and its width varies from about 150 metres to 200 metres. Again, additional buffer is proposed behind the reserve to protect the coastal vegetation. The coastal buffer provided is about 120 metres wide.

It is also proposed to place additional sand on the beach east of the breakwaters as a buffer against potential erosion between sand bypass events. This is discussed further in **Section 5.2.13**.

The additional buffers to the rear of the coastal dunes will achieve separation between the coastal reserve and the development in order to protect the native vegetation within the coastal reserve. The coastal dunes contain numerous exotic weed species, including bridal creeper and cyprus pines, and the additional buffer provided will help to prevent further invasion of exotic weeds. Along the majority of the vegetated dune, the separation will be provided by a 6.0 metre wide buffer, as discussed in Section 5.2.15. In other areas a roadway consisting of approximately 7.0 metres of pavement and a total road reserve of 12.4 metres achieves the separation.

Although the protection of existing reserves and the provision of coastal reserves will provide for the protection of the coast either side of the breakwaters, between the breakwaters there will inevitably be an interruption of the coast. This limited area has previously suffered significant disturbance by public access and activities, despite the fact that it is in private ownership. The prior disturbance has included two beach accessways and associated rubble surfaced public car parking areas within the coastal foredunes, resulting in the removal and fragmentation of coastal native vegetation. This area has been selected for the proposed marine channel and breakwaters as the additional disturbance is minimised at this location.

<u>Measures to Protect the Dunes and Beach</u>

The measures to protect the beach and dunes from the potential effects of the development on the dunes and beach during and after construction are discussed below. The potential effects include:

- damage to coastal vegetation from construction activities;
- fragmentation of coastal vegetation;
- exotic weed invasion, including garden escapes and proliferation of existing exotic species within the coastal dune system;
- wildfire;
- “people pressure” ie; changes to human activities within the dune/beach areas;
- changes to coastal processes, including changes to seagrass or sand movement, and changes to coastal accretion or erosion;
- sea level rise;
- changes to the groundwater levels that may effect the coastal vegetation; and
- monitoring.

Potential Construction Effects on Coastal Vegetation

Construction vehicles, equipment and machinery will not traverse or enter the dunes area at any time during construction. Necessary clearance of shrubs will be undertaken using minimum disturbance methods and disturbance will be restricted to the construction areas only.

Construction of the canals will involve excavation and the excavated materials will be used to raise the land level for some of the residential allotments. During construction, the sandy materials may be unstable in strong winds, especially where not protected by the vegetated foredunes (ie; greater than 40 metres from the dunes). Protection from wind erosion can be enhanced by sowing cereal rye with complete fertiliser after the opening rains of winter if necessary. Mulching of spoil may also be necessary to minimise dust nuisance from wind-blown sand.


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Management and mitigation of potential construction related effects are discussed in further detail in Section 5.5.

Potential Fragmentation of Coastal Reserve

The development will provide significant long term protection of the coastal dunes as these areas will be excised from private ownership in order to create a coastal reserve, which will provide the appropriate level of protection to this area.

Construction of unauthorised access through the coastal reserve or unauthorised clearing will be prohibited. A limited number of controlled access tracks are proposed to allow access to the beach whilst minimising the potential effects on the dunes. Fencing will be used where appropriate to manage access through the dunes.

The existing public boat ramp facilities within the coastal dune and associated vehicle access onto the beach will be relocated in order to further protect the coastal dune and associated native vegetation. Where appropriate, the previously disturbed areas will be rehabilitated and reseeded in consultation with Parks and Wildlife, using local seed in order to encourage the re-establishment of native species along the coastal dunes.

Exotic Weeds

As discussed above, a buffer zone will be maintained on the seaward side of the development adjacent to the coastal vegetation. The buffer will generally not be used for vehicular traffic and will be maintained in a stable and weed-free state, thus providing protection against garden escapes. Further information is provided in Section 5.2.15.

Dumping of garden refuse/lawn clippings and grass mowing adjacent to the coastal native vegetation will all be prohibited. Prior exotic weed invasion will be controlled and re-establishment of native species along the coastal dunes will be encouraged, as outlined in Section 5.2.15.

Wildfire

The vegetation along the coastal dunes is not particularly flammable and the risk of uncontrolled fire is low, nevertheless unauthorised burning will be prohibited. The buffer zones and roadways, in addition to providing separation, will allow access for fire control.

People Pressure

There are a number of changes to human activities in the beach and coastal dune areas that might have effects. The removal of boat launching and associated car parking from the beach and adjacent coastal dunes will relieve some of these existing pressures and this is discussed further in Section 5.2.28.

The dunes will be fenced on the non beach frontages to control access into the dunes, and pedestrian accessways will be created to allow managed public access through the dunes only along dedicated fenced paths. These accessways will be created to be clearly identifiable from the beach to minimise intrusion into other areas of the dune and any consequential damage to the vegetation. The relocation of vehicle access to the beach is expected to reduce vehicle traffic and associated potential effects of the beach fringing vegetation in this area.

Coastal Processes

The existing coastal processes, including sand/seagrass wrack movement and coastal accretion/erosion, are discussed in **Sections 4.10** to **4.13**. The effects of the development on the coastal processes are discussed in **Section 5.2.13** and detailed assessment is presented in **Appendix 16.**

The dominant coastal process is the longshore drift of sand, and sand bypass will be provided to manage the longshore drift and maintain the coastal profile. As a further protection, it is proposed to place additional sand along the beach east of the breakwaters to act as a buffer against potential erosion between bypass events, thereby allowing the longshore sand drift to be maintained without adverse effects on the beach and coastal dunes. The presence of the breakwaters will have a moderating effect on the wave climate to the immediate east of the breakwaters, which will reduce potential effects in that area. Further, additional sand will be stockpiled in case additional buffer is needed in the future.

Seagrass wrack within waterways is minimised by the design and orientation of the breakwaters. Further, the design is such that any seagrass wrack that does enter on a flood tide will most likely settle on the beach between the breakwaters where it is easily managed, rather than enter the inner waterways. See **Section 5.2.13** for further information.

Sea Level Rise

Clearly, changes to sea level rise will not result from the development, nevertheless they must be considered in ensuring that the coast and the development are protected from these effects.

Mitigation of the effects of sea level rise requires that development land is elevated sufficiently in order to avoid flooding and this vertical separation is discussed in **Section 5.2.17**. In addition, coastal recession resulting from sea level rise must also be considered in determining the width of coastal buffer required to protect the coast and the development behind the coastal dune system. The expected shoreline recession as a result of sea level rise is less than about 10 metres, as discussed in **Section 5.2.17**. More than sufficient coastal buffers has been provided to accommodate this.

Groundwater Levels

The changes to groundwater levels and its potential effects on the coastal vegetation are discussed in **Sections 5.2.3** and **5.2.5**, which conclude that there are no expected adverse effects on the coastal vegetation.

Monitoring

Monitoring, including regular inspections of the dune will be undertaken to identify any initial evidence of effects on the dune system, particularly dune vegetation due to pedestrian or vehicular traffic. These inspections will occur at regular intervals and evidence of problems will be reported for review and appropriate remedial action. This monitoring will identify management actions as outlined above.

A permanent photographic record of the status of the dune vegetation for comparative purposes will be maintained. As part of the Adaptive Coastal Management strategy, monitoring surveys to assess coastal accretion and erosion will be conducted on a regular basis, as described in **Section 5.2.13**.

5.2.17 Detail the requirements of the sea level rise policies in the Development Plan and how these will be achieved with this development.

The relevant policies in the Development Plan are set out in **Appendix 22**, together with a statement as to how these requirements will be achieved with this development. Protection against the effects of sea level rise is also discussed in Coastline #26 – Coastal Erosion, Flooding and Sea Level Rise Standards and Protection Policy (CPB 1992). Also presented is the more recent assessment of expected future sea level rise. Coastal accretion/erosion and recession due to sea level rise is discussed in **Sections 5.2.13** and **5.2.16**.

Sea Level Rise Predictions

Scientific research has indicated a discernible human influence on global climate as a result of increasing concentrations of gases in the atmosphere that trap solar radiation. The resulting global warming has the potential to change weather patterns and to result in rising mean sea level (McInnes *et al.* 1998, Walsh *et al.* 1998 and Walsh and Ryan 1999). Sea level records show that a global sea level rise of 1 to 2 mm/yr, with a central rate of about 1.5 mm/yr, has occurred during the 20th Century and that sea level rise has occurred as a stepped rather than constant function (**Appendix 16**). Mean sea level measurements at Fort Denison, Sydney Harbour over the last century are presented in **Appendix 16**.

The dominant contributions of global warming to sea level rise are expected to be thermal expansion of oceans and transfer of water from melting glaciers and ice sheets. Estimation of the extent of climatic change is made using complex numerical simulation of the earth's climate system. The models used are being continually refined and there has been considerable improvement to the models over the past decade (**Appendix 16**).

The Australian Institution of Engineers National Committee on Coastal and Ocean Engineering recommends that planning and design of coastal developments be in accordance with the assessments of sea level rise provided by the United Nations Intergovernmental Panel on Climate Change (IPCC). The IPCC 2001 predictions of sea level rise from 1990 to 2100, obtained from Atmospheric-Ocean General Circulation Models (AOGCMs) under various scenarios, indicate a range of 0.11 to 0.77 metres, with a central value of 0.44 metres (**Appendix 16**).

In order to be conservative, the planning and initial design has been based on sea level rise to 2100 of 0.8 metres, which is in excess of the upper range of predicted sea level rise. At the time of development of sea level rise policy (early 1990s), the best estimates of sea level rise to 2100 indicated a possible range of 0.35 to 1.1 metres, with a mid range figure of 0.65 metres. At that time, policy was developed that required protection against sea level rise to 2100 of 1.0 metre, which included a margin for greater than expected increase and for weather changes that could result in more storm surge and higher tides (CPB 1992). Given the extent to which the more recent assessments of sea level rise have been reduced (about 0.25 metres), it is considered to be conservative to adopt sea level rise to 2100 of 0.8 metres.

The Development Plan and sea level rise policy also define protection requirements against sea level rise to 2050 of 0.3 metres. Although recent predictions indicate that a lesser allowance may be appropriate, sea level rise to 2050 of 0.3 metres has been adopted in accordance with the policy.

Shoreline Response to Sea Level Rise

With rising sea level there is an upward and landward translation of the beach profile. The "Bruun Rule" (Bruun 1962) assesses the shoreline recession for a given sea level rise based on the local coastal profile. For the typical nearshore and coastal profile slopes derived from surveys at Cape Jaffa (**Figure 4.55**), the calculated shoreline recession associated with predicted future sea level rise to the year 2100 is in the range 2.0 metres to 10 metres, most probably around 6.0 metres (**Appendix 16**). Allowance for this recession has been made in the discussion on coastal buffers presented in **Section 5.2.16**.

Additional effects may occur from changes to weather conditions associated with enhanced greenhouse effects, such as shifts in wind and wave directions and strengths, changes to intense weather systems, and changes to rainfall and storm surge intensity. Nevertheless, it is considered that the Bruun rule represents the best technique available to assess the shoreline retreat associated with sea level rise and it is generally regarded as being conservative. As a result, a provision for shoreline retreat at Cape Jaffa of 5.0 to 10 metres would appear appropriate (**Appendix 16**).

In order to be conservative, the development has been planned based on shoreline retreat to 2100 of 10 metres. The width of coastal reserves and buffers proposed are discussed in **Section 5.2.16**.

Standard Sea-flood Risk Level

The Development Plan defines the standard sea-flood risk level as the 100 year Average Return Interval (ARI) extreme sea level, including the combined effects of tide, storm surge, stormwater and wave effects, plus an allowance for 50 years of land subsidence.

The 100 year ARI extreme tide event at Cape Jaffa has been assessed to be in the range 1.38 to 1.45 mAHD based on NTF analysis of historical sea level measurements. See **Section 4.11** and **Appendix 15** for further information. 1.45 mAHD has been adopted and this includes a small safety margin to allow for uncertainties in the conversion from mean sea level to Australian Height Datum.

Waves within the waterways have also been assessed, as detailed in **Appendix 15**, which show that wave heights are within the requirements of the Guidelines for Design of Marinas (AS 3962). Although the walls that form the edge of the waterways result in no wave run up, an allowance of 0.2 metres has been made for wave effects in addition to the 1 in 100 year extreme sea level.

Negligible land subsidence is expected, nevertheless an allowance of 50 millimetres to 2050 has been made in order to be conservative. The stormwater design is such that it does not pose flooding risk in addition to the extreme sea levels as it is designed to overflow to the sea in extreme flooding events.

As a result, the adopted standard sea flood risk level is 1.7 mAHD (1.45 + 0.2 + 0.05 mAHD) for development within the marina behind the coastal dunes. This sea flood risk level has been based on conservative assumptions and as such is considered to be conservative.

Sea Level Rise Policies

The policies for protection against the risk of flooding for extreme sea levels and sea level rise define minimum levels for roads, parking areas, development sites and building floor levels.

To protect against sea level rise to 2050, roads, parking and adequate development sites on each allotment will be a minimum of 0.3 metres above the sea flood risk level, ie; will be a minimum of 2.0 mAHD and minimum floor levels 0.25 metres above that height. Note that the Development Plan provides for development at lower levels if adequate protection measures are provided, however there is no proposal for these areas to be lower than 2.0 mAHD.

Further, practical measures must be available to the future landowners to protect against further sea level rise to 2100. Thus, using the most recent assessments of sea level rise to 2100 of 0.8 metres, practical measures to protect against an extreme sea level event of 2.5 mAHD must be available in the future. Raising the walls that form the edge of the waterways or additional seawall within the space between the waterways and any buildings, can readily provide this protection.

Having said that, in order to avoid the need for future protection against sea level rise to 2100, each building site will be raised to accommodate sea level rise to 2100. Thus, minimum building site and floor levels will generally be 2.5 mAHD and 2.75 mAHD respectively. Although no buildings are proposed over water, if building over water is proposed in the future, building floor levels will also be a minimum of 2.75 mAHD. In this way, protection against extreme sea level events and sea level rise to 2100 is incorporated into the initial development design. Nevertheless, as described above, should the need arise in the future to provide protection against further sea level rise, this can be readily provided by raising the walls around the edges of the waterways.

The adoption of minimum building levels of 2.5 mAHD and minimum floor levels of 2.75 mAHD is considered to be conservative. The Kingston District Council Development Plan defines minimum site and floor levels of 2.4 and 2.65 mAHD respectively for development in urban coastal areas, including the Cape Jaffa Policy Area 5, which includes the existing Cape Jaffa settlement and a large part of the subject land.

The policies also set out requirements for coastal reserves and buffers to protect the development against the effects of coastal processes. The buffers provided are described in Section 5.2.16. The effects of the establishment of the breakwaters on the coastal processes is discussed in Section 5.2.13.

Additional protection for sea level rise past 2100 can be readily provided in the future by raising the walls that form the edge treatments around the waterways and the breakwaters. The Marine Infrastructure Fund provides for the future protection measures that might be required. The fund is to be established using part proceed of land sales and also a portion of the first five years of Council rates, and is available for the Council's use in long term maintenance and repair of the marina facilities.

5.2.18 Describe the impact of increased commercial and recreational boating.

During the summer period, the beach is used on a daily basis when weather permits for launch and retrieve of up to about 80 recreational vessels. Commercial vessels and vehicles associated with the aquaculture industry also use the beach and intertidal zone from time to time for maintenance, servicing and repairs.

Kingston District Council has previously proposed and made funding applications for a protected recreation boat ramp located on the beach adjacent to the existing beach access points, in recognition of the increase in boating traffic that has occurred in recent years and the outmoded facilities currently provided. Thus, increased boating traffic is likely to occur at Cape Jaffa regardless of this proposal.

The development will result in some additional boating traffic above the current use. Assuming a 50 percent berth uptake for waterfront residential allotments (174 vessels), as not every allotment will have a vessel on the water, 100 percent uptake for recreational berths (66 vessels), and use of the boat ramp by 80 vessels, an increase of 240 recreational vessels using Cape Jaffa can be anticipated. Typically, recreational vessels are used for about 20 days per year concentrated over a four month period or 16 percent of summer days. However, a conservative estimate of 20 percent has been used to calculate an average of 48 vessels or 96 movements per day over the whole of the summer period. This increase is considered to be minor for this environment, given that Lacepede Bay has an area greater than 2,000 hectares. This equates to about one vessel for every 50 hectares and approximately one movement for every 4.7 minutes through a ten hour day for the total recreational boating traffic from Cape Jaffa.

The effects of increased aquaculture will occur mainly in the area of the bay in which aquaculture pens are located, which is quite some distance offshore and well away from the development. On the basis of detailed assessments of the environmental conditions and the expected effects on the marine environment made by PIRSA/EPA/Planning SA, provision has been made for expansion in the aquaculture industry at Cape Jaffa to allow a limited number of additional operators. Estimates of additional boat movements have been made and an extra eight boat movements per day are expected, thus minimal effect is anticipated.

The increase in commercial fishing activity will be limited as the overall use of the fishery is generally defined by the management of the fishery. This development will allow the activity to occur in a more controlled and efficient manner.

It is not proposed to attract new market from elsewhere, but to better satisfy the needs of the existing rock lobster fishing fleet and create a safer, more efficient environment in which to operate. Some minor increase in movements is possible if new vessels are attracted. Therefore, there will be the same or similar movements in the locality that currently occur with reduced risk of environmental damage due to the removal of the vessels from the open moorings. Further, the seagrass beds will regenerate once the swing moorings are removed, thus reducing the impact of the fleet in this locality.

It is also noteworthy that the value of the product is weather dependant as during periods of poor weather, supply drops and prices increase. By providing facilities that allow safe operations in poor weather, the value of the catch from Cape Jaffa will likely be increased.

Although there are some overall increased boating movements, it is likely that there will be fewer vessel movements in and around the existing jetty and reef habitat located to the west of the jetty, thereby minimising the potential effects on the more sensitive parts of the marine environment. The development allows both the additional boating traffic and the existing boating traffic to occur in a more controlled environment with reduced potential effect on the nearby sensitive marine habitats.

Currently the great majority of boat launching occurs from the beach just west of the alignment of Cape Jaffa Road where it meets Lacepede Bay. At times there are 80 boats and trailers parked on the beach and at peak holiday periods associated camping facilities. The launching and retrieval of vessels and the parking of vehicles can be better managed with fewer effects on the visual and physical environment in a comprehensively planned and designed facility as part of this proposal. This is discussed further in **Sections 5.2.15** and **5.2.16**.

General people pressure issues are discussed in **Section 5.2.27**.

Water

5.2.19 Describe the approach to water sustainability, including opportunities for reducing and recycling water and wastewater and ways in which mains water use can be minimised or supplemented.

The following opportunities have been identified to assist in the efficient use of water resources as part of the development:

- plantings - plant types and species will be selected that are suited to this coastal environment and have minimum requirement for additional watering. The climate at Cape Jaffa should allow species to be selected that thrive in these conditions with minimal watering once established;
- native species – using natives as feature plantings in public places, in lieu of expansive introduced mown lawns;
- stormwater reuse - numerous public open spaces also act as stormwater detention basins. Thus, vegetation in these areas naturally obtain their water needs from the stormwater flows, which minimises the need for additional watering. See **Section 5.2.4** and **5.7**;
- Water Sensitive Urban Design (WSUD) - utilising these principles, as described in the Good Residential Design Guide (Planning SA 1999), minimises the need for garden watering by maximising on-site retention of stormwater and approximating the natural water balance. See **Section 5.7.2**;
- efficient irrigation systems - properly installed, maintained and operated drip irrigation systems drastically reduce water use for the same benefit to plants;
- reducing household water demand – improved water efficiency within the home will be required as part of the design guidelines, including dual flush toilets and water efficient shower heads, taps and AAA appliances;

- rainwater tanks - will be required as part of all new development to capture roof runoff for on-site reuse. This will reduce mains water demand for high use activities such as garden watering. A minimum of 5,000 litres will be required, which in this climate and urban environment should be sufficient to drastically reduce household mains water use;

- improving soil water holding capacity – clays excavated on-site will be recovered and used in improving topsoil quality. Opportunities exist for soil conditioning and mulching to save water as part of the construction and landscaping activities in developing the site. Kingston District Council have a trial underway to utilise seagrass wrack as a soil additive, together with green organics recycling from Kingston District Council's parks and gardens maintenance program; and

- all of the wastewater is to be recycled in accordance with current best practice techniques. This will allow the reuse of the water and also the reuse of the nutrients contained within the water, which will thus be converted to a resource. This minimises the use of water and the application of fertilisers that are associated with existing agricultural production. See Section 5.2.20 below for further details.

5.2.20 Describe the impact of developing a wastewater treatment system to which the existing development can connect, including the impact of an irrigated woodlot on the groundwater and the marine environment.

The wastewater treatment and potential effects on the groundwater are outlined in Section 5.2.20. This section provides further information on the wastewater treatment system and the recycling of the water reclaimed from the wastewater treatment process by reusing it for the irrigation of an agricultural fodder crop. It also discusses the implications of connecting the existing development at Cape Jaffa to a wastewater treatment system.

Wastewater Collection and Treatment System

The wastewater management and treatment system includes the following features:

- a full sewer system is to be constructed, therefore no on-site septic tanks are required for the development;

- the system proposed also allows for the existing development at Cape Jaffa to connect to the same treatment system that is to be used for the collection and treatment of raw sewage from future development;

- it is proposed to provide the required sewerage infrastructure throughout the existing Cape Jaffa settlement, thereby allowing existing development the option of connection. This eliminates the need for on-site effluent disposal such as septic tank soakage trenches and the associated effects on the unconfined aquifer;

- options are being considered for the type of sewerage collection system. These include a combination of gravity drainage and pumping stations or the use of a vacuum collection system;

- a packaged mechanical aeration treatment plant is to be located at the south eastern extent of the development. Packaged treatment plants are readily available from various suppliers, are modular in design, easily upgraded to meet the future development needs, and are ideal for smaller communities such as Cape Jaffa. It also provides improved odour control, includes primary and secondary wastewater treatment, and is capable of producing high quality reclaimed water, which allows a range of options for the reuse of the reclaimed water;

- a separate winter storage of the reclaimed water will be required, as discussed later;

- provisions for emergency storage capacity and emergency power supply connection will be incorporated into the package treatment plant design;

- the footprint of a packaged plant is small compared to conventional lagoon treatment systems. The location of the treatment plant is shown in **Figure 5.12** and a total area of about 0.8 hectares is required for the operation and maintenance of the treatment facility; and

- the Guidelines for Separation Distances (EPA August 2000) defines a minimum distance of 200 metres between residential areas and wastewater treatment facilities of capacity up to 5,000 people, such as that proposed at Cape Jaffa, and this is achieved with the proposed location and layout.

As part of the Waste Water Management Plan (WWMP) and Irrigation Management Plan (IMP), ongoing monitoring will be implemented and actions taken to minimise potential contamination of groundwater, and hence the marine environment.

The treatment will allow reuse of the water in accordance with the South Australian Reclaimed Water Guidelines (DHS/EPA April 1999) to achieve a minimum reclaimed water quality of Class C, which allows for a wide range of reuse of the reclaimed water.

The Kingston District Council and SELGA are currently investigating various strategies for waste management, including composting techniques that may incorporate the use of biosolids. If appropriate, this system will be utilised for biosolids from this facility.

Reuse of Reclaimed Water

During early planning, it was envisaged that the recycled water would be used to irrigate a woodlot. As a consequence of the investigations, it is preferred that a perennial crop such as lucerne or ryegrass be irrigated in order to minimise effects on the groundwater environment and to better utilise the nutrient and water resources of the reclaimed water. The reclaimed water is to be reused in accordance with current best practices, sensitive to potential human health and environmental issues. These issues include:

- minimising the total water use associated with the development;

- protection of groundwater quality, particularly nutrient loading;

- protection of water quality within the basins and channels;

- protection of the marine environment; and

- human health.

The South Australian Reclaimed Water Guidelines (DHS/EPA April 1999) define management practices for the sustainable reuse of reclaimed water. It *"establishes acceptable levels of constituents of reclaimed water for a variety of uses and describes means of assuring reliability in production so that using reclaimed water does not impose undue risks to health and the environment."*

The guidelines define the various classes of water quality and their recommended uses. Class C water has generally undergone primary treatment than either lagooning or, as is proposed at Cape Jaffa, full secondary treatment. Additional disinfection may be required to achieve the prescribed microbiological criteria.

Class C water is recommended for the following uses:

- irrigation of pasture and fodder crops for grazing animals;
- irrigation of crops for human consumption, with restrictions on type of crop, water application methods and harvesting methods;
- municipal use, including the irrigation of public parks and gardens, with restricted public access during irrigation and withholding periods; and
- passive recreational use, for example the creation of water bodies for picnicking, fishing and other activities that do not involve bodily contact with the water.

The guide also defines standard buffer distances between the water use and other activities, particularly residential development. For Class C water the standard buffer distance is 50 metres. Reduced buffer distances are allowed if controls to minimise airborne drift are implemented. Airborne drift control options include low rise, small throw, part circle or micro sprinklers, screenings using trees or shrubs, watering at night or in other restricted access situations, and systems that shut off watering during adverse wind conditions. Further, subsurface irrigation systems can be used to reduce health risks in areas of public access.

The primary reuse proposed at Cape Jaffa will be the irrigation of an agricultural pasture/fodder crop in areas of no public access. Lucerne is the preferred option, however other options including perennial grasses such as ryegrass, eucalypt woodlot or a combination of these have been considered. Compared to many reuse options, all of the options mentioned provide increased separation between the irrigation activities and residences, waterways, the coast and other public areas. In addition, these crops pose a lower health risk than other uses such as the irrigation of crops for human consumption.

Opportunities for the irrigation of parks and gardens and other uses will be investigated as the development proceeds. Regardless of the use, the quality of the groundwater, waterways, marine environment and public health must be protected. Treatment of water to higher quality through the use of additional disinfection and/or turbidity removal treatment to allow a broader range of reuse options will also be investigated. Upgrades to the package treatment plant can be incorporated at a later stage if required to implement alternate reuse options. Prescribed buffer distances from waterways and residential properties may preclude a number of these potential reuse opportunities and further investigation is required before implementing alternate reuse options.

The Class C water criteria has mean biological oxygen demand less than 20 mg/L, suspended solids less than 30 mg/L and median thermotolerant coliforms (including E coli) less than 1,000 per 100 mL. Additional water quality requirements exist for many uses for sustainability in terms of human health, environmental protection and, when reused for grazing/fodder production, animal health. These include chemical quality requirements such as salinity, pH, heavy metals, pesticides and trace elements.

Additional microbiological requirements can include the removal of specific viruses and intestinal parasites, including protozoa and Helminths, and may include withholding times or detention periods in order to break the lifecycle of microbiological organisms. In addition to consulting Department of Health and the South Australian EPA regarding the requirements outlined in the South Australian Reclaimed Water Guidelines (DHS/EPA April 1999), Primary Industry and Resources South Australia (PIRSA) will be consulted in relation to animal health requirements for fodder crop production. The Reclaimed Water Irrigation of Pasture for Grazing of Cattle and Pigs (EPA September 2003) provides some guidance.

The nutrient content of the water also needs to be considered in relation to the reuse. Irrigation of pasture or crops is effective in minimising the environmental effects of the nutrients as the plants will absorb the nutrients in addition to the water, thereby protecting the groundwater and marine environments. The recycling of these resources into a fodder crop minimises the use of fertiliser and water from other sources, thereby providing the additional environmental benefit of minimising existing agricultural water and fertiliser use.

Different plant and soil types have different capacity and response to the application of water and nutrients by irrigation. As a result, the water and nutrient requirements of the crop at the irrigation site must be assessed to ensure that the irrigation practices are sustainable. This assessment is presented below and will form part of the finalised IMP.

Irrigation Management Plan (IMP)

The IMP will describe the irrigation and its sustainable management, taking into account the irrigation site, soil characteristics and potential effects on surface water and groundwater, public health and air quality. It will include a description of the short and long term potential environmental effects, nutrient balance, irrigation/distribution infrastructure, system maintenance, salinity, other potential contaminants, drainage, monitoring, reporting, and the health and safety of operations personnel and the public. Preliminary investigations into the sustainability of crop irrigation have been conducted, including the preparation of hydraulic and nutrient balances (Appendix 20).

Preliminary Hydraulic Balance

The water requirements of the crop have been assessed using potential rainfall and crop evapo-transpiration to determine the crops capacity to utilise additional water from irrigation. Data recorded at the Kingston weather station has been used to assess monthly rainfall. In order to be conservative, the water balance has been performed assuming consecutive 1 in 10 wet years.

The potential evapo-transpiration of the crop is assessed using pan evaporation data from Robe and crop efficiency factors provided by PIRSA (Department of Agriculture 1989). The volume of water available for irrigation has been assessed using Department of Health standard design figures based on the ultimate development of approximately 550 residential allotments, as shown in **Table 5.3**.

Table 5.3: Ultimate Water Available for Reuse
Source: **Appendix 20**

Ultimate Number of Allotments	550
Number of People per Allotment during Summer	3.5
Number of People per Allotment during Winter	2
Average Daily Flow per Person (litres per day per person)	170
Ultimate Annual Water Volume (kilolitres per year)	90,000

The results are shown in **Table 5.4** for suitable crop options. Wine grapes are listed for reference as the irrigation of vines nearby at Cape Jaffa/Mt Benson may be a suitable reuse option in the future. Lucerne is considered the preferred option as it provides good nutrient uptake, is deep rooted thus effectively utilises moisture and nutrients within the whole soil profile, and is ideally suited to the soil types found near Cape Jaffa. It is easily established and managed, as evidenced by its extensive use throughout the region, easily harvested using readily available equipment, and an established market exists for lucerne fodder in the region. The operation of a long term rotation between lucerne and perennial grasses, for example ryegrass, is a common agricultural practice and may have some merit in optimising the value created by the reuse of the reclaimed water whilst minimising the potential effects on the groundwater.

Table 5.4: Ultimate Minimum Irrigation Areas
Source: **Appendix 20**

Crop	Potential Irrigation Uptake	Minimum Irrigated Area	Comments
Lucerne	814 mm/year	11 hectares	Good nutrient uptake, deep rooted, grows well in sandy soils over a wide range of water and nutrient application rates
Pasture, Perennial Grasses or Turf	747 mm/year	12 hectares	
Eucalypt Woodlot	995 mm/year	9 hectares	Young trees have low uptake
Mature Wine Grapes	149 mm/year	50 to 65 hectares	Larger seasonal variations

Typical agricultural irrigation practices in the region indicate lower application rates, hence larger irrigation areas for the same water supply. The Department of Water, Land and Biodiversity Conservation (DWLBC) Water Licensing Fact Sheet Lacepede – Kongorong Prescribed Wells Area Zone 3 Irrigation Equivalents – A Users Guide (DWLBC May 2004) describes licensed groundwater irrigation rates for the irrigation of various crops, and can be used to determine areas for the reuse of reclaimed water at Cape Jaffa, as shown below in **Table 5.5**. As a further guide, discussion with farmers in the region provides guidance and these irrigation rates and areas are also shown.

Table 5.5: Ultimate Irrigation Areas based on Agricultural Practices in the Region

Crop	Assessment Method	Irrigation Rate (mm/yr)	Irrigated Area (ha)
Lucerne Hay	DWLBC Fact Sheet	352	26
Full Pasture	DWLBC Fact Sheet	493	18
Vines	DWLBC Fact Sheet	205	44
Lucerne	Common Practice	550 to 500	16 to 18
Pasture	Common Practice	500	18

The two tables above define a range of suitable irrigation rates for various crop options and the corresponding ultimate irrigation areas are summarised below in **Table 5.6**. In order to be conservative, it is considered appropriate to adopt the larger irrigation areas shown.

Table 5.6: Adopted Ultimate Irrigation Areas

Crop	Irrigated Area to be Adopted
Lucerne	11 to 26 hectares
Pasture, Perennial Grasses or Turf	12 to 18 hectares

The range of appropriate irrigation rates provides flexibility in management of the irrigation practices. It allows seasonal variations in rainfall to be managed effectively and the staging of the installation of infrastructure and the areas under irrigation to ensure that:

- sufficient capacity is available to manage the maximum expected flows and nutrient loading as the development proceeds; and
- sufficient water is available for healthy crop growth and nutrient take-up.

Preliminary Nutrient Balance

Optimum nutrient removal will be achieved by regular harvesting of the fodder crop to remove the nutrients from the irrigation area. In addition, winter storage will be provided so that irrigation only occurs during the growing season when plant nutrient take-up is highest (**Appendix 20**).

Based on an irrigation area of 26 hectares, the estimated total nitrogen application is expected to be 70 to 90 kilograms per hectare per year (kg/ha/yr). This application rate is well within the nitrogen removal rate of both lucerne and perennial grasses. Nitrogen loss due to nitrification and denitrification will further reduce the nitrogen loading and risks to the environment, and these effects will be assessed in more detail as part of the finalised IMP.

The estimated loading rate of total phosphorus is 30 to 40 kg/ha/yr, which is similar to plant requirements for lucerne (25 to 30 kg/ha/yr) and well within the removal rate of perennial grasses such as ryegrass (60 to 80 kg/ha/yr). The soil chemistry will reduce the availability of phosphorus for both uptake and leaching, and the phosphorus sorption capacity of the soil will be assessed as part of the finalised IMP.

If required, additional treatment of the reclaimed water can be performed in order to reduce phosphorous concentrations of the reclaimed water, however it is considered preferable to optimise irrigation practices in order to reuse all of the nutrients whilst minimising potential effects on the groundwater and hence the marine environment.

Reclaimed Water Winter Storage Dam

Storage of reclaimed water will be provided to balance the seasonal fluctuations in crop water demand and water supply from the wastewater treatment system. In addition, winter storage allows the nutrients associated with the water to be applied during the optimum plant growth period, thereby maximising the nutrient take-up by the plants.

The water balance performed has been used to assess the required size of the winter storage dam for the crop options considered and the results are shown in **Table 5.7**. It shows that rainfall exceeds crop water demand for two to five months during winter, depending on the type of crop irrigated and the seasonal rainfall (**Appendix 20**).

Table 5.7: Reclaimed Water Winter Storage

Crop	Approximate Storage Dam Volume	Approximate Storage Dam Size
Lucerne	40,000 Kilolitres	1 hectares, 100 by 100 metres
Pasture, Perennial Grasses or Turf	40,000 Kilolitres	1 hectares, 100 by 100 metres
Eucalypt Woodlot	35,000 Kilolitres	0.88 hectares, 95 by 95 metres
Mature Wine Grapes	50,000 Kilolitres	1.25 hectares, 110 by 110 metres

The reclaimed water storage dam will be constructed and sited in accordance with the guideline (DHS/EPA, April 1999). The requirements for the construction of a reclaimed water storage dam are summarised below:

- stored water must meet Class C specification or better;
- storage dam to be located to:
  - avoid close proximity to public areas;
  - avoid obstructing watercourses;
  - avoid areas subject to 1 in 25 year flood events;
  - minimise nuisance from odour and pests such as mosquitoes; and
  - avoid potential adverse effects on the groundwater.
- storage dam to be constructed with the following features:
  - base at least 1.0 metre above highest seasonal groundwater levels, otherwise to have a synthetic liner;

- embankments that prevent inflow of surface runoff and prevent bank rupture;
- 600 millimetre freeboard above design capacity to prevent overtopping;
- lined to minimise seepage;
- minimised evaporative concentration of salts by avoiding large shallow dam design;
- designed to prevent the unapproved or uncontrolled discharge of reclaimed water to adjoining land, water bodies or marine environment; and
- fenced to prevent uncontrolled access and signage erected stating that the water is reclaimed and that various activities are prohibited, for example swimming, wading and boating.

Irrigation and Storage Location

The proposed storage and reuse of water is to be located on the land immediately east of the site within Section 92, Hundred of Mt Benson. An agreement with the current landowner is being finalised which provides permanent use of the land for the purposes of ensuring the long term sustainability of the storage and irrigation of recycled water. See **Figure 5.12**.

More than sufficient space is available for winter storage and irrigation of the reclaimed water at a number of locations, including that shown above. Alternate water use includes the irrigation of parks and gardens as discussed previously, and the rehabilitation and irrigation of an exhausted area of a nearby quarry operated by Kingston District Council. This site is located on Limestone Coast Road approximately 4.0 kilometres south east of the site. Further, nearby agricultural producers have expressed interest in using the reclaimed water, as may the nearby wineries. The available locations allow the required buffer distances to be easily achieved. All of the options will allow the water and the nutrients to be converted to a resource of value and will avoid potential environmental or health issues.

Effects of Connecting the Existing Development

The connection of the existing development at Cape Jaffa to the wastewater treatment and reclaimed water reuse systems will have the following effects:

- reduction in effluent disposal to the groundwater environment within the existing settlement, thus reducing the risk of groundwater contamination;
- reduced risk to human health associated with extraction of groundwater for the purposes of domestic, commercial (food processing) and irrigation use in close proximity to the disposal of septic tank effluent into the groundwater resource;
- additional costs to extend the collection infrastructure through the existing settlement; and
- additional treatment system throughput, increasing operating and capital costs.

The provision of an alternative effluent disposal option for the existing development minimises the risks associated with the combined effect of the existing effluent disposal into the aquifer and the existing domestic use of groundwater from the same aquifer. The existing groundwater has elevated levels of various compounds that are cause for potential concern in relation to its domestic use, and the existing groundwater quality is discussed in **Section 4.14**.

The provision of a town water supply also mitigates these risks (**Section 5.2.21**), and the other potential benefits and effects on the existing domestic water supplies are discussed further in **Section 5.2.23**.

Summary of Effects of Reuse of Reclaimed Water

During early planning, it was envisaged that the recycled water would be used to irrigate a woodlot. As a consequence of the investigations, it is preferred that a perennial crop such as lucerne or ryegrass will be irrigated in order to minimise effects on the groundwater environment and to better utilise the nutrient and water resources of the reclaimed water.

The discussion above shows that the irrigation of a crop to the east of the development will provide a number of benefits to the groundwater environment. Monitoring and management of the recycled water quality and the irrigation practices will ensure that these resources can be recycled, used beneficially and the potential effects on the groundwater environment and thus the marine environment can be mitigated.

The IMP will detail the design and practices required to ensure that potential effects are minimised. Each plant and soil type has differing capacities and response to water, nutrient and salinity loadings, thus the finalised IMP will incorporate a detailed study of crop requirements, proposed receiving soils, nutrient take-up capacity, salinity, drainage and waterlogging characteristics. It will detail the ongoing monitoring of irrigation water, groundwater and soil during operations in order to ensure the appropriate management of operations.

The proposed site for reclaimed water reuse is to be located well away from any existing groundwater users. The groundwater in this area exhibits elevated salinity levels, as can be seen in **Figures 4.73** and **4.74**, and the recent investigations show salinity levels at the eastern extent of the site as high as 14,900 mg/L TDS (**Section 4.14.6**). The extent of separation between the irrigation area and the existing settlement minimises the risk to other users of the groundwater resource, particularly in relation to the highly sensitive domestic use within the existing township.

The provision of a wastewater treatment facility and the reuse of recycled water will allow the wastewater being produced by the existing settlement to be better managed and will result in reduced discharge to the aquifer at Cape Jaffa. Currently, septic tank effluent disposal occurs into the unconfined aquifer and extraction from the same aquifer occurs for the purposes of domestic, commercial and irrigation uses. The provision of wastewater treatment facilities allows the effects on the aquifer to be managed more appropriately and mitigates the risks associated with the existing use of the groundwater.

5.2.21 Describe the connection to water supply for the development and include information on the quantity of potable water required. In particular, identify the effect on local aquifers and groundwater users if local groundwater is to be a supply source.

Potable water for the development is to be supplied from the confined aquifer. The Department of Water, Land and Biodiversity Conservation have advised (refer **Appendix 7**) that water allocation for the use of the unconfined aquifer will be provided and that the allocation is to be made in two stages: The first stage provides an allocation that is effective immediately, without requiring revision of the water allocation plan, and provides sufficient water allocation for the first 3 stages of the development. This provides ample time until the next planned revision of the water allocation plan, when the Department has advised that an allocation will be made for the water needs of the whole of the development. The paragraph below is an extract from the advice provided by the Department of Water, Land and Biodiversity in relation to its planned provision of water allocation. The Department's letter is attached as **Appendix 7**.

> *… the Minister for Environment and Conservation, John Hill, has approved a proposal that an authorisation under section 11 of the Water Resources Act 1997 be made to allow the water to be taken on a temporary basis for the purposes of public water supply. Provision can then be made in the revised water allocation plan to allow a water allocation and licence be granted for this use, around mid 2006 when the plan will be revised.*

The results of initial investigations into the viability and sustainability of supply from the confined aquifer for potable water supply are outlined below. Discussions have been held with SA Water to ascertain the expected quantity of potable water and water treatment facilities required. SA Water has also provided an outline of the expected design of the water supply system.

The quantity of potable water supply required for the development, assessed in consultation with SA Water, indicates an ultimate water demand of about 250 megalitres per year (ML/yr). This is based on 550 new residential connections, commercial water usage and connections to the existing settlement. By comparison, the Kingston town water supply currently has approximately 850 connections (pers comm. S Rufus CEO Kingston District Council August 2004), has a water allocation of 600 ML/yr, and usage in the 1999/2000 year was 337 ML (SECWMB 2001).

The use of the public water supply will increase gradually over approximately ten years, as shown below in **Table 5.8**. Note that this is considered conservative as it assumes relatively rapid construction and connection once allotments are developed. As outlined in **Table 5.8**, the expected annual requirement up to the end of 2006, when the revised Water Allocation Plan is to be introduced, is 40 ML and the existing temporary authorisation provides for 43 ML. The expected annual water requirement prior to the end of 2011, when the Water Allocation Plan might next be revised, is estimated to be 180 ML.

DWLBC have advised that to date limited data is available on the nature of the confined aquifer in the area, due to the lack of confined aquifer bores in the vicinity. As a result, an exploration well has been drilled into the confined aquifer in order to provide a preliminary assessment of the sustainability of supply. The exploration well was drilled in to a depth of 188 metres below ground level (approximately

184 mAHD) at the south eastern extent of the development within the infrastructure area shown in **Figure 3.24**. Drilling ceased once approximately 22 metres of coarse sand/gravel aquifer had been penetrated, from 166 metres to 188 metres. The results, including drill cutting and geophysical logs, are provided in **Appendix 23**.

Table 5.8: Estimated Water Requirement

Year	Estimated Connections	Estimate Water Requirement (ML)
2005	40	16
2006	100	40
2007	170	68
2008	240	96
2009	310	124
2010	380	152
2011	450	180
2012	520	208
2013	590	236
2014	625	250
2015	625	250

The results of the exportation well, together with experience in the region, indicates that one well into sands of this thickness and grain size is likely to produce at a sufficient rate to meet the ultimate public water supply needs of the development (pers comm. M Cobb Watersearch Pty Ltd, **Appendix 23**). Nevertheless, in order to better define the characteristics of the confined aquifer in this area, it is proposed that additional testing of the production well will be performed as follows:

- constant rate pump test for 2 to 4 days, followed by three 1 hour steps at progressively higher pumping rates. The duration of the pump test may be extended if required, as indicated by the data acquired during the test;
- monitoring of the pressure build-up for approximately 48 hours, or until stable, after shut-in;
- acquisition of pressure and flow rate for further analysis, during both production and recovery testing; and
- assessment of the aquifer transmissivity and well equation, ie the relationship between drawdown and production rate applicable to that well.

Although the production from a single well is expected to be significant, additional well(s) can be drilled if required. The investigations performed to date show that significant water is available, the nearest existing confined aquifer well is about 10 kilometres from the site (**Section 4.14.15**) and any adverse effect on other users of the confined aquifer is unlikely.

Discussions with SA Water indicate that the water treatment required is expected to be minimal. Similar treatment and infrastructure to that provided at Kingston is envisaged, including standard disinfection treatment and possibly iron removal (pers comm. Paul Feronas and Chris Marles, SA Water). Wells, treatment facilities and some on-site buffer storage tanks are to be located at the south eastern extent of the site, and detailed design will be conducted in conjunction with SA Water to normal design criteria.

In summary, effects on confined aquifer users are very unlikely as there are no confined aquifer users nearby. Regionally, the confined aquifer supports significant extraction and the recent investigations indicate that this will also be the case locally at Cape Jaffa. Thus, no adverse effects on the confined aquifer or users of the confined aquifer are expected. In addition, no adverse effects are expected on the unconfined aquifer as a result of establishing the water supply. The provision of a town water supply to the existing settlement will likely reduce the existing extraction from the unconfined aquifer.

5.2.22 Outline the measures proposed to protect and maintain suitable water quality in waterways and flushing basins, particularly the management of run-off and the control of pollutant and micro-organism sources.

<u>Expected Waterways Water Quality</u>

The waterways model developed (**Appendix 21**) investigates advection, diffusion and tidal hydrodynamics within the waterways in order to evaluate dispersion, mixing and tidal flushing. This enables assessment of the effects of potential contaminants and the water quality in the waterways and marine environment near the mouth of the breakwaters. In addition, the model incorporates the effects of groundwater inflow on the hydrodynamics within the waterways.

The modelling has been performed using the RMA-10 modelling package (**Appendix 21**) and specific features include:

- three dimensional, dynamic modelling of the combined effects of tide, wind, bed friction, coriolis forces and waves on the movement of water;
- flexible mesh geometry that permits refined fitting of the computational network to the waterway shape. In addition, finer mesh detail can be used in areas of greatest interest;
- modelling of wetting and drying over expansive shoal areas and beaches; and
- integrated modelling of temperature, salinity and sediment transport to enable a more accurate determination of density variations and any vertical stratifications that may be associated with those variations.

RMA-10 is a very flexible finite element model that is used for steady state or dynamic modelling of the estuarine and river system, and also permits the simulation of three dimensional stratified and unstratified flow. Assemblages of one, two or three dimensional elements may represent the three dimensional system so that full three dimensional equations are only solved in areas of truly three dimensional flow.

The model has a state of the art provision for the simulation of wetting and drying of marshes, sandbanks, and overbank areas in tidal and flood flow. It permits flexible input of surface stresses such as winds or waves and is capable of simulating estuarine systems where stratification is caused by a combination of temperature, salinity or sediment concentrations.

Bathymetry and Waterways Layout

Bathymetric information was based on detailed nearshore and onshore surveys recently undertaken specifically for the design and assessment of the project (**Appendix 21**). The model data was extracted from offshore bathymetry and survey performed by Flinders Ports Pty Ltd and Allsurv Engineering Surveys Pty Ltd, which contained 4,352 points and was used to generate a digital elevation model of the beach and nearshore seabed.

The bed level of the proposed basin, waterways and navigation channel approaching the entrance to the marina was set at -3.5 mAHD. The model plan form was adopted from the current layout of the waterways at January 2004 and the model boundary was set to represent the waterways.

The modelled configuration of the breakwaters comprises a shore normal eastern breakwater and a western breakwater that is shore normal for some distance before curving towards the east to protect the entrance channel. The model extends for around 1,000 metres both east and west along the coast and for around 1,000 metres offshore. The offshore boundary of the model had a depth that varies from -3.5 to -4.5 mAHD.

The model mesh is shown in **Figure 5.36**, along with the proposed layout of the waterways and the aerial photograph as the background. As shown, the model mesh has a variable level of detail, with greater detail in the vicinity of the entrance and inlet channel where the processes being investigated display the greatest amount of variation. The modelled water depths are also illustrated in **Figure 5.36**.

Modelling Assessments

The simulations undertaken as part of this assessment require boundary data in the form of tidal, wind and constituent inflows for the hydrodynamic and flushing simulations.

To provide a thorough assessment of the proposed waterway processes, both hypothetical (sinusoidal) and real (varying neap/spring tide variation) water level boundary data have been used.

While some recorded water level data has been obtained for the site during late 2003, this is influenced by various weather patterns and does not reflect the typical full range of neap to spring tide conditions of particular significance to the flushing assessments. Accordingly, a selected time series of recorded water levels exhibiting extremes of both small neap and large spring tide conditions from Victor Harbor has been used. Available information indicates that the Cape Jaffa tide is sufficiently similar to that at Victor Harbor for this to be reasonable and appropriate for the purpose of identifying the effects associated with the full range of prevailing tidal conditions (**Appendix 21**).

Comparison of tidal planes for the region (as indicated by Kingston) and Victor Harbor, as shown in **Table 5.9**, confirms close similarity in neap/spring tidal ranges. The tide cycle used is described in **Appendix 21**.

The modelling was undertaken using conventional model settings and coefficients considered appropriate, as derived from professional judgement and experience elsewhere. In view of the relative simplicity of the waterway network, this is considered reasonable as the basis for identifying the essential processes.

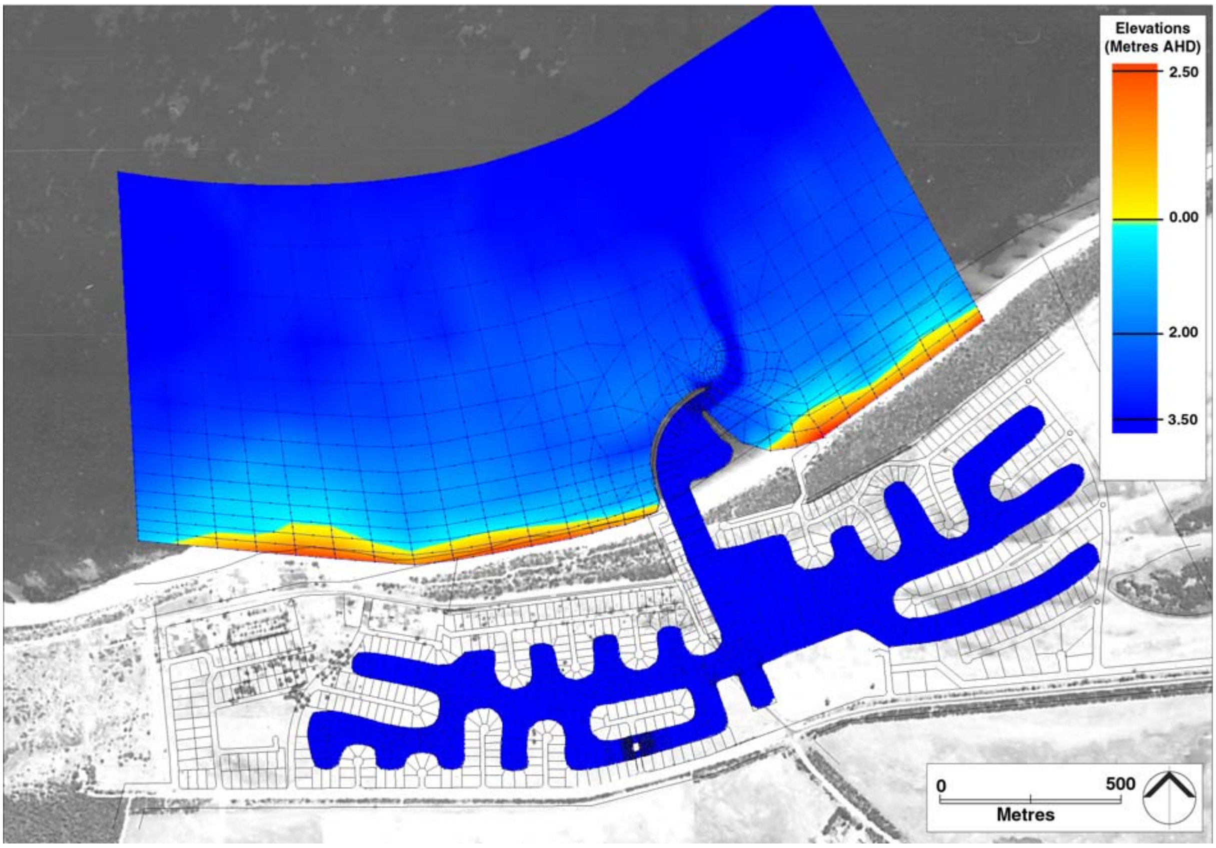


Figure 5.36: Model Bathymetry
Source: Appendix 21

Table 5.9: Tidal Planes at Kingston and Victor Harbor
Source: Appendix 21

Tidal Plane	Tidel Level (mAHD)	
	Kingston	Victor Harbor
Mean Higher High Water	+0.46	+0.47
Mean Lower High Water	+0.17	+0.21
Mean Higher Low Water	-0.17	-0.21
Mean Lower Low Water	-0.46	-0.47

Tidal Hydraulics

Tidal hydraulic simulations were undertaken to predict:

- tidal variations within the marina;
- tidal prism at various locations within the marina for representative spring and neap tide conditions; and

- typical peak tidal currents within the marina, including current patterns in the vicinity of the entrance breakwaters.

Because of the relatively small size of the waterways, the water levels within the marina are almost identical to the water level at the ocean entrance for most circumstances (within a few millimetres). However, following the ebb of a larger spring tide, the water levels within the marina can remain slightly elevated, with modelled differences of up to 3.0 centimetres in the water level between the entrance and the end of the south west arm. Essentially, the waterways can be considered to have a flat water surface during all tidal conditions (**Appendix 21**).

Tidal Prism

The tidal prism is defined as the quantity of water entering and leaving the marina during a tidal cycle. This has been determined by calculating the quantity of flow passing a control line extending across the mouth of the entrance channel. As the diurnal variation in tides is dominant at this site, a diurnal tide of a 25 hour period and various ranges has been used to indicate tidal prisms for the waterway, as shown in **Table 5.10**. As an indicator of the relative exchange of water with the tide, these can be compared with a waterway volume below Lower Low Water of about 1,260,000 m^3 (**Appendix 21**).

Table 5.10: Estimated Tidal Prism Values

Tidal Range	Tidal Prism
0.4m	168,000m^3
0.6m	252,000m^3
0.8m	336,000m^3
1.0m	420,000m^3

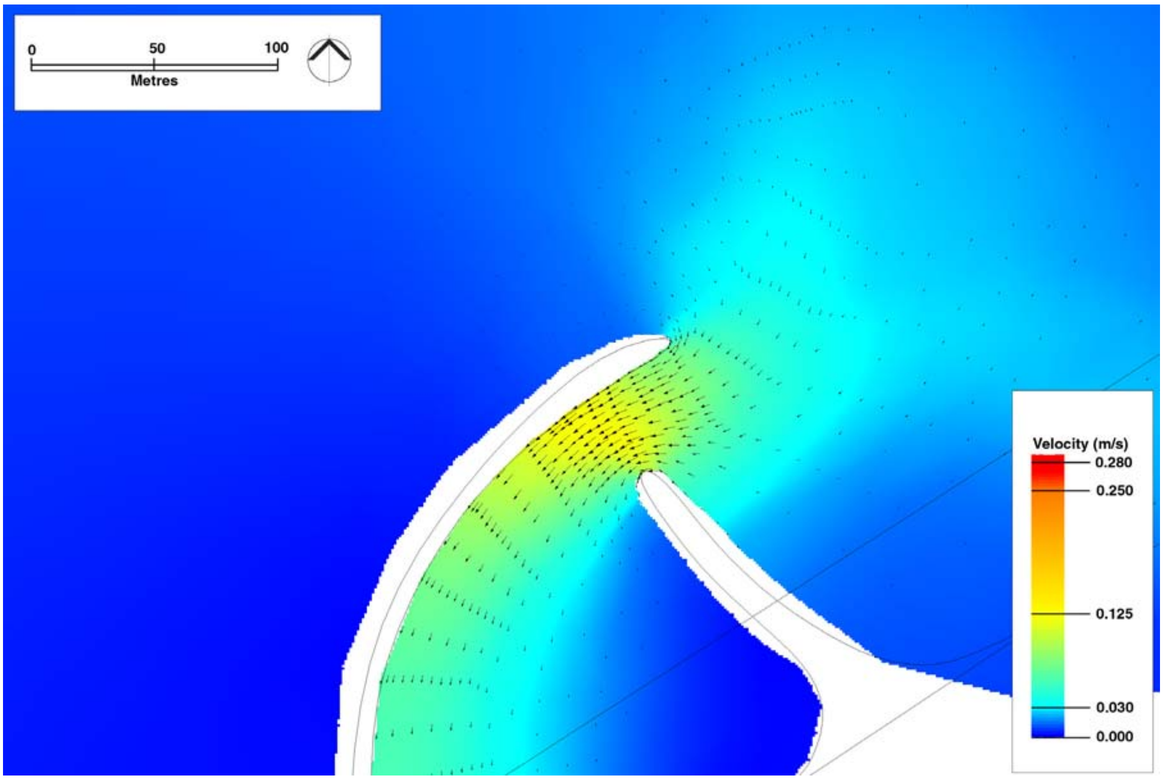
Tidal Currents

The maximum ebb and flood tidal currents have been analysed for the larger modelled spring tide conditions, which occurred between 29 November 2000 to 30 November 2000. The results are presented in **Figure 5.37**.

These patterns show that tidal velocities in the vicinity of the entrance are relatively small. Peak velocities for both the ebb and the flood condition are concentrated near the tip of the eastern breakwater and are around 0.2 metres per second. Such minor currents will not cause issues with navigation or disturbance to the seabed or benthic communities, and there is unlikely to be any problems with current related seabed scour or siltation within the waterway itself (**Appendix 21**).

Tidal Flushing

Tidal flushing simulations were undertaken for various commonly occurring tidal ranges. The model was set up to introduce a conservative, non-settleable constituent into the waterway system with a uniform initial concentration of 1.0 in the marina and a concentration of 0.0 in the ocean outside the marina, thus the model results show the concentration of a constituent as a fraction of its initial concentration. Sinusoidal tides were simulated with ranges of 0.4 metre, 0.6 metre, 0.8 metre and



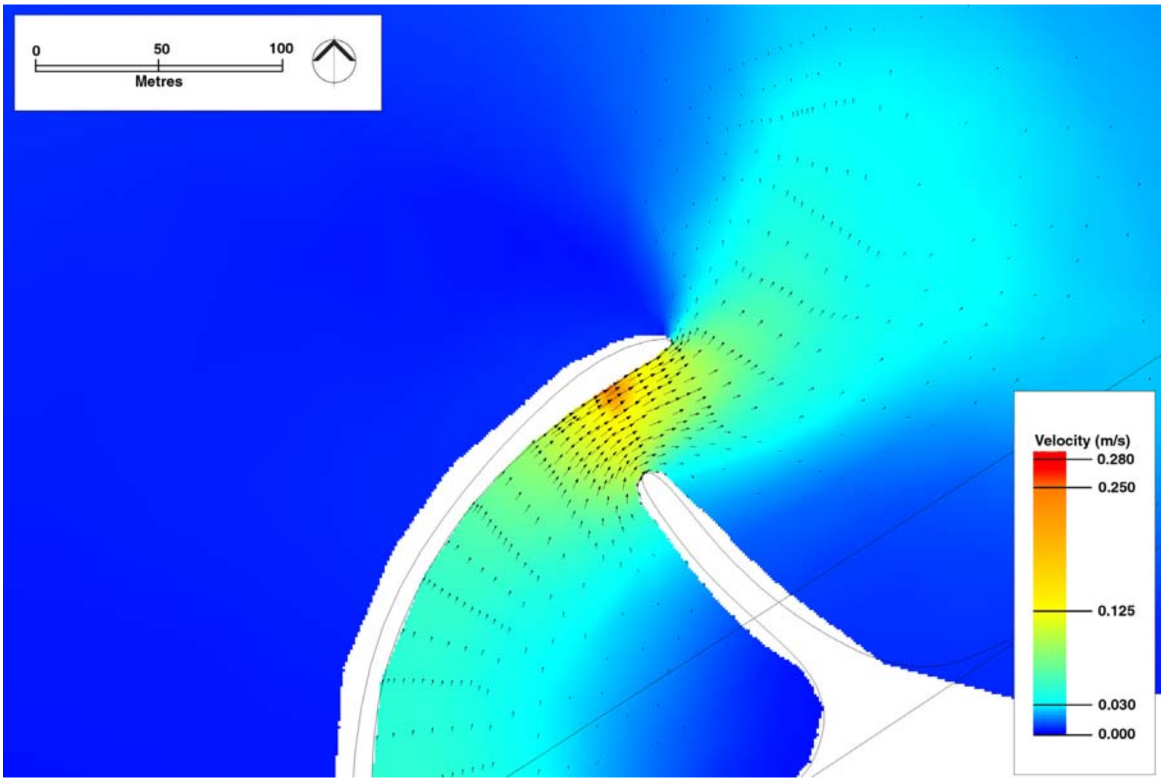


Figure 5.37: Flood and Ebb Tide Current Patterns at Marina Entrance
Source: Appendix 21

1.0 metre respectively, allowing for interpretation of the likely tidal flushing capacity under real tide circumstances (Appendix 21).

Specific locations at which tidal flushing rates have been determined are shown in Figure 5.38. The model simulated the advection/dispersion processes associated with the tidal exchange to derive the time for the constituent concentration within the waterway to fall to a specified level. The value adopted in this simulation is the conventional standard value of the inverse of the natural anti-logarithm of one (1/e = 0.37), referred to as the 'e-folding' time (Appendix 21).

E-Folding flushing times for the extreme ends of the canal arms for each case are presented in Table 5.11 and maps of the flushing times throughout the waterways are shown in Figures 5.39 to 5.42. Time series concentration decays at various locations in the waterways are shown in Appendix 21.

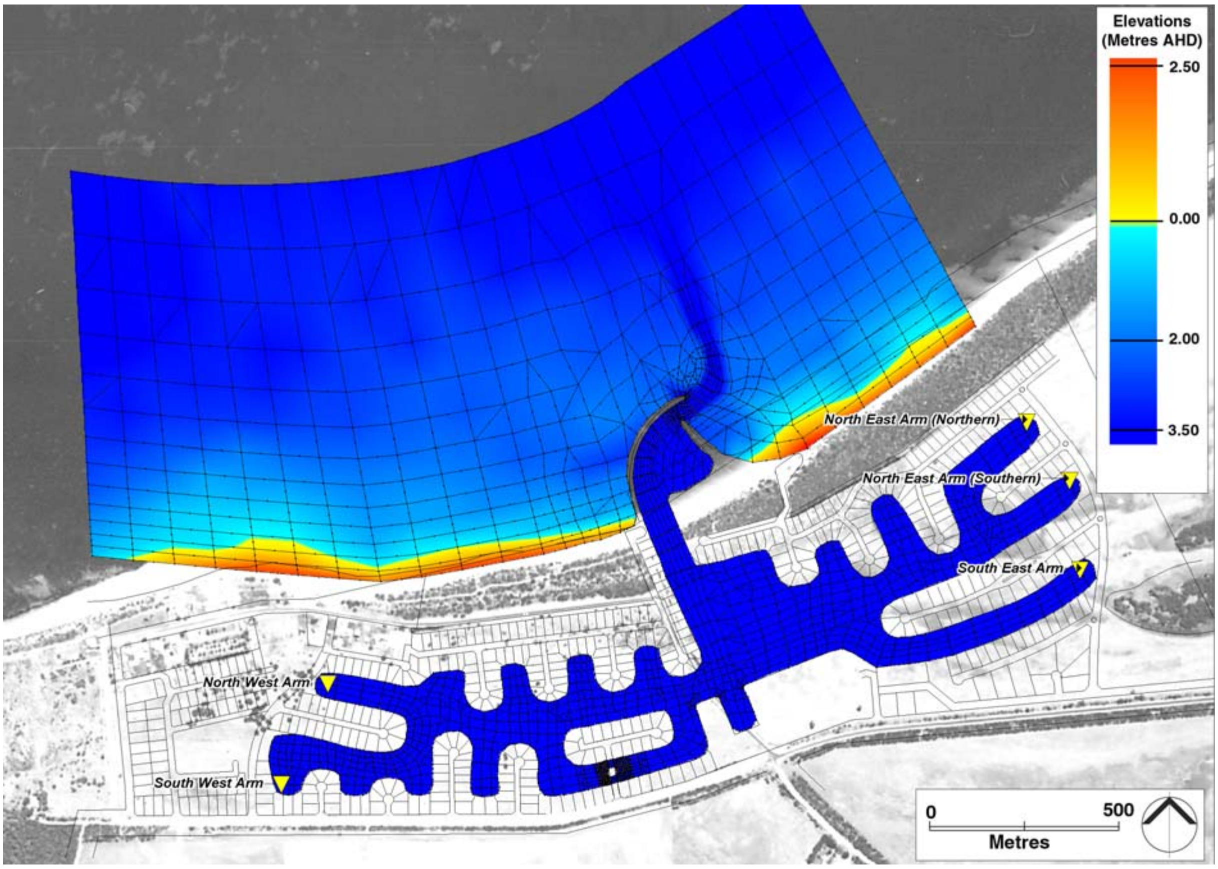


Figure 5.38: Tidal Variation Reporting Locations
Source: Appendix 21

The results show that the marina would be well flushed, with the e-folding concentration being reached throughout the marina/canal in less than eight days for essentially all tidal conditions, including relatively small ranges of 0.4 metres. The south western arm of the canal network is the most critical area and care is needed to ensure that this part of the system is not subject to excessive input of contaminants or nutrients (Appendix 21).

Clearly, during very small 'dodge' tides of two to three days duration, there will be little flushing. However, these conditions are not sustained and subsequent increasing tides will result in flushing expected to be no worse than is indicated for the 0.4 metre range situation. These periods will be followed by larger tides and increased flushing and there will be no periods of sustained poor flushing.

Table 5.11: E-Folding Flushing Times (Days)
Source: Appendix 21

Location	1.0m Range	0.8m Range	0.6m Range	0.4m Range
South West Arm	5.5	6.1	6.9	7.7
North West Arm	5.3	5.8	6.6	7.5
South East Arm (northern)	3.9	4.6	5.3	5.9
North East Arm (southern)	3.8	4.5	5.3	5.8
South East Arm	3.6	4.4	4.8	5.6

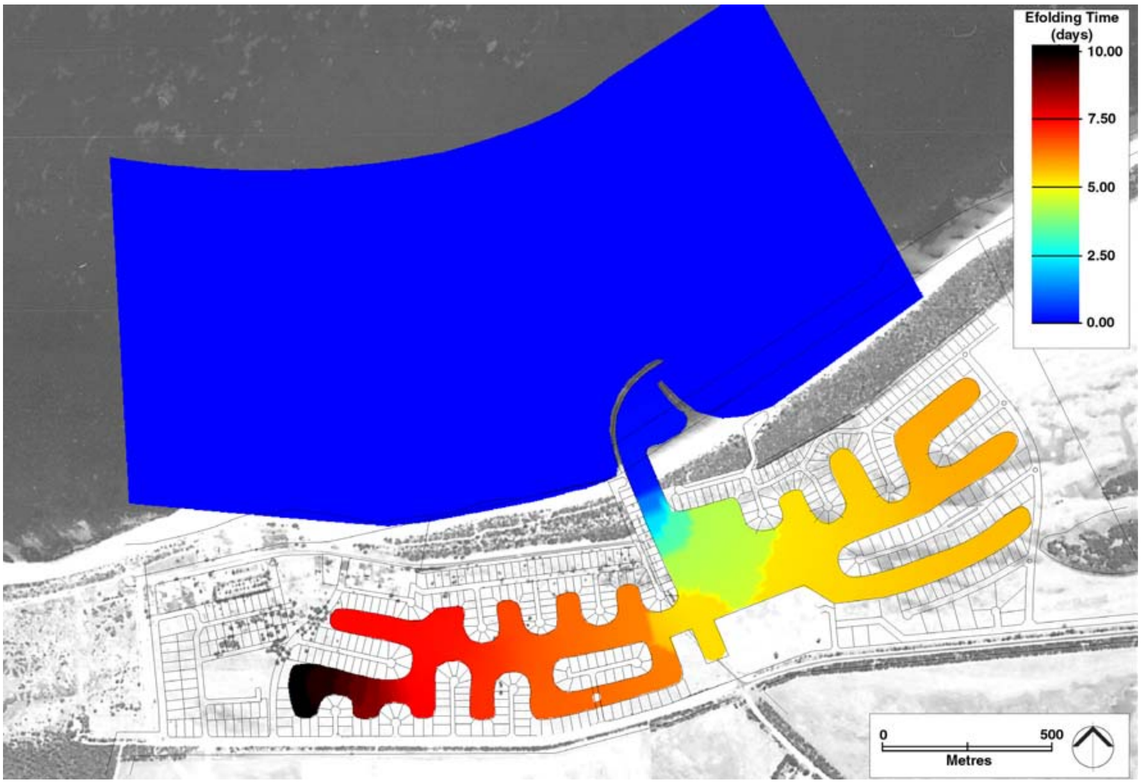


Figure 5.39: E-Folding Flushing Times – 0.4 metre Tides
Source: Appendix 21

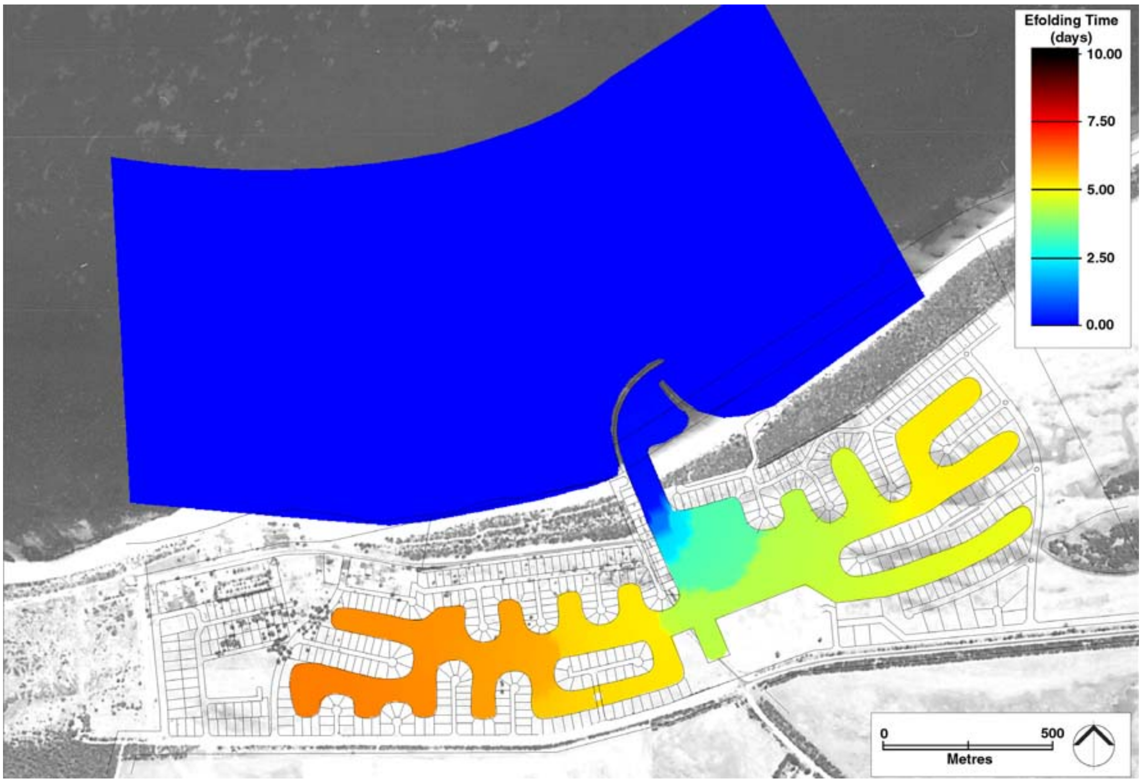


Figure 5.40: E-Folding Flushing Times – 0.6 metre Tides

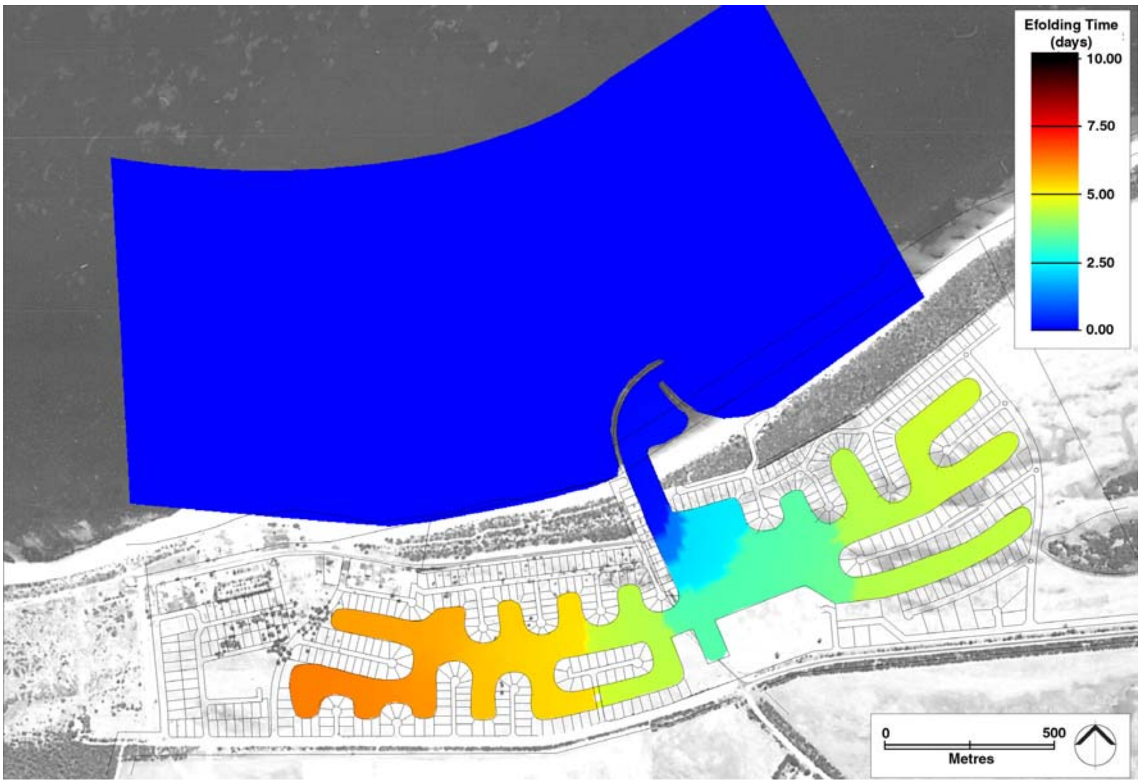


Figure 5.41: E-Folding Flushing Times – 0.8 metre Tides

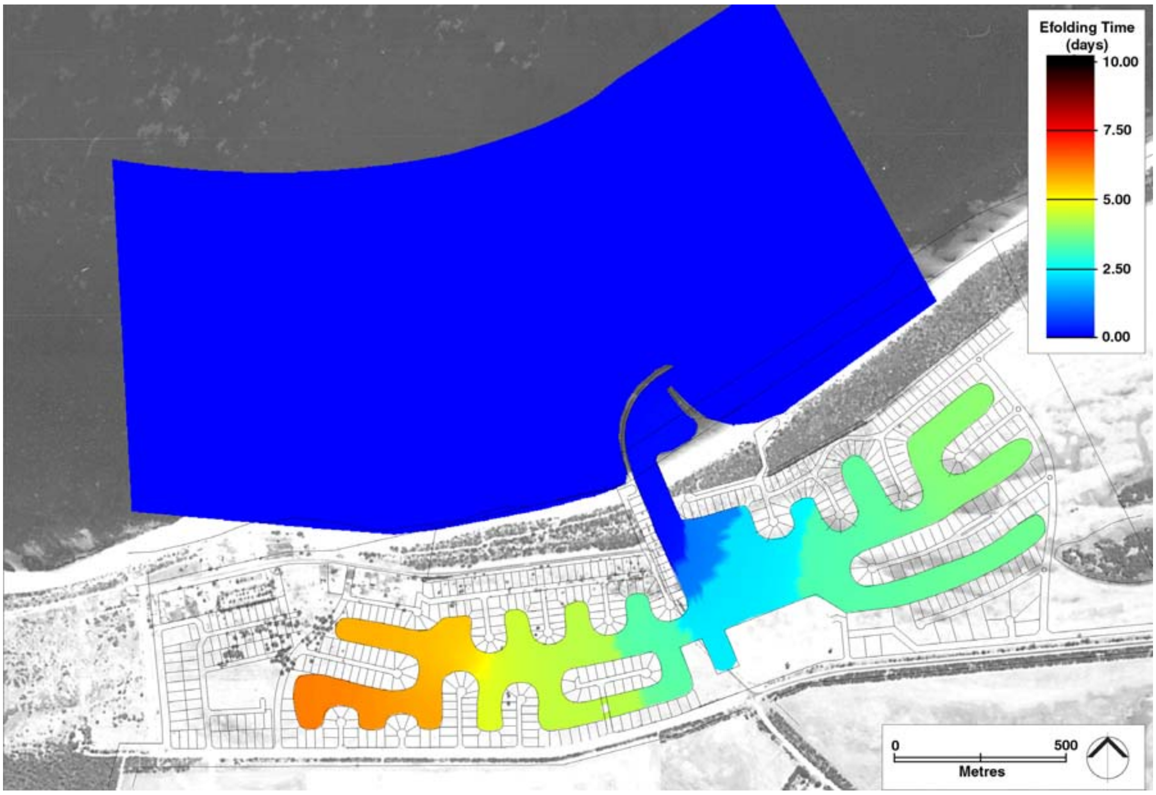


Figure 5.42: E-Folding Flushing Times – 1.0 metre Tides
Source: Appendix 21

Groundwater Flow Effects

The land surrounding the canal and marina waterway comprises coastal sands with relatively high permeability. There will be an interaction between the groundwater and the tidal waters in the marina/canal such that groundwater flow into the waterway will occur. Any contaminants that may have leached to the surrounding groundwater would enter the waterway system and be subject to dispersion and mixing through tidal flushing processes (Appendices 14 and 21).

Computer modelling has been undertaken of the tidal flushing in conjunction with groundwater flow to determine the likely extent of dispersion and mixing of any potential contaminants that may enter the waterway via the groundwater. Thus, the modelling has sought to determine the 'equilibrium' mixing factors that would occur as a result of the dynamic interaction of the groundwater inflows and tidal exchange.

The modelling process outlined previously has been used for this purpose, with additional input of groundwater flows around the canal edges. The likely groundwater flow rates have been assessed using the groundwater flow modelling described in Sections 5.2.2 and 5.2.3 (Appendix 14) and are shown in Figure 5.43. These flows were input to the tidal flushing model (Appendix 21) along the landward canal edges to represent the flow from the landward side toward the coast as intercepted by the waterways. For modelling purposes, the groundwater inflow was designated with a constituent concentration of one unit (100 percent) such that the model outputs show concentrations as proportions of the input.

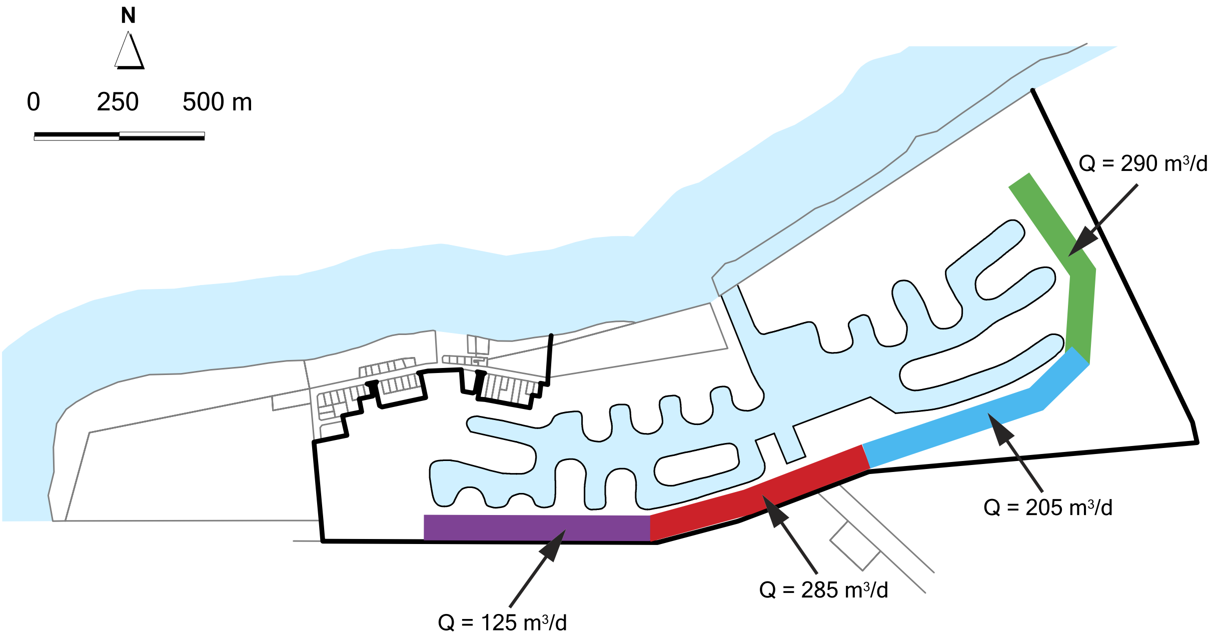


Figure 5.43: Groundwater Outflow to Waterways
Source: **Appendix 14**

The model simulations were extended over 50 days to achieve dynamic equilibrium in the concentrations, with similar concentration patterns being observed in consecutive tides, as the measure of ongoing sustained mixing. To identify the likely worst case situation, the modelling was undertaken with a tidal range of 0.4 metres, equivalent to a neap tide. Mixing rates would be significantly greater for larger tides. **Figure 5.44** shows the results in terms of the spatial distribution of the mixing factor.

The modelling shows that the effects of groundwater flow and likely contamination of the waterway are minimal, with the maximum concentration values within the south eastern arms of the marina/canal system being about 0.66 percent of the concentrations in the groundwater flows. The factor for the south western arm is 0.57 percent. At the entrance itself, that figure falls to less than 0.3 percent of the concentration in the groundwater flows.

The reasons for this are clear. In total, the maximum expected groundwater flow to the marina system would be about 900 cubic metres per day. On the other hand, the tidal prism is around 170,000 cubic metres per day (based on a diurnal tidal range of 0.4 metres and an internal waterway area of around 420,000 square metres), which is several orders of magnitude higher. As the groundwater flow rate is so small, the dispersive and water exchange (flushing) processes will quickly mix and remove inflow material to negligible levels within the waterway and adjacent ocean (**Appendix 21**).

Additional testing has been undertaken to assess the effect of the groundwater inflows on the tidal flushing characteristics of the waterway. Modelling of flushing equivalent to that described previously has been carried out, with the groundwater flow included for the 'worst case' scenario of 0.4 metres tidal range. The time series of concentrations with and without the groundwater flows indicate negligibly small change in the flushing time, reflecting the very small rate of groundwater flow relative to the tidal exchange (**Appendix 21**).

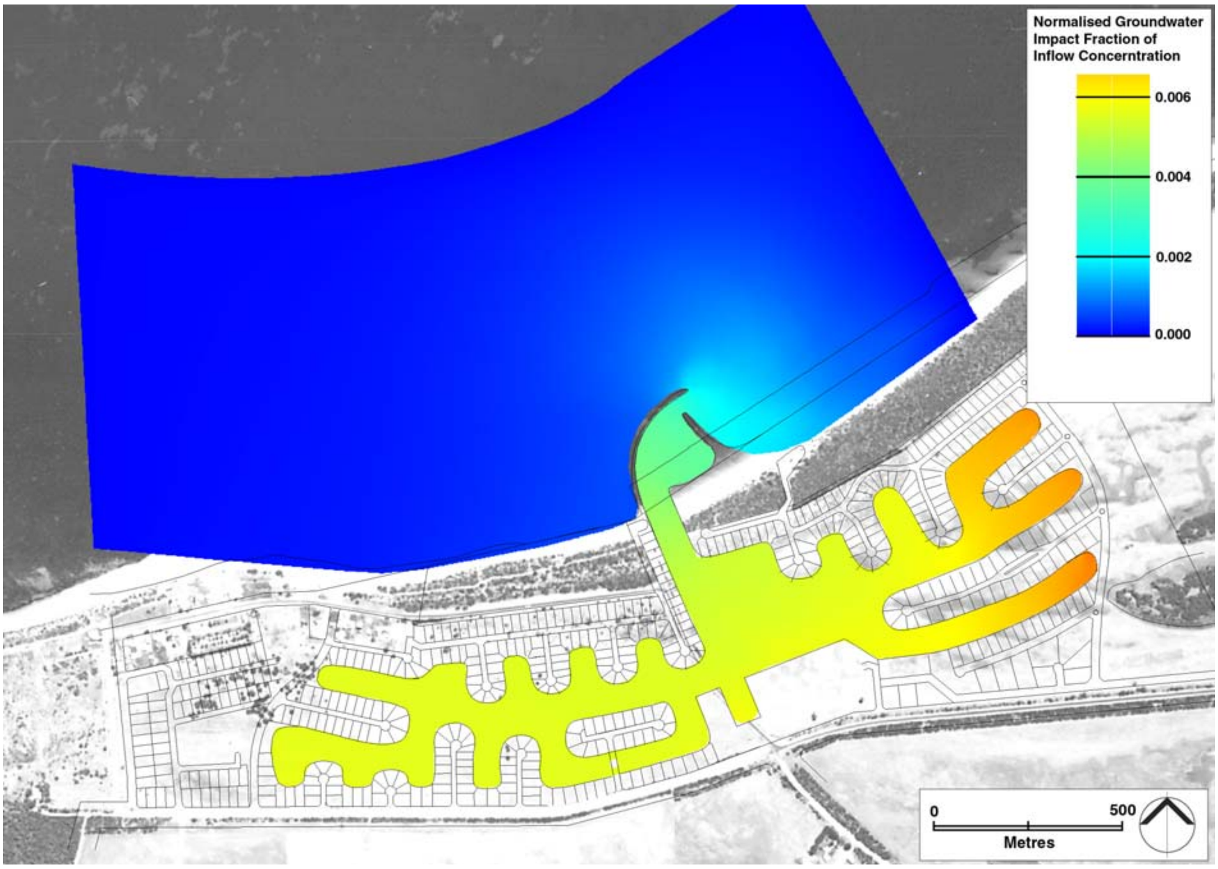


Figure 5.44: Groundwater Mixing Factors
Source: Appendix 21

Waterway Flushing and Water Quality Considerations

There is no single flushing time criterion by which the water quality of a water body subject to tidal exchange and flushing may be determined. This will depend intimately on the inputs to the system and the processes and conditions within the water body. Of concern would be excessive inputs of nutrients and contaminants that may adversely affect the short and longer term quality of the water.

For this development, nutrient inputs leading to algal growth would be the main concern, given that stormwater will be directed and controlled elsewhere.

Nutrients and/or contaminants may be sourced from:

- groundwater inflows from surrounding areas;
- fertilisers leaching through the sandy soil from domestic gardens immediately adjacent to the canals; and
- decay of seagrass wrack derived from offshore and deposited in the marina/canal system.

The modelling has shown that mixing of material flowing to the waterway via the broader groundwater transport is very effective with the prevailing low rate of inflow and the tidal flushing and dispersion processes within the waterway system. There may be some greater inflows from local domestic gardens (**Appendix 21**).

Algae problems may arise if nutrient concentrations in the water become too high or the bed of the waterway accumulates excessive nutrients that are released to the water column. Shallow water depth will lead to better flushing, the relative volume of water exchange compared with the total canal volume being higher. However, shallow depth may lead to too much sunlight penetration to the bed, causing excessive benthic algae growth and potential algal blooms. This will be exacerbated substantially by the likely accumulation of the seagrass wrack on the waterway seabed (**Appendix 21**).

The proposed water depth of 3.5 metres will provide an optimum situation that minimises sunlight penetration to the bed, provided tidal flushing is acceptable. Lesser depths, to say approximately 2.5 metres, are also likely to allow minimal sunlight penetration.

In regard to tidal flushing, it is expected that an e-folding flushing time of about three to four days would result in water quality being close to that in the ocean. A flushing time of up to about 14 days is likely to be acceptable, even with some nutrient/seaweed inputs.

The modelled flushing time of about six to eight days indicates that the water quality in the proposed marina/canal system will be of good quality and similar to that in the nearby open sea. Nevertheless, management action should be taken to mitigate potential problems that may arise from excessive deposition of the weed. This involves:

- initial design of the entrance has been performed to minimise the potential for the seagrass wrack to enter from the ocean; and
- regular removal of the seagrass wrack as required.

The entrance breakwaters have been designed to enhance the flow of waters past the marina rather than being directed into it by the tide and wind action. Some modelling has been undertaken to assist in this design. **Figure 5.45** and **5.46** shows the current patterns associated with a typical north west wind of 30 knots, indicating the effect of the curved western breakwater in directing flow away from the immediate mouth.

Nevertheless, there is local inflow on the flood tide from the area immediately near the tip of the western breakwater. It is expected that for seagrass wrack with some tendency to sink to the seabed, the enlarged and somewhat deeper area immediately inside the mouth would act as a trap, where it might be more readily controlled by harvesting, and may reduce its penetration further along the canals. The feasibility and success of such action depends on how the seagrass wrack is transported and deposited on the bed (**Appendix 21**). See **Section 5.2.13**, **5.6.9** and **5.6.16** for further information in relation to breakwater design.

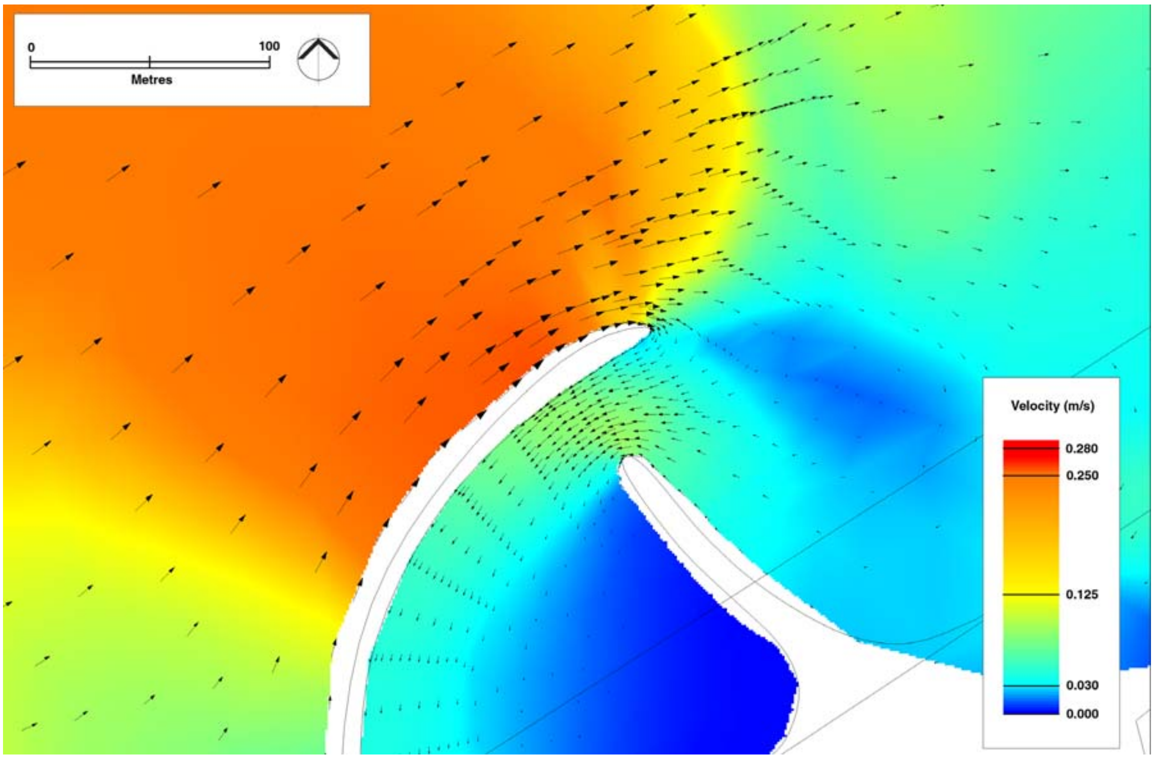


Figure 5.45: Wind Induced Current Past Breakwaters – Flood Tide and 30 knot NW Wind

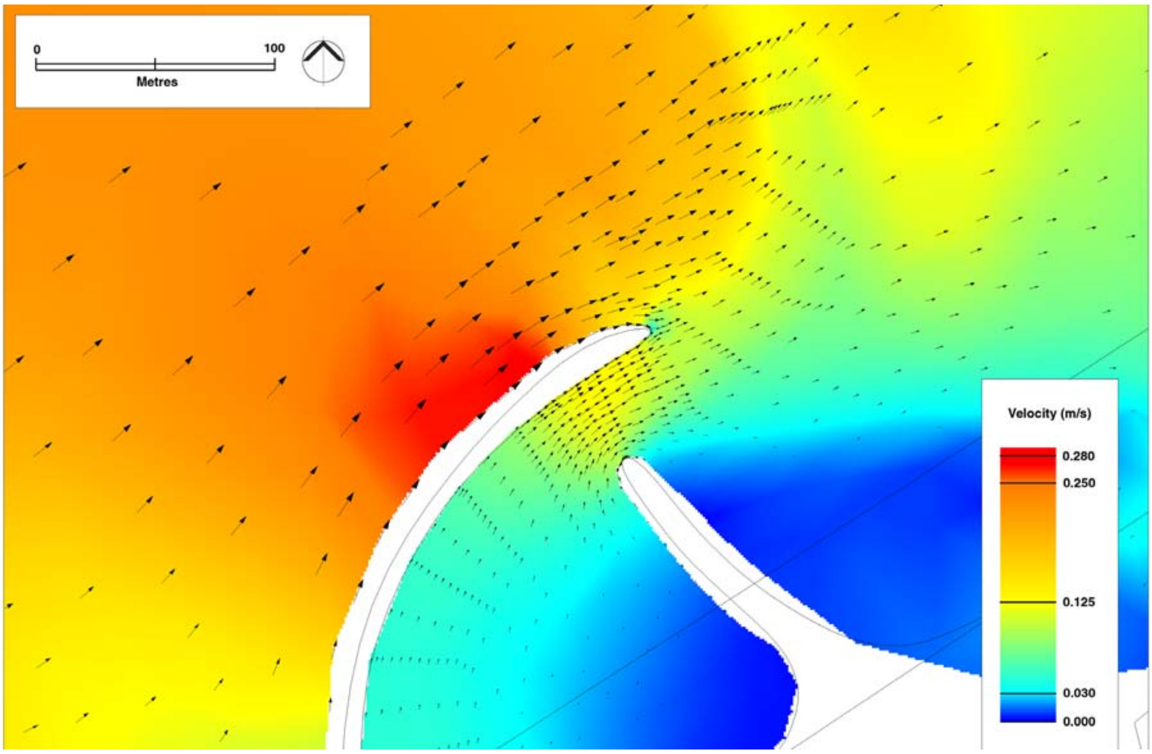


Figure 5.46: Wind Induced Current Past Breakwaters – Ebb Tide and 30 knot NW Wind

Source: Appendix 21

<u>Conclusions</u>

Based on the modelling undertaken (**Appendix 21**) as outlined above, the following conclusions may be reached:

- the proposed marina/canal waterway will be sufficiently well flushed by tidal exchange to maintain good water quality commensurate with that in the adjacent ocean with the layout and water depth (3.5 metres) as designed;
- groundwater inflow from the broader surrounding area will be very rapidly diluted through dispersion and tidal flushing, with any contaminants entering the waterway in this way being reduced to less than 0.66 percent of the inflowing concentrations within the canal/marina system and considerably less in the adjacent ocean;
- the proposed breakwater configuration design will help to minimise the inflow of seagrass wrack from the adjacent ocean area, thereby minimising its accumulation in the waterway and associated risk of water quality problems; and
- a canal design and management strategy that provides for trapping and removing seagrass wrack that does enter the waterway will assist in further reducing the risk of water quality problems arising from its accumulation and decay on the bed and banks of the waterway.

5.2.23 Describe the effect of watertable drawdown or contamination on local domestic water supplies, including that used for drinking and the watering of gardens.

The potential effects of drawdown, saltwater intrusion or other contamination on existing groundwater users, including domestic users, have been investigated at various stages of the project including:

- during dewatering of Stage 1 excavations;
- at completion of Stage 1; and
- at completion of the project.

Changes to the groundwater levels and location of the seawater interface near the waterways are discussed in more detail in **Section 5.2.3**.

Figure 5.47 illustrates the location of existing registered wells, their depth below ground level and the development concept. **Figure 5.48** shows the registered use of the existing groundwater wells.

<u>Effects of Establishing Basins and Channels</u>

Section 5.2.3 details the potential effects of establishment of the waterways on groundwater quality and quantity, and these are outlined below.

Dewatering during construction will result in temporary lowering of groundwater levels in the immediate vicinity of the dewatering activities. The potential groundwater changes that result from the establishment of Stage 1 have been shown to be negligible and Stage 1 poses no threat to existing groundwater users. The effects of other stages located away from the existing settlement are also expected to be very limited.

In the long term, the completed project will result in lowering of groundwater levels in the vicinity of the waterways. Nearby existing wells will experience level changes less that about 0.6 metres and the wells within the existing Cape Jaffa settlement will experience level changes less than about 0.2 metres. The changes in groundwater levels results in corresponding reduced available head for extraction. As the changes are small, they are expected to have no noticeable effects on yield from existing wells. In addition, the groundwater level changes are small compared to the existing seasonal level changes in the unconfined aquifer, which have been recorded by DWLBC in nearby regional observation wells as being up to 1.3 metres and generally between 0.5 and 1.0 metre, as described in **Section 4.14.9**. **Figure 5.13** shows the expected change in groundwater levels that result from the completed development and also shows the nearby registered groundwater wells.

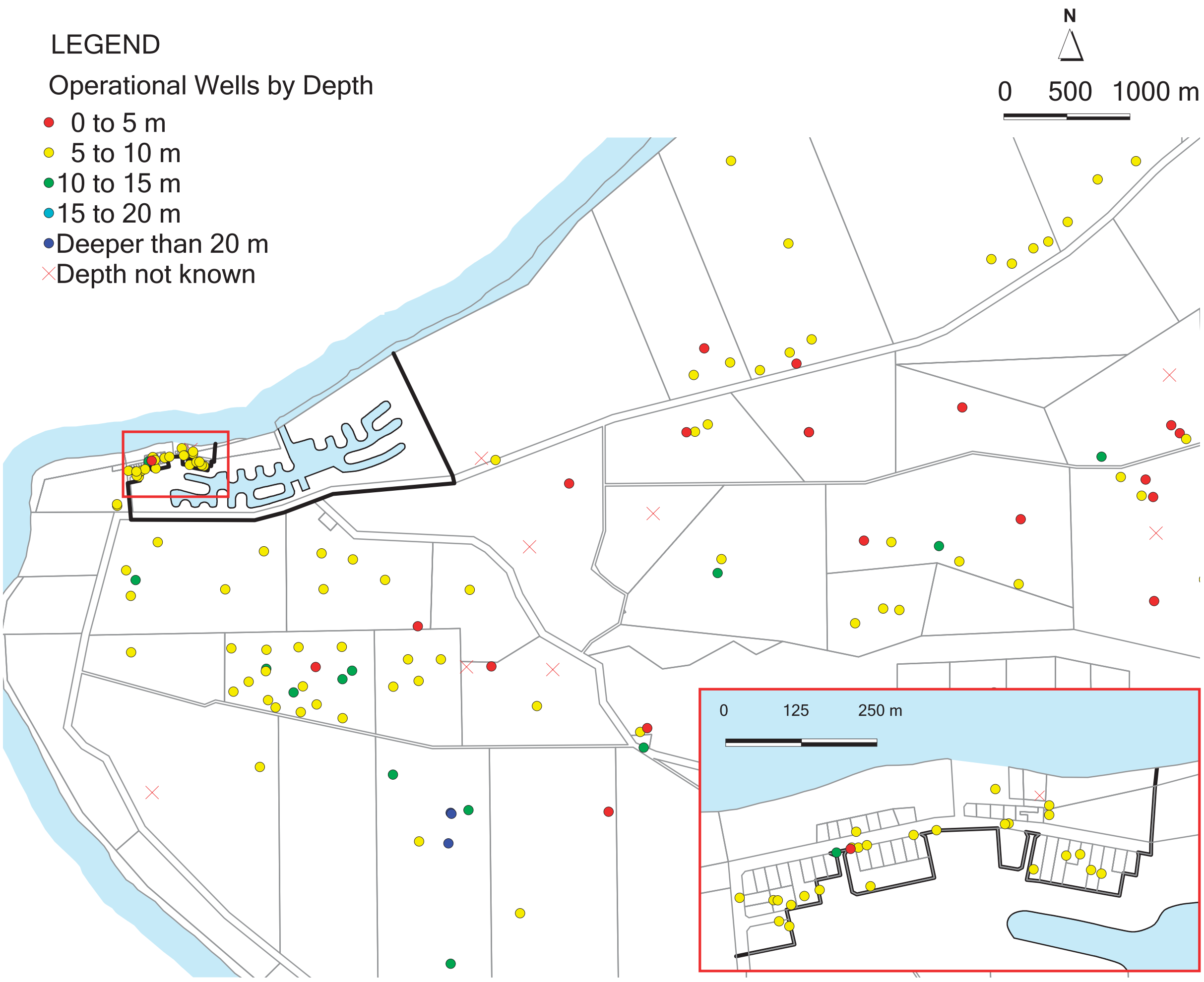


Figure 5.47: Registered Groundwater Well Depth
Source Data: PIRSA Well Database July 2003

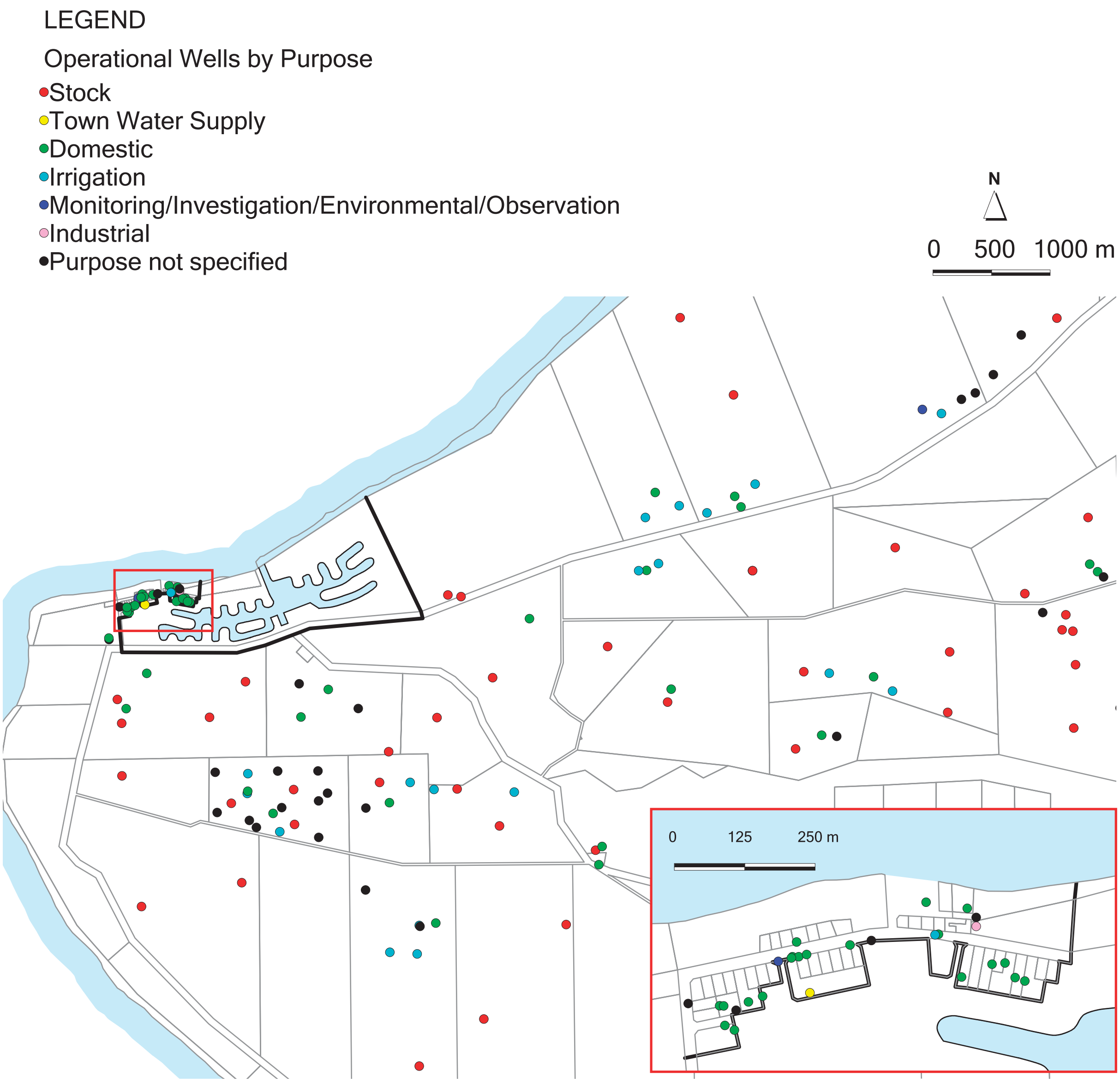


Figure 5.48: Registered Groundwater Well Use

Source Data: PIRSA Well Database July 2003

It is expected that the proposed development will result in changes to the existing seawater interface within the unconfined aquifer. The nature and location of the existing seawater interface is discussed in detail in **Section 4.14**, and the effects of establishing the waterways on the location of the seawater interface is discussed in detail in **Section 5.2.3**.

Active seawater intrusion is not expected to occur other than for short durations in localised areas during dewatering. This is not expected to adversely affect the groundwater nearby the development. The effects are minimised by staging the construction of the waterways to reduce the duration, extent and depth of each dewatering event.

The wells at the eastern end of the Cape Jaffa settlement will be located on a peninsula between the waterways and the coast, and groundwater extraction in this area is likely to be effected by seawater intrusion over time. At the western end of the Cape Jaffa settlement, the seawater interface will shift upward to extend into the aquifer at a shallower angle. Existing wells at the western end of the Cape Jaffa settlement are subject to increased risk of seawater coning, depending on extraction rate, depth and location, and the potential effects progressively diminish to the west as the distance from the waterways increases. Adverse effects of seawater intrusion on existing groundwater uses within the remainder of the locality are unlikely. An assessment of the separation between the seawater interface and the existing wells is provided in **Section 5.2.3**.

Ongoing monitoring and assessment will be undertaken during the first stages of the development prior to the later stages of construction of waterways.

The staged construction of the waterways minimises risks to the groundwater environment and nearby groundwater users as it minimises the zone of influence around each stage of the waterways and locates early stages away from the existing groundwater users. Monitoring and mitigation measures including the extension of the town water supply to the existing settlement are described in **Section 5.2.10**, **5.2.29** and **5.4.9**. This allows additional investigations to be performed and greater understanding to be gained well before any risks to existing uses of the aquifer arise.

The modelling and analysis undertaken is sufficiently accurate to allow planning and assessment of the effects of the waterways and shows that the effects are limited to the immediate vicinity of the waterways. See **Section 5.2.3** for further details.

<u>Groundwater Quality Effects</u>

Further to the discussion on potential contamination from the establishment of the waterways presented above, potential contamination from other sources has been assessed. Overall, it is likely that the development will result in reduced contamination of the aquifer and improved groundwater quality.

The provision of an alternative effluent disposal option for the existing development minimises the risks associated with the combined effect of the existing effluent disposal into the aquifer and the existing domestic use of groundwater from the same aquifer, as discussed in **Section 5.2.4** and **5.2.20**. The existing groundwater has elevated levels of various compounds that are cause for potential concern in relation to its domestic use and the existing groundwater quality is discussed in **Section 4.14**. The provision of a town water supply also mitigates these risks (see **Section 5.2.21**).

Although the development will potentially result in some nutrient loading from the fertilising of lawns and gardens, it is likely that the net effect will be a reduction in contaminant loading. The fertilising of lawns and gardens is limited and expected to be less than has occurred previously or would otherwise occur from agricultural use of the land. See **Section 5.2.9** for a discussion on some of the other potential effects on the groundwater quality.

It should also be noted that a significant portion of the development land is currently zoned for residential and commercial development and that this residential/commercial development is likely to occur regardless of this proposal. This alternate development scenario would likely proceed in a less orderly manner and without the benefit of a sewerage system or town water supply, thus resulting in increased contamination from septic tank effluent disposal in the aquifer together with an increased dependence on the unconfined aquifer for domestic water supply. Compared to the alternative, this development proposal will result in a significant reduction in contamination of the unconfined aquifer.

Management

5.2.24 Describe the sewage disposal and rubbish collection systems for the commercial and recreational boats.

Sewage from Boats

It is proposed that a sewerage pump out facility will be installed which meets the "Best Practice Guidelines for Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand" (ANZECC 1997).

A pump out point will be provided at the wharf facility. All reception points and storage containers will be clearly identified to provide information on the correct use and the types of wastes that are accepted.

The connection fittings for the waste facilities will be standardised (ISO) connections with a quick coupling to ensure compatibility with vessel waste systems designed in accordance with the appropriate Australian Standard: Pleasure boats - toilet waste collection, holding and transfer systems (AS 3542 1996). The pump out facility will be connected to the sewage treatment and disposal system, and wastewater from vessels will be treated in the same manner as sewerage from land based activities.

Solid Waste from Boats

A waste collection system will be employed with receptacles for waste provided in convenient locations adjacent the wharf and boat ramp facilities. The receptacles will have self-closing lids to prevent escape of rubbish, manage odours and to exclude rainwater, rodents and scavengers such as seagulls.

Users of the facility will be encouraged to segregate the rubbish to enable the recyclable materials to be separated at the point of disposal. This will be achieved by providing clearly marked bins and signs identifying types of materials that may be deposited in each recycling container.

In addition, a waste oil reception station will be provided within the commercial precinct to ensure the appropriate disposal of oils, fuels and solvents. Cape Jaffa has an existing facility and therefore the crews are well versed in its use.

All collection of rubbish and waste oils will be carried out by a licensed contractor and shall be treated or disposed of at an appropriately licensed facility.

Generally around the Cape Jaffa settlement, the existing arrangements will continue and be extended according to the growth of the area. Kingston District Council currently contracts this service and the operator is a licensed transporter of waste and uses a range of facilities and sites for treatment and disposal of wastes.

Kingston District Council is currently engaged in the review of waste facilities locally and regionally, and is in the process of finalising documents for the development of a transfer station which until recently has not been feasible. However, with the steady growth in population, the changing nature of the waste industry and the identified need to reduce waste to landfill, Council wishes to ensure the best possible arrangements for its community. Whilst it is not anticipated that overseas vessels will use the facility, a designated secure receptacle will be provided for quarantine wastes.

These containers are not to be multipurpose. Once used for quarantine waste, a container cannot be used for general waste unless it has been cleaned appropriately. Quarantine waste containers are to be permanently marked and securely covered and bunded to effectively prevent spillage or access by birds or animals. The quarantine waste may only be removed to an approved quarantine waste disposal area by an authorised contractor. Records of type and quantity of quarantine waste should be kept as specified by legislation and reflected in the Waste Management Plan.

5.2.25 Describe the use of amenity/landscape plantings, including opportunities for the use of native species.

The proposed development will change the visual amenity of the area with the construction of the marina and the development of allotments.

The opportunities for amenity/landscape plantings include the vegetated dunes, parks and reserves, road reserves and individual allotments. The following identifies these opportunities. Much of the change will occur on the landward side of the foredune, emphasising the importance of maintaining the native vegetation on the dunes and creating the opportunity to enhance the habitat in this area.

Several park areas are to be established, many of which will also function as areas for stormwater soakage. These areas are to be designed and developed in accordance with a comprehensive landscaping theme to achieve several outcomes. They will also be developed to create views to the water, as recreation spaces and links between localities. Plantings will also be used to break up expansive areas of parking and in so doing provide shade and shelter. Plantings are also used to define spaces and accentuate or punctuate features, vistas or views in the landscape.

Plantings along the main roads on arrival at the settlement will be improved by the removal of weeds and replanting areas that have become degraded in recent times. A more formal approach to landscaping and amenity planting is intended along main access roads within the development to create a sense of structure and order, and to highlight views and points of focus. This will be consistent with the orderly design approach sought in the development of the allotments where setbacks, height and design elements will be guided to reinforce the fishing village theme.

Amenity plantings will be undertaken in accordance with a landscape plan which provides opportunities for the use of local provenance native plants that can tolerate high pH soils, low fertility, low moisture regimes and salt laden winds (**Appendix 11**), as outlined in **Table 5.12**.

Design guidelines for these plantings will take account of:

- visual amenity, both short and long term;
- ease of maintenance (ie; as sustainable as possible);
- minimising water requirement;
- creation of litter;
- health and safety issues; and
- habitat value for native birds.

Table 5.12: Recommended Amenity and Revegetation Plant List
Source: Appendix 11

Species Name	Common Name	Habitat
Acacia longifolia var sophorae	Coastal wattle	Dune
Allocasuarina verticillata	Drooping sheoak	Dune, chenier ridges, above saltmarsh
Alyxia buxifolia	Sea box	Dune
Atriplex cinerea	Coastal saltbush	Dune, embankments
Atriplex paludosa	Marsh saltbush	Saltmarsh, dune, embankments
Atriplex semibaccata	Scrambling berry saltbush	Saltmarsh, dune, embankments
Brachycome parvula	Coast daisy	Dune and coast above saltmarsh
Calostemma purpureum	Garland lily	Coast above saltmarsh
Carpobrotus rossii	Pigface	Saltmarsh, dune, embankments
Comesperma volubile	Love creeper	Dune and coast above saltmarsh
Danthonia spp.	Wallaby grasses	Dune and coast above saltmarsh
Dianella brevicaulis	Black anther flax lily	Dune and coast above saltmarsh
Disphyma crassifolium	Round leaved pigface	Dune, interdune, embankments
Distichlis distichophylla	Emu grass	Dune and coast above saltmarsh
Dodonea viscosa	Sticky hop-bush	Dune and coast above saltmarsh
Enchylaena tomentosa	Ruby saltbush	Dune, embankments
Frankenia pauciflora	Common sea-heath	Embankments, dunes
Lawrencia spicata	Thorny lawrencia	Saltmarsh, dune, embankments
Lotus australis	Australian trefoil	High saltmarsh, dune, embankments
Maireana brevifolia	Small leafed bluebush	High saltmarsh, dune, embankments
Melaleuca halmaturorum	Swamp paperbark	Interdune, swampy near-coastal areas
Melaleuca lanceolata	Dryland ti-tree	Dune and coast above saltmarsh
Muehlenbeckia gunnii	Coastal lignum	Dune and interdune
Myoporum insulare	Common boobialla	High saltmarsh, dune, embankments
Myoporum parvifolium	Creeping boobialla	Dune, embankments
Nitraria billardierei	Nitre bush	High saltmarsh, dune, embankments
Olearia axillaris	Coast daisy bush	Dune and embankment
Pittosporum phylliraeoides	Native apricot	Dune, interdune, embankments

Species Name	Common Name	Habitat
Poa poiformis	Tussock grass	Dune and embankment
Puccinellia stricta	Australian salt-marsh grass	High saltmarsh, dune, embankments
Rhagodia candolleana	Seaberry saltbush	High saltmarsh, dune, embankments
Rhagodia crassifolia	Fleshy saltbush	High saltmarsh, dune, embankments
Sporobolus virginicus	Salt couch	High saltmarsh, dune, embankments
Stipa drummondii	Cottony spear-grass	Dune and coast above saltmarsh
Stipa elegantissima	Elegant spear-grass	Dune and coast above saltmarsh
Themeda triandra	Kangaroo grass	Dune and coast above saltmarsh
Threlkeldia diffusa	Coast bonefruit	High saltmarsh, dune, embankments
Vittadinia gracilis	Woolly New Holland daisy	Dune and coast above saltmarsh
Wilsonia humilis	Silky wilsonia	Saltmarsh, embankments

5.2.26 Describe the risk of causing or exacerbating any environmental problems in the locality, and describe mitigation measures and their expected effectiveness.

A number of environmental problems exist in the area and this development seeks not only to minimise potential exacerbation of these issues, but also to take definitive measures to improve the environment in relation to these issues.

Potential general environmental problems within the coastal foredunes include the spread of weeds, wind erosion and the destruction of native vegetation. There is an existing track running through the middle of the dune that extends from the village to the existing public boat ramp. This track has been used by walkers and others resulting in degraded native vegetation and the spreading of weeds into the centre of the vegetated area. The degradation of the area will continue if significant rehabilitation works are not undertaken and the area not protected. The coastal dunes and roadside vegetation have been significantly infested by bridal creeper, false caper and various exotic grasses including onion weed. Cyprus pines can also be found.

To mitigate against further degradation, the area is to be fenced and signed to exclude general access. Dedicated pathways will be created and rehabilitation works undertaken. The walkways through the dune will be 1.5 metre wide fenced and fitted with a boardwalk to prevent erosion. These are commonly used methods of protecting vegetated dunes and are expected to be highly effective in eliminating indiscriminate access to the vegetated dunes. The management of the coastal dunes is discussed in various sections elsewhere in this report, including Section 5.2.5, 5.2.15 and 5.2.16.

The areas of the beach currently used by the boating fraternity will be replaced with a new purpose built ramp and associated facilities within the development, thus removing this activity from the beach where damage can occur resulting in reduced stability of the toe of the dune and hence greater risk of erosion. This will significantly reduce the effects of beach launches, retrieval and motor vehicle effects on the beach.

A 6.0 metre buffer zone will be established between the existing native vegetation and the northern boundary of the adjacent residential allotments. An all-weather access track with a stabilised surface will be provided to limit the movement of garden plant seed into the native vegetation and allow for regular monitoring and maintenance. The arrangements are depicted on **Figures 5.34** and **5.35**.

Areas of seagrass beds within the rock lobster sanctuary to the north of the Cape Jaffa jetty have been damaged as a result of the effects of swing moorings. The provision of alternate safe anchorage will allow these effects to cease and seagrasses to recolonise these areas. The existing mooring arrangements also present a risk of damage to marine and coastal habitats associated with boats breaking their mooring during storm events. See **Section 5.2.14** for further information.

Degradation of groundwater quality has occurred as a result of nutrient and chemical applications associated with historical agricultural practices and the disposal of septic tank effluent into the unconfined aquifer. Various nutrients and compounds have been identified in the groundwater and which, together with the existing use of the groundwater for domestic purposes, presents environmental concerns. This is particularly of concern as land is zoned to allow significant expansion of the settlement, regardless of this proposal. This proposal seeks to mitigate these risks by providing an appropriately managed sewage treatment and reuse scheme and a town water supply and these services will be extended to include the existing settlement. See **Sections 5.2.4**, **5.2.9**, **5.2.20** and **5.2.21** for further information.

Currently there is trail bike and off-road vehicle activity along the beach and within the coastal dunes. Pressure from such activities is likely to increase as allotments are taken up and the resident population increases. An integral part of the development involves the provision of vehicle access only to the beach north of the site. All commercial fishing activities currently using the beach can be accommodated within the marina, thus removing some potential for damage to the beach.

Potential changes in watertable levels are discussed in **Sections 5.2.2** to **5.2.5**.

5.2.27 Outline the effects of boating traffic and "people pressure" on the surrounding environment.

Boating Traffic

The development will result in some additional boating traffic above the current use of the beach by up to 80 recreational vessels. Assuming a 50 percent berth uptake for waterfront residential allotments (174 vessels) as not every allotment will have a vessel on the water, 100 percent uptake for recreational berths (66 vessels), and use of the boat ramp by 80 vessels represents an increase of 240 recreational vessels using Cape Jaffa. Typically, recreational vessels are used for about 20 days per year concentrated over a four month period or 16 percent of summer days. However, a conservative estimate of 20 percent has been used to calculate an average of 48 vessels or 96 movements per day over the whole of the summer period. This increase is considered to be minor for this environment, given that Lacepede Bay has an area greater than 2,000 hectares. The total recreational boating traffic from Cape Jaffa equates to about 1 vessel for every 50 hectares and approximately 1 movement for every 4.7 minutes through a ten hour period.

Kingston District Council has previously proposed and made application for funding for a protected recreation boat ramp located on the beach adjacent to the existing beach access points, in recognition of the increase in boating traffic that has occurred in the recent past and the outmoded facilities currently provided. Thus, increased boating traffic is likely to occur at Cape Jaffa regardless of this proposal.

The effects of increased aquaculture will occur mainly in the area of the bay in which aquaculture pens are located, which is quite some distance offshore and well away from the development. On the basis of detailed assessments of the environmental conditions and the expected effects on the marine environment made by PIRSA/EPA/Planning SA, provision has been made for expansion in the aquaculture industry at Cape Jaffa to allow a limited number of additional operators. Estimates of additional boat movements have been made and an extra eight boat movements per day are expected, thus minimal effect is anticipated.

The increase in commercial fishing activity will be limited as the management of the fishery defines its overall use. This development will allow the activity to occur in a more controlled and efficient manner.

It is not proposed to attract new vessels from elsewhere but to better satisfy the needs of the existing rock lobster fishing fleet and create a safer, more efficient environment in which to operate. Some minor increase in movements is possible if new vessels are attracted. There will be similar movements as currently occur with reduced risk of environmental damage due to the removal of the vessels from the open moorings. Further, the seagrass beds will regenerate once the swing moorings are disused.

It is also noteworthy that the value of the fishery's product is weather dependant as during periods of poor weather, supply drops and prices increase. By providing facilities that allow safe operations in poor weather, the value of the catch from Cape Jaffa will likely be increased.

Although there are some overall increased boating movements, it is likely that there will be fewer vessel movements in and around the existing jetty and reef habitat located to the west of the jetty, thereby minimising the potential effects on the more sensitive parts of the marine environment. The development allows both the additional boating traffic and the existing boating traffic to occur in a more controlled environment with reduced potential effect on the nearby sensitive marine habitats.

Currently the great majority of boat launching occurs from the beach just west of the alignment of Cape Jaffa Road where it meets Lacepede Bay. At times there are 80 boats and trailers parked on the beach. The launching and retrieval of vessels and the parking of vehicles can be better managed with fewer effects on the visual and physical environment with the comprehensively planned and designed facility which form part of this proposal, as discussed further in **Section 5.2.15** and **5.2.16**.

People Pressure

The use of the area will alter as a consequence of the proposal and in a number of instances this change will include the relocation of existing activities. Examples include:

- aquaculture and/or rock lobster fishers choosing to use the marina basin, wharf and moorings will result in the relocation of the boating traffic from the open swing moorings and jetty. This represents a removal of the traffic from a more sensitive area, that is part of the Rock Lobster Sanctuary, to an environment in which risks are reduced and events can be more easily managed and controlled. It is also possible that as many as ten vessels may choose to relocate to Cape Jaffa given the additional facilities. In the context of the relocation of vessels, and the extensive waters used by these vessels, neither the relocation or the increase in vessels is likely to have a detrimental effect on the environment and in fact may result in less pressure on the more sensitive areas by the ultimate removal of some or all of the swing moorings;

- boat launching and retrieval which currently occurs on the beach could be relocated to a purpose built facility within the development. There is therefore removal of the associated impacts away from the beachfront to facilities which incorporate car and trailer parks, waste, stormwater and wastewater collection facilities. The net result is that the beach will have significantly reduced boat and trailer launch and retrieval events, thus reducing significantly the risk of damage; and
- the existing beach access is proposed to be relocated eastward to enable the creation of a vehicle free beach zone which will result in an improvement to pedestrian beach safety in this zone.

Other changes include:

- the development may also result in an increase in the number of boat movements overall given the number of allotments along the waterfront. Many of these will be recreational vessels to cruise or fish this coastline. The area of Lacepede Bay readily accessible to Cape Jaffa, west to Margaret Brock Reef and within about 7.0 kilometres out from the coast extending north to Kingston comprises an area of more than two thousand hectares. During peaks this 2,000 hectares may accommodate a total of say 100 vessels from Cape Jaffa and 50 vessels from Kingston excluding the rock lobster fleet as their fishery is generally well beyond these recreational waters. This equates to 1 vessel for every 13.3 hectares or 133,000 square metres. This density is very low;
- the proposal creates dedicated walkways through the foredune to confine people to specific pathways. With the existing accessways through the dunes, some of the more timid wildlife are forced deeper into the vegetation to maintain the level of security that they need. With the development of dedicated pathways, and hence the protection of large sections of the vegetation from intrusion by people, vehicles and non-native animals, it is unlikely that any species will be forced to leave to seek refuge elsewhere;
- the exclusion of people and other vectors for weed seeds from the vegetated and rehabilitated areas reduces the threat of further weed spread into areas of native vegetation. Weed management in the buffers around the edges of the native vegetation will form part of the ongoing management of the vegetated dunes;
- currently there are predators such as foxes and feral cats that frequent the foredunes however with increased urban development, these predators are expected to diminish. Although these may be replaced with domestic dogs and cats, these are less likely to have the freedom to roam and disturb the local fauna and controls on domestic pets needs to be enforced;
- ground dwellers and feeders are most threatened by predators and the rehabilitation and replanting of the vegetation will improve fauna safety. Given that there are no known threatened species that inhabit the area, this is a minor issue; and

- the development of Cape Jaffa in accordance with the current Development Plan does not make provision for any protection or rehabilitation of the dunes or beach and therefore has the potential to effect the environment as a consequence of natural growth and a lesser management regime.

Increased road traffic to and from Cape Jaffa can be anticipated from either the growth according to the current Development Plan or the proposal, and more activity in and around the township has the potential to raise the general noise level, though this is not expected to be significant such as to cause any environmental problems.

Therefore, although changes will occur, and the population and boating traffic increase, the environment can readily accommodate these changes with appropriated management. Both Robe and Kingston have had significant increases in activity, and foredunes or vegetation has not been subjected to significant or unmanageable effects.

5.2.28 Describe the disposal of dredged or excavated material.

Dredging for Channel Construction

Construction of the channel within the breakwaters will involve a combination of suction cutter dredging and an excavator, with the excavator being employed where hard limestone is encountered. For additional information on the proposed construction methodology refer to **Section 5.5.10**.

The preferred option for excavation of hard limestone is to use an extended turret excavator, whereby the track assembly runs on the seabed and the majority of the excavator is elevated sufficiently to ensure it is above water level. Excavated limestone will be loaded onto conventional articulated trucks on a barge and conveyed to the beach. The barge will land at the beach within the area that will later be excavated for the channel into the main basin. The material will then be carted for placement in mounds together with the material excavated from the land-based excavations. A barge mounted excavator may also be employed in a similar manner. In addition, where the channel is accessible using a conventional excavator located on the breakwater, excavation and cartage via the breakwater will be employed.

The sediments in the area are predominantly fine to medium sand (0.125 millimetres to 0.5 millimetres in diameter), with only a few percent silt and clay (**Appendix 16** and SKM 2001). Given the small volume of sediment to be excavated, the open nature of the area with good flushing, the short duration of the dredging period and the relatively coarse nature of the sediment, it is very unlikely that increased turbidity will produce any substantial problems for the seagrasses in the vicinity (**Appendix 13**).

Maintenance Dredging

The breakwater has been designed to minimise the need for maintenance dredging. It is of solid core design that does not allow sand movement alongshore through the breakwaters, thereby avoiding sand build-up in the channel where it might effect safe navigability of the channel. As a result, maintenance dredging of the channel is expected to be very infrequent, of the order of once every 10 to 25 years.

Longshore sand drift will result in sand accumulation to the west of the breakwaters and periodic sand bypassing will be required. The longshore drift rate is expected to be less than about 15,000 m^3/year and the assessment of sand movement and a detailed discussion of coastal processes is presented in **Sections 4.13** and **5.2.13**.

In order to minimise the effects of the sand bypass activities on the beach, nearshore seabed and coastal dunes, it is proposed to use a conventional cutter suction dredge to excavate the sand from the western side of the western breakwater and pump it to the eastern side of the eastern breakwater, thereby preserving the natural sand drift along the coast. The use of a dredge will result in reduced effects as compared to land based excavation and haulage. As the bypassing involves the moving of relatively clean beach sands, it is not expected to pose any environmental issues.

For additional information on the proposed dredging and the Dredging Environmental Management Plan, refer to **Section 5.5.10**.

<u>Management of the Dredged Material and Associated Runoff</u>

All material excavated by the dredging activities will be placed on land and there is no disposal to sea proposed.

For the initial construction, dredging discharge will be to land-based settling ponds located within the main basin area that will later be excavated. Overflow will occur through the settling ponds for eventual return to the sea between the breakwaters. Sieve analysis of the sand shows that it is medium to fine grained (0.5 millimetres to 0.125 millimetres diameter), with only a few percent silt and clay, thus the methodology described above is expected to ensure very low turbidity and good quality of the water returned to the sea.

For the maintenance dredging, discharge will be to the beach immediately east of the breakwaters in order to replenish the beach in that location and to match the natural longshore sand drift.

Using a properly designed series of settlement ponds for dewatering of the dredged materials, it is expected that the water returned to the sea will be high quality. In addition to the settling ponds, if necessary to meet water quality requirements, a coffer dam can be formed by constructing a temporary bund across the mouth between the breakwaters. In this manner, the overflow from the settling ponds will be directed to the coffer dam and then be returned to sea from the coffer dam using one of two options. One option is to pump the water off the end of the breakwater, approximately 200 metres from the low tide mark. This is generally the preferred option under the Environment Protection (Water Quality) Policy 2003 (EPPWQP), but will result in the discharge being over seagrass.

The alternative is to discharge it further inshore, which is a less sensitive environment, being bare sand, however more stringent water quality restrictions apply under the EPPWQP, which may not be possible to meet. This situation will be discussed with the EPA prior to a final decision being made, as it is considered more environmentally appropriate to return water within the strip of bare sand closer to the coast in order to minimise potential effects on seagrasses. In either case, increased turbidity will be short lived and the seagrasses in the area are likely to experience decreased light availability for less than one month in total.

Posidonia and *Amphibolis* seagrasses are readily capable of accommodating this short period of low light with no long-term negative effects (Appendix 13).

Given the relatively undeveloped nature of the site, it is highly unlikely that the materials excavated will contain any significant levels of contamination. To confirm this, the sediments will be sampled and tested for the main potential contaminants prior to any dredging activity, as part of finalising the Dredging Environmental Management Plan.

Prior to commencement of dredging, as part of the licence application process, more detailed investigations into the potential effects of dredging will be conducted, as described in Section 5.2.29. These investigations will include exposure/elutriation tests, supernatant water quality testing and settling tests to determine the required water retention times, settling pond location and sizing. Further, investigations of the potential pH changes that might occur on excavation and oxidation of the materials to be dredged will be conducted. Investigations into potential acid sulphate soils have been conducted, which show that due to the high calcium carbonate content of the calcareous sands and limestone, pH changes are minimal and thus no adverse effects are expected. See Section 5.6.2 for further details of these investigations.

As stated previously, it is intended that all of the material excavated by dredging be placed on land. It will subsequently be excavated and relocated into mounds and general fill around the site together with the material sourced from land based excavations. Materials excavated by dredging that match the beach sands will be placed on the beach to the east of the eastern breakwater as part of the provision of a buffer against the sand loss that may occur in that area as a result of the natural longshore sand drift between sand bypassing events, see Section 5.2.13 for further information.

General

5.2.29 Detail investigations required to include in an environmental management plan.

This section discusses additional investigations proposed, as distinct from the ongoing monitoring and management regimes that form a part of the environmental management plans. These investigations are detailed below and relate to various aspects as follows:

- groundwater;
- dredging;
- irrigation using reclaimed water; and
- use of confined aquifer for water supply.

Groundwater Investigations

Additional investigations into the effects of the development, particularly in relation to potential salinity changes and seawater intrusion will be conducted.

Comparison between the actual and modelled response of the groundwater system as a result of the early stages of the development will allow refinement of the model and continuous improvement in the understanding of the groundwater environment. Following completion of Stage 1, the results of the monitoring program will be reviewed and, if required, the groundwater flow model will be revised.

As discussed in **Section 5.2.3**, in later stages of the development the construction of the western extent of the waterways will result in increased risk of seawater intrusion for existing wells. Although increased risk is expected, it is desirable to have additional information in relation to the current location of the seawater interface and the extent to which its location may change as a result of the construction of the waterways. As a result, this will be the focus of the ongoing investigations into the groundwater environment.

The staged approach to construction of the waterways allows this risk to be managed effectively. The zone of influence of the first stages is located away from the existing township. Construction of waterways in small stages minimises the zone of groundwater influence around each stage, both in aerial extent and magnitude of groundwater level changes.

It is expected that additional groundwater monitoring wells will be required in the vicinity of Stage 1 in order to locate the seawater interface near the coast and to allow observation of the movement of the seawater interface during and after construction of Stage 1. Further, it is expected that continuous groundwater level monitoring will be required in up to two locations in and around Stage 1 and that continuous sea level monitoring in the adjacent ocean will be required. Kingston District Council and CJDC have purchased and installed the equipment to perform continuous high resolution monitoring of sea level and groundwater levels at Cape Jaffa and this monitoring has been ongoing since mid 2003. The data from the ongoing monitoring will be used in the detailed design of the future investigations and will further define the ongoing monitoring and assessment program to be implemented as part of the Groundwater Management Plan (GMP).

Kingston District Council and CJDC have invested significant effort into understanding current and post-development groundwater conditions in the vicinity of the proposed Cape Jaffa Anchorage Marina and are committed to continuing monitoring and assessment during the development phase in order to protect the groundwater resources. CJDC will maintain the GMP prior, during and after construction of the marina that will focus on the effects on salinity and water level, and is outlined and discussed in **Section 5.2.10**.

Dredging Investigations

As part of finalising the Dredging Environmental Management Plan, more detailed investigations into the materials to be excavated by dredging are proposed.

Although the materials to be excavated, the quantities of the excavations, the expected placement of the material and quality of the water runoff, together with the associated effects of these factors has been assessed and is presented in **Sections 5.2.28**, **5.5.10** and **5.5.11**, further investigations will include:

- more detailed sampling and analysis of materials to be dredged. Initial assessment indicates the medium to fine grained sands have almost no clay content, will result in low turbidity water and do not contain any contamination. To confirm this, the sediments will be sampled and tested for the main potential contaminants (heavy metals) and more detailed assessment of the clay content;

- exposure/elutriation tests, supernatant water quality testing and settling tests to determine the required water retention times, expected turbidity of the returned water, and settling pond location and sizing;
- identification of materials to be excavated by dredging that match the beach sands as part of the placement of sand on the beach to the east of the eastern breakwater to provide a buffer against the sand loss that may occur as a result of the natural longshore sand drift between sand bypassing events; and
- investigations of the potential pH changes that might occur on excavation and oxidation of the materials to be dredged will be conducted. Investigations into potential acid sulphate soils have been conducted, which show that due to the high calcium carbonate content of the calcareous sands and limestone, pH changes are minimal and thus no adverse effects are expected. See **Section 5.6.2** for further details of the investigations performed to date.

Reclaimed Water Irrigation Investigations

Further investigations are required to finalise the Irrigation Management Plan (IMP) for the reuse of reclaimed water. These investigations include:

- site and soil survey of the proposed irrigation area in accordance with Australian Soil and Land Survey Field Handbook. Soil profiles will be described to 1.0 metre below ground level and 20 percent of sampling locations will be extended to 3.0 metres;
- sampling to determine soil sorption capacity, including sampling at various depth intervals and submitting sufficient samples for analysis. The analysis is to include assessment of pH, EC, exchangeable cations, Colwell P, total P, total Kjeldahl N, total organic carbon and P sorption capacity of the soil types described;
- comparison of the site and soil aspects of site with suitability criteria for effluent irrigation, as defined by PIRSA *et al.* (2002) and Hird *et al.* (1996);
- reviewing the nutrient and hydraulic loadings to confirm the irrigation area and irrigation application rate requirements;
- confirmation of reclaimed water storage capacity;
- recommendations regarding the site and irrigation management practices required; and
- finalisation of the proposed IMP.

Water Supply Investigations

The investigations performed to date show that water is available from the confined aquifer and that a single well into the aquifer is likely to meet the long term public water supply needs of the Cape Jaffa community. Nevertheless, detailed production testing is proposed in order to confirm the infrastructure required. The proposed additional investigations include:

- constant rate pump test for 2 to 4 days, followed by three 1 hour steps at progressively higher pumping rates. The duration of the pump test may be extended if required, as indicated by the data acquired during the test;
- monitoring of the pressure build-up for approximately 48 hours, or until stable, after shut-in;
- acquisition of pressure and flow rate for further analysis, during both production and recovery testing;
- assessment of the aquifer transmissivity and well equation, that is the relationship between drawdown and production rate that is applicable to the well; and
- development of a long term water supply plan that defines the infrastructure required to meet the ultimate water requirements and ensure sustainability of supply without adverse effects on the aquifer or other users of the aquifer.

On the basis of these investigations, the infrastructure required to meet the ultimate water requirements of the community can be defined whilst ensuring sustainability of supply without adverse effects on the aquifer or other users of the aquifer.

5.2.30 Describe how all potential sources of air pollution (particularly dust) will be controlled and monitored, including measures for the reduction or elimination of dust.

The only relevant potential source of air pollution is expected to be dust arising from construction activities, which is discussed in Section 5.5.4, and outlined below. Potential odour related to seagrass wrack on the beach is discussed elsewhere in Section 5.3.3.

The Site Construction Management Plan is described in Section 5.5 and an outline is attached as Appendix 8. It provides various measures for minimising potential dust during construction, including:

- prevention of wind blown dust, including stockpile management including silt fences, landscaping and appropriate stockpile location;
- general site management of dust related to construction, including control of construction traffic (traffic management plan), haul road maintenance and landscaping. See Section 5.5.3 for further information;
- avoiding silt deposition, particularly on public roads. This included sediment barriers, stabilised entry/exit points and control of runoff entering or leaving the site;
- site access, construction traffic management, separation buffers and construction staging are all proposed to assist in limiting the potential adverse effects of construction activities; and
- separation between construction and developed areas will be used to minimise interaction between construction and the existing town. In the case of later stages, interaction with the previously completed stages will also be minimised. The separation will provide improved public safety and minimise potential environmental effects, including dust. Further, it is intended to achieve a general amenity within the completed stages of a completed development, so that the whole of the site does not look or feel like it is still under

construction. Staging has been planned to minimise the interaction between stages and each stage is a compact and defined area, in order to provide the opportunity for separation between construction areas and public spaces.

The soil types found on-site are generally sand and limestone with minimal clay content. In addition, construction roads are only prone to the creation of significant dust where they are poorly constructed or the materials are poorly selected. Given the nature of the materials available and appropriate maintenance and construction of haul roads, dust issues are not expected to be significant. Dust can be best controlled by regular light watering particularly in heavily trafficked areas and on hot, dry or windy days. Regular monitoring will be conducted, including visual inspections and assessment of weather conditions, particularly during construction phases.

Once the site is established, air pollution from dust is expected to be negligible as the site will be developed such that there will be no exposed areas of soil left without some form of vegetation cover. Vacant house lots will have plantings to assist in dust suppression.

Air pollution related to activities conducted on the land after construction is not expected, given the general nature of the facilities. Nevertheless, any activity proposed in the future that might result in air pollution will require approvals and be regulated via the normal processes of development assessment and EPA approvals. Such licensing may require air quality impact assessments using design ground level pollutant concentrations (DGLCs), in accordance with the relevant EPA guideline (EPA 386/03).

5.2.31 Provide information on the expected levels of environmental noise associated with the operation of the facility, identifying all potential noise sources, and describe the extent to which these noise emissions can be reduced and contained to minimise effects upon the wider locality.

The following response considers the potential effects of noise as it relates to the existing settlement and wider locality, whilst **Section 5.3.16** considers those potential effects in relation to the uses within the development.

The existing Cape Jaffa settlement is an operational fishing port with associated industrial activities near the waterfront and distributed throughout the settlement where vessels are stored and maintained off season along with the associated storage and maintenance of equipment. The current Development Plan also anticipates the development of industrial facilities to the east of the settlement up to Cape Jaffa Road extending back to Rothalls Road.

This proposal creates the opportunity to relocate the fishing fleet and associated industrial activities within the marina and thereby move the activities and the potential industrial development away from the existing settlement residences. There is also a single dwelling located on Limestone Coast Road approximately 270 metres south of the current Industrial Zone. The proposed Industrial Precinct will be no closer than the current Industrial Zone whilst the fishing fleet will be closer than the existing swing moorings.

An investigation into the existing noise levels of various activities associated with the fishing operations has been undertaken. Further noise levels were also recorded at Lake Butler, Robe. This was considered to be representative of the likely anticipated noise levels associated with the marina facility.

The noise testing that was carried out utilised a calibrated noise level meter to enable comparative assessment between recorded readings. The readings were recorded as an 'A' weighted sound pressure level with 'F' time weighting. Readings were taken at varying distances from the noise source and were taken down wind of the source in order to assess the worst case scenario. Background noise levels were recorded to determine the ambient noise levels at the sites in conjunction with the measurement of noise associated with noise sources including motor boats, rigging etc.

It was found that the ambient noise level on a calm day was approximately 55 dB(A). Environmental noise levels including noise associated with the operation of commercial fishing vessels and recreational motor boat traffic ranged between 65 to 70 dB(A), which is typical of the noise levels associated with commercial activities. These noise levels were recorded at the Cape Jaffa jetty and adjacent the existing urban residential areas surrounding Lake Butler, which is a working fishing port.

From the readings it is considered that the proposed development will produce noise levels similar to other established coastal developments such as Robe. The noise levels recorded are generally in accordance with the EPA requirements on Environmental noise (EPA 424/4, October 2004) for areas classified as Urban residential with some manufacturing industry or with some place of public entertainment or place of public assembly or licensed premises. Motor boat noise and other commercial activities are generally within the limits prescribed for commercial and industrial areas.

<u>Sources and Management of Noise</u>

There are a number of regulatory mechanisms for the control of environmental noise emissions, including *Environment Protection Act* 1993 and associated policies, and the *Development Act* 1993 and associated Development Plan provisions. The following identifies potential noise sources and describes the reduction and containment of these noises to minimise the effect on the wider locality.

Commercial Vessels

The Rock Lobster fleet is operational over a limited period of the year and within that timeframe their activity is not significant as they typically leave port in the early morning and return during daylight hours. Vessels today are typically West Coaster style planning hulls with relatively quiet diesel engines and wet exhaust, as compared to the heavier displacement vessels used in the prawning and tuna industries.

The aquaculture industry requires feed to be transported on a regular basis to the fish rings. The capacity of the industry in this locality is limited by the availability of licence area, nevertheless if this industry was to grow, then more movements would result from feed vessels. These activities, including loading, unloading, fuelling and maintenance of vessels will be controlled to occur during the hours of 7.00 am and 10.00 pm.

The Marina Rules will incorporate operational requirements for the commercial activities within the marina facility.

Rigging

Noise generated due to rigging has also been identified and all vessels with rigging will be required as part of the marina rules to use spar and rigging separators such as shock cord to eliminate slapping and clanging.

Construction

Construction noise generated by individuals for the purpose of building construction will also be covered by the EPA Guideline on Construction Noise (July 2002) and AS 2436 (Guide to Noise Control on Construction, Maintenance and Demolition Sites). Construction noise is discussed further in Section 5.5.4 and the Site Construction Management Plan.

Building Services

Building services noise such as ventilation, air conditioning plants, ducts, heat pumps or plumbing systems will be required to be properly designed and acoustically shielded to prevent unwanted noise in accordance with EPA requirements. Encumbrances or management agreements will incorporate specific provision relating to building services location and emissions.

Transportation

The road network is designed to minimise interruptions to traffic flows. The commercial area is located such that no commercial or industrial vehicle needs to travel through any residential area. At this time, all commercial vehicles servicing the existing fishing fleet, aquaculture interests and the processors pass through a part of the developed Cape Jaffa settlement. This activity has not caused noise problems or conflicts to date.

Leisure Activities

Leisure activities such as jet skiing and waterskiing within the internal waterways will not be permitted, with the exception of transporting the vessel from its berth to the open sea. These circumstances will require users to adhere to speed restrictions, which will reduce the level of noise.

Entertainment Activities

Noise prevention and abatement will be considered during the planning of entertainment activities. This includes the following:

- speakers, amplified music and public address systems shall be directed away from residential areas where possible; and
- avoid directing speakers, musical instruments and systems, and public address systems towards noise sensitive areas or reflective surfaces that direct the sound towards those areas.

Service Infrastructure

All service infrastructure, such as the wastewater treatment plant and water supply, is located in the commercial/industrial area in the far south-eastern extremity of the site. All buildings and structures that house mechanical equipment will be acoustically shielded to contain the noise.

5.2.32 Describe the benefits of the proposal to the local environment.

The benefits to the local environment are numerous, including:

- a significant part of the coastal vegetated dune is currently in private ownership and, as part of this proposal, will be transferred to community ownership to facilitate its ongoing protection;
- the coastal vegetation on the foredune, both that which is currently in community ownership and that which is proposed to be transferred to community ownership, is to be rehabilitated for its protection;
- significant employment and expenditure results from the proposal in three key components of the economic and social environment, these are during the construction phase, the ongoing operation of the developed community, and one off benefits that result in the sphere of influence of this proposal;
- up to date facilities to satisfy the various interests of this community can be provided through a comprehensive scheme;
- greater housing choice can be accommodated in the development;
- is consistent with strategic planning directions;
- reinforces/enhances the fishing and aquaculture industries with greater efficiencies in servicing operations for these industries, thus creating jobs and potential for greater exports;
- provides opportunities to upgrade the fish processing facilities which are limited by land ownership and service infrastructure;
- the creation of a safe harbour in which vessels can be berthed together with the efficiencies to the operators on the water and onshore of direct servicing at a wharf;
- provides better wharf facilities, increasing efficiencies to boat operators;
- reduces risk to vessels on swing moorings in the open sea;
- creates the necessary protected facilities to service the aquaculture operations;
- creates better and safer waste management and fuel handling facilities;
- reinforces and creates new business and economic opportunities and offerings in the tourism industry;
- creates short and long term employment opportunities;

- provides for a coordinated planned growth of an existing coastal port;
- reduces risk of damage to the marine environment from vessels moored in the open sea;
- creates in the long term a greater critical mass to support community infrastructure, i.e. hospital and medical services, and creates greater confidence in the community for services to be provided;
- enables expansion of the tourist park;
- creates a new exciting attraction for tourist and resident communities;
- an improved recreational amenity on the jetty;
- major savings in the short and long term to government if the jetty is downgraded to recreation standard;
- better quality mains water supply to residents;
- new and improved effluent treatment and reclaimed water reuse facilities;
- provision of a vehicle free beach area;
- allows regrowth of seagrass on swing mooring area;
- provides for the removal of swing moorings from the Rock Lobster Sanctuary;
- relocates industrial and commercial activities away from the coast and beach;
- provides a comprehensive integrated plan for the development of the area;
- provides a more detailed design guidance for the development of the settlement;
- enhances safety of mariners by providing safe access and anchorage in all weather conditions;
- better quality habitat for native fauna in the foredune area;
- increased protection of foredune vegetation from foot and vehicular traffic; and
- increased level of weed management in foredune vegetation.

5.3 Effects on Communities

5.3.1 Outline the size and source of the construction workforce and identify how accommodation requirements are to be met.

The construction workforce consists of two main components including infrastructure construction and housing construction personnel.

Table 5.13 below provides details of the expected number of jobs that will arise from both the infrastructure construction and the housing component of the project.

It is also noteworthy that the table presents the broad employment impact in full time equivalents and therefore also includes the workforce off-site that results from the development. This reduces the demand for additional accommodation.

It is expected that the labour force will be found from a combination of sources including:

- local labour (Kingston and the broader South East region);
- the developer's existing workforce;
- Adelaide; and
- Western Victoria.

Table 5:13 Expected Employment
Source: Appendix 24

Estimated Economic Impacts	
Year	Broad Employment Impact (FTEs)
1	12
2	222
3	81
4	73
5	177
6	109
7	113
8	117
9	160
10	121
11	145
12	125
13	125
14	125
15	125

The infrastructure workforce is expected to be sourced initially primarily from Adelaide, with some of the workforce being local. As the project proceeds, it is anticipated that on the job training will allow a progressively larger proportion of the workforce to be sourced locally, and ultimately the entire workforce sourced locally, including some permanent in-migration.

A number of builders and building contractors exist within the region and the development will create significant opportunities for additional jobs in the housing construction industry.

The expected breakdown by percentage is:

- infrastructure construction – 50 percent existing (Adelaide) and 50 percent local labour;

- housing construction – 70 percent imported from Adelaide and other areas outside the region and 30 percent from the South East region, including Kingston.

It is expected that about 50 percent of the estimated workforce changes identified above will come from outside the region and will have their own temporary effects on Cape Jaffa and the broader region. The influx of labour will in its own right stimulate the local economy and have associated multiplier effects.

Housing for the construction workforce can be provided through a number of options, including:

- local tourist facilities, for example caravan parks with cabin style accommodation;
- rental accommodation in Kingston and Robe;
- the purchase of existing housing in Kingston and Robe;
- the construction of new housing in Cape Jaffa, Kingston and Robe;
- an on-site construction camp; and
- owner occupied accommodation, both for the workforce sourced locally and for workforce employed elsewhere who move to the area.

Existing dwelling occupation rates in Kingston, Robe and the Cape Jaffa area are shown in **Chapter 4, Table 4.3**, which indicates that there are about 826 unoccupied dwellings in this area. Although not all of this housing would be available, there is capacity to house a significant proportion of the additional workforce within existing dwellings in the area. In addition, land is being developed at Kingston for housing and there are areas currently zoned for residential purposes at Cape Jaffa that are available for development in the early stages of the project, thus creating further choices.

The creation of a workers camp on-site is also a realistic proposition to accommodate staff should the existing infrastructure be inadequate. It is noteworthy that the peak infrastructure development periods will be during the low season for tourists and therefore there will be significant capacity in the existing tourist facilities at Cape Jaffa and Kingston. The tourist park alone at Cape Jaffa has a total of 42 beds in 10 cabins, of these 32 are normally available during the low season. In addition, there is capacity for an additional four 5 berth cabins, adding a further 20 beds to total 52 beds (pers comm. Lindsay Gilchrist).

These facilities would be valuable for the short term infrastructure construction staff and an economic advantage to the operators of the tourist park during the winter low season. During the peak Christmas and New Year holiday period, when the highest demand is on the tourist accommodation at the park, the construction activities will be at their lowest.

5.3.2 Describe the effect on visual amenity and landscape quality, including the effects of the built form of structures including the breakwaters, earthworks, power lines and impact on the coastal environment.

Current Amenity

The key elements of the landscape at Cape Jaffa are a combination of natural and manmade features. These are the beach and the sea, the vegetated dune, the jetty and the settlement, all of which are located next to a large area of open farm land. The settlement has developed over many years and as a consequence some buildings are outdated in their form and presentation. They therefore do not contribute positively to the quality or amenity of the area. Overall, the settlement does not exhibit a contemporary standard of development, but rather one which has been inhibited in its growth. The most attractive feature is the jetty together with the fishing fleet and the views out to sea.

In terms of the coastline and the sea, there are no single outstanding natural features such as a bluff or headland, cliff or platform which creates a point of focus on the beach and seascape. Indeed, the beach and sea is generally much like that which extends from Cape Jaffa to and beyond Kingston. Focal points or features are the grassed reserve area at the sea front and the jetty which are a focus for residents, visitors, and the commercial fishing and aquaculture operators. The jetty, a structure extending out into the sea and creating opportunities for commercial and recreation uses, is considered by visitors and regular users as an attractive element in the landscape at Cape Jaffa.

The current landscape on arrival at the junction of Cape Jaffa Road and Rothalls Road is dominated by open low lying cleared farmland which is somewhat affected by weeds and does not present as a high quality landscape. There exists a strip of coastal dune vegetation which creates a visual separation between the farmland and the sea, and when viewed from a distance creates a visual barrier to the sea. It is not an outstanding or singularly attractive feature in the landscape and a closer view of these vegetated areas reveals serious infestation of bridal creeper and a general impression of an area somewhat neglected. Refer **Figure 4.17** and **Section 4.6.1**.

There are no outstanding landscape features on this part of the site. Views toward and on arrival at the settlement of Cape Jaffa, whether approaching from Cape Jaffa Road or Rothalls Road, are not momentous nor are they such as to create a strong sense of arrival. There are no built form features of attraction or design to create points of arrival or vistas, however there are areas of crown reserve where once there was native vegetation, which now provide open attractive views to the sea and the jetty.

There has been some attempt at amenity planting along a 200 metre section of King Drive just east of the township. However, some unsuitable species were planted with poor results, and the trees and shrubs were planted in regular rows and spacing thus creating a very artificial arrangement. Care needs to be given to planting suitable species, plants which can tolerate high lime content, low fertility and salt laden winds.

Zoning

It is noteworthy that the current zoning of the land as set out in the Development Plan (Planning SA July 2003) allows for further development as far as Cape Jaffa Road in the east and Rothalls Road in the south, including raising the land to ensure protection from flooding, the development of residential, commercial and industrial buildings, which together will result in a change to the overall character of the area. **Appendix 9** is an extract of selected parts of the Development Plan currently applicable to Cape Jaffa. The mapping depicts the zones and their extent whilst the associated text sets out the detailed policies for each of the designated zones.

The Development Plan sets out a minimum site level for development of 2.4 mAHD and minimum floor level of 2.65 mAHD. Approximately 40 percent of the land is below this level and therefore build up is required. Refer **Figure 4.3**.

Powerlines

The settlement is currently served by an overhead single wire earth return service extending from the north east. There is an existing 11kV overhead supply running parallel to Cape Jaffa Road from the Southern Ports Highway to a point approximately 5.0 kilometres north east of the site. This overhead supply serves the Kreglinger winery activities on the Limestone Coast Road, but does not extend to Cape Jaffa. Should this service be extended, it will continue as an above ground service due to the supply voltage, but be directed underground once it has terminated at the service area at the eastern end of the site. Any on-site supply and distribution will be underground, thus ensuring that electricity infrastructure will not create visual clutter.

Vegetation

Detailed landscape plans for the site will be commissioned with emphasis on reinforcing the natural appearance of the native vegetation. Whenever possible, local native species based on Trees for Life's new Lower South East Coastal Zone will be used. Refer **Appendix 6**. The rehabilitation of the foredunes and the native vegetation is also a key component to enhancing the amenity of this locality. The dunes are also to be properly fenced and designated walkways developed to manage public access.

The current terrestrial landscape is dominated by open low lying cleared farmland with alien species prevalent. Roads leading to the proposed development will have a screen of native vegetation, which will be based on the indigenous plant species reported for the region. This screen will present an attractive, typically Australian entrance. The vegetated foredune is not currently in public ownership but will be set aside as reserve with provision for access to the beach. This area is approximately 14 hectares. The foredune will have the existing strip of vegetation cleared of alien species and reseeded, again based on the indigenous flora of the region, creating a visual separation between the marina development when viewed from the beach. Due to the requirements of the Development Plan there is a minimum site level for development of 2.4 mAHD, which since the indigenous plant species are mostly shrubs rather than trees, will allow for a visual separation of the development from the beach, while allowing sea views from the actual development areas.

Breakwater

The breakwaters will inevitably become a point of focus along the coast, with people wishing to walk on, fish from and use as viewing platforms. They also afford some protection for sections of the beach, thus creating areas which at times will be more usable by the public. The breakwater has a design height of 2.5 mAHD, the same as the pedestrian walkway on the jetty, which height ensures safe pedestrian access at all tides. For comparison, the balustrades on the jetty are approximately 1.2 metres above the jetty footway and therefore the jetty presents visually as a higher construction than the height of the breakwaters. **Figure 5.49** present two photograph composite representations of the breakwater .

Figure 5.49: Cape Jaffa Breakwater

Visual Effects on the Coast

The main visual impact will be from the beach looking towards the breakwater. There are no outstanding landscape features on the site nor are there any built form features of attraction which could be prejudiced by the breakwaters. The view of the long beach will be interrupted locally in a manner similar to that of the existing jetty albeit that the jetty at close range is not a solid structure as is the breakwater. The breakwater will be constructed to allow a walkway along the top and hence allow for an enhanced view along the beach to the west and the east, and views out to sea. The profile of the breakwater will be lower on the upper edge of the beach, thus enabling beach access to the top of the breakwater and views of the dunes and vegetation.

Views from the sea will be similar to those from the beach with the breakwater presenting the major change as a new structure near, in relative terms, to the existing jetty. The marina development will be predominately hidden behind the breakwater, foredune and the dune vegetation..

Inevitably the proposed development will change the visual amenity of the area with the construction of the marina and the development of the residential, tourist, commercial, industrial and recreation facilities. Most of the development will be on the landward side of the foredune with the exception of a small number of allotments and the breakwaters and channel. The design height and elevation of development immediately behind the dunes will result in roofs and upper levels of development only visible from a distance. The cross section in **Figure 3.22** illustrates that the distance from which the first floor elevation of dwellings behind the dune with a maximum ground floor level of 7.5 mAHD is only visible from well over 200 metres offshore. Therefore, the views from the beach looking inland will not change except that the vegetated dunes will be improved.

Conversely, views from the roads and other public spaces through much of the development out to sea and the breakwaters will not be possible. The main exception to this is the central facilities area fronting the main basin where views directly out along the channel allow views of the breakwaters. The other views will be, as they are today, limited by the coastal dune and the associated vegetation. Therefore, the effect on the coastline will be primarily the interruption of the view along the coast, however this effect is localised.

5.3.3 Identify impacts on local amenity, including the potential build up of seagrass on the beach and around the jetty, particularly in terms of odour and pests.

The amenity of an area comprises the features that create the character and ambiance of an area. Many of these features are discussed throughout this chapter including:

- potential visual effects of the development including the breakwater and built form are discussed in **Sections 5.2.11**, **5.2.12** and **5.3.2**;
- landscape plantings are described in **Section 5.2.25**;
- potential noise effects are discussed in **Sections 5.2.31** and **5.3.16**; and
- construction related effects including dust, noise, vibration, traffic, public safety and weeds are discussed in **Sections 5.5.1**, **5.5.3**, **5.5.4** and **5.5.7**.

Build up of seagrass wrack can be a nuisance in terms of odour and the harbouring of pest insects, predominantly midges, as permanent build-up results in a long-term decomposition of the seagrass wrack. In addition, if permanent build-up occurs it can severely and permanently limit access for pedestrians and vehicles on the beach. As permanent build-up is not expected, the general amenity of the beach will be maintained.

At Cape Jaffa, seagrass wrack on the beach is an existing seasonal phenomenon that occurs during the winter with the more northerly winds. The beach is generally cleared of seagrass wrack rather abruptly during spring in periods of combined high tide and southerly winds.

This is expected to continue to occur in much the same manner. None of the geological evidence, excavations, test pits or soil investigation bores at the site indicate that seagrass build-up has occurred in a persistent manner that results in long-term deposition.

Further to the north-east in the head of Lacepede Bay where the beach faces west, persistent build-up of seagrass wrack does occur as the southerly and south-westerly winds are not able to clear the beach seasonally. In addition, the head of the bay is in the path of the wrack from the seagrass meadows throughout the whole of the bay and significantly more deposition occurs in this part of the bay than at Cape Jaffa. See Sections 4.10 and 5.2.13.

The breakwaters have been designed to allow the natural movement of seagrass to continue. They are curved in order to minimise a dead zone in which build-up might occur and if it does occur it is expected to be limited to the area adjacent to the breakwaters. There is not expected to be any change to seagrass wrack on the beach around the jetty. Although not expected to occur, if there is a build up of seagrass wrack, it can be readily removed from the beach for reuse as a soil conditioner. Refer Sections 5.2.13, 5.6.9 and 5.6.16.

5.3.4 Describe how access to the public foreshore and reserve areas will be maintained, enhanced and managed, including loss of uninterrupted access along the beach.

Access to the beach will be enhanced by the creation of public car parking areas and dedicated walkways. A new vehicular beach access will be created at the eastern end of the development to create a zone between the new accessway and the channel, where no public vehicular movement is permitted thus creating a safe beach zone for pedestrian traffic only, with the exception of service and emergency vehicles. Access to the public foreshore and reserve areas is depicted on Figure 3.12

The beach access at the main existing boat ramp will be maintained as a pedestrian access and car park. Currently cleared areas used for parking, occasional camping and equipment storage at the top of the dune will be rehabilitated including revegetation using indigenous species. Although this area has been used as a beach access and for boat launching for many years, the access road, ramp, coastal dune and a portion of the beach is on private land. As part of the development, this will become public land in order to secure long term public access to the area.

The creation of a public walkway reserve between the vegetated coastal dune reserves and residential areas, together with a number of access points to the beach, will enhance public access to the beach and yet allow controlled access in order to limit the potential people pressure on the coastal vegetation.

Numerous public car parks will be created near the beach access points, including near the breakwaters. This will enhance access to the beach for those who do not wish to drive onto the beach. The majority of vehicles access the beach via the existing ramp to the east of the proposed breakwaters, others the ramp on the Cape Jaffa Road reserve, whilst a small number of vehicles access the beach near the jetty from the end of the paved area in front of the fish processors area.

The construction of the channel and breakwaters results in the interruption of a section of the beach. This results in a stretch of beach between the jetty and the channel of about 700 metres.

West of the jetty is a long beach extending around the point of Cape Jaffa southward to the camping ground at Wright Bay a distance of about 15 kilometres. East of the channel and breakwaters is a continuous beach 20 kilometres long to the Kingston jetty. Beyond the Kingston jetty the beach extends to the Coorong and to the River Murray Mouth. In terms of the overall beach environment this interruption is considered minor as there are significant uninterrupted beaches for accessing, walking and enjoying.

People travelling by foot, cycle or motor car who wish to access the opposite side of the channel will need to travel back out to Rothalls Road at the southern extremity of the development and circulate back to the beach. There is no bridge or other means proposed to transport motor cars, cyclists or pedestrians from one side of the channel to the other along or immediately adjacent the beach. Nevertheless, appropriately designed and developed accessways will ensure the quality of the dunes, and the parking and footpath facilities will provide an improved environment for users. Access to the opposite side will require travelling back to Rothalls Road or Cape Jaffa Road and circulating around to the other side of the channel.

For pedestrian and vehicular purposes generally an alternative route is available to access the beach to the east. Overall the facilities for beach access for pedestrians will be considerably improved and the dune areas fenced, pathways formalised and dune areas rehabilitated.

Accessways will also be created behind the dunes, and together with the public road system will connect these major accessways to reserves and the sections of public waterfront in the proposal. In total, there will be approximately 1.6 kilometres of additional dedicated accessways along the coastal corridor for pedestrians and cyclists as a consequence of the scheme. Although there will be an interruption to the beach, the extent of beach directly accessible to the west of the breakwater and channel to the point at Cape Jaffa is significant and measures 1.9 kilometres. Pedestrian access, amenity and safety will be enhanced by the removal of vehicular activity from a portion of the beach and by the partial segregation of pedestrian linkages from the road network.

In terms of management, once the fencing, rehabilitation and walkways have been created and the private land transferred to Council as reserve, the constructed facilities will be handed over to Kingston District Council after the required two year maintenance period where appropriate. Council will then manage the reserve and pathway areas along with their other public land responsibilities.

5.3.5 Outline the traffic generation and truck movements to and from the site and their hours of operation during the construction period.

Construction is expected to occur over a 5 to 10 year period. The most intensive phase being during Stage 1, encompassing the development of the breakwaters, channel, main basin and other major infrastructure facilities. The great majority of construction related traffic will travel to and from the site via the Cape Jaffa Road and Limestone Coast Road. Cape Jaffa Road is sealed whilst Limestone Coast Road is currently sealed up to about 5.5 kilometres from the Cape Jaffa intersection.

The main construction periods are during the summer and autumn to early winter months primarily to avoid the wetter periods. During this period a total of about 50 truck movements per day is anticipated, ie; 25 trips per day to and from the site.

Standard semi-tippers and B-Double tipping vehicles will be used to transport raw materials, pipes, conduit, cement, cable, transformers, fencing, plant and equipment storage sheds, water treatment equipment, pits, and general supplies. Subsequent stages will be less intensive as the head works and major infrastructure works have already been completed.

Hours of construction activity will typically be between 7.00 am and 7.00 pm based on a six day working week. However, in some cases the construction techniques or activities may require continuous shifts which would extend the hours of construction to nightfall. In addition, some maintenance and support vehicle movements will occur. However, these are likely to be infrequent and in most cases will be light commercial vehicles as opposed to heavy vehicle traffic.

An increase in short trips to and from the site to the existing settlement is anticipated given that it is expected that much of the local labour force will reside in the local community whilst construction is underway. The number of these trips is expected to average 80 trips per day (40 round trips).

5.3.6 Describe the implications for public service providers including health, education and recreation to support the development, particularly for the elderly.

<u>Health</u>

The development will reinforce the provision of health and related service infrastructure of doctors, hospital and dispensary facilities in Kingston and Robe, the two most proximate service centres to Cape Jaffa. These towns in the past have experienced some difficulty attracting and retaining professional health workers and associated facilities (pers comm. Kingston District Council CEO), however in more recent times the growth in the area has resulted in the ability to justify and retain the services. This proposal will reinforce the justification for these support facilities.

Retirees and the elderly are choosing to live on or near the coast, and the demographic profile for the region suggest that there will be an increasing need for accommodation for those who have finished their working careers. This development does not affect this process or the demand for coastal living and therefore the development of appropriate areas and accommodation for retirees and the elderly is

an essential part of any urban development. The proposal has considerable capacity to provide a range of housing types and styles to satisfy the varying needs of the community.
Council is proactive in the provision of aged care housing and related support services. There is a steady and growing demand for the range of facilities required for the elderly and this development will gradually provide greater impetus and economic rationale for the development of associated facilities. This is typical and appropriate for a community that is growing and which acknowledges the changing structure and needs of its community. In essence, the proposal will create additional critical mass to ensure a range of services can be provided in an orderly and efficient manner.

There is capacity within the existing hospital and there are proposals for extensions to the general practice facilities in Kingston (pers comm. Kingston District Council CEO).

<u>Education</u>

Similarly, the school facilities at Kingston are under their capacity (pers comm. Kingston District Council CEO) and additional patronage will reinforce their position and ability to serve the educational needs convenient to the population they serve. Other education opportunities also exist to improve and enhance the education offerings in the region with the reinforcement and promotion of the aquaculture industry at Cape Jaffa and the building activity growth resulting from all aspects of the development. Opportunities will also arise for youth employment through apprenticeships and/or skills development resulting from the infrastructure and housing construction activities.

<u>Recreation</u>

The development reinforces an existing and significant recreation focus. Those attracted to the area are often recreational fishers, boat enthusiast or are attracted by the seaside lifestyle. The district has a vibrant recreation club environment with football, netball, golf, bowls and tennis being the mainstream sports. The participation rate, as is the case in many country areas, is high and the infrastructure exists to readily accommodate additional membership. Indeed, the additional membership would reinforce and create more sustainable recreation facilities (pers comm. Kingston District Council CEO). There are numerous informal passive and active recreation interests mostly focussed on the coast. Fishing and boating as a part of this coastal focus is not fully satisfied, in the district and there is a distinct lack of facilities at Cape Jaffa. The proposal redresses these shortcomings and aims to provide state of the art facilities in a safe marine environment with additional opportunities to enjoy the coast.

Many of the recreation pursuits are satisfied in the immediate locality and in the district. Council's Boating Strategy (KDC 2000) and the South East Recreation Sport and Open Space Strategy Final Draft (SGL 2003) also acknowledged the need for facilities in this area. In addition, the local golf course at Kingston is readily capable of accommodating new members as are a number of the other already well supported clubs.

5.3.7 Identify the effects on the existing character of Cape Jaffa.

The key effects on the existing character are:

- change in emphasis of the focal point of the settlement with less commercial/industrial activity at the entry to the jetty;

- creation of a main boat harbour core area with boats on floating pontoons;
- potential long term rejuvenation of the area currently occupied by the fish processing activities;
- change in overall dwelling character with the introduction of more contemporary designs and greater housing choice;
- reinforcement and encouragement of vegetated reserves and open spaces building on the existing spaces established by the community; and
- creation of a larger settlement presence as distinct from the shack area character currently established.

It is noteworthy that many of these changes are likely to occur albeit in a simpler and more conservative fashion as a consequence of the current Development Plan provisions, which provide for the extension of the residential development area, centre facilities, tourist facilities and the creation of a new industrial area extending east to Cape Jaffa Road and south to Rothalls Road. Refer **Appendix 9**.

The proposal will result in a more comprehensive, contemporary, managed and ordered township with greater segregation of functions and facilities developed to better cater for the specific industry needs. It will also create several new points of interest and activity that will provide a more inviting and varied locality.

Notwithstanding these changes, due to the limited size of the development, Cape Jaffa will remain a small coastal fishing village focussed around the fishing industry and the sea. In these respects, the overall character in functional terms will not change.

The introduction of the breakwaters also alters the character of the beach in the immediate vicinity of the breakwaters, however the overall beach and coastline character that extends from Cape Jaffa to Kingston and beyond, and from the jetty west and south around the Cape will not be lost or diminished. The jetty, a man-made feature, is a positive attribute of the character of Cape Jaffa and the features of the development can likewise be positive contributors to the overall character and desirability of the settlement.

5.3.8 Determine the consequences of a safe haven for the recreational and commercial boating fraternities.

The location will be more attractive to the commercial and recreational boating fraternities as there are no facilities with available space on the South East coast of South Australia.

The aquaculture industry has been keenly pursuing the establishment of facilities in order that they can operate safely and efficiently so as not to risk damage to vessels, equipment, personnel, fish or the environment, particularly in rough weather when undertaking maintenance or loading and unloading food or product or refuelling. It will improve the efficiency and hence the economy of operations enormously particularly in relation to feeding and harvesting the fish. At this time, feed is delivered in small bags by utility or truck to the jetty where it is unloaded onto the jetty trolley. It is then railed out to the dinghy and transported in small quantities out to the service vessel, Barry The Barge.

With a new safe harbour, the food can be delivered in bulk and loaded directly onto the feed vessel for delivery to the fish thus avoiding several handling operations. The aquaculture industry is being developed offshore and a safe mooring is likely to encourage expansion of the industry.

Similarly, there are operational advantages having a safe haven for the loading and unloading of supplies and catch for the fishing industry directly at the wharf frontage. A safe haven also provides economic and environmental advantages as vessels are not exposed to rough seas, the risk of breaking a mooring or the spill of pollutants in the sea or on the beach.

There is a small charter fleet also that will benefit from safe calm waters for loading and unloading patrons, refuelling and servicing the charter vessels. Although hard stand areas will be required, there will be less reliance on these areas for winterisation.

Recreational boat users will be afforded greater access to services including wash down facilities, waste services and fuel in a more sustainable manner than is capable of being provided on the beach. A safe haven will result in the facilities at Cape Jaffa being more attractive and therefore may draw users from other locations in the South East. The haven also provides a valuable site for emergency services from which to operate as it can provide all weather access for emergency vessels.

In all of these respects, the safer environment for vessels and users provides their communities and families with a greater confidence and less anxiety whether it is the skipper concerned about the vessel on a swing mooring in a storm or a partner's concern for the safety of the crew.

5.3.9 Outline the impact on existing tourism and recreation infrastructure (eg jetty, boat launching and camping).

There are currently limited facilities for tourism and recreation at Cape Jaffa. The Cape Jaffa Tourist Park is the only existing formal tourist facility and is underdeveloped with limited facilities to cater for the needs of the summer demands. The proposed development incorporates opportunities for expanded and enhanced tourist accommodation to serve the growing needs of the travelling public. The facilities that could be added to the current complement includes additional cabins with full facilities, motel and apartments.

The existing jetty is currently a designated commercial facility and provides access to the commercial fleet for loading, unloading, refuelling and limited servicing. These commercial activities occur principally through the warmer months of the year at the same time as the peak tourist season. Tourists stroll along the jetty, fish and swim from the jetty during the times of the jetty's commercial use. Potential for conflicts between commercial and public activities exist which could prejudice the safety of the public. The opportunity for the provision of a safe all weather wharf area that is considerably less restricted in space would reduce the risk of activity conflicts, whilst maintaining the opportunity for tourists to watch commercial operations in progress. The jetty could then become a recreational jetty under the control of Council and reduce government commitment to this infrastructure.

The existing beach access serves the recreational fishing and boating community and the aquaculture industry to a degree, however the access is not always reliable and the beach becomes busy with cars and boat trailers during summer. The land on which this access is developed is privately owned.

Council has made application for funding assistance to establish a safe and protected boat launching facility at the beach. The proposal incorporates an area for the development of public facilities for the safe launching and retrieval of vessels. The beach ramp would therefore not be required and the boating community and aquaculture industry would be better served.

The breakwaters will add to the recreational experience of the area as they provide platforms for strolling, fishing and sightseeing. There is a stretch of beach from the breakwater extending north east to the proposed new beach accessway which will only allow service and emergency vehicle access and no public vehicle access. This will improve the safety for the pedestrian beach goers and hence the tourist and recreation facilities.

The growing attraction of Cape Jaffa will serve to enhance the existing businesses and enable further expansion of the accommodation offerings, retail facilities and charter operations.

5.3.10 Describe the impact on local and regional land uses (eg viticulture, horticulture and other forms of primary production) from groundwater drawdown or contamination.

Changes to the groundwater in the vicinity of the development are discussed in detail in **Sections 5.2.3**, **5.2.4**, **5.2.5** and **5.2.9**. As outlined in these sections, there are no expected adverse effects on groundwater quality that might affect land use. The effects of groundwater levels changes are discussed below.

Effects of Groundwater Level Changes on Land Use

Extensive agriculture is the dominant land use in the area of potential changes to the groundwater levels as a result of the development. The land is limited in its primary production capacity due to the poor nutritional and structural characteristics of the soils and a propensity to inundation in low-lying areas. Other land uses in the region include forestry, viticulture, conservation and horticulture. Bernouilli Conservation Reserve is a vegetated area along the coast to the south of Cape Jaffa. There is an almond grove south of the Major Development area, a number of wineries about 4.0 kilometres south east, and pine forests approximately 6.0 kilometres south east.

The settlement is predominantly residential although the area zoned for development is more extensive. The caravan park provides tourist accommodation and the commercial activities including crayfish processors are located immediately adjacent to the jetty.

The areas to the east and immediately south of the site are generally low-lying and portions are seasonally inundated. Further south of the site the land rises, resulting in increased depth below ground level to the watertable. In this area, the changes in groundwater elevation are minor and become progressively smaller with increased distance from the site.

The most significant effect of the reduced groundwater levels is expected to be the improved drainage in seasonally inundated low-lying areas. As a result of periodic inundation or very shallow groundwater levels, some areas currently exhibit low agricultural productivity, elevated groundwater salinity or elevated soil salinity. **Section 4.14** presents the salinity of the unconfined aquifer measured in the recently installed monitoring wells. Generally the groundwater in low lying areas immediately to the south and east of the site exhibited greater than 2,000 mg/L TDS, whilst at locations within the site, within the existing settlement and further to the south where the topography rises, salinity was generally lower Refer **Appendix 14**.

After construction of the waterways, land currently subject to seasonal inundation within the groundwater depression zone is likely to be inundated less often or for shorter periods, thus allowing improved agricultural productivity and reduced soil salinity over time. In addition, low-lying areas within the groundwater depression zone will become more suitable for residential or commercial use. In the more elevated areas where the depth to the groundwater is greater, no noticeable effects are anticipated. See **Section 5.2.3** in relation to potential effects of groundwater wells nearby the development.

The horticultural activities are on the periphery of the zone of influence where water level changes are expected to be about 0.3 metres. This land is elevated at 8 to 10 mAHD and the groundwater level is generally less than 1.5 mAHD, which corresponds to approximately 6.0 metres below ground level. Horticultural crops in these areas are generally shallow-rooted and unlikely to be dependant on the groundwater, and in any case the levels changes are small.

The potential impact on the urban activities at the Cape Jaffa settlement is expected to be minor, though poorly drained areas may benefit from reduced risk of inundation. Viticulture and forestry areas are well outside the zone of influence of the development and no effects are anticipated. No significant effect on the dune vegetation is expected following the construction of the waterways as this vegetation is unlikely to be dependent on the groundwater. As development progresses, the ground and surface water conditions in the surrounding areas will be monitored, and water regimes managed as required to ensure minimal effect on the native vegetation.

5.3.11 Describe the planned future use and maintenance of the Cape Jaffa jetty.

Kingston District Council's preferred outcome is that subject to the development of commercial fishing facilities including wharf, fuel and waste management facilities within the development, the jetty should become a recreational facility owned and managed by Council in the same manner as the Kingston Jetty (pers comm. Kingston District Council CEO). Refer **Sections 5.3.12**, **5.3.15**, **5.4.4**

The jetty would then be used exclusively for recreational purposes such as walking, sitting, fishing and general resident and tourist use.

5.3.12 Outline the effects of removing commercial activities and loadings on the Cape Jaffa jetty.

As noted previously, Council have indicated that removal of the commercial activities is only a viable option if the development proceeds. However, it is also recognised that the current practices may not meet EPA or best practice guidelines for the safety and operation with respect to the jetty as a commercial facility.

The removal of the commercial operations from the Cape Jaffa jetty immediately reduces the risk of marine damage that could result from a major spillage from a vessel or the fuel facility if it were for example hit by a vessel that had broken its mooring. The jetty is not in good condition with numerous areas requiring attention, such as piles and decking members. The jetty is the subject of review by Transport SA, which manages the jetty (pers comm. Kingston District Council CEO). Removing the commercial operations and the associated loads and the jetty's redevelopment for recreational use will ensure the long term enjoyment of the jetty by the general and travelling public.

There is also potential conflict between the commercial uses and tourists, and there are safety issues with the current arrangements for the transport of bait and catch along raised rails on the jetty. The jetty is narrow and little room is available to separate the different users.

As described above in **Section 5.3.11**, if the transfer of ownership occurs, Council would be responsible for the maintenance and liability of the structure. To minimise liability, Council could remove all infrastructure associated with commercial activities, ie; fuel pipework, reticulated water supply line, and the rails and rail cart. This would reduce the superimposed loading on the structure, which may increase the serviceable life of the jetty.

5.3.13 Describe the land tenure arrangements for the marina and the opportunities for commercial, private recreational or public access to berths, launching facilities or other associated facilities.

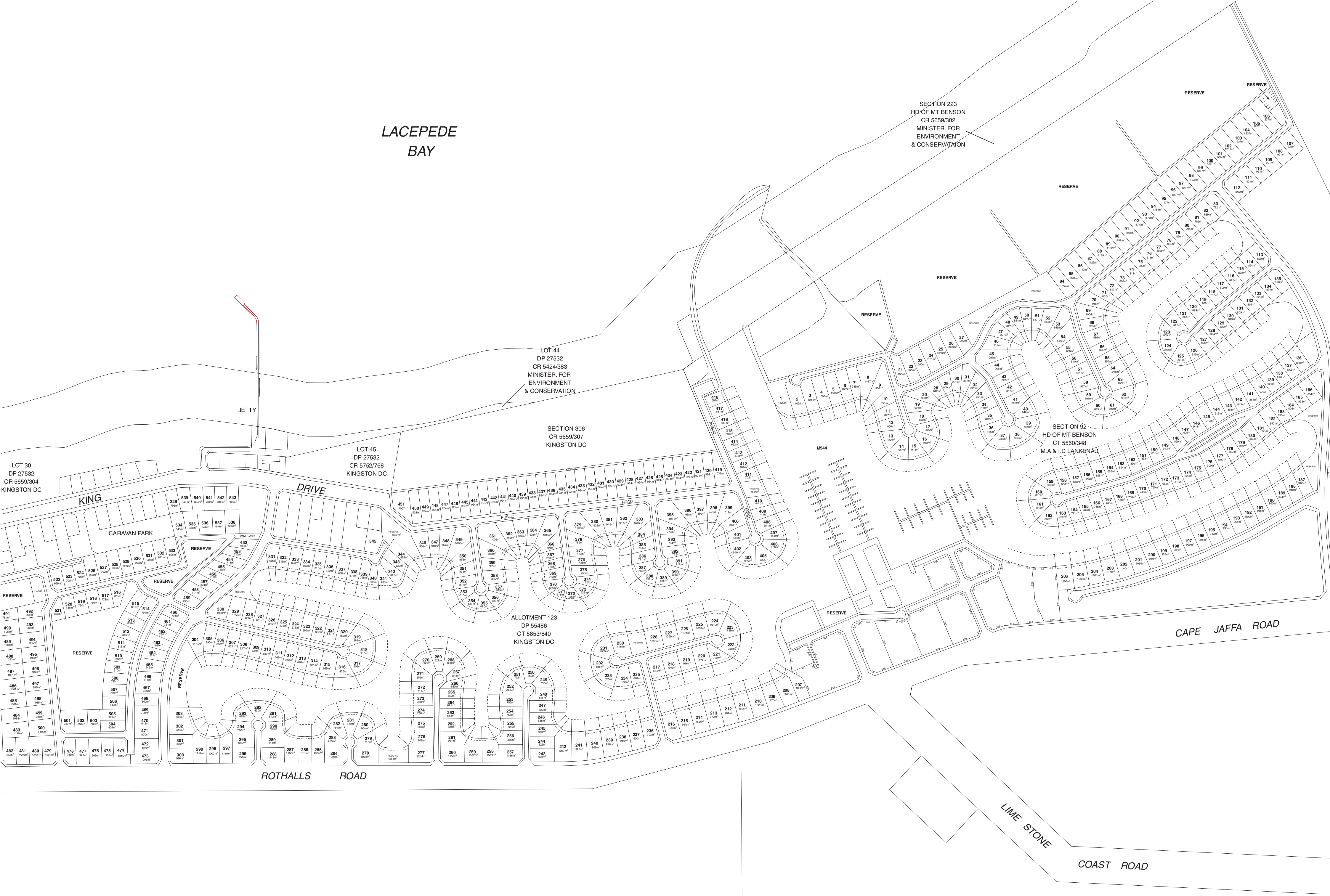
The marina will have a combination of tenure arrangements to satisfy a range of needs including residential, tourist, retail, commercial and industrial activities that surround and relate to the waterways. The marina berth facilities will most likely be established as community titles with detailed scheme descriptors to ensure their development, management and maintenance. Access to other associated facilities will also be available through the services of a marina manager. The manager will also be employed to manage the facilities in accordance with licensing and other statutory requirements. All users of the facilities will be required to meet a standard set of requirements in terms of insurance, activities undertaken and charges paid. The general arrangement for these features are set out below and on **Figure 5.50**.

<u>Commercial Berths</u>

The commercial operators will be able to purchase or lease a berth from a Community Title Corporation or similar authority responsible for the berths and their operation. Arrangements have been made for the Council to purchase at market value, berths to ensure they are available to the fishing fleet. This facility will be developed according to market need. To date registrations for 21 of these berths have been recorded.

<u>Recreational Berths</u>

Recreational berths will also be established within the main basin for those users who require a berth separate from any other property at Cape Jaffa. This facility will be established as a Community Title and therefore will be available for purchase in the first instance with any additional berths available for lease or short term rental. This facility will be developed according to market need. A number of spaces will be available for visitors on a short term rental basis. Some of this demand is will occur during the holiday period when visitors wish to leave their vessels in the water for the duration of their



20m Allotment Channel

4m Easement

Residential Waterfront Allotments

These allotments extend out into the water of the waterways. This extension is for the purpose of accommodating berths and associated facilities for the mooring of vessels. These areas will be the subject of agreements that ensure the design, development, management and maintenance of these areas and facilities therein. A manager will be employed to manage the facilities in accordance with licensing and other statutory requirements.

Commercial Waterfront Allotments

A small number of commercial allotments may have allotments extending out into the water. This extension is for the purpose of accommodating berths and associated facilities for the mooring of vessels only and related equipment. This may only be possible in the area directly associated with the commercial/industrial area of the development.

Launching and Related Facilities

The scheme incorporates the potential for the development of a public boat ramp and area for the retrieval of larger vessels and wharf area. The public boat ramp facilities are the subject of an application by Kingston District Council for funding from South Australian Boating Facilities Advisory Committee (SABFAC), and the other launch and retrieve facilities are subject to market interest and funding. The public boat ramp will be made accessible to the public for access in the same manner as the Kingston ramp and will be developed by Council held in Council ownership.

Navigable Waterways

The areas of the development set aside for the passage of vessels including the channel area within the breakwaters and the waterways will remain in the ownership of Council as these areas will be controlled and managed by Council. **Figure 5.50** shows the land tenure for the development in generic terms.

5.3.14 Outline the location and availability of public facilities including telephones, toilets, showers and the lighting of public areas.

It is intended to provide an additional public telephone near the waterfront adjacent to the main public wharf, office and tavern area. Council proposes to maintain public toilets at the waterfront near the jetty and similarly another public facility will be established at the public wharf central facilities area. These facilities will be created as a part of the total provision of toilet and shower facilities for private and public users of the marina berths and commercial enterprises in the public wharf area.

Lighting of public areas will be entirely consistent with the theme established for the whole of the development. Lighting will be established to meet the criteria for public safety and convenience along the public wharf front and in car park areas. Lighting will be established along the marina walkways and at entry gateways for safety and security.

Public reserves are also provided around the development in key locations to provide visual and pedestrian access to beaches, the waterfront and between localities.

5.3.15 Describe the benefit and amenity improvements due to infrastructure changes.

The infrastructure changes are numerous and there are consequential benefits to the amenity of Cape Jaffa as set out below.

Power

The provision of a new power supply will result ultimately in all powerlines around the development being underground thus avoiding above ground wires and poles, and accordingly producing a more attractive visual amenity. The power supply will also enable the removal of a number of generator sets located around the settlement, which are employed on a regular basis when the limited power cuts out. This will result in noise from generator sets to be minimised together with the associated fumes.

With a better, more reliable power supply, a number of the facilities are more likely to be upgraded and hence improved visually.

Water

The provision of a public water supply will result in improved quality of water available to the community, which currently relies on rainwater and groundwater. Groundwater is currently used for domestic purposes and the risks associated with the combined effect of the existing effluent disposal into the aquifer and the existing domestic use of groundwater from the same aquifer will be mitigated. In addition, the existing use of groundwater from the unconfined aquifer may not be sustainable. The long term expectation is that the settlement will be served by a treated water supply which will produce a healthier environment and improved amenity.

Effluent Treatment

A full sewer system is proposed, which ultimately has the potential to serve the existing settlement. Once effluent is collected and treated, the potential risks to public health and the coastal environment is reduced. The current Development Plan provisions accommodate the further development of the settlement and concepts have been prepared to determine the development potential. The Residential Zone has the capacity to accommodate a further 146 allotments or thereabouts each with a minimum size of 1,000 square metres. The Industry Zone accommodates a further 26 allotments averaging about 4,000 square metres and an area within a Local Centre Zone of about 6,000 square metres. This has the potential to produce a significant flow of effluent into the shallow groundwater and the nearby coast. The collection of this effluent and its treatment for beneficial purposes will result in great improvements to the amenity of this locality.

The beneficial use by the reclamation of the water from the effluent will also result in the potential improvement in the visual amenity of the receiving environment, whether the immediate locality in the open low productivity grazing land by the creation of greener pastures or crops or alternatively the establishment of woodlots or vegetated park areas.

Telecommunications

The additional number of residences will likely result in improved telecommunication facilities at Cape Jaffa.

Safe Haven and Harbour

The operating environment for the professional and recreational fishers and boat users will be enhanced through the provision of a safe haven and harbour in which to launch, retrieve, moor and operate vessels. The facility also creates a safe place from which emergency services can operate. These features produce a better, safer, more enjoyable and reliable amenity for all of these users.

Visual Amenity

Amongst other benefits, the creation of a marina and waterway that provides a focus for commercial and recreational activities is generally perceived as attractive and desirable in amenity terms. The extent to which these facilities are desirable is measured against the environment in which these changes will take place. Cape Jaffa is one of the five designated southern ports and the only port without some physical protection for the fishing fleet, other than the natural protection afforded by the Cape itself.
Various general benefits of the development to the local environment are identified in Section 5.2.32.

It should also be noted that a significant portion of the development land is currently zoned for residential and commercial development, and that development is likely to occur regardless of this proposal. This alternate development scenario would likely proceed in a less orderly manner and without the benefit of improved infrastructure such as reticulated sewerage system and town water supply. Compared to the alternative, this development proposal will result in significant benefits to the existing community and general amenity of the area.

5.3.16 Identify all sources of noise from the operation of the development and describe attenuation measures to minimise the impacts of potentially incompatible uses.

Potential noise sources have been identified in Section 5.2.31, which describes the reduction and containment of these noises to minimise the effect on the wider locality. The following discussion considers attenuation to minimise potential incompatibles.

As a working port, it is also appropriate to acknowledge the need to provide a balance between the needs of industry and residents. The port activities produce noise in various forms and at varying times, which are essential for its efficient operation.

This recognition can be accommodated in several ways including:

- incorporation of information about the activities of a working fishing port in the marketing information for the purchase of all land;
- the application of minimum specifications for sound attenuation in the design and construction of dwellings in areas immediately abutting the main basin;

- formal acknowledgment that some operational noise from the fleet may result from time to time; and
- the control of activities and the times of those activities on the commercial wharf.

Environmental Noise Controls

There are a number of regulatory mechanisms for the control of environmental noise emissions, including the *Environment Protection Act* and associated policies, and the *Development Act* and associated Development Plan provisions. The following measures are control strategies that can be applied to noise generating activities to limit, control or abate noise levels affecting noise sensitive locations.

Time Limits

Time limits are applied to activities that may generate intrusive environmental noise at neighbouring properties, external to the site. Time limits will vary depending on the nature of the activity. However, in all circumstances, no noise that can be heard inside a habitable room at a noise sensitive location will be generated during the night time period (10.00 pm to 7.00 am).

Noise Level Limits

Noise limits are applicable to certain activities that may generate intrusive environmental noise at sensitive, surrounding properties and during sensitive times. Noise limits will vary depending on the nature of the activity and time. For activities not listed in this procedure, the sound levels shall not be intrusive at any noise sensitive locations.

Designated Areas

Some activities due to their expected noise levels shall be restricted to defined locations in the site to distance the activity from noise sensitive locations and/or take advantage of existing structures and/or landscape to abate noise levels.

Acoustic Barriers

Acoustic barriers will be incorporated primarily for fixed machinery and plant with identified attenuation requirements. Acoustic barriers will include the following:

- acoustically treated walls to absorb noise;
- enclosed rooms or cases for stationary machinery such as central air conditioning units and compressors; and
- noise attenuated equipment (mufflers, etc).

Natural Barriers

Trees, grass and all other forms of vegetation will be maintained and/or developed at the site to:

- act as natural noise barriers for direct emission from the site; and
- act as barriers to noise reaching reflective surfaces.

Noise Enforcement

The marina rules incorporate operational requirements in relation to minimising the effects of noise, including hours of operation, speed limits, and loading and unloading. These measures are further discussed in Section 5.2.31. The Marina Manager will be responsible for the enforcement of the marina rules. These are in addition to the statutory requirements and policing provisions.

5.3.17 Describe the impact of groundwater drawdown or contamination on the source and use of domestic water.

The potential effects of drawdown, saltwater intrusion or other contamination on existing groundwater users, including domestic users, have been investigated at various stages of the project including:

- during dewatering of Stage 1 excavations;
- at completion of Stage 1; and
- at completion of the project.

Changes to the groundwater levels and location of the seawater interface near the waterways are discussed in more detail in Section 5.2.3.

Figure 5.51 illustrates the location of existing registered wells, their depth below ground level, and the development concept. Figure 5.52 shows the registered use of the existing groundwater wells.

<u>Effects of Establishing Basins and Channels</u>

Section 5.2.3 details the potential effects of establishment of the waterways on groundwater quality and quantity, and these are outlined below.

Dewatering during construction will result in temporary lowering of groundwater levels in the immediate vicinity of the dewatering activities. The potential groundwater changes that result from the establishment of Stage 1 have been shown to be negligible and Stage 1 poses no threat to existing groundwater users. The effects of other stages located away from the existing settlement are also expected to be very limited.

In the long term, the completed project will result in lowering of groundwater levels in the vicinity of the waterways. Nearby existing wells will experience level changes less than about 0.6 metres and the wells within the existing Cape Jaffa settlement will experience level changes less than about 0.2 metres. The changes in groundwater levels results in corresponding reduced available head for extraction. As the changes are small, they are expected to have no noticeable effects on yield from existing wells. In addition, the groundwater level changes are small compared to the existing seasonal level changes in the unconfined aquifer, which have been recorded by Department of Water, Land and Biodiversity Conservation (DWLBC) in nearby regional observation wells as being up to 1.3 metres and generally between 0.5 and 1.0 metre, as described in Section 4.14.9.

Figure 5.9 shows the expected change in groundwater levels that result from the completed development and also shows the nearby registered groundwater wells.

It is expected that the proposed development will result in changes to the existing seawater interface within the unconfined aquifer. The nature and location of the existing seawater interface is discussed in detail in Section 4.14.11 and the effects of establishing the waterways on the location of the seawater interface is discussed in detail in Section 5.2.3.

Active seawater intrusion is not expected to occur other than for short durations in localised areas during dewatering. This is not expected to adversely affect the groundwater nearby the development. The effects are minimised by staging the construction of the waterways to reduce the duration, extent and depth of each dewatering event.

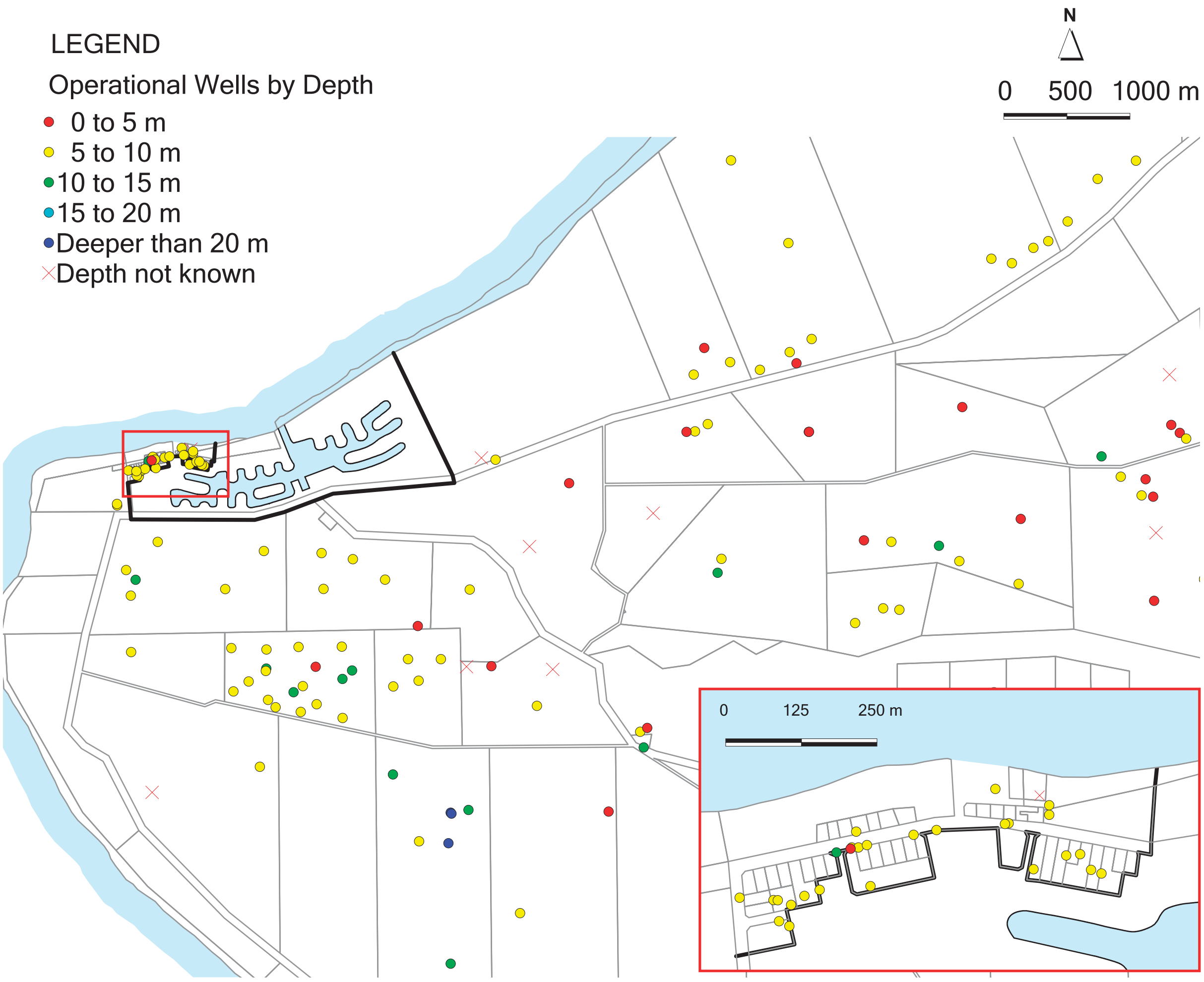


Figure 5.51: Registered Groundwater Well Depth
Source Data: PIRSA groundwater wells database July 2003

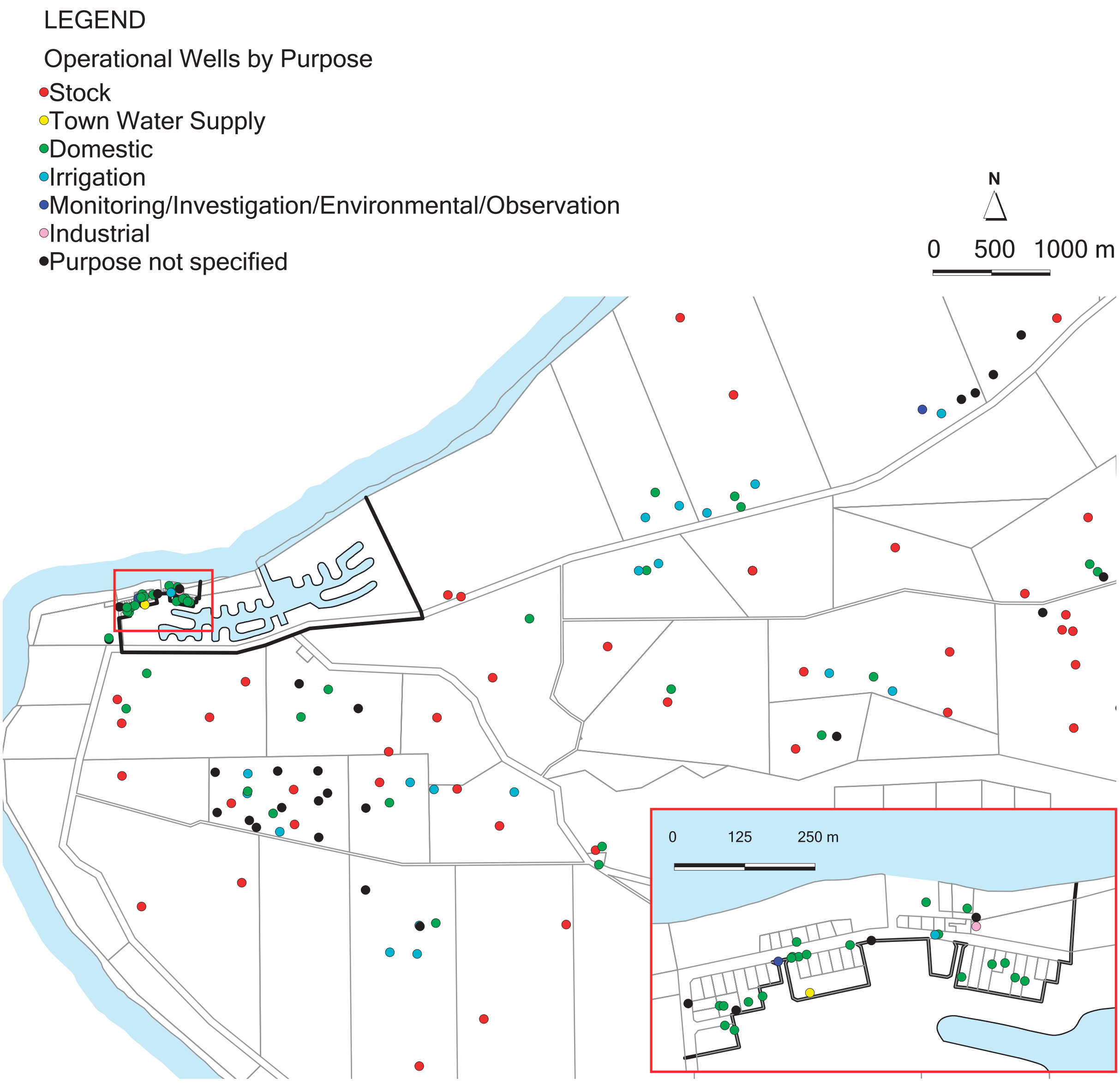


Figure 5.52: Registered Groundwater Well Use

Source Data: PIRSA groundwater wells database July 2003

The wells at the eastern end of the Cape Jaffa settlement will be located on a peninsula between the waterways and the coast, and groundwater extraction in this area is likely to be effected by seawater intrusion over time. At the western end of the Cape Jaffa settlement, the seawater interface will shift upward to extend into the aquifer at a shallower angle. Existing wells at the western end of the Cape Jaffa settlement are subject to increased risk of seawater coning, depending on extraction rate, depth and location, and the potential effects progressively diminish to the west as the distance from the waterways increases. Adverse effects of seawater intrusion on existing groundwater uses within the remainder of the locality are unlikely. An assessment of the separation between the seawater interface and the existing wells is provided in **Section 5.2.3**.

Ongoing monitoring and assessment will be undertaken during the first stages of the development prior to the later stages of construction of waterways.

The staged construction of the waterways minimises risks to the groundwater environment and nearby groundwater users as it minimises the zone of influence around each stage of the waterways and locates early stages away from the existing groundwater users. Monitoring and mitigation measures including the extension of the town water supply to the existing settlement are described in Section 5.2.3, 5.2.10, 5.2.23 and 5.4.9. This allows mitigation of any risks well in advance of their possible occurrence.

The modelling and analysis undertaken is sufficiently accurate to allow planning and assessment of the effects of the waterways and shows that the effects are limited to the immediate vicinity of the waterways. See Section 5.2.3 for further details.

Groundwater Quality Effects

Further to the discussion on potential contamination from the establishment of the waterways presented above, potential contamination from other sources has been assessed. Overall, it is likely that the development will result in reduced contamination of the aquifer and improved groundwater quality.

The provision of an alternative effluent disposal option for the existing development minimises the risks associated with the combined effect of the existing effluent disposal into the aquifer and the existing domestic use of groundwater from the same aquifer, as discussed in Section 5.2.4 and 5.2.20. The existing groundwater has elevated levels of various compounds that are cause for potential concern in relation to its domestic use, and the existing groundwater quality is discussed in Section 4.14. The provision of a town water supply also mitigates these risks. Refer Section 5.2.21.

Although some minor nutrient loading from the use of garden fertilisers is expected, this is not anticipated to be significantly different to that associated with the previous agricultural use of the land. See Section 5.2.9 for a discussion on some of the other potential effects on the groundwater quality.

It should also be noted that a significant portion of the development land is currently zoned for residential and commercial development, and that development is likely to occur regardless of this proposal. This alternate development scenario would likely proceed in a less orderly manner and without the benefit of a sewerage system or town water supply, thus resulting in increased contamination from septic tank effluent disposal in the aquifer together with an increased dependence on the unconfined aquifer for domestic water supply. Compared to the alternative, this development proposal will result in a significant reduction in contamination of the unconfined aquifer.

5.3.18 Determine the effect of losing the current entrance road to the town (King Drive) for local residents and visitors.

The development and relocation of the entrance road to the existing settlement will result in benefits by redirecting much of the traffic away from residential areas. In particular, movements associated with commercial fishing activities will now be directly via Cape Jaffa Road, rather than past residences. The 'Jetty Precinct' will be provided a more direct route from Rothalls Road. The existing access to the western part of the settlement will be maintained via Rothalls Road.

There is currently no significant sense of arrival at the settlement travelling along King Drive. There is no visual focal point, except that the removal of foredune vegetation now allows a view out to sea and the jetty to the north or right once abreast of the first houses of the settlement. Given the Development Plan arrangements for the further development of Cape Jaffa, speed limits will be reduced in the area and further development will occur along King Drive resulting in changes in the visual presentation along King Drive.

In terms of movements to and from the settlement, fewer commercial vehicle movements associated with the fishing and aquaculture activities will result. These will go direct to the commercial area from Cape Jaffa Road thereby reducing the impact of commercial activities on the existing settlement area. Directional signposting will need to be revised to reflect these road changes. Access to the beach will be maintained via the realigned King Drive. This will also provide access to the western breakwater. Access to the existing caravan park will be maintained via Rothalls Road or the new connector.

Access to the beach areas east of the breakwater will be maintained via the proposed 'collector' road in the eastern part of the development together with a car park and walkway.

Overall, the redevelopment of road infrastructure at Cape Jaffa presents an opportunity to reduce the effects of commercial and industrial traffic, enhance the streetscapes leading to the settlement, and provide a new collector road and a sense of arrival to create a memorable first impression of Cape Jaffa. The travel distance to the existing township is essentially the same.

5.4 ECONOMIC ISSUES

An economic analysis has been undertaken as contained in **Appendix 24**, the relevant content of which has been incorporated in response to the various economic issues raised.

5.4.1 Outline the opportunity for tourism and investment in the area from the development.

It is expected that the development will be a major stimulus to tourism and investment in the Cape Jaffa and broader Kingston region and is expected to create investment opportunities for existing and new businesses in Kingston, the nearest service centre. Tourism assets of this nature add value to the existing attractions of the region and it is expected that the project will attract tourists who would normally visit the Limestone Coast region and new visitors to the region. Potential tourism and other investment opportunities associated directly with the development are detailed in **Appendix 24** and outlined below.

Caravan Park Redevelopment – potential exists for the caravan park to double in size, incorporating an additional 30 cabins, 30 to 40 caravan sites and up to 50 camping sites. The direct economic impact of such a development is estimated at about $1 million (development costs) with an ongoing employment impact of two full-time equivalent (FTE) persons.

Motel/Serviced Apartments – consistent with most marina/coastal projects, potential exists for a motel comprising serviced apartments to be established at Cape Jaffa. The estimated development cost is $5 million for up to 20 units. This would also result in increased employment of two FTE persons.

Multifunction Facility – current project plans anticipate the establishment of a tavern/café at the Cape Jaffa Anchorage site in association with a range of other facilities including, for example:

- Marina Management/Administration/Marketing;
- Kiosk;
- Tourism Information Centre; and
- Local History Centre.

It is estimated that an initial investment of $400,000 in the first stage could employ up to three FTE persons.
Winery Value Added – the increased regional activity and tourism demand creates opportunities for the existing wineries to develop and offer additional services such as accommodation and cellar door services. Potential investment is estimated to be up to $2 million with a possible two FTE persons.

Fishing Charters – to cater for increased tourism, it is anticipated that fishing charter services could be established/expanded requiring an investment of up to $250,000 and employing two FTE persons.

Housing Construction – with the demand for additional workers during the construction phase of the project, there is expected to be a need for additional accommodation which may stimulate further housing construction in the Kingston district. Estimated investment is up to $3 million and 19 FTE persons.

Aquaculture Industry Development – the regional aquaculture industry is expected to receive a significant boost from the Cape Jaffa development. The potential is estimated at $2.6 million per annum and 31 FTE jobs. This industry and associated opportunities is addressed in detail in **Section 5.4.6**.

5.4.2 Identify employment and investment opportunities, including the "multiplier effect".

Introduction

The report in **Appendix 24** details employment and investment opportunities including 'multiplier' impacts as measured by employment and value added components incorporating salaries, wages and profit. These impacts cover all aspects of the project including the construction and operational phases. All economic impacts are taken into consideration which includes those employment and investment opportunities that might arise as a consequence of the project.

The multiplier or downstream impacts are important in the context of total regional and State wide impacts and hence value of the project. They recognise that there will be 'leakage' of expenditure associated with the project to other regions including Adelaide, the South East and possibly Western Victoria, and that the economic impacts reach further than the immediate region.

Project Contribution to Economic Development

The development has the potential to provide a major economic stimulus to Kingston and the South East region of South Australia as a residential, tourism and commercial project. A model has been developed to assess the economic impacts, and an input-output methodology has been employed to assess the impact of the development on the regional economy in terms of potential jobs and incomes as provided in tables below.

Job and income creation are critical elements of the social agenda for economic regions. Economic and social development is intertwined and there is a very strong correlation between economic growth and social indicators, for example unemployment and crime rates.

The direct impact of the project is the value added and employment contribution associated directly with the expenditure, for example the labour and profits involved in construction activity. The indirect impacts are those associated with suppliers to the construction services and the expenditure of wages. The following construction multipliers are indicated from the input-output tables for the South East region of the State, as developed by the South Australian Centre for Economic Studies.

Table 5.14: Construction Multipliers
Source: **Appendix 24**

South East Region Construction Sector Multipliers (1995/1996)	
Employment ($'000)	0.027
Value Added ($m)	1.5251

The above multipliers mean that $1 million of construction output (in 1995/1996) results in the employment of 27 persons, directly and through the multiplier effects. The value added, salaries, wages and profits associated with $1 million of construction output would therefore be $1,525,100.

Development Phase

The economic contribution by the project during the development phase will depend on the final nature and scale of the project. For the purposes of the EIS and economic assessment, the assumptions in **Table 5.15** are made based on information provided by CJDC.

Based on the above assumptions and economic multipliers, the estimated annual economic impacts are Set out in **Table 5.16**. An inflation factor of 2% per annum has been applied to account for inflation since 1995/96.

There are potentially high employment and value added benefits that the project could generate for the region and South Australia. During the development phase, employment associated with the project is expected to peak at 222 FTEs with value added reaching $21 million.

Table 5.15: Development Schedule
Source: Appendix 24

Year	Major Construction Capital Expenditure (ie: Marina) ($2003)	Roll Out Capital (ie Roads, etc) and Maintenance Expenditure ($2003)	House Construction Numbers	Housing Construction Value ($2003)
1	$542,000	$0	0	$0
2	$9,656,842	$4,300,000	0	$0
3	$1,773,754	$2,700,000	10	$1,750,000
4	$28,400	$1,215,519	18	$3,150,000
5	$3,686,837	$1,215,519	23	$4,025,000
6	$14,200	$1,215,519	27	$4,725,000
7	$14,200	$1,215,519	28	$4,900,000
8	$0	$1,215,519	29	$5,075,000
9	$1,876,476	$1,215,519	29	$5,075,000
10	$0	$1,215,519	30	$5,250,000
11	$898,657	$0	31	$5,425,000
12	$0	$0	31	$5,425,000
13	$0	$0	31	$5,425,000
14	$0	$0	31	$5,425,000
15	$0	$0	31	$5,425,000
Totals	$18,491,366	$15,508,634	349	$61,075,000

Table 5.16: Estimated Economic Impacts
Source: Appendix 24

Year	Broad Employment Impact (FTEs)	Value Added Impact ($)
1	12	$827,000
2	222	$21,286,000
3	81	$9,492,000
4	73	$6,701,000
5	177	$13,615,000
6	109	$9,082,000
7	113	$9,348,000
8	117	$9,594,000
9	160	$12,455,000
10	121	$9,861,000
11	145	$9,644,000
12	125	$8,274,000
13	125	$8,274,000
14	125	$8,274,000
15	125	$8,274,000

The Operational Phase

The economic contribution by the project when operational will also depend on the nature and scale of the final development. The following economic outcomes are expected as identified by Hudson Howells (2004) over and above the development impact:

- expenditure by new residents on local goods and services - there will be an average population increase in the order of 600 persons upon project completion based on approximately 400 housing units, a lower than average number of occupants per household due to retirees, and an adjustment to account for holiday houses. Based on the median weekly household income of $500 (ABS 2001) and assuming an initial leakage of 50%, it is estimated that there could be an injection into the regional economy of up to $5.2 million per annum;
- increased tourist visitor numbers, lengths of stay and expenditure in the region - 2002 data is available for the Limestone Coast region and is summarised below:
  - total day trips – 681,000.
  - total overnight market – 652,000.
  - total visitor nights – 1,714,000.
  - average spending by domestic overnight visitors - $83 per night.
  - average spending by day trip visitors - $85 per visit.

  If it is conservatively estimated that the Kingston/Cape Jaffa region attracts an additional 5% of existing day trip visitors for one day, as a consequence of the project and improved tourism promotion. It is estimated that this could result in an injection into the local economy of $2.9 million per annum.
- an expanded professional fishing and aquaculture industry operating from the region with a potential $1.8 million investment in plant, equipment and facilities leading to an increased output of $3 million per annum within three years;
- increased recreational boating, including expenditure on facilities based on Council and State Government funding;
- new business investment opportunities in, and in proximity to the development including:
  - caravan park redevelopment – estimated direct economic impact of such a development is $1 million (development costs) with an ongoing employment impact of two FTE persons;
  - motel/serviced apartments – estimated development cost is $5 million plus two FTE persons;
  - multifunction facility – estimated initial investment of $400,000 employing up to three FTE persons;

- winery value added – potential investment estimated to be up to $2 million and two FTE persons;

- fishing charters – estimated investment of up to $250,000 and employing two FTE persons; and

- housing construction – estimated investment of up to $3 million and 19 FTE persons.

The overall economic impact of the development in full operation can only be estimated as the nature of future tourism and other industry development is unknown. Also, longer term strategies of the proponents will contribute significantly to such impacts. However, as already noted, the input-output tables for the State's South East region provide multipliers across a broad range of industries. The following regional value added and employment multipliers for the effected industry sectors have been extracted from the 1995 to 1996 tables.

Table 5.17 South East Region Economic Multipliers
Source: Appendix 24

Sector	Employment Multiplier per $1,000	Value Added Multiplier ($)
Wholesale and Retail	0.02667	1.2098
Construction	0.02793	1.5251
Fishing/Aquaculture	0.01214	0.8519
Wine	0.01652	0.9967

Therefore for every $1 million injection from tourists and residents, the regional economy would benefit by:

- An additional $1,209,800 in value added (salaries, wages and profits).

- An additional 22.7 total jobs per annum (adjusted for inflation).

The economic impacts for the operational phase of the project are set out in **Table 5.18** below.

Based on the range of assumptions and South East region multipliers detailed above, it is estimated that the project will have the following operational economic benefits over and above the construction phase benefits previously identified:

- Additional Once Only Employment Impacts from Construction and Investment Activity – 311 FTE jobs;

- Additional Once Only Value Added Impacts from Construction and Investment Activity – $21.4 million (salaries, wages and profits);

- Ongoing Employment Impacts from New Residents, Tourists and Increased Industry Output – 215 FTE jobs per annum; and

- Ongoing Value Added from New Residents, Tourists and Increased Industry Output – $12.4 million per annum (salaries, wages and profits). Refer **Table 5.18**.

These benefits demonstrate the significant economic impact that the project will have on the region, and support the assumptions made earlier regarding new investment and employment opportunities associated with the project.

Table 5.18 Estimated Operational Economic Impacts
Source: Appendix 24

Item	Employment Impact FTEs	Value Added Impact ($)
New Resident Expenditure - $5.2 million pa	118 FTE jobs pa	$6.3 million pa
Increased Tourism Expenditure - $2.9 million pa	66 FTE jobs pa	$3.5 million pa
Potential Increased Aquaculture Output - $3 million pa	31 FTE jobs pa	$2.6 million pa
Potential Aquaculture Plant and Equipment Investment - $1 million	22 FTE jobs - once only	$1.5 million - once only
Potential Aquaculture Construction Investment - $800,000	18 FTEs - once only	$1.2 million - once only
Construction of Recreational Boating Facilities - $600,000	14 FTEs - once only	$0.9 million - once only
Caravan Park Redevelopment - $1 million	22 FTEs - once only	$1.5 million - once only
Motel/Serviced Apartments - $5 million	110 FTEs - once only	$7.6 million - once only
Multifunction Facility - $400,000	9 FTEs - once only	$0.6 million - once only
Winery Value Added - $2 million	44 FTEs - once only	$3.1 million - once only
Fishing Charters - $250,000	6 FTEs - once only	$0.4 million - once only
Additional Housing Construction - $3 million	66 FTEs - once only	$4.6 million - once only

In summary, the following investment and employment opportunities are anticipated:

- full time equivalent employment varies during construction ranging from 12 in year 1 to 222 in year 2 with associated value added impact. Refer Table 5.16;
- operational benefits on completion of 400 housing units are $5.2 million per annum into the regional economy;
- tourist visitation is estimated to create an injection of $2.9 million per annum;
- expansion to the fishing industry with potential for investment in plant, equipment and facilities of $1.8 million leading to an increased output of $3 million per annum by 2006;
- increased recreation boating expenditure of $600,000; and
- new business investment - for every $1 million injected from tourists, the residents boost the regional economy by:
    - $1,209,800 in value added components (salaries, wage and profits).
    - an additional 22.7 total jobs per annum.

5.4.3 Outline the potential for the development to attract and enhance the business operations of other allied industries and commercial ventures.

Existing tourism and commercial businesses, for example caravan park, retailers, wineries and service providers, will all have opportunities to benefit from increased demand associated with new tourists and residents. Other industries, for example fishing, aquaculture, and allied industries, will benefit from improved infrastructure associated with the development.

Importantly, the extent to which existing businesses take advantage of these opportunities to enhance their own operations will depend on how they plan and prepare for the future. Failure by local businesses to seize opportunities could lead to new investment from outside the region.

Beyond the construction and operational economic impacts identified in **Section 5.4.2** above, there is an opportunity for the Kingston District Council, in association with other stakeholders, to put in place economic, industry and social development strategies to generate and leverage additional business and community benefits from the project.

The overall objective of implementing economic and social development strategies in tandem with the Cape Jaffa Anchorage Development is to maximise business opportunities and sustainable employment growth which deliver social and environmental benefits to the Kingston community. In doing so the region could capitalise on the new economic strengths associated with the Cape Jaffa Anchorage Development and the opportunities presented to develop and promote the region for the benefit of the community.

Economic and social development strategies for the Kingston and wider community should be formulated around objectives which lead to an increase in the region's business activity and per capita output. Regional development strategies should be developed that focus on undisputable drivers of successful economic and social development, and lead to sustainable income and employment outcomes including thise listed below.

Investment Attraction - new investment in the region by existing businesses or by business from outside the area, including interstate and overseas. This investment could be in the form of:

- new or upgraded commercial and retail properties;
- new tourism assets, for example, a Visitor Information Centre; and
- new housing developments.

Export Growth - export of goods and services to regions outside the Kingston area.

Local Demand Growth - increasing demand for goods and services in the Kingston area through import substitution, higher visitation and new expenditure by tourists and shoppers. Education and training initiatives specifically targeted at employment growth areas will maximise immediate regional benefits for Kingston and nearby residents.

In addition to the above, there is an opportunity for the Kingston community to work with Regional Development Agencies to identify potential future gaps in service provision that may represent future business development opportunities. Changing demographics and demand profiles may represent opportunities for new or expanded services.

Further, the Cape Jaffa Anchorage Development will also enhance the status of Kingston as a significant regional service centre. With Kingston currently offering a good level of health services, education, aged care facilities, shopping and commercial businesses, demand placed on these services and the general service nature of Kingston will increase in line with the gradual resident and tourist increases.

The development at Cape Jaffa and the continued development at Kingston will enhance each other in this regard. It provides a greater critical mass to support essential and desirable services and infrastructure.

5.4.4 Describe any potential costs or savings to the Government of infrastructure expansion with regard to transport networks, water supply, and dredging or coastal management.

Overview

The following discussion sets out the costs and savings to the State Government in relation to transport, water supply, dredging and coastal management. When considering these costs and the potential substantial savings to the Government, consideration of the potential revenue streams, for example stamp duty from property transactions and land tax should be factored into calculations.

Transport Network

As part of the transport network, Transport SA owns and is responsible for the maintenance of the Cape Jaffa jetty and the Kingston Marine Parade hardstand area, both of which are sub-standard and in need of extensive improvement. There is a reasonable expectation that these provide safe and secure facilities for servicing and storing vessels.

Ongoing maintenance costs are also significant over the remaining life of the jetty and these will be reduced if not removed. Other elements of the transport network include the provision of safe and navigable waters, roads and associated infrastructure.

The Cape Jaffa jetty requires a significant upgrade if it is to remain as a service facility to the fishing fleet working out of Cape Jaffa. Any upgrade for commercial purposes also implies an ongoing responsibility for the maintenance of the facility to service the fleet. The costs for the upgrade of the jetty are likely to be high and the ongoing maintenance costs are also significant over the remaining life of the jetty.

The development of new facilities for commercial fishing within the project, which can replace the commercial function of the jetty, means savings in capital for the State Government. The Cape Jaffa jetty could then be upgraded to recreational standard with the potential to transfer the jetty to Council, thus removing long term liability for its maintenance and hence savings to the State Government.

Kingston District Council has proposed that the jetty become a recreational jetty and be transferred to Council and that the funds allocated to its commercial upgrade and some maintenance be allocated by the Government to the replacement facilities as these will become the responsibility of the Kingston District Council in the long term.

The proposal provides a safe haven for these commercial vessels thus encouraging the vessels to relocate from the exposed open moorings. Transport SA also owns a boat hardstand area located on Marine Parade, Kingston which may become obsolete should a new hardstand be provided at Cape Jaffa. There is potential therefore, for Transport SA to remove its obligations to maintain this land and hence benefit from the long term savings by removing the recurrent costs of this facility. The Government is therefore requested to make contributions that will assist to create these long term benefits to the industry, the community at Cape Jaffa and the governments long term responsibilities.

There is a current list of 21 registrants who have indicated their desire for a berth within the main basin and for an associated hardstand space. Navigation beacons will be required for navigation purposes. This is the responsibility of Transport SA.

Increased traffic to and from Cape Jaffa will increase traffic on existing road infrastructure including:

- the Cape Jaffa Road – Southern Ports Highway Junction. There are already safety concerns at this junction which requires upgrading. Council has estimated a cost in the order of $250,000; and
- an unsealed 6.0 kilometres of the Limestone Coast Road will need to be sealed. Estimated cost of $450,000. Council has already allocated funds for this purpose.

The Cape Jaffa Road however is a fully developed and sealed roadway with capacity to readily accommodate the increased traffic flows without cost implications for Council.

Recreational Boating

Council has commenced the process of application for Recreational Boating Facilities Funds from the South Australian Boating Facilities Advisory Committee to assist with the establishment of recreational boating facilities at Cape Jaffa. The recreational facilities will include car parking, boat ramp and recreational marina area. These funds are external to Government Treasury.

Water and Sewage

Water and sewage supply are presently incorporated in the proponents plans and costs. It is proposed that the existing properties at Cape Jaffa be provided access to extended reticulation systems for environment and public health benefits when appropriate. On this basis, a contribution will be sought from the Government to assist with the costs associated with head works, treatment, connection and supply which will assist with the provision of services consistent with those provided elsewhere in coastal developments in the South East and to make these services available to the existing community. Such a contribution would be sought on the basis of accessing funds already committed to water and wastewater infrastructure development in the region and not new funding requiring additional Government appropriation. Discussions with Government will also take into consideration future revenues from town water supply. With the exception of the above works, all internal infrastructure to service the development will be installed by the proponents as part of the normal arrangements with the construction of a development or subdivision. Likewise, sewage costs will also be met by the proponent.

Dredging and Coastal Management

All dredging and coastal management works are to be undertaken by the proponent. No request is made to the Government to fund any maintenance or other ongoing coastal management works. The proponent is responsible for coast and waterways management. Other costs such as dredging will also be the responsibility of the proponent for the first 8 years and Kingston District Council thereafter. Funds will be allocated from land sales and rate revenue and placed into a managed single purpose fund to cover potential future liabilities. Refer **Sections 5.4.5 and 5.4.7**.

Ongoing Maintenance

The proponents as part of the formal agreement, propose to establish the maintenance and management fund as referenced above. This fund will provide the capital for the long term maintenance and management of the waterway walls, wharfs, channels, basins, breakwaters and hardstand, thus removing some recurrent obligations from the Government, ie the jetty and the hardstand area. If the Kingston District Council takes over the jetty for recreational purposes, there are substantial savings to the State Government over the long term. There are therefore significant short term capital and long term recurrent savings to the State Government of expenditure on the existing port and marine related infrastructure.

5.4.5 Describe the sustainability of long-term management of the development, including potential costs and benefits to Council and ratepayers of ongoing management and maintenance of the marina.

The Kingston District Council has recognised the significance of the Cape Jaffa Anchorage Development and has undertaken substantial investigations into the potential financial impacts and risks associated with the project. Refer **Appendix 24**. This Section 48 report was made available to the public, and public meetings were held to inform the community of Council's intentions and the management mechanism.

Issues associated with the ongoing maintenance of the marina as set out in the Infrastructure Agreement are addressed below.

Council and Developer Roles

The Kingston District Council has committed to being a part of the Cape Jaffa Anchorage Development and in February 2003 signed an Infrastructure Development Agreement with the developer, the Cape Jaffa Development Company. The agreement specifies the roles of both parties in the development, and responsibilities for the purchase and holding of land, the lodgement of relevant development applications, costs associated with the preparation of Environmental Impact Statements, and preparation of final design concepts for the development. In accordance with the agreement, Council obtained options on the land and is progressing with its purchase.

The agreement specifies that Kingston District Council will:

- Exercise the options and complete the purchase of the land required by the development at Cape Jaffa (being in the ownership of Janz and Lankenau, Janz is complete);
- Prepare and lodge a development application and all associated documentation to ensure that development approval for the development is obtained within a reasonable time;
- Seek support from the SA Government to provide a suitable three phase power link and potable water supply to the development;
- Seek funding assistance from the SA Government to upgrade the professional fishing facilities including those for the rock lobster fishing industry and the aquaculture industry;
- Seek funding from the SA Boating Facilities Advisory Committee (SABFAC) and Transport SA to assist with the establishment and construction of recreational boating facilities and associated facilities;
- Be responsible at its own cost for the maintenance of the public infrastructure including roads, kerbing and effluent disposal scheme from the date, being two years after the date of completion of each stage of the development, all marina based infrastructure including the breakwater, waterways, wharf facilities being handed to Council after four years from the date of completion and a requirement for the developer to ensure the channel area is cleared of seagrass and sand build up so that the area is maintained in a navigable manner for a period of eight years after completion;
- Be responsible for undertaking a Plan Amendment Report process for the purpose of achieving the appropriate zoning for the development; and
- Undertake either alone or in conjunction with the development application process, the necessary road process for a realignment of King Drive and partial closure of Cape Jaffa Road necessary to achieve the objectives of the development.

The agreement specifies that the Cape Jaffa Development Company will:

- be responsible for and pay all costs associated with the planning of and obtaining development approval for the development, including the preparation of an Environmental Impact Statement, plans, studies and associated documents;
- construct the development and contract with Council to construct all necessary public infrastructure, including effluent disposal head works and treatment facilities, and power and water supply head works;
- construct and install at its cost all infrastructure associated with the residential development;
- construct all waterways required for the development;
- finance the residential development and make contributions towards any shortfalls in Government and other financial assistance in relation to the construction of Stage 1; and

- pay the price for and all fees and costs (including stamp duty) of and associated with the purchase of the land incurred by Council.

In addition, the agreement also refers to finance and risk, and the agreement of Kingston District Council to apply to the Local Government Finance Authority for a line of credit facility that would be limited to the value of the land and all costs associated with the purchase of the land. This agreement also includes the fact that the CJDC will pay all interest and other fees and costs associated with the LGFA line of credit facility.

The principal associated with the LGFA line of credit facility will be reimbursed to Kingston District Council by the CJDC based on the sale of residential allotments.

In relation to the marina berths, special mention is made in the agreement that CJDC own both the commercial and recreational marina berths unless and until they are sold to Kingston District Council or third parties. In addition, CJDC has given an undertaking that Kingston District Council have the right of first refusal to purchase the commercial marina berths at market value.

Kingston District Council's expected expenditure associated with the development currently involves the purchase of land and also contributions to match grant funding for the establishment of recreational boating facilities.

Kingston District Council is currently committed to the purchase of the project land which it will own and under the agreement provide the right to CJDC to develop. CJDC will pay Kingston District Council for all interest as it arises and other costs associated with the establishment and maintenance of the loan facility and repay the principal associated with the loan obtained by Council for purchasing the land.

Project Arrangements

Kingston District Council has been particular to ensure it was providing a facilitation role and accordingly, the appropriate mechanisms and arrangements for carrying out the project have been subject to considerable discussion between Kingston District Council, Council's solicitors and CJDC. The Infrastructure Development Agreement establishes a Project Control Group to provide a regular forum for representatives of Kingston District Council and CJDC to meet with any relevant infrastructure development consultants and contractors to review, discuss and exchange ideas in relation to any or all aspects of the infrastructure development. In addition, a Project Liaison Group will be established which provides a regular forum for representatives of Kingston District Council and CJDC to discuss and exchange ideas in relation to the whole of the development area.

Kingston District Council Costs and Benefits

The detailed financial analysis and key assumptions are contained in **Appendix 24**. A financial model has been developed to assist with the assessment of implications for rate revenue and to estimate financial costs to the Kingston District Council in servicing the Cape Jaffa Anchorage Development. The model has also been designed to assist with an assessment of the 'shadow effect' of the development on adjacent areas. The shadow effect is defined as the increased property values and rates that are estimated to occur as a direct consequence of the Cape Jaffa Anchorage Development.

A range of assumptions need to be made regarding the development based on past practices, other development projects, or simply estimates based on known project parameters. Council staff were also asked to provide assessments of the likely cost impacts of the development on Council programs and service areas.

The financial model uses a 15 year evaluation period starting 12 months prior to completion of Precinct 1, and ending in about June 2022. The last currently programmed stage may be completed by June 2016, so the evaluation period includes at least two years of post development conditions to cater for the developer to Council infrastructure handover.

Table 5.19 summarises the rate revenue and financial cost impacts associated with the Cape Jaffa Anchorage Development. Increased rate revenue for the Kingston District Council is expected to be derived from two main sources as follows:

- Rates from new residential, commercial and marina assets in the development area, less any existing rates to be terminated as a consequence of the development, although these are not significant.
- Additional rates associated with the 'shadow effect', or increases in property values in adjacent areas (above normal property value trends) due to the positive impact of the development.

Table 5.19: Revenue and Financial Impacts

Source: Appendix 24

Summary of Rate Revenue and Financial Impacts (Rounded to $'000)		
Item	Impact	Comments
Estimated NPV of additional rate revenue in the development area.	$4,128,000	Includes residential and commercial rates. This impact is directly associated with projected sales and excludes any impact from Council or developer 'integration' expenditure. The NPV includes revenue assigned to Council's Marina Maintenance Fund ($1,436,850) and the estimated net growth in the Developer's Marina Maintenance Fund ($665,068).
Estimated NPV of additional rate revenue in the development 'shadow area'.	$550,000	This impact is directly attributable to the Cape Jaffa Anchorage Development and excludes any impact from Council or developer 'integration' expenditure.
Total estimated NPV of additional rate revenue over the 15 year development period.	**$4,678,000**	
Estimated NPV of financial costs to Council in servicing the development over the 15 year development period.	$1,916,000	Excludes 'integration' capital works and other 'integration' expenditures being considered by Council (eg; Limestone Road completion).
Estimated NPV benefit to Council over the 15 year development period.	**$2,762,000**	Excludes any 'sinking fund' provision for the replacement of long term assets.

Note: 15 year Net Present Value (NPV) @ 7% discount rate

In addition to the above, there may also be a positive impact on property values in the development area and in the 'shadow area' associated with any Council and developer expenditures on 'integration' activities. However, such gains cannot be accurately defined as the extent of 'integration' activity has yet to be determined. This aspect has been discounted and therefore the forecast is conservative.

The above estimates for rate revenue and overall benefit to Kingston District Council may be conservative for the following reasons:

- capital values of properties constructed in the earlier years of the development may appreciate at a greater rate than expected depending on demand and actual prices achieved for properties during the later stages of the project; and
- it is expected that Kingston District Council and CJDC will contribute to 'integration' activities in and adjacent to the development area which is likely to impact positively on capital values and rates. It is also noted that there may be other positive revenue implications for Council associated with the development and an increasing population base. These could include, for example:
  - the potential for matching 'integration' funds from other sources including State and Commonwealth Government programs and the developer.
  - the potential for better access to Commonwealth and State Government grant and industry assistance funds.

Therefore, the sustainability of long-term management of the development is assured through the project agreement and the potential costs to Council and ratepayers are well exceeded by the benefits that result from the prudent allocation of funds from CJDC and ratepayers from the development in the locality.

5.4.6 Describe the opportunities for the aquaculture and fishing industries and their support services.

Overview

The Cape Jaffa Anchorage Development is expected to stimulate other industries and business investment especially in tourism, retail, services and aquaculture. As a consequence of improved industry infrastructure, the aquaculture and fishing industries will grow and downstream industries will benefit from increased demand for their products and services. The extent of demand will depend to some degree on State Government policy and investment decisions related to aquaculture industry development.

Overall, the development will provide vastly improved support infrastructure for fishing and aquaculture industry development, and an environment that is expected to prove attractive to people operating in these industries.

The activities associated with the marina development are expected to create considerable interest for visitors to the area and also those wishing to invest in residential housing. Another advantage of the development will be an upgrade of recreational boating facilities that are required in this location. Refer Appendix 24.

Atlantic Salmon

During the past five years a fledgling industry has developed, principally with land based hatchery and fish being transferred to sea cages for grow out. There are two existing leases with further applications possible. Commercial harvesting of Atlantic Salmon commenced in 1998 with production in 1999 totalling 14 tonnes. During 2000, production reached 45 tonnes with a turnover value of $320,000. The industry then employed six to seven people including owners.

Potential exists for growth to 500 tonnes in the near future with an estimated value of $3.5 million and employing up to twenty people. (Hudson Howells 2000). To achieve this potential, a range of infrastructure is required including:

- improved wharf/jetty facilities for harvesting, new stock delivery, feed loading and servicing;
- integrated factory processing site;
- equipment storage and repairs; and
- electricity upgrade.

The Cape Jaffa Development has the potential to contribute to this infrastructure, such as power and stimulate future industry development. It is estimated that the finfish/Atlantic Salmon industry could invest up to $250,000 into other infrastructure to support ongoing industry development.

The direct economic impact this rate of industry development could result in is shown on Table 5.20.

Table 5.20: Estimated Aquaculture Economic Effects
Source: Appendix 24

Item	Employment Impact FTEs	Value Added Impact ($)
Potential Increased Aquaculture Output - $3 million per annum	31 FTE jobs per annum	$2.6 million per annum
Potential Aquaculture Plant and Equipment Investment - $1 million	22 FTE jobs - once only	$1.5 million - once only

This input could also be supporting up to an additional thirty jobs in South Australia.

This assessment assumes a very modest level of industry investment and growth. However, should licenses be available and suitable investors interested, the industry could expand to levels well beyond the current forecast of 500 tonnes per annum. This could result in a regional economic impact of up to 200 jobs and $35 million value added.

Rock Lobster

The rock lobster industry is also expected to benefit from the Cape Jaffa Anchorage Development. Existing processing facilities are considered to be inadequate and will eventually require relocation/replacement. Assuming five processors at a cost of $50,000, there is expected to be an investment in the order of $250,000. In addition, there is potential for relocation of industry participants from other areas (for example Robe) to Cape Jaffa. However, the extent of this potential migration is unknown at this stage.

Other Fishing Industry Sectors

The development will offer a 'safe haven' during winter which could stimulate the development of professional shark fishing during the off season which in turn results in increased demand for support services and facilities.

The following services/businesses are expected to be established in association with an expanding fishing/aquaculture industry:

- chandlery;
- shipwrights, mechanics, etc;
- hardstand area – estimated cost $250,000;
- storage areas – estimated cost $500,000;
- services for the recreational boating industry (mechanics, marine electrical, etc); and
- retail – bait, tackle, fuel, etc.

5.4.7 Outline the financial strategies to be employed to ensure the relevant infrastructure is in place for each stage in the project.

The Cape Jaffa Development Company will be responsible for the provision of all internal infrastructure to support each stage of the project. State Government and the Kingston District Council assistance will be sought as detailed in **Section 5.4.4**. The infrastructure responsibilities of the Cape Jaffa Development Company are to:

- construct the development and contract with Council to construct all necessary public infrastructure including effluent disposal head works and treatment facilities, and power and water supply head works;
- construct and install at its cost all infrastructure associated with the residential development;
- construct all waterways required for the development; and
- finance the residential development and make contributions towards any shortfalls in Government and other financial assistance in relation to the construction of Stage 1.

All of the works are to be undertaken on a staged basis to ensure the economic sustainability of the development program. The Kingston District Council and the Cape Jaffa Development Company have established the Project Control Group specifically to manage the development. Refer **Section 5.5.8**. The Kingston District Council and the Cape Jaffa Development Company also propose to establish a Marina Maintenance Fund as follows:

Kingston District Council Marina Maintenance Fund

A special purpose fund to provide for infrastructure related remedial costs should they arise will be funded by allocating 50% of rates raised from all rateable land based property, including related improvements in the development area over a five year period commencing upon rates becoming first payable for each property.

CJDC Marina Maintenance Fund

$2,000 for every allotment, excluding 'fingers' and berths, will be set aside by CJDC following sales settlement and will accrete in a fund to provide for infrastructure related remedial costs if required. Out of this fund, amounts will be transferred to Council in several staged transfers. Each transfer will be related to a development stage. It will occur four years after the infrastructure pertaining to that stage is completed to a standard satisfactory to Kingston District Council.

The amount transferred will be the $2,000 per allotment sold during that four year period out of the allotments available from that stage, less any marina infrastructure related remedial costs incurred. Therefore, a conservative estimate of sales of 25 allotments per annum yields $50,000 and if that were to be sustained for ten years, a fund of $500,000 would be available in ten years plus interest.

Given the well known performance of marina facilities around Australia and in South Australia, many of which are in higher wave energy environments, the maintenance costs are not likely to be significant for the first twenty years. This will result in a compounding fund that will be more than sufficient to provide for the perpetual maintenance of the marine infrastructure. See Section 5.5.8 for further information.

5.4.8 Describe the land tenure arrangements during and after construction of each stage.

The Kingston District Council owns the land with an agreement with CJDC to pay for and develop the land. The area within which the breakwaters are located is land owned/controlled by the Crown. CJDC may at any time purchase from Kingston District Council part or the whole of the land to hold or develop. During this time CJDC is wholly responsible for interest and costs associated with the finance of the land. Should CJDC wish to proceed to develop a stage, it can proceed with that development and the subsequent sale of the land, and when settlement occurs with a third party, the transfer occurs between the Kingston District Council and that third party with payment to CJDC for expenses.

After the first 150 allotments have been sold, the principal is reduced by an amount from the proceeds of every allotment. This deferral is in recognition of the extraordinary costs associated with the early development phases of the port and related facilities.

Residential, Commercial and Industrial Allotments

The land developed for residential and non-residential purposes are held either by the Kingston District Council or CJDC. The agreement between the parties provides for the land to be taken up by

CJDC in super lots for further division or alternatively, the division occurs and the land is transferred to the third party or to CJDC once the development works are undertaken.

Some of the land that has direct association with the water have the allotment extending past the edge treatment and beyond out into the water to incorporate an area in which a floating marina can be established for the berthing of vessels and where vessels can manoeuvre to and from the marina berth. Beyond this area are defined navigable channels which remain in the ownership of the Kingston District Council. Refer Figure 5.50.

Marina Berths

CJDC will develop and retain ownership of the commercial marina berths unless and until they are sold to the Kingston District Council or third parties. In addition, CJDC has given an undertaking that the Kingston District Council have the right of first refusal to purchase the commercial marina berths at market value. These berths will form part of a Community Title scheme or similar which will establish the individual allotments and the common property to be managed collectively. Likewise, the recreation berths will be established on a needs basis and the area within which they are to be accommodated will be established as a community title scheme.

Marina Basin

The marina basin will be retained in Council ownership and CJDC will maintain at its cost the marina basin in a navigable condition for eight years after the infrastructure pertaining to the basin is completed to a satisfactory standard. After that period, the marina basin asset, its responsibility and ongoing maintenance costs are transferred to the Kingston District Council.

Waterway Navigable Channels

The waterways will be established with a minimum 25 metre wide navigable channel to allow for the passage and manoeuvring of vessels. This waterway will remain in the ownership of the Kingston District Council, however it will be maintained in a clean and navigable manner for a period of eight years by CJDC. After this period, the maintenance responsibilities will pass to the Kingston District Council.

Marine Infrastructure

The main channel, breakwaters, edge treatments, boat ramp, main basin, wharfs and associated car parking will be the responsibility of CJDC for a period of four years after its satisfactory establishment. At this time the responsibility will transfer to Council. The ownership will vary from place to place, however the control of the maintenance of all these facilities will remain with Council. The proponent proposes to seek from Transport SA the transfer of the whole of the area within and including the breakwaters as freehold title for its ongoing care and maintenance as part of the total development. Refer Figure 5.50. This is the area also to be incorporated within the corporate boundary of the Kingston District Council.

Roads, Verges and Other Public Infrastructure Assets

CJDC will maintain at its cost roads, verges, street lighting, common service trenches, electricity distribution systems, and sewer and water reticulation systems in a satisfactory condition for two years after the infrastructure in each stage is completed to satisfactory engineering standards. Two years after completion of each stage, these assets, their responsibility and ongoing maintenance costs become the responsibility of Council.

5.4.9 Describe compensation or amelioration measures for any loss of groundwater resources for users.

The short and long term effects of establishing the waterways on the groundwater, particularly in regard to drawdown and potential saltwater contamination, have been investigated in detail (Appendix 14) and are presented in Section 5.2.3. Further, the effect of residential and commercial development on groundwater has been assessed and presented in Section 5.2.9. The potential effects on nearby users of the groundwater resources are presented in Section 5.2.23 and 5.3.17.

The investigations have focused on the unconfined aquifer as there are no existing users of the deeper confined aquifer near Cape Jaffa and the potential adverse effects on the confined aquifer or other users of the aquifer are negligible. See Section 5.2.21 for a separate discussion on the use of the confined aquifer as the source for the potable water supply.

Sections 5.2.3, 5.2.10 and 5.2.29 detail various measures to ameliorate the potential effects on existing users of groundwater resources. These measures, designed to mitigate, minimise or improve the effects of the development, include:

- the initial stages have been located away from existing groundwater users in an area where no potential effects are likely. This is also expected to be the case for subsequent stages that are located away from the existing settlement;
- dewatering during construction will be limited to short durations in localised areas, thereby avoiding adverse affects on nearby groundwater users;
- the design and separation of the waterways from existing users of the groundwater resources minimises the potential effects on those users. Existing wells will experience level changes less than about 0.6 metres and wells within the settlement will experience level changes less than about 0.2 metres. The changes are small compared to the natural seasonal fluctuations in groundwater levels and no noticeable effect on yield from the existing wells is expected;
- the design and location of the waterways limits the area that is expected to have reduced separation to the seawater interface such that the majority of the existing wells are not affected. Wells located south of King Drive at the eastern end of the Cape Jaffa settlement may experience seawater intrusion over time. Wells in other areas are unlikely to be effected;
- the location of the waterways and separation to wells further inland is such that there is negligible risk of seawater intrusion into these wells under the existing extraction regimes;
- the staged construction of the waterways minimises risks to the groundwater environment and nearby groundwater users as it minimises the zone of influence around each stage of the

waterways and locates early stages away from the existing groundwater users. This allows additional investigations to be performed and greater understanding to be gained well before any risks arise to existing users of the aquifer; and

- ongoing monitoring and assessment will be undertaken during the first stages of the development prior to the later stages of construction of waterways. Once the modelling of effects of the early stages have been validated using measured data, the effects of subsequent stages can be determined in greater detail. Refer Section 5.2.29.

To further ameliorate potential effects on existing groundwater users, access to a reticulated supply will be afforded. A town water supply will be established and the distribution infrastructure will be extended to include the existing Cape Jaffa settlement, thereby mitigating any risks associated with potential effects of later stages well in advance of their possible occurrence.

It should also be noted that a significant portion of the development land is currently zoned for residential, commercial and industrial development, and hence development is likely to occur regardless of this proposal. The alternate development scenario would likely proceed in a less orderly manner and without the benefit of a sewerage system or town water supply, thus resulting in increased potential contamination of the unconfined aquifer from septic tank effluent disposal together with increased dependence on the aquifer for domestic water supply. Compared to the alternative, this development proposal will result in a significant reduction in contamination of the unconfined aquifer and the provision of a town water supply will reduce the extraction from the unconfined aquifer.

5.4.10 Describe how increased groundwater flows out to sea would be measured and whether such usage would be metered and charged for from the prescribed water resource.

The effect of the waterways is to divert groundwater flow from the existing coast into the waterways and then out to sea. The groundwater flow via the waterways out to sea occurs instead of the existing groundwater flow direct to the coast. Overall, the groundwater flow to the marine environment in the Cape Jaffa area does not change as a result of the establishment of the waterways. The relevant effect is the local redistribution of outflow to the marine environment. The waterways act as a conduit for groundwater flow to the marine environment and the outflow to the coast immediately adjacent to the waterways is correspondingly reduced. This is discussed in Section 5.2.6 and shown diagrammatically in Figure 5.15. As there is no increase in overall groundwater flows out to sea, no plans have been made to meter or charge for the ongoing flow from the prescribed water resource out to sea.

The quantity of groundwater flow out to sea via the waterways has however been assessed. Refer Section 5.2.6 and Appendix 14. A groundwater flow model has been used to predict groundwater levels around the waterways and hence compute the groundwater flow into the waterways. The modelled groundwater flow into the waterways has been assessed to be about 900 cubic metres per day, with a distribution around the waterways as shown in Figure 5.16.

5.4.11 Identify the economic implications for the rock lobster industry from increased groundwater flows and run-off out to sea.

The potential economic effects of the groundwater flows to the waterways and/or sea and the stormwater runoff to the waterways and/or sea are discussed below. The broader economic benefits of the development to the rock lobster and other fishing related industries are discussed elsewhere in the document in **Section 5.4.6**.

Redistribution of Groundwater Outflow to the Sea

As has been discussed previously in **Sections 5.2.3** and **5.2.6** and summarised above in **Section 5.4.10**, there is no increase in the overall groundwater flows out to sea. In addition, there is no increase in overall outflow of potentially contaminating compounds within the groundwater, nor are there overall salinity changes. Refer **Figures 5.15** and **5.17**. Although there are localised changes to the outflow of groundwater and associated potentially contaminating compounds as discussed below, no adverse economic implications are anticipated.

The establishment of the waterways will result in a local redistribution of groundwater outflow to the marine environment. The waterways will act as a conduit for groundwater flow to the marine environment and the existing outflow to the coast immediately adjacent to the waterways will be diverted and correspondingly reduced. Similar redistribution will occur to the potential contaminant loading (nutrients, heavy metals, etc) to the marine environment (**Section 5.2.6** and **Appendix 14**). A total of approximately 900 cubic metres per day of groundwater discharges to the waterways and thus enters the marine environment at the mouth of the breakwaters. The corresponding reduction in outflow direct to the coast occurs over a length of coast that is approximately the same as the extent of the Major Development area.

Section 5.2.6 assesses the effects of the outflow of potential contaminants associated with the groundwater into the marine environment via the waterways at the mouth of the breakwaters. The assessment shows that the concentrations of all potential contaminants in the outflow are well below the Environment Protection (Water Quality) Policy 2003 Marine Criteria. As a result, there is no expected adverse effect on the marine environment or the rock lobster industry.

A corresponding reduction in the existing outflow of groundwater and associated contaminants will occur along the coast nearby, as described above. This is particularly the case in relation to the area of light platform reef west of the jetty within the rock lobster sanctuary. On the basis that the groundwater and associated potential contaminants are diverted away from the reef area to the mouth of the breakwaters, there are some advantages to the water quality within the area of light platform reef in the rock lobster sanctuary west of the jetty. Nevertheless, the changes from redistribution of the groundwater outflow are minor.

Stormwater Runoff

None of the stormwater runoff will be directed to the waterways or marine environment, thus there are no adverse economic implications anticipated. Stormwater will be directed into localised holding basins via open swales, thus maximising the soakage into the groundwater water system and providing rainwater recharge in those areas in accordance with the principles of water sensitive urban design. This minimises the potential effects on the water quality in the waterways and the marine environment. See **Section 5.2.4**, **5.2.19** and **5.7.2** for further information.

The quality of the stormwater reaching the groundwater will be maximised by providing ample soakage opportunity into the highly permeable sandy soils, on individual allotments, grassed swales in public roads and at strategic locations within landscaped basins.

Summary

There is no expected increase in groundwater flow out to sea nor is there to be any additional runoff to the waterways or the sea as a consequence of this project. Redistribution of the groundwater flow results in less groundwater flow to sea within the rock lobster sanctuary as it flows instead to the sea further east via the waterways at the mouth of the breakwaters, at the edge of the sanctuary. Accordingly, there will be no economic impact from these factors on the rock lobster industry.

5.4.12 Identify the economic implications for groundwater users from groundwater drawdown or contamination, particularly primary producers.

There are a number of general economic benefits to nearby residents, primary producers and other businesses, for example the 'shadow effect' on land values and the increased tourism to the area. These are discussed elsewhere in **Section 5.4.5**.

The main potential economic effects on users of the groundwater and on primary producers from changes to the groundwater are:

- the potential effects on nearby groundwater wells; or
- the potential effects on the productivity of agricultural land.

The effects on nearby groundwater wells have been assessed in **Sections 5.2.3** and **5.2.23**, which show that:

- the effects on groundwater levels have been shown to be limited and are expected to have no noticeable effects on yield from existing wells;
- the wells at the eastern end of the Cape Jaffa settlement will be located on a peninsula between the waterways and the coast, and groundwater extraction in this area is likely to be effected by seawater intrusion over time. At the western end of the Cape Jaffa settlement, the seawater interface will shift upward to extend into the aquifer at a shallower angle, thus wells in this area are subject to increased risk of seawater coning. Adverse effects of seawater intrusion on existing groundwater uses within the remainder of the locality are unlikely; and
- the potential contamination of groundwater and associated effects as a result of the development is considered to be negligible.

Section 5.2.5 and **5.3.10** assess the local and region land uses and the potential effects of the development on the land and land use. These sections show that:

- the most significant effect of the reduced groundwater levels on the land is expected to be the improved drainage in seasonally inundated low-lying areas. As a result of periodic inundation or very shallow groundwater levels, some areas currently exhibit low agricultural productivity, elevated groundwater salinity or elevated soil salinity;

- after construction of the waterways, land currently subject to seasonal inundation within the groundwater depression zone is likely to be inundated less often or for shorter periods, thus allowing improved agricultural productivity and reduce soil salinity over time. This is expected to provide an economic benefit to nearby primary producers. In addition, low-lying areas within the groundwater depression zone will become more suitable for other land uses including residential or commercial use. In the more elevated areas where the depth (below ground level) to the groundwater is greater, no noticeable effects are anticipated;

- the horticultural activities are on the periphery of the zone of influence where water level changes are expected to be small, i.e. about 0.3 metres. This land is elevated (8 to 10 mAHD) and the groundwater level is generally less than 1.5 mAHD, which corresponds to approximately 6.0 metres below ground level. Horticultural crops in these areas are generally shallow-rooted and unlikely to be dependant on the groundwater.

- the potential impact on the urban activities at the Cape Jaffa settlement is expected to be minor, though poorly drained areas may benefit from reduced risk of inundation; and

- viticulture and forestry areas are well outside the zone of influence of the development and no effects are anticipated.

As a result, no adverse economic implications on groundwater users and primary producers are expected.

5.4.13 Identify the economic effect the workforce would have locally and regionally.

Table 5.21 summarises the estimated employment impacts from the construction phase of the project.

Throughout South Australia at present there is little spare capacity in the construction sector, however this situation will most likely change as the Cape Jaffa Anchorage develops. It is expected that the labour force will be found from a combination of sources including:

- local labour (Kingston and the broader South East region);
- CJDC own workforce;
- Adelaide; and
- Western Victoria.

The expected breakdown by percentage is:

- infrastructure construction – 50 percent existing (Adelaide) and 50 percent local labour; and

- housing construction – 70 percent imported from Adelaide and other areas outside the region and 30 percent from the south east region, including Kingston.

Table 5.21: Estimated Annual Employment Effects

Source: Appendix 24

Year	Broad Employment Impact (FTEs)
1	12
2	222
3	81
4	73
5	177
6	109
7	113
8	117
9	160
10	121
11	145
12	125
13	125
14	125
15	125

It is therefore expected that at least 50 percent of the estimated workforce impacts identified above will come from outside the region and will have their own temporary impacts on the Cape Jaffa and broader region. While these impacts are captured in the economic impact assessments, it is important to note that the influx of labour will in its own right stimulate the local economy and have associated multiplier impacts.

Based on the economic multipliers discussed earlier, it is estimated that every $1 million injection from an imported workforce could, for example, boost the regional economy by an additional $1,209,800 in value added (salaries, wages and profits) and an additional 22.7 FTE jobs per annum.

Assuming for example that the 222 workforce estimated for the first full project year each spend $200 per week locally, then the regional economy could be boosted by an initial $2.3 million resulting in value added of $2.8 million and 52 FTE jobs.

5.4.14 Identify any potential impact on tourism or investment due to the changed nature of Cape Jaffa.

The changed nature of Cape Jaffa is expected to provide a significant boost to regional tourism and associated investment. Potential impacts identified elsewhere in this analysis include those listed below.

Caravan Park Redevelopment – there is potential for the existing caravan park to double in size, incorporating an additional 30 cabins, 30 to 40 caravan sites, and up to 50 camping sites. The estimated direct economic impact of such a development is $1 million (development costs) with an ongoing employment impact of two FTE persons.

Motel/Serviced Apartments – consistent with most marina/coastal projects, there is potential for a motel comprising serviced apartments to be established at Cape Jaffa. The estimated development cost is $5 million for up to 20 units.

Multifunction Facility – current project plans anticipate the establishment of a tavern/café at the Cape Jaffa Anchorage site in association with a range of other facilities including, for example:

- marina management/administration/marketing;
- kiosk;
- tourism information centre; and
- local history centre.

It is estimated that such a facility would require an initial investment of $400,000 and could employ up to three FTE persons.

Winery Value Added – with increased regional activity and tourism demand, there is potential for the existing wineries to develop and offer additional services such as accommodation and cellar door services. Potential investment is estimated to be up to $2 million.

Fishing Charters – also to cater for increased tourism, it is anticipated that a fishing charter service could be established requiring an investment of up to $250,000 and employing two FTE persons.

In addition to the above, there is expected to be a significant boost to regional tourism visitor numbers, lengths of stay and expenditure in the region. Detailed visitor data is available for 2002 for the Limestone Coast region is summarised below (SATC 2003). Refer **Appendix 24**.

- total day trips – 681,000;
- total overnight market – 652,000;
- total visitor nights – 1,714,000;
- average spending by domestic overnight visitors - $83 per night; and
- average spending by day trip visitors - $85 per visit.

It is conservatively estimated that the Kingston/Cape Jaffa region will attract an additional 5% of existing day trip visitors for one day as a consequence of the Cape Jaffa Anchorage Development and improved tourism promotion. It is estimated that this could result in an injection into the local economy of $2.9 million per annum.

5.5 Construction and Operational Effects

5.5.1 Provide a site construction plan and outline strategies to minimise effects on the local environment, particularly the ecological impact on seagrass and reef communities.

An outline of the construction activities and environmental management is attached as Appendix 8. The Site Construction Management Plan (SCMP) contained in the appendix also discusses strategies for minimising effects on the local environment.

Marine Construction Activities

Construction of the marine infrastructure that might have effects on seagrass and reef communities is outlined below and presented in more detail in Appendix 8. The breakwaters will be constructed with an impermeable core and lined with locally won limestone rock. The core is medium to fine grained sand and silts with minimal clay content, sourced from the onsite excavations. The rock for lining is to be durable consolidated limestone and will be sorted to remove fine material and graded to achieve appropriate rock sizing. The breakwater construction involves the placing of core material from the shoreline in short stages, shaping and placing the armour rock immediately. In this way, minimal core material is exposed and subject to erosion at any time and the core is protected by armour rock as soon as possible. The operation will be suspended in rough weather in order to avoid increased turbidity in those conditions. The existing breakwater at Kingston was constructed using a similar construction technique from material sourced from the drain excavations. See Sections 5.6.9 and 5.6.16 for further information on breakwater design and construction.

Dredging will be required to establish a navigable channel to the open sea. From the coast to the entrance between the breakwaters, approximately 300 metres of channel will be constructed to a depth of -3.5 mAHD. Seaward of the breakwaters the channel is -3 mAHD and extends offshore until that water depth is reached, approximately 280 metres from the breakwaters. The seabed consists of sand overlying limestone. A hydrogeological survey of water depths and probe survey to assess the thickness of the sand overlying the limestone has been performed. The survey indicate that the material to be dredged seaward of the breakwaters is sand and will be readily dredged using a conventional suction cutter dredge. See Sections 5.2.28, 5.5.10 and 5.5.11 for further information in relation to dredging practices and the strategies to minimise ecological effects on seagrass habitat and ecological communities.

Construction of the channel within the breakwaters will involve a combination of suction cutter dredging and, where limestone is encountered, will be complimented by an excavator. The preferred option for excavation of the limestone is to use an extended turret excavator, whereby the track assembly runs on the seabed and the majority of the machine is elevated sufficiently to ensure it is above water and wave level. Trafficking of the seabed will be limited to the areas to be excavated in order to minimised disturbance of the seabed and seagrasses. Excavated limestone will be loaded onto a conventional articulated truck mounted on a barge that will convey the truck to the beach in the area that will be later excavated for the channel into the main basin. The trucks will then cart the spoil for placement in mounds together with the material excavated from the land-based excavations, in the conventional manner. The breakwater will be substantially constructed prior to this work being performed, thus minimizing the effects of weather and associated turbidity.

All of the material excavated by dredging will be placed on land. Dredging discharge will be to a land-based cofferdam located within the area to be excavated as part of stage one. Overflow will occur through a chain of settling ponds and eventual return to the marine environment between the breakwaters. Sieve analysis of the sand shows that it is medium to fine grained (0.125 to 0.5 millimetre diameter), with only a few percent silt and clay, thus appropriate water handling will ensure very low turbidity discharge and will maintain high water quality. See **Section 5.2.28** for further information on the management of dredged materials and associated runoff.

The excavation of basins and waterways covers approximately 47 ha and the main basin will be excavated to a depth of -3.5 mAHD. Dewatering of the excavations will likely be required and the water produced will be managed in a similar fashion to the dredging discharge. See **Sections 5.2.3** and **5.5.10** for further information.

Strategies to Minimise Effects on Seagrass and Reef Communities

The marine flora and fauna has been assessed and is discussed in **Section 4.7** and further information can be found in **Appendix 13**. In addition, the potential effects the development on native flora and fauna, including coastal and marine flora and fauna are outlined in **Section 5.2.15**.

The marine area of the site seaward of the seagrass line is mixed *Posidonia/Amphibolis* seagrasses. Inshore of the seagrass line is bare sand to the east of the jetty and bare sand with some rocky reef to the west of the jetty. There is relatively little bare sand, a few small patches of macroalgae and very few macroinvertebrates. The nearest reef habitats are some distance from the site, west of the Cape Jaffa jetty, as shown on **Figure 4.20** (**Appendix 13**). See **Section 4.7** for further information.

Effects associated with the construction phase may be direct, such as habitat removal, or indirect such as turbidity. The major effect, although very localised, will be the direct loss of about 3.4 ha of seagrasses from the breakwater and entrance channel construction. This area is likely to be similar in extent to the area that is expected to recolonise with seagrasses once the current swing moorings become disused, as discussed in **Section 5.2.14** (**Appendix 13**). See **Section 5.2.15** for further information.

The indirect effects of construction include increased turbidity and sedimentation related to dredging, scouring of seagrasses around the breakwater and the potential propagation of 'blowouts' from the channel. Given the small volume of sediment to be excavated (about 4,000 m3), the open well-flushed nature of the area, the short dredging duration (about 2 weeks), and the relatively coarse sediments, it is very unlikely that increased turbidity will cause problems for the seagrasses in the vicinity. Construction sources of turbidity are expected be short-lived, with the seagrasses in the area likely to experience decreased light availability for less than 1 month in total.

Scouring of seagrasses around the base of the breakwater could occur if increased sand movement or suspended sediment concentrations occur in this region. Any direct increase in sediment concentrations will be short-lived, and are therefore unlikely to be significant. As part of the development, provisions will be made for bypassing sand around the breakwater in order to control sand build up.

There is the potential for the excavated entrance channel to form an erosion scarp that could then propagate away from the channel. 'Blowouts' are common along the southern Adelaide metropolitan coast, and form when wave energy erodes the sediment in a patch devoid of seagrass, although given the low wave energy at Cape Jaffa effects are less likely. There has been very little erosion around Maria Creek (Kingston boat ramp), where conditions are similar, and the same is expected at Cape Jaffa.

Runoff from the dredge spoil could potentially cause problems, through increasing turbidity or resuspension of contaminants. Using a series of settlement ponds for dewatering will ameliorate turbidity problems. These ponds will be located in the marina basin, isolated from the ocean during construction by a coffer dam. Low turbidity water will then be disposed of to sea. Given the relatively undeveloped nature of the site, it is unlikely that the sediments to be excavated will contain any significant levels of contamination. To ensure that this is the case, sediments will be sampled and tested for the main problem contaminants (heavy metals) prior to any dredging activity. In order to avoid potential adverse effects, all of spoil will be placed on land rather than at sea (Appendix 13).

The short and long term effects of groundwater discharge, including dewatering discharge, on water quality has been assessed, which concludes that "*any existing groundwater contamination will have no detectable impact on the marine environment* " (Appendix 13). In addition, the short term effects of groundwater pumping during construction dewatering discharging direct to the sea were investigated. Natural currents and tidal movement will rapidly disperse this water so "*it is unlikely to have any detectable impact*" (Appendix 13).

The nearest reef habitat is to the west of the Cape Jaffa jetty and is protected by the rock lobster sanctuary that extends west of the proposed breakwater around the cape to the south of Cape Jaffa. It is very unlikely that the development will have an impact on the sanctuary's protection of rock lobster (Appendix 13), given that rock lobster occur on reef rather than seagrass, that the nearest reef is greater than 1 kilometre from the development and that, although rock lobster may move into seagrass areas to forage (Jones & Morgan 2001), they normally restrict their movements to less than 1 kilometre and remain within the vicinity of reef shelter (Ward *et al.* 2003). See Section 5.2.13, 5.2.14 and Appendix 13 for further information.

The construction of a marina is likely to favour opportunistic marine organisms. Mitigation includes ensuring that water quality within the waterways is good so that local species are able to colonise, which is expected to be the case within the waterways of Cape Jaffa Anchorage. Marine construction equipment will be cleaned before arrival in order to minimise the potential introduction of marine pest species. See Sections 5.2.15 and 5.6.6 for further information.

5.5.2 Identify the source of any construction materials including fill for the breakwaters, revetments and land forming and their origins.

The source of construction materials has been discussed in Appendix 8 in relation to each of the construction activities, including for breakwater, revetments and general landforming. Table 5.22 below summaries the materials and their sources:

Table 5.22: Source of Construction Materials

Construction Activity	Type of material Required	Source
Breakwater	Core: silts and fine sands	Onsite
	Armour: boulders of competent armour rock, sizes from 0.5 to 4 tonne	Previously excavated and placed adjacent to drains 20 km east of Cape Jaffa
Rock revetment for edge treatment to waterways	200 mm competent rock	Previously excavated and placed adjacent to drains 20 km east of Cape Jaffa
Blocks for waterway edge treatment	Limestone rubble Sand	Council's rubble pit approx. 4 km south-east of Cape Jaffa Onsite excavation of waterways
Landform and allotments	Fine, sand, silt and limestone	Onsite excavation of waterways

The breakwaters will be constructed with an impermeable core and lined with locally won limestone armour rock. The core is medium to fine grained sand and silts with minimal clay content, sourced from the onsite excavations. The rock for lining is to be won from existing stockpiles of durable consolidated limestone excavated from drains constructed previously and located about 20 kilometres east of the site. The volume of breakwater core is approximately 19,500 m^3 and the volume of rock lining is approximately 14,500 m^3.

The excavation of basins and waterways covers approximately 47 ha and totals approximately 2,568,000 m^3. Stage 1, which includes the main basin and opening to the sea covers approximately 14 ha and involves the excavation of about 810,000 m^3.

5.5.3 Describe the transport and storage of any construction materials to minimise effects on the local amenity.

The Site Construction Management Plan (**Appendix 8**) provides a number of specific measures for minimising the effects of transport and storage of construction materials on the local amenity, including:

- construction traffic management. A traffic management plan will be developed to control construction traffic and to minimise and control interaction with public roads. Construction traffic within the construction areas will be limited to designated haul roads and appropriate maintenance of the haul roads will minimise potential effects on the local amenity. The majority of the filling will occur to the east of the site away from the existing township and construction traffic will be limited to the defined construction areas, thus in general will not be allowed on the developed land or internal roads;
- separation between construction and developed areas will be used to minimise interaction between construction and the existing town. In the case of later stages, interaction with the previously completed stages will also be minimised. The separation will provide improved public safety and minimise potential environmental effects, such as construction noise and dust. Further, it is intended to achieve a general amenity within the completed stages of a

completed development, so that the whole of the site does not look or feel like it is still under construction.

- staging has been planned to minimise the interaction between stages and each stage is a compact and defined area. The connection between stages of waterways is in areas of narrower waterways in order to minimise the effects of opening subsequent stages on uses of the existing waterways. The commission of waterways stages will be performed to eliminate water surges by flooding of the waterway in a controlled manner to obtain equalisation of water levels prior to opening the new stage of waterway.

- site access controls including fencing, signage and procedural controls will be used to prevent public access to the construction areas. A separate dedicated access will be provided for construction personnel and traffic. The access will be stabilised to minimise sediment transport onto public roads and any material that is will be removed as soon as practical.

- construction noise: Landscaped mounds will be use where appropriate to reinforce the separation between construction and completed areas of the development. Noise monitoring will be used to ensure all equipment meets the relevant noise emission criteria.

- dust: Control of construction traffic to the designated haul roads and appropriate maintenance of the haul roads will minimise potential dust issues. Regular light watering will be used to suppress dust on haul roads or other potentially dusty areas. Completed areas will be landscaped as soon as practical to prevent dust associated with windblown erosion. The soil types found on site are generally sand or limestone so dust issues are not expected to be significant. See Section 5.2.30 for further information.

5.5.4 Identify the measures for the control of dust, vibration, noise, stormwater and groundwater and other emissions during construction.

The SCMP described in Appendix 8 provides specific measures for minimising emissions during construction, including:

- sediment barriers, stabilised entry/exit points and control of run-off entering or leaving the site;

- stockpile management including silt fences, landscaping and appropriate location;

- monitoring and management of dewatering activities. See Section 5.2.10 for additional information;

- noise control including separation, buffers, noise mounds and monitoring; and

- dust control, including control of construction traffic (per Traffic Management Plan), haul road maintenance and landscaping. See Section 5.2.30 for further information;

Site access, construction traffic management (per Traffic Management Plan), separation buffers and construction staging are all proposed to assist in limiting the potential adverse effects of construction activities.

There will be no blasting or impact rolling, thus potential sources of vibrations will be limited to normal construction activities, such as construction traffic and soil compaction rollers. Thus, vibrations are not expected to have any adverse effect on existing residence or structures. If construction activities are proposed that may result in potential effects in close proximity to existing residence or structures, vibration monitoring will be employed to ensure vibrations are within acceptable limits per AS 2187.2 and DIN 4150(1).

An assessment of construction dewatering release to the sea was undertaken by SARDI Aquatic Sciences (**Appendix 13**), which concluded *"natural current and tidal movement should rapidly dilute it, so it is unlikely to have any detectable impact "*. See **Sections 5.2.28**, **5.5.10** and **Appendix 13** for further information.

5.5.5 Describe the implementation of environmentally acceptable work practices and monitoring programs, particularly through management plans.

The Site Construction Management Plan (SCMP) is outlined in **Appendix 8**. The purpose of the SCMP is to manage and mitigate the potential adverse effects related to the construction activities. The SCMP incorporates what is sometimes known as the Soil Erosion and Drainage Management Plan (SEDMP), although it covers a number of additional issues as discussed below. It is intended as an overall management plan incorporating environmental, quality, occupational health and safety, and public safety issues related to construction, in an integrated approach to ensure appropriate construction management.

Implementation of the SCMP

A number of strategies will be employed via the SCMP to ensure appropriate implementation of the SCMP and thus management of the construction activities. These include:

- risk management will be employed to appropriately identify, manage and mitigate construction risks. This process ensures that all of the various risks are identified, assessed and managed appropriately;
- development of policies will clearly communicate the commitment and expectations of Kingston Council and CJDC in relation to the project. The following policies will be developed specifically for the project:
  - Environmental Policy.
  - Occupational Health and Safety Policy.
  - Quality Management Policy.
  - Drug and Alcohol Policy.
  - Hours of Work Policy.
  - Industrial Relations Policy.
  - Return to Work Policy.

- procedures. Site induction for all personnel on the site, covering procedures for the issues listed above, including occupational health and safety, heritage protection, noise prevention, soil erosion and drainage, site access control, dewatering, marine construction and dredging, vehicle maintenance and washdown, soil compaction testing and inspection, services trenching laying and backfill, hours of work and subcontractor management; and
- monitoring, reporting and auditing. In order to ensure the management plans are effectively controlling the potential risks, monitoring and reporting of the outcomes is incorporated. Further, this allows ongoing assessment and modification of the plans in order to improve the outcomes sought. Independent auditing of the management, monitoring and reporting process further enhances the degree of certainty associated with the operation of the plans.

Structure of the SCMP

Prior to construction commencing, the Site Construction Management Plan outlined in **Appendix 8** will be developed, consisting of a family of management plans including:

- soil erosion and drainage management;
- aboriginal heritage management;
- general environmental management incorporating noise, dusts, pest plants and animals;
- marine construction and dredging management;
- adaptive coastal management;
- groundwater management;
- vegetation management;
- traffic management;
- emergency response, covering fire, spills, explosions and flood;
- quality management;
- occupational health and safety management;
- site access and public safety management; and
- potential acid sulphate soils management.

All plans will be submitted to the appropriate government agencies for approval prior to implementation.

5.5.6 Outline the provisions for any future expansion beyond Stage 7.

No expansion is currently envisaged thus none is included as part of this proposal. Nevertheless, from a broader planning perspective it is relevant to consider the longer term future development at

Cape Jaffa. The accompanying **Figure 5.53** depicts the locality and the zones and the areas considered for future development. The review of future expansion potential considers 4 main areas:

1 west of the site;

2 south of the site and Rothalls Road;

3 south of Cape Jaffa Road east of Limestone Coast Road; and

4 east of the site.

1 The land to the west extending to the point at Cape Jaffa and the west facing beach is primarily in private ownership and has two dwellings and substantial vegetation. This land also abuts the Bernouilli Conservation Reserve which extends to the south. The land is currently zoned Rural Coastal and is unlikely to be suitable for future settlement expansion due to the extent of vegetation coverage and its greater exposure to the sea from the west.

2 To the south of the proposal and Rothalls Road, the land is generally flat close to the road and rises to the south. The land is zoned for Primary Industry purposes and is divided into allotments of about 40 hectares near Rothalls Road with larger allotments further south. The land could accommodate an expansion of the settlement with Rothalls Road either retained in its current location or realigned to the south to encompass the additional land in a more comprehensive manner.

3 The land to the south of the proposal and Cape Jaffa Road is in large part low lying and has the capacity in geographic terms to accommodate an expansion of the settlement and the waterways subject to the necessary water quality requirements. Expansion in this direction however for waterway expansion would also require the relocation of Cape Jaffa Road to join with the Limestone Coast Road.

4 The land to the east of the proposal presents the least complicated expansion of the settlement as it provides a contiguous development with no interruption to the traffic arrangements and connects directly into the existing waterway scheme. Preliminary investigations indicate that suitable water quality can be maintained with some extension of the waterways to the east. This arrangement is more likely to be capable of meeting the required marina water quality criteria as a direct extension to the existing layout.

Therefore, there are practical options for the future expansion of the settlement and the consequential benefits to the locality, the district and the region, subject to the necessary investigations into the potential environmental effects, however none of these options are contemplated as part of the proposal the subject of this EIS.

Figure 5.53: Areas Considered

5.5.7 Indicate how the spread of weeds and diseases is going to be managed.

There are significant occurrences of seven proclaimed pest plants in the Major Development area. Under the *Animal and Plant Control (Agricultural Protection and Other Purposes) Act* 1986, section 52(2) prohibits transport of proclaimed plants in a control area and section 57(2) requires the landowner to control proclaimed plants. Table 5.23 lists the relevant provisions of the legislation and extent of investigations as it relates to these seven species.

Bridal creeper (*Asparagus asparagoides*) is a serious weed in the region and is well-established on the foredune and roadside vegetation. It smothers and displaces native vegetation and prevents regeneration, especially of groundcover and understorey plants. The seed is spread by birds and foxes which makes control extremely difficult.

Cooperative ongoing control programs developed with local Animal and Plant Control Officers including the introduction of the leaf miner and leaf rust biological control agents will be undertaken.

False caper (*Euphorbia terracina*) is a serious agricultural problem plant in the district and most efforts to control it have been based on using herbicides on a buffer zone around the perimeter of the cleared land adjacent to the township. It is a prolific seedier and there are large reserves of seed in the soil Excavated material used to build up allotments will almost certainly contain false caper seed, and invasion of disturbed areas must be monitored. Effective management and control can be achieved through regular mowing.

Table 5.23: Proclaimed Plants in the Major Development Area
Source: Appendix 11

Common Name	Botanical Name	Relevant sections of Act	Infestation
Bridal creeper	*Asparagus asparagoides*	52(2), 57(2)	Extensive infestations in roadside vegetation and edges of coastal heath
Cut-leaf mignonette	*Reseda lutea*	52(2), 57(2)	Occasional in pasture
False caper	*Euphorbia terracina*	52(2), 57(2)	Very heavy infestation in pasture and infiltrating edges of coastal heath
Horehound	*Marrubium vulgare*	52(2)	Occasional throughout pasture
Onion weed	*Asphodelus fistulosus*	57(2)	Widespread in pasture and around edges of coastal heath
Salvation Jane	*Echium plantagineum*	52(2), 57(2)	Occasional on roadsides and in pasture
Soursob	*Oxalis pes-caprae*	52(2), 57(2)	Occasional on roadsides, in pasture and around edges of coastal heath

Onion weed (*Asphodelus fistulosus*) competes with pasture species, significantly reducing production. In some areas of southern Australia it has invaded considerable areas of pasture as it is a prolific seeder and the seeds remain viable for many years. It is very easily spread through the movement of soil and most effective control is achieved through chemical application or cultivation. Onion weed does not compete well with native perennial species, and revegetation with desirable species can be used as part of an integrated management program.

Onion weed will be managed by a combination of Chemical application, cultivation and revegetation with native perennial grasses in selected locations.

Diseased and pest plant control will be based on the following strategies:

- Liaison will be maintained and advice sought from local Animal and Plant Control (APC) Officer;
- Spoil will be removed from site only in a controlled manner and only to designated sites;
- Construction equipment and vehicles will be cleaned before leaving site;
- Vacant land will be slashed regularly at appropriate times to reduce seed set;
- The perimeter of the site will be treated (with advice from APC Officer) regularly to maintain buffer zones;
- Stock movement will be restricted to and from infested areas; and
- Biological control agents will be introduced (with advice from APC Officer) to help control bridal creeper.

5.5.8 Describe the management agreements between the District Council of Kingston and the Cape Jaffa Development Company during and after construction.

Agreement has been established for the management of the project during and after construction to ensure:

- informed decision making;
- that the project is undertaken in an orderly, economic and efficient manner; and
- the long term maintenance and care of the facilities.

To that end, a Project Control Group (PCG) has been established as a vehicle for managing the development of the primary infrastructure for the project and its management thereafter. This body has the following purpose:

> *…the Project Control Group is to provide a regular forum for representatives of CJDC and Council to meet together with any relevant Infrastructure Development consultants and contractors to review, discuss and exchange ideas in relation to any or all aspects of the Infrastructure Development.*

The representatives from Council then report to Council the outcomes and progress of the development as recorded at the PCG. The arrangements require:

- monthly meetings;
- reports on the progress of the Infrastructure Development including the proposals and budgets for the Infrastructure Development to be presented to the Project Control Group;
- the PCG to authorise representatives of the Parties to sign contracts and agreements in relation to the Infrastructure Development;
- CJDC to be responsible for:
  - the maintenance, repair, cleaning and upkeep of the land division infrastructure for a period of 2 years after the Practical Completion of each stage;
  - the maintenance, repair and upkeep of the marine infrastructure and waterways for a period of 4 years after the Practical Completion of each stage; and
  - maintaining the marine infrastructure and waterways in a clean and navigable condition for a period of 8 years after the Practical Completion of the Stage 1 marine infrastructure.

Following the above prescribed periods, Council will be responsible for the maintenance, repair, cleaning and upkeep of the land division infrastructure, the marine infrastructure and the waterways in the same manner as Council manages the existing infrastructure and facilities at Cape Jaffa, Kingston and the district.

Further, CJDC as the Development Manager of the project will:

- provide all necessary management and other services required to implement the development of the Infrastructure;
- conduct all operations in a proper, efficient, economical and safe manner;
- prepare and submit to the Project Control Group regular reports on the progress of the implementation of the Infrastructure Development;
- prepare and submit for execution by Council all documents required to divide the Development Area into Allotments and Marina Berths;
- ensure compliance with all applicable laws and regulations and lawful directions of any Authority and in particular implement the Infrastructure Development in accordance with the Act and all other planning and development legislation;
- do all other things necessary and economic to implement the Infrastructure Development;
- plan and submit to the Project Control Group for consideration proposals as to the stages and sections of the Development Area to be developed;
- supervise direct and control all site work and installation of services;
- call tenders where necessary;
- ensure appropriate Contractor's Risks, Public Liability and Workers Compensation insurances on which there are noted the respective interests of the Parties and make payment of all required Work Cover levies;
- take all reasonable steps to minimise any industrial or other disputes that could affect the development; and
- execute all such acts deeds documents and things as may be necessary or incidental in expeditiously completing the Infrastructure Development.

To ensure the long term maintenance and management of the infrastructure, a marina maintenance fund will be established comprising a contribution from CJDC of two thousand dollars per allotment sold and 50% of Council rates for 5 years after each allotment is sold. This fund will therefore be substantial allowing growth of the fund over time. An actuarial analysis of the fund has been performed, incorporating the effects of the contributions by CJDC, Council, accumulated interest and the expected ongoing cost of maintenance of the marine infrastructure. This analysis has been performed using conservative assumptions, for example, it is based on an ultimate development of 500 residential allotments, conservative (2003) rateable values and conservative maintenance costs. More than sufficient funds will accumulate for the perpetual maintenance of the marine infrastructure, thus the future purchasers of land within the development are secure in the knowledge that the maintenance and upkeep is fully funded. Similarly, Kingston District Council and the State Government will not be left with a financial burden associated with maintenance of the facilities.

The management agreement incorporates the requirement for Council to prepare an amendment to the Development Plan to reflect the approved development. This document provides the necessary development management and control criteria for the future development of the land and therefore plays an important role in the management of the area. It is also proposed to reinforce the Development Plan provisions with a set of design guidelines encapsulated in an encumbrance or management agreement to control activities and development over water and over the land, thereby providing owners with a high degree of confidence of what is considered appropriate in the area. These agreements will require that all development proposals within the Major Development Area be approved by CJDC or its delegate.

5.5.9 Identify proposed by-laws and encumbrances to control and manage activities.

The development of the land by the creation of allotments and the subsequent development on that land will be controlled primarily by the *Development Act* 1993 and the Regulations thereto, which by definition includes the Development Plan. This includes the building of sheds, dwellings and commercial infrastructure, as well as the use of land and buildings. Further, the Environment Protection Act, Regulations and related Policies will control development in terms of the licensing and operation of prescribed activities. Activities may also require licences and approvals from various other authorities including PIRSA, TSA Marine Facilities, Liquor Licensing Court and Department of Health. In addition to these normal control mechanisms, it is appropriate and common in integrated development schemes such as marinas to incorporate additional measures to manage and control activities as discussed below. These measures provide confidence in terms of the expectations and use of the area and thus provide additional protection of the interests of users and landowners.

All titled property will have an encumbrance or agreement registered on the title which sets out the various requirements or obligations for the development form, land use, occupation and activities appropriate to the property, together with a record of recognition in relation to activities essential to the operation of a working fishing port. There will also be a set of marina rules that apply to the use and development of the waterways. Enforcement of these agreements and rules will be the responsibility of the marina manager together with Kingston District Council.

In terms of building development, the following factors are intended to be incorporated in any agreement:

- requirements for applications;
- approval process;
- land use;
- design character;
- siting of development;
- building height;
- building setbacks;
- building materials and finishes;
- outbuildings;

- plant and equipment;
- landscaping;
- fencing;
- privacy;
- stormwater management;
- definitions;
- maintenance;
- construction management; and
- land use relationships.

Council by-laws together with the agreements and the marina rules provide control and guidance for various activities on and adjacent the waterways including:

- the use and berthing of vessels;
- vessel types;
- vessel speed;
- maintenance and related activities;
- fishing areas;
- swimming areas;
- maintenance of facilities and vessels within the water;
- activities on landings, berths and ramps;
- wharf access and use;
- refuelling
- parking controls;
- vehicles on beaches and breakwaters; and
- camping on Council land;

For properties that have the opportunity to establish a marina berth, guidelines will apply to the type, style and form of construction to ensure a consistent approach and presentation to maintain a high quality of development throughout the marina. The agreements and marina rules will also apply to the whole of the wet part of any allotment and those parts that may require maintenance so that the relevant parties can undertake management, maintenance and monitoring of the waterways. For these reasons, an easement will be applied along the whole waterfront to control development and activities within the easement and to enable access for management, maintenance and monitoring of the edge treatment and the immediate land area for a distance of 4 m from the top of the marina waterway edge wall.

Where appropriate, the Development Plan will reflect aspects of the agreements relating to the development and use of land, thereby reinforcing the intent of those agreements and desire for development that satisfies the character, form and function expectations of the development.

The proposed agreements and guidelines will provide confidence to users that a high quality and consistency of development will be established and assurance that an attractive and desirable environment and amenity will prevail in the long term.

5.5.10 Describe the proposed methodology for dredging and earthworks drainage, dredging frequency, disposal of excavated material, and impacts on water quality and the environment.

Introduction

This section describes the proposed methodology for dredging and excavation of the channel to Lacepede Bay, the associated earthworks, drainage and the disposal of the dredged or excavated material. It also describes the Dredging Environmental Management Plan, the potential environmental effects and the strategies to be incorporated to manage and mitigate those effects.

Dredging for Channel Construction

Initial dredging is proposed as part of construction in order to establish a navigable channel from the waterways to the open sea. From the coast to the entrance between the breakwaters, approximately 300 metres offshore, the proposed channel is to be dredged to a depth of -3.5 mAHD. Seaward of the breakwaters the channel is -3 mAHD and extends until -3 mAHD water depth is reached, approximately 280 metres from the breakwaters. The channel is approximately 25 metres wide plus sides with slopes of 1in 5, so the total width varies up to about 45 metres.

The seabed consists of sand overlying limestone. Hydrographic survey of water depth and a seabed probe survey to assess the thickness of the sand overlying the limestone have been performed. **Figure 5.54** shows the results of these surveys, the proposed channel and a recent aerial photograph.

The volume of excavation seaward of the breakwaters is approximately 4,000 m^3 and within the breakwaters is approximately 15,000 m^3. The total area of seabed disturbed by the channel is about 2.2 hectares. **Figure 5.55** shows the cumulative volume of excavation of sand and limestone verses distance along the channel alignment from the beach. Note that the end of the breakwaters is about 340 m along the curved alignment of the channel and the seaward end of the sea channel is at about 620 m along the channel alignment. All of the limestone to be excavated (approximately 5,600 m^3) is within the breakwaters, so the excavation of sand seaward of the breakwaters will be readily dredged using a conventional suction cutter dredge.

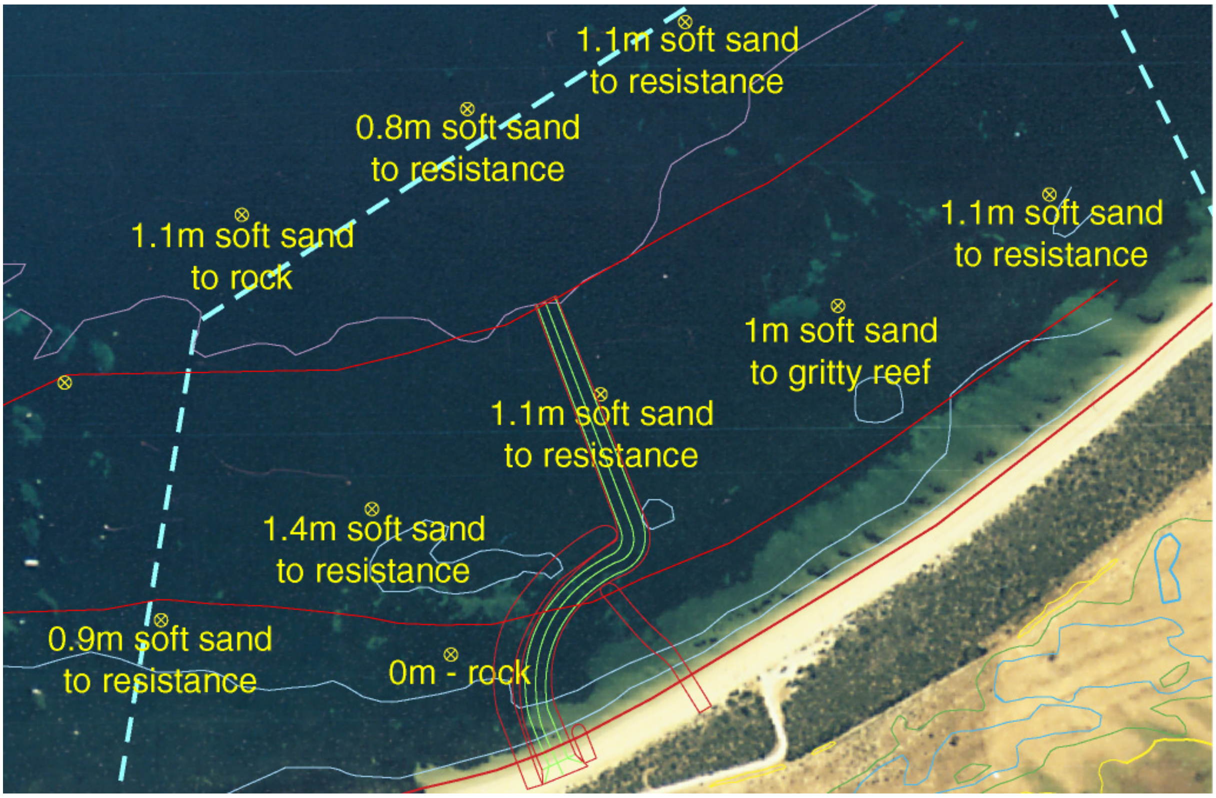


Figure 5.54: Location of Sea Channel

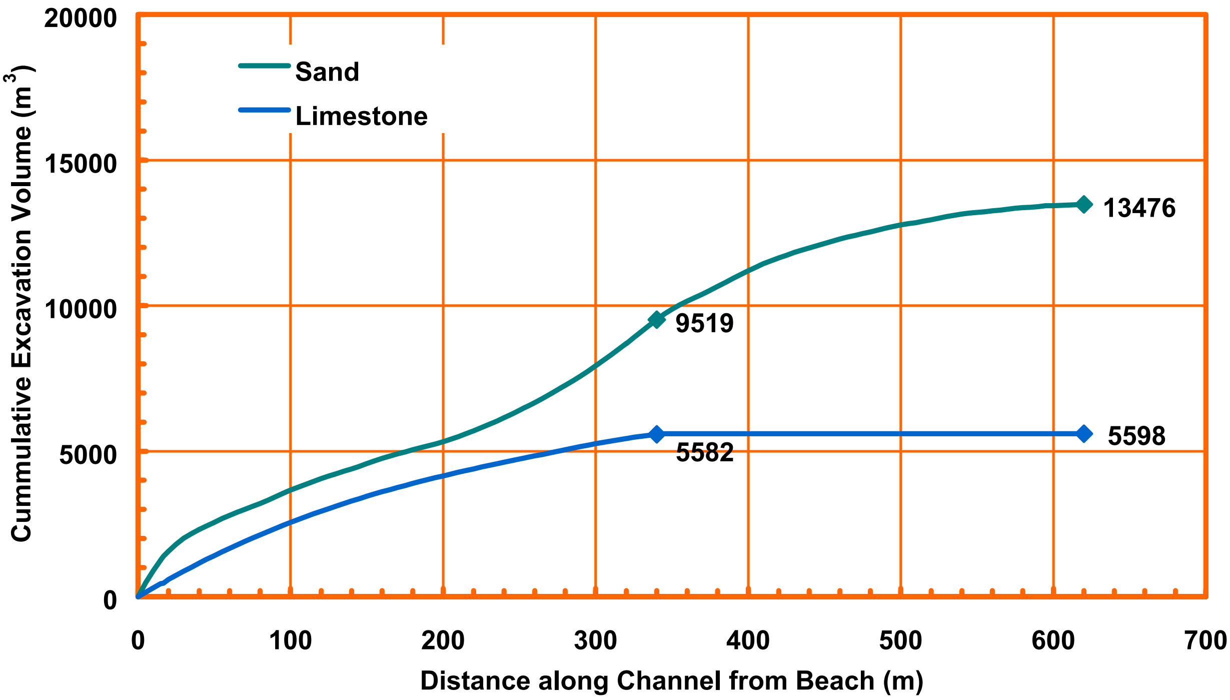


Figure 5.55: Sea Channel Excavation Volumes

Construction of the channel within the breakwaters will involve a combination of suction cutter dredging and an excavator, with the excavator being employed where hard limestone is encountered. The preferred option for the excavation of hard limestone is to use an extended turret excavator, whereby the track assembly runs on the seabed and the majority of the excavator is elevated sufficiently to ensure it is above water and wave level. Water depth within the breakwaters is generally less than 2.5 metres and this construction method is well suited to these water depths. Excavated limestone will be loaded onto conventional articulated trucks on a barge and conveyed to the beach. The barge will land at the beach within the area that will later be excavated for the channel into the main basin. The material will then carted for placement in mounds together with the material excavated from the land-based excavations. A barge mounted excavator may also be employed in a similar manner and where the channel is accessible using a conventional excavator located on the breakwater, excavation and cartage via the breakwater will be employed.

The only effect on water quality expected will be that associated with increased turbidity levels and various strategies exist to minimise the effects of turbidity. These will include timing dredging events to coincide with periods of low water movement, use of a cutter-suction dredge where possible in soft sediments, and where necessary, the use of shrouds around the area being dredged.

The sediments in the area are predominantly fine to medium sand (0.125 mm-0.5 mm in diameter), with only a few percent silt and clay (**Appendix 16** and SKM 2001). Given the small volume of sediment to be excavated, the open nature of the area with good flushing, the short duration of the dredging and the relatively coarse nature of the sediment, it is very unlikely that increased turbidity will produce any substantial problems for the seagrasses in the vicinity (**Appendix 13**).

If needed, metal shields will be placed around the section of channel being dredged as a silt curtain, so that only a single pulse of turbidity occurs when the shields are removed. This technique has recently been used successfully at Tumby Bay and other locations. Given the coarse nature of the material to be removed, it not expected that it would be necessary to employ this procedure to maintain turbidity levels within acceptable levels.

Further, if necessary to meet water quality requirements during construction of the channel between or within the breakwaters, a coffer dam can be formed by constructing a temporary bund across the mouth between the breakwaters. Again, this limits effects to only a single pulse of turbidity when the coffer dam is reopened. When the coffer dam is first opened, turbidity will be minimised by ensuring a minimal amount of loose material is left in the excavated area when it is opened to the ocean, and by slowly equalising the water levels prior to opening.

Overall, increased turbidity will be short lived and the seagrasses in the area likely to experience decreased light availability for less than 1 month in total. This short period of low light is well within the capability of both *Posidonia* and *Amphibolis* to withstand and no long term negative effects on the seagrasses are expected (**Appendix 13**, Clarke 1987, Greg Collings SARDI unpublished report).

Maintenance Dredging

Sand Management

The breakwater has been designed to minimise the need for maintenance dredging. It is of solid core design that does not allow sand movement alongshore through the breakwaters, thereby avoiding sand build-up in the channel where it might effect safe navigability of the channel. As a result, maintenance dredging of the navigable channel is expected to be very infrequent, of the order of once every 10 to 25 years.

The length of the breakwaters has been determined to ensure that ample sand storage volume is available updrift (west) of the breakwaters without affecting the navigation channel. Longshore sand drift will result in sand accumulation to the west of the breakwaters and ongoing sand bypassing will be required and is expected to be less than about 15,000 m3/year. A detailed discussion of coastal processes and the expected coastal management requirements is presented in Section 4.13 and Section 5.2.13. It is likely that this will require sand bypassing once every 1 to 5 years.

It is proposed to use a conventional cutter suction dredge to excavate the sand from the western side of the western breakwater and pump it to the eastern side of the eastern breakwater, thereby preserving the natural sand drift along the coast. The use of a dredge will result in reduced effects as compared to land based excavation and haulage. As the bypassing involves the moving of relatively clean beach sands, it is not expected to pose any environmental issues.

The environmental management of this operation will be undertaken in accordance with the Dredging Management Plan, which will have been developed in consultation with the EPA prior to the commencement of excavation.

Seagrass

Seagrass wrack management may be required if weather conditions, particularly wind direction, result in excessive build-up of seagrass wrack over the winter period. Ongoing build-up of seagrass wrack is not expected to occur adjacent to the breakwaters, rather seaweed is expected to be found on the beaches over winter and to leave the beaches again over summer, as currently occurs along the southern beaches of Lacepede Bay. Seagrass wrack movement is discussed in Section 5.2.13.

If required for water quality or general amenity reasons (odour, insects etc), seaweed will be cleared from the beach using a loader to scrape the seaweed off the beach and load it into trucks. This is a limited area and limited quantities are expected, so the potential adverse effects of this activity are expected to be minimal and the benefits are expected to outweigh the potential concerns. Section 5.2.22 discusses water quality in detail and Section 5.3.3 discussed the potential odour and pest nuisance associated with long term seaweed build up.

Management of the Dredged Material and Associated Runoff

All material excavated by the dredging activities will be placed on land and there is no disposal to sea proposed.

For the initial construction, dredging discharge will be to land-based settling ponds located within the main basin area that will later be excavated. Overflow will occur through the settling ponds for eventual return to the sea between the breakwaters. Sieve analysis of the sand shows that it is medium to fine grained (0.5 millimetres to 0.125 millimetres diameter), with only a few percent silt and clay, thus the methodology described above is expected to ensure very low turbidity and good quality of the water returned to the sea.

For the maintenance dredging, discharge will be to the beach immediately east of the breakwaters in order to replenish the beach in that location and to match the natural longshore sand drift.

Using a properly designed series of settlement ponds for dewatering of the dredged materials, it is expected that the water returned to the sea will be high quality. In addition to the settling ponds, if necessary to meet water quality requirements, a coffer dam can be formed by constructing a temporary bund across the mouth between the breakwaters. In this manner, the overflow from the settling ponds will be directed to the coffer dam and then be returned to sea from the coffer dam using one of two options. One option is to pump the water off the end of the breakwater, approximately 200 metres from the low tide mark. This is generally the preferred option under the Environment Protection (Water Quality) Policy 2003 (EPPWQP), but will result in the discharge being over seagrass.

The alternative is to discharge it further inshore, which is a less sensitive environment, being bare sand, however more stringent water quality restrictions apply under the EPPWQP, which may not be possible to meet. This situation will be discussed with the EPA prior to a final decision being made, as it is considered more environmentally appropriate to return water within the strip of bare sand closer to the coast in order to minimise potential effects on seagrasses. In either case, increased turbidity will be short lived and the seagrasses in the area are likely to experience decreased light availability for less than one month in total. *Posidonia* and *Amphibolis* seagrasses are readily capable of accommodating this short period of low light with no long term negative effects (**Appendix 13**).

Given the relatively undeveloped nature of the site, it is highly unlikely that the materials excavated will contain any significant levels of contamination. To confirm this, the sediments will be sampled and tested for the main potential contaminants prior to any dredging activity, as part of finalising the Dredging Environmental Management Plan (DEMP). More detailed investigations into the potential effects of dredging will be conducted as described in **Section 5.2.29**. These investigations will include exposure/elutriation tests, supernatant water quality testing and settling tests to determine the required water retention times, settling pond location and sizing. Further, investigations of the potential pH changes that might occur on excavation and oxidation of the materials to be dredged will be conducted. Investigations into potential acid sulphate soils within the development site have been conducted, which show that due to the high calcium carbonate content pH changes are minimal and no adverse effects are expected. See **Section 5.6.2** for further details of these investigations.

As stated previously, it is intended that all of the material excavated by dredging be placed on land. It will subsequently be excavated and relocated into mounds and general fill around the site together with the material sourced from land based excavations. Materials excavated by dredging that match the beach sands will be place on the beach to the east of the eastern breakwater as part of the provision of a buffer against the sand loss that may occur in that area as a result of the natural longshore sand drift between sand bypassing events, see **Section 5.2.13** for further information.

<u>Dredging Environmental Management Plan and Licensing Requirements</u>

The dredging will be performed in accordance EPA licensing requirements and the EPA Guidelines for Dredging and Earthworks Drainage (EPA 396/02 Sept 2003). The DEMP will be developed in consultation with the EPA as part of the licensing process and incorporated into the Site Construction Management Plan. Elements of the DEMP are discussed in **Appendix 13** and it is expected to incorporate the following:

- more detailed sampling and analysis of materials to be dredged. Initial assessment indicates that the medium to fine grained sands have almost no clay content, will result in low turbidity water and do not contain any contamination, however additional testing as outlined above will be performed;
- further investigation in the potential pH changes that might occur on excavation and oxidation of the materials to be dredged. Investigations conducted to date show that pH changes and adverse effects are very unlikely;
- definition of the required monitoring of turbidity during dredging;
- definition of various strategies to be put in place to reduce turbidity in case monitoring indicates increased turbidity;
- definition of the location to which excavated and dredged material is to be placed;
- procedures to minimise the risk of introduction of marine pest flora and fauna;
- public notification procedures;
- auditing of the monitoring program results by an independent consultant; and
- regular reporting and discussion of findings with the EPA.

5.5.11 Outline the impact of dredging and channel maintenance on boat access.

The dredging methods and general effects of the dredging are outlined in Section 5.5.10 and 5.2.28. This section discusses particularly the effects of the dredging activities on navigability of the channel.

In order to minimise the effects of the sand bypass activities on the beach, nearshore seabed and coastal dunes, it is proposed to use a conventional cutter suction dredge to excavate the sand from the western side of the western breakwater and pump it to the eastern side of the eastern breakwater, thereby preserving the natural sand drift along the coast.

Pipework will be installed under the breakwaters and the channel prior to construction in order to allow the sand bypass to occur without any effect on the navigability of the channel and allow unimpeded boat access from the waterways to Lacepede Bay. Between bypass activities, the ends of the pipework will be capped, surveyed and buried in the sand in order to preserve the general amenity of the area. Other breakwater and channel maintenance activities are not expected to impede boat access.

5.5.12 Detail the proposed monitoring of impacts during and after construction.

The Environmental Management Plan (EMP) will contain the proposed monitoring of any impacts during and after construction. Monitoring and the reporting of results will be undertaken in accordance with the EMP, which will have been developed in consultation with the EPA prior to the commencement. In addition, it is intended to undertake regular meetings with all appropriate agencies to keep them informed on the progress of the monitoring program. The monitoring is discussed in various sections of this report and it outlined below, together with references to the relevant sections.

Groundwater levels, quality and salinity: Refer Section 5.2.10 for further details of the monitoring of the groundwater and nearby existing groundwater wells.

Coastal monitoring and survey of the existing beach profile and alignment to determine the actual long shore sand drift and assessment of coastal accretion or erosion or seagrass wrack build up. Refer Section 5.2.13 for details in relation to coastal monitoring.

Monitoring the performance of weed eradication programs and the rehabilitation of vegetation in the coastal dune. Refer Sections 5.2.15 and 5.6.7.

Water quality within the waterways will be monitored for nutrients, micro-organisms and heavy metals. See Section 5.2.22. The waterways will also be monitored for early detection and eradication of pest marine organisms as outlined in Section 5.6.6.

Monitoring of the waste water treatment system and the reuse of reclaimed water by irrigation will be detailed as part of the Waste Water and Irrigation Management Plans as outlined in Section 5.2.20. This includes monitoring of biological oxygen demand, thermotolerant coliforms, nutrients and chemical quality requirements of the reclaimed water, the groundwater surrounding the irrigation area and the soils of the irrigation area.

The Marina Manager will be responsible for routine monitoring of environmental noise within the marina. See Sections 5.2.31 and 5.3.16 for further information.

Monitoring of the turbidity, pH and potential contaminants of the dredging water returned to the sea. See Sections 5.2.28 and 5.5.10.

Monitoring of construction related effects includes monitoring in relation to preservation of aboriginal heritage, soil erosion, stormwater/groundwater pollution, silt transport to public roads, potential acid sulphate soils, noise, dust, vibration, pest plants and animals, spills. See Sections 5.2.30, 5.5.1, 5.5.3, 5.5.4, 5.5.5, 5.5.7, 5.6.2, 5.6.3, 5.6.4 and 5.8.1. The Site Construction Management Plan outlined in Appendix 8 discussed monitoring related to the construction activities.

The Marina Manager will be responsible for regular monitoring and management of facilities and services in the marina including the fuel and waste pump out facilities, the wash down and ramp areas including the wash down waste water collection and holding system, waste collection facilities the general state of repair and cleanliness of the waterways and marine infrastructure.

5.5.13 Describe how waterways will be flushed during each stage of construction.

Detailed investigations and modelling of tidal and dispersion effects on water quality has determined that the layout of the waterways is such that forced flushing is not required to achieve good water quality within the waterways. Section 5.2.22 details the investigations and modelling that has been performed and shows that during most tidal conditions, water quality in the waterways is essentially the same as that which exists in the nearby open sea. Even during periods of very small "dodge tides", the layout of the waterways is such that water exchange is sufficient to avoid potential adverse effects. Further discussion relating to water quality within the waterways can be found in **Sections 5.2.6**, **5.2.7** and **5.2.22**.

After construction of each stage of the waterways and prior to opening that stage to the previously constructed waterways, the following will be conducted in order to minimise silt dispersal into the existing waterways and nearby sea:

- after construction, the new waterway will be cleaned of materials which might otherwise result in silt or turbidity;
- dewatering will cease and sea water slowly pumped into the new excavation to equalise water levels on either side of the bund between the existing waterway and the new waterway;
- once filled, the waterway will be left for silt to settle and to reduce turbidity before removing the bund that connects the new waterway to the existing waterway; and
- the bund wall will be removed during periods of low tidal movement .

Although these measures will minimise turbidity, there may be a pulse of increased turbidity for a short period resulting in reduced light at the seabed. This short term period of low light will have no adverse effects on seagrasses as discussed in **Appendix 13**.

5.5.14 Describe the design and operation measures to prevent stormwater and other run-off from the residential, commercial, boat ramp and other built areas from entering waterways and the marine environment.

<u>Design</u>

Stormwater from residential and commercial sites will be directed away from the waterways and run-off will be minimised using various strategies. Rainwater tanks will collect a portion of roof run-off. In these highly permeable sandy soils, significant potential exists to use various on-site detention methods such as pebble paths, infiltration trenches and soak wells, in accordance with the principles of Water Sensitive Urban Design.

The stormwater system will consist of grassed drainage swales located adjacent to the roads, which allow stormwater quality improvement via soakage as well as provide safe conveyance of extreme event flows into the stormwater detention basins and away from the waterways. The sandy, free draining soils will mean that for most rainfall events, settling of solids and filtering of stormwater will occur within the swale system, providing infiltration to the groundwater system distributed around the site. The swales are designed for flows up to the 100 year ARI storm event.

The design levels of internal roads are an important aspect of the stormwater management system. The open swales associated with the roads will have sufficient grade and flow capacity to carry extreme rainfall events. The roads will also be sufficiently elevated to avoid compromising access during combined extreme rainfall events, extreme high tide and extreme storm surge events, in accordance with best practice coastal management techniques and development guidelines in coastal areas.

The swales will direct water towards retention basins located in grassed reserves in order to treat the water before it infiltrates into the underlying sandy soil. The basins will be grassed and require maintenance similar to other reserve areas. Overflow to the waterway will not occur except during extreme rainfall events in order to prevent flooding. The basins capacity will be optimised to minimise overtopping and maximise soakage into the underlying permeable sandy soils.

Refer to **Section 5.2.4** for a further description of the stormwater management system.

Operation

As part of ensuring the operation of the stormwater system, the swales and basins will be maintained at regular intervals to remove the build up of litter and sediments, remove noxious plants and weeds and to revegetate any areas where the density of the vegetation has suffered damage from high flood flows or traffic. In some instance regrading of the swales may be required if scour or other damage occurs.

Boat wash down facilities will be incorporated adjacent the public boat ramp. This area will be clearly identified and the runoff from this site will be collected to ensure it does not enter the stormwater or waterways. This area will be sealed and bunded to prevent any liquid escaping the site and to divert all uncontaminated stormwater away from the area.. The wastewater and the associated paint, hull scrapings, oil and fuel will be diverted to a trade waste collection system. Further details regarding this system are provided in **Section 5.6.11**.

5.5.15 Outline controls on future housing and commercial construction activities.

Construction activities of all types will be managed to ensure that the existing and future residents are not affected by unreasonable noise or activities. To this end, no noisy housing or commercial construction activities will commence before 7.00am or continue after 6.00pm on any business day, and 9.00 am to 6.00 pm on any Sunday. This accords with the EPA Construction Noise Policy (EPA July 2002). Further, pollution avoidance will be required in accordance with the Handbook for Pollution Avoidance on Commercial and Residential Building Sites (EPA June 2004).

In addition, it is proposed to incorporate various guidelines in the encumbrances or management agreements that will apply to all allotments within the development. These include a range of construction management policies for stormwater, sedimentation, building site maintenance and waste management. Refer **Section 5.5.9**. In addition, the Development Plan will provide policies to guide all development.

5.5.16 Detail long-term management agreements for operation of the development, including the ownership of land and infrastructure.

The management agreements discussed in **Section 5.5.8** sets out short and long term arrangements during and post construction. The following discussion considers the long term operational arrangements for the development.

The agreement between Kingston District Council and CJDC sets out responsibilities for funding, construction and long term operation of infrastructure including recreational boat ramp, commercial wharf and associated facilities, port access infrastructure (breakwater, channels and main basin), power, water and waste water treatment. It is proposed that the services and infrastructure provided are made available to the public and extended to the existing settlement in order to improve the general amenity and economic development of the Cape Jaffa area.

Kingston District Council, as part of the development agreement, has agreed to make application for the funding of the public infrastructure. The extent of infrastructure provided, its accessibility, ownership and operation will be contingent upon the source and availability of funding. For example, the extent of publicly accessible commercial wharf will be determined by the level of public funding provided. For the purpose of this EIS it is assumed that appropriate funding contributions are provided for the full development of the facilities described herein. Refer **Section 5.4.4**.

Following construction and the prescribed maintenance periods, Kingston District Council will be responsible for the maintenance of the public infrastructure in the same manner as it manages the existing infrastructure and facilities throughout the Council area. Refer **Section 5.5.8**. This infrastructure includes roads, reserves, stormwater facilities, waste water treatment facilities and the marine infrastructure including the breakwaters, main channel, main basin, waterways and waterway edge treatments, boat ramp, wharfs and commercial facilities associated with aquaculture and the fishing industries. For these purposes, where appropriate, easements and rights will be created to ensure the necessary access.

Where possible, service providers may be retained to maintain, operate and/or own service infrastructure. For example, the water supply may become the responsibility of SA Water.

To ensure the long term maintenance and management of the marine infrastructure does not place an undue burden on Council, the Government or the community, a maintenance fund will be established from proceeds of lot sales and a portion of Council rates as described in **Section 5.5.8**

Private land, waterway and marina berths will be the responsibility of the respective owners in accordance with marina rules and agreements in relation to its use, operation, maintenance and management, subject to any responsibility of CJDC or Kingston District Council for the management and maintenance of the marina, waterways and edge walls. Marina Manager will be employed by the proponents to provide the ongoing management and maintenance responsibilities, including daily inspections and checks, floating pontoon and associated services maintenance, licence conditions compliance, cleaning, on water activity surveillance and reporting and action protocols.

5.5.17 Identify measures to protect any historic shipwrecks proximate to the development.

The Department of Environment and Heritage has advised that the closest shipwreck is the wreck of the Victoria, a 28 tonne wooden schooner built in Hobart town in 1838, which was lost in 1846 and is located several kilometres north east of the site. Other wrecks are located on Margaret Brock Reef some distance to the west of the site.

Shipwrecks are protected under the Commonwealth and State Acts (*Historic Shipwrecks Act* 1976 and 1981 respectively). The Acts prohibit the removal of any artefacts from the site, outline a number of protection measures and provide penalties for non-compliance.

It is proposed to provide signs at the boat ramp and in the public realm identifying the historical value of these wrecks and the responsibilities of the public under the Acts. This will provide more information to the boating public and a greater awareness of the value of these features.

5.5.18 Describe the compatibility of land uses, particularly measures to avoid conflict between commercial fishing/aquaculture and residents/ tourists.

The layout has been designed to provide a logical and practical separation of activities to minimise potential conflict whilst recognising the function of the working fishing port. The central facilities area comprising the public, retail and commercial sectors are located with direct access from Cape Jaffa Road such that vehicles do not need to travel through a residential area to attend the these facilities, which minimises the potential effects of non-residential traffic. Further, this location provides the most direct link between the land-based facilities and the sea. Any alternate location for the commercial and main public areas, such as close to the beach, would result in the need for traffic associated with these activities to pass through residential areas and hence result in greater potential effects.

The marina rules will require users, including the commercial fishers, to minimise as far as practicable the noise emissions from their operations and will define hours of operation for certain activities. The commercial fleet area is located in the main basin a minimum of 60 metres from any residential allotment. The wharf areas are further separated from the residential allotments and the nature of the rock lobster fleet loading and unloading activities are limited to the fishing season (October to May inclusive) during which time the vessels sail only about 60 days. The activities for loading the rock lobster vessels are limited to boxes of bait and the arrival and boarding of the crew prior to departure, usually between the hours of 3.30 am and 7.00 am. The unloading comprises hand loading plastic tubs with live fish onto the wharf where the PIRSA Monitor weighs the catch. Unloading occurs on return and fuelling and any routine maintenance is undertaken during the day upon return.

The aquaculture activities include daily feeding of fish which are resident for a limited growing period and when the rings are empty, occasionally for ring maintenance. Fish feeding will result in a limited number of trips and the loading and unloading activities are generally limited to the hours of 7.00 am to 7.00 pm. The feed for the fishery will be loaded in bulker bags directly into the feed vessels during daylight hours after 7.00 am. It is noteworthy that the operations of the port are very different from those at Port Lincoln.

Although the passage of vessels past residential properties on the water front is unavoidable, it is limited to a small number of properties. Given the nature of the development, this degree of association is not unreasonable and indeed expected in a working fishing port. A methodology for addressing issues will be included in the Operational Management Plan. This includes the requirement for all properties with frontage to the main basin area be constructed using noise attenuation measures and acknowledgement of the fishing port activities, operating hours and activities to be recorded on the title.

Figure 3.9 depicts the main facilities and functions where different land uses are identified. There is also a degree of transition between different uses as a means of creating a form of buffer between activities. In the western part of this precinct adjacent to the public marina berths is an area with potential to incorporate tourist development including some accommodation. Although part of the retail and activity focus, a small element of accommodation for short stay such as motel accommodation is appropriate and creates a more lively and active locality. Further to the west is an area set aside for additional tourist accommodation including apartments, which is considered appropriate given the separation from the activity precinct. This also provides a transition between the activity precinct and the residential areas further to the west.

On the east of the commercial/industrial area, there is to be a landscaped reserve space which provides a separation between the commercial/industrial precinct and residential and tourist accommodation. The eastern most commercial/industrial land will be limited in the range of activities allowed to ensure that any use approved in this sector has limited effects. Examples of appropriate uses in this part of the precinct include storage, warehousing, fish nursery and fish processing.

The service infrastructure area located at the south-eastern most extent of the development is designed with significant distance and visual buffers including landscaped spaces. This area is well separated from any sensitive receiver and will be required to meet the appropriate noise control legislation in order to avoid nuisance or disturbance.

In Stage 3 of the development there are residential allotments proposed to the rear of the existing tourist park. The allotments in this locality are well proportioned and provide ample space to create landscaped areas within the allotment, which provides an appropriate degree of visual separation between the tourist park and the residence. This separation can be enhanced by the development of a solid fence on the boundary between these uses.

The remainder of the stages comprise residential development adjacent to other residential development and therefore compatibility is ensured.

Expected noise sources, levels and mitigation measures are identified and discussed in **Sections 5.2.31** and **5.3.16**.

5.5.19 Outline measures to protect and monitor water quality in waterways and the marine environment from commercial fishing/aquaculture activities, including maintenance and repair.

The management and monitoring of water quality within the waterways is discussed in various sections including **Section 5.2.7**. These sections discuss the diversion of stormwater away from the waterways, the prevention of discharge from vessels, the management and treatment of commercial wastewater, the effects of groundwater and the water monitoring regime. The monitoring will identify any potential effects that the commercial fishing or aquaculture activities may have on water quality within the waterways.

Lacepede Bay Aquaculture Management Policy, (PIRSA August 2004) identifies several zones in which aquaculture activities can take place and defines appropriate management practices to protect the water quality within the marine environment. The policy specifies maximum stocking rates and depth of water for various species. These zones are well beond the areas currently used for aquaculture farming which ensure that the farming occurs well outside the Major Development area and hence will have negligible effect on the development.

Any associated maintenance and repair work to vessels or fishing infrastructure, including aquaculture rings, that may affect water quality will be conducted on land in order to eliminate the potential effects on water quality. The requirement will be stipulated in the marina rules. The land based areas for these activities will have appropriate infrastructure to carry out such works and the disposal of waste products will be subject to the normal regulatory authority approvals such as EPA licensing or Development Approval process, such that the material will not be disposed of to the sea. The dry dock management for careening and interception of potential pollutants such as hull scrapings is described in **Section 5.6.11**.

Particular activities within the development may require specific EPA licensing that includes additional water quality management and monitoring. An example includes the provision of reticulated seawater to facilitate fish processing and/or land based aquaculture. The provision of a seawater reticulation pipeline has been incorporated and it is proposed to construct a buried pipeline beneath the breakwater structure for this purpose. The operation and disposal of any wastewater to the sea would be governed by EPA guidelines and subject to approved licensing conditions.

5.5.20 Describe the impact on road networks during construction and operation of the development.

Construction Effects

The majority of construction traffic will travel to and from the site via the Cape Jaffa Road and Limestone Coast Road. Construction traffic will consist predominantly of standard semi trailers, some B-Doubles and tippers. The importation of quarried materials will ultimately dictate the routes of these vehicles and it is anticipated that there will generally be less than 50 truck movements per day, that is 25 laden trucks travelling to the site and 25 empty trucks travelling away (**Appendix 25**).

The movement of these vehicles will generally be local rural roads, and as such, should have no adverse impact on amenity within the broader district. Once at site, the vast majority of construction traffic will be confined to the areas of the site under construction, and should have little impact on the amenity of the existing township.

Discussions with the DC Kingston and Transport SA have revealed that there are no known load limitations on the local road network in the area. Therefore, legally loaded vehicles are unlikely to have an adverse effect on the road pavement structure and the existing road construction should be adequate to withstand the traffic loadings(**Appendix 25**).

All vehicles leaving site will be required to remove loose sediment or material prior to leaving the site in order to minimise the transportation of sediment on to public roads. See the Site Construction Management Plan (SCMP) for further details (**Appendix 8**).

A Traffic Management Plan (TMP) will be incorporated into the SCMP in order to control the effects of construction activities on the nearby public road network. The TMP will be developed as part of the detailed specification for each stage.

Operational Effects

The detailed design of internal roads will be based on current 'best practice' in order to maintain accessibility and road safety. The existing local road network will be expanded and fully integrated with the proposed roads to be constructed as part of the development. The final road network will provide access for residents, commercial and industrial activities, as well as tourist activities associated with the beach, jetty and caravan park (**Appendix 25**).

The development will result in benefits to the existing settlement by redirecting traffic away from residential areas. In particular, movements associated with commercial fishing activities will now be directly via Cape Jaffa Road, rather than past residences. The 'Jetty precinct' will be provided a more direct route from Rothalls Road. The existing access to the western part of the settlement will be maintained via Rothalls Road. Access to the beach of Lacepede Bay will be via the proposed collector road in the eastern part of the development together with a car park and walkway (**Appendix 25**).

A traffic generation assessment for the new residential development has been conducted based on the NSW Guide Traffic Generating Guidelines. There will be seasonal variations in traffic volumes and therefore the expected number of daily trips per residence will be less than a typical metropolitan residential development. Off peak periods have been assumed to have 60% of the peak traffic movements. **Table 5.24** provides estimated one-way trip traffic volumes based on 550 new residential allotments.

Table 5.24: Additional Traffic Generated

Source: **Appendix 25**

Residential trips per day	3,300 - 4,950 vpd
Allowance for tourist traffic	500 vpd
Allowance for commercial / fisheries traffic	500 vpd
TOTAL PEAK SUMMER TRAFFIC	**4,300 – 5,950 vpd**
TOTAL OFF PEAK WINTER TRAFFIC	**2,580 – 3,570 vpd**

These figures represent the total trip generation of the development, and a certain proportion of the residential trips will be internal to the development, e.g. to/from the tavern or local facilities. The NSW Guide for (Metropolitan) Residential Developments provides expected proportion of the trips external to Cape Jaffa and **Table 5.25** details the expected external traffic volumes.

Table 5.25: Additional External Traffic to and from Cape Jaffa
Source: Appendix 25

Traffic Source	Off Peak Winter	Peak Summer
Residential trip generation	1,485 vpd	2,475 vpd
Allowance for tourist traffic	300 vpd	500 vpd
Allowance for commercial / fisheries traffic	300 vpd	500 vpd
TOTAL	2,085 vpd	3,475 vpd

Overall, the level of expected traffic movements is considered to be well within the capacity of the existing wider road network.

5.6 Risk/Hazard Management

5.6.1 Describe strategies for ensuring public safety during construction.

The Site Construction Management Plan (SCMP) is discussed in Section 5.5 and a draft is presented in Appendix 8. It provides a number of specific measures for managing public safety during construction, including:

- site access controls including fencing, signage and procedural controls will be used to prevent public access. A separate dedicated access will be provided for construction traffic which will be stabilised to minimise sediment transport onto public roads and any material that is will be removed as soon as practical;
- construction traffic will be management using the Traffic Management Plan, which will be developed to minimise and control interaction with public roads and incorporated into the SCMP. Construction traffic will be limited to designated haul roads within the construction areas of the development and appropriate maintenance of the haul roads will minimise potential effects on the public;
- separation between construction and developed areas will be used to minimise interaction between construction and the existing town. In the case of later stages, interaction with the previously completed stages will also be minimised. The separation will provide improved public safety and minimise potential environmental effects, such as construction noise and dust. The staging has been planned to minimise the interaction between stages and each stage is a compact and defined area;
- the commissioning of waterway stages will be performed to eliminate water surges by filling of the waterway in a controlled manner. The equalisation of water levels prior to opening the new stage will minimise risks to users of the existing waterways; and
- dredging will be performed in accordance with the marine navigation rules define by the *Harbours and Navigation Act* 1993. In addition, the dredging infrastructure has been designed to minimise effects on boating access, as described in Section 5.5.11.

5.6.2 Detail procedures to be adopted if acid sulphate soils are encountered.

Introduction

Acid Sulphate Soil (ASS) is soil containing iron sulphides that oxidise and reduce the pH of soil or groundwater when exposed to air by drainage or excavation. If pH is reduced significantly the potential exists for reduced soil fertility, adverse effects of human health, animals or aquatic organisms, corrosion of metallic structures or the leaching of heavy metals from contaminated soils (Ahern *et al.* 1998).

ASS deposition can occur in mangroves, salt marsh vegetation, tidal areas or at the bottom of coastal rivers and lakes in clayey or sandy soils. The majority of ASS was formed during the Holocene period in areas where the following conditions existed (Ahern *et al.* 1998):

- the presence of iron-rich sediments;
- the presence of sulphates, usually from seawater;
- the removal of reaction products such as bicarbonate;
- the presence of sulphate reducing bacteria; and
- the presence of a plentiful supply of organic matter.

The term ASS refers to both actual and potential acid sulphate soils. Actual ASS (AASS) is soil where the sulphides have been oxidised, resulting in acidic conditions with pH less than 4 and can often be identified by the presence of pale yellow mottles and jarosite coatings. Potential ASS (PASS) are soils that contain sulphidic material which has not been exposed to air and oxidised. On exposure to oxygen the sulphides within PASS oxidise which may result in reduced pH, thus they may form AASS on exposure to oxygen.

The risk of adverse environmental effects of PASS near the site has been investigated and determined to be low (Appendix 26). The soils generally contain large amounts of calcareous minerals that act as a buffer against potential pH reduction. Nevertheless, a PASS assessment, monitoring and management plan is outlined below and results of the assessment and the procedures to be adopted if ASS are encountered are detailed in Appendix 26.

Likelihood of PASS

Investigations into AASS and PASS has been conducted to assess the likelihood of these conditions being present in soils on the site. These investigations included a review of known ASS/PASS in the area and a number of field investigations at the site (Appendix 26).

Preliminary Investigations

The potential for ASS to be present has been classified as “Nil” by PIRSA Land Information, as shown on Figure 5.56, which is a reproduction of a portion of the Southern South Australia Potential for Acid Sulphate Soil map (PIRSA Land Information 2001).

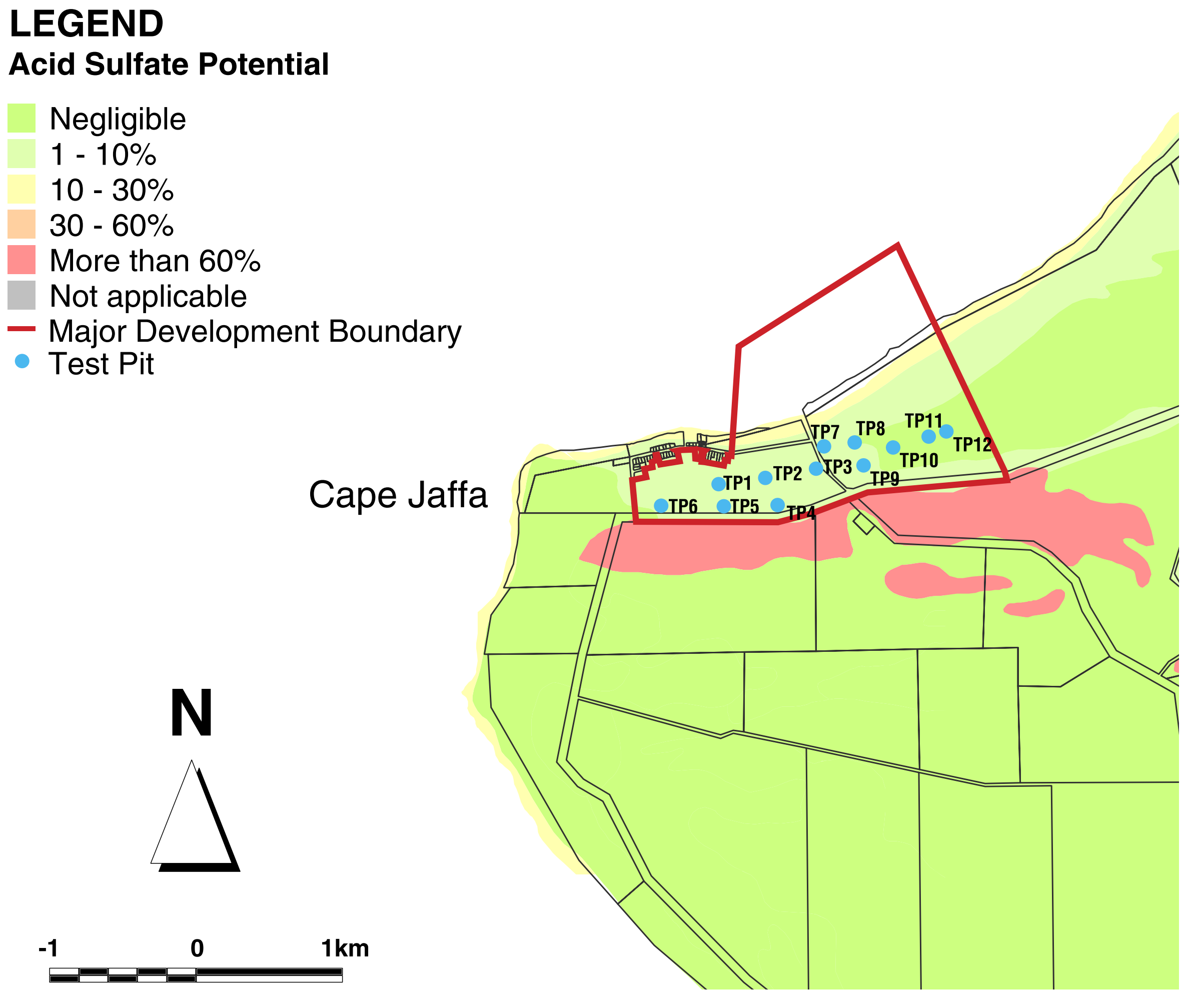


Figure 5.56: Extract of Southern South Australia Potential for Acid Sulphate Soil Map
Source Base Map: PIRSA Land Information 2001

Assessment of various criteria commonly used as indicators of possible ASS is summarised in Table 5.26. Key indicators such as swampy locations and absence of bicarbonates are not present, although the site is located adjacent to the coast and has sediments of recent geological age. The dunes found at the site are not usually associated with ASS as they are very recent and bicarbonate deposits from seawater are unlikely to have yet leached, hence they are likely to be too young to have yet formed acid sulphate sediments. The site is nevertheless coastal and of recent geological age so further site investigations were conducted.

Table 5.26: Possibility of PASS as Indicated from Geomorphological Criteria at Cape Jaffa
Source: Appendix 26

Criteria for PASS Indication	Possibility of PASS Indicated
Dominant vegetation is mangroves, reeds, rushes and other swamp tolerant or marine vegetation	No
Absence of bicarbonate	No
Sediments of a recent geological age	Yes
Soil horizons less than 5.0 mAHD	Yes
Sulphide bearing minerals, coal deposits or former marine shales/sediments shown in geological maps	No
Sulphurous odour	?[1]
Groundwater chloride:sulphate ratio < 2	No
Deep older estuarine sediments of Holocene or Pleistocene age	No
Soft, grey, unripe mud or estuarine, grey silty sands	No
Marine or estuarine sediments	Yes
Interdunal swales or coastal sand dunes (deep excavation only)	Yes
Presence of shell	Yes

[1] a seaweed odour was noted in places

Soil and Groundwater Analysis

Soil bore and groundwater sample results from the bore drilled within the site are presented in Table 5.27. The soil types were similar with a uniform profile of sand overlying limestone and a green clay and/or a calcrete layer were present between the sand and limestone at some locations. The limited variation in the soil profile suggests that the sampling program undertaken is representative of the site. The soil types at the site are further discussed in Section 4.8 and details can be found in Appendix 26 and 14. The pH of the groundwater at the site is neutral to slightly alkaline.

The Chloride to Sulphate ratio ($Cl:SO_4$) is used as an indicator of additional sulphate from prior sulphide oxidation (Mulvey 1993). $Cl:SO_4$ less than 2 is an indicator of additional sulphate from prior oxidation and ratios less than 4 is a possible indicator. Table 5.27 shows that the $Cl:SO_4$ ratios measured on the site average about 4.8 and range from 3.2 to 6.9. None of the samples exhibit ratios below 2 and 5 of the 24 samples exhibit ratios below 4.

Table 5.27: Soil and Groundwater Sample Results
Source: Appendix 26

Bore ID	Location	Field pH	Lab pH	Chloride	Sulphate	$Cl:SO_4$
CJ01	Near coast	7.33	7.88	334	102	3.3
CJ02	Near northern boundary	7.31	8.15	529	129	4.1
CJ03	Central	7.23	7.64	770	129	6
CJ03A	Shallow well	7.49	7.5	290	50	5.8
CJ04	Southern boundary	7.13	7.52	929	153	6.1
CJ05	Central	7.38	7.87	438	135	3.2
CJ06	Central	7.36	8.21	460	135	3.4
CJ07	Central	7.28	7.85	620	142	4.4
CJ08	Central	7.27	7.52	576	87	6.6
CJ09	Central	7.29	7.69	365	104	3.5
CJ10	Southern boundary in road verge	7.57	7.93	481	125	3.9
CJ11	In road verge	7.38	7.85	574	116	5
CJ12	In road verge	7.17	7.52	739	169	4.4
CJ13	Near coast	7.18	7.66	3430	494	6.9
CJ14	Northern boundary	7.2	7.63	911	174	5.2
CJ16	Southern boundary	7.14	8.16	1120	202	5.5
CJ17	Southern boundary	7.17	7.65	370	89	4.2
CJ18	South west corner	7.43	7.69	551	117	4.7
CJ19	Western end	7.1	7.59	594	122	4.9
CJ20	Northern boundary behind houses	7.36	7.88	433	89	4.9
CJ21	Northern boundary near houses	7.36	7.71	630	119	5.3
CJ21A	Shallow well	7.59	7.38	135	30	4.5
CJ22	Northern boundary	7.44	7.74	375	93	4
CJ23	Northern boundary	7.22	7.73	449	107	4.2

Test Pit Field Analysis

Test pits were excavated 3.0 metres to 4.0 metres below ground level at 12 locations around the site, as shown in Figure 5.56, and samples were assessed for pH and oxidised pH using the method of Ahern *et al*. (1998), who recommend interpretation as follows:

- oxidised pH < 3 and strong reaction – high level of certainty of the presence of PASS;
- oxidised pH 3 to 4 – less positive and laboratory analysis required to confirm;
- oxidised pH 4 to 5 – neither positive nor negative; and
- oxidised pH > 5 and little or no drop in field pH – little net acid generating ability.

The field results are shown in Table 5.28. None of the oxidised pH readings are below 5.5, indicating little net acid generating ability. The oxidised pH averages about 8.5 and ranges from 6.3 to 9.13.

None of the initial pH readings were acidic: the soil is generally alkaline, whilst the green-grey clay is pH neutral.

Table 5.28: Test Pit Field Results

Source: **Appendix 26**

Backhoe Testpit ID	Depth (m bgl)	Description	Initial pH (pH F)	Oxidised pH (pH FOX)	pH Change
TP1	2.0 - 2.3	White-yellow sand	8.26	6.57	1.69
TP 1	2.5 - 2.8	Grey sand	8.25	7.06	1.19
TP 1	3.0 - 3.3	Grey shelly sand	8.25	6.59	1.66
TP 2	2.1 - 2.3	Pale yellow sand	8.45	6.4	2.05
TP 2	2.6 - 3.0	Grey shelly sand	9.01	6.96	2.05
TP 3	2.2 - 2.5	Yellow shelly sand	9.12	[1]	[1]
TP 4	2.3 - 2.6	Grey shelly sand	8.45	6.72	1.73
TP 4	2.7 - 2.9	Green clay	8.7	5.91	2.79
TP 5	2.6 - 2.8	Shelly sand	8.54	6.37	2.17
TP 6	0.8 - 1.0	Pale yellow sand	8.07	6.41	1.66
TP 6	1.2 - 1.5	Grey shelly sandy clay	8.5	5.92	2.58
TP 8	1.8 - 2.0	Seaweed layer	9.11	6.29	2.82
TP 9	2.6 - 2.9	White sand	9.07	6.11	2.96
TP 10	1.2 - 1.4	Grey sand	8.46	6.63	1.83
TP 12	2.7 - 3.0	Grey sand (sulphur odour)	8.5	6.12	2.38

[1] peroxide test not undertaken as Initial pH was strongly alkaline

Test Pit Laboratory Analysis

In order to investigate in further detail and confirm the field indications, laboratory analysis was performed on eleven soil samples using the Peroxide Oxidation Combined Acidity and Sulphur (POCAS) method (Ahern *et al.* 1998b) and the results are shown below in **Table 5.29**.

The laboratory results show that the oxidised pH of the majority of samples remained strongly alkaline. All of the samples exhibited oxidised pH well above 3, which is the recommended action criteria, and also above 5.5, indicating little acid generating capacity. Some potentially oxidisable Sulphur (Spos) exists, however the pH difference when oxidised is not strongly correlated to Spos, indicating high buffering capacity of the soils to varying degrees. Clay, organic matter, lime or other carbonates increase the buffering capacity of the soil and analysis of soils at the site indicates calcium carbonate contents up to about 80 percent.

Based on the sampling undertaken, some of the soil layers contain potentially oxidisable sulphide, however the buffering capacity of the soil neutralises potential acidity and only slight pH changes occur.

Table 5.29: Test Pit Laboratory Results
Source: Appendix 26

Backhoe Testpit ID	Depth (m bgl)	Sample Description	Spos (%)	pH KCl	pH Change	Oxidised pH
BH1	2.0 - 2.3	White-yellow sand	0	9.4	0.66	8.74
BH1	2.5 - 2.8	Grey sand	0.062	9.5	0.5	9
BH3	2.6 - 3.0	Grey sand	0.027	9.8	0.85	8.95
BH4	2.3 - 2.6	Grey sand	0.071	9.6	0.47	9.13
BH4	2.7 - 2.9	Green clay	0.849	7.95	1.65	6.3
BH6	0.8 - 1.0	Yellow sand	0.013	9.8	0.79	9.01
BH6	1.2 - 1.5	Grey sandy clay	0.486	9.29	0.89	8.4
BH8	1.8 - 2.0	White-yellow sand	0.048	9.66	0.82	8.84
BH8	2.0 - 2.4	Seaweed	0.198	8.62	0.98	7.64
BH9	2.6 - 2.9	White sand	0	9.8	1.06	8.74
BH12	2.7 - 3.0	Grey sand, sulphur odour	0.021	9.74	0.91	8.83
Criteria			> 0.03		> 1	< 3

Summary of Presence of ASS at Cape Jaffa

The potential for ASS to be present at the site has been classified as "Nil" by PIRSA Land Information (2001). Nevertheless, investigations into the presence of ASS at the site have been conducted.

The investigations show that the soils at Cape Jaffa have little net acid generating ability and pH changes are not likely to pose a threat of detrimental affects on terrestrial or aquatic organisms or the quality of surface and groundwater resources.

ASS Management Plan

A draft ASS Management Plan has been prepared in case soils containing AASS or PASS are encountered and is attached as part of Appendix 26. As a precautionary measure, it is proposed to monitor the pH of soil stockpiles and groundwater as part of the Management Plan. A plentiful supply of materials rich in calcium carbonate is available from the materials to be excavated on site, so treatment methods are readily available should potentially acidic soils be encountered.

5.6.3 Describe procedures to prevent and manage pollution spills or sewage leaks.

The design of the sewerage system incorporates preventative measures to manage any potential sewage spills or leaks. The design and construction will be performed in accordance with the current specifications and guidelines of the relevant water authority including those of the Water Services Association of Australia and SA Water. These measures include locating the sewer mains within the road reserve to assist in containing possible sewage leaks or spills and avoiding the construction of sewer mains beneath the waterways wherever possible, in order to minimise serviceability and maintenance issues. Alarms will be incorporated in all pumping station controls to provide early indication of potential spills.

The use of hazardous chemicals or materials within the commercial area will be subject to approval from the Marina Manager and the EPA where required. Bunding of areas where the use of chemicals is allowed will ensure that any accidental spills will be contained.

Emergency response procedures will be incorporated in the Operational Management Plan for the development. These procedures will provide information regarding contacting the relevant emergency services personnel and information regarding the methodology and equipment for containment and disposal of spills or sewage leaks.

A waste oil depository will be located in a convenient location adjacent the commercial areas to provide appropriate facilities for the disposal of waste oil as discussed in **Section 5.2.24**.

5.6.4 Detail procedures to minimise effects of pollution spills or sewage leaks.

As part of the Emergency Response procedures described in **Section 5.6.3**, the following procedures will be incorporated into the Operational Management Plan.

The reporting of any spills or leaks will be the responsibility of the general public. The Marina Manager should be the first point of contact. Information will be provided in conspicuous locations to advise the public of the contact details of emergency services personnel and the Marina Manager.

The Marina Manager will record all details of the spill or leak including the time of the spill, location and any information regarding the type of substance and an estimate quantity.

Upon notification, the Marina Manager shall contact the necessary emergency service personnel. Further in the case of a large oil spill the State Oil Spill Commander will be contacted to coordinate any additional resources to assist in the containment and clean up operation.

In the case of hazardous materials including fuel, oil, and sewage spills the EPA shall be notified.

The containment of the spill is of the utmost importance. The method of containment will depend largely on the location of the spill and the type of substance. Wherever possible the containment of the spill to the land is a priority. Therefore, all entry points to the stormwater drainage systems shall be sealed to prevent spill from spreading.

Emergency spill kits will be located at the commercial wharf area and in other areas as deemed appropriate.

The clean up and disposal of the spill will be carried out by an appropriately licensed Contractor. In the case of a sewage spill the Marina Manager shall contact the relevant authority responsible for the maintenance and operation of the wastewater treatment plant.

5.6.5 Detail fire management processes, particularly on boats or flammable or explosive materials in the commercial areas.

As part of Transport SA requirements for mandatory safety equipment on recreational vessels, all boats must have a fire extinguisher complying with the applicable part of AS 1841 "Portable Fire Extinguishers – General Requirements".

All commercial vessels must meet the requirement of the Uniform Shipping Laws (USL) Code and Harbours and Navigation Regulations 1994, which include the number, type and configuration of fire safety appliances fitted to the vessel.

The commercial berths area will be serviced by a fire main and fire hose reels. Appropriate signage will be provided in public locations which will have emergency contact numbers for the Marina Manager and emergency service personnel including CFS, Police, SES and Sea Rescue Squadron.

Refuelling facilities will be designed to best practice guidelines as detailed in Protecting Our Coastal Waters, Doing It Better, Refuelling Guidelines (Transport SA 1998). In addition, the marina rules will include refuelling procedures, such as prevention of refuelling of vessels from individual drums or containers within the waterways.

Other flammable or potentially explosive materials may be stored within individual workshops in the commercial area. This will be managed through the development process which will identify the potential for storage and use of such chemicals and materials. Such commercial premises are required to install appropriate fire safety measures such as automatic sprinklers and will also require the storage of materials in a secure area, which is appropriately bunded and meets the requirements of AS 1940 "The Storage and Handling of Flammable and Combustible Liquids".

Further, limitations will be placed on the activities and operations that can occur within the marina in order to preclude activities that imposed undue risk of fire or explosion. They will be included in the marina rules and reinforced by Council by-laws where appropriate for policing by the Marina Manager.

5.6.6 Describe how the introduction of pest or nuisance marine organisms are to be dealt with.

There are over 250 known introduced marine pest or nuisance species in Australia (Thresher 1999), although the actual number is likely to be much higher (Hayes and Sliwa 2003). For example, within the Outer Harbour area of the Port Adelaide River, Cohen *et al.* (2001) found 22 known exotic species which included 17 exotic species in the nearby North Haven marina and 5 at the Royal South Australian Yacht Squadron (RSAYS), with a further 8 having been found previously (Cohen *et al.* 2001).

The degree of marine pest infestation for the majority of South Australia's developments, including waterways outside the Adelaide metropolitan area, is largely unknown. The vectors for most South Australian marine pest introductions are also unknown. Elsewhere in Australia, recreational and fishing vessels are known to have resulted in the introduction and spread of organisms. These include the black-striped mussel *Mytilopsis salei* in Darwin, the Asian Green Mussel in Cairns, and the Mediterranean fanworm *Sabella spallanzanii* in Eden (McEnnulty *et al.* 2001, Pollard & Rankin 2003).

In terms of marine pests, the environmental effects of a coastal development such as a marina may be considered from three interrelated perspectives (**Appendix 13**):

- there is the possibility of introducing or enhancing the distribution of a marine pest by the act of construction;
- a new marina presents a large expanse of new habitat for colonisation by species that may not otherwise occur in the area due to dominance of seagrass. Invaders that may be local species from outside the general area, as well as introduced pest species, may be afforded a substantial opportunity; and
- there is the ongoing potential for introducing pest species from other infected areas by virtue of the increased boating traffic.

The act of construction itself may result in new introductions to an area if any dredges, barges or other equipment are contaminated. Sediment remaining in barges/dredges from previous jobs can be a mechanism for the spread of exotic species. Ballast water, bilge water and hull fouling could also cause problems, especially as these craft tend to spend large amounts of time in major ports, which generally have numbers of introduced species. As a result, construction vessels will be cleaned and/or assessed for potential pest species before arrival. If the barge/dredge being used is based locally (ie in the south east of South Australia), this cleaning is unlikely to be needed unless it is known to have spent time in an area with a marine pest problem (**Appendix 13**).

The disturbance created by construction of a marina is likely to favour opportunistic marine organisms. Many of the most successful introduced species have these "weedy" properties and are thus likely to be successful in a disturbed habitat. Similarly, the new substrates available after construction favour taxa with these habits. Mitigation includes ensuring that water quality is sufficient so that local species are able to colonise, which is likely to be the case at Cape Jaffa (**Appendix 13**).

Pleasure craft may be more likely vectors for marine pests than larger ships, particularly for those species that occur as hull fouling. Shipping operators spend substantial sums on antifouling mechanisms as any level of biofouling has a detrimental influence on the efficiency of a vessel's movement and therefore the cost. Conversely, pleasure craft often accumulate substantial levels of fouling as they are often left at moorings for a protracted period without cleaning, and can accumulate substantial loads of fouling organisms. Fishing vessels can also be important agents of new introductions, particularly those that use easily contaminated bottom trawling or dredging gear.

The risks associated with both of these agents will depend on the amount of vessel traffic from other ports. Boats based in the marina which rarely travel to areas such as Port Adelaide and Port Phillip Bay are likely to be low risks, whereas visiting vessels from these ports will be higher risk. Similarly, local rock lobster vessels will be low risk, as they generally restrict their voyages to the south east of South Australia. Visiting trawlers operating out on the shelf will be high risk if they use the marina, although this is unlikely (**Appendix 13**).

Invasions of species such as the European fanworm (*Sabella spallanzanii*) and the solitary ascidian (*Ciona intestinalis*), as well as other species already found in South Australia are likely to be unpreventable. Both species are well established along the metropolitan coast of Adelaide (Boxall and Westphalen 2003, NIMPIS 2003) and their further spread is sure to continue. A marina may also act as a point source for marine pest invasion of the surrounding community. Longer-term predictions as to the effect of a marina in terms of invasive species are difficult to make, as the biological consequences of such invasions are often unknown (McEnnulty *et al.* 2001).

Most of these species are unlikely to invade the nearby seagrass meadows as they have not become a problem in similar habitats in Gulf St Vincent. *Sabella spallanzanii*, along with several other species, may have the potential to invade nearby reefal habitats, although this has not yet been documented in the Adelaide region where it is more likely to occur due to higher population sizes and greater human disturbance. The only natural substrate on which *Sabella* has been found around Adelaide are *Pinna* (razorfish) shells, which do not occur around Cape Jaffa (Edgar 2001).

The taxa that are of greatest concern are those targeted for eradication in South Australia, namely *Caulerpa taxifolia*, and those species that are major problems elsewhere but do not yet occur in this state, such as the pacific seastar (*Asterias amurensis*) and the Japanese kelp (*Undaria pinnatifida*). The former is a major economic and environmental problem in Port Phillip Bay, while the latter only occurs in Tasmania to date, and is thus only an immediate risk if vessels move between Tasmania and Cape Jaffa. Those species on the Australian Ballast Water Management Advisory Council's marine target species list that are not currently present in Australia are unlikely to be primary introductions to Cape Jaffa, as it will not receive international shipping.

Public awareness of marine pests and a mechanism of reporting potential sightings have been instigated elsewhere, as early detection is critical to the possibility of control. In addition, prevention is far cheaper than remediation of marine pest issues (McEnnulty *et al.* 2001) and as part of the management of marina facilities, these processes will be encouraged through signage with images of the most serious threats and contact numbers to report possible sightings to the relevant authorities. The local fishing and aquaculture community will be targeted with an awareness campaign, as they are the most likely to see something, and have the most to lose from any introduction.

The waterways will be monitored for introduced pests regularly by the marina manager. It is important to achieve early detection if a pest is introduced, as while it is generally possible to control recent introductions, it will likely be impossible to control any introductions that have become firmly established and which have gained a foothold outside of the marina itself. If any of these species are found, then the relevant authorities in PIRSA will be advised and consulted for an appropriate response strategy, which will likely be species and event specific.

5.6.7 Describe how weed species will be prevented from invading the coastal vegetation.

There are significant occurrences of proclaimed pest plants in the project area (see Sections 4.6, 5.2.15 and 5.5.7).

Pest plant control will be based on the following strategies:

- liaison will be maintained and advice sought from the local Animal and Plant Control Officer;
- no spoil will be removed from the site;
- construction equipment and vehicles will be cleaned before leaving the site;

- vacant land will be slashed regularly at appropriate times to reduce seed set;
- perimeter of the site will be treated (with advice from APC Officer) regularly to maintain buffer zones;
- stock movement will be restricted to and from infested areas; and
- biological control agents will be introduced (with advice from APC Officer) to help control bridal creeper.

Spread of pest plants from the developed area into areas of native vegetation will be minimised through:

- restricting access to native vegetation areas;
- maintaining weed control in the buffer areas between residential allotments and the foredunes;
- monitoring the edges of native vegetation areas and responding with appropriate management if new infestations occur; and
- informing residents of the importance of weed control through appropriate signage or printed material.

5.6.8 Outline the proposals for bunding of hazardous materials storage areas.

The permanent storage of hazardous materials will need to meet all existing legislation and have received appropriate approval.

Areas such as service stations will have bunded areas to prevent and spillage from reaching the waterways, as will certain commercial workshop facilities. Any bunded area will be required to meet with EPA guideline 080/04. In addition the bund floor and walls must be constructed of suitable materials and must be of sufficient strength and integrity to ensure that it does not fail in ordinary use.

It is preferable that the bunded area have a covered roof to prevent the ingress of rainwater. If this is not the case then a suitable drainage system must be incorporated such that any contaminated liquids can be removed and disposed of safely.

5.6.9 Detail the design of the breakwater and its accessibility and safety.

Breakwater Design

The breakwater is designed with the following objectives:

- to provide protection for safe mooring;
- to ensure a navigable entrance under all weather conditions;
- to allow operation of commercial vessels; and

- to provide protection for the harbour facilities.

Two breakwaters will extend out to sea approximately 300 metres to provide a protected seaway access from the waterways into Lacepede Bay as shown on **Figure 3.6**. The crest is at 2.5 mAHD, which is approximately the same height as the highest sections of the footway on the Cape Jaffa jetty. The longer western breakwater is designed to provide protected waters from the westerly through northerly weather and waves.

The breakwater structure is designed as an earth mound protected by rock armour. This type of structure is commonly used in other ports, marinas and boat ramp areas. Examples include Cape Jervis, Wirrina and Kingston. Further information regarding the breakwater design is outlined in **Section 5.6.16** and as shown on **Figure 3.7**.

Accessibility and Safety Aspects

Public foot traffic access to the breakwater structure will be provided for recreational purposes such as fishing activities. Restricted vehicle access will be provided for emergency service vehicles and other vehicles for maintenance purposes only.

5.6.10 Outline the risk contours around commercial areas in case of fire, explosion or toxic spills.

It is anticipated that the commercial area will support premises used for refuelling, shipyard construction and maintenance. These construction activities may involve spray painting, steel fabrication, welding, anti-fouling treatment and the like.

The risks of explosions or spills have been assessed in accordance with AS 4360 and each of the potential events has been classified to determine the appropriate risk status, as detailed below. In addition, appropriate management strategies has been identified.

The refuelling operations within the commercial area are considered to be an “extreme risk” exposure, potentially resulting in fire, explosion or toxic spill. In the event of an extreme risk exposure, immediate action is required to manage the risk. Areas designated for refuelling activities will be designed to ensure that adequate protection for spillage, such as emergency spill kits and bunding, which will confine any spills. Further the storage of any fuels will be in storage tanks that meet the requirements of AS 1940 “Storage and Handling of Flammable and Combustible Liquids” and the Petroleum Products Regulations Act 1995. Furthermore, to effectively manage the bulk fuel storage compound and refuelling facility, the licence conditions and operating rules will be strictly enforced.

Workshop activities and operations within privately owned premises have been assessed as having a high risk exposure. In all instances these activities will be carried out in workshop areas that incorporate safety measures in the event of an accident. Therefore in the case of an explosion or fire the damage will be confined locally to the site on which the premises are situated, in accordance with the Building Code of Australia (BCA). To provide containment to the site, the BCA requires that the building have adequate separation and construction type and fire protection installed. Furthermore, the Marina Manger will implement emergency procedures which will involve other emergency services to assist in minimising the potential impact on the facility.

Activities and operations within the public areas such as the hard stand and wharf area have been assessed as a moderate risk exposure. These activities include the disposal of waste oil and liquids, cleaning and washing of vessels and the like. As these areas will be clearly designated and adequate infrastructure for the containment and storage and disposal of the waste is provided, it is considered that this can be adequately managed and enforced by the Marina Manager as part of daily operations.

The storage of hazardous chemicals has been assessed as having a low risk. Storage of hazardous chemicals such as solvents, degreasers, paints/thinners and the like will meet the appropriate sections of the *Environment Protection Act*, *Dangerous Substances Act* and *Harbours and Navigation Act* where relevant. The individual property owner will be responsible for the safe storage of hazardous chemicals and where appropriate this will be enforced by the Marina Manager.

5.6.11 Detail the dry-dock management for careening (access to hull) and interception of pollutants such as hull scrapings.

Boat Washing, Hull Cleaning

Boat wash down facilities will be incorporated adjacent the public boat ramp. This area will be clearly identified and the runoff from this site will be collected to ensure it does not enter the stormwater or waterways. This area will be sealed and bunded to prevent any liquid escaping the site and to divert away from the area all uncontaminated stormwater. Further, it will be located above the storm surge/sea flood risk level (including allowance for sea level rise) in order to ensure that the collection system is not flooded by storm surge or king tide events. See **Figure 3.10** for the location of this facility.

The boat washing/cleaning area will be located adjacent to both the commercial slipway/travel-lift bay and the public boat ramp in order to ensure it is readily accessible to both commercial and recreational users.

The wastewater and the associated paint and hull scrapings, oil and fuel will be diverted to a trade waste collection system designed in accordance with EPA requirements as outlined in Stormwater Management for Marinas, Boat Sheds and Slipways (EPA 521/04). This system incorporates silt traps to collect gross solids and sediments and all liquids in order to meet the appropriate guidelines. A licensed contractor will undertake removal and disposal of the solids on a regular basis.

Activities such as abrasive or high pressure cleaning and wet rubbing will be limited to this area.

Maintaining and Repairing Vessels

Mechanical repairs of engines, fibreglass repair work and painting of vessels will be carried out in workshop areas with facilities to collect and treat solvents, degreasers and other potential contaminants.

All general boat repair work will be carried out on the land in an appropriately designated area. Activities will be restricted to ensure that no contamination of the stormwater can occur. Precluded activities include hull cleaning and wet rubbing. Areas will be regularly maintained and cleaned as part of the operation and management of the facility.

In water hull cleaning within the marina development will not be allowed without approval. EPA approval may be given subject to the operation satisfying the Code of Practice for Anti-fouling and In-water Hull Cleaning and Maintenance (ANZECC undated).

5.6.12 Describe how the development will comply with the coastal flooding policy outlined in the Development Plan.

The relevant policies in the Development Plan, together with a statement as to how these requirements will be achieved with this development, are set out in **Appendix 22**. A description as to how the development will comply with the coastal flooding policy is presented in **Section 5.2.17**, and is summarised below:

- standard sea-flood risk level has been conservatively assessed as 1.7 mAHD. The standard sea-flood risk levels accounts for the combined effects of a 100 year ARI extreme sea level, incorporating combined tide, stormwater and associated wave effects, plus an allowance for land subsidence for 50 years at that site;
- protection against sea level rise effects to 2050, of 0.3 metres, has been based on the Development Plan. Protection against sea level rise effects to 2100 have been based on the recent sea level rise assessments performed by the United Nations Intergovernmental Panel on Climate Change (IPCC 2001), in accordance with the recommendations of the Institution of Engineers of Australia's National Committee on Coastal and Ocean Engineering. The IPCC 2001 assessment has been used as it is about ten years more recent than that used during development of the coastal flooding policy outlined in the Development Plan. The adopted sea level rise is:
    - 0.3 metres to 2050; and
    - 0.8 metres to 2100, based on an expected range of 0.11 to 0.77 metres, with a central value of 0.44 metres;
- the Development Plan requires that protection be provided against sea level rise to 2050 and that protection measures are practical for the further sea level rise to 2100. In this development, protection will generally be provided now that accords with the expected sea level rise to 2100;
- protection against sea level rise to 2050 of the roads, parking and development sites on each lot requires land to be 0.3 metres above the sea flood risk level, i.e. a minimum of 2.0 mAHD. Corresponding minimum floor levels for commercial, industrial and residential buildings will be 2.25 mAHD;
- protection of development sites against sea level rise to 2100 will generally be provided now, by requiring that they are elevated a minimum of 0.8 metres above the sea flood risk level, ie; a minimum of 2.5 mAHD. Corresponding minimum floor levels for commercial, industrial and residential buildings will thus be 2.75 mAHD;
- these levels are conservative as compared with the Development Plan, which stipulates minimum site and floor levels of 2.4 and 2.65 mAHD respectively; and

- additional protection past 2100 can be readily provided in the future by raising the walls that form the edge treatments around the waterways and the breakwaters. The Marine Infrastructure Fund provides for the future protection measures that might be required. The fund is to be established using part proceed of land sales and also a portion of the first five years of Council rates.

5.6.13 Detail flood mitigation strategies including prevention of flooding and operation of canals and flushing basins.

Coastal flooding requirements are discussed in detailed in Section 5.2.17 and 5.6.12. The risk of coastal flooding is managed by ensuring that the minimum site levels, floor levels, seawall height and breakwater height are sufficient to ensure protection against the risk of sea flood, including allowance for sea level rise.

In addition, provision is made to allow additional future protection against further sea level rise, within the marina waterways by enabling the height of the revetment wall to be increased. Further protection is available adjacent the foredune which acts as a buffer against sea level rise and the effects of wave run up.

The stormwater system is described in Sections 5.2.4, 5.5.14 and 5.7.2 (Appendix 19). The design of the stormwater system uses best practice principles to mitigate the risk of flooding of the site and is summarised below.

Grassed swales along all roads will allow for stormwater quality improvement and soakage of runoff as well as safe conveyance of flows up to the 100 year ARI to stormwater retention basins.

The design levels of the swales and internal roads will be such that runoff is directed towards a number of stormwater retention basins. The basins would be designed such that all runoff from a 20 millimetre rainfall event would be retained and discharged via soakage only. This event is equivalent to a:

- 1 year ARI, 4 hour event;
- 5 year ARI, 1 hour event;
- 20 year ARI, 20 minute event; and
- 100 year ARI, 10 minute event.

Very large storm events in excess of the basin capacity will overflow into the marina waterways, thus storm events cannot result in flooding to levels in excess of the sea flood risk levels. Detailed design of the stormwater management system will define the location, number and capacity of the retention basins and also the layout and capacity of the swales. The detailed design will be carried out at the engineering documentation stage.

There will be no flushing basins incorporated in the final design of the marina.

5.6.14 Identify the risk to the proclaimed water resource (Lacepede - Kongorong Prescribed Wells Area).

The effects of the development on the aquifers will be very localised, as such, the risk to water resources of the Lacepede-Kongorong Prescribed Wells Area is expected to be negligible, other than within the immediate vicinity of the site (**Appendix 14**).

In close proximity to the site, the expected effects include localised changes to groundwater level, minor salt water intrusion fringing the waterways, and local changes to the groundwater flow conditions. These issues are discussed in detail in **Section 5.2**, particularly **Sections 5.2.1** to **5.2.10**.

5.6.15 Identify the risk to the marine environment and the rock lobster industry from increased discharges of groundwater that may potentially be contaminated by fertilisers.

Overall, the groundwater flow to the marine environment in the Cape Jaffa area does not change as a result of the establishment of the waterways (**Section 5.2.6**). The effect of the waterways is to divert groundwater flow from the existing coast into the waterways and then out to sea. The groundwater flow via the waterways out to sea occurs instead of the existing groundwater flow direct to the coast. Further, as there is no increase in groundwater outflow to the sea, there can be no increases in associated potential contaminants such as fertilisers. See **Sections 5.2.6**, **5.2.7**, **5.2.9**, **5.2.15** and **5.2.22** for further information.

Accordingly, there is no increased risk to the marine environment and the rock lobster industry, as discussed in various parts of **Section 5.2**. **Appendix 13** discusses the nearby rock lobster sanctuary and concludes *"it is very unlikely that the development will have an impact on the sanctuary's ability to achieve its objectives (protection of rock lobster)"*.

With regard to rock lobster habitat, the proposed development borders on a Rock Lobster Sanctuary, with the western breakwater to be located at the eastern border of the sanctuary. As the sanctuary is to protect the rock lobster habitat on rocky reef, rather than seagrass habitats, it is very unlikely that the development will have any effect on the sanctuary's ability to protect the rock lobsters. The reef is greater than 1.0 kilometre from the marine sections of the development, and the boundary of the sanctuary was apparently set to coincide with easily observable marks on land rather than based on marine habitat boundaries relevant to rock lobster or their prey. While lobsters may move into seagrass areas to forage, it is unlikely that they will move this far, and the major prey species are also relatively sedentary (Jones & Morgan 2001). While lobsters are capable of migrations greater than 1.0 kilometre, most animals restrict their movements to less than 1.0 kilometre, and remain within the vicinity of shelter (Ward *et al.* 2003). Longer distance migrations are to other areas with shelter, not to seagrass habitats (**Appendix 13**).

5.6.16 Describe breakwater design requirements for coastal hazards (eg tidal and wave action).

The purpose of the breakwater is to provide protection for safe mooring, to ensure a navigable entrance under all weather conditions, to allow operation of commercial vessels and to provide protection for the harbour facilities.

Two breakwaters will extend out to sea approximately 300 metres to provide a protected seaway access from the waterways into Lacepede Bay as shown on **Figure 3.6**. The crest is at 2.5 mAHD, which is approximately the same height as the highest sections of the footway on the Cape Jaffa jetty. The longer western breakwater is designed to provide protected waters from the westerly through northerly weather and waves.

The orientation of the breakwater is such that the entrance is protected from the predominant swell direction, which reduces the likelihood of weed or other floating debris from entering the inner waterways.

It is inevitable that the floating debris can enter on the flood tide, however the area immediately inside the entrance of the breakwater provides an area for the debris to settle out where it can be removed as part of a management plan to ensure water quality of the waterways is not compromised. Modelling has been carried out to verify the current velocity and direction, details are provided elsewhere in **Appendix 21**.

The structural design of the breakwater considers the local wave environment, using proven hindcasting techniques, as set out in **Section 4.12**. As part of the hindcasting analysis, known meteorological data comprising wind, swell and wave data was analysed to provide local wave conditions at the site. The breakwater has been designed to adequately dissipate the wave energy over a range of storm and tidal events, the most critical being a 100 year high tide event in combination with a 100 year wave height. This information, in conjunction with the natural beach slope profile, has been used to determine the wave characteristics at the location of the breakwaters. The design of the breakwater structure follows the principles of the Shore Protection Manual (SPM), which has been proven through many years of in-service observations and determines the required height, geometry and size of rock armour for the breakwater structure. **Figure 3.7** provides a typical detail of the breakwater and further information is provided in **Appendix 27**.

The breakwater structure has been designed for a crest height of 2.5 mAHD, such that under extreme weather conditions the structure will provide an acceptable wave climate within the marina waterways. AS 3962 provides details on a "good" wave climate in small craft harbours. Analysis reveals that under a high tide of 1.43 mAHD with a significant wave height of 1.0 metre, the transmitted wave within the breakwater entrance is less than 0.4 metres. This is considered acceptable for a 1 in 50 year event in accordance with AS 3962 "Guidelines for Design of Marinas".

5.6.17 Describe strategies to ensure public safety on and around waterways and the permitted recreational use of waterways, including boating navigation.

Public safety will be controlled by a consistent approach to the application of rules, by-laws and regulations. These include normal Transport SA marine safety requirements, Kingston District Council requirements (enacted via Council by-laws), Land Management Agreements defining entitlements and responsibilities of the owners of waterfront allotments in relation to waterways and the 'rules' for all berth users. The Marina Manager will be charged and where appropriate delegated responsibilities to assist policing of activities on and around the waterways.

Controlled activities to ensure public safety on and around the waterways include:

- within the waterways boating speed will be restricted to a maximum of 4 knots. All boat owners are expected to comply with the international boating code which outlines navigational requirements and other safety aspects, in accordance with the marine navigation rules;
- swimming and wading activities will be allowed only in designated/signposted areas and privately owned waterways. These activities will be prohibited in areas such as the commercial berths, recreational berths, wharves and navigation channel;
- fishing activities will be allowed in areas signposted for such activities and will include breakwater structures. Fishing using handheld fishing lines from privately owned waterways will be allowed, however restricted to the owners of the area. No fishing activities will be permitted in the commercial wharf and recreational or commercial berth areas;
- no structures other than approved structures for the berthing of boats can be constructed in the waterways;
- the safe use of Personal Water Craft (PWC) such as jet skis will be governed as prescribed by Transport SA and this requirement will apply within all of the waterways. This prohibits the use of PWCs other than for transport to and from Lacepede Bay and the use of PWC will be prohibited in all commercial areas. Signposts advising of the designated areas will be provided in conspicuous locations. Council will have the power to police and prosecute offenders;
- non powered vessels less than 3.0 metres (canoes and kayaks) will be allowed in the recreational areas of the waterways but will be prohibited from the commercial areas including the wharf and berths areas;
- recreational, diving, scuba diving, snorkelling, jumping/diving off revetment wall will be prohibited. Warning signs will be erected in conspicuous locations. Council will have the power under the *Local Government Act* to police this and fine offenders to actively discourage this practice;
- commercial diving will be allowed within the marina waterways for the purpose of maintenance and repair only. It is proposed that these activities will require approval from Council, its agent and the Marina Facilities Manager;
- public areas such as the boat ramp facility will be under the control of Kingston District Council. As such Council will manage any safety issues relating to the operation and management of the facility;
- the commercial and recreational berthing area will be privately owned under a community title arrangement. As such public safety will be managed under the arrangements made by the private corporate body. It is likely that access will be restricted to those owning a berth in the area under normal day-to-day activities; and
- any persons or organisations wishing to conduct a special event for the purpose of a water sport or activity (water-skiing/boat race, etc), may apply for an aquatic activity licence to enable a designated area of the waterway to be closed to the public for exclusive use. As part of the conditions in granting such a licence the organisation will be required to have adequate public liability insurance to cater for any claim against personal injury or damage of property to

members of the public and damage to property resulting from the activity during the period of the licence. Approval for these activities is the responsibility of Transport SA Marine Facilities Section or Kingston District Council and the CJDC.

- Navigational markers will be erected from the channel in Lacepede Bay into the main basin area which will define the main navigation areas. Signs will also be posted indicating a standard 4 knot speed limit.

5.7 Effects on Infrastructure Requirements

5.7.1 Outline the requirements for and likely location of gas, electricity, water, sewerage, stormwater management, communications systems and local roads.

Provision of services such as telecommunication, potable water, electricity and sewer will be provided as part of the development. Services such as telecommunication and electricity supply are expected to be located in a common service trench within the road reserve, as shown in **Figure 5.57**, which is adapted from Figure 17 of "Services in Streets – A Code for the Placement of Infrastructure Services in New and Existing Streets" (PUACC 1997). The reticulated water and sewerage will be located underground within the roadway as is typical of new subdivision developments, with the final layout the subject of detailed engineering design.

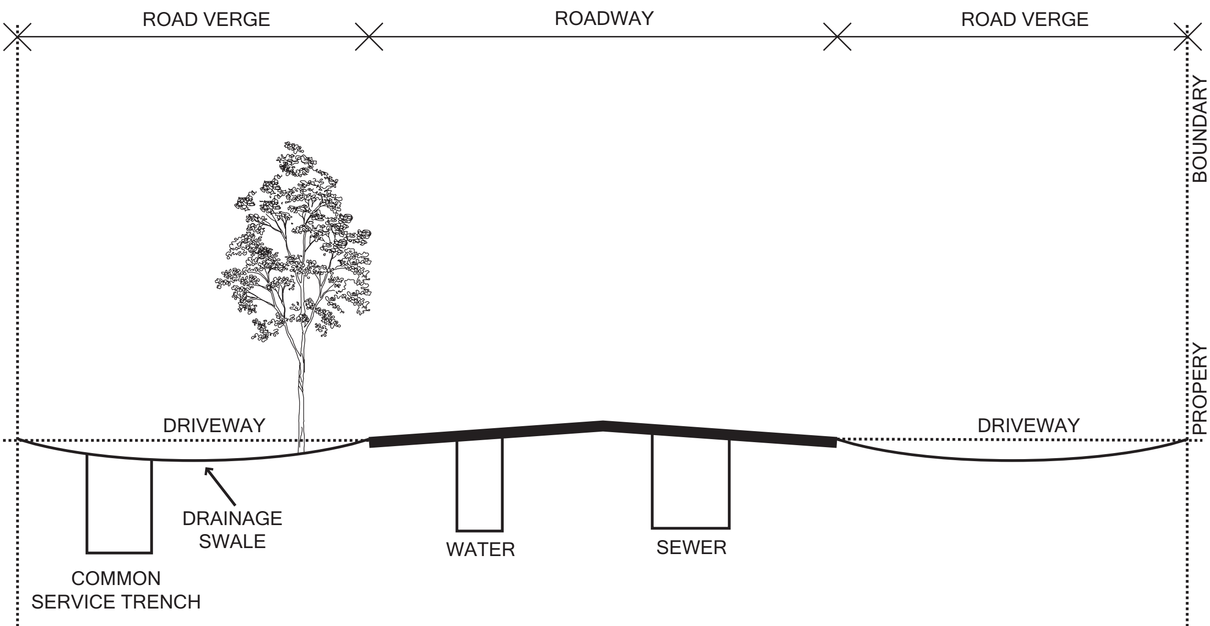


Figure 5.57: Typical Service Locations
Source: PUACC 1997

Each of these services will be installed in such a manner so as to satisfy the requirements of the local service authorities and, where appropriate, relevant standards as listed below:

- electricity – ETSA, Electrical Installations (AS 3000) and Electrical Installations Marinas and Pleasure Craft at Low Voltage (AS 3004);
- water – SA Water, Water Supply Code of Australia (WSA-03);
- sewerage – SA Water, Sewerage Code of Australia (WSA-02), Best Practice Guidelines for Waste Reception at Ports and Marinas, and Boat Harbours in Australia and New Zealand (ANZECC 1997);
- stormwater – Kingston District Council, relevant EPA Code of Practice (EPA September 1997 and EPA July 1998);
- telecommunication – Telstra, Telecommunications in Road Reserves – Operational Guidelines for Installations (AP-G72/02), and the Telecommunications National Code (Austel 1995); and
- local roads – Kingston District Council.

An infrastructure reserve has been incorporated into the development, for the purpose of locating infrastructure required for the operation of machinery and plant to provide for each service, such as water and wastewater storage, treatment and pumping facilities, electrical sub-station (electricity generation) and distribution. The layout of infrastructure within these areas is the subject of detailed engineering design. Gas reticulation is subject to ongoing discussions and future negotiations.. See **Figures 3.6 and 5.12.**

5.7.2 Outline the potential for adopting water sensitive urban design for managing stormwater.

This development provides an opportunity for adopting water sensitive urban design (WSUD) principles for improved stormwater management. The local sandy conditions are also most conducive to infiltration. It is proposed to incorporate the following WSUD elements:

- grassed swales along all roads which will allow for stormwater quality improvement and soakage of runoff as well as safe conveyance to stormwater retention basins for flows up to the 100 year ARI storm event;
- stormwater detention basins to allow settling of suspended solids and soakage of runoff into the underlying sandy soils, thereby minimising discharge to the marine environment. During dry weather the ponds would normally be dry, filling during rainfall events. Overflow discharge to the waterway would only occur during extreme rainfall events;
- rainwater tanks will be required as part of all new residential and commercial development to capture roof runoff for on-site reuse. This will reduce runoff discharged to the stormwater system and reduce mains water demand for high use activities such as garden watering. Overflow from these systems would be directed to the roadside swales; and
- treatment of runoff from the commercial and boat ramp areas to specifically target oil and grit removal, with provision for interception and capture of oil spills. Runoff from these areas

would be collected separately to allow for treatment required. This system is described in Section 5.5.14 and 5.6.11.

5.7.3 Detail emergency services arrangements.

Cape Jaffa will be serviced from Kingston as is currently the case. The following emergency services are currently available in Kingston:

- SA Police;
- CFS;
- SES;
- Sea Rescue Squadron;
- SA Ambulance Service;
- Hospital, including accident and emergency service; and
- Kingston Airport with lighting for all hours Flying Doctor access.

Further, sea rescue services for the upper South East coast that currently operate from Kingston have expressed interest in relocating some of their activities to Cape Jaffa as it would offer a better location to serve the wider region. There is ample opportunity to provide the space required and much of the infrastructure that might be needed will be provided as part of the development.

The Marina Manager will have, as part of the emergency response plan, procedures for the communication and liaison with the various emergency services groups and will assist in the coordination with emergency service personnel. Furthermore, signage will be provided advising visitors and residents of the area of contact details for individual emergency service providers.

5.7.4 Outline opportunities to incorporate best practice measures of infrastructure design.

Various opportunities exist for best practice infrastructure design, and the infrastructure and various measures are outlined below on a service by service basis.

Roads

The design of the road network will be based on current 'best practice' and will maintain accessibility for anticipated users while controlling excessive speeds. The code for the placement of infrastructure services in new and existing streets (PUACC 1997) will be used as a guide to the design and installation of the utility services. The road network design provides for safe and convenient traffic movement in order to create an attractive environment, in accordance with the principles of the Good Residential Design Guide (Planning SA 1999). Commercial traffic within residential areas has been minimised whilst improving the road access to the existing settlement.

The road layout will provide access for residents, commercial and industrial activities, as well as tourist activities associated with the beach, jetty and caravan park. Commercial and industrial areas are provided direct access to the main roads to minimise impact to the adjacent residential areas. Direct access onto collector roads is minimised. By locating the new commercial/industrial activities with direct access to the main roads, the effects of commercial traffic on residential users of the facilities is minimised.,

Water Supply

The design of the water supply reticulation network will be carried out in accordance with SA Water design criteria and Water Supply Code of Australia (WSA-03). As part of any development approval process all dwellings and commercial premises will be required to install rainwater tanks. The minimum storage capacity will be determined as a function of the size of the building or structure. The use of rainwater tanks has the advantage of reducing the demand on the mains water and can provide some additional benefit in reducing the stormwater runoff from each site. Furthermore, water conservation measures will be mandated (dual flush cisterns, low flow shower head and grey water reuse), to reduce the demand on the water supply system in all developments.

Stormwater

Water Sensitive Urban Design (WSUD) principles will be adopted as part of the design process to ensure sustainability principles of water consumption, water recycling, waste minimisation and environmental protection are achieved. Particular reference will be made to Urban Stormwater: Best Practice Environmental Management Guidelines (Victorian Stormwater Committee 1999), and the draft publication WSUD Engineering Procedures (Melbourne Water June 2004).

The use of grassed swales along all roads which will allow for stormwater quality improvement and soakage of runoff as well as safe conveyance of flows up to the 100 year ARI to stormwater retention basins to allow settling of suspended solids and soakage of runoff into the underlying sandy soils, thereby minimising discharge to the marine environment.

Wastewater and Reuse of Reclaimed Water

The wastewater treatment facility will be designed to treat the wastewater from residential, commercial and industrial areas. The treated water will be recycled for agricultural irrigation, thereby minimising the agricultural use of water resources and fertilisers whilst protecting the groundwater environment through appropriate management practices. See **Section 5.2.4**.

The opportunity exists to integrate a comprehensive reuse scheme within the development that could enable residents and commercial property owners to reduce water consumption and this option is being investigated. This could be undertaken on a macro scale for the entire development, where reclaimed non-potable water that has been suitably treated is reticulated to each household via a separate water main system. This is similar to the system that has been installed at Mawson Lakes near Adelaide.

Power

The major supply would likely be from connection to the grid but alternative cogeneration facilities are under active consideration, including a wind turbine or solar generation, augmented by conventional generation facility. Other opportunities such as utilising solar powered street lights will also be investigated in order to reduce power consumption.

Telecommunications

As part of the construction of the development, the latest technology as part of telecommunications infrastructure will be employed to enable:

- wider mobile phone coverage;
- improved internet availability through a range of dial-up, wireless and satellite delivery technologies; and
- access to pay TV broadcast.

This infrastructure will take the form of underground telecommunications cabling (optic fibre), satellite receivers and mobile phone tower receivers.

5.7.5 Outline strategies for the relocation of existing commercial fishing activities on King Drive.

The existing commercial fishing activities located on King Drive include:

- a number of commercial fish processors and buyers adjacent to the jetty;
- commercial fishers, mainly rock lobster fishers, operate from the jetty and adjacent service area accessed from King Drive;
- aquaculture operations including the loading and unloading of fish and feed via the jetty;
- maintenance and refuelling of boats associated with the fishing/aquaculture industries, particularly the provision of a diesel fuel bowser on the jetty and the associated fuel storage and pumping facility adjacent to the jetty on King Drive;
- fishing charter operators leaving and arriving via the jetty;
- waste oil storage facility on the foredune immediately east of the jetty service area and accessed from King Drive;
- solid waste incinerator on the foredune immediately east of the jetty service area and accessed from King Drive; and
- fishing support facilities including storage and maintenance, co-located with residential dwellings along King Drive.

Some of the existing longstanding facilities used as part of the above activities are inefficient, outmoded, poorly developed or in need of significant refurbishment or repair. Many of the users of the existing facilities have expressed the desire for improved infrastructure located within the main basin area of the development and have had input to the design concept as part of the ongoing consultation process.

The proponent will provide the existing operators with the choice to move in order to gain access to improved facilities and will create opportunities for the existing operators to expand and improve their efficiency. It is expected that the migration to improved facilities will occur over time without implementing additional relocation strategies.

Of the commercial rock lobster fishers, 21 have already registered their interest in securing berths within the anchorage. A similar number have registered their desire to have hardstand space within the commercial area for the storage of vessels and equipment. These expressions of interest represent the majority of the existing fleet. Further, the existing aquaculture operators have been intimately involved in discussions concerning their requirements and have expressed their strong desire to operate from and moor vessels within the main basin. This has resulted from ongoing discussion with fishers and operators.

The land along King Drive on which the existing commercial fish processors operate is freehold land and fish processing has occurred in this location for some time. It is also noteworthy that the *Development Act* 1993 provides protection of existing use rights.

At the same time, there are potential benefits to the community if these activities relocate into the main basin including the opportunity to clean up and develop the existing area into a tourist attraction. It is desirable that an informed public debate and consultation commences on the future use of the land adjacent to the jetty along King Drive. It has been suggested that the land might be returned to public ownership for recreational (public reserve) use as it becomes available.

5.7.6 Describe the facilities to be provided for waste disposal from recreational and commercial vessels, including black water, grey water and solid waste.

Wastewater pump out facilities will be provided in accordance with current best practice guidelines for Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand. These facilities will be available for use by the commercial vessels as well as the recreational boating community, including short stay visiting boats, for example passing recreational yachting traffic. For more information refer to Section 5.2.24.

Vessels may not have the facilities to separate grey and black water and therefore the pump out facility will accept both grey water and black water either separately or in combination, and both will be discharged to the sewerage system and treated via the wastewater treatment facility.

Solid waste facilities will be located within the commercial wharf, public boat ramp and public wharf areas. Refer to Section 5.2.24 for further details of the treatment of solid wastes.

Ample access to waste disposal facilities will be available to all users of the waterways. This waste is collected and managed in the same manner as the existing waste originating from land based sources.

5.8 Native Title and Aboriginal Heritage

5.8.1 Identify the effect on any Aboriginal sites of archaeological, anthropological or other significance under the Aboriginal Heritage Act 1988, including any sites listed in the Register of the National Estate and the SA Register of Aboriginal Sites and Objects, or identified after consultation with Aboriginal Councils or groups.

Consultation with various Aboriginal communities throughout South Australia, including Kungari Inc, together with a review of the Register of the National Estate and the SA Register of Aboriginal Sites and Objects has been conducted. This review revealed that there were no known sites of archaeological, anthropological or other significance within the Major Development area. Nevertheless, a series of site investigations were undertaken with representatives of Kungari Inc. and others These investigations occurred between July 2003 and August 2004 and included walkovers, backhoe test pits, surface rotary hoeing (**Appendix 10**) and further investigations by the Department for Aboriginal Affairs and Reconciliation (DAARE). Refer **Appendix 28**. The investigations identified four areas that contain cultural objects within the land and confirmed that there are no anthropological or ethnological sites within the land (DAARE). Refer **Figure 5.58**.

The archaeological sites identified are discrete, highly disturbed sites lacking subsurface deposits and exhibiting poor integrity. They contain remnant scatters of stone tools and some faunal material (mainly flint tools and shell fragments), have low artefact densities (fewer than or equivalent to one artefact per square metre), have been significantly disturbed by ongoing pastoral activity and have extremely low site integrity (**Appendix 10**). Site #3 consisted of a greenstone axe head that has been relocated by representatives of Kungari Inc for it's protection (**Appendix 28**).

No evidence of any subsurface, stratified deposits or burial areas have been identified and there are no records of burials in the Major Development area or the vicinity of Cape Jaffa (**Appendix 10**). Numerous (19) backhoe trenches were conducted during which no subsurface cultural material was identified, the underlying loose sand was found to be devoid of any evidence of occupation and the sites appear to be confined to the upper horizons of darker sandy soil (**Appendix 10**).

The sites are typical of sites that have been previously identified along the coastal foreshore in the area, which have been characterised as containing predominantly flint flakes and cores with little faunal material and having poor to moderate integrity (Wood 1995). They are also consistent with sites recorded in the broader region in various text (Campbell & Noone 1943, Campbell *et al.* 1946, Egloff *et al.* 1989, Frankel 1986, Luebbers 1978, 1980, 1982, 1983 and 1984, Rhoads 1982 and 1983, Tindale 1957 and Wood 1995). The lack of previous site recordings within the Major Development area probably reflects the less intensive previous investigations, limited access and low ground surface visibility (**Appendix 10**).


CARAVAN PARK
Enlarged for
display purposes

Discussions with representatives of Kungari Inc and others suggests a desire for the collection and interpretation of material in order to protect the artefacts and provide the wider community a greater understanding of the life and culture of the region's indigenous community. Further, given the European maritime history associated with Cape Jaffa, the potential for a combined interpretation of the Aboriginal and European history would provide a valuable exposition of the associations with the land and coastal waters.

A determination, under Section 12 of the *Aboriginal Heritage Act* 1988 was sought with respect to the objects identified during the investigations. DAARE has completed an extensive consultation program on behalf of the Minister, including a community meeting held at Mt Gambier in October 2004 and has provided the opportunity for interested Aboriginal organisations and people to make submissions. Following completion of the consultation program, the Minister for Aboriginal Affairs and Reconciliation determined that the four archaeological sites identified during the recent investigations should be entered onto the SA Register of Aboriginal Sites and Objects.

Any development that proposes to disturb, salvage or damage a site requires approval from the Minister for Aboriginal Affairs and Reconciliation under Section 23 of the Act. A Section 23 application was made in December 2003 and DAARE is presently undertaking further consultation. Subject to the Minister's authorisation, it is proposed to collect and interpret the Aboriginal objects in conjunction with Kungari Inc, in accordance with previous discussions and consultation. In this way, any sites or objects can be carefully managed and protocols established for the construction and development of the project. As part of the overall management system, an Aboriginal Heritage Management Plan will be prepared to ensure all workers are trained and aware of their responsibilities and the procedures for managing all Aboriginal objects and locations.

5.8.2 Describe the impact on any Native Title Claimants and the consequent impact on the potential ongoing enjoyment of native title rights (if any) by native title holders.

Consultation with the Chairperson of Kungari Inc, Ms Leonie Casey, and DAARE was undertaken as part of the investigation process which determined that there are no Native Title Claims or Indigenous Land Use Agreements over the proposed development area.

5.8.3 Identify any native title issues and seek advice on any compliance with or requirements of the Native Title Act 1993 (Cth.) and Native Title (South Australia) Act 1994.

As there are no claims or agreements in place, there are no conditions or agreements for compliance in relation to Native Title.

5.8.4 Detail steps, if required, to include negotiations with possible native title claimants.

As there are no native title claims there is no requirement for negotiations.

5.9 Planning and Environmental Legislation and Policies

5.9.1 Describe the consistency of the development with the relevant Development Plans and Planning Strategy.

Introduction

The proposal is located within the South East planning and development area of the State, and the land is within the Kingston (DC) and Land Not Within a Council Area (Coastal Waters) parts of the Development Plan. The following sections summarise the current relevant strategic directions and planning policy for this area and locality. The Planning Strategy is reviewed in the first instance.

The parts of the Development Plan that were relevant at the time of lodgement and referred to herein are:

- Kingston (DC) - Consolidated 28 February 2002; and
- Land Not Within A Council Area (Coastal Waters) - Consolidated 12 September 2002.

However, prior to Council deciding to progress any development scheme for Cape Jaffa, it had commenced the preparation of a PAR (Plan Amendment Report) to amend the zoning to allow further development at Cape Jaffa. This PAR was approved on 24 July 2003 and accordingly alters the extent and nature of development anticipated at Cape Jaffa. For comparative analysis purposes therefore, the assessment of the proposal has been made against the current Development Plan as this is the policy that would apply if any application made since 24 July 2003 was being assessed.

This section sets out the relevant aspects of planning strategies and the main parts of the Development Plan relevant to the zones and describes the consistency with these planning documents. Detailed commentary in relation to the zone principles and the Council Wide and Coastal Waters principles are incorporated in Appendix 22 as supporting documentation to the assessment in this section.

Planning Strategy

The Kingston District Council, as part of its ongoing review of community needs, identified shortcomings and opportunities at Cape Jaffa. These findings are consistent with the current planning strategy for the development of regional South Australia, including the need for the consolidation and reinforcement of services and facilities to support key industry areas of aquaculture and fishing, tourism and recreation.

The following summarises relevant key aspects of the State's Planning Strategy for Regional South Australia, dated January 2003, beginning with extracts from the commentary for the South East followed by specific strategic actions and some commentary relevant to this proposal. At the time of lodgement the draft planning strategy for regional South Australia was in place. This summary refers to the amended wording of the strategy which included minor changes. The commentary however is the same, as the intent of the strategy has not changed as it applies to this proposal.

Economic Activity

Aquaculture and Fishing

The coastal waters of the South East support an important fishing industry based on the port towns in the area. The industry should consolidate its position in the area with opportunities available for development that supports value added production initiatives (particularly for rock lobster) export and marketing

Cape Jaffa is a strategically located fishing port that currently accommodates approximately thirty fishing vessels and associated support facilities. There are other vessels working from Lake Butler at Robe that might choose Cape Jaffa, given that Lake Butler is at capacity, if there were safe and protected mooring facilities available.

The proposal incorporates a safe haven and improved support facilities for the fishing industry that is necessary to continue the development and sustainability of the industry. Further, Cape Jaffa is the most proximate town to the existing aquaculture ventures and is being used for load out, maintenance and harvesting. Improved facilities are essential if the aquaculture objectives for the State are to be satisfied.

The safety of mariners and environmental protection can be best provided in a safe haven. Vessels have in past years broken moorings and have been beached. Risks of this nature can be avoided in a secure marina. Further, refuelling and waste management facilities can be significantly improved.

Tourism

Its position between Adelaide and the eastern States provides opportunities to tap into a significant population base and through traffic not available to many other areas

The strategy also seeks to leverage off key features of the region. The opportunity for a multi-faceted, integrated boat haven and residential marina will be unique in the South East and is not practical elsewhere on the coastline of South Australia between Victor Harbor and the South Australia border.

The nearby Mt Benson wine region has experienced significant development and investment in recent years, including the growth of Cape Jaffa Wines and Kreglinger Winery, which alone has invested over $30 million in the establishment of facilities. These commitments reinforce the local interest and attractions for the area.

There is an existing tourism focus at Cape Jaffa with tourist accommodation facilities that cannot meet current demands. The prior owners of the tourist park made submissions to Council to enable the expansion of their facilities however the privately owned land at the time was not able to be purchased. Cape Jaffa is a proven destination particularly for western Victorian tourists due to its proximity and access to excellent fishing, swimming and recreation waters. The proposal reinforces and assists to achieve this strategy.

<u>Environment and Resources</u>

Conservation

The coast …… is a significant and valuable feature contributing to the character and identity of the area. Protection …… from degradation and 'unsightly development' is essential to retain their value for amenity, tourism and conservation of natural resources

The South East coastline is predominantly beaches and rugged cliff coastline backing national park and conservation areas. Coastal townships and settlements have been established in locations where there is some protected access to the sea. Cape Jaffa's identity will be enhanced by the development of well planned, orderly facilities and attractive developments.

The Cape Jaffa settlement and site possesses a north facing aspect, thus providing protection from prevailing wind and sea conditions. Due to this orientation, a fleet of about thirty rock lobster boats presently use swing moorings out in the bay, and load and unload from the aging jetty. Growth in the fishing industry and its needs can be better planned and provided through a comprehensive development scheme. This fishing character is well established and forms part of the coastal character.

The jetty is in need of significant upgrade and ongoing maintenance if it is to continue serving the fishing industry and public needs. The proposal will enable safe moorings and significantly improved servicing and loading facilities for the commercial fishers. As part of this development, it is also anticipated to provide environmentally acceptable fuelling and waste management facilities not currently provided at Cape Jaffa jetty. This will assist in protecting this coastline.

<u>Community Development</u>

Main Settlements

Kingston, the closest regional service centre, is one of the gateways to the lower South East.

Development in keeping with the surrounding agricultural industry and development to enhance transport and tourism gateway functions should be promoted

The growth of Cape Jaffa, given its role and service to the aquaculture, fishing and tourism industries, will serve to reinforce and develop the role and function of Kingston as a major service centre and reinforce the nearby wine industry.

Increase private sector investment in housing in regional areas needs to be encouraged along with appropriate management structures, infrastructure requirements, supply of land, and ensuring land use policies encourage a diverse range of housing types to meet the changing needs of the community

The proposal will result in considerable investment and infrastructure for a growing community, creating opportunities for education, skills development and employment. Land supply for the development has been determined and infrastructure needs are being addressed.

<u>Coastal Centres and Ports</u>

The coast surrounding Kingston is recognised as providing "a unique environmental and recreational experience".

> *The southern ports should retain and protect their coastal features and character, and promote development in harmony with the coastal environment*

The character of fishing ports and anchorages is a desirable and attractive feature to tourists, visitors and residents, and should be reinforced whilst respecting the coastline. The development of new facilities will enhance safety and minimise risk of damage from fuel spills and broken moorings.

The strategy also states:

> *… continue to develop service and infrastructure support for the important fishing industry …*

The proposal provides a significant service and infrastructure support to the fishing industry that is not currently provided in an environmentally sustainable and sensitive manner.

<u>Infrastructure</u>

> *Energy*
>
> *Investment in power, gas and other energy infrastructure needs to be strategic to ensure maximum benefit*

The provision of a three phase power supply to Cape Jaffa can lead to the further and better distribution of energy in the district to better serve the fishing, aquaculture, horticulture and wine industries.

<u>Transport</u>

The area is generally well served, however it is recognised that:

> *…. upgrading of local roads and bridges is necessary to ensure local industry is better able to move its raw product to processing facilities and to enable it to market its produce and compete successfully in Australian and international markets.*

The proposed development will contribute to local road improvements around the Cape Jaffa area and improve the exposure of Cape Jaffa to a broader market as a consequence of the development.

<u>Economic Activity Strategies</u>

> *…identify key infrastructure development requirements to support industry growth…*
>
> *…address shortage of housing in parts of the south east…*

...identify and promote new sustainable fishing and aquaculture opportunities utilising coastal and underground water resources that are appropriately located, well managed and contribute to regional development...

...review Aquaculture Management Plans and include land use policies in Development Plans...

...exploit potential for land based marine and freshwater aquaculture and freshwater crayfish aquaculture...

...promote development to support established fish processing and distribution facilities...

...allow for land based infrastructure and support services for the marine fishing industry...

...develop new tourism ventures and products...

...develop tourism links with significant economic activities of the area, ie wine, wool, dairy, timber, fishing, agriculture and processed food...

...develop value adding opportunities to wineries, ie cellar door sales, accommodation and restaurants...

...maintain the south east's nationally and internationally recognised ecotourism assets and develop visitor amenities and interpretive facilities (for caves, volcanoes, sinkholes, coastline, etc)...

...develop interpretive facilities and tours for major industries including wine, timber and agriculture...

...develop holiday accommodation and recreation opportunities...

...develop and connect tourist linkages with Melbourne and Adelaide to involve interstate travellers, utilising features such as coastal roads, key towns, and natural and cultural attractions...

A number of the significant strategies listed above can be satisfied or be facilitated and achieved as part of this proposal. In broad terms, the strategy strongly encourages the growth and reinforcement of existing activities and developing associated tourism and support infrastructure. The proposal is located ideally to promote the existing aquaculture and fishing industries. There is no other site available in this locality or district that enables the fulfilment of these strategies in such a comprehensive and holistic way. The site provides:

- the safety of the Lacepede Bay with the Cape's protection from the south westerly weather;
- ready access to the waters identified as best suited to Atlantic Salmon;

- extension of an already well defined tourism market;
- the excellent geographical relationship Cape Jaffa has with the local and regional tourism attractions including the wineries at Cape Jaffa and Mt Benson; and
- an opportunity to address housing choice and options.

Environment and Resources Strategies

…conserve, restore and develop the unique landscape features and biodiversity of the area that contributes to its distinct character (including the coast, wetlands, national parks and conservation areas, remnant vegetation, volcanic lakes and caves)…

…protect areas of native vegetation and associated native fauna on both public and private lands…

…identify new areas of conservation significance and ensure their protection…

…ensure land use policy recognises and protects areas of conservation significance…

…maintain and improve public access to the coast while protecting fragile areas, habitats and sites of cultural significance…

…promote efficient water use…

…reduce soil salinity and waterlogging in conjunction with better land and water management…

…ensure Development Plans address salinity impacts of development…

Given the existing function of Cape Jaffa as a Southern Port, it is entirely appropriate that the facilities provided are commensurate with the safety, environmental and service requirements of the industries and users of these facilities. The character and landscape of the wider area will be little affected by the proposed development whilst Cape Jaffa will have its fishing port status and character reinforced.

The vegetated foredunes will be significantly enhanced as a result of this proposal and its conservation value increased accordingly. Land use policy can be readily incorporated into new/updated policy documents including the Development Plan and implemented as part of the requirements for the development of the project. In that policy framework, requirements for water sensitive use and energy efficiency can also be promoted.

The proposal encourages access to the coast in a sensitive and practical manner by creating separate parking areas behind the dunes, fencing the vegetated areas, and creating defined walkways along and through the vegetated dunes.

Salinity affects the productivity of land and is evident in a number of areas in the locality. The proposal provides an opportunity to undertake remediation measures on these saline areas by the placement of soil, thus removing the opportunity for evaporation from low lying areas and implementing better land management practices including the improved primary production of the land.

People, Towns and Housing Strategies

> *…maintain the coastal townships as important tourist and local service centres and key fishing ports …*
>
> *…develop holiday accommodation and recreation opportunities at coastal townships while maintaining residential amenity…*

The proposal reinforces Cape Jaffa's role as a southern port and significantly enhances its role as a tourist destination. The proposal specifically incorporates opportunities for holiday accommodation and recreation, and through design and the establishment of improved infrastructure, will maintain the overall residential amenity.

Infrastructure Strategies

> *…investigate the need to upgrade facilities at existing aerodromes in the area…*
>
> *…develop a range of innovative energy generation and transmission proposals…*
>
> *…promote innovative means of energy supply and capacity to areas that are remote from the distribution network…*
>
> *…ensure land use policies guide the development of alternative energy infrastructure by providing for its specific requirements, and managing the visual and environmental effects on a locality…*
>
> *…promote opportunities to facilitate renewable energy development and its supporting infrastructure as a primary contributor in redressing greenhouse gas emissions and fossil fuel dependency…*

Although the first strategy listed under infrastructure above is written as encouragement from a region-wide perspective, it should be put in the context of the existing and proposed arrangements at Cape Jaffa. The current supply is single wire earth return only and is not a reliable service. There are a number of enterprises locally that rely on power for fresh seawater circulation and other essential processes to service the fishing and aquaculture industries. As a consequence, there are a number of properties at Cape Jaffa that run generators to supplement the single phase service.

Kingston has a sealed, lit runway which is regularly reviewed to determine its suitability and capacity. The strip serves the area well and Council maintains the facility to the highest standards.

The proponents have examined options for the supply of power to Cape Jaffa and have selected to provide a three phase supply. Investigations are also proceeding into cogeneration facilities incorporating generators, wind and solar generated power connected at a later stage to the grid.

Infrastructure improvements to serve the fishing, aquaculture and tourist industries are necessary to enable towns and localities like Cape Jaffa to prosper and grow.

Land use policy is to be put in place which will encourage energy efficiency in all developments and as a consequence assist in reducing the demand for power per property. This policy will also incorporate the necessary framework to ensure the visual amenity of the head works infrastructure and the individual facilities are designed and sited to minimise visual effects. For example, the power generation station will be developed in the south eastern corner with landscaped earth bunds to the east, south and west to eliminate views into the land. Further, the reticulation of the supply through the development will be entirely underground, therefore removing from the skyline the visual clutter of overhead wires and associated poles.

In summary, the State Regional Strategy is supportive of the development of the existing port, its fishing and aquaculture, and tourist industry activities. The strategy also recognises the benefits of value adding enterprises that results from these local enterprises and activities whilst seeking an orderly and efficient provision of energy without detriment to the visual amenity of the area.

Development Plan Policy

The subject land is shown on Map King/29 and to a lesser extent Map King/12 of the Development Plan as Residential Zone, Local Centre Zone, Industry (Cape Jaffa) Zone, Urban Coastal Zone, Rural Coastal Zone and Primary Industry Zone. On Map King/38 the residential component is defined as the Cape Jaffa Residential Policy Area. Refer **Appendix 9**.

The Council boundary is clearly marked at the low water mark beyond which, within the Major Development area, there is no zone designated. This part of the development is therefore within the part of the Development Plan known as Land Not Within A Council Area (Coastal Waters).

The current Development Plan incorporates amendments made on 24 July 2003 after the lodgement of the application. Notwithstanding the usual approach to have regard to legislation applicable at the time of application, the amended policy is more onerous and its aims for the development of this area are more relevant for comparative assessment purposes and has therefore been used for assessment purposes.

The most relevant objectives and principles of development control for the zones and the Coastal Waters in the current Development Plan affected by this development are set out in **Table 5.30** together with a planning assessment commentary as to whether the proposal satisfies these current policies. The more detailed zone principles and Council Wide sections of the Development Plan are extensive and together with detailed commentary are contained in **Appendix 22**.

Table 5.30: Development Plan Provisions and Commentary

Development Plan Provisions	Commentary
Residential Zone	
Objective 1: A zone primarily accommodating detached dwellings located on sites of varying size with other forms of medium density residential development and community facilities in suitable areas.	A good proportion of the proposed residential development area will be located within the current Residential Zone, consistent with the zoning objectives. The eastern portion of the development is within the Primary Industry Zone with a small portion within the Rural Coastal Zone. The scheme allows for the creation of allotments of varying sizes to accommodate the varying needs within the community, albeit the concept plan provides a more generic allotment arrangement depicting a generally consistent allotment size of approximately 800 square metres. Opportunities for recreation facilities, tourist accommodation and community facilities in suitable areas also exist. There are various areas for passive and active recreation, public waterfront and a centre area with space to accommodate a range of facilities.
Objective 2: The visual appearance of residential streets progressively improved through well designed new dwellings, substantial front garden landscaping and street tree planting.	As a planned, orderly and coordinated development proposal, the opportunity exists to create a high quality visual appearance throughout the development. Setbacks will be established to ensure appropriate opportunity for landscaping on private properties and the streets will be sized to allow for street tree planting. These features will ensure the creation of attractive streetscapes.
Objective 3: A zone containing residential development consistent with the coastal outlook and location.	The opportunity exists to create a unique residential development consistent with the coastal outlook and setting and its fishing port character.
PDC 13 Within the Cape Jaffa Policy Area 5: (a) the area should accommodate residential and tourist accommodation development; (b) residential development should not be undertaken on any allotment with an area of less than 1,000 square metres; (c) all development should have a minimum site level of 2.4 metres Australian Height Datum (AHD) and a floor level of 2.65 metres AHD; and (d) all dwellings should provide for the installation of a rainwater tank of at least 22,500 litre capacity.	The development is designed to accommodate residential and tourist accommodation. Residential allotments have been designed with appropriate site areas given that the policy is written for an un-serviced area which is as part of this proposal to be connected to a full sewer system. Development will have minimum building ground levels of 2.5 metres which exceeds the policy expectation. A reticulated water supply is to be developed and therefore this policy designed for larger allotments designed to also accommodate on-site effluent disposal is no longer essential. However, it is desirable that all properties provide for rainwater collection and some degree of on-site stormwater management.
PDC 19 All buildings or structures should be of a high standard of design with regard to the external appearance, building materials, colours, siting, landscaping and provision for future maintenance having regard to the amenity of the locality.	Development and design guidelines will be prepared to reflect the coastal and port character and to ensure a high standard of design, finish and landscaping. These guidelines can also form the basis of the design requirements in the Development Plan.

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PDC 20 Areas of public reserve should be located strategically and, wherever possible, linked.	The proposal provides for a series of public reserves which will be strategically located and where practical linked to allow for coordinated pedestrian access. There are extensive areas of reserve and open space along the beach and the foredune area and these are linked to other open spaces. Likewise, behind the existing settlement area is a large reserve which is connected by link reserves to the road system convenient to the coast. There is a section of the proposal where there is public waterfront extending around the central facilities area, the public boat ramp and the commercial fishing wharf.
Local Centre Zone	
Objective 1: Provision for a limited range of convenience services and facilities catering for the day to day requirements of local residents and visitors.	The development site accommodates the area set aside as a Local Centre Zone on King Drive next to the Tourist Park. This allows an opportunity to provide for a limited range of convenience services and facilities to serve existing and new development within the settlement.
PDC 2 Large scale retail development, and other services which would be beyond those required by the local community, should not be undertaken in the zone.	While it is unlikely that this particular site will be developed intensively for this purpose, the proposed development does not prejudice the current zoning of the area. There is suitable flexibility in the design to allow for the Local Centre site to remain or be redeveloped for residential purposes. This allows the retention of the current function of the kiosk at the abutting Tourist Park as the local service centre for this part of the settlement.
Industry (Cape Jaffa) Zone	
Objective 1: A zone containing a range of commercial, storage and light industrial activities. Objective 2: A zone accommodating facilities for the existing fishing industry and a wide range of onshore aquaculture and activities ancillary to onshore and offshore aquaculture which contribute to economically efficient, clean and ecologically sound production of aquaculture based markets. Objective 3: A zone where development is designed, managed, sited and maintained such that it minimises any adverse effects on surrounding properties in terms of pollution, dust creation, noise, smell and other forms of pollution.	Regardless of whether the Cape Jaffa Anchorage scheme proceeds or not, there is a need for service facilities for the fishing and aquaculture industry. The current zone will be superseded by an alternate location where wharfage and moorings for the fleet are conveniently available. The development makes provision for a range of facilities to serve the fishing and aquaculture industries in a location where easier access and more efficient operations can be achieved. Further, these facilities can be established to up to date standards to ensure clean and ecologically sound operations and production. These features can be achieved, however they are not in the same location as presently designated in the Development Plan, a location where a number of these standards and efficiencies would be more difficult to achieve. The area set aside for these activities in the proposal is adjacent to Cape Jaffa Road and have buffers to provide separation from residential and more sensitive receivers and hence will minimise any adverse effects.

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PDC 1 This zone should accommodate a range of commercial and light industrial development to serve the local fishing industry, marine and onshore aquaculture industry, and local primary industries. PDC 20 Development of land that is adjacent to the Residential Zone should be established to ensure the use: (a) is compatible with adjoining residential uses having regard to noise, odour, air pollution, hours of operation and outdoor lighting; and (b) includes a continuous buffer to adjoining residential development consisting of earth mounding to a height of 3.0 metres at a maximum grade of 1-in-4 with landscaping.	There is suitable flexibility to ensure that the policy can be complied with, particularly in regard to: the provision of a range of commercial and light industrial development to serve the local fishing industry; the provision of suitable buffers; the development of land according to current emission control policy; and although there are no residential zones immediately abutting the commercial/industrial development area, the opportunity to create appropriate separators including landscaped earth mounds between commercial/industrial and residential development whilst maintaining linkages and connections to ensure the maritime and working port character is maintained.
Primary Industry Zone	
Objective 1: The long-term sustainability of primary industries. Objective 2: The protection of primary industry from incompatible uses.	The eastern part of the site is in the Primary Industry Zone. This will be reviewed as part of the long term plan to rezone the subject land and to provide appropriate policy in accordance with the proposed scheme. In the meantime, the small proportion of land located in the Primary Industry Zone is unlikely to impact on the long term sustainability of primary industry in the region. This land is characterised by generally poor sandy soils with low productivity. The opportunity exists to improve some of the nearby salt affected lands and to utilise reclaimed water for crop production at rates greater than can be currently achieved. This would be a positive outcome for primary production in the region. Therefore, the use is not only compatible but beneficial.
Urban Coastal Zone	
Objective 1: A zone containing mainly low intensity recreation activities and minor public works associated with the coast. Objective 2: The conservation of natural coastal vegetation and dune systems.	The Urban Coastal Zone lies on the northern side of King Drive and extends from the north south arm of Cape Jaffa Road westward to the north south arm of Rothalls Road incorporating vegetated dune, mown foreshore, oil storage facilities, incinerator, fuel storage, fish processors and storage facilitates, public toilets, and

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	residential development. The zone boundary runs along the centre line of King Drive and on the eastern side of Cape Jaffa Road as shown on Map King/29. Portions of the proposed development extend into the Urban Coastal Zone as follows: the easternmost extremity of the zone abutting Section 306 and currently forming part of the Cape Jaffa Road reserve will be redeveloped for road purposes as it is today; the northern half of the King Drive road abutting the southerly extent of Section 306 will include a public walkway and buffer between the vegetated dune and residential allotments that will commence 6.0 metres from the southern boundary of Section 306. In addition, these residential allotments will have a setback for buildings a further 9.0 metres from the walkway resulting in no building being in the current Urban Coastal Zone boundary; the proposed public space will be developed such as to create a separation from the vegetated dunes, thus providing for their protection and hence conservation. This separation is depicted on Figure 3.18; and the vegetated dune areas are far from pristine and warrant rehabilitation including the removal of significant Bridal Creeper and other weed infestations, remnants of fencing and introduced trees. This work will require reseeding and fencing to secure the area and create dedicated defined walkways. The proposal creates the opportunity for this work to be undertaken including the transfer of significant areas of privately owned dune and beach to public ownership.
PDC 1 **This zone should remain undeveloped except for facilities associated with recreational use of the coast.**	The development proposed will enhance the recreational use of the coast as well as providing for the protection of the dune and its vegetation. Given the setbacks proposed there will be no building within the currently defined Urban Coastal Zone. The development will provide enhanced access to the coast in locations dedicated for that purpose with added protection to the dunes and vegetation. An additional 1.6 kilometres of walkways are proposed in and adjacent to the dunes.
PDC 3 **Car parking areas should be designed and located so as to minimise their impact on the coastal features of the zone.**	A car parking area is to be redeveloped in the general location of the existing rubble car park at the end of Cape Jaffa Road near the commencement of the main breakwater where access is required to the breakwater. This will ensure good public access to this part of the coast and the breakwater which is likely to become a regular place for walking and fishing. Its design will take into account its proximity to the coast and will not intrude into any elevated dune or vegetated area.
PDC 5	The road, car park and public walkway are all located

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Development should not be located on the sand dunes or land subject to erosion.	adjacent to the dune or on the area where the dune has already been significantly modified. The allotments will be built up in this area away from the dunes. These areas are away from the active part of the coast.
PDC 6 Development which would have an adverse impact on the dune system or natural vegetation should not be undertaken.	The public walkway will provide a buffer between allotments and the dunes. The road to the east together with the car park will be separated from the dune by a post and wire fence to restrict access and the potential for dune or vegetation damage. In these respects the dune and vegetation system will be protected from adverse impacts.
PDC 7 All development within this zone should have a minimum site level of 2.40 mAHD, and a floor level of 2.65 mAHD.	There is no built form only public facilities proposed within this zone.
PDC 8 Development should not restrict the effective public access to the coast.	The development will provide enhanced access to the coast in locations dedicated for that purpose with added protection to the dunes and vegetation. An additional 1.6 kilometres of walkways are proposed in and adjacent to the dunes.
PDC 9 Development should not impede safe movement and manoeuvring of boats and other waterborne craft.	The safety of vessels will not be affected by the public facilities proposed within the Urban Coastal Zone.
PDC 10 Buildings should not be erected in the zone unless: (a) they are toilet blocks or for other public health purposes; (b) they are for shelter or to be used in association with public or community recreation uses; or (c) they are required for the mooring, servicing, handling, fuelling or launching of boats and other waterborne craft.	No toilet blocks, shelters, or other buildings are proposed to be erected in the zone with the exception of low retaining walls for the southern edge of the public walkway. These will provide vertical and horizontal separation between the residential allotments, the walkway and the dunes.
PDC 11 All kinds of development are non-complying in the Urban Coastal Zone except for: Recreation Area Public Amenities Public Shelters	That portion of the development comprising the allotments are non-complying albeit that the great majority of the allotments to be created will be outside of the zone. It is also noteworthy that no dwellings are to be built within the current definition of the zone. This area to the south is currently zoned for either industrial or residential purposes and therefore development is anticipated immediately abutting this zone.
Rural (Coastal) Zone	
Objective 1: A zone in which the natural coastal features and scenery are preserved. PDC 1 Development which would detract from the natural coastal features and scenery of the zone should not be undertaken.	The Rural (Coastal) Zone runs along the northern portions of the land to the east of Cape Jaffa Road out to the low water mark and mainly includes vegetated dune, however there is also the open parking areas, tracks and ramps that have been developed and used for many years. The whole of this land is in private ownership. The significant majority of the land within the vegetated dune and the beach will retain their natural features,

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	however due to weed infestations, there is a need to remediate and rehabilitate these areas. The proposal incorporates works which will positively benefit the natural vegetation aspects of the coast.
PDC 2 **Development which would have a detrimental effect on the coastal, environmental or landscape amenity of the zone should not be undertaken.**	It is noteworthy that a significant part of this zone at its western end has been modified by the creation of roads, access tracks, car parking areas and beach accessways. The private land currently provides access to the existing boat ramp and beach. This is the main launching and retrieval area for recreational fishers and boat users as well as the area of beach used for aquaculture ring maintenance. The area is the camp for tourists during peak periods at Cape Jaffa. It is proposed to relocate the boat launching and retrieval area, create alternate facilities for aquaculture operations, and to move the beach access eastward in order to create a section of beach for pedestrian access only. To the rear of these areas the land has been cleared of native vegetation and is used for rural purposes such that there are no remaining natural features. The existing vegetated foredune with the exception of a predominantly cleared portion is proposed to be placed into community ownership with appropriate protection measures. Further, the extent to which the coastline will be modified is to be minimised. The southern extremity of the eastern breakwater and the protected channel together with a small development area to the west of the channel and waterway, and residential and public areas to the east of the channel occupy some of the Rural (Coastal) Zone. Refer Figure 4. As this area has also been significantly modified, the natural features are limited and in part, non existent. Refer Chapter 4. The Rural Coastal Zone is extensive being about 15 kilometres of coastline to Wyomi Beach at the southern extremity of Kingston and in its greatest majority will not be affected by the proposal. Therefore, the creation of the channel and the development of residential allotments adjacent the channel within the Rural (Coastal) Zone do not result in a serious loss of landscape amenity to the Rural (Coastal) Zone. The majority of the existing Rural (Coastal) Zone proposed to be developed is behind the vegetated coastal dunes on cleared agricultural land. The proposed development in this location can be undertaken without impacting on the sensitive environmental areas and without detrimentally affecting the scenic amenity of the coastline. In this respect, the proposal satisfies the Development Plan.
PDC 3	The development within the zone comprises portions of

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The development of buildings and structures other than those: (a) necessary for navigation, public works or public recreation or park management; or (b) associated with the management of an agricultural activity, should not be undertaken.	the breakwaters, the channel into the main basin and a limited number or portions of allotments. The majority of the works serve public purposes for the safe navigation of vessels or facilities to gain access and car parking for the beach. In these respects the development satisfies this principle. The establishment of a small number of allotments and the provision of defined public parking and access to the beach will not prejudice the overall nature of the Rural Coastal Zone, the great majority of which will be untouched and the immediate portion affected by this proposal will be enhanced.
PDC 4 All development within this zone should have a minimum site level of 2.40 metres Australian Height Datum (AHD), and a floor level of 2.65 metres AHD.	Any development within this zone is readily capable of site levels of 2.40 mAHD and floor levels above 2.65 mAHD. It is proposed to exceed these with building ground levels of 2.5 mAHD minimum.
PDC 5 Buildings should not be erected: (a) on active dunes, cliff tops or in other locations likely to result in environmental damage; (b) if the clearing of significant areas of native vegetation would be required; (c) in areas of significant vegetation; (d) if they would affect detrimentally the scenic amenity of the coastline, beaches, parks, lookout points and other public places, or the view from National Route 1; (e) if their location, siting, form, design, materials or colour is inappropriate for the locality; (f) if the intensity of development would change the function or nature of the natural features of the locality; (g) if it would result in restriction of public access to a beach; or (h) if effluent cannot be disposed of satisfactorily within the boundary of the allotment.	No buildings are to be erected on any active dune or cliff area. No significant areas of vegetation are to be cleared but rather will be protected and enhanced. Development will occur behind areas of significant vegetation. The development will ultimately result in a change to the overall character of the area, however the separation from the beach is such that views from the beach will be limited and the development behind the dunes will not be readily visible. The area is not viewed from any defined scenic route or lookout nor is it near National Route 1. Council proposes that development and design guidelines will be incorporated into an amended Development Plan to guide and control the location and external appearance of development within this location. This amendment to the Development Plan will necessarily incorporate a boundary adjustment to reflect the development scheme boundaries as may be approved. The function of the area will be reinforced by the protection of the dunes and the creation of facilities for the community using the beach. Public access to the beach will be enhanced overall with designated car parking areas and walkways. Effluent will be collected and not have to be disposed on individual sites as is the current arrangements. In all of these respects, the proposal satisfies the Development Plan.
Land Not Within A Council Area (Coastal Waters) The following policies apply from the low water mark to the line three nautical miles seaward of the low water mark. Some of these policies are irrelevant to the proposal and where that is the case are marked as not relevant NR. Alternatively, comment is made about related activities or implications for adjoining areas.	
Objective 1: Orderly and economic development.	The objectives for coastal waters are numerous, however in essence they seek development that is orderly and economic, safe and efficient, and

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	sympathetic to the values of character and environment of the coast. The proposal in terms of the area of the Coastal Waters satisfies the design, form and function criteria as set out in the more detailed policy below.
Objective 2: A proper distribution and segregation of living, working and recreational activities by the allocation of suitable areas for those purposes.	Although not within the area of the coastal waters as defined it is worthy to note that the proposal provides for segregation of differing functions by the identification of various activity areas. Refer Figure 3.6 and 3.9. These functions include public boat ramp, public car parking, public waterfront, café, residential, commercial and industrial areas.
Objective 3: The proper location of public and community facilities.	Public and community facilities are provided in appropriate areas such as to enable safe and convenient access. For the purpose of this zone, those functions within the coastal waters area are specifically for the safe navigation and passage of vessels. As such the breakwaters, channels and associated navigation aids are appropriately located in an area already well used by the fishing and aquaculture industries and visiting fishers and boat users. Public facilities will be provided in the central facilities area where control and management will ensure an appropriate quality of public convenience.
Objective 4: The safe and efficient movement of people and goods.	The proposed facilities will enhance safety by providing a sheltered area and a sheltered passageway to an all weather boat launching/retrieval facility and moorings. The proposal is to be designed to all relevant standards and significant improvements to safety can be gained by the provision of safe mooring and servicing areas for the fishing and aquaculture fleets.
Objective 5: Better public access to scenic areas along the coast in keeping with other objectives.	Excellent public access will be maintained to the coast and further opportunities made available to the public to view the coast from the breakwaters. The landscape quality and scenic amenity in this locality has already been modified and created by the range of activities undertaken and the features in and around this designated settlement area. These features in the context of the status of Cape Jaffa as a Southern Port, are attractive and desirable elements of the overall character. These include the jetty, moorings, aquaculture activities and accessways to the beach and ramps. This proposal does not create a first intrusion into a pristine or unaltered environment. Further, the frontline of the development is setback behind the foredunes.
Objective 6: The protection of the landscape from undue damage from quarrying and similar extractive and associated manufacturing industries, and from prospecting and exploring for new	There are no proposals to establish a quarry or similar form of extraction or manufacturing activity . It is however noteworthy that the landscape in this locality has been modified by the agricultural industries as well

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resources.	as the settlement of Cape Jaffa.
Objective 7: The continued availability of metallic, industrial and construction minerals by preventing development likely to inhibit their exploitation.	No known mineral or similar resources will be prejudiced by this proposal.
Objective 8: The conservation, preservation or enhancement of scenically attractive areas adjoining water or scenic routes.	The development of breakwaters will change the views within the bay. The height of the breakwaters is the same as the existing jetty, 2.5 mAHD, which as viewed from the position of the proposed western breakwater is not significant. Refer Figure 5.19. The change however will be entirely consistent with the form of development required to create a safe harbour. The area has attractive sandy beaches and although this feature will be interrupted locally, there remain extensive areas on which to walk, drive and view. The breakwaters will also create a focal point or point of interest in its own right and will become part of the scenic amenity and experience of Cape Jaffa as has the jetty.
Objective 9: The preservation of trees of historical, ecological, or particular visual significance.	There are no trees in the Coastal Waters area.
Objective 10: The conservation of buildings or sites of architectural, historical, or scientific interest.	There are no known sites within the coastal waters area of historical or scientific interest that would be prejudiced by the breakwaters or associated works. The closest historical sites include the Lighthouse cottages in the Bernouilli Conservation Reserve well over a kilometre from the site and a shipwreck about 5 kilometres north east of the site in Lacepede Bay. It is wreck number 352 and is the wreck of the Victoria, a 28 tonne wooden schooner built in Hobart Town in 1837 and lost in 1846.
Objective 11: The retention of environmentally significant areas of native vegetation.	The areas of seagrass that will be lost due to the placement of the breakwaters and the creation of the channel will not, in the context of the extensive sea grass meadows in Lacepede Bay, be significant. The opportunity to relocate many of the fishing fleet in a safe harbour reduces the risk of environmental damage from spills and allows the regrowth of seagrass within the Rock Lobster Sanctuary in the area of the current swing moorings. Refer **Figure 4.16**.
Objective 12: The retention of native vegetation where clearance is likely to lead to problems of soil erosion, soil slip and soil salinisation, flooding or a deterioration in the quality of surface waters.	There is no other native vegetation in the Coastal Waters that if cleared will result in the problems identified in Objective 12.
Objective 13: The conservation and preservation of terrestrial and marine flora, fauna and scenery, and the creation of recreation areas by establishing parks and reserves.	Within the breakwaters is an area of protected water fringing the beach that will provide a haven for those seeking quiet protected areas. No other reserve is to be created in the coastal waters area.
Objective 14: The amenity of localities not impaired by the appearance of land, buildings, objects and structures.	There are no buildings within the zone except the breakwaters and navigation markers. These will change the appearance of the immediate locality as was the

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	case when the jetty was developed. These features are an important component in creating a safe environment for many of the users of the coastal waters for recreational and commercial pursuits. The locality is a recognised port and has characteristics of its amenity that comprise fishing vessels, associated commercial facilities, storage areas and jetty with commercial working features. The character of Cape Jaffa is derived from a combination of these features and the development of breakwaters, channels and navigation aids are consistent with this theme or character. For these reasons, the additional infrastructure is consistent with the amenity of the area, albeit that there will be a greater intensity of activity associated with the improved facilities.
Objective 15: Sustain or enhance the natural coastal environment in South Australia.	The investigations undertaken by SARDI as contained in Appendix SARDI and WBM in relation to coastal processes, conclude that the effects on the coast of this development is minimal and that the natural regime of coastal processes can be sustained using appropriate management techniques.
Objective 16: Preserve and manage the environmentally important features of coastal areas, including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas.	There are no terrestrial habitats in the coastal waters area, however it is noteworthy that the closest areas of terrestrial vegetation are to be retained and enhanced. The area will be set aside for public reserve purposes.
Objective 17: Preserve sites of heritage, cultural, scientific, environmental, educational or landscape importance.	The area to the west of the breakwaters forms part of a Rock Lobster Sanctuary, refer Figure 4.6. This area currently accommodates the fishing and aquaculture fleets and this proposal offers the opportunity for the relocation of the fleets into protected waters away from the sanctuary. This will assist in the protection and management of the sanctuary. It is noteworthy that more than two thirds of the fleet have formally indicated their wish to relocate.
Objective 18: The protection of offshore islands, their natural features and scenic beauty within and adjoining the islands.	There are no offshore islands proximate to the development site.
Objective 19: A rural and coastal environment not disfigured by advertisements.	Advertisements resulting from the development in the coastal waters area will be limited to safety, information and education signs on the breakwaters, the subject of separate applications. However, it is intended to promote the development in an orderly and attractive fashion and to ensure that the area's attractiveness is not diminished by incorporating appropriate guidelines for advertising.
Objective 20: Location of activities, uses and development in areas zoned for that purpose.	The Development Plan allows for the expansion of Cape Jaffa. This proposal is a more comprehensive, detailed and complex scheme than Council earlier envisaged in

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	its Development Plan.
	Therefore, the extent of development extends beyond the earlier bounds of expectations and ensures proper planning. New policy is to be prepared by Council to marry with an agreed scheme.
Objective 21: Manage development in coastal areas to sustain or enhance the natural coastal environment.	Investigations into the terrestrial and marine coastal environment have been undertaken and as a consequence, a more detailed knowledge and understanding of the locality is available. From these investigations, management plans for the activities along the coast have been identified to ensure the protection of the coast.
Objective 22: Protect the coast from development that will adversely affect the marine and onshore coastal environment whether by pollution, erosion, damage or depletion of physical or biological resources, interference with natural coastal processes or any other means.	The management plans as referred to above provide for the adaptive management of the coast.
Objective 23: Development which does not interfere with environmentally important features of coastal areas, including mangroves, wetlands, dune areas, stands of native vegetation, wildlife habitats and estuarine areas.	There are no mangroves or wetlands affected by this proposal. The native vegetation affected by the proposal within the Coastal Waters area is the marine flora in the area of the channel and the footprint of the breakwater. The investigations conclude that in the long term, there will not be a net loss of marine flora or habitat as the proposal will result in the removal of the swing moorings from the Rock Lobster Sanctuary.
Objective 24: Development which does not detract from or reduce the value of sites of ecological, economic, heritage, cultural, scientific, environmental or educational importance.	The ultimate relocation of fishing vessels from the Rock Lobster Sanctuary acknowledges the value of this area and enhances the protection by the reduction of risks and activities from this area.
Objective 25: Preserve areas of high landscape and amenity value including stands of vegetation, exposed cliffs, headlands, islands and hill tops, and areas which form an attractive background to urban and tourist developments.	There are no formally identified areas at Cape Jaffa in the Development Plan however; every effort has been made to create a landscape with a high level of amenity for all users. In the Coastal Waters area breakwaters and associated navigation facilities are proposed. These will provide an attraction to visitors and create visual interest out to sea.
Objective 26: Development which maintains or enhances public access to coastal areas in keeping with objectives for protection of the environment, heritage and amenity by provision of: (a) planned, appropriate easy to use public access to and along beaches; (b) coastal reserves and lookouts; (c) convenient and safe public boating facilities at selected locations; (d) convenient vehicular access to points near beaches and selected points of interest; and	The breakwaters will provide enhanced public access to the water for viewing and fishing. The beach area is to remain accessible whilst an area to the west of the proposed new access way will be designated for pedestrian purposes thus creating a safe pedestrian environment. Associated with the improved beach access will be car parking, and pedestrian pathways. The vegetated coastal dunes will also be significantly enhanced by their protection and rehabilitation.

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(e) adequate car parking.	
Objective 27: Development only undertaken on land which is not subject to, or can be appropriately protected from, coastal hazards such as: (a) inundation by storm tides or combined storm tides and stormwater; (b) coastal erosion; or (c) sand drift.	The only part of the development proposal within the Coastal Waters area is the breakwaters and the dredged channel. The breakwaters are designed to provide a protected safe seaway for vessels and takes into account coastal processes. Refer 5.6.16.
Objective 28: Development located and designed to allow for changes in sea level due to natural subsidence and probable climate change during the first 100 years of the development. This change to be based on the historic and currently observed rate of sea level rise for South Australia with an allowance for the nationally agreed most-likely predicted additional rise due to global climate change.	The breakwaters allow for future extension to accommodate sea level changes.
Objective 29: Development which will not require, now or in the future, public expenditure on protection of the development or the environment.	The development arrangements by the proponent provides for ongoing management and maintenance of facilities including the creation of funds from the proceeds of the development and from the rate revenue of those benefiting from the development.
Objective 30: The protection of the physical and economic resources of the coast from inappropriate development.	The development of the facilities out to sea only serves to reinforce and hence protect the economic resources of this coast.
Objective 31: Development of coastal urban settlements, coastal rural living areas, tourist complexes and marinas only in environmentally acceptable areas.	The area has been developed as one of the five Southern Ports along the coast of south east South Australia and includes fishing industry activities including fish processing and storage. Cape Jaffa is also a significant tourist destination and residential area for permanent residents. The environmental assessment confirms the suitability of the Cape Jaffa locality as a focal point for a coordinated, integrated development as an extension to the existing settlement.
Objective 32: Urban development including housing, holiday houses, tourist accommodation, and rural living, as well as land division for all such purposes, only in the zones specifically created for such developments.	There is no urban development proposed within the Coastal Waters area.
Objective 33: Development of coastal urban settlements, coastal rural living, tourist accommodation, marinas and ports in an orderly and economic manner which provides for a range of sites while ensuring the number of locations and the size of the zones do not exceed that which is indicated as being required by a realistic	The size of the facility is directly related to the requirements of the existing operators with a small capacity for increasing the number of commercial vessels. Twenty one commercial operators have indicated their intentions to occupy berths within the marina to Council whilst a further 21 dry berths have been requested. There is no other facility available to

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assessment of future demand.	accommodate the fleet or any facilities to serve the aquaculture industry. The facilities allow for progressive or staged development of the berths and the commercial area. Likewise with the recreational and residential components of the development, there is an existing demand for seafront land and ready access to the water. This demand has been evident throughout the state and locally and the demographic structure of the community reinforces the demand over the next 10 years. There are in excess of 120 registrants for residential allotments and the project has not been marketed. There is also an existing tourist and visitor demand which has not been satisfied for a number of years. The previous owner of the Tourist Park was unable to secure additional land for their expansion plans and the current owners recognise the need for improved and expanded facilities. (pers comm. Lindsay Gilchrist) In addition, the boat ramp facilities provide a good guide to the demand for facilities. During the summer periods, there are a significant number of users of the beach launching area and the nearby beach for parking cars and associated boat trailers. There are also associated camping activities on the beach and in the dune parking area as overspill from the tourist park during the summer months. The development of facilities in this location is an orderly and economic development in the context of the existing operations and activities.
Objective 34: To redesign and redevelop coastal living areas which do not satisfy environmental, health or public access standards for coastal areas.	Given the level of activities and their inadequacy, the proposal provides the redesigned elements to better serve the environmental, health and public access standards and expectations and safety along the coast.
Objective 35: Development of the marine environment and in particular the marine aquaculture industry: (a) in an ecologically sustainable way; (b) in a manner which recognises other users of marine and coastal areas and ensures a fair and equitable sharing of marine and coastal resources; (c) to conserve environmental quality, in particular water quality, and other aspects of the coastal environment including sea floor health, visual qualities, wilderness, ecosystems and biodiversity; (d) to minimise conflict between water and land based uses including: (i) aquaculture; (ii) wildfisheries; (iii) recreational fishing; (iv) passive and active recreation activities (eg. boating, skiing, sailing, swimming, diving, sightseeing, enjoyment of coastal wilderness);	The proposal incorporates features specifically to encourage and support the aquaculture industry in a manner that allows them to operate in a more efficient and effective manner. Their removal from the Rock Lobster Sanctuary and from jetty use provides a more sustainable basis for the operations. The extent of the aquaculture facilities within the Coastal Waters is insignificant in aerial terms and considerable opportunity exists for sharing of the waters with other users and producers. The wharf, pump out, fuelling, berthing and related facilities all provide an excellent basis for ensuring conflict or environmental damage does not occur. Extensive investigations have been undertaken to determine an appropriate form and extent of aquaculture in Lacepede Bay. These investigations considered environmental sustainability, location criteria and management regimes. The controls to be placed on the industry will enable monitoring of effects and adaptive

Development Plan Provisions	Commentary
(v) farming; (vi) residential, other urban development, and holiday areas; (vii) tourism; (viii) industrial development; (ix) defined national and conservation parks, and wilderness areas;	management of the fishery. All of these considerations ensure the protection of the special features of the environment whilst ensuring sustainability of the living and working environments of the community. There are numerous users of the facilities at Cape Jaffa both recreational and commercial. The proposal enables all of these groups the opportunity to access the sea and the improved infrastructure throughout the development.
(x) mining and areas with significant mineral deposits; (e) to maintain adequate safety standards, including navigational safety; (f) to minimise the risk of pollution from external sources and activities; (g) so that onshore support facilities and activities are appropriately designed and located; (h) to maintain public access to the foreshore and coastal waters; (i) to minimise adverse impact on the visual amenity of the coastal environment, and unspoilt views adjacent to the coast; (j) to minimise any adverse impacts on sites of ecological, economic, cultural, heritage or scientific significance such as: (i) Indigenous, Non-Indigenous or Natural Heritage sites;* (ii) National Parks, Conservation Parks and reserves; (iii) Recreation reserves; (iv) Marine Parks and reserves; (v) Sites of scientific importance; (vi) Mineral reserves; (vii) Areas of high public use; (viii) Areas valued for their beauty or amenity; (ix) Breeding grounds for both marine and terrestrial species (k) in a manner which recognises the social and economic benefits to the community.	Navigational safety will enhanced as a consequence of the development as a safer launch and retrieve environment is to be created enabling excellent access for emergency services. The removal of vessels from the open moorings assists in minimising risk to the marine environment and allows for more ready containment if spills occur within the confines of the marina. On shore facilities have been located and designed with input of the industries to ensure an appropriate provision of wharf and related services. Public access to the foreshore and coastal waters is a high priority in the scheme in a number of forms including public car parks, walkways, a new access to the beach for vehicles. Council has also applied for funds to develop a public boat ramp. The sea conditions in Lacepede Bay at Cape Jaffa are such that the proposed breakwaters can be kept to a height of 2.5 mAHD, the same height as the walkway of the Cape Jaffa Jetty. This is not a high feature and although it will interrupt the beach, there are significant beaches on either side of the breakwaters that are readily accessible. The proposal does not affect any heritage site within the marine environment, national park, marine park or otherwise. The area of the Rock Lobster Sanctuary of note is the rocky platforms which are well separated from the proposal to the east as depicted in Figure 4.15. The proposal properly recognises and encourages the numerous benefits to the community. Although the character and overall presentation of Cape Jaffa will change, these changes are designed to improve the living environment and the services to the community.
Objective 36: Telecommunications facilities provided to meet the needs of the community.	Telecommunications facilities will be extended to provide the best available service.
Objective 37: Telecommunications facilities located and designed to minimise visual impact on the amenity of the local environment.	Should telecoms facilities be required in the Coastal Waters area for telemetry or related purposes, they will be designed to minimise visual impact.
Objective 38: The development of renewable energy facilities, such as wind and biomass energy facilities, in appropriate locations.	No energy facilities are proposed in the Coastal Waters area.

Development Plan Provisions	Commentary
Objective 39: Renewable energy facilities located, sited, designed and operated to avoid or minimise adverse impacts and maximise positive impacts on the environment, local community and the State.	No energy facilities are proposed in the Coastal Waters area.

The proposed development provides a comprehensive and planned approach to the development of the Cape Jaffa settlement by accommodating the existing demands of the fishing and aquaculture industries, tourists and residents in an orderly and efficient manner. The development builds on the existing infrastructure and improves the service level to the community in various ways. By expanding on the existing infrastructure, the varied social and cultural, employment, economic and recreational needs of the communities at Cape Jaffa today and those in the future can be satisfied.
The proposed development provides for industrial, business, residential, recreational and tourist accommodation activities in a form and manner that cannot be developed within the current infrastructure and policy constraints and arrangements. This proposal provides the impetus for improvements and enhancements of infrastructure and services.

Whilst a number of varied facilities and features can be established at Cape Jaffa, the principal service functions of Kingston town remain dominant as the major urban and service centre for the district. The scheme sets out areas for functions and it is readily apparent that it is not intended to compete with the function of Kingston. The existing industry base, the land and environmental conditions have been investigated and are suited to the development of a safe harbour and related facilities, and will not replace those commercial business and main centre functions of Kingston.

The development is located where the movement of people and goods can be readily designed to ensure a safe and convenient network of roads and connections, and where the visiting public can gain ready access to the coast. The new road arrangements in terms of access to the existing settlement area ensures improved roads and routes which in some parts eliminates through traffic to the eastern end of the settlement. The use of Rothalls Road to the south and west is entirely consistent with the access to Cape Jaffa in its early days of development. Public utilities will also be considerably enhanced by the provision of a reticulated water supply, sewer system and three phase power supply. None of these exist at Cape Jaffa.

The vegetated dunes warrant rehabilitation and through this project, this will be achieved. The proposal promotes the transfer of privately owned vegetated dune and beach for reserve purposes. This will assist in encouraging native fauna into the dunes and the improvement of the vegetation corridor link along the coast. With the relocation of vessels from the swing moorings within the Rock Lobster Sanctuary to the main basin, the seagrass areas damaged by the mooring chains will regenerate. Tourist facilities will be enhanced and the safety of the boating public attracted to Cape Jaffa will also be significantly improved. A facility will exist for improved sea rescue and related operations.

The appearance of the development will differ from the limited development of the existing settlement in size and form. There is however an expectation for the settlement to grow whether this proposal proceeds or not. This is entirely consistent with the current Development Plan provisions for development to extend east to Cape Jaffa Road and south to Rothalls Road. This zoning will of itself result in a significant change in the development of this locality. The proposal can reinforce the fishing village character and attractiveness of Cape Jaffa as a whole.

Portion of this development area is designated in the current Development Plan for commercial and industrial purposes. This area extends to King Drive in the north, Cape Jaffa Road in the east and Rothalls Road in the south. This area is not serviced and individual developments would have to rely on the creation of their own three phase power on-site, disposal of effluent and the provision of water. The only existing source of water for individual users is from the shallow groundwater aquifer, which would result in greater drawdown from the aquifer. The proposal incorporates the reticulation of a more desirable and sustainable water supply.

The proposal will also incorporate many new features which provide a much needed efficiency of service and hence economy to the fishing and aquaculture industries, whilst also enabling the development of coastal waterfront that is not readily available elsewhere in the region.

The greater efficiency in the fishing and aquaculture industries will reinforce and enhance their market position and improve local economy. The creation of additional residential and tourist accommodation land will go towards satisfying the longer term demands for coastal housing associated with retirement trends and recreation pursuits. There are few opportunities in the South East of South Australia where a comprehensive planned approach can be accommodated.

In general:

- the proposal can provide appropriate arrangements for safe access and all service infrastructure;
- will enhance the economic opportunities for the existing industries at Cape Jaffa and in the region including fishing, aquaculture, recreation, tourism and wine production;
- investigations into the terrestrial and marine coastal environment as part of this Major Development process provides an excellent understanding of the characteristics of the area and highlights improvements that can be made through this development;
- the vegetated dunes can be considerably enhanced;
- public facilities, access, parking, reserves and boating facilities will all be enhanced;
- the land can be appropriately and readily protected from floods, erosion and sand drift;
- the proposal incorporates design characteristics and is located such as to allow for sea level rise;
- the physical and economic resources of the coast have been identified and the effects of development assessed as part of the Major Development process;
- Cape Jaffa has been a defined settlement for many years serving a resident, tourist and fishing community;
- this proposal reinforces this settlement in a location suited to a protected harbour for an existing fishing fleet. This is also consistent with the strategic directions for aquaculture and the provision of safe and environmentally appropriate facilities;

- this proposal redesigns and expands on the earlier expectations for the development of Cape Jaffa, and in so doing, significantly reduces the risk of environmental degradation by the provision of safe mooring, service infrastructure, including pump out facilities, waste and refuelling facilities; and
- public access to the beach and the coast will be enhanced with the development of footpaths and car parks close to the coast as well as public boat launching facilities.

For these reasons, the proposal is orderly and economic and satisfies good planning principles for the development of facilities in a coordinated manner for the varied needs of the community.

Development Plan Review

The South East Local Government Association completed a review in 2002 in accordance with Section 30 of the *Development Act* 1993.

As part of that review the community, community groups and committees, government agencies and departments, and Local Government were consulted to identify issues, shortcomings, and desirable future outcomes for planning policy in the region.

Issues identified as part of the Development Plan review that are relevant to the proposal include the following:

- investigate and promote tourism development through appropriate policy, including review of the State Tourism Plan, the South East Coastal Management Strategy, proposed boating and marina facilities, short term accommodation options, wineries, and protection and promotion of the region's natural features and cultural and built heritage;
- the commercial fishing industry is important for export earnings (in excess of $12 million in 2001/2002) and tourism, a major contributor to the local economy;
- the fishing industry requires safe port access and adequate mooring, fuel and unloading facilities;
- appropriate provision of berths for both professional and recreational fishing vessels is required;
- aquaculture is an emerging industry in the region, and planning policies need to encourage and accommodate this form of development. Marine based aquaculture requires suitable areas for land based infrastructure;
- planning policy needs to take into account proposed upgrading or establishment of various boating and marina facilities;
- Cape Jaffa township – zoning, future development and expansion of residential areas, coastal planning, and facilities for professional and recreational mariners;
- investigate potential marina opportunities at Cape Jaffa;
- investigate policy issues relating to offshore aquaculture;

- aquaculture is an emerging industry;
- proposed upgrading or establishment of various boating and marina facilities;
- provision and suitability of infrastructure;
- coastal issues;
- growth of marine and land based aquaculture;
- aquaculture development has potential to impact on tourism development; and
- policies for land based aquaculture with particular regard to water use.

Conclusion

The State's Regional Strategy and the regional review of development policy are in unison in their encouragement of facilities for recreational and commercial fishers, the aquaculture industry, tourist industry, settlement development and for the overall economic betterment of the region. This consistency is logical given the geography of the locality and the evidence of its suitability by the long term establishment of the fishing fleet and the more recent development of the aquaculture industry.

Council's current Development Plan as at 24 July 2003 recognises a significant area suited to residential, tourist and industry growth, however that plan did not contemplate the prospects of a safe harbour and marina facilities which inevitably increase the area required to be zoned. Accordingly, the proposal in its eastern third extends into the Primary Industry Zone which does not contemplate more intensive forms of urban development. The Development Plan does however contemplate residential, commercial, industrial, tourism and retail developments, all of which form part of the proposal albeit with a different functional arrangement.

The proposal is therefore consistent with the strategic directions and the policy for the development of this area.

5.9.2 Identify potential changes that will need to be made to the zoning of the site.

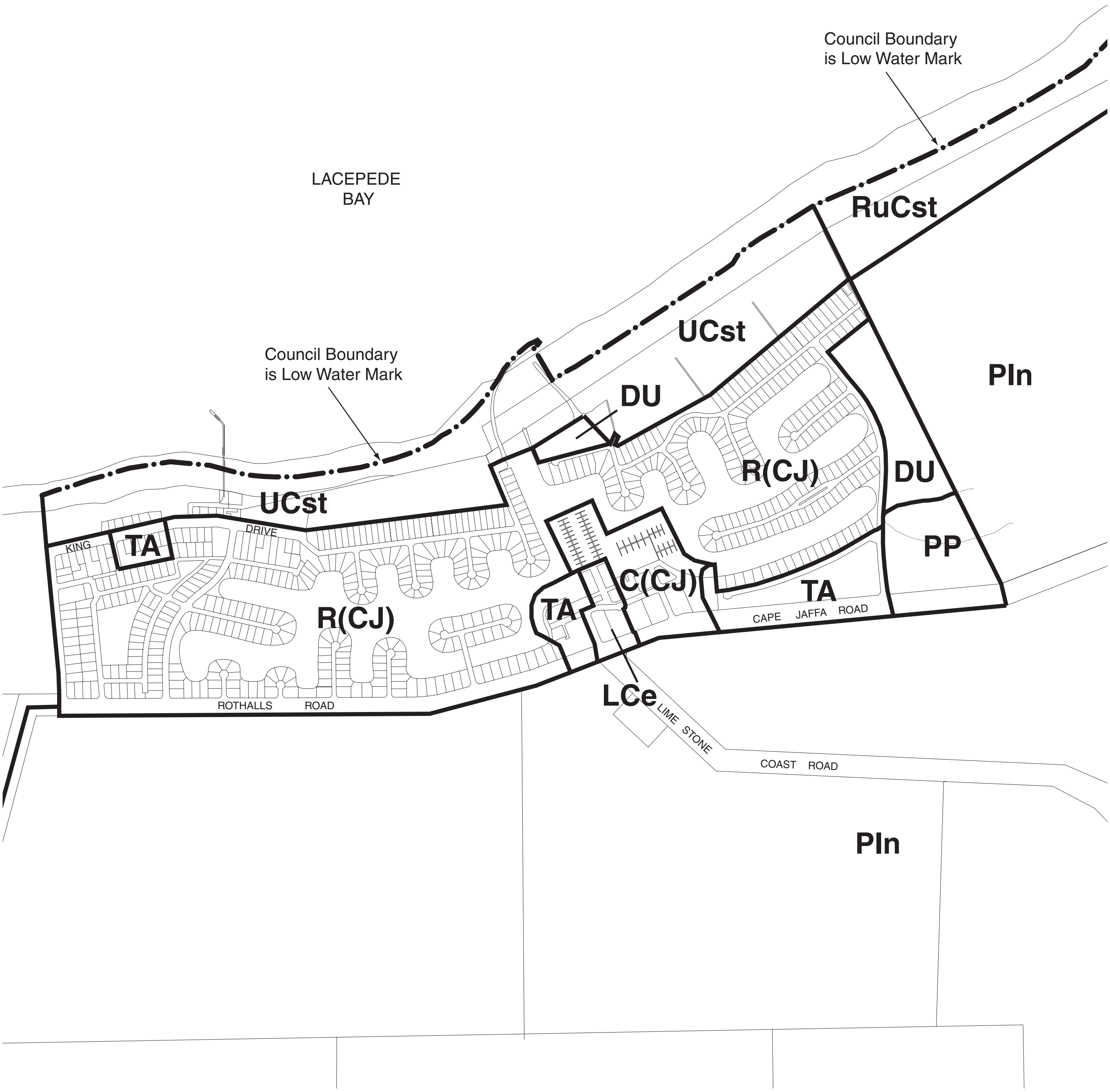
At the time of lodgement, the subject land was located within the Cape Jaffa Zone and part of the General Farming Zone, General Farming (Forestry) Zone and the Rural Coastal Zone. Part of the proposed breakwaters and channel development currently extends beyond the Council boundary and is therefore within part of the Land Not Within a Council Area (Coastal Waters) Development Plan.

Since then the zoning has changed as a result of the Kingston DC General PAR approved on 24 July 2003. The subject land is now located within a combination of zones including Rural Coastal, Urban Coastal, Residential, Industry (Cape Jaffa), Local Commercial and Primary Industry Zones.

The potential changes that will need to be made to the zoning of the site when approved will include:

- inclusion of the coastal waters section of the scheme, ie to the end of the breakwaters in the Kingston Development Plan (after amendment to the Local Government boundary);
- minor realignment of the landward boundary of the Urban Coastal and Rural Coastal Zones to reflect the approved plan;
- rezoning of the Rural Coastal Zone in the eastern part of the area to Urban Coastal Zone to provide consistent coastal policy adjacent to the proposed development area;
- rezoning of the Residential, Industry (Cape Jaffa) and the affected part of the Primary Industry Zones within the study area to an appropriate zone to reflect the uses in the approved scheme; and
- the creation of new policies for each of the identified functional areas as shown on **Figure 5.59** which depicts a possible zone layout.

Figure 5.59 shows one approach to set out separate zones within the marina area, for example Residential (Cape Jaffa) and Commercial (Cape Jaffa) etc similar to the existing arrangements and the Port Vincent example. Another approach would be to establish a Marina Zone with various policy areas, ie Residential, Commercial, Boat Haven and Tourist Accommodation, similar to North Haven. The final outcome will be determined after appropriate investigations in the PAR process and may include elements deriving from the Better Development Plan Program.



C(CJ)	Commercial (Cape Jaffa)
DU	Deferred Urban
LCe	Local Centre
PIn	Primary Industry
PP	Public Purpose
R(CJ)	Residential (Cape Jaffa)
RuCst	Rural Coastal
TA	Tourist Accommodation
UCst	Urban Coastal

Zone Boundary

Council Boundary

CAPE JAFFA
PROPOSED ZONES
Figure 5.59

5.9.3 Describe the consistency of the development with State and Commonwealth legislation and initiatives relating to conservation and protection of the environment and heritage items.

The following legislation is most relevant to the project for approvals and management purposes and those considered in the preparation of the EIS. The commentary below does not seek to set out a description of every detail covered in the various Acts but rather a brief statement of intent.

Commonwealth Legislation

Aboriginal and Torres Strait Islander Commission Act 1989

Recognises the past dispossession and disposal of the Aboriginal and Torres Strait Islander peoples and their present disadvantaged position in Australian society.

The Act is designed to establish an Aboriginal and Torres Strait Islander Commissioner, a Torres Strait Regional Authority, an Indigenous Land Corporation and an Aboriginal and Torres Strait Islander Commercial Development Corporation.

Aboriginal and Torres Strait Island Heritage Protection Act 1984

Preserves and protects areas and objects in Australia and in Australian waters from injury or desecration where the areas and objects are of particular significance to Aboriginals in accordance with Aboriginal traditions.

Australian Heritage Commission Act 1975

Provides for the establishment of functions and powers of the Australian Heritage Commission.

Endangered Species Protection Act 1992

Promotes the recovery of species and ecological communities that are endangered or vulnerable, and prevents other species or ecological communities from becoming endangered. Reduces conflict in land management through readily understood mechanisms relating to the conservation of species and ecological communities that are endangered or vulnerable.

The Act also provides for public involvement in the promotion of public understanding of the conservation of such species, and ecological communities, and it is designed to encourage co-operative management for the conservation of such species and ecological communities.

Environment Protection and Biodiversity Conservation Act 1999

Designed to ensure matters significantly affecting the environment are examined and taken into account in the formulation of proposals, the carrying out of works and other projects, the negotiation, operation and enforcement of arrangements, the making of decisions and recommendations and the incurring of expenditure by or on behalf of the Australian Government and authorities of Australia either alone or with others. The Act deals with direct financial assistance granted or proposed to be granted, to the States.

Reference is made to the *Commonwealth Environment Protection Biodiversity and Conservation Act* (EPBC Act), the draft Regional Natural Resource Management Plan for the south east, and heritage issues relevant to the area.

Under the Commonwealth EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance are subject to rigorous assessment. These include world heritage items, Ramsar wetlands of international significance, listed threatened species and ecological communities, listed migratory species, Commonwealth marine areas and nuclear activities. In this regard the only area of relevance may be impacts on potential threatened species. Refer to previous comments in Section 5.2.15. A referral has been made to Environment Australia, and there are no features of the site which trigger the application of the Commonwealth legislation. Refer Appendix 1.

Environment Protection (Sea Dumping) Act 1981

Provides for protection of the environment by regulating the dumping into the sea and the incineration at sea of certain wastes and other matter, and the dumping into the sea of certain other objects.

Industrial Chemicals (Notification & Assessment) Act 1989

Provides for a national system of notification and assessment of industrial chemicals for the purposes of aiding in the protection of the Australian people and the environment, in relation to risks to occupational health and safety, to public health and the environment that could be associated with the importation, manufacture or use of chemicals.

The Act requires the provision of information and for making recommendations about chemicals to Commonwealth, State and Territory bodies with responsibilities for the regulation of industrial chemicals, and giving effect to Australia's obligations under relevant international agreements.

National Environment Protection Council Act 1994

Establishes the National Environment Protection Council to promote peoples enjoyment of the benefit of protection from air, water or soil pollution and from noise wherever they live in Australia. The Council seek that decisions of the business community are not distorted and markets not fragmented by variations between participating jurisdictions in relation to the implementation of major environment protection measures.

National Parks and Wildlife Conservation Act 1975

Designed to make provision for and in relation to the establishment of National Parks and other parks and reserves and the protection and conservation of wildlife.

Native Title Act 1993

Provides for the recognition and protection of native title and the establishment of ways in which future dealings affecting native title may proceed and sets the standards and mechanisms for determining claims for native title and to provide for or permit validation of past Acts, and intermediate period Acts, invalidated because of the existence of native title.

Occupational Health and Safety (Commonwealth Employee) Act 1991

Provides for the promotion of the occupational health and safety of persons employed by the Commonwealth and Commonwealth authorities.

The Act is designed to protect the health, safety and welfare of the employees of the Commonwealth and of Commonwealth authorities and persons at or near workplaces from risks arising out of activities at work. Expert advice is to be available on occupational health and safety matters affecting employers, employees and contractors to promote an occupational environment for such employees at work that is adapted to their needs relating to health and safety and to foster a co-operative consultative relationship between employers and employees on health, safety and welfare of such employees at work.

World Heritage Properties Conservation Act 1983

Relates to the protection and conservation of certain property.

State Legislation (South Australia)

Following is a summary of relevant aspects of the legislation considered in the preparation of the EIS. These do not seek to set out a description of every detail covered in the various Acts but rather a brief statement of intent.

Aboriginal Heritage Act 1988

Provides for the protection and preservation of the Aboriginal Heritage (As Amended 4 May 2002). It repeals the *Aboriginal Historical Relics Preservation Act* 1965 and the *Aboriginal Heritage Act* 1979. It amends the *Mining Act* 1971, the *Planning Act 1982* and the *South Australian Heritage Act* 1978.

As detailed in **Section 5.8** above, there are no Native Title claims over the land and the process of determining sites is progressing with a view to preserving and interpreting objects as part of the overall scheme under the *Aboriginal Heritage Act* 1988. The interpretation of collected/recovered objects means that the history and lives of the aboriginal community can be made more relevant to others in the wider community which will assist in better understanding the importance of the land. In addition, the European heritage can also be interpreted and together, the values past and present of Cape Jaffa will be better understood and appreciated.

Animal and Plant Control (Agricultural Protection and Other Purposes) Act, 1986 and Regulations, 2002;

Provides for the control of animals and plants and for the protection of agriculture and the environment and for the safety of the public (as Amended 14 November 2003)

Coast Protection Act 1972 and Coast Protection (South East) Regulations, 2000

Provides for the conservation and protection of the beaches and coast of this State (as Amended 24 November 2003). The coast will be affected by this proposal as the breakwaters and channel interrupt the natural flow of sand and seagrass along the coast. As described in **Section 5.2.13** the adaptive management regime will ensure that the extent and nature of sand and wrack movement can be readily managed given the relatively calmer environment of this part of the bay. In doing so, the coastline can be protected from downstream impacts.

Controlled Substances Act 1984

Provides for the regulation and prohibition of the manufacture, production, supply, possession, handling or use of certain poisons, drugs, therapeutic or other substances (as Amended 1 February 2003).

Country Fires Act 1989 and Regulations, 1996

Provides for the prevention, control and suppression of fires to provide for protection of life and property in fire and other emergencies and to repeal the Country Fires Act 1976 (as Amended 18 December 2003).

Crown Lands Act 1929

Relates to all lands in the State (with certain exceptions), and lands abutting those lands (as Amended 24 November 2003).

Dangerous Substances Act 1979

Provides for the regulation of the keeping, handling, transporting, conveyances, use and disposal, and the quality, of dangerous substances (as Amended 1 June 2000).

Development Act 1993

The object of the Act is to provide for proper, orderly and efficient planning and development in the State including strategic and policy planning and amongst other things to enhance the proper conservation, use, development and management of land and buildings.

Economic Development Act 1993

The object of this Act includes the promotion of economic development, productive partnership between public and private enterprise in SA, investment, industrial and commercial development, public understanding of issues affecting economic development, and it establishes the Economic Development Board (as Amended 1 July 1999).

Environment Protection Act 1993 and Environment Protection (General) Regulations, 1994

Provides for the protection of the environment. Its objectives include the promotion of ecologically sustainable development to ensure that all reasonable and practicable measures are taken to protect, restore and enhance the quality of the environment.

A general environment duty is imposed on all persons not to undertake activities on land that pollute or might pollute the environment unless all reasonable and practicable measures are taken to prevent or minimise any resulting environmental harm.

Prescribed activities of environment significance require an environmental authorisation.

Environment Protection (Sea Dumping) Act 1984

Provides for the protection of the environment by regulating the dumping into the sea, and the incineration at sea of waste and other matter and the dumping into the sea of certain other objects. The Act also annexes as a schedule the Convention on the Prevention of Marine Pollution by Dumping of Waste (as Amended 21 October 1995). Associated resolutions are also annexed to the Act.

Environment, Resources and Development Court Act 1993

Establishes the Environment, Resources and Development Court (as Amended 2 April 2001).

Explosives Act 1936

Consolidates and amends the law relating to explosives (as Amended 1 December 2001).

Fisheries Act 1982 and Regulations

Provides for the conservation, enhancement and management of fisheries, the regulation of fishing and the protection of certain fish and to provide for the protection of marine mammals and the aquatic habitat (as Amended 24 November 2003).

The Regulations include 12 prescribed "Schemes of Management" for the various commercial fisheries i.e Prawn, Rock Lobster, Abalone and Blue Crab, River Murray, Lakes and Coorong, Marine Scalefish and Miscellaneous Fisheries.

Harbors and Navigation Act, 1993 and Regulations, 1994

An Act to provide for the administration, development and management of harbours and to provide for safe navigation in South Australian waters.

Heritage Act and Regulations, 1993

Provides for the conservation of places of heritage value (as Amended 24 November 2003).

Highways Act 1926

Provides for the appointment of a Commissioner of Highways, and to make further and better provision for the construction and maintenance of roads and works.

Historic Shipwrecks Act, 1981 and Regulations, 1999

An Act relating to the protection of certain shipwrecks and relics of historic significance (As Amended 24 November 2003).

Local Government Act 1999 and Regulations;……….

Provides a decision maker in the interest of the community and its resources and a co-ordinator of public services at a local level. Promotes the interests of the community generally.

National Environment Protection Council (South Australia) Act 1995

Provides for the establishment of a National Environment Protection Council and to amend the Environment Protection Act 1993 (as Amended 20 December 2003).

National Parks and Wildlife Act 1972 and Regulations;…………

Provides for the establishment and management of reserves for public benefit and enjoyment and to provide for the conservation of wild life in natural environment.

Native Title (South Australia) Act, 1994 and Regulations, 2001

Relates to native title in SA and confers appropriate jurisdiction on the Supreme Court and the Environment, Resources and Development Court in this State.

Native Vegetation Act 1991 and Regulations, 2003

Provides incentives and assistance to land owners in relation to the preservation and enhancement of native vegetation and to control the clearance of native vegetation.

The substantive area to be developed has been cleared for many years as part of the primary production activities of cropping and grazing of the land. There is therefore little native vegetation remaining on the land. The most significant area is the foredune to the east of Cape Jaffa Road and it is proposed to protect and enhance that area by fencing and weed removal. There is also a stand of vegetation in a low lying area near the south eastern corner of the property which is also to be enhanced and fenced for its conservation.

Occupational Health, Safety and Welfare Act 1986

Provides for the health, safety and welfare of persons at work (as Amended 24 November 2003).

Outback Areas Community Development Trust Act 1978

Establishes the Outback Areas Community Development Trust with objectives including the promotion of development and communications in outback areas of the State (as Amended 1 July 1999).

Pastoral Land Management and Conservation Act 1989

Provides for the management and conservation of pastoral land (As Amended 24 November 2003).

Public and Environmental Health Act 1987 and Regulations

An Act dealing with public and environmental health; to repeal the Health Act 1935, the Noxious Trades Act 1943 and the Venereal Diseases Act 1947 (as Amended 6 July 2000).

Recreation Greenways Act, 2000

An Act to provide for the establishment and maintenance of trails for recreational walking, cycling, horse riding, skating or other similar purpose; to make a related amendment to the *Development Act* 1993.

Road Traffic Act 1961

An Act to consolidate and amend certain enactments relating to road traffic (as Amended 1 January 2004).

Sewerage Act 1929

Consolidates certain Acts providing for the sewerage and cleansing of the metropolitan area and other places (as Amended 4 November 1996).

Soil Conservation and Landcare Act, 1989

An Act to provide for the conservation and rehabilitation of the land of this State; and for other purposes (as Amended 24 November 2003).

South Eastern Water Conservation and Drainage Act, 1992

An Act to provide for the conservation and management of water and the prevention of flooding of rural land in the South East of the State (as Amended 24 November 2003).

Upper South East Dryland Salinity and Flood Management Acts and Regulations, 2002

An Act to provide for a scheme to protect and improve the environment and agricultural production in the Upper South East through the proper conservation and management of water and the initiation or implementation by the Government of the State of works and environmental management programs and other initiatives; to make related amendments to the South Eastern Water Conservation and Drainage Act 1992.

Water Conservation Act 1936

Consolidates certain Acts relating to the conservation of water in SA (as Amended 1 January 1995).

Water Resources Act, 1997 and Regulations

An Act to provide for the management of the State's water resources (as Amended 24 November 2003)

Wilderness Protection Act 1992

Provides for the protection of wilderness and the restoration of land to its condition before European colonization (as Amended 4 May 2002).

Protection of Movable Cultural Heritage Act 1986

An Act to protect Australia's heritage of movable cultural objects, to support the protection by foreign countries of their heritage of movable cultural objects (as Amended 24 May 2001).

<u>Other Applicable State Plans</u>

Regional Natural Resource Management Plan

The South East Natural Resource Management Plan has been developed to provide the strategic framework for achieving the vision for natural resource management in the South East. The framework will be used to facilitate integrated approaches to the management of the region's natural resources and to attract investment to address priority issues.

The design and planning of the marina is being undertaken in accordance with the strategic framework of the draft Regional Natural Resource Management Plan for the South East and is consistent with the vision for that plan, ie:

> *…the natural resources of the South East managed in an integrated manner to protect and/or enhance environmental values, promote sustainability in economic development and build social capacity…*

The substantive area to be developed has been cleared for many years as part of the primary production activities of cropping and grazing of the land. There is therefore little native vegetation remaining on the land. The most significant area is the foredune to the east of Cape Jaffa Road and it is proposed to protect and enhance that area by fencing and weed removal. There is also a stand of vegetation in a low lying area near the south eastern corner of the property which is also to be enhanced and fenced for its conservation.

The coast will be affected by this proposal as the breakwaters and channel interrupt the natural flow of sand and seagrass along the coast. As described in Section 5.2.22, the adaptive coastal management regime will ensure that the extent and nature of sand and wrack movement can be readily managed given the relatively calmer environment of this part of the bay. In doing so, the coastline can be protected from downstream impacts.

<u>Other Related Policies, Guidelines and References for this Type of Development</u>

Commonwealth

- ANZECC Best Practice Guidelines for Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand (ANZECC, 1997);
- ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance (ANZECC, 2000);
- Australia's Oceans Policy: Caring, Understanding, Using Wisely (Commonwealth of Australia, 1998);
- Interim Marine and Coastal Regionalisation for Australia, IMCRA Technical Group, (1998);
- International Convention for the Prevention of Pollution from Ships (MARPOL, 1973/1978);
- Migratory Bird Agreements, including the Ramsar and Bonn conventions, the China-Australia Migratory Bird Agreement (CAMBA) (Commonwealth of Australia, 1995);
- Japan-Australia Migratory Bird Agreement (JAMBA) (Commonwealth of Australia, 1995);
- National Strategy for the Conservation of Australia's Biological Diversity, Commonwealth of Australia, 1991;
- National Strategy for Ecologically Sustainable Development, (Ecologically Sustainable Development Steering Committee, December 1992); and
- National Water Quality Management Strategy: Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000);

State

- Australian Ballast Water Management Requirements (Dept. of Agriculture, Fisheries and Forestry);
- Biodiversity Plan for the South East of South Australia, (Dept. for Environment, Heritage and Aboriginal Affairs, 1999);
- Code of Practice for Commercial Users of Transport SA Marine Facilities (Transport SA, 1998);
- Draft Aquaculture Environmental Management Policy, (PIRSA, April 2003);
- Draft Aquaculture Environmental Management Policy Report, (PIRSA, April 2003);
- Draft Aquaculture Resource Management and Ecologically Sustainable Development Policy, (PIRSA, April 2003);
- Draft Aquaculture Resource Management and Ecologically Sustainable Development Policy Report, (PIRSA, April 2003);

- Draft Management Plan for Harvesting Beach-cast Seagrass and Marine Algae (PIRSA, September 2003);
- Ecotourism: A South Australian Design Guide for Sustainable Development, (South Australian Tourism Commission, 1994);
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- Management Plan for the South Australian Southern Zone Rock Lobster Fishery, South Australian Fisheries Management Series Paper No. 29., (Zachrin, W. (ed), PIRSA, 1997);
- Management Policy for the South Australian Giant Crab Fishery, (Sloan, S., PIRSA, October 2002);
- South East Aquaculture Management Plan, PIRSA (June 1996);
- South East Visitors Survey, 1992, Volumes 1 and 2, (South Australian Tourism Commission, 1992);
- Tourism Means Business, (South Australian Tourism Commission, 1996); and
- Guidelines For the Planning and Development of Coastal Marinas in South Australia (MAAC, Deptartment of Environment and Planning, 1988);
- Wild Fisheries with a Future: Environmental Management Plan of the Southern Fishermen's Plan, (Baker, D. & Pierce, B.E. (eds), 1998).

Reference is made to the *Commonwealth Environment Protection Biodiversity and Conservation Act* (EPBC Act), the draft Regional Natural Resource Management Plan for the South East, and heritage issues relevant to the area.

Under the Commonwealth EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance are subject to rigorous assessment. These include world heritage items, Ramsar wetlands of international significance, listed threatened species and ecological communities, listed migratory species, Commonwealth marine areas and nuclear activities. In this regard the only area of relevance may be impacts on potential threatened species. Refer to previous comments in Section 5.2.15. A referral was made to Environment Australia and there are no features of the site which trigger the application of the Commonwealth legislation.

Conclusion

Having regard to the various assessments undertaken as presented throughout this document and particularly in Chapter 5, the design development of the proposal has taken into account all of these statutes and related relevant documentation and the proposal is consistent with the objectives, initiatives and policies for the conservation and protection of the environment and heritage.

5.9.4 Detail any commercial fishing or aquaculture policies and any recreational boating and facilities policies relevant to the development.

Reference is made to the Draft Aquaculture Policy for the South East region for Lacepede Bay, pursuant to The Aquaculture Act, released on 27 November 2003 and gazetted as a formal document on 12 August 2004. The policies establish zones for commercial aquaculture out from Cape Jaffa. These policies have been prepared in recognition of the suitability of this locality for Atlantic Salmon aquaculture, a unique feature of this particular marine environment in South Australia.

Operators have established facilities several years ago and await formalisation of the zones and the establishment of infrastructure to support the activities. To support this industry, land based services and facilities are required and therefore this proposal supports the policy intentions of the State Governement. The area is subject to the standard recreational fishing requirements issued by PIRSA for the lower South East region.

Recreational boating facilities are lacking at Cape Jaffa and as a consequence, Council has submitted a funding application to SABFAC for the development of a protected boat ramp and associated facilities at the location of the existing sandy beach ramp. The proposal will provide a replacement location for these facilities. SABFAC is independent of the government in terms of the allocation of the funds sourced from the recreational boating community. However, the general policies expressed in the Regional Strategy for safety and the encouragement of tourist and recreation facilities support the development of facilities in the development. The State Government has a policy of transferring jetty facilities to local government for recreational purposes where possible. The jetty continues to be used for commercial purposes and as such, as the jetty deteriorates the ongoing repair and maintenance costs increase.

Accordingly, the cost of maintaining the jetty and more importantly its upgrade to satisfy current expectations for services, facilities and safety at the Cape Jaffa jetty are significant. These facilities can be relocated within the development and the ongoing responsibilities to maintain the jetty at commercial standard eliminated.

5.9.5 Identify legislative requirements and the range of approvals needed to complete the development.

Once Major Development approval has been granted, the following legislative requirements and approvals will be initiated:

- amendments to the local government boundary pursuant to the *Local Government Act*;
- subsequent amendment to the Council boundary as depicted in the Development Plan;
- Plan Amendment Report pursuant to the *Development Act*, 1993 to amend zones and policies;
- road closures/realignments pursuant to the *Roads Opening and Closing Act* for various aspects of the development;

- land division approvals under the *Development Act*, 1993 for super lots and creation of individual allotments for development purposes;
- development approvals for various land uses under the *Development Act*, 1993;
- access to new marine services pursuant to the *Maritime (Access) Act*, 2000;
- licence for marina facilities under the *Environment Protection Act* 1993;
- Trade Waste Disposal Licences under the *Environment Protection Act* 1993;
- clearance of native vegetation in areas for beach access under the *Native Vegetation Management Act*;
- approval to proceed with development according to the *Environment Protection Biodiversity and Conservation Act*;
- *Aboriginal Heritage Act* 1988 Section 23 clearance;
- approval from the Minister for Water Resources for Water Allocation under the Water Resources Act;
- requirements under the *Harbours and Navigation Act*; and
- requirements under the *Coast Protection Act*.

5.9.6 Detail any other relevant plans or studies that relate to the area.

The following identifies a range of strategic planning documents, plans and studies most relevant to the Cape Jaffa and Kingston area whilst the References identifies all reference material including detailed studies undertaken expressly for this investigation. Also refer to **Section 2.0**.

- Kingston District Council Strategic Plan 2004 - 2007;
- South East Coastal Management Strategy September 2002;
- State Planning Strategy for Regional South Australia;
- South East Development Plan Review 2002;
- Development Plan Kingston District (DC) 24 July 2003;
- Council's Recreational Boating Facilities Strategic Plan 2000;
- Draft South East Recreation Sport and Open Space Strategy March 2004;
- South Australian Tourism Plan 2003 to 2008; and
- South East Natural Resource Management Plan Final Consultation Report October 2003 (SENRCC 2003).

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GLOSSARY

Accretion:	The process of growth or enlargement of the beach by the deposition of sand.
Acid sulphate soils (ASS)	Sediment and soil containing iron sulphides which, when exposed to oxygen, generate sulphuric acid.
Adaptive sand management	The management of coastal sand drift that adapts to the prevailing longshore sand drift in order to matain the coastal profile on the most effective manner.
Aeolian	Pertaining to the wind, used with deposits such as loess and dune sand, and sedimentary structures like wind-formed ripple marks
Amelioration	To make better, or overcome effects.
Anthropological	Pertaining to the study of the beginnings and development of humans
Aquifer	A geological unit that can store and transmit water at rates fast enough to supply reasonable amounts to wells.
Aquitard	Geological unit of low permeability that can store groundwater and transmit it slowly from one aquifer to another.
Archaeological	Pertaining to the study of the people by the recovery and examination of remaining material evidence such as graves, building tools and pottery
Ascidians	Minute sedentary marine invertebrate having a saclike body with siphons through which water enters and leaves. Also known as sea squirt.
ASS	See Acid sulphate soils.
Astronomical tide	The periodic rise and fall of the water of oceans, seas, bays, etc., caused mainly by the gravitational interactions between the Earth, Moon and Sun.
Attenuation	The lessening of the amplitude of a wave with distance from its origin.
Australian Height Datum	The level datum, adopted as the standard uniform datum throughout Australia, derived from Mean Sea Level observations at 30 tide gauge stations located along the Australian coastline. Used as a base reference for elevation throughout Australia.
Back-beach:	The zone of the beach lying between the foreshore and the coastline and acted upon by waves only during severe storms.

Beaufort Scale	A visual observation system for assessing wind speed (eg a gale of Force 8 on the Beaufort Scale).
Bed friction	See seabed friction.
Biodiversity	the number and variety of organisms found within a specified geographic region, also the variability among living organisms of the earth, including the variability within and between species and within and between ecosystems.
Breaking	A wave breaking on a shore or over a reef.
Bryozoal limestone:	Limestone containing fossils of Bryozoan, a small marine invertebrate.
Calcarenite	A limestone or dolomite rock composed of 50 percent or more coral sand or shell sand whose particle size ranges from 0.1 to 2mm.
Calcareous	Containing calcium carbonate (CaCO3), chiefly as the minerals calcite and aragonite. When applied to rock, it implies that as much as 50 percent of the rock is carbonate (e.g., calcareous sand).
Chart Datum	A permanently established surface from which tide heights or chart soundings are referenced and used as the zero level of tide heights reported in tide tables and on marine navigation charts. Generally corresponds is very close to the Lowest Astronomical Tide level.
Chert:	Or flint. A hard, dense sedimentary rock, consisting chiefly of interlocking crystals of quartz less than about 30um in diameter
Confined aquifer	An aquifer which is confined by an overlying aquitard.
Cores	a stone from which one or more flakes have been removed, serving as a source for such flakes or as a tool in itself.
Crenulate	An indented or wavy shoreline, with the regular seaward-pointing parts rounded rather than sharp points, as in the cuspate type.
Cretaceous	A geological period during the Mesozoic era extending from 66.4 million years ago to 144 million years ago.
Deltaic	Of river delta origin.
Dolomitised	Enrichment of calcite ($CaCO_3$) with magnesium to form dolomite ($CaMgCO_3$).
Down-drift	The direction of predominant movement of sand particles or other materials along a shoreline.
Ecosystem	an ecological community together with its environment functioning as a unit
EIS	Environmental impact statement.
Embayment	An indentation in the shoreline forming an open bay.
Equinoxes	The two points in the celestial sphere where the celestial equator intersects the ecliptic; also, the times at which the Sun crosses the

	equator at these points (vernal equinox about March 21 and autumnal equinox about September 23).
Erosion	The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.
Evapo-transiration (ET)	The total water loss from the soil profile to the atmosphere by the combined effects of evaporation (the volume of water lost due to direct vaporisation of water from the soil and other surfaces) and transpiration (the indirect transportation of water from the soil, through the plants where it is then released to the atmosphere from the plants leaves via the stomata).
Fetch	The area in which seas are generated by wind having a rather constant direction and speed.
Foredune	The front dune immediately behind the back beach.
Friction factor	Coefficient applied to the sea bed friction to account for the local environment under consideration, higher values are assigned for areas with rocky or reefy outcrops and seagrass coverage than for sandy seabed profiles.
Hearth stones	Stones used in the construction of a hearth or fireplace
Heath	An area of open land dominated by low shrubs
Holocene	An epoch of the Quarternary period, from the end of the Pleistocene, about 8,000 to 10,000 years ago, to the present time. Also refers to time and strata younger than about 17000 years, the time when the sea level began to rise. Also called Recent.
Highest Recorded Tide (HRT)	Highest tide level event recorded.
Hydraulic gradient	The rate of change in head between two points in a groundwater system as compared to the distance between the two points.
Hydraulic conductivity	The inherent ability of an aquifer media to transmit water due to interconnected void spaces within the media, and describes the ease with which water can pass through an aquifer.
Hydrogeological	Pertaining to the science that deals with sub-surface waters.
Indian Spring Low Water (ISLW)	The lowest level, for most practical purposes, to which the tide falls. Only in exceptional circumstances will the tide fall lower.
Interbedded	A geological layer laid down between other layers.
Intertidal zone	The zone between the low tide line and high tide line that is periodically inundated.
Jurassic	A geological period during the Mesozoic era extending from 144 million years ago to 208 million years ago.
Lacustrine	Pertaining to, produced by or formed in a lake.
Lagoonal	Formed within an area of shallow water separated from the sea.

Lowest Astronomical Tide (LAT)	The lowest tide expected under average meteorological conditions and any combination of astronomical conditions.
Lunette	a water body in the shape of a half moon or half circle.
Marl:	Unconsolidated deposits consisting chiefly of clay and calcium carbonate.
Mean Sea Level	The average level of the surface of the sea over a long period of time in all stages of oscillation, or the average level which would exist in the absence of tides.
Mitigate	To make less intense or severe.
Morphology, geo-	The branch of physical geography which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc. The investigation of the history of geologic changes through the interpretation of topographic forms.
Perched watertable	A layer or lens of saturated soil formed above the main water table due to downward migration of water accumulating on top of a lower permeability layer.
Percolation	The movement of a liquid through something porous.
Permeability	A property of a porous medium, which is a function of the size of openings and pore spaces within that media, and describes the ease with which fluids can pass through a porous medium.
Potentiometric surface	For a confined aquifer, is the level to which water will rise in a well cased to the aquifer.
Propagation	The transmission of a wave through a medium.
Proponent	A person or organisation putting forward a proposal.
Recharge (of an aquifer)	The process of additional water being added to a groundwater system
Recurved spit	An emerged spit extending into an embayment that is curved landward at its distal end, typical deposited by wave action.
Refraction	The process by which the direction of a wave is changed by the action of moving in shallow water at an angle to the beach contours.
Salt scalded	Land effected by salt and not capable of supporting most plants. Generally exhibits a white crust of crystalline salt.
Sea cast wrack	Dead seagrasses deposited on the beach.
Sea waves	Waves generated by local winds that are within their fetch distance.
Seabed friction	Attenuation of the wave height due to the seabed profile as the waves propagate to the shore.
Shoaling	The alteration of a wave as it proceeds from deep water to shallow water.

Significant wave height	The average height of the one-third highest waves of a given wave group. Note that experience indicates that a careful observer who attempts to establish the character of the higher waves will record a height that approximately corresponds to the significant wave height.
Siliceous	Rock or soil containing abundant silica.
Solstices	The two points of the ecliptic farthest from the celestial equator where the Sun reaches its maximum north or south declination: about June 21 and December 22.
Spatial and temporal	Of space and of time.
Spilling Waves	Waves where bubbles and turbulent water spill down front face of wave. The upper 25 percent of the front face may become vertical before breaking. Breaking generally occurs over quite a distance.
Stilling well	A wellbore places around a tide gauge to filter wave effects. The tide gauge measures the sea level within the stilling well which is connected to the sea through a small orifice which filters out any high-frequency waves whilst admitting the long period tidal (and other) level variations.
Strandline vegetation	Vegetation that has recently established between the current shoreline and a shoreline of an earlier and higher water level.
Stratigraphic profile	The chronological succession of sedimentary rocks.
Stratigraphic unit	A stratum or body of strata recognised as a unit for description purposes.
Substrates	A surface on which an organism grows or is attached.
Sub-tidal zone	The zone that is always inundated by seawater and immediately below the intertidal zone. Generally considered to include the area from about 10 metres water depth to the low tide line.
SWAN	Simulating Waves At Nearshore. Software used for modelling the propagation of swell waves from deep water to nearshore.
Swell waves	Waves that occur as a result of the propagation of waves that have been generated elsewhere and have travelled out of their generating area, typically waves generated offshore in deep water and propagated to nearshore areas. Swell waves characteristically exhibit a more regular and longer period, and has flatter crests than locally generated sea waves within their fetch.
Taxa	A taxonomic category or group such as phylum, order, family, genus or species.
TCSA	Tertiary confined sand aquifer, the confined aquifer of the South East of South Australia and south-western Victoria.
TLA	Tertiary limestone aquifer, the unconfined aquifer of much of the South East of South Australia.

Topographic relief	The variation on elevation exhibited by the landform.
Unconfined aquifer	An aquifer which is not confined by an overlying aquitard – the watertable aquifer.
Unconformably overlayed	Strata that do not succeed the underlying strata in immediate order of age or in parallel position.
Up-drift	The direction opposite of that of the predominant movement of sand particles or material.

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