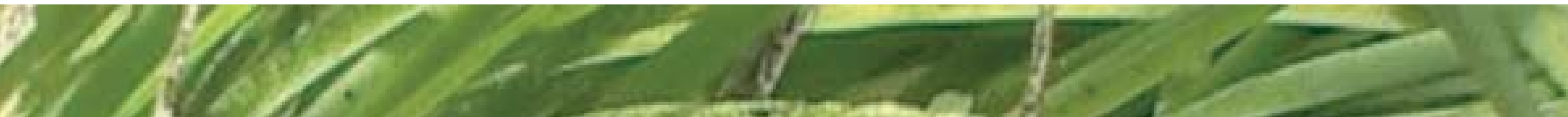
cape jaffa anchorage

environmental impact statement february 2005

APPENDICES 15 - 28

cape JAFFA ANCHORAGE



eis

cape jaffa anchorage

environmental impact statement february 2005

APPENDICES 15 - 28

prepared for

Kingston District Council

and

Cape Jaffa Development Company Pty Ltd

by

Masterplan SA Pty Ltd

and

Tonkin Consulting

Also see Authors & Contributors

This book was designed and produced by
MasterPlan SA Pty Ltd
33 Carrington Street
Adelaide 5000

LIST OF APPENDICES 15 to 28

Section 4.0 (continued)

Appendix 15

Climatology of the Cape Jaffa Region: Winds, Waves, Tides and General Climate, Tonkin Consulting, May 2004, Ref No. 20010779RA1

Appendix 16

Cape Jaffa Marina Assessment of Coastal Processes and Impacts, WBM Oceanics Australia, May 2004, Ref No R.B14794.001.01

Appendix 17

Coastal Investigations, Tonkin Consulting, September 2004, Ref No 20010779RA3

Section 5.0

Appendix 18

Guidelines for the preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Marina Proposal by District Council of Kingston and the Cape Jaffa Development Company, Major Developments Panel South Australia, June 2003, ISBN 1 876702 850

Appendix 19

Stormwater Management Cape Jaffa Development, Tonkin Consulting, December 2003, Ref No 20010779RA2

Appendix 20

Cape Jaffa Domestic Wastewater Disposal, Tonkin Consulting, December 2003, Ref No 2003.0779.101203

Cape Jaffa Wastewater Disposal, Tonkin Consulting, January 2004, Ref No 2003.0318.130104

Appendix 21

Cape Jaffa Anchorage Marina Assessment of Tidal Flushing, WBM Oceanics Australia, May 2004, Ref No R.B14794.001.01

Appendix 22

Cape Jaffa Anchorage Development Plan Assessment, MasterPlan SA Pty Ltd, February 2004, Ref 9399Let03

Appendix 23

Assessment of Cape Jaffa Confined Aquifer Well, Water Search Pty Ltd, May 2004

Appendix 24

Cape Jaffa Anchorage Development EIS Economic Issues Report, Hudson Howells, April 2004, Kingston District Council Cape Jaffa Anchorage Development Section 48 Prudential Report, Hudson Howells, October 2003

Appendix 25

Cape Jaffa Development Traffic Assessment, Tonkin Consulting, December 2004, Ref No 20010779 LA7/PCS/PCS

Appendix 26

Acid Sulphate Soil Investigation and Management, Tonkin Consulting, December 2003, Ref No. 20030318RA3

Appendix 27

Cape Jaffa Marina Breakwater Design, Tonkin Consulting, December 2004, Ref No. 20010779 LA6/JT/JT

Appendix 28

Review of Documentation for Section 12 determination under the *Aboriginal Heritage Act* 1988: Cape Jaffa Anchorage, Department of Aboriginal Affairs and Reconciliation, August 2004, prepared by Australian Cultural Heritage Management – Confidential DAARE Document

APPENDIX 15

Climatology of the Cape Jaffa Region: Winds, Waves, Tides and General Climate, Tonkin Consulting, May 2004, Ref No. 20010779RA1

Cape Jaffa Development Company Pty Ltd

Climatology of the Cape Jaffa Region

Winds, Waves, Tides and General Climate of the Cape Jaffa Region, SA

Principal Contact
Chris Purton

May 2004
Ref No 20010779RA1B

Table of Contents

Cape Jaffa Development Company Pty Ltd
Climatology of the Cape Jaffa Region
Winds, Waves, Tides and General Climate of the Cape Jaffa Region, SA

Tables

Figures

Appendicies

Document History and Status

Rev	Description	Author	Rev'd	App'd	Date
A	Final	CMP	JCT	JCT	20/08/03
B	Revised with New Tide Data	CMP	JCT		13/05/04

1. Introduction

This document has been prepared to provide a climatology of the Cape Jaffa region. It is intended that the information in this document shall provide basic data and analyses to assist the investigation and design of various aspects of the proposed marina near Cape Jaffa. These design processes include:

- Design of the entrance channel breakwater structures
- Design and maintenance of the entrance channel
- Structural design of ancillary marina structures
- Vegetation selection and planting layout.

This document includes:

- General climatology for temperatures and rainfall of the region
- An analysis of wind direction and speed data
- An analysis of wave and swell data
- An analysis of tidal data and storm surges.

The above data has been used to build up a comprehensive picture of the climatology of the area with particular emphasis on marine operations and marina design requirements.

A tide gauge was installed on the Cape Jaffa jetty in September 2003. There is now sufficient tide data at that site to warrant a revision of the Tidal Data section in the initial Climatology study prepared in August 2003.

At the beginning of 2004, the National Tidal Facility was renamed the National Tidal Centre, and is now affiliated with the Commonwealth Bureau of Meteorology . The revised report reflects this name change.

2. Data

The following data records were consulted for this study:

2.1 Climatic observations from Robe, about 25km south of the proposed marina site. These observations are for 9am and 3pm only. Measurements include about 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.

2.2 Rainfall observations from Kingston SE, about 18km north-east of the proposed marina site, over 127 years, and 45 years of rainfall observations from Cape Jaffa (Jaffa Hills) about 3km south-southeast of the proposed marina site.

2.3 Wind observations at half-hourly intervals for 11 years from the Cape Jaffa (Curley Hills) Automatic Weather Station. This AWS is located about 2km south-southeast of the proposed marina site on a ridge about 17mAHD.

2.4 Tidal data over a 4 year period at Cape Jaffa collected by the National Tidal Centre from 1 May 1980 to 30 April 1984. The data was sourced from a pressure transducer positioned on the seabed, and is not accurately referenced to a known height datum. The astronomical tide prediction data and tidal range data for Kingston SE, Robe and Victor Harbor were also consulted.

2.5 Tidal data from the Cape Jaffa jetty from September 2003 to February 2004

2.6 The Australia Pilot, Volume 1 (Royal Navy, 1973, 1986, with corrections to 1986 contained in Supplement No 9 – 1986), published by the Hydrographer of the Navy (United Kingdom). This publication has much useful information on wave and swell behaviour in Lacepede Bay between Cape Jaffa and Kingston SE.

2.7 Australian Hydrographic Service chart Aus 127, published 30 March 2001.

3. General Climatology

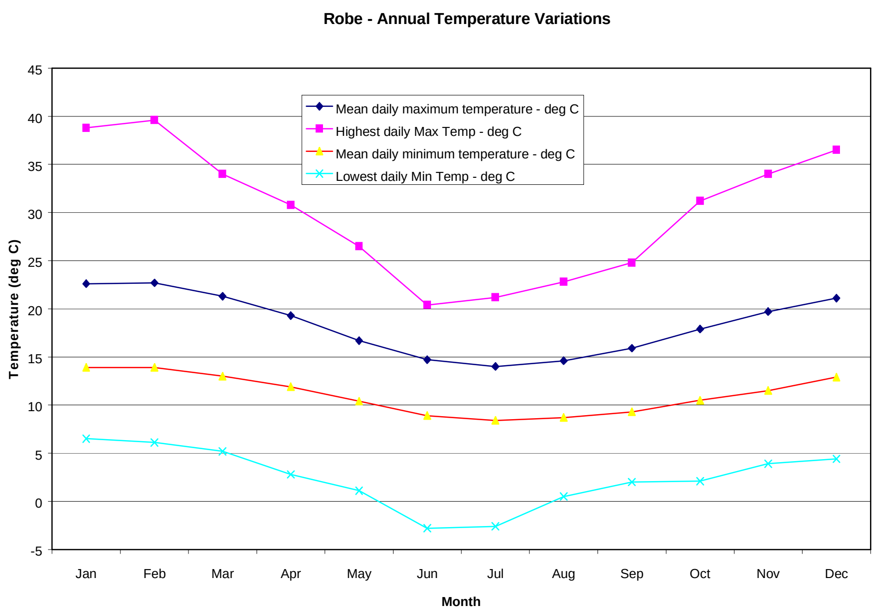
The nearest climatology observing station to Cape Jaffa is Robe, about 25km to the south. Climatic averages for Robe are given in Appendix A.

Rainfall data for Kingston SE, about 18km northeast of Cape Jaffa and Cape Jaffa (Jaffa Hills) about 3km south-southeast of the marina site are given in Appendix B.

With respect to rainfall, it can be seen that the mean annual rainfall at Kingston of 589mm (127 years) and at Cape Jaffa (Jaffa Hills) of 559mm (45 years) is less than the mean annual rainfall at Robe of 633mm (140 years). This difference is probably due to the fact that the rainfall gradient drops off as the distance north of Robe increases. Average rainfall at Cape Jaffa will be approximately 560mm to 590mm per year.

The temperature and humidity climate at Cape Jaffa will be very similar to Robe. This is essentially a temperate maritime climate with maximum temperatures in summer rarely exceeding 35°C and minimum temperatures rarely dropping below 2°C. The average monthly temperature variations are given in Figure 3.1.

Figure 3.1 Monthly Mean Temperature Variations for Robe



4. Statistical Analysis of Wind Speed Observations

4.1 Data

Wind speed and direction observations are available for Robe for a 65 year period from 1938 to the present. Observations are taken manually at 9am and 3pm, and weekend observations are often missed. For much of the 65 years of record the wind speed was estimated using the Beaufort Scale (a wind estimation method described in the Bureau of Meteorology "Observers Handbook").

Instrumental wind speed and direction observations are also available from 6 April 1992 to the present day (about 12 years) from the Cape Jaffa (Curley Hills) Automatic Weather Station (AWS). Observations are every half hour, with occasional more frequent observations.

4.2 Cape Jaffa (Curley Hills) Half-Hourly Wind Observations-Annual Series Analysis

An annual series analysis was carried out on the 10 complete years 1993-2002, plus the 2 part years 1992 and 2003. This involved fitting a Log Pearson 3 distribution to the maximum annual wind speed for each year. A Log Pearson 3 distribution was also fitted to the annual maximum 1 hour, 3 hour, 6 hour and 9 hour average wind speeds. The results are summarised in Table 4.1, and graphically in Figure 4.1.

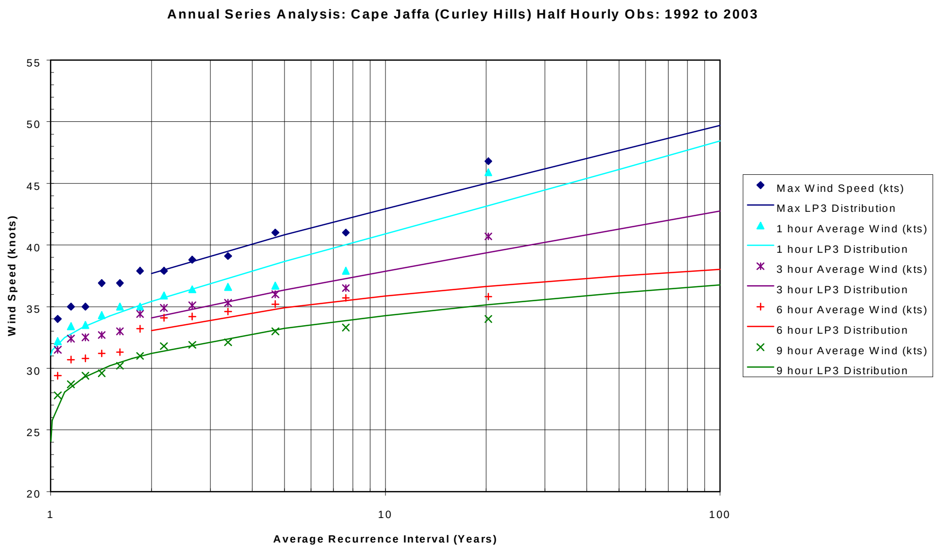
Table 4.1 Cape Jaffa (Curley Hills) 1992 to 2003: Annual Series Analysis of Wind Speeds (knots) – Log Pearson 3 Distribution

ARI (yr)	Max Wind Spd (knots)	1 hr Ave Wind Spd	3 hr Ave Wind Spd	6 hr Ave Wind Spd	9 hr Ave Wind Spd
1.1	34.71	32.49	31.96	30.24	28.07
2	37.69	35.43	34.09	33.06	31.21
5	40.82	38.66	36.35	34.91	33.22
10	42.93	40.92	37.88	35.86	34.27
20	44.98	43.15	39.36	36.63	35.14
50	47.66	46.14	41.29	37.47	36.12
100	49.71	48.44	42.76	38.03	36.77

From Table 4.1, it can be seen that analyses of the Cape Jaffa (Curley Hills) data gives the following design wind speeds for wave and breakwater design.

- ARI 100 year maximum wind 50 knots
- ARI 100 year 1 hour average wind 48 knots
- ARI 100 year 3 hour average wind 43 knots
- ARI 100 year 6 hour average wind 38 knots
- ARI 100 year 9 hour average wind 37 knots

Figure 4.1 Cape Jaffa (Curley Hills) Wind Speed Analysis



4.3 Robe 9am and 3pm Wind Observations: Annual Series Analysis

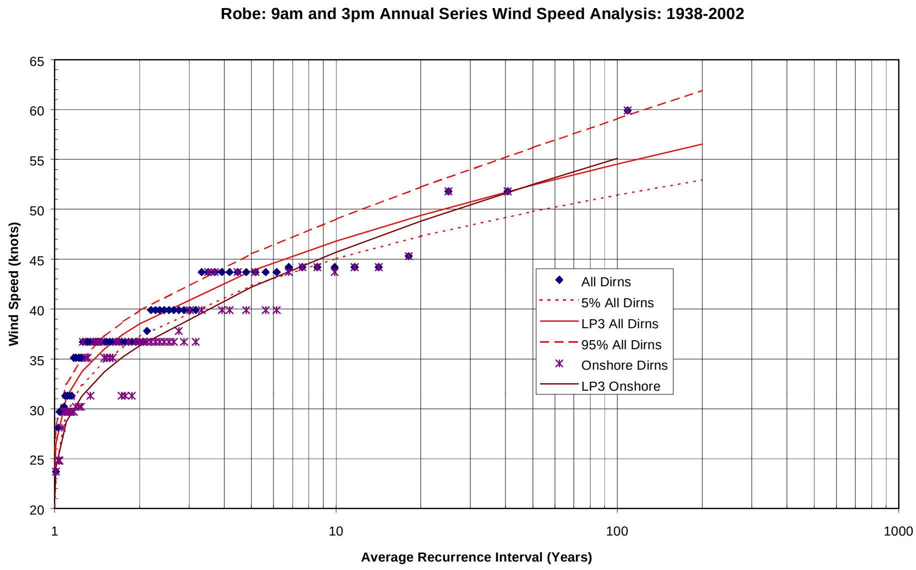
An annual series analysis was carried out on the total Robe wind data set for 9am and 3pm from 1938 to 2003. The data set has 6% missing observations, mostly on weekends in more recent years. A Log Pearson 3 distribution was fitted to the annual maximum wind speed for each year. The analysis was repeated using a subset of onshore (270° to 045°) winds, since onshore winds are critical for raising sea levels along the coast (storm surges) and raising waves. The resulting distributions are given in Table 4.2, and shown graphically in Figure 4.2.

Table 4.2 Robe: Annual Series Analysis of Maximum Wind Speeds (knots) – Log Pearson 3 Distribution

ARI (Years)	All Wind Observations Speed (knots)	Onshore Wind Observations Speed (knots)
1.1	31.2	28.7
2	38.5	36.3
5	43.8	42.2
10	46.8	45.7
20	49.4	48.8
50	52.4	52.5
100	54.5	55.1

From Table 4.2, it can be seen that the ARI 100 year design wind for wave and breakwater design is 55 knots. Note that this is 5 knots more than the value given by the Cape Jaffa AWS wind speed analysis. However, given the fact that Robe has 65 years of wind speed data, compared with 12 years for Cape Jaffa, the higher value of 55 knots is preferred.

Figure 4.2 Robe Annual Series Wind Analysis



A similar wind speed analysis undertaken in Adelaide Metropolitan Waters (Tonkin, 2002) showed that Adelaide Coastal Winds are about 5 to 12 knots less than Cape Jaffa winds for the same Average Recurrence Intervals. Adelaide based design teams should take account of this difference.

4.4 Monthly Wind Climatology for Cape Jaffa (Curley Hills) AWS and Robe

Wind roses for Cape Jaffa (Curley Hills) AWS for each month for each synoptic observation hour (12am, 3am, 6am, 9am, 12pm, 3pm, 6pm and 9pm) are given in Appendix C.

Overnight winds (12 midnight, 3am, 6am) show marked south to south-east prevailing winds in warmer months (Dec, Jan, Feb, Mar). During the rest of the year overnight winds are more evenly distributed directionally, and generally exceed 20km/hr (11 knots).

Wind direction at 9am are evenly distributed around the compass in all months of the year and generally exceed 20km/hr (11 knots).

At noon, 12pm, wind directions show a pronounced southerly direction from November though the summer to March. In the autumn, winter and spring months, the wind direction shows an equally pronounced northerly wind direction, with westerly wind directions also common in the August to October period.

During the afternoon and evening from November to March, the prevailing southerly wind dominates. In the other months of the year the wind directions are evenly distributed around the compass.

Wind roses for Cape Jaffa (Curley Hills) for all observations based on 10° increments of wind direction for April 1992-1995, 1996-1999 and 2000-May 2003 are given in Appendix D. These wind roses show clearly the preferred directions of lighter winds less than 12.5 knots being from 060° to 160°, as well as the preferred directions of stronger winds exceeding 12.5 knots from 180° to 270°.

Wind roses and frequency tables for Robe for 9am and 3pm only are given in Appendix E. These wind roses are for a longer period of record than the Cape Jaffa (Curley Hills) data, but show a similar pattern for 9am. During summer afternoons (3pm) there is slightly less southerly winds than at Cape Jaffa, and slightly more south-westerly winds.

5. Tidal Data

5.1 Tidal Data Sources

Astronomical tide predictions are available for Kingston SE and Robe. These are based on predictions by the National Tidal Centre for the reference port for the Southeast coast region, which is Victor Harbor.

Local tidal data comprises a 4 year period (April 1980-May 1984) of continuous tidal data from Cape Jaffa collected by the National Tidal Centre, and data from a new tide gauge on the Cape Jaffa jetty installed by the Cape Jaffa Development Company Pty Ltd in September 2003.

5.2 Astronomical Tide Predictions

The nearest ports to Cape Jaffa, Kingston SE and Robe, are designated as secondary ports in the annual “Tide Tables for South Australian Ports” publication. Predicted astronomical tide levels for Kingston SE and Robe can be calculated from the Tide Tables by reference to the standard port for the Southeast coast region , which is Victor Harbor, using the ratio of rises and time difference information. The harmonic constants for Kingston SE and Robe have also been published by the National Tidal Centre, so the astronomical tide levels can be calculated by computer using any one of the tide calculation software packages available on the market.

Tidal information for Kingston SE, Robe and Victor Harbor from “2002 Tide Tables for South Australian Ports” (published by Transport SA) is given in Table 5.1 where all tide heights are referred to Chart Datum. Table 5.1 also has some tide reference points from the Australian Hydrographic Survey Chart (AUS 127, 30 March 2001) and extreme historic tide levels supplied by Ports Corp South Australia. The same data is repeated in Table 5.2 in Australian Height Datum units (mAHD).

It can be seen in Table 5.1 and Table 5.2 that slight discrepancies are evident between tide data from the Australian Hydrographic Survey Chart and the Tide Table data. The Australian Hydrographic Service is gradually revising all Australian charts and these discrepancies should gradually disappear (see *Notes on Datums*, in the 2002 Tide Tables for South Australian Ports).

Table 5.1 Tide Data for Southeast Coast Ports referred to Chart Datum

	Kingston			Robe			Victor Harbor (Ref. Port)		
All Heights nominally referred to Chart Datum (m)	Aust. Hydrog Survey Chart	TSA Tide Tables 2002	Ports Corp 1946-52	Aust. Hydrog Survey Chart	TSA Tide Tables 2002	Ports Corp 1946-52	Aust. Hydrog Survey Chart	TSA Tide Tables 2002	Ports Corp 1953 -
Highest Recorded Tide			1.95			1.95			2.27
Highest Astronomical Tide	1.7			1.2			1.6		
Mean High Water Springs	1.2	1.1		1.1	0.9		1.2	0.8	
Mean High Water Neaps	0.9	0.8		0.8	0.7		0.9	0.6	
Mean Sea Level (~ AHD)	0.8	0.8		0.6	0.6		0.7	0.6	
Mean Low Water Neaps	0.6			0.5			0.5		
Mean Low Water Springs	0.3			0.2			0.2		
Lowest Astronomical Tide		0.1			0			-0.15	
Indian Spring Low Water		0.1			0.1			-0.1	
Lowest Recorded Tide			-0.4			-0.46			-0.2
PCSA Local Datum		31.846			31.974			31.882	
Ratio of Rises to Refererence Port		1			0.85			-	
Time Differerence to Refererence Port (min)		5			14			-	

Table 5.2 Tide Data for Southeast Coast Ports referred to mAHD

	Kingston			Robe			Victor Harbor (Ref. Port)		
All Heights nominally referred to mAHD	Aust. Hydrog Survey Chart	TSA Tide Tables 2002	Ports Corp 1946-52	Aust. Hydrog Survey Chart	TSA Tide Tables 2002	Ports Corp 1946-52	Aust. Hydrog Survey Chart	TSA Tide Tables 2002	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 (~ AHD)	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			-0.7	
Indian Spring Low Water		-0.7			-0.5			-0.7	
Lowest Recorded Tide			-1.16			-1.04			-0.78
Correction from Chart Datum to mAHD - Source: PCSA			-0.758			-0.58			-0.58

The tides in the Southeast coast region generally have two tide cycles per day, although dodge tides and single daily tides occasionally occur. The tidal cycles are characterised by spring to neap cycles over a little more than a fortnight . The daily tidal range varies from larger (spring) tides to smaller (neap) tides and back to larger (spring) tides. On an annual time scale the maximum daily tidal range is larger around the solstices and smaller around the equinoxes. Astronomical tides reach higher levels during winter than in summer. Maximum astronomical daily tide limits in the region are typically from –0.7 mAHD to 1.0 mAHD

Figure 5.1 shows typical fortnightly astronomical tidal cycles, and Figure 5.2 shows a typical annual astronomical cycle at Victor Harbor.

Figure 5.1 Typical Fortnightly Astronomical Tide Cycles at Victor Harbor (Source: National Tidal Centre)

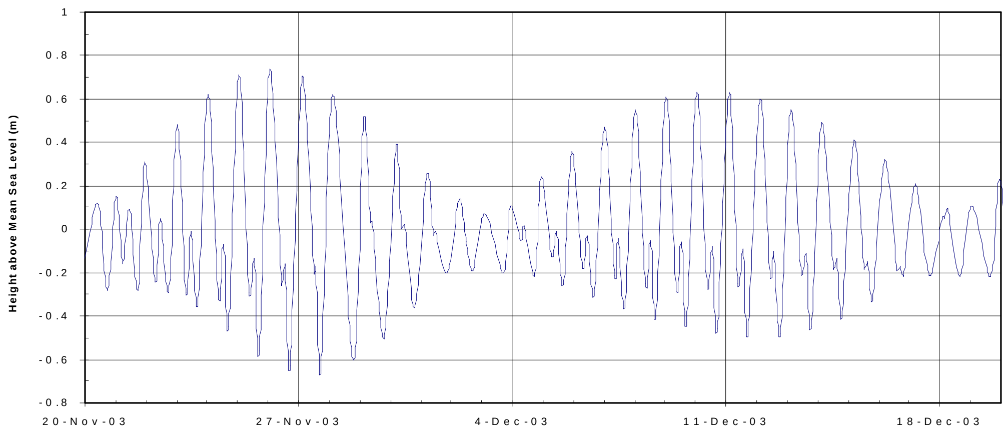
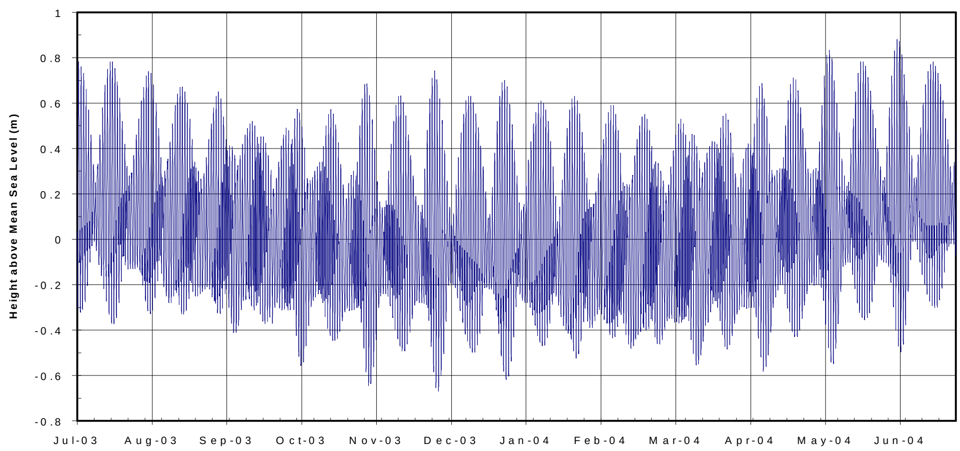


Figure 5.2 Typical Annual Astronomical Tide Variations at Victor Harbor (Source: National Tidal Centre)



5.3 Meteorological Effects on Astronomical Tides

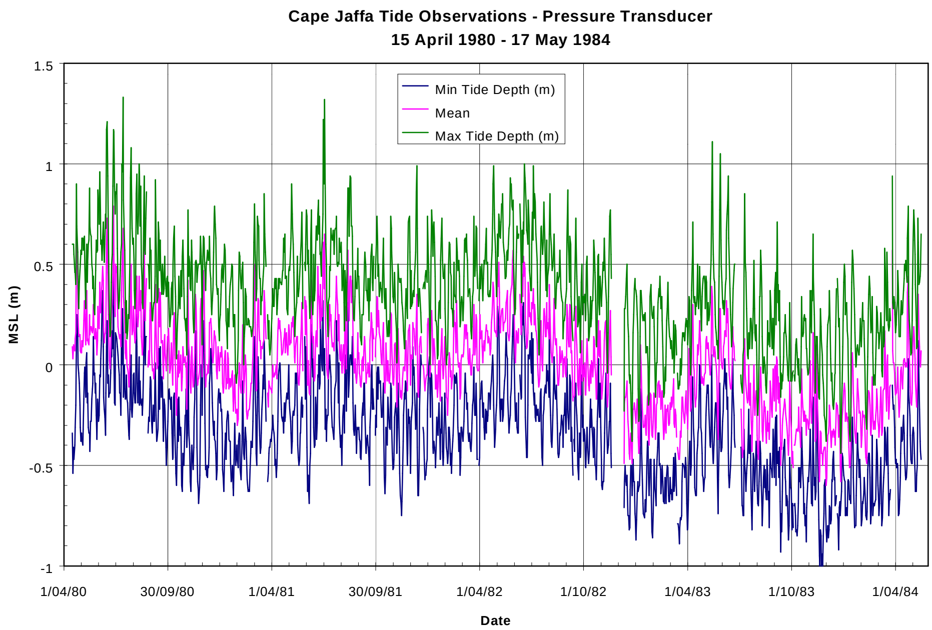
The "Tide Tables for South Australian Ports" note that astronomical tide levels are affected by meteorological factors. Sea levels rise (fall) as the barometric pressure falls (rises) about 0.1m for every 7 hectopascals change. Sea levels are also affected by winds and by the alignment of the coast.

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.

5.4 Cape Jaffa Tidal Statistics: 1980-1984

A plot of the daily mean, maximum and minimum tide levels over the 4 years, 1980-1984, is given in Figure 5.3. Tidal analyses performed by the National Tidal Centre are given in Appendix F. The data were measured by a pressure transducer positioned on the seabed, rather than by a fixed tide gauge. Furthermore, Figure 5.3 indicates that there is a break in the record from 20 November 1982 to 11 December 1982. When the tidal record resumed, there are indications of a shift in the datum downwards by 0.2m to 0.25m. The National Tidal Centre will not give a datum for the data, but have simply referenced their analyses to the calculated mean sea level of the four year record. The actual mean sea level may be about 0.2m higher than the National Tidal Centre estimate.

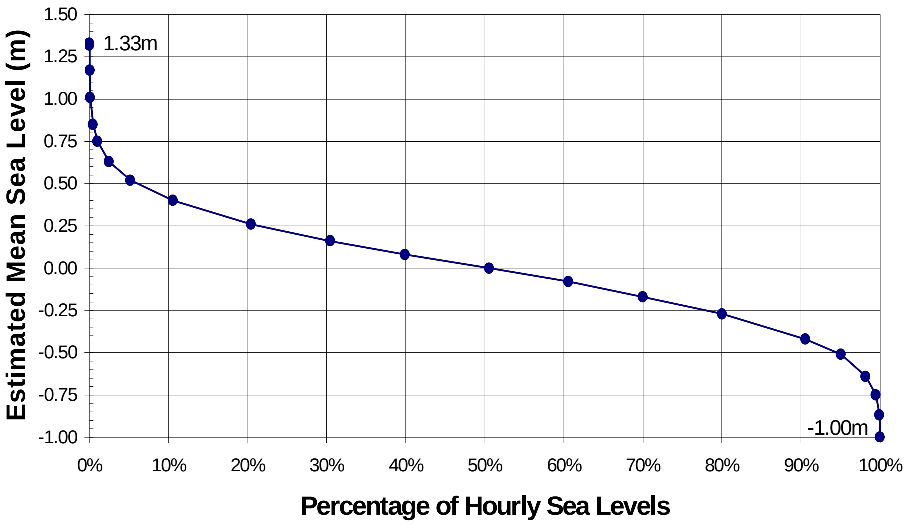
Figure 5.3 Daily Mean, Maximum and Minimum Tide Levels at Cape Jaffa (Source: National Tidal Centre)



Reference to Figure 5.3 shows that the lowest tide level was –1.0m referred to instrumental Mean Sea Level (MSL) on the 20, 23 and 25 November 1983. Daily tidal range on these days ranged from 1.0m to 1.12m. Wind directions over this period were south-easterly, which would lower the observed tide levels from the expected astronomical tide levels.

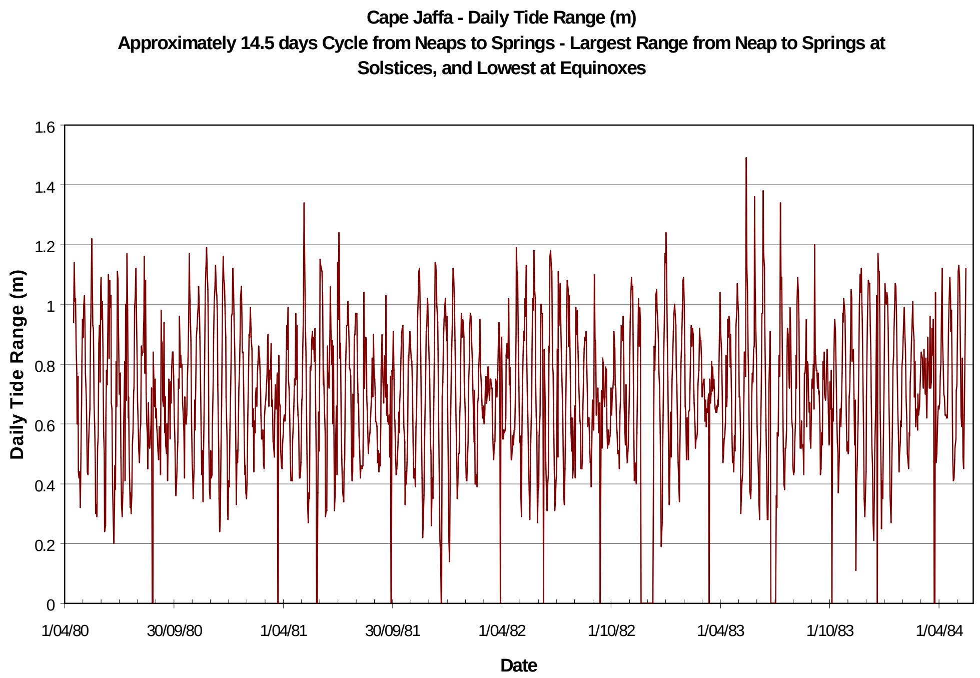
An analysis of the 1980-1984 data has been performed by the National Tidal Centre to rank the percentage exceedance of specified tide levels above instrumental MSL. This analysis is given in Appendix F and shown graphically in Figure 5.4. The analysis is based on the complete 1980 to 1984 dataset of 35,043 hourly sea level observations.

Figure 5.4 Percentage Exceedance Distribution of Hourly Sea Levels relative to MSL for Cape Jaffa 1980-1984



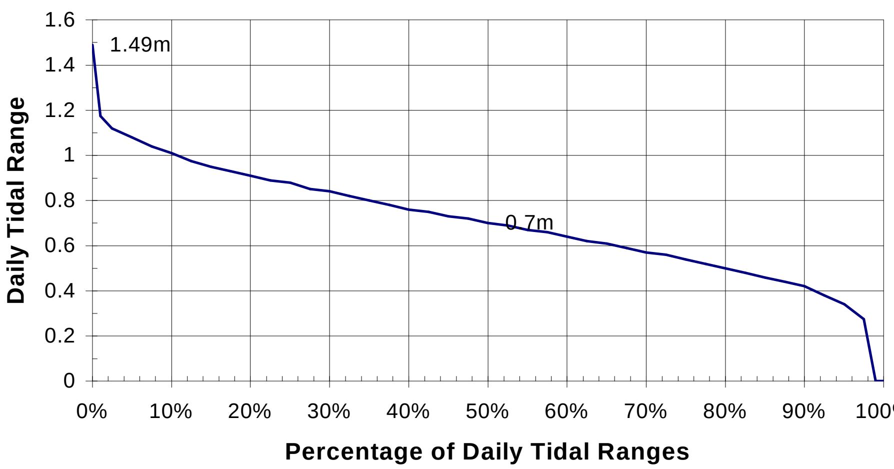
A graph of the variation in daily tide range is given in Figure 5.5, which shows the typical fortnightly cycle in tidal range, as well as a six monthly cycle where the maximum daily tidal range occurs around the solstices and the minimum daily tidal range occurs at the equinoxes. Discounting the days of “dodge” tides, where the tidal range is zero, it can be seen that the observed daily tidal range over 4 years ranges from about 0.2m up to 1.2 to 1.5m.

Figure 5.5 Cape Jaffa Daily Tide Range Variations (1980-1984)



A statistical analysis of the daily tidal ranges is shown in Figure 5.6, which presents the percentage of observed daily tidal ranges that exceed a certain tidal range value. This analysis is based on the complete 1980 to 1984 dataset of approximately 1,492 days.

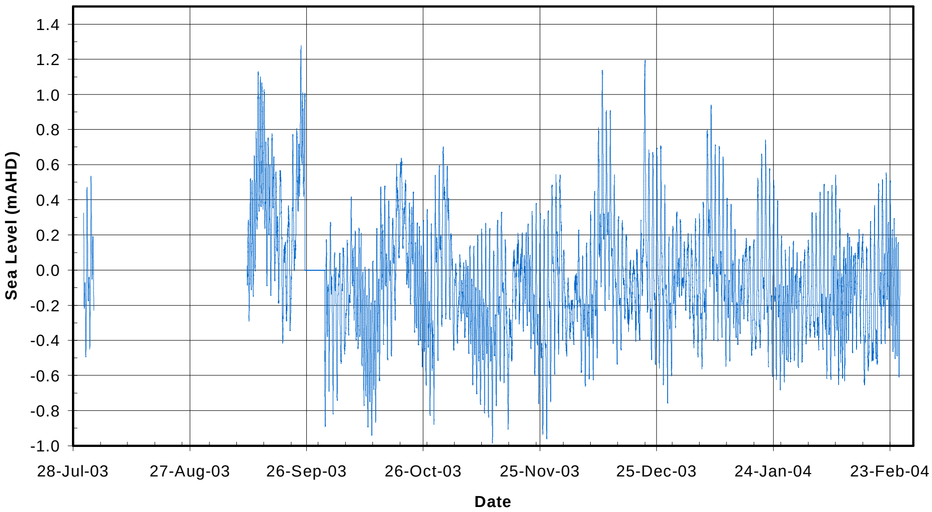
Figure 5.6 Percentage Exceedance of Daily Tide Range for Cape Jaffa 1980-1984



5.5 Cape Jaffa Tidal Statistics: September 2003-February 2004

In order to better assess tidal levels at Cape Jaffa a high-resolution tide gauge was installed on the Cape Jaffa jetty mid 2003. The gauge measures the tide level at the jetty once a second and reports the average tide level in each 5 minute interval. The gauge has been surveyed to Australian Height Datum (AHD) and all readings are referenced to AHD. Note that there is no stilling well installed and Figure 5.7 shows the 40 minute moving average tide height recorded since July 2003.

Figure 5.7 Tide Measurements at Cape Jaffa Jetty (40 minute moving average tide height)



Although only approximately 6 months of data has been recorded to February 2004, this data continues to be recorded and allows confirmation of the previous data records. Further, it provides a 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.

The National Tidal Centre has performed an assessment of the data collected to date and produced residual plots. These plots show the difference between the observed tide levels and predicted tide levels. The residual differences result from meteorological effects and/or inaccuracies in tidal predictions (or gauge error). The typical use of these plots is in assessing the accuracy and validity of the tidal predictions and to allow more accurate calculation of the harmonic coefficients that are used to predict tides. Examples of these plots are shown in Figure 5.8 for Cape Jaffa and Figure 5.9 for Portland over the period September 2003 to February 2004. Similar trends between Cape Jaffa and Portland can be seen as a result of meteorological effects.

Figure 5.8 Cape Jaffa Tidal Residuals (Source: National Tidal Centre)

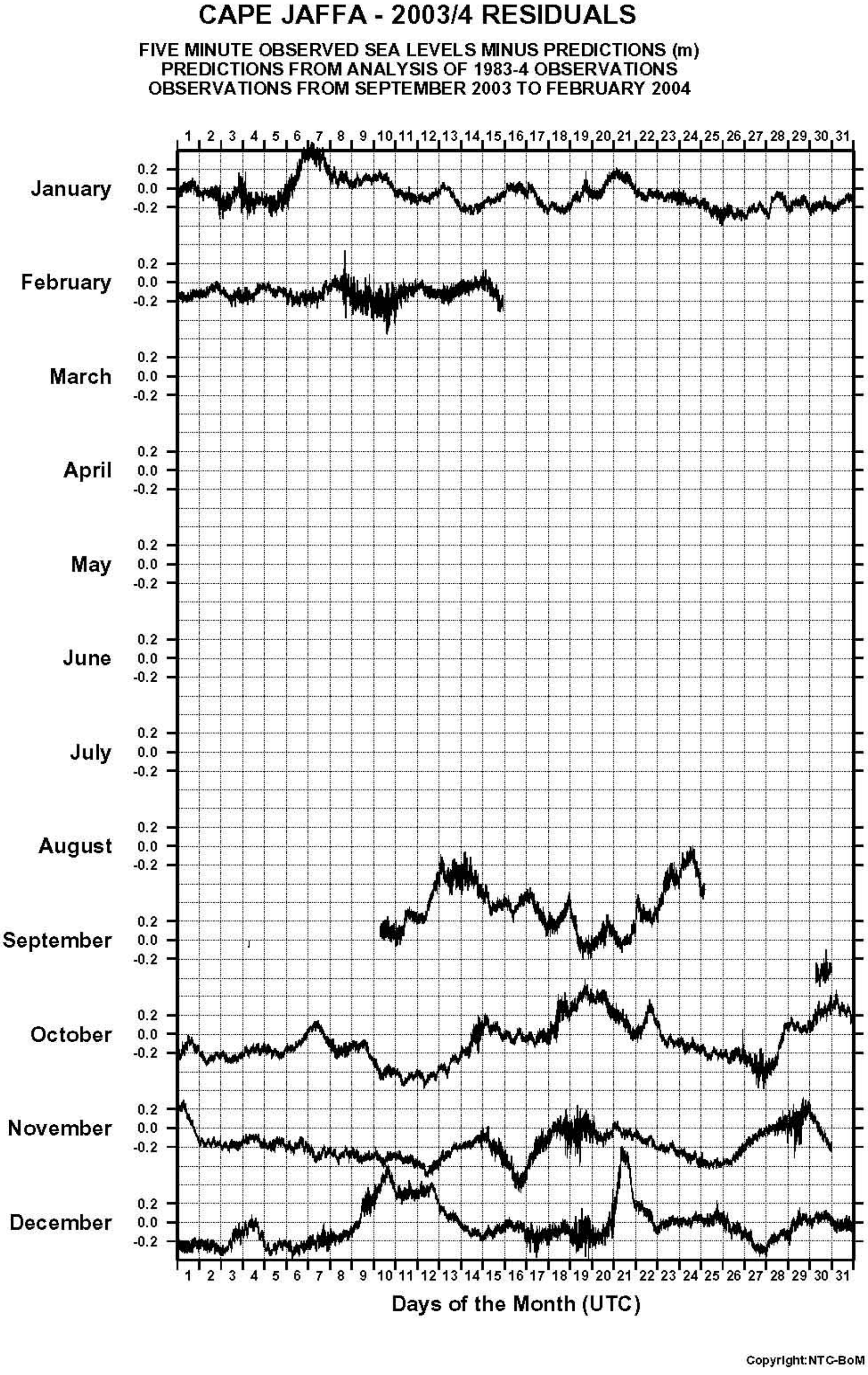
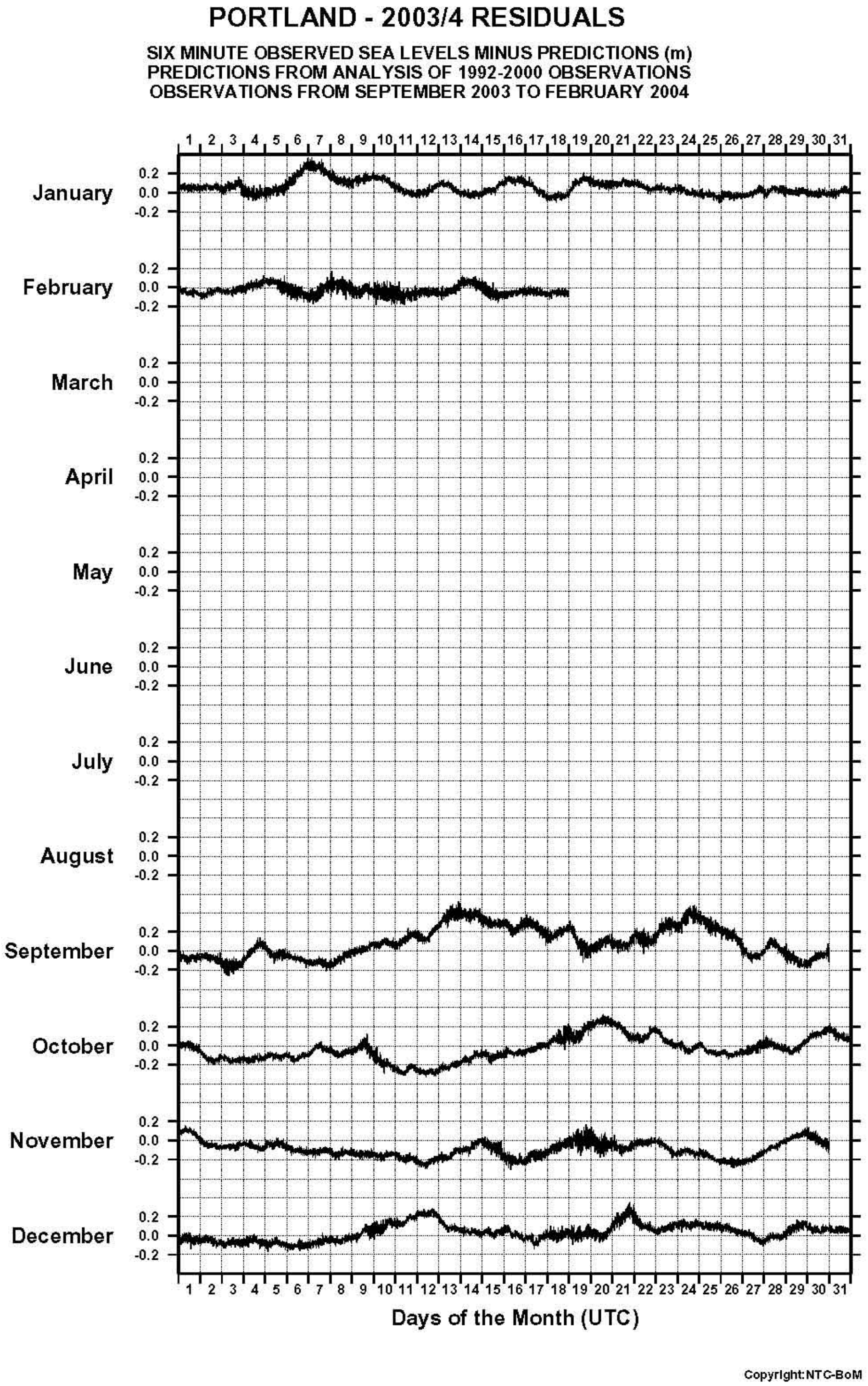


Figure 5.9 Portland Tidal Residuals (Source: National Tidal Centre)



On the basis of the data measured at Cape Jaffa, the National Tidal Centre have performed a calculation of the harmonic tide prediction coefficients and provided a comparison between the harmonic coefficients from the recent 6 months of data and the prior 1983-1984 data. This information is presented in Table 5.3. Apart from the O1 constituent, the time differences are small and there is a slight amplification in the signal. This would lead to only minor changes in tidal predictions.

Table 5.3 Tide Prediction Harmonic Constants for Cape Jaffa (Source: National Tidal Centre)

	Cape Jaffa 2003/2004 Analysis		Cape Jaffa 1983/1984 analysis		Difference	
Harmonic Constituent	H (mm)	g (deg)	H (mm)	g (deg)	g (min)	Ratio
O1	134	10.5	135	6.8	15.6	0.99
K1	189	40.9	184	41.3	-1.5	1.03
M2	142	341.3	136	340.2	2.2	1.04
S2	165	41.8	153	40.9	1.9	1.08

The 2003/2004 measured data also provides assessment datum data such as mean sea level and lowest astronomical tide, as compared to Australian Height Datum. The latest National Tidal Centre advice (9 march 2004) based on 6 months of data collected to 15 February 2004 predicts the LAT as -0.750 mAHD and Mean Sea Level as -0.051 mAHD (compared to -0.758m and +0.042m at Kingston SE). It should be noted that accurate MSL prediction will require a full calendar year of data in order to eliminate the bias towards lower than astronomical tides during the summer period for the 6 months of data recorded to date.

Progressively improved predictions of both the tidal constituents and the correlation between MSL / LAT and AHD can be made as more data is collected. It is expected that 12 months of data should be collected to provide a reasonable level of certainty.

5.6 Extreme Sea Level Event Analysis

Table 5.4 lists the highest recorded tide levels as were shown in Figure 5.3. Robe wind direction and speeds for these occasions are also given.

Table 5.4 Cape Jaffa Maximum Tide Levels (1980-1984) and Robe 9am Winds

Date	Max Tide Depth above Local MSL (m)	Wind Direction (° true)	Wind Speed (knots)
14 July 1980	1.33	315	30
3 July 1981	1.32	315	30
1 July 1981	1.22	292	18
16 June 1980	1.21	338	30
15 June 1980	1.17	270	20
27 June 1980	1.17	Missing	Obs
28 June 1980	1.16	270	30
15 May 1983	1.11	Missing	Obs
28 July 1980	1.08	360	14

The two factors common to the occurrence of high tide levels greater than the astronomical tide level, is the coincidence of the winter solstice and strong north-westerly to westerly winds. Figure 5.3 shows the link between the solstices and the maximum tidal heights. The occurrence of strong onshore winds would elevate sea levels above the normal astronomical tide levels.

The National Tidal Centre provided an extreme event analysis of high tide levels based on about 3 years of uncorrected (raw) tidal data from Cape Jaffa (1980-1982). This analysis used techniques described in “A spatial analysis of Australian Extreme Sea Levels” by J Tawn and W Mitchell, and is given in Table 5.5. An approximate factor of 0.048m has been used to convert from the local MSL to mAHD (National Tidal Centre advice of 25 February 2004).

Table 5.5 Average Recurrence Interval (Years) of Tidal Levels at Cape Jaffa – Based on 3 Years of Hourly Tide Data 1980-1982 (Source: National Tidal Centre) assuming local MSL is –0.051m AHD based on 6 months tide data from Sept 2003 to Feb 2004

Average Recurrence Interval (Years)	Height (m) above Local MSL	Estimated Height (mAHD)
1.01	0.91	0.86
2	1.09	1.04
5	1.19	1.14
10	1.26	1.21
20	1.31	1.26
50	1.38	1.33
100	1.43	1.38

The heights given in Table 5.5 are approximate, given the uncertainty in the stability of the pressure transducer, and the uncertainty of the datum on which the pressure transducer was positioned. The magnitude of error is also uncertain, but could be of the order of + 0.02m.

5.7 Cape Jaffa Tidal Summary

Through a combination of the historical records, spatial extreme event analysis and recent high frequency gauge data, a reasonably accurate assessment of tide level, tidal ranges, extreme tide events and also the correlation between tide datums and Australian Hight Datum is possible. Table 5.6 summarises the most relevant parameters in relation to the Cape Jaffa tidal environment.

Table 5.6 Summary of Cape Jaffa Tidal Records and Analyses (all levels to AHD)

Predicted 1 in 100 ARI high tide level (1980-1984 data)¶	1.38m-1.45m ¶
Maximum recorded tide from Cape Jaffa 1980-1984 data *	1.35 m
Maximum recorded tide from Cape Jaffa 2003-2004 data	1.278 m
Maximum recorded tide at Kingston SE 1946-1952	1.192 m
Mean Sea Level (estimated for 2003-2004 data)+	-0.05 m
Lowest recorded tide from Cape Jaffa 1980-1984 data *	-0.98 m
Lowest recorded tide from Cape Jaffa 2003-2004 data	-0.984 m
Lowest recorded tide at Kingston SE 1946-1952	-1.158 m
PCSA Chart Datum elevation for Kingston SE	-0.758 m

* note that the 1980 to 1984 Cape Jaffa data incurred errors such that the maximum recorded may be higher than actual and the lowest recorded may be lower than actual.

+ Mean Sea Level estimate based on the latest National Tidal Centre estimate of 6 months of Cape Jaffa tide data 2003-2004. This may alter when further data becomes available.

¶ The National Tidal Facility advise that the Harmonic Analysis (Table 5.3) indicates that the true MSL may be 0.02m higher than the datum of the analysis in Table 5.5 and Appendix F. Allowing for the expected rise in local MSL over the 2004 winter tide observations (0.05m) and the 0.02m correction to the extreme event analysis, it is possible that the actual 1 in 100 year tide level could be as high as 1.45mAHD.

6. Wave and Swell Data

6.1 Historical Information

The Australia Pilot (1973) remarks that:

> *"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".*

There are considerable areas of sea grass growing over the flat, relatively shallow bottom of Lacepede Bay. At times Maria Creek, just north of Kingston, is blocked with weed blown into the groynes that protect the entrance to the creek. It is our opinion that during winter gales from the west to north-west, the wave interaction with the sea floor detaches patches of sea grass which are then washed up on the shore.

The calculations of wave heights in Lacepede Bay given in Section 6.2 below illustrate the physical reasons behind the lack of swell and surf in the area between Cape Jaffa and Kingston.

6.2 Wave Height Calculations

Significant wave height for deep water waves is a function of wind speed, fetch length and wind duration. Once the relative depth, d/L, where d is the water depth and L is the wavelength between crests, is less than 0.5 then the wave characteristics start to be influenced by the interaction of the wave with the bottom. The Shore Protection Manual (US Army, 1973) gives a series of nomograms for forecasting significant wave heights for various constant shallow depths. These nomograms combine the basic assumptions applying to calculating deep water wave heights with assumptions on bottom friction loss and percolation loss.

Another relevant factor is the type of wave, such as breaking, surging or spilling, where the wave train dissipates energy due to interaction with the sea floor. In areas with very shallow sea floor slopes (greater than 1:50) spilling waves, which break gradually and are characterised by white water at the crest, are dominant. Bottom slopes offshore from the proposed marina site at Cape Jaffa are between 1:200 to 1:600 for distances up to 7km offshore, and are therefore almost flat.

Estimated significant wave heights for shallow water for estimated ARI 100 year wind speeds, using Robe and Cape Jaffa (Curley Hills) wind observations are given in Table 6.1, based on the US Army (1973) nomograms for shallow water. Significant wave height is defined as the average height of the highest third of the waves.

Table 6.1 Significant Wave Heights (m) offshore of the proposed Cape Jaffa Marina for ARI 100 Years Wind Speeds

Water Depth (m)	Approx Distance Offshore (km)	Significant Wave Height (m)			
		Max Speed 55 kts	1 Hr Ave 48 kts	3 Hr Ave 43 kts	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	0.9
3	0.6 to 1	0.9	0.8	0.8	0.7

6.3 Wave Set Up in the Proposed Marina

The longest fetch within the proposed marina concept plan (Masterplan, Plan No 8527, September 2002) is about 800m and the average depth is 2.5 to 3m below low tide. The Shore Protection Manual (US Army, 1973) gives a technique for calculating effective fetch for rectangular water bodies which is applicable for the proposed marina channels, which gives an effective fetch of about 0.21 times the actual length of the channel. Applying the standard shallow water wave forecasting nomograms given in the Shore Protection Manual (US Army, 1973) with the ARI 50 year wind, about 46 knots for a 1 hour average, gives a resulting ARI 50 year wave height of a maximum of 0.4m with a head sea period of 1.8 seconds at the end of the effective fetch, assuming the wind is blowing exactly along the marina arm for a sufficient time to develop a full sea. The ARI 1 year, 1 hour average wind is 32 knots which gives a maximum wave height of 0.24m with a head sea period of 1.5 seconds. Where winds are blowing obliquely across the marina channel alignment, wave heights will be less than above. These wave heights comply with AS 3962 – 2001 (Guidelines for the Design of Marinas) which recommend a maximum ARI 50 year wave height of 0.4 m, and a maximum ARI 1 year wave height of 0.3m.

7. Conclusions

A statistical analysis of the Cape Jaffa (Curley Hills) and Robe wind speed records indicates that Cape Jaffa is 5-12 knots windier than Adelaide for the same average recurrence intervals.

Wave hindcasting techniques have confirmed the wave and swell descriptions given in the Australia Pilot. The shallow water and very flat grade of the sea floor in Lacepede Bay limit wave heights to well below deep water significant wave heights for equivalent wind speeds.

Winter wind directions are predominantly north to north-west, leading to higher tide levels than the predicted astronomical tide. Summer wind directions are predominantly south-east to south, leading to lower tide levels than the predicted astronomical levels.

Winter north-west winds and the resulting interaction of waves with the sea bottom tear sea grass from the bed of Lacepede Bay (in our opinion) and wash the weed up on the shore. The breakwater and entrance channel design will need to take account of this feature, and the additional transport of sand shoreward at this time of year.

8. References

Australian Hydrographic Service, 2001. Chart AUS 127, 30 March 2001

National Tidal Centre, 2003. Tidal Analysis of Cape Jaffa Tidal Data: April 1980 to May 1984. Flinders University of South Australia

Royal Navy, 1973, 1986. Australia Pilot, Volume 1. Sixth Edition (with corrections to 22 November 1986). Hydrographer of the Navy.

Standards Australia, 2001, AS 3962 – 2001 Guidelines for Design of Marinas, 2nd Edition

Tonkin Consulting, 2002, A Report on the Wind Conditions, Wave Heights and Sea Levels in Adelaide Metropolitan Waters, SA on 16 March 2001 and 26 April 2001

US Army Coastal Engineering Research Centre, 1973, Shore Protection Manual, 3 Volumes

Appendix A

Climatic Averages for Robe. Source: Bureau of Meteorology

026026 ROBE Commenced: 1860 Last record: 2001
Latitude:-37.1639 S Longitude: 139.7550 E Elevation: 3.3 m State: SA

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN	No. Yrs	%age comp
Mean Daily Max Temp (deg C)	22.6	22.7	21.3	19.3	16.7	14.7	14.0	14.6	15.9	17.9	19.7	21.1	18.4	42.1	95
Mean no. Days, Max >= 40.0 deg C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.5	96
Mean no. Days, Max >= 35.0 deg C	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	42.5	96
Mean no. Days, Max >= 30.0 deg C	2.4	2.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.4	7.2	42.5	96
Highest Max Temp (deg C)	38.8	39.6	34.0	30.8	26.5	20.4	21.2	22.8	24.8	31.2	34.0	36.5	39.6	44.1	100
Mean Daily Min Temp (deg C)	13.9	13.9	13.0	11.9	10.4	8.9	8.4	8.7	9.3	10.5	11.5	12.9	11.1	42.4	96
Mean no. Days, Min =< 2.0 deg C	0.0	0.0	0.0	0.0	0.0	0.4	0.6	0.3	0.0	0.0	0.0	0.0	1.3	42.9	97
Mean no. Days, Min =< 0.0 deg C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	42.9	97
Lowest Min Temp (deg C)	6.5	6.1	5.2	2.8	1.1	-2.8	-2.6	0.5	2.0	2.1	3.9	4.4	-2.8	44.1	99
Mean 9am Air Temp (deg C)	18.5	18.3	17.3	15.7	13.3	11.4	10.8	11.5	13.0	14.7	15.9	17.3	14.8	42.0	95
Mean 9am Wet-bulb Temp (deg C)	15.0	15.1	14.5	13.2	11.7	10.1	9.4	9.7	10.8	12.0	12.9	14.0	12.4	38.7	88
Mean 9am Dew Point Temp (deg C)	12.2	12.6	12.1	11.1	10.0	8.7	7.9	7.8	8.5	9.3	10.0	11.2	10.1	38.7	88
Mean 9am Relative Humidity (%)	68	71	73	75	81	84	83	79	75	71	69	68	75	38.7	88
Mean 9am Wind Speed (km/hr)	16.5	14.6	15.0	17.9	19.9	20.0	22.3	22.3	22.3	21.1	19.8	18.3	19.2	41.4	94
Mean 3pm Air Temp (deg C)	20.8	21.0	19.7	17.8	15.5	13.5	12.8	13.3	14.6	16.3	18.0	19.4	16.8	39.8	90
Mean 3pm Wet-bulb Temp (deg C)	16.2	16.6	15.6	14.5	12.9	11.5	10.7	10.9	11.8	13.0	14.1	15.2	13.6	36.5	83
Mean 3pm Dew Point Temp (deg C)	12.7	13.2	12.4	11.6	10.5	9.3	8.5	8.3	8.9	9.9	10.7	11.7	10.6	36.5	83
Mean 3pm Relative Humidity (%)	61	63	64	68	73	77	76	72	70	67	63	63	68	36.5	83
Mean 3pm Wind Speed (km/hr)	20.9	19.5	18.0	18.4	19.8	20.5	22.8	21.9	21.4	21.1	22.0	21.4	20.7	39.9	90
Mean Rainfall (mm)	20.2	18.5	26.3	46.9	74.3	95.8	104.7	85.2	59.3	44.7	29.6	27.8	633.2	140.8	100
Median (Decile 5) Rainfall (mm)	_ 13.4	12.2	20.2	43.5	67.9	95.2	101.3	82.5	55.9	40.2	27.2	23.1	624.3	140	
Decile 9 Rainfall (mm)	_ 48.0	42.2	62.5	87.5	127.6	157.2	162.3	137.9	95.5	78.2	56.0	54.8	785.9	140	
Decile 1 Rainfall (mm)	_ 2.5	1.3	4.2	13.5	29.1	40.6	54.8	36.4	32.0	18.7	9.6	5.9	507.0	140	
Mean no. of Raindays	5.3	5.0	7.5	11.9	16.5	18.7	21.0	19.6	16.4	13.2	9.5	7.9	152.5	127.1	90
Highest Monthly Rainfall (mm)	131.9	104.0	123.6	150.9	192.9	217.1	214.2	192.0	176.1	108.1	87.6	187.8		140.8	100
Lowest Monthly Rainfall (mm)	0.0	0.0	0.0	0.0	7.4	15.8	32.6	12.2	17.4	3.3	1.3	0.0		140.8	100
Highest Recorded Daily Rain (mm)	68.1	74.4	56.1	68.6	67.6	49.3	63.5	41.0	49.5	33.8	46.6	93.2	93.2	136.1	97
Mean no. of Clear Days	8.0	7.9	6.1	4.2	2.8	2.3	2.3	2.5	2.8	3.8	4.1	4.7	51.5	44.1	100
Mean no. of Cloudy Days	8.9	7.8	10.5	13.3	16.0	14.9	15.3	14.4	14.3	13.5	12.5	11.9	153.3	44.1	100

Appendix B

Rainfall Data for Kingston SE and Cape Jaffa (Jaffa Hills). Source: Bureau of Meteorology

Monthly and Annual Rainfall recorded at Kingston SE

Station Number: 026012 36 50 S 139 51 E 5m Elevation
Rainfall in Millimetres

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1875	9.1	37.1	0	49.5	117.1	164.8	59.2	112.3	22.9	26.4	67.6	94	760
1876	21.1	10.9	32.5	49.5	44.5	97.8	60.5	33.3	29.7	33.3	43.9	21.8	478.8
1877	2	18	52.6	23.4	136.9	56.1	35.3	40.9	70.1	22.6	16.3	6.6	480.8
1878	0	7.4	26.4	61.7	42.7	103.4	51.8	70.4	44.7	40.1	21.1	12.7	482.4
1879	2	7.4	16.5	54.1	94.7	72.4	77.5	72.6	42.7	30.7	48.8	28.7	548.1
1880	6.4	7.4	52.1	75.4	77	92.2	50.5	75.9	31.8	33.3	22.4	5.8	530.2
1881	47	13.5	2.3	33.5	83.1	158.2	45	38.4	34.8	34.3	18.3	9.4	517.8
1882	8.1	0	11.4	35.1	72.6	52.8	184.7	56.6	34.8	29.2	7.9	0.3	493.5
1883	8.4	25.7	34	48.3	159.8	142.2	94.5	73.7	62.2	57.7	49.8	30	786.3
1884	54.5	4.1	12.5	43.2	115.5	152.3	49.9	60.9	78.8	31.6	9.1	45.9	658.3
1885	20.4	26.3	19.1	39.6	59.8	127.7	59	86.9	47.7	19.9	3.5	30.5	540.4
1886	16.8	19.4	3.8	54.4	31.8	43.9	69.2	148.4	59.8	71.5	32.8	6.1	557.9
1887	13.7	5.1	11.1	25.7	94.9	166.7	79.3	62	71.7	37.3	102.5	13.8	683.8
1888	17.9	4.1	14	16.3	67.1	123.3	141.4	50.7	49.6	8.1	12	7.4	511.9
1889	33.9	18.9	12.2	137.7	111.2	147.9	34.6	115.9	64	55.6	34.4	9	775.3
1890	5.6	1.3	6.9	30.1	19.4	107.5	100	104.3	79.9	49.9	81	12.1	598
1891	9.2	3.6	10.9	31.5	30.6	38.8	94.3	54.1	43.5	65.6	23.9	60.2	466.2
1892	38.2	1.8	39.9	40.7	90.1	87.2	66.3	69	48	55	27.3	49.3	612.8
1893	8.5	0	3.6	116.3	119.2	93.7	77.7	115.7	134.8	45.7	41.7	12.2	769.1
1894	18.3	2.6	57.6	61.2	51.3	73.3	164	128.3	49.4	87.4	7.6	132.8	833.8
1895	32.6	3.6	57.3	55.6	39	86.7	118.3	134.4	58.5	16.3	3.4	65.9	671.6
1896	67.2	23.6	27.8	88.7	80.9	79.1	121.8	49.2	35.6	6.6	14	63.1	657.6
1897	15.9	16.3	30.7	37.9	95.7	71.9	68	137.4	47.3	44.3	18.4	2.6	586.4
1898	3.9	35.5	13.4	88.1	51.4	116.4	127.5	69.6	58.1	42.1	34.6	13.9	654.5
1899	47	15	26	57.7	71.4	118.2	49.8	21.6	40.2	44	28.4	41.4	560.7
1900	32.2	1.8	55.4	110.5	45.4	143.8	49	155.7	43.8	31.8	15.8	10.9	696.1
1901	29.4	2.3	18.1	62.9	52.9	169.8	79.4	65.8	67.1	35.6	13.4	30	626.7
1902	5.3	35.5	28.1	6.9	26.8	91.5	64.5	52.7	48.6	51.3	17.7	103.6	532.5
1903	32.5	52.9	68.9	75.2	57.6	114.3	96.1	89.1	66.9	39.3	40.5	19.9	753.2
1904	75	24.2	10.5	35.1	62.1	55.6	126.2	56.9	34.6	50	21.5	2.1	553.8
1905	15.7	12.5	6.6	56.7	69.4	156.3	121.4	77.3	65.5	71.1	15.7	6.1	674.3
1906	8.7	5.3	78.9	31.9	69.2	139.8	215.1	81.8	78.2	47	45	1.5	802.4
1907	1.3	3.8	6.9	80.8	50.6	54.4	85.7	87.8	21	55.4	41.2	19.8	508.7
1908	0.8	29.7	43.7	9	78.8	156.7	43.4	44.2	47.2	57	14	12	536.5
1909	16.2	6.9	24.3	94.7	130.8	112.6	128.8	95.2	55.4	51	32	26.9	774.8
1910	0	1.8	94	15.6	153.1	94.5	94.8	57.1	121.5	63.6	65.8	36.9	798.7
1911	0	85.1	20.5	19.8	71.2	100.4	73.5	47.6	67.6	37.3	3	100.4	626.4
1912	2	24.1	21.3	55.7	53.1	118.2	105.3	118.8	149.9	51.6	63.9	21.5	785.4
1913	7.5	14.5	47.7	18	51.2	20.6	50	73.6	57.3	30.9	47.1	49.8	468.2
1914	8.2	13	54.6	77.7	49.8	35.6	52.6	15.6	17.4	12.7	35.3	20.9	393.4
1915	16.6	0.3	13.4	29.3	37.2	162.1	87	111.3	111.6	37.9	18.1	0.5	625.3
1916	25.1	14.5	3	53.2	23.4	157.3	93.7	92.6	41.1	54.2	60.3	39.2	657.6
1917	10.2	41.5	22.1	36.8	162.7	62.1	182.5	77.4	96.4	73.6	27.1	21.1	813.5
1918	7.4	1.8	9.6	4.6	116.3	91.9	92.5	67.3	33.6	95.1	17.8	25.5	563.4
1919	10.4	61.2	29.7	3.1	65.6	62	80.8	59.8	100.9	44.8	7.1	22.3	547.7
1920	2.3	4.4	15.3	9.1	79.2	151.9	125.8	104.5	41	29.7	41	10.5	614.7
1921	27.3	10.7	31	12.7	64.4	77	120.9	86	72.6	50	77.3	22	651.9
1922	51.6	1.5	9.2	46.6	150.3	74.9	83.5	94.6	74.3	42.6	8.5	42	679.6
1923	13.5	3.8	0	0	139.3	136.7	109.5	68.2	59.3	54.4	16.8	48.2	649.7
1924	28.6	41.9	57.7	49.2	66.9	80.4	38.5	76.2	79.8	65.2	46.6	11.5	642.5
1925	13	34.8	1.3	50.9	103.1	73.2	90	60.2	107.8	17.2	29.6	8.7	589.8
1926	1.8	16.1	2.8	76.9	98.4	53.9	100.6	94	28.2	50.5	22.8	33.5	579.5
1927	16.3	21.7	28	4.4	99.2	34.5	77.6	114.9	23.7	18.2	54.1	29.5	522.1
1928	12	32.7	24.1	35.5	69.4	138.6	86.7	32.3	73.4	74.2	12.9	6.1	597.9
1929	32	11.4	4.8	28.5	65.6	104	103.9	62.8	58.5	41	11.2	52.4	576.1
1930	0	90.3	2.5	30.5	18.5	30.2	129	100.8	66.9	63.4	21	19.2	572.3
1931	27.7	5.7	27.7	44.1	132.1	122.2	108.8	78.3	44	9.4	19.7	0.3	620
1932	0.8	54.7	50	66.9	28.9	121.7	100.9	97.9	49.9	61	24.4	14.5	671.6
1933	31.7	2	24.6	19.2	127.5	42	37	63.8	77	22.7	23.2	16.8	487.5
1934	7.4	2.3	5.2	93.8	5.1	19.5	53.8	97.8	91.9	102.8	57.3	13.6	550.5
1935	21.8	1.9	42.3	64.6	74	90.7	121.5	67.6	51.2	33.9	40.3	8.6	618.4

1936	41.8	0.5	6.9	30.6	85.2	99.3	81.1	98.7	29.9	69.2	10.8	59	613
1937	53.4	5.9	15.2	15.3	87.2	18.1	47.7	85.4	82.8	21.5	16.7	137.5	586.7
1938	14.6	24.7	6.7	87.8	37.5	110.9	73.4	39.1	35.1	10.1	30.3	26.4	496.6
1939	27.7	14.2	18.7	93	27.6	149	36.9	112.1	36.3	58.9	39.7	17.7	631.8
1940	39.4	6.6	16.3	72.6	28.7	44.2	132.4	31.2	27.6	22.7	42.5	31.1	495.3
1941	43.4	13.2	40.5	51.6	41.4	26	81.8	28.6	127.1	26.8	10	14.9	505.3
1942	55.2	2.3	19	25.4	144	147.7	114.1	108.4	85.3	85.8	25.1	22.3	834.6
1943	4.9	43.1	5.6	65.5	48.9	95.3	125.9	130.6	63.8	28.3	30.9	42.4	685.2
1944	8.4	18.1	20.2	72.1	107.4	35.2	103.7	15.6	25.5	95.3	34.1	45.4	581
1945	13.2	56.6	6.5	5.7	49.6	61.2	79	83.9	85	90.9	66.5	48.8	646.9
1946	112.7	106.5	107.6	23	80.1	73.1	137.9	49	45.5	26.8	12.2	26.5	800.9
1947	11.6	9.1	87.6	57.5	56.8	108	145.3	70.8	69.6	76.3	72.4	29.4	794.4
1948	12.1	20.7	7.8	102.6	78.2	40.9	83.8	75	47.5	68.9	37.2	27.4	602.1
1949	21.3	72.8	4.7	7.2	81.5	40.4	62.6	39.7	24.3	84.6	66.1	5.7	510.9
1950	5.1	28.2	12.6	21.7	77.5	38.7	76.4	69.5	59.8	61.7	24.7	22.9	498.8
1951	12	6.6	1.6	81.4	103.3	52.6	149.6	90.6	16.4	56.5	15.9	35.7	622.2
1952	44.5	35.7	3.5	65.1	80	94.2	90.8	64	55.1	34.9	49.4	36.2	653.4
1953	3.8	15.3	2.9	28	77.2	142.6	101.4	125	67.4	34.8	66.3	45.5	710.2
1954	23.9	1.8	17.8	105.7	45	92.6	90.9	64.1	49.9	46.4	34.7	25.8	598.6
1955	12.8	32.5	2.3	82.3	107.1	100.4	59.4	106.4	44.1	67.2	35.9	30.4	680.8
1956	36.5	0	19.6	74.1	60.9	129.2	127.3	109.5	70.7	60.2	7.4	30.8	726.2
1957	0	0.6	42.4	47.8	45.9	55.4	64	42.4	72.3	47.4	29.9	35.2	483.3
1958	1.3	35	17.3	13.7	116.8	46.2	104.3	106.1	79.5	62.1	25.1	2.6	610
1959	1	37.8	64.6	10.4	15.9	29.8	38.4	67.1	50.2	16.6	27	42.1	400.9
1960	11.4	77.8	39.9	65.9	113	52.1	69.9	77	111.8	31.5	11.3	12.3	673.9
1961	4.3	9.2	5.6	75.6	40.4	68.2	90.3	55.8	31.9	23.2	12.7	27.2	444.4
1962	6.1	24.7	24.4	14.2	94.7	98.1	60.1	68.1	85.6	64	19.8	29	588.8
1963	80.6	1.8	3.6	26.1	71.2	57.4	98.8	84.9	59.7	12.4	9.8	3.8	510.1
1964	13.4	12.2	14.2	27.8	45.2	97.4	210.6	53.6	69.9	52.8	61.7	63.4	722.2
1965	1.5	1	19.9	41.3	76	55.1	91.8	73.1	33.5	8.8	28.1	4.1	434.2
1966	1.8	7.9	18.4	13.1	65.4	53.3	103.7	30.9	64.4	56.7	22.2	90.4	528.2
1967	1.8	31.8	6.8	7.6	25.1	15.5	107.9	71.3	19.7	6.4	8.3	31.5	333.7
1968	24.9	7.6	33.1	94.4	145	48.3	88.3	98.4	36.1	54.3	51.4	28.4	710.2
1969	8.9	32.2	15.3	43.4	59.2	19.8	98.6	47.5	80.9	10.3	16.3	31.4	463.8
1970	30.3	0.8	21	64.4	51	107.6	86.5	92	44.7	20.7	38.1	44.8	601.9
1971	3.8	13.5	29.3	100.9	67	82.8	50.6	104.3	66.4	52.5	58.2	59.4	688.7
1972	42.8	26.5	0	52	25.6	40.2	111.5	77.5	23.2	38.9	18.6	1	457.8
1973	16.7	34.1	49.3	47.6	70.7	125	74.1	74.1	67.7	28.9	7.4	30	625.6
1974	31.4	53.2	6.6	59.4	27.6	45.4	119.2	59.8	79.8	89.3	13.6	16.2	601.5
1975	20	13	43.6	22.5	74.4	71.1	130.9	83	52.4	82.6	36.6	13.4	643.5
1976	11.4	11.6	25.8	29.1	43.2	80.6	37.8	67.4	90.5	18	18	52.6	486
1977	34	9.1	43.8	21.6	75.5	82.4	33.8	18.8	37.2	30.2	83.2	4	473.6
1978	13	5.6	6.2	20	65.3	111.2	97.6	64.4	59.8	28.9	57	26	555
1979	25.8	24.8	10.6	36	67	42.4	90.4	78.6	100.2	45.4	61	14.8	597
1980	8.8	0.8	0.2	70.2	38.2	78.6	122.2	48.6	43.8	54.4	19	16.4	501.2
1981	31.6	0.8	36.4	18.2	42.6	105.2	114.2	121	18.8	38.6	25.2	1.8	554.4
1982	13.6	4	31.6	36.2	57.5	84.4	58.4	17.3	24.8	13.8	6.6	5.6	353.8
1983	11	0.6	102.8	54	68.8	71	100.8	86	68	13	40.6	14	630.6
1984	32	1.8	30.9	20	52.6	42.2	74.8	124.4	73.4	28.8	65.2	15.8	561.9
1985	3.6	5	25.4	50.6	92.4	79	62.6	60.4	22	32.4	10.6	23	467
1986	6	1.2	0.8	69	47.4	45.8	86.7	74.2	53.4	59.8	9.2	41.6	495.1
1987	2.2	9.4	6.2	22.4	141.2	71.8	102.4	36.4	12.4	36.6	4.4	19.2	464.6
1988	45	10.2	15.4	11.6	84.2	99.2	76.8	70.6	48.4	26.4	21	17.6	526.4
1989	12	2.6	7.4	16.6	59.8	129.8	109.8	108.6	34.4	47	8.4	8.6	545
1990	15.6	11	5.8	13.4	19	93.4	132.6	84.8	49	29.8	7.6	17	479
1991	11	0	12.6	31.2	9	119.8	76.6	121.6	57.2	5.8	21.6	6	472.4
1992	0.4	5.6	34.8	98.8	64.6	59.4	72.8	83.9	78.6	69.4	65.8	79.4	713.5
1993	33.8	5	18	2.4	36.9	50.6	57.4	53.8	81.4	53	18.6	46	456.9
1994	25.2	5.8	0	19.4	62.8	104.2	94.4	37.8	23.2	44.8	33.6	8.4	459.6
1995	30.6	23.8	17.2	53	24.6	109.8	162.6	39	22	21.8	2.6	11.4	518.4
1996	16.8	17.6	8.6	31	26.8	111.6	102	132.8	77.4	15.6	6.1	5.8	552.1
1997	34	7	15.8	6.6	102	69.2	44.1	65.9	68.8	23.4	60.8	2.2	499.8
1998	6.2	26.2	8.5	59.6	36.8	61.8	78.8	33.2	54.8	27.1	16.1	11.5	420.6
1999	3.8	6.6	26.7	14.6	77.4	94	53.7	43.2	65.6	35.4	35.6	59	515.6
2000	3.6	44.8	23.6	66.4	140.2	126.2	97.6	82.6	68.4	77.4	11		
2001	1.2	31	84	20.6	42	76.1	33.6	95.4	91.6	58			
Average	19.2	18.0	23.9	45.3	71.0	87.3	90.3	75.8	58.0	43.6	30.3	28.2	589.4
No. Years	127	127	127	127	127	127	127	127	127	127	126	125	125

Monthly and Annual Rainfall recorded at Cape Jaffa (Jaffa Hills)

Station Number: 026004 36 58 S 139 43 E 10m Elevation
Rainfall in Millimetres

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1934							54.1	104.3	86.6	59.2	55.5	11.7	
1935	21.3	0.6	41.6	43.5	93.9	96.1	105.4	47.6	45.3	36.4	43.2	4.3	579.2
1936	24.2	0.5	3.0	38.0	61.1	73.5	94.1	92.9	37.6	61.3	0.0	25.7	511.9
1937	43.1	1.5	12.2	19.3	74.4	25.1	48.1	68.0	79.6	6.4	17.2	159.6	554.5
1938	8.1	23.9	5.3	69.5	33.5	119.7	75.3	39.4	10.9	9.1	24.9	0.0	419.6
1939	27.7	19.6	19.3	91.9	29.0	176.1							
1940													
1941									144.0	17.4	10.2	12.4	
1942					165.5	134.8	94.5	139.1	73.2	69.8	16.6	13.8	
1943	4.9	51.8	3.3	49.0	44.6	70.5	118.2	101.9	57.0	20.7	23.7	25.4	571.0
1944	3.8	18.5	13.2	49.1	89.9	33.5	80.6	14.0	33.7	85.4	33.6	39.1	494.4
1945	7.9	46.0	3.6	5.8	57.8	100.3	70.9	76.6	77.1	71.7	62.0	19.1	598.8
1946	107.2	97.8	63.8	19.1	73.8	42.5	128.0	49.5	36.3	14.5	16.2	19.8	668.5
1947	8.1	3.8	70.5	38.4	60.0	79.4	146.0	69.5	40.9	74.4	9.7	19.8	620.5
1948	6.6	14.7	6.6	90.5	42.3	33.5	108.7	62.4	40.8	56.4	15.7	12.7	490.9
1949	12.9	68.2	1.5	3.8	82.0	28.5	85.7	22.6	33.0	71.4	51.6	23.4	484.6
1950	4.3	23.6	2.8	25.7	58.7	58.2	88.0	63.0	52.8	66.1	25.1	22.8	491.1
1951	3.0	4.8	0.0	64.1	120.6	64.2	189.8	92.3	12.9	40.9	3.6	32.2	628.4
1952	63.2	35.6	0.0	68.3	104.9	86.8	85.7	73.8	53.4	45.9	44.5	24.6	686.7
1953	2.0	9.7	1.3	25.8	44.3	127.9	94.0	120.4	58.4	10.2	57.6	31.3	582.9
1954	23.9	0.0	16.5	110.3	56.7	110.9	65.5	40.5	57.2	42.1	25.6	18.0	567.2
1955	13.2	32.3	0.0	44.9	110.4	100.6	42.8	115.6	48.6	83.9	47.3	16.0	655.6
1956	16.8	0.0	8.3	80.2	70.1	125.0	186.9	114.0	60.0	67.9	2.8	21.4	753.4
1957	0.0	0.0	30.7	49.4	45.2	52.7	100.4	44.3	49.7	47.8	30.5	21.8	472.5
1958	0.0	1.6	25.6	16.2	115.4	76.2	123.2	109.7	61.8	67.9	18.0	2.0	617.6
1959	1.0	30.2	65.1	11.8	17.6	21.9	43.6	47.2	68.6	20.3	19.3	29.0	375.6
1960	15.7	64.7	40.1	41.0	122.5	73.9	77.2	97.0	115.6	24.4	0.0	16.0	688.1
1961	0.0	8.3	6.4	75.7	42.8	67.7	109.5	34.3	35.0	22.3	3.0	16.5	421.5
1962	0.0	0.0	0.0	0.0	81.6	92.5	55.1	78.1	102.5	51.0	11.7	41.7	514.2
1963	93.0	0.0	0.0	21.1	74.6	54.5	130.0	91.6	81.3	3.6	0.3	0.0	550.0
1964	5.4	13.9	6.1	38.9	61.2	112.6	181.1	35.1	57.3	76.2	43.9	72.3	704.0
1965	0.0	0.0	15.7	36.0	97.8	45.9	88.7	49.3	22.0	4.3	11.7	6.6	378.0
1966	2.3	8.1	15.5	15.4	57.4	51.1	117.8	22.8	49.1	30.5	25.1	112.8	507.9
1967	0.0	20.3	0.0	3.8	19.1	9.7	112.7	46.0	4.5	2.0	7.1	20.9	246.1
1968	12.7	0.0	36.8	83.4	153.5	53.2	115.4	119.3	49.7	60.6	50.7	24.9	760.2
1969	7.6	35.6	16.5	46.4	63.7	23.3	101.1	27.3	95.9	9.2	19.4	29.0	475.0
1970	12.0	0.0	14.3	84.5	40.8	90.1	67.5	78.1	40.7	21.6	31.2	40.3	521.1
1971	0.0	0.0	0.0	111.0	74.4	105.0	58.9	119.2	76.0	37.5	12.9	46.3	641.2
1972	59.2	12.2	0.0	30.0	2.5	61.7	107.1	100.8	14.4	23.4	20.3	0.0	431.6
1973	11.7	47.8	0.0	41.7	64.2	184.4	70.9	70.4	83.2	27.4	8.6	16.5	626.8
1974	24.4	58.2	27.2	56.6	34.6	37.8	169.8	74.0	61.8	59.0	13.0	20.0	636.4
1975	15.4	0.0	40.1	16.0	93.2	64.0	130.6	72.6	30.8	131.0	17.4	0.0	611.1
1976	10.4	11.0	25.0	29.8	36.2	57.3	57.6	60.7	67.5	21.0	39.5	14.8	430.8
1977	40.4	9.1	38.2	13.8	64.0	31.0	65.8	29.2	51.1	16.0	67.0	12.8	438.4
1978	24.8	6.4	11.8	16.4	59.2	115.6	122.5	80.1	46.8	7.4	33.4	18.7	543.1
1979	18.3	32.7	16.7	61.3	60.6	77.0	108.0	121.9	108.3	43.6	65.5	18.4	732.3
1980	19.8	2.4	1.0	79.6	68.8	108.1	112.3	59.0	72.0	65.1	24.9	29.0	642.0
1981	25.6	4.2	38.8	10.6	98.7	196.7	117.2	132.0	21.1	41.8	31.5	5.2	723.4
1982	22.8	9.5	30.1	55.4	73.5	109.2	77.5						
Average	18.3	18.4	17.2	44.1	69.5	79.6	99.6	73.5	56.7	41.9	25.9	25.4	559.3
No. Years	45	45	45	45	46	46	46	45	46	46	46	46	43

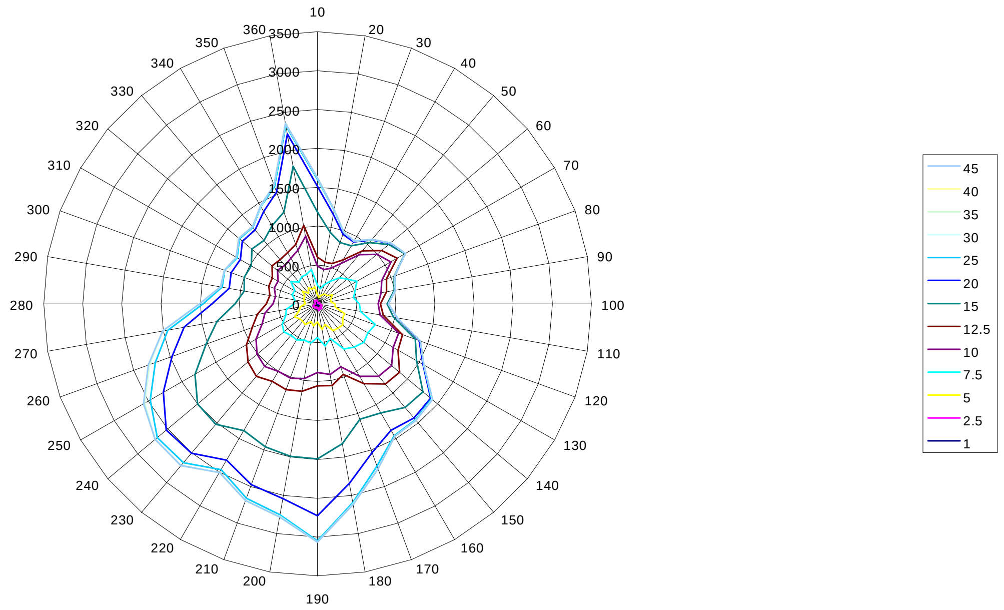
Appendix C

Wind Roses for Cape Jaffa (Curley Hills) AWS for each Month for Each Synoptic Observation Hour (12am, 3am, 6am, 9am, 12pm, 3pm, 6pm and 9pm). Source: Bureau of Meteorology

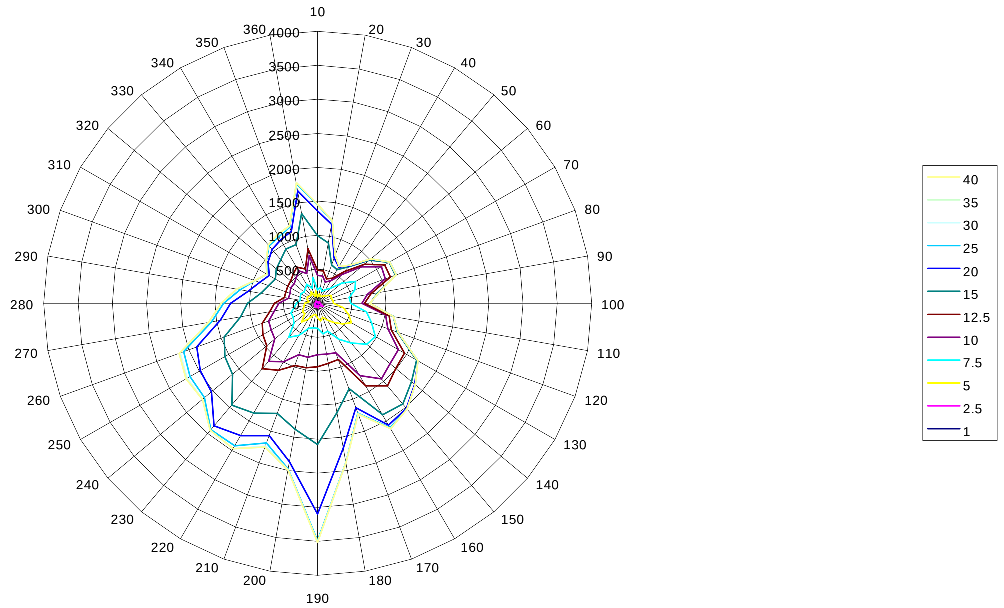
Appendix D

Wind Roses for Cape Jaffa (Curley Hills) for all Observations Based on 10° Increments of Wind Direction for April 1992-1995, 1996-1999 and 2000-May 2003. Base data from the Bureau of Meteorology

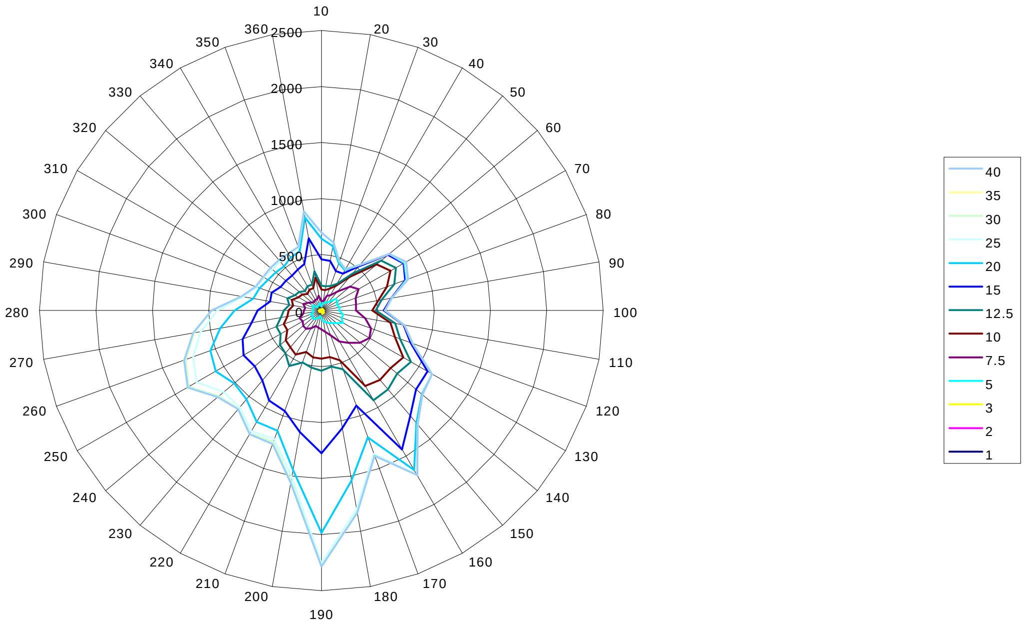
Cape Jaffa (Curley Hills) AWS: April 1992-1995
Cumulative Frequency of Occurrence of Wind Direction/Speed (knots) of Half-Hourly Observations



Cape Jaffa (Curley Hills) AWS: 1996-1999
Cumulative Frequency of Occurrence of Wind Direction/Speed (knots) of Half-Hourly Observations



Cape Jaffa (Curley Hills) AWS: 2000 - May 2003
Cumulative Frequency of Occurrence of Wind Direction/Speed (knots) of Hourly Observations



Appendix E

Wind Roses and Frequency Tables for Robe for 9am and 3pm. Source: Bureau of Meteorology

Appendix F

Tidal Analyses Performed by the National Tidal Centre, Flinders University, SA

Cape Jaffa - hourly sea level observations from 1980 to 1984

Mean	:	0.002
Mean of absolute value	:	0.252
Standard deviation	:	0.315

Execeedance Distribution

Level MSL(m)	Number of Hours	Percentage of Readings
-1.000	35043	100.00 %
-0.990	35039	99.99 %
-0.980	35039	99.99 %
-0.970	35039	99.99 %
-0.960	35039	99.99 %
-0.950	35035	99.98 %
-0.940	35032	99.97 %
-0.930	35031	99.97 %
-0.920	35029	99.96 %
-0.910	35026	99.95 %
-0.900	35026	99.95 %
-0.890	35025	99.95 %
-0.880	35022	99.94 %
-0.870	35019	99.93 %
-0.860	35016	99.92 %
-0.850	35011	99.91 %
-0.840	35003	99.89 %
-0.830	34996	99.87 %
-0.820	34983	99.83 %
-0.810	34968	99.79 %
-0.800	34958	99.76 %
-0.790	34947	99.73 %
-0.780	34924	99.66 %
-0.770	34905	99.61 %
-0.760	34891	99.57 %
-0.750	34869	99.50 %
-0.740	34845	99.43 %
-0.730	34817	99.36 %
-0.720	34793	99.29 %
-0.710	34766	99.21 %
-0.700	34706	99.04 %
-0.690	34669	98.93 %
-0.680	34624	98.80 %
-0.670	34567	98.64 %
-0.660	34522	98.51 %
-0.650	34464	98.35 %
-0.640	34414	98.21 %
-0.630	34357	98.04 %
-0.620	34307	97.90 %
-0.610	34256	97.75 %
-0.600	34190	97.57 %
-0.590	34120	97.37 %
-0.580	33995	97.01 %
-0.570	33922	96.80 %
-0.560	33827	96.53 %
-0.550	33742	96.29 %

-0.540	33648	96.02 %
-0.530	33554	95.75 %
-0.520	33444	95.44 %
-0.510	33323	95.09 %
-0.500	33192	94.72 %
-0.490	33048	94.31 %
-0.480	32899	93.88 %
-0.470	32759	93.48 %
-0.460	32590	93.00 %
-0.450	32327	92.25 %
-0.440	32135	91.70 %
-0.430	31921	91.09 %
-0.420	31735	90.56 %
-0.410	31514	89.93 %
-0.400	31283	89.27 %
-0.390	31099	88.75 %
-0.380	30887	88.14 %
-0.370	30672	87.53 %
-0.360	30437	86.86 %
-0.350	30210	86.21 %
-0.340	29968	85.52 %
-0.330	29721	84.81 %
-0.320	29349	83.75 %
-0.310	29189	83.29 %
-0.300	28775	82.11 %
-0.290	28612	81.65 %
-0.280	28201	80.48 %
-0.270	28040	80.02 %
-0.260	27642	78.88 %
-0.250	27445	78.32 %
-0.240	27050	77.19 %
-0.230	26791	76.45 %
-0.220	26441	75.45 %
-0.210	26129	74.56 %
-0.200	25647	73.19 %
-0.190	25276	72.13 %
-0.180	24979	71.28 %
-0.170	24535	70.01 %
-0.160	24292	69.32 %
-0.150	23791	67.89 %
-0.140	23591	67.32 %
-0.130	23037	65.74 %
-0.120	22822	65.13 %
-0.110	22247	63.48 %
-0.100	22058	62.95 %
-0.090	21433	61.16 %
-0.080	21232	60.59 %
-0.070	20576	58.72 %
-0.060	20327	58.01 %
-0.050	19672	56.14 %
-0.040	19474	55.57 %
-0.030	18863	53.83 %
-0.020	18588	53.04 %
-0.010	18018	51.42 %
0.000	17722	50.57 %
0.010	17179	49.02 %

0.020	16832	48.03 %
0.030	16367	46.71 %
0.040	15978	45.60 %
0.050	15325	43.73 %
0.060	14824	42.30 %
0.070	14497	41.37 %
0.080	13994	39.93 %
0.090	13693	39.07 %
0.100	13088	37.35 %
0.110	12854	36.68 %
0.120	12250	34.96 %
0.130	12051	34.39 %
0.140	11463	32.71 %
0.150	11263	32.14 %
0.160	10673	30.46 %
0.170	10504	29.97 %
0.180	9927	28.33 %
0.190	9724	27.75 %
0.200	9197	26.24 %
0.210	8994	25.67 %
0.220	8501	24.26 %
0.230	8306	23.70 %
0.240	7843	22.38 %
0.250	7631	21.78 %
0.260	7175	20.47 %
0.270	6955	19.85 %
0.280	6626	18.91 %
0.290	6355	18.13 %
0.300	5942	16.96 %
0.310	5631	16.07 %
0.320	5429	15.49 %
0.330	5139	14.66 %
0.340	4973	14.19 %
0.350	4630	13.21 %
0.360	4508	12.86 %
0.370	4190	11.96 %
0.380	4087	11.66 %
0.390	3774	10.77 %
0.400	3697	10.55 %
0.410	3389	9.67 %
0.420	3305	9.43 %
0.430	3028	8.64 %
0.440	2931	8.36 %
0.450	2699	7.70 %
0.460	2624	7.49 %
0.470	2415	6.89 %
0.480	2337	6.67 %
0.490	2159	6.16 %
0.500	2072	5.91 %
0.510	1917	5.47 %
0.520	1812	5.17 %
0.530	1683	4.80 %
0.540	1578	4.50 %
0.550	1452	4.14 %
0.560	1354	3.86 %
0.570	1289	3.68 %

0.580	1183	3.38 %
0.590	1131	3.23 %
0.600	1029	2.94 %
0.610	996	2.84 %
0.620	902	2.57 %
0.630	869	2.48 %
0.640	768	2.19 %
0.650	728	2.08 %
0.660	655	1.87 %
0.670	634	1.81 %
0.680	574	1.64 %
0.690	557	1.59 %
0.700	502	1.43 %
0.710	486	1.39 %
0.720	440	1.26 %
0.730	414	1.18 %
0.740	376	1.07 %
0.750	361	1.03 %
0.760	333	0.95 %
0.770	319	0.91 %
0.780	286	0.82 %
0.790	269	0.77 %
0.800	252	0.72 %
0.810	238	0.68 %
0.820	223	0.64 %
0.830	200	0.57 %
0.840	184	0.53 %
0.850	161	0.46 %
0.860	153	0.44 %
0.870	138	0.39 %
0.880	132	0.38 %
0.890	121	0.35 %
0.900	115	0.33 %
0.910	93	0.27 %
0.920	89	0.25 %
0.930	76	0.22 %
0.940	70	0.20 %
0.950	63	0.18 %
0.960	62	0.18 %
0.970	54	0.15 %
0.980	54	0.15 %
0.990	46	0.13 %
1.000	45	0.13 %
1.010	37	0.11 %
1.020	35	0.10 %
1.030	34	0.10 %
1.040	33	0.09 %
1.050	31	0.09 %
1.060	30	0.09 %
1.070	29	0.08 %
1.080	26	0.07 %
1.090	25	0.07 %
1.100	23	0.07 %
1.110	21	0.06 %
1.120	20	0.06 %
1.130	20	0.06 %

1.140	19	0.05 %
1.150	18	0.05 %
1.160	16	0.05 %
1.170	13	0.04 %
1.180	10	0.03 %
1.190	9	0.03 %
1.200	8	0.02 %
1.210	7	0.02 %
1.220	5	0.01 %
1.230	5	0.01 %
1.240	5	0.01 %
1.250	5	0.01 %
1.260	5	0.01 %
1.270	4	0.01 %
1.280	3	0.01 %
1.290	3	0.01 %
1.300	3	0.01 %
1.310	3	0.01 %
1.320	1	0.00 %

Number of values = 35043, Number of gaps = 813

APPENDIX 16

Cape Jaffa Marina Assessment of Coastal Processes and Impacts, WBM Oceanics Australia, May 2004, Ref No R.B14794.001.01

Cape Jaffa Marina

Assessment of Coastal Processes and Impacts

Prepared For:	Tonkin Consulting
Prepared By:	WBM Oceanics Australia

Offices

Brisbane
Denver
Karratha
Melbourne
Morwell
Newcastle
Sydney
Vancouver

DOCUMENT CONTROL SHEET

WBM Oceanics Australia Brisbane Office: WBM Pty Ltd Level 11, 490 Upper Edward Street SPRING HILL QLD 4004 Australia PO Box 203 Spring Hill QLD 4004 Telephone (07) 3831 6744 Facsimile (07) 3832 3627 www.wbmpl.com.au ABN 54 010 830 421 002	***Document:***	R.B14794.001.01.coastal management.doc
	Title:	Cape Jaffa Marina Assessment of Coastal Processes and Impacts
	Project Manager:	DCP
	Author:	DCP
	Client:	Tonkin Consulting
	Client Contact:	Jeff Tyler
	Client Reference:	
	Synopsis:	Assessment of potential impacts and coastal management and impact mitigation strategies associated with the proposed marina and canal development at Cape Jaffa. The assessments have involved wave propagation modelling and calculation of time series longshore transport rates, together with shoreline change modelling to predicy impacts on the beach system. Sand bypassing is proposed as the key strategy for dealing with the effects on longshore transport. Other general coastal management procedures are also outlined.

REVISION/CHECKING HISTORY

REVISION NUMBER	DATE	CHECKED BY		ISSUED BY	
0	24 November 2003		Craig Witt		Dean Patterson
1	20 May 2004		Craig Witt		Dean Patterson

DISTRIBUTION

DESTINATION	REVISION										
	0	1	2	3	4	5	6	7	8	9	10
Tonkin Consulting	Digital 1	Digital 1									
WBM File	1	1									
WBM Library	2	2									

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

It is proposed to develop a marina and canal waterway at Cape Jaffa, to be excavated within the existing onshore land, with a channel connection to the sea across the present shoreline. The waterway will be fully tidal. The entrance channel will extend about 500m seaward of the beach line at a depth of about 3.5m (below AHD). The entrance channel will be protected from waves and sand inflow by breakwaters.

The site location is shown in Figure 1-1. An aerial photograph of the site is presented in Figure 1-2, illustrating the nature of the coastal area involved. A conceptual layout design of the proposed marina and canal system is shown in Figure 1-3.

The Cape Jaffa coastal processes have been investigated for the present study in order to assess likely effects on shoreline stability of the proposed channel and breakwaters. This investigation has involved both review of the geological (past 6,000-7,000 years of the Holocene period) evidence and analytical calculation of wave and sand transport processes. The findings have been used to investigate likely shoreline responses and management strategy options, specifically addressing the requirements for sand bypassing.

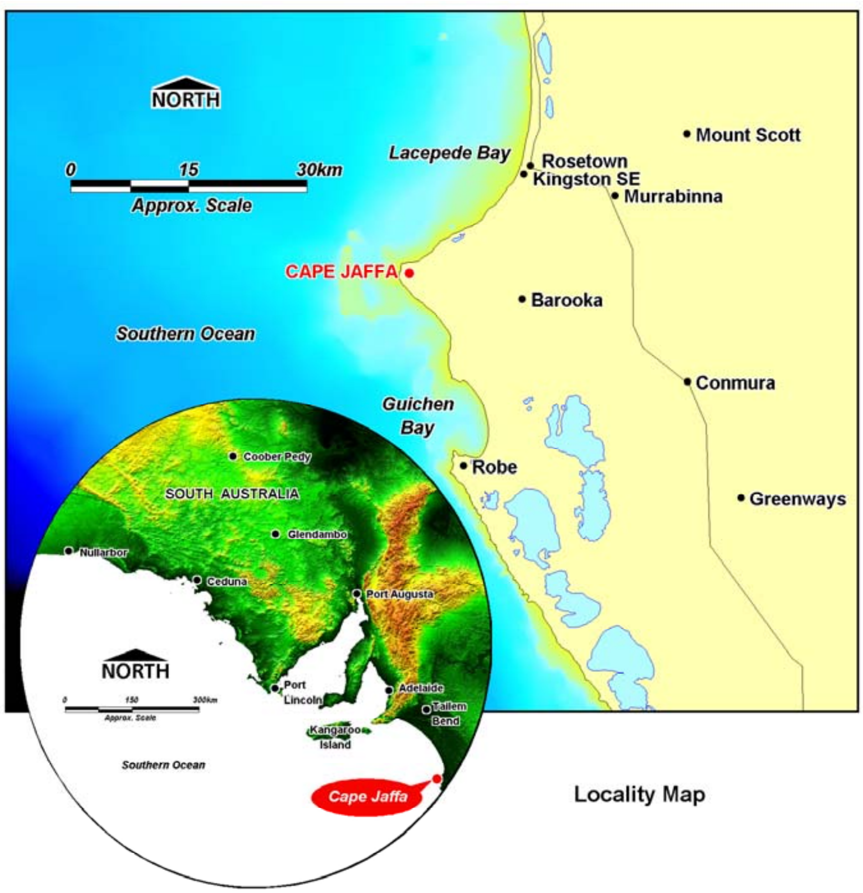


Figure 1-1 Cape Jaffa Locality Plan

Figure 1-2 Aerial Photograph of Cape Jaffa

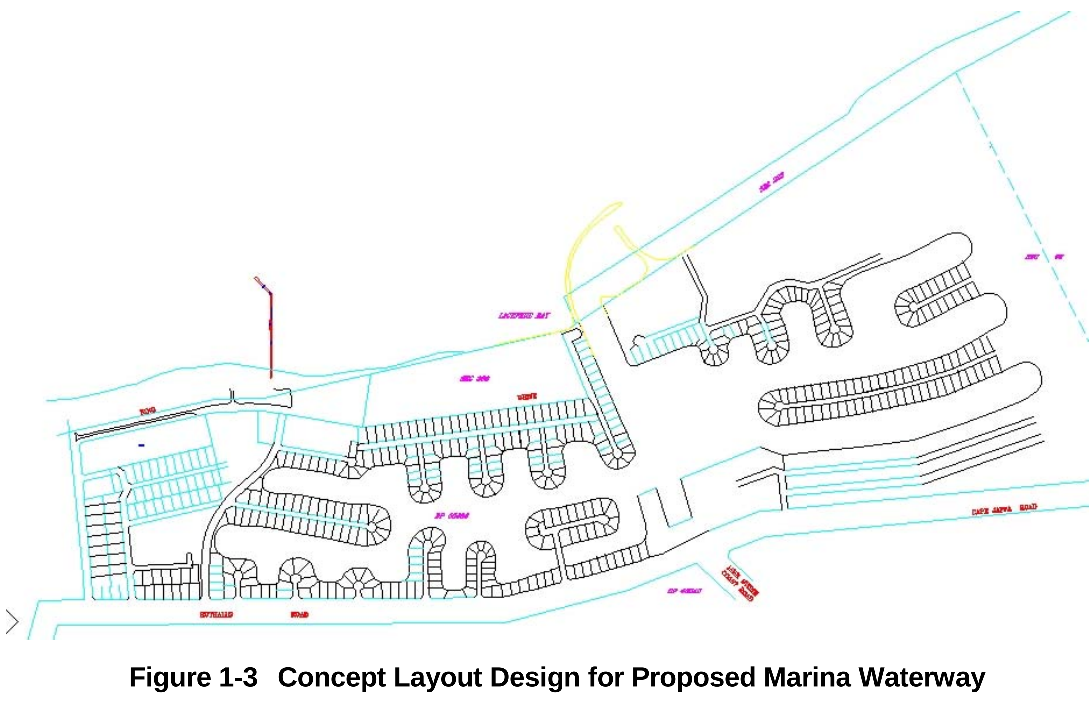


Figure 1-3 Concept Layout Design for Proposed Marina Waterway

2 REVIEW OF GEOLOGICAL EVIDENCE

The recent geology of the shoreline at Cape Jaffa shows clear evidence of substantial net accretion over the 6,000 to 7,000 years since the end of the last major transgression of the sea. This is seen in the context that, between 18,000 years and about 7,000 before present, the sea level rose some 120 metres, creating a new shoreline. The present day shoreline has evolved since that time.

Where there has been significant accretion of the coast, as at Cape Jaffa, there is an 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 as the supply of sediment diminished relative to its removal.

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

2.1 Findings from Short & Hesp (1980)

The 190km section of curving sandy coast from the Murray Mouth to Cape Jaffa represents a classic example of spatial variation in nearshore energy and beach surfzone morphology controlling the evolution, extent and nature of the entire coastal system. Two factors are paramount in the evolution of this coast; the gradient of the nearshore profile and the breaker wave energy.

Whereas the 10m water depth occurs at about 2km offshore near the Murray Mouth, it is some 18km offshore at Lacapede 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), has a significant effect in attenuating wave energy at the shore at Cape Jaffa.

The Lacapede Bay coastal unit extends some 21km from around Kingston to Cape Jaffa. Although Short & Hesp (1980) describe the wave energy here as 'zero', this is not strictly the case. Wave energy does affect this shoreline and causes significant sand movements, albeit at much lower level than at the shoreline further to the north-west.

Short & Hesp describe nearshore sand waves and their effect in controlling the shoreline shape and behaviour. This has since proven to be not the case, the shallow nearshore protrusions in fact being hard limestone bedrock. Nevertheless, these protrusions do have effects on the shoreline shape through their effects on wave propagation.

Short & Hesp describe the beaches of the area as:

- Low to moderate beach gradients;
- Medium to coarse sand;
- 70-80% carbonate content;
- Relatively wide Holocene accretionary dune system of average width about 1.65km, featuring extensive recurved spits, enclosed lagoons and beach ridges.

Most 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 Lacapede Bay."

The clear implication of this is that the sand that now forms the coastal dune system at Lacapede Bay has been derived from material moving along the coast from around Cape Jaffa 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 and North Rock form part.

This is supported by the existence of accreted dunes at the tip of the Cape itself and the relatively high (10m) and extensive dune accumulation to the southeast 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.

Figure 2-1 shows the spatial extent of the Holocene accretion of the shoreline. It occurs predominantly along the 21km between the jetties at Cape Jaffa and Kingston, pinching down to narrower dune system width beyond Kingston. Figure 35 of Short & Hesp (1980) indicates an average dune volume along this length of about 10,000m^3/m, reducing to about 2,000 m^3/m for a further (approx.) 20km past Kingston. This suggests a total dune system accumulation of about 250x10^6 cubic metres of sand since the sea level reached its present level about 6,000 to 7,000 years ago, an average of about 35,000 to 40,000 m^3/yr.

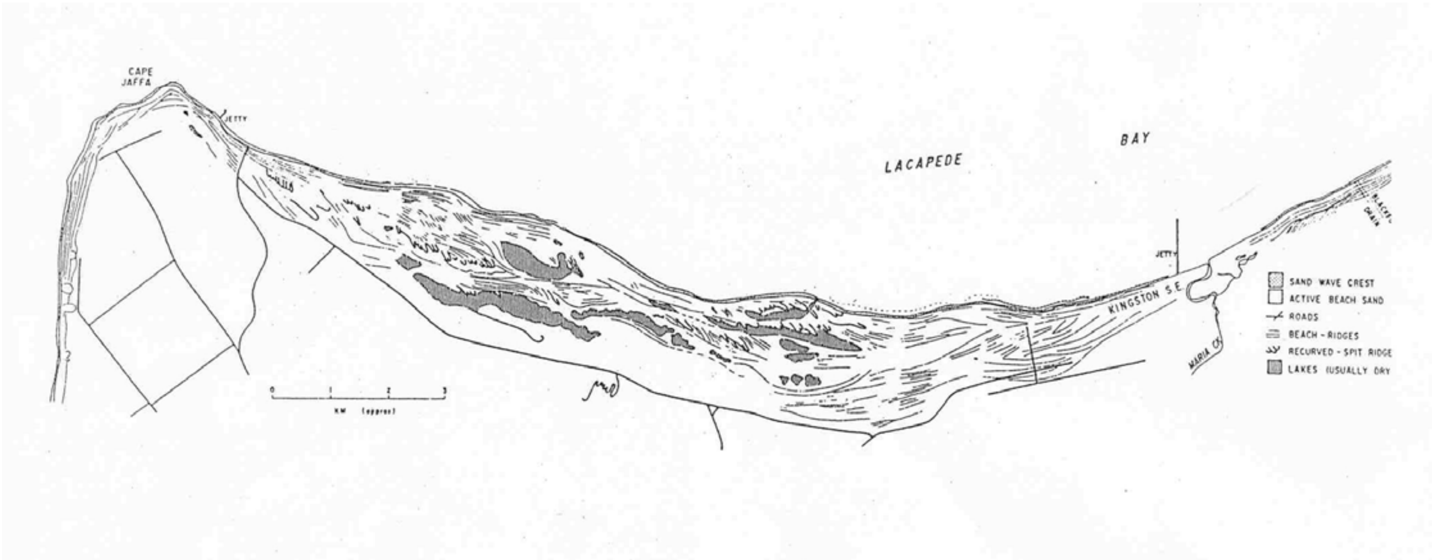


Figure 2-1 Morphologic Forms of the Cape Jaffa Holocene Coastal Plain (recurved spits, beach ridges & lakes

2.2 Contemporary Processes

The typical Holocene shoreline evolution pattern in other areas would suggest that the present day sand supply and sand transport regime at Cape Jaffa is not a direct match of the average conditions over the past 6,000-7,000 years. Some of the sand now forming the onshore coastal system may have been supplied directly onto the shore from adjacent nearshore areas rather than alongshore, particularly during the initial period after the sea level still-stand and prior to extensive colonization by seagrass. As well, the onshore supply may have been much stronger initially than is presently occurring. It is commonly understood in other coastal areas that the sea transgression swept large quantities of sand onto the shoreline up to about 3,000 years before present, after which the rate declined and the ongoing process has shifted towards longshore redistribution of that sand.

There is evidence of recent (at least since the 1940s) erosion of the shoreline at the development site. This may be part of a natural pattern of erosion and accretion that has persisted for millennia, with net accretion as identified, or an outcome of reduced sand supply relative to the rate of longshore removal. Nevertheless, it is clear evidence that:

- longshore transport of sand continues to occur at this site, and
- the contemporary shoreline response is not consistent with the long term Holocene average pattern of behaviour.

With respect to interpretation of the geological evidence as an indicator of the longshore transport rate, it is feasible that:

- the present day rate of shoreline accretion is significantly less than the longer term average, and
- not all of the sand in the coastal dune system was sourced as longshore supply past Cape Jaffa.

As such, it would follow that the contemporary rate of movement of sand along the coast from Cape Jaffa past the study site may be significantly less than the long term (Holocene) rate of sand supply as determined from the extent of dune sand accumulation.

That is, the long term average longshore transport of sand past the proposed development site is most likely to be less than about 30,000 m^3 per year, and more probably less than 20,000-25,000m^3/yr. In that regard, a rate of about 25,000m^3/yr may be regarded as the upper limit, with a possibility that the rate could be significantly less.

3 ANALYSIS OF SAND TRANSPORT AND BYPASSING REQUIREMENTS

Modelling and analyses have been undertaken to determine:

- Swell and 'sea' wave propagation behaviour;
- Wave characteristics at the beach;
- Longshore sand transport rates, both seasonal and long term; and
- Likely responses of the shoreline to the proposed works.

Wave information has been obtained in the form of hindcast sea and swell from the British Meteorological Office (BMO) from their global wave model. It has the form of 6 hourly time series values of wave height (Hsig), period (spectral peak Tp) and direction (true) for both sea and swell. The information has been obtained for a site in deep water offshore from Cape Jaffa. Wind speed and direction from the model have also been obtained to assist in determining locally generated fetch-limited 'sea' waves at the study site for the north to north-west directions.

Conventional two-dimensional wave propagation modeling has been undertaken using the well-known SWAN software package that includes the effects of refraction and bed friction attenuation. Wave height and direction factors have been derived from the modeling and used to develop algorithms for determining the equivalent values immediately offshore from the site. These algorithms, together with provision for further wave propagation to the breakpoint have also been included in the analysis within a sand transport calculation spreadsheet, providing for nearshore refraction and bed friction attenuation.

Conventional one-line shoreline evolution analysis has then been carried out to determine the likely shoreline response to channel breakwater construction, in the form of potential up-drift accretion and down-drift erosion patterns. This has been used to assess the nature and extent of sand bypassing required to maintain shoreline stability.

3.1 Wave Propagation Analysis

The SWAN wave model used for the analysis of wave propagation from deep water to the site extended over an area 60km x 60km (refer Figure 3-1). Water depths were derived from available charts of the region, and converted to approximate Mean Sea Level datum.

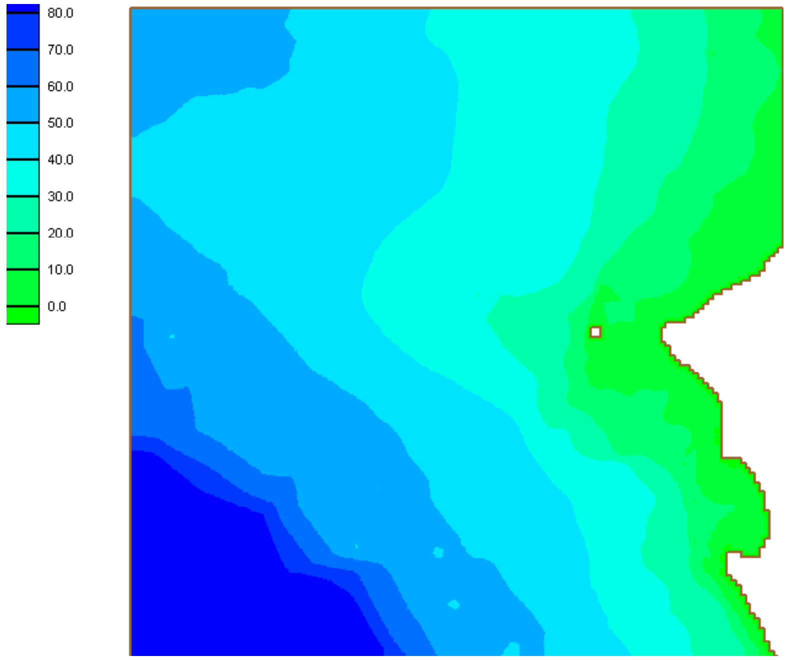


Figure 3-1 Spatial Extent of SWAN Wave Model – 60kmx60km

Swell waves were modelled as two spectral peak periods (10 and 14 seconds) and two wave heights (2m and 4m) to identify any differences in wave height and direction factors between deep water and the study site for different wave conditions. Tests were run for a range of representative directions. Waves from directions north of west were treated as shorter period 'sea'.

The wave model results are summarized in Figure 3-2 and Figure 3-3 in terms of wave height factors and nearshore versus deep water wave directions. Algorithms giving the initial wave transformation factors to the nearshore area were derived by curve fitting in MS Excel.

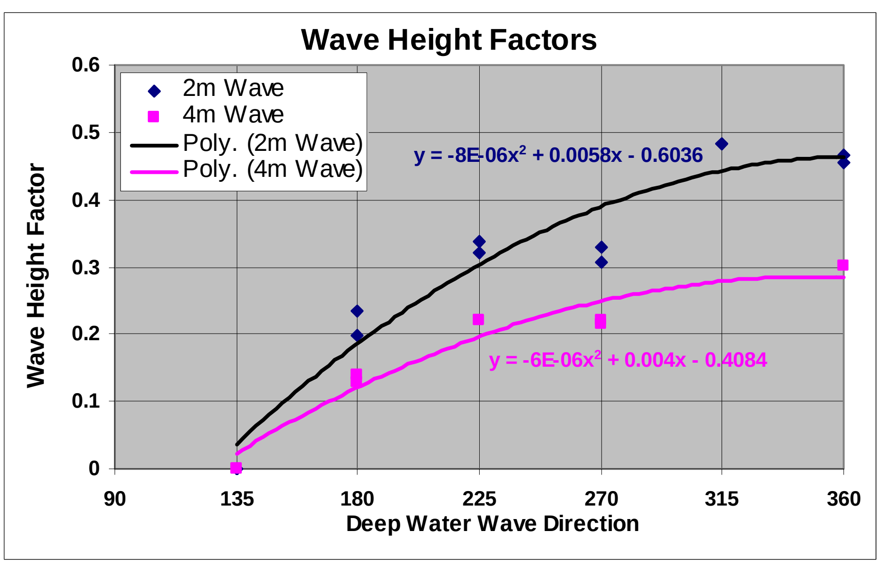


Figure 3-2 Refracted Wave Height Factors

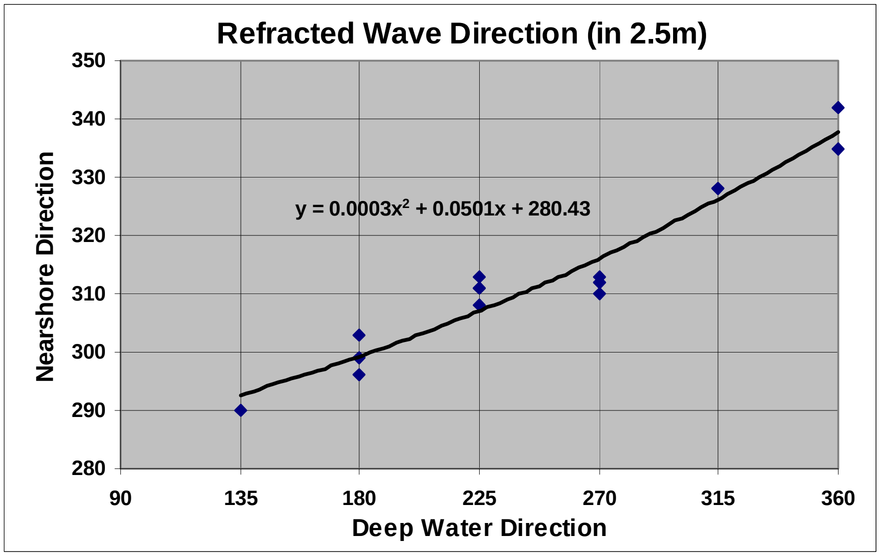


Figure 3-3 Wave Direction Transformation

It can be seen that, as would be expected, the wave height factor is strongly related to the deep water wave height. This is because bed friction attenuation is a significant factor, being strongly increased with larger waves. 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 (default values in SWAN).

Table 3-1 shows the results of sensitivity tests using the methods of Madsen and Collins, as described in the SWAN manual. It can be seen that the Madsen method leads to considerable attenuation compared with that of Collins for this application. A Collins friction factor of 0.03 was adopted, although there is no basis for calibrating it directly other than by general subjective observation, as discussed with local fishermen. Nevertheless, there could be some basis for lower wave height factors than those derived from the adopted method and friction coefficient, based on the indications of the Madsen results.

Table 3-1 Results of Sensitivity Tests for Bed Friction Attenuation

Method	Friction Coefficient	Wave height Factor
Collins	0.015 (default)	0.36
Collins	0.030	0.30
Madsen	0.050 (default)	0.23
Madsen	0.10	0.16

Note: Sensitivity tests are for SW swell; Hs = 2m; Tp = 10s; propagating to water depth of 4.5m off Cape Jaffa

The importance of bed friction attenuation of waves traversing the extensive shallow nearshore zone in reaching Cape Jaffa is illustrated in Figure 3-4. This shows the extent of wave height reduction over a distance of 5km for the Cape Jaffa nearshore profile, with Collins friction factor of 0.03. This example also illustrates the effect of wave height on the attenuation factor, the larger waves being reduced relatively more due to their greater orbital velocity at the bed.

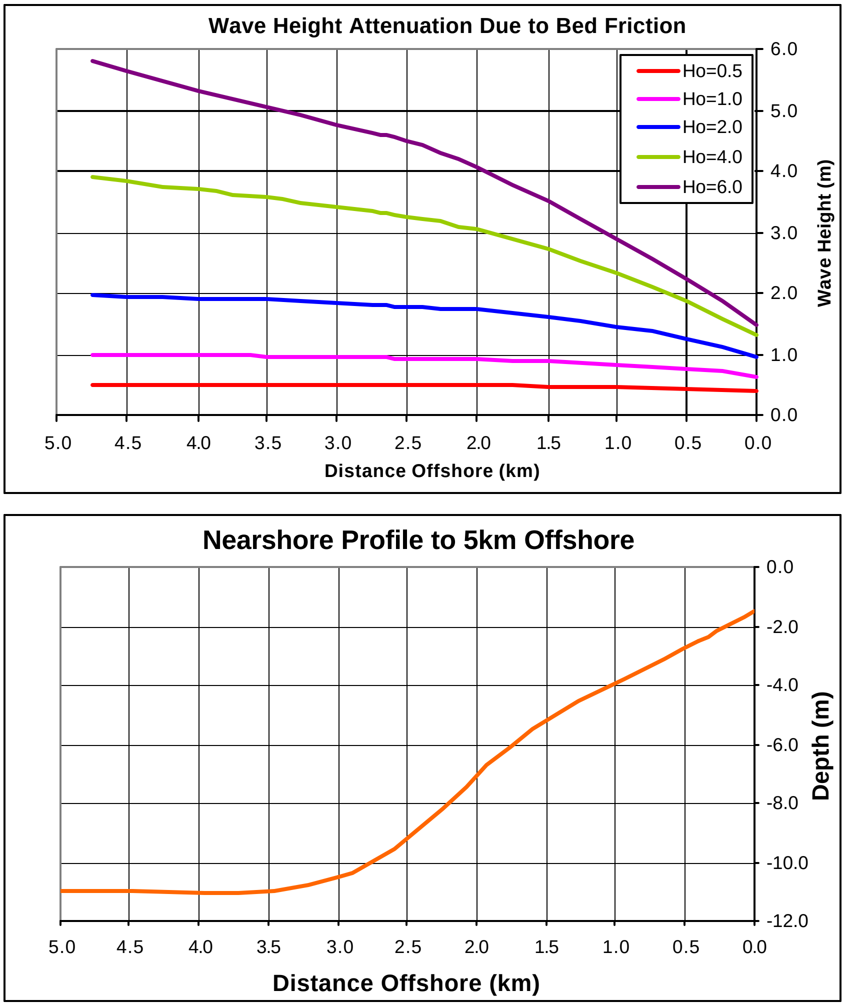


Figure 3.4 Example of Nearshore Wave height Attenuation by Bed Friction

Thus, even without refractive effects, waves at the shore would never exceed about 1.5m regardless of the deep water height. The effects of refraction will reduce heights further, such that waves at the Cape Jaffa shoreline would not be expected to exceed about 1m (Hs) height at any stage. This is consistent with advice from the local fishermen, although they indicate that maximum waves (Hmax) sometimes wash over the jetty.

3.2 Measured Nearshore Wave Heights

Some limited wave information has been provided as part of the present studies from water level data collected at the Cape Jaffa jetty. The recorder uses a high resolution laser sensor with sample water surface levels each second, providing both five-minute averages for the tide and five-minute maxima and minima from which the wave height (Hmax) variation may be derived.

An example of the data for the period September to November 2003 is presented in Figure 3-5. The H_{max} values have been determined for 'running' 20 minute blocks and converted to significant wave height (H_s) values using conventional relationship factors. As well, the wave heights at the recorder have been converted to equivalent breaking wave heights at the beach, also using conventional shoaling and breaking wave criteria. The resulting wave heights are shown in Figure 3-6.

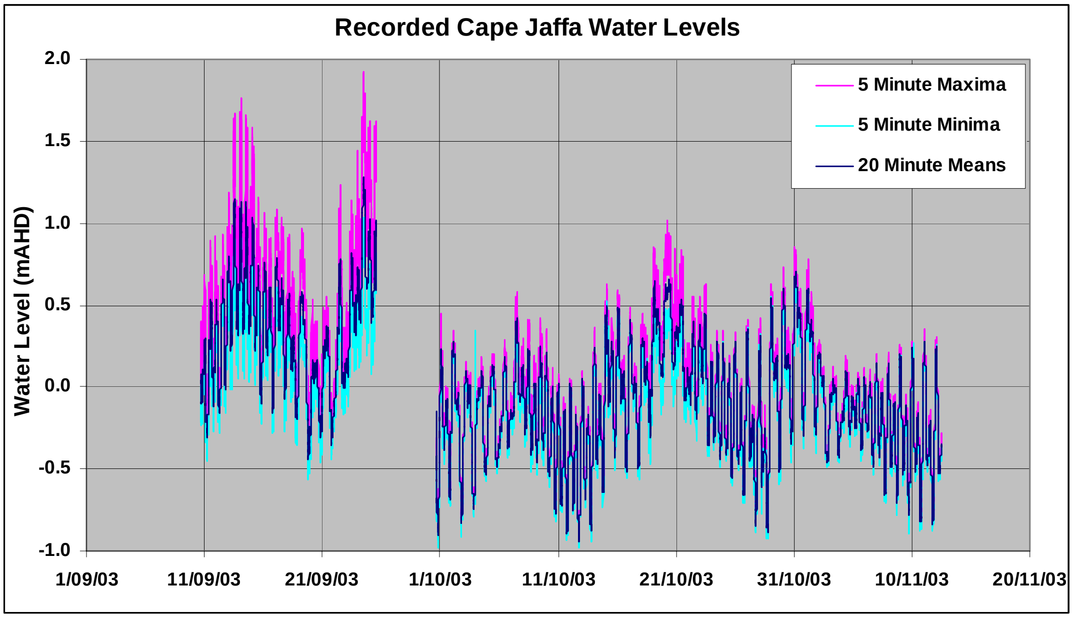


Figure 3-5 Water Level Data – Cape Jaffa Jetty

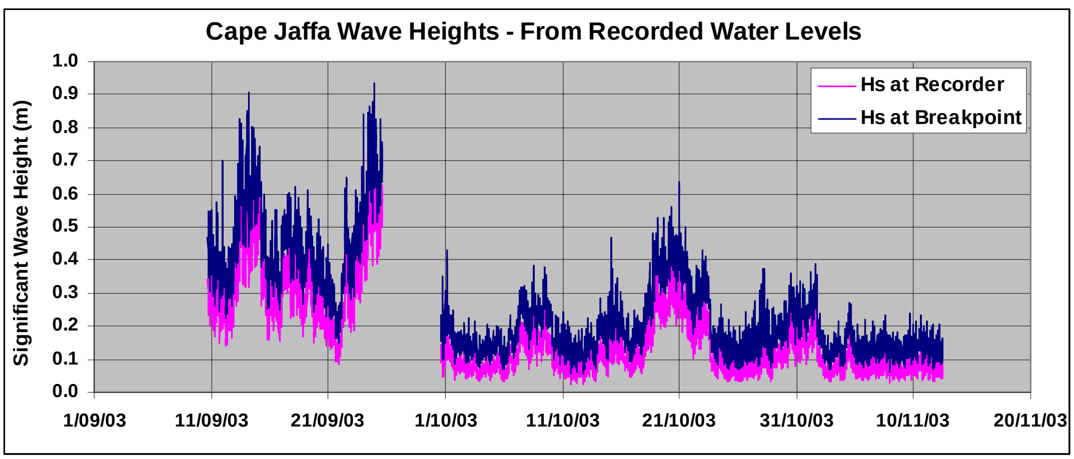


Figure 3-6 Derived Recorded Significant Wave Heights for Cape Jaffa

As an indicator of approximate reliability of the wave propagation modeling and transformation modeling undertaken, as described above, the recorded data may be compared with deep water ocean wave information obtained from Buoyweather model data available directly from the internet on a daily basis (Figure 3-7). This data is not separated into 'sea' and 'swell', as is done for the BMO data, and its reliability and compatibility with the BMO data are not known.

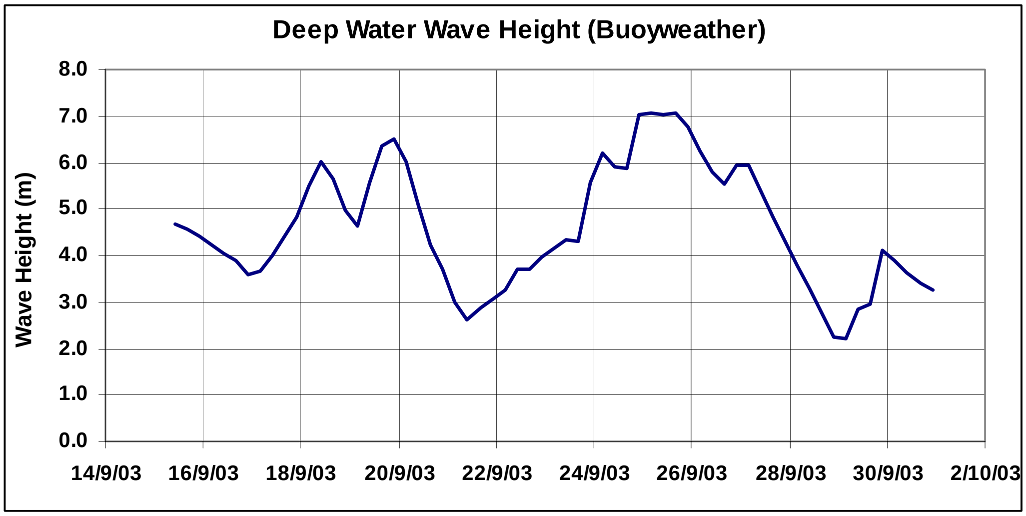


Figure 3-7 Deep Water Ocean Wave Heights from Buoyweather Internet Site

Nevertheless, it can be seen from these data that:

- there is substantial wave height reduction from deep water to Cape Jaffa with nearshore wave heights peaking up to about 0.7m, even with deep water ocean waves up to 6-7m height, reasonably consistent with the modeling;
- however, there is an indication that the modeled wave height reduction factors as presented in Figure 3-2 may be somewhat too high (for example, the above case indicates a factor as low as 0.1 for west to southwest waves), probably related to the bed friction coefficient value adopted; and
- for more accurate prediction of the nearshore wave heights, a reduction by up to 20-30% in the wave height reduction factors in Figure 3-2 may be warranted.

This analysis gives confidence that the modeled wave transformation processes are reasonable and sufficiently reliable, though conservatively high, for impact assessment and planning purposes. However, for the purpose of deriving a 'best estimate' of the waves and sand transport rates, a reduction in the nearshore swell wave heights of 15% has been adopted. This is consistent with the indication from the data that bed friction plays a greater role in attenuating wave heights than the modeling shows, but remains conservative in terms of the sand transport rates and consideration of management (bypassing) options considered herein.

3.3 Calculation of Longshore Sand Transport

Time series of longshore sand transport rates have been calculated at 6 hourly time increments for the 3 year period January 2000 to December 2002, for which deep water wave information has been obtained from the British Meteorological Office. Thus, 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 modeling for a location immediately offshore from the Cape Jaffa site;

- 'Sea' wave hindcasting from the BMO model winds for the north-west (270° to 360°) direction sector;
- Further wave propagation to the breakpoint, including additional refraction and bed friction attenuation over the distance involved;
- Calculation of equivalent daily sand transport rates for both sea and swell using the conventional so-called CERC relationship (CERC 1977, 1984) in the form:

  $S = K.\ H_b^2.\ n_b.\ c_b.\ \mathrm{Sin}2\theta_b$ (m^3/day)

  Where:
  H_b = Significant breaking wave height
  n_b = Group velocity (approx = 1)
  c_b = wave celerity at breakpoint
  θ_b = wave angle to shore at breakpoint
  K = factor depending on grain size and possibly wave height and/or breaker type
- 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 $0.125x10^6$ to $0.79x10^6$ by various authors for a range of circumstances, where the transport rate is equivalent to m^3/yr. This is equivalent to 340 to 1730 for daily rates. It has been 'calibrated' at 1120 for the Gold Coast beaches where the median sand grain size is 0.22mm (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 thus the likely variation of K as a function of grain size. Figure 3-8 illustrates the effect of grain size for typical Cape Jaffa wave/current conditions, based on the van Rijn method.

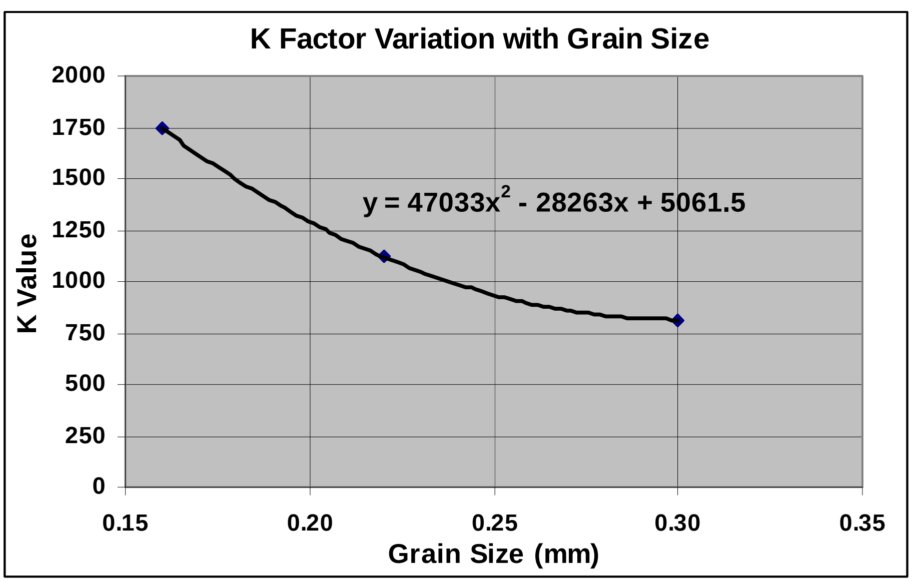


Figure 3-8 Variation of K Factor with Grain Size

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 (D_{50}) size of 0.30mm (Figure 3-9). 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.

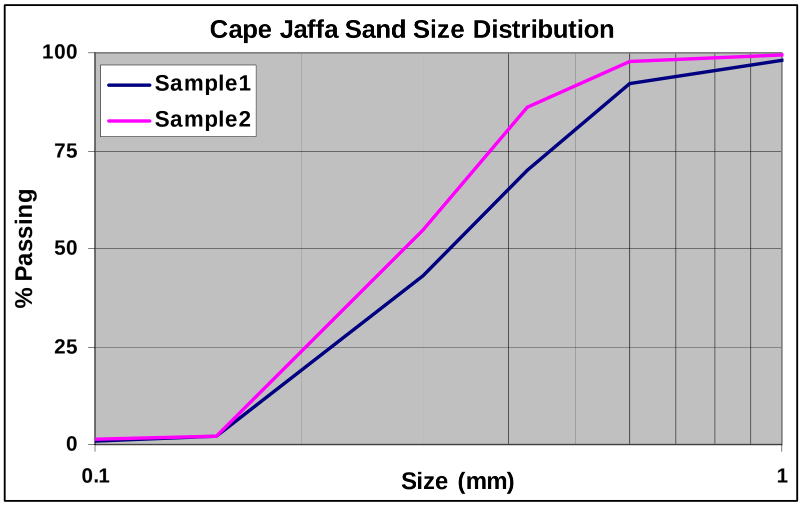


Figure 3-9 Beach System Sand Grain Size Distribution

The calculated sand transport rates are presented in Figure 3-10, Figure 3-11 and Figure 3-12 as 6 hourly time series values of equivalent daily transport for each of the three years of available wave data respectively. It can be seen that:

- There is a clear seasonal pattern to the transport, with most movement taking place 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 200m^3/day;
- While swell waves consistently cause transport up the coast, locally generated 'sea' waves may lead to downcoast transport from time to time.

Cumulative annual transport rates for each of the three years analysed are:

YEAR	**TRANSPORT**
2000	16,300 m^3/yr
2001	12,800 m^3/yr
2002	16,100 m^3/yr
AVERAGE	~15,000 m^3/yr

The uncertainty of these calculations must be recognized. The average annual longshore sand transport rate is likely to be (order of) 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. This rate is consistent with but somewhat lower than that derived as the long term Holocene average from the geological evidence. Information on recent geological behaviour, as opposed to the 6,000-7,000 year average, is not available as a basis for correlation with the calculated rates.

It should be noted that, even without the 15% reduction in nearshore wave heights as discussed in Section 3-2 above, the calculated average annual sand transport for these three years is about 20,000m^3/yr (calculated at 21,000m^3/yr). This would represent an upper limit to the rate as derived from the modeling.

Analysis of shoreline changes at the site (Coastal Management Branch 1984) indicates a retreat of about 60m along a length of some 400m upcoast of the Cape Jaffa jetty over the 30 year period 1945 to 1975. This represents a quantity of about 120,000 m^3, assuming it involved the beach berm and foredune over a vertical height of about 5m. This represents an annual loss of 4,000m^3/yr, expected to be alongshore. On the basis that this loss is due to an alongshore differential in longshore transport, and that the inflow to that section of beach is unlikely to be zero over that time (assume say 50-80% of the outflow), a minimum transport rate out of that section of 8,000-20,000m^3/yr is indicated.

While the uncertainty in the average annual transport rate is significant, as reflected in the relatively wide range of possible rates indicated, a basis exists for planning and design of the proposed development, involving an initial stage of monitoring and design refinement. For the purposes of the EIS, impact assessments have been based on an upper limit transport rate (25,000m^3/yr) in the knowledge that the actual rate and its variability may be determined accurately via the monitoring and that management action (sand bypassing) needs to deal with only the rate of transport that actually occurs, as discussed below.

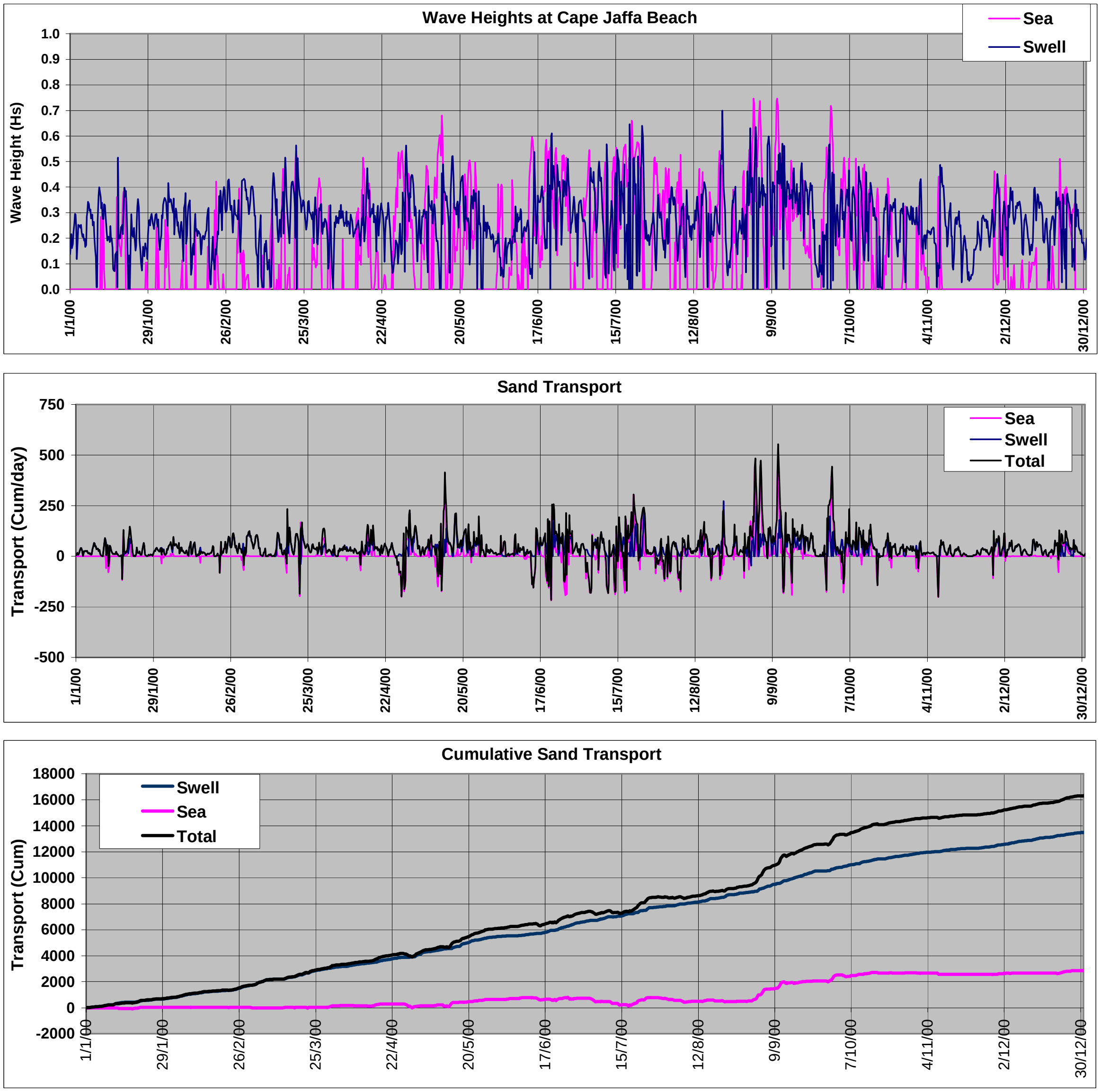


Figure 3-10 Calculated Daily Longshore Sand Transport Rates – 2000

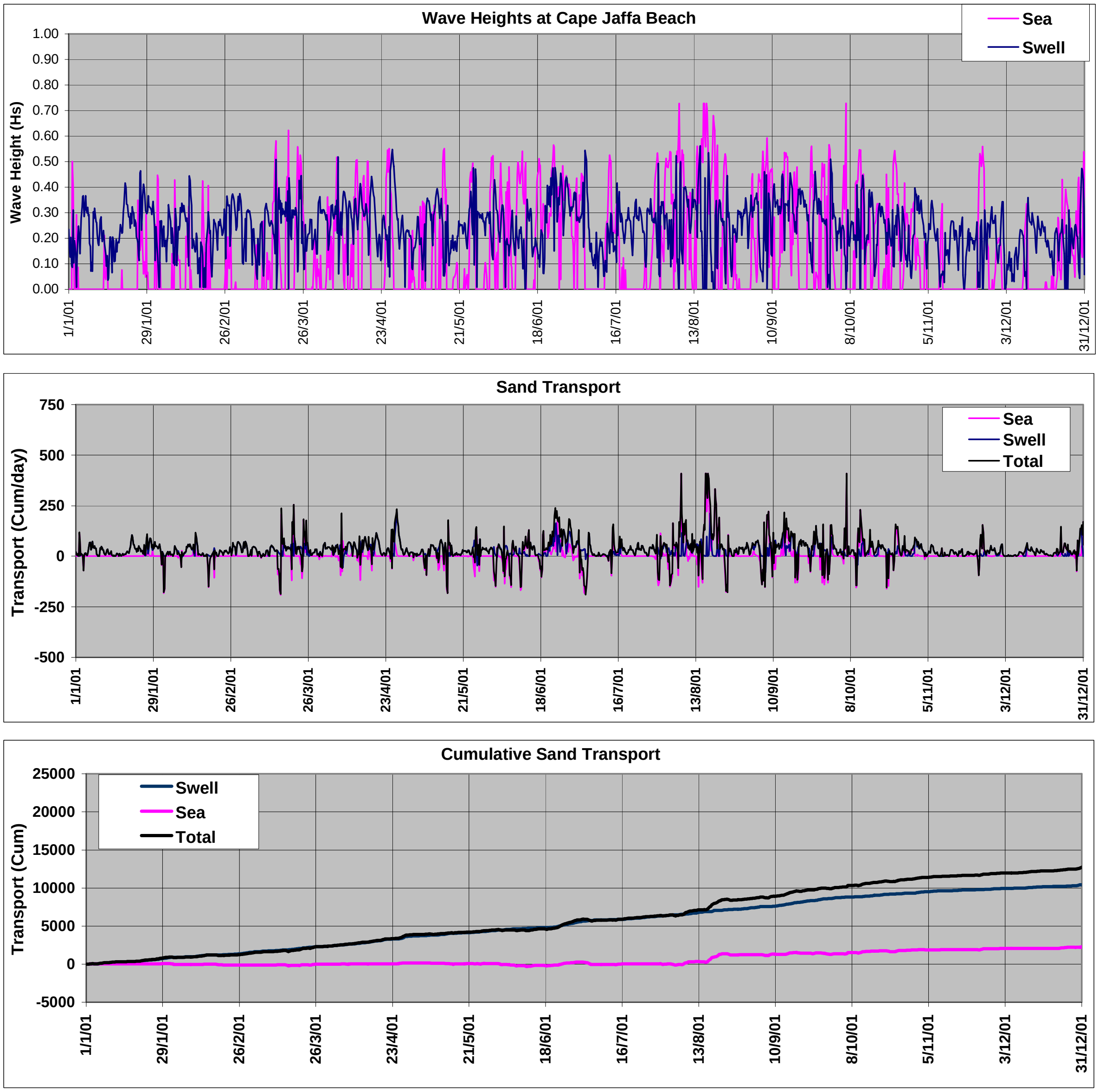


Figure 3-11 Calculated Daily Longshore Sand Transport Rates – 2001

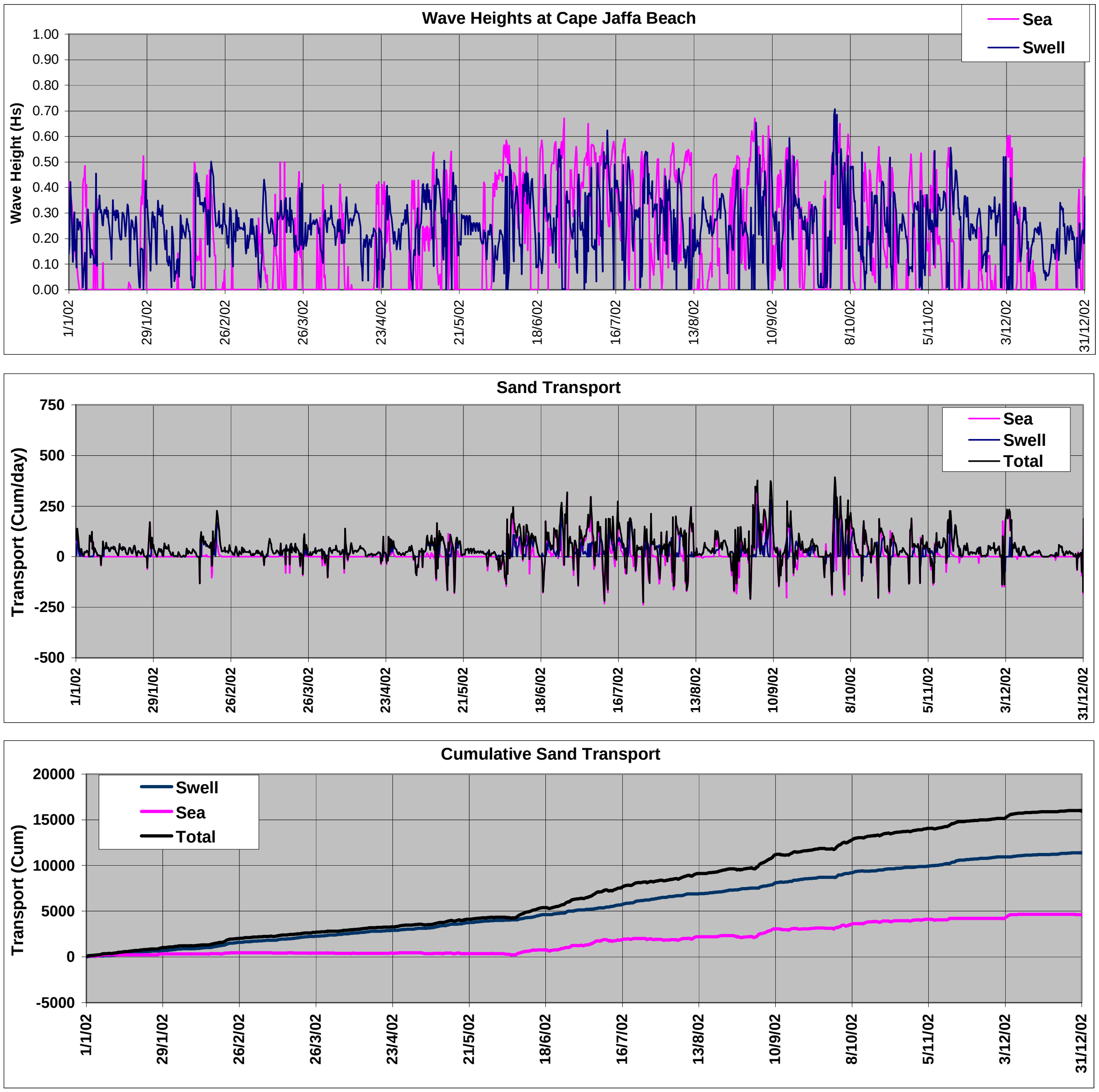


Figure 3-12 Calculated Daily Longshore Sand Transport Rates – 2002

4 ANALYSIS OF SHORELINE IMPACTS

4.1 Response to Marina Entrance Breakwaters

The one-line shoreline evolution modeling software GENESIS has been used to determine the likely response of the beach shoreline to construction of the channel entrance breakwaters and associated management options for dealing with the longshore sand transport.

Based on the above, assessment of potential impacts and, particularly, planning and design of ameliorative action should be based on the expectation that the average annual longshore sand transport rate at the site is in the range 8,000-25,000m^3/yr, and most probably around 15,000m^3/yr. Because of the uncertainty about the actual rate, it is recommended that a management strategy be adopted that:

1 provides for monitoring to determine the actual rate more reliably in the initial stage of development,

2 targets a low to moderate bypass requirement while the monitoring is being undertaken and assessed, and

3 incorporates allowance for the possibility of the 'worst case' upper limit scenario, should it prove to be required.

It is recommended that the strategy involve placing sand (approximately 25,000m^3, being the likely upper limit one year of bypassing) as a buffer on the downdrift beach to accommodate any potential erosion there, while both monitoring and some lower level bypassing are implemented. Over time, the actual bypassing rate may be increased or decreased as appropriate to match the natural sand transport.

Several shoreline response scenario tests have been undertaken. These have been based on the likely upper limit transport and bypassing rate of 25,000m^3/yr in the knowledge that, should the actual rate be less, then the responses will be less acute. Local beach characteristics (grain size and profile shape) were used as the basis for the modeling, together with the time series of nearshore wave height and angle to the shore, as derived from the algorithms described above.

Typical shoreline profiles in the vicinity of the proposed development are illustrated in Figure 4-1.

The GENESIS modeling has included:

- Initial analysis of shoreline response without management action (ie. no bypassing), based on the calculated longshore transport rate of 25,000m^3/yr;
- Analysis of shoreline response with sand bypassing occurring over part of the year, based on the likely upper limit average annual longshore transport rate of 25,000m^3/yr;
- Analysis of shoreline response with initial downdrift beach fill of 25,000m^3 and adaptive sand bypassing to match the actual longshore transport following a year of monitoring, with bypassing in the first year at 20,000m^3/yr.

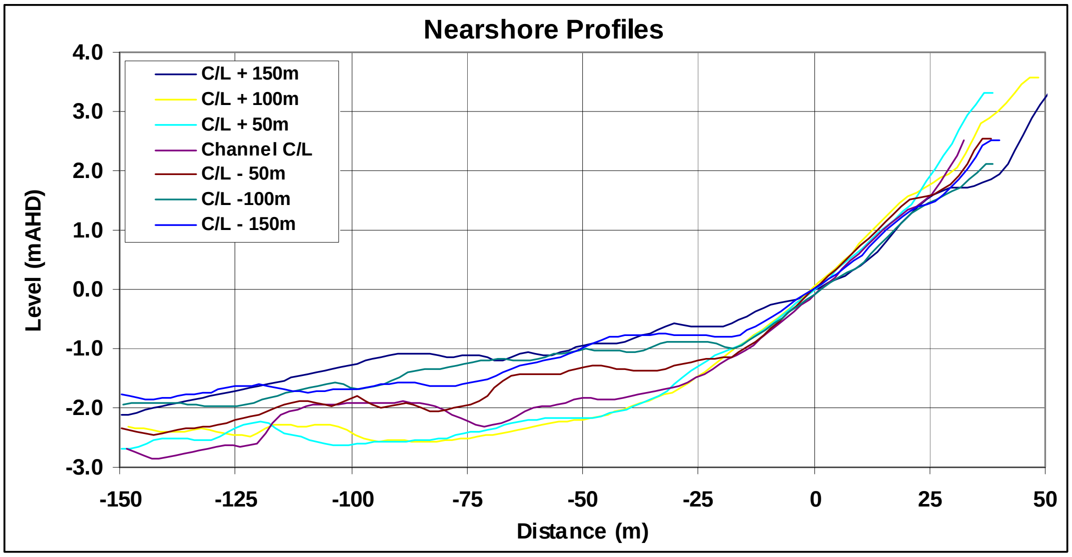


Figure 4-1 Nearshore Profiles at Development Site

The modeling was based on continuous hourly bypassing at rates equivalent to the daily rates. For example, 25,000m^3/yr bypassed over 4 months involves an average of approximately 200m^3/day. That is equivalent to an actual capacity requirement of about 35m^3/hr over each working day of 8 hours, 5 days per week.

The bypassing strategy was assessed in terms of beach response and cost-efficiency of the dredging operation. For example, while it may be more cost-effective to operate the dredging equipment to its capacity over several months each year rather than prolonged dredging at low rate in transferring the required bypassing quantity, the beach response to such infrequent, high level action would be more extreme. The optimum strategy would be assessed on the basis of reactive monitoring of the performance of the system. The primary purpose of the modelling is to demonstrate that such a strategy is both feasible and effective.

Results of the analyses are shown in Figure 4-2 in terms of shoreline change relative to the existing situation. These indicate:

1. If no bypassing is carried out, there is potential for accretion and erosion of the shoreline by approximately 60-70m immediately updrift and downdrift (respectively) of the channel entrance, based on 25,000m^3/yr average annual transport, as shown in Figure 4-2(a). However, this would more likely be significantly (proportionately) less on the basis that the actual transport rate is less. It has been shown that the contemporary transport rate is most probably about 15,000m^3/yr.

2. The longshore sand transport can be managed by implementing bypassing, with or without placement of an initial fill of suitable sand on the downdrift beach.

3. Long term dynamic beach stability can be achieved, with the variability of beach width depending on the timing and rate of bypassing adopted. For bypassing of the annual amount over about four (4) continuous months from May to August, as shown in Figure 4-2(b), beach width variation of up to 20-30m could be expected for the adopted upper limit transport rate of 25,000m^3/yr. The extent of beach variability will be proportionately less if:

    a. the transport rate is less (ie. approximately 15,000m^3/yr as calculated), and/or if

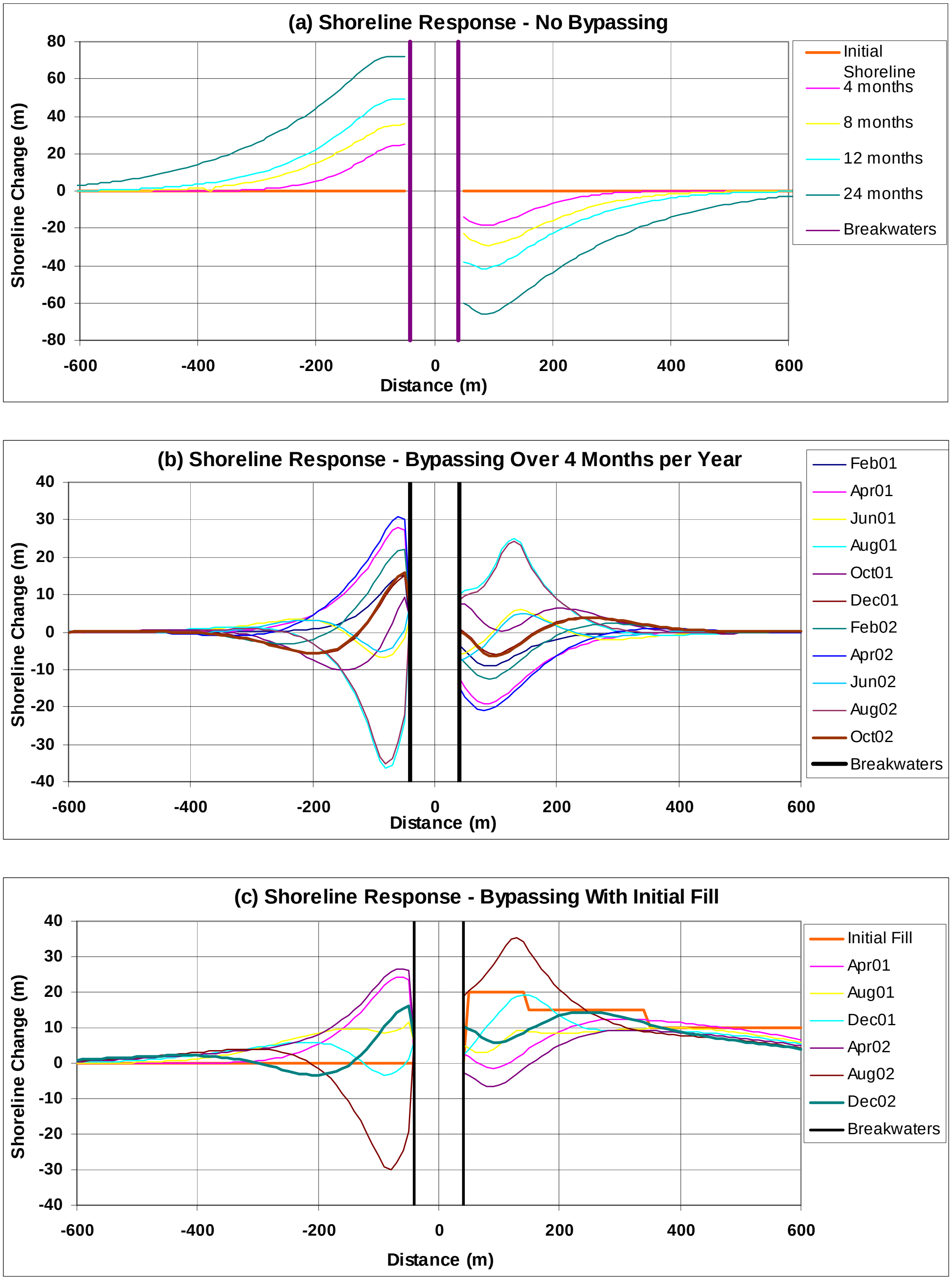


Figure 4-2 Shoreline Responses to Bypassing With and Without Initial Downdrift Fill – Based on 25,000m^3/yr Transport

b. the bypassing were undertaken at a lower rate over a longer period, or at the same rate over several shorter periods each year, thus providing the option of choosing how the operation may be best and most cost effectively implemented.

4. If initial downdrift fill of about 25,000m^3 were placed in conjunction with the development, a substantial buffer would be provided both for the long term and to accommodate short term downdrift erosion while the optimum bypassing strategy is determined from the reactive monitoring. Figure 4-2(c) shows the beach response with initial bypassing of 20,000m^3/yr in the first year and then subsequent bypassing at 200m^3/day over four (4) months May to August, equivalent to the result shown in Figure 4-2(b). Minimal downdrift beach recession relative to the present situation would occur over the first year even if the actual transport is significantly higher than that bypassed. Should the actual transport rate prove to be 25,000m^3/yr, then ample opportunity exists to 'ramp up' the bypassing rate as appropriate.

It is noted that bypassing over just four (4) months would cause temporary retreat of the updrift beach due to removal of the sand at a rate faster than the longshore transport rate over that time. This is evident as the June/August shorelines in Figure 4-2. An alternative strategy has been modelled, based on the case with initial downdrift fill, in which the bypassing in the second and subsequent years occurs at 200m^3/day over two (2) months in May/June and then again over two months in October/November. The result is shown in Figure 4-3, with no significant recession of the beach on either side of the entrance, illustrating the potential outcome of an optimum strategy once it has been properly determined from the monitoring.

A range of further alternative strategies could be modelled. However, the testing undertaken shows that it is feasible and practicable to manage the shoreline impacts provided a capacity to bypass sand at the rates indicated is installed.

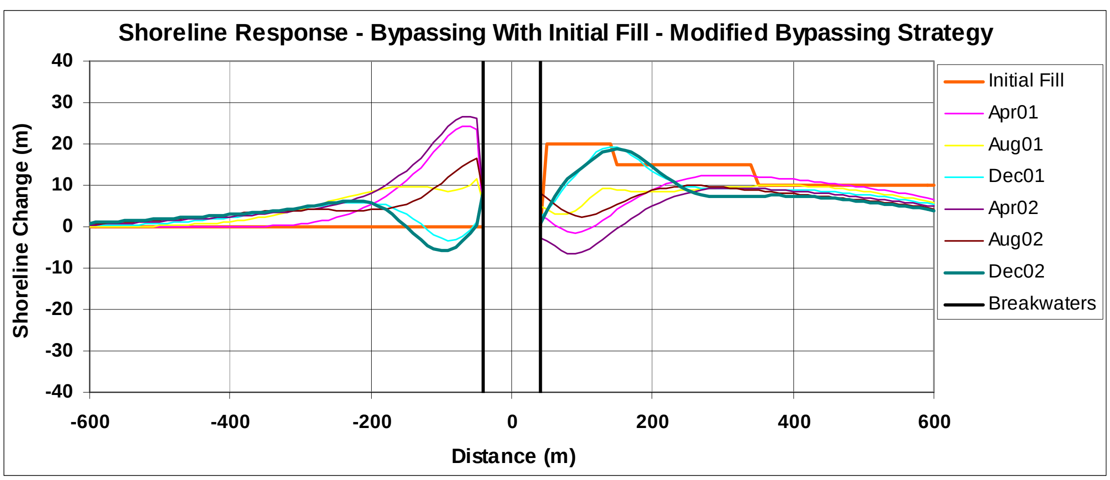


Figure 4-3 Shoreline Response with Revised Bypassing Strategy and Initial Downdrift Fill

4.2 Effects of Climate Change

4.2.1 General Considerations

Current concern with climate change arises from scientific research indicating a discernible human influence on global climate. Increasing concentrations within the earth's atmosphere of various gases, largely derived from the burning of fossil fuels, are trapping solar radiation. The resulting global warming (enhanced Greenhouse Effect) has the potential to change weather systems (Walsh et al 1999), rainfall patterns, wind velocities and, significantly, cause mean sea level to rise (McInnes et al 1998 and Walsh et al 1998). These factors all can have an impact on the environment within the coastal zone.

The Institution of Engineers, Australia, National Committee on Coastal and Ocean Engineering recommends that the possible impact of climate change associated with the 'Greenhouse Effect' should be included in the design process for coastal developments. Further, a robust design philosophy should be adopted which examines the consequences of failure and if this is significant and/or the design life is long, this robustness ensures that the design can either cope with or be adapted to the climate change.

4.2.2 Sea Level Rise

Recorded data indicates a global sea level rise of 1.0 to 2.0 mm/yr during the 20th century, with a central rate of about 1.5 mm/yr. A diagram showing the mean sea level evident during the last century at Fort Denison, Sydney Harbour, is shown in Figure 4-4 and indicates that sea level rise has occurred as a stepped rather than constant function.

Sea-level rise is caused by a number of processes that operate on different spatial scales. On the global scale, the dominant contributions to sea level rise are expected to be thermal expansion of oceans and transfer of water from melting glaciers and ice sheets.

Estimation of climatic change effects is made using numerical simulation of the earth's climate system. The models used are extremely complex and extensive and, while there has been considerable improvement over the past decade, the results of such simulations still only provide indicative scenarios rather than definitive predictions. Despite the uncertainty, there is a strong indication that climate change is likely to cause significant increase in the rate of sea level rise.

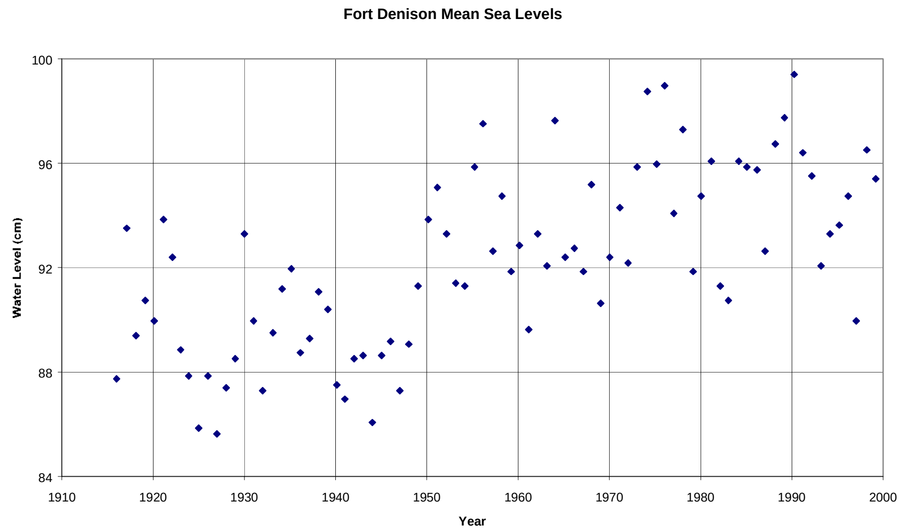


Figure 4-4 Historical Annual Mean Sea Levels at Fort Denison, Sydney Harbour

There are uncertainties as to the actual magnitude and rate of rise of sea level as a result of thermal expansion of the oceans and transfer of water from melting of glaciers and ice-sheets. This has lead to various scenarios being adopted by the Intergovernmental Panel on Climate Change (IPCC). They are based on the range of model results available and dependant upon the amount of future emissions assumed. The Institution of Engineers, Australia, National Committee on Coastal and Ocean Engineering recommends that these values be used for planning and design.

IPCC 2001 redictions for sea level rise predictions for the period over the next century from 1990 to 2100 obtained from Atmospheric-Ocean General Circulation Models (AOGCMs) indicate:

- Ocean thermal expansion component of 0.11 to 0.43m accelerating through the 21st century;
- Ocean mass (ice melt) contribution of 0.01 to 0.23m;
- A ‘Greenland’ contribution of –0.02 to 0.09m; and
- An ‘Antarctic contribution of –0.17 to 0.02m.

The sum of these components gives a range of 0.11 to 0.77m with a central value of 0.44m, the relatively wide range reflecting the systematic uncertainties in the modelling. This most recent estimate is slightly lower than the equivalent 1996 estimates of 0.20 to 0.86m, with a best estimate of 0.49m.

4.2.3 Shoreline Response to Sea Level Rise

It is generally accepted that with rising sea level there is an upward and landward translation of the beach profile. This concept forms the basis of the “Bruun Rule” (Bruun 1962). Figure 4-5 shows how shoreline recession is related to sea level rise.

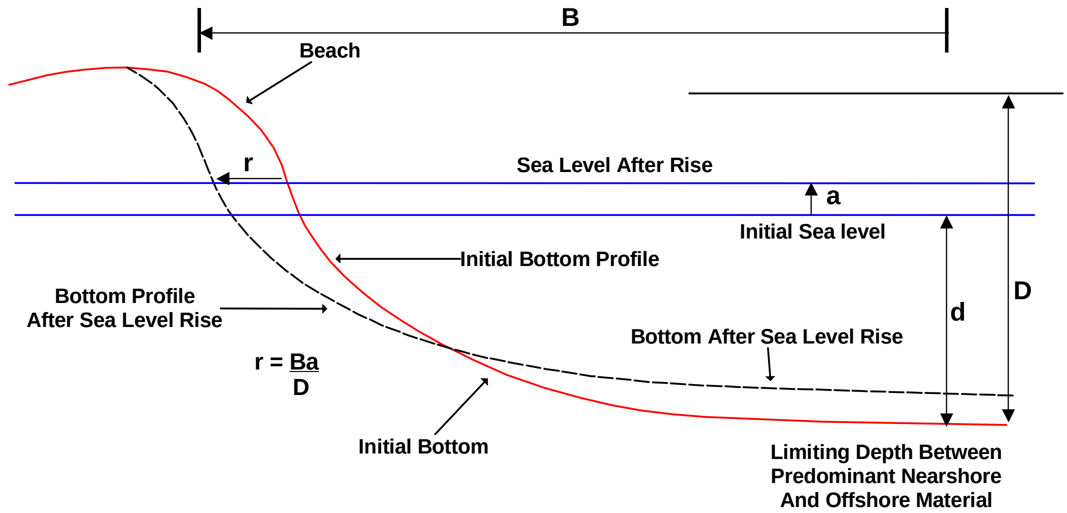


Figure 4-5 Bruun Rule for Shoreline Response to Rising Sea Level

Shoreline recession predicted by the Bruun rule is given by:

$$r = \frac{Ba}{D}$$

where a (metres) is the sea level rise, B (metres) is the width of the bottom influenced by the sea level rise extending offshore to d (metres), the depth of closure, and D (metres) is the depth to closure including the full height of the active profile.

There is debate regarding the most appropriate basis for selecting the value of D, thus introducing even more uncertainty into estimates of shoreline recession due to climate change. Because of the quite low wave climate at Cape Jaffa, with upper limit wave heights around 1m or less, it is considered that the depth (d) of active cross-shore transfer of sand from the beach is small (<2 metres).

For the typical profile slopes derived from surveys in the area (refer Figure 4-1), the calculated shoreline recession distances associated with predicted future sea level rise to year 2100 are in the range 2 to 10m, most probably around 6m.

The Bruun rule is a significant simplification of the processes involved in the sea level rise impact on shoreline recession. Also, it does not take into account the impact of changing weather conditions associated with enhanced Greenhouse Effects such as shifts in wind, and consequently wave, directions and strengths, changed intensities of intense weather systems and changes to rainfall and storm surge intensity.

However, it is considered that the Bruun rule represents the best technique available at this time to assess the shoreline retreat associated with sea level rise and it is generally regarded as being conservative in this respect. For planning purposes, a provision for shoreline retreat at Cape Jaffa of 5-10m would appear appropriate.

5 COASTAL MANAGEMENT CONSIDERATIONS

5.1 Overview

The coastal system will be impacted by the proposed channel and breakwater primarily through interception of the longshore movement of sand along the beach. The form of potential impact is accretion of the beach on the updrift (eastern) side and directly equivalent erosion on the downdrift (western) side of the structures.

It has been shown that the zone of sand movement is quite narrow, extending less than 20m offshore from the beach, due to the relatively small wave heights, evidenced by the low wave heights and the proliferation of thick seagrass beds beyond that width. Thus, it is unlikely that the dredged channel will experience significant siltation, although deposition of weed and some slow accumulation of sand may occur over the longer term.

As well, introduction of more people to the area will increase usage of the beach and, as a consequence, potential damage to the dunal vegetation through pedestrian or vehicle traffic of the vegetated areas. This may lead to wind erosion of the dunes if allowed to occur excessively.

These impacts may be mitigated and/or managed through measures implemented to:

- Monitor the actual behaviour, including quantification of the nature and extent of such impacts;
- Undertake works to transfer beach sand from the updrift side to the downdrift side to prevent excessive accretion that may impact on the channel and, particularly, prevent excessive erosion of the downdrift beach;
- Undertake maintenance of the channel depth through removal of any weed and sand deposition there, sufficient to ensure adequate navigability; and
- Undertake dune vegetation maintenance, including protective fencing of any badly affected areas and provision of controlled access paths, if and as necessary.

Additional to the above, it would be beneficial (but not necessary) to place additional sand on the downdrift beach at commencement of the project, should suitable sand be available from the development site. The sand would need to be essentially of the same nature as the beach sand, considered likely to be the case.

These measures are discussed below.

5.2 Monitoring

5.2.1 Beach Changes

Monitoring of the beach may be undertaken by land survey along profile sections extending from the back of the dune to (at least) low water mark. This will identify any changes in the beach berm width and dune profile.

The profile sections should be located on both sides of the entrance channel, commencing immediately against the breakwaters and spaced at (approx) 10m intervals for the first 100m in each direction and subsequently at 20m intervals to 500m in each direction. The predominant changes caused by the works will occur within 200m of the breakwaters. General changes affecting the whole extent of the monitoring area may not be attributable to the project.

Analysis of the survey data should be maintained and any progressive trends of change identified.

5.2.2 Dune Vegetation

Regular inspections of the dune should be undertaken to identify any initial evidence of vegetation breakdown due to pedestrian and/or vehicular traffic. These inspections could occur at monthly intervals.

Evidence of problems should be reported to Council for review of appropriate remedial action.

It is advisable to maintain a permanent photographic record of the status of the dune vegetation for comparative reference in the future.

5.2.3 Channel Depth

The status of the channel depth should be monitored regularly, at least each six (6) months initially and then, depending on the identified pattern of behaviour, at less frequent intervals. Preferably, sections across the channel should be sounded using conventional echo sounder techniques, with depths converted to standard datum (AHD) via tidal and other appropriate adjustments.

Cross-section surveys will identify the extent of any siltation and any cross-channel differential in the deposition pattern.

The survey cross sections should commence within the entrance channel between the breakwaters and/or marina basin and progress offshore at approximately 10m intervals to about 100m from the seaward end of the breakwater, and 20m intervals beyond that distance. Analysis of the survey data should be maintained and any progressive trends of change identified.

5.3 Shoreline Impact Management

5.3.1 Sand Bypassing

There are two issues to be dealt with in the sand bypassing operations. These are:

- Prevention of excessive accretion of sand and potential leakages into the channel on the updrift side; and
- Ensuring adequate and timely placement of sand on the downdrift side to maintain the beach and dune system there.

Care must be taken to implement a bypassing operation that is flexible in the location and rate of collecting and transferring the sand. For example, simply excavating a hole in the beach with fixed plant to obtain the sand will not be sustainable if it does not draw back the accreting shoreline and guarantee continuing inflow of sand to the system intake.

For the quantities involved here (up to about 25,000m^3/yr), it may be most effective to utilize a slurry pump to transfer the sand. This could be a permanent part of the development infrastructure or mobilized (say) one or two times per year. In either case, installation of a permanent pipeline under the entrance channel for use as required may be a convenient option. A small slurry pump could deliver up to (say) 40m^3/hr (capacity of 200-300m^3/day with downtime), thus requiring about 4 months operation to deliver the annual quantity of sand, allowing for downtime. If the pump is installed at a particular location for extended periods, it would need other plant to deliver the sand to its intake at that rate. This should be feasible with conventional plant operating in a manner compatible within the local environmental and social constraints.

The discharge will need to be placed in a manner compatible with the potential erosion pattern on the downdrift side. That is, the majority of the sand will need to be placed in the section of beach where otherwise most erosion would occur. This can be achieved by moving and extending the discharge pipeline as appropriate, without undue need for other plant to reshape the sand.

Computer modeling has shown that some flexibility exists in how the bypassing is undertaken without adverse effects. Experience over several years, including monitoring as recommended, will allow the procedures and rates to be optimized for best results.

5.3.2 Initial Downdrift Sand Placement

It is likely that a significant quantity of sand from the development site, compatible with the existing beach sand, will be available for initial placement onto the beach system.

This should be placed on the downdrift beach and would provide additional beach/dune width and a buffer against potential future erosion.

Such sand should be placed in a manner that:

- Is consistent with the future shoreline shape in the immediate vicinity of the breakwater, and
- Is predominantly located in the section of beach most susceptible to downdrift erosion while bypassing is not taking place.

Thus, such sand should be distributed along the beach predominantly within about 100-200m of the breakwater, reducing over the zone out to about 500-600m, depending on the total quantity involved.

5.4 Channel Maintenance

It is not expected that significant channel maintenance dredging will be required, provided sand bypassing is implemented effectively. Nevertheless, there will be a certain amount of fine sediment in suspension in the water column and some of that will deposit in the channel slowly over extended time periods. As well, there may be deposition of weed in to the channel and this may require action to remove it to maintain channel navigability.

Removal of this material may be achieved by:

- Suction dredging, with discharge to shore and disposal elsewhere by land plant, or
- Use of a seabed 'scraper' device to bring the material close to the breakwaters where land-based plant could excavate it in similar manner to the existing operation at Kingston.

The need for such action and the extent of channel over which it may occur cannot be predicted. However, the quantities are expected to be relatively small and the timing infrequent (each 1-2 years).

While this action is feasible and practicable, detailed assessment of the method to be used and the timings involved will need to be undertaken on the basis of the monitoring outcomes.

5.5 Dune Management

The primary purpose of dune management provisions in the proposed works is to ensure that the increased pressure on the dune vegetation associated with increased use of the beach/dune in the area does not lead to breakdown of the vegetation and wind erosion. It is to be noted that use of the sandy beach berm itself will cause no problems, whereas trafficking across or along the vegetated dune areas may need to be controlled.

This is best dealt with by a combination of actions as follows:

1. Construction of fenced access paths across the dune to the beach at intervals convenient for use by the adjacent residents;
2. Monitoring of use and damage to dune vegetation in unfenced areas;
3. Action to repair damaged vegetation where any such damage occurs, with focus on maintaining local native dune species; and
4. If necessary, additional action to control access to the dune along the beach length in the form of either local or extended fencing of appropriate design.

Fencing may be of a nature in harmony with the beach environment. Use of steel components should take consideration of the corrosive marine environment.

There are various publications describing appropriate dune management procedures and designs for reference in planning these works.

6 REFERENCES

Coastal Engineering Research Center (CERC) (1977,1984). Shore Protection Manual. U.S. Army Corps of Engineers 3rd &4th Editions, 1977 & 1984.

Coastal Management Branch (1984). Cape Jaffa: Coastal Erosion Study. Technical Report 84/3, December 1984.

IPCC, 1996, Climate Change 1995 - The Science of Climate Change, Intergovernmental Panel of Climate Change, Working Group 1, June.

IPCC, 2001. Climate Change 2001: The Scientific Basis. Report of the Intergovernmental Panel on Climate Change, 2001.

McInnes, K., Walsh, K., Whetton, P and B. Pittock., 1998. The Impact of Climate Change on Coastal New South Wales - Final Report. CSIRO Atmospheric Research, August 1998.

Patterson D.C. (1985). Low Cost Visual Determination of Surf Zone Paramenters. Master of Engineering Science Thesis, University of Queensland, 1985.

Short & Hesp (1980). Coastal Engineering and Morphodynamic Assessment of the Coast Within the South East Coast protection District, South Australia.

Walsh, K.J.E. and Ryan, B.F. 1999. Tropical Cyclone Intensity Increase near Australia as a Result of Climate Change, September 1999. CSIRO Division of Atmospheric Research.

Walsh, K.J.E., Jackett, D.R., McDougall, T.J and Pittock, A.B. 1998. Global Warming and Sea Level Rise on the Gold Coast. Report Prepared for the Gold Coast City Council, April 1998. CSIRO Division of Atmospheric Research and CSIRO Division of Marine Research.

APPENDIX 17

Coastal Investigations, Tonkin Consulting, September 2004, Ref No 20010779RA3

Cape Jaffa Development Company

Cape Jaffa

Coastal Investigation

Principal Contacts
Jeff Tyler

September 2004
Ref No 20010779RA3

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au

MOUNT GAMBIER
JONES TONKIN
1 KRUMMEL STREET
MOUNT GAMBIER SA 5290
T +61 8 8723 5002
F +61 8 8723 5004
E mtgambier@tonkin.com.au

Cape Jaffa Development Company

Cape Jaffa

Coastal Investigation

Principal Contacts
Jeff Tyler

September 2004
Ref No 20010779RA3

Table of Contents

Cape Jaffa Development Company
Cape Jaffa
Coastal Investigation

Document History and Status

Rev	Description	Author	Rev'd	App'd	Date
A	Draft for comment	JT			09/04

1. Introduction

At your request, Tonkin Consulting has reviewed existing reports undertaken for the Coastal Protection Board relating to the coastal processes along the coastline of Lacapede Bay. Further we have undertaken additional investigation of the coastline of Lacapede Bay, particularly in the area of Cape Jaffa.

The purpose of this investigation is to gain a better understanding of the natural erosion and accretion cycles of the coastline in particular the area adjacent the site proposed for the Cape Jaffa marina development. This information will allow recommendations to be made for suitable buffer distances to ensure that the development will be protected due to the natural process and to ensure suitable planning measures are adopted to provide for a suitable coastal amenity.

2. Coastal Evolution

2.1 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 affecting the coast at Cape Jaffa.

Subsequent to Short & Hesp's assessment of the South East Coast (1980), which nominated 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.

The process used by Mavrinac to assess the coastal changes are considered adequate to identify the general trend of erosion and or accretion for this section of coastline, however inaccuracies exist in the technique adopted to accurately determine the relative measurements of the coastline movements.

In order to better understand the coastline movement in the area, Tonkin Consulting conducted a similar review of the aerial photographs using a more sophisticated approach to better understand the coastline movement in the area.

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.

Aerial photos and other survey data prior to 1958 was not included in the investigation as the source data was considered less reliable, with insufficient detail to accurately register the positions of notable features to ensure that the same datum was being used in comparing the coastline.

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.

Table 1 below summarises the coastal movement observed by comparison of aerial photography.

Table 1 Coastal Movement - Aerial Photography Comparison

	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 towards breakwater	Accretion at jetty, erosion towards breakwater	Erosion with some areas of accretion	Accretion	Accretion with some areas of slight erosion	Accretion ~13m at jetty 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, tending 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 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 limit of investigation

Aerial Photos 1-6 (Appendix A) 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 Project boundary.

Photo 7 shows the edge of the coastal vegetation from each of the aerial photographs analysed together with the 2002 aerial photograph. Photo 8 shows an enlarged portion in the vicinity of the proposed development.

In order to depict the coastal movement, with known features of the proposed development and other existing features, a plot of the movement of the coastal vegetation line (since 1958) verses distance along the coast has been produced

(Figure 1). The plot shows, for each of the photographs, the perpendicular offset from the 1958 vegetation line verses longitudinal distance along that line.

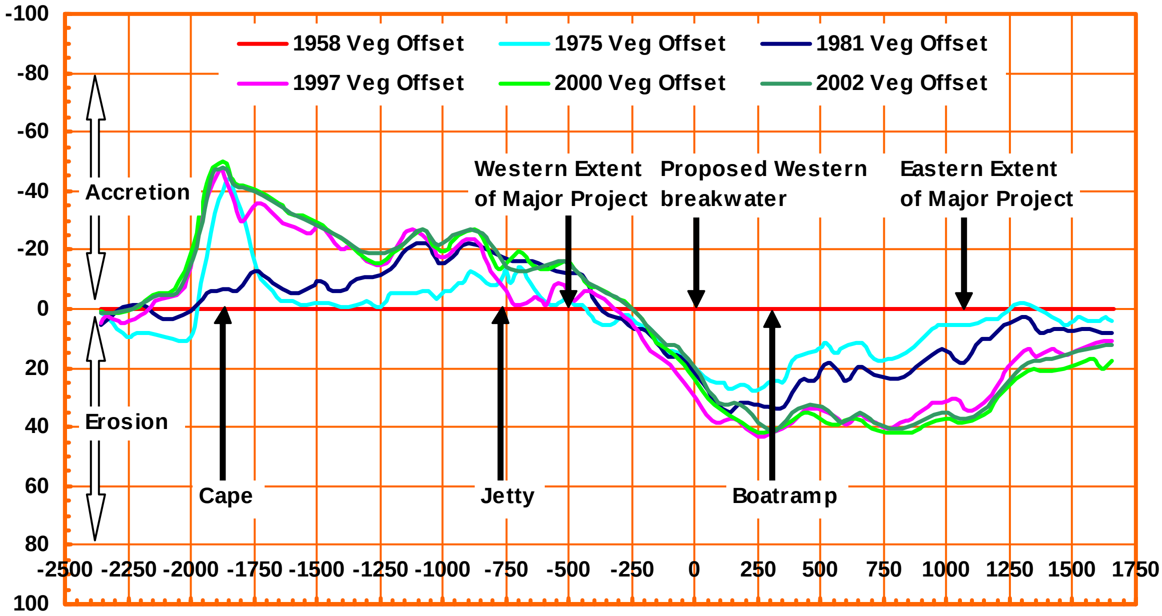


Figure 1 Cape Jaffa Coastal Accretion and Erosion Since 1958

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.

2.2 Conclusion

In his conclusion Mavrinac supports the study conducted by Short & Hesp (1980), with areas of erosion highlighted in similar areas to those postulated by Short & Hesp. He concludes with the comment that the “Cape Jaffa vicinity is under constant active change.”

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.
The additional study carried out by Tonkin Consulting generally supports Mavrinac's findings that the coast line has been eroding in the area of the development, for a period of approx 40 years (1958 – 2002), with a total shoreline retreat of approximately 40m measured at the most affected area.

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.

However in more recent times the coastline is showing signs of accretion (1997-2002). This further strengthens both Mavrinac and Short & Hesp that the coast line undergoes a natural evolution of erosion and accretion cycles.

3. Current Coastal Profile

In addition to the coastal investigation described in the previous section, 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.

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.

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 2 shows a plan with contours of the nearby seabed. Also shown are the beach and coastal dune survey, the outer boundary survey and the development site boundary. Figure 3 shows seabed and coastal profiles in the vicinity and Figure 4 shows detailed cross sections along the beach close to the proposed breakwater site. 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.

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

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'

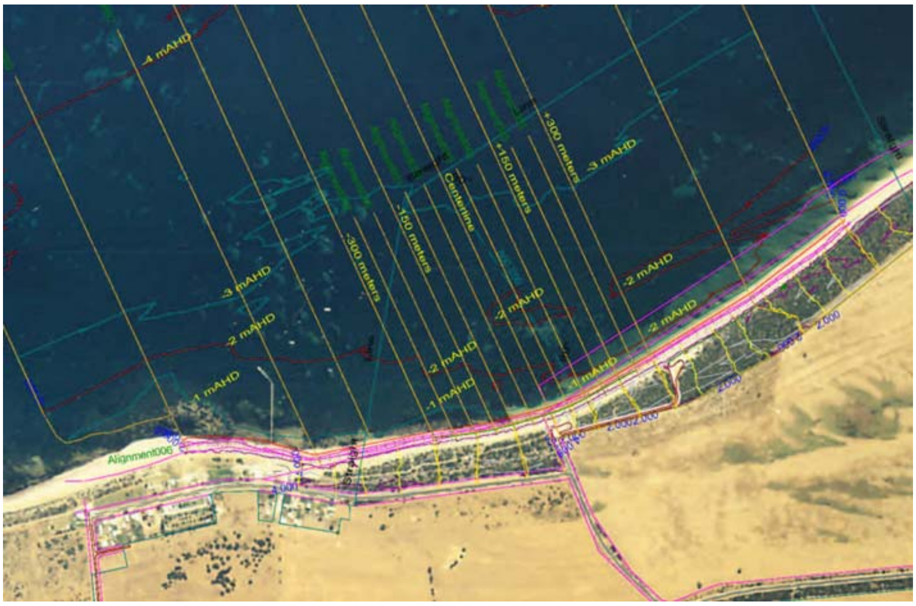


Figure 2 - Plan of Seabed Contours and Location of Seabed, Beach and Dune Profiles

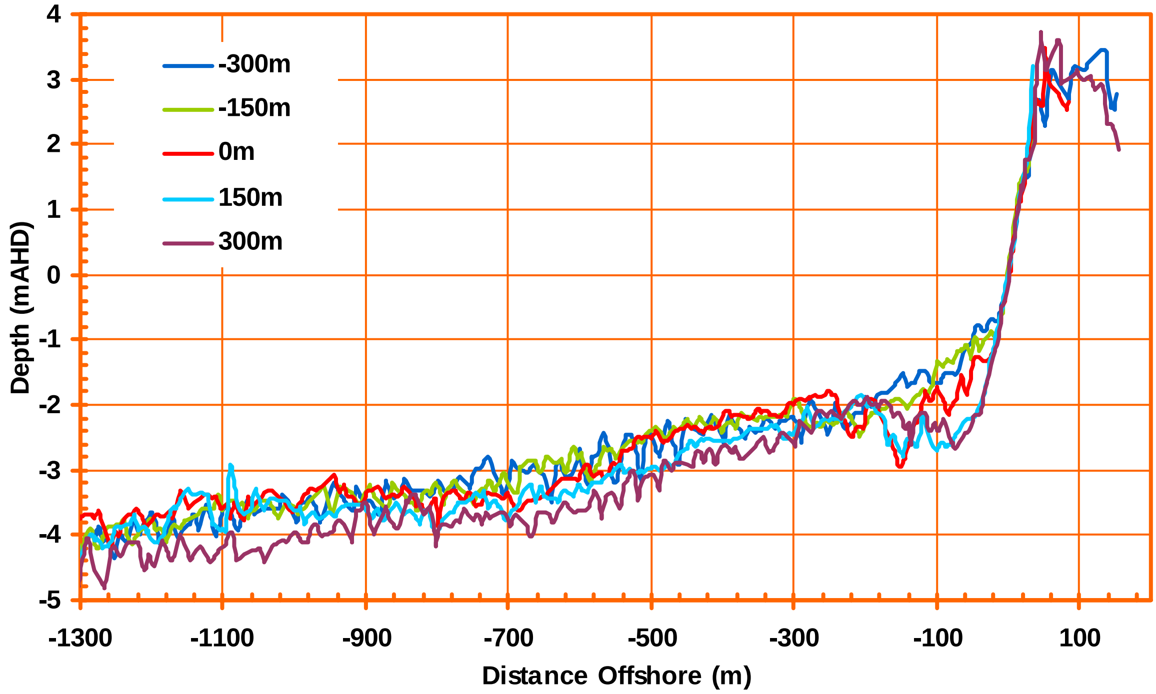


Figure 3 – Seabed and Coastal Profiles

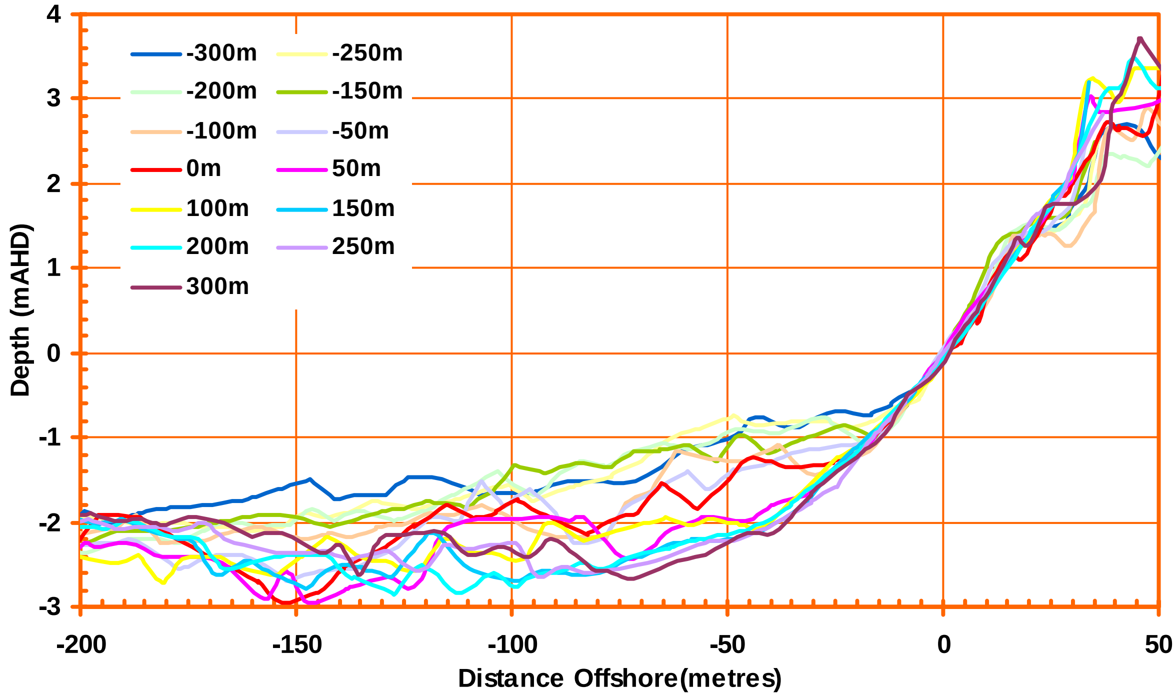


Figure 4 – Nearshore seabed and coastal profiles

3.1 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

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 5.

Figure 5 shows lines of +1.0 mAHD elevation for each survey, which provides an indication of coastal movement over the period between surveys.

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 6. Areas of erosion are depicted at ‘cut’ and areas of accretion are depicted as ‘fill’ (fill is 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.

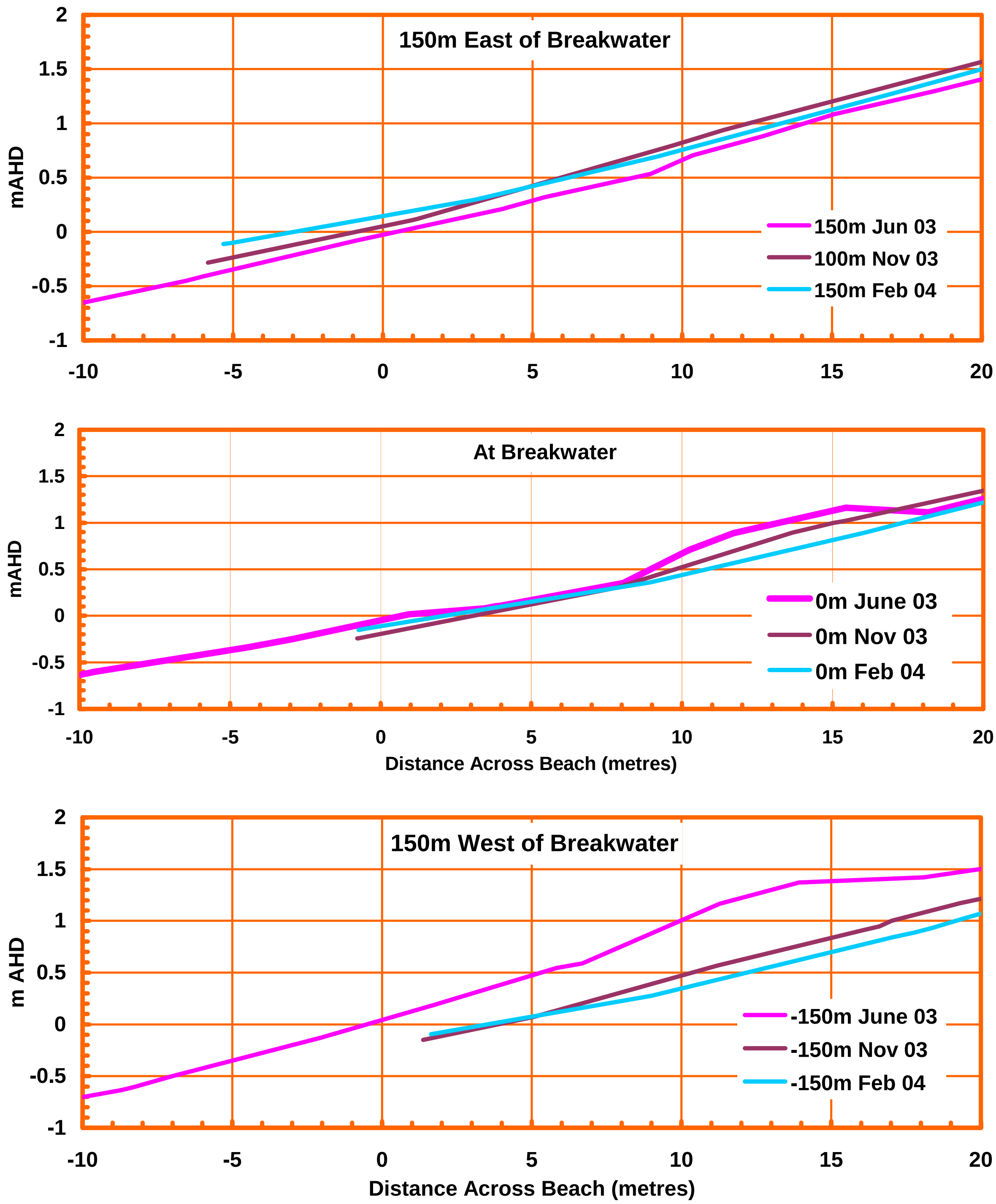
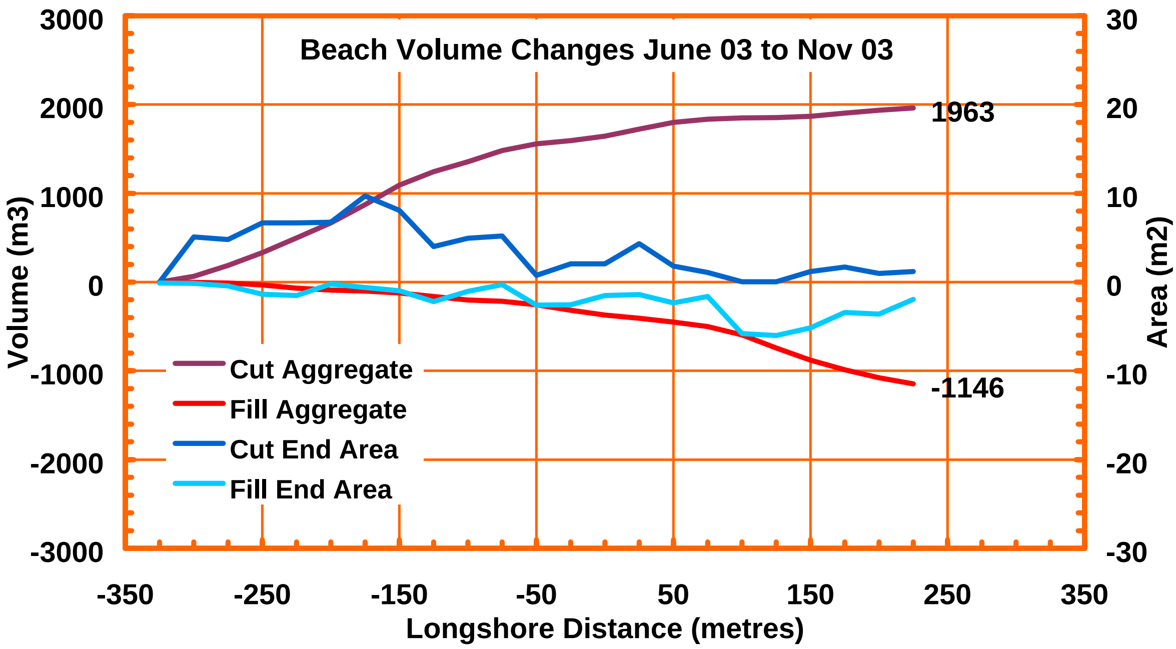


Figure 5 - Beach Profile Changes in the Vicinity of the Proposed Breakwater



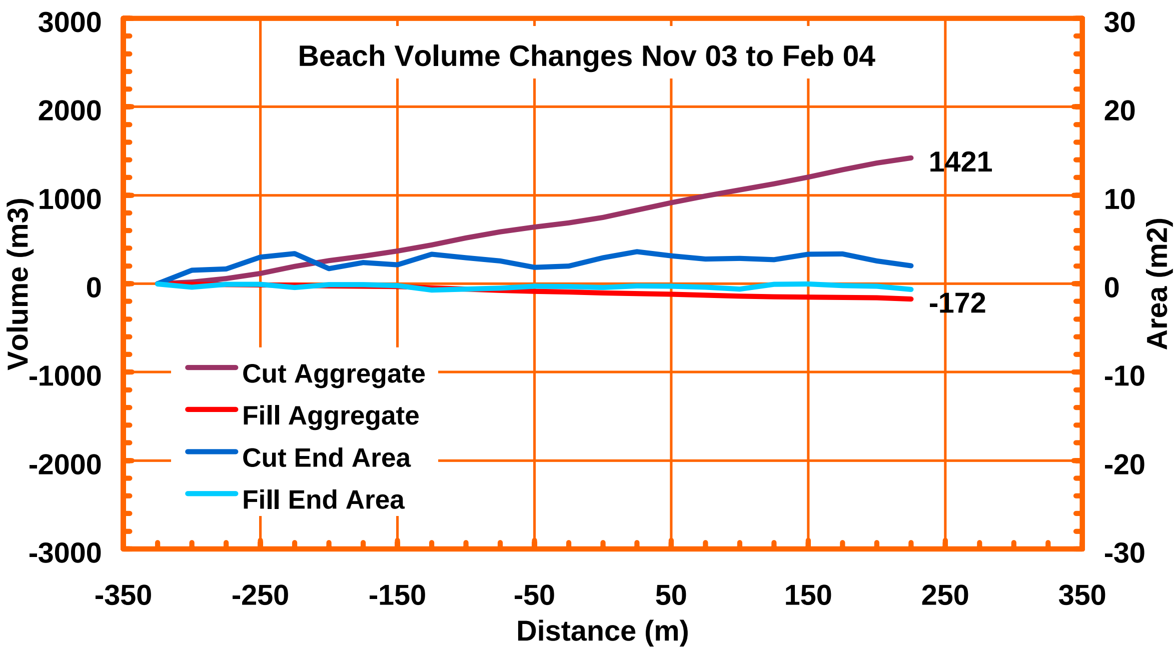


Figure 6 - Beach Volume Changes in the Vicinity of the Proposed Breakwater

3.2 Beach Changes Between July 2003 and November 2003

The cross sections (Figure 6) 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 6 and Figure 8. A reversal to erosion is observed at the far eastern extent of the survey.

Figure 7 shows erosion and accretion volumes verses longshore distance. There is some general redistribution of sand on the beach: 1,960 m3 of erosion (an average of 188 millimetres over the eroded area) has occurred predominately west of the proposed breakwater and 1,150 m3 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 m3 has occurred, which is an average of approximately 40 millimetres over the total area surveyed

3.3 Beach Changes Between November 2003 and February 2004

The cross sections (Figure6) 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 8 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 7 shows beach erosion and accretion verses longshore distance. 1420 m3 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 m3 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 m3 has occurred, which is an average of approximately 64 millimetres over the total area surveyed.

Figure 7 - Beach 1.0 mAHD Location at July 2003, November 2003 and February 2004

3.4 Conclusion

From the investigation it is apparent 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 Project 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

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.

Appendix A

Aerial Photographs

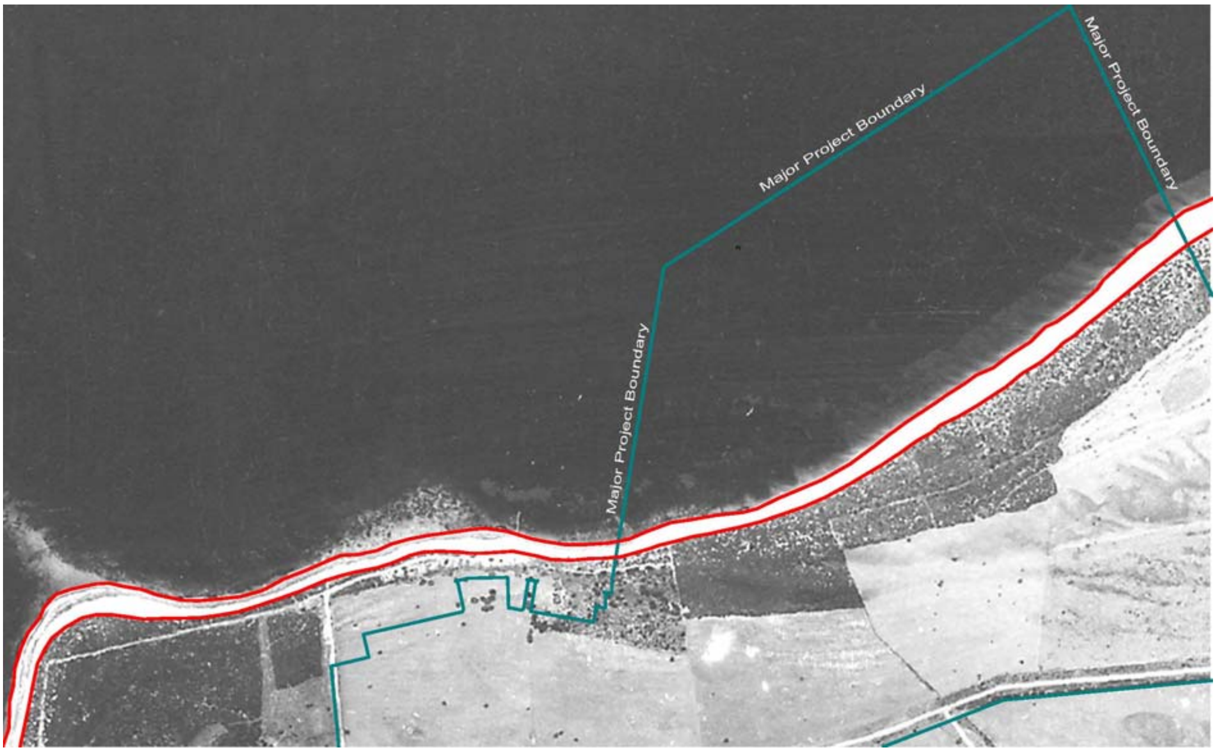


Photo 1 Coastal Profile – 1958, Showing the Visible Waterline and Coastal Vegetation Line

Photo 2 Coastal Profile – 1975, Showing the Visible Waterline and Coastal Vegetation Line

Photo 3 Coastal Profile – 1981, Showing the Visible Waterline and Coastal Vegetation Line

Photo 4 Coastal Profile – 1997, Showing the Visible Waterline and Coastal Vegetation Line

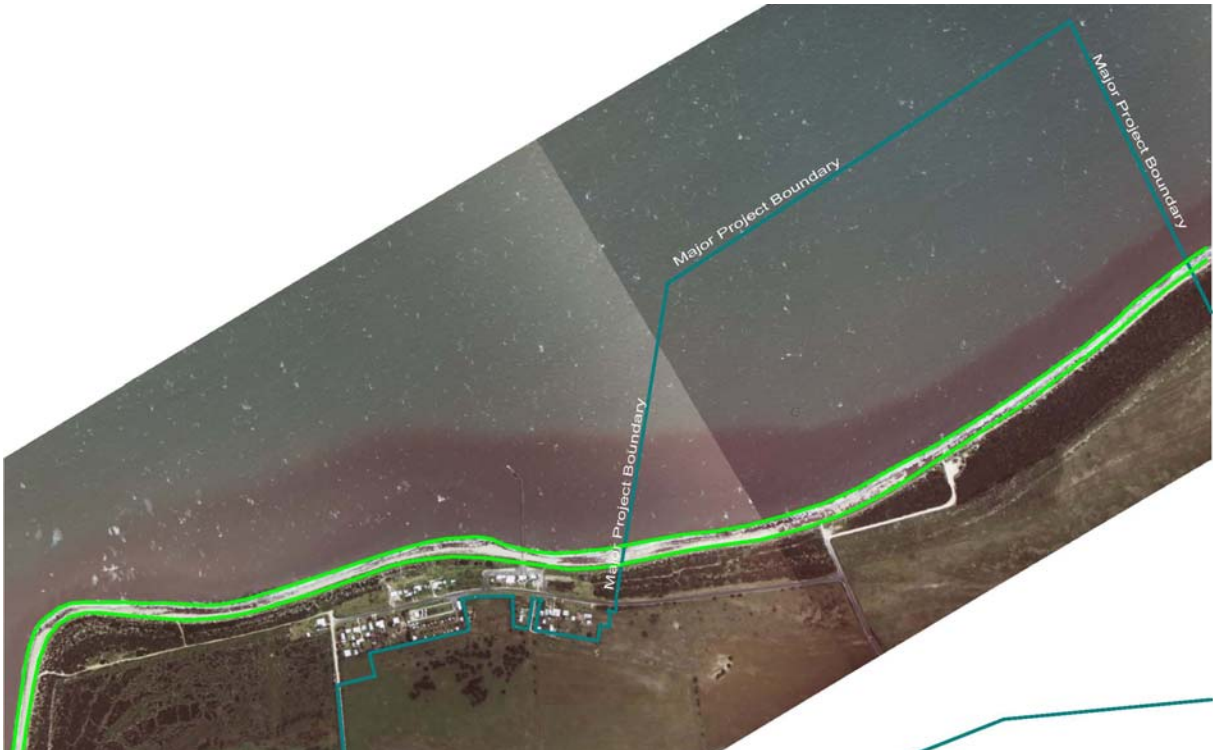


Photo 5 Coastal Profile – 2000, Showing the Visible Waterline and Coastal Vegetation Line

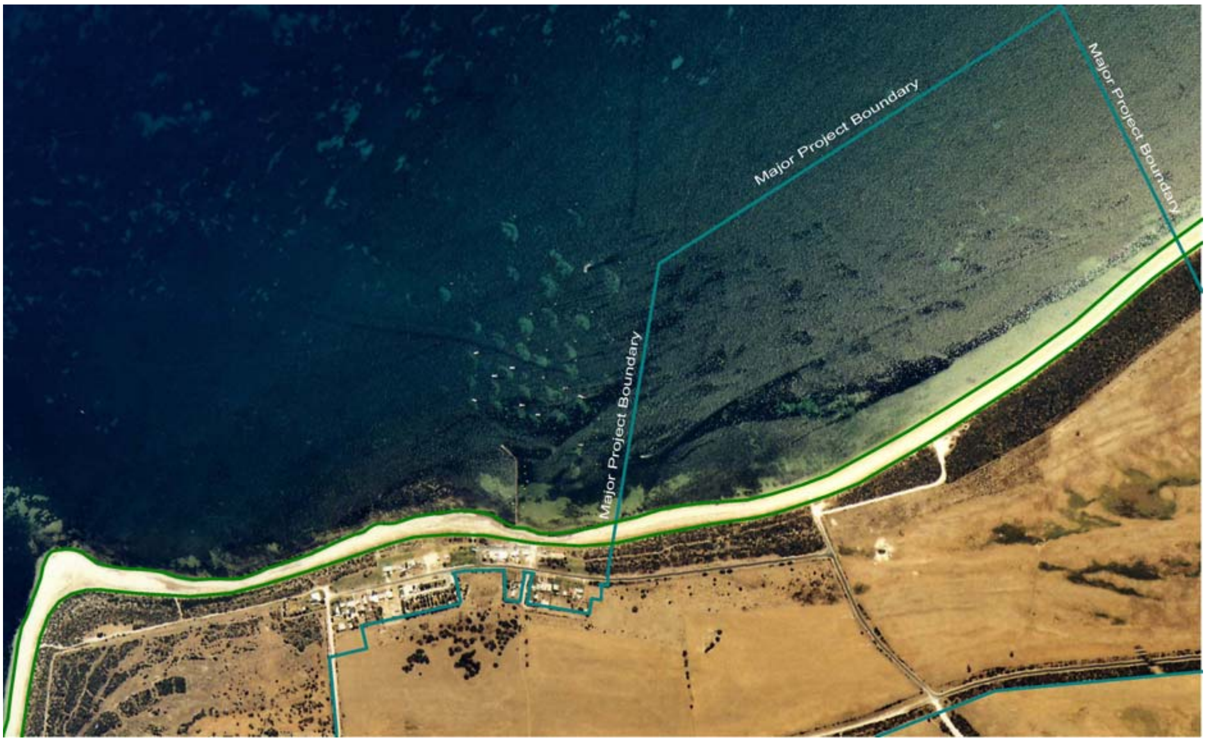


Photo 6 Coastal Profile - 2002, Showing the Visible Waterline and Coastal Vegetation Line

Photo 7 Evolution of Coastal Profile Since 1958

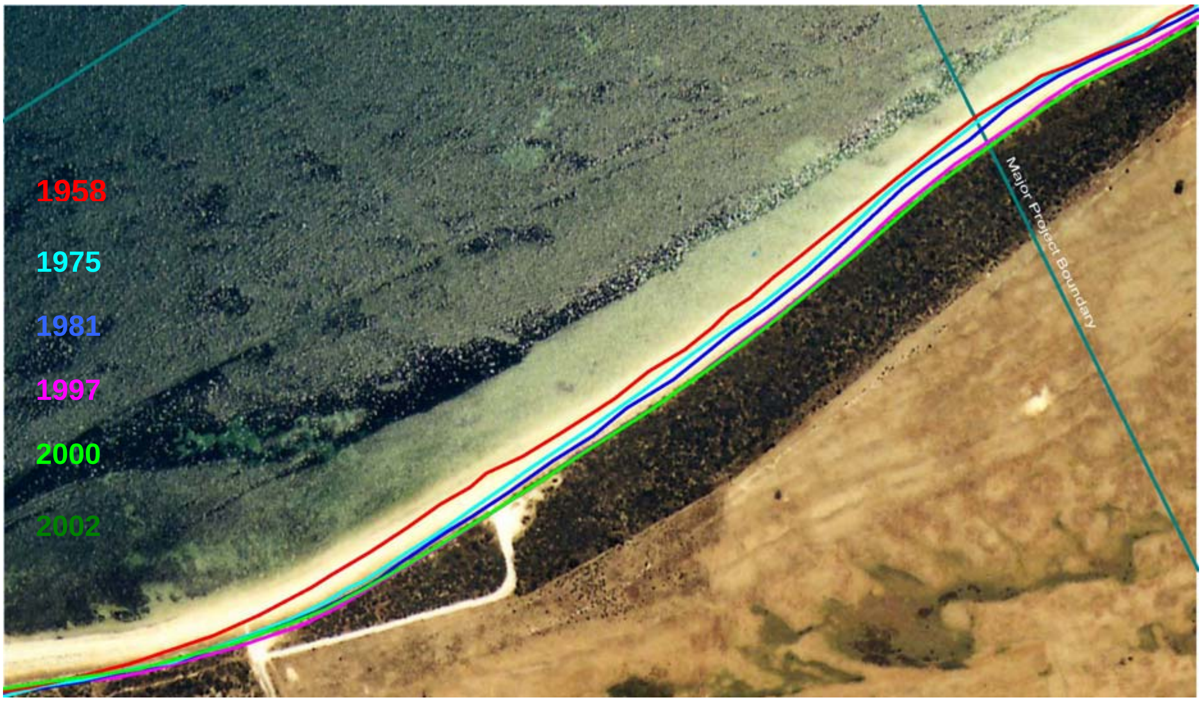


Photo 8 Evolution of Coastal Profile in the Eastern Portion of the Site Since 1958

APPENDIX 18

Guidelines for the preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Marina Proposal by District Council of Kingston and the Cape Jaffa Development Company, Major Developments Panel South Australia, June 2003, ISBN 1 876702 850

GUIDELINES

For the preparation of an

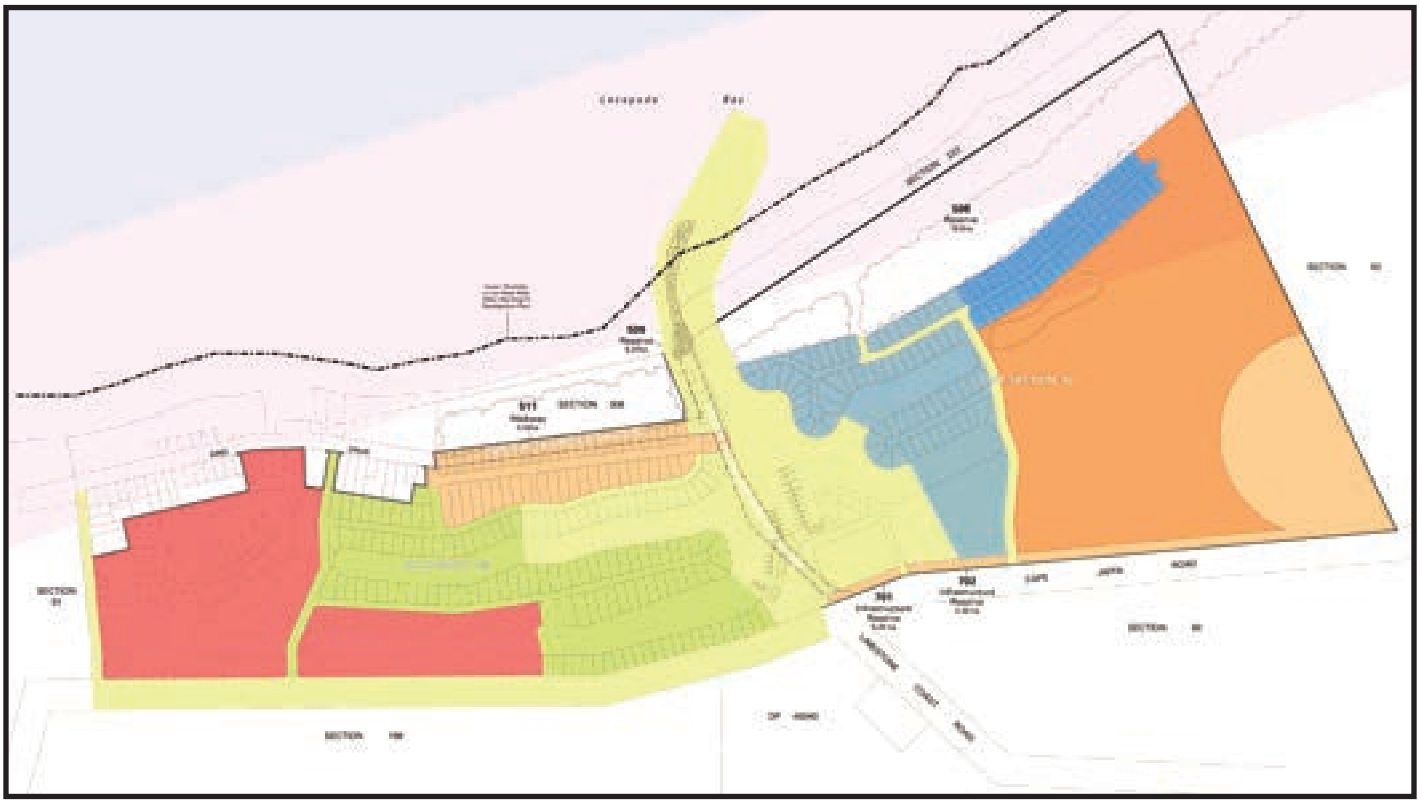
ENVIRONMENTAL IMPACT STATEMENT

for the

Cape Jaffa Anchorage Marina

Proposal by

Kingston District Council and Cape Jaffa Development Company



MAJOR DEVELOPMENTS PANEL

GUIDELINES

For the preparation of an
ENVIRONMENTAL IMPACT STATEMENT
for the
Cape Jaffa Anchorage Marina
Proposal by
Kingston District Council and Cape Jaffa Development Company

Major Developments Panel
South Australia

www.planning.sa.gov.au/md_panel/index.html

ISBN 1 876702 850
FIS 22102

June 2003

CONTENTS

1 INTRODUCTION

1.1 On 19 December 2002, the Minister for Urban Development and Planning ('the Minister') made a declaration in the Government Gazette for the proposed Cape Jaffa Anchorage marina proposal, to be assessed as a Major Development under the provisions of Section 46 of the *Development Act 1993*.

1.2 The proposed Cape Jaffa Anchorage development is a multi-component commercial/recreational marina facility and associated waterfront residential development, on land located immediately east of the Cape Jaffa township.

1.3 The Major Developments Panel (the Panel) is an independent statutory authority that has the task of determining the appropriate form of assessment for a Major Development, and setting Guidelines for the requisite documentation. To assist in this process, the Panel produced an Issues Paper on the proposal and invited public and Government Agency comment. The closing date for public submissions on the Issues Paper has closed, but the Issues Paper can still be accessed free of charge to obtain further information about the proposal at Planning SA, and the District Council of Kingston. It can also be viewed at Planning SA's 'Major Developments Panel' website: http://www.planning.sa.gov.au/md_panel/index.html

1.4 Following consideration of all public and government submissions, the Panel has determined that the proposal will be subject to the processes and procedures of an Environmental Impact Statement (EIS), as set out in Section 46B of the *Development Act 1993*, for the following reasons:

- the magnitude of the development and the range of activities proposed (including residential, tourism, recreational, commercial and semi-industrial uses)
- the general sensitivity of the coastal location
- the potential impacts on groundwater, coastal processes, the marine environment and the community
- the Economic implications and sustainability of the proposal

1.5 The Panel has now prepared Guidelines for the proposed Cape Jaffa Anchorage marina based on the significant issues relating to the proposed development and taking into consideration the issues raised in the submissions. The EIS should be prepared in accordance with these Guidelines and should describe what the proponent wants to do, what the environmental effects will be and how the proponent plans to manage the project.

1.6 A further opportunity for public comment will occur when the completed EIS is released for public exhibition. At that time, an advertisement will be placed in the *Advertiser*' and relevant local newspapers to indicate where the EIS is available, and the length of the public exhibition period. During the exhibition period, written submissions on the proposal can be made to the Minister for Urban Development and Planning, the Hon. Jay Weatherill, MP.

1.7 The Panel's role in the assessment process is now fulfilled. The Minister will continue with the assessment process under Section 46 of the *Development Act 1993* from this point. The object of Section 46 is to ensure that matters affecting the environment, the community or the economy to a significant extent, are fully examined and taken into account in the assessment of this proposal.

1.8 The documentation and the analyses from the assessment process will then be used by the Governor in the decision-making process, under Section 48 of the *Development Act 1993*, to decide whether the proposal can be approved, and the conditions that will apply.

2 BACKGROUND

2.1 The proponent of the proposed Cape Jaffa Anchorage marina is the District Council of Kingston and the Cape Jaffa Development Company, namely a consortium of council and constructors.

2.2 District Council of Kingston and the Cape Jaffa Development Company now proposes to establish a combined 'working harbour' for the commercial fishing/aquaculture industry and waterfront residential sub-division, with associated commercial/semi-industrial, tourist and public recreational facilities. The proposal would progressively be developed in stages over 10 years.

2.3 On 19 December 2002, the Minister for Urban Development and Planning made a declaration in the Government Gazette for the proposed development to be assessed as a Major Development under the provisions of Section 46 of the *Development Act 1993*.

2.4 The Panel has determined that the proposal will be subject to the processes and procedures of an Environmental Impact Statement (EIS), as set out in Section 46B of the *Development Act 1993*.

2.5 The proponent has been advised by the Minister for Urban Development and Planning that an Environmental Impact Statement is required to assist the Government in assessing the environmental, social and economic impacts of the proposal. An EIS is prepared by the proponent, and describes what the proponent wants to do, what the impacts will be and how the proponent plans to manage the impacts of the project.

2.6 The Panel has prepared these Guidelines for the proponent based on the significant issues relating to the proposed development. These Guidelines identify the issues associated with the proposal that must be addressed in the EIS. To assist in determining the significant issues, an Issues Paper was released for public and agency comment. This period for comment closed on 7 May 2003. In preparing the Guidelines, the Panel has considered the issues raised in the submissions.

2.7 A further opportunity for public comment will occur when the completed EIS is released for comment. At that time, an advertisement will be placed in the '*Advertiser*' and the relevant local newspaper to indicate where the EIS document is available and the length of the public exhibition period, during which time written submissions can be made to the Minister for Urban Development and Planning. A public meeting will also be held during the exhibition period and this will also be advertised in the *Advertiser* and the relevant local newspaper.

3 THE ENVIRONMENTAL IMPACT STATEMENT PROCESS

3.1 An EIS, as defined in Section 46B of the *Development Act* 1993, includes a description and analysis of issues relevant to the development and the means by which those issues can be addressed.

3.2 The EIS should detail the expected environmental, social and economic effects of the development. The EIS must 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*. The EIS should also state 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. Further to this, any other information required by the Minister must be considered.

3.3 In preparing the EIS, the proponent should bear in mind the following aims of the EIS and public review process:

3.3.1 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 alternatives, the environment which would be affected, the impacts that may occur and the measures to be taken to minimise these impacts.

3.3.2 To provide a forum for public consultation and informed comment on the proposal.

3.3.3 To provide a framework in which decision-makers may consider the environmental aspects of the proposal in parallel with social, economic, technical and other factors.

3.4 Following the release of the Guidelines adopted by the Panel:

3.4.1 The EIS must be prepared by the proponent in accordance with these Guidelines.

3.4.2 The EIS is referred to any prescribed authority or body, and to other relevant authorities or bodies for comment.

3.4.3 Public exhibition of the EIS document by advertisement is undertaken for a least 30 business days. Written submissions are invited.

3.4.4 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 to make submissions under the *Development Act 1993.*

3.4.5 Copies of the submissions from the public and other relevant agencies will be given to District Council of Kingston and the Cape Jaffa Development Company (the proponent) soon after closing of the public comment period.

3.4.6 The proponent must then prepare 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.

3.4.7 The Minister then prepares an Assessment Report taking into account any submissions and the proponent's response to them. Comments from any other authority or body may be considered as the Minister thinks fit.

3.4.8 The Assessment Report and the Response Document 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.

3.4.9 A copy of the EIS, the Response Document prepared by the proponent and the Assessment Report will be given to the District Council of Kingston for distribution purposes.

3.4.10 The Governor is the relevant decision maker under Section 48 of the *Development Act 1993*, when a development application is subject to the EIS process.

3.4.11 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*.

4 THE ENVIRONMENTAL IMPACT STATEMENT DOCUMENT

4.1 The Guidelines set out the major issues associated with the proposal and their degree of significance as determined by the Panel. It describes each issue and then outlines the way that these issues should be dealt with in the Environmental Impact Statement.

4.2 In these Guidelines the terms “description” and other similar terminology should be taken to include both quantitative and qualitative materials as practicable and meaningful. Similarly, adverse and beneficial effects should be presented in a quantitative and/or qualitative terms as appropriate.

4.3 The main text of the EIS should be clear and precise and presented in terms that are readily understood by the general reader. Technical details should be included in the appendices so that the EIS forms a self-contained entity.

4.4 The document should give priority to the major issues associated with the proposal. Matters of lesser concern should be dealt with only to the extent required to demonstrate that they have been considered to assist in focussing on the major issues.

4.5 The following should be included in the EIS:

4.5.1 SUMMARY

4.5.2 The EIS should include a concise summary of the matters set out in section 46B of the *Development Act 1993* and include all aspects covered under the headings set out in the Guidelines below, in order for the reader to obtain a quick but thorough understanding of the proposal and the resulting environmental impact.

4.5.3 INTRODUCTION

The introduction to the EIS should briefly cover the following:

- Background to, and objectives of, the proposed development.
- Details of the proponent.
- Staging and timing of the proposal, including expected dates for construction and operation.
- Relevant legislative requirements and approval processes.
- Purpose and description of the EIS process.

4.5.4 NEED FOR THE PROPOSAL

The Introduction to the EIS should briefly cover the following:

- The specific objectives that the proposal is intended to meet, including market requirements.
- Expected local, regional and state benefits and costs, including those that cannot be adequately described in monetary or physical terms (eg. effects on aesthetic amenity), and
- A summary of environmental, economic and social arguments to support the proposal, including the consequences of not proceeding with the proposal.

4.5.5 DESCRIPTION OF THE PROPOSAL

The description of the proposal should cover a description of the existing environment, the nature of the proposal and the location, construction and commissioning timeframes, and a description of construction, operation, maintenance and monitoring practices and techniques. This should include reference to the location, layout, elevation and appearance of structures (and buildings where relevant), an indicative land division plan, a description of easements and infrastructure requirements and availability. A discussion of management arrangements for the construction and operational stages should be provided.

4.6 The EIS must include the following:

4.6.1 ASSESSMENT OF EXPECTED ENVIRONMENTAL SOCIAL AND ECONOMIC EFFECTS

The assessment of effects should include all issues identified in Section 5 of these Guidelines.

4.6.2 CONSISTENCY WITH GOVERNMENT POLICY

The *Development Act 1993* requires the EIS to state its consistency with the relevant Development Plan and Planning Strategy.

4.6.3 AVOIDANCE, MITIGATION, MANAGEMENT AND CONTROL OF ADVERSE EFFECTS

The proponent's commitments to meet conditions to avoid, mitigate, satisfactorily manage and/or control any potentially adverse impacts of the development on the physical, social or economic environment must be clearly stated as part of the EIS.

The design of the proposal should be flexible enough to incorporate changes to minimise any impacts highlighted by this evaluation or by post-operation monitoring programs.

4.7 The EIS should provide the following additional information:

4.7.1 SOURCES OF INFORMATION

The sources of information (eg reference documents, literature services, research projects, authorities consulted) should be fully referenced, and reference should be made to any uncertainties in knowledge. Where judgments are made, or opinions given, these will need to be clearly identified as such, and the basis on which these judgments or opinions are made will need to be justified. The expertise of those making the judgments including the qualifications of consultants and authorities should also be provided.

4.7.2 APPENDICES

Technical and additional information relevant to the EIS that is not included in the text should be included in the appendices (maps, graphs, tables, photographs, reports etc). A glossary may also be appropriate.

The design of the proposal should be flexible enough to incorporate changes to minimise any impacts highlighted by this evaluation or by post-operation monitoring programs.

4.7.3 OTHER

Appropriate drawings, including plans and elevations, are needed for a decision to be made. As much information as possible is required of the design and layout of the proposal.

5 ISSUES IDENTIFIED BY THE PANEL

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.

5.1.2 Detail the potential demand for this type of development at the proposed location.

5.1.3 Assess the “do nothing” option.

5.2 ENVIRONMENTAL ISSUES

Groundwater

5.2.1 Describe the known existing groundwater environmental conditions.

5.2.2 Detail any groundwater investigations and modelling undertaken on the site or in the locality of the site.

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 salt water intrusion.

5.2.4 Describe stormwater and wastewater management and the potential impact on groundwater.

5.2.5 Detail the impact on land and native vegetation, of the off-site depression of the water table and outline the extent of groundwater depression and effect on farming and horticulture and other operations within the groundwater depression zone.

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.

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.

5.2.8 Detail any seasonal variations of groundwater level and impact on marina design and offsite operations.

5.2.9 Describe the impact of housing and the commercial fishing base on groundwater quality.

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.

Coastal

5.2.11 Describe the visual effect of the construction of the breakwater into the bay at Cape Jaffa.

5.2.12 Outline the visual effect of the development in this locality.

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.

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.

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.

5.2.16 Detail measures to protect dunes and beach during and after construction, including buffers.

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.

5.2.18 Describe the impact of increased commercial and recreational boating.

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.

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 groundwater and the marine environment.

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.

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.

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.

Management

5.2.24 Describe the sewage disposal and rubbish collection systems for the commercial and recreational boats.

5.2.25 Describe the use of amenity/landscape plantings, including opportunities for the use of native species.

5.2.26 Describe the risk of causing or exacerbating any environmental problems in the locality, and describe mitigation measures and their expected effectiveness.

5.2.27 Outline the effects of boating traffic and "people pressure" on the surrounding environment.

5.2.28 Describe the disposal of dredged or excavated material.

General

5.2.29 Detail investigations required to include in an environmental management plan.

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.

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.

5.2.32 Describe the benefits of the proposal to the local environment.

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.

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.

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.

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.

5.3.5 Outline the traffic generation and truck movements to and from the site and their hours of operation during the construction period.

5.3.6 Describe the implications for public service providers including health, education and recreation to support the development, particularly for the elderly.

5.3.7 Identify the effects on the existing character of Cape Jaffa.

5.3.8 Determine the consequences of a safe haven for the recreational and commercial boating fraternities.

5.3.9 Outline the impact on existing tourism and recreation infrastructure (e.g. jetty, boat launching and camping).

5.3.10 Describe the impact on local and regional land uses (e.g. viticulture, horticulture and other forms of primary production) from groundwater drawdown or contamination.

5.3.11 Describe the planned future use and maintenance of the Cape Jaffa jetty.

5.3.12 Outline the effects of removing commercial activities and loadings on the Cape Jaffa 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.

5.3.14 Outline the location and availability of public facilities including telephones, toilets, showers and the lighting of public areas.

5.3.15 Describe the benefit and amenity improvements due to infrastructure changes.

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.

5.3.17 Describe the impact of groundwater drawdown or contamination on the source and use of domestic water.

5.3.18 Determine the effect of losing the current entrance road to the town (King Drive) for local residents and visitors.

5.4 ECONOMIC ISSUES

5.4.1 Outline the opportunity for tourism and investment in the area from the development.

5.4.2 Identify employment and investment opportunities, including the “multiplier effect”.

5.4.3 Outline the potential for the development to attract and enhance the business operations of other allied industries and commercial ventures.

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.

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.

5.4.6 Describe the opportunities for the aquaculture and fishing industries and their support services.

5.4.7 Outline the financial strategies to be employed to ensure the relevant infrastructure is in place for each stage in the project.

5.4.8 Describe the land tenure arrangements during and after construction of each stage.

5.4.9 Describe compensation or amelioration measures for any loss of groundwater resources for users.

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.

5.4.11 Identify the economic implications for the rock lobster industry from increased groundwater flows and run-off out to sea.

5.4.12 Identify the economic implications for groundwater users from groundwater drawdown or contamination, particularly primary producers.

5.4.13 Identify the economic effect the workforce would have locally and regionally.

5.4.14 Identify any potential impact on tourism or investment due to the changed nature of Cape Jaffa.

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.

5.5.2 Identify the source of any construction materials including fill for the breakwaters, revetments and land forming and their origins.

5.5.3 Describe the transport and storage of any construction materials to minimise effects on the local amenity.

5.5.4 Identify the measures for the control of dust, vibration, noise, stormwater and groundwater and other emissions during construction.

5.5.5 Describe the implementation of environmentally acceptable work practices and monitoring programs, particularly through management plans.

5.5.6 Outline the provisions for any future expansion beyond Stage seven.

5.5.7 Indicate how the spread of weeds and diseases is going to be managed.

5.5.8 Describe the management agreements between the District Council of Kingston and the Cape Jaffa Development Company during and after construction.

5.5.9 Identify proposed by-laws and encumbrances to control and manage activities.

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.

5.5.11 Outline the impact of dredging and channel maintenance on boat access.

5.5.12 Detail the proposed monitoring of impacts during and after construction.

5.5.13 Describe how waterways will be flushed during each stage of construction.

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.

5.5.15 Outline controls on future housing and commercial construction activities.

5.5.16 Detail long-term management agreements for operation of the development, including the ownership of land and infrastructure.

5.5.17 Identify measures to protect any historic shipwrecks proximate to the development.

5.5.18 Describe the compatibility of land uses, particularly measures to avoid conflict between commercial fishing/aquaculture and residents/tourists.

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.

5.5.20 Describe the impact on road networks during construction and operation of the development.

5.6 RISK/HAZARD MANAGEMENT

5.6.1 Describe strategies for ensuring public safety during construction.

5.6.2 Detail procedures to be adopted if acid sulphate soils are encountered.

5.6.3 Describe procedures to prevent and manage pollution spills or sewage leaks.

5.6.4 Detail procedures to minimise effects of pollution spills or sewage leaks.

5.6.5 Detail fire management processes, particularly on boats or flammable or explosive materials in the commercial areas.

5.6.6 Describe how the introduction of pest or nuisance marine organisms are to be dealt with.

5.6.7 Describe how weed species will be prevented from invading the coastal vegetation.

5.6.8 Outline the proposals for bunding of hazardous materials storage areas.

5.6.9 Detail the design of the breakwater and its accessibility and safety.

5.6.10 Outline the risk contours around commercial areas in case of fire, explosion or toxic spills.

5.6.11 Detail the dry-dock management for careening (access to hull) and interception of pollutants such as hull scrapings.

5.6.12 Describe how the development will comply with the coastal flooding policy outlined in the Development Plan.

5.6.13 Detail flood mitigation strategies including prevention of flooding and operation of canals and flushing basins.

5.6.14 Identify the risk to the proclaimed water resource (Lacepede – Kongorong Prescribed Wells Area).

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 fertilizers.

5.6.16 Describe breakwater design requirements for coastal hazards (eg tidal and wave action).

5.6.17 Describe strategies to ensure public safety on and around waterways and the permitted recreational use of waterways, including boating navigation.

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.

5.7.2 Outline the potential for adopting water sensitive urban design for managing stormwater.

5.7.3 Detail emergency services arrangements.

5.7.4 Outline opportunities to incorporate best practice measures of infrastructure design.

5.7.5 Outline strategies for the relocation of existing commercial fishing activities on King Drive.

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.

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.

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.

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.

5.8.4 Detail steps, if required, to include negotiations with possible native title claimants.

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.

5.9.2 Identify potential changes that will need to be made to the zoning of the site.

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.

5.9.4 Detail any commercial fishing or aquaculture policies and any recreational boating and facilities policies relevant to the development.

5.9.5 Identify legislative requirements and the range of approvals needed to complete the development.

5.9.6 Detail any other relevant plans or studies that relate to the area.

ATTACHMENT A

***Development Act 1993*, Section 46B:**

EIS process - Specific provisions

46B. (1) This section applies if an EIS must be prepared for a proposed development or project.

(2) The Minister will, after consultation with the proponent -

(a) require the proponent to prepare the EIS; or

(b) determine that the Minister will arrange for the preparation of the EIS.

(3) The EIS must be prepared in accordance with guidelines determined by the Major Developments Panel under this subdivision.

(4) The EIS must include a statement of -

(a) the expected environmental, social and economic effects of the development or project;

(b) the extent to which the expected effects of the development or project are consistent with the provisions of -

(i) any relevant Development Plan; and

(ii) the Planning Strategy; and

(iii) any matters prescribed by the regulations;

(c) if the development or project involves, or is for the purposes of, a prescribed activity of environmental significance as defined by the *Environment Protection Act 1993*, the extent to which the expected effects of the development or project are consistent with -

(i) the objects of the *Environment Protection Act 1993*; and

(ii) the general environmental duty under that Act; and

(iii) relevant environment protection policies under that Act;

(d) the proponent's commitments to meet conditions (if any) that should be observed in order to avoid, mitigate or satisfactorily manage and control any potentially adverse effects of the development or project on the environment;

(e) other particulars in relation to the development or project required -

(i) by the regulations; or

(ii) by the Minister.

(5) After the EIS has been prepared, the Minister -

(a) -

(i) must, if the EIS relates to a development or project that involves, or is for the purposes of, a prescribed activity of environmental significance as defined by the *Environment Protection Act 1993*, refer the EIS to the Environment Protection Authority; and

(ii) must refer the EIS to the relevant council (or councils), and to any prescribed authority or body; and

(iii) may refer the EIS to such other authorities or bodies as the Minister thinks fit,

for comment and report within the time prescribed by the regulations; and

(b) must ensure that copies of the EIS are available for public inspection and purchase (during normal office hours) for at least 30 business days at a place or places determined by the Minister and, by public advertisement, give notice of the availability of copies of the EIS and invite interested persons to make written submissions to the Minister on the EIS within the time determined by the Minister for the purposes of this paragraph.

(6) The Minister must appoint a suitable person to conduct a public meeting during the period that applies under subsection (5)*(b)* in accordance with the requirements of the regulations.

(7) The Minister must, after the expiration of the time period that applies under subsection (5)*(b)*, give to the proponent copies of all submissions made within time under that subsection.

(8) The proponent must then prepare a written response to -

(a) matters raised by the Minister, the Environment Protection Authority, any council or any prescribed or specified authority or body, for consideration by the proponent; and

(b) all submissions referred to the proponent under subsection (7),

and provide a copy of that response to the Minister.

(9) The Minister must then prepare a report (an "Assessment Report") that sets out or includes -

(a) the Minister's assessment of the development or project; and

(b) the Minister's comments (if any) on -

(i) the EIS; and

(ii) any submissions made under subsection (5); and

(iii) the proponent's response under subsection (8); and

(c) comments provided by the Environment Protection Authority, a council or other authority or body for inclusion in the report; and

(d) other comments or matter as the Minister thinks fit.

(10) The Minister must -

(a) notify a person who made a written submission under subsection (5) of the availability of the Assessment Report in the manner prescribed by the regulations; and

(b) by public advertisement, give notice of the place or places at which copies of the Assessment Report are available for inspection and purchase.

(11) Copies of the EIS, the proponent's response under subsection (8), and the Assessment Report must be kept available for inspection and purchase at a place determined by the Minister for a period determined by the Minister.

(12) If a proposed development or project to which an EIS relates will, if the development or project proceeds, be situated wholly or partly within the area of a council, the Minister must give a copy of the EIS, the proponent's response under subsection (8), and the Assessment Report to the council.

APPENDIX 19

Stormwater Management Cape Jaffa Development, Tonkin Consulting, December 2003, Ref No 20010779RA2

Cape Jaffa Development Company Pty Ltd

Stormwater Management

Cape Jaffa Development

Principal Contacts
Jeff Tyler
Drew Jacobi

December 2003
Ref No 20010779RA2

Table of Contents

Cape Jaffa Development Company Pty Ltd
Stormwater Management
Cape Jaffa Development

Document History and Status

Rev	Description	Author	Rev'd	App'd	Date
A	Draft for comment	DJ			

1. Introduction

This report addresses the stormwater and flood management issues identified by the Development Assessment Panel. The responses to each of the issues raised are located within the report as summarised in Table 1.1 below.

Issue	Issue Ref	Section
Stormwater Reuse	5.2.19	2
Coastal Flooding Policy	5.6.12	3
Stormwater Infrastructure Requirements	5.7.1	2
Water Sensitive Urban Design	5.7.2	2
Marine Stormwater Discharge	5.5.14	2

Table 1.1 Stormwater Management Issues

2. Stormwater Management Plan

Opportunities are available for the incorporation of Water Sensitive Urban Design (WSUD) principles into the stormwater management plan for the proposed development. Features of the proposal include:

- 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;
- 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. 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. The basins would be grassed and require maintenance similar to other reserve areas.
- Rainwater tanks as part of all new residential and commercial dwellings to capture roof runoff for on-site re-use. This will significantly reduce runoff discharged to the marine environment and reduce mains water demand for high-use activities such as garden watering. Overflow from these systems would be directed to the roadside swales.
- 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 efficient treatment required for these areas. The surface levels of these areas would also be designed to slope away from waterway edges towards the stormwater treatment system.

The design levels of the 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 mm 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.

Prior to construction commencing, a Soil Erosion and Drainage Management Plan (SEDMP) will be prepared to document strategies and procedures for effectively treating and discharging runoff during the construction phase. The SEDMP would be prepared in accordance with the Stormwater Pollution Prevention Code of Practice for Local, State and Federal Government and would be primarily concerned with minimising discharge to the marine environment.

Detailed design of the stormwater management system is required at the engineering documentation stage.

3. Seawater Flooding

The District Council of Kingston Development Plan provides direction on site level and floor level requirements for new developments to be safeguarded against seawater flooding.

The Development Plan prescribes that site levels for new development must be set above the 100 year ARI tide level, with additional allowances of 300 mm for sea level rise over the next 50 years, 700 mm for further sea level rise, and an allowance for 50 years of land subsidence.

NTF analysis of the limited tidal record available at Cape Jaffa determined a 100 years ARI tide level of 1.46 mAHD. This leads to a required site level of 2.51 mAHD and minimum floor level of 2.76 mAHD, assuming a land subsidence rate of 1 mm/yr due to ongoing consolidation of filling material.

The Development Plan also prescribes minimum site levels and floor levels for all development within the Urban Coastal Zone. This development is adjacent to but not within this Planning Zone. Minimum site levels and floor levels of 2.40 and 2.65 mAHD are specified within this Zone.

Appendix A

Stormwater Management Concept Plan


STORMWATER MANAGEMENT CONCEPT PLAN
SWALE FLOW DIRECTION (PRELIMINARY)
STORMWATER RETENTION BASIN AREA (EXTENT TO BE CONFIRMED)
EXISTING DEVELOPMENT
COMMERCIAL / BOAT RAMP AREA
LACEPEDE BAY
SEC 283
SEC 82
SEC 306
DRIVE
KING
DP 55486
DP 45040
DP 80617
ROTHALLS
ROAD
CAPE JAFFA ROAD
LIME STONE COAST ROAD
Reserve

APPENDIX 20

Cape Jaffa Domestic Wastewater Disposal, Tonkin Consulting, December 2003, Ref No 2003.0779.101203

Cape Jaffa Wastewater Disposal, Tonkin Consulting, January 2004, Ref No 2003.0318.130104

Memorandum

TO	Simon Tonkin / File				
FROM	David Smith	DATE	10 December 2003	JOB NO	2001.0779
SUBJECT	Cape Jaffa Domestic Wastewater Disposal				

1. Background:

As part of DAC approval for the proposed development, EPA will be assessing information on the proposed method of wastewater collection, treatment and disposal.

We are unsure whether the same level of detail usually required for DAC approval would also be required for the EIS. Please advise in this regard.

Disposal usually incorporates a land based method, such as irrigation of crops or parks/reserves, evaporation, or re-use within the development (eg garden watering / toilet flushing).

Disposal can be undertaken within the confines of the development, on a separate developer / Council site away from the development, or involve a third party (eg farmer / irrigator / golf course) who manages the disposal of the wastewater. Disposal to road reserves inside or outside of the development could also be considered, but must be away from drainage paths. Disposal to a single, compact area (eg dedicated crop field) would be more economic than a "strip" area, such as road reserves.

Any disposal method, particularly where a third party is involved, will require long term security involving the disposal site and agreements to allow ongoing disposal.

The wastewater collection, treatment and disposal system will require approval from DHS and licensing from EPA.

2. Treatment Classes:

Depending on the preferred method of disposal, different levels of wastewater treatment are required, in accordance with the "South Australian Reclaimed Water Guidelines" (DHS / EPA, April 1999). Classes are as follows:

Class A – This allows near unrestricted use for irrigation of crops, parks and gardens at any time, and some household reuse (toilet flushing and garden watering). Class A requires a high level of secondary and tertiary treatment and is usually cost prohibitive. Household reuse requires laying of additional water mains and has a high initial capital cost. For these reasons, Class A treatment is not often the preferred option for the disposal of wastewater.

Class B – This allows for irrigation of parks and gardens with restricted access (eg watering times usually at night, fencing to irrigation areas) to minimise human contact. Food crops which are not consumed raw or not in ground contact (eg almonds) can be irrigated with Class B water. Class B water can be produced through standard treatment plants or lagoons, with disinfection afterwards. Class B is commonly used for municipal irrigation and crop irrigation. Buffer distances to residential and areas with public access apply.

Class C – Reuse opportunities for Class C are similar to Class B but with more stringent controls on buffer distances and some types of crop. Irrigation of wine grapes and pasture for dairy animals or fodder (eg lucerne) can be undertaken with Class C. The same level of treatment is typically used as per Class B (treatment plant or lagoon) but without disinfection.

Class D – Limited irrigation applications, such as woodlots. Treatment by treatment plant or lagoon.

Typical buffer distances required between residential boundaries and irrigation areas are 30m for Class B, 50m for Class C and 100m for Class D, and are subject to the type of sprinkler (eg spray, dripper etc) used. The required Class may also be subject to the type of sprinkler when irrigating food crops.

Airborne drift to residential areas must also be avoided.

3. Treatment Plant Sizing and Location:

It is envisaged that a "package" type mechanical aeration wastewater treatment plant (WWTP) will be constructed. DAC will be seeking preliminary information on this (eg type, sizing, proposed location). These plants offer the advantage of a small area and reduced buffer distance requirements compared to traditional lagoons. Disadvantages compared to lagoons include the need for power, greater monitoring and operation requirements, and a lesser capacity to take "shock" loadings, although this is unlikely to be a problem, even given an itinerant population at Cape Jaffa.

The area required for such a plant is approximately 0.2Ha, compared to approximately 2.0Ha for lagoons. This area is not including that required for storage, which is discussed below.

EPA / DHS have published guidelines relating to buffer distances from WWTP's and treatment lagoons from residential areas. These are 200m and 350m respectively.

4. Security of Disposal:

EPA will require security of tenure over the land to be used for disposal, most likely as part of final approval for licensing. This will require that the development (or Council) have freehold title of the land, or some other legal entitlement to the land use (eg easements for irrigation disposal). In the case that a third party (eg farmer / vigneron) is provided with the water, a legal agreement that the landholder is required to dispose of the water appropriately, and that any successors to the company or third party has the same obligation. This information is further detailed in the attached sheet below.

5. Sustainability of Disposal Method:

Disposal by irrigation changes the natural hydraulic and nutrient loading on the receiving plants, soils and groundwater. Each plant and soil type has differing capacities and responses to water, nutrient, chemical and salinity loadings applied. As such a study of the proposed receiving site soils, looking at the capacity of the soils to take up nutrients, drainage, potential waterlogging, effect on watertable and plantings is necessary prior to final approval, and should ideally be undertaken prior to and included with the DAC submission.

The limiting factor of any disposal site may be due to the hydraulic capacity of the planting to take up moisture or nutrients, or the capacity of the soil to accept nutrients / salinity.

The results of any such study may also influence the required treatment processes, eg incorporating nutrient removal as part of the treatment if the soil has low nutrient absorbing capacity.

At this stage not enough site information has been gathered for this specific purpose. Once a potential site has been identified (even if it may be the marina site itself), this can then be investigated in further detail. This expertise is available in-house.

6. DAC / EPA Requirements

Further to details on the proposed method of wastewater collection (eg gravity sewer / vacuum sewer / pump stations etc) and the proposed method of treatment (eg aeration treatment plan), it is probable that DAC / EPA will require that adequate allowance has been made for a wastewater disposal site.

As part of licensing of the wastewater collection, treatment and disposal system, a sustainable long term method of disposal and associated management requirements, as detailed above, must be supplied for the license to be granted. As such, once a potential disposal site is identified, it would be prudent (although it may not be necessarily essential) to determine information on the sustainability of the disposal site, prior to the DAC submission. If this information is not obtained early on, substantial delays may occur if the site is found to be unsustainable later on.

In addition, a management plan for the long term monitoring and management of the irrigation will be required to demonstrate the ongoing sustainability of the proposed site. If this is not done prior to the DAC submission, the development runs the risk of not having a suitable disposal site.

7. Typical Disposal Method Strategies

In similar developments, it is typical for a separate disposal site to be established away from the development. This has the advantage of ensuring that the development site itself can be utilised for more cost effective purposes (and not wastewater disposal), and that the disposal site can be established on a simpler basis without the possible impediments that adjacent services, land zoning and buffer areas may cause.

In the case of Cape Jaffa, land away from the proposed marina and in an elevated location, where the proximity to groundwater is less likely to be an issue, is considered more suitable.

Also, existing irrigators or farmers willing to accept the water would implement a suitable management regime. However, Council / the Developer would hold the EPA license and would be ultimately responsible for wastewater management and disposal.

Note that any disposal site should ideally be in close proximity to three phase power for irrigation and for possible additional water treatment if required.

Setback distances for disposal areas must be determined in consultation with the EPA, however these are likely to be in accordance with Item 2.

8. Wastewater Storage and Disposal Options

With regard to irrigation disposal, the capacity of any disposal site to receive wastewater is seasonal (ie high summer capacity / low winter capacity), and wastewater is generated year-round. Therefore, a storage for the wastewater over low irrigation demand periods is required. Different irrigated cops have different capacity to take up wastewater over a year (eg vines have a limited demand for water and only over a few summer months, but turf or lucerne have a higher demand spread over more of the year).

The size of the storage will depend on the irrigated crop / soil type and also the overall population served by the development. For evaporation disposal, the size of the disposal site will depend on the size of the development and evaporation potential.

The design population would need to be agreed with the approving authority, but for the purposes of establishing notional sizes of storage and disposal sites, the following is assumed:

Total residential lots served (including existing):	550
Summer Population – 3.5 persons per lot (DHS standard):	1 925 persons total
Winter Population - 2.0 persons per lot (notional allowance):	1 100 persons total
Daily Flow per person to Wastewater Treatment (standard WWTP design figure):	170 litres per person per day

An estimate of the size of storage to store treated wastewater during low irrigation demand periods, and the size of irrigation disposal area required based on the above figures is given in the following table. In addition, an estimate of the disposal site for evaporation is provided. Note that these exclude buffer distances and the disposal area is based on hydraulic loadings only. A larger area may be required due to the nutrient or chemical loading on the soil and potential impact to watertable.

Disposal Method / Crop	Notional Storage Volume / Area	Notional Disposal Area (hectares)	Comments
Evaporation	Nil	25 Ha (500m x 500m)	Very low evaporation rates during wet years result in a large evaporation areas being required. Evaporation area to be lined, flat
Turf	40ML / 12 000m2	12Ha (350m x 350m)	
Eucalypt Woodlot	35ML / 11 000m2	9 Ha (300m x 300m)	Juvenile trees have low uptake, Woodlots require significant management
Lucerne	40ML / 12 000m2	11 Ha (330m x 330m)	Potential cash crop, good nutrient uptake
Mature Winegrapes	50ML / 15 000m2	50-65Ha (800m x 800m)	Disposal area size sensitive to climatic variations
Pasture	40ML / 12 000m2	12Ha (350m x 350m)	
Household Reuse	40ML / 12 000m2	12Ha (350m x 350m)	Similar to turf – limited reuse to toilets, assume nearly all to garden areas. Costly to install

9. Staged Construction

If staged construction is considered, initial wastewater volumes are less, however it is unlikely approval for ultimate development would be granted unless a disposal mechanism for the entire area can be demonstrated.

The low volumes associated with staged construction may not be attractive to potential third party irrigators, who would have to manage a small initial volume which would slowly increase until the development is fully established. In addition, the availability of reasonable quality groundwater in the region may reduce the demand for alternative water supplies such as treated wastewater.

10. Summary and Recommendation:

A wastewater disposal site of the notional dimensions shown in Section 8 needs to be identified and investigated to determine that long term sustainability for disposal can be achieved. Actual sizing will be subject to final population estimates.

The most expedient solution would involve use of the developer's land however this will impact on the area available for development.

An ideal solution would be to acquire land (eg Council land, or freehold or long term lease to the developer with easements) that will allow for irrigation disposal. Such a portion of land should not be in low-lying areas that are in close proximity to groundwater.

There may be an opportunity to provide water to a third party (eg irrigators / farmers), however the staged approach with initial low volume flows, which would increase with development, may make management of the treated wastewater by the third party more difficult and the availability of reasonable quality groundwater may reduce the demand for alternative water supplies.

Wastewater Disposal Obligations

Who Owns the Water → Public System ??

→ Council has Control &Responsibility for ongoing Operation & maintenance

or

→ Land Management Agreement with Developer Transferring Responsibility

Who has Responsibility

→ Ultimately - Council,s Responsibility

EPA Licensing Requirements
(Council hold License)

Can transfer to.

Third Party Involvement

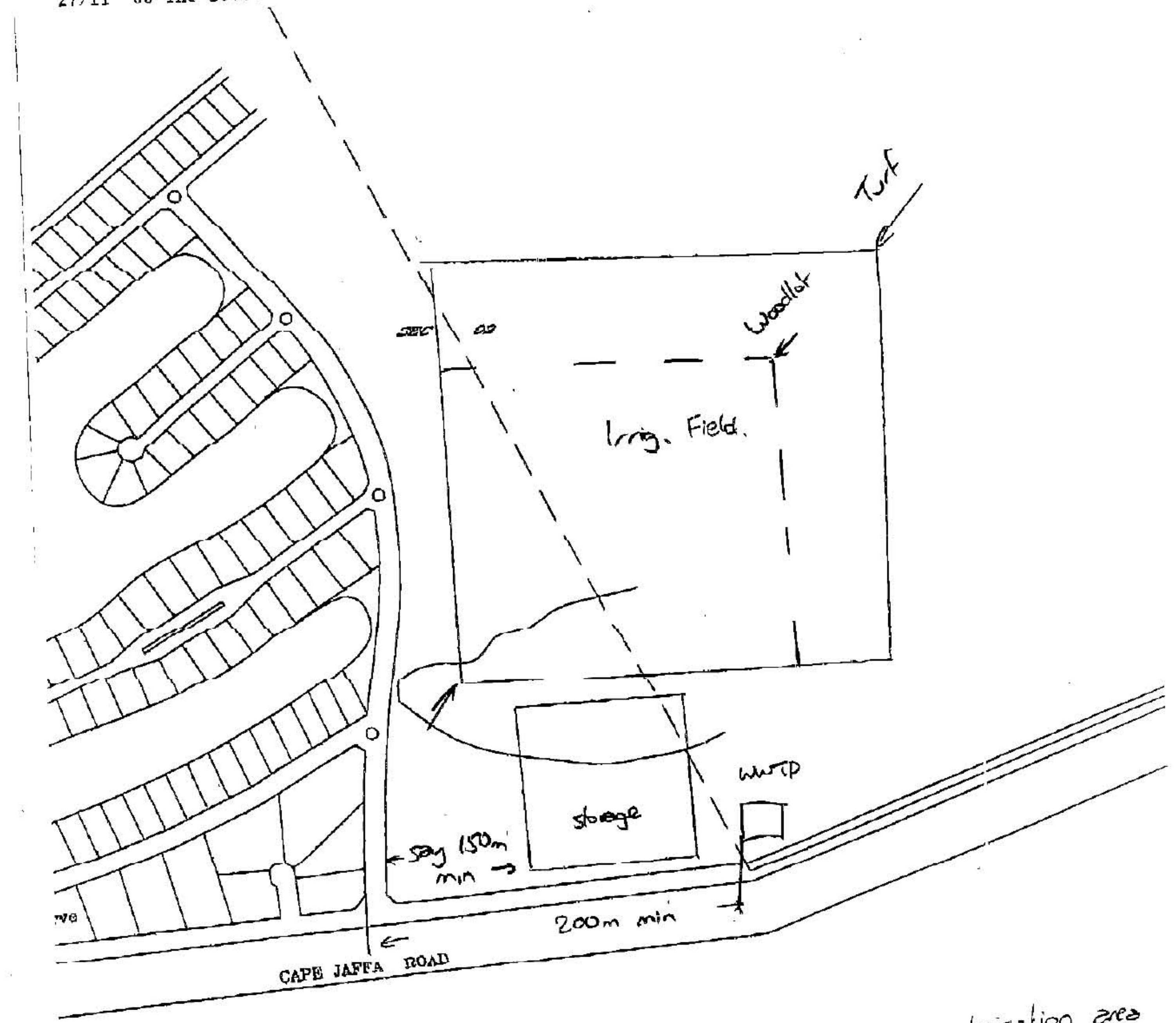
→ Transfer responsibility by **Formal Agreement**, detailing Rights and Obligations of the Parties

Need to Protect Council's Interests

→ EG: What happens in Case of a failure to act by the third party.
Council has ongoing responsibility for disposal of water in a way that does not create environmental harm. Need to consider rights to enter and use system to dispose of water.

Other matters for consideration in Formal Agreement:

Quality of supply (Is it suitable for use)
Quantity
Guarantee of Supply
Storage
Nature of use
Obligations & Responsibilities of Parties
Who will do what & when
Indemnities
Who maintains what
Costs (eg payment for water)
Compliance with Statutory requirements
Eg: Under EPA License third party to obtain SAHC approval and prepare Irrigation Management Plan.



550 Lots

Summer Pop 1925 (3.5/lot) ≻ Ave 1450 (2.6/lot)
Winter Pop 1100 (2.0/lot)

Turf
Storage 40 ML (110x110x3.5) say 150sq.
Irrigation 12 Ha. 120 pers/ha.
say 15 Ha inc buffers
say 400 x 400

Wood lot
Storage 35 ML say as above
Irrigation 9 Ha say 300 x 300

Irrigation area needs

NB 100m setback required from HWL (DHS regulation)

WWTP needs 200m setback from residential areas (EPA guideline)

Memorandum

TO	Simon Tonkin/Rob Gabb				
FROM	Glenn Passfield	DATE	13/01/04	JOB NO	2003.0318
SUBJECT	Cape Jaffa Wastewater Disposal				

The following issues are addressed in this memo:

5.2.4 Describe stormwater and wastewater management and the potential impact on groundwater.

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 groundwater and the marine environment.

Stormwater management and its potential impact on groundwater is addressed in a separate memo.

Sewage Treatment

Sewage collected at the development site will be treated by a “package” type mechanical aeration wastewater treatment plant (WWTP), located near the south-eastern corner of the site adjacent Cape Jaffa Road. A buffer distance of 200 m in accordance with “Guidelines for Separation Distances” (EPA Consultation Draft, August 2000) will be maintained from the treatment plant to residential areas.

The wastewater will be treated Class B quality water in accordance with the “South Australian Reclaimed Water Guidelines” (Department of Human Services (DHS) and the Environmental Protection Agency (EPA), April 1999). Treatment to this class allows for irrigation of parks and gardens with restricted access to minimise human contact, irrigation of food crops which are not consumed raw or not in ground contact and irrigation of pasture and fodder for grazing animals.

Wastewater Disposal/Reuse

The wastewater reuse and disposal options considered for the development included irrigation of crops or parks/reserves with reclaimed water, evaporation or reuse within the development (eg. Garden watering, toilet flushing). Based on an assessment of these options, the preferred option was selected as being the irrigation of a suitable crop species. A number of crops were considered, including turf, eucalypt woodlot, lucerne, mature winegrapes and perennial grasses. The preferred crop was lucerne or pasture due to their lower capital and maintenance costs and the established market for cattle fodder in the region.

A preliminary hydraulic balance was undertaken to determine the approximate area required for irrigation of reclaimed water based on the ultimate development of 550 residential lots (refer below for further details). An area of approximately 11 hectares of lucerne or 12 hectares of perennial grasses was considered to be ultimately required to meet the hydraulic loading capacity for consecutive 1 in 10 (ie. Decile 9) wet years. These areas exclude buffer distances and other required setbacks.

Based on these areas, an assessment was undertaken to identify potentially suitable irrigation sites in the region. A staged approach is proposed, involving disposal to the eastern portion of the site during the initial stages of development, expanding to a disused quarry site owned by the Council located on the Limestone Coast Road approximately 2 km south-east of the site (Allotment 104 in Deposited Plan 49493). Excess soil from the development may be used for landform modification at the quarry site prior to irrigation. Any areas of fill would be compacted to the appropriate engineering requirements to minimise settlement. Further investigation is proposed at the quarry site to confirm its suitability for reclaimed water irrigation.

These sites have the advantage of long term security of tenure as both sites will ultimately be vested in Council. In addition, both sites have sufficient land to enable the establishment of vegetated buffer zones of up to 30 m (subject to the type of irrigation sprinkler used, eg. spray or dripper) to reduce airborne drift to residential areas or public places, as required for wastewater treated to a Class B standard (DHS/EPA, 1999). Further studies will be necessary to confirm the sustainability and the size of the irrigation areas required.

Remnant native vegetation located in proximity to the irrigation sites will be retained and not irrigated.

Reclaimed Water Storage

The capacity of any irrigation site to receive reclaimed water is seasonal (i.e. high summer capacity, low winter capacity), whereas reclaimed water is generated year round. Therefore, a storage for the reclaimed water over the low irrigation demand period is required. Different irrigated crops have differing capacities to take up water over the year, and the size of the storage depends on the irrigated crop selected, the soil type and the overall population served by the system.

Based on the preliminary hydraulic balance (refer below for further details), a storage volume of approximately 40 ML is likely to be required. As the irrigation sites will be developed in stages, it is likely that the volume would be split into separate basins. One of these basins would be located in the south-eastern corner of the site in proximity to the initial irrigation area. The other basin would be located at the Council quarry site during subsequent stages of the development. Both storages would be lined to minimise groundwater impact and managed to minimise the generation of odours.

The storage facility will be located in accordance with the requirements of the “Environment Protection (Water Quality) Policy 2003”, including a buffer distance of 200 m to the closest residential allotment.

Sustainability of Disposal Method

Irrigation of reclaimed water changes the natural hydraulic and nutrient loading on the receiving crops, soils and groundwater. Each plant and soil type has differing capacities and responses to water, nutrient, contaminant and salinity loadings applied. As such a detailed study of the proposed irrigation sites, assessing the nutrient sorption capacity of the soils, drainage and potential waterlogging issues as well as the effect on watertable and crops will be undertaken. Other management issues requiring consideration include sodicity (as measured by Sodium Adsorption Ratio), boron and heavy metals. For the purpose of this EIS, preliminary hydraulic and nutrient balances have been undertaken and are detailed below and will be confirmed through on-site studies.

Helminth control for cattle fodder will be undertaken in accordance with (DHS/EPA, 1999) for Class B reclaimed water.

Preliminary Hydraulic Balance

The preliminary hydraulic balance estimated the irrigation requirements of both lucerne and perennial grasses based on potential evapotranspiration and rainfall from consecutive 1 in 10 (i.e. Decile 9) wet years recorded at the Kingston SE weather station. Evaporation data from Robe was used to estimate the potential evapotranspiration based on crop efficiencies provided by PIRSA (based on the former SA Department of Agriculture, Water Balance Model, 1989).

The wastewater flow was estimated based on a total of 550 residential lots being ultimately developed for the project, with a transient population (greater in summer than in winter) and typical wastewater generation volumes per person.

The results of the preliminary hydraulic balance indicate that an area of approximately 11 hectares for lucerne and 12 hectares for perennial grasses would ultimately be necessary to match disposal volumes to irrigation requirements. A larger area may be required due to nutrient or chemical loading on the soil and the potential impact on groundwater.

Preliminary Nutrient Balance

Optimum nutrient removal at the disposal site will be achieve by regular harvesting of the crop as fodder to provide a removal mechanism for nutrients off site. In addition, storage will be provided so that irrigation can occur during the growing season when plant nutrient requirements are highest.

Based on the irrigation areas calculated for the preliminary hydraulic balance, the estimated total nitrogen application is expected to be 150 to 200 kg/ha/year. This application rate is approximately within the nitrogen removal rate of perennial grasses and lucerne. Nitrogen losses due to nitrification and denitrification have been assumed to be a minor component of the nutrient cycle have been ignored in the preliminary nutrient balance. Nitrification and denitrification will reduce the nitrogen loading and will need to be considered prior to completing the nutrient balance.

The estimated loading rate of total phosphorus is 70 – 90 kg/ha/year, which is above average plant requirements. However, due to the complexity of soil chemistry, the availability of phosphorus for either uptake or leaching is currently not known. Soil testing at the selected disposal site is proposed to assess this issue prior to completing the nutrient balance. If the phosphorus sorption capacity of the soil is low, consideration will be given to securing additional irrigated area in order to minimise leaching of phosphorus to groundwater. Alternatively, additional water treatment (such as alum dosing) could be undertaken to reduce phosphorus concentrations.

The disposal site will need to be well managed by qualified personnel to ensure that optimum agricultural yields will be achieved and the sustainability of the disposal method is maintained.

Impact on Groundwater and Marine Environment

The impact to groundwater as a result of irrigating with reclaimed water will be managed by optimising plant uptake of water and nutrients by matching the hydraulic and nutrient load to crop requirements. In addition, storage of the reclaimed water during the cooler months will enable irrigation to occur during the growing season/warmer months. This will minimise the potential impact of irrigation during wet weather.

During the warmer months, salts from the reclaimed water may build up in the soil, and as such, salt tolerant crop species will be selected.

With appropriate management practices, the impact on groundwater is likely to be minimal. As migration via groundwater is likely to be the principle pathway to the marine environment, the impact on the marine environmental is also likely to minimal.

Further investigations are proposed to assess the nutrient sorption capacity of the soil as well as to address the management of sodicity, boron and heavy metals.

>>> sodicity by gypsum ,

Irrigation Management Plan

An Irrigation Management Plan (IMP) will be required as part of the license issued by the EPA. The IMP will be prepared in accordance with DHS/EPA (1999) and will incorporate:

- Description of the irrigation scheme and consideration of short and long term environmental considerations;
- Details of approvals and licenses obtained;
- Description of the design and operational requirements of the scheme;
- Monitoring and reporting requirements, including monitoring of the treated wastewater, groundwater, surface water and soils;
- Health and safety requirements for operators and the public; and
- Quality control including requirements for independent verification of the monitoring program.

Further Site Studies

The long term sustainability of the proposed irrigation sites is dependent on site specific characteristics and the preparation of a suitable management plan. On-site studies will be undertaken to confirm that the irrigation sites are suitable as a sustainable, ongoing irrigation area.

Licensing and Approvals

The wastewater collection, treatment and disposal system will require approval from DHS following completion of the system design.

An EPA licence will also be required for the system. This will be obtained once an the IMP has been completed and accepted and prior to scheme commissioning.

APPENDIX 21

Cape Jaffa Anchorage Marina Assessment of Tidal Flushing, WBM Oceanics Australia, May 2004, Ref No R.B14794.001.01

Cape Jaffa Marina

Assessment of Tidal Flushing

Prepared For:	Tonkin Consulting
Prepared By:	WBM Oceanics Australia

Offices

Brisbane
Denver
Karratha
Melbourne
Morwell
Newcastle
Sydney
Vancouver

DOCUMENT CONTROL SHEET

WBM Oceanics Australia Brisbane Office: WBM Pty Ltd Level 11, 490 Upper Edward Street SPRING HILL QLD 4004 Australia PO Box 203 Spring Hill QLD 4004 Telephone (07) 3831 6744 Facsimile (07) 3832 3627 www.wbmpl.com.au ABN 54 010 830 421 002	***Document:***	R.B14794.002.01.flushing.doc
	Title:	Cape Jaffa Marina - Assessment of Tidal Flushing
	Project Manager:	Dean Patterson
	Author:	Dean Patterson / David Wainwright
	Client:	Tonkin Consulting
	Client Contact:	Jeff Tyler
	Client Reference:	
	Synopsis:	Assessment of the flushing characteristics of the proposed marina and canal waterway system at Cape Jaffa. The investigation has involved numerical modeling of advection and dispersion processes under tidal and groundwater flow influences to ensure sufficient water exchange for maintenance of good water quality within the waterway. General hydrodynamic processes associated with the design layout of the entrance are also assessed.

REVISION/CHECKING HISTORY

REVISION NUMBER	DATE	CHECKED BY		ISSUED BY	
0	24/12/03	D Wainwright		D Patterson	
1	04/03/04	D Wainwright		D Patterson	

DISTRIBUTION

DESTINATION	REVISION										
	0	1	2	3	4	5	6	7	8	9	10
Tonkin Consulting	1	1 CD									
Master Plan SA	1	1 CD									
WBM File	1	1									
WBM Library	1	2									

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

It is proposed to develop a marina and canal waterway at Cape Jaffa, to be excavated within the existing onshore land, with a channel connection to the sea across the present shoreline. The waterway will be fully tidal at a depth of about 3.5m (below AHD). The entrance channel will be protected from waves and sand inflow by breakwaters.

The site location is shown in Figure 1-1. An aerial photograph of the site is presented in Figure 1-2, illustrating the nature of the coastal area involved. A conceptual layout design of the proposed marina and canal system is shown in Figure 1-3.

The proposed Cape Jaffa Anchorage marina and canal layout has been assessed in terms of its potential tidal flushing characteristics. A comprehensive numerical model has been used for that purpose, covering the whole development waterway and extending some distance beyond the marina entrance to include the adjacent ocean area. Results from the model have been used to assess the likely water quality characteristics within the waterway.

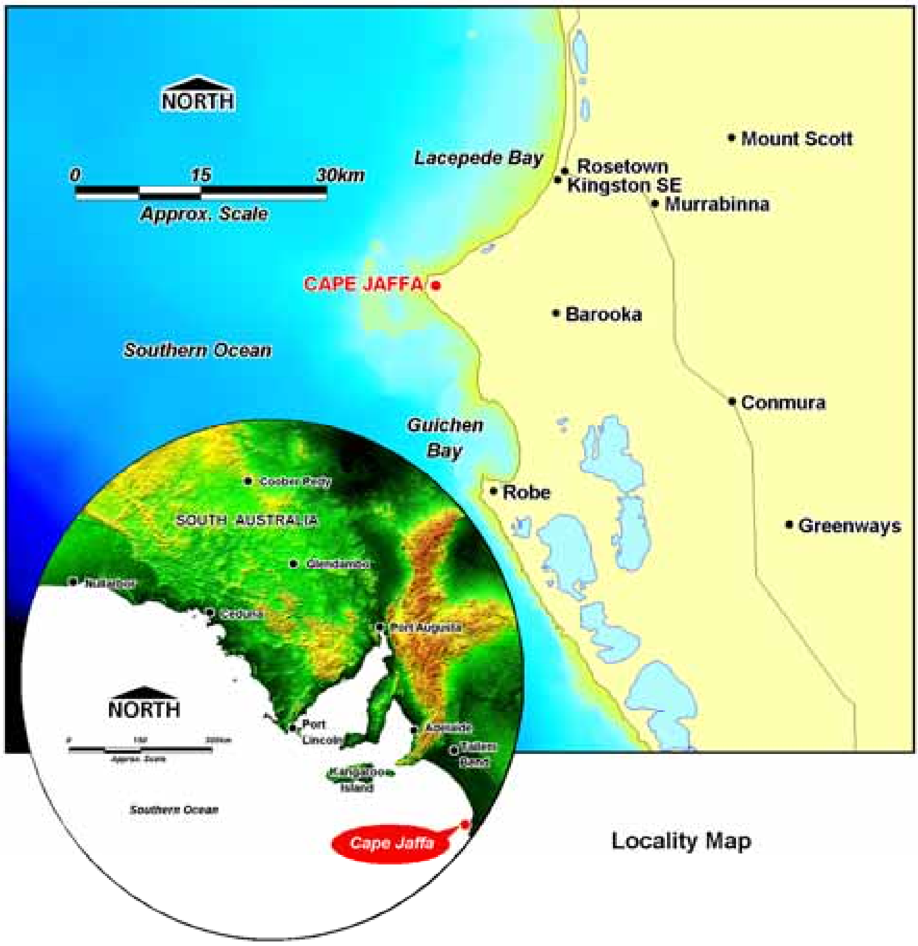


Figure 1-1 Cape Jaffa Locality Plan

Figure 1-2 Aerial Photograph of Cape Jaffa

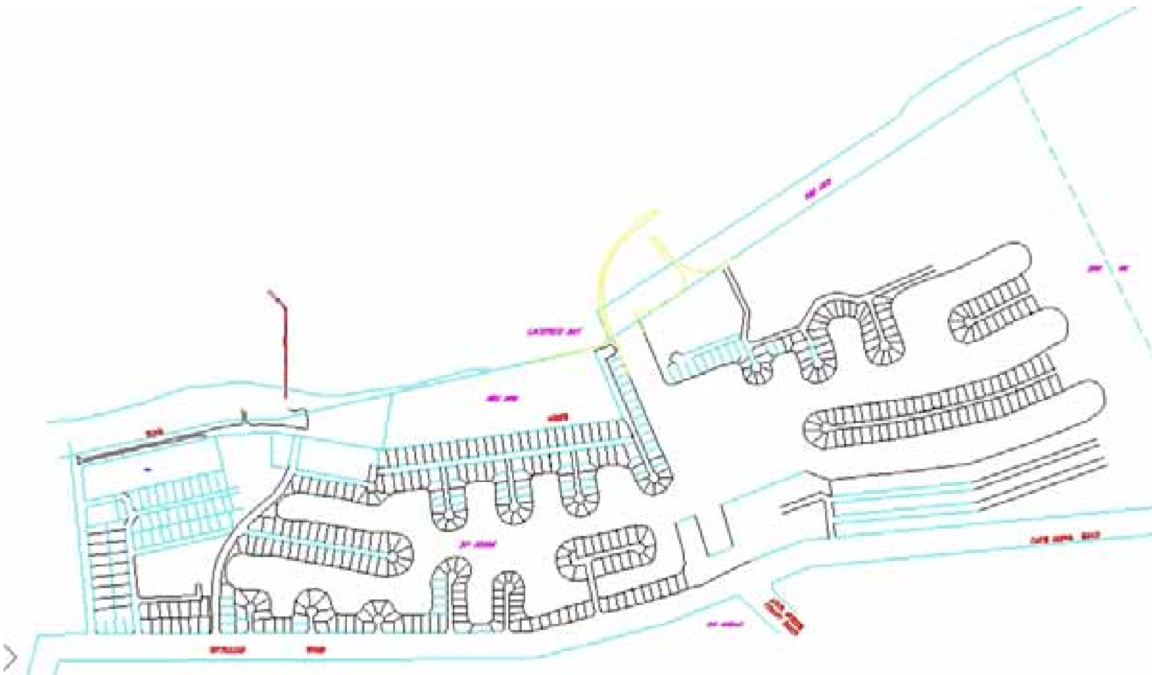


Figure 1-3 Concept Layout Design for Proposed Marina Waterway

2 MODELLING OF HYDRODYNAMIC AND FLUSHING PROCESSES

2.1 Model Setup

A finite element model, using the RMA-10 modelling software, was developed to assess the following characteristics of the proposed Cape Jaffa Anchorage Marina:

- Tidal hydrodynamics;
- Tidal flushing; and
- Effects of groundwater inflows.

2.1.1 Model Software

The RMA modelling suite, of which RMA-10 is a part, is widely used to model coastal and estuarine situations. Specific features of RMA-10 are:

- Three dimensional, dynamic model to simulate the combined effects of tide, wind, bed friction, coriolis effect and (as needed) waves upon the movement of water;
- Flexible mesh geometry that permits refined fitting of the computational network to the waterway shape and finer detail in areas of greatest interest;
- Simulated 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 allows full three-dimensional finite element representation of stratified flow. This involves:

- The solution of the Navier-Stokes equations in three-dimensions;
- The use of the shallow-water and hydrostatic assumptions;
- Coupling of advection and diffusion of temperature, salinity and sediment to the hydrodynamics;
- The inclusion of turbulence in Reynolds stress form;
- Horizontal components of the non-linear terms are included;
- A capacity to include one-dimensional, depth-averaged, laterally-averaged and three-dimensional elements within a single mesh as appropriate;
- No, partial and full slip conditions can be applied at both lateral boundaries;
- Partial or no slip conditions can be applied at the bed;
- Depth-averaged elements can be made wet and dry during a simulation;
- Vertical turbulence quantities are estimated by either a quadratic parameterisation of turbulent exchange or a Mellor-Yamada Level 2 turbulence sub-model.

RMA-10 is a very flexible finite element model that may be used for estuarine and river simulation in either steady state or dynamic mode and that 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. This leads to considerable computer time and cost saving in large estuary or floodplain systems.

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 wind or wave radiation stresses and is capable of simulating estuarine systems where stratification is caused by any combination of temperature, salinity or sediment concentrations.

2.1.2 Bathymetry and Proposed Layout Design

Bathymetric information was based on detailed nearshore and onshore surveys undertaken specifically for the design and assessment of this proposal. The model data was extracted from a text file, provided to WBM by Tonkin Consulting, containing 4352 x, y and z coordinate triplets representing beach and nearshore levels, and offshore bathymetry. These points were imported into a Geographical Information System (GIS) using projection MGA 94 (Zone 54) and a digital elevation model was generated from those points.

The bed level of the proposed marina, and the navigation channel approaching the entrance to the marina was set at –3.5 m AHD. The area between the breakwaters immediately inside the entrance is somewhat deeper as an area to trap and remove inflowing weed.

The model plan form was adopted from an Autocad drawing provided to WBM by Tonkin Consulting and and showing the general arrangement of roadways and lots surrounding the marina waterways. The model boundary was set to represent the waterways represented on those drawings. The model boundary broadly follows the alignment of the beach berm either side of the entrance breakwaters. It is likely that this layout will be modified somewhat in the final design. It is considered unlikely that changes to the layout will alter the findings of the assessments outlined herein.

The modeled configuration of the breakwaters is preliminary and somewhat subjective, aimed at providing the essential effect of the final design. It 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 1000 m both east and west along the coast and for around 1000 m offshore. The offshore boundary of the model had a depth that varies from –3.5 to –4.5 m AHD.

2.1.3 Model Mesh

The model geometry comprises a mesh of nodes interconnected by a series of triangular and quadrilateral elements. The model mesh is displayed as Figure 2-1, along with the proposed marina layout and a recent aerial photograph as the background. As shown, the model 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 bed levels, which are stored at each node, were extracted directly from the DTM. The bathymetry, as interpreted by the model, is illustrated in Figure 2-2.

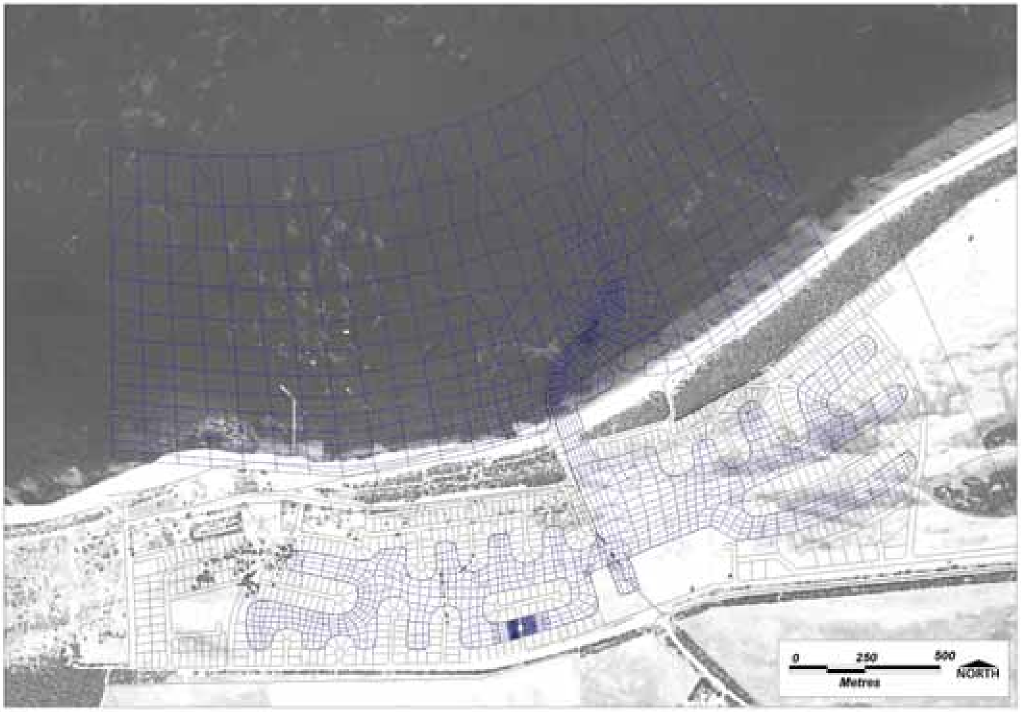


Figure 2-1 Model Mesh

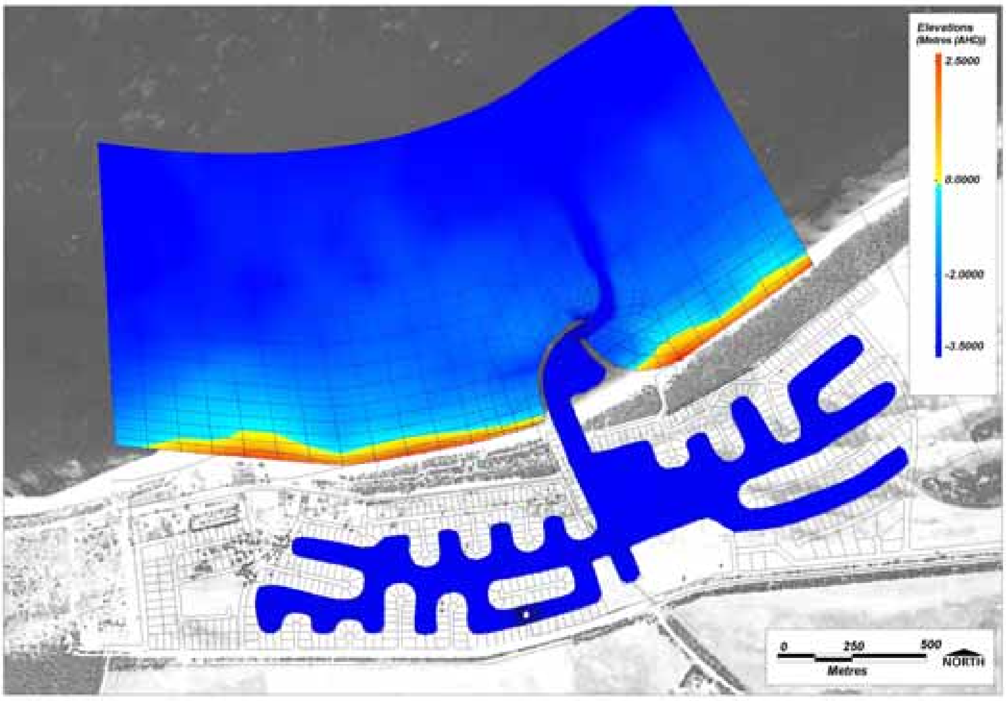


Figure 2-2 Model Bathymetry

2.2 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 Harbour has been used. Available information indicates that the Cape Jaffa tide is sufficiently similar to that at Victor Harbour for this to be reasonable and appropriate for the specific purpose of identifying the effects associated with the full range of prevailing tidal conditions.

For example, comparison of tidal planes for the region (as indicated by Kingston) and Victor Harbour, as shown in Table 2-1, confirms close similarity in neap/spring tidal ranges. Figure 2-3 shows the data that was used.

Table 2-1 Tidal Planes at Kingston and Victor Harbour

Tidal Plane	Tidel Level (mAHD)	
	Kingston	Victor Harbour
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

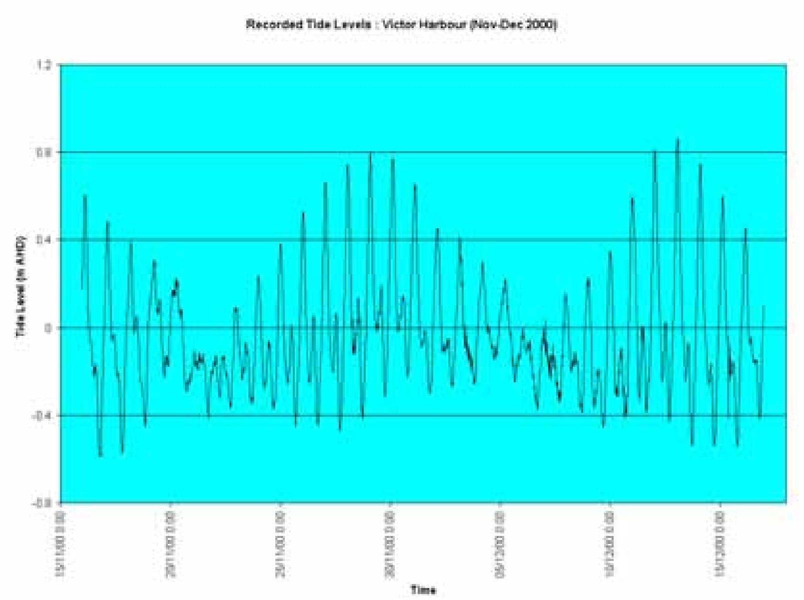


Figure 2-3 Tidal Boundary Data Adopted for Simulations

Calibration of the marina/canal model was not feasible, given that the marina does not yet exist. The simulations were 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.

Specific locations for which tidal flushing rates have been determined are referenced in Figure 2-4.

2.3 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;
- Typical peak tidal currents within the Marina, including current patterns in the vicinity of the entrance breakwaters.

Because of the small size of the waterway relative to the temporal/spatial scale of tidal propagation, the water levels within the Marina are almost identical (within a few millimetres) to the water level at the ocean entrance for most circumstances. However, following the ebb of a larger spring tide, the water levels within the marina can remain slightly elevated, with differences of up to 3 cm in the water level being simulated between the entrance and the end of the south-west arm. Essentially, the marina can be considered to have an almost flat water surface during all tidal conditions.

2.3.1 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 25 hour period and various ranges has been used to indicate tidal prisms for the waterway, as shown in Table 2-2.

Table 2-2 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

These may be compared with a waterway volume below Lower Low Water of about 1,260,000m^3 as an indicator of the relative exchange of water with the tide.

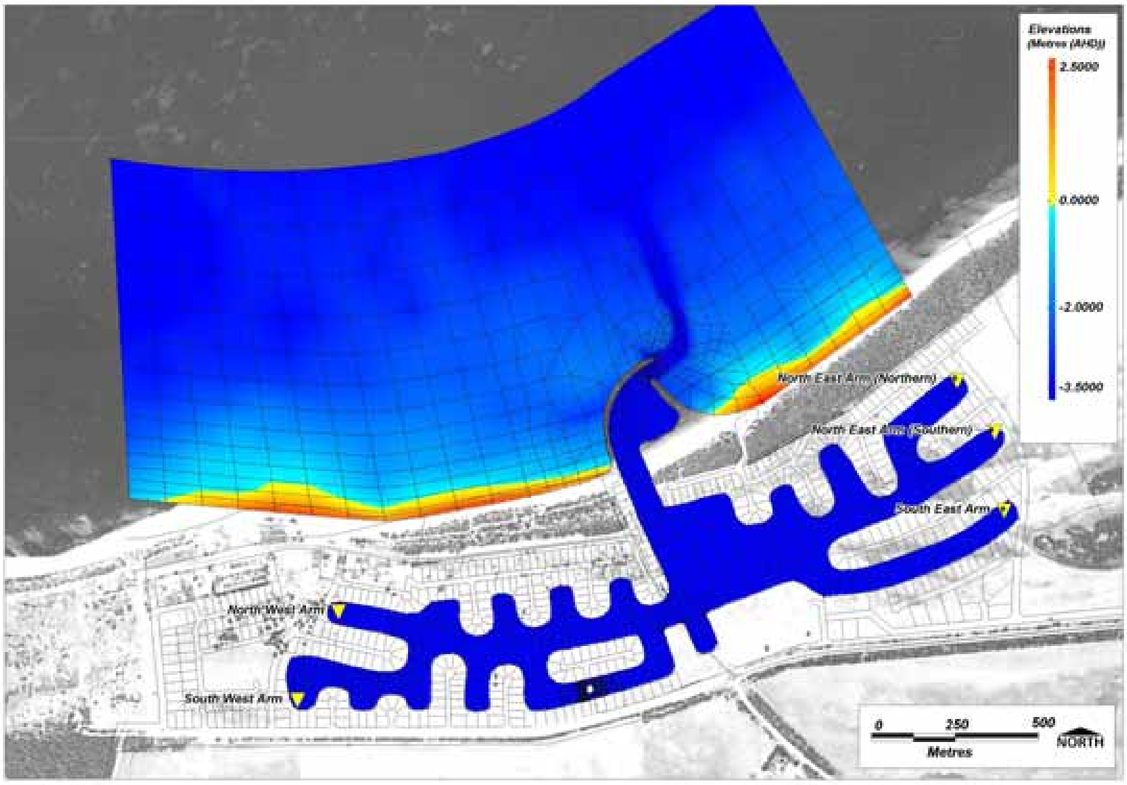


Figure 2-4 Tidal Variation Reporting Locations

2.3.2 Tidal Currents

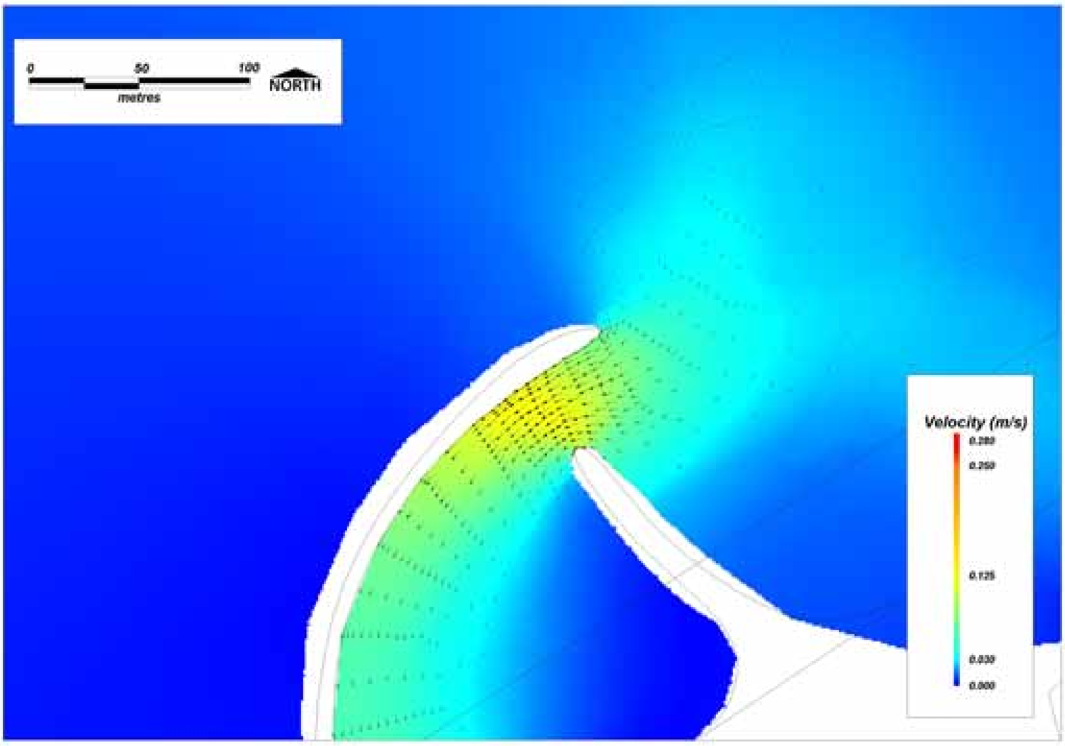
The maximum Ebb and Flood Tidal Currents, for the larger simulated spring tide conditions (i.e. from analysing current patterns between 29/11/00 02:30 – 30/11/00 03:30) are presented in Figure 2-5.

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. Simulated peak maximum velocities in this area for the flood and ebb condition are around 0.2m/s.

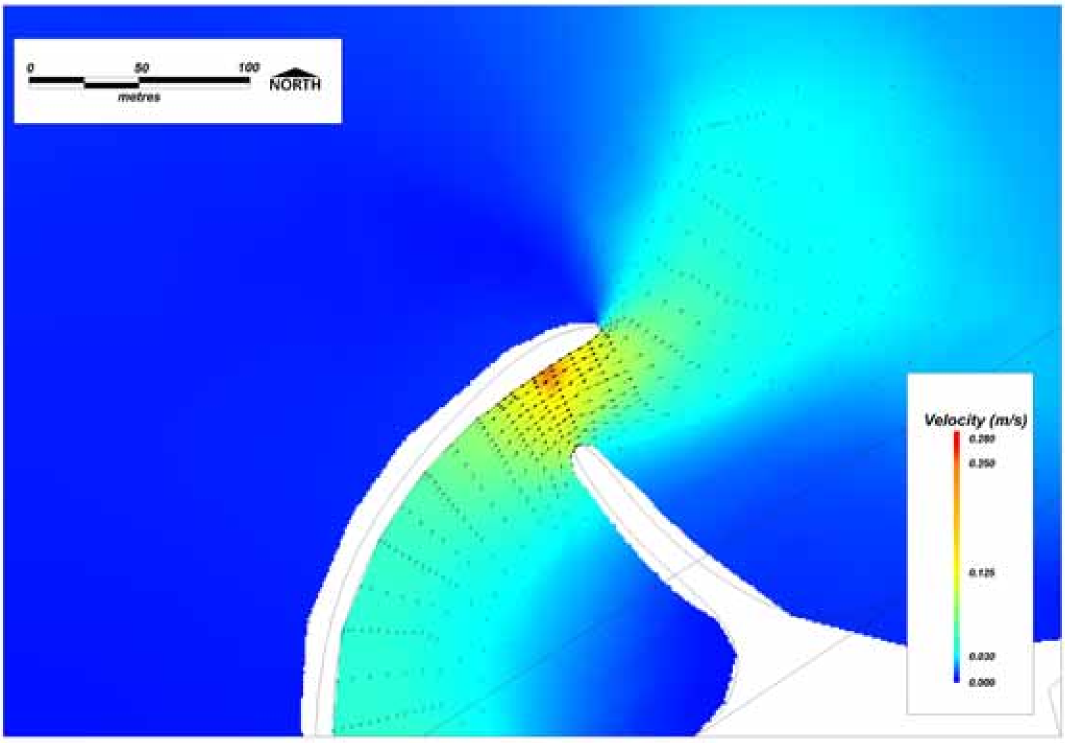
Such minor currents will not cause issues with navigation or disturbance to the seabed or benthic communites. Thus, there is unlikely to be any problems with current-related seabed scour or siltation within the waterway itself.

2.4 Tidal Flushing

Tidal flushing simulations were undertaken for a 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. Sinusoidal tides were simulated with ranges of 0.4m, 0.6m, 0.8m and 1.0m respectively, allowing for interpretation of the likely tidal flushing capacity under real tide circumstances.



Flood Tide Current – No Wind



Ebb Tide Current - No Wind

Figure 2-5 Flood and Ebb Tide Current Patterns at Marina Entrance

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.

Time series of concentrations of the conservative pollutant at various locations in the marina/canal waterway are shown in Figure 2-6. The derived e-folding times throughout the waterway for the various tidal ranges assessed are shown in Figure 2-7. Results for the extreme ends of the canal arms for each case are presented in Table 2-3.

Table 2-3 E-Folding Flushing Times (Days)

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
Southeast Arm	3.6	4.4	4.8	5.6

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 0.4m. The southwestern 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.

Clearly, during very small 'dodge' tides of 2-3 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 0.4m range situation. These periods will be followed by larger tides and increased flushing and there will be no periods of sustained poor flushing.

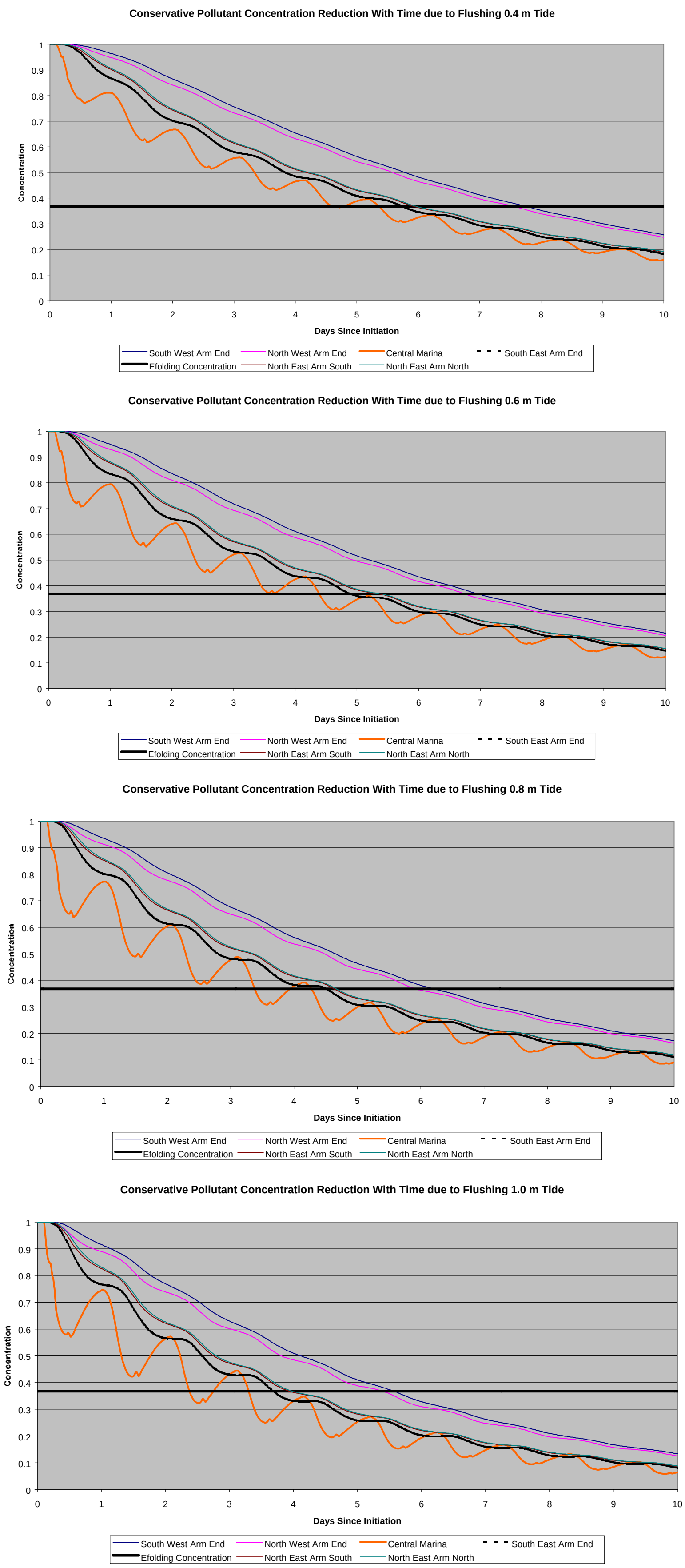
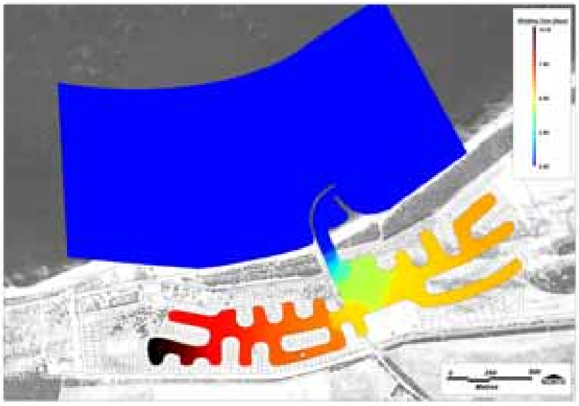
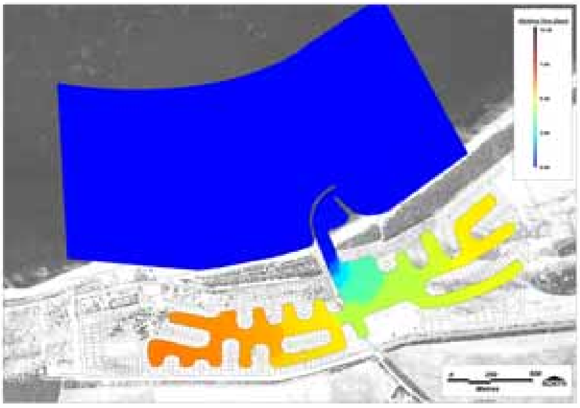


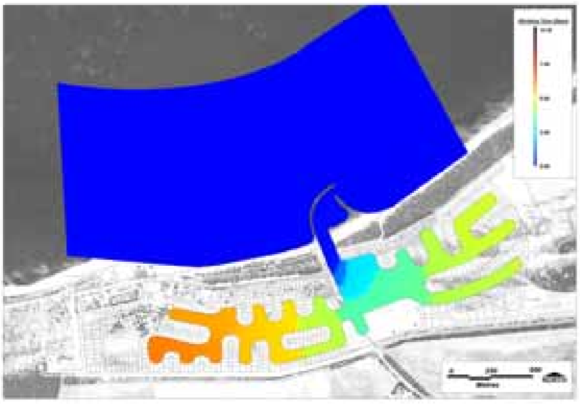
Figure 2-6 Time Series Decline in Conservative Pollutant Concentrations



0.4m Range



0.6m Range



0.8m Range

1.0m Range

Figure 2-7 E-Folding Flushing Times for Marina and Canal Waterway

3 GROUNDWATER FLOW EFFECTS

The land surrounding the canal and marina waterway will be comprised of 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. This flow could contain some contaminants that may have leached to the surrounding groundwater and that would enter the waterway system and be subject to dispersion and dilution through tidal flushing processes.

Computer modelling has been undertaken of tidal flushing in conjunction with groundwater flow to determine the likely extent of dispersion and dilution of any contaminants that may enter the waterway in this way. Thus, the modelling has sought to determine the 'equilibrium' dilution factors that would occur as the result of the dynamic interaction of the inflows and flushing exchange.

The modelling process outlined in Chapter 2 has been used for this purpose, with additional input of flows around the canal edges. The likely groundwater flow rates have been assessed and advised by Tonkin Consulting, as illustrated in Figure 3-1.

These flows were input to the model along the landward canal edges to represent the flow from the landward side toward the coast as intercepted by the marina. For modelling purposes, the groundwater inflow was designated with a contaminant concentration of 1 unit (100%) such that the model outputs show concentrations as proportions of the input (ie. relative dilution).

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 dilution. To identify the likely worst-case situation, the modelling was undertaken with a tidal range of 0.4m, equivalent to a neap tide. Dilution rates would be significantly greater for larger tides.

Figure 3-2 shows the results in terms of the spatial distribution of the dilution factor.

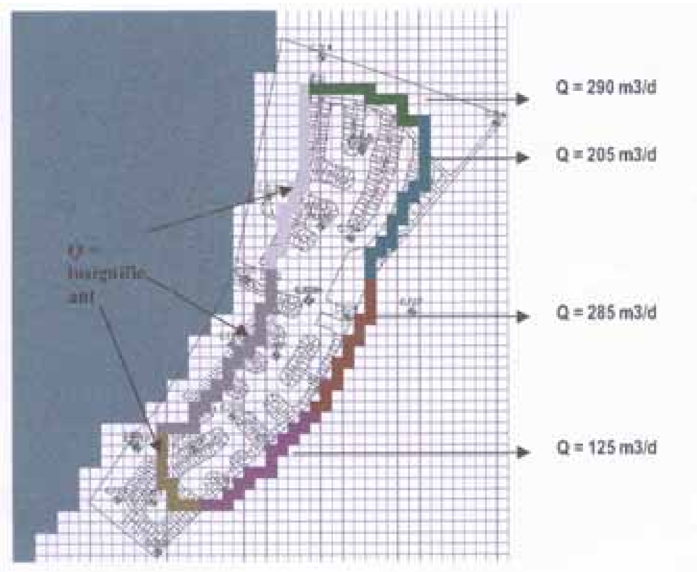


Figure 3-1 Pattern and Estimated Rates of Groundwater Flow

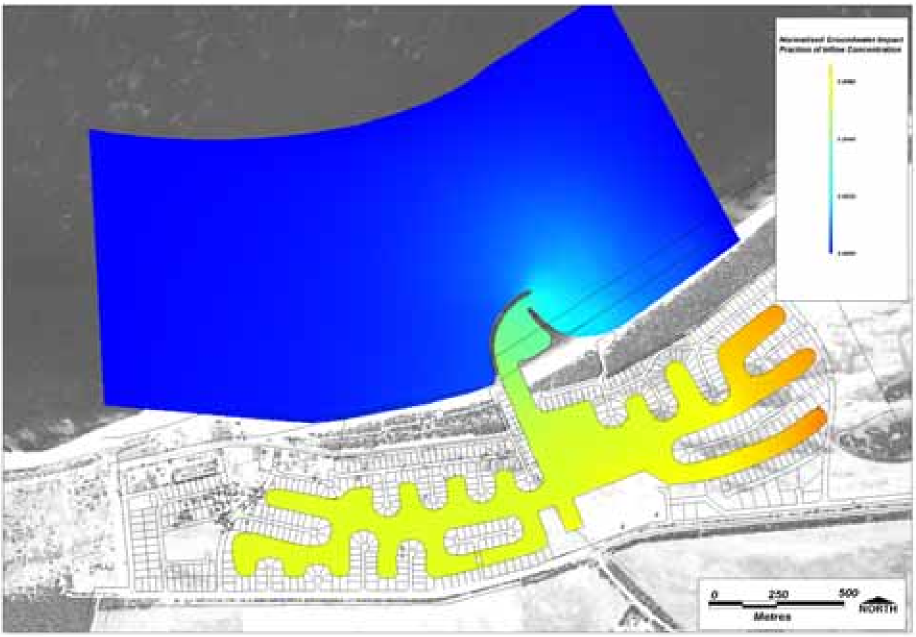


Figure 3-2 Dilution Factors for Contaminants From Groundwater Inflow

The modeling shows that the impact of groundwater flow and likely contamination of the waterway are minimal, with the maximum concentration values within the southeastern arms of the marina/canal system being about 0.66% of the concentrations in the groundwater flows. The factor for the southwestern arm is 0.57%. At the entrance itself, that figure falls to less than 0.3% 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 0.4m and an internal waterway area of around 420,000 square metres), several orders of magnitude higher. As the groundwater flow rate is so small, the dispersive and water exchange (flushing) processes will quickly dilute and remove inflow material to negligible levels within the waterway and adjacent ocean.

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 in Chapter 2 has been carried out, with the groundwater flow included, for the 'worst case' scenario of 0.4m tidal range. The time series of concentrations with and without the groundwater flows are shown in Figure 3-3, indicating negligibly small change in the flushing time, reflecting the very small rate of groundwater flow relative to the tidal exchange.

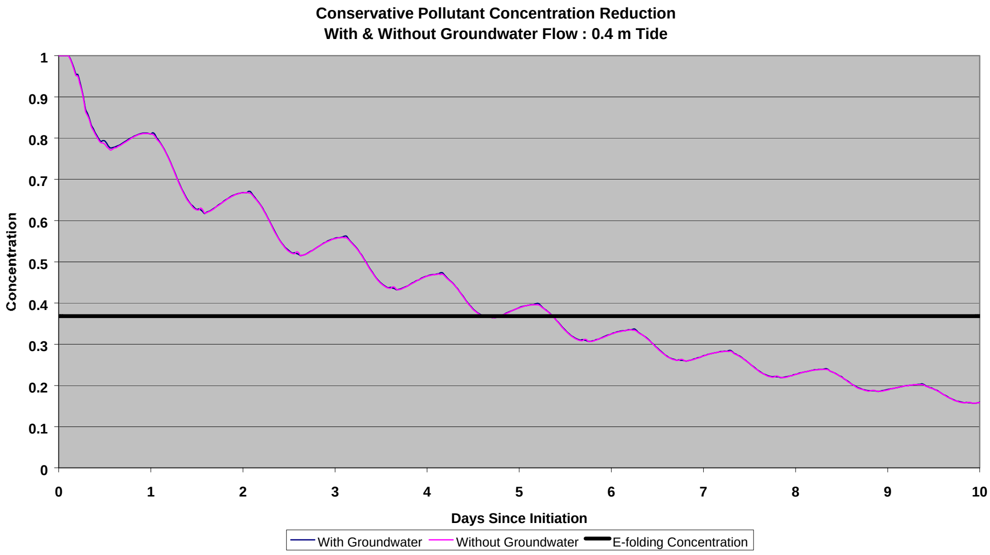


Figure 3-3 Tidal Flushing Concentrations With and Without Groundwater Flows

4 WATERWAY FLUSHING AND WATER QUALITY CONSIDERATIONS

4.1 Key Issues

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 storm water 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 ('weed') derived from offshore and deposited in the marina/canal system.

The modelling has shown that dilution 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.

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 weed on the waterway seabed.

The proposed water depth of 3.5m will provide an optimum situation that minimizes sunlight penetration to the bed, provided tidal flushing is acceptable.

In that regard, it is expected that an e-folding flushing time of about 3-4 days would result in water quality being close to that in the ocean. A flushing time of up to about 10 days is likely to be acceptable, even with some nutrient/weed inputs.

The modelled flushing time of about 6-8 days indicates that the water quality in the proposed marina/canal system will be of good quality. However, management action should be taken to mitigate potential problems that may arise from excessive deposition of the weed. This would involve:

- Initial design of the entrance to minimize the potential for the weed to enter from the ocean; and
- Regular removal of the weed 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 4-1 shows the current pattern associated with a typical northwest wind of 30 knots, indicating the effect of the curved western breakwater in directing flow away from the immediate mouth.

However, there is local inflow on the flood tide from the area immediately near the tip of the western breakwater. It is expected that, for weed with some tendency to sink to the seabed, the enlarged and somewhat deeper area immediately inside the mouth would act as a weed trap, where it might be more readily harvested, and may reduce its penetration further along the canals. The feasibility and success of such action depends on how the weed is transported and deposited on the bed.

4.2 Conclusions

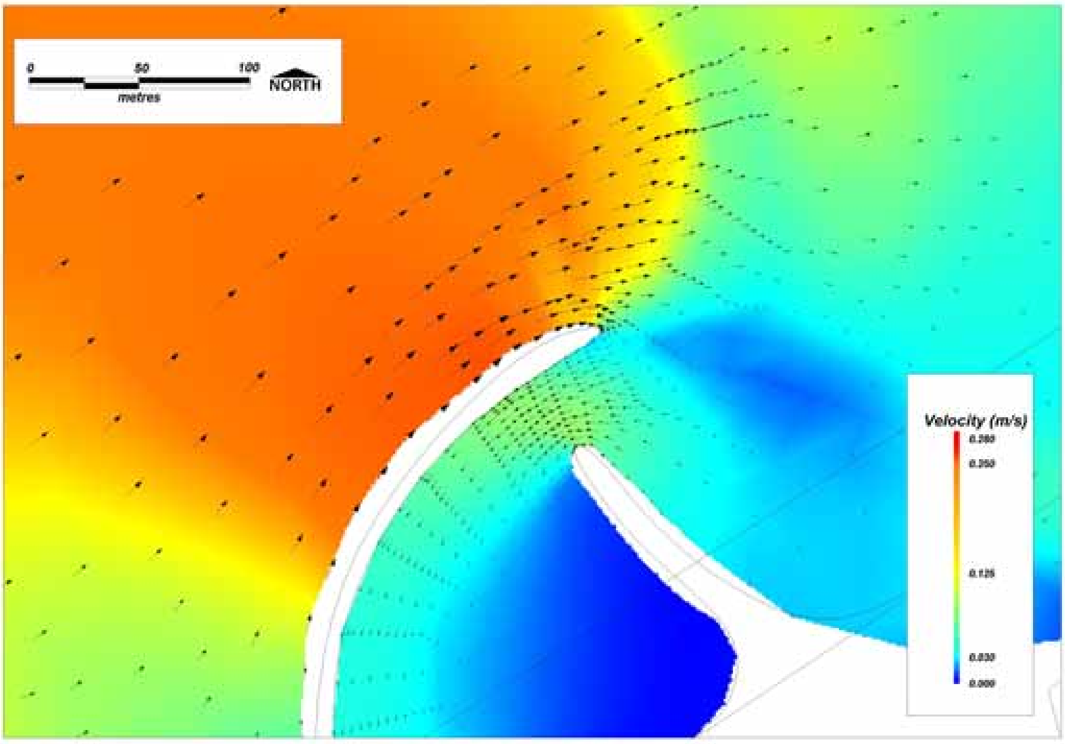
Based on the above considerations and modelling undertaken, the following conclusions may be reached:

1 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 (3.5m) as designed;

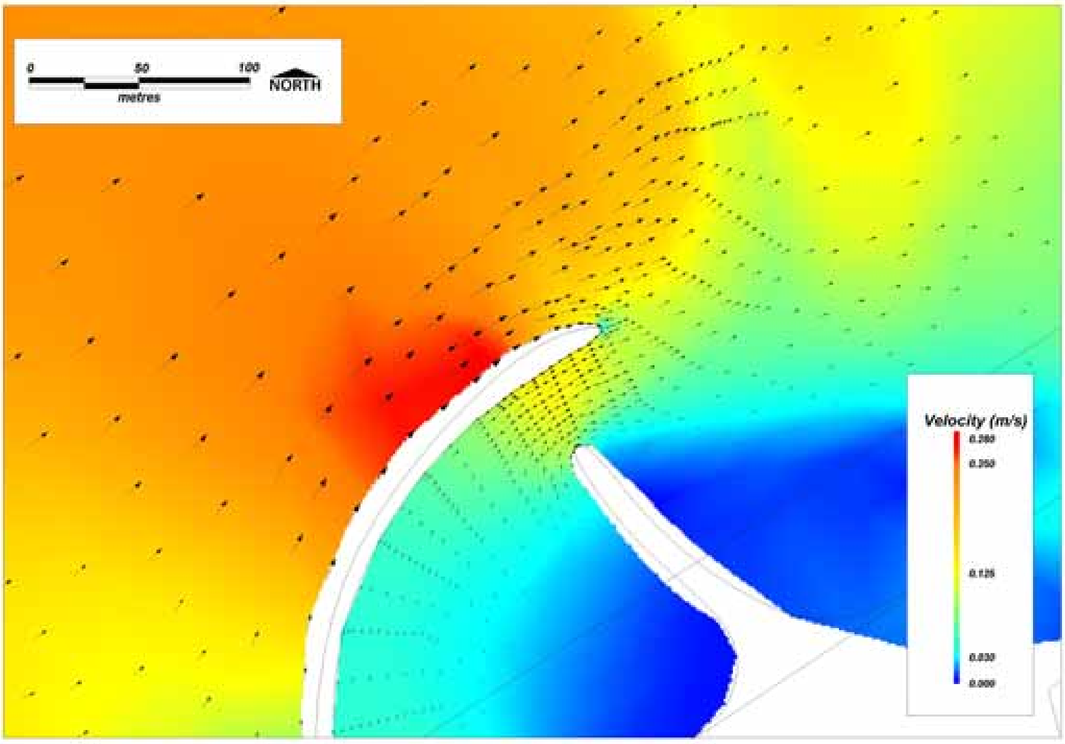
2 Groundwater inflow from the broader surrounding area will be very rapidly diluted through dispersion and tidal flushing, with any contaminants entering the waterway in this way being reduced to less than 0.66% of the inflowing concentrations within the canal/marina system and considerably less in the adjacent ocean;

3 The proposed breakwater configuration design will help to minimize the inflow of ‘weed’ from the adjacent ocean area, thereby minimizing its accumulation in the waterway and associated risk of water quality problems;

4 A canal design and management strategy that provides for trapping and removing weed 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.



Flood Tide With Longshore Current From 30knot NW Wind



Ebb Tide With Longshore Current From 30knot NW Wind

Figure 4-1 Flow of Wind-Induced Current Past Breakwaters

APPENDIX 22

Cape Jaffa Anchorage Development Plan Assessment, MasterPlan SA Pty Ltd, February 2004, Ref 9399Let03

33 Carrington Street,
Adelaide, South Australia, 5000 | Telephone (08) 8221 6000
Facsimile (08) 8221 6001 | plan@masterplan.com.au
www.masterplan.com.au

MasterPlan
Town & Country Planners

11 February 2004

Our Ref: lm:9399LET03.doc

Cape Jaffa Development Company
C/- Lucas Earthmovers Pty Ltd
PO Box 143
BRIGHTON SA 5048

ATTENTION: MR ROB GABB

Dear Sir,

Re: Cape Jaffa Anchorage Development Plan Assessment

Further to our various discussions and your request, we have now undertaken a review of what we consider to be all of the provisions from the development plan that relate to your proposed Cape Jaffa Anchorage development. The relevant provisions are contained within various parts of the Development Plan including the Kingston (DC) and Land out of Council's (Coastal Waters) sections. These parts of the Development Plan were obtained from the electronic version of the Development Plan issued by Planning SA. To assist in the assessment, we have prepared three tables the first of which identifies the relevant zone objectives and main principles, the second and third tables incorporate the complementary provisions including principles and the Council Wide components of the Development Plan. We have provided a commentary with each of the identified provisions.

You will note that there a number of provisions which have been included in the table which may not be directly relevant to your project and these have been identified accordingly.

The policies are numerous and repetitive and therefore the tables are lengthy.

We have concluded from this assessment that to a great extent the proposal satisfies the Development Plan as much of the land is zoned for urban purposes. There are of course those areas that are zoned as Coastal Waters, Primary Industry and Rural Coastal with which the proposal does not conform. Given the status of your project as a Major Development, it is relevant to be aware of the extent of consistency of your proposal, however, it is not imperative that full or absolute compliance be achieved.

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.

The Council boundary is clearly marked at the low water mark beyond which, within the Major Project 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 which is after the lodgement of the application for your development. 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 this assessment.

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.

Development Plan Provisions	Commentary
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.

Development Plan Provisions	Commentary
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 residential development. The zone boundary runs along

Development Plan Provisions	Commentary
	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 **Development should not be located on the sand dunes or land subject to erosion.**	The road, car park and public walkway are all located 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.

Development Plan Provisions	Commentary
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, however due to weed infestations, there is a need to remediate and rehabilitate these areas. The proposal incorporates works which will positively benefit the

Development Plan Provisions	Commentary
	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 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**	The development within the zone comprises portions of 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

Development Plan Provisions	Commentary
agricultural activity, should not be undertaken.	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 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

Development Plan Provisions	Commentary
	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 resources.	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 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

Development Plan Provisions	Commentary
	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 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	The investigations undertaken by SARDI as contained in Appendix SARDI and WBM in relation to coastal

Development Plan Provisions	Commentary
coastal environment in South Australia.	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 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

Development Plan Provisions	Commentary
	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 (e) adequate car parking.	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.
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	The development of the facilities out to sea only serves to reinforce and hence protect the economic resources

Development Plan Provisions	Commentary
development.	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 assessment of future demand.	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 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.

Development Plan Provisions	Commentary
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); (v) farming; (vi) residential, other urban development, and holiday areas; (vii) tourism; (viii) industrial development; (ix) defined national and conservation parks, and wilderness areas;	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 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;	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

Development Plan Provisions	Commentary
(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.	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.
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 following sets out two tables, the first incorporating the provisions for Land Not Within A Council Area (Coastal Waters) followed by Council Wide provisions. These tables support the policies and assessment made in relation to the Zone specific provisions. Where provisions are not deemed to be relevant the term Policy Not Relevant is used.

Land Not Within A Council Area (Coastal Waters)	Commentary
PDC 1 Landfill facilities should not be located in existing or future urban, township, living, residential, commercial, centre, office, business, industry or institutional zones, or environment protection, conservation, landscape, open space or similar zones, or in a Water Protection Area.	This proposal does not include any landfill activities for the storage or disposal of waste and therefore is not relevant to this assessment.
2 Development, including flood, erosion and wave protection measures, should not adversely affect the ecology of coastal areas, the seabed or coastal waters by pollution, significant loss of habitat, interference with coastal processes or any other means.	The effect of the breakwaters on coastal processes has been assessed and detailed in 5.2.13. It is proposed to implement an adaptive management strategy for the ongoing coastal processes. There will no net loss of habitat nor is there expected any pollution of coastal waters.
3 Development should not be located in delicate or environmentally sensitive coastal features such as sand dunes, wetlands or important remnants of native vegetation.	The environmental assessment of the coast, dunes and vegetation reveal that the proposal is appropriately located given the extent of effects already apparent from the rural and other uses in the locality. This locality in relative terms is more capable of accommodating the proposal and has been selected over many years as the preferred location due to its orientation and the protection afforded by the Cape and the associated reef system. Other localities along the south east coast are more exposed with consequential higher energy conditions and associated coastal sensitivities. For

	these reasons, the selection of Cape Jaffa reconfirms the states regional and the Councils strategic intentions for this location. The proposal also incorporates the protection of vegetated coastal dune currently in private ownership.
4 Development should not, nor be likely in the future to, adversely affect the ecology and stability of environmentally sensitive coastal features.	The proposal has been carefully designed having regard to the prevailing environmental conditions and management plans are designed to monitor, review, adapt and respond to the environment in order to maintain its stability and to protect sensitive areas and features.
5 Development should not be undertaken where it will create or aggravate coastal erosion, or where it will require coast protection works which cause or aggravate coastal erosion.	The breakwaters will interrupt the flow of sand along the beach. These flows are not significant when compared with say the metropolitan Adelaide coast nevertheless it is important to ensure the continuity of the natural processes. To that end, a management program has been designed to replace the natural flow by mechanically bypassing the breakwaters. Given the relatively low quantities of sand to be moved this is a relatively simple process as detailed in 5.2.13. It is also noteworthy that this part of the coast is experiencing an overall accretion trend and in that context the coastal processes assessment concludes that an erosion outcome is not expected and that in any case the adaptive management plan will allow for any erosion and accretion.
6 Land should only be divided in such a way that: (a) it or the subsequent development and use of the land will not adversely affect the management of the land, adjoining land or the coast; (b) sand dunes, wetlands and remnant vegetation are maintained in single parcels; (c) the number of allotments abutting directly onto the coast or onto a reserve for conservation purposes is minimised; and (d) outside of urban, tourist-accommodation and rural living zones it will not result in allotments with frontages to the coast or coastal reserve shorter than the depth of the allotment (or less than the square root of the area for irregular shaped allotments);	The area enclosed by the breakwaters is proposed to be incorporated into the jurisdiction of the Kingston District Council as a consequence, a division of land is required to create and identify the land. This division, of itself does not effect the dunes, vegetation or other coastal features nor does it result in an allotment that creates building development out in the Coastal Waters.
7 Development should be designed for solid or fluid wastes and stormwater run-off to be disposed of so that it will not cause pollution or other detrimental impacts on the marine and on-shore environment of coastal areas.	There is no requirement for treatment or management of stormwater in the Coastal Waters area as the only source of stormwater arises from rainfall on the breakwaters and directly on the sea.
8 Effluent disposal systems incorporating soakage trenches or a similar system should be located not less than 100 metres or greater where it is necessary to avoid effluent migration onto the inter-tidal zone, the 100 metres to be measured from: (a) the mean high water mark at spring tide adjusted for any subsidence for the first 50 years of development plus a sea level rise of one metre; or (b) the nearest boundary of any erosion buffer determined in accordance with principle of	There is no requirement for effluent treatment facilities in the Coastal Waters area.

development control numbered 33; whichever is the greater. Except where SA Health Commission standards can be met by a lesser setback.	
9 Development should preserve natural drainage systems and should not significantly increase or decrease the volume of water flowing to the sea. Where necessary it should incorporate stormwater management schemes including: (a) on-site harvesting of water and land based disposal systems; (b) retention basins to facilitate settlement of pollutants and to regulate water flow; and (c) infiltration.	There is no requirement of stormwater management in the Coastal Waters area. Refer 7 above.
10 Development should not cause deleterious effects on the quality or hydrology of groundwater.	Extensive investigations of the groundwater as set out in chapter 4 and the consideration of the effects of the development conclude that some effects may result but that those effects are limited . There are however no effects on groundwater from the establishment of breakwaters in the Coastal Waters area.
11 Development proposed to include or create confined, coastal waters (whether partially or wholly), including water subject to the ebb and flow of the tide, should ensure the quality of such waters is maintained at an acceptable level.	Water quality analysis has been undertaken within the enclosed waterway out to the mouth of the breakwater. The conclusions confirm that the water quality will be maintained above all relevant standards. Refer Sections 5.2.7 and 5.2.22.
12 Development should not preclude the natural geomorphological and ecological adjustment to changing climate, sea level or other conditions. For example landward migration of coastal wetlands should not be prevented by embankments. Development should be designed to allow for new areas to be colonised by mangroves and wetland species and for removal of existing embankments where practical.	The area of the Coastal Waters will not be prejudiced by the development in terms of its capacity to accommodate the changing coastal conditions. A discussion of potential effects of climate change is presented in Section 5.2.13.
13 Marine aquaculture should be located, sited, designed, constructed and managed to be ecologically sustainable, to minimise interference and obstruction to the natural processes of the marine environment, and to allow maintenance of the environmental quality of the foreshore, coastline, ocean and ocean bed. Marine aquaculture should be developed and undertaken: (a) in areas which will not contaminate the product for human consumption;	The proposal has no influence over the siting or arrangements at sea of these facilities. The proposal will however provide facilities and services essential for the sustainability of the industry. This provision relates to proposals for aquaculture. This proposal does not seek approval for marine aquaculture activities at sea.
(b) a suitable distance from pollution sources including country townships, urban and residential areas, established shack areas, industrial development, stormwater or other drainage outlets, sewage treatment facilities and outfall; (c) a sufficient height above the sea floor and in a manner to minimise seabed damage, and in areas with adequate water current to disperse sediments to prevent the build up of waste (except where	

waste can be removed); (d) to avoid damage to sensitive ecological areas, creeks, estuaries, wetlands and significant seagrass and mangrove communities; (e) to avoid the risk of pollution to and from external sources including any accidental discharge of pollutants; (f) to ensure satisfactory removal and disposal of litter, disused material, shells, debris, detritus, faecal matter, and dead animals from the farm to prevent fouling of waters, publicly owned wetlands, or the nearby coastline; (g) so as not to involve the discharge of human waste on the site, or any adjacent land, or into nearby waters (if required, sanitary facilities should be provided); (h) to avoid adverse impacts to wildlife (marine and terrestrial, plants and animals), and on breeding grounds and habitats of native marine mammals and terrestrial fauna, especially migratory species; (i) to minimise harm or destruction of marine predators such as seals, dolphins and birds; (j) to facilitate relocation or removal of structures in the case of emergency such as oil spills, algal blooms and altered waterflows.	
14 Development should not result in the disturbance or the devaluation of sites of heritage, cultural, scientific or educational significance.	No known sites of significance will be affected by the proposal.
15 Development which is proposed to be located outside of urban and tourist zones should be sited and designed to not adversely affect: (a) the natural, rural or heritage character of the area; (b) areas of high visual or scenic value; (c) views from the coast, near-shore waters, public reserves, tourist routes and walking trails; or (d) the amenity of public beaches by intruding into undeveloped areas.	The siting of the breakwaters is based on the environmental conditions and practical requirements of the users. The amenity of portion of the beach for pedestrians will be significantly improved and there will be additional facilities for tourist's, visitors and residents to enjoy the coast.
16 Development within urban and tourist accommodation zones should be designed and sited in sympathy with the existing natural and built character of its locality. It should not be out of scale, of conflicting colour or materials or detract from any natural backdrop to the zone, nor project above the skyline visible from the coast.	That part of the proposal within the Coastal Waters part of the Development Plan provides specifically for the safety of vessels and the protection of a channel to an area designed to accommodate an existing fishing fleet and an expanded settlement. The settlement proposed is small in scale compared to Kingston and Robe, small country coastal towns with populations in the order of 5000 each as compared to an estimated 1500 or so persons at Cape Jaffa. The settlement is designated for development purposes and has been promoted as such for several years.
17 Marine aquaculture and other offshore development should: (a) minimise adverse impacts on the visual amenity or natural character of the coast and foreshore, particularly in areas of outstanding beauty or areas of high public use;	The proposal does not influence the offshore development activities of the aquaculture industry however the proposal supports these activities consistent with the strategic directions for the area.

(b) avoid adverse impacts on: (i) National Parks, Conservation Parks and Conservation Reserves; (ii) Marine Parks and Reserves; (iii) Recreation Reserves; (iv) Indigenous, Non-Indigenous and natural heritage sites including shipwrecks;* (v) Sites of scientific importance including geological monuments and habitats of rare species; (vi) Mineral reserves; (vii) Areas valued for their outstanding beauty or amenity. *Note: Heritage sites are recorded under the Register of the Aboriginal Heritage Act, 1988, the Register of the Heritage Act, 1993, the Register of the Historic Shipwrecks Act, 1976 (Commonwealth of Australia), and the Register of the Historic Shipwrecks Act, 1981, (South Australia)	
18 Marine aquaculture and other offshore development should be located at least: (a) 550 metres from a proclaimed shipwreck; (b) 1,000 metres seaward from the boundary of any Reserve under the National Parks and Wildlife Act, unless a lesser distance is agreed with the Minister responsible for that Act.	Refer 17 above.
19 Racks, floats and other farm structures associated with marine aquaculture or other offshore development should be as visually unobtrusive as possible, apart from those required by the relevant authority for navigational safety. Development should: (a) blend visually with the environment and have a low profile; (b) be constructed of non reflective materials; (c) use uniform, subdued colours throughout a development, suited and in keeping with the local surrounding features; (d) use feed hoppers which are painted in subdued colours, and suspended as low as possible above the water; (e) design and locate structures in relation to surrounding features; (f) position structures to protrude the minimum distance practicable above water;	Refer 17 above.
(g) not jeopardise the attainment of visual amenity provisions by incorporating unnecessary shelters and structures above cages and platforms.	
20 Development adjacent to the coast should not be undertaken unless it has or incorporates the provision of a public reserve, not including a road	Public reserves are provided along the coast ensuring appropriate setbacks and separation of development from the coast. A public reserve will be created along

or erosion buffer provided in accordance with principle of development control numbered 33, of at least 50 metres width between such development and the toe of the primary dune or the top edge of the escarpment, unless the development relates to small-scale infill development in a predominantly urban zone or to development associated with the operation of ports.	the coast from privately owned land.
21 Development which abuts or includes a coastal reserve for scenic, conservation or recreational purposes should be located and designed in such a way as to have regard to the purpose, management and amenity of the reserve and to prevent illegal incorporation of reserve land into private land.	Vegetated foredune is to be cleared of weed infestation, reseeded with native plant species and set aside for public purposes to the benefit of the community and the coastal environment.
22 Development, including marinas, should be located and designed to allow public access along the waterfront, to beaches, and to coastal reserves, except where public safety reasons preclude or where operational requirements at ports renders this inappropriate. 23 Access to beaches and reserves should be, by means of walkways and roads suitably designed and constructed to meet the environmental objectives and principles of development control for coastal areas.	The proposal incorporates extensive access to the waterfront, coast and reserves. Pedestrian accessways, and vehicle access will be designed to ensure the protection of the coast and the coastal dunes and the vegetation.
24 Access roads to the coast and lookouts should preferably be spur roads. Tourist routes may be loop roads but should be located back from the coast and only where the road will not detract from the amenity of the area or lead to management problems.	Only spur routes created by the development will provide access to the coast but no roads extend into the Coastal Waters area only an access track along the top of the breakwaters for service and emergency purposes.
25 Marine aquaculture and other offshore development should: (a) be located to minimise adverse impacts on public access to beaches, public watercourses, or the foreshore; (b) be located to take into account the requirements of traditional both indigenous and non-indigenous historic fishing grounds; (c) in ocean waters be located a minimum of 100 metres seaward of high water mark; (d) be located not to obstruct nor interfere with navigation channels, access channels, frequently used natural launching sites, safe anchorage areas, known diving areas, commercial shipping movement patterns or activities associated with existing jetties and wharves;	This proposal does not alter or affect in any way marine aquaculture activities.
(e) be developed to maintain existing rights of way within or adjacent to a site; and (f) where possible use existing and established roads, tracks, ramps and paths to or from the sea.	
26 Marine aquaculture access, launching and maintenance facilities wherever possible should be developed co-operatively, and co-located to serve the needs of the industry and community as a whole, and where necessary may be located on the	The proposal incorporates wharf areas, marina berths, an area for the launch and retrieval of vessels and areas for the repair and maintenance of aquaculture infrastructure.

foreshore.	
27 Development should not occur on land where the risk of flooding is unacceptable having regard to personal and public safety and to property damage.	There is no proposal to develop other than the breakwaters channel and marine related navigation facilities in the Coastal Waters area.
28 For the purposes of assessing coastal developments the standard sea-flood risk level for a development site is defined as the 100-year average return interval extreme sea level (tide stormwater and associated wave effects combined), plus an allowance for land subsidence for 50 years at that site.	The determination of the standard sea-flood risk level, that is the combined effect of extreme tides, storms, waves and subsidence, is presented in **Section 5.2.17**. Assessment by the National Tidal Facility, based on the 100 yr ARI high tide, together with conversion to AHD, using data recorded at Cape Jaffa, indicates 100 yr ARI extreme sea level in the range 1.38 mAHD to 1.45 mAHD. Adopted 100 yr ARI extreme sea level is 1.45 mAHD. Wave run-up and set-up is 0.20 metres around the waterways. 50 yrs land subsidence has been assessed as 0.00m to 0.05m. 0.05m has been adopted. Thus, the standard sea-flood risk level is 1.7 mAHD . There is no proposal for development in the Coastal Waters area other than the breakwaters, channel and marine related navigation facilities. Refer **Sections 4.11**, **5.2.17** and **5.6.12**.
29 Land should not be divided for commercial, industrial or residential purposes unless a layout can be achieved whereby roads, parking areas and adequate development sites on each allotment are at least 0.3 metres above the standard sea-flood risk level, unless the land is or can be protected in accordance with principle of development control numbered 32.	Allowance for sea level rise to 2050 of 0.3m, in accordance with this principle and South Australian Coast Protection Board Coastline bulletin No 26 1992, has been made. Thus, roads, parking areas and development sites, which are not protected in accordance with PDC 32, will have a minimum elevation of 2 mAHD . Although this provision allows for roads, parking areas and development sites to be lower than 2 mAHD, there is no proposal for such areas to be lower than 2 mAHD. There is no proposal to develop other than the breakwaters channel and marine related navigation facilities in the Coastal Waters area.
30 Commercial, industrial or residential development should only be undertaken where: **(a) building floor-levels are at least 0.25 metres above the minimum site level of principle of development control numbered 28 (ie: 0.55 metres above the standard sea-flood risk level), unless the development is or can be protected in accordance with principle of development control numbered 32; and** **(b) there are practical measures in accordance with principle of development control numbered 32 available to the developer, or subsequent owners, to protect the development against a further sea level rise of 0.7 metres above the minimum site level determined by principle of development control numbered 29.**	(a) Commercial, industrial and residential building floor-levels will be a minimum of 2.25 mAHD, unless the development is or can be protected in accordance with PDC 32. Although this provision allows for lower building floor-levels, there is no proposal for building floor-levels lower than 2.25 mAHD. (b) There are practical protection measures, in accordance with PDC 32, to protect commercial, industrial and residential development against further sea level rise in excess of 0.7 m. These measures consist of raising the edges of the waterway by adding to the top of the walls that form the edge of the waterways. Further, in order to protect commercial, industrial and residential development against sea level rise to 2100 without the need for protection measures, minimum site

	and floor-levels 0.5 m above that required by PDC 29 and PDC 30(a) will be adopted. Thus, the minimum building site and floor-levels will generally be 2.5 mAHD and 2.75 mAHD respectively. See **Section 5.2.17** for further information. There is no proposal to develop other than the breakwaters channel and marine related navigation facilities in the Coastal Waters area. The breakwater is 2.5 mAHD.
31 Buildings to be located over tidal water or which are not capable of being raised or protected by flood protection measures in future, should have a floor level of at least 1.25 metres above the standard sea-flood risk level.	No buildings are proposed over water, however If building over water is proposed in the future, building floor level will be a minimum of 2.75 mAHD. Refer to **Section 5.2.17** for further information. There is no proposal to develop other than the breakwaters channel and marine related navigation facilities in the Coastal Waters area.
32 Development which requires protection measures against coastal erosion, sea or stormwater flooding, sand drift or the management of other coastal processes at the time of development, or which may require protection or management measures in the future, should only be undertaken if: (a) the measures themselves will not have an adverse effect on coastal ecology, processes, conservation, public access and amenity; (b) the measures do not now, or in the future require community resources, including land; (c) the risk of failure of measures such as sand management, levee banks, flood gates, valves or stormwater pumping, is appropriate to the degree of the potential impact of a failure; and (d) adequate financial guarantees are in place to cover future construction, operation, maintenance and management of the protection measures.	With reference to protection against coastal erosion, sand drift or other coastal processes, refer to PDC 33. With reference to sea or stormwater flooding, the proposed development does not require protection measures against sea or stormwater flooding as described in PDC 29 and 30(a). Further, the development will generally not require future protection measures against additional sea level rise to 2100 as building site and floor levels will be elevated at the time of land development, see PDC 30(b) and **Section 5.2.17** for further information. Nevertheless, should the need arise for protection measured, they will: (a) be designed so that they do not have an adverse effect on the coast. Provision has been made in the design for potential future protection measures, such as the raising of the waterway edge treatment walls. See **Section 5.2** for further information. (b) not require community resources. Sufficient land has been provided to accommodate potential protection measures. Sufficient funds are made available via the Marina Facilities Maintenance Fund, which is seeded from part proceeds of land sales and part proceeds of rates derived from rateable properties within the development. (c) be designed so that the risk of failure is commensurate with the potential impact of failure. (d) have adequate financial guarantees provided by the Marina Facilities Maintenance Fund described above. There is no proposal to develop other than the breakwaters channel and marine related navigation facilities in the Coastal Waters area.
33 Development should be set-back a sufficient distance from the coast to provide an erosion buffer which will allow for at least 100 years of coastal retreat for single buildings or small-scale developments, or 200 years of retreat for large-scale developments such as new towns, unless: (a) the development incorporates private coastal works to protect the development and public reserve from the anticipated erosion, and the	Coastal processes are assessed in detail in **Section 5.2.13**. Ongoing coastal erosion is not expected, nevertheless, significant set-back is provided in order to ensure protection of the development and coastal reserve against potential erosion. Further, protection measures will be provided as part of the proposal, in accordance with PDC 32. These

private coastal works comply with principle of development control numbered 32; or **(b) the Council is committed to protecting the public reserve and development from the anticipated coastal erosion.**	include the sand bypass and adaptive coastal management system described in **Section 5.2.13**. In addition, Council has committed to ensure the ongoing protection of the development and coastal reserve against potential erosion, by maintaining the sand bypass and coastal management regime. Therefore, the proposal satisfies each of the requirements of PDC 33.
34 Where a coastal reserve exists, or is to be provided in accordance with principle of development control numbered 20, it should be increased in width by the amount of buffer required.	The development adjacent to the coast is setback from the coast a minimum of 50 metres in order to establish a coastal reserve, as set out in PDC 20. It is not expected that ongoing erosion will occur hence additional buffer is not required, nevertheless, significant additional coastal reserve has been provided in order to preserve and enhance the costal dunes and vegetation. The costal dune and part of the beach to the east of the proposed breakwaters is currently in private ownership and a strip between 150 and 200 metres wide metres will be transferred to public ownership. This will create a coastal reserve that extends between 110 and 130 metres inland from the toe of the primary dune. Along the road that provides access to the western breakwater and beach, a small number of allotments are proposed, one of which is within 50 metres of the toe of the foredune. This allotment is set behind the breakwater and hence there is no risk of erosion resulting in loss of coastal reserve in this area.
35 The width of an erosion buffer should be based on: **(a) the susceptibility of the coast to erosion;** **(b) local coastal processes;** **(c) the effect of severe storm events;** **(d) the effect of a 0.3 metres sea level rise over the next 50 years on coastal processes and storms; and** **(e) the availability of practical measures to protect the development from erosion caused by a further sea level rise of 0.7 metres per 50 years thereafter.**	The prevailing coastal processes have been assessed in **Section 5.2.13**. The coast in this area experiences cycles of accretion and erosion within an overall accretionary trend. The dominant coastal process is the longshore drift of sand, which has been assessed to be less than about 15,000 m3/yr and sand bypass will be provided in order to maintain the prevailing longshore drift. The complex cycles of erosion and accretion result from interaction between the coastal processes and the shape of the coast, which causes variations in the longshore sand drift rate along the length of the coast and cycles of coastal movement. The presence of the breakwaters will moderate the waves and reduce the longshore sand drift east of the breakwaters. In addition to the adaptive sand bypass, it is recommended that additional sand be placed downdrift (east) of the breakwaters to provide a buffer against potential temporary erosion between bypass events, and that additional sand be stockpiled in case it might be required in the future. Overall, ongoing erosion is not expected and the sand bypass and adaptive coastal management plan will approximately maintain the current coastal profile. The effect of a 0.3 metre sea level rise has been assessed and is expected to result in a 2.25 metre take of the coast. The expected effect of the sea level rise to 2100 has also been assessed, and is expected to result in a total of 6 metre take of the coast to 2100. The width of the coastal reserve provides sufficient space in case further protection measures against ongoing erosion associated with sea level rise are required in the long

	term. All of these effects are adequately provided for in the proposed overall coastal reserve, which is between 150 and 200 m wide, and extends between 110 and 130 metres inland of the toe of the primary dune.
36 Where there is inadequate area to provide the necessary erosion buffer to development on land at risk from long-term coastal erosion (for example small-scale infill development including land division), such development should not occur unless: (a) the proponent has committed to erosion protection measures which may be necessary along this section of the coast; or (b) a legally binding agreement is included on the freehold certificate(s) of title(s) that protection measures will not be built and that any building will be transportable and will be removed when threatened by erosion or storm surge flooding; or (c) a legally binding agreement is included on the freehold certificate(s) of title(s) that protection measures that comply with principle of development control numbered 32 for coastal development will be built by the land owner(s) when required.	Adequate erosion buffer/coastal reserve is provided. There is a small area adjacent on either side of the canal where development occurs closer to the coast, however this area is protected by the breakwaters, road and car park structures. The breakwaters are capable of being extended, should the need arise.
37 Development should not occur where essential services cannot be economically provided and maintained having regard to flood risk and sea level rise or where emergency vehicle access would be prevented by a 100-year average return interval extreme sea level event, adjusted for 100 years of sea level rise.	Essential services can be provided including access for emergency services.
38 Marine aquaculture development should minimise its impact on navigational safety and: (a) be suitably marked for navigational purposes; (b) be sited to allow an adequate distance between farms for safe navigation; (c) be located at least 250 metres from a commercial shipping lane; (d) comprise structures secured and/or weighted to prevent drifting; (e) ensure that structures and materials used are maintained to prevent hazards to people and wildlife; (f) provide for rehabilitation of sites no longer operational.	This proposal does not incorporate marine aquaculture development.
39 Development outside of urban zones should not take place if there is the potential for significant conflict with likely development which benefits the wider community based on any of the special economic or physical resources of coastal areas such as:	The proposal will provide specifically for the advancement of the economic and physical resources of the Cape Jaffa locality including its tourist attractions and facilities, harbour and marina sites, the aquaculture activities and port functions.

Tourist Attractions; Harbour and Jetty Sites; Aquaculture Sites; Marina Sites; Mineral Deposits of State or National importance; Ports and Port Related functions.	
40 Development should be sited, designed and managed so as not to conflict with or jeopardise the continuance of an existing aquaculture development.	The proposal reinforces the aquaculture activities and creates no conflict.
41 Marine aquaculture development should: (a) be carried out in a manner which ensures a fair and equitable sharing of marine and coastal resources and minimises conflict between legitimate users of the marine resource, both commercial and recreational; (b) not significantly obstruct or adversely affect: (i) areas of high public use; (ii) areas established for recreational activities; (iii) areas of outstanding visual, environmental, commercial or tourism value; (iv) sites used for recreational activities such as swimming, fishing, skiing and sailing and other water sports, including beaches.	This proposal does not incorporate marine aquaculture development
42 Urban development including holiday house settlements and tourist developments, marinas, rural living, country living and other development of a non-commercial farming nature, including land division for all such development, should only be undertaken in zones designated for such development.	Portion of the proposal is not on land zoned for urban development. The Minister determined the project as a Major development for reasons including the complex mix of zones and the range of activities proposed. Therefore it is intended that once approved, a Plan Amendment Report will be prepared to reflect the approved proposal.
43 Tourist development outside of zones designated for such development should be confined to small-scale, short-stay accommodation within or adjacent to an existing inhabited farmhouse and operated as a minor adjunct to normal commercial farming.	As for PDC 42 above, rezoning will be undertaken in accordance with the approved proposal.
44 Outside of urban and tourist-accommodation zones no more than one dwelling should be constructed on an allotment.	As for PDC 42 above, rezoning will be undertaken in accordance with the approved proposal which will define the requirements for dwelling densities and related development requirements.
45 The coastline and its visual amenity should not be significantly impaired by the onshore development of marine aquaculture storage, cooling and processing facilities. Where possible these facilities should be: (a) located, sited, designed, landscaped and developed at a scale and using external materials to minimise any adverse visual impact on the coastal landscape; (b) established in areas appropriately zoned and with appropriate vehicular access arrangements;	The marine aquaculture maintenance operations currently occupy the waters immediately off the coast and the beach from time to time. The proposal will enable the development of facilities for maintenance within the commercial area thus removing the need for maintenance, repair and construction on the beach. Further, areas are to be established to manage wastes in a more sensitive and sustainable manner. Thus these activities will be removed from the Coastal Waters.

and (c) developed to ensure that wastes are disposed of in a complete and effective system which is legally approved.	
46 Development, including land division, urban, holiday settlement, tourist development and other urban-type developments should: (a) be compact not linear development; (b) be contiguous with any existing built-up areas; (c) be developed in a staged and orderly manner which facilitates the economic provision of services and infrastructure; and (d) not occur without provision of an adequate reticulated domestic-quality mains water supply and a common effluent drainage scheme.	The development proposal has been designed to create a comprehensive fully integrated scheme having regard to the existing settlement in an orderly and staged manner. Further the development will incorporate a reticulated water supply and sewer system which can extend to incorporate the existing township thus reducing risk of pollution to Coastal Waters.
47 Existing development which is contrary to the objectives for coastal areas should not be redeveloped unless the redevelopment significantly rectifies the unsatisfactory aspects.	There are numerous benefits that result from the development of the proposed facilities, including the provision of sewer facilities thus removing the disposal of waste into coastal sands; alternate location for the fishing fleet hence reducing risks of impacts on the Rock Lobster Sanctuary and the coast should vessels break their moorings.
48 Telecommunications facilities should: (a) be located and designed to meet the communication needs of the community; (b) utilise materials and finishes that minimise visual impact; (c) have antennae located as close as practical to the support structure; (d) primarily be located in industrial, commercial, business, office, centre, and rural zones;	No telecoms facilities are proposed within the Coastal Waters However should telemetry facilities be required in the Coastal Waters area, they will be designed to minimise visual impact.
(e) incorporate landscaping to screen the development, in particular equipment shelters and huts; and (f) be designed and sited to minimise the visual impact on the character and amenity of the local environment, in particular visually prominent areas, main focal points or significant vistas.	
49 Where technically feasible, co-location of telecommunications facilities should primarily occur in industrial, commercial, business, office, centre and rural zones.	Refer 48 above..
50 Telecommunications facilities in areas of high visitation and community use should utilise, where possible, innovative design techniques, such as sculpture and art, where the facilities would contribute to the character of the area.	Refer 48 above..
51 Telecommunications facilities should only be located in residential zones if sited and designed so as to minimise visual impact by: (a) utilising screening by existing buildings and vegetation; (b) where possible being incorporated into, and	Refer 48 above..

designed to suit the characteristics of an existing structure that may serve another purpose; and (c) taking into account existing size, scale, context and characteristics of existing structures, land forms and vegetation so as to complement the local environment.	
52 Telecommunications facilities should not detrimentally affect the character or amenity of Historic Conservation Zones or Policy Areas, Local Heritage Places, State Heritage Places, or State Heritage Areas.	Refer 48 above..
53 Renewable energy facilities, including wind farms, should be located, sited, designed and operated in a manner which avoids or minimises adverse impacts and maximises positive impacts on the environment, local community and the State.	There are no proposals within the Coastal Waters for renewable energy facilities.
54 Renewable energy facilities, including wind farms, and ancillary developments should be located in areas that maximise efficient generation and supply of electricity.	There are no proposals within the Coastal Waters for renewable energy facilities.
55 Renewable energy facilities, including wind farms, and ancillary development such as substations, maintenance sheds, access roads and connecting power-lines (including to the National Electricity Grid) should be located, sited, designed and operated in a manner which: (a) avoids or minimises detracting from the character, landscape quality, visual significance or amenity of the area; (b) utilises elements of the landscape, materials and finishes to minimise visual impact;	There are no proposals within the Coastal Waters for renewable energy facilities.
(c) avoids or minimises adverse impact on areas of native vegetation, conservation, environmental, geological, tourism or built or natural heritage significance; (d) does not impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips; (e) avoids or minimises nuisance or hazard to nearby property owners/occupiers, road users and wildlife by way of: (i) shadowing, flickering, reflection and blade glint impacts; (ii) noise; (iii) interference to television and radio signals; (iv) modification to vegetation, soils and habitats; and (v) bird and bat strike.	POLICY NOT RELEVANT.
56 The following kind of development is non-complying: Advertisements Landfill that constitutes solid waste disposal required to be licensed as a waste depot under the	None of the listed kinds of non-complying development are proposed.

Environment Protection Act 1993.	

The Development Plan for the Kingston District Council also sets out a range of more general provisions for which there are numerous objectives and principles for:

- Form of Development;
- Residential Development;
- Land Division;
- Movement of People and Goods;
- Public Utilities;
- Conservation;
- Tourist Facilities; and
- Appearance of Land and Buildings.

Objective 1: Orderly and economic development.	A development can be considered orderly and economic where it provides an appropriate balance of the design and function requirements of facilities and services to a community in an economic, safe and convenient manner. This proposal enhances the service provision to this community in an orderly well designed manner to ensure its function and the continuity and growth in enterprise of this community.
Objective 2: A proper distribution and segregation of living, working and recreational activities by the allocation of suitable areas of land for those purposes.	The proposal has been designed to segregate the functional areas whilst providing the necessary association or linkages between the various parts of the development.
Objective 3: The proper location of public and community facilities by the reservation of suitable land in advance of need.	Land has been set aside for a range of facilities that will not be developed immediately but will be required in the long term.
Objective 4: The redevelopment of localities which have a bad or unsatisfactory layout, or have unhealthy or obsolete development.	The Cape Jaffa settlement lacks a three phase power supply, a reticulated water supply and effluent disposal. The proposal will create the opportunity for the whole of Cape Jaffa to be fully serviced.
Objective 5: Development to satisfy the social, educational, cultural, employment, recreational, and economic, needs of the population of the district.	The proposal will enhance significantly opportunities for work and for the existing industries to operate more efficiently and effectively. Recreation facilities will also be improved thus encouraging and attracting greater tourism to the locality.
Objective 6: Towns and settlements protected from the adverse effects of intensive rural industries.	The proposal is well separated from any intensive rural activity.
Objective 7: Provision for industrial, business, residential, recreational, tourist accommodation, and community, development in township areas.	The proposal provides for the orderly staged development of a range of facilities and areas for these key urban functions as a logical and contiguous extension to the settlement.
Objective 8: Development of the town of Kingston SE as the major urban and service centre for the district.	The proposal reinforces the function of Kingston as the major urban centre as the proposal does not create extensive commercial or business zones but rather functional areas express for the service of the fishing and tourist and local residential communities.
Objective 9: Shopping, administration, cultural, community, entertainment, educational, religious and recreational, facilities located in integrated centres.	A small centre area is proposed to accommodate a local service centre including a small retail, tavern, club, service station, office and tourist and permanent accommodation.
Objective 10: Centres established and developed in accordance with a hierarchy based on function of each type of centre as appropriate for the region.	The size of the facility will remain only as a neighbourhood service at the low end of the hierarchy.
Objective 11: A hierarchy of centres located in centre zones.	A centre zone can be readily defined to guide the development of the facilities.
Objective 12: District centres to include shopping facilities that provide mainly 'convenience' goods and a sufficient range of 'comparison' goods to serve the major weekly shopping trips, as well as a comparable range of other community facilities.	The facilities at Cape Jaffa are local not district level facilities.

Objective 13: Neighbourhood centres to include shopping facilities that provide mainly 'convenience' goods to serve the day-to-day needs of the neighbourhood, and a limited range of more frequently required 'comparison' goods as well as a narrow range of facilities. There are not likely to be administrative facilities in neighbourhood centres.	The facilities at Cape Jaffa are local not district level facilities.
Objective 14: Local centres to include shopping and local community facilities to serve the day-to-day needs of the local community.	The facilities will be designed to complement those of the kiosk at the Tourist Park.
Objective 15: Retailing, not consistent with facilities envisaged in a centre, located and operated so as not to adversely affect any designated centre, commercial, business or residential area and traffic movement on local, primary and primary arterial roads.	This centre will incorporate some facilities not normally located in local or neighbourhood centres due to its location and primary purpose as a service to a harbour and marina facility. There are therefore expectations for offices and club facilities and retail associated with the commercial and recreational boating interests.
Objective 16: A road network which facilitates safe and efficient movement within the district and towns, maintains convenient road connections with adjacent local government areas, and minimises future road maintenance costs.	The road network is designed to ensure the safety of users and creates an orderly connections and segregation of areas to minimise conflict between different users. There is no direct road linkage with adjoining Councils.
Objective 17: The safe and efficient movement of people and goods by road.	The roads are designed to allow safe and efficient movement. Refer Objective 16 above.
Objective 18: The free flow of traffic on roads by minimising interference from adjoining development.	The traffic flows will not interfere with or be prejudiced by any adjoining development.
Objective 19: A range of services and utilities commensurate with development.	The service infrastructure is designed to be developed in a staged manner directly in accordance with the development requirements.
Objective 20: The protection of the landscape from undue damage from quarrying and similar extractive and associated manufacturing industries, and from prospecting and exploring for new resources.	No quarrying, extractive industry or related manufacturing is proposed to be undertaken.
Objective 21: The continued availability of industrial minerals and construction materials through the prevention of development likely to inhibit their exploitation.	The development will not prejudice any known mineral or construction material.
Objective 22: The protection of the petroleum industry and its associated plant and pipelines.	This proposal does not effect the petroleum industry.
Objective 23: Extraction of mineral resources in a manner that does not disadvantage the community.	There is no extraction of mineral resources proposed.
Objective 24: The orderly and economic development of landfill facilities in appropriate locations.	There is no landfill proposal in this development. Waste will be collected as part of the normal collection contract and be treated, stored or disposed at an appropriate licensed facility.
Objective 25: Minimisation of environmental impacts from the location, operation, closure and post management of landfill facilities.	The landfill to the west of the site was ceased many years ago. Waste is now collected and disposed at licensed facilities
Objective 26: Landfill facilities to be protected from incompatible development.	There is no proposal for a landfill as part of this development.
Objective 27: The conservation, preservation or enhancement of scenically attractive areas,	There are no designated scenic routes in the area. The proposal incorporates the protection of the dunes and the creation of an attractive extension to the settlement

including land adjoining water or scenic routes.	of Cape Jaffa.
Objective 28: The protection of water resources against pollution and contamination.	Extensive investigations have been undertaken into the water resources and groundwater generally. ROB words Please.
Objective 29: Development should not lead to the deterioration in the quality of surface or underground waters.	Surface waters will be managed in order to provide recharge to the groundwater through a process of filtration. Surface flows will be directed to stormwater detention facilities which also provide for natural filtration into the groundwater. The creation of the waterways will introduce seawater into the areas immediately around those waterways. However
Objective 30: Land free from erosion.	The construction management will ensure there is no erosion of the land.
Objective 31: The preservation of roadside vegetation.	Roadside vegetation in the locality is significantly impacted by weed infestations and requires considerable effort to rehabilitate these areas. Accordingly the retention of the roadside vegetation is not necessarily appropriate.
Objective 32: The preservation of trees of historical, local, or particular visual, significance.	There are no trees of historical, local or visual significance on the land.
Objective 33: The preservation of buildings or sites of architectural, historical or scientific, interest.	There are no sites of architectural, historical or scientific, interest on the site.
Objective 34: Unpolluted lakes.	POLICY NOT RELEVANT.
Objective 35: The retention of environmentally significant areas of native vegetation.	The vegetated dunes are proposed to be retained.
Objective 36: 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.	The vegetated fore dunes are specifically identified for retention and rehabilitation to protect the land from erosion, to improve corridors for native fauna and the creation of an attractive coastal reserve.
Objective 37: The retention of native vegetation for amenity purposes, for livestock shade and shelter and for the movement of native wildlife.	The vegetation will be fenced to ensure no livestock enter the area and that the amenity and fauna benefits are advanced.
Objective 38: Water resources protected from pollution or excessive usage which would threaten their long-term reliability.	Extensive investigations have been undertaken into the effects on groundwater and reveal that the water resources will not be affected by pollution and that the resources will not be threatened, **Section 5.2.3, 5.2.23, 5.3.10, 5.3.17, 5.4.12 and 5.6.14**.
Objective 39: Conservation of significant areas of native vegetation, geomorphological features, important wetland swamp areas, sensitive sand dune environments and associated animal and bird life.	The vegetation although degraded and heavily infested with weed is an area that is significant as it provides stability to the fore dune. The vegetation is to be fenced to ensure no livestock enters the area and that pedestrian traffic is directed through designated pathways. Weeds will be removed and reseeding of native plant species. This will provide an improved environment for animal and bird life.
Objective 40: Minimisation of pollution.	The design incorporates extensive protection measures & separation to minimise pollution & pollution impacts.
Objective 41: Development involving ecologically sustainable development should be encouraged.	The approach taken in the development of the concept has been to improve the circumstances that prevail for the users at Cape Jaffa including the incorporation of policies and practices to ensure the sustainability of the development.

Objective 42: Provision of tourist information and facilities throughout the district and particularly in the town of Kingston SE.	Tourist information is available at the Tourist Park and with the establishment of the proposal, the available information for the locality and the region will be more widely promoted. This will reinforce the need and economic viability of the region and Kingston.
Objective 43: The conservation and preservation of flora, fauna and scenery and the creation of recreation areas by establishing parks and reserves.	Extensive areas of parks and reserves will be established. The area of coastal vegetation to the east of the proposed entry channel is currently privately owned and will be as part of the proposal transferred for reserve and conservation purposes.
Objective 44: The amenity of localities not impaired by the appearance of land, buildings and objects.	The amenity of the area as a result of the development of the area is expected to change significantly resulting from the current zoning of the land. This effect will be extended in an easterly direction as a consequence of the proposal. The amenity resulting from the proposal is higher than that expected from the current zone provisions as the proposal incorporates significant open waterway areas, several open space reserves, and the protection and enhancement of the coastal foredune. The inclusion into this locality of boats on moorings and the general views into the marina and the harbour area will not impair the amenity of the locality but rather enhance that amenity.
Objective 45: Productive and viable agricultural and forest land protected from conversion to non-productive uses by indiscriminate land division.	The land designated for development is marginal degraded primary production land a significant part of which is already allocated for development purposes. The eastern land is heavily weed infested and is used only for occasional grazing. The division of the land will not in any way be indiscriminate but rather orderly and well planned. Nearby farming land is salt scalded and is not productive. The opportunity exists for this land to be improved with some filling thus improving the productivity of this area. Further, if the use of reclaimed water occurs in the locality there will be an immediate productivity benefit from this application.
Objective 46: The maintenance of primary industries which support the district's economy, including fishing, forestry and related activities.	The primary industries of the district are a main focus of this proposal and are as a consequence being supported and maintained.
Objective 47: The retention of rural areas for agricultural, farming, pastoral, and forestry purposes and the maintenance of the natural character and rural beauty of such areas.	The rural areas are non productive and do not possess of themselves and natural character or beauty warranting retention. The overall community benefits will result from supporting and reinforcing the productive primary industries of fishing, aquaculture, and viticulture which also reinforce the tourist industry.
Objective 48: An urban environment and rural landscape not disfigured by advertisements.	Advertising signs will be limited to the commercial areas as there is nor need or requirement for advertising elsewhere in the residential portions of the development.
Objective 49: Advertisements in retail, commercial and industrial urban areas, and centre zones, designed to enhance the appearance of those areas.	The style and presentation of signs will be carefully managed to ensure that a consistent approach and theme is presented to the public.
Objective 50: Advertisements not hazardous to any person.	Advertisements will be carefully controlled in their location to ensure there is no prejudice to safety.
Objective 51: Development of Cape Jaffa as a pleasant seaside township.	The proposal conforms to this ideal entirely by the creation of waterways around a harbour designed to accommodate an existing fishing fleet and aquaculture

	industry.
Objective 52: Sustain or enhance the natural coastal environment in South Australia.	There will be effects on the coast in the immediate locality of the entrance channel by the development of the breakwaters. Accordingly, there is the need to monitor and respond to the changes that result. These changes have been predicted and are set out in some detail in **Section 5.2.13**.
	This process of Adaptive Management will ensure that there is a substitution process established for the passage of sand along the coast to overcome the interruption occasioned by the breakwaters.
Objective 53: 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 mangroves wetlands or estuarine areas however, the vegetated dunes will be protected and rehabilitated and managed to the benefit of the native vegetation, wildlife and the public.
Objective 54: Preserve sites of heritage, cultural, scientific, environmental, educational or landscape importance.	Investigations have been undertaken in consultation with the Kungari Inc representing the indigenous community in the district. As a consequence of these investigations, there was the identification of past use of the land by indigenous people. The recommendations from the investigations and the desired outcome includes the collection of items and their interpretation together with a presentation of the life and culture of these people in the area. Further, it is considered appropriate that this presentation be a collaborative venture to present the indigenous and European history relevant to the area. In this way the wider community will benefit from a better understanding of the culture history and associations with the land in the area. There are no other relevant items or sites of historical or cultural significance immediately affected on the land or in the water.
Objective 55: Maintain and improve public access to the coast in keeping with other objectives.	The public will be afforded improved access to the coast with new walkways created through the dune area on defined and fenced paths and formal car parking areas. Further, access by foot will be available along the breakwaters enabling a greater viewing of the coast than currently exists. Safety will also be enhanced in sections of the coast by the designation of formal car parking areas and the creation of a pedestrian only area on the beach.
Objective 56: Development which recognises and allows for hazards to coastal development such as inundation by storm tides or combined storm tides and stormwater, coastal erosion and sand drift; including an allowance for changes in sea level due to natural subsidence and predicted climate change during the first 100 years of the development.	The development allows for sea level rise and erosion by raising relevant parts of the land and locating and designing the development in a manner that separates the development from exposure to erosion.
Objective 57: Developers bearing the costs of protecting private development from the effects of coastal processes or the environment from the effects of development rather than the community.	The proponent will develop the land to provide the necessary protection.
Objective 58: Protect the physical and economic resources of the coast from inappropriate development.	The proposal provides for existing enterprises to maximize their safety and access to the resources of the coast. The members of the industries benefiting from the coastal resources have indicated their support for the proposal which has environmental and public

	safety advantages.
Objective 59: Locate all housing, including holiday houses, tourist accommodation, marinas and rural living located on land zoned for that purpose and for it to be environmentally acceptable and consistent with orderly and economic development.	The land is in part zoned for a range of urban functions. This proposal extends the area affected and will be the subject of a rezoning proposal to create appropriate zones and policies to guide development in an environmentally acceptable and orderly manner.
Objective 60: To redevelop and redesign unsatisfactory coastal living areas which do not satisfy environmental, health or public access standards for coastal areas.	The existing Cape Jaffa settlement incorporates holiday housing, permanent residences and fish processing and storage developed over many years. There is no permanent public water supply or effluent treatment facilities. Accordingly, all residential and commercial operations rely on shallow groundwater resources, septic tank disposal on the sites from which groundwater is drawn, seawater in the case of some commercial operations and rainwater. Further, some of the stormwater and wastewater handling features in the settlement are outmoded. This proposal will result in the establishment of a reticulated public water supply and waste water treatment facilities. In these respects public health and safety in the settlement will be improved to current standards.
Objective 61: Manage development in coastal areas to sustain or enhance the natural coastal environment.	There is the need to manage various aspects of any development. Changes to the natural features of the coast will be isolated and limited to the immediate area of the breakwaters. These changes have been predicted and are set out in some detail in Section 5.2.13. The process of Adaptive Coastal Management will ensure that there is a substitution process established for the passage of sand along the coast to overcome the interruption occasioned by the breakwaters.
Objective 62: 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 design of the proposal will ensure minimal and manageable effects. The effects identified are set out in Section 5.2.13 and the design, monitoring and management regime is established to achieve the least interference whilst providing a valuable improvement to the services and facilities at Cape Jaffa.
Objective 63: 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.	This part of the coast is the least impacted by the natural coastal processes and does not exhibit and outstanding environmental, marine vegetative or dune features. The vegetated dunes however are important for this coast and are therefore recognised for rehabilitation and protection. This will result in benefits to this area as a native vegetation precinct and wildlife habitat.
Objective 64: Development which does not detract from or reduce the value of sites of ecological, economic, heritage, cultural, scientific, environmental or educational importance.	There are numerous opportunities to enhance the value of sites of ecological, economic, heritage, cultural, scientific, environmental or educational importance. These include the interpretation of the cultural history of the area, the protection and rehabilitation of the vegetated foredune, and the removal of potential risks of environmental damage from vessels moored in the open.

Objective 65: 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.	The local environment does not exhibit high landscape or high amenity values in relative terms although it is an attractive coastal area. For this purpose comparisons may be made with Lake Butler at Robe or Nora Criena amongst others in terms of landscape quality or value. Nevertheless, it is desirable to protect and enhance those elements that form the foundation to developing a more highly valued environment and in this instance the key component that can benefit from this is the fore dune vegetation.
Objective 66: 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 (e) adequate car parking.	The proposal creates additional opportunities for controlled, managed access to the beach and to locations which provide coastal viewing with associated car parking. Public boating facilities and safety will also be significantly enhanced by the development of a boat ramp in protected waters located in a most convenient manner.
Objective 67: 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.	All of the land can be protected from coastal hazards.
Objective 68: 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.	Minimum building levels of 2.5 mAHD, minimum finished floor levels of 2.75 mAHD, based on: 100 yr ARI
Objective 69: Development which will not require, now or in the future, public expenditure on protection of the development or the environment.	The proposed ground levels are designed to accommodate all sea level rise. Further, provision is made to enable the raising of the wall around the waterways to protect development in the future. It is noteworthy that this coastal locality has a general trend toward accretion not erosion and therefore there is less likelihood that additional protective measures will be required. A fund is to be established for the maintenance of the facilities and the environment to be provided by the proponent as part of the land development and thereafter funds from rates collected will be allocated to the long term maintenance fund. This will ensure that the users are responsible for the long term maintenance of this environment.
Objective 70: The protection of the physical and economic resources of the coast from inappropriate	The physical and economic resources relate to the tourist, resident and fishing industry activities of the locality. The proposal is directly responsive to these

development.	activities and needs and the protection of the environment used by these sectors. Improved facilities are being provided for all of these sectors in an orderly and safe manner.
Objective 71: Development of coastal urban settlements, coastal rural living areas, tourist complexes and marinas only in environmentally acceptable areas.	The environment has been examined in considerable detail for this EIS. The EIS concludes that all of the effects identified are manageable and that there are no significant effects considered unacceptable. There have been several significant studies, strategies and plans that identify Cape Jaffa as an appropriate location to reinforce the existing settlement and to reinforce the existing aquaculture, fishing and tourist industries. Given the direction provided in these studies and reports which promote Cape Jaffa as an appropriate location.
Objective 72: 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.	It is proposed to expand the existing zoning to accommodate the varied arrangements that will result from the proposal.
Objective 73: Development of coastal urban settlements, coastal rural living, tourist accommodation and marinas 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 assessment of future demand.	The proposal has been designed having regard to: the size of the existing fishing fleet and aquaculture activities and the comments and advice received from the industry members; the anticipated requirements for retail and related commercial facilities given the existence of existing facilities and their sizes at Cape Jaffa; the response from the community in relation to the demand for land in this coastal settlement;
Objective 74: To redesign and redevelop coastal living areas which do not satisfy environmental, health or public access standards for coastal areas.	The proposal will assist the existing settlement in environmental and health terms by the provision of a reticulated water supply and waste water treatment systems.
Objective 75: 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) wild fisheries; (iii) recreational fishing; (iv) passive and active recreation activities (eg. boating, skiing, sailing, swimming, diving,	The proposal provides the opportunity for the creation of facilities for the aquaculture industry that do not exist in a manner that allows for the orderly or economic operation of the industry.

sightseeing, enjoyment of coastal wilderness); (v) farming; (vi) residential, other urban development, and holiday areas; (vii) tourism; (viii) industrial development; (ix) defined national and conservation parks, and wilderness areas; (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.	
Objective 76: Telecommunications facilities provided to meet the needs of the community.	Telecoms will be provided throughout the development.
Objective 77: Telecommunications facilities located and designed to minimise visual impact on the amenity of the local environment.	There are no proposals for towers within the development.
Objective 78: The development of renewable energy facilities, such as wind and biomass energy facilities, in appropriate locations.	There are no proposals for any of these features on the site although investigations are proceeding to identify opportunities for renewable energy.
Objective 79: Renewable energy facilities located, sited, designed and operated to avoid or minimise adverse impacts and maximise positive impacts on	There are no proposals for any of these features on the site.

the environment, local community and the State.	
1 Development should be in accordance with the District Structure Plan, Maps King/1 (Overlay 1 and 2), the Kingston SE and Environs Structure Plan, Map King/1 (Overlay 1) Enlargement A, and the Cape Jaffa Structure Plan, Map King/1 (Overlay 1) Enlargement B.	The Development Plan depicts Cape Jaffa as one of the two settlement areas for the whole of the Council. The proposal extends the defined development area of the settlement and rearranges the functional elements of the settlement to create an orderly development area.
2 Development should occur only where the land is suitable for the proposed use, and where that use is compatible with those preferred for the locality.	The environment has been examined in considerable detail for this EIS. The EIS concludes that all of the effects identified are manageable and that there are no significant effects considered unacceptable. There have been several significant studies, strategies and plans that identify Cape Jaffa as an appropriate location to reinforce the existing settlement and to reinforce the existing aquaculture, fishing and tourist industries. Given the direction provided in these studies and reports which promote Cape Jaffa as an appropriate location.
3 Development should not interfere with the effective and proper use of any other land.	The proposal has features and outcomes that has the potential to improve the use of other land by irrigation of reclaimed water. Areas of salt effected soils can also be rehabilitated so they can become more usable for production purposes.
4 Development in townships should be orderly and economic so as to form compact extensions to existing developed areas which are provided with appropriate services.	The proposal is designed to fully integrate with the existing settlement and for the extension of facilities to be available throughout.
5 Urban development should not be in the form of ribbon development along arterial roads.	There is no ribbon development proposed. There are no arterial roads at Cape Jaffa.
6 Additional urban development involving the division of land should only be undertaken following substantial development of existing vacant allotments, and only if appropriate services and facilities are available.	There are no vacant allotments at Cape Jaffa and the proposal provides specifically for a planned, managed and orderly staged release of the land. The costs associated with the development of each stage are significant and therefore there will be market based release of land thus avoiding the unnecessary release of additional land. It is also proposed to provide incentives to property owners to develop allotments within specified time frames. All development will be undertaken in association with the necessary service infrastructure.
7 Development likely to be adversely affected by flooding should not be undertaken: **(a) on land subject to inundation by water;** **(b) where there is significant risk of flooding or cause of flooding of other land; and** **(c) where there is a risk to life, or property damage could result.**	The development ensures the land is protected from flooding.
8 Development on poorly drained land should not take place unless effective remedial measures have been taken.	The land is extremely well drained.
9 Development should be of a high standard of design, be appropriately sited, and setback from road frontages a distance related to the height of the building and intensity of use, and should be landscaped with suitable species of trees and	The proposal incorporates allotments that will allow for appropriate setbacks. Development will be assessed on an individual basis.

shrubs.	
10 Development should not be undertaken which would create excessive noise, smell, glare, smoke, dust or other hazards likely to be injurious or detrimental to the health, safety and welfare of the community.	All development of a type that could cause nuisance will be located such that there is an appropriate separation and buffer to any sensitive receiver. Marine engineering activities for example will be located in the commercial/industrial area which is to be developed with a landscaped mound. These operations will also be controlled by the policies and licensing requirements of the EPA.
11 An adequate buffer should be provided between any noxious industry, solid refuse dump, wastewater or common effluent treatment works, and any residential area or other similar development.	The waste water treatment facility is the only relevant use listed in PDC 11. This facility is located in the south eastern corner of the site and has separation/buffer distances in accordance with required standards.
12 Residential or similar development should not be undertaken within 400 metres of an existing or proposed effluent drainage lagoon.	There will be no effluent lagoon required as the water is to be treated and used elsewhere for irrigation purposes.
13 Residential development should not be undertaken on any allotment which has dimensions or an area less than that specified in the following tables or such greater area as may be specified in individual zones: (a) where the development is, or can be, connected to sewerage or a septic tank effluent drainage scheme: Detached Dwelling 600 m^2 Semi-detached Dwelling 420 m^2 Row Dwelling 370 m^2 Other dimensions for frontage and width also apply	The development will be established with a full sewer system and no allotment size or dimension is less than that prescribed in the table associated with Principle 13 (a).
14 A residential flat building should not be erected on any allotment where the minimum area and dimensions of the allotment and the minimum site area per dwelling, are less than the minimum area and dimensions set out in the following tables: Residential Flat Building Single Storey 300 m^2 Residential Flat Building 2 or more stories 230 m^2 Other dimensions for frontage, width and area also apply	There are no detailed proposals for this form of development however allotment configuration allows for these to be accommodated.
15 The area of the allotment covered by a row dwelling or residential flat building should not exceed 40 percent of the area of the allotment on which the building is being erected. The remaining portion of the allotment, except that used for car parking or clothes drying, should be landscaped.	There are no detailed proposals for this form of development however allotment configuration allows for these to be accommodated.
16 A multiple dwelling or residential flat building	There are no detailed proposals for this form of

should satisfy the following requirements: (a) the number, location and design of access and exit points from or to a road, street or thoroughfare, and the design, layout and pavement of the parking area should be established so as best to ensure the safety of the public and the free flow of traffic in the locality; (b) the use of parking areas by vehicles should not detract unduly from the amenity of the locality or cause nuisance to any person resident in the immediate locality and such vehicles should be screened adequately so as to prevent a view of them in the parking areas from an abutting allotment road, street or thoroughfare; (c) the location, provision for screening from view, and design of storage space for refuse containers should be convenient to the occupants of the residential flat building or multiple dwelling and should not cause nuisance to any person or be detrimental to the amenity of the locality. Provision of a holding place for refuse containers should be made in a position near the boundary of a road, street or thoroughfare convenient for collection of refuse; (d) proper provision should be made for storage, clothes drying and airing facilities which are screened from view; (e) the external appearance of the residential flat building or multiple dwelling should not be detrimental to the amenity of the locality; (f) a sign should be provided on the allotment or building to ensure that the location of the parking area is readily apparent to visitors; (g) the allotment should be landscaped; and (h) any loss of privacy and daylight on adjoining properties and occupiers should be minimised.	development however allotment configuration allows for these to be accommodated. The detailed design considerations should be assessed at the time of a detailed application.
17 Development should not exceed two storeys in height (vertical wall height of any point, excluding gables) and should not exceed 7.0 metres above natural ground level.	Height controls will be included in the building guidelines applied to the development.
18 To maintain privacy of adjoining residents the design of dwellings should: (a) ensure that balconies and windows to habitable rooms (eg bedrooms, lounges, dining rooms and studies) do not directly overlook the windows and private open space of adjacent dwellings; and (b) ensure that balconies and windows are located in walls which have a maximum degree of separation from adjoining dwellings of the boundaries of the development site.	This will also be included in the building restrictions applied to the development.
19 Where direct overlooking of the habitable rooms of adjoining dwellings by a development is	This will be included in the building restrictions applied to the development.

otherwise unavoidable, alternative methods of providing daylight to habitable rooms within that development should be adopted such as the use of skylights, high level windows and windows with enlarged sill widths.	
20 To ensure a reasonable separation between dwellings to minimise the potential for overshadowing of adjacent dwellings, and to create attractive streetscapes, the walls of dwellings, garages and carports should be set-back not less than the following minimum distances from site boundaries:	This will be included in the building restrictions applied to the development.
21 For all dwellings, other than aged person dwellings, at least two parking spaces should be provided, and one space should be covered.	This will be included in the building restrictions applied to the development.
22 For any dwelling without direct street frontage (excluding common space) not less than two individually accessible car parking spaces should be provided, of which one should be covered and the other may be either with the site boundaries of that dwelling or within commonly held space and available for visitor use.	This will be included in the building restrictions applied to the development.
23 An outdoor space area should be provided available to each dwelling; it should have sufficient area to allow for outdoor activities and functions such as entertaining, clothes drying and refuse storage in an area screened from public view.	This will be included in the building restrictions applied to the development.
24 Land should not be divided: (a) in a manner which would prevent the satisfactory future division of the land, or any part thereof; (b) if the proposed use or the establishment of the proposed use, is likely to lead to undue erosion of the land or land in the vicinity thereof; (c) unless wastes produced by the proposed use of the land, or any use complying with the principles of development control, can be managed so as to prevent pollution of a public water supply or any surface or underground water resources; (d) if the proposed use of each of the proposed allotments is not compatible with the objectives for the area in which the land is situated; (e) if the size, shape and location of, and the nature of the land contained in, each allotment resulting from the division is unsuitable for the purpose for which the allotment is to be used; (f) if any part of the land is likely to be inundated by tidal or floodwaters and the proposed allotments are to be used for a purpose which would be detrimentally affected when the land is inundated; (g) where community facilities or public utilities are lacking or inadequate;	The concept layout shows that the further future division of land will not be prejudiced. The division will not lead to erosion and is consistent with the whole of the development concept and hence will be suitable for the intended purposes. The gradual staged growth of the settlement will be readily serviced by the existing community facilities at Kingston. Public utilities will be developed in a progressive manner according to the staged take up and development of allotments. There are no allotments available in the existing settlement. There are no by laws or Building Code that will be infringed. There is no river, lake or creek on the land. There are no mineral resources that require protection.

(h) into allotments for use for the same purpose as allotments in the vicinity, if a substantial number of existing allotments have not been used for that purpose; (I) if it would cause an infringement of any provisions of the Building Code or any by-law or regulation made thereunder; (j) if it involves the division of land bordering a river, lake or creek and the land immediately adjoining the river, lake, or creek, does not become public open space at least 30 metres in width, with a public road fronting the open space; or (k) if extraction of significant mineral resources could be prevented or prejudiced by the land division.	
25 When land is divided: (a) any reserves or easements necessary for the provision of public utility services should be provided; (b) stormwater should be capable of being drained safely and efficiently from each proposed allotment and disposed of from the land in a satisfactory manner; (c) a water supply sufficient for the purpose for which the allotment is to be used should be made available to each allotment; (d) provision should be made for the disposal of waste waters from each allotment without risk to health or of ground water pollution; (e) allotments not connected to a common effluent drainage scheme should be of sufficient area to ensure the satisfactory disposal of septic tank effluent within the confines of each allotment; (f) roads or thoroughfares should be provided where necessary for safe and convenient communication with adjoining land and neighbouring localities; (g) proposed roads should be graded or be capable of being graded to connect safely and conveniently with an existing road or thoroughfare; (h) each allotment resulting from the division should have safe and convenient access to the carriageway of an existing or proposed road or thoroughfare; (I) for urban purposes, provision should be made for suitable land to be set aside for useable local open space; and (j) the natural features of the land being divided should be taken into account.	The proposal acknowledges the need for easements. The area comprises excellent draining soils and it is proposed to require the incorporation of on site collection and filtration of stormwater into the ground. A reticulated water supply is to be established for the whole of the development. A waste water treatment scheme is to be established to remove wastes from each site and to reclaim the water for beneficial primary production purposes. A road network has been designed to provide a balanced and orderly distribution of traffic and good access to the existing settlement and the coast. These roads will be sealed. Significant and numerous areas are to be established as local open space. The natural features of the land being developed were destroyed many years ago by the removal of vegetation and the development of the land for primary production purposes.

26 "Hammerhead" allotments should not be created unless all of the following criteria apply: (a) the land cannot otherwise be satisfactorily and efficiently developed for the purposes for which it is zoned, and no alternative access to a road or services can be made available; (b) the access strip of land is not less than 5.0 metres wide or longer than 50 metres; (c) the area of the allotment, excluding the access strip of land, is not less than the minimum allotment area prescribed for the zone in which the land is situated.	No hammerhead allotments are proposed.
27 Shopping development should be located as follows: (a) a shop, or group of shops, with a gross leasable area greater than 450 square metres should be located in a business, centre, or shopping zone, or area; (b) a shop or group of shops with a gross leasable area of 450 square metres or less should not be located on a primary road unless located in a business, centre, or shopping zone, or area; (c) a shop or group of shops with a gross leasable area of 450 square metres or less located outside a business, centre, or shopping zone, or area, should: (i) not hinder the development or function of any business, centre, or shopping zone, or area; and (ii) conform to the design, access, and car parking requirements for business, centre and shopping zones, or areas, set out in principles of development control numbered 28, 29 and 30 below.	A small area is provided for retail, restaurant, tavern and related facilities. The existing centre is focussed on the tourist park and will remain.
28 Business, centre, and shopping zones, or areas, should meet the following criteria: (a) their location and assigned role in the hierarchy of designated centres and designated centre zones, or areas; (b) the need to integrate facilities in the zone, or area; (c) the need for any future expansion of the zone, or area, as a whole; (d) multiple use of facilities and sharing of utility spaces; (e) attractive development, with a unified design of buildings and a close relationship between shops, in a lively setting; (f) materials compatible with the natural features of the site and adjacent development;	The level of facilities to be provided are commensurate with the specific market requirements of the increased community and the maritime functions created by the proposal. These facilities will the subject of detailed design and application and include the necessary provision of carparking, landscaping and screening.

(g) acceptable microclimatic conditions and degree of exposure in designing and orienting buildings, and locating open space and parking areas;	
(h) development and operation of facilities within a zone, or area, compatible with adjoining areas. This should be promoted through landscaping, screen walls, centre orientation, location of access ways, buffer strips and transitional use areas; (I) signs designed in scale with the amenity of the area, and carefully located. Illumination from signs or floodlights should not spill over to adjacent areas; (j) access and parking for residential areas located within centres shall be separate from the access and car parking areas serving the other centre facilities; and (k) integration of public transport requirements, where appropriate.	
29 Provision for the movement of people and goods within business, centre, and shopping zones or areas, should comply with the following: (a) development should not cause inconvenient and unsafe traffic and pedestrian movements, or be likely to result in the need for significant expenditure on transport and traffic works, or facilities within, or outside, the locality; (b) developments should be concentrated for pedestrian convenience and not allowed to extend unnecessarily along road frontages (increasing the depth of development is a more desirable alternative); (c) the separation of pedestrian and vehicle movements within zones is most desirable to ensure safety and convenience; (d) access to car parking areas should be designed not to cause congestion or detract from the safety of traffic, on abutting roads; (e) adequate and convenient provision should be made for service vehicles and the storage and removal of waste goods and materials; (f) car parks should be orientated to facilitate direct and convenient access of pedestrians between them and the facilities they serve; and (g) parking areas should be consolidated and coordinated into convenient groups, rather than located individually, and access points should be minimised.	The design detail for specific proposal will be the subject of separate applications. The general layout and arrangements however ensure the ability to provide the necessary support infrastructure.
30 Landscaping should form an integral part of centre design, and be used to foster human scale, define spaces, reinforce paths and edges, screen utility areas, and generally enhance the visual amenity of the locality.	Landscaping will form part of separate applications for the development.
31 Centres should be highly accessible to the population to be served, especially by public	The centre facilities area is well located to be highly accessible.

transport, where applicable.	
32 Centres should have a minimal adverse impact on traffic movements on primary and primary arterial roads.	The location of these facilities ensures that there will be no adverse impacts on traffic movements.
33 Centres should develop on one side of a primary, or primary arterial, road, or one quadrant of a primary, or primary arterial, road intersection. Where centre facilities already straddle a primary, or primary arterial road, or the intersection of two primary, or primary arterial roads, development within them should: (a) concentrate on one side of the primary, or primary arterial, road, or one quadrant of the primary, or primary arterial road intersection; and (b) minimise the need for pedestrian and vehicular movement across the primary, or primary arterial road, from one part of the centre to another.	The centre is located away from and on one side of the Cape Jaffa Road.
34 Centres should have minimal adverse impacts on residential areas.	The centre area is separated from the residential areas.
35 Centres should be so located as to make effective use of existing investment in public infrastructure utilities, transport and other facilities, and any costs involved should be offset by benefits to the population being served.	The centre is well located to be efficient in its development and connection to the existing infrastructure at no cost to the community but with enhancements to the level and service to the community.
36 Centres should be located consistent with policies pertaining to adjoining Council areas.	This facility will not impact in any deleterious way to the Robe Council provision of centre facilities.
37 The development of centres should not result in the physical deterioration of any designated centre.	The existing centre will continue to serve the tourist park and the local settlement area of Cape Jaffa and it is not intended to duplicate that service.
38 Shopping development which is more appropriately located outside of business, centre, or shopping zones or areas, should: (a) be of a size and type which would not hinder the development or function of any business, centre, or shopping zone or area, in accordance with the objectives and principles of development control for centres and shops, and the objectives and principles of development control for the appropriate zones, or areas; (b) conform to the criteria above, and the design, access, and car parking requirements for business, centre, and shopping zones, or areas, set out in the principles of development control above; (c) result in a maintenance of retail employment in the locality; and (d) not demonstrably lead to the physical deterioration of any designated centre.	The area is currently not zoned however it is proposed to create appropriate zones to accommodate the special needs of the area.
39 Development should ensure that the following conditions are satisfied in relation to the provision of roads, streets, or thoroughfares: (a) a road, street or thoroughfare should be designed and constructed to be safe and convenient for vehicles, pedestrians and cyclists;	The road and allotment layout ensures the safe connection of land to the road system which provides appropriate access about the development area.

(b) a road, street or thoroughfare should be capable of being graded to connect safely with an existing road, street or thoroughfare; (c) access from each allotment to any road, street or thoroughfare should be safe and convenient; (d) adequate provision of roads, streets and thoroughfares should be made for safe and convenient intercommunication with neighbouring localities; (e) adequate provision of roads, streets or thoroughfares required as a consequence of the proposed development is made and access is provided to or from any roads through adjoining land and to or from any road proposed on adjoining land; (f) the width of any proposed road, street or thoroughfare should not be less than 12.4 metres. If the road or street is likely to be used by commercial vehicles the width should not be less than 21 metres. Thoroughfares which are not roads or streets should not be less than 2.0 metres wide; (g) the minimum width of the turning area at the head of every cul-de-sac should be 25 metres for a length of not less than 25 metres, whilst adequate provision should be made for the turning of vehicles at the head of every cul-de-sac; and (h) a road, street or thoroughfare should not have a gradient of more than 1-in-12.	
40 Development should be provided with areas for on-site loading and unloading of service and delivery vehicles.	The layout of the commercial areas include adequate space for the development of facilities with loading and unloading areas.
41 Off-street car parking should be developed in accordance with the appropriate Australian Standard as approved by the Standards Association of Australia and in accordance with Table King/4.	The relevant standards will apply to the applications for development.
42 Car parking areas should be sealed to provide a hard standing surface, landscaped and designed so as to facilitate the efficient movement of traffic within the parking areas.	Facilities will be developed to appropriate standards to ensure efficient traffic movement.
43 The location, siting, size, illumination, shape and materials of construction, of advertisements should be: (a) consistent with the desired character of areas or zones as described by their objectives; (b) consistent with the predominant character of the urban or rural landscape; or (c) in harmony with any building or site of historic significance or heritage value in the locality.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.

44 Advertisements should not detrimentally affect by way of their siting, size, shape, scale, glare, reflection or colour, the amenity of areas, zones or localities, in which they are situated.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
45 Advertisements should not impair the amenity of areas, zones or localities in which they are situated by creating, or adding to, clutter, visual disorder and the untidiness of buildings and spaces.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
46 Advertisements should not obscure views of attractive landscapes or particular trees or groups of trees.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
47 The scale of advertisements should be compatible with the buildings on which they are situated and with nearby buildings and spaces.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
48 Advertisements should be constructed and designed in a workmanlike manner.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
49 Advertisements wholly or partly consisting of bunting, streamers, flags, windvanes and the like, should not detrimentally affect the amenity of areas, zones or localities, in which they are situated.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
50 Advertisements on buildings that have a single architectural theme but which contain a number of tenancies, should be attached and displayed so as to be coordinated with that theme.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
51 Advertisements should not be erected in positions close to existing electricity mains so that potentially hazardous situations are created.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
52 Advertisements should not create a hazard to persons travelling by any means.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
53 Advertisements should not obscure a driver's view of other road vehicles, of rail vehicles at or approaching level crossings, of pedestrians, and of features of the road, such as junctions, bends, changes in width, traffic control devices and the like, that are potentially hazardous.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
54 Advertisements should not be so highly illuminated as to cause discomfort to an approaching driver, or create difficulty in his perception of the road, or of persons or objects on it.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
55 Advertisements should not be liable to interpretation by drivers as an official traffic sign or convey to drivers information that might be confused with instructions given by traffic signals or other control devices or impair the conspicuous nature of traffic signs or signals.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
56 Advertisements should not distract drivers from the primary driving task at a location where the demands on driver concentration are high.	Advertising signs will be the subject of separate applications except for standard marketing and presentation signs and directional and traffic signs.
57 Outdoor advertising signs should: (a) be displayed on the site on which the business	Advertising signs will be the subject of separate applications except for standard marketing and

or activity to which they relate is located; (b) be designed, sited and constructed so as not to detract from the character of the locality; (c) minimise individual product advertising; (d) convey a simple, direct, and clear message; (e) be located safely and conveniently, and constructed so that they do not present a hazard to vehicular and pedestrian traffic; and (f) be of such a scale and colours that will be in keeping with the character of the locality.	presentation signs and directional and traffic signs.
58 Land should not be developed unless there are adequate reserves or easements provided for water supply, sewerage, drainage or electricity supply purposes.	Adequate and appropriate reserves and easements will be established for all infrastructure and maintenance purposes.
59 Development should not be dependent on an indirect water supply.	A direct water supply is to be provided as authorised by the Minister in accordance with the Water Allocation Plan.
60 Development intended for human occupation should have a domestic, potable water supply available sufficient for domestic purposes. Where this would require the construction or extension of a private water supply scheme, there should be available water of an acceptable quality, magnitude and reliability of supply and suitable legal arrangements for supply between parties to satisfy the ongoing requirements for the prospective community.	The water supply will be developed according to the requirements for the staged development of the settlement at a standard and quality commensurate with accepted town supply as in the case at Kingston.
61 All development should make adequate provision for the treatment and disposal of waste waters, and all other waste, without risk to health, or pollution of a water resource.	Waste water will be collected and treated for its reuse.
62 Where a residential dwelling is proposed on an allotment not connected to an existing reticulated water supply, such an allotment shall provide a minimum on-site water storage capacity of 20,000 litres.	All allotment for residential purposes will be connected to sewer.
63 Mineral resources should be protected from development which is incompatible with extractive industry or which is likely to add to the cost of extracting the resource at a later date.	There are no mineral resources on the land.
64 Development should not be undertaken in the vicinity of known mineral deposits: (a) until the full extent and significance of such deposits has been determined; (b) if such development would be incompatible with mining operations; or (c) if it would add to the cost of extracting the resource.	There are no extractive operations proposed on or near the land.
65 Mining operations, including borrow pits for Council, and other public works, should be undertaken only where:	There are no mining operations proposed.

(a) the overall benefit to the community from the minerals produced together with the planned after use of the site, outweigh any loss of amenity or other resources resulting from the extractive operation; (b) the site contains minerals of the necessary quality and, for reasons of location, quality, or other factors, no practical alternative source is available; (c) the proposed operation maximises utilisation of the resource but minimises the adverse impacts; (d) an effective buffer area, which could include tree planting and mounding, is established around the site to protect adjoining land users from the effects of the operation; (e) operations are conducted in accordance with a development and reclamation program approved by the appropriate authority and which: (i) ensures that danger and uPolicy Not Relevanteasonable damage or nuisance does not arise from the workings or any operations associated with them; (ii) provides for progressive reclamation of disturbed areas; (iii) provides for the removal of buildings, plant, equipment, rubbish, and litter, when operations are complete; and (iv) renders the site safe for future occupiers or users; (f) an after-use appropriate to the site and the locality is established on completion of extractive operations; and (g) the quality and quantity of surface and ground water will not be adversely affected; and important conservation areas, that rely on a regional water balance for their continued viability, will be unaffected.	
66 New extractive operations should not be opened within the Urban Coastal Zone, Fringe Zone, or Rural Living Zone shown on Maps King/14, 16 to 25, 27 and 29, unless required for short term public works programs or other special purposes.	There are no extractive operations proposed.
67 Waste management facilities should be located, sited, designed and managed to minimise adverse impacts on both the site and surrounding areas due to generation of surface water and ground water pollution, traffic, noise, odours, dust, vermin, weeds, litter, gas and visual impact.	There are no waste landfill facilities proposed therefore PDC's 67 to 91 inclusive in relation to waste related policies are not relevant
68 Landfill operations should not be located in existing or future urban, township, living, residential, commercial, centre, office, business or institutional zones or environmental protection,	POLICY NOT RELEVANT.

conservation, landscape, open space or similar zones.	
69 Waste management facilities should be provided with appropriate separation distances to minimise adverse impacts on the surrounding area and land uses.	POLICY NOT RELEVANT.
70 Land uses and activities which are compatible with waste management facilities may be located within any separation distances established.	POLICY NOT RELEVANT.
71 Land uses and activities which are not compatible with a waste management facility should not be located within any separation distances established.	POLICY NOT RELEVANT.
72 Organic waste processing facilities for the composting of waste should be located at least a distance of 500 metres from the nearest dwelling, shop, office, public institution or other building designed primarily for human occupation. A lesser distance may be provided where the processing operations and technologies are considered compatible with the surrounding area, land uses and activities. Alternatively, a greater distance may be required where the processing operations are considered incompatible with the surrounding area, land uses and activities.	POLICY NOT RELEVANT.
73 Landfill and associated facilities for the handling of waste, should be located at least a distance of 500 metres from the boundaries of the landfill site. A lesser distance may be provided within the landfill site where the landfill facility is considered compatible with the surrounding area, land uses and activities so that an effective minimum separation distance of 500 metres can be provided and maintained between the landfill facility and potentially incompatible land uses and activities.	POLICY NOT RELEVANT.
74 The area of landfill operations on a site should: (a) be located a minimum distance of 100 metres from any river, creek, inlet, wetland or marine estuarine area and not within the area of a 1 in 100 year flood event; (b) not be located on areas with ground slopes of greater than 10 percent except where the site incorporates a disused quarry; (c) not be located on land subject to land slipping; d) not be located within three kilometres of an airport used by commercial aircraft. If located closer than three kilometres the landfill operations should incorporate bird control measures to minimise the risk of bird strikes to aircraft.	POLICY NOT RELEVANT.
75 The area of the organic waste processing facilities on a site should: (a) be located a minimum distance of 100 metres from any dam, river, creek, natural watercourse, channel or bore, and not within the area of a 1 in 100 year flood event;	POLICY NOT RELEVANT.

(b) not be located on areas with ground slopes of greater than 6 percent; (c) not be located on land subject to land slipping; (d) not be located within three kilometres of an airport used by commercial aircraft. If located closer than three kilometres the organic waste processing operations should incorporate bird control measures to minimise the risk of bird strikes to aircraft; and (e) not be located within 250 metres of a public open space reserve, a forestry reserve, a National Park, a Conservation Zone or Policy Area.	
76 The waste management site should be landscaped to screen views of the processing facilities and operational areas.	POLICY NOT RELEVANT.
77 Sufficient area should be provided within the waste management site to ensure on-site containment of potential groundwater contaminants and for the diversion of stormwater.	POLICY NOT RELEVANT.
78 Noise reduction treatments comprising separation distances and the incorporation of on-site treatments should be provided to ensure noise generation associated with the waste management operation does not result in an adverse impact to any existing or future development on an adjacent allotment.	POLICY NOT RELEVANT.
79 Litter control measures which minimise the incidence of windblown litter should be provided on the site of a waste management operation.	POLICY NOT RELEVANT.
80 Leachate from waste management activities should be contained within the property boundary of the waste management site and should not contaminate surface water or groundwater.	POLICY NOT RELEVANT.
81 A leachate barrier should be provided between the operational areas and the underlying soil and groundwater of organic waste processing operations.	POLICY NOT RELEVANT.
82 The interface between any engineered landfill liner and the natural soil should be: (a) greater than 15 metres from unconfined aquifers bearing ground water with a water quality of less than 3,000 milligrams per litre of total dissolved salts;	POLICY NOT RELEVANT.
(b) greater than 5.0 metres from groundwater with water quality between 3,000 milligrams per litre of total dissolved salts and 12,000 milligrams per litre of total dissolved salts; or (c) greater than 2.0 metres from groundwater with a water quality exceeding 12,000 milligrams per litre of total dissolved salts.	

83 Surface water run-off from the waste management operations should not cause unacceptable sediment loads in receiving waters.	POLICY NOT RELEVANT.
84 Landfill activities that have a total storage capacity exceeding 230 000 cubic metres should sustainably utilise landfill gas emissions. For smaller landfill activities, if the sustainable utilisation of the gas emissions is not practically feasible then controlled flaring is appropriate to avoid gases being vented directly to the air.	POLICY NOT RELEVANT.
85 Fencing to a minimum height of 2.0 metres should be erected on the perimeter of a waste management site to prevent access other than at appropriate entries. For landfill sites, the fencing should be of chain wire mesh or pre-coated painted metal construction.	POLICY NOT RELEVANT.
86 Plant, equipment or activities that could cause a potential hazard to the public within a waste management site should be enclosed by a security fence.	POLICY NOT RELEVANT.
87 Waste management sites should not be located where access to the site using non-arterial roads in adjoining residential areas is required or likely.	POLICY NOT RELEVANT.
88 Waste management sites should be accessed by an appropriately constructed and maintained road.	POLICY NOT RELEVANT.
89 Traffic circulation movements within the waste management site should be adequate in dimension and construction to support all vehicles hauling waste and to enable forward direction entry to and exit from the site.	POLICY NOT RELEVANT.
90 Suitable access for emergency vehicles to and within the waste management site should be provided.	POLICY NOT RELEVANT.
91 A proposal to establish, extend or amend a waste management operation should include an appropriate Environmental Management Plan that addresses the following: (a) the prevention of groundwater and surface water contamination; (b) the need to protect and enhance native vegetation; (c) litter control, dust control and sanitary conditions generally; (d) odour and noise control;	POLICY NOT RELEVANT.
(e) fire safety; (f) security; (g) maintenance of landscaping and the general condition of the site; and (h) final contour plan and rehabilitation proposals including soil cover, landscaping, drainage, the removal of any contamination or waste, restoration and the like to ensure compatibility with the surrounding landscape and to enable a suitable	

after use of the site.	
92 Development adjacent to substantial areas of native vegetation should use indigenous species in any site landscaping works.	The investigations have identified a significant list of appropriate native species and this list will be provided to all applicants for development to incorporate within sites. Further the public areas particularly near the vegetated fore dune will be developed using native species.
93 Buildings, structures, sites, areas or relics which have architectural, aesthetic, historic, social, archaeological, scientific or other special significance should be preserved.	Investigations have been undertaken in consultation with the Kungari Inc representing the indigenous community in the district. As a consequence of these investigations, there was the identification of past use of the land by indigenous people. The recommendations from the investigations and the desired outcome include the collection of items to ensure there preservation and their interpretation together with a presentation of the life and culture of these people in the area. Further, it is considered appropriate that this presentation be a collaborative venture to present the indigenous and European history relevant to the area. In this way the wider community will benefit from a better understanding of the culture history and associations with the land in the area. There are no other relevant items or sites of historical or cultural significance immediately affected on the land or in the water.
94 Development in proximity to land, buildings or structures of heritage significance should not be undertaken if it is likely to detract from their heritage significance or integrity.	No item of significance will be prejudiced.
95 Development within the region should be compatible with its use as a water catchment and storage area.	The proposal will be managed to have regard to the water quality of the region.
96 Activities which produce strong organic, chemical or other intractable wastes should not be established within water catchments.	No strong organic, chemical or intractable wastes will be produced in this locality.
97 Development should not be undertaken if it is likely to result in: (a) the pollution of surface or ground water; (b) the degradation of watercourses or wetlands; (c) the increased risk of flooding or impairment of stream water quality through the disposal of stormwater.	The proposal incorporates management features to ensure that it is unlikely that pollution of surface or groundwater, degradation of wetlands or increased flooding occurs.
98 Development which could result in a risk of pollution or contamination of surface or ground water, or result in changes to drainage patterns, or reduce the quantity of ground water, should not be undertaken except where it can be demonstrated that such changes would not affect adversely the viability of established agricultural uses or the conservation of significant natural features.	The viability of existing agricultural activities is not expected to be affected. In some respects there will be improvements to agricultural capacity by improvements to salt scalded land and by irrigation of reclaimed water that will result from the proposal. The management regime incorporates a monitoring programme to regularly test the effects of the development on a staged basis.
99 Development which could cause soil erosion should not be undertaken.	No development will result in erosion.
100 Drainage schemes should be undertaken only if they can be demonstrated to be necessary for improved agricultural production and where the community interest in areas of conservation	There are no specified drainage schemes proposed.

significance is preserved.	
101 Development utilising surface and groundwater resources should ensure that the water balance is maintained.	The management of stormwater and reclamation of waste waters ensures the best opportunity to maintain resources.
102 Development that will lead to the over-exploitation of groundwater resources should not be undertaken.	Significant quantities of water exist in the confined aquifer from which the town supply is to be extracted. The quantity to be extracted is small in comparative terms and will not over-exploit the resource.
103 Development should not impair the character, or amenity, of rural areas, or have adverse impacts on wildlife habitats.	The remnant vegetated dune area is to be protected and enhanced to improve wildlife habitats and improve the amenity of the area.
104 Development should not cause the discharge of any waste which could pollute surface or underground water resources unless such waste meets levels of pollution authorised under any other act.	No wastes are to be discharged into the surface waters or groundwater.
105 Development which could have a detrimental effect on wetland areas of conservation significance, should not be undertaken.	There are no wetlands on the site.
106 Native vegetation should not be cleared if it: (a) provides important habitat for wildlife; (b) has a high plant species diversity or has rare or endangered plant species and plant associations; (c) has high amenity value; (d) contributes to the landscape quality of an area; (e) has high value as a remnant of vegetation associations characteristic of a district or region prior to extensive clearance for agriculture; (f) is associated with sites of scientific, archaeological, historic, or cultural significance; or (g) is growing in, or is characteristically associated with, a wetland environment.	Native vegetation is to be protected and rehabilitated along the dune. A small area of degraded vegetation in the area of the existing carpark on the dune is to be removed to allow for the entry channel into the development. Further, some minor clearance will be undertaken to create dedicated walkways through the dunes and a new vehicle access way to the beach to replace the two current access ways.
107 Development should not occur where extensive clearance of native vegetation or significant modification of the landscape would be necessary and in particular: (a) No vegetation within ten metres of a watercourse should be cleared except declared noxious species. Noxious species should not be removed in a manner likely to result in significant erosion.	No extensive clearance of native vegetation is proposed.
108 Native vegetation should not be cleared if such clearance is likely to: (a) create or contribute to soil erosion; (b) decrease soil stability and initiate soil slip; (c) create, or contribute to, a local or regional soil salinity problem; (d) lead to the deterioration in the quality of surface waters; or	. Areas of native vegetation to be cleared are limited and are to provide for public access. These areas will be developed and managed to ensure there is no erosion, soil degradation, soil salinity or increased potential for flooding.

(e) create or exacerbate the incidence or intensity of local or regional flooding.	
109 When clearance is proposed, consideration should be given to: (a) retention of native vegetation for, or as: (i) corridors or wildlife refuges; (iii) amenity purposes; (iii) livestock shade and shelter; or (iv) protection from erosion along watercourses and the filtering of suspended solids and nutrients from run-off; (b) the effects of retention on farm management; and (c) the implications of retention or clearance on fire control.	The proposal incorporates the necessary considerations to the retention of significant areas of vegetation, its enhancement and the creation of protected wildlife areas.
110 Dwellings should be sited and landscaped to minimise the energy required for heating and cooling of the building.	The concept has resulted from a range of considerations and the allotment arrangements are such that individual development can accommodate design elements for energy efficiency.
111 Dwellings should be orientated and designed to allow maximum access to daylight and winter sunlight to habitable rooms.	The allotment arrangement is such that individual development can accommodate design elements for energy efficiency.
112 Dwellings should incorporate insulation to the external walls and ceiling, or utilise construction materials and designs that use natural ventilation flows for heating and cooling purposes.	Subject to individual applications.
113 Development, where possible, should utilise roof catchment water for on-site water usage.	This will be encouraged as one means of managing water on individual properties.
114 Development, where possible, should utilise or encourage renewable energy resources.	Renewable energy options will be encouraged with the development of individual allotments.
115 An approved housing energy rating system of 3.5 stars or better is recommended for the external shell of all dwellings.	This will be included in the building restrictions applied to the development and forms part of the Building Code of Australia requirements
116 Development should be designed, sited, and landscaped, so as not to detract from the scenic amenity and rural character of land within the district.	The rural character will remain around the site.
117 Development should exhibit a high standard of design with regard to external appearance, building materials, colours, siting and landscaping so as to preserve and enhance the character of the locality.	The character of the locality will develop gradually as the waterways and allotments are developed. The individual applications for development will be subject to separate applications to be tested against the design, character and function criteria in the Development Plan.
118 Development should be designed, sited, and landscaped, so as not to impair the amenity of the locality.	This will be included in the building restrictions applied to the development.
119 Building development should be designed, sited, and landscaped, to minimise: (a) any earthworks; (b) the visual impact when viewed from Princes Highway, Southern Ports Highway, and Kingston	This will be included in the building restrictions applied to the development.

SE to Lucindale Road; and (c) removal of native vegetation.	
120 Development should be maintained so that: (a) unsanitary conditions do not arise; (b) unsightly accumulation and disorderly storage of materials does not arise; (c) the safety of the general public is not threatened; and (d) waste products and materials are properly disposed of so that pollution does not arise.	This PDC applies to the ongoing use of land and its maintenance. It will not be desirable for any unsightly conditions to develop as these will detract from the ongoing development of the remainder of the area. The area is designed to create a safe environment for existing fishers, residents and tourists as an enhancement of the existing arrangements.
121 The materials, textures and colours used in buildings and structures should harmonise with the rural environment. Second-hand or reused materials should not be used unless such materials are of good quality, the building is painted in a neutral shade and maintained in good repair and condition.	This will be included in the building restrictions applied to the development.
122 Development should not: (a) be finished in bright colours; or (b) incorporate reflective external surfaces.	This will be included in the building restrictions applied to the development.
123 External walls and fences should be clad in materials that do not impair visual amenity.	This will be included in the building restrictions applied to the development.
124 Domestic outbuildings should not: (a) be of a size or in a location which results in their visual dominance of the dwelling to which they relate, to neighbouring dwellings or to the locality; (b) be of a size or in a location which results in the uPolicy Not Relevanteasonable overshadowing of a main habitable window in a dwelling.	This will be included in the building restrictions applied to the development.
125 Campervans, caravans and tents should not be used for permanent accommodation (except in caravan parks and camping grounds).	This will be included in the building restrictions applied to the development.
126 Development of allotments adjacent to Princes Highway and Southern Ports Highway should: (a) incorporate a 10 metre wide landscape and mounded buffer area and fencing of non-reflective appearance along the boundary of the site continuous with the respective road boundary; (b) provide a building set-back distance of 50 metres from the respective road to any building erected on the site; and (c) not have direct access to the respective road.	The site is not adjacent to the Southern Ports Highway.
127 Buildings should be set-back a minimum distance of eight metres from all public roads with the exception of: (a) a building on a corner allotment, where the building may be sited a minimum distance of four metres from one road boundary; and (b) a building located within the District Centre Zone, shown on Maps King/18 and 21 where the building may be sited on an allotment boundary so	The concept plan allows for suitable setbacks to be provided.

as to conform with existing development in the locality.	
128 No building, which is elevated on posts, other than a farm building, should be erected without a timber infill, or a solid brick, stone or concrete block base upon the perimeter footings, enclosing the space between the floor of the building and the ground surface.	Design guidance will be included in the building restrictions applied to the development.
129 Intensive animal keeping should not be undertaken within three kilometres of the Fringe Zone shown on Maps King/16 to 19, 21, 22, 24 and 25, Cape Jaffa on Map King/29, and the Rural Living Zone shown on Maps King/14, 17 to 19, 21, 23, 24, 27 and 28 or a greater distance where the development will be sited down wind and in line with the dominant wind direction from the town of Kingston SE and Cape Jaffa or the Rural Living Zone.	No intensive animal keeping is proposed.
130 The location of an intensive animal keeping unit should be chosen, and its site characteristics used, to minimise any adverse impact it may have on the local community and the environment.	No intensive animal keeping is proposed.
131 Waste waters and other wastes from animal keeping should be managed properly in accordance with environmental or health requirements and for the control of water pollution.	No intensive animal keeping is proposed.
132 All buildings, pens, runs, holding yards and other auxiliary structures should be sited as unobtrusively as possible, particularly where they may be seen from arterial roads or scenic routes.	No intensive animal keeping is proposed..
133 The keeping of horses should only be undertaken where the location and site characteristics are such as not to create any significant adverse impacts on the local community and the environment.	No horse keeping is proposed..
134 All animals kept for intensive purposes should be confined adequately.	No intensive animal keeping is proposed.
135 Horse keeping should not be located within, or in areas adjoining townships or developed areas, or areas in which residential development is planned, other than in specifically designated zones.	No horse keeping is proposed.
136 Horse keeping should be provided with secure fencing of a design and construction which does not detract from the appearance of the locality, second-hand or reused cladding should be of good quality and painted a neutral shade of colour.	No horse keeping is proposed
137 Horse keeping activities should not cause any significant nuisance, hazard or damage to nearby residents or property by way of: (a) the disposal of water and waste products; (b) any risk to health and well-being of the community;	No horse keeping is proposed.
(c) the generation of noise, dust, smell, effluent	

and other similar obnoxious conditions; (d) destruction of surface vegetation and soils; or (e) inadequate security precautions being taken to prevent straying of animals from the land.	
138 Horse keeping should not be located on flood prone land.	No horse keeping is proposed.
139 All holding yards and other auxiliary structures should be sited so that: (a) they are isolated from, and will not cause a nuisance to, nearby residents; and (b) they are unobtrusive when viewed from primary, secondary, district or scenic roads.	No horse keeping is proposed.
140 Horse keeping shall only be established on allotments where the density of horses is no greater than one horse per three hectares.	No horse keeping is proposed.
141 The keeping of horses and other animals, other than domestic pets, should be undertaken only where: (a) if the size of the allotment to be used is less than two hectares, it does not contain a dwelling; (b) fences are provided to prevent animals causing damage to neighbouring land and vegetation; and (c) there is a distance of at least 20 metres between any dwelling and the allotment where the animals are to be kept.	No horse keeping is proposed.
142 Development, including flood, erosion and wave protection measures, should not adversely affect the ecology of coastal areas, the seabed or coastal waters by pollution, significant loss of habitat, interference with coastal processes or any other means.	The proposal has been designed to take into account all aspects of the coastal processes and environment and is to be managed in accordance with an adaptive management plan.
143 Development should not be located in delicate or environmentally sensitive coastal features such as sand dunes, wetlands or important remnants of native vegetation.	The development avoids the significant vegetated areas and is located in a less sensitive part of the coastline.
144 Development should not, nor be likely in the future to, adversely affect the ecology and stability of environmentally sensitive coastal features.	The adaptive management plan will ensure there are no adverse effects on the coastal ecology.
145 Development should not be undertaken where it will create or aggravate coastal erosion, or where it will require coast protection works which cause or aggravate coastal erosion.	The Adaptive Management Plan has been designed to maintain sand transportation along the coast at its natural level.
146 Land should only be divided in such a way that: (a) it or the subsequent development and use of the land will not adversely affect the management of the land, adjoining land or the coast; (b) sand dunes, wetlands and remnant vegetation are maintained in single parcels;	The division is designed as part of an overall management regime to provide protection to the coast and the vegetation. The concept provides for a separation between the vegetation to be protected and the allotments.
(c) the number of allotments abutting directly onto the coast or onto a reserve for conservation purposes is minimised; and	

(d) outside of urban, tourist-accommodation and rural living zones it will not result in allotments with frontages to the coast or coastal reserve shorter than the depth of the allotment (or less than the square root of the area for irregular shaped allotments).	
147 Development should be designed for solid or fluid wastes and stormwater run-off to be disposed of so that it will not cause pollution or other detrimental impacts on the marine and on-shore environment of coastal areas.	Stormwater and waste water systems are an integral part of the proposal.
148 Effluent disposal systems incorporating soakage trenches or a similar system should be located not less than 100 metres or greater where it is necessary to avoid effluent migration onto the inter-tidal zone, the 100 metres to be measured from: (a) the mean high water mark at spring tide adjusted for any subsidence for the first 50 years of development plus a sea level rise of one metre; or (b) the nearest boundary of any erosion buffer determined in accordance with principle of development control numbered 174, whichever is the greater. Except where SA Health Commission standards can be met by a lesser setback.	The proposal incorporates a fully reticulated sewer scheme.
149 Development should preserve natural drainage systems and should not significantly increase or decrease the volume of water flowing to the sea. Where necessary it should incorporate stormwater management schemes including: (a) onsite harvesting of water and land based disposal systems; (b) retention basins to facilitate settlement of pollutants and to regulate water flow; and (c) infiltration.	There are no natural drainage systems apart from direct infiltration present on the land.
150 Development should not cause deleterious effects on the quality or hydrology of groundwater.	Already addresses above-cut and paste rob
151 Development proposed to include or create confined, coastal waters (whether partially or wholly), including water subject to the ebb and flow of the tide, should ensure the quality of such waters is maintained at an acceptable level.	Water quality will be maintained through the natural flushing of the waterways as detailed in Section 5.2.22.
152 Development should not preclude the natural geomorphological and ecological adjustment to changing climate, sea level or other conditions. For example landward migration of coastal wetlands should not be prevented by embankments. Development should be designed to allow for new areas to be colonised by mangroves and wetland species and for removal of existing embankments where practical.	This area is subject to a general trend of accretion.
153 Marine aquaculture should be located, sited, designed, constructed and managed to be ecologically sustainable, to minimise interference and obstruction to the natural processes of the	There is no marine aquaculture development as part of this proposal.

marine environment, and to allow maintenance of the environmental quality of the foreshore, coastline, ocean and ocean bed. Marine aquaculture should be developed and undertaken: (a) in areas which will not contaminate the product for human consumption; (b) at a suitable distance from pollution sources including country townships, urban and residential areas, established shack areas, industrial development, stormwater or other drainage outlets, sewage treatment facilities and outfall; (c) at a sufficient height above the sea floor and in a manner to minimise seabed damage, and in areas with adequate water current to disperse sediments to prevent the build up of waste (except where waste can be removed); (d) to avoid damage to sensitive ecological areas, creeks, estuaries, wetlands and significant seagrass and mangrove communities; (e) to avoid the risk of pollution to and from external sources including any accidental discharge of pollutants; (f) to ensure satisfactory removal and disposal of litter, disused material, shells, debris, detritus, faecal matter, and dead animals from the farm to prevent fouling of waters, publicly owned wetlands, or the nearby coastline; (g) so as not to involve the discharge of human waste on the site, or any adjacent land, or into nearby waters (if required, sanitary facilities should be provided); (h) to avoid adverse impacts to wildlife (marine and terrestrial, plants and animals), and on breeding grounds and habitats of native marine mammals and terrestrial fauna, especially migratory species; (i) to minimise harm or destruction of marine predators such as seals, dolphins and birds; (j) to facilitate relocation or removal of structures in the case of emergency such as oil spills, algal blooms and altered water flows; (k) at a suitable distance from any tidal creek to ensure that adverse impacts are minimised; (l) of a sufficient standard of construction to ensure that structures can withstand normal marine conditions.	
154 Development should not degrade the character or nature of buildings or sites of cultural heritage, scientific or visual significance, nor interfere with or damage any Aboriginal site or object.	Investigations have been undertaken in consultation with the Kungari Inc representing the indigenous community in the district. As a consequence of these investigations, the past use of the land by indigenous people was identified. The recommendations from the investigations and the desired outcome includes the collection of items and their interpretation together with a presentation of the life and culture of these people in the area. Further, it is considered appropriate that this presentation be a

	collaborative venture to present the indigenous and European history relevant to the area and Cape Jaffa in particular. In this way the wider community will benefit from a better understanding of the culture, history and associations with the land in the area. There are no other relevant items or sites of historical or cultural significance immediately affected on the land or in the water.
155 Development which is proposed to be located outside of urban and tourist zones should be sited and designed to not adversely affect: (a) the natural, rural or heritage character of the area; (b) areas of high visual or scenic value; (c) views from the coast, near-shore waters, public reserves, tourist routes and walking trails; or (d) the amenity of public beaches by intruding into undeveloped areas.	The development is proposed in a location which is strongly encouraged as a growth area to accommodate and enable the sustainability of the fishing aquaculture and tourist industries A significant part of the area is already zoned for development and there is no area on the land of high scenic amenity.
156 Development within urban and tourist accommodation zones should be designed and sited in sympathy with the existing natural and built character of its locality. It should not be out of scale, of conflicting colour or materials or detract from any natural backdrop to the zone, nor project above the skyline visible from the coast.	The arrangement of the various activities will ensure an appropriate relationship between uses.
157 Marine aquaculture and other offshore development should: (a) minimise adverse impacts on the visual amenity or natural character of the coast and foreshore, particularly in areas of outstanding beauty or areas of high public use; (b) avoid adverse impacts on: (i) National Parks, Conservation Parks and Conservation Reserves; (ii) Marine Parks and Reserves; (iii) Recreation Reserves; (iv) Indigenous, Non-Indigenous and natural heritage sites including shipwrecks;* (v) sites of scientific importance including geological monuments and habitats of rare species; (vi) mineral reserves; (vii) areas valued for their outstanding beauty or amenity.	There is no marine aquaculture development as part of this proposal.
158 Marine aquaculture and other offshore development should be located at least: (a) 550 metres from a proclaimed shipwreck; (b) 1,000 metres seaward from the boundary of any reserve under the National Parks and Wildlife Act, unless a lesser distance is agreed with the Minister responsible for that Act.	There is no marine aquaculture development as part of this proposal.
159 Racks, floats and other farm structures	There is no marine aquaculture development as part of

associated with marine aquaculture or other offshore development should be as visually unobtrusive as possible, apart from those required by the relevant authority for navigational safety. Development should: (a) blend visually with the environment and have a low profile;	this proposal.
(b) be constructed of non reflective materials; (c) use uniform, subdued colours throughout a development, suited and in keeping with the local surrounding features; (d) use feed hoppers which are painted in subdued colours, and suspended as low as possible above the water; (e) design and locate structures in relation to surrounding features; (f) position structures to protrude the minimum distance practicable above water; and (g) not jeopardise the attainment of visual amenity provisions by incorporating unnecessary shelters and structures above cages and platforms.	
160 Development adjacent to the coast should not be undertaken unless it has or incorporates the provision of a public reserve, not including a road or erosion buffer of at least 50 metres width between such development and the toe of the primary dune or the top edge of the escarpment, unless the development relates to small-scale infill development in a predominantly urban zone.	Refer PDC above
161 Development which abuts or includes a coastal reserve for scenic, conservation or recreational purposes should be located and designed in such a way as to have regard to the purpose, management and amenity of the reserve and to prevent illegal incorporation of reserve land into private land.	Private land is to be transferred to community ownership for the establishment of a reserve and the rehabilitation and protection of the vegetated fore dune.
162 Development, including marinas, should be located and designed to allow public access along the waterfront, to beaches, and to coastal reserves, except where public safety reasons preclude.	Public access will be enhanced in several ways by this proposal. A new access way to the beach is proposed at the western end to create a controlled and defined entry onto the beach for vehicles. West of this area the safe pedestrian movement along the beach will be enhanced by limiting vehicle access to service and emergency vehicles only. Defined pedestrian paths are also to be created through the vegetated dunes. In this way indiscriminate access through the dunes will be better controlled. There are also areas where public carparking will be provided to improve accessibility to the beach for those otherwise unable to access the beach. The breakwaters also provide added opportunities for the public to view the coast and the Bay.
163 Access to beaches and reserves should be, by means of walkways and roads suitably designed and constructed to meet the environmental objectives and principles of development control for coastal areas.	The walkways and access roads will be designed and constructed in accordance with the coastal areas policy and in particular will create safe and defined pedestrian areas
164 Access roads to the coast and lookouts should	The design ensures that the access routes to the coast

preferably be spur roads. Tourist routes may be loop roads but should be located back from the coast and only where the road will not detract from the amenity of the area or lead to management problems.	are not on through roads.
165 Marine aquaculture and other offshore development should: (a) be located to minimise adverse impacts on public access to beaches, public watercourses, or the foreshore; (b) be located to take into account the requirements of traditional fishing grounds; (c) in ocean waters be located a minimum of 100 metres seaward of high water mark;	The design of the waterways and entry channel are such as to accommodate aquaculture industry activities such as the movement of fish rings and the like without intruding into or reducing public access to the coast or beach areas.
(d) be located not to obstruct nor interfere with navigation channels, access channels, frequently used natural launching sites, safe anchorage areas, known diving areas, commercial shipping movement patterns or activities associated with existing jetties and wharves; (e) be developed to maintain existing rights of way within or adjacent to a site; and (f) where possible use existing and established roads, tracks, ramps and paths to or from the sea.	
166 Marine aquaculture access, launching and maintenance facilities wherever possible should be developed cooperatively, and co-located to serve the needs of the industry and community as a whole, and where necessary may be located on the foreshore.	The proposal makes provision for aquaculture in a cooperative manner with the shared use of facilities.
167 Development should not occur on land where the risk of flooding is unacceptable having regard to personal and public safety and to property damage.	No part of the development will be at risk of flooding.
168 For the purposes of assessing coastal developments the standard sea-flood risk level for a development site is defined as the 100-year average return interval extreme sea level (tide, stormwater and associated wave effects combined), plus an allowance for land subsidence for 50 years at that site.	Repeat of above stuff
169 Land should not be divided for commercial, industrial or residential purposes unless a layout can be achieved whereby roads, parking areas and adequate development sites on each allotment are at least 0.3 metres above the standard sea-flood risk level, unless the land is or can be protected in accordance with principle of development control numbered 172.	All land can be developed to meet the sea level and flooding risk criteria Will be covered under the agreements
170 Commercial, industrial or residential development should only be undertaken where: (a) building floor-levels are at least 0.25 metres above the minimum site level of principle of development control numbered 166 (ie: 0.55 metres above the standard sea-flood risk level), unless the development is or can be protected in	Building levels will be set a minimum 0.25 m above the sea-flood risk level.

accordance with principle of development control numbered 172; and (b) there are practical measures in accordance with principle of development control numbered 172 available to the developer, or subsequent owners, to protect the development against a further sea level rise of 0.7 metres above the minimum site level determined by principle of development control numbered 169.	
171 Buildings to be located over tidal water or which are not capable of being raised or protected by flood protection measures in future, should have a floor level of at least 1.25 metres above the standard sea-flood risk level.	No buildings are proposed over tidal water.
172 Development which requires protection measures against coastal erosion, sea or stormwater flooding, sand drift or the management of other coastal processes at the time of development, or which may require protection or management measures in the future, should only be undertaken if: (a) the measures themselves will not have an adverse effect on coastal ecology, processes, conservation, public access and amenity; (b) the measures do not now, or in the future require community resources, including land; (c) the risk of failure of measures such as sand management, levee banks, flood gates, valves or stormwater pumping, is appropriate to the degree of the potential impact of a failure; and (d) adequate financial guarantees are in place to cover future construction, operation, maintenance and management of the protection measures.	Repeat from above
173 Development should be set-back a sufficient distance from the coast to provide an erosion buffer which will allow for at least 100 years of coastal retreat for single buildings or small-scale developments, or 200 years of retreat for large scale developments such as new towns, unless: (a) the development incorporates private coastal works to protect the development and public reserve from the anticipated erosion, and the private coastal works comply with principle of development control numbered 172; or (b) the Council is committed to protecting the public reserve and development from the anticipated coastal erosion.	Repeat from above
174 Where a coastal reserve exists, or is to be provided in accordance with principle of development control numbered 160, it should be increased in width by the amount of buffer required.	Repeat from above
175 The width of an erosion buffer should be	Repeat from above Repeat from above

based on: (a) the susceptibility of the coast to erosion; (b) local coastal processes; (c) the effect of severe storm events; (d) the effect of a 0.3 metres rise in sea level over the next 50 years on coastal processes and storms; and (e) the availability of practical measures to protect the development from erosion caused by a further sea level rise of 0.7 metres per 50 years thereafter.	
176 Where there is inadequate area to provide the necessary erosion buffer to development on land at risk from long-term coastal erosion (for example small-scale infill development including land division), such development should not occur unless: (a) the Council has committed itself to erosion protection measures which may be necessary along this section of the coast; or (b) a legally binding agreement is included on the freehold certificate(s) of title(s) that protection measures will not be built and that any building will be transportable and will be removed when threatened by erosion or storm surge flooding; or (c) a legally binding agreement is included on the freehold certificate(s) of title(s) that protection measures that comply with principle of development control numbered 172 for coastal development will be built by the land owner(s) when required.	Repeat from repeat of repeat of repeat of above
177 Development should not occur where essential services cannot be economically provided and maintained having regard to flood risk and sea level rise or where emergency vehicle access would be prevented by a 100-year average return interval extreme sea level event, adjusted for 100 years of sea level rise.	Service infrastructure and emergency access can be economically provided throughout the development and will be installed by the proponent. Arrangements around the site and the road levels will provide continuity of access.
178 Marine aquaculture development should minimise its impact on navigational safety and: (a) be suitably marked for navigational purposes; (b) be sited to allow an adequate distance between farms for safe navigation; (c) be located at least 250 metres from a commercial shipping lane; (d) comprise structures secured and/or weighted to prevent drifting; (e) ensure that structures and materials used are maintained to prevent hazards to people and wildlife; and (f) provide for rehabilitation of sites no longer operational.	There is no marine aquaculture development as part of this proposal.
179 Development outside of urban zones should not take place if there is the potential for significant conflict with likely development which benefits the	The proposal is one which comprehensively reviews the relationship of functional areas and creates an arrangement that provides for these uses together with

wider community based on any of the special economic or physical resources of coastal areas such as: Aquaculture Sites Boat Ramps Harbour and Jetty Sites Marina Sites Mineral Deposits of State or National importance Tourist Attractions	their support infrastructure in a manner which segregates activities, minimises potential for conflict and creates good access to all users.
180 Development should be sited, designed and managed so as not to conflict with or jeopardise the continuance of an existing aquaculture development.	The proposal will provide the opportunity to advance not hinder aquaculture development.
181 Marine aquaculture development should: (a) be carried out in a manner which ensures a fair and equitable sharing of marine and coastal resources and minimises conflict between legitimate users of the marine resource, both commercial and recreational; (b) not significantly obstruct or adversely affect: (i) areas of high public use; (ii) areas established for recreational activities; (iii) areas of outstanding visual, environmental, commercial or tourism value; and (iv) sites used for recreational activities such as swimming, fishing, skiing and sailing and other water sports, including beaches.	There is no marine aquaculture development as part of this proposal.
182 Urban development including holiday house settlements and tourist developments, marinas, rural living, country living and other development of a non-commercial farming nature, including land division for all such development, should only be undertaken in zones designated for such development.	Portion of the proposal is not on land zoned for urban development. The Minister determined the project as a Major development for reasons including the complex mix of zones and the range of activities proposed. Therefore it is intended that once approved, a Plan Amendment Report will be prepared to reflect the approved proposal.
183 Tourist development outside of zones designated for such development should be confined to small-scale, short-stay accommodation within or adjacent to an existing inhabited farmhouse and operated as a minor adjunct to normal commercial farming.	It is proposed to undertake a review of the zones to represent the proposal in its approved form.
184 Outside of urban and tourist accommodation zones no more than one dwelling should be constructed on an allotment.	It is proposed to undertake a review of the zones to represent the proposal in its approved form.
185 The coastline and its visual amenity should not be significantly impaired by the onshore development of marine aquaculture storage, cooling and processing facilities. Where possible these facilities should be: (a) located, sited, designed, landscaped and developed at a scale and using external materials to minimise any adverse visual impact on the coastal landscape;	The area set aside for marine commercial and industrial purposes will replace some of the activities being undertaken on the beach and the open carpark area behind the beach. The porposed area will be readily accessible from Cape Jaffa Road but will not be readily visible and will be some considerable distance from the coast. Further, the area will form part of the amended zoning arrangements and the management of wastes will be a significant improvement on practices which are limited by the lack of facilities.

(b) established in areas appropriately zoned and with appropriate vehicular access arrangements; and (c) developed to ensure that wastes are disposed of in a complete and effective system which is legally approved.	
186 Development, including land division, urban, holiday settlement, tourist development and other urban type developments should be: (a) compact not linear development; (b) contiguous with any existing built-up areas; (c) developed in a staged and orderly manner which facilitates the economic provision of services and infrastructure; and (d) particularly not occurring without provision of an adequate reticulated domestic quality mains water supply and a septic tank effluent drainage scheme.	The proposal is a comprehensive integrated development that extends the existing settlement in an easterly direction as there are practical environmental limitations to the west and the part of the beach and coast to be developed is the most acceptable part of the coast to accommodate the activities already operating from the locality. The development is not linear but rather it encapsulates or surrounds the waterway which is located in the most orderly and logical location. The proposal is contiguous with the existing settlement and ensures an appropriate integration with the existing uses. The development will be staged and will be developed in accordance with the market demands. Services will be developed commensurate with demand and the existing community will benefit from the ability to connect to these services.
187 Existing development which is contrary to the objectives for coastal areas should not be redeveloped unless the redevelopment significantly rectifies the unsatisfactory aspects.	The proposal fits with the needs for this port and the industries that have developed this locality. A number of key improvements will result from this development including the safety and operating viability of the users.
188 Telecommunications facilities should: (a) be located and designed to meet the communication needs of the community; (b) utilise materials and finishes that minimise visual impact; (c) have antennae located as close as practical to the support structure; (d) primarily be located in industrial, commercial, business, office, centre, and rural zones; (e) incorporate landscaping to screen the development, in particular equipment shelters and huts; and (f) be designed and sited to minimise the visual impact on the character and amenity of the local environment, in particular visually prominent areas, main focal points or significant vistas.	POLICY NOT RELEVANT.
189 Where technically feasible, co-location of telecommunications facilities should primarily occur in industrial, commercial, business, office, centre and rural zones.	POLICY NOT RELEVANT.
190 Telecommunications facilities in areas of high visitation and community use should utilise, where	POLICY NOT RELEVANT.

possible, innovative design techniques, such as sculpture and art, where the facilities would contribute to the character of the area.	
191 Telecommunications facilities should only be located in residential zones if sited and designed so as to minimise visual impact by: (a) utilising screening by existing buildings and vegetation; (b) where possible being incorporated into, and designed to suit the characteristics of an existing structure that may serve another purpose; and (c) taking into account existing size, scale, context and characteristics of existing structures, land forms and vegetation so as to complement the local environment.	POLICY NOT RELEVANT.
192 Telecommunications facilities should not detrimentally affect the character or amenity of Historic Conservation Zones or Policy Areas, Local Heritage Places, State Heritage Places, or State Heritage Areas.	POLICY NOT RELEVANT.
193 Renewable energy facilities, including wind farms, should be located, sited, designed and operated in a manner which avoids or minimises adverse impacts and maximises positive impacts on the environment, local community and the State.	Dealt with above but is not POLICY NOT RELEVANT.
194 Renewable energy facilities, including wind farms, and ancillary developments should be located in areas that maximise efficient generation and supply of electricity.	As 193 POLICY NOT RELEVANT.
195 Renewable energy facilities, including wind farms, and ancillary development such as substations, maintenance sheds, access roads and connecting power-lines (including to the National Electricity Grid) should be located, sited, designed and operated in a manner which: (a) avoids or minimises detracting from the character, landscape quality, visual significance or amenity of the area; (b) utilises elements of the landscape, materials and finishes to minimise visual impact; (c) avoids or minimises adverse impact on areas of native vegetation, conservation, environmental, geological, tourism or built or natural heritage significance; (d) does not impact on the safety of water or air transport and the operation of ports, airfields and designated landing strips; (e) avoids or minimises nuisance or hazard to nearby property owners/occupiers, road users and wildlife by way of: (i) shadowing, flickering, reflection and blade glint impacts;	As 193 POLICY NOT RELEVANT.

(ii) noise; (iii) interference to television and radio signals; (iv) modification to vegetation, soils and habitats; and (v) bird and bat strike.	

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.

Therefore:

- 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 Project 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 Project 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.

Yours sincerely
MASTERPLAN SA PTY LTD

SP TONKIN

APPENDIX 23

Assessment of Cape Jaffa Confined Aquifer Well, Water Search Pty Ltd, May 2004

WATER SEARCH PTY. LTD.
GROUNDWATER AND GEOLOGICAL CONSULTANTS
A.C.N. 088 673 518

Postal Address: *Box 191, Angaston, South Australia 5353*
Telephone/Facsimile: *(08) 8564 2362*
International: *+618 8564 2362*
Mobile: *0417 800 482*

Mr. Glen Passfield
Tonkin Consulting
5 Cooke Tce
Wayville 5034

20 May 2004

Dear Sir,

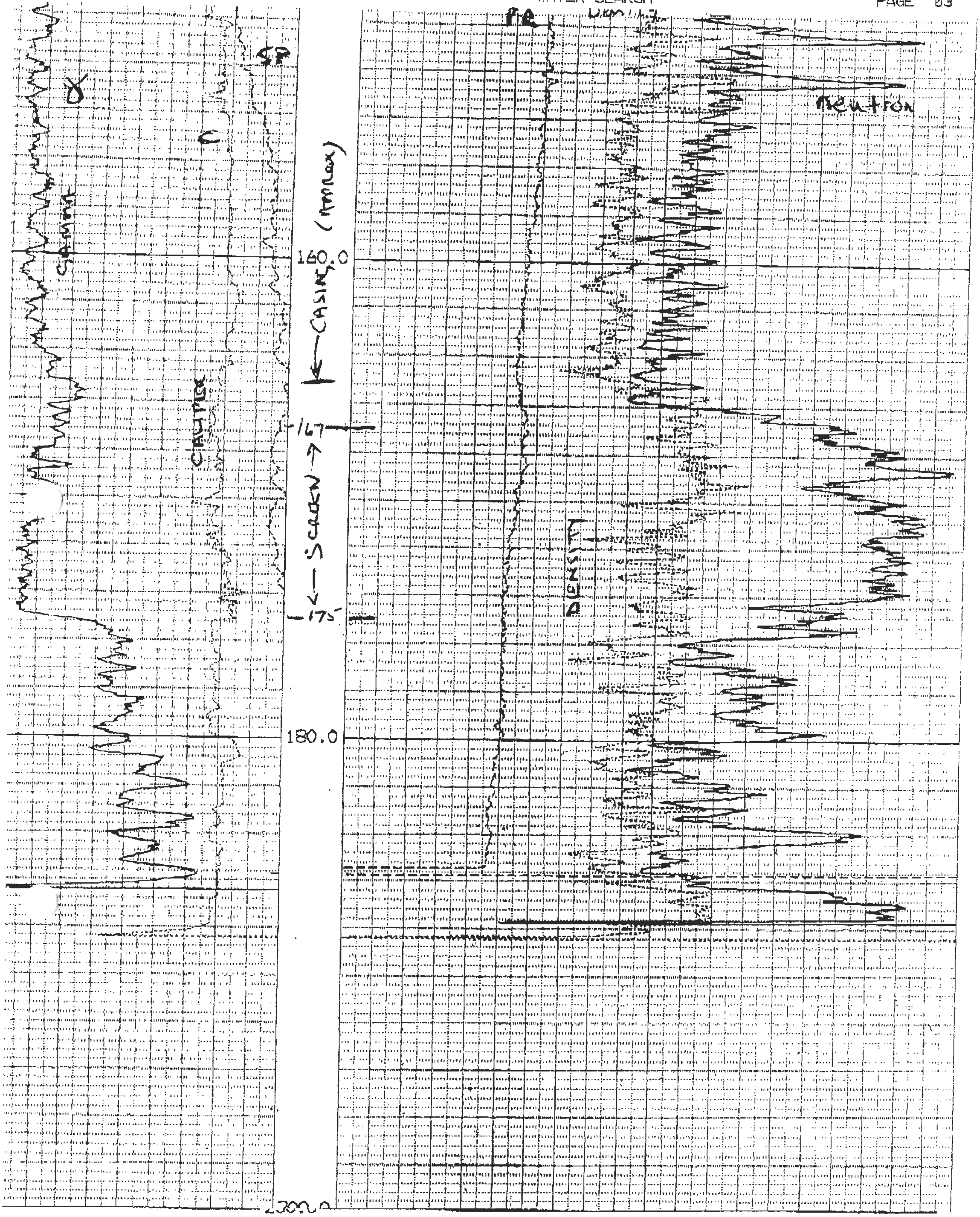
Cape Jaffa Confined Aquifer Well

We visited the drilling site on the 14th May 2004 to log the drill cuttings and to interpret the geophysical logging to determine the final well construction details.
A copy of our descriptive log and a copy of the lower portion of the geophysical logs are enclosed.
Drilling ceased at a depth of 188 metres when the drill cuttings indicated the hole had penetrated around 20 metres of a coarse sand/gravel aquifer. However the geophysical logs (gamma) revealed that below 175 metres the clay content increased such that from that depth to 188 metres the in-situ material is a series of clay and sandy clay layers.
It is probable that the clays dispersed into the drilling fluid hence not being seen in the collected drill cuttings.
The drill samples and geophysical logs (neutron) show a slightly clayey sand/gravel aquifer from 166 - 175 metres hence we recommend setting the sand screen from 167 - 175 metres. Inspection of the samples indicate that a 1.5 mm slot width will be suitable. A 1 metre blank on the bottom of the screen would allow settling of any fines that may enter the well after development. Two hundred mm FRP casing should be run to around 164 - 165 metres and pressure cemented. Screen development should be by high velocity water jetting and sufficient time should be allowed to perform this because of the slightly clayey nature of the aquifer.
The well will need to be capped as it will flow and we suggest tapping a pressure guage into the casing to determine the shut in pressure.
Whilst the aquifer is slightly clayey it is otherwise a medium- coarse grained aquifer of a thickness of around 10m which from experience suggests a potential well yield of around 30-40 L/sec assuming proper well construction and adequate screen development. Controlled well testing only will determine its yield-drawdown relationship and hence safe yield.
If you have any questions on the above please feel free to contact us at any time.
Yours faithfully

Michael Cobb
Principal Geologist

DRILL CUTTINGS LOG
WELL PERMIT 64322
CAPE JAFFA MARINA

Depth(m)	Description
0-2	**Lime Sand**
2-4	**Lime Sand** with whole shells (bivalves)
4-6	**Shell Bed** (bivalves)
6-10	**Limestone** medium grained, yellow. Green clay bands below 8m
10-12	**Marl** pale grey
12-22	**Limestone** off-white, bryozoal
22-36	**Limestone** pale grey/off-white, marly
36-38	**Limestone** medium-coarse grained, bryozoal, angular flint fragments
38-42	**Limestone** off-white, marly
42-46	**Limestone** medium-coarse grained, flint fragments
46-54	**Marly Limestone** pale grey, bryozoal
54-58	**Limestone** coarse grained, significant flint fragments
58-66	**Marly Limestone** off-white/pale grey, angular flint fragments
66-68	**Limestone** glauconitic (green), flint fragments
68-70	**Marly Limestone**
70-84	**Bryozoal Limestone** coarse grained, glauconitic at top
84-92	**Bryozoal Limestone** marly
92-94	**Bryozoal Limestone** coarse grained, medium grey
94-96	**Bryozoal Limestone** with hard fine grained limestone bands/nodules
96-144	**Bryozoal Limestone** medium-coarse grained, medium grey
144-150	**Clay** brown-black
150-156	**Bryozoal Limestone** with dark clay interbeds
156-160	**Clay(Marl)** medium-dark grey
160-166	**Marl** bryozoal, flinty, medium-dark grey
166-188	**Sand/Gravel** dark brown,bryozoal, glauconitic, quartz angular to rounded average grain size 2-4mm, slightly clayey. Odd shark tooth.Lignitic bands. Geophysical logs indicate alternating sand/clay bands below 175m


γ
SP
GAMMA
CALIPER
Pe
Neutron
DENSITY
CASING (APPROX)
160.0
167
SCREEN
175
180.0

APPENDIX 24

Cape Jaffa Anchorage Development EIS Economic Issues Report, Hudson Howells, April 2004

Kingston District Council Cape Jaffa Anchorage Development Section 48 Prudential Report, Hudson Howells, October 2003

Hudson Howells

Cape Jaffa Anchorage Development

EIS – Economic Issues Report

April 2004

TABLE OF CONTENTS **Page**

1.0 Introduction and Report Objectives

1.1 Introduction

Hudson Howells has been engaged by the Cape Jaffa Development Company (CJDC) to prepare a report on Economic Issues to satisfy the requirements of the Guidelines for the preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Development. The purpose of this report is to address the specific economic requirements of the Guidelines issued by the Minister for Urban Development and Planning under the Development Act 1993 whereby the development has been declared a *Major Development* under the Act.

1.2 Environmental Impact Statement Requirements

Due to the myriad of issues identified that need to be addressed as part of the development concept, an application was forwarded to the Minister for Urban Development and Planning seeking determination of the Cape Jaffa Anchorage Development as a Major Project in accordance with the provisions of Section 46-48 of the Development Act. The application to seek major project status was on the basis of the issues of significant environmental, social and economic importance. These issues have implications for the existing residents of Cape Jaffa, the service town of Kingston, Council, State Government, business interest, as well as service infrastructure authorities.

As a result of the application forwarded to the Minister, on 19 December 2002 the Minister formally declared the development proposal as a major project in accordance with section 46 (1) of the Development Act 1993, as the Minister was of the opinion that a declaration under that section is appropriate for the proper assessment of the Cape Jaffa Anchorage Development due to major environmental, social and economic importance.

As a major project, the development therefore required the preparation of an Environmental Impact Statement (EIS) based on guidelines determined by the Minister.

This report addresses the Economic Issues in the Guidelines for the Environmental Impact Statement which are:

1. Outline the opportunity for tourism and investment in the area from the development.

2. Identify employment and investment opportunities, including the “multiplier effect”.

3. Outline the potential for the development to attract and enhance the business operations of other allied industries and commercial ventures.

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.

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.

6. Describe the opportunities for the aquaculture and fishing industries and their support services.

7. Outline the financial strategies to be employed to ensure the relevant infrastructure is in place for each stage in the project.

8. Describe the land tenure arrangements during and after construction of each stage.

9. Describe compensation or amelioration measures for any loss of groundwater resources for users.

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.

11. Identify the economic implications for the rock lobster industry from increased groundwater flows and run-off out to sea.

12. Identify the economic implications for groundwater users from groundwater drawdown or contamination, particularly primary producers.

13. Identify the economic effect the workforce would have locally and regionally.

14. Identify any potential impact on tourism or investment due to the changed nature of Cape Jaffa.

2.0 EIS Economic Issues

2.1 Introduction

Support for economic and industry development within the region is a major objective of the Kingston District Council and is recognised in Council's strategic management plans. This support is evidenced by the establishment of the committee to investigate development at Cape Jaffa for the creation of facilities to support the fishing industry, the aquaculture industry and to develop facilities for recreational boating.

This section of the report addresses the specific economic issues detailed in the EIS Guidelines[1]. *However, it is highlighted that the Cape Jaffa Anchorage Project represents a major regional project that is consistent with the State Government's Strategic Plan and Economic Development Framework. In particular, it offers an opportunity to diversify a regional economy that has traditionally been heavily reliant upon primary industries, thereby generating a new range of business and employment opportunities to offset the changing structure of the rural economy. Also consistent with the State's Strategic Plan, it provides an opportunity to increase the regional population base and contribute to the State's population strategy.*

2.2 Tourism and Investment

Outline the opportunity for tourism and investment in the area from the development.

The Cape Jaffa Anchorage Development will be a major stimulus to tourism and investment in the Cape Jaffa and broader Kingston region. Tourism assets of this nature add value to the existing attractions of the region and it is expected that the project will attract both tourists who would normally visit the Limestone Coast region and new visitors to the region. The development will offer immediate opportunities for investment in Cape Jaffa itself and it is also expected to offer investment opportunities for existing and new businesses in Kingston, the nearest service centre.

The scope of opportunities is expected to cover the needs of tourists, residents and regional industries including wine and aquaculture. The Cape Jaffa Anchorage Development will complement existing tourism, industry and residential assets and will add significantly to the region's tourism assets. The project is also timed well to coincide with a major new initiative being planned by TravelLink Australia to establish and market a range of self drive itineraries between Melbourne and Adelaide and the return journey, on behalf of participating tourism

[1] Guidelines for the Preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Marina, Major Developments Panel South Australia, June, 2003

operators. A partnership between South Australian regional marketing authorities, the Great Southern Touring Route and Great Ocean Road Tourism Authorities is proposed to promote the business. TravelLink Australia, a subsidiary of Kangaroo Island SeaLink, will manage and operate a tourism-marketing program for tourism industry products along the journey between Melbourne and Adelaide. This journey links the established tourist icon of the Great Ocean Road and products along the Great Southern Touring Route to Adelaide via South Australia's Limestone Coast, Murraylands, Adelaide Hills, Fleurieu Peninsula and Kangaroo Island regions. TravelLink will market tourism and sell touring products along this route via a trade and consumer marketing program to build the business profile of travel to the regions en-route and ultimately the business success of Kangaroo Island SeaLink Pty Ltd. Importantly, Cape Jaffa is highlighted in the company's Marketing Plan2. Initially, TravelLink will provide product development and marketing services for co-operative industry participants along the journey between the Victorian border and Adelaide, incorporating Beachport, Cape Jaffa and Robe. Within two years this is planned to extend all the way along the Great Ocean Road to Melbourne, bringing in product from the Great Southern Touring Route and the Great Ocean Road completing the Melbourne to Adelaide journey.

Discussions with the Cape Jaffa Development Company and Kingston District Council have identified the following potential tourism and other investment opportunities associated directly with the Cape Jaffa development.

Caravan Park Redevelopment – There is potential for the existing caravan park to double in size, incorporating an additional 30 cabins, 30-40 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 2 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
- Local History Centre

[2] Southern Australia Touring Route and Great Southern Touring Route, Melbourne to Adelaide 2003 – 2006, TravelLink Australia, April 2003

It is estimated that such a facility would require an initial investment of $400,000 and could employ up to 3 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 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 2 FTE persons.

Housing Construction – With the demand for additional workers during the construction phase of the project, there is expected to be a shortage of accommodation which may stimulate housing construction in the Kingston region. Estimated investment is up to $3 million.

Aquaculture Industry Development – The regional aquaculture industry is expected to receive a significant boost from the Cape Jaffa development. This industry and associated opportunities is addressed in detail in Section 2.7 below.

The above tourism and investment opportunities are incorporated into economic impact assessments contained in this report.

2.3 Employment and Investment Opportunities

Identify employment and investment opportunities, including the "multiplier effect"

This section of the report details the employment and investment opportunities associated with the Cape Jaffa Anchorage Project including 'multiplier' impacts as measured by employment and value added (salaries, wages and profits). These impacts cover all aspects of the project including both the construction and operational phases. All economic impacts are taken into consideration including 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 Statewide impacts of the project. They recognise that there will be 'leakage' of expenditure associated with the project to other regions (Adelaide, South East and possibly Western Victoria) and that the economic impacts reach further than the immediate region. Later sections of this report estimate the extent of labour leakage to other regions.

2.3.1 Project Contribution to Economic Development

The Cape Jaffa Anchorage Development has the potential to provide a major economic stimulus to the Kingston region as a residential, tourism and commercial project for residents and tourists. This section of the report provides estimates of the economic impact that the project could have on the regional economy over the lifetime of the project including both the Development and Operational Phases of the project. The Operational Phase incorporates the Tourism and Investment Opportunities identified in previous sections.

A Microsoft Excel model has been developed to assess the economic impacts and an Input – Output methodology has been employed to model the impact of the development on the regional economy. 1995/96 Input - Output Tables for the South East Region of South Australia (developed by the South Australian Centre for Economic Studies) have been sourced as a methodology for assessing the economic impacts.

This economic impact assessment has been undertaken to identify the potential jobs and incomes that may be associated with the Cape Jaffa Anchorage Development. Job and income creation are critical elements of the social agenda for economic regions. Economic and social development are intertwined and there is a very strong correlation between economic growth and social indicators (eg: unemployment and crime rates). An accepted methodology for measuring economic outcomes, one that is used nationally and internationally, is to measure the value added and employment associated with investment or turnover outcomes. *Value added* is defined as the extent to which the local economy adds value to the product supplied, and essentially is the returns to labour and capital in the region for that activity – it represents the incomes to labour and capital. It is consistent with the predominant national measure of economic activity of Gross Domestic Product.

This value added and employment impact can be measured at two levels. Firstly there is the direct impact – the value added and employment contribution or share associated directly with the expenditure (eg the labour and profits involved in construction activity). Secondly there is the indirect impact – for example that associated with the suppliers to the construction service and the spend of wages. The following construction multipliers have been obtained from the Input – Output tables for the South East Region

Table 1
South East Region Construction Sector Multipliers[3]
($1995/96)

Employment ($'000)	**0.027**
Value Added ($m)	**1.5251**

The above multipliers mean that $1 million of construction output (in 1995/96) would have resulted in the employment of 27 persons (directly and through the multiplier effects). The value added (salaries, wages and profits) associated with this activity is $1,525,100.

The following sections of this report estimate the employment and value added impacts of the Cape Jaffa Anchorage Project on the region, based on the above multipliers. The following additional notes and assumptions are made:

- Value added is defined as returns to capital and labour (ie: salaries, wages and profits).
- Employment is defined as full time equivalent (FTE) employees.
- As the Input-Output tables were prepared in 1995 - 1996, they do not incorporate movements in the value of money (inflation) since that time. Without adjustment, this would result in an overestimation of the number of jobs generated per $1m of increased production. Australia's rate of inflation has fluctuated in recent years but has consistently been below 5%. A deflator of 2% p.a. is considered appropriate and is applied to new expenditures to adjust for inflation during the period 1995 - 2003.

[3] 1995/96 Input - Output Tables for the South East Region of South Australia, South Australian Centre for Economic Studies

- There may also have been structural and other changes in the regional economy during this time which are not reflected in the tables. For example, structural reform may have improved the efficiency of some industries thereby leading to shifts in the relationships between economic inputs and outputs.

- As this assessment is based on the Kingston (South East) region only, adjustments may have to be made for 'leakage' of economic activity from the region as in future people employed in the region and on the project may reside elsewhere.

- The Input-Output Tables provide multipliers across a broad range of industries. For the purposes of this assessment the construction sector's multipliers have been used as it is assumed that the majority of expenditure will go into capital works and other construction related economic activity.

2.3 2 The Development Phase

The economic contribution to be made by the project during the development phase will depend on the final nature and scale of the project. However, for the purposes of EIS and economic assessment, the assumptions in the following table are made based on advice from the Cape Jaffa Development Company.

Table 2
Development Schedule
(Source: Cape Jaffa Development Company)

Year	Major Construction Capital Expenditure (ie: Marina) ($2003)	Roll Out Capital (ie: Roads, etc.) & Maintenance Expenditure ($2003)	House Construction Numbers	Housing Construction Value ($2003)[4]
1- 2003	$542,000	$0	0	$0
2 – 2004	$9,656,842	$4,300,000	0	$0
3 – 2005	$1,773,754	$2,700,000	10	$1,750,000
4 – 2006	$28,400	$1,215,519	18	$3,150,000
5 – 2007	$3,686,837	$1,215,519	23	$4,025,000
6 – 2008	$14,200	$1,215,519	27	$4,725,000

[4] Assumes 25% of lots built on after 1 year and an average construction cost of $175,000

7 – 2009	$14,200	$1,215,519	28	$4,900,000
8 – 2010	$0	$1,215,519	29	$5,075,000
9 – 2011	$1,876,476	$1,215,519	29	$5,075,000
10 – 2012	$0	$1,215,519	30	$5,250,000
11 – 2013	$898,657	$0	31	$5,425,000
12 – 2014	$0	$0	31	$5,425,000
13 – 2015	$0	$0	31	$5,425,000
14 – 2016	$0	$0	31	$5,425,000
15 - 2017	$0	$0	31	$5,425,000
Totals	**$18,491,366**	**$15,508,634**	**349**	**$61,075,000**

Based on the above assumptions and economic multipliers, the following annual economic impacts are estimated (an inflation factor of 2% p.a. has been applied to account for inflation since 1995/96):

Table 3

Cape Jaffa Anchorage Development - Estimated Economic Impacts[5]

Year	**Broad Employment Impact (FTEs)**	**Value Added Impact ($)**
1- 2003	12	$ 827,000
2 – 2004	222	$ 21,286,000
3 – 2005	81	$ 9,492,000
4 – 2006	73	$ 6,701,000
5 – 2007	177	$ 13,615,000
6 – 2008	109	$ 9,082,000
7 – 2009	113	$ 9,348,000
8 – 2010	117	$ 9,594,000
9 – 2011	160	$ 12,455,000
10 – 2012	121	$ 9,861,000
11 – 2013	145	$ 9,644,000
12 – 2014	125	$ 8,274,000

[5] Based on 1995/96 Input - Output Tables for the South East Region of South Australia, South Australian Centre for Economic Studies

13 – 2015	125	$ 8,274,000
14 – 2016	125	$ 8,274,000
15 - 2017	125	$ 8,274,000

(Note: The above estimated employment impacts are annual and not cumulative ie: employment associated with the project is expected to peak at 222 in year 2.)

In summary, there are potentially high employment and value added (salaries, wages and profits) 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. There is a challenge to ensure that the Kingston region captures as much of this economic benefit as possible by immediately putting in place appropriate strategies that assist local companies and individuals to prepare themselves for the opportunities associated with the project that might emerge.

2.3.3 The Operational Phase

The economic contribution to be made by the Cape Jaffa Anchorage Project when operational will also depend on the nature and scale of the final development. However, it is expected that there will be the following economic outcomes over and above the development impact:

- Expenditure by new residents on local goods and services. It is expected that 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[6], 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 tourism visitor numbers, lengths of stay and expenditure in the region. Detailed visitor data is not available for the Kingston/Cape Jaffa region. However, 2002 data are available for the Limestone Coast region and are summarised below[7]:

    - 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

[6] Source: ABS 2001 Census of Population and Housing
[7] Source: Tourism SA, Limestone Coast, October 2003, www.tourism.sa.gov.au

If it is conservatively assumed 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 p.a.

- 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 p.a. by 2006. (These estimates are detailed later in this report.)

- Increased recreational boating, including expenditure of $600,000 on facilities (assumes Council and State Government funding).

- New business investment opportunities in and in proximity to the development including tourism, retail and services to tourism and other industries as previously detailed in this report and including

  - **Caravan Park Redevelopment** – Estimated direct economic impact of such a development is $1 million (development costs) with an ongoing employment impact of 2 FTE persons.

  - **Motel/Serviced Apartments** – Estimated development cost is $5 million.

  - **Multifunction Facility** – Estimated initial investment of $400,000 employing up to 3 FTE persons.

  - **Winery Value Added** – Potential investment estimated to be up to $2 million.

  - **Fishing Charters** – Estimated investment of up to $250,000 and employing 2 FTE persons.

  - **Housing Construction** – Estimated investment of up to $3 million.

The overall economic impact of the development in full operation is difficult to estimate as the nature of future tourism and other industry development is unknown. Also, longer term strategies of Council and the developers will contribute significantly to such impacts. However, as already noted, the Input-Output Tables for the 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 - 1996 tables:

Table 4 South East Region Economic Multipliers[8]		
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

Interpreting the above economic multipliers, every $1m injection from tourists, residents, etc could, for example, boost the regional economy by:

1. An additional $1,209,800 in value added (salaries, wages and profits).
2. An additional 22.7 total jobs per annum (adjusted for inflation).

The following economic impacts are therefore estimated for the operational phase of the Cape Jaffa Anchorage Development.

[8] Source: 1995/96 Input - Output Tables for the South East Region of South Australia, South Australian Centre for Economic Studies

Table 5 Estimated Operational Economic Impacts		
Item	**Employment Impact FTEs**	**Value Added Impact ($)**
New Resident Expenditure - $5.2 million p.a.	118 FTE jobs p.a.	$6.3 million p.a.
Increased Tourism Expenditure - $2.9 million p.a.	66 FTE jobs p.a.	$3.5 million p.a.
Potential Increased Aquaculture Output - $3 million p.a.	31 FTE jobs p.a.	$2.6 million p.a.
Potential Aquaculture Plant & 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	9FTEs – 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
Housing Construction - $3 million	66 FTEs – once only	$4.6 million – once only

Based on the range of assumptions and South East Region multipliers detailed above, it is estimated that the Cape Jaffa Anchorage Development 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 Impact 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 p.a.
- Ongoing Value Added From New Residents, Tourists and Increased Industry Output - $12.4 million p.a. (salaries, wages and profits).

These benefits demonstrate the significant economic impact that the Cape Jaffa Anchorage Project is expected to have on the region and support the assumptions made earlier in this report regarding new investment and employment opportunities associated with the project.

2.4 Attraction of Business Operations

Outline the potential for the development to attract and enhance the business operations of other allied industries and commercial ventures

Existing regional businesses, especially tourism and other commercial businesses in Cape Jaffa and Kingston plus surrounding wineries, fishing and aquaculture businesses will benefit and have the potential to be enhanced by new opportunities that will arise from the Cape Jaffa Anchorage Development.

Existing tourism and commercial businesses (eg: caravan park, retailers, wineries, service providers, etc.) will all have opportunities to benefit from increased demand associated with new tourists and residents. Other industries (eg: fishing, aquaculture, industrial, etc.) will benefit from improved infrastructure associated with the development itself.

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 above, there is an opportunity for 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 Cape Jaffa Anchorage Project.

The adoption of a ‘place management strategy’ or other formal structure for the Cape Jaffa Anchorage Development is currently under investigation by the Kingston District Council. Such strategies could be implemented by Council and/or be incorporated into agreements to be reached with the developer. They would have additional cost implications but would also have associated economic and social benefits. Any opportunities to leverage developer or government contributions to these strategies will obviously increase the region’s economic and social returns on the project.

The overall objective of implementing economic and social development strategies in tandem with the Cape Jaffa Anchorage Development would be 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 could be formulated around objectives which will lead to an increase in the region's business activity and per capita output. Strategies could be developed that focus on undisputable drivers of successful economic and social development and lead to sustainable income and employment outcomes including, for example:

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, for example:

- New or upgraded commercial and retail properties.
- New commercial and retail businesses.
- New tourism assets (eg: a Visitor Information Centre).
- 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 expenditures by tourists, shoppers,* etc. *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 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, the demand placed on these services and the general service nature of Kingston will increase in line with resident and tourist increases. The development at Cape Jaffa and the continued development at Kingston will enhance each other in this regard.

2.5 Government Infrastructure Costs

Describe any potential costs or savings to the Government of infrastructure expansion with regard to transport networks, water supply, and dredging or coastal management.

The infrastructure needs of the development are numerous and Council and the Cape Jaffa Development Company will be seeking support from the State Government in a number of areas including the supply of power and water to the development, road upgrades, provision of professional and recreational fishing facilities and navigation facilities.

While this section of the EIS addresses potential costs and savings to Government from infrastructure expansion, it is stressed that these should be considered in the broader context of the overall financial impacts on Government which would bring potential revenue streams (eg: stamp duty from property transactions) into calculations. While it is not the objective of this report to estimate the net impact of the project on the State Government financial position, it is a factor that should be considered by Government when assessing the development's overall implications.

It is also important to note that, at the time of preparing this EIS, discussions are only just commencing with the State Government on project infrastructure implications and how the Kingston District Council, the developers and the State Government might best approach project requirements. It is difficult therefore to predict with any accuracy what the State Government might be asked to contribute to the development infrastructure and associated costs.

Notwithstanding the current situation, it is intended that the following specific infrastructure issues will be addressed with the State Government by the Cape Jaffa Development Company and the Kingston District Council:

> **Water and Sewage Supply** – Although currently incorporated in the developer's plans and costs, it is intended that a contribution be sought from Government to assist with the costs associated with headworks, treatment, connection and supply. Such a contribution would be sought on the basis of accessing funds already committed to water infrastructure development in the region and not new funding requiring additional Government appropriation. Discussions with Government would 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 developer as part of the normal arrangements with the construction of a development or subdivision. Sewage costs will also be met by the Cape Jaffa Development Company.

Power – Power augmentation cost have been estimated to be $2.8 million. While power supply is being privately negotiated, the augmentation costs will be discussed with the State Government. The supply of three phase power will require an extension to the upgraded power link provided to the newly developed Kreglinger Winery within the Mount Benson Wine Region. A 6 kilometre extension will be required to provide power to the proposed development site. It is anticipated that a substation will be required to be installed to help boost the power to service the needs of the development and the existing township of Cape Jaffa. With the exception of the substation, all internal infrastructure to service the development will be installed by the developer as part of the normal arrangements with the construction of a development or subdivision.

Jetty and the Provision of Professional Fishing Facilities – Transport SA owns and maintains the Cape Jaffa jetty which is sub-standard and in need of extensive upgrading, estimated to cost in the order of $1 million. However, with the development of new facilities for commercial fishing, $0.5 million may be sufficient for upgrading to recreational fishing standard. Any reduced capital expenditure by Transport SA on the existing jetty could be redirected to the new development, especially for the construction of professional fishing facilities associated with the development. Transport SA also owns a boat hardstand area located on Marine Parade, Kingston which, it is understood, may be contaminated but will become obsolete when the new hardstand is constructed at Cape Jaffa. There is potential, therefore, for Transport SA and the developer to negotiate a new hardstand facility at Cape Jaffa in exchange for a Government contribution to the project, which could involve the existing hardstand site valued in the vicinity of $500,000. Another issue that needs to be taken into consideration is the ongoing jetty maintenance costs currently being incurred by Transport SA.

Roads – Increased traffic to and from Cape Jaffa will place additional pressure on existing infrastructure including:

- The Cape Jaffa Road – Southern Ports Highway Junction: There are already safety concerns at this junction which will require upgrading. Estimated cost is in the order of $250,000.

- An unsealed 6 kilometres of the Limestone Coast Road which will need to be sealed. Estimated cost of $450,000.

Navigation Facilities – Beacons will be required for navigation purposes. This responsibility will be taken over by Transport SA and the beacons have an estimated cost in the order of $250,000.

Recreational Boating Facilities – Funds will be sought from the South Australian Boating Facilities Advisory Committee to assist with the establishment of recreational boating facilities as part of the project. The recreational facilities will include car parking, boat ramp and recreational marina area.

Coastal Management – The Cape Jaffa Development Company is responsible for coast and waterways management. The company and Kingston District Council will allocate a proportion of sales and rate revenue to establish a fund to cover potential future liabilities. Other costs, such as dredging, will also be the responsibility of the Cape Jaffa Development Company.

2.6 Council Management and Financial Impacts

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 project and has undertaken substantial investigations into the potential financial impacts and risks associated with the project. In collaboration with the Cape Jaffa Development Company, the Council has put in place long term management plans for the project and has addressed the financial impacts on Council, and associated risks, through the preparation of a Local Government Act Section 48 Report[9].

Issues associated with the ongoing maintenance of the marina are addressed in the Infrastructure Development Agreement are also addressed below .

2.6.1 Council and Developer Roles

The Kingston District Council has committed to being a part of the Cape Jaffa Anchorage Development project and in 2004 signed an Infrastructure Development Agreement with the developer, the Cape Jaffa Development Company, which specifies the roles of both parties in the development. The Agreement specifies which party is responsible for the purchasing and holding of land, the lodgement of relevant development applications and costs associated with the preparation of Environmental Impact Statements and preparation of final design concepts for the development. In accordance with the Agreement, Council has obtained options on the land to be developed.

The Infrastructure Development Agreement[10] specifies that Council will:

1. Exercise the Development Land Options and complete the purchase of the Development Land;

2. Prepare and lodge development applications and all associated documents as requested by the Development Manager from time to time to ensure that the Development Approval for the Infrastructure Development (if granted) is obtained within a reasonable time;

[9] Kingston District Council Cape Jaffa Anchorage Development Section 48 Report, Hudson Howells, October 2003
[10] Infrastructure Development Agreement, Kingston District Council and Cape Jaffa Development Company Pty Ltd, 2004

3. Seek support from the State Government to provide a suitable three phase power link and potable water supply to the Infrastructure Development;

4. Use its best endeavours to obtain Government Funding to assist it in upgrading the existing professional fishing facilities including those for the rock lobster industry and the aquaculture industry;

5. Use its best endeavours to obtain Government Funding to assist it in establishing and constructing recreational boating facilities including car parking, boat ramp and recreational marina area and the Infrastructure Development;

6. Be responsible at its own cost in all things for the maintenance, repair, cleaning and upkeep of the Land Division Infrastructure, the Marine Infrastructure and the Waterways from and after the respective dates on which CJDC's responsibilities in relation to the Land Division Infrastructure, the Marine Infrastructure and the Waterways cease under Clauses 2.3.2.8, 2.3.2.9 and 2.3.2.10;

7. Be responsible for ensuring the preparation of a Plan Amendment Report for the purpose of achieving the appropriate zoning for the Infrastructure Development;

8. Undertake either separately or in conjunction with the development application process, the necessary road opening and closing process for the partial closure of King Drive, Rothalls Road and Cape Jaffa Road, Cape Jaffa to achieve the Objective;

9. Not during the term of this Agreement make any application for any development approval in respect of the Development Area or any part thereof or undertake any development or other work upon the Development Area or any part thereof without the prior written approval of CJDC which will not unreasonably be withheld;

10. Establish a dedicated fund ('Council Maintenance Fund') for the purposes of funding the expenses to be incurred under Clause 2.3.1.6 and contribute into that fund an amount equal to 50% of Council rates received by Council from owners of each of the Allotments for the period of 5 years after the Allotment is sold in accordance with this Agreement; and

11. In assessing rates payable to Council, undertake that it will not apply differential rating to the Allotments for the purposes of assessing liability to Council rates and so that the maximum rating for those purposes will be equivalent to the rate applicable from time to time to properties within the Kingston township.

The Infrastructure Development Agreement specifies that the Cape Jaffa Development Company will:

1. Be responsible for and pay all costs associated with the planning of and obtaining development approval for the Infrastructure Development including the preparation of reports, plans, studies, tests and associated documents provided that Council will have input into and the right to approve all engineering, planning and design aspects of the Infrastructure Development in accordance with all relevant standards;

2. Construct the Infrastructure Development;

3. Construct all waterways required for the Infrastructure Development;

4. Undertake the overall management and direction of the Infrastructure Development;

5. Implement the Infrastructure Development to completion;

6. Undertake all appropriate marketing and promotional activities in relation to the Infrastructure Development;

7. Cause all the Infrastructure Development Costs to be paid as and when they fall due (provided that for that purpose, CJDC will have the right to apply the funds contributed to Development as contemplated by Clause 19.1);

8. Subject to the right to apply for assistance from the CJDC Maintenance Fund under Clause 2.3.4, at its own cost in all things maintain and repair each stage of the Marine Infrastructure and the Waterways for the period expiring on the date being 4 years after the date of Practical Completion of that stage of the Marine Infrastructure and the Waterways, provided that CJDC's responsibilities under this Clause will cease only after that stage of the Marine Infrastructure and the Waterways, as the case may be, have been inspected by representatives of both CJDC and Council and the Parties have agreed in writing that CJDC has satisfied its obligations under this Clause;

9. At its own cost in all things clean and keep navigable the Marine Infrastructure and the Waterways for the period expiring on the date being 8 years after the date of Practical Completion of the Stage 1 Marine Infrastructure, provided that CJDC's obligations under this Clause will only cease after representatives of both CJDC and Council have inspected the Marine Infrastructure and the Waterways and the Parties have agreed in writing that CJDC has satisfied its obligations under this Clause; and

10. At its own cost, maintain, repair and clean the Land Division Infrastructure for the period expiring on the date being 2 years after the date of Practical Completion of the Land Division Infrastructure, provided that CJDC's obligations under this Clause will cease only after representatives of both CJDC and Council have inspected the Land Division Infrastructure and the Parties have agreed in writing that CJDC has satisfied its obligations under this Clause.

In relation to the marina berths, special mention is made in the Infrastructure Development Agreement that the Cape Jaffa Development Company will be granted and retain ownership of both the commercial and recreational marina berths unless and until they are sold to Council or third parties. In addition, Cape Jaffa Development Company has given an undertaking that Council have the right of first refusal to purchase the commercial marina berths at market value.

Council's expected expenditure associated with the development currently involves the purchasing of land and also contributions to match grant funding for the establishment of recreational boating facilities.

Council is currently committed to investing $2.1 million in the purchase of the project land which includes all costs associated with purchase of the land, which it will own and provide the right to Cape Jaffa Development Company to develop. Cape Jaffa Development Company will repay the principle associated with the loan obtained by Council for purchasing the land and all interest and other costs associated with the establishment and maintenance of the loan facility.

2.6.2 Project Arrangements

The appropriate mechanisms and or arrangements for carrying out the project have been subject to considerable discussion between Council, Council's solicitors and the Cape Jaffa Development Company. It was considered by Council that a facilitation approach towards the project would be the most appropriate mechanism to have in place based on Council's involvement in the purchase of the land and also to assist with obtaining Government grant funding and other Government assistance associated with the project.

The Infrastructure Development Agreement provides for a Project Control Group 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.

In addition, a Project Liaison Group will be established which provides a regular forum for representatives of CJDC and Council to discuss and exchange ideas in relation to the whole of the development area.

2.6.3 Council Costs and Benefits

The detailed Financial Analysis and Key Assumptions for this section of the EIS are contained in Appendix 1.

A financial model has been developed in Microsoft Excel to assist with the assessment of implications for rate revenue and to estimate financial costs to 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 June 2005, 12 months prior to completion of Precinct 1, and ending in June 2022. The last currently programmed stage may be completed by June 2016, so the evaluation period includes at least 2 years of post development conditions to cater for the developer to Council infrastructure handover. In the scenario prepared for this report, the selling rate is that provided confidentially by the developers. Within the project period, further changes may arise from project refinements and regulatory requirements. Beyond the project period there may be further sales and developments that are not taken into account in this exercise.

The results of the detailed financial analysis, including the confidential sales timing and revenue data supplied by the developers, are contained in a confidential Microsoft Excel model developed for the purposes this report.

Table 7 on the following page 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 being:

1. 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; and

2. 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.

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 can not be accurately determined as the extent of ‘integration’ activity has yet to be determined.

Table 6 Summary of Rate Revenue and Financial Impacts (Rounded to $ '000)		
Item	**Impact**	**Comments**
Estimated NPV[11] of additional rate revenue in the development area.	$ 4,128,000	Includes residential, commercial 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.

[11] 15 year Net Present Value (NPV) @ 7% discount rate.

The above estimates for rate revenue and overall benefit to Council may be conservative for the following reasons:

1. 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.

2. It is expected that Council and the developer 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:

1. The potential for matching ‘integration’ funds from other sources including State and Commonwealth Government programs and the developer.

2. The potential for better access to Commonwealth and State Government grant and industry assistance funds.

2.7 Aquaculture and Fishing Industry Opportunities

Describe the opportunities for the aquaculture and fishing industries and their support services

As already discussed, the Cape Jaffa Anchorage Development is expected to stimulate other industries and business investment especially in tourism, retail, services and aquaculture. As the aquaculture and fishing industries grow and develop as a consequence of improved industry infrastructure, downstream industries will also see the benefits of increased demand for their products and services. The extent of this industry development will depend to some degree on State Government policy and investment decisions related to aquaculture industry development. However, the Cape Jaffa 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.

An advantage of the development is that the facilities could service an existing rock lobster fishing industry, which operates from the port of Cape Jaffa (this fishing fleet consists of 25 to 30 boats). Council advised that the value of the rock lobster industry is estimated at $12 million per annum. With aquaculture also gaining momentum in this location the activity associated with the marina development is expected to create considerable interest for persons visiting 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.

Atlantic Salmon

Aquaculture (principally Atlantic salmon and ocean trout) is in its infancy in the region but there is good growth potential. During the past 5 years a fledgling industry has developed, principally with land based hatchery and fish being transferred to sea cages for grow out. It is understood that 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 6 to 7 people including owners. Planned growth could see production increase to 500 tonnes p.a. by 2005 with an estimated value of $3.5m and employing up to 20 people[12]. In order to achieve this potential, a range of infrastructure is required including:

- Improved wharf/jetty facilities for harvesting etc.
- Compound factory processing site.
- Equipment storage and repairs.

[12] Source: Atlantic Salmon Demand Chain Study, prepared by Hudson Howells for PIRSA Aquaculture, 2000

- Electricity upgrade.

The Cape Jaffa Development has the potential to contribute to this infrastructure (eg: power) and stimulate future industry development. With the realisation of improved wharf facilities, it is estimated that finfish/Atlantic salmon industry could invest up to $250,000 into other infrastructure to support ongoing industry development.

To achieve the potential production increases, it is estimated that the industry itself will need to invest over $1m in new plant and equipment such as boats, trucks, cages and nets.

In terms of direct economic impact (ie: excluding any multiplier impacts), this rate of industry development could be expected to result in:

- New investment - $1 million
- Increased annual turnover - $3 million

The economic impact of this increased activity has been estimated earlier in this report and is summarised below:

Table 7

Estimated Aquaculture Industry Economic Impacts

Item	Employment Impact FTEs	Value Added Impact ($)
Potential Increased Aquaculture Output - $3 million p.a.	31 FTE jobs p.a.	$2.6 million p.a.
Potential Aquaculture Plant & Equipment Investment - $1 million	22 FTE jobs – once only	$1.5 million – once only

This economic impact does not include potential production and employment increases associated with processing in South Australia. Should processors eventually use 500 tonnes p.a. of salmon from the South East, this input could be supporting up to an additional 30 jobs in South Australia.

It should be noted that the above assessment assumes a very modest level of industry investment and growth. However, should licenses be available and suitable investors be interested, the industry could expand to levels well beyond the current forecast of 500 tonnes p.a. by 2005. For example in Tasmania, farms can support production of over 2,000 tonnes p.a. An industry farming, say 5,000 tonnes p.a., would have a significantly greater economic impact on the region and the State (and would require significant investment and infrastructure). Based on the multipliers contained in this report, such a scenario could result in a regional economic impact of up to 200 jobs and $35m 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 require relocation/replacement. Assuming 5 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 (eg: Robe) to Cape Jaffa. However, the extent of this potential migration is unknown at this stage.

Other Fishing Industry Sectors

There is potential for other sectors to develop as commercial facilities are improved at Cape Jaffa. For example, the new development id expected to offer a ‘safe haven’ during winter which could stimulate the development of shark fishing during the off season.

Expansion of the fishing and aquaculture industries will result in increased demand for support services and facilities. The following services/businesses are expected to be established in association with an expending fishing/aquaculture industry:

- Chandlery.
- Shipwrights, mechanics, etc.
- Hard stand area – estimated cost $50,000.
- Storage areas – estimated cost $500,000.
- Services for the recreational boating industry (mechanics, marine electrical, etc.)
- Retail – bait, tackle, fuel, etc.

2.8 Infrastructure Financial Strategies

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 Council assistance will be sought as detailed in this report. The infrastructure responsibilities of the Cape Jaffa Development Company are to[13]:

- 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.

The Kingston District Council and the Cape Jaffa Development Company will establish Marina Maintenance Funds as follows:

<u>Council Marina Maintenance Fund</u>

A special purpose fund to provide for infrastructure related remedial costs (if required) will be funded by allocating 50% of rates raised from all rateable land based property including related improvements in the development area over a 5 year period commencing upon rates becoming first payable for each property. The eventual impact on Council is not determinable as the relevant cost obligations on this fund are not foreseeable with certainty, and the terms and conditions of the fund are not yet determined.

<u>The Developer's Marina Maintenance Fund</u>

[13] Infrastructure Development Agreement, Kingston District Council and Cape Jaffa Development Company Pty Ltd, 2004

$2,000 for every allotment, excluding ‘fingers’ and berths, will be set aside by the developer 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 4 years after the infrastructure pertaining to that stage is completed to a satisfactory standard to council. The amount transferred will be the $2,000 per allotment sold during that 4-year period out of the allotments available from that stage, less any marina infrastructure related remedial costs incurred. The eventual impact on Council is somewhat uncertain as the relevant cost obligations on this fund are not foreseeable with certainty.

2.9 Land Tenure Arrangements

Describe the land tenure arrangements during and after construction of each stage.

The Local Government Act Section 48 refers to finance and risk and the agreement of 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 Cape Jaffa Development Company 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 Council by the Cape Jaffa Development Company based on the sale of residential allotments.

In relation to the marina berths, special mention is made that the Cape Jaffa Development Company will be granted and retain ownership of both the commercial and recreational marina berths unless and until they are sold to Council or third parties. In addition, Cape Jaffa Development Company has given an undertaking that Council have the right of first refusal to purchase the commercial marina berths at market value.

<u>Marina Basin</u>

The developer will maintain at its cost the marina basin in a navigable condition for 8 years after the infrastructure pertaining to the basin is completed to a satisfactory standard to Council.

After that period, the marina basin asset, its responsibility and ongoing maintenance cost is transferred to Council.

<u>Roads, Verges and Other Public Infrastructure Assets</u>

The developer will maintain at his cost roads, verges, street lighting, common service trenches, electricity distribution systems, and sewer & water reticulation systems in a satisfactory condition for 2 years after the infrastructure in each stage is completed to satisfactory engineering standards.

2 years after each stage is completed, these assets, their responsibility and ongoing maintenance costs transfer to Council.

2.10 Groundwater Compensation

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, **5.2.9**, **5.2.23** and **5.3.17** detail various measures to ameliorate the potential effects on existing users of groundwater resources. The 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 there can be no potential effects. 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 that 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 are expected to experience some reduced separation between the seawater interface and the bottom of wells, however the seawater interface will not be raised sufficiently to envelope these wells. This minimises the potential effects to some increase in the risk of seawater intrusion from coning whilst extracting groundwater. This risk is limited to wells that have some existing risk of seawater intrusion, such as deep wells that are extracting at high rates very near to the waterways and the existing coast. There are no known wells that are expected to be affected. Wells in other areas are unlikely to be effected, including at the western end of the existing settlement and north of King Drive;

- the location of the waterways and separation to wells further inland is such that there is negligible risk of seawater intrusion into these wells;

- the design is such that the effects of saltwater intrusion are unlikely to extend more than about 50 metres from the perimeter of the waterways and existing wells generally have separation significantly in excess of this distance;

- 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 to existing uses of the aquifer arise; and

- in order to provide more detailed assessment of the effects of changes to the seawater interface, 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 obtained from the ongoing monitoring and assessment, the effects of subsequent stages can be modelled in greater detail in order to reconfirm the findings of the modelling performed to date (see Section 5.2.29);

To further ameliorate potential effects on existing groundwater users, access to a reticulated supply will be afforded. As part of stage 1, 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 unexpected 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 and commercial development and 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 contamination of he 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. Also, the provision of a town water supply will likely reduce the extraction from the resource. This particularly applies to the irrigation of the coastal reserve within the existing settlement, which currently extract a significant volume of water from the unconfined aquifer.

As a result of the amelioration measures employed, there is not expected to be a need for monetary compensation and no compensation is proposed.

2.11 Groundwater Flows

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 does not change as a result of the establishment of the waterways. 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 extraction from the aquifer. As the establishment of the waterways does not change the recharge or extraction quantities, there is no change to the overall groundwater outflow to the sea.

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 (**Section 5.2.6**). The 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 m^3/day, with a distribution around the waterways as shown in **Figure 5**.16. Once the waterways have been constructed the ongoing monitoring of actual groundwater levels around the waterways will allow a more accurate assessment of groundwater flow into the waterways.

2.12 Groundwater Rock Lobster Industry Implications

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 (**Section 5.4.**).

Redistribution of Groundwater Outflow to the Sea

As has been discussed previously in **Section 5.2.3** and **5.2.6** and summarised 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 (**Appendix 14**). See **Figure 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 m^3/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 Project Area.

Section 5.2.6 assesses the effects of the outflow of potential contaminants associated with the groundwater water into 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 EPP 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 with 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 permeable sandy soils, including within individual allotments, grassed swales and at strategic locations within the landscaped basins.

Summary

There is no expected increase in groundwater flow out to sea nor is there to be any additional run-off 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 – it flows instead to the sea further east via the waterways at the mouth of the breakwaters, at the edge of sanctuary. Accordingly, there will be no economic impact from these factors on the rock lobster industry.

2.13 Groundwater Economic Implications

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 this report (**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** and have been shown to be minimal. These sections show that:

- the effects on groundwater level changes on existing wells are small and expected to have no noticeable effects on yield. In addition, the groundwater level changes are small compared to the existing seasonal level changes in the unconfined aquifer;

- the risk of seawater intrusion into existing wells is generally negligible. At the east of the existing township south of King Drive there is reduced separation between the seawater interface and the bottom of wells, however the seawater interface is not expected to be raised sufficiently to envelope these wells. As a result, there is some increased risk of seawater intrusion in wells that are deep, extracting at very high rates and located close to both the waterways and the existing seawater interface (i.e. close to both the waterways and the coast). All other registered existing groundwater wells have separation to the seawater interface that remains significant and thus there is negligible risk of seawater intrusion.

- 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 landuse. 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. Section 4.14 presents the salinity of the unconfined aquifer measured in the recently installed monitoring wells. Salinity ranged from 439 mg/L TDS to 14,900 mg/L TDS and generally the low lying areas immediately to the south and east of the site exhibited salinity greater than 2,000 mg/L TDS. Further to the south where the topography rises and the shallow sediments are geologically older, salinity was generally less than 1,000 mg/L TDS (Appendix GW2);

- 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. 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 residential or commercial use. In the more elevated areas where the depth 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 about 0.3 metres. This land is elevated (8 to 10 metres AHD) and the ground water level is generally less than 1.5 metres AHD, 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; 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 but there is expected to be a net benefit to primary producers from improved drainage.

2.14 Workforce Implications

Identify the economic effect the workforce would have locally and regionally.

The following table summarises the estimated employment impacts from the construction phase of the project.

Table 7

Cape Jaffa Anchorage Development - Estimated Annual Employment Impacts

Year	**Broad Employment Impact (FTEs)**
1- 2003	12
2 – 2004	222
3 – 2005	81
4 – 2006	73
5 – 2007	177
6 – 2008	109
7 – 2009	113
8 – 2010	117
9 – 2011	160
10 – 2012	121
11 – 2013	145
12 – 2014	125
13 – 2015	125
14 – 2016	125
15 - 2017	125

Throughout South Australia there is little spare capacity in the construction sector at present. However, this situation may change as the Cape Jaffa Anchorage Project 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).
- The developer's own workforce.
- Adelaide.
- Western Victoria.

The expected breakdown by percentage is:

- Earthmoving – 50% existing developer labour (Adelaide) and 50% local labour (50% Kingston and 50% remainder of the South East).

- Housing Construction – 70% imported from Adelaide and other areas outside the region and 30% from the South East region, including Kingston.

It is therefore expected that at least 50% 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 contained in this report, 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 contained in this report, it is estimated that every $1m 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.

2.15 Tourism and Investment Impacts

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 report include:

Caravan Park Redevelopment – There is potential for the existing caravan park to double in size, incorporating an additional 30 cabins, 30-40 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 2 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
- Local History Centre

It is estimated that such a facility would require an initial investment of $400,000 and could employ up to 3 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 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 2 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. As already discussed in this report, detailed visitor data is not available for the Kingston/Cape Jaffa region. However, 2002 data are available for the Limestone Coast region and are summarised below[16]:

- 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

[16] Source: Tourism SA, Limestone Coast, October 2003, www.tourism.sa.gov.au

- Average Spending by Day Trip Visitors - $85 per visit

If it is conservatively assumed 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 p.a.

APPENDIX 1

Council Financial Analysis and Key Assumptions

Model Development

A financial model has been developed in Microsoft Excel to assist with the assessment of implications for rate revenue and to estimate financial costs to 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.

Model Approach and Key Assumptions

Overview

As noted earlier in this report, 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. This assessment and the assumptions supporting the assessment are contained in Appendix 1 – Assumptions.

The financial model uses a 15 year evaluation period starting June 2005, 12 months prior to completion of Precinct 1, and ending in June 2022. The last currently programmed stage may be completed by June 2016, so the evaluation period includes at least 2 years of post development conditions to cater for the developer to council infrastructure handover. In the scenario prepared for this report, the selling rate is that provided confidentially by the developers. Within the project period, further changes may arise from project refinements and regulatory requirements. Beyond the project period there may be further sales and developments that are not taken into account in this exercise.

Land, Marina Property and Improvements

The following rateable property types are assumed to emerge from the project

“Wet” allotments

236 “Wet” allotments at an average rateable value of $175,000 each.

“Dry” allotments

165 “Dry” allotments at an average rateable value of $125,000 each.

Commercial allotments

25 allotments at an average rateable value of $40,000 each.

“Fingers”

199 “Fingers” or personal marine craft landings extending from wet allotments at an average rateable value of $22,000 each.

Marina berths - Commercial

50 berths at an average rateable value of $50,000 each or their equivalent under community title.

Marina berths - Recreational

40 berths at an average rateable value of $35,000 each or their equivalent under community title.

Building Improvements

Improvements resulting in an average rateable value increase of $170,000 occur at a monthly rate of 2% on the stock of unimproved allotments sold.

Council Rates

Rate Structure

All rateable property is assessed at the residential rate of 0.63 cents in the dollar of rateable property value.

Rate Timing

Any rateable property becomes first assessable for its full year’s rates starting the 1st of July following the date of its sale and council rates become payable in 4 quarterly instalments starting in the following September.

Rateable Value

There is no escalation factor assumed over the duration of the project.

Assignment to the Council Marina Maintenance Fund

A special purpose fund to provide for infrastructure related remedial costs (if required) will be funded by allocating 50% of rates raised from all rateable land based property including related improvements in the development area over a 5 year period commencing upon rates becoming first payable for each property. The eventual impact on Council is not determinable as the relevant cost obligations on this fund are not foreseeable with certainty, and the terms and conditions of the fund are not yet determined. For the purposes of this model, the value of the fund is treated as an asset of the Council.

Application of Increased Rate Revenue

The model applies estimated changes in rate revenue to estimated changes in Council operating expenditures. Any surplus or deficit is not further dealt with as the purpose of this exercise is to assess the degree and nature of fiscal impact during the development period.

It should not be assumed that this surplus or deficit would necessarily become an actual outcome as it will be further dealt with by Council in ways that are beyond the scope of this report, for example rate reductions or changes in the level or range of services provided to the community.

Other Revenue Considerations

The Commonwealth Grants Commission funding for the council will be influenced by a number of factors including average property values in the council area relative to the South Australian State average, and population changes. These latter two factors tend to offset each other but the overall year to year effect of these changes cannot be determined without further assistance from the commission and additional assumptions.

Infrastructure Completion

The model assumes infrastructure associated with each stage is completed by 9 months after stage commencement. The expected program is detailed in the following table:

Table 1
Expected Development Program

Stage	Expected Start Date
1	Jan-05
2	Jan-05
3	Jan-06
4	Nov-07
5	Jul-11
6	Jul-13
7	Jul-15

The Developer's Marina Maintenance Fund

$2,000 for every allotment, excluding 'fingers' and berths, will be set aside by the developer 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 4 years after the infrastructure pertaining to that stage is completed to a satisfactory standard to council. The amount transferred will be the $2,000 per allotment sold during that 4-year period out of the allotments available from that stage, less any marina infrastructure related remedial costs incurred.

The eventual impact on Council is somewhat uncertain as the relevant cost obligations on this fund are not foreseeable with certainty. For the purposes of this model a provision of $3 per month of relevant cost per ‘wet’ allotment expected to be in existence in that month has been deducted from the accruals to the value of the fund. This proportionality to the number of ‘wet’ allotments expected to be in existence is approximately proportional to the stage by stage rollout of marine infrastructure and hence the degree of liability for its cost related to timing. The value of relevant cost obligations on this fund (if any), however, are not foreseeable with certainty and may significantly exceed or fall below the nearly $70,000 of costs provided for in this model over the development period.

For the purposes of this model the net value of the fund is treated as an asset of the Council as ultimately all unused monies in this fund are intended to be transferred to council.

Marina Basin

The developer must maintain at its cost the marina basin in a navigable condition for 8 years after the infrastructure pertaining to the basin is completed to a satisfactory standard to council.

After that period, the marina basin asset, its responsibility and ongoing maintenance cost is transferred to Council. An amount of $15,000 p.a. in maintenance costs has been allowed for this purpose but is uncertain as it is highly dependent on environmental factors and construction options outside the scope of this model and not yet fully evaluated by other investigations at the time of writing this report.

The expected Government funding has not been included in the model at this stage.

Roads, Verges and Other Public Infrastructure Assets

The developer must maintain at his cost roads, verges, street lighting, common service trenches, electricity distribution systems, and sewer & water reticulation systems in a satisfactory condition for 2 years after the infrastructure in each stage is completed to satisfactory engineering standards.

2 years after each stage is completed, these assets, their responsibility and ongoing maintenance costs transfer to Council. Annual costs to maintain each of these assets has been allowed using estimates based on Council historical records and other experience or estimates where necessary. These are tabled in Appendix 1.

The program for roads, footpaths and open space/reserves is detailed in the following table.

Table 2 Other Infrastructure Program			
Stage	Roads, kms	Footpaths, kms	Open Space, ha
1	0.62	0.60	-
2	1.30	1.30	4.40
3	0.53	0.53	5.15
4	1.70	1.70	0.42
5	0.60	0.60	7.91
6	0.48	0.48	-
7	-	-	-

It is assumed that the maintenance costs of coastal dune open space and coastal reserve to be handed over to Council in Stage 1 are insignificant.

Resident Population

The new permanent resident population within the development area has been estimated using current trends in Kingston Township. A usual ratio of 2.5 people per residence has been adjusted to 2.25 to recognise that a higher proportion of retiree couples are expected to live in the area. This lower ratio has been further reduced by 20% to account for the percentage of residences used for holiday home owner purposes. This therefore represents a conservative estimate.

Selling Program

The selling program is based on forecasts by the developer and has not been independently reviewed. Early indications, resulting from prospective purchasers registering an expression of interest following public meetings, suggest the forecast is achievable in the early development period. However, the present expressions of interest may not be realised if property market conditions change in the future. The timing of sales is a significant factor in determining Council rate revenue.

The sales forecasts by the developer was expressed in calendar years. Council rates are based on June 30 fiscal years. The model converts the developer's calendar sales forecasts to estimated June 30 fiscal year sales by assuming:

- All 2004 calendar year sales occur in the 2005 fiscal year.

- From 2005 to 2014, 50% of each calendar years' sales are attributed to the fiscal year ending June 30 within that calendar year and the other 50% to the following fiscal year.

- All 2015 calendar year sales occur in the 2015 fiscal year.

Shadow Effect

The 'shadow effect' is a future indirect effect, which is heavily dependent on the degree of integration and association of surrounding areas with the style and features arising from the development. The most pronounced effect will be on properties in the immediate vicinity of Cape Jaffa used or capable of being used for residential, commercial or related purposes.

There are currently 29 rateable properties including 5 commercial lots with an aggregate value of $2.9M. Some adjoining lots are used in combination.

It is assumed that these will enjoy an upward revaluation of 30% early in the project life and will contribute to additional rate revenue.

Any revaluation of proximate rural property values has been ignored as there is no certainty that a change in land use status would be approved.

There is also a likelihood of a broad but lower shadow effect leading to an increase in general property values throughout the Kingston area, particularly the Kingston township. The aggregate valuation change from this broad effect will be significant but no benefit from rate revenue has been attributed to Council as, under existing policy and rate determination history, the most likely effect will be some degree of an offsetting reduction in council's rate in the dollar determination. *This could, however, give rise to a significant saving in the hands of the rate paying community and would have obvious regional economic benefits.*

STED Scheme

The cash flows from Council's operation of the Cape Jaffa STED scheme are not shown as they are assumed to be cash flow neutral based on a the self funding principal adopted by Council. The STED scheme is covered by a service rate charge on properties which includes maintenance and future asset replacement.

Financial Assumptions

AS detailed in Council's Local Government Act Section 48 Report, Council will access funds from the Local Government Financing Authority (LGFA) for the purchase of land and associated costs and Cape Jaffa Development Company will pay

- The interest, costs and fees associated with the LGFA Facility as and when they fall due; and

- The principal under the LGFA Facility on the sale of allotments in accordance with the schedule contained in the Development Agreement.

There is therefore no lasting effect on Council's cash position from these transactions which have been ignored in the financial model.

All dollar figures are expressed as 2003 real (before inflation) dollar equivalents and there has been no adjustment for:

- General inflation.
- Real wage cost growth.
- Property revaluations.

Accordingly, a real discount rate of 7% is used for all present value calculations. This rate incorporates the opportunity cost of future real cash flows relative to a cash flow at the present time and a provision for risk.

There has been no refinement for annually recurring seasonal patterns for the incidence of program costs.

A contingency provision of 10% has been allowed for on costs in this model.

Asset Renewals and Depreciation

Asset renewal expenditure incurred during the project period is shown as either a single outlay or as a series of costs that equate to the asset renewal cost cumulatively over time.

The liability to Council to renew long life assets has not been evaluated within this model framework. Detailed infrastructure costings are not available but based on limited information, of an estimated $34 million of developer's capital expenditure there may be about $16 million of depreciating long life assets that could eventually become Council's responsibility for replacement. Assuming an average 40 year life, an annual sinking fund provision of $260,000 p.a. would accrue sufficient funds at a real rate of interest of 2% p.a. to cover their replacement. The assets not requiring renewal at Council's additional expense that could be identified at the time of this report were the sea channel, breakwater, dredged entrance, main basin/waterways, dewatering, revetment & 1m high wall, electricity infrastructure, sewer, water, boat ramp, common ramp, stormwater, engineering/planning/project management, others and contingency costs.

The depreciation component in each expense item has been excluded where significant. An inclusion of depreciation, whose nature is to estimate decline in asset value, would necessitate the inclusion of the value of the assets transferred to Council in order to be consistent. Such an inclusion would not reflect the fiscal impact on Council as there is no cash flow effect from either depreciation or the transfer of assets that have in any case not yet been well defined. It would also entail a determination as to whether the present value of contingent future liabilities associated with these assets should also be taken into account.

Financial Analysis and Viability

This section of the report details the findings of the financial analysis based on the criteria and assumptions contained in Section 8. The analysis has been undertaken over a 15 year period which approximates the expected life of the development project. It is important to recognise that the findings are also based on revenue and cost data supplied by the developer and Council and that these data have not been independently sourced.

The results of the detailed financial analysis, including the confidential sales timing and revenue data supplied by the developers, are contained in the confidential Microsoft Excel model developed and used by Hudson Howells for this study.

Implications for Rate Revenue and Financial Costs

Table 7 on the following page 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 being:

1. 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; and

2. 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.

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 can not be accurately determined as the extent of ‘integration’ activity has yet to be determined.

Table 3 Summary of Rate Revenue and Financial Impacts (Rounded to $ '000)		
Item	**Impact**	**Comments**
Estimated NPV[17] of additional rate revenue in the development area.	$ 4,128,000	Includes residential, commercial 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.

[17] 15 year Net Present Value (NPV) @ 7% discount rate.

Rate Revenue

The above estimates for rate revenue and overall benefit to Council may be conservative for the following reasons:

1. 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.

2. It is expected that Council and the developer 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:

1. The potential for matching ‘integration’ funds from other sources including State and Commonwealth Government programs and the developer.

2. The potential for better access to Commonwealth and State Government grant and industry assistance funds.

Existing Council Infrastructure

Based on consultation with staff, Council has very little existing infrastructure within the development area.

Council has some roads in the development area, however these will be closed/moved and incorporated into the new development.

It is therefore assumed that if the Cape Jaffa Anchorage Development did not proceed, Council would retain only a minimum financial obligation in the development area.

APPENDIX 2

Bibliography

- 2001 Census of Population and Housing, Various Catalogues, Australian Bureau of Statistics
- 2003/2004 Budget, Schedules and Notes, Kingston District Council
- 1995/96 Input - Output Tables for the South East Region of South Australia, South Australian Centre for Economic Studies
- Atlantic Salmon Demand Chain Study, prepared by Hudson Howells for PIRSA Aquaculture, 2000
- Cape Jaffa Anchorage Joint Venture, Information for Section 48 Report, Kingston District Council and the Cape Jaffa Development Company, July, 2002
- Cape Jaffa Anchorage Marina Proposal Issues Paper, Major Developments Panel South Australia, March 2003
- Draft Aquaculture Policy, South East Aquaculture Resource Management Policy, Kingston Policy Area, PIRSA Aquaculture, October, 2002
- Guidelines for the Preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Marina, Major Developments Panel South Australia, June, 2003
- Infrastructure Development Agreement, Kingston District Council and Cape Jaffa Development Company Pty Ltd, 2004
- Kingston District Council Cape Jaffa Anchorage Development Section 48 Report, Hudson Howells, October 2003
- Limestone Coast Visitors and Market Structure 2002, Tourism SA, October 2003

Strictly Confidential

Kingston District Council

Cape Jaffa Anchorage Development

Section 48 Report

October 2003

TABLE OF CONTENTS **Page**

1.0 Introduction and Report Objectives

1.1 Introduction

Section 48 of the Local Government Act deals with Local Government prudential requirements as they may be affected by Council's involvement in a commercial activity or project meeting specified criteria.

Hudson Howells has been engaged by the Kingston District Council to prepare a report to satisfy the requirements of Section 48 of the Local Government Act 1999 for the Cape Jaffa Anchorage Development project. The purpose of this report is to address the prudential requirements of Section 48 and includes investigations into the project's relationship with Council's strategic management plan, objectives of the Development Plan, contribution to economic development of the area, community consultation, projected revenue and financial risks, recurrent and whole of life costs, financial viability, potential risks and risk management, and appropriate project mechanisms or arrangements.

This report also outlines the background to the project, the nature of the relationship between Council and the Cape Jaffa Development Company, the project's history, development concept and development issues. The report concludes that the project will provide significant economic benefits to the region and that certain Council risks identified within the scope of this report could be managed through arrangements with the Cape Jaffa Development Company.

1.2 Council and Cape Jaffa Development Company Agreement

The Kingston District Council has committed to being a part of the Cape Jaffa Anchorage Development project and in February 2003 signed a Heads of Agreement with the developer, the Cape Jaffa Development Company, which specifies the roles of both parties in the development. The Agreement specifies which party is responsible for the purchasing and holding of land, the lodgement of relevant development applications and costs associated with the preparation of Environmental Impact Statements and preparation of final design concepts for the development. In accordance with the Heads of Agreement, Council has obtained options on the land to be developed.

The Heads of Agreement specifies that Council will:

1. 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).

2. Prepare and lodge a development application and all associated documentation to ensure that development approval for the development is obtained within a reasonable time.

3. Seek support form the SA Government to provide a suitable three phase power link and potable water supply to the development.

4. 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.

5. 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.

6. Be responsible at its own cost in all things for the maintenance of the public infrastructure from the date being two years after the date of completion of each stage of the development. (This clause has subsequently been amended in the agreement. The clause now refers to infrastructure such as roads, kerbing and effluent disposal scheme being transferred to Council within two years, all marina based infrastructure including the breakwater, waterways, wharf facilities etc being handed to Council after four years from 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 eight years after completion).

7. Be responsible for undertaking a Plan Amendment Report process for the purpose of achieving the appropriate zoning for the development.

8. Undertake either alone or in conjunction with the development application process, the necessary road process for a partial closing of King Drive and Cape Jaffa Road necessary to achieve the objectives of the development.

The Heads of Agreement specifies that the Cape Jaffa Development Company will:

1. Be responsible for and pay all costs associated with the planning of and obtaining development approval for the development including the preparation of Environmental Impact Statements, plans, studies, and associated documents.

2. 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.

3. Construct and install at its cost all infrastructure associated with the residential development.

4. Construct all waterways required for the development.

5. Finance the residential development and make contributions towards any shortfalls in Government and other financial assistance in relation to the construction of stage 1.

6. Will 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 Heads of Agreement also refers to finance and risk and the agreement of 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 Cape Jaffa Development Company 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 Council by the Cape Jaffa Development Company based on the sale of residential allotments.

In relation to the marina berths, special mention is made in the Heads of Agreement that the Cape Jaffa Development Company will be granted and retain ownership of both the commercial and recreational marina berths unless and until they are sold to Council or third parties. In addition, Cape Jaffa Development Company has given an undertaking that Council have the right of first refusal to purchase the commercial marina berths at market value.

Agreement was recently reached between Council and the Cape Jaffa Development Company with regard to the Cape Jaffa Anchorage Development, which deals with the major infrastructure required for the development, that includes the main fishing industry areas, electricity and water supply, breakwaters and other marina facilities, together with private sector components of the marina.

The agreements were negotiated in line with the terms and conditions accepted by both parties in the Heads of Agreement.

1.3 *Requirements Under Section 48*

Council's expected expenditure associated with the development currently involves the purchasing of land and also contributions to match grant funding for the establishment of recreational boating facilities. As recreational boating facilities are considered a normal activity of the Council, with a similar facility currently provided at Kingston, this contribution is not considered within the context of Section 48 but does not, however, effect the requirement for Council to consider a Section 48 report.

Council is currently committed to investing $2.1 million in the purchase of the project land which includes all costs associated with purchase of the land, which it will own and under the agreement and provide the right to Cape Jaffa Development Company to develop. Cape Jaffa Development Company will repay the principle associated with the loan obtained by Council for purchasing the land and all interest and other costs associated with the establishment and maintenance of the loan facility.

Council has advised its average operating expenses over the previous five years as follows:

Table 1 **Council Operating Expenditure 1997 - 2002** **$**	
1997/1998	$2,682,930
1998/1999	$2,734,694
1999/2000	$2,351,144
2000/2001	$3,711,644
2001/2002	$3,924,882
Total	**$15,405,294**

Based on the above, Council's average annual operating expenses over the previous five financial years is $3,081,059. The estimated property purchase price of $1.7 million is greater than 20 per cent of Council's average annual operating expenses over the previous five financial years. On this basis, Council is required to consider the prudential issues contained in this report notwithstanding the arrangement with CJDC regarding the repayment of the loan principle, interest and other land acquisition costs.

The following are prudential issues required to be considered under Section 48 of the Act:

a. The relationship between the project and relevant strategic management plans;

b. The objectives of the Development Plan in the area where the project is to occur;

c. The expected contribution of the project to the economic development of the local area, the impact that the project may have on businesses carried on in the proximity and, if appropriate, how the project should be established in a way that ensures fair competition in the market place;

d. The level of consultation with the local community, including contact with persons who may be affected by the project and the representations that have been made by them, and the means by which the community can influence or contribute to the project or its outcomes;

e. If the project is intended to produce revenue, revenue projections and potential financial risks;

f. The recurrent and whole-of-life costs associated with the project including any costs arising out of proposed financial arrangements;

g. The financial viability of the project, and the short and longer term estimated net effect of the project on the financial position of the council;

h. Any risks associated with the project, and the steps that can be taken to manage, reduce or eliminate those risks (including by the provision of periodic reports to the chief executive officer and to the council);

i. The most appropriate mechanisms or arrangements for carrying out the project.

This report specifically addresses each of the above issues in relation to the Cape Jaffa Anchorage Development project.

1.4 Major Projects Status and Environmental Impact Statement Requirements

Due to the myriad of issues identified that need to be addressed as part of the development concept, an application was forwarded to the Minister for Urban Development and Planning seeking determination of the Cape Jaffa Anchorage Development as a Major Project in accordance with the provisions of Section 46-48 of the Development Act. The application to seek major project status was on the basis of the issues of significant environmental, social and economic importance. These issues have implications for the existing residents of Cape Jaffa, the service town of Kingston, Council, State Government, business interest, as well as service infrastructure authorities. In the application, Council advised that it has considered the ways in which to proceed and progress investigations and the development, and concluded that:

- The range of land uses and activities incorporated in the scheme, its complexity and local significance, the extent to which the proposal varies from the current development plan, and the manner in which it extends beyond the Council's jurisdiction and its development plan, all suggested development of significance.

- As the proposal extends beyond Councils jurisdiction and there are no policies relevant outside that boundary at this time, Councils Development Assessment Panel and the Development Assessment Commission have no policies to guide their assessment.

- The range of environmental and infrastructure issues to be investigated and resolved can not be adequately accommodated through a Ministerial PAR.

Subsequently, Council resolved that the most appropriate mechanism for all of the issues to be properly resolved and assessed is for the proposal to be determined as a major development in accordance with sections 46-48 of the Development Act.

As a result of the application forwarded to the Minister, on 19 December 2002 the Minister formally declared the development proposal as a major project in accordance with section 46 (1) of the Development Act 1993, as the Minister was of the opinion that a declaration under that section is appropriate for the proper assessment of the Cape Jaffa Anchorage Development due to major environmental, social and economic importance.

In February 2003, a formal development application was submitted to the Major Developments Panel for assessment. The development application outlined in detail the development proposal and provided a formalised concept of the development with projected stages for the implementation of the development. In addition, the application provided more specific information that related to the planning strategy and development plan. This information addressed economic activities associated with the aquaculture and fishing industry and tourism, environment and resources including conservation of the coast line, community development that referred to the main settlement of Kingston and relevant coastal centres and ports, infrastructure that addressed issues associated with energy, transport, economic activity strategies, environment and resources strategy, community development strategies, and infrastructure strategies. The application also provided a preliminary assessment against Council's Development Plan and other relevant statutory investigations such as the Regional Section 30 Review.

As part of the assessment by the Major Developments Panel, an issues paper on the proposed Cape Jaffa Anchorage Development was released for consultation with relevant government agencies and also the community. Resulting from submissions received on the issues paper, the guidelines for the Environmental Impact Statement have now been addressed and work is being conducted at present to address the issues identified within the guidelines document.

The issues to be addressed as part of the Environmental Impact Statement refer to environmental issues, including groundwater, coastal issues, water issues, waste management and general environmental management issues, effects on communities, economic issues, construction and operational effects, risk and hazard management, effects on infrastructure requirements, native title and aboriginal heritage issues and planning and environmental legislation and policy issues. The guidelines for the preparation of the Environmental Impact Statement for Cape Jaffa Anchorage Development proposal provides further information as to the requirements of the Environmental Impact Statement.

Section 5 of this report - *Contribution to Economic Development* – addresses some of the Economic Issues in the Guidelines for the Environmental Impact Statement which are:

1. Outline the opportunity for tourism and investment in the area from the development.

2. Identify employment and investment opportunities, including the “multiplier effect”.

3. Outline the potential for the development to attract and enhance the business operations of other allied industries and commercial ventures.

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.

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.

6. Describe the opportunities for the aquaculture and fishing industries and their support services.

7. Outline the financial strategies to be employed to ensure the relevant infrastructure is in place for each stage in the project.

8. Describe the land tenure arrangements during and after construction of each stage.

9. Describe compensation or amelioration measures for any loss of groundwater resources for users.

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.

11. Identify the economic implications for the rock lobster industry from increased groundwater flows and run-off out to sea.

12. Identify the economic implications for groundwater users from groundwater drawdown or contamination, particularly primary producers.

13. Identify the economic effect the workforce would have locally and regionally.

14. Identify any potential impact on tourism or investment due to the changed nature of Cape Jaffa.

2.0 Cape Jaffa Anchorage Development – Project Background

2.1 Project History

The Kingston District Council, since the formation of a committee in January 2000, has been investigating future development requirements at Cape Jaffa in relation to the rock lobster fishing industry, the aquaculture industry and the provision of facilities for recreational boating. With the demands of these industries and activities requiring significant upgrades to onshore infrastructure, the Committee was tasked to plan for all infrastructure requirements to meet the needs of the future.

Council advised that investigations conducted by the Committee involved discussion with interest groups such as the fishing industry and the aquaculture industry to determine future infrastructure needs. Discussions were also held with recreational boating users to determine requirements for an adequate recreational boating facility at Cape Jaffa. In addition, discussions were held with an adjoining landowner to discuss their requirements or visions for future development at Cape Jaffa. 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, nearby viticulture industries, tourism industry and residential development.

Council also advised that since May 2001, investigations into the development of Cape Jaffa and improved facilities gained momentum with discussion between Council and Mr David Lucas of Lucas Earthmovers (now of Cape Jaffa Development Company). As a result of these discussions, progression towards providing a facility at Cape Jaffa to incorporate all fishing and tourism industries and the possibility of future residential development was viewed by Council in a favourable manner. Investigations and discussions lead to Council obtaining options for the purchase of private land adjacent to Cape Jaffa, which will be exercised based on favourable approval of a concept for a multi purpose service facility and marina development. The investment committed by the Council for purchasing the land is approximately $1.8 million.

As part of performing preliminary investigations into the project, Council advised that test digs were conducted on the land to be purchased to ensure its suitability for construction of canals and wharf facilities as part of this service facility and marina development. According to Council, the trial digs proved that the site is suitable and subsequently a preliminary concept plan for the development was developed.

2.2 Development Concept

The preliminary development concept incorporates breakwaters, wharf facilities, recreational and professional boat ramp facilities, fishing industry facilities, commercial/industrial areas and canal residential development. The development will also include professional and recreational boat moorings within the facility to form the focus of the development.

An advantage of the development is that the facilities could service an existing rock lobster fishing industry, which operates from the port of Cape Jaffa (this fishing fleet consists of 25 to 30 boats). Council advised that the value of the rock lobster industry is estimated at $12 million per annum. With aquaculture also gaining momentum in this location the activity associated with the marina development is expected to create considerable interest for persons visiting 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.

2.3 Development Issues

Council has advised the following issues related to the development:

<u>Infrastructure</u>

The infrastructure needs of the development are numerous, however the Council and the developer will be seeking support from the Government to provide a suitable power link and water supply to the development. The linkage of power, being three phase, will require an extension to the upgraded power link provided to the newly developed Kreglinger winery within the Mount Benson Wine Region. This will require an extension of 6kms to provide a power link to the proposed development site. It is anticipated that a substation will be required to be installed to help boost the power to service the needs of the development and the existing township of Cape Jaffa. In addition, assistance will also be requested for the provision of a potable water supply to the development.

In relation to the provision of power and water, the request of the government is only to assist with the provision of these services to the development site. With the exception of a substation for power and possible treatment works for the water supply, all internal infrastructure to service the development will be installed by the developer as part of the normal arrangements with the construction of a development or subdivision.

Professional Fishing Facilities

Council will seek funding assistance to provide facilities for the professional fishing industry, including the rock lobster industry and the aquaculture industry. Due to the provision of new wharfage and facilities it is expected that the Cape Jaffa jetty will no longer be maintained as a commercial facility. The Council will be requesting the Government to give consideration to providing funding to assist with the construction of professional fishing facilities associated with this development.

Recreational Boating Facilities

The Council will be seeking funding via the South Australian Boating Facilities Advisory Committee to assist with the establishment of recreational boating facilities as part of the project. The recreational facilities will include car parking, boat ramp and recreational marina area.

In relation to all boating facilities, both recreational and professional, funding assistance will be sought towards the construction of breakwaters and also channels and basin area that will host the main boating and wharf facilities. Therefore, it is envisaged that funding will be sought from the South Australian Boating Facilities Advisory Committee and Transport SA to assist with the construction of this infrastructure.

Environmental Issues

With the construction of the marina and associated infrastructure, including the breakwater, wharfs and waterways, there are a number of environmental issues that need to be investigated to determine their effects on the development. These environmental issues include:

- The visual effect of the construction of a seawall/breakwater into the bay at Cape Jaffa.
- The visual effect of the development in this locality generally.
- The effect on seagrass and sand movement on the coast.

- The effect of removing swing moorings from the rock lobster sanctuary and off the seagrass bed.

- The effects of removing commercial activities and loadings on the Cape Jaffa jetty.

- The effect of constructing channels and basins on groundwater quality and movement.

- The effects of developing a waste water treatment system to which the existing development can connect.

- The effects of developing a water reticulation system to which the existing development can connect.

- The effect of the development on any native flora and fauna.

- The quantity of potable water required to supply the development.

Social Issues

The social issues that form part of the development and thus requiring further investigation for the impact are as follows:

- The effect of employment and housing in the area.

- The implications for service sector including health, education and recreation to support or be supported by the development.

- The effects on the existing settlement at Cape Jaffa.

- The consequences of a safe haven on the recreational and commercial boating fraternities.

Economic Issues

The economic issues that require further investigation as part of the development are as follows:

- The consequences on employment and housing, tourism and investment in the area.

- The reinforcement to existing tourist operators including wineries, tourist park and marine based tourist operators.

- The loss of the land from primary production to urban coastal development.

- The consequences for the aquaculture and fishing industries, support and service infrastructure.

3.0 Relationship With Council's Strategic Management Plans

Support for economic and industry development within the region is a major objective of Council and is recognised in Council's strategic management plans. This support is evidenced by the establishment of the committee to investigate development at Cape Jaffa for the development of facilities to support the fishing industry, the aquaculture industry and to develop facilities for recreational boating.

Council is currently reviewing its strategic directions, the new strategic management plan will provide a greater emphasis on recognizing the Cape Jaffa Anchorage Development and the potential benefits it will offer to the community. These potential benefits include, for example, increased population, economic benefit through the expansion of the rate base of the Council, infrastructure and facilities provided to the Cape Jaffa area and the support to existing industries in the area.

In addition, Council forwarded to the South Australian Boating Facility Advisory Committee in 2000 a strategic plan for the development of recreational boating facilities within the Council area. The strategic plan's vision is to provide safe all year round boat launching facilities at Kingston and Cape Jaffa for recreational fisherman and emergency purposes. The objectives of Council regarding recreational boating facilities were as follows in the plan:

- Construct safe all weather and all year recreational boat launching facilities.
- Design and construct recreational boat launching facilities that minimize the effect of seagrass movement and build-up to reduce ongoing maintenance costs.
- Provide recreational boating facilities to compliment and continue to enhance tourism activity and economic development within the area.
- Construct boat launching facilities to provide safe all weather and all year round launching and retrieval of emergency vessels.

With the establishment of the recreational boating facility at Kingston, the strategies to upgrade the boat launching facilities at Cape Jaffa can now be put in place in conjunction with the Cape Jaffa Anchorage Development.

4.0 The Objectives of the Development Plan

In 1999 Council, prior to the formulation of the Cape Jaffa Anchorage development proposal , commenced the preparation of a PAR, which included the Cape Jaffa settlement. Council's intention was to rezone the land to expand the residential, centre and commercial/industrial functions to enhance on the single zone policies and hence the uses to which the land could be put and extent of development possible at Cape Jaffa.

The current Kingston District Council Development Plan states the principles of development control and form of development at Cape Jaffa that primarily should accommodate residential development, tourist accommodation facilities, and facilities associated with the fishing industry. The objectives and principles of development control stipulate the form of development within the residential Cape Jaffa Policy Area 5, the Local Centre Zone and the Industry (Cape Jaffa) Zone.

The objectives of the Residential Zone are:

> *Objective 1:* A zone primarily accommodating detached dwellings located on sites of varying size with other forms of medium density residential development, district educational, recreational facilities, tourist accommodation and community facilities in suitable areas.
>
> *Objective 2:* The visual appearance of residential streets progressively improved through well designed dwellings, substantial front garden landscaping and street tree planting.

The objective of the Local Centre Zone is provision for a limited range of convenience services and facilities catering for the day to day requirements of local residents and visitors.

The objectives of the Industry (Cape Jaffa) Zone are:

> *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 and 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.

5.0 Contribution to Economic Development

The Cape Jaffa Anchorage Development has the potential to provide a major economic stimulus to the Kingston region as a residential, tourism and commercial project for residents and tourists. This section of the report provides estimates of the economic impact that the project could have on the regional economy over the lifetime of the project including both the Development and Operational Phases of the project.

A Microsoft Excel model has been developed to assess the economic impacts and an Input – Output methodology has been employed to model the impact of the development on the regional economy. 1995/96 Input - Output Tables for the South East Region of South Australia (developed by the South Australian Centre for Economic Studies) have been sourced as a methodology for assessing the economic impacts.

This economic impact assessment has been undertaken to identify the potential jobs and incomes that may be associated with the Cape Jaffa Anchorage Development. Job and income creation are critical elements of the social agenda for economic regions. Economic and social development are intertwined and there is a very strong correlation between economic growth and social indicators(eg: unemployment and crime rates). An accepted methodology for measuring economic outcomes, one that is used nationally and internationally, is to measure the value added and employment associated with investment or turnover outcomes. *Value added* is defined as the extent to which the local economy adds value to the product supplied, and essentially is the returns to labour and capital in the region for that activity – it represents the incomes to labour and capital. It is consistent with the predominant national measure of economic activity of Gross Domestic Product.

This value added and employment impact can be measured at two levels. Firstly there is the direct impact – the value added and employment contribution or share associated directly with the expenditure (eg the labour and profits involved in construction activity). Secondly there is the indirect impact – for example that associated with the suppliers to the construction service and the spend of wages. The following construction multipliers have been obtained from the Input – Output tables for the South East Region

Table 2 South East Region Construction Sector Multipliers ($1995/96)	
Employment ($'000)	**0.027**
Value Added ($m)	**1.5251**

The above multipliers mean that $1 million of construction output (in 1995/96) would have resulted in the employment of 27 persons (directly and through the multiplier effects). The value added (salaries, wages and profits) associated with this activity is $1,525,100.

The following sections of this report estimate the employment and value added impacts of the Cape Jaffa Anchorage Project on the region, based on the above multipliers. The following additional notes and assumptions are made:

- Value added is defined as returns to capital and labour (ie: salaries, wages and profits).

- Employment is defined as full time equivalent (FTE) employees.

- As the South East Region Input-Output tables were prepared in 1995 - 1996, they do not incorporate movements in the value of money (inflation) since that time. Without adjustment, this would result in an overestimation of the number of jobs generated per $1m of increased production. Australia's rate of inflation has fluctuated in recent years but has consistently been below 5%. A deflator of 2% p.a. is considered appropriate and is applied to new expenditures to adjust for inflation during the period 1995 - 2003.

- There may also have been structural and other changes in the regional economy during this time which are not reflected in the tables. For example, structural reform may have improved the efficiency of some industries thereby leading to shifts in the relationships between economic inputs and outputs.

- As this assessment is based on the Kingston (South East) region only, adjustments may have to be made for 'leakage' of economic activity from the region as in future people employed in the region and on the project may reside elsewhere.

- The Input-Output Tables provide multipliers across a broad range of industries. For the purposes of this assessment the construction sector's multipliers have been used as it is assumed that the majority of expenditure will go into capital works and other construction related economic activity.

5.1 The Development Phase

The economic contribution to be made by the project during the development phase will depend on the final nature and scale of the project. However, for the purposes of this Section

48 report, the assumptions in the following table are made based on advice from the Cape Jaffa Development Company:

Table 3
Development Schedule
(Source: Cape Jaffa Development Company)

Year	Major Construction Capital Expenditure (ie: Marina) ($2003)	Roll Out Capital (ie: Roads, etc.) & Maintenance Expenditure ($2003)	House Construction Numbers	Housing Construction Value ($2003)[1]
1- 2003	$542,000	$0	0	$0
2 – 2004	$9,656,842	$4,300,000	0	$0
3 – 2005	$1,773,754	$2,700,000	10	$1,750,000
4 – 2006	$28,400	$1,215,519	18	$3,150,000
5 – 2007	$3,686,837	$1,215,519	23	$4,025,000
6 – 2008	$14,200	$1,215,519	27	$4,725,000
7 – 2009	$14,200	$1,215,519	28	$4,900,000
8 – 2010	$0	$1,215,519	29	$5,075,000
9 – 2011	$1,876,476	$1,215,519	29	$5,075,000
10 – 2012	$0	$1,215,519	30	$5,250,000
11 – 2013	$898,657	$0	31	$5,425,000
12 – 2014	$0	$0	31	$5,425,000
13 – 2015	$0	$0	31	$5,425,000
14 – 2016	$0	$0	31	$5,425,000
15 - 2017	$0	$0	31	$5,425,000
Totals	**$18,491,366**	**$15,508,634**	**349**	**$61,075,000**

Based on the above assumptions and economic multipliers, the following annual economic impacts are estimated (an inflation factor of 2% p.a. has been applied to account for inflation since 1995/96):

[1] Assumes 25% of lots built on after 1 year and an average construction cost of $175,000

Table 4 Cape Jaffa Anchorage Development - Estimated Economic Impacts		
Year	**Broad Employment Impact (FTEs)**	**Value Added Impact ($)**
1- 2003	12	$ 827,000
2 – 2004	222	$ 21,286,000
3 – 2005	81	$ 9,492,000
4 – 2006	73	$ 6,701,000
5 – 2007	177	$ 13,615,000
6 – 2008	109	$ 9,082,000
7 – 2009	113	$ 9,348,000
8 – 2010	117	$ 9,594,000
9 – 2011	160	$ 12,455,000
10 – 2012	121	$ 9,861,000
11 – 2013	145	$ 9,644,000
12 – 2014	125	$ 8,274,000
13 – 2015	125	$ 8,274,000
14 – 2016	125	$ 8,274,000
15 - 2017	125	$ 8,274,000

(Note: The above estimated employment impacts are annual and not cumulative ie: employment associated with the project is expected to peak at 222 in year 2.)

In summary, there are potentially high employment and value added (salaries, wages and profits) 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. There is a challenge to ensure that the Kingston region captures as much of this economic benefit as possible by immediately putting in place appropriate strategies.

5.2 The Operational Phase

The economic contribution to be made by the Cape Jaffa Anchorage Project when operational will also depend on the nature and scale of the final development. However, it is expected that there will be the following economic outcomes over and above the development impact:

- Expenditure by new residents on local goods and services. It is expected that 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.

- Increased tourism visitor numbers, lengths of stay and expenditure in the region.

- An expanded professional fishing industry operating from the region.

- Increased recreational boating, including expenditure of $600,000 on facilities (assumes Council and State Government funding)

- New business investment opportunities in and in proximity to the development including tourism, aquaculture, retail and services to tourism and other industries.

The overall economic impact of the development in full operation is difficult to estimate as the nature of future tourism and other industry development is unknown. Also, longer term strategies of Council and the developers will contribute significantly to such impacts. However, as already noted, the Input-Output Tables for the South East Region provide multipliers across a broad range of industries. For the purpose of assessing the potential impact of additional resident and tourism expenditure, the wholesale/retail trade sector's multipliers have been used as it is assumed that the majority of expenditure will go into this sector.

The following regional value added and employment multipliers for the wholesale/retail trade sector have been extracted from the 1995 - 1996 tables:

1. Value Added ($) – 1.2098
2. Employment per $1,000 – 0.02667

Based on the economic multipliers identified above, a $1m injection from tourists, residents, etc could boost the regional economy by:

1. An additional $1,209,800 in value added (salaries, wages and profits).
2. An additional 22.7 total jobs per annum (adjusted for inflation).

Further, the 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, the demand placed on these services and the general service nature of Kingston will increase in line with resident and tourist increases. The development at Cape Jaffa and the continued development at Kingston will enhance each other and in this regard it is expected that there will be no unfair competition in the market place resulting from the development.

More detailed assessments of the economic issues and potential economic impacts of the operational phase of project will be undertaken for the Environmental Impact Statement.

5.3 Aquaculture Industry Development

As noted above, the Cape Jaffa Anchorage Development is expected to stimulate other industries and business investment especially in tourism, retail, services and aquaculture.

Aquaculture (principally Atlantic salmon and ocean trout) is in its infancy in the region but there is good growth potential. During the past 5 years a fledgling industry has developed, principally with land based hatchery and fish being transferred to sea cages for grow out. Two leases exist, with further applications imminent. 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 6 to 7 people including owners. Planned growth could see production increase to 500 tonnes p.a. by 2005 with an estimated value of $3.5m and employing up to 20 people. In order to achieve this potential, a range of infrastructure is required including:

- Improved wharf/jetty facilities.
- Compound factory processing site.
- Equipment storage and repairs.
- Electricity upgrade.

The Cape Jaffa Development has the potential to contribute to this infrastructure (eg: power) and stimulate future industry development.

5.4 Potential Economic, Industry and Social Development Strategies

Beyond the above construction and operational impacts, there is an opportunity for Kingston District Council, in association with other stakeholders, to put in place economic, industry and social development strategies to generate and leverage additional community benefits from the Cape Jaffa Anchorage Project.

The adoption or otherwise of a ‘place management strategy’ or other formal structure for the Cape Jaffa Anchorage Development is not the focus of this report. However, such strategies could be implemented by Council and/or be incorporated into agreements to be reached with the developer. They would have additional cost implications but would also have associated economic and social benefits. Any opportunities to leverage developer or government contributions to these strategies will obviously increase Council’s economic and social returns on the project.

Research undertaken by Hudson Howells highlights a gathering pace of adoption of ‘place management’ or integration strategies both interstate and overseas as a means of achieving better economic, social and environmental outcomes associated with project/precinct developments. This is attributable to the potentially high economic returns associated with integration expenditure and the leveraging of other private and public sector investment.

The overall objective therefore of implementing economic and social development strategies in tandem with the Cape Jaffa Anchorage Development would be to maximise sustainable employment growth which delivers social and environmental benefits to the Kingston community. In doing so Council 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.

As already noted, economic development occurs when a region’s per capita output increases. The result is an increase in incomes and, subject to the distribution of that income, an increase in employment as already demonstrated in this report. The employment increase can occur in the local region or be ‘leaked’ via the importation of goods and services from other regions, or the importation of labour.

Economic and social development strategies should therefore be formulated around objectives which will lead to an increase in the region’s per capita output. It is therefore considered that Council could develop and adopt strategies that focus on undisputable drivers of successful economic and social development and lead to sustainable income and employment outcomes including, for example:

***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, for example:

- New or upgraded commercial and retail properties.
- New commercial and retail businesses.
- New tourism assets (eg: a Visitor Information Centre).

- 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 expenditures by tourists, shoppers,,* etc. Economic development occurs when a region's per capita output increases. The result is an increase in incomes and, subject to the distribution of that income, an increase in employment. The employment increase can occur in the local region or be 'leaked' via the importation of goods and services from other regions, or the importation of labour. Import substitution strategies should therefore accompany strategies to increase demand via tourism and retail strategies. *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 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.

6.0 Local Community Consultation

Council has advised that the following community consultation has taken place in relation to the project:

Since the agreement of Council to support the Cape Jaffa Anchorage Development Proposal in June 2001 and further in January 2002, the Council has released concept plans and information relating to the development for the community 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 person to make comments both positive and negative on the development. In addition, this questionnaire was also used for interested person to lodge an expression of interest for possible investment in the project by way of residential allotments, marina berths, etc.

In July 2002, Council undertook a key stakeholder workshop that included elected members of Council, Cape Jaffa residents, the tourist park operators, rock lobster industry representatives, aquaculture industry representatives and recreational fishing representatives. 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 existing industry requirements and poor existing infrastructure, including the jetty, water quality, beach access, safety issues, mooring and launching/retrieval facilities. This consultation process with the key stakeholders greatly assisted in the formation of a revised concept plan that recognized the input and issues raised during the workshop.

More recently, Council and the developer on 7 March 2003 conducted a meeting with residents of Cape Jaffa, which advised of the release of the issues paper for the preparation of the guidelines of the Environmental Impact Statement required as part of the development application process. This meeting was well attended by residents from Cape Jaffa and other interested person that had direct links mainly with the professional fishing industry and recreational boating within the area.

In addition, Council on 9 April 2003 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 60 interested members of the public. Several issues were discussed and general support for the project was evident.

Throughout the consultation process, it has been emphasised to the community that members of the public can provide information to the Council, CJDC and also the Major Developments Panel in order to influence, inform or contribute to the project and its outcomes. The Council and CJDC recognise the importance of consultation with the community to ensure that every opportunity is provided to forward a valuable contribution towards the outcome of the development.

7.0 Consultation and Data Collection

7.1 Council

Council staff were consulted as necessary during the preparation of this report in order to obtain information that would assist an assessment of the impact of the Cape Jaffa Anchorage Development on Council services. Staff were also consulted to obtain information necessary to construct the financial model used to assess the overall impacts of the development on Council's financial position.

7.2 Cape Jaffa Development Company

The Cape Jaffa Development Company was consulted throughout the project to obtain information regarding financial and timing aspects of the project in order to assist the assessment of the financial impacts on Council. Specific information sought from the developer included:

1. Anticipated selling program by type by year by average unit values;
2. Anticipated commercial/tourism selling program by type by year by unit value;
3. Expected occupancy (number of adults, number of children) by dwelling type;
4. Length of roads in kilometres;
5. Length of footpaths in kilometres and average width;
6. Length of promenades in kilometres and average width;
7. Area of parks, playgrounds and reserves in hectares;
8. Capital costs of infrastructure, effluent system, wharfs, marina, parks, etc. that will be transferred to Council; and
9. Timing of infrastructure transfer to Council ownership?

This process necessitated a range of assumptions being made regarding the development based on past practices, other development projects or simply estimates based on known project parameters. All assumptions and estimates were forwarded to the developer for review and comment if any of the assumptions were considered to be ‘outside normal expectations or parameters’.

The Kingston District Council was also consulted extensively during the project to obtain information relating to the proposed development and especially the potential impacts on Councils revenues and expenses.

Section 8 of this report contains all assumptions made in undertaking this study.

8.0 Financial Model

8.1 Model Development

A financial model has been developed in Microsoft Excel to assist with the assessment of implications for rate revenue and to estimate financial costs to 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.

The Section 48 requirements for this study limit the financial analysis to the estimation of:

- Revenue projections and potential financial risks.

- The recurrent and whole of life costs associated with the project.

- The financial viability (from Council's perspective) of the project and the short and longer term estimated net effect of the project on the financial position of the Council.

However, in undertaking this work and developing the financial model, it was decided that Council would get a more comprehensive analysis and superior basis for assessing future decisions if the analysis was extended to incorporate a full discounted cash flow analysis and sensitivity analysis. This additional work has resulted in a model which not only estimates all Council's expected revenues and costs, but estimates an expected overall financial impact on Council and provides for 'what if' scenarios should Council wish to alter any key assumptions to test the sensitivity of findings.

8.2 Model Approach and Key Assumptions

8.3.1 Overview

As noted earlier in this report, 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. This assessment and the assumptions supporting the assessment are contained in Appendix 1 – Assumptions.

The financial model uses a 15 year evaluation period starting June 2005, 12 months prior to completion of Precinct 1, and ending in June 2022. The last currently programmed stage may be completed by June 2016, so the evaluation period includes at least 2 years of post development conditions to cater for the developer to council infrastructure handover. In the scenario prepared for this report, the selling rate is that provided confidentially by the developers. Within the project period, further changes may arise from project refinements and regulatory requirements. Beyond the project period there may be further sales and developments that are not taken into account in this exercise.

8.3.2 Land, Marina Property and Improvements

The following rateable property types are assumed to emerge from the project

“Wet” allotments

236 “Wet” allotments at an average rateable value of $175,000 each.

“Dry” allotments

165 “Dry” allotments at an average rateable value of $125,000 each.

Commercial allotments

25 allotments at an average rateable value of $40,000 each.

“Fingers”

199 “Fingers” or personal marine craft landings extending from wet allotments at an average rateable value of $22,000 each.

Marina berths - Commercial

50 berths at an average rateable value of $50,000 each or their equivalent under community title.

Marina berths - Recreational

40 berths at an average rateable value of $35,000 each or their equivalent under community title.

Building Improvements

Improvements resulting in an average rateable value increase of $170,000 occur at a monthly rate of 2% on the stock of unimproved allotments sold.

8.3.3 Council Rates

Rate Structure

All rateable property is assessed at the residential rate of 0.63 cents in the dollar of rateable property value.

Rate Timing

Any rateable property becomes first assessable for its full year's rates starting the 1st of July following the date of its sale and council rates become payable in 4 quarterly instalments starting in the following September.

Rateable Value

There is no escalation factor assumed over the duration of the project.

Assignment to the Council Marina Maintenance Fund

A special purpose fund to provide for infrastructure related remedial costs (if required) will be funded by allocating 50% of rates raised from all rateable land based property including related improvements in the development area over a 5 year period commencing upon rates becoming first payable for each property. The eventual impact on Council is not determinable as the relevant cost obligations on this fund are not foreseeable with certainty, and the terms and conditions of the fund are not yet determined. For the purposes of this model, the value of the fund is treated as an asset of the Council.

Application of Increased Rate Revenue

The model applies estimated changes in rate revenue to estimated changes in Council operating expenditures. Any surplus or deficit is not further dealt with as the purpose of this exercise is to assess the degree and nature of fiscal impact during the development period.

It should not be assumed that this surplus or deficit would necessarily become an actual outcome as it will be further dealt with by Council in ways that are beyond the scope of this report, for example rate reductions or changes in the level or range of services provided to the community.

<u>Other Revenue Considerations</u>

The Commonwealth Grants Commission funding for the council will be influenced by a number of factors including average property values in the council area relative to the South Australian State average, and population changes. These latter two factors tend to offset each other but the overall year to year effect of these changes cannot be determined without further assistance from the commission and additional assumptions.

8.3.4 Infrastructure Completion

The model assumes infrastructure associated with each stage is completed by 9 months after stage commencement. The expected program is detailed in the following table:

Table 5 Expected Development Program	
Stage	**Expected Start Date**
1	Jan-05
2	Jan-05
3	Jan-06
4	Nov-07
5	Jul-11
6	Jul-13
7	Jul-15

8.3.5 The Developer's Marina Maintenance Fund

$2,000 for every allotment, excluding 'fingers' and berths, will be set aside by the developer 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 4 years after the infrastructure pertaining to that stage is completed to a satisfactory standard to council. The amount transferred will be the $2,000 per allotment sold during that 4-year period out of the allotments available from that stage, less any marina infrastructure related remedial costs incurred.

The eventual impact on Council is somewhat uncertain as the relevant cost obligations on this fund are not foreseeable with certainty. For the purposes of this model a provision of $3 per month of relevant cost per 'wet' allotment expected to be in existence in that month has been deducted from the accruals to the value of the fund. This proportionality to the number of 'wet' allotments expected to be in existence is approximately proportional to the stage by stage rollout of marine infrastructure and hence the degree of liability for its cost related to timing. The value of relevant cost obligations on this fund (if any), however, are not foreseeable with certainty and may significantly exceed or fall below the nearly $70,000 of costs provided for in this model over the development period.

For the purposes of this model the net value of the fund is treated as an asset of the Council as ultimately all unused monies in this fund are intended to be transferred to council.

8.3.6 Marina Basin

The developer must maintain at its cost the marina basin in a navigable condition for 8 years after the infrastructure pertaining to the basin is completed to a satisfactory standard to council.

After that period, the marina basin asset, its responsibility and ongoing maintenance cost is transferred to Council. An amount of $15,000 p.a. in maintenance costs has been allowed for this purpose but is uncertain as it is highly dependent on environmental factors and construction options outside the scope of this model and not yet fully evaluated by other investigations at the time of writing this report.

The expected Government funding has not been included in the model at this stage.

8.3.7 Roads, Verges and Other Public Infrastructure Assets

The developer must maintain at his cost roads, verges, street lighting, common service trenches, electricity distribution systems, and sewer & water reticulation systems in a satisfactory condition for 2 years after the infrastructure in each stage is completed to satisfactory engineering standards.

2 years after each stage is completed, these assets, their responsibility and ongoing maintenance costs transfer to Council. Annual costs to maintain each of these assets has been allowed using estimates based on Council historical records and other experience or estimates where necessary. These are tabled in Appendix 1.

The program for roads, footpaths and open space/reserves is detailed in the following table.

Table 6
Other Infrastructure Program

Stage	Roads, kms	Footpaths, kms	Open Space, ha
1	0.62	0.60	-
2	1.30	1.30	4.40
3	0.53	0.53	5.15
4	1.70	1.70	0.42
5	0.60	0.60	7.91
6	0.48	0.48	-
7	-	-	-

It is assumed that the maintenance costs of coastal dune open space and coastal reserve to be handed over to Council in Stage 1 are insignificant.

8.3.8 Resident Population

The new permanent resident population within the development area has been estimated using current trends in Kingston Township. A usual ratio of 2.5 people per residence has been adjusted to 2.25 to recognise that a higher proportion of retiree couples are expected to live in the area. This lower ratio has been further reduced by 20% to account for the percentage of residences used for holiday home owner purposes. This therefore represents a conservative estimate.

8.3.9 Selling Program

The selling program is based on forecasts by the developer and has not been independently reviewed.. Early indications, resulting from prospective purchasers registering an expression of interest following public meetings, suggest the forecast is achievable in the early development period. However, the present expressions of interest may not be realised if property market conditions change in the future. The timing of sales is a significant factor in determining Council rate revenue.

The sales forecasts by the developer was expressed in calendar years. Council rates are based on June 30 fiscal years. The model converts the developer's calendar sales forecasts to estimated June 30 fiscal year sales by assuming:

- All 2004 calendar year sales occur in the 2005 fiscal year.
- From 2005 to 2014, 50% of each calendar years' sales are attributed to the fiscal year ending June 30 within that calendar year and the other 50% to the following fiscal year.
- All 2015 calendar year sales occur in the 2015 fiscal year.

8.3.10 Shadow Effect

The 'shadow effect' is a future indirect effect, which is heavily dependent on the degree of integration and association of surrounding areas with the style and features arising from the development. The most pronounced effect will be on properties in the immediate vicinity of Cape Jaffa used or capable of being used for residential, commercial or related purposes.

There are currently 29 rateable properties including 5 commercial lots with an aggregate value of $2.9M. Some adjoining lots are used in combination.

It is assumed that these will enjoy an upward revaluation of 30% early in the project life and will contribute to additional rate revenue.

Any revaluation of proximate rural property values has been ignored as there is no certainty that a change in land use status would be approved.

There is also a likelihood of a broad but lower shadow effect leading to an increase in general property values throughout the Kingston area, particularly the Kingston township. The aggregate valuation change from this broad effect will be significant but no benefit from rate revenue has been attributed to Council as, under existing policy and rate determination history, the most likely effect will be some degree of an offsetting reduction in council's rate in the dollar determination. *This could, however, give rise to a significant saving in the hands of the rate paying community and would have obvious regional economic benefits.*

8.3.11 STED Scheme

The cash flows from Council's operation of the Cape Jaffa STED scheme are not shown as they are assumed to be cash flow neutral based on a the self funding principal adopted by Council. The STED scheme is covered by a service rate charge on properties which includes maintenance and future asset replacement.

8.3.12 Financial Assumptions

Under the Heads of Agreement and the Development Agreement, Council will access funds from the Local Government Financing Authority (LGFA) for the purchase of land and associated costs and Cape Jaffa Development Company will pay

- The interest, costs and fees associated with the LGFA Facility as and when they fall due; and

- The principal under the LGFA Facility on the sale of allotments in accordance with the schedule contained in the Development Agreement.

There is therefore no lasting effect on Council's cash position from these transactions which have been ignored in the financial model.

All dollar figures are expressed as 2003 real (before inflation) dollar equivalents and there has been no adjustment for:

- General inflation.
- Real wage cost growth.
- Property revaluations.

Accordingly, a real discount rate of 7% is used for all present value calculations. This rate incorporates the opportunity cost of future real cash flows relative to a cash flow at the present time and a provision for risk.

There has been no refinement for annually recurring seasonal patterns for the incidence of program costs.

A contingency provision of 10% has been allowed for on costs in this model.

8.3.13 Asset Renewals and Depreciation

Asset renewal expenditure incurred during the project period is shown as either a single outlay or as a series of costs that equate to the asset renewal cost cumulatively over time.

The liability to Council to renew long life assets has not been evaluated within this model framework. Detailed infrastructure costings are not available but based on limited information, of an estimated $34 million of developer's capital expenditure there may be about $16 million of depreciating long life assets that could eventually become Council's responsibility for replacement. Assuming an average 40 year life, an annual sinking fund provision of $260,000 p.a. would accrue sufficient funds at a real rate of interest of 2% p.a. to cover their replacement. The assets not requiring renewal at Council's additional expense that could be identified at the time of this report were the sea channel, breakwater, dredged entrance, main basin/waterways, dewatering, revetment & 1m high wall, electricity infrastructure, sewer, water, boat ramp, common ramp, stormwater, engineering/planning/project management, others and contingency costs.

The depreciation component in each expense item has been excluded where significant. An inclusion of depreciation, whose nature is to estimate decline in asset value, would necessitate the inclusion of the value of the assets transferred to Council in order to be consistent. Such an inclusion would not reflect the fiscal impact on Council as there is no cash flow effect from either depreciation or the transfer of assets that have in any case not yet been well defined. It would also entail a determination as to whether the present value of contingent future liabilities associated with these assets should also be taken into account.

9.0 Financial Analysis and Viability

This section of the report details the findings of the financial analysis based on the criteria and assumptions contained in Section 8. The analysis has been undertaken over a 15 year period which approximates the expected life of the development project. It is important to recognise that the findings are also based on revenue and cost data supplied by the developer and Council and that these data have not been independently sourced.

The results of the detailed financial analysis, including the confidential sales timing and revenue data supplied by the developers, are contained in the confidential Microsoft Excel model developed and used by Hudson Howells for this study.

9.1 Implications for Rate Revenue and Financial Costs

Table 7 on the following page 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 being:

1. 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; and

2. 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.

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 can not be accurately determined as the extent of ‘integration’ activity has yet to be determined.

Table 7

Summary of Rate Revenue and Financial Impacts

(Rounded to $ '000)

Item	Impact	Comments
Estimated NPV[2] of additional rate revenue in the development area.	$ 4,128,000	Includes residential, commercial 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.

2 15 year Net Present Value (NPV) @ 7% discount rate.

Rate Revenue

The above estimates for rate revenue and overall benefit to Council may be conservative for the following reasons:

1. 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.

2. It is expected that Council and the developer 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:

1. The potential for matching ‘integration’ funds from other sources including State and Commonwealth Government programs and the developer.

2. The potential for better access to Commonwealth and State Government grant and industry assistance funds.

9.2 Existing Council Infrastructure

Based on consultation with staff, Council has very little existing infrastructure within the development area.

Council has some roads in the development area, however these will be closed/moved and incorporated into the new development.

It is therefore assumed that if the Cape Jaffa Anchorage Development did not proceed, Council would retain only a minimum financial obligation in the development area.

10.0 Risk Management

In undertaking the financial and economic assessments contained in this Section 48 report, some potential risks have been identified from Council's perspective and are included in the following table. It is stressed however, that there are potentially many other risks, outside the scope of this report, that may arise from, for example, the Environmental Impact Statement or other legal, technical and specialist advice received on the project.

Table 8
Potential Risks

Potential Risk	Comments
The developer being unable to complete the development and/or being unable to meet its principal and interest repayments under Councils LGFA loan obligations, including associated litigation risks.	Council is managing this risk through the Infrastructure Development Agreement which state that the obligations of the parties are subject to and conditional upon Cape Jaffa Development Company providing to Council security by way of Bank Guarantees in a form acceptable to Council, first, in an amount of $200,000.00 on or before 15 August 2003 ("first Bank Guarantee") and, within 30 days thereafter, taking into account the first Bank Guarantee, in amounts that are required to provide security to Council equal to the purchase price that would be payable by Cape Jaffa Development Company from time to time upon exercise by Council of the Put Option in the Development Agreement.
Interest rate risk	If the developer pays for land sold, or makes an early payment requiring the loan to be repaid, there may be a capital gain or loss on the loan if market interest rates at the time of repayment have changed from the time of entering into a fixed rate loan agreement with the LGFA, and it is the fixed loan part (a combination of fixed and variable loans is possible for the $2.1 million loan) that is to be repaid ahead of maturity.

Table 8 Potential Risks	
Impact on Council's borrowing capacity	Council has advised that the LGFA have advised that the Council's future borrowing capacity will not be affected by this project because of the bank guarantee provided by the developer and other relevant arrangements with the developer.
LGFA security over Council's rate revenue	The LGFA will have security over Council's rate revenue for the loan, not over the land.
Public liability risk	Adequate cover should be included in Council's insurance.
Infrastructure risk	Infrastructure transferred to Council may not perform to Council's standards. However, Council has advised that the agreement with the developer provides to Council a greater level of development control than would normally exist in a development.
Financial model results risk	There is a risk if any of the financial model variables and assumptions are not applicable to the Cape Jaffa development situation. For example, a slower selling program will result in lower rates.

Risk management will be important throughout and beyond the project. It is understood that a management structure will be put in place that will have Council representation on relevant project groups and other management committees that will oversee the implementation of the project. This should ensure that Council has ongoing involvement in the construction of the project and also any alterations to the design.

11.0 Project Arrangements

The appropriate mechanisms and or arrangements for carrying out the project have been subject to considerable discussion between Council, Council's solicitors and the Cape Jaffa Development Company. It was considered by Council that a facilitation approach towards the project would be the most appropriate mechanism to have in place based on Council's involvement in the purchase of the land and also to assist with obtaining Government grant funding and other Government assistance associated with the project.

The Infrastructure Development Agreement provides for the following:

Project Control Group

The purpose of 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 following provisions shall apply to the operation of the Project Control Group:

- *the Project Control Group shall consist of three (3) representatives of Council and three (3) representatives of CJDC;*
- *the Project Control Group shall meet at least once per calendar month during the currency of the Infrastructure Development;*
- *the Project Control Group will receive from CJDC reports on the progress of the Infrastructure Development including the proposals and budgets for the Infrastructure Development and authorise representatives of the Parties to sign contracts and agreements in relation to the Infrastructure Development;*
- *CJDC will ensure that complete minutes shall be made and taken of each of the Project Control Group Meetings and the decisions made therein. A copy of these minutes shall be distributed to the Parties following each meeting;*
- *any decision of the Project Control Group must be passed by a majority of the members of the Project Control Group to be valid and binding provided that if a majority decision cannot be reached then the provisions of Clause 11 shall apply;*

- *either Council or CJDC may at any time on 48 hours notice call a meeting of the Project Control Group;*

- *one (1) representative of Council and one (1) representative of CJDC will form a quorum;*

- *each Party may from time to time replace a representative appointed by it;*

- *each Party will give written notice to the other of the appointment and replacement of its representatives and may do so by notice tabled at any meeting of the Project Control Group. Such notice will provide the date from which the appointment is to take effect and will be recorded in the Minutes of such meeting; and*

- *a representative may be accompanied at a meeting of the Project Control Group by such other person as such Party's representative invites to attend with the prior approval of the other Party.*

In addition, a Project Liaison Group will be established which provides a regular forum for representatives of CJDC and Council to discuss and exchange ideas in relation to the whole of the development area.

12.0 Conclusions

In conclusion, it is highlighted that the purpose of this study was to provide information for consideration by the Kingston District Council that addresses the prudential requirements of Section 48 of the Local Government Act.

This report addresses the specific requirements of Section 48 and, in relation to the revenue and cost implications for Council, identifies a potential NPV benefit to Council over the 15 year development period estimated to be $2,762,000 million incorporating all rate revenue benefits (direct and shadow) and all major cost implications. This benefit excludes any 'sinking fund' provision that may be required for the replacement of long term assets.

Economic issues addressed in this report identify the potentially high employment and value added (salaries, wages and profits) 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. There is a challenge to ensure that the Kingston region captures as much of this economic benefit as possible by immediately putting in place appropriate strategies.

The overall economic impact of the development in full operation is difficult to estimate as the nature of future tourism and other industry development is unknown. Also, longer term strategies of Council and the developers will contribute significantly to such impacts. However, it is estimated that for every $1m injection from tourists, residents, etc. the regional economy could be boosted by:

- An additional $1,209,800 in value added (salaries, wages and profits).
- An additional 22.7 total jobs per annum (adjusted for inflation).

Further, the development will also enhance the status of Kingston as a significant regional service centre with ongoing development potential. With Kingston currently offering a good level of health services, education, aged care facilities, shopping and commercial businesses, the demand placed on these services and the general service nature of Kingston will increase in line with resident and tourist increases. This is expected to present new development and investment opportunities as the development proceeds.

APPENDIX 1 – Assumptions

Section A. Rate Table

		Rate in the $
Rate - Residential		$ 0.0063
Rate - Rural		$ 0.0054
Rate - Rural Living		$ 0.0590
Minimum Rate		$ 345.00
STEDS levy	Per Property	100

Section B. Non integration, non discretionary additional expense assumptions exclusive of significant depreciation at 2003 prices

Additional Council Costs		Units	Unit Cost $pa	Adj factor	Project Area Cost	Ongoing	Other Notes, Assumptions
1#1 - Aboriginal Cultural Issues	SR						Pending EIS
2#17 – Strategic & Corporate Planning	SR				20,000	N	New PAR
3#24 - Tourism and Special Events	SR	1	3,000	60%	4,800	Y	60% extra attendees at Cape Jaffa Seafood & Wine fair
4#25 - Urban Development	SR						
5#26 - Footways - Construction	SR						
6#27 - Footways - Maintenance	SR						Broad sealed areas cleaned during CFS practices
7#27a - Footways - Maintenance	SR		1.00		1	Y	Estimated average cost / m2
8#36 - Storm Water Drainage - Maintenance	SR	10	267	0%	267	Y	Maintenance on 10 drainage bores
9#37 - Traffic Management - Capital	SR						Paid by the developer
10#40 - Development - Planning Assessment & Monitoring	SR	0.5	60,000	35%	40,500	N	0.5 FTE extra Officer @ $60K pa / FTE + 35% on costs
11#41 - Development - Building Assessment & Monitoring	SR						
12#49 - Parking - Signage	SR						
13#49a - Parking - Capital Facilities	SR						Developer
14#49b - Parking - Capital Facilities	SR						Developer
15#54 - Waste Management Services - property collection	SR		67		67	Y	At council's average cost assuming a $78,000contract for 1,100 dwellings, 30 rural points & 40 commercial
16#54a - Waste Management Services - Landfill	SR		10		10	Y	At council's expected variable cost of $12,000 for 1,100 dwellings, 30 rural points & 40 commercial
17#54b - Waste Management Services - Street bins	SR	12	$ 65.00		780.00	Y	At council's average cost of $65 pa / bin

18#67 - Public Conveniences	SR	1	100,000		100,000	N	Estimated Cost Operational costs including cleaning, vandalism, insurance, lighting, Emergency Services Levy, water, consumables and
19#67a - Public Conveniences - maintenance	SR		5,000		5,000	Y	sundry maintenance
20#76 – Sport & Recreation (Passive) - Maintenance	SR		5,417		5,417	Y	At council's average cost / ha
21#42 – Development - Policy Review and Environmental Management	SR						
22	SR						
23#16 - Risk Management	SR				-		Covered within council's existing insurance policies
24#19 - Publicity Service	SR				-		Provided for in line 3 - Tourism and Special Events for the Cape Jaffa Seafood and Wine Fair
25#33 - Roadways - Maintenance (Pavement)	SR		-		-		No cost for 20 years. Thereafter reseal when necessary at $4.50 / m2 @ ave 10 m width
26#34 - Roadways - Maintenance (Kerb & Water Table)	SR						
27#38 - Traffic Management - Maintenance	SR						
28#39 - By-Laws & Local Govt Act - Inspectorial	SR				-		Within current capacity
29#44 - Environmental Management	SR				-		see Foreshore Management #45 at line 66 below
30#47 – Infrastructure – Power & Lighting	SR		151.20	0%	151.20	Y	1 light / 50 m applied to combined length of roads @ $7.56 /light implies $151.20 per km of road
31#48 - Parking - Inspectorial	SR						
32#50 - Street Care - Tree Planting	SR				-		By developer (if any)
33#51 - Street Care - Tree Maintenance	SR				-		no trees expected
34#53 - Street Care - Street Cleaning	SR				-		no trees expected
35#56 – Community & Visitor Information	SR				-		Within current capacity
36#65 - Libraries - resource materials	SR				-		Contribution rate changes when population changes by 5,000 from previous change
37#65a - Libraries - fittings	SR				-		Use school library facility
38#68 - Community Centres and Halls - upgrade	SR				-		Within current capacity
39#68a - Community Centres and Halls - running costs	SR				-		Within current capacity
40#75 - Sport & Recreation (Passive) - Capital	SR				-		
41	SR				-		
42#2 - Community Development	SR				-		
43#3 - Community Grants	SR				-		

44	#4 – Community Volunteers	SR				-		
45	#5 - Crime Prevention	SR				-		
46	#6 - Youth Development	SR				-		
47	#57 - Community Bus	SR				-		
48	#58 – Community Services	SR				-		
49	#8 - Computing Services	SR	0.5	35,000	35%	23,625	Y	Covers #8 - 15, 18, 20 & 43, mainly rates notice management and incidentals
50	#9 - Finance Management	SR				-		0.5 FTE extra Officer @ $35K pa / FTE + 35% on costs
51	#10 - Geographical Information System	SR				-		See above
52	#11 - Human Resource Management	SR				-		See above
53	#13 – Property Management	SR				-		See above
54	#14 - Rates	SR				-		See above
55	#15 - Records Management	SR				-		See above
56	#20 - Commercial Activities	SR				-		See above
57	#43 - Dog and Cat Management	SR				-		See above
58	#18 - Customer Support Services	SR				-		See above
59	#22 - Private Works	SR				-		
60	#23 - Regional Strategy	SR				-		
61	#28 - Infrastructure Support - Capital	SR				-		
62	#29 - Infrastructure Support - Operating	SR				-		
63	#31 - Plant & Machinery - Operating	SR				-		
64	#32 - Roadways - Construction	SR				-		
65	#35 - Storm Water Drainage - Construction	SR				-		
66	#45 - Foreshore (Coast Care)	SR		35,000		35,000	Y	Foreshore management and beach cleaning starts immediately to boost marketability
67	#46 - Health Services - Water Catchments	SR				-		
68	#52 - Street Care - Grass Control	SR				-		
69	#55 – Governance	SR				-		No extra councillors
70	#59 – Health Services - Communicable & Infectious Disease Control	SR				-		
71	#60 - Health Services - Food Safety & Nutrition Services	SR				-		
72	#61 - Health Services - Health Care & Welfare Services	SR				-		Not applicable - hostel type regulation
73	#62 - Libraries	SR				-		none
77	#69 - Foreshore & Marina - Capital	SR				-		none

78	#70 - Marina - Maintenance	SR	15,000	15,000	Undeterminable pending EIS. Starts July 2013
80	#72 - Sport & Recreation – Recreation Development	SR		-	none
81	#73 - Sport & Recreation (Active) - Capital	SR		-	none
82	#74 - Sport & Recreation (Active) - Maintenance	SR		-	none
83	#12 - Organisation Development	SR		-	none
84	#30 - Plant & Machinery - Capital	SR	35,000	35,000	1 vehicle (also to be used for dredge towing) and small equipment
85	#7 - Cash Management Reserves, Sinking and Trust Funds, Loans and Finance Leases, Provisions	SR		-	none
Section C. - Outside the area					
	#24 - Tourism and Special Events			-	
	#24a - Tourism and Special Events- Lighthouse Area			-	
	#24b - Tourism and Special Events- Lighthouse Area			-	
	#50 - Street Care - Tree Planting			-	
	#51 - Street Care - Tree Maintenance			-	
	#50b - Street Care - Tree Planting Adjacent Areas			-	
	#51b - Street Care - Tree Maintenance			-	
	#76 – Sport & Recreation (Passive) - Maintenance			-	
	#37 - Traffic Management - Capital				
C1	#37a - Cnr Cape Jaffa Rd & Southport Highway		20,000	20,000	Once off upgrade.
C2	#37b - Sealing Limestone Rd completion		400,000	400,000	Once off upgrade.
C3	#38 - Traffic Management - Maintenance		- 1,500	- 1,500	Savings to above road due to sealing
	#47 – Infrastructure – Power & Lighting			-	
	#49a - Parking - Capital Facilities			-	
	#49b - Parking - Capital Facilities Operating Expense			-	
	Public Art			-	
Section D. - Financial Ratios, etc					
	Discount Rate	7%			
	Contingency Provision	10%			
	Permanent Population Density per Occupied Dwelling	2.25			

APPENDIX 25

Cape Jaffa Development Traffic Assessment, Tonkin Consulting, December 2004, Ref No 20010779 LA7/PCS/PCS

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au

MOUNT GAMBIER
JONES TONKIN
1 KRUMMEL STREET
MOUNT GAMBIER SA 5290
PO BOX 1192
MOUNT GAMBIER SA 5291
T +61 8 8723 5002
F +61 8 8723 5004
E mtgambier@tonkin.com.au

20010779LA7/PCS/PCS

20th December 2004

Mr Rob Gabb
Cape Jaffa Development Company
PO Box 150
BRIGHTON SA 5048

Dear Rob

CAPE JAFFA DEVELOPMENT – TRAFFIC ASSESSMENT

As requested, we have considered the possible traffic impacts associated with the Cape Jaffa Marina both during the construction period and once fully developed/operational, and offer the following comments.

<u>Construction Effects</u>

The majority of construction traffic will travel to and from the site via the Cape Jaffa Road and Limestone Coast Road. Construction traffic will predominantly consist of standard semi trailers and some B-Double, 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).

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.

All vehicles that travel on public roads will be subjected to legal load limitations. 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 a detrimental impact on the road pavement structure. The existing road construction should be adequate to withstand the traffic loadings.

All vehicles leaving site will be required to pass over a cattle grid type shaker ramp to ensure that any loose sediments or materials are contained on the site and minimise the transportation of sediment from construction sites on to public roads or adjacent properties via the wheels, chassis and sides of vehicles. If muddy conditions are experienced, facilities will be provided for vehicles to be washed down on the pad prior to leaving the site. This will be a necessary practice in muddy conditions where the shaking action of the pad is not sufficient to dislodge material attached to the outside of the vehicles.

Operational Effects

The design of road network will be based on current 'best practice' and will maintain accessibility for anticipated users while controlling excessive speeds. 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.

The redevelopment will see beneficial changes to traffic movements within the existing 'township'. In particular, movements to/from commercial fishing activities will now be directly to / from Cape Jaffa Road rather than along King Drive. The 'Jetty precinct' will be provided a new road from Rothalls Road. Access to the beach area will be via the proposed 'collector' road on the eastern boundary and a car park / walkway Access to the caravan park will be maintained via Rothalls Road.

We have undertaken a traffic generation assessment for the new residential development based on the NSW Guide Traffic Generating Guidelines. However, we have reduced the likely number of daily trips per residence, on the basis that the development will not be a 'typical' metropolitan residential development and there will be significant seasonal influences in actual traffic volumes.

For example, while the NSW Guide prescribes a traffic generation of 9 trips per day for a standard residential development, this figure is based on new metropolitan residential developments, which are influenced by trips to/from employment, shops, schools, etc. and are predicated on a proportion of trips on public transport. As such, the figures aren't all that applicable for the Cape Jaffa Marina, the nature of which will be substantially different from a typical metropolitan residential development.

With regard to trips made external to the development, we have also had to broadly estimate the proportion of trips that will be made on the sealed Kingston Road or the unsealed Limestone Coast Road. Variables include the proportion of 'trips' that will actually be external to the Cape Jaffa development, and how many are likely to/from the north (Kingston) or east and south (Limestone Coast). The NSW Guide suggests that in metro areas, around 25% of trips are internal to the precinct, but again this can only be used as a rough guide for Cape Jaffa.

Recognising the variables in estimating traffic volumes for the overall development we submit the following information as a guide to the likely traffic generation and distribution patterns associated with Cape Jaffa (assuming it is constructed in its entirety).

Number of residential allotments	550
Trips per day based on NSW Guide (9 per household)	4,950 vpd
Trips per day based on 'more likely' scenario (6 per household)	3,300 vpd
Allowance for tourist traffic	500 vpd
Allowance for commercial / fisheries traffic	500 vpd
TOTAL PEAK TRAFFIC GENERATION OF DEVELOPMENT	**4,300 – 5,950 vpd**
TOTAL OFF PEAK TRAFFIC GENERATION OF DEVELOPMENT	**2,580 – 3,570 vpd**

(Off peak traffic has been estimated at 60% of peak traffic generation)

Note that 'trip generation' is a one way movement. That is a journey from a home to Kingston and back to the home equates to two "trips".

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.

As previously acknowledged, the NSW Guide for (Metro) Residential Developments suggests that 25% of trips are local to the precinct. We have no basis to suggest that this figure will be different at Cape Jaffa.

Taking the 'more likely' scenario (6 trips per day per household), the residential trip generation of the development might be in the order of 3,300 vpd (peak summer) and 1,980 vpd (off peak winter). If 25% of these trips are internal / local, then the number of external residential trips could be in the 1,485 – 2,475 vpd. Assuming that all of the tourist and commercial trips are external, provides the following table.

Estimated External Trips – Peak Summer

Residential trip generation	2,475 vpd
Allowance for tourist traffic	500 vpd
Allowance for commercial / fisheries traffic	500 vpd
TOTAL	3,475 vpd

Estimated External Trips – Off Peak Winter

Residential trip generation	1,485 vpd
Allowance for tourist traffic	300 vpd
Allowance for commercial / fisheries traffic	300 vpd
TOTAL	2,085 vpd

As previously noted, it is very difficult at this stage to estimate how this traffic might distribute between the sealed road to/from Kingston and the unsealed Lime Stone Coast Road. A 50:50 split would mean that each road would have an additional traffic load of 1,042 – 1,738 vpd (i.e. approximately 500 – 870 vehicles in each direction). In many respects it is likely that more traffic will use the unsealed Lime Stone Coast Road, as this provides access to the general south east area, Mount Gambier and Victoria. A 40:60 split (i.e. 40% on the sealed Kingston Road) could result in 1,251 – 2,085 vpd on the Lime Stone Coast Road.

Overall, the level of traffic movements expected are considered to be well with the capacity of the existing wider road

Yours faithfully
TONKIN CONSULTING

Paul Simons
Technical Specialist Road Safety and Traffic

APPENDIX 26

Acid Sulphate Soil Investigation and Management, Tonkin Consulting, December 2003, Ref No. 20030318RA3

Kingston District Council and
Cape Jaffa Development Company

Cape Jaffa Anchorage Marina

Acid Sulfate Soil Investigation & Management

Principal Contact
Melissa Salt

December 2003
Ref No 20030318RA3

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au

MOUNT GAMBIER
JONES TONKIN
1 KRUMMEL STREET
MOUNT GAMBIER SA 5290
T +61 8 8723 5002
F +61 8 8723 5004
E mtgambier@tonkin.com.au

Table of Contents

Kingston District Council and Cape Jaffa Development Company
Cape Jaffa Anchorage Marina
Acid Sulfate Soil Investigation and Management

Tables

Figures

Appendices

Document History and Status

Rev	Description	Author	Rev'd	App'd	Date
A	Draft for comment	MS	GRP		

Executive Summary

Kingston District Council and the Cape Jaffa Development Company are proposing to develop an anchorage marina to provide mooring for the commercial fishing industry and develop tourist and residential facilities adjacent to the existing township of Cape Jaffa, south-east South Australia.

The proposed development was declared a Major Development, indicating it is considered to be of major environmental, social and/or economic importance. The Major Developments Panel determined that an Environmental Impact Statement (EIS) was required and prepared guidelines to aid the proponent in preparing the EIS.

Acid Sulfate Soil (ASS) was identified as a risk/hazard management issue and, if present, may impact on environmental issues related to groundwater quality. Detailed procedures to be adopted if ASS is encountered were required by the Major Developments Panel.

Detailed procedures were developed based on preliminary field investigations which were used to develop management strategies and prepare an Acid Sulfate Soil Management Plan for the construction phase of the marina. Preliminary field investigations were focussed on the potential for ASS to be excavated during the construction of the main basin and canals of the marina.

The soil types and geology of the region were determined from published maps and soil logging undertaken by Tonkin Consulting during groundwater monitoring well construction. The soil is comprised of a brown, sandy topsoil over layers of yellow and grey sand. This formation is known as the Kingston Land System and is part of the Semaphore Sand, a Quaternary sedimentary (dunal) deposit of the St Kilda Formation. Underlying this is the Gambier Limestone, laid during the Tertiary period.

The potential for ASS to be present has been classified as "Nil" by PIRSA Land Information, though areas to the south of the Cape Jaffa Rd have been classified with a potential of "60% or more". Comparison of the geomorphology of the Cape Jaffa site with recommended criteria shows that there is potential for ASS to exist, as summarised in Table 1.1.

Table 1.1 Geomorphological Criteria Comparison for Cape Jaffa Site

Criteria	Present
Sediments of a recent geological age	✓
Soil horizons less than 5 m AHD	✓
Marine or estuarine sediments	✓
Interdunal swales or coastal sand dunes (deep excavation only)	✓
Dominant vegetation is mangroves, reeds, rushes and other swamp-tolerant or marine vegetation	✗
Sulfide bearing minerals, coal deposits or former marine shales/sediments shown in geological maps	✗
Deep older estuarine sediments of Holocene or Pleistocene age	✗
Absence of bicarbonate	✗
Groundwater chloride:sulfate ratio < 2	✗
Soft, grey, unripe mud or estuarine, grey silty sands	✗
Presence of shell	✓
Sulfurous odour	?

It should be noted that some of the "key" criteria, such as swampy location and absence of bicarbonate, were not present. In addition, the dunal formations at Cape Jaffa are very recent and do not overlie estuarine sediments, but rather overlie limestone. As a result, the potential for ASS to exist at the Cape Jaffa site, based on the geomorphological characteristics, is unclear.

Field investigations targeting the main basin and canals included observations, field pH testing (including the peroxide test) and sampling for subsequent laboratory analysis.

The soil was generally brown, medium to coarse sandy topsoil overlying a white-yellow to pinkish-yellow sandy subsoil. Shell layers, grey sand and green-grey clay were occasionally present in the subsoil. The field observations which were potentially indicative of the presence of ASS were the inclusion of shells in many layers and occasional iron staining of these shells. However, jarosite mottles and soft grey buttery layers were not a feature of any of the soil profiles. Sulfur odours were associated with the presence of seaweed in some profiles and in one profile was likely related to piggery effluent management.

The field pH and peroxide pH test showed that the initial pH of the soil was generally alkaline. The exception was the green-grey clay layer which was pH neutral. After oxidation with peroxide, all pH dropped by up to 3 units. However, the pH of all samples was neutral to slightly acidic and all remained above pH 5.5 (a "critical" pH value for potentially detrimental soil chemical affects).

Selected samples were submitted to the laboratory for analysis using the POCAS method. The initial pH of the samples was alkaline to neutral and dropped by up to 1.7 units on addition of peroxide, though for the majority of samples, the drop was less than 1 unit. The oxidisable sulfur content was greater than recommended action criteria in a number of samples, indicating the presence of PASS. However, the resultant pH remained above 5.5 and hence the actual, potential and sulfidic acidity were zero, i.e. the buffering capacity of the soil is sufficient to ameliorate most the acid produced on oxidation and little detrimental soil chemical or water quality affects are likely from excavation of this material.

Due to the limited field survey undertaken and the presence of PASS on the site, an ASS Management Plan has been prepared and is contained herein. The plan has been prepared as a draft, as further field investigations may be required, depending on the outcome of the Groundwater Impact Assessment.

PASS are present in the main basin and canals at the Cape Jaffa site, however the soil buffering capacity minimises the net acid generated from the oxidation of sulfur. As a precautionary measure, it is proposed to monitor the pH of stockpiled soil and groundwater as part of the ASSMP.

1. Introduction

1.1 Project Background

Cape Jaffa is located on the coast at the southern end of Lacepede Bay in the south-east of South Australia. This small township of 30-40 residents is between Kingston SE and Robe and supports an established fishing industry, mainly for Southern Rock Lobster. The existing township is concentrated near the jetty and includes a tourist park. The facilities for the fishing industry include storage facilities, waterfront weighing and holding facilities and accommodates approximately 33 fishing vessels on swing moorings.

Kingston District Council and Cape Jaffa Development Company are proposing to develop a safe haven and moorings for existing and future fishing fleet, recreational boating facilities and tourist and residential development adjacent to the existing township. The development, as detailed in the Development Proposal (Kingston District Council & Cape Jaffa Development Company, 2002), is currently proposed to include:

- Groyne extending into the sea;
- Main basin and canal system. The depth of the entrance and main basin is anticipated to be -3.5 m AHD with an entrance width of approximately 60 m. The canal waterways are anticipated to be -3.5 m AHD depth and 40-50 m in width;
- Commercial fishing births for 45 vessels and public marina berths for 40 vessels;
- Commercial and public boat ramps and associated facilities;
- Fish and aquaculture service industry, eg. fish receival, processing and holding, as well as dockside offices; and
- 380 residential allotments, private marina berths, tourist accommodation and services.

The plan of the proposed development is presented in Appendix A.

Cape Jaffa was chosen as suitable location due to its proximity to fishing areas, potential for development and safe waters.

Kingston District Council has requested that the development be treated as a Major Project to ensure a full and proper assessment is undertaken of this complex proposal.

1.2 The Study Area

The site incorporates:

- Allotment 123 in Deposit Plan 55486 (CT 5863/840)
- Part Section 92 of the Hundred of Mount Benson (CT 5560/348)
- Portion of King Drive and
- Portion of Cape Jaffa Road

in the area named Cape Jaffa.

The boundary of the land-side portion of the development is illustrated on Figure 1.1.

1.3 Major Projects Legislative Requirements

Developments which are considered to be of a special or more complex nature than anticipated by the Development Plan may be declared as Major Developments, as allowed under Section 46 of the Development Act 1993.

The process for assessing and approving Major Developments or Projects involves:

Step 1. Declaration by the Minister for Transport and Urban Planning.

Step 2. Lodgement of a project proposal with the Major Development Panel to identify issues associated with the projects.

Step 3. Preparation and release of an Issues paper for government and public comment prior to determination of the level of assessment required for the proposal.

Step 4. Preparation of Guidelines by the Major Development Panel as a result of this review to enable the proponent to prepare an Environmental Impact Statement (EIS), Public Environmental Report (PER) or a Development Report (DR) for the proposal.

Step 5. Assessment of the EIS, PER or DR by the Minister and release to the public for comment.

Step 6. Forward of the Development Application to the Governor or relevant Minister and gazettal of decision in the Government Gazette.

Cape Jaffa was declared a major development by the Minister for Urban Development on 19 December 2002. This indicates the project is considered to be of major environmental, social or economic importance.

Following public and government submissions on the proposed development, the Major Development Panel (MDP) has determined that the proposal will be subject to the processes and procedures of an Environmental Impact Statement (EIS). As a result, the Panel has prepared “Guidelines for the Preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Marina. Proposal by District Council of Kingston and the Cape Jaffa Development Company”.

MAP DETAILS

Roads Data: MapInfo Australia Pty Ltd
State Border: MapInfo Australia Pty Ltd
Job Number: 2003.0318
Filename: Figure11.wor
Drawn: Tina Freeman
Date: 04/12/2003

Cape Jaffa Development Corporation

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au
W www.tonkin.com.au

N

Scale 1:2,000,000

Cape Jaffa Marina
EIS Groundwater Assessment

SITE LOCATION PLAN

Figure 1.1

1.4 MDP Identified Acid Sulfate Soil Issues

The Major Development Panel (MDP) has identified one risk/hazard management issue for ASS and two environmental issues that may be impacted if ASS are present. These issues are listed below, with numbers shown remaining consistent with those in the Guidelines (MDP, 2003).

5.2 ENVIRONMENTAL ISSUES
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.
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.

5.6 RISK/HAZARD MANAGEMENT
5.6.2 Detail procedures to be adopted if acid sulfate soils are encountered.

The environmental issues are relevant as the presence of acid sulfate soil can impact on water quality and the availability of soil pollutants to be leached into the groundwater and out to sea. The oxidation of acid sulfate material can result in the production of acid. This acid can leach into groundwater and alter the pH and aquifer chemistry. Fish kills have been associated with acidic leachate from ASS entering surface water. In addition, acidic conditions can result in increased availability of heavy metals, such as cadmium, copper, nickel and zinc, that are then more readily leached out of the soil.

1.5 Scope of Works

The Scope of Works to address the issues identified by MDP and enable assessment of the potential risks to the Cape Jaffa Anchorage development from ASS will involve three stages, as outlined below.

STAGE 1: Preliminary Field Investigations

Review published information on geology and ASS potential and field borehole logs from the installation of groundwater bores by Tonkin Consulting.
Undertake a limited field investigation targeting the main basin and canal system and analyse selected samples using the Peroxide Oxidation Combined Acidity and Sulfur (POCAS) method. Initially it was proposed to undertake investigations across the whole site, to determine the extent and severity of the acid sulfate soil and potentially highlight “hot spot” areas. This investigation was limited to the areas requiring significant excavation, i.e. the canals.

STAGE 2: Develop Management Strategies

Utilising the information collected during the limited field investigations (Stage 1), the potential presence of ASS in the canals may be ascertained and the acid generating potential estimated. These factors can be used to assess the potential impact of the ASS problem and aid in the development of management strategies. These strategies will be developed in consultation with the Cape Jaffa Development Company and Tonkin Consulting. The need for further information will also be assessed during this process.

STAGE 3: Prepare ASS Management Plan

The management strategies proposed for the construction phase/s of the Cape Jaffa Marina will be detailed in an ASS Management Plan, as required by the Major Development Panel. In addition to the management of ASS material identified during the preliminary field investigations, the plan will consider the need for further sampling and analysis to delineate ASS and emergency response procedures required for the discovery of unidentified ASS layers during excavation.

This report details the investigations and analysis undertaken on the site of the proposed Cape Jaffa Anchorage Marina and presents the proposed Acid Sulfate Soil Management Plan, based on the interpretation of these investigations.

2. Desktop Review

2.1 Acid Sulfate Soil

Acid Sulfate Soil (ASS) is the common name given to naturally occurring sediment and soil containing iron sulfides (principally iron sulfide or iron disulfide or their precursors), which when exposed to oxygen by drainage or excavation, leads to the generation of sulfuric acid. The majority of acid sulfate sediments were formed during the Holocene period in areas where iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter occurred (Ahern *et al.*, 1998b). These conditions exist in mangroves, salt marsh vegetation or tidal areas and at the bottom of coastal rivers and lakes and may occur in clayey or sandy soil.

ASS includes actual acid sulfate soil and potential acid sulfate soil. Actual ASS (AASS) contain highly acidic layers where the sulfidic material has been oxidised resulting in pH of less than 4. This soil can often be identified by the presence of pale yellow mottles and jarosite coatings.

Potential ASS (PASS) contain sulfidic material which has not been exposed to air or oxidised. As a result, the pH of the soil is usually greater than 4 and may be neutral or even alkaline. Once exposed to oxygen, however, this soil can become extremely acidic and become AASS.

The longer term implications of the extremely acidic leachate or runoff from ASS on the downstream human and natural environment include:

- reduced soil fertility;
- loss of aquatic habitat;
- reduction of aquatic biodiversity
- mortality of marine organisms;
- release of heavy metals from contaminated soil or sediment;
- poor health in humans and animals in contact with polluted water;
- corrosion of structures.

The potential long term impacts show the importance of identifying ASS as early as possible and managing ASS to prevent or reduce any adverse environmental impacts.

2.2 Local Geology & Soil Types

The study area lies within the Gambier Embayment of the Otway Basin, which extends from Kingston to the Mornington Peninsula in Victoria. The upper formations at Cape Jaffa are the Gambier Limestone, laid during the Tertiary Period, and the dunal formations of the Quaternary Period. The Gambier Limestone is a bryozoal limestone formed during open marine conditions and may also contain some marl, chert or dolomite. The limestone is noted as "dolomitized" (i.e. includes magnesium) along an inferred fault zone at Cape Jaffa (Dept of Mines, 1951).

Overlying the Gambier Limestone are the surface dunal formations deposited during the Quaternary Period, which are a record of sea level change. The Bridgewater Formation is the oldest Quaternary sedimentary deposit and is located to the south of Cape Jaffa. This formation is subtidal beach and aoelian (wind-blown) calcarenite (limestone) from stranded coastal ridges. The coastal strip around Cape Jaffa is predominantly Semaphore Sand of the St Kilda Formation, which is comprised of coastal barrier, beach ridge and dune sediments. To the east of this are the older lagoonal and lacustrine (lake) sediments and shell beds of the St Kilda Formation. Slightly older than these formations and further east is the Glanville Formation, which is comprised of lagoonal sediments and shell beds.

The soil type series of the Cape Jaffa area are part of the Kingston Land System, which consists of low, parallel coastal dunes alternating with swamps. The dunes are predominantly vegetated and therefore stable and are comprised of deep shelly calcareous or calcareous, siliceous sand. Swamps and lunettes are also found in the Cape Jaffa area, predominantly as interdunal formations. The swamps are moderately saline, dark cracking clay, though calcareous clay on marl is also found. The lunettes are dark clay loam, often over dark clay on calcrete (PIRSA, 2001a). The salinity of the swamps and lunettes is predominantly induced by the saline groundwater at these locations.

Field investigations undertaken by Tonkin Consulting for the Groundwater Impact Assessment, included drilling and logging 34 soil bores. The Field Borelogs for these wells are presented in the Groundwater Impact Assessment report. It should be noted that many of the boreholes were drilled using compressed air and hence only major layer changes are discernible.

Sandy, dark brown to black topsoil was noted in most borelogs to an average 0.2 m to 0.3 m depth, though topsoil extended to 0.5 m depth in some boreholes. The subsoil was comprised of various layers of a yellow-brown to pale grey sand, which extended to depths of between 2.4 m to 7.6 m across the site. An occasional orange-brown sandy clay to clay layer was noted between the sand layers.

A dark grey to green layer of clay of medium to high plasticity underlying the sand layers was observed in several boreholes located in the centre and along the southern boundary of the site. The clay layer was also noted in one borehole on the northern boundary along the coast. Soft and wet limestone was observed in all soil profiles underlying the sand and clay units.

Soil described as having a 'seaweed odour' was recorded in sand observed in several monitoring wells (CJ01, CJ13, CJ14, CJ16, CJ17, CJ24, CJ26, CJ30 and CJ31). An odour described as 'decaying' was reported in clay observed in CJ04 and CJ11. The location of these boreholes is shown on Figure 1.1.

An effluent-type odour was also recorded in soil observed during installation of monitoring wells CJ 15 and CJ15A. The owner of this land reported that piggery effluent had applied in proximity to this area.

2.3 Groundwater Indicators

Mulvey (1993) proposed that the ratio of chloride to sulfate in seawater could be used to determine if additional sulfur inputs to groundwater were occurring in an area. This was based on the concept that the ratios of the dominant anions in saline water remain approximately the same when diluted with fresh water. As a result, estuaries, coastal saline creeks and associated groundwater can be expected to have similar ratios to seawater.

Ahern *et al.* (1998b) note that the concentration of chloride in seawater is approximately 19,400 mg/L and that the sulfate concentration is approximately 2,700 mg/L, which results in soluble chloride to soluble sulfate ratio of 7.2. Mulvey (1993) suggested that a $Cl^-:SO_4^{2-}$ ratio of less than 4, and definitely less than 2, is a strong indication of an extra source of sulfate from previous sulfide oxidation.

Groundwater sampling undertaken at the Cape Jaffa site, included analysis of chloride and sulfate. Samples were recovered from all monitoring wells, comprising 3 shallow monitoring, which were installed to intercept groundwater in the sand horizons, and 31 deeper monitoring wells, installed to intercept the upper sediments of the Tertiary limestone aquifer. Monitoring wells at the Cape Jaffa site may also be affected by sewage (septic) infiltration and piggery effluent disposal. Monitoring wells CJ15 and CJ15A have been excluded as they are in an area known to have been received piggery effluent. The chloride and sulfate concentrations reported in the remaining wells are shown in Table 2.1.

The reported chloride concentrations varied from 121 mg/L to 3,430 mg/L with an average concentration of 619 mg/L. The highest concentration was reported in monitoring well CJ13, which is close to the coast. All concentrations were below the seawater concentrations.

The reported sulfate concentrations varied from 30 mg/L to 494 mg/L, with an average concentration of 122 mg/L. The maximum concentration was recorded in CJ13, which is close to the coast. All reported concentrations were below the sulfate concentration in seawater.

Table 2.1 Groundwater Chloride and Sulfate Concentrations

Well ID	Location	Groundwater concentrations (mg/L)		
		Chloride	Sulfate	Cl:SO4
CJ01	Near coast	334	102	**3.3**
CJ02	Near northern boundary	529	129	4.1
CJ03	Central	770	129	6.0
CJ03A	Shallow well	290	50	5.8
CJ04	Southern boundary	929	153	6.1
CJ05	Central	438	135	**3.2**
CJ06	Central	460	135	**3.4**
CJ07	Central	620	142	4.4
CJ08	Central	576	87	6.6
CJ09	Central	365	104	**3.5**
CJ10	Southern boundary in road verge	481	125	**3.9**
CJ11	In road verge	574	116	5.0
CJ12	In road verge	739	169	4.4
CJ13	Near coast	3430	494	6.9
CJ14	Northern boundary	911	174	5.2
CJ16	Southern boundary	1120	202	5.5
CJ17	Southern boundary	370	89	4.2
CJ18	South west corner	551	117	4.7
CJ19	Western end	594	122	4.9
CJ20	Northern boundary behind houses	433	89	4.9
CJ21	Northern boundary near houses	630	119	5.3
CJ21A	Shallow well	135	30	4.5
CJ22	Northern boundary	375	93	4.0
CJ23	Northern boundary	449	107	4.2
CJ24	East end of site	540	160	**3.4**
CJ25	South on roadway	150	60	**2.5**
CJ26	0.5km south on roadway	335	58	5.8
CJ27	0.3km south on roadway	1100	171	6.4
CJ28	0.5 km south and from coast	919	74	12.4
CJ29	0.5km west on coast	290	90	**3.2**
CJ30	2km south, inland	249	41	6.1
CJ31	2km south, inland	121	35	**3.5**
Minimum		121	30	2.5
Maximum		3430	494	12.4
Average		619	122	5

The $Cl^-:SO_4^{2-}$ ratio varied from 2.5 to 12.4, with the highest ratio recorded in the conservation area to the south west of the site and the lowest ratio recorded on the southern side of Cape Jaffa Rd. Based on published geology and soil type maps, it is likely that CJ25 is located in a different soil type, related to swampier conditions, from the Marina site. Monitoring well CJ13 is close to the coast and has the closest ratio to seawater at 6.9. Ratios below 4 are shown in highlighted and do not appear to form a pattern across the site. It is likely that the range of ratios represents natural variation across the site and the source of relatively higher sulfur concentrations is unclear.

2.4 ASS Potential

PIRSA Land Information (2001b) has prepared the "Southern South Australia Potential for Acid Sulfate Soil" map. The map units were based on interpretation of the soil landscape units and reflect the proportion of area susceptible to the development of acid sulfate soil. In general the site area is classified as "Nil" potential for acid sulfate soil development (Figure 2.1). The clayey soil located predominantly to the south of Cape Jaffa – Kingston road has been classified with a potential of "60% or more".

CSIRO is preparing acid sulfate soil map classes for South Australia. This publication is currently in press but was presented by SA Coastal Protection Board (SA CPB, 2003). Ten soil map classes are presented, including classes potentially relevant to the Cape Jaffa site:

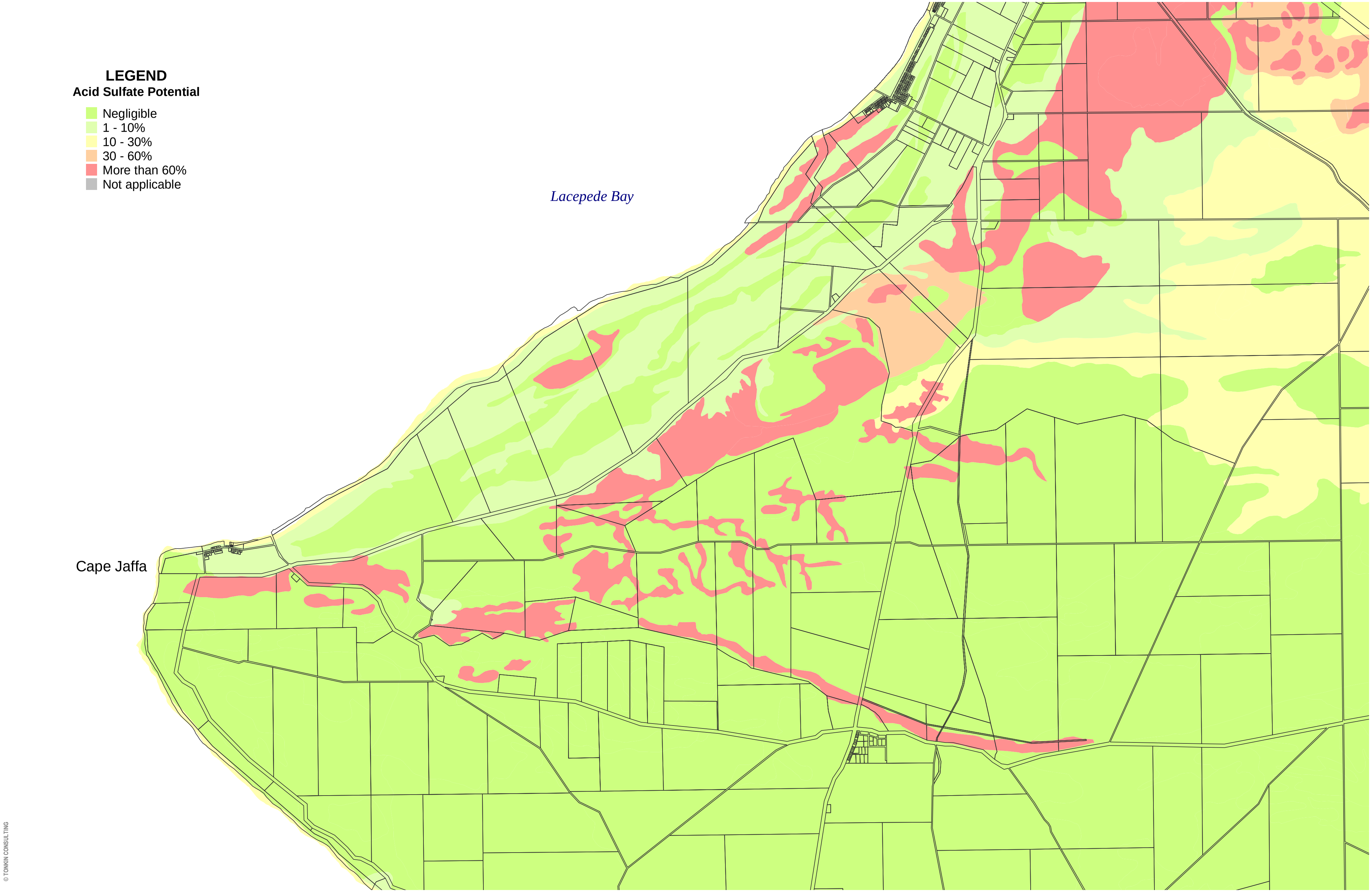
- Class 6: Sand. Soils of dunes, ridges (No PASS and ASS within 1 metre of surface) Low risk of PASS below water table.
- Class 8: Marine Soils. Subtidal and intertidal marine (PASS may be present; ASS neutralised by tides and carbonates). No or very low risk.

The above classes indicate that there is low or negligible risk of acid sulfate soil occurring in these areas. It should be noted however, that the same article showed evidence of PASS buried below sand dunes and below the water table at Barcoo Outlet, i.e. in a Class 6 area noted as having low risk of PASS.

Ahern *et al.* (1998b) recommend geomorphic and site criteria to be used to determine if ASS is likely to be present. These criteria include:

- Sediments of a recent geological age (Holocene);
- Soil horizons less than 5 m AHD;
- Marine or estuarine sediments;
- Interdunal swales or coastal sand dunes (if deep excavation or drainage proposed).

The sand deposition at the Cape Jaffa site occurred in very recent times and is potentially too young to have yet formed acid sulfate sediments. ASS are not usually associated with dunes as found at Cape Jaffa but have been mapped by PIRSA in the interdunal lagoons, which are located south and north east of Cape Jaffa. The Gambier Limestone, which in most cases is directly underlying the sand layers, would be a source of bicarbonate and hence it is unlikely that the conditions for acid sulfate development would be present. However, the other factors for formation of ASS are present, i.e. sulfate from seawater and organic matter from seaweed



ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au
W www.tonkin.com.au

MAP DETAILS

Cadastral Data:	DEH
Soil Data:	PIRSA (2001)
Job Number:	2003.0318
Filename:	ASS_Potential.wor
Drawn:	Tina Freeman
Date:	19/12/2003

Cape Jaffa Development Corporation

Cape Jaffa Marina
EIS Groundwater Assessment

ACID SULFATE POTENTIAL

Figure 2.1

observed in the boreholes. The yellow mottling often associated with AASS could not be determined due to the method of drilling.

During drilling for monitoring well installation, one sample was collected from the grey-green clay layer observed in borehole CJ3 at –1.24 m to –1.44 m AHD. For comparison, one sample was collected from the white to pale yellow sand observed in borehole CJ17 at 2.4 m to 2.2 m AHD. The sand layer was noted as having a "seaweed" odour. It should be noted that the samples were intended as a qualitative assessment of the presence of ASS and analysis was undertaken outside recommended holding time. The laboratory report and COC are presented in Appendix B.

The clay sample produced little oxidisable sulfur when treated with peroxide (S_{pos}), i.e. 0.01 % S_{pos}. The resultant pH drop was from 7.4 to 6.0 units, i.e. neutral to slightly acidic. The sand sample reported a peroxide oxidisable sulfur content of 0.51 %. The resultant pH drop was from 6.4 to 2.9 units, i.e. slightly acidic to extremely acidic. This marked pH drop is indicative of PASS.

Ahern *et al.* (1998b) recommend action criteria triggering a management plan. For coarse textured soil, such as sand, the action criteria are a peroxide oxidisable sulfur (S_{pos}) content > 0.03 % or total sulfidic acidity (TSA) > 18 mol H^+/tonne. The reported contents for the sand sample were in excess of these criteria and hence it was determined that further soil investigation was warranted.

3. ASS Investigations

A preliminary acid sulfate soil investigation was undertaken to validate results from groundwater installation works. The objective of the investigation was to assess the variability of soil types and the potential for ASS to be present in the main basin and canal system. Where ASS may be present, the magnitude of the acid generating potential was analysed.

3.1 Field Work

3.1.1 Soil Sampling Plan

A soil sampling plan was prepared targeting the main basin and canal system. Subsequent to field investigations, the design of the development was reviewed and hence the borehole locations no longer target the basin and canals (Figure 3.1).

Twelve test pits were described and sampled with distances between sampling locations of 300 m to 400 m in an approximate grid sampling pattern. A GPS was used on site to assist in locating the sampling points. Sampling points were preferentially located in lower lying areas where ASS is more likely to be present.

3.1.2 Soil Profile Description

The test pits were excavated on 21 August 2003 to approximately 3 metres below ground level (bgl) using a backhoe. The excavation depth was limited by instability of the pit walls and was less than the proposed depth of the marina excavation (i.e. -3.5 m AHD). The texture, colour, coarse fragments and odour were noted in test pits and recorded on Field Borehole Logs, copies of which are reproduced in Appendix C. The surface elevations presented on the borelogs were interpolated from survey data and are only provided as an approximate elevation.

The soil was predominantly a uniform, coarse texture profile with a sandy, brown to black topsoil overlying a sandy, pinkish-yellow to white-yellow subsoil. Soil horizons (O, A, B and C) have been determined based on descriptions provided by McDonald *et al.* (1984).

The topsoil (the A1 horizon) extended to 0.2 m to 0.5 m below ground level (bgl). Abundant roots were noted in the topsoil, with no obvious limitation on rooting depth. In test pits BH06 and BH10, the topsoil was a slightly finer with the texture recorded as sandy silt and silty sand respectively. Seaweed was noted in the topsoil of test pit BH01.

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au
W www.tonkin.com.au

MAP DETAILS

Cadastral Data:	DEH
Aerial Photo:	DEH
Job Number:	2003.0318
Filename:	Figure31_ASS.wor
Drawn:	Tina Freeman
Date:	10/11/2003

Cape Jaffa Development Corporation

Cape Jaffa Marina

EIS Groundwater Assessment

ASS SAMPLING PLAN

Figure 3.1

The upper subsoil (the B21 horizon) was generally a coarse sand, similar to beach sand, and occasionally noted with orange mottling and/or shell fragments. Red fringing was noted in test pits BH10 and BH12 at the boundary between the B21 and the underlying layer (B22 horizon).

The lower subsoil (the B22 horizon) was a grey sand containing up to 80% whole shells and/or shell fragments. The exceptions were:

- BH09 which had a very coarse, white sand horizon above the grey sand layer;
- BH06 which had a grey, sandy clay horizon with orange mottling;
- BH11 which had a coarse, white, yellow and grey-yellow layers between the pinkish-yellow and grey sand horizons.

Seaweed layers were noted in test pits BH01 and BH08. In BH01, the seaweed was present mixed in the topsoil and the grey sand layer, while in BH08 a layer of seaweed was present in a light grey sand.

Sulfurous odours were noted as being “slight” in BH01 where it was associated with the seaweed layer. In BH12, a strong sulfurous odour was noted at depth during excavation. This test pit was located in close proximity to the overflow drain from the effluent dam on the adjoining property and is within the area to which piggery effluent was applied.

Other features noted in some profiles were:

- Groundwater was cut in test pit BH01 at 3.1 m bgl and in BH06 at 2.1 m bgl.
- Green clay layer at 2.7- 2.9 m bgl in BH04 above a cemented limestone layer, which prevented further excavation.
- Cemented calcrete was found at 1.5 m bgl in test pit BH06 and was overlying limestone at 1.8 m bgl.

3.1.3 Field pH tests

Field pH and peroxide pH tests were undertaken as recommended by Ahern *et al.* (1998b). This method includes measuring the field pH of the soil in a 1:5 soil:water solution and comparing this result with the pH after oxidation with peroxide. The field pH (pH_F) and field peroxide pH (pH_{FOX}) were measured in soil samples recovered from various layers in the excavation pits. These results are shown in Table 3.1.

Ahern *et al.* (1998b) note that if the pH_{FOX} is over one unit below the pH_F then it may indicate the presence of PASS. Greater differences between results and the lower the value of the pH_{FOX}, the better indication of the presence of PASS. However, it should be noted that other minerals (particularly manganese) and organic matter may also react with peroxide and hence this test is only an indicator test and is not a

substitute for analytical test results. The interpretation of field peroxide results is recommended by Ahern *et al.* as follows:
pH_{FOX} < 3 and strong reaction – high level of certainty of the presence of PASS.
pH_{FOX} 3 to 4 – less positive and laboratory analysis required to confirm.
pH_{FOX} 4 to 5 – neither positive nor negative.
pH_{FOX} > 5 and little or no drop in field pH – little net acid generating ability.

Table 3.1 Field pH and peroxide pH Test Results

Borehole ID	Sample depth (m bgl)	Sample type	pH_F	pH_{FOX}	pH difference
BH1	2.0 – 2.3	White-yellow sand	8.26	6.57	1.69
	2.5 – 2.8	Grey sand	8.25	7.06	1.19
	3.0 – 3.3	Grey, shelly sand	8.25	6.59	1.66
BH2	2.1 – 2.3	Pale yellow sand	8.45	6.40	2.05
	2.6 – 3.0	Grey, shelly sand	9.01	6.96	2.05
BH3	2.2 – 2.5	Yellow, shelly sand	9.12	--	--
BH4	2.3 – 2.6	Grey, shelly sand	8.45	6.72	1.73
	2.7 – 2.9	Green clay	8.70	5.91	2.79
BH5	2.6 – 2.8	Shelly sand	8.54	6.37	2.17
BH6	0.8 – 1.0	Pale yellow sand	8.07	6.41	1.66
	1.2 – 1.5	Grey, shelly sandy clay	8.50	5.92	2.58
BH8	1.8 – 2.0	Seaweed layer	9.11	6.29	2.82
BH9	2.6 – 2.9	White sand	9.07	6.11	2.96
BH10	1.2 – 1.4	Grey sand	8.46	6.63	1.83
BH12	2.7 – 3.0	Grey sand (sulfur odour)	8.50	6.12	2.38

-- peroxide test not undertaken

Field tests undertaken on Cape Jaffa soil samples all resulted in a decrease of over 1 unit. However, all pH_{FOX} results were > 5. This indicates neither a positive nor a negative result as the limited determination of the field method, combined with the low temperature on the day of sampling, may have limited the soil's response to oxidation.

3.2 Laboratory Results

During pit excavations, 27 soil samples were recovered by removing material from the backhoe bucket which appeared to be representative of the layer. Clean glass jars supplied by the laboratory were filled to minimise headspace and closed with an air-tight, plastic lid with teflon insert.

The recommended holding time between sampling and analysis is 24 hours. This was unlikely to be achievable for samples taken in Cape Jaffa. Ahern and Blunden (1998) recommend that quick drying in a fan forced oven or freezing the sample may be used to minimise the oxidation of sulfides where the recommended holding time can not be met. As a result, all samples were immediately placed into a portable freezer in the field and kept frozen until delivery at the laboratory.

The Peroxide Oxidation Combined Acidity and Sulfur (POCAS) method was used to measure the ASS potential of representative samples. This method is recommended by Ahern *et al.* (1998a) as it provides information on the acid trail and the sulfur trail. This is especially useful in sandy soil types where the oxidisable sulfur content may be low but the acid producing potential is relatively high due to the low buffering capacity of the sand.

Eleven samples, representative of the various soil horizons described, were submitted to Amdel's Adelaide laboratory for analysis. Samples were not ground before analysis to ensure that the buffering capacity of the whole shells and shell fragments was not overestimated. In addition to potential ASS layers, one sample of the underlying limestone was submitted to the laboratory and ground to determine its neutralising value and the potential of utilising this material for management of ASS. The laboratory report and COC are presented in Appendix D and summarised in Table 3.2, below.

Table 3.2 POCAS Analysis Results

Borehole ID	Sample depth (m bgl)	Soil Texture	Shell presence	POCAS analysis results for samples			
				pH_{KCl}	pH_{ox}	pH diff.	S_{pos} (%)
BH1	2.0 – 2.3	White-yellow sand	✓	9.40	8.74	0.66	0.000
	2.5 – 2.8	Grey sand	×	9.50	9.00	0.5	**0.062**
BH3	2.6 – 3.0	Grey sand	✓	9.80	8.95	0.85	0.027
BH4	2.3 – 2.6	Grey sand	✓	9.60	9.13	0.47	**0.071**
	2.7 – 2.9	Green clay	×	7.95	6.30	**1.65**	**0.849**
BH6	0.8 – 1.0	Yellow sand	×	9.80	9.01	0.79	0.013
	1.2 – 1.5	Grey sandy clay	✓	9.29	8.40	0.89	**0.486**
BH8	1.8 – 2.0	White-yellow sand	×	9.66	8.84	0.82	**0.048**
	2.0 – 2.4	Seaweed	×	8.62	7.64	0.98	**0.198**
BH9	2.6 – 2.9	White sand	×	9.80	8.74	**1.06**	0.000
BH12	2.7 – 3.0	Grey sand, sulfur odour	×	9.74	8.83	0.91	0.021
ASS Indicators				**–**	**< 3**	**> 1**	**> 0.03**

The initial pH (pH_{KCl}) reported in the soil samples was alkaline, with the pH above 9 units, excluding the green clay, which was 7.95 units (Table 3.2). After oxidation, the pH (pH_{ox}) dropped in all samples by 0.5 to 1.65 units, though the majority of samples remained strongly alkaline. The exception was the green clay which became slightly acidic, however this pH is unlikely to result in detrimental off-site affects. All reported pH were above the ASS indicator value of 3 units and were reported with less than 1 unit pH change. This indicates that these samples have a low acid generating potential. The green clay and white sand were the exceptions, with a pH drop of over 1 unit.

The potentially oxidisable sulfur content (S_{pos}) varied from 0 % to 0.849 %. The white-yellow, yellow and white sand reported the lowest concentrations of S_{pos} with the green clay reporting the highest concentration. The low oxidisable sulfur content in the sample from BH12, which was noted with sulfur odour, further indicates the sulfur is more likely to be derived from piggery effluent than ASS. Comparison with the ASS action criteria of 0.03 % for coarse textured soil shows that the majority of samples exceeded the action criteria.

The total actual acidity (TAA), total potential acidity (TPA) and total sulfidic acidity (TSA) are 0 for all samples as the pH before and after oxidation was greater than 5.5 units.

No clear relationship was evident between the presence of whole shell or fragments in the sample and the pH response or between the pH difference and the S_{pos}.

3.2.1 Neutralising Value

The upper sediments of the Tertiary limestone at Cape Jaffa were sampled in test pit BH06 from -0.7 m AHD to –1.1 m AHD. The neutralising value of the sample was reported by Amdel as 34 % calcium carbonate ($CaCO_3$) equivalent, i.e. for every 34 tonne of lime calculated to be required, at least 100 tonne of Tertiary limestone would be required to result in equivalent acid neutralising capacity. It should be noted that the particle size, or fineness, of the final limestone product will affect the efficacy of the product and that safety factors are usually used to overcome difficulties in achieving a homogeneous mixture of ASS and crushed limestone.

4. Discussion

The desktop review undertaken of published information and data collected during groundwater investigations indicated that some factors associated with ASS formation are present in the Cape Jaffa area, though other factors suggest ASS formation is unlikely. The low lying topography, marine influences and recent deposition of sediments are often associated with ASS formation. However, the free-draining nature of the soil profile and underlying limestone is unlikely to be conducive to the formation of metal sulfides.

The initial samples submitted to the laboratory were outside holding time and had not been frozen or preserved. Also, the sample from CJ17 is on the southern boundary of the development and may be in the adjoining soil type and hence these results are unreliable and may not be indicative of the soil across the site.

The soil types across the site were similar with a uniform sand profile overlying limestone. At some locations, a green clay and/or a calcrete layer were present between the sand and limestone. The limited variation in soil horizons present in the profile across the canal areas of the site, suggests that the limited sampling programme undertaken may be representative of the site and that the change of design does not affect the conclusions of this report. However, the limited sampling programme can not determine the presence of ASS “hot spots” or fully describe the potential variation within the soil.

Potential impacts identified by MDP (2003) included potential changes to groundwater depth and quality. Lowering of the groundwater table in areas with ASS, may result in oxidation of ASS layers and release of acid into the groundwater, which can affect groundwater quality directly or by leaching heavy metals from the soil, which also affects groundwater quality.

The preliminary investigation described herein focussed on the potential for ASS to be present in the development site and did not include surrounding areas. South of the site and up hydraulic gradient from the Cape Jaffa site is a low lying, potentially clayey soil type, which appears to have formed in swampy, interdunal conditions. This soil type has a high possibility (> 60%) of containing ASS layers. If ASS is present in surrounding areas and the groundwater is lowered in these areas, there is a potential for acid generation from these soil types and for this acidic leachate to enter the groundwater. Further assessment of the surrounding areas may be required once the potential impacts on the groundwater in the area have been identified and their magnitude or extent assessed, as being undertaken as part of the Groundwater Impact Assessment.

The analysis of soil samples recovered from the test pits shows that the pH does decrease on oxidation. All samples were subsoil samples and, excluding the seaweed sample, are unlikely to contain significant quantities of organic matter. In addition, manganese nodules were not noted during field investigations and hence the reaction to added peroxide is most likely due to the presence of oxidisable sulfur. The exception was the white sand in BH9 where a marked change was reported in pH with no reported S_{pos}. This sample was predominantly pure sand and would have little or no buffering capacity, hence any oxidation is likely to result in a marked pH change.

The pH, both before and after oxidation, remained alkaline in all samples. The green clay was the exception however the pH in this sample remained above acceptable levels (i.e. pH > 5.5). The pH difference was not strongly correlated to S_{pos} suggesting variable buffering capacity within the soil profile.

The buffering capacity of the soil is increased by clay, organic matter and lime or other carbonates. However, Ahern *et al.* (1998a) note that in the soil environment most shells (which may be a source of cabonate) become coated with gypsum or insoluble iron compounds preventing short-term neutralising action. As a result, the POCAS method was undertaken on unground soil samples to prevent overestimation of the soil's inherent buffering capacity. Comparison of the pH change with the presence of shell in the samples shows little or no correlation between these factors, thus suggesting the inherent soil buffering capacity is not derived from the shell fragments.

The neutralising potential of seawater has been recognised in the management of acid generated from ASS. The bicarbonate concentration of seawater is approximately 142 mg/L (Goldberg *et al.*, 1971) while the reported concentration in groundwater at Cape Jaffa ranged from 180 mg/L to 420 mg/L (excluding monitoring wells potentially affected by piggery effluent). As a result, it is likely that the buffering capacity of the soil is due to bicarbonates deposited from groundwater fluctuations and the capillary fringe.

Based on the sampling undertaken, it appears that the soil, regardless of texture, may be regarded as potentially acid sulfate soil (PASS), due to high potentially oxidisable sulfide content. However, the buffering capacity of the soil can neutralise the majority of the acid released during sulfide oxidation. It should be noted that this buffering capacity may be inherited from the groundwater and hence monitoring may be required if:

- soil is to be stockpiled for extended periods of time, or
- the development of the marina results in reduction in groundwater level.

Additionally, observations during excavation/dredging should be considered to verify the general findings of the preliminary investigation.

5. Preliminary ASS Management Plan

5.1 Introduction

A preliminary acid sulfate soil investigation has been undertaken at the Cape Jaffa marina site. This investigation suggested that potential acid sulfate soil is present on site but that the soil has buffering capacity to prevent acid leachate from entering the environment. However, due to the limited investigation undertaken, a management plan is required during construction to confirm the findings of the investigation and provide management options in the event of discovery of ASS without sufficient buffering capacity.

This Management Plan is preliminary and will be finalised upon completion of the Groundwater Impact Assessment and finalisation of the construction techniques and programme for the dredging/excavation operations.

For the Cape Jaffa site, it has been assumed that the predominant mechanism for environmental impact from ASS is through the vertical movement of acid leachate into groundwater and then to the ocean. This assumption is based on the high permeability of the sandy soil type and lack of surface water bodies at Cape Jaffa.

5.2 Additional Reading

1. Stone, Y, Ahern, C.R. and Blunden, B. 1998. Acid Sulfate Soil Manual 1998. Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW.
2. VicEPA. 1999. Acid Sulfate Soil and Rock. Publication 655. Victorian Environment Protection Authority.

5.3 Definitions

<u>Acid Sulfate Soil (ASS)</u> – common name given to naturally occurring sediment and soil containing iron sulfides (principally iron sulfide or iron disulfide or their precursors), which when exposed to oxygen by drainage or excavation, leads to the generation of sulfuric acid.

<u>Actual Acid Sulfate Soil (AASS)</u> – contain highly acidic layers where the sulfidic material has been oxidised resulting in pH of less than 4. This soil can often be identified by the presence of pale yellow mottles and jarosite coatings.

<u>Potential Acid Sulfate Soil (PASS)</u> – contain sulfidic material which has not been exposed to air or oxidised. As a result, the pH of the soil is usually greater than 4

and may be neutral or even alkaline. Once exposed to oxygen, however, this soil can become extremely acidic.

Lime – for the purpose of this document, this term shall include liming agents and other products able to neutralise acid.

5.4 Responsible Persons

A 'Responsible Person' will be identified who shall be responsible for all observation and monitoring required during excavation/dredging and stockpiling works. It is envisaged that this would be one of many duties of this person. This person shall be responsible for enacting the management and mitigation plans detailed herein and shall report directly to the Construction Manager. The Responsible Person shall seek advice from experienced ASS consultants as required.

The Construction Manager shall be responsible for ensuring the fast and effective implementation of the management and mitigation practices required, as advised by the Responsible Person and after consultation with an experienced ASS consultant.

An experienced ASS consultant will be required to provide advice to the Responsible Person and potentially undertake further investigations once the Groundwater Impact Assessment has been completed.

5.5 Further Assessment

The preliminary assessment undertaken was focussed on the development site and did not assess the potential for ASS to occur in surrounding areas. Pending the outcome of the Groundwater Impact Assessment, further soil investigations may be required to assess the ASS potential in surrounding areas to the site. If ASS is located then consideration of management and mitigation practices will be undertaken. These investigations and assessment will be undertaken by an experienced ASS consultant.

5.6 Monitoring Requirements

Monitoring of soil stockpiles (both sand and clay layers) and groundwater is required during the construction phase/s of the development. Further monitoring may be required as an outcome of further assessment. The monitoring requirements shall include observation, soil pH monitoring and water pH monitoring as detailed below and represented in the flow chart in
Figure 5.1.

STEP 1: Observation

Observations of stockpiles and excavation works shall be undertaken every day to every second day during any excavation works on site. Visual and olfactory indicators of ASS include (VicEPA, 1999):

- Unripe muds (soft buttery, blue grey or dark greenish grey) or estuarine silty sands or sands (mid to dark grey)
- Offensive odour, predominantly due to 'rotten egg gas' (H_2S).
- Any pale yellow mineral deposit (probably jarosite) or iron oxide mottling in recently exposed surfaces. In areas of fluctuating groundwater table, pale yellow deposits may be found along cracks and root channels in the soil;
- Yellow mottling in surface encrustations on dredged or excavated material;
- Unusually clear or milky blue-green drain water flowing from or within the area;
- Iron staining on any drain or pond surfaces or iron stained water and ochre deposits.

Where any of the above indicators are observed in stockpiled material or excavation areas then soil pH (pH_F) and peroxide pH (pH_{FOX}) testing should be undertaken, as described in Steps 2 and 3 below.

STEP 2: Field pH Testing of Stockpiled Soil

Field pH testing is only required where Step 1: Observations indicate that ASS may be present. pH testing should preferably be undertaken using a battery-powered field pH meter. The meter should be calibrated for the expected range of values prior to each sampling round. This method is a qualitative method only and provides a quick indication of the likely presence of AASS or PASS. Attachment 1 details the methodology of Field pH and Peroxide pH tests, as detailed by Ahern *et al.* (1998b).

Interpretation of the soil pH tests is as per Table 5.1.

Table 5.1 Interpretation of Field pH Tests

Result	Indication	Further action
$pH_F \leqslant 4$	AASS are present	Manage ASS, as per Section 5.7
$pH_F > 4$	PASS may be present	Perform Peroxide Test
$pH_{FOX} < 3$	PASS present	Manage ASS, as per Section 5.7
$3 < pH_{FOX} < 4$	PASS may be present	Manage ASS, as per Section 5.7
$4 < pH_{FOX} < 5$	Neither positive or negative	Refer to Additional Indicators. If present, Manage ASS. If not, continue monitoring at recommended frequency
$pH_{FOX} > 5$ & < 1 unit pH drop	Unlikely ASS is present	No further action
$pH_{FOX} > 5$ & > 1 unit pH drop	PASS may be present	Continue monitoring at recommended frequency unless result changes

Additional indicators of PASS include:

- Change in soil colour from grey to brown;
- Effervescence and release of heat;
- Release of sulfur smelling gases, such hydrogen sulfide (“rotten egg gas”);
- Lowering of pH by at least one unit.

Monitoring frequency recommended for soil pH testing is daily for the first three days and then weekly monitoring. It has been assumed that longer term stockpiling, i.e. over 6 months would not be undertaken. Where stockpiles are to remain on-site for longer periods, advice should be sought from an experienced ASS consultant for any additional management requirements.

The number of samples tested depends on the size of the stockpile and the uniformity of the material within the stockpile. The minimum requirement is for one sample tested for every 10,000 m^3. Sampling locations should be distributed around the stockpile. Particular focus should be on the near-surface material in the stockpile as this is the material most likely to oxidise. However, deeper samples should also be tested to assess the extent of oxidation through the stockpile. The location and depth of sampling should be noted on the field sheet.

STEP 3: Water pH Testing

Water pH testing is only required where Step 1: Observations indicate that ASS may be present.

Collection of leachate from stockpiles is unlikely to be practical due to the sandy texture of the underlying soil. During construction of the canals, opportunistic water samples should be taken from any collected pools that are downstream from the excavation. More permanent ponds should be sampled weekly while persisting.

Groundwater monitoring will be required at least weekly in at least 2 monitoring wells during excavation works as a minimum. Monitoring is to include pH, preferably using a battery operated field pH meter which can be lowered into the well. The pH meter should be calibrated for the range of expected values prior to each sampling round. Salinity monitoring is also recommended. Independent verification of the pH is recommended every three months. Consideration should be given to chloride and sulfate analysis if affects on the groundwater quality are indicated from field monitoring.

Further water monitoring may be required, depending on the outcome of the Groundwater Impact Assessment and the monitoring of stockpiles during construction.

5.7 ASS Management

Where ASS is potentially present, as indicated by the Monitoring Requirements outlined in Section 5.6, management practices will be implemented. It is not recommended that laboratory testing be undertaken due to the relatively long turn-around times from the laboratory compared to the time for net acid generation to commence and result in environmental impacts.

5.7.1 Stockpile Management Practices

Stockpiles containing ASS must be managed to minimise oxidation of metal sulfides and acid generation potential, neutralise any acid produced and prevent acid leachate from leaving the site. This may be achieved by one or more of the following:

- Minimise time material is exposed to air;
- Create large compacted stockpiles of moist soil to prevent oxygen and water movement into the stockpile;
- Cover stockpiles with a low permeability or impermeable material (eg. clay, plastic) to prevent oxygen and water movement;
- Mix a liming agent with the stockpile material. For short-term management, lime may be broadcast over the stockpile surface;
- Return material to below the groundwater table or maintain soil moisture between field capacity and saturation to limit oxidation and minimise the potential for leaching;

Alternatively, accelerated oxidation or separation may be undertaken with advice from an experienced ASS consultant. Other practices may be acceptable but must be discussed with an experienced ASS consultant prior to implementation.

Specific management requirements for erosion and sediment control have not been recommended. Reference should be made to the Sediment, Erosion and Drainage Management Plan for stormwater management.

Consideration may need to be given to acid resistant construction materials in the event that net acid generation from ASS layers, in excess of soil buffering capacity, is encountered.

5.7.2 Water Remediation Techniques

Water remediation is unlikely to be required due to the presence of limestone, an alkaline aquifer and bicarbonate additions from seawater. However, "slugs" of acid water must be avoided and hence some remediation may be required.

Remediation of acid water generally requires the addition of a neutralising agent, such as lime. Care must be taken to ensure that overdosing does not occur and result in strongly alkaline conditions which may also damage groundwater and near shore ecosystems. Application rates must be careful calculated prior to application and then pH changes monitored during and after application. Caution must be exercised as a change in pH is unlikely to be instantaneous.

Application of lime to water bodies is difficult due to the low solubility of lime. Firstly lime needs to be formed into a slurry and then mixed into the water otherwise the lime will sink and result in little or no pH change.

Prior to dewatering trenches, the pH of the water shall be tested. If the pH is < 6, then remediation with lime will be required. Preferably, a lime slurry should be incorporated into the pump line, prior to discharge.

Other techniques may be available and will be discussed with an experienced ASS consultant before implementation.

5.8 Attachments

Attachment 1 – Field pH and Peroxide pH Tests

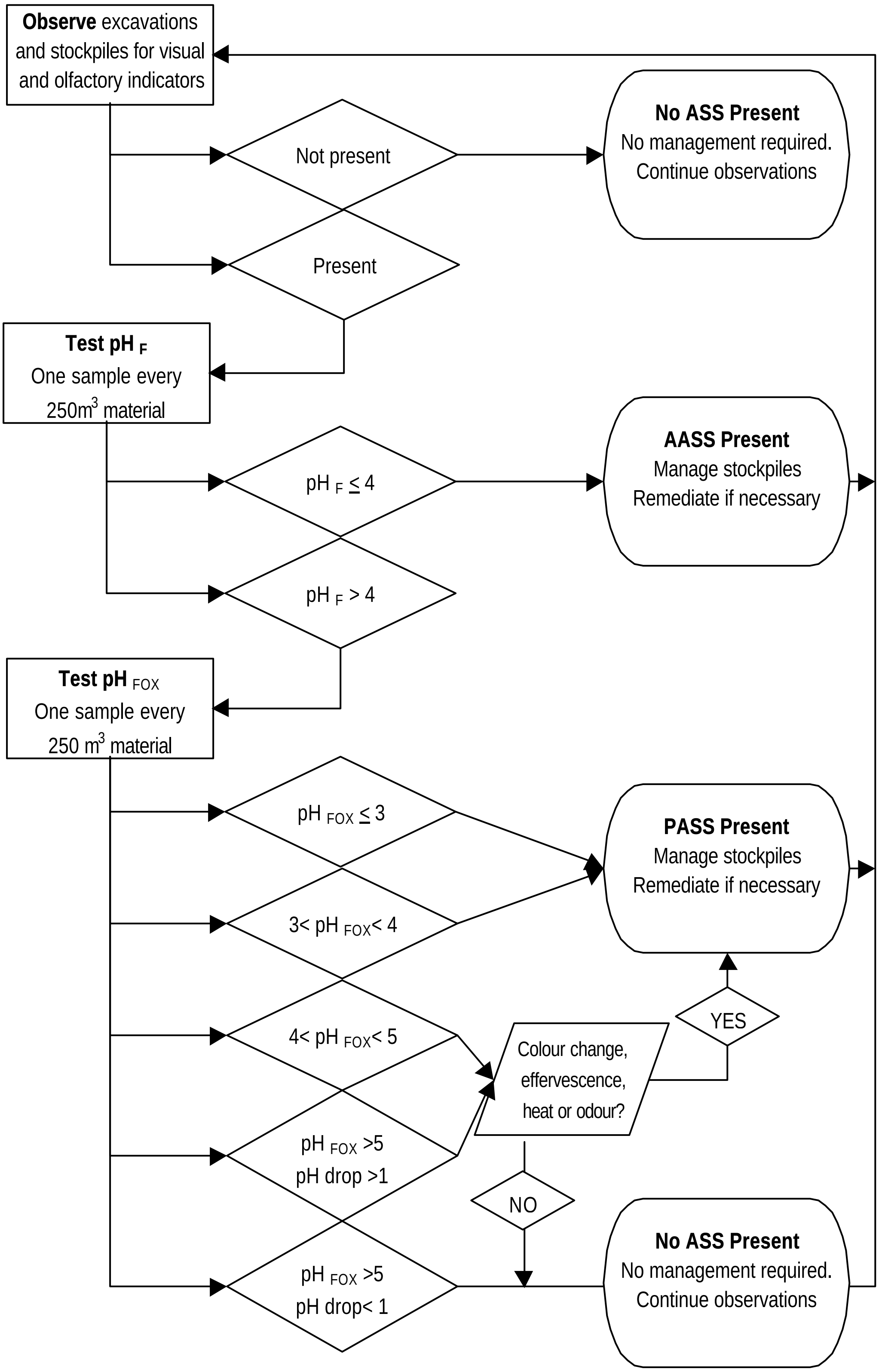


Figure 5.1 Flow chart of ASS Monitoring Actions and Interpretation

ATTACHMENT 1: Field pH and Peroxide pH Test

1. Field pH Test

The field pH (pH_F) provides a useful, quick indication of the likely presence and severity of actual acid sulfate soil. This test is not a substitute for laboratory analysis for the identification of ASS.

Prior to going to the field, the pH meter should be calibrated. For Cape Jaffa, it is envisaged that calibration should focus on the alkaline spectrum and hence calibration using a pH 7 and pH 10 buffer is recommended. In addition, the pH of the deionised water to be used in the field should be checked to ensure it is at pH 7.

Step 1. Place 1 tablespoon of soil into a small container, preferably glass or non-reactive plastic.

Step 2. Add 60 ml of deionised water and shake.

Step 3. Insert pH probe into soil:water solution and allow to equilibrate. Gently moving the probe in the solution can aid in equilibration. Ensure that the pH probe is inserted to the recommended depth within the solution.

Step 4. Record the pH_F on the Field Sheet and discard sample.

Step 5. If the pH_F is ≤ 4, the soil is AASS.
If the pH_F is > 4, proceed to the Peroxide pH test.

2. Peroxide pH Test

The Peroxide pH test checks for the presence of unoxidised sulfides and therefore potential acid sulfate soil, by using peroxide to promote the oxidation reaction.

Prior to going to the field, the pH of the peroxide should be checked and, if necessary, adjusted to 4.5 - 5.5. Peroxide also has a limited shelf life and hence must be stored in a dark, cool environment, such as a cupboard. Peroxide should be discarded every 6-12 months.

Step 1. Place 1 tablespoon of soil into a small container, preferably glass. Avoid selecting material high in organic matter in the sample as this may give a false positive.

Step 2. Add 20 ml of hydrogen peroxide and observe reaction for colour changes, effervescence, odour and heat. The reaction may be instantaneous or may take 10 minutes or more. Reaction may be violent and/or release a large amount of heat. To assist the reaction when slow, heating over hot water or in the sun may be required on cold days. Keeping the peroxide in a warm place may also aid the reaction.
WARNING: Hydrogen peroxide is a strong oxidising agent and should be handled carefully with appropriate eye and skin protection.

Step 3. Record observations.

Step 4. Allow the digested solution to cool after the reaction as most pH probes will not measure at high temperatures.

Step 5. Add 40 ml deionised water and shake.

Step 6. Insert the probe into the solution and allow to equilibrate. Gently moving the probe in the solution can aid in equilibration. Ensure that the pH probe is inserted to the recommended depth within the solution.

Step 7. Record the pH_{FOX} and discard the sample.

6. Conclusions

Limited soil investigation has allowed assessment of the main basin and canals and hence management strategies for excavated material have be developed. However, the presence of ASS in surrounding areas is unknown and pending the outcome of Groundwater Impact Assessment, further ASS investigation in surrounding areas may be required to determine the presence of ASS and any potential impacts.

PASS is present at the Cape Jaffa site, but sufficient inherent buffering capacity to prevent pH changes to less than 5.5 is present. The soil's buffering capacity is likely to be inherited from bicarbonate in the groundwater as the sandy soil, lack of organic matter and shells (due to the likely presence of coatings) are unlikely to provide buffering capacity.

Management during construction will require monitoring of the pH of stockpiles and groundwater as a precautionary measure. Remediation will be required in the event of excessive acid generation. Consultation with an experienced ASS Consultant will be undertaken to ensure remediation techniques are practical and adequate.

7. References

Ahern, C.R. and Blunden, B. 1998. 'Designing a soil sampling and analysis program'. In Ahern CR, Blunden, B and Stone Y (Eds) *Acid Sulfate Soils Laboratory Methods Guidelines.* Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW.

Ahern, C.R., McElnea, A. and Baker, D.E. 1998a. 'Peroxide oxidation combined acidity & sulfate POCAS – Method 21'. In Ahern CR, Blunden, B and Stone Y (Eds) *Acid Sulfate Soils Laboratory Methods Guidelines*. Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW.

Ahern, C.R., Stone, Y. and Blunden, B. 1998b. *Acid Sulfate Soil Assessment Guidelines.* Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW.

Department of Mines. 1951. *Geological Survey of SA, Kingston SE, 1 Mile Geological Series*, First Ed.

Goldberg, E. D., Broecker, W.S., Gross, M. G., and Turekian, K.K. 1971. 'Marine chemistry'. In *Radioactivity in the marine environment: Washington D.C.*, National Academy of Sciences, p. 137-146.

Kingston District Council & Cape Jaffa Development Company. 2002. Cape Jaffa Anchorage, Cape Jaffa Lacepede Bay South Eastern South Australia *Development Proposal for Major Projects Consideration.*

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J and Hopkins, M.S. 1984. *Australian Soil and Land Survey Field Handbook.* Inkata Press, Melbourne.

MDP. 2003. *Guidelines for the Preparation of an Environmental Impact Statement for the Cape Jaffa Anchorage Marina Proposal by District Council of Kingston and the Cape Jaffa Development Company*. Major Developments Panel, Adelaide.

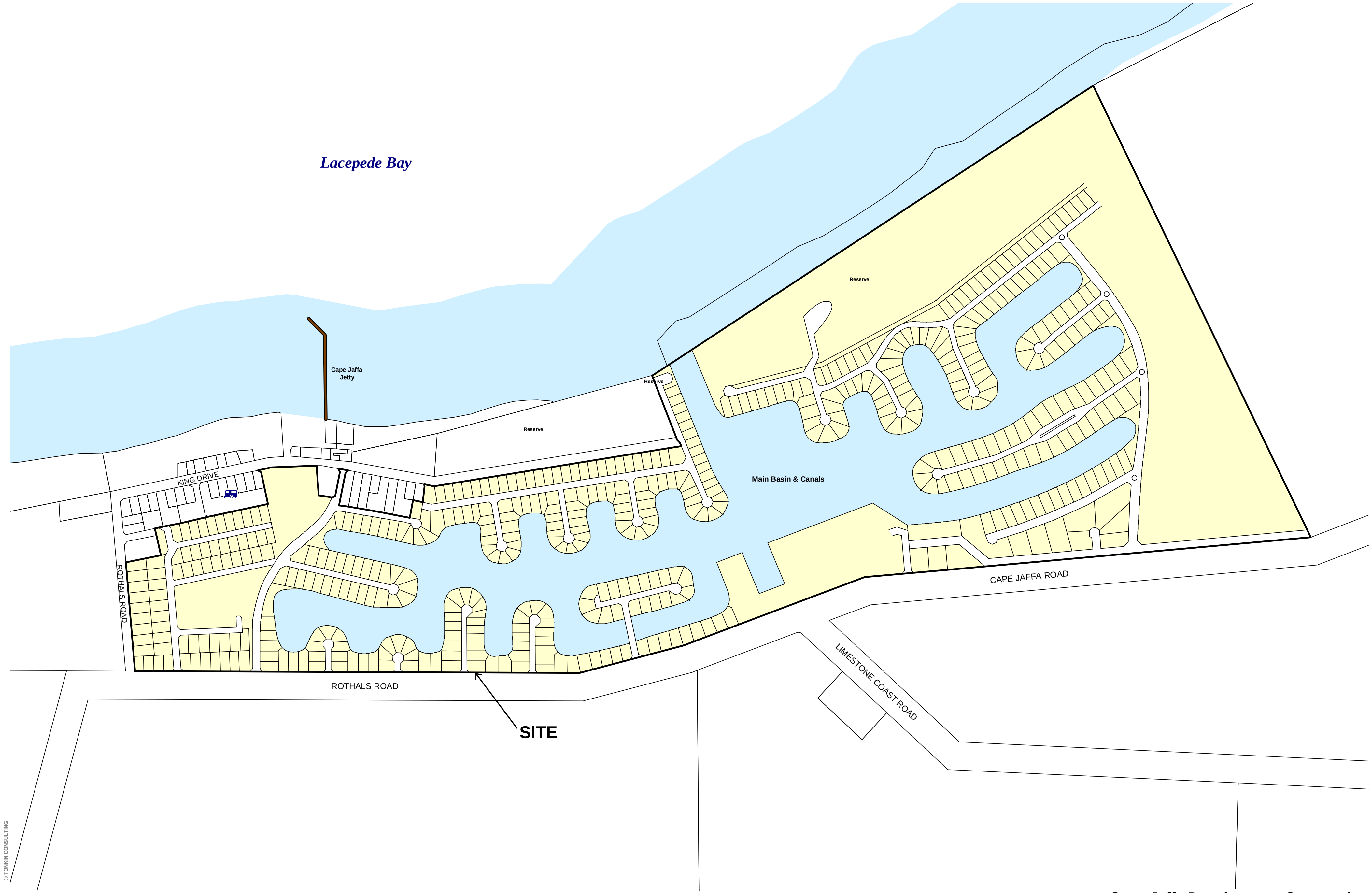
PIRSA. 2001a. *South East Land Resource Information.* Primary Industry and Resources South Australia and National Heritage Trust.

PIRSA. 2001b. *Soils of South Australia's Agricultural Lands.* Primary Industry and Resources South Australia and National Heritage Trust.

SA CPB. 2003. 'A strategy for implementing CPB policies on coastal acid sulfate soils in South Australia' in *Coastline* No 33. South Australian Coast Protection Board.

Appendix A

Proposed Development Plan



Cape Jaffa Development Corporation

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au
W www.tonkin.com.au

N

MAP DETAILS

Cadastral Data:	DEH
Job Number:	2003.0318
Filename:	Figure12.wor
Drawn:	Tina Freeman
Date:	04/12/2003

-200 0 200 400 600 m

Scale 1:7,500

Cape Jaffa Marina
EIS Groundwater Assessment

PROPOSED DEVELOPMENT PLAN

Figure 1.2

Appendix B

Initial Laboratory Results

amdel
www.amdel.com
A subsidiary of the Gribbles Group
A.B.N. 58 625 960 402

585 Blackburn Road Notting Hill,
Victoria, Australia 3168
Telephone (03) 9562 5899 Fax (03) 9562 0336

Replacement Analytical Report

Replacement for Report no: 99264, issued on: 23 Jul 2003

TONKIN CONSULTING
6 Cooke Terrace
Wayville

SA 5034

Contact	: **MELANIE KOERNER**
Batch Number	: **0311724**
Job Ref	: **2003.0318**
Sample(s) Received	: **09/07/2003**
Replacement Report No	: **99996**

Methods:

250 POCAS - Oxidisable Sulfur (Sulfur Trail) #
250 POCAS - Sulfidic Acidity (Acid Trail) #
250 POCAS - TPA, TAA, pH(KCl), pH(ox) #

Attached Results Approved by:

Susan Groth
B.Sc.
Senior Analyst - Waters

Anthony Crane
B.App.Sci. (Environmental)
Laboratory Manager

John Levvey
Dip.App.Sci (Chemistry)
Senior Analyst - Metals

Document may not be reproduced except in full.

**** This is the Final Report which supersedes any reports previously issued relating to the sample(s) included.***
All samples tested as submitted by client.
 # Denotes methods not covered by NATA terms of accreditation

amdel
www.amdel.com
A subsidiary of the Gribbles Group
A.B.N. 58 625 960 402
585 Blackburn Road Notting Hill,
Victoria, Australia 3168
Telephone (03) 9562 5899 Fax (03) 9562 0336

Results

Replacement Report No: 99996

	0311724/001 CJ17 Soil 08/07/2003	0311724/002 CJ03 Soil 08/07/2003
PEROXIDE OXIDATION - COMBINED ACIDITY & SULFATE		
Method: ASS Method 21 (POCAS) Units : %		
Peroxide Oxidisable Sulfur (Sulfur trail), Spos% #	0.51	0.01
PEROXIDE OXIDATION-COMBINED ACIDITY & SULFATE		
Method: ASS Method 21 (POCAS) Units: As Stated		
pH (KCl) extract #	6.4	7.4
pH (ox) Peroxide Extract #	2.9	6.0
Total Actual Acidity # mol H+/t	<5.0	<5.0
Total Potential Acidity # mol H+/t	144	<5.0
Total Sulfidic Acidity # (Acid trail), mol H+/t	139	<5

Appendix C

Field Borehole Logs

Tonkin Engineering

Test Pit
BH01

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	383342	**Final Depth (m)**	3.35
Logged	MS	**Surf Elev (mDatum**	3.69	**N (m)**	5910475		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes Water cut at 3.1 m

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0.3			D SP SAND- Coarse, brown, fibrous due to roots and possibly seaweed. Topsoil					
0.6			D SP SAND- Coarse, white-yellow, occasional shells					
0.9								
1.2								
1.5								
1.8								
2.1					BH1/1 A		2-2.3	
2.4								
2.7			M SP SAND- Medium to fine, grey, brown-orange fibrous tinges, possibly seaweed. Slight sulfurous odour		BH1/2 A		2.5-2.8	
3			W SP SAND- Fine, grey, >50% shell fragments		BH1/3 A		3-3.3	
3.3								
3.6			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator......MO...................................... Project Manager/Authorisation.......M O.......................................

Tonkin Engineering

Test Pit
BH02

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	383665	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	3.56	**N (m)**	5910519		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes Hard layer above sandstone at about 3.0 metres

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0 – 0.2			D SP SAND- Coarse, brown, abundant roots, topsoil					
0.2 – 2.4			SP SAND- Coarse, pale yellow, occasional orange mottle					
2.2					BH2/1 A		2.1-2.3	
2.4 – 3			SP SAND- Medium to coarse, grey, 30% shell fragments					
2.6					BH2/2 A		2.6-3	
3			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator......MO...... Project Manager/Authorisation....M Dair....

Tonkin Engineering

Test Pit BH03

Project Cape Jaffa Anchorage Marina		**Job No** 20030318ASS	
Client KDC & CJDC			

Date	21/08/2003	**Datum**	AHD	**E (m)**	384011	**Final Depth (m)**	3.2
Logged	MS	**Surf Elev (mDatum**	3.66	**N (m)**	5910577		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0.2, 0.4			SP SAND- Coarse, dark brown, topsoil. Gradual change to underlying layer					
0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2			SP SAND- Coarse, yellow, orange mottle					
2.4			SP SAND- Coarse, yellow, 40% shell fragments		BH3/1 A		2.2-2.5	
2.6, 2.8, 3, 3.2			SP SAND- Medium, grey, 20% small shell fragments		BH3/2 A		2.6-3	

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator..MO..... End of Hole .... Project Manager/Authorisation....M Dalt........

Tonkin ENGINEERING SCIENCE

Test Pit
BH04

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	383747	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	3.01	**N (m)**	5910340		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0–0.4			D — SP SAND- Coarse, dark brown. Topsoil					
0.4–2.1			D — SP SAND- Coarse, pale yellow, orange mottle					
2.1–2.7			SW SAND- Grey, 80% whole shells		BH4/1 A		2.3-2.6	
2.7–2.9			M — CL CLAY- Green		BH4/2 A		2.7-2.9	
2.9–3			LIMESTONE- Cemented limestone		BH4/3		2.9-3	
			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator..MS.................................... Project Manager/Authorisation..M.K.Pant..

Test Pit BH05

Project Cape Jaffa Anchorage Marina		**Job No** 20030318ASS	
Client KDC & CJDC			

Date	21/08/2003	**Datum**	AHD	**E (m)**	383378	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	3.52	**N (m)**	5910330		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0–0.5			D — SP SAND- Coarse, brown. Topsoil					
0.5–2.5			D — SP SAND- Coarse, yellow, orange mottle					
2.5–3			SP SAND- Medium to coarse, whole shell fragments - 10% near top and up to >50% near base		BH5/1 A		2.6-2.8	
					BH5/2		2.8-3	
3			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator..MVO.................................... Project Manager/Authorisation..M Pa[illegible]...........

Tonkin Engineering

Test Pit
BH06

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	382946	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	1.9	**N (m)**	5910334		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes Water cut at 2.1 metres

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0–0.3			D SM Silty SAND- Sandy silt, dark brown. Topsoil					
0.3–1.2			SP SAND- Pale, yellow, distinct yellow-orange mottle		BH6/1 A		0.8-1	
1.2–1.5			CL Sandy CLAY- Grey, orange mottle, small shell fragments		BH6/2 A		1.2-1.5	
1.5–1.8			W - CALCRETE-cemented					
1.8–3			LIMESTONE- Limestone		BH6/3 A		2.6-3	
3			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator. MO .... Project Manager/Authorisation. M Pault ....

Test Pit BH07

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	384066	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	2.33	**N (m)**	5910726		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0–0.5			SP SAND- Coarse, dark brown. Topsoil					
0.5–2.3			SP SAND- Coarse, pinkish yellow. Similar to beach sand. Small shell fragments present					
2.3–2.5			GP GRAVELS- Shell grit, very coarse, red staining					
2.5–3			SP SAND- Grey, few shells		BH7/1		2.7-3	
3			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator...MMO.................................. Project Manager/Authorisation..M Part..................................

Tonkin Engineering

Test Pit
BH08

Project Cape Jaffa Anchorage Marina
Job No 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	384280	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	2.71	**N (m)**	5910749		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0.0			SW SAND- Very dark brown. Topsoil					
0.4			SP SAND- Coarse, pale yellow					
1.6			SP SAND- Coarse, no odour					
1.8			PT PEAT- Seaweed layer		BH8/2 A		1.8-2	
2			SP SAND- Coarse, no odour		BH8/1 A		2-2.4	
3			End of Hole					

Depth scale: 0.2, 0.4, 0.6, 0.8, 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2, 2.4, 2.6, 2.8, 3

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator: MO .... Project Manager/Authorisation: M Duitt ....

Test Pit
BH09

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	384338	**Final Depth (m)**	3.2
Logged	MS	**Surf Elev (mDatum**	3.29	**N (m)**	5910599		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0–0.2			SP SAND- medium, dark brown, topsoil					
0.4			SP SAND- coarse "beach sand"					
2.6			SP SAND- very coarse, white		BH9/1 A		2.6-2.9	
3			SP SAND- Grey		BH9/2		3-3.2	
3.2								

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator MO End of Hole .... Project Manager/Authorisation M Quatz ....

Tonkin Engineering

Test Pit BH10

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	384545	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	1.9	**N (m)**	5910715		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0–0.2			SM Silty SAND- Black. Topsoil					
0.2–1			SP SAND- Medium to coarse, pale yellow/grey. Red fringing to underlying layer					
1–1.2			GP GRAVELS- Shell grit					
1.2–2.5			SP SAND- Grey		BH10/1 A		1.2-1.4	
2.5–3			SP SAND- Grey, whole shells and shell fragments present		BH10/2		2.7-3	
3			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator MVO.................................... Project Manager/Authorisation...M....Dart..............................

Tonkin Engineering

Test Pit BH11

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS

Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	384786	**Final Depth (m)**	3
Logged	MS	**Surf Elev (mDatum**	2.96	**N (m)**	5910791		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0.0–0.3			SP SAND- Medium, black. Topsoil. Gradational change to underlying layer					
0.3–1.2			SP SAND- Coarse, pinkish-yellow					
1.2–1.5			SP SAND- Coarse, grey-yellow, occasional shells		BH11/1		1.2-1.4	
1.5–2.0			SP SAND- Coarse, white					
2.0–2.5			SP SAND- Coarse, yellow		BH11/2		2-2.3	
2.5–3.0			SP SAND- Coarse, grey		BH11/3		2.5-2.8	
3			End of Hole					

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator: MO .... Project Manager/Authorisation: M Dutt ....

Tonkin Engineering

Test Pit BH12

Project Cape Jaffa Anchorage Marina **Job No** 20030318ASS
Client KDC & CJDC

Date	21/08/2003	**Datum**	AHD	**E (m)**	384911	**Final Depth (m)**	3.8
Logged	MS	**Surf Elev (mDatum**	2.55	**N (m)**	5910824		
Sampled	MS			**Driller**	Lucas Earthmovers		
		Upstand (mDatum)		**Method**	BH		

Notes Located near overflow drain from adjoining farmers effluent dam

Depth (m)	Water (m)	Gr Log	Soil Description and Observations (Refer AS1726-1993 and AS4482.1-1997)	S R	Sample No	QA/QC	Sample Depth (m)	PID (ppm)
Surface Level			Moisture, Consistency, Field Classification, Soil Type					
0.0–0.4			SP SAND- Coarse, black, topsoil					
0.4–1.1			SP SAND- Coarse, pale yellow. Red fringe above underlying layer					
1.1–2.5			SP SAND- Coarse, grey		BH12/1		1.4-1.7	
2.5–3.8			SP SAND- Coarse, grey, sulfurous odour		BH12/2 A		2.7-3	
3.8			End of Hole					

Depth scale: 0.3, 0.6, 0.9, 1.2, 1.5, 1.8, 2.1, 2.4, 2.7, 3, 3.3, 3.6, 3.9

Please refer to the definition sheets provided with this borelog for explanations and notes on soil classification and description. See Site Plan for location.

Originator.....MS..... Project Manager/Authorisation.....M Batt.....

Appendix D

Laboratory Results

MINERAL CHEMISTRY

QUALITY MANAGEMENT SYSTEM

Amdel Laboratories Ltd
PO Box 338
Torrensville Plaza SA 5031
ACN 009 076 555
Telephone (08) 8416 5300
Facsimile (08) 8234 0321

amdel
www.amdel.com

Ms Melissa Salt
Tonkin Consulting
5 Cooke Terrace
WAYVILLE SA 5034

2 3 OCT 2003

FINAL ANALYSIS REPORT

Your Order No:	2003.0318	Our Job Number:	3AD1948
Sample rec'd:	28/08/03	Results reported:	12/09/03
No. of samples:	12		

Results apply to sample(s) as submitted by the client.

Report comprises a cover sheet and pages: 1 to 1

Approved Signature:

A Ciplys

for
Alan Ciplys
Manager, Geoanalytical Central Region

Report Codes:
N.A. - Not Available
L.N.R. - Listed But Not Received
I.S. - Insufficient Sample

Distribution Codes:
CC - Carbon Copy
EM - Electronic Media
MM - Magnetic Media

POCAS ANALYSIS

JOB No. **3AD1948** **PAGE** **1**
CLIENT REF **TONKIN CONSULTING**

SAMPLE I.D	pH kcl	pH ox	S kcl	S p	S pos	TAA	TPA	TSA	N.V.
BLANK	7.21	3.67	0.000	0.000	0.000	0	0	0	N.A
STD IMS1	9.62	8.71	0.026	0.090	0.064	0	0	0	N.A
BH1/1	9.40	8.74	0.001	0.001	0.000	0	0	0	N.A
BH1/2	9.50	9.00	0.006	0.068	0.062	0	0	0	N.A
BH3/2	9.80	8.95	0.003	0.030	0.027	0	0	0	N.A
BH4/1	9.60	9.13	0.005	0.076	0.071	0	0	0	N.A
BH4/2	7.95	6.30	0.024	0.873	0.849	0	0	0	N.A
BH6/1	9.80	9.01	0.002	0.015	0.013	0	0	0	N.A
BH6/2	9.29	8.40	0.014	0.500	0.486	0	0	0	N.A
BH6/3	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	34.0
BH8/1	9.66	8.84	0.006	0.054	0.048	0	0	0	N.A
BH8/2	8.62	7.64	0.009	0.207	0.198	0	0	0	N.A
BH9/1	9.80	8.74	0.004	0.004	0.000	0	0	0	N.A
BH12/2	9.74	8.83	0.005	0.026	0.021	0	0	0	N.A
BH12/2 RPT	9.71	8.85	0.005	0.025	0.020	0	0	0	N.A

Code	ASS21A	ASS21B	ASS21C	ASS21D	ASS21E	ASS21F	ASS21G	ASS21H	VOL1B
Units	nounit	nounit	%	%	%				%CaCO3 eq
Det'n Limits	0.01	0.01	0.001	0.001	0.001	8	8	8	0.1

Units for TAA, TPA, TSA mol H+/tonne

APPENDIX 27

Cape Jaffa Marina Breakwater Design, Tonkin Consulting, December 2004, Ref No. 20010779 LA6/JT/JT

ADELAIDE
TONKIN CONSULTING
5 COOKE TERRACE
WAYVILLE SA 5034
T +61 8 8273 3100
F +61 8 8273 3110
E adelaide@tonkin.com.au

MOUNT GAMBIER
JONES TONKIN
1 KRUMMEL STREET
MOUNT GAMBIER SA 5290
PO BOX 1192
MOUNT GAMBIER SA 5291
T +61 8 8723 5002
F +61 8 8723 5004
E mtgambier@tonkin.com.au

20010779LA6/JT/JT

10 December 2004

Cape Jaffa Development Company
PO Box 150
BRIGHTON SA 5048

Attention: Rob Gabb

Dear Rob

CAPE JAFFA MARINA BREAKWATER DESIGN

At your request we have carried out a detailed analysis of the breakwater structures for the proposed marina at Cape Jaffa.

The breakwater is to be constructed as a rubble core mound with locally sourced materials used in the construction. In addition it is understood that you propose to use rock spoil from previously constructed open channel stormwater drains which are located in the general area.

This type of structure is commonly used in other ports, marinas and boat ramp areas. Examples include Cape Jervis, Wirrina, Wallaroo and Kingston.

The design of the breakwater has been undertaken using the design principles of the US Army Corps Shore Protection Manual. The design methods have been proven through many years of in service construction and monitoring of existing structures.

Based on the investigations undertaken by this office, WBM Australia and data recorded from the tide gauge installed on the Cape Jaffa Jetty by you, the local wave climate adopted for the design has been determined.

For the purposes of the design the 1 in 100 year high tide (approx. 1.45m AHD) in combination with the 100 year significant sea and swell wave (Hs=1m), with a wave period in the order of 5-10 seconds has been adopted as the extreme wave event for which the height of the breakwater structures can designed.

Other factors such as the natural beach slope and slope of the breakwater structure will have an affect on the wave run up and energy dissipation of the breaking wave and have been considered in the design.

The height and size of the structure is also a function of the cost of construction and it can be preferable to design a structure that allows for overtopping of the structure under infrequent storm events as a more cost effective solution. However you have indicated a preference for the height of the structure to be such that no overtopping will take place.

Based on the local wave climate and existing beach conditions the height of the break water structure is 2.5mAHD. This height will provide a for a "good" wave climate within the marina waterways under the majority of weather conditions, with only locally generated sea waves due to the wind (which will be fetch limited) occurring within the waterways.

This height is similar to the deck height of the existing Cape Jaffa jetty. Anecdotal evidence form the local fisherman in the area suggests that waves are rarely seen at this height during extreme storm events.

The design is such that no overtopping of the structure should occur for the combination of 100 year wind and high tide event.

We have assessed samples of the limestone rock that is proposed as the rock armour for the structure, and consider that the characteristics are satisfactory. Furthermore it is understood that similarly sourced rock has been used on the Kingston breakwater and is performing adequately.

It is important that the rock armour for the structure is suitably graded to ensure that the individual size of the stones are such that they are not displaced by wave action and are of sufficient shape to provide some interlock with other units when placed.

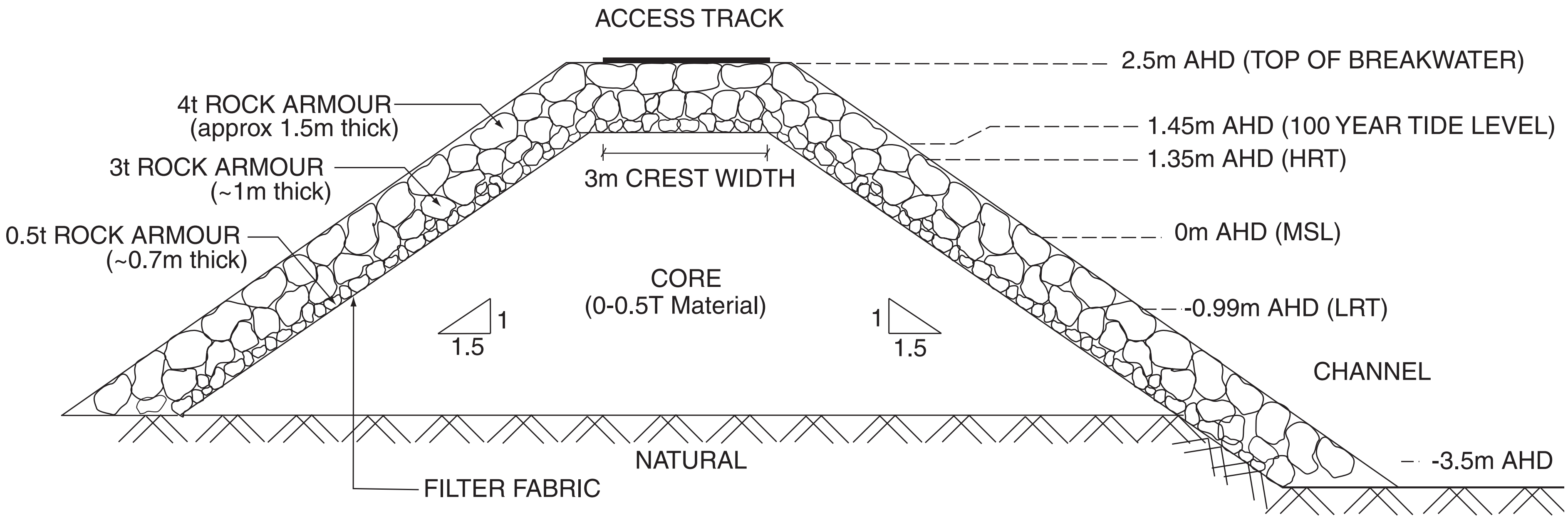
The width of the crest has been designed at 3m. As indicated it is preferable that an access track is provided to enable restricted access to emergency services and Council vehicles for maintenance purposes. Further the track would provide pedestrian access to the general public for recreational activities.

The attached plan shows a typical cross section of the breakwater structure, including the size and number of layers of armour stone required.

Yours faithfully
TONKIN CONSULTING

RAH ARENS, FIEAust
Chartered Professional Engineer

Enc 2001.0779 Sheet 1 – Typical Cross Section


ACCESS TRACK
2.5m AHD (TOP OF BREAKWATER)
4t ROCK ARMOUR
(approx 1.5m thick)
1.45m AHD (100 YEAR TIDE LEVEL)
1.35m AHD (HRT)
3t ROCK ARMOUR
(~1m thick)
3m CREST WIDTH
0.5t ROCK ARMOUR
(~0.7m thick)
0m AHD (MSL)
CORE
(0-0.5T Material)
-0.99m AHD (LRT)
1
1.5
1
1.5
CHANNEL
NATURAL
-3.5m AHD
FILTER FABRIC

APPENDIX 28

Review of Documentation for Section 12 determination under the *Aboriginal Heritage Act* 1988: Cape Jaffa Anchorage, Department of Aboriginal Affairs and Reconciliation, August 2004, prepared by Australian Cultural Heritage Management – Confidential DAARE Document

Australian Cultural Heritage Management

Cultural Heritage Management
Community Development
Anthropology
Native Title

Geographic Information Systems
Cultural Tourism
Archaeology
Cartography

CONFIDENTIAL

Review of documentation for the Section 12 determination under the *Aboriginal Heritage Act 1988*: Cape Jaffa Anchorage

August 2004