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R753 Rev 1

July 2016

marinas
boat harbours
canals
breakwaters
jetties
seawalls
dredging
reclamation
climate change
waves
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flood levels
water quality
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Ocean Beach Alternate Boat Launching Facility Study

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1. Introduction

The coastline near Denmark, in Western Australia, has no formal boat launching facilities providing direct access to the ocean. The nearest formal ocean boat launching facilities are more than 50 km away at Albany to the east and 200 km away at Augusta to the west. There are a number of informal boat launching sites including over the beach launching, however these can be dangerous during certain conditions. At Ocean Beach, boat launching occurs in the south eastern corner of the bay over the beach. Once launched, vessels have to navigate along the edge of the rocky headland through an area which is popular with swimmers and surfers.

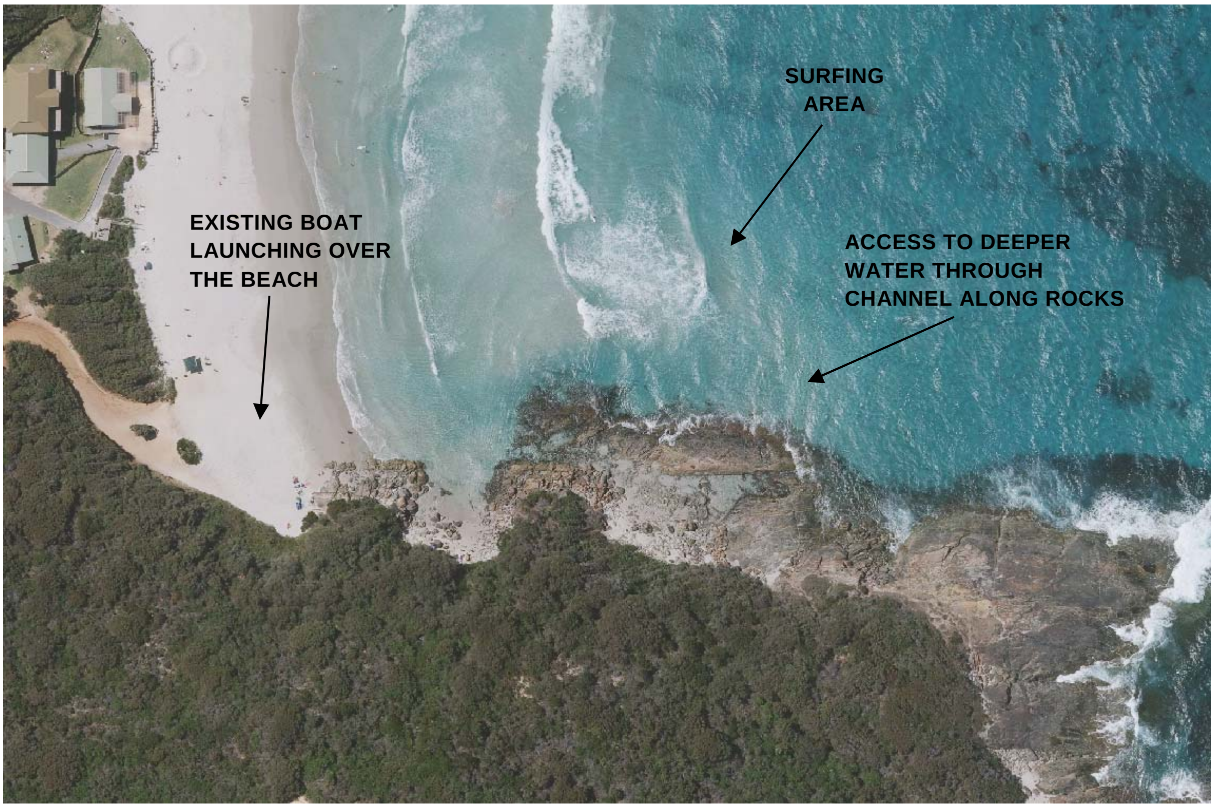

Figure 1.1 Aerial Photograph of Existing Boat Launching Site at Ocean Beach

Figure 1.2 Photograph of Location of Existing Ocean Beach Boat Launching

There have been some serious safety concerns related to the conflicts between swimmers/surfers and vessels. Historically there have been some 'near miss' incidents and in the past as a short term measure the Shire of Denmark (SoD) have closed the area to boating during peak periods.

To address these issues the SoD applied for, and, was successful in receiving a grant to undertake a feasibility study of an alternate ocean boat launching facility at McGeary's Rock further to the south of the existing boat launching location. This grant was provided under the Recreational Boating Facilities Scheme (RBFS) which is administered by the Department of Transport (DoT). An aerial photograph showing the existing boat launching site and the proposed alternate site is shown in the figure below.

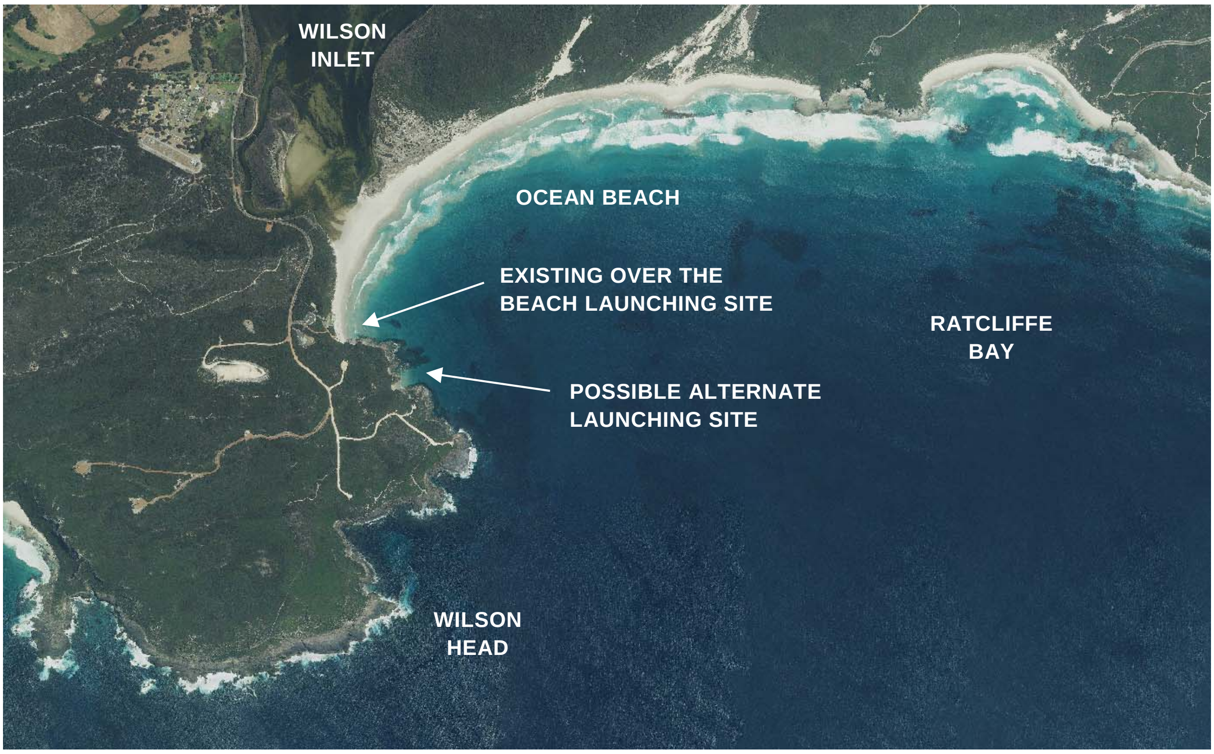

Figure 1.3 Location Diagram

To complete the investigation of the feasibility of the alternate site the SoD engaged specialist coastal and port engineers, M P Rogers & Associates Pty Ltd (MRA). The aim of the project was to undertake the following.

- Prepare concept designs for the proposed facility.
- Seek technical advice regarding the 'order of cost' of the alternate facility.
- Investigate the impact on the existing natural shoreline and the existing surfing breaks.

This report presents the findings from the investigation.

This study has been funded by the Department of Transport's Recreational Boating Facilities Scheme and the Department of Regional Development's Royalties for Regions Funding.

2. Design Criteria

2.1 Design Standards & Guidelines

The design of boat launching facilities generally falls under the requirements of the following Australian Standards.

- AS3926-2001 Guidelines for design of marinas.
- AS4997-2005 Guidelines for the design of maritime structures.

The DoT has also published a guideline for the design of boat launching facilities.

- Guidelines for the Design of Boat Launching Facilities in Western Australia below the 25th Parallel (DoT, 2009).

Where applicable the concept designs completed under this project have been completed in accordance with the minimum requirements set out in these standards and guidelines.

2.2 Key Design Criteria

The required design criteria proposed for the boat launching facility was provided by the SoD and DoT as follows.

"The facility shall contain at least two boat ramp lanes capable of taking heavy trailer-boats together with a boat holding jetty and shall have a minimum of 60 car-trailer parking spaces.

Due to the likely need for breakwaters to provide the necessary protected water space at the ramps, there should be an allowance for a jetty/wharf to Class 15 of AS 4997: Guidelines for the Design of Marine Structures with berthing space for at least one 20m long vessel.

The facility shall provide a 'good' wave climate as nominated in Table 4.2 of AS 3962: Guidelines for Design of Marinas and shall otherwise comply with that standard and AS 4997."

3. Existing Site Conditions

An aerial photograph showing the key features of the proposed site is presented in the following figure.

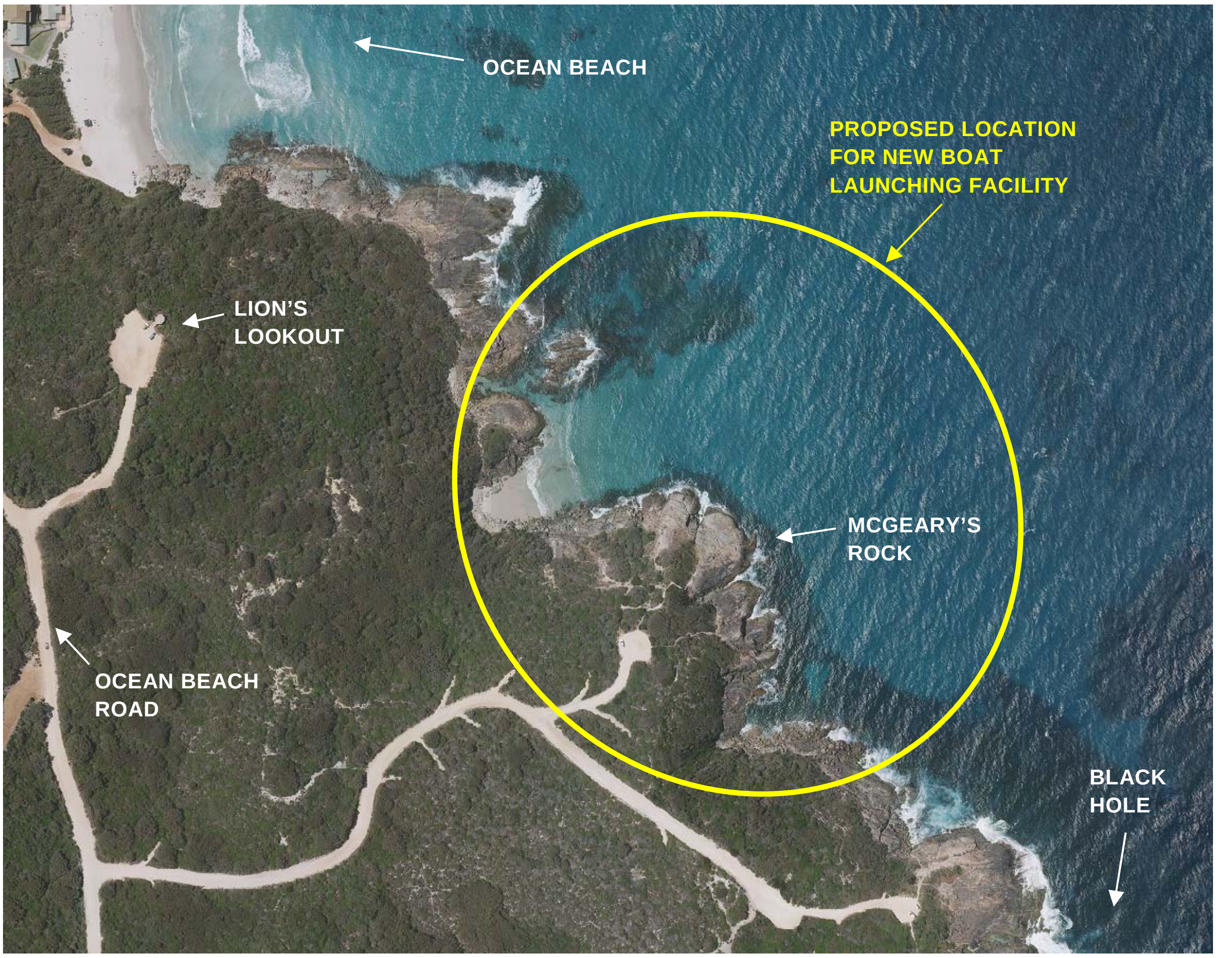

Figure 3.1 Aerial Photograph of Proposed Site for Facility

The site is currently a popular rock fishing location with relatively deep water close to the shore. Access to the site is by a gravel road which comes off Ocean Beach Road. There are two existing small gravel car parks at McGeary's Rock and further to the south at Black Hole.

3.1 Site Inspection

An inspection of the site was carried out by Senior Coastal Engineer, Peter Doust, on the 24th March 2016. A selection of photographs taken during the site inspection are presented in the following figures.

Figure 3.2 Looking North to Ocean Beach

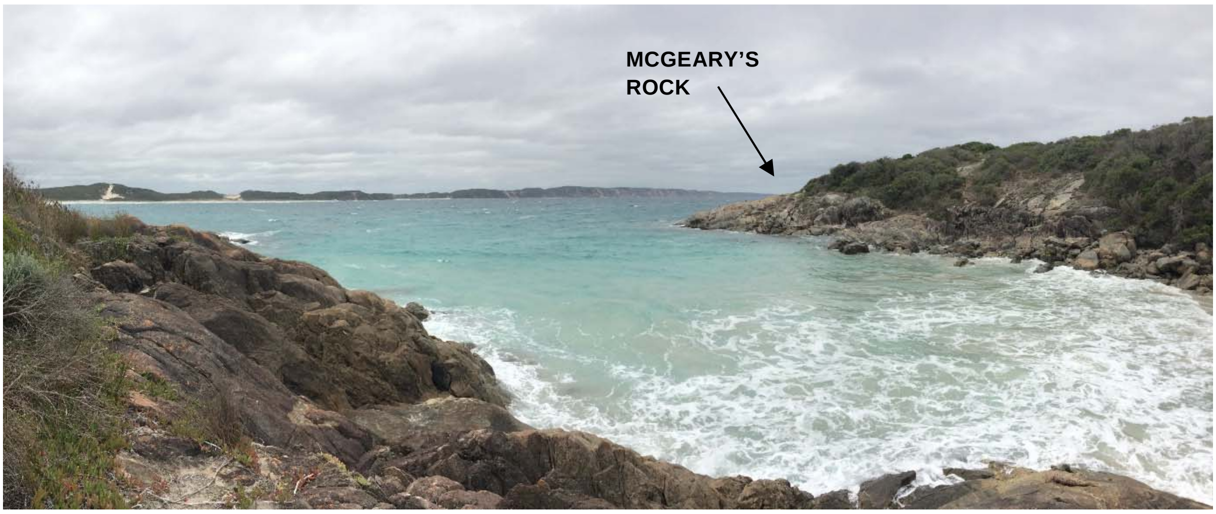

Figure 3.3 Photograph of Small Bay on Northern Side of McGeary's Rock

Figure 3.4 Looking South towards McGeary's Rock

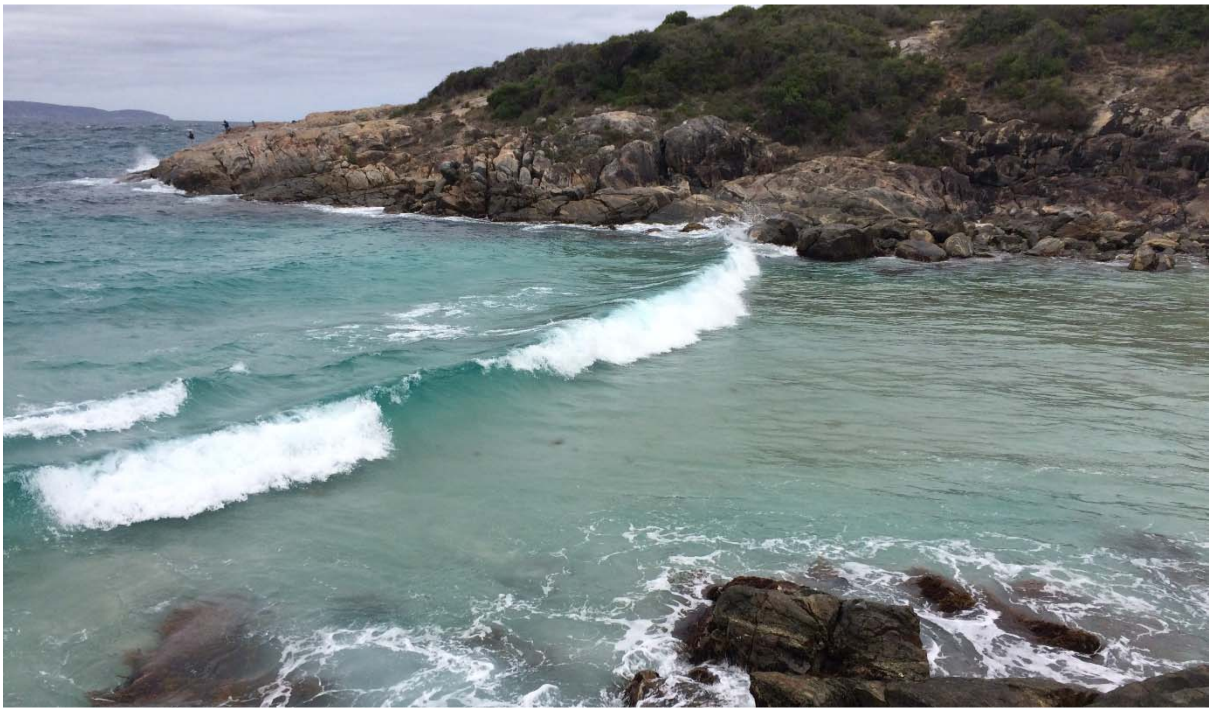

Figure 3.5 Breaking Waves in Small Bay During Site Inspection

Key items noted during the site inspection are summarised in the following dot points.

- The site is exposed to large waves from the southeast to east. Even when the offshore wave direction is from the southwest waves refract around the headland to reach the site. Locally wind generated seas can also reach the site from the east to northeast direction.

- The small bay on the northern side of McGeary's Rock has some sheltering from the open ocean, but wave heights within the bay still greatly exceed the require limit on wave heights outlined in the Australian Standard for a boat launching facility. During the site inspection, the significant wave height (H_s) within the bay was measured to be 0.5m. The offshore H_s measured at the Albany Waverider Buoy at the time was 3.0m from the southwest which is a typical wave height for this coastline. Therefore, additional protection is required at the site if a boat ramp is constructed.

- The site is backed by a large hill reaching heights of more than 50m above sea level near Ocean Beach Road. Along the coastline there are steep granite outcrops making access to the water difficult.

- There is relatively deep water close to the shore, however, in some locations there are shallow granite outcrops with waves breaking over them. These could result in dangerous navigation for vessels depending on the chosen location and alignment of the proposed facility.

- The hill is densely vegetated with coastal scrub typical of headlands along the south coast of Western Australia.

- The surfing area at Ocean Beach extends up to ~200m from the shoreline, where waves break over the nearshore sandbars. It is understood that when the bar between Wilson

Inlet and the ocean breaks open sand can be deposited further offshore extending the surfing area further seaward.

3.2 Survey

The following survey & bathymetric information was obtained for this study.

- Bathymetric survey information from the Department of Transport taken in November 1995. This covered a large portion of Ratcliffe Bay and the nearshore area around Wilson Head out to about the -30m contour.
- Topographical contours at 5m intervals from Landgate.
- AUS759 nautical chart was also used to estimate seabed levels outside of Ratcliffe Bay where survey information was not available.

The following figure shows the bathymetric and topographical contours surrounding the site. These levels refer to Australian Height Datum (AHD).

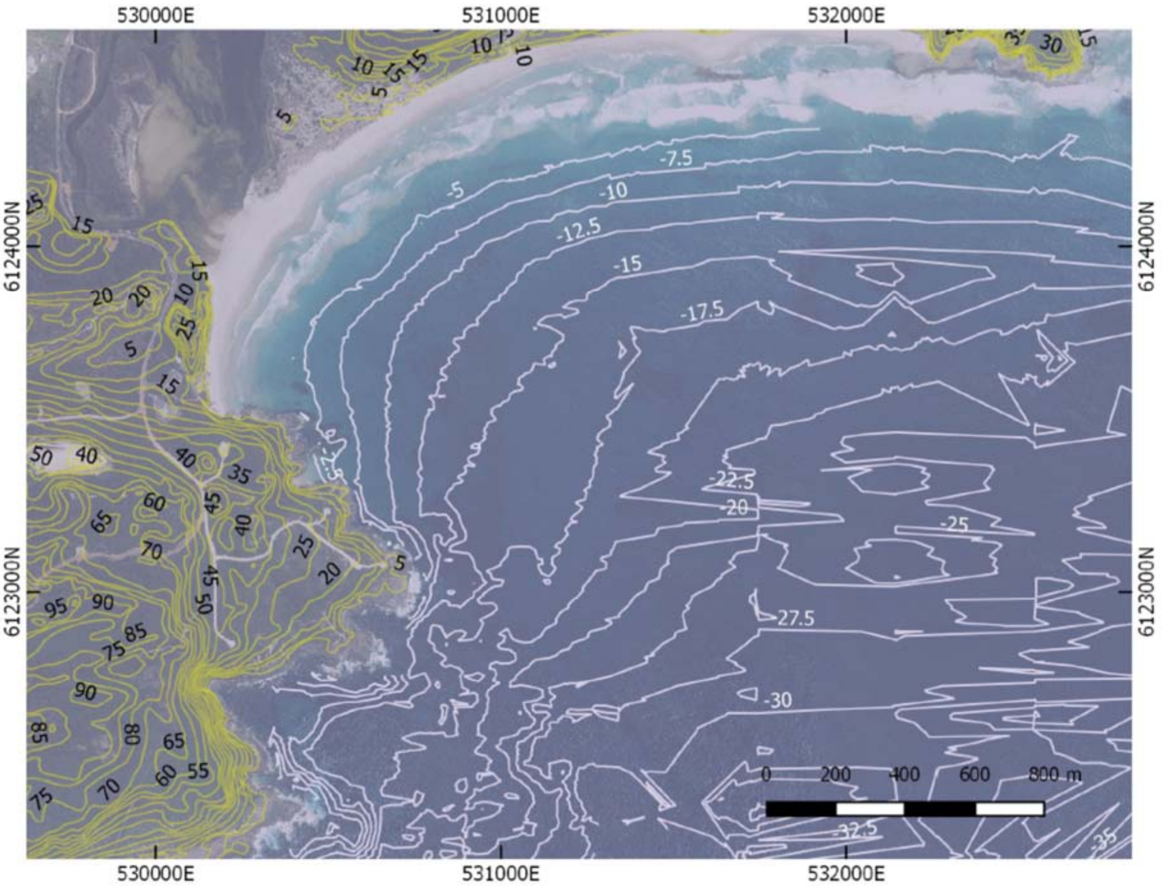

Figure 3.6 Bathymetric & Topographical Contours (mAHD)

As shown in the above figure, at the proposed site for the boat launching facility the -7.5mAHD contour is less than 50m from the shoreline. This shows that there is relatively deep water close to shore and large quantities of material will be required to construct breakwaters.

The survey information also confirms the high land adjacent to the site and steep grades down to the waterline. A large amount of earthworks would be required to achieve suitable grades to provide access between the existing road and the proposed boat ramp.

3.3 Geotechnical Conditions

The geotechnical conditions at the site comprise of undulating granite outcrops overlayed with sand in some locations. Some limestone was also encountered at the top of the hill adjacent to the site. The following photographs show the typical geotechnical conditions on the surface.

Figure 3.7 Geotechnical Conditions

Further geotechnical investigation is required to assess the strength and quality of the rock to determine the likely yield for large armour rock for use in the construction of the exposed breakwaters. However, based on the visual assessment on site it appears that the rock is similar to the rock at the recently constructed Augusta Boat Harbour. Therefore it may be possible that a quarry is set up on site to produce material for the construction of the breakwaters. This has the added benefit that at the completion of the quarrying operations, the area that was quarried could be used to construct the car park and access roads.

Piled foundations will be required for the finger jetty and wharf structures. Based on the geotechnical conditions at the site it is likely that the piles will need to socketed into the rock, similar to the methodology adopted for the Augusta Boat Harbour.

3.4 Waves

3.4.1 Offshore Wave Climate

The offshore wave climate has been previously investigated by MRA and the results are contained in MRA (2013). The typical elements of the offshore wave climate are as follows.

- Locally generated seas which are fetch and duration limited by the extent of the local wind conditions. In the summer months strong south easterly winds can generate waves which are typically 0.5 to 1.5 metres high, with periods of 3 to 6 seconds.
- Seas generated locally by the passage of cold fronts during winter. The wave heights and periods vary markedly from storm to storm. Often the wave heights exceed 4 metres and the wave periods reach 8 to 10 seconds. The direction from which these storm waves approach is generally from the west to south during the passage of the storm.
- Swell waves from distant storms in the Southern Indian Ocean continually reach the offshore area throughout the year. The swell waves often exceed 3 metres and typical periods are between 10 and 16 seconds. The swell waves commonly approach from the southwest, and tend to be slightly higher in winter compared to summer.

DoT have recorded wave conditions offshore from Albany in approximately 60 m of water depth since 2005. While this is a valuable data set to understand the offshore wave climate a longer data set is preferred to determine the extreme design wave heights.

The National Oceanic and Atmospheric Administration (NOAA) have completed a 31 year wave hindcast from 1979 to 2009 using the WAVEWATCH III model. The wave hindcast was generated using the NCEP Climate Forecast System Reanalysis Reforecast (CFSRR) homogeneous data set of hourly 1/2° spatial resolution winds.

MRA have extracted the modelled offshore wave conditions from this 31 year wave hindcast at a location close to the 60m depth contour. A comparison was made between the measured waves by DoT and the modelled waves by NOAA and they were found to generally be within about ±10%. Therefore the longer NOAA record was considered suitable to represent the offshore wave conditions at Denmark. A plot of the total significant wave height (Hs) is provided in Figure 3.8 for the 31 year period.

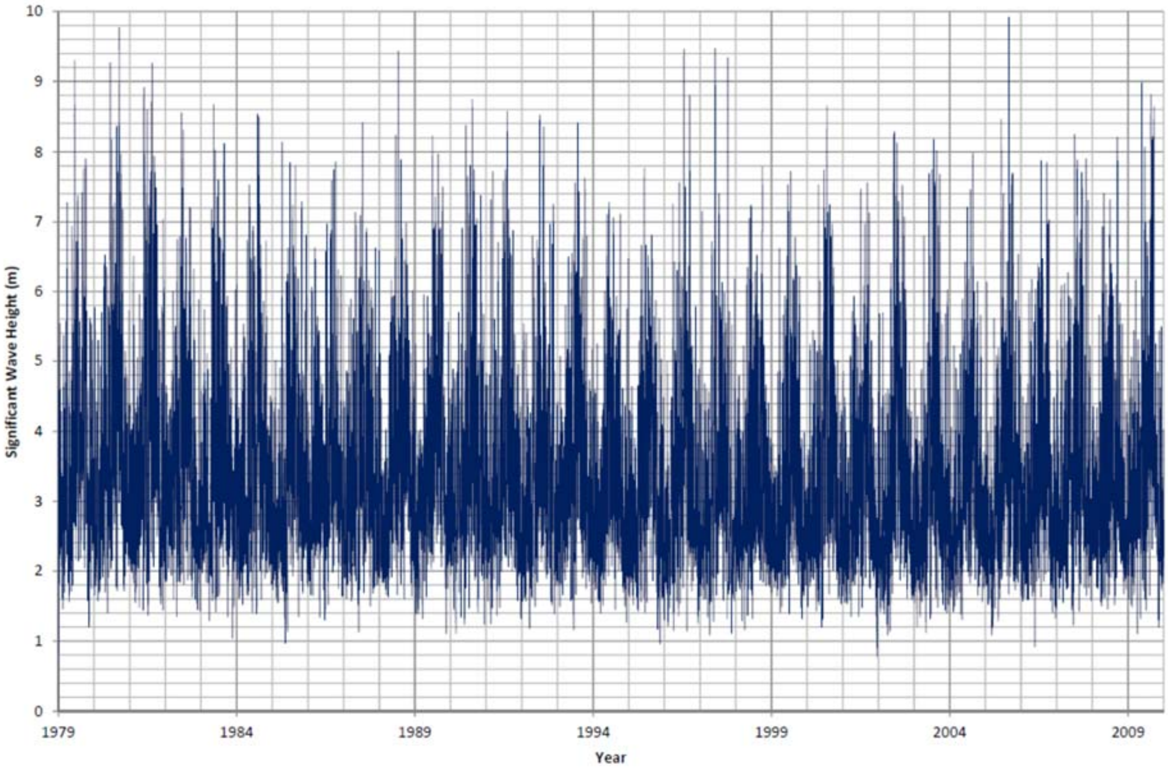

Figure 3.8 Offshore Significant Wave Height (1979 to 2009)

From the data the median offshore significant wave height was 3.1m. The maximum significant wave height was 9.9m and the minimum significant wave height was 0.8m.

The seasonal changes in the wave climate can also be seen with much larger waves during the winter months. This is a result of the storm belt moving further north closer to the site and the passage of more cold fronts during the winter months.

A time history plot of the peak wave period was also plotted and is included in Figure 3.9. From this data the median wave period was around 13s, with a range from 4s to nearly 23s.

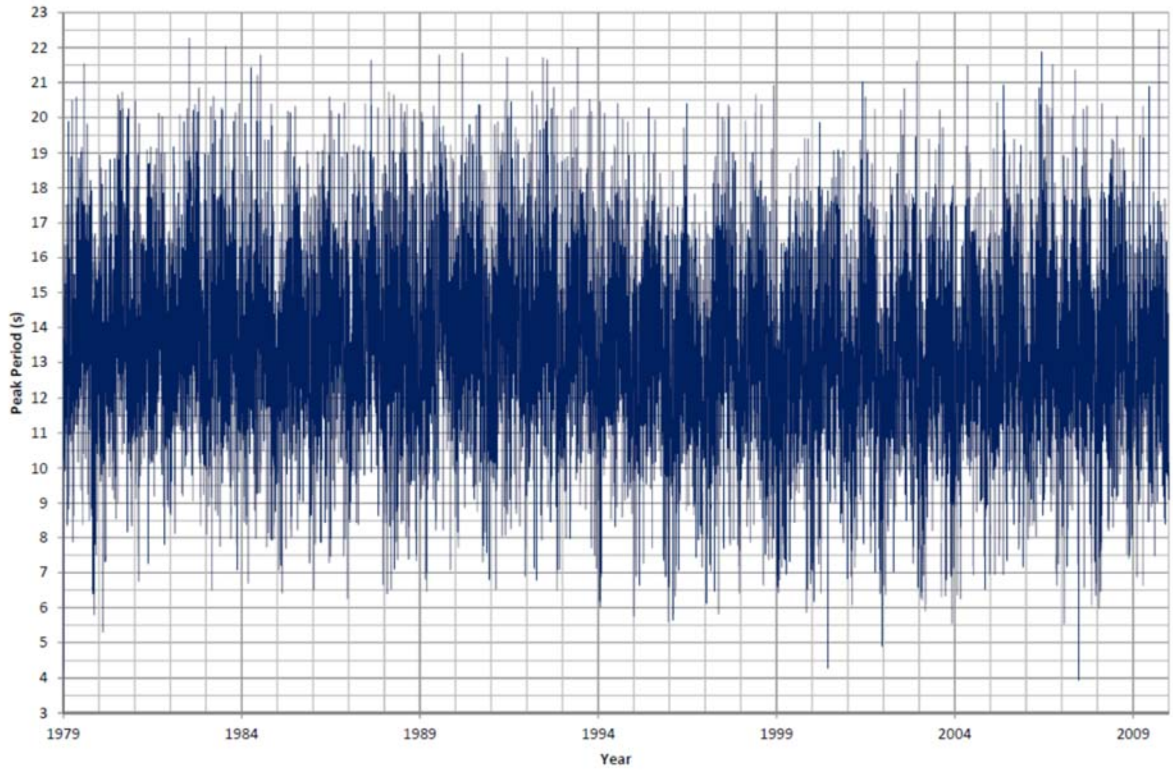

Figure 3.9 Offshore Wave Period (1979 to 2009)

A wave rose has been prepared using the modelled wave heights and directions at the offshore wave location. This is shown in the following figure and illustrates that the predominant offshore wave direction is from the southwest.

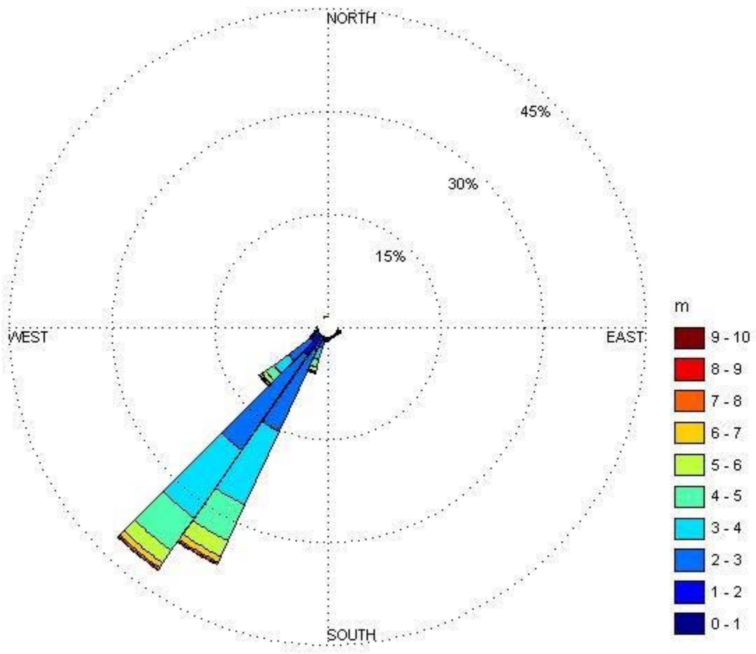

Figure 3.10 Offshore Wave Rose (1979-2009)

To determine the design wave conditions, an extreme analysis was completed in MRA (2013). The results are presented in the following figure.

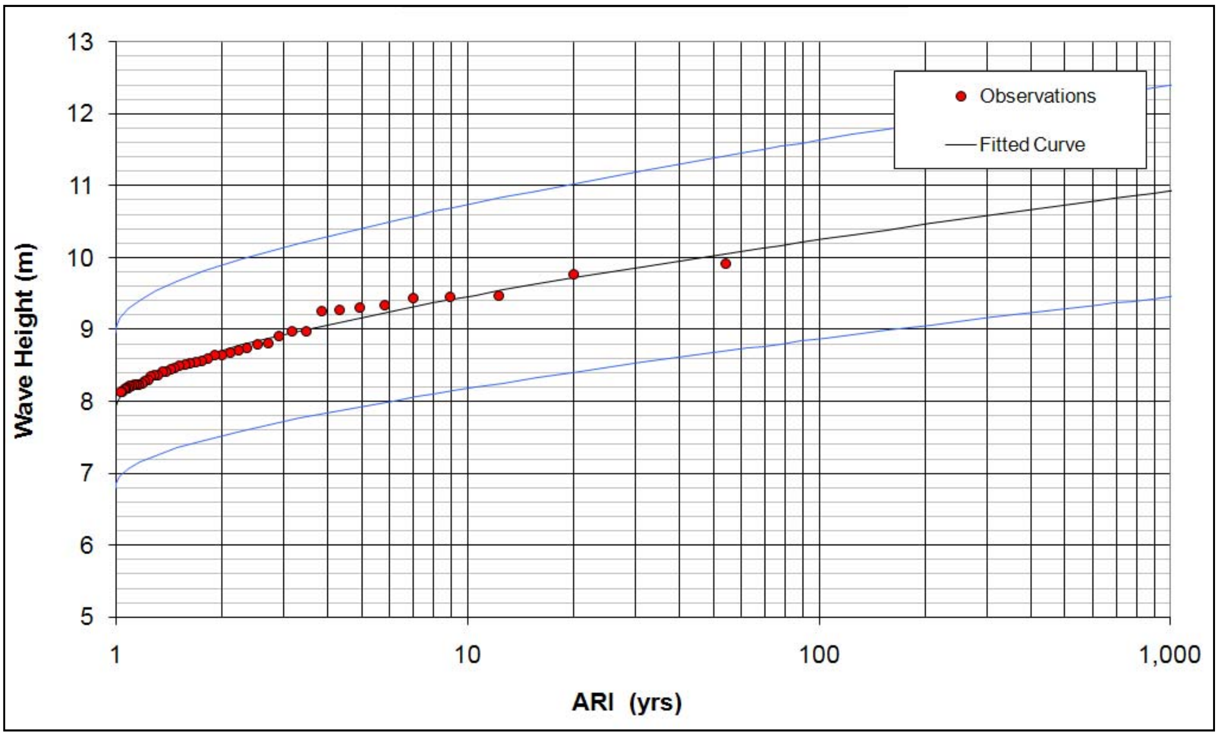

Figure 3.11 Extreme Offshore Wave Height Distribution Curve (1979-2009)

The above plots shows that the design 50 yr ARI offshore significant wave height is around 10m. Further analysis of the extreme wave from the southeast was also completed (for directions between 90° and 180°). From this analysis the 50 yr ARI offshore significant wave height was found to be less than 7m.

3.4.2 Wave Transformation & Modelling

To determine the transformation of waves from the offshore site to the proposed location of the boat launching facility, detailed numerical wave modelling was undertaken. This analysis used the DELFT 3D software which included the third-generation SWAN wave model as outlined in Booij et al (1999) and Ris et al (1999). This model was developed by the Delft University of Technology in the Netherlands and is based on the discrete spectral action balance equation and is fully spectral in all directions and frequencies. The model accounts for the following processes:

- Wave generation by wind.
- Dissipation due to white-capping, bottom friction and depth-induced wave breaking.
- Non-linear wave-wave interactions.
- Wave blocking by currents.

The model was set up as a nested grid to allow more detailed resolution close to the site to correctly model the complex nearshore reefs. The outer coarse grid had a resolution of around 250m while the inner fine grid had a resolution of around 25m. The following figures show the extent of the two modelling grids used overlayed on the AUS759 nautical chart.

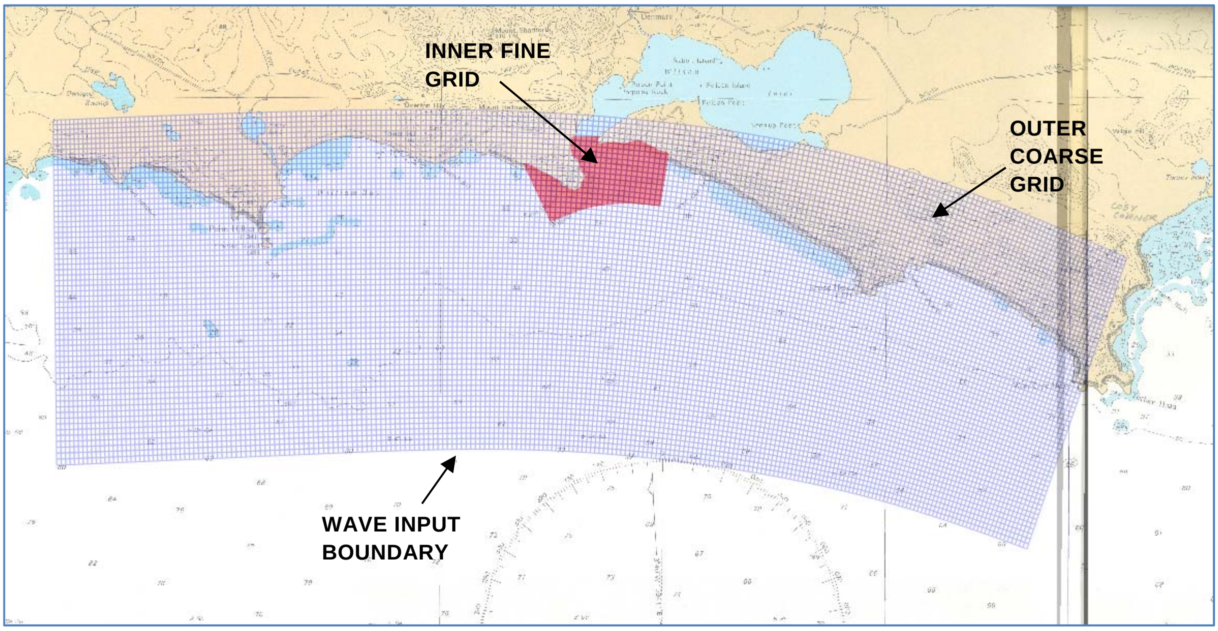

Figure 3.12 SWAN Wave Model Grids

The model was set up and run to determine the following wave conditions at the site of the proposed boat launching facility.

- Typical wave conditions during swell events to assess the impact of the structure on the surfing conditions at Ocean Beach.
- Typical operational wave conditions at the proposed boat ramp to assist in the functional layout of the breakwaters.
- Design wave conditions for the structural design of the breakwater and other marine structures including the 1 yr and 50 yr ARI events.

The following spatial plots show an example of the modelled wave conditions at the site.

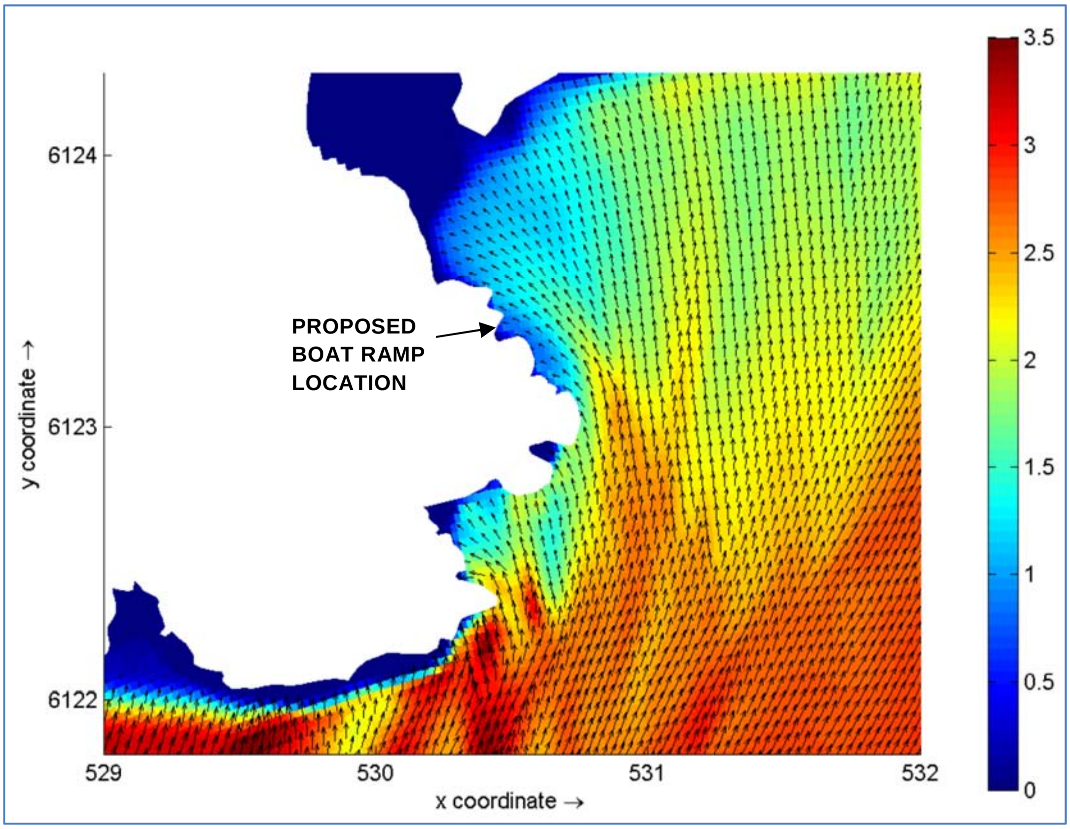

Figure 3.13 Spatial Plot of Typical Swell Hs at the Site

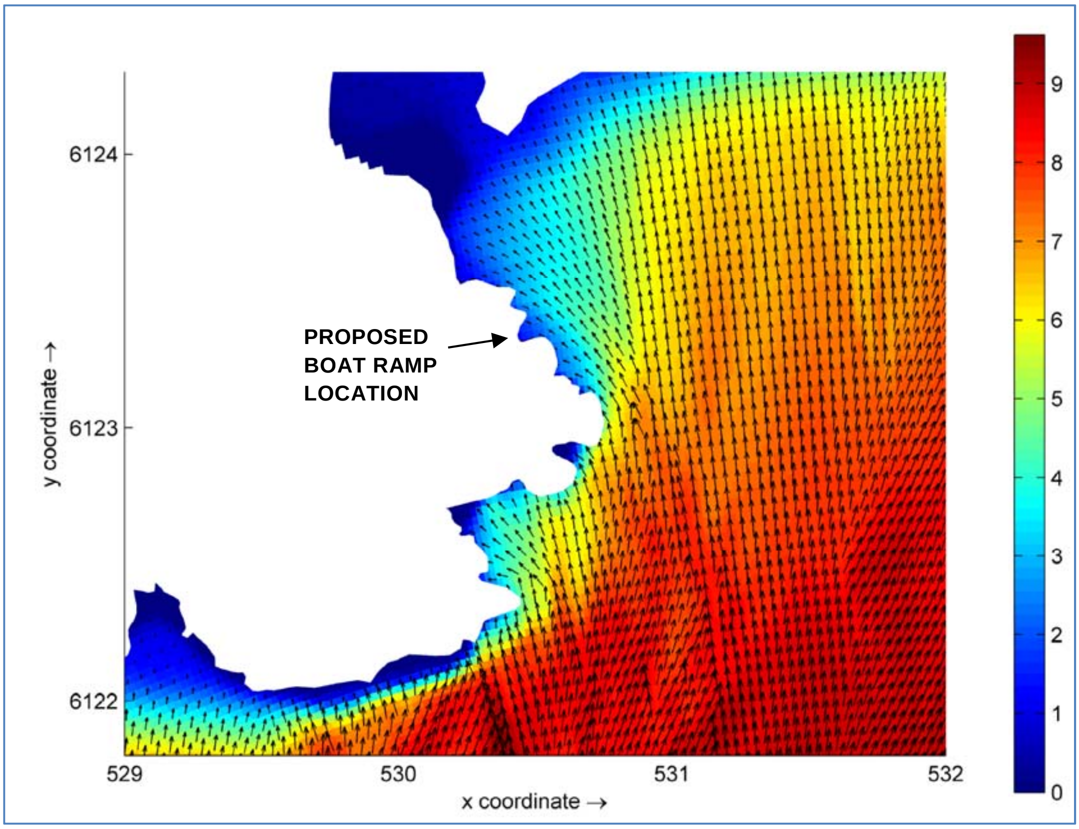

Figure 3.14 Spatial Plot of Hs during 50 yr ARI Storm Event at the Site

3.4.3 Design Waves for Concept Design

The table below provides the design wave conditions for the concept design of the proposed boat launching facility.

Table 3.1 Design Waves at Proposal Boat Launching Facility

Design Event	Offshore Waves (~60m water depth)			Wave at Site Wave at Site (~10m water depth)		
	Hs (m)	Tp (s)	Dir (°)	Hs (m)	Tp (s)	Dir
1 yr ARI Storm Event (SW)	8.0	13	215	4.2	13	148
50 yr ARI Storm Event (SW)	10.1	13	215	5.0	13	148
50 yr ARI Storm Event (SE)	6.5	13	150	4.4	13	138

A local hindcast for waves generated across the fetch to the northeast of the site was also completed. From this assessment waves with a Hs of around 0.5m in the 1yr ARI event and around 0.7m in the 50 yr ARI event were estimated.

Further refinement of these wave conditions is recommended should the facility proceed to preliminary and detailed design phase. However, for concept design purposes the above wave conditions are appropriate.

3.5 Sediment Dynamics

The sediment transport regime at Ocean Beach is made up of the following key processes.

- Cross-shore transport resulting from storm events which erode material from the beach berm and dunes and deposit it in nearshore bars, and swell events which move sediment shoreward to build the beach berm.
- Longshore transport resulting from the wave driven currents due to waves arriving obliquely to the shoreline. This process varies depending on the wave event occurring at the time. There can be large seasonal differences in the longshore transport rate due to the seasonal changes in the direction and heights of waves.
- The mouth of the Wilson Inlet also creates complex sediment transport patterns at the site due to the river flows interacting with the ocean processes. During strong river flows out of Wilson Inlet sediment can be deposited up to 200 to 300m from the shoreline.
- Wind-blown sand can also move along the beach and deposit sand into the dunes behind the beach.

The combination of these processes results in a complex system that can have large changes to the beach and nearshore sand bars. Aerial photographs are provided below showing an example of the changes to the beach and sandbars with the mouth of the Wilson Inlet open and closed.

Figure 3.15 Sediment Dynamics at Ocean Beach (GoogleEarth)

At the proposed site for the boat launching facility there relatively deep water close to the shore with most of the shoreline made of rock outcrops. The exception to this is the small embayment on the northern side of McGeary's Rock. Sediment is likely to be moved around within the bay due to the action of breaking waves and currents. Further offshore the dominant waves will move sediment towards Ocean Beach, however due to the deeper water the flux is likely to be small. This is illustrated in the figure below.

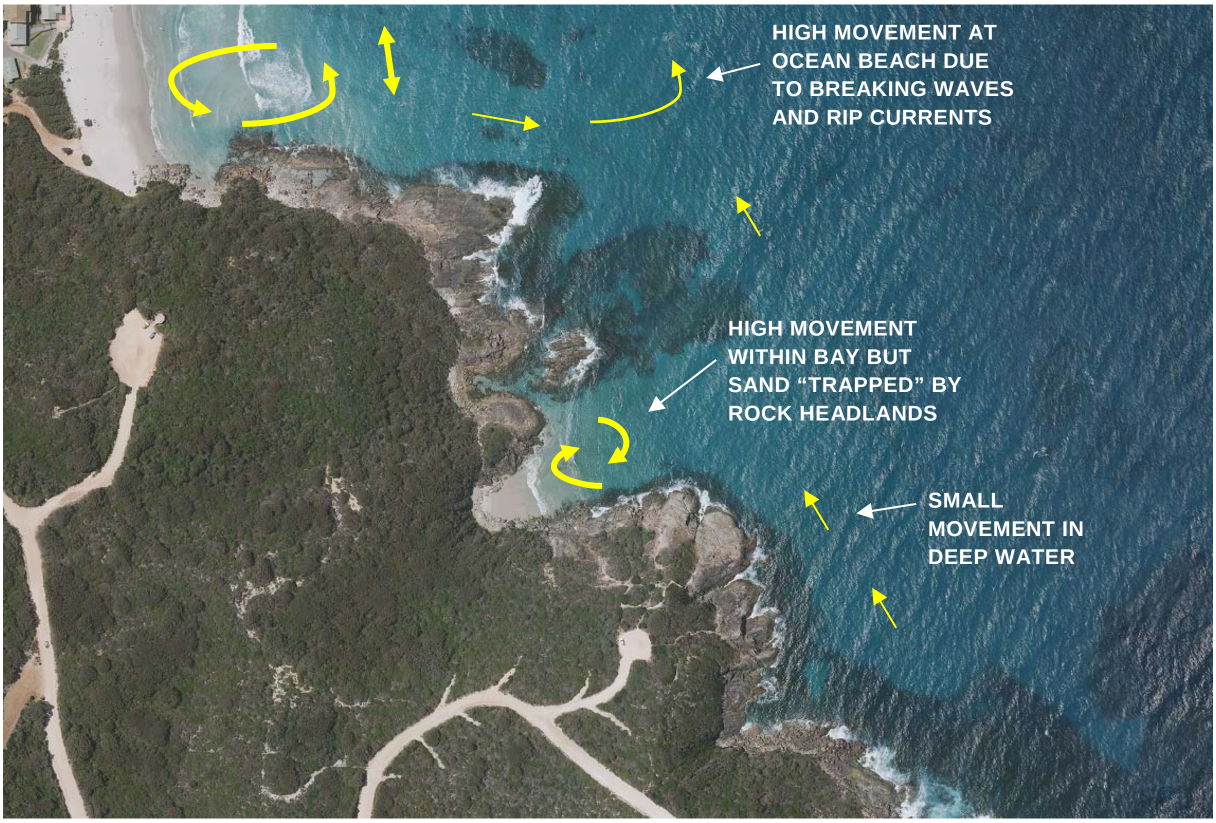

Figure 3.16 Sediment Dynamics Near McGeary's Rock

4. Concept Design

Three concept options were prepared for the proposed boat launching facility. Concept drawings of these options are presented in Appendix A.

The key design features of the concepts are discussed below.

4.1 Concept Design Features

4.1.1 Wave Penetration

To determine the wave conditions at the proposed boat ramp location, wave diffraction calculations were completed using the diffraction diagrams presented in Goda (2010).

To provide sufficient sheltering from the ocean waves it was determined that significant breakwater protection would be required. It was determined that two separate breakwaters would be required with overlapping at the entrance to provide sufficient protection at the ramp.

4.1.2 Navigation & Channel Dimensions

As outlined in the design criteria the facility is to accommodate berthing space for at least one 20m long vessel. Sufficient manoeuvring area is required at the berth to allow a vessel of this length to turn around. AS3962-2001 outlines the minimum width for interior channels to be 1.5L and the preferred width to be 1.75L, where L is the overall length of the design vessel. Therefore to accommodate a 20m vessels the minimum width for interior channels is 30m and the preferred width 35m.

The preferred width for the entrance channel is 30m, however AS3962 permits a reduction of the width to around 18m over a short length to minimise wave penetration into the protected waters behind the breakwater.

Within the breakwaters the seabed level will need to be around -3mAHD to allow for safe navigation for a 20m vessel.

Navigation through the entrance also needs careful consideration, so that vessels are not directed towards any hazards such as submerged reefs or breaking waves.

4.1.3 Breakwater Layout

Three concept options were prepared with different breakwater layouts. The key features of each layout is discussed below. The concept plans for each option are presented in Appendix A.

Concept Option 1

This option was prepared to try to get a functioning boat launching facility with minimal breakwater construction and to limit the seaward extent of the breakwaters and the impact on the waves and surfing at Ocean Beach. It is shown in sketch SK1308-160520-1[A] in Appendix A.

For this option there is a concern that it may be hazardous for vessels entering or leaving the facility due to the narrow entrance channel and its proximity to the submerged rocks. More detailed survey information is required to confirm the depths of the rocks near the entrance.

As vessels leave the shelter of the main breakwater waves will be approaching the vessels side on, which can make navigation dangerous. This is shown in the following figure. Therefore, to improve the navigation and safety through the entrance of the facility the breakwaters need to extend further seaward.

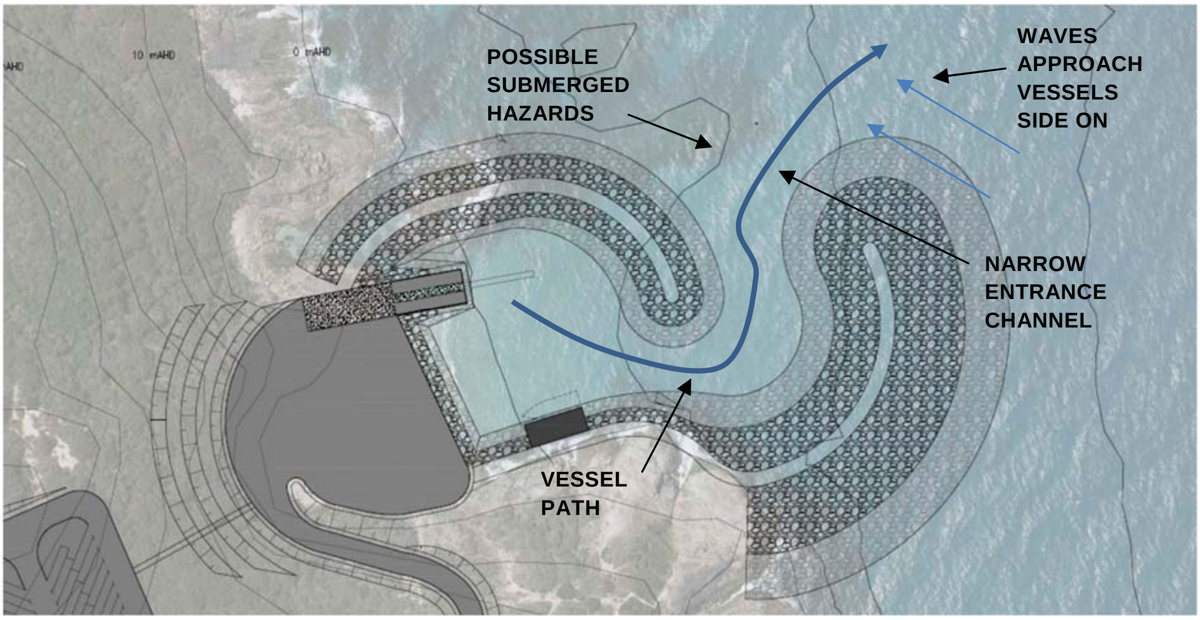

Figure 4.1 Concept Option 1 Breakwater Layout

Concept Option 2

Concept Option 2 is shown in sketch SK1308-160520-2[A] in Appendix A. This option involves constructing the breakwaters further seaward to improve navigation through the entrance of the facility. The entrance channel is away from the submerged rocks and is wider than the layout presented in Concept Option 1. This allows vessels more manuovering space and they can align with the incoming waves before rounding the head of the breakwater. This is shown in the following figure.

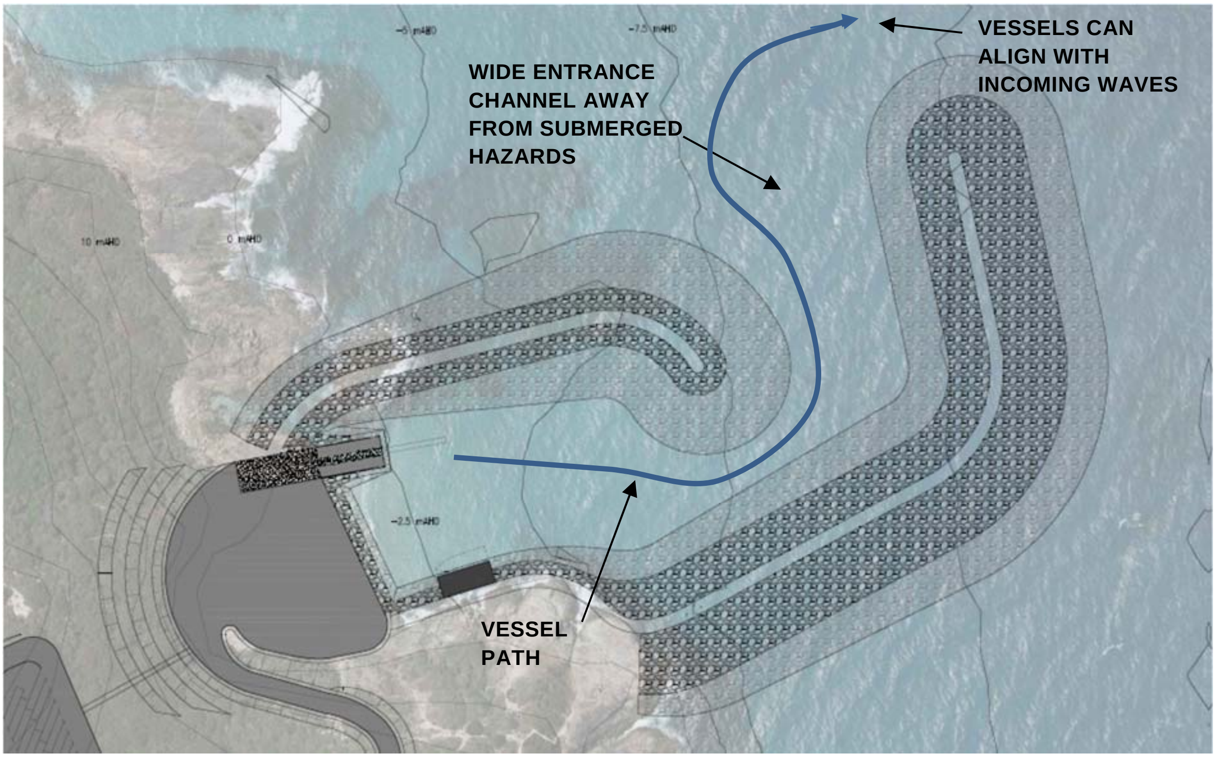

Figure 4.2 Concept Option 2 Breakwater Layout

Due to the longer length of the breakwaters this options has a higher impact on the waves reaching ocean beach. This is discussed in more detail in Section 4.2.

Concept Option 3

Concept Option 3 is shown in sketch SK1308-160520-3[A] in Appendix A. This option has the facility more aligned to the shoreline with the southern breakwater attached to the shore on the southern side of McGeary's Rock. This options has improved navigation compared to Option 1 and doesn't impact the waves reaching Ocean Beach as much as Option 2.

The breakwater layout also results in a larger protected water area which could be used for additional mooring or boat pens in the future if required. This is shown in the figure below.

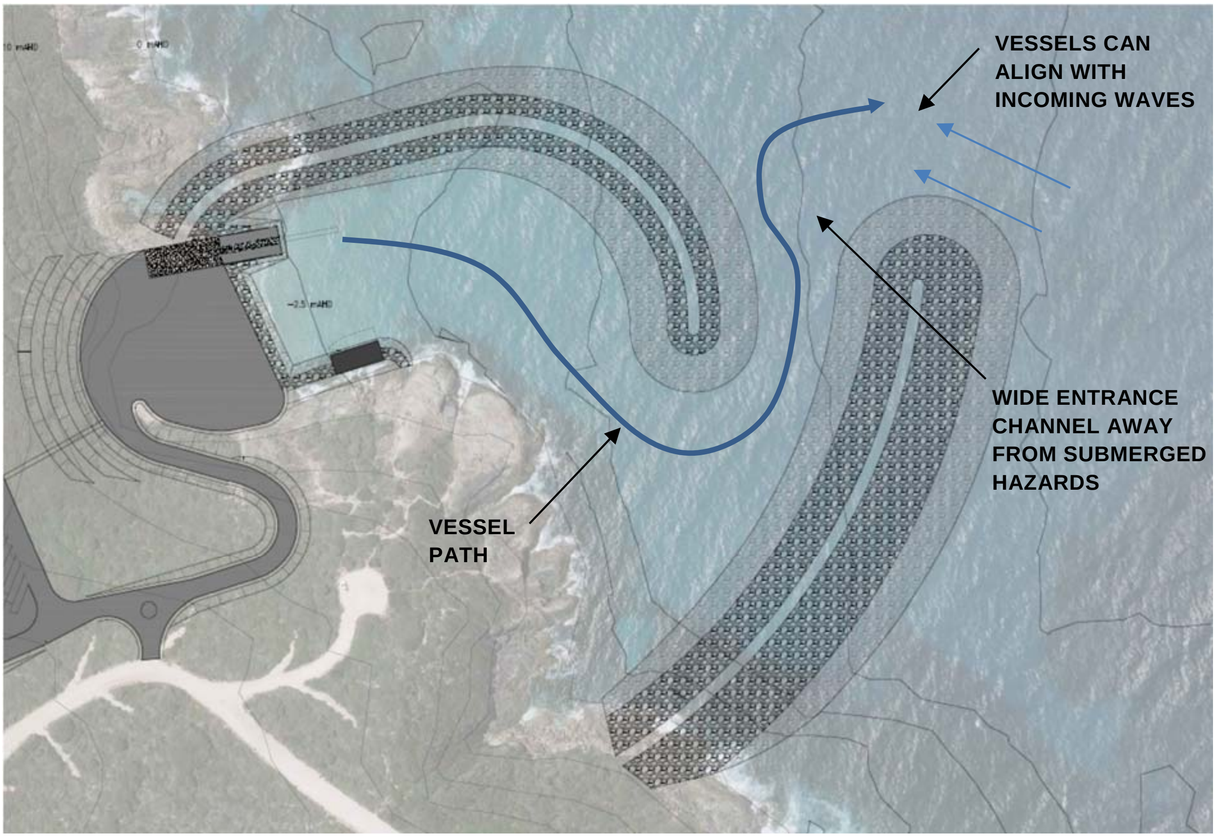

Figure 4.3 Concept Option 3 Breakwater Layout

4.1.4 Breakwater Design

Preliminary calculations suggest that the required armour rock size (M_{50}) on the exposed face of the main breakwater would need to be in the range of 10 to 15 tonnes. This would require and underlayer of around 2t rocks to provide adequate filtering to the core material.

The large design waves and deep water at the site may be close to the limits for a conventional rubble mound breakwater. It is likely that multiple layers and flatter slopes (say 1:2) will be required for the stability of the breakwater. It is recommended that physical model testing is carried out to confirm the required rock size and geometry for the breakwaters.

To limit damage to the structure and potential safety issues the crest level needs to be high enough to ensure overtopping rates are below acceptable limits. Preliminary estimates suggest that the crest height of the main breakwater would need to be around +10mAHD while the more sheltered northern breakwater could have a crest height around +4mAHD.

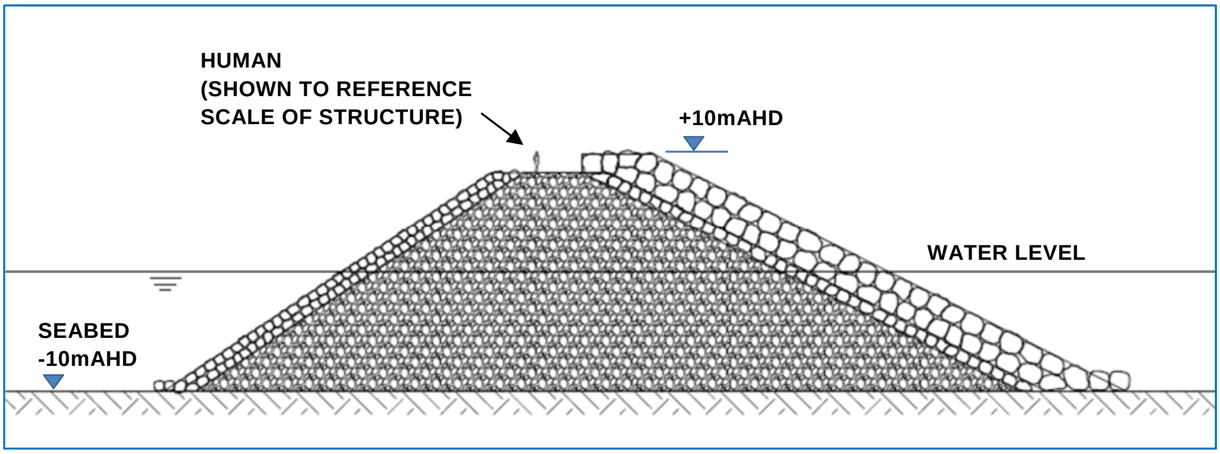

Figure 4.4 Concept Cross-section for Main Breakwater

4.1.5 Boat Ramp & Finger Jetty Design

The concept design for the boat ramp is a standard concrete ramp constructed with precast concrete panels. The finger jetty will be a proprietary floating pontoon system to allow easy access into and out of vessels. An example is shown in the following photograph taken at the Point Peron Boat Launching Facility.

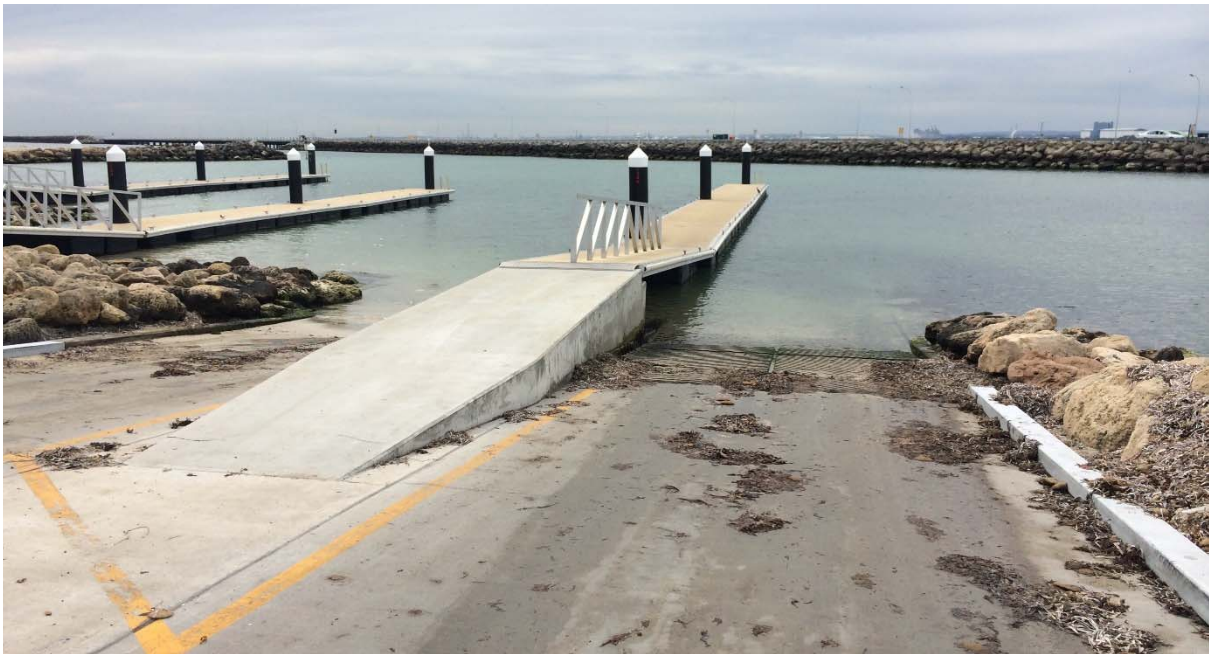

Figure 4.5 Example of Boat Ramp & Floating Finger Jetty

4.1.6 Wharf

The concept for the wharf is concrete deck supported on steel piles. The structure will have sufficient capacity to accommodate the loads for a Class 15 wharf as outlined in AS4997. The wharf will have chafers and fendering to accommodate the berthing and mooring loads of vessels up to 20m in length. An example is shown in the following photograph taken from the service wharf at the Albany Waterfront, however for the proposed boat launching facility no services (power, water, fuel, sullage etc) are proposed.

Figure 4.6 Example of Wharf

4.1.7 Car / Trailer Parking Area

As outlined in the brief the carpark layout has been prepared with capacity for 60 car and tailer bays. Due to the steep grades at the existing site extensive earthworks and levelling will be required to construct the car park.

If rock for the breakwaters is quarried on site, then this levelling and earthworks can be carried out as part of the quarrying operations.

4.1.8 Access Roads

To provide access from the existing gravel road down to the proposed boat ramp a new access road will need to be installed. A maximum grade of 1:10 was adopted for this road.

A width of 10m (including shoulders) has been adopted for the concept design.

4.2 Impact on Waves

To assess the impact of the proposed concept designs on the waves reaching Ocean Beach detailed wave modelling was completed using SWAN. The structures were included in the model as ‘thin dams’ to restrict waves from transmitting through them.

It should be noted that SWAN does not directly model the process of diffraction around the head of breakwater structures. Therefore the results directly behind breakwaters should be used with care.

The resulting modelled wave heights during a typical swell are presented in the following figures for the three concept options. These can be compared to the case of no structures presented in Figure 3.13.

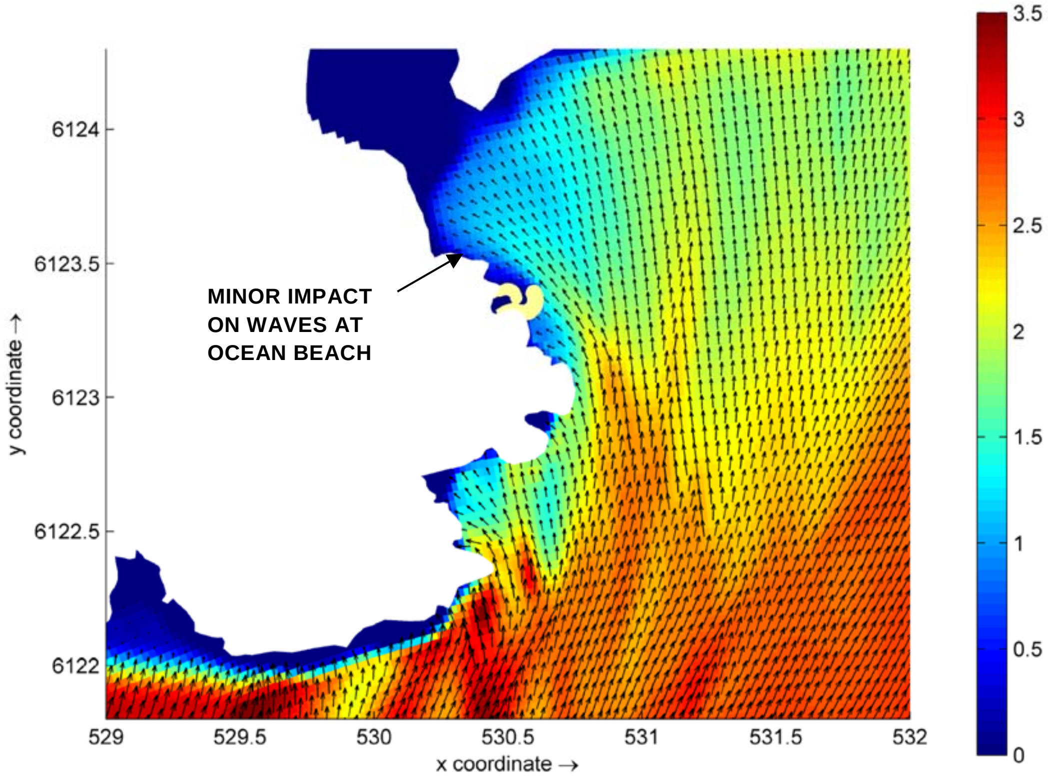

Figure 4.7 Concept Option 1 – Typical Swell

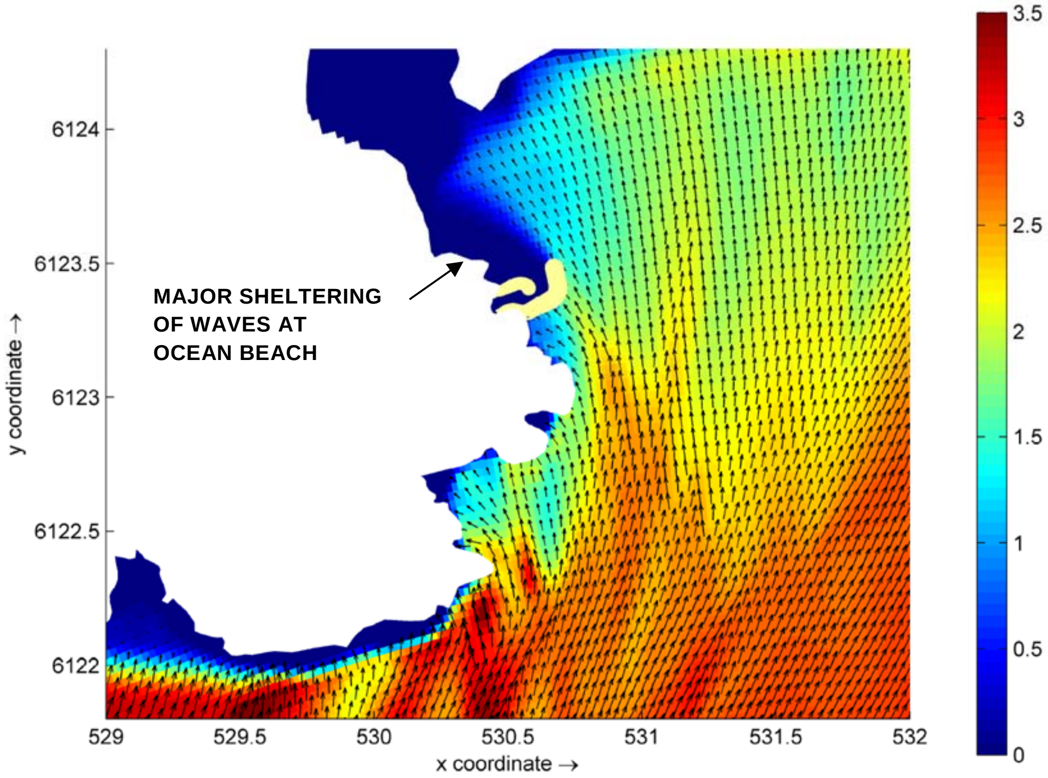

Figure 4.8 Concept Option 2 – Typical Swell

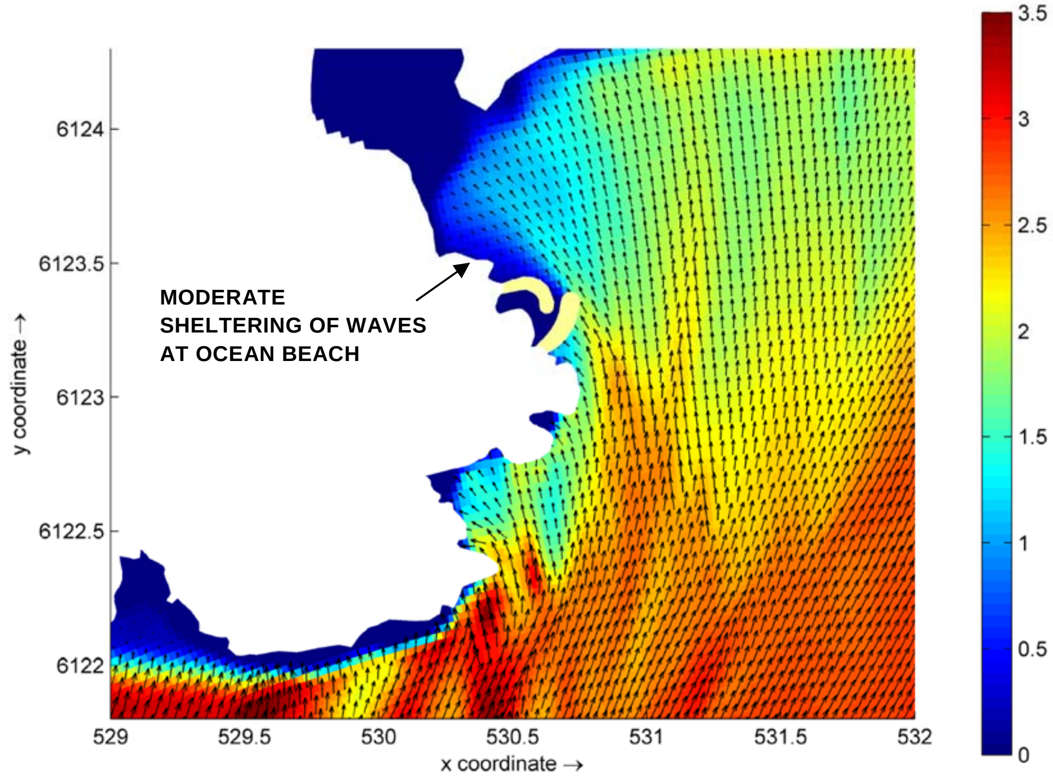

Figure 4.9 Concept Option 3 – Typical Swell

As shown in the above figures, Option 1 is likely to have only a minor effect on the waves reaching Ocean Beach, while Options 2 and 3 are likely to cause significant sheltering of the waves reaching the southern corner of Ocean Beach.

Options 2 and 3 are likely to have large impacts on the surfing conditions at the southern end of Ocean Beach.

4.3 Impact on Sediments

The construction of breakwaters will result in changes to the waves on the leeward side of the structures. They also provide a barrier to any longshore transport along the coastline.

The longshore transport of sediment at the site of the proposed facility is estimated to be relatively low due to the rocky coastline and the deep water adjacent to the shoreline. Therefore it is not expected that there would be significant build-up of sand adjacent to the structure or that sand would need to be bypassed around the structures.

At Ocean Beach the changes to the incoming waves will change the sediment dynamics along the shoreline. In general terms, the realignment of waves after they are diffracted around the head of the breakwaters will lead to waves approaching the shoreline at more of an angle. This will set up transport of sediment towards the southern corner of Ocean Beach and the shoreline will realign. This is shown diagrammatically in the following figure.

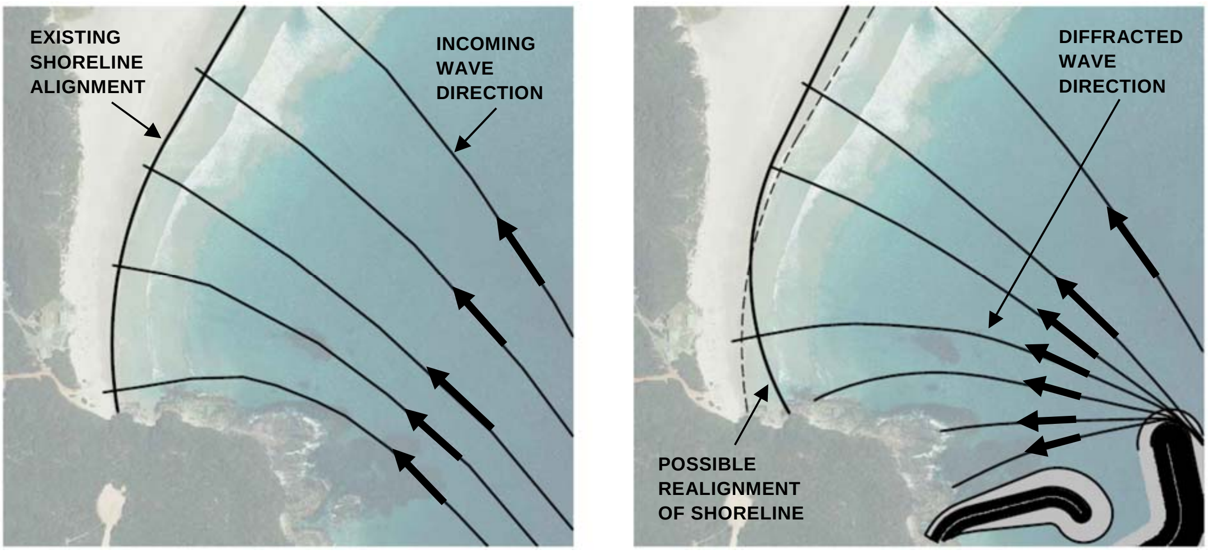

Figure 4.10 Possible Beach Alignment Change from Structure

There may also be more complex changes to the currents and waves which could result in changes to the location of bars and rips at the southern end of Ocean Beach. A more detailed assessment would be required to assess these impacts, however this is beyond the scope of this feasibility assessment.

4.4 Construction Aspects

Some key considerations for the construction of the facility are discussed below.

Rock Availability & Quarry Yields

Further investigation will be required to determine if a quarry on site can produce the required armour sizes (M_{50} = 10 to 15 tonnes). From discussions with WA Limestone, who completed the quarrying for the Augusta Boat Harbour, if good quality rock is found on site similar to the Augusta site, then the required yields for armour should be able to be achieved. However, if the rock is found to be more fractured than Augusta then very large quantities may need to be quarried to produce the required quantity of large armour. This may lead to a surplus of rock and additional space will be required to stockpile this rock for other uses.

Difficulties Constructing in Exposed Ocean

Due to the sites exposure to large waves in the Southern Ocean, there will be challenges in the construction of the facility. There may be periods were no breakwater construction can occur due the seastate. These potential delays will add to the construction cost.

Access to Site

The access to the site for construction is difficult with steep grades from the top of the hill down to the shoreline. Access roads will need to be installed with suitable grades to allow construction equipment access to the shoreline. These will be relatively costly.

Quarrying on Site

As outlined in the previous sections, it is assumed that rock can be quarried on site. This is similar to the methodology adopted for the Augusta Boat Harbour as shown in the following photograph.

Figure 4.11 Augusta Boat Harbour Construction

Further investigations are required to confirm the suitability of the rock for the breakwater construction. If the rock is found to be unsuitable then alternative sources will be required. This will mean there will be additional transports costs to get the rock to site. Some quarrying will still be required on site to achieve the required grades for the car park and access road.

5. Concept Cost Estimate

Concept level construction cost estimates have been prepared for the three concept options presented. A summary of the costs is provided in the following table.

Table 5.1 Concept Construction Cost Estimate

Item	Activity	Concept Option 1	Concept Option 2	Concept Option 3
1	Preliminaries	$ 800,000	$ 1,000,000	$ 1,250,000
2	Bulk Earthworks & Quarry Setup	$ 1,600,000	$ 2,100,000	$ 2,100,000
3	Breakwaters	$ 10,546,000	$ 20,466,000	$ 21,010,000
4	Access Road & Trailer Parking Area	$ 1,265,000	$ 1,195,000	$ 1,265,000
5	2 Lane Boat Ramp & Finger Jetty	$ 700,000	$ 700,000	$ 700,000
6	Wharf for 20m Vessel	$ 1,000,000	$ 1,000,000	$ 1,000,000
7	Revegetation	$ 100,000	$ 150,000	$ 200,000
8	Navigation Aids	$ 180,000	$ 20,000	$ 20,000
9	Miscellaneous (Bins, Signage & Lighting)	$ 55,000	$ 55,000	$ 55,000
	Subtotal 1	**$ 16,246,000**	**$ 26,686,000**	**$ 27,600,000**
	Management & Design Fees (5%)	$ 812,300	$ 1,334,300	$ 1,380,000
	Contingencies (20%)	$ 3,249,200	$ 5,337,200	$ 5,520,000
	Subtotal 2	**$ 20,307,500**	**$ 33,357,500**	**$ 34,500,000**
	Goods & Services Tax	$ 2,030,750	$ 3,335,750	$ 3,450,000
	Total Estimated Cost	**$ 22,338,250**	**$ 36,693,250**	**$ 37,950,000**

Aside from the capital cost for constructing the facility there will be ongoing management costs including the following.

- Monitoring and maintenance of the breakwaters. An average cost for this could be 0.5% to 1% of the construction cost for the breakwaters per annum. Maintenance works might only be carried out every 5 to 10 years due to the high costs for mobilising construction equipment to site.

- Maintenance of the boat ramp and finger jetty. This could include cleaning algae off the ramps twice a year and general maintenance of the floating pontoons such as tightening loose bolts or replacing and damaged members. An allowance of $10,000 to $15,000 per year is considered appropriate.

- General maintenance items such as emptying bins and rectifying any vandalism.

6. Summary & Conclusions

The following dot points provide a summary of the feasibility study into an alternate boat launching facility at McGeary's Rock.

- Three concept options were presented with different breakwater layouts. Each of the options had different pros and cons as follows.

  - Option 1 had the shortest breakwaters and therefore the impacts on the waves at Ocean Beach were low and the construction costs were lower than the other options. There are however, concerns about the safety of navigating through the entrance during large swells. Additional survey information is required to assess this in more detail.

  - Option 2 provided safer navigation with a wider entrance channel away from any submerged hazards. This option has a large impact on the waves reaching Ocean Beach and is therefore unlikely to be supported by the surfing community. Due to the sheltering of waves there are also likely to be significant changes to the alignment of the shoreline.

  - Option 3 provided less impact on the waves than Option 2 and it also provided a larger protected water area. This could be used for additional boat moorings or other marine facilities.

- Order of costs were estimated and are summarised as follows:

  - Option 1 $20.3 million (excl GST)

  - Option 2 $33.4 million (excl GST)

  - Option 3 $34.5 million (excl GST)

- The majority of the costs are in the construction of the breakwaters. The breakwaters are expensive due to the relatively deep water, large design waves and difficult access to the site. Given the large construction costs, alternate more protected sites such as Parry's Beach or Peaceful Bay may warrant further investigation.

- Should the McGeary's Rock site be pursued, the next step would be to complete quarry investigations, and refine the design wave estimates and breakwater cross-sections.

7. References

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8. Appendices

Appendix A Concept Design Drawings

Appendix A Concept Design Drawings

AT CORRECT SCALE THIS IS 100 mm

CAD: D1308 MASTER.dwg

AT CORRECT SCALE THIS IS 100 mm

REV	DATE	APPROVED	AMENDMENT
A	19.6.16	PMD	PRELIMINARY ISSUE

This plan is not to be used for construction unless issued as Rev 0 and signed below

CLIENT: SHIRE OF DENMARK

DESIGNED: P DOUST
CHECKED: M ROGERS
APPROVED:
DRAWN: J CHEN
CHECKED: P DOUST

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PROJECT: OCEAN BEACH ALTERNATE BOAT LAUNCHING FACILITY

TITLE: CONCEPT LAYOUT OPTION 1

SCALE AT A1: 1:1,000
DRAWING NUMBER: SK1308-160520-1
REV: A

AT CORRECT SCALE THIS IS 100 mm

AT CORRECT SCALE THIS IS 100 mm

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A	19.6.16	PMD	PRELIMINARY ISSUE

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PROJECT: OCEAN BEACH ALTERNATE BOAT LAUNCHING FACILTIY

TITLE: CONCEPT LAYOUT OPTION 2

SCALE AT A1: 1:1,000 | DRAWING NUMBER: SK1308-160520-2 | REV: A

AT CORRECT SCALE THIS IS 100 mm

AT CORRECT SCALE THIS IS 100 mm

CAD: D1308 MASTER.dwg

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PROJECT: OCEAN BEACH ALTERNATE BOAT LAUNCHING FACILITY

TITLE: CONCEPT LAYOUT OPTION 3

SCALE AT A1: 1:1,000

DRAWING NUMBER: SK1308–160520–3

REV: A

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