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R528 Rev 1

April 2015

Shire of Gingin

Boat Launching Facility Planning Study

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1. Introduction

The Shire of Gingin (SoG) has approximately 65km of coastline including the coastal towns of Guilderton, Seabird, Ledge Point and Lancelin. This is shown in Figure 1.1 below. The region is popular for recreational boating but does not have any formal boat launching facilities on the ocean shoreline. Currently boats are launched over the beach at a number of locations. The nearest formal boat ramps to the region are the Two Rocks Boat Ramp to the south and Jurien Bay Boat Ramp to the north. Both are more than 40km from the coastal communities in the SoG.

Previous investigations have highlighted the high demand for boat launching facilities in the SoG and with further development along the coast this demand is expected to increase.

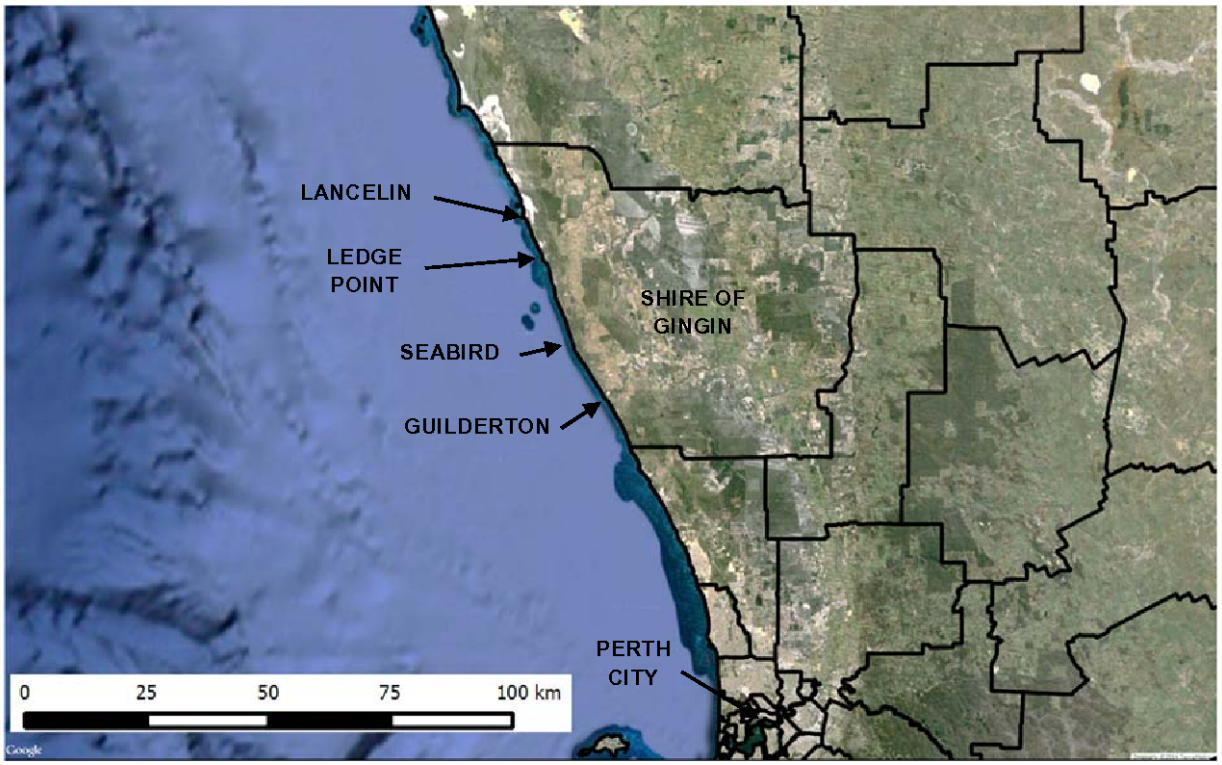

Figure 1.1 Location Diagram

To address this demand for boating facilities, the SoG required an investigation to identify a safe site for ocean boat launching within the SoG. In particular the sites to be investigated were Lancelin, Ledge Point, Seabird and Guilderton. The SoG engaged specialist coastal and port engineers, M P Rogers & Associates Pty Ltd, to carry out the investigation. This report presents the findings of this 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. Previous Investigations

There have been numerous previous investigations into boat launching facilities and other marine facilities on the SoG's coastline. These have included DoT (1995 & 1996), Strata Marine Pty Ltd (1976), PWD (1976), Maunsell & Partners Pty Ltd (1977), PA Australia (1981), BSD Consultants (1992), Mappin Marjoram Pty Ltd (1992), DMH (1993), MRA (1994 & 1999), and Port and Harbour Consultants (2000a & 2000b).

DoT (1996) provided a summary of a number of previous studies completed. Boating demand for the region was assessed and the need for a formal boat launching facility was recognised.

The report recommended that a new boat launching facility incorporating two ramps, a central finger jetty, vehicle and trailer parking and protective groynes be constructed at Ledge Point within 18 months. A drawing showing the proposed boat ramp at Ledge Point is provided in the following figure.

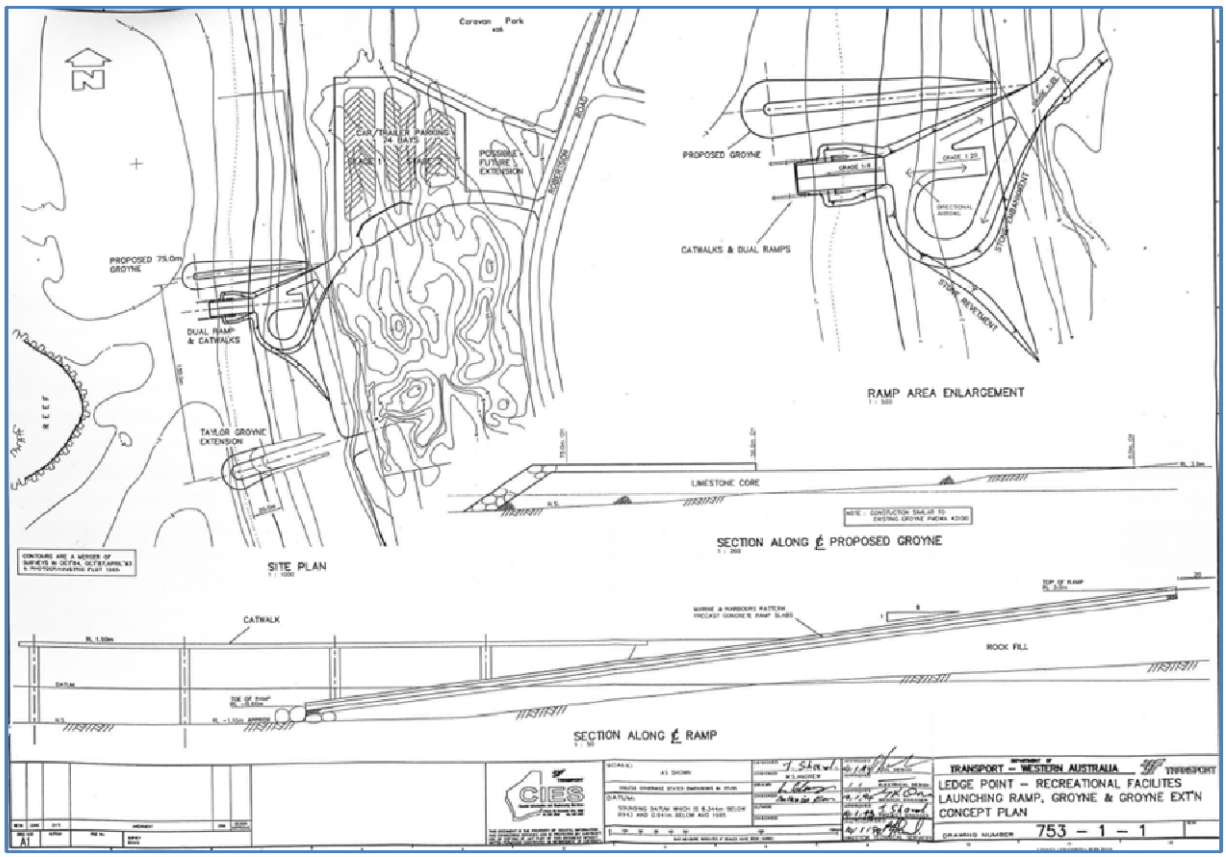

Figure 2.1 Proposed Ledge Point Boat Launching Facility (DoT 1996)

Investigations were completed by Port and Harbour Consultants for the Ledge Point Boat Launching Facility, which found that any unprotected boat ramp located between the groynes would have restricted use due to its exposure to waves. Issues with sedimentation around the ramp were also raised (Port and Harbour Consultants 2000a & 2000b).

The DoT (1996) report also recommended that a possible boat launching facility at Lancelin, both inside and outside the bay, be investigated and that the Guilderton Groyne be repaired to enable limited boat launching and retrieval at that location.

Despite the numerous previous investigations no formal boat ramp has been constructed on the SoG ocean coastline, except for a small ramp at Lancelin which has since been removed or buried by sediment movement in the area (Martin Baird, DoT 2014, pers comm).

3. Design Criteria for Boat Launching Facilities

3.1 Design Standards

The design of boat launching facilities in Australia is covered by the requirements of the Australian Standard *AS3926-2001 Guidelines for design of marinas*. Structures built in the marine environment are also covered by *AS4997-2005 Guidelines for the design of maritime structures*.

The Department of Transport (DoT) has also produced guidelines for the design of boat launching facilities in Western Australia (DoT 2009).

Where applicable these standards and guidelines are referenced within this report.

3.2 Design Life

Boat launching facilities generally fall into the category of a small craft facility in accordance with AS4997-2005 (Facility Category 2). Accordingly, it is recommended the boat launching facility is designed with a design life of 25 years.

If breakwater protection is required for the boat ramp it may be appropriate to design these components with a longer design life of say 50 years with appropriate maintenance. The required design event is likely to have an annual probability of exceedance of 1/20 to 1/50.

3.3 Wave Criteria

AS3962-2001 states that boat launching facilities shall be located as follows.

- Aligned into the dominant waves from swell, sea and boat wash.
- Sheltered from waves larger than 0.2m.

For the second requirement above, there is no information provided in the Standard as to the frequency of occurrence of the 0.2m wave. It is assumed that in the peak boating season that this requirement is only exceeded under rare conditions (say a few times per year) or the use of the facility is actively managed to maintain safety when wave conditions exceed 0.2m.

This requirement of waves less than 0.2m is very difficult to achieve. Even in protected waters strong winds can generate waves of 0.3 to 0.4m over short fetches and boat wash can be in the order of 0.3m. AS3962-2001 also states that a 'Good' wave climate in small craft harbours is to have the 1 year ARI significant wave height less than 0.3m and a 'Moderate' wave climate less than 0.4m. Therefore, even in sheltered harbours which have a 'Good' or 'Moderate' wave climate the requirement of 0.2m outlined above may not be met.

3.4 Dimensional Requirements

The following dimensional requirements are outlined in AS3962-2001 and the DoT Guidelines.

- The ramp section is to have a uniform grade extending from above the high water mark to below the lowest predicted water level. A 1:8 grade is preferred.
- Land approaches should be level, perpendicular to the ramp centreline and uniformly graded parallel to the centre line to assist in the backing of trailers.
- Sufficient manoeuvring areas are required for both vehicles and vessels.

- Trailer rigging, de-rigging and queuing areas should be provided.

3.5 Parking Requirements

For a rural boat ramp with a boat holding structure (ie a finger jetty), AS3962-2001 recommends 30-40 car/trailer spaces for each ramp lane.

Generally a new boat launching facility would be installed with 2 lanes and the option for future expansion. This means that car/trailer parking should initially be provided with 60-80 bays and if expanded to 4 lanes provided with 120 to 160 bays. This equates to about 1 hectare of space required for parking initially with room for expansion.

Additional overflow parking should also be considered for peak use periods such as school holidays and public holidays.

4. Types of Boat Launching Facilities

There are a variety of different types of boat launching facilities which include the following.

- Slab on grade ramp where the ramp panels are placed directly on the ground.
- Elevated ramp to allow for sand and water to pass beneath the structure. This is often used when there is a large longshore sediment transport component. If the ramp was not elevated the sediment would end up smothering the ramps and creating issues with navigation.
- Ramps protected by structures. If the wave climate is too severe then protection in the form of breakwaters may be required.

Photographs showing these different types of ramps are provided below.

Figure 4.1 Typical Slab on Grade Ramp (Point Peron, Rockingham)

Figure 4.2 Elevated Ramp (Port Kennedy, Rockingham)

Figure 4.3 Ramp Protected by Breakwater (Coral Bay)

Figure 4.4 Ramps Protected by Breakwater (Ocean Reef)

5. Coastal Environment

5.1 Geology & Bathymetry

The coastline of the Study Area is made up of carbonate sands abutting or overlying limestone and the associated quartz sands. Sections of the coastline, such as Lancelin Bay, have wide sandy beaches which have accumulated behind nearshore reefs and islands. Other sections of the coastline are rocky with limestone cliffs and rock platforms (SKM 2003, Short 2005). Examples of these are shown in the following photographs.

Figure 5.1 Sandy Beach South of Ledge Point

Figure 5.2 Rocky Coastline South of Seabird

The Study Area is protected from the direct impact of ocean waves by an extensive chain of offshore reefs and islands. This is shown in the following figure taken from the AUS Nautical Chart 754.

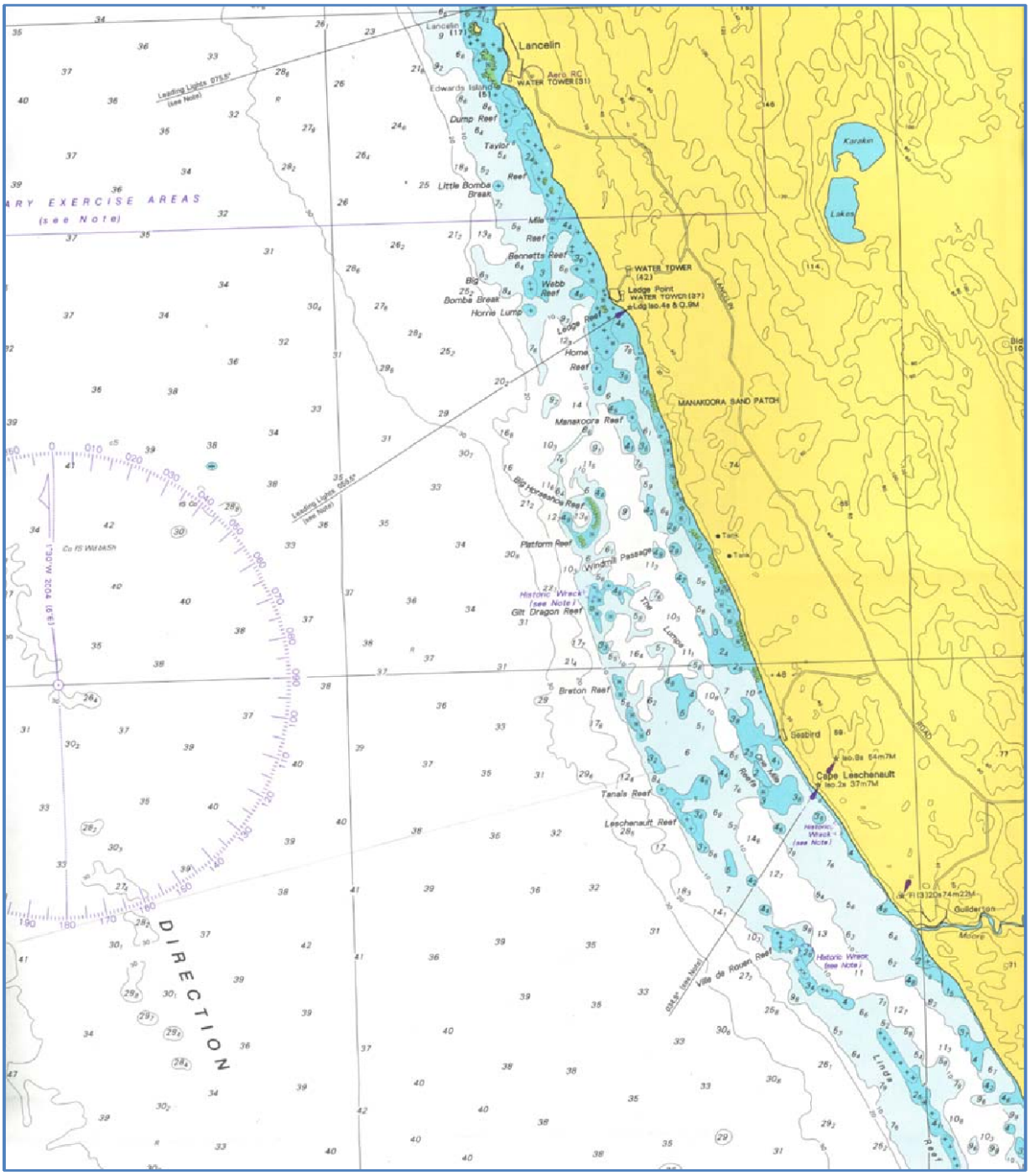

Figure 5.3 Bathymetry of the Study Area (AUS Chart 754)

5.2 Wind, Waves, Currents & Water Levels

Any comprehensive study of coastal processes must be done with knowledge of the fundamental driving forces. Consequently, an understanding of the magnitude and potential variation in the wind, waves, currents and water level conditions are important in assessing the coastal processes and also for determining the best design for a boat launching facility.

5.2.1 Wind Climate

The seasonal weather patterns along the SoG coastline are largely controlled by the position of the Subtropical High Pressure Belt. This is a series of anticyclones that encircle the Earth at the

mid-latitude (latitudes of 20 degrees to 40 degrees south). These high pressure cells are continuously moving from west to east across the southern portion of the Australian continent. A notional line joining the centres of these cells is known as the High Pressure Ridge.

In the Southern Hemisphere, winds circulate in an anti-clockwise direction about the centres of the high pressure cells. Consequently, on the northern side of the High Pressure Ridge, the winds tend to be easterly. Whereas, on the southern side, the winds are predominantly westerly.

In winter, this ridge lies across Australia typically at latitudes between 25 and 30 degrees south. This is to the north of the Study Area which is at approximately 31 degrees south. During summer, the High Pressure Ridge moves south of the Study Area and lies between 35 and 40 degrees south. This seasonal shift in the position of the High Pressure Ridge is fundamental to the seasonal changes in wind patterns experienced along the SoG coastline.

In addition to these synoptic scale effects which cause seasonal variations, the meso-scale phenomenon of a land / sea breeze system is commonly experienced at the Study Area. This causes marked changes in the winds on a daily basis. Breezes come from the east and southeast in the morning and southwest and south in the afternoons. Land / sea breezes are common in spring, summer and autumn.

Wind speed and direction has be recorded at Lancelin by the Bureau of Meteorology since 1965. Because of the land / sea breeze effect, two wind recordings are taken each day, one at 09:00 in the morning and the second at 15:00 in the afternoon. Wind roses for Lancelin have been prepared the BoM incorporating data from 1965 to 2014. These are shown in the following figure.

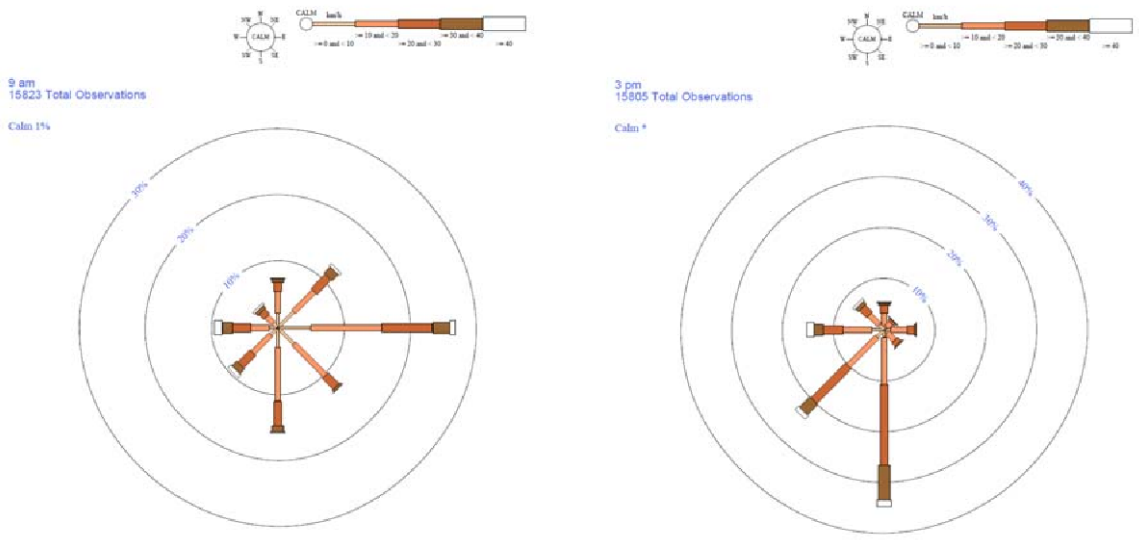

Figure 5.4 Lancelin Wind Roses – 9am (Left), 3pm (Right) (BOM)

The wind roses for spring, summer and autumn all show the land / sea breeze effect. The diagrams also show that the south-westerly and southerly sea breezes often reach 20 to 40 km/hr.

During winter, the winds are more variable. During winter storms, gale force winds (speeds > 50 km/hr) are common from the northwest, west and southwest.

For safe boating, the wind conditions are important as locally generated seas can quickly make boating conditions hazardous and can also make it difficult for launching and retrieval of vessels. Wind generated waves also need to be considered in the design of structures.

5.2.2 Waves

The area offshore from the Study Area experiences reasonably high wave energy. The main elements of the offshore wave climate are as follows.

- Locally generated seas which are fetch and duration limited by the extent of the sea breeze system. These waves are typically 0.5 to 1.5 metres high, with periods of 3 to 6 seconds and are generally from the southwest to south.
- 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 can range from northwest to southwest 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 2 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.
- Severe waves caused by dissipating tropical cyclones. These storms are infrequent at the Study Area, however, when they do occur they cause severe conditions for short periods of time.

As the offshore waves travel toward the shore, they are greatly affected by the nearshore bathymetry and the presence or absence of reefs. As shown in Figure 5.3 there is a discontinuous line of reefs in the Lancelin to Guilderton area. The deep-water waves are modified by the following physical processes as they travel towards the shore.

- Reflection off the reef faces.
- Depth limited breaking on the reef tops and other shallow areas.
- Diffraction through the gaps in the reefs.
- Attenuation due to hydraulic turbulence as the waves travel over the reefs and other areas of shallow water.
- Refraction and shoaling.

These processes act in varying degrees, and can significantly attenuate the waves as they approach the beaches within the Study Area.

The resultant waves that break on the beach are very important in the transport of sand in the littoral zone and the design of any breakwaters and boat ramps.

Guilderton Wave Climate

Wave measurements were recorded at Guilderton by the Department of Planning and Infrastructure (now the DoT) in the late 1980s. The location of the wave buoys is shown in the following figure.

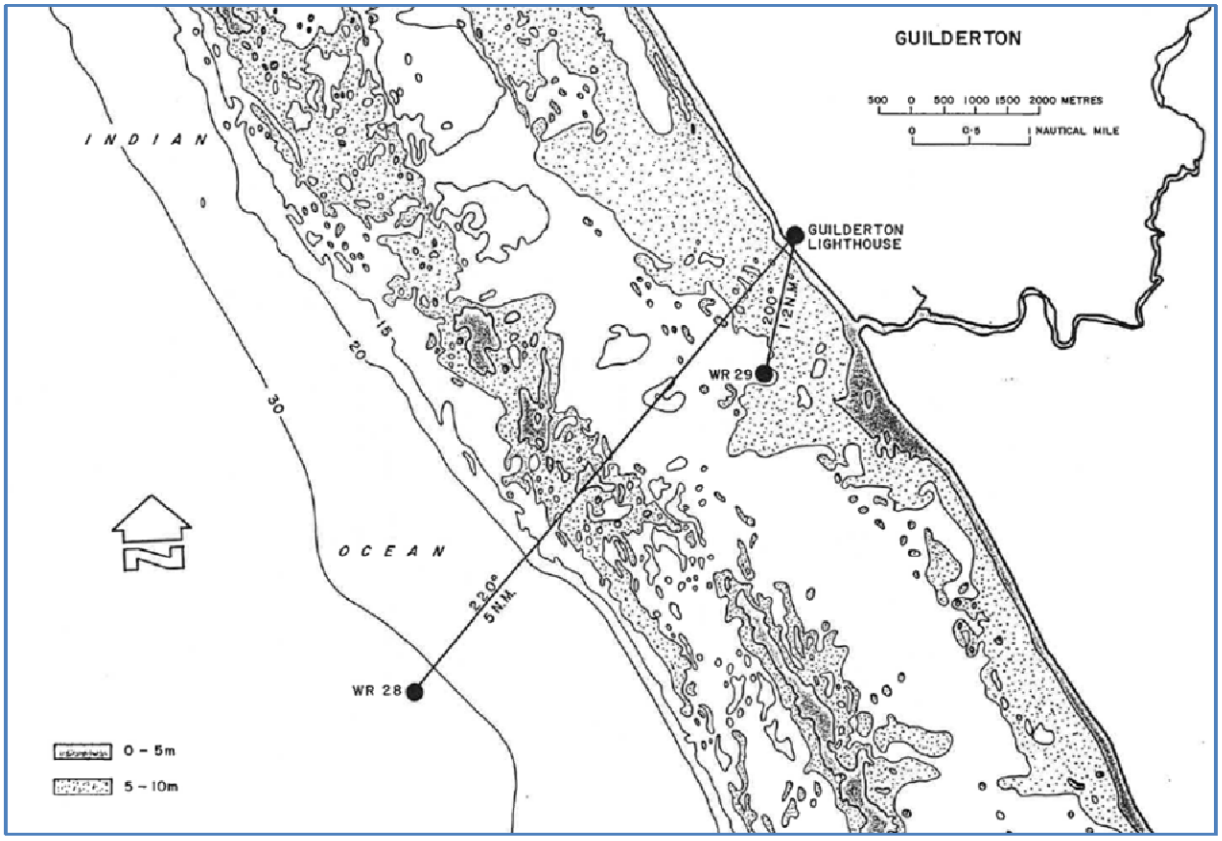

Figure 5.5 Guilderton Wave Measurement Locations (DoT, 1996)

The buoys recorded 9 months of data from April 1988 to January 1989. An analysis of the data was undertaken in Worley (2002) to estimate the extreme wave conditions at the site. The following tables provide the results of this analysis by Worley.

Table 5.1 Return Period Significant Wave Heights at Guilderton

Return Period	Offshore Guilderton Hs	Inshore Guilderton Hs
1 year	4.9	2.4
5 years	5.5	2.8
10 years	5.7	3.0
25 years	6.0	3.2
50 years	6.3	3.3
100 years	6.5	3.5

Note: 1. Taken from Worley (2002).
2. The results for return periods greater than 5 years are not reliable due to the short period of measurement.

It should be noted that these values are based on only a short period of records and they therefore may be inaccurate for design purposes. A much longer record of offshore wave heights has been recorded southwest of Rottnest Island. From MRA's comparison of this data against

measurements at Ledge Point and Jurien Bay, it is expected that the offshore wave heights at Guilderton will be about 75% of the wave heights recorded in 50m of water southwest of Rottnest.

The values in Table 5.1 show the high level of attenuation as waves travel from offshore to inside the reefs. Extreme wave heights at the inner buoy location are about 50% of the wave height at the outer buoy location.

Even with this high level of attenuation as wave travel ashore, the coastline at Guilderton is still relatively exposed to waves and greatly exceeds the wave height limits recommended in AS3962-2001. The following figures shows wave conditions at Guilderton during a moderate swell event.

Figure 5.6 Large Waves at Guilderton (26th August 2014)

Figure 5.7 Wave Conditions at Guilderton Groyne (26th August 2014)

Significant wave heights at the shoreline at Guilderton are estimated to be around 1 to 1.5m during typical swell and sea breeze events. This exceeds the requirements of AS3962-2001 of 0.2m for a boat launching facility or 0.3m for a good wave climate for a small craft harbour. Given the exposure of the Guilderton coastline to ocean swell and locally generated sea any boat launching facility would require breakwaters to provide sufficient protection from waves.

Seabird Wave Climate

The wave climate at Seabird is similar to Guilderton by slightly more protected by the offshore reefs. Detailed wave modelling was completed by Worley when investigating options to address the erosion being experienced at Seabird (Worley 2002). Under ambient conditions (Offshore Hs

= 2m) the mean significant wave heights at Seabird were modelled to be around 1 to 1.5m near the shoreline. The north side of Seabird was found to have slightly more sheltering than the southern side.

A photograph shown the wave conditions at Seabird during a moderate swell is provided in the following figure.

Figure 5.8 Waves at Seabird (26th August 2014)

The wave conditions at Seabird greatly exceed the requirements for a boat launching facility as outlined in AS3962-2001. Therefore a breakwater would be required to provide adequate sheltering from waves for safe launching conditions.

Ledge Point Wave Climate

The wave conditions at the shoreline at Ledge Point are affected by the complex pattern of nearshore reefs.

Offshore wave measurements were recorded by the DoT from June 2002 to October 2004. This data was recorded approximately 6km offshore from Ledge Point in a water depth of 26 metres on the seaward side of the offshore reefs.

From the data the following statistics were calculated.

- Average Offshore Significant Wave Height = 2.1m.
- Maximum Recorded Offshore Significant Wave Height = 6.3m.
- Typical Peak Period 10 to 15 seconds. Average 13 seconds.

A time history plot of this data during a summer and winter period are provided in Appendix A.

Port & Harbour Consultants also undertook a series of wave measurements inside and outside of the reefs at Ledge Point for a summer and winter period in 1999/2000. There report suggests that typical wave heights near the groynes in a summer period could be around 0.3 to 0.5m.

To determine the wave conditions for various locations along the shoreline at Ledge Point detailed wave modelling has been completed by MRA. This analysis used the DELFT 3D software which included the third-generation SWAN wave model (Booij et al 1999; 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 whitecapping, bottom friction and depth-induced wave breaking.
- Non-linear wave-wave interactions.
- Wave blocking by currents.

The model was set up with the ocean boundary in approximately 26m water depth. The grid was extended north and south of Ledge Point to allow for a variety of wave directions to be properly modelled. The total grid was about 17km x 8km. Variable bottom friction was incorporated into the model to account for the different bed surfaces of sand, reef, and seagrass.

Plots of the resulting wave conditions are provided in the following figures for a typical swell event and a sea breeze event.

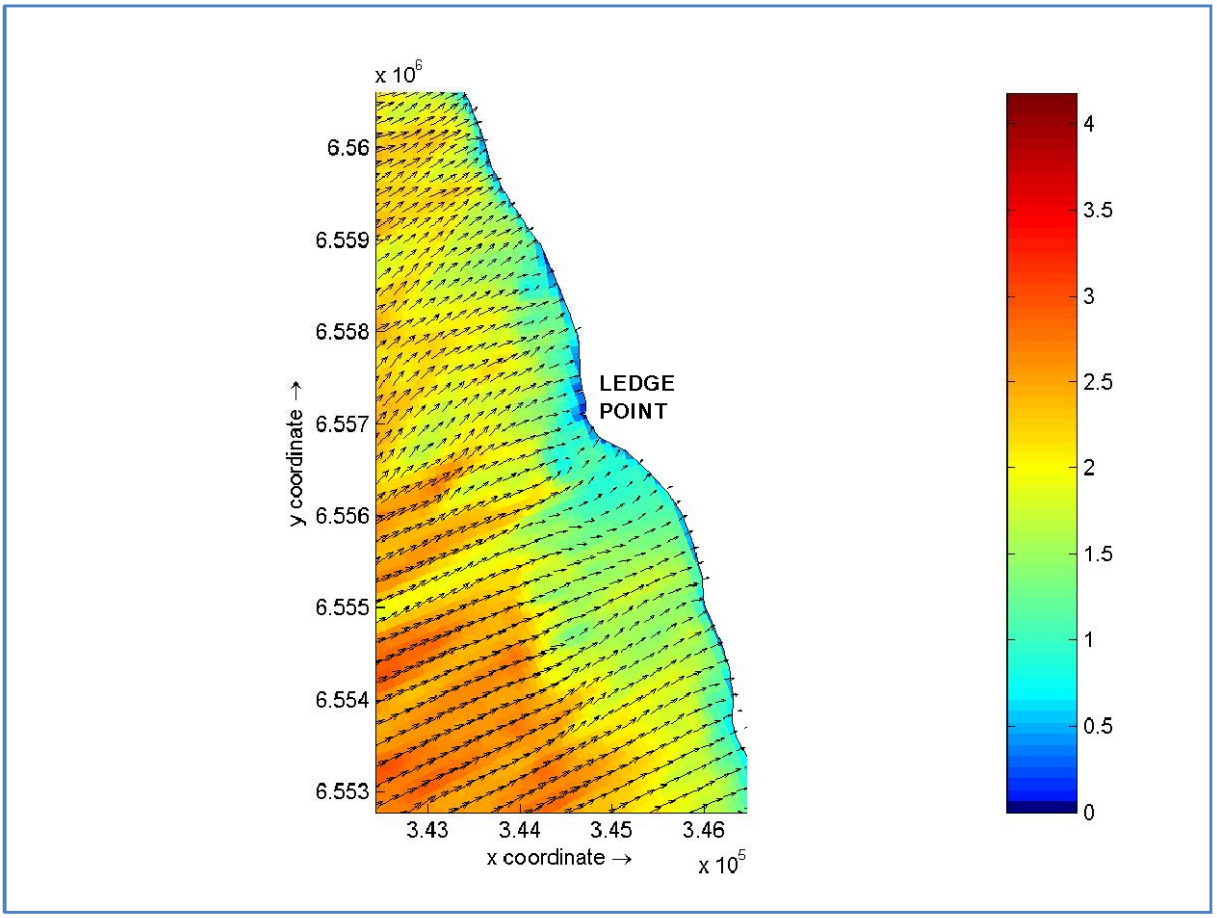

Figure 5.9 Ledge Point – Typical Swell Event

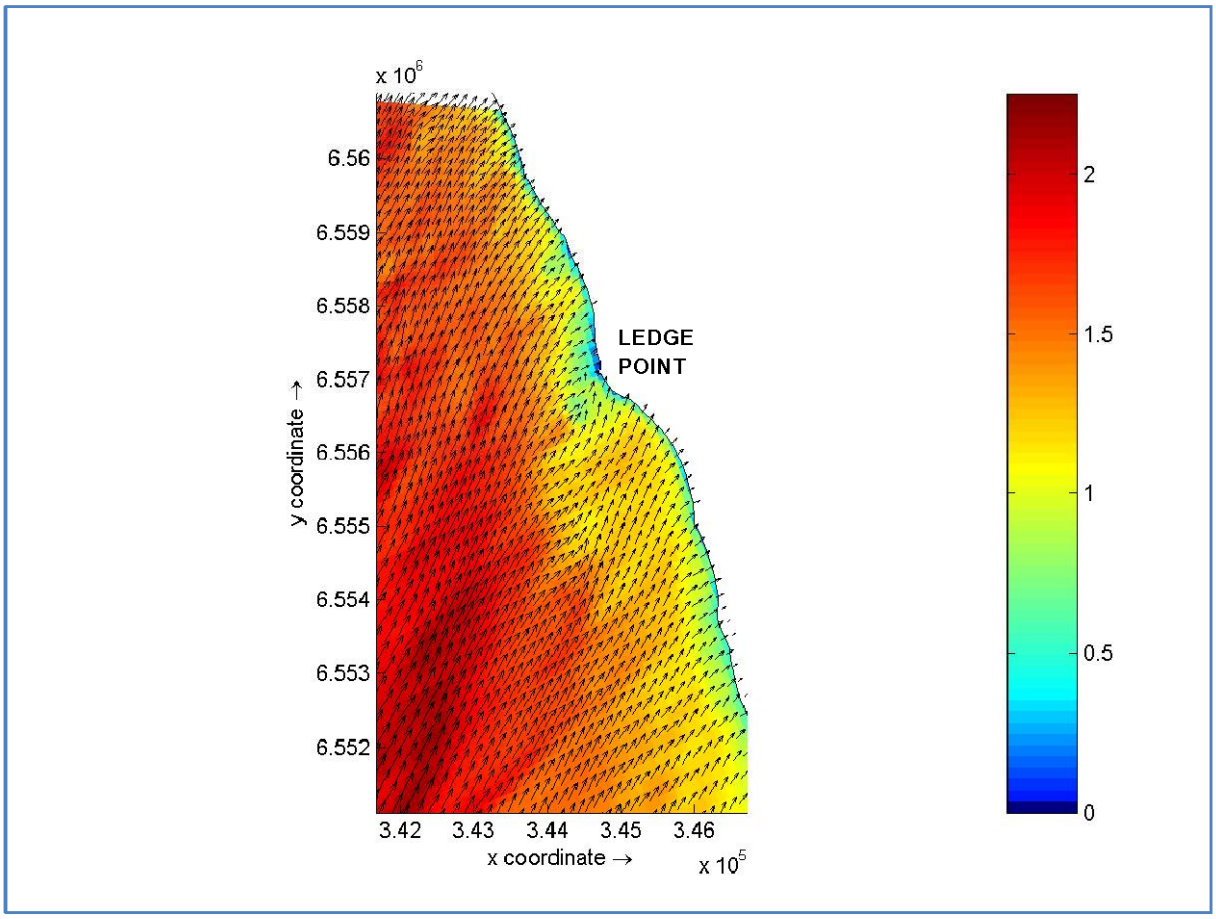

Figure 5.10 Ledge Point – Typical Sea Breeze Event

From the modelling results the typical significant wave heights at the shore are estimated to be up to around 1m during swell events and 0.2 to 0.5m during sea breeze events. This exceeds the requirements for a boat launching facility as outlined in AS3962-2001. Therefore a breakwater would be required to provide adequate sheltering from waves.

Lancelin Wave Climate

Similar to the wave modelling undertaken at Ledge Point, detailed wave modelling was also undertaken at Lancelin to account for the complex reefs and islands. Plots of the wave conditions in a typical swell and sea breeze event are provided in the following figures.

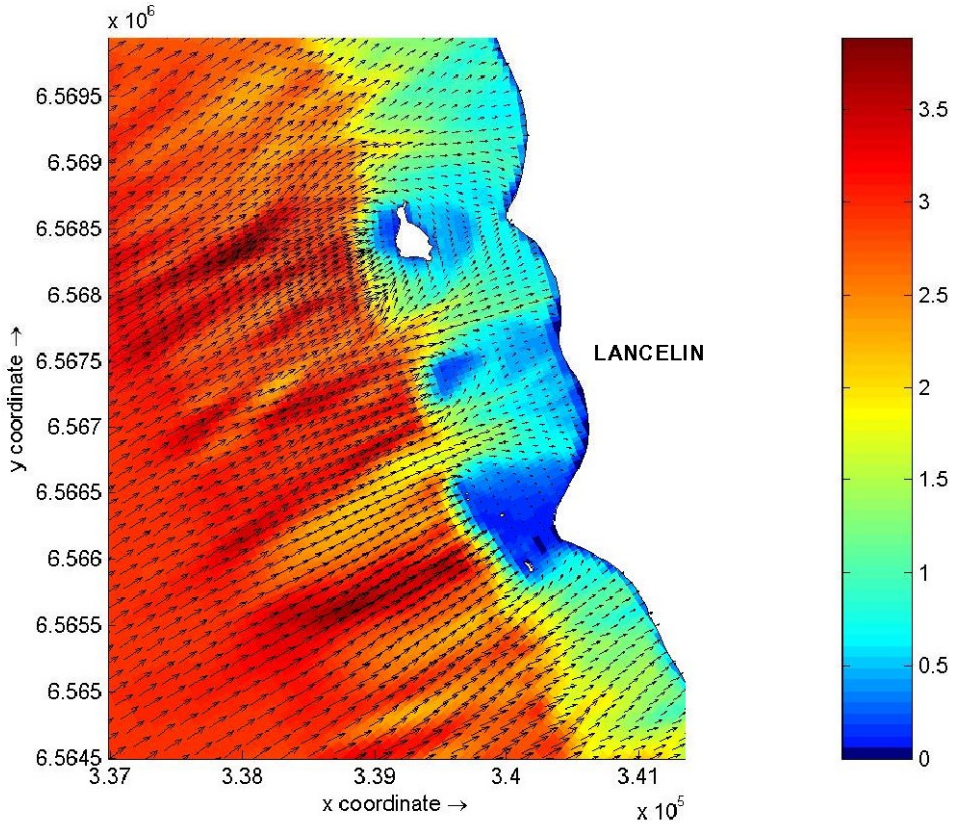

Figure 5.11 Lancelin – Typical Swell Event

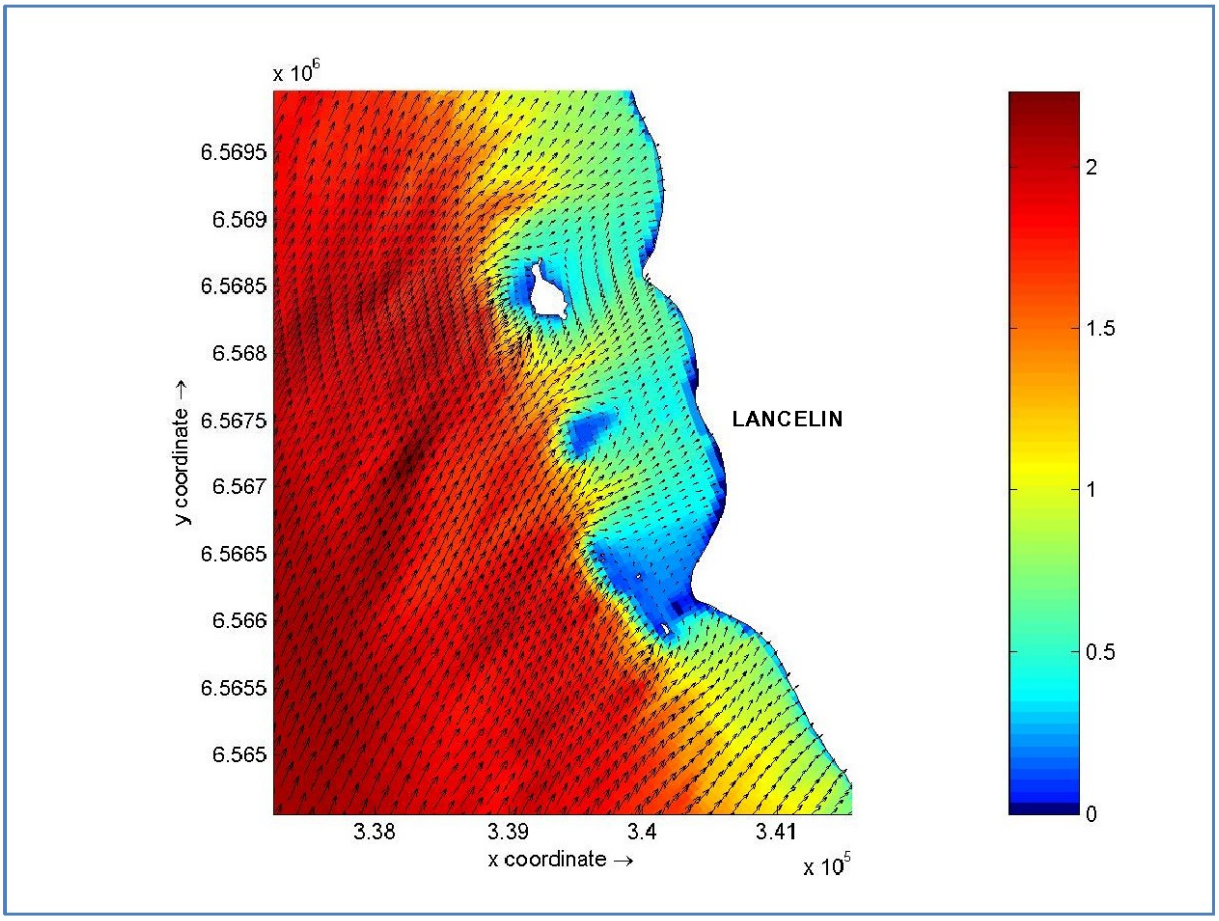

Figure 5.12 Lancelin – Typical Sea Breeze Event

Within the bay at Lancelin the modelling results show that under swell conditions the significant wave height at the shoreline is less than 0.5m and during sea breeze events it is in the order of 0.3 to 0.5m.

The southern end of the bay is more protected and wave heights are around 0.2 to 0.3m during both typical swell and sea breeze events. This is close to the limit for boat launching facilities outlined in AS3962-2001. It is possible that a ramp could be constructed at the southern end of the bay without protection provided it is carefully managed. This may mean closing the facility when it is unsafe for boat launching.

Long Period Surge

All sites being investigated are likely to experience long period surge due to the interaction of the incoming waves with the complex offshore reefs. This will need to be investigated further in the detailed design stage.

5.2.3 Currents

It is anticipated that the largest currents in the nearshore area along the SoG coastline result from the action of the wind blowing over the water surface and waves breaking onto the beaches. The dominant southerly winds in the region will generally create currents that flow towards the north, but periods of reversal could occur during some winter storms. These wind driven currents are believed to be typically less than 0.2 m/s, but may be amplified by the local bathymetric features.

Approximate measurements of the wave induced inshore currents at Dawesville were taken as part of the investigations for the design of the Dawesville Channel (DMH 1987). The

measurement technique involved the release of a dye tracer in the surf zone and measurement of the speed in which it moved away from the point of release. Even though this measurement technique is fairly coarse, it did indicate that the wave induced currents often exceeded 0.5 m/s on exposed ocean coasts.

The magnitude of these nearshore currents is such that they will have a minor effect on the movement of sand in the inshore areas except in the presence of breaking waves which would stir up the sand and permit the currents to move the suspended sediment along the beach.

5.2.4 Water Levels

The SoG coastline experiences fluctuations in water levels on varying timescales as a result of astronomical, meteorological and hydrological effects. These are discussed in the following sections.

Astronomical Tides

The astronomical tides along the SoG coastline are predominantly diurnal (one tidal cycle each day) and relatively limited in range. The daily range is typically about 0.5 metres during spring tides and less than 0.2 metres during neap tides. The spring / neap tidal cycle occur each fortnight.

The following are the key tidal characteristics taken from the Two Rocks submergence curve prepared by the DoT. Given the location of Two Rocks the tidal characteristics are likely to be similar for the Study Area.

Table 5.2 Key Tidal Levels (Two Rocks)

Tidal Level		mAHD	mCD
Highest Astronomical Tide	HAT	0.47	1.33
Mean High High Water	MHHW	0.08	0.94
Mean Sea Level	MSL	-0.14	0.72
Mean Low Low Water	MLLW	-0.38	0.48
Lowest Astronomical Tide	LAT	-0.74	0.12

Note: 1. Chart Datum (CD) is 15.555m below BM A432 and is 0.86m below Australian Height Datum (AHD).

Seasonal shifts in the sea level occur due to meteorological effects. Typically, the mean sea level at the Study Area rises 0.1 metre during winter and falls 0.1 metre during summer. Inter-annual variations in the Leeuwin Current can cause variations in the mean sea level of a similar magnitude.

Extreme Water Levels / Storm Surge

During storm events (both winter storms and cyclones) barometric and wind effects can cause significant storm surges. In rare and extreme storms, the surge can exceed 1 metre above the astronomical tide level. In addition to the storm surge measured at tidal stations there can be inshore setup. This increases the steady water level on the beach compared to within a harbour. Measurements by MRA has shown the more usual winter storms often cause inshore setup of

about 0.4 to 0.6 metres. A diagram showing this storm surge and setup is provided in the following figure.

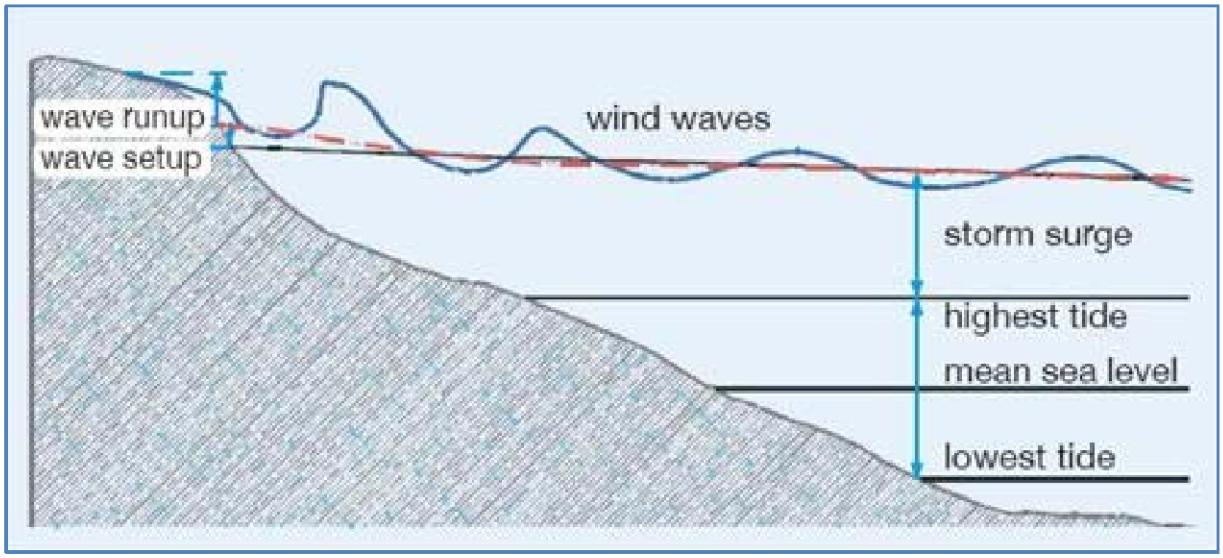

Figure 5.13 Storm Surge & Setup

Given the small astronomical tides, the level of the sea would generally have a secondary effect on the sand transport along the beaches, except during storm events when high water levels would enable the waves to attack the rear of the sandy beaches.

5.3 Coastal Processes

From a coastal engineering perspective, the most important coastal processes are generally the interaction of waves, currents and beaches to transport sediment. There are three fundamental mechanisms that can transport sand towards or away from a point on the beach.

- Longshore sediment transport.
- Cross-shore sediment transport.
- Wind-blown sand transport.

The following sections discuss the fundamental mechanisms for the shoreline across the Study Area.

5.3.1 Longshore Sediment Transport

A simplistic description of longshore sediment transport is that in the surf zone of sandy beaches, the breaking waves agitate the sand and place it into suspension. If the waves are approaching the beach at an angle, then a longshore current can form and this can transport the suspended sand along the beach. The suspended load is accompanied by a bed load transport where sand is rolled over the bottom by the shear of the water motion.

There can also be considerable variation in magnitude and direction of the longshore transport from season to season and year to year. Along the SoG coastline, it is believed that typically the longshore sediment transport is north in summer and south in winter. There may be local areas where the longshore transport patterns are different. The strong sea breezes blow from the south-west in summer, creating wind waves at an angle to the shoreline. This transports sediment

to the north (Masselink and Pattiaratchi 2001). In winter, severe storms generate waves from the northwest, swinging to the southwest over their duration. This typically transports sediment to the south in winter storms (Masselink and Pattiaratchi 2001).

However, longshore sediment transport along rocky sections of shoreline, such as sections of the SoG coastline is believed to be more complex than the sandy beaches across most of the study area. Figure 5.14 depicts typical longshore transport mechanisms along rocky shorelines.

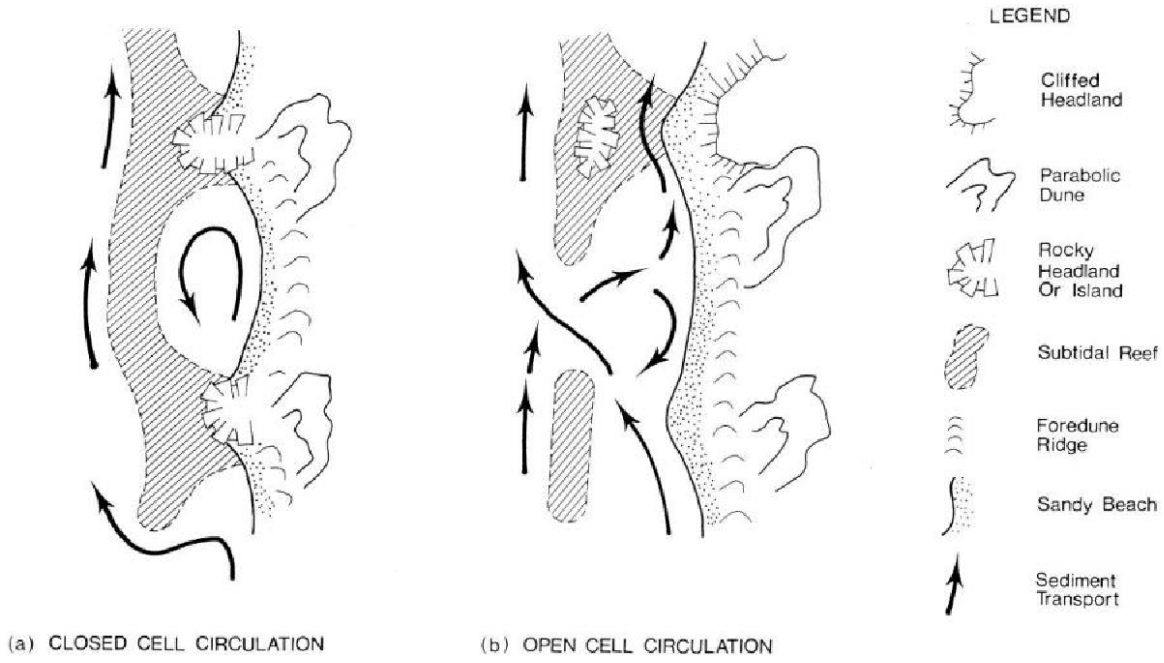

Figure 5.14 Longshore Transport Along Rocky Coastlines (Sanderson & Eliot 1999)

Channels exist through to the open ocean, allowing sediment to be transported offshore between the reefs, while some sediment will be transported adjacent to the coast and some will be transported on the outer edge of the reefs and rock platforms.

5.3.2 Cross-Shore Sediment Transport

The second mechanism is the onshore/offshore movement of sediment, commonly referred to as cross-shore sediment transport. During significant storm events, the strong winds generate high steep waves and an increase in water level known as storm surge. These factors, acting in concert, allow the waves to attack the higher portion of the beach that is not normally vulnerable.

For sandy beaches, the initial width of the surf zone is often insufficient to dissipate the increased wave energy of the storm waves. The residual energy is often spent in eroding the beach face, beach berm and sometimes the dunes. The eroded sand is carried offshore with return water flow where it is deposited and forms an offshore bar. Such bars can eventually grow large enough to break the incoming waves further offshore, causing the wave energy to be spent in a wider surf zone. This is shown diagrammatically in Figure 5.15.

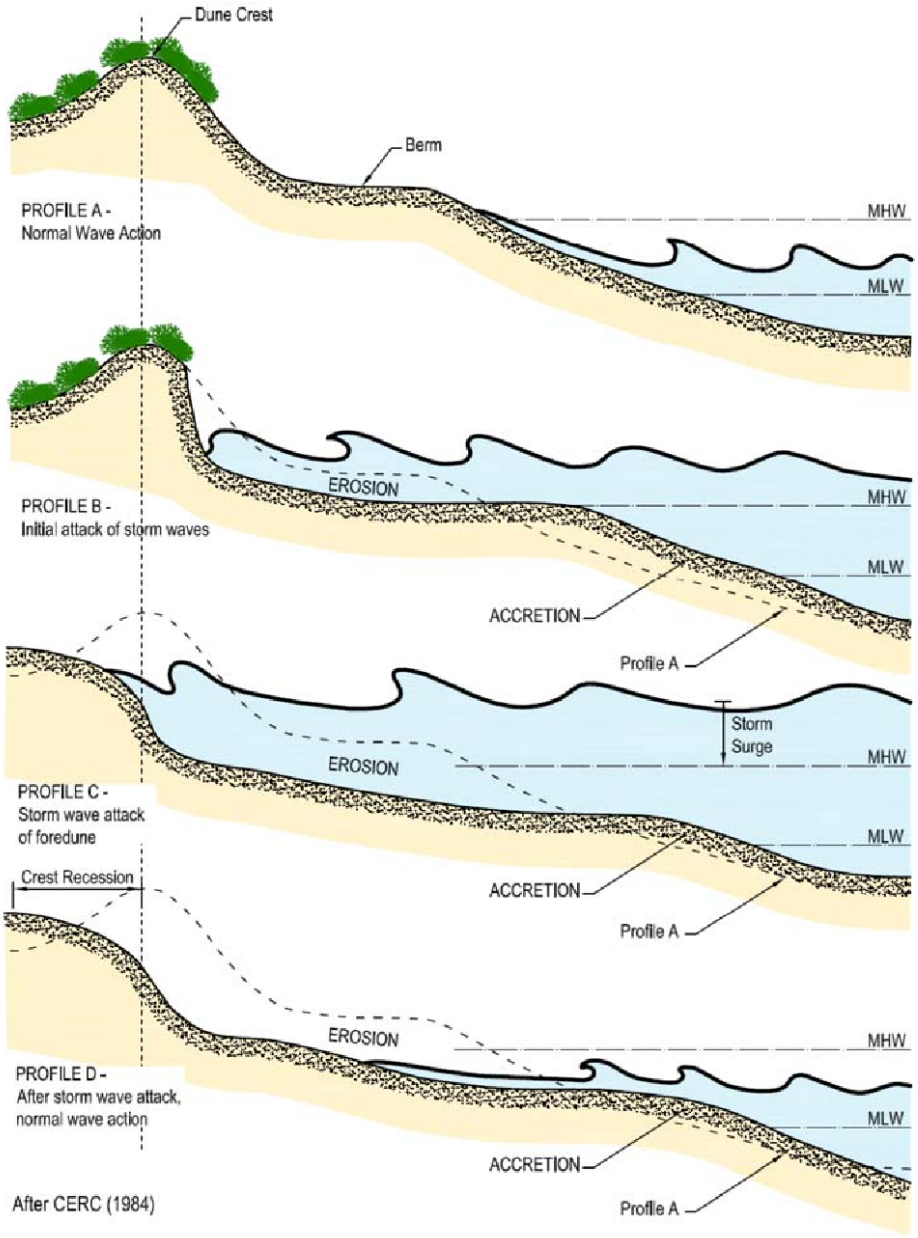

Figure 5.15 Severe Storm Erosion Mechanism

Erosion of sandy beaches during storms can be quite rapid and significant changes can occur in a matter of hours. Subsequent to the storm, the swell activity may move sand from offshore to the shore. This onshore process is generally at a much, much slower rate than the storm erosion.

The Study Area also includes rocky coastlines with number of embayed beaches. The effects and processes of cross shore transport in these areas can vary from those of a sandy beach.

5.3.3 Wind Blown Sand

The final mechanism for the movement of sediment is wind-blown sediment transport. This can move sand from the beach into nearby dunes. This is the mechanism by which coastal dunes are formed and grow. There needs to be careful management of the public use and access through

coastal dunes to prevent dune blowouts occurring due to lack of vegetation. The coastal dunes form a natural buffer to accommodate the erosion during severe storms.

There are a number of large dune systems along the SoG's coastline. An example is the Lancelin dunes which are shown in the following figure. The location and movement of dunes needs to be taken into account when investigating possible locations for boat launching facilities.

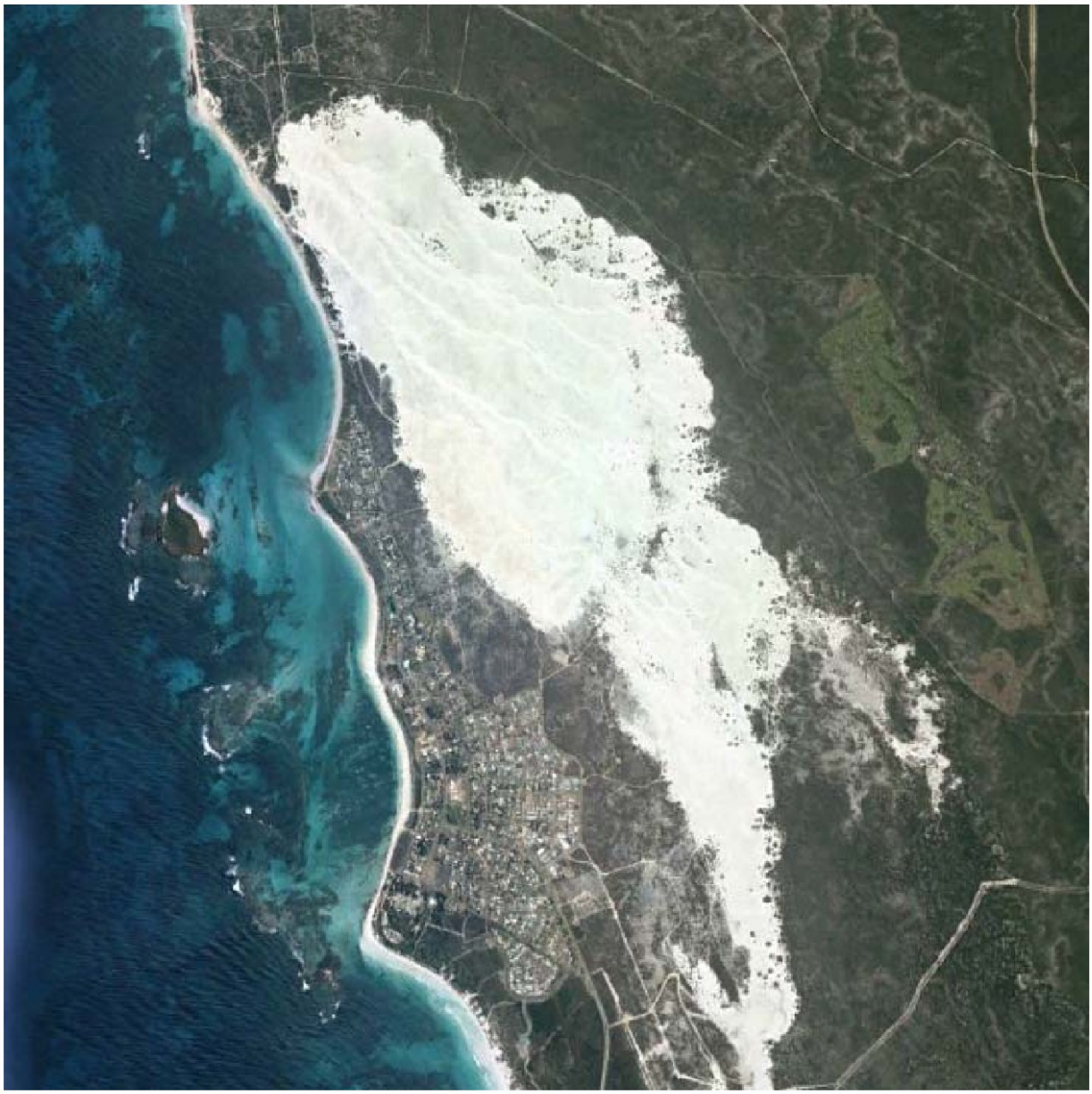

Figure 5.16 Mobile Sand Dunes on Northern and Eastern Side of Lancelin

5.3.4 Summary of Sediment Transport Rates

Reliable measurements of longshore sediment rates for the study area are not available. MRA has estimated the following rates using the available data coupled with engineering judgement.

Table 5.3 Summary of Indicative Sediment Transport Rates

Location	Gross Seasonal Movements	Net Annual Movement
Guilderton	100,000 to 150,000m^3	~20,000 to 50,000 m^3/year to the North
Seabird	50,000 to 100,000m^3	~20,000 m^3/year to the North
Ledge Point	50,000 to 100,000m^3	~10,000 to 20,000 m^3/year to the North
Lancelin	30,000 to 50,000m^3	~5,000 to 10,000 m^3/year to the North within the bay

Note: 1. These estimates are based on MRA engineers' judgement as reliable measurements of longshore drift are not available. This are indicative only and should be used with caution and refined in the future stages of any ramp project.

5.4 Sea Wrack

The accumulations of detached macrophytes and seagrass in the surf zone and on beaches are commonly referred to as wrack (Kirman & Kendrick 1997). In south-western Australia, wrack comprises a mixture of seagrasses and macroalgae (Hansen 1984).

Wrack accumulation, and its management, has impacted on the local amenity at a number of marina and boat harbours in Western Australia, including Port Geographe, Two Rocks and Jurien. This has been investigated at a number of locations.

The Department of Transport (DoT) and Shire of Busselton commissioned a comprehensive study into the dynamics of seagrass wrack in Geographe Bay, to inform the management of wrack at Port Geographe (Oldham et al 2010).

This study suggested the lifecycle of seagrass wrack could be described by the following:

- Wrack is generated by offshore seagrass meadows, which continually shed their leaves and stems. This wrack accumulates in the meadows and unvegetated zones until autumn. Initially, the wrack is slightly denser than the seawater and remains in the meadows.
- The first significant storms suspend the wrack in the water column and transport it towards the shoreline. Some wrack is or becomes slightly buoyant and can accumulate a mass on the ocean surface. Other wrack is not buoyant and generally stays on the seabed. The wrack is generally deposited on beaches during storm events when water levels are high.
- The wrack then moves on and off the beaches depending on local hydrodynamics and meteorological conditions. If it was deposited high enough on the beach it can become incorporated into the beach sand and compacted, making it harder to be washed off the beach. However, as the wrack dries out, it also becomes more buoyant.
- The next high water level event which covers the wrack or storm event can then return the wrack to the water column, where it can be transported away from the beach.

The volumes of wrack present on beaches and the time it stays on the beach can therefore vary with local weather and ocean conditions. The presence of coastal structures or formations can interrupt the clearing of wrack and result in large accumulations. This is the case at locations

such as Port Geographe, where the breakwaters were very efficient at trapping wrack on the western side (Oldham et al 2010) and Two Rocks, where the presence of the Marina and the nearshore rock and reef hold wrack on the southern side (MRA 2000).

While the lifecycle described above was developed for Geographe Bay, the processes are believed to be very similar on the SoG coastline.

In areas with significant nearshore reef and rock platforms, macroalgae assemblages dominate. This is the case for most of the SoG coastline where macroalgae forms a large proportion of the beach wrack. The processes of movement onto and from the beach are believed to be similar to those reported above for seagrass. The following photograph shows wrack accumulated along the beach and in the water at Seabird.

Figure 5.17 Sea Wrack at Seabird

All of the sites being investigated for this study were noted as having sea wrack accumulate on the beach from time to time. Therefore the construction of a boat launching facility has the potential to trap this wrack and could require management. Management options include the following.

- Removal by machine from the beach or boat ramp. This could be a small excavator and trucks.
- Removal by fishing trawler. This has been trialled by the DoT at Jurien Bay and Port Geographe.
- Removal by dredge. This can be time consuming and costly, as dredging operations need to be modified specifically for the wrack.

Accumulations present on the beaches and shorelines adjacent to the development may naturally disperse and break down, as they often do on many shorelines. However should the accumulations begin to impact the recreational values of these areas, the SoG may want to mechanically remove the wrack.

6. Community Consultation

Community consultation sessions were held on Saturday 11th October 2014. Three separate sessions were held in Guilderton, Seabird and Ledge Point. Representatives from Lancelin attended the Ledge Point session.

The aim of the workshops was to undertake the following.

- Provide information to the community in the form of a technical presentation delivered by Peter Doust, a Senior Coastal Engineer from MRA. The presentation contained information on the following.
    - Exposure to waves.
    - Design requirements.
    - Issues with sedimentation and sea wrack.
    - Navigation.
    - Other technical and management issues.
- Facilitate a discussion with the community and gain their input on the four (4) locations, Seabird, Lancelin and Ledge Point and Guilderton. The following questions were asked:
    - What are the risks and constraints of the location?
    - What are the Benefits?
    - Is this the preferred location?

Around 150 people attended these sessions. Learning Horizons were engaged by the SoG to facilitate these sessions and to collate the feedback from the community. A report prepared by Learning Horizons summarises the results from these sessions and is included in Appendix B.

A petition was also received supporting a boat launching facility at Ledge Point.

7. Guilderton Concept Plan

7.1 Guilderton Coastal Processes

The indicative coastal processes affecting Guilderton are summarised in the following figure.

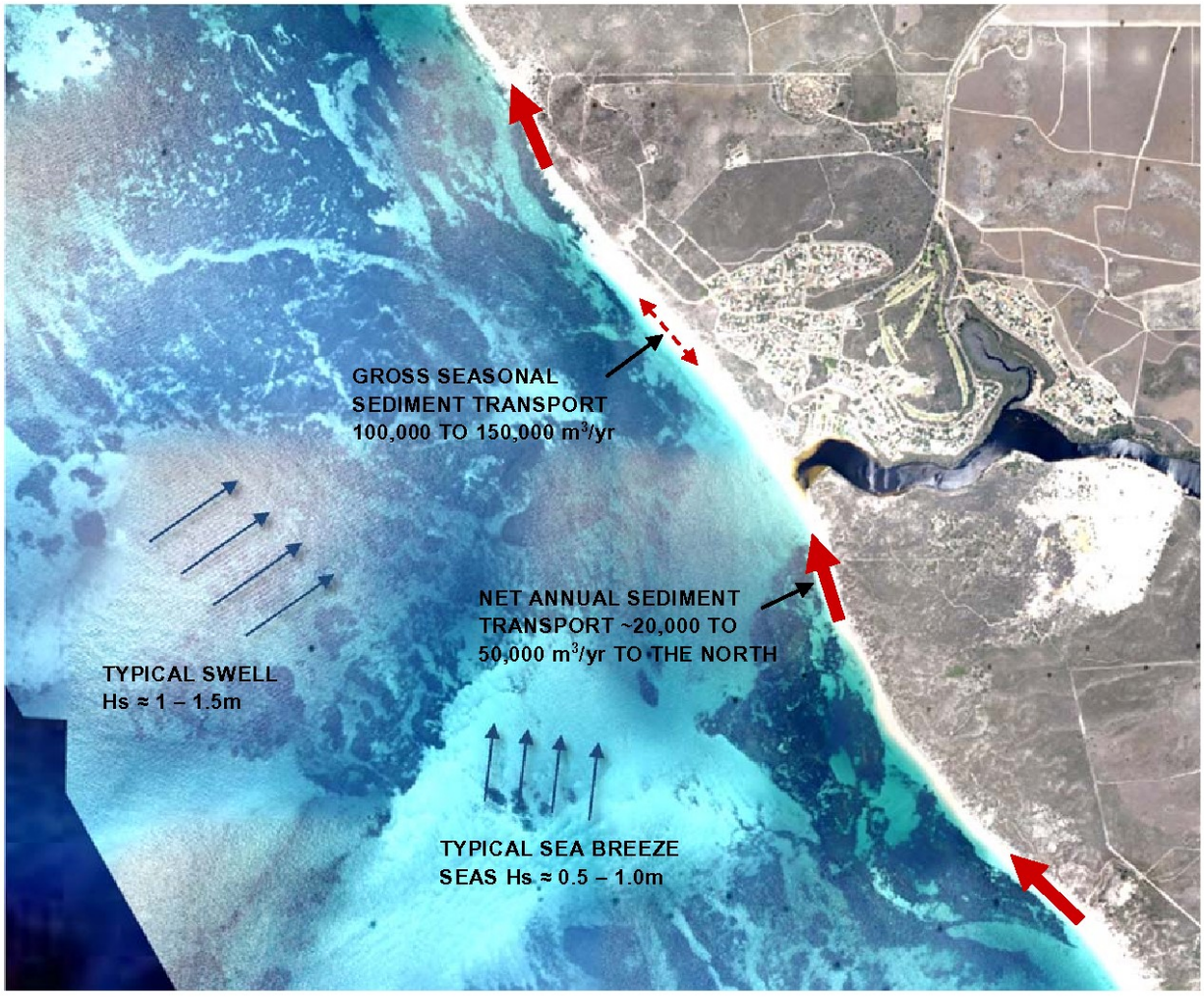

Figure 7.1 Guilderton Indicative Coastal Processes

7.2 Guilderton Community Consultation

The key items from the Guilderton Community Consultation workshop are summarised below.

- The community support a boat launching facility at either Guilderton or Seabird. A facility at Ledge Point or Lancelin is not supported by the local community as it would not serve them.
- A ramp at Guilderton would be closer for Perth users, but is further from Lancelin and Ledge Point users than the other options.
- A protected ramp would provide much safer launching and retrieval of vessels than the current arrangement of over the beach launching at the groyne.
- South of the Moore River is not supported due to difficult access.
- The option of permanently opening the river was raised, but understood to be very costly.

7.3 Navigation & Safety

An extract from the Guilderton Nautical Chart is provided in the following figure. As shown in the figure there is relatively deep water close to the shore inside the reefs at Guilderton. Safe access through the reefs is provided by the lead line to the north of Guilderton. The southern side of Guilderton has a number of shallow reefs which have waves breaking over them during swell events.

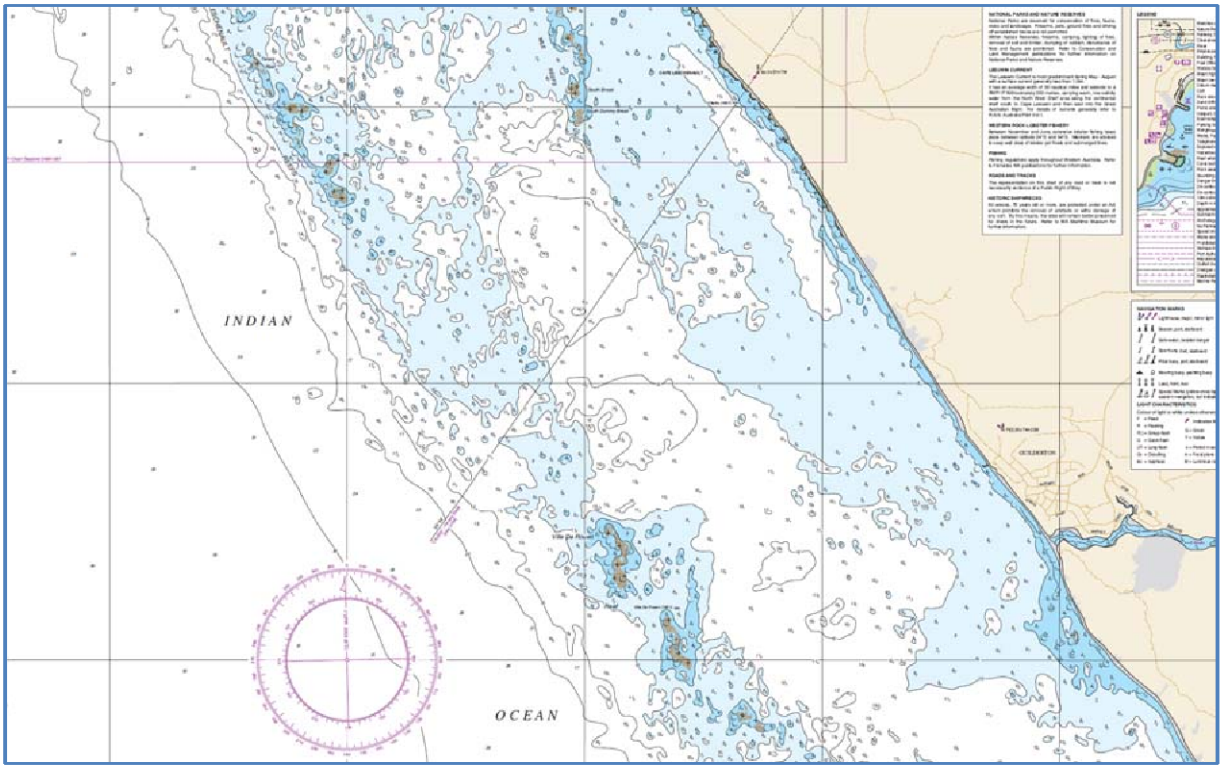

Figure 7.2 Guilderton Nautical Chart

The main boating hazards at Guilderton are summarised as follows.

- Submerged reefs.
- Breaking waves.
- Exposed to large waves near the shoreline.
- Access between from inside to outside the reefs.

7.4 Guilderton Concept Plan

A concept plan for a boat launching facility at Guilderton has been prepared and is included in Appendix C.

The key features of this concept plan are summarised as follows.

- The proposed location of the facility is on the northern side of the town where there is an existing groyne. This area is relatively undeveloped and has space to allow for future expansion of a facility.

- Due to the exposure to waves a breakwater is required to provide adequate protection.
- The entrance depth into the harbour has been chosen as around -5mCD to ensure safe navigation and to minimise the chance of waves breaking at the entrance.
- The location also has the benefit of being aligned with the lighthouse which can be used for navigation for vessels returning to the ramp.
- The length of the breakwaters allows for seasonal fluctuations in the shoreline position.
- Due to the net longshore transport of sediment regular bypassing will be required. The average annual quantity is estimated to be around 20,000 to 50,000 m^3.
- Sea wrack will also need to be managed.

7.5 Guilderton Cost Estimate

A cost estimate for the Guilderton Boat Launching Facility has been prepared and is provided in the following table.

Table 7.1 Guilderton Boat Launching Facility Cost Estimate

Item	Activity	Quantity	Units	Unit Rate	Subtotal	Total for Item
1	**Preliminaries & Site Establishment**					**$ 350,000**
1.1	Insurances and management plans	1	Item	$ 50,000	$ 50,000	
1.2	Mobilisation & site establishment	1	Item	$ 150,000	$ 150,000	
1.3	Demobilisation & site clean-up	1	Item	$ 100,000	$ 100,000	
1.4	Environmental compliance (during construction)	1	Item	$ 50,000	$ 50,000	
2	**Breakwater Protection**					**$ 7,870,000**
2.1	Physical Model Testing	1	Item	$ 100,000	$ 100,000	
2.2	Excavation & Earthworks for breakwater construction	1	Item	$ 100,000	$ 100,000	
2.3	Supply and place core material	65,000	m^3	$ 55	$ 3,575,000	
2.4	Supply and place 4t armour underlayer on the exposed side of the breakwaters	20,000	m^3	$ 70	$ 1,400,000	
2.5	Supply and place 8t armour on the exposed side of the breakwaters	25,000	t	$ 70	$ 1,750,000	
2.6	Supply and place 4t armour on the inside of the main breakwater through the entrance channel	7,000	t	$ 70	$ 490,000	
2.7	Supply and place 1t armour on the inside of the breakwaters	7,000	t	$ 65	$ 455,000	
3	**Boat Ramps**					**$ 550,000**
3.1	2 lane concrete boat ramps with one finger jetty	1	Item	$ 550,000	$ 550,000	
4	**Parking & Manoeuvring Area**					**$ 1,100,000**
4.1	80 bay sealed parking area (includes rigging and de-rigging areas, drainage and kerbing)	1	Item	$ 1,100,000	$ 1,100,000	
5	**Miscellaneous**					**$ 151,000**
5.1	Signage	1	Item	$ 4,000	$ 4,000	
5.2	Solar Lighting	5	Item	$ 10,000	$ 50,000	
5.3	Nav aids	3	Item	$ 15,000	$ 45,000	
5.4	Bins	2	Item	$ 1,000	$ 2,000	
5.5	Landscaping & Re-vegetating	1	Item	$ 50,000	$ 50,000	
	Subtotal 1				**$ 10,021,000**	**$ 10,021,000**
	Management & Design Fees	**5%**			**$ 501,050**	**$ 501,050**
	Contingencies	**25%**			**$ 2,505,250**	**$ 2,505,250**
	Subtotal 2				**$ 13,027,300**	**$ 13,027,300**
	Goods & Services Tax				**$ 1,302,730**	**$ 1,302,730**
	Total Estimated Cost				**$ 14,330,030**	**$ 14,330,030**
Notes	1. All rates based on similar works within the Perth metro area factored for Guilderton.					
	2. Armour size and breakwater cross sections to be confirmed through detailed design and physical modelling.					
	3. No allowance for services to site.					
	4. Savings can be made if the car park was made from gravel rather than sealed.					

No power or water services have been included in the concept plan. These items could be added in future stages of the development if required. Solar lighting has been allowed for initially.

On top of the capital cost for the facility are the ongoing maintenance costs. These include the following.

- Annual sand bypassing of around 20,000 to 50,000m^3. An allowance of \$15/m^3 should be included to cover this bypassing. Therefore, this could be in the order of \$300,000 to \$750,000 per year.
- Sea wrack management will vary from year to year. An allowance of \$20,000 per year on average should be included. This will cover removal of wrack from the beach and from within the harbour.
- Costs associated with general maintenance of the facility also need to be taken into account.

8. Seabird Concept Plan

8.1 Seabird Coastal Processes

The indicative coastal processes affecting Seabird are summarised in the following figure.

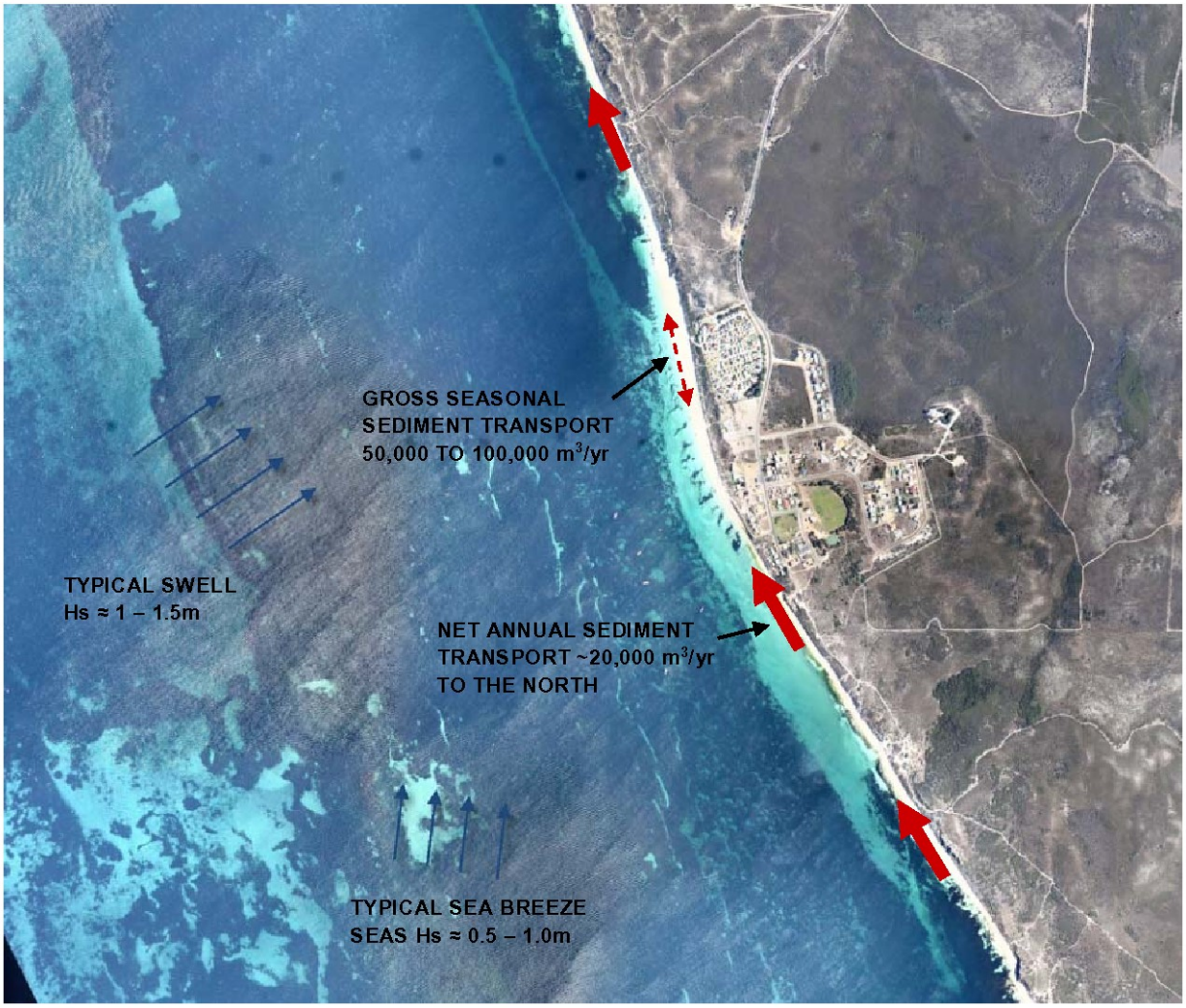

Figure 8.1 Seabird Indicative Coastal Processes

8.2 Seabird Community Consultation

The key items from the Seabird Community Consultation workshop are summarised below.

- There was a large amount of support from within the community for a boat launching facility at Seabird.
- The Seabird Progress Association had developed a concept option for a boat launching facility to the south of Seabird with a proposed new road connecting Seabird and Guilderton.
- An alternative option is for the facility to be designed in a way to assist in reducing the erosion occurring to the southern shoreline at Seabird.
- A facility at Seabird would serve a large proportion of the Shire of Gingin community.

- A breakwater would be required to protect the ramp from waves.
- Space is limited within town.
- A boat launching facility would assist the local economy.

8.3 Seabird Navigation & Safety

An extract from the Seabird Nautical Chart is provided in the following figure. As shown in the figure there is relatively deep water close to the shore inside the reefs at Seabird. Safe access through the reefs is provided by the lead line to the south of Seabird. The southern side of Seabird is more exposed to ocean swell than the northern side of the town.

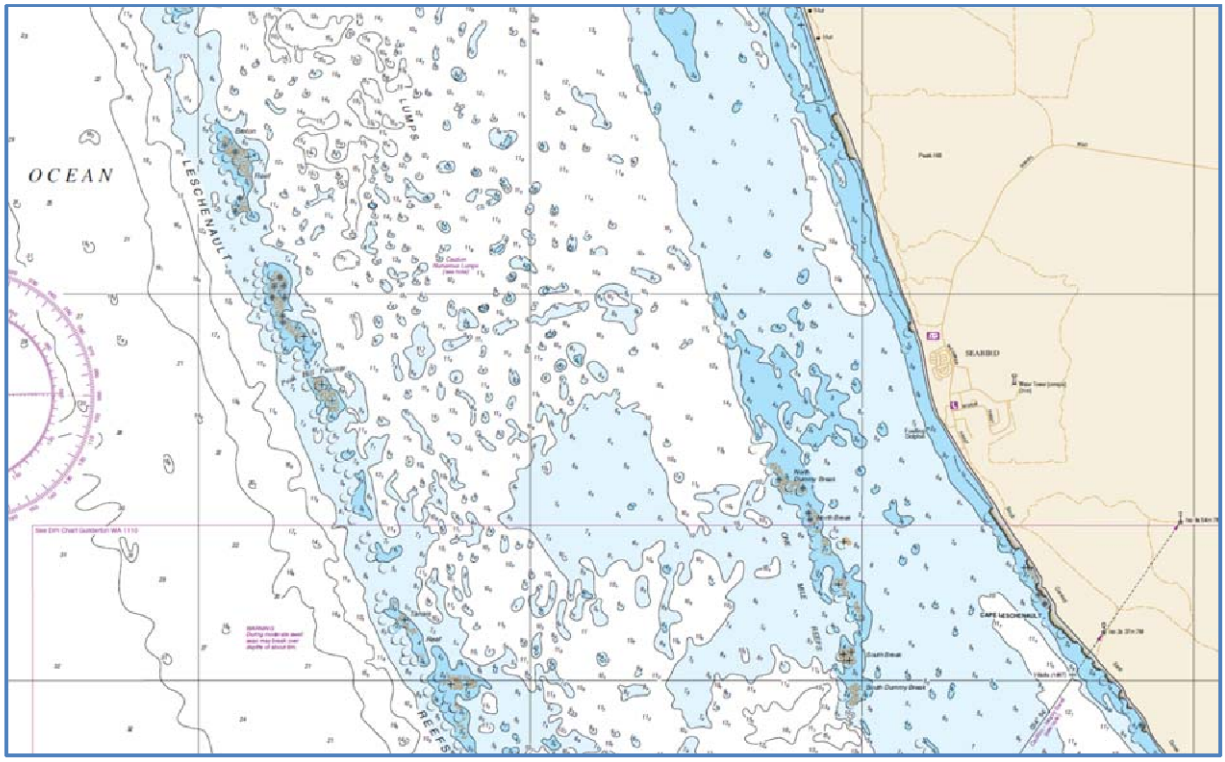

Figure 8.2 Seabird Nautical Chart

The main boating hazards at Seabird are summarised as follows.

- Submerged reefs.
- Breaking waves.
- Exposed to large waves near the shoreline.
- Access between from inside to outside the reefs.

8.4 Seabird Concept Plan

A concept plan for a boat launching facility at Seabird has been prepared and is included in Appendix D.

The key features of this concept plan are summarised as follows.

- The proposed location of the facility is on the northern side of the town as this side of the town is more sheltered from waves. This area is relatively undeveloped and has space to allow for future expansion of a facility.
- Due to the exposure to waves a breakwater is required to provide adequate protection.
- The entrance depth into the harbour has been chosen as around -5mCD to ensure safe navigation and to minimise the chance of waves breaking at the entrance.
- The length of the breakwaters allows for seasonal fluctuations in the shoreline position.
- Due to the net longshore transport of sediment regular bypassing will be required. The average annual quantity is estimated to be around 20,000 m^3.
- Sea wrack will also need to be managed.

An alternative location for the boat launching facility was considered for the southern side of the town. This option could be developed to help combat the erosion currently occurring on the southern side of the town. It is likely that this option would be more costly due to being more exposed, having to fit in with existing infrastructure, and reclaiming land for car parking and other facilities.

The location proposed by the Seabird Progress Association was considered but was not preferred due to the following reasons.

- Difficult access. A new road ~2km long would be required to get access to the site. This would be very costly.
- Nearshore reefs would make construction and navigation difficult. The facility would need to be constructed further seaward to allow sufficient depth making it more costly.
- The land side of the proposed facility is very steep in places making access difficult. Significant cut and fill may be required to achieve the required grades in access roads and parking areas.
- The site is more exposed to swell which results in increased costs for the structure and maintenance.

8.5 Seabird Cost Estimate

A cost estimate for the Seabird Boat Launching Facility has been prepared and is provided in the following table.

Table 8.1 Seabird Boat Launching Facility Cost Estimate

Item	Activity	Quantity	Units	Unit Rate	Subtotal	Total for Item
1	**Preliminaries & Site Establishment**					**$ 350,000**
1.1	Insurances and management plans	1	Item	$ 50,000	$ 50,000	
1.2	Mobilisation & site establishment	1	Item	$ 150,000	$ 150,000	
1.3	Demobilisation & site clean-up	1	Item	$ 100,000	$ 100,000	
1.4	Environmental compliance (during construction)	1	Item	$ 50,000	$ 50,000	
2	**Breakwater Protection**					**$ 8,195,000**
2.1	Physical Model Testing	1	Item	$ 100,000	$ 100,000	
2.2	Excavation & Earthworks for breakwater construction	1	Item	$ 100,000	$ 100,000	
2.3	Supply and place core material	85,000	m^3	$ 55	$ 4,675,000	
2.4	Supply and place 8t armour on the exposed side of the breakwaters	30,000	t	$ 70	$ 2,100,000	
2.5	Supply and place 4t armour on the inside of the main breakwater through the entrance channel	10,000	t	$ 70	$ 700,000	
2.6	Supply and place 1t armour on the inside of the breakwaters	8,000	t	$ 65	$ 520,000	
3	**Boat Ramps**					**$ 550,000**
3.1	2 lane concrete boat ramps with one finger jetty	1	Item	$ 550,000	$ 550,000	
4	**Parking & Manoeuvring Area**					**$ 1,100,000**
4.1	80 bay sealed parking area (includes rigging and de-rigging areas, drainage and kerbing)	1	Item	$ 1,100,000	$ 1,100,000	
5	**Miscellaneous**					**$ 276,000**
5.1	Site access (gravel road)	1	Item	$ 125,000	$ 125,000	
5.2	Signage	1	Item	$ 4,000	$ 4,000	
5.3	Solar Lighting	5	Item	$ 10,000	$ 50,000	
5.4	Nav aids	3	Item	$ 15,000	$ 45,000	
5.5	Bins	2	Item	$ 1,000	$ 2,000	
5.6	Landscaping & Re-vegetating	1	Item	$ 50,000	$ 50,000	
	Subtotal 1				**$ 10,471,000**	**$ 10,471,000**
	Management & Design Fees	**5%**			**$ 523,550**	**$ 523,550**
	Contingencies	**25%**			**$ 2,617,750**	**$ 2,617,750**
	Subtotal 2				**$ 13,612,300**	**$ 13,612,300**
	Goods & Services Tax				**$ 1,361,230**	**$ 1,361,230**
	Total Estimated Cost				**$ 14,973,530**	**$ 14,973,530**

Notes
1. All rates based on similar works within the Perth metro area factored for Seabird.
2. Armour size and breakwater cross sections to be confirmed through detailed design and physical modelling.
3. No allowance for services to site.
4. Savings can be made if the car park was made from gravel rather than sealed.

No power or water services have been included in the concept plan. These items could be added in future stages of the development if required. Solar lighting has been allowed for initially.

On top of the capital cost for the facility are the ongoing maintenance costs. These include the following.

- Annual sand bypassing of around 20,000 m^3. An allowance of \$15/m^3 should be included to cover this bypassing. Therefore, this could be in the order of \$300,000 per year.
- Sea wrack management will vary from year to year. An allowance of \$20,000 per year on average should be included. This will cover removal of wrack from the beach and from within the harbour.
- Costs associated with general maintenance of the facility also need to be taken into account.

9. Ledge Point Concept Plan

9.1 Ledge Point Coastal Processes

The indicative coastal processes affecting Ledge Point are summarised in the following figure.

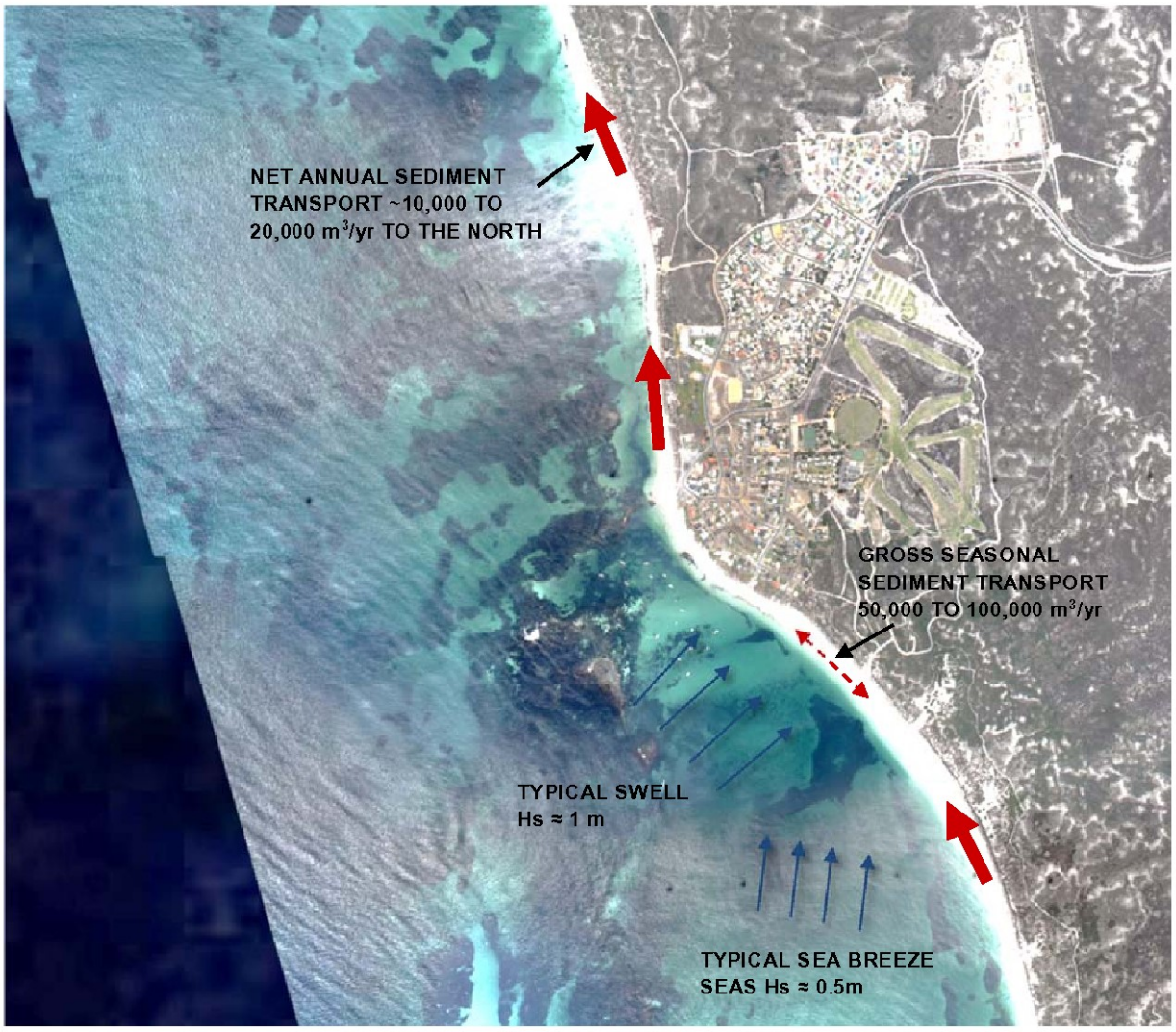

Figure 9.1 Ledge Point Indicative Coastal Processes

9.2 Ledge Point Community Consultation

The key items from the Ledge Point Community Consultation workshop are summarised below.

- There was strong support for a boat launching facility at Ledge Point. A petition was received with 387 signatures in support of the facility.
- The existing reef provides good protection from waves.
- There were some concerns about congestion and space for parking.
- It was noted that a boat launching facility would assist the local economy.

9.3 Ledge Point Navigation & Safety

An extract from the Ledge Point Nautical Chart is provided in the following figure. As shown in the figure the southern side of the point provides a sheltered area inside the reefs. Access is provided to the ocean via the lead line to the south of the town. There are a large number of nearshore reefs making navigation in the area hazardous.

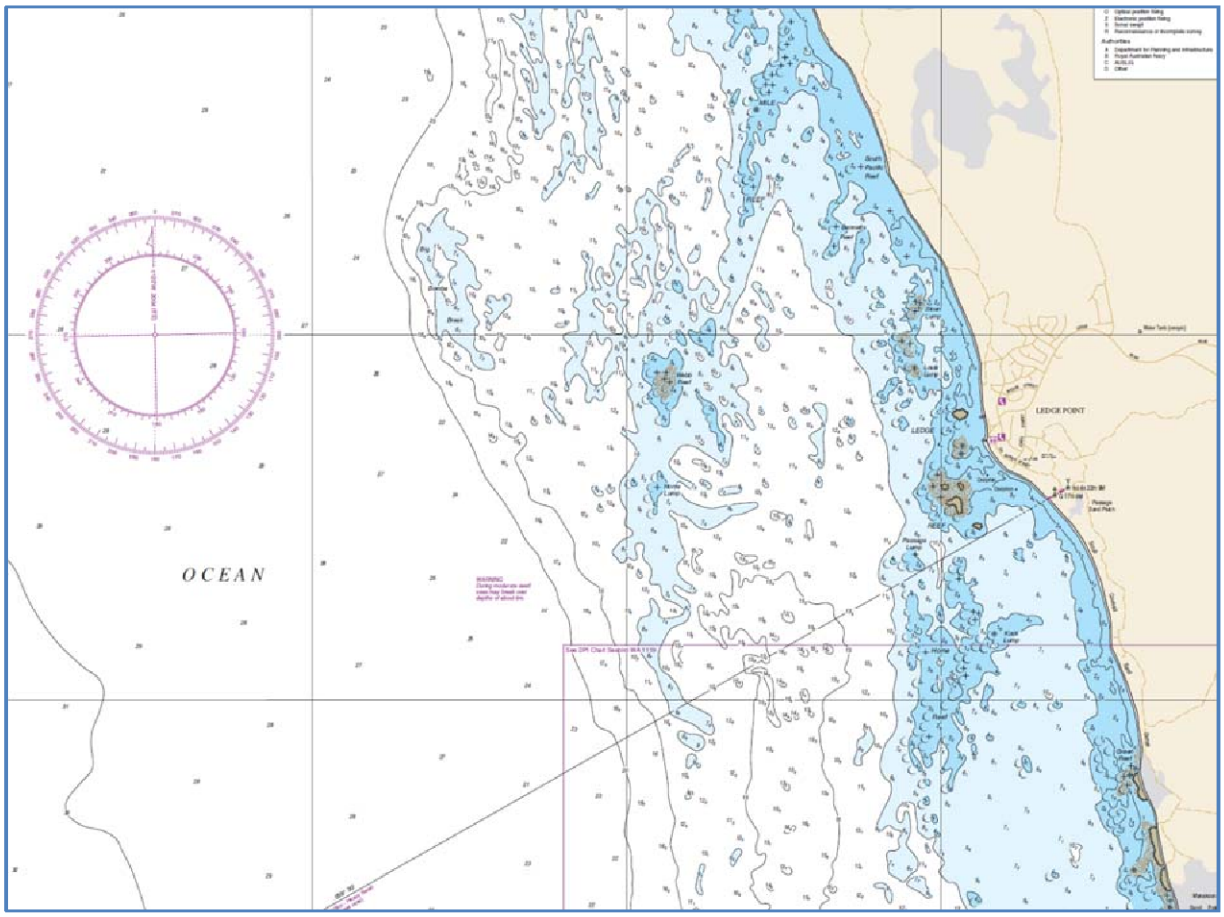

Figure 9.2 Ledge Point Nautical Chart

The main boating hazards at Ledge Point are summarised as follows.

- Submerged reefs.
- Breaking waves.
- Exposed to large waves near the shoreline.
- Access between from inside to outside the reefs.
- Exposure to wind generated seas from the sea breeze.

9.4 Ledge Point Concept Plan

A concept plan for a boat launching facility at Ledge Point has been prepared and is included in Appendix E.

The key features of this concept plan are summarised as follows.

- The proposed location of the facility is on the southern side of the town which has an existing sheltered area where boats currently moor. This area is relatively undeveloped and has space to allow for future expansion of a facility.
- The location is also aligned with the lead line which provides safe access through the reefs.
- Due to the exposure to waves a breakwater is required to provide adequate protection.
- The entrance depth into the harbour has been chosen as around -4mCD to ensure safe navigation and to minimise the chance of waves breaking at the entrance.
- The length of the breakwaters allows for seasonal fluctuations in the shoreline position.
- Due to the net longshore transport of sediment regular bypassing will be required. The average annual quantity is estimated to be around 10,000 to 20,000 m^3.
- Sea wrack will also need to be managed.

9.5 Ledge Point Cost Estimate

A cost estimate for the Ledge Point Boat Launching Facility has been prepared and is provided in the following table.

Table 9.1 Ledge Point Boat Launching Facility Cost Estimate

Item	Activity	Quantity	Units	Unit Rate	Subtotal	Total for Item
1	**Preliminaries & Site Establishment**					**$ 350,000**
1.1	Insurances and management plans	1	Item	$ 50,000	$ 50,000	
1.2	Mobilisation & site establishment	1	Item	$ 150,000	$ 150,000	
1.3	Demobilisation & site clean-up	1	Item	$ 100,000	$ 100,000	
1.4	Environmental compliance (during construction)	1	Item	$ 50,000	$ 50,000	
2	**Breakwater Protection**					**$ 8,715,000**
2.1	Physical Model Testing	1	Item	$ 100,000	$ 100,000	
2.2	Excavation & Earthworks for breakwater construction	1	Item	$ 100,000	$ 100,000	
2.3	Supply and place core material	75,000	m^3	$ 65	$ 4,875,000	
2.4	Supply and place 8t armour on the exposed side of the breakwaters	30,000	t	$ 80	$ 2,400,000	
2.5	Supply and place 4t armour on the inside of the main breakwater through the entrance channel	8,000	t	$ 80	$ 640,000	
2.6	Supply and place 1t armour on the inside of the breakwaters	8,000	t	$ 75	$ 600,000	
3	**Boat Ramps**					**$ 550,000**
3.1	2 lane concrete boat ramps with one finger jetty	1	Item	$ 550,000	$ 550,000	
4	**Parking & Manoeuvring Area**					**$ 1,100,000**
4.1	80 bay sealed parking area (includes rigging and de-rigging areas, drainage and kerbing)	1	Item	$ 1,100,000	$ 1,100,000	
5	**Miscellaneous**					**$ 251,000**
5.1	Site access (gravel road)	1	Item	$ 100,000	$ 100,000	
5.2	Signage	1	Item	$ 4,000	$ 4,000	
5.3	Solar Lighting	5	Item	$ 10,000	$ 50,000	
5.4	Nav aids	3	Item	$ 15,000	$ 45,000	
5.5	Bins	2	Item	$ 1,000	$ 2,000	
5.6	Landscaping & Re-vegetating	1	Item	$ 50,000	$ 50,000	
	Subtotal 1				**$ 10,966,000**	**$ 10,966,000**
	Management & Design Fees	**5%**			**$ 548,300**	**$ 548,300**
	Contingencies	**25%**			**$ 2,741,500**	**$ 2,741,500**
	Subtotal 2				**$ 14,255,800**	**$ 14,255,800**
	Goods & Services Tax				**$ 1,425,580**	**$ 1,425,580**
	Total Estimated Cost				**$ 15,681,380**	**$ 15,681,380**

Notes
1. All rates based on similar works within the Perth metro area factored for Ledge Point.
2. Armour size and breakwater cross sections to be confirmed through detailed design and physical modelling.
3. No allowance for services to site.
4. Savings can be made if the car park was made from gravel rather than sealed.

No power or water services have been included in the concept plan. These items could be added in future stages of the development if required. Solar lighting has been allowed for initially.

On top of the capital cost for the facility are the ongoing maintenance costs. These include the following.

- Annual sand bypassing of around 10,000 to 20,000 m^3. An allowance of \$15/m^3 should be included to cover this bypassing. Therefore, this could be in the order of \$150,000 to \$300,000 per year.
- Sea wrack management will vary from year to year. An allowance of \$20,000 per year on average should be included. This will cover removal of wrack from the beach and from within the harbour.
- Costs associated with general maintenance of the facility also need to be taken into account.

10. Lancelin Concept Plan

10.1 Lancelin Coastal Processes

The indicative coastal processes at Lancelin are summarised in the following figure.

Figure 10.1 Lancelin Indicative Coastal Processes

To address siltation issues around the jetty at Lancelin the Department of Transport carries out regular maintenance dredging. The following table shows the quantities of material dredged from around the jetty since 2000.

Table 10.1 Lancelin Dredging Quantities

Year	Quantity Dredged (m^3)
2000	42,000
2001	4,680
2002	12,164
2003	11,760
2004	12,400
2005	10,852
2006	~5,350
2007	10,920
2008	5,346
2009	4,104

Therefore, on average about 5,000 to 10,000m^3 of material is removed from around the jetty each year. Most of this material will be from the longshore sediment transport coming from the south.

10.2 Lancelin Community Consultation

The key items from the Lancelin Community Consultation workshop (held at Ledge Point) are summarised below.

- The bay offers good natural protection from waves.
- Lancelin has existing infrastructure (eg Marine Rescue).
- It is a central location between Two Rocks and Jurien.
- There is not much room for infrastructure such as parking.
- There are safety issues. It is dangerous to navigate when the swell is greater than 3.5m.
- The area is very shallow.

10.3 Lancelin Point Navigation & Safety

An extract from the Lancelin Nautical Chart is provided in the following figure. As shown in the figure the Lancelin Bay is very protected by an extensive chain of reefs and islands. Access is provided to the ocean via the lead line through the north passage.

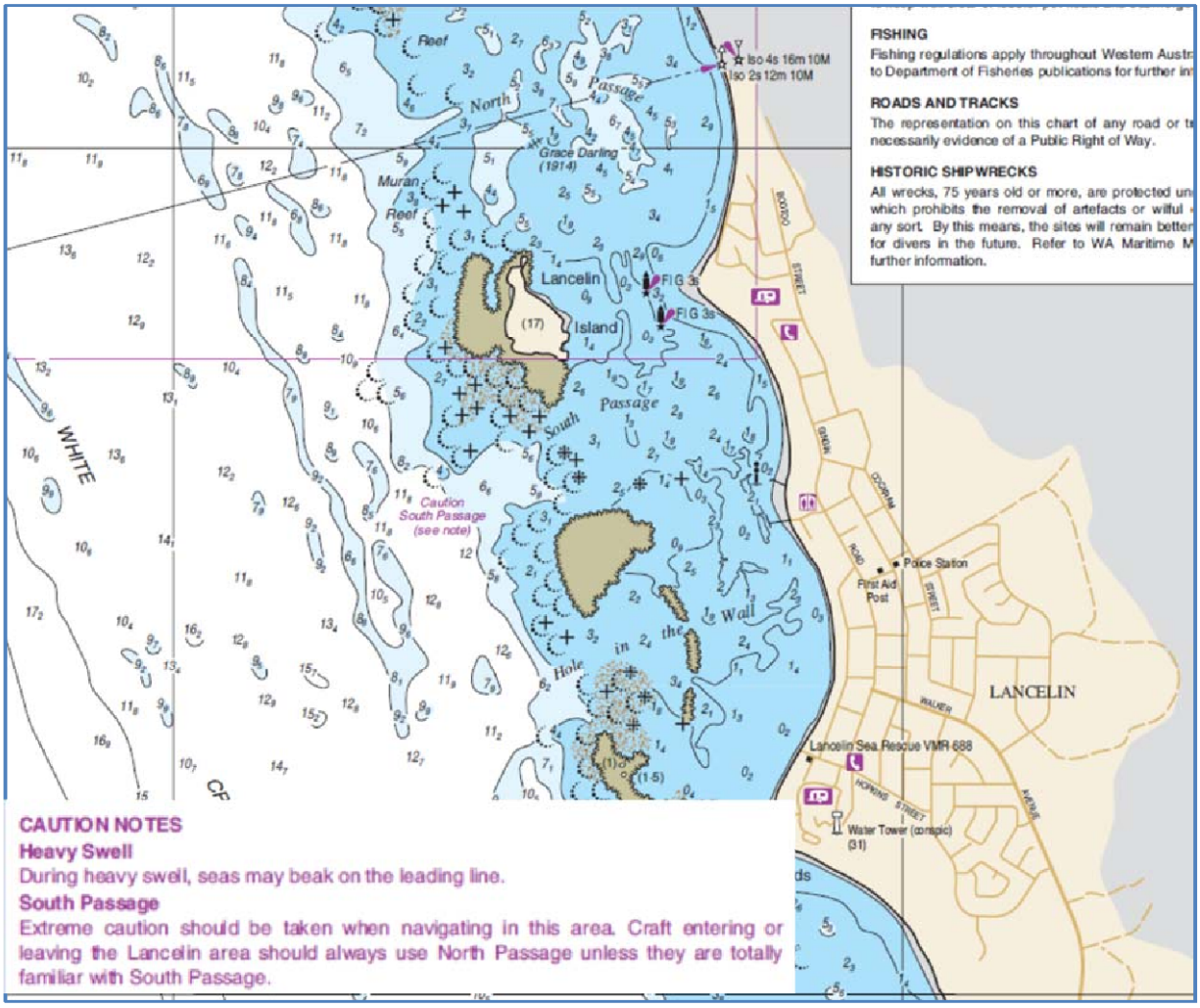

Figure 10.2 Lancelin Nautical Chart

The main boating hazards at Lancelin are summarised as follows.

- Submerged reefs. There are a number of shallow obstacles within the bay.
- Breaking waves. During large swell or storm events wave can break across the lead line.
- Access from inside to outside the reefs.
- Conflicts with commercial operators and other users (eg windsurfers).

10.4 Lancelin Concept Plan

A concept plan for a boat launching facility at Lancelin has been prepared and is included in Appendix E.

The key features of this concept plan are summarised as follows.

- The proposed location of the facility is on the southern side bay which is most protected from swell and wind generated waves during the sea breeze.

- The wave conditions are close to the limit specified in the Australian Standards and management of the facility will be required when wave heights become unsafe for boat launching.
- The southern end of the bay is relatively shallow and access for deeper draft vessels during low tides may be restricted.
- An elevated ramp is proposed to minimise the issues associated with sediment and sea wrack accumulation.
- Management of sedimentation around the structure is likely to be required.
- Seawrack may also need to be managed if it accumulates around the structure.
- A seawall is required to protect the car parking area from storm erosion.

10.5 Lancelin Cost Estimate

A cost estimate for the Lancelin Boat Launching Facility has been prepared and is provided in the following table.

Table 10.2 Lancelin Boat Launching Facility Cost Estimate

Item	Activity	Quantity	Units	Unit Rate	Subtotal	Total for Item
1	**Preliminaries & Site Establishment**					**$ 130,000**
1.1	Insurances and management plans	1	Item	$ 50,000	$ 50,000	
1.2	Mobilisation & site establishment	1	Item	$ 50,000	$ 50,000	
1.3	Demobilisation & site clean-up	1	Item	$ 20,000	$ 20,000	
1.4	Environmental compliance (during construction)	1	Item	$ 10,000	$ 10,000	
2	**Seawall Protection**					**$ 915,000**
2.1	Excavation & Earthworks for seawall construction	1	Item	$ 85,000	$ 85,000	
2.2	Supply and place geotextile	5,000	m^2	$ 20	$ 100,000	
2.3	Supply and place filter layer	3,000	m^3	$ 70	$ 210,000	
2.4	Supply and place 0.4t armour underlayer	1,500	t	$ 80	$ 120,000	
2.5	Supply and place 2.0t armour on exposed face	5,000	t	$ 80	$ 400,000	
3	**Boat Ramps**					**$ 2,600,000**
3.1	2 lane elevated boat ramps with one finger jetty	1	Item	$ 2,600,000	$ 2,600,000	
4	**Parking & Manoeuvring Area**					**$ 950,000**
4.1	80 bay sealed parking area (includes rigging and de-rigging areas, drainage and kerbing)	1	Item	$ 950,000	$ 950,000	
5	**Miscellaneous**					**$ 121,000**
5.1	Signage	1	Item	$ 4,000	$ 4,000	
5.2	Lighting	5	Item	$ 10,000	$ 50,000	
5.3	Nav aids	3	Item	$ 15,000	$ 45,000	
5.4	Bins	2	Item	$ 1,000	$ 2,000	
5.5	Landscaping & Re-vegetating	1	Item	$ 20,000	$ 20,000	
	Subtotal 1				**$ 4,716,000**	**$ 4,716,000**
	Management & Design Fees	**5%**			**$ 235,800**	**$ 235,800**
	Contingencies	**25%**			**$ 1,179,000**	**$ 1,179,000**
	Subtotal 2				**$ 6,130,800**	**$ 6,130,800**
	Goods & Services Tax				**$ 613,080**	**$ 613,080**
	Total Estimated Cost				**$ 6,743,880**	**$ 6,743,880**

Notes
1. All rates based on similar works within the Perth metro area factored for Lancelin.
2. Armour size and seawall cross sections to be confirmed through detailed design.
3. No allowance for services to site.
4. Savings can be made if the car park was made from gravel rather than sealed.

On top of the capital cost for the facility are the ongoing maintenance costs. These include the following.

- Managing sediment accumulation around the structure. An allowance $20,000 per year should be included for excavation and removal of sand around the ramps.
- Sea wrack management will vary from year to year. An allowance of $10,000 per year on average should be included. This will cover removal of wrack from the ramps.
- Costs associated with general maintenance of the facility also need to be taken into account.

11. Summary & Conclusions

As outlined in the report four concept options for a boat launching facility have been prepared.

The ocean wave conditions at Guilderton, Seabird, and Ledge Point would be unsafe for launching and retrieving boats during most seabreeze events. Consequently any ramp development at these locations would need breakwaters to provide safe conditions. The navigable entrance between the breakwaters would need to be in water with a seabed level of around -4 mCD to -5mCD in order to avoid breaking waves and to enable practical management of the sediment movements along the adjacent shorelines.

The following table provides a summary of the estimated costs for the four locations investigated.

Table 11.1 Summary of Options

Location	Estimated Capital Cost ($, excl GST)	Ongoing Average Annual Maintenance Costs	
		Sediment Management	Sea Wrack Management
Guilderton	$13.0M	$300,000 to $750,000 per year	~$20,000 per year
Seabird	$13.6M	~$300,000 per year	~$20,000 per year
Ledge Point	$14.3M	$150,000 to $300,000 per year	~$20,000 per year
Lancelin	$6.1M	~$20,000 per year	~$10,000 per year

Other than the capital and ongoing costs for the facility other items need to be considered including the following.

- Existing infrastructure to support the facility.
- Flow on benefits to the local community (eg increase tourism, economic benefits).
- Room for expansion. The boat launching facility may be the first stage of a larger facility with more of a regional development focus.
- Value adding benefits. For example, recreational fishing opportunities from the breakwaters, or protected swimming opportunities at the sheltered beach within the breakwaters.

Due to the high ongoing cost of managing the sediment, Guilderton is not a preferred option.

Lancelin is a favourable option because of its relatively low cost compared to the other options, but it has restricted room for expansion and access through the reefs can be dangerous during large swells. Constructing the facility adjacent to existing residential properties may also cause issues. However, Lancelin does have existing infrastructure able to support a boat launching facility.

Ledge Point and Seabird have comparable costs, however, the ongoing management costs at Ledge Point are likely to be slightly less than Seabird due to it being more sheltered by the

offshore reefs. There is a large amount of support for a boat launching facility at Ledge Point and it also has the benefit of being more centrally located on the SoG coastline than the other options.

Following discussions with the SoG it was recommended that both the Lancelin and Ledge Point options are progressed to Preliminary Design prior to a final site being chosen for the Detailed Design. A grant application to the DoT's Recreational Boating Facilities Scheme is being prepared to obtain funding for this next stage of work which will include the following items.

- Detailed investigations (surveys and geotechnical) for both options.
- Preliminary designs for both options.
- Detailed cost estimates and financial modelling.
- Marine safety review.
- Environmental impact reports (eg coastal processes).
- Detailed engineering drawings and technical specifications for the final chosen option.
- Environmental and other approvals.

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13. Appendices

Appendix A **Ledge Point Offshore Measured Wave Data**

Appendix B **Community Consultation**

Appendix C **Guilderton Concept Plan**

Appendix D **Seabird Concept Plan**

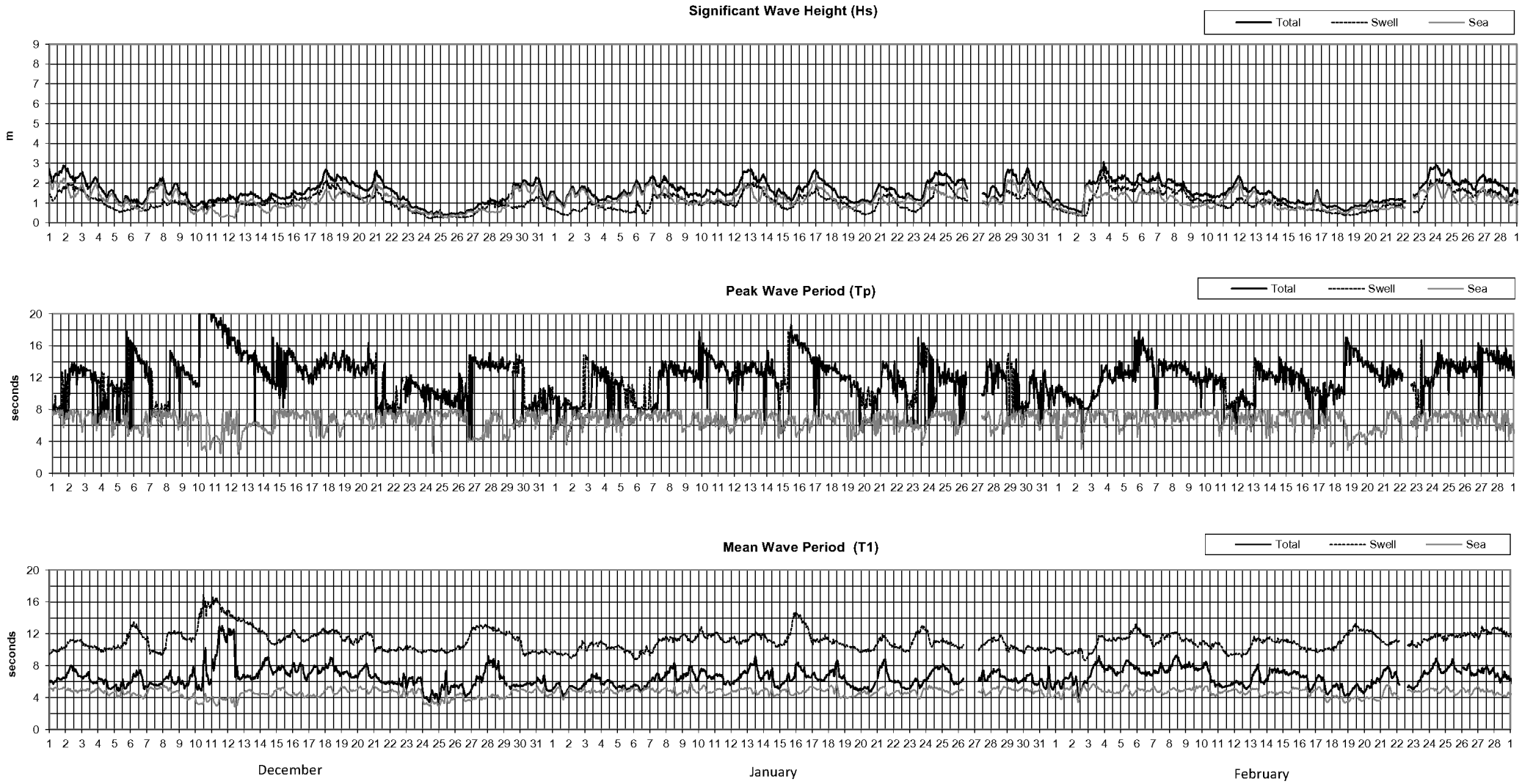
Appendix E **Ledge Point Concept Plan**

Appendix F **Lancelin Concept Plan**

Appendix A Ledge Point Offshore Measured Wave Data

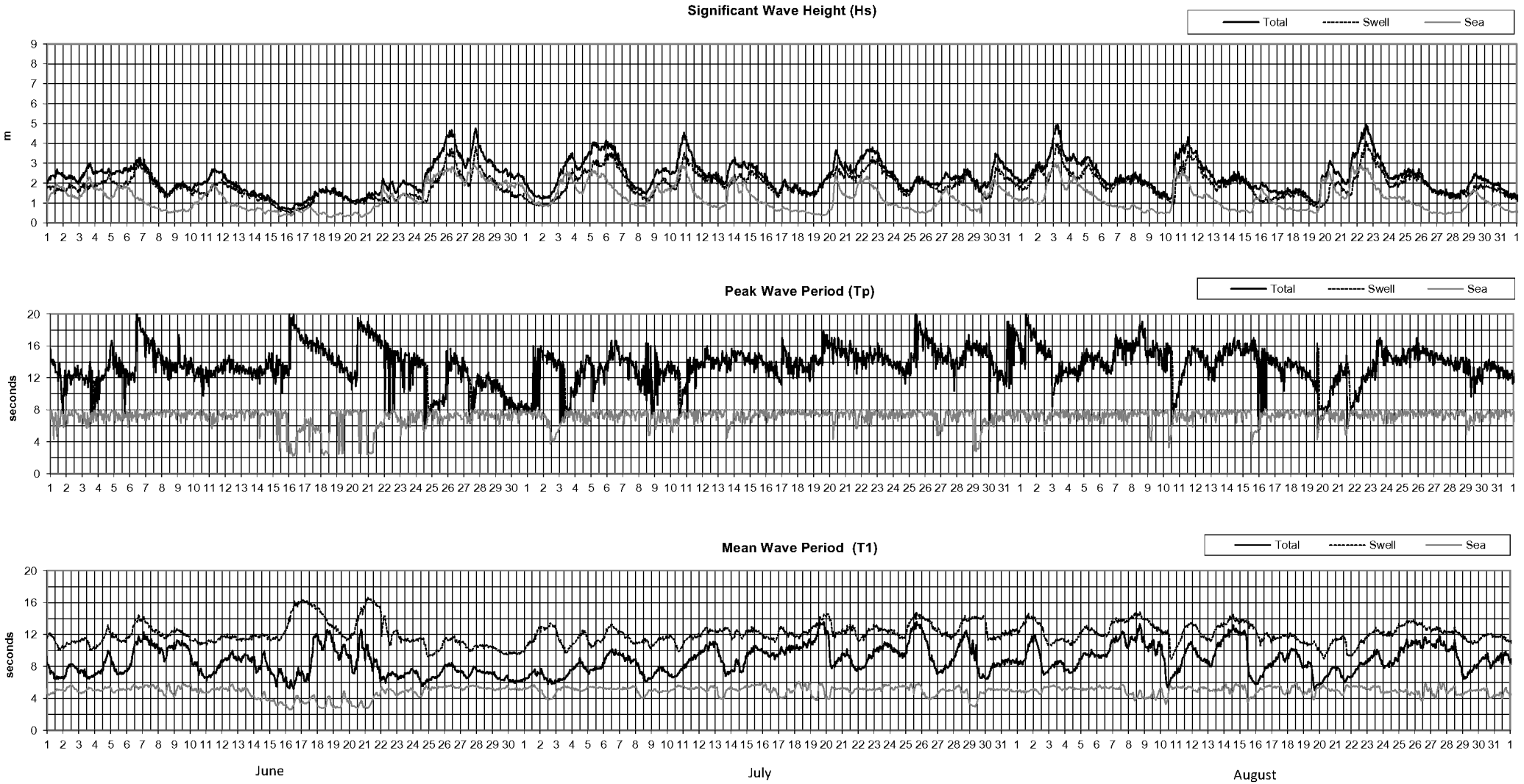
Ledge Point Time History Plot - Dec02-Feb03

DoT Measurements, 26 m water depth



Ledge Point Time History Plot - Jun03-Aug03

DoT Measurements, 26 m water depth



Appendix B Community Consultation

Shire of Gingin Community Workshop – Planning Study – Launching Facility

October 2014

Prepared by Learning Horizons

About this Report

This report was prepared by Learning Horizons and contains information collected from three (3) of workshops held with residents from the Gingin Shire. The residents whom attended the workshops did so voluntarily.

The workshops were held on 11th October 2014 at the following locations:

Location of workshop	No. of attendees
Guilderton	18
Ledge Point	70
Seabird	60

Note: these are approximate numbers only

Purpose of the workshops

The aim of the workshops was to:

1. Provide information to the community in the form of a technical presentation delivered by Peter Doust. The presentation contained information on:

    - Exposure to Waves
    - Design Requirements
    - Issues with sedimentation and seawrack
    - Navigation
    - Other technical and management issues

2. Facilitate a discussion with the community and gain their input on the four (4) locations, Seabird, Lancelin and Ledge Point and Guilderton.

    The following questions were asked:

    - What are the risks and constraints of the location?
    - What are the Benefits?
    - Is this the preferred location?

Workshop format

1. Welcome by Shire President Cr Michael Aspinall.

2. Introduction and explanation to the attendees that the Shire of Gingin would like their input into their preferred location for a boat launching facility.

3. Technical presentation by Peter Doust covering the following information:

    - Exposure to Waves
    - Design Requirements
    - Issues with sedimentation and seawrack
    - Navigation
    - Other technical and management issues

4. Question time

5. Facilitated discussion with the community to gain their input on the four (4) locations, Seabird, Lancelin and Ledge Point and Guilderton.

    The following questions were asked:

    - What are the risks and constraints of the location?
    - What are the Benefits?
    - Is this the preferred location?

6. Final questions and close

Preferred Location

The feedback from the community workshops have been summarised below

Community Input	Location			
	Lancelin	**Guilderton**	**Ledge Point**	**Seabird**
Guilderton	Yes = 50% No = 50%	Yes = 25% No = 75%	Yes = 0% No = 100%	Yes = 50% No = 50%
Seabird	Yes = 12.5% No = 87.5%	Yes = 0% No = 100%	Yes = 0% No = 100%	Yes = 87.5% No = 12.5%
Ledge Point	Yes = 25% No = 75%	Yes = 0% No = 100%	Yes = 75% No = 25%	Yes = 0% No = 100%

Note: % is calculated by yes/no answers divided by the number of feedback groups in each workshop. For example Guilderton workshop location 1, 4 feedback groups, 1 x yes = (1 / 4) x 100 = 25%answered yes this was their preferred location.

Based on the above analysis, the preferred location in order 1 to 4 are as follows:

1. **Seabird**
2. **Ledge Point**
3. **Lancelin**
4. **Guilderton**

Whilst the above quantitative feedback reflects preferred location based on percentages of those attending, the qualitative feedback (risks/constraints/benefits, refer below in 'Summary of feedback') shows that Lancelin and Ledge Point had considerable less risks and costs and greater benefits associated with the proposed launching facility than that compared to Seabird and Guilderton.

It is recommended that both the quantitative and qualitative feedback be considered and that appropriate weighting should be applied where necessary, and communicated to all participants.

Summary of feedback

The feedback from the community workshops have been summarised below:

1. Guilderton Workshop

Location 1: Guilderton

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Infrastructure • Already has a river boat ramp doesn't need another one • Doesn't need any more visitors already at capacity • St johns ambulance is already stretched with the amount of visitors • Environmental - Largest waves of all, most sand movement north and south • Not central between Two Rocks and Jurien • Parking space • South of the river location is not accessible • Groyne are preferred but would need a breakwater arrangement to meet 0.2m requirement • Option to force the river to be permanently open would be ideal but probably cost prohibitive
What are the benefits?
• Closest rural boat ramp to Perth • Reduced risk of injury using the existing arrangement at the groyne (several boats overturned trying to launch/return) • Good access for traffic – no adverse impact on local traffic • Safe boat launching facility into the sea would help reduce congestion on the river • Number of users would benefit – day trippers, holiday makers, residents in the locality.
Is this the preferred location?
• Yes x 1 • No x 3 • No due to wave heights and dynamics, Any facility at Ledge Point or Lancelin is less convenient to Guilderton than Two Rocks is , Sea bird is the most relevant site

Location 2: Seabird

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Open to the sea but could be re-engineered • Can be done in conjunction with coastal erosion mitigation works • Needs a breakwater to achieve 0.2M spec • Would require a roadway along the beach from Guilderton (to serve all visitors etc) • Gradients would create a problem re access and get infrastructure to the area it would need to be well out of town • 2nd most exposed • Limited parking area • Environmental - Sand movement, seaweed, erosion, protection from wave power
What are the benefits?
• Available for access to the largest pop. node in the Shire. • Plenty of available land for infrastructure, car parking etc. • Accessible to more of the population and to all local townships • Convenient to Guilderton and surrounding estates • Accessible • Good for local economy • Additional wave infrastructure would help towards the erosion in Seabird. This would give Seabird the potential to expand into tourism which is doesn't have at the moment • Water is deeper in seabird for a boat ramp • Safety access road for fire as well
Is this the preferred location?
• Yes x 2 • No x 2

Location 3: Ledge Point

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• No area for parking • Would increase congestion • beach and town access • infrastructure would be out of town • not easily accessible to major population centre's • Environmental - narrow channel to open ocean, reef close to shore, shallow water, exposed – need breakwater • too far away for some locals
What are the benefits?
• Would assist local economy • Only good for Lancelin and Ledge Point • Sheltered • Community growth • Has the protection at the reef
Is this the preferred location?
• no x 4 • no real need, beach launch is already happening safely • No too far for visitors from Perth

Location 4: Lancelin

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• No room for Infrastructure i.e. parking • Environmental - Seawrack • Too far away , two Rocks is closer • Safety - Shallow waters , dangerous to navigate in swells over 3.5m
What are the benefits?
• Can launch off beach • Best infrastructure - has Marine rescue, cheaper/easier to build • Natural protection • Central location between two rocks – Jurien • Existing density of population plus central to Yanchep and Jurien • Future growth
Is this the preferred location?
• Yes x 2 • No x 2

2. Ledge Point Workshop

Location 1: Ledge Point
Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Environmental– seagrass, pollution, erosion, reef impact, swell • Cost and maintenance • Insufficient infrastructure • Lack of sea rescue and service facilities for marine craft • Busier = Increased safety issues and traffic with only one road into town • Increased big boats – impact on fish stocks • Impact on town - Change in demographic, increase population, anti social behavior and waste, costs to rate payers • Loss of beach access • Interface with swimmers • Undue influence should not be given to industry and commercial entities
What are the benefits?
• Increased Tourism • Benefits local businesses, new business opportunities and employment • Safer for the aged and families • Central location • Increase population • Reduce erosion and impact on beach • Lessen traffic on beach – increase safety and better access • Improved infrastructure • Increase land value and assets • Leadlights are already there • Makes area more attractive as it caters for wider community • Needs base for boating • Central location - midway point between Jurien and Two Rocks • Increase in fishing • Possible revenue recoup - non shire residents to pay for maintenance cost
Is this the preferred location?
• Yes but would prefer marina as opposed to just a boat ramp • Yes south of lead lights • What is the justification for a ramp? • No ramp at all in shire • Premature – desktop analysis of all previous studies and summarize, then look at preferred options, then do community consultation • Yes x 6 • No x 2

Location 2: Seabird

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• No infrastructure • Erosion • Only one road in • Dangerous location
What are the benefits?
• None
Is this the preferred location?
• No • Erosion • No facilities/infrastructure • Less population • Premature • Too dangerous • No x 8

Location 3: Guilderton

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Very open and exposed to big waves • Only one road in • Too close to Two Rocks • Reef navigation • Maintenance
What are the benefits?
• Deep water
Is this the preferred location?
• No too close to two rocks • Premature • No swell too big • No x 8

Location 4: Lancelin

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Environmental impacts – reef, moving sand and subsidence of beach, sea weed, already required dredging • Traffic access is poor with only one road in - Increase in all types of traffic on roads (trucks, tractors, boats, cars) • Too dangerous - Ocean is too open, big swells, shallow reef, low water movement low water depth • Need to still be able to use beach for small fishing • Clashes with wind surfers • Locals are against the boat ramp
What are the benefits?
• Sea rescue • More protected • Communications is better • Economic opportunities • Marina would be safer • New land development • New caravan park proposed • Fuel jetty • Service station • Supermarket • Holiday accommodation
Is this the preferred location?
• No – already has a good boat launch facility and jetty • No – water levels too shallow, sand dredging an issue • Yes, but 2 people also do not want a ramp in Shire at all • No too risky for boats in swell • Premature – desktop analysis of all previous studies and summarize, then look at preferred options, then do community consultation • No highly undesirable • Yes x 2 • No x 6

3. Seabird Workshop

Location 1: Seabird

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Environmental - Wave movement, exposure to elements, swells • Lack of infrastructure - Without development of this sort there will be no further expansion of seabird • Cost • Shire support • Accommodation • None • Presently difficult to get boats in - n current launch facility • Insufficient projected environmental impacts
What are the benefits?
• More cost effective • Improve/lessen coastal erosion • Increase safety to boat owners, fisherman and beach users (Deep water launch) • Increase prosperity - Benefits to local community and future generations i.e. employment and increase business • Services the Gingin area • Attract tourism - Attract people to the town and surrounding developments • Potentially us seawrack as fertilizer • Most central between two rocks and Jurien and close proximity to metro area • Preferred launching site for Gingin residents • Improves facilities and recreation opportunity • Beach fishing
Is this the preferred location?
• Yes x 7 • No x 1

Location 2: Ledge Point

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• parking • environmental damage • not central for Gingin residents • already adequate launching facility • too close to Lancelin
What are the benefits?
• None
Is this the preferred location?
• No x 8

Location 3: Guilderton

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• cost • Environmental - no outer reef for protection, coast is very exposed, close off shore reefs • sensitive river environment • lack of community support • congested already • parking inspectors • too far from other location
What are the benefits?
• None
Is this the preferred location?
• No x 8

Location 4: Lancelin

Consider suitability and support infrastructure

What are the risks and constraints of the location?
• Interface with commercial crayfishing industry • No new area that could be developed - Adequate facilities already • Parking • Environmental damage • No community support
What are the benefits?
• none
Is this the preferred location?
• Yes x 1 • No x 7

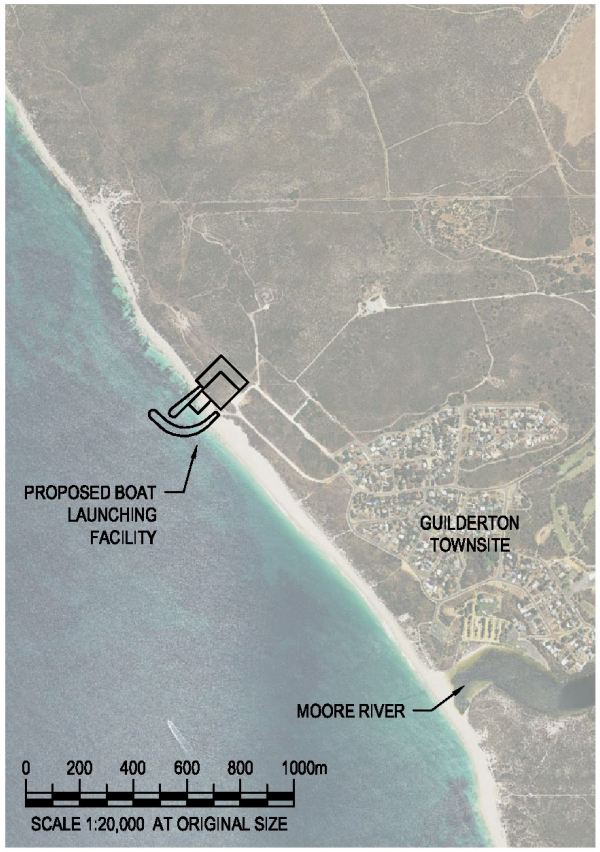
Other key findings and /or questions

The following was not captured in the above summary and has been provided for further information:

- At the Guilderton workshop, a resident raised that they were disappointed that the workshop was only about the sea/ocean and not the river. The river is just as bad or as big of a safety issue.
- What about the possibility of a joint venture with industry/commercial?
- What about smaller ramps in each location?
- Seabird residents submitted a report and presentation and would like that information to be included into the Shires decision making.

Appendix C Guilderton Concept Plan

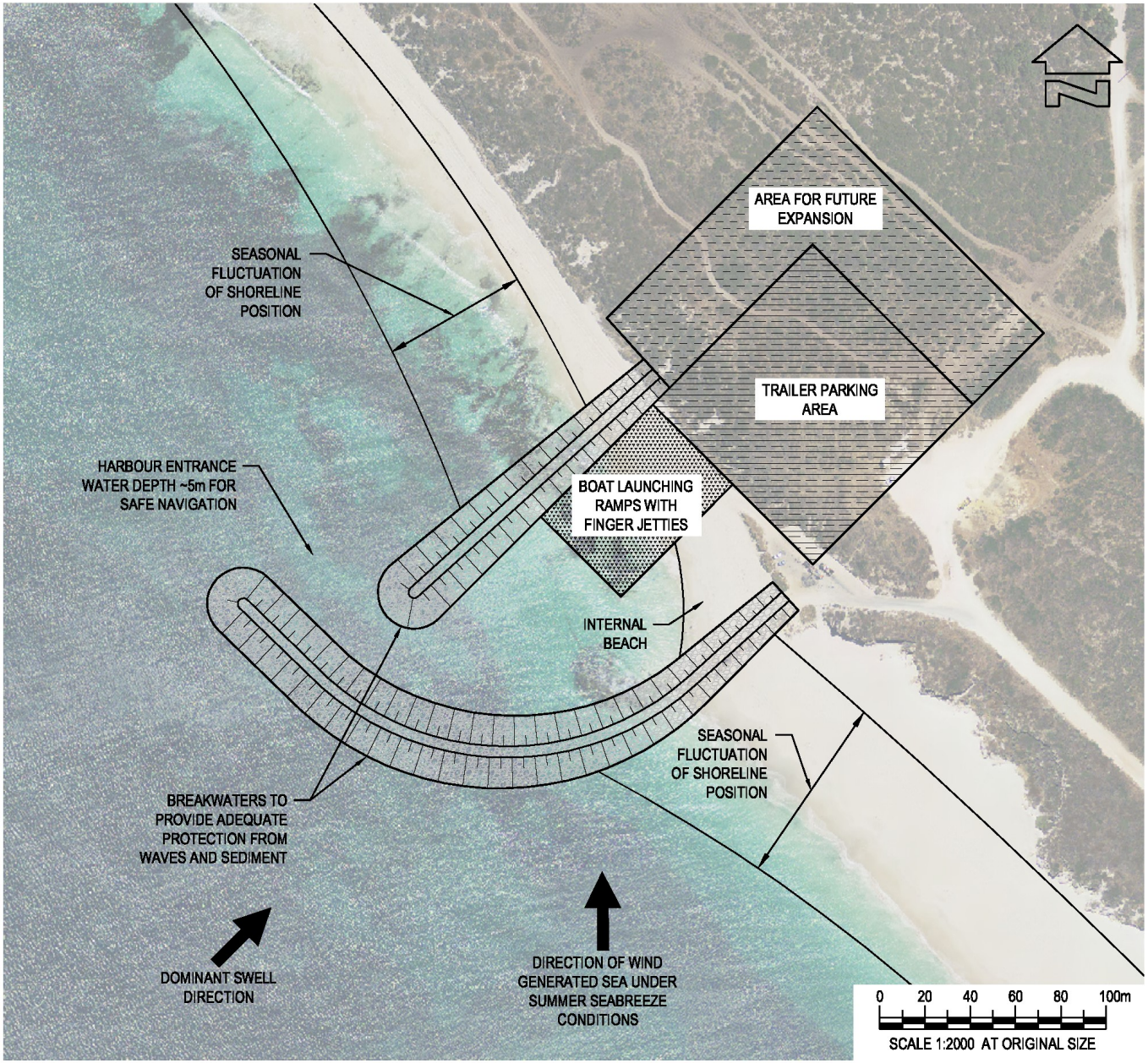
AT CORRECT SCALE THIS IS 100 mm



LOCATION
1:20,000

NOTES:

1. BREAKWATER REQUIRED TO PROVIDE ADEQUATE PROTECTION FROM WAVE CLIMATE.
2. LENGTH OF BREAKWATERS TO BE SUFFICIENT TO ACCOMODATE SEASONAL FLUCTUATIONS IN SHORELINE POSITION.
3. ENTRANCE LOCATED IN WATER DEPTH ~5m TO ALLOW SAFE NAVIGATION THROUGH ENTRANCE.
4. SEDIMENT AND SEA WRACK WILL REQUIRE MANAGEMENT.
5. NET LONGSHORE SEDIMENT TRANSPORT FROM SOUTH TO NORTH. REGULAR SAND BYPASSING WILL BE REQUIRED.



CONCEPT PLAN
1:2,000

AT CORRECT SCALE THIS IS 100 mm

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SHIRE OF GINGIN - BOAT LAUNCHING FACILITIES STUDY

GUILDERTON CONCEPT

DECEMBER 2014

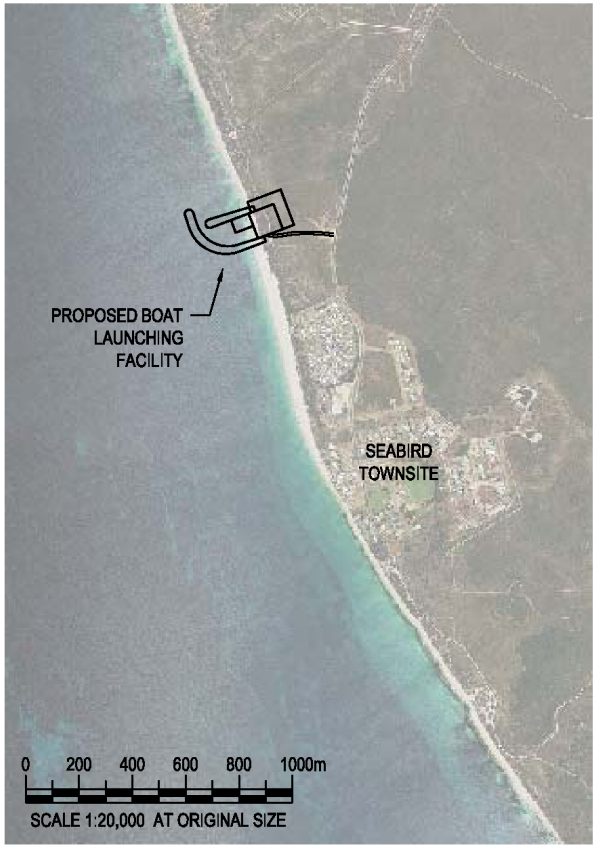
SCALE AT A3 AS SHOWN

SK1175-16/12/14-1A

P:\MRA Paying Jobs\K1175 SoGingin Boat Launching Facilities Study\MRA Drawings\D1175-Master

Appendix D Seabird Concept Plan

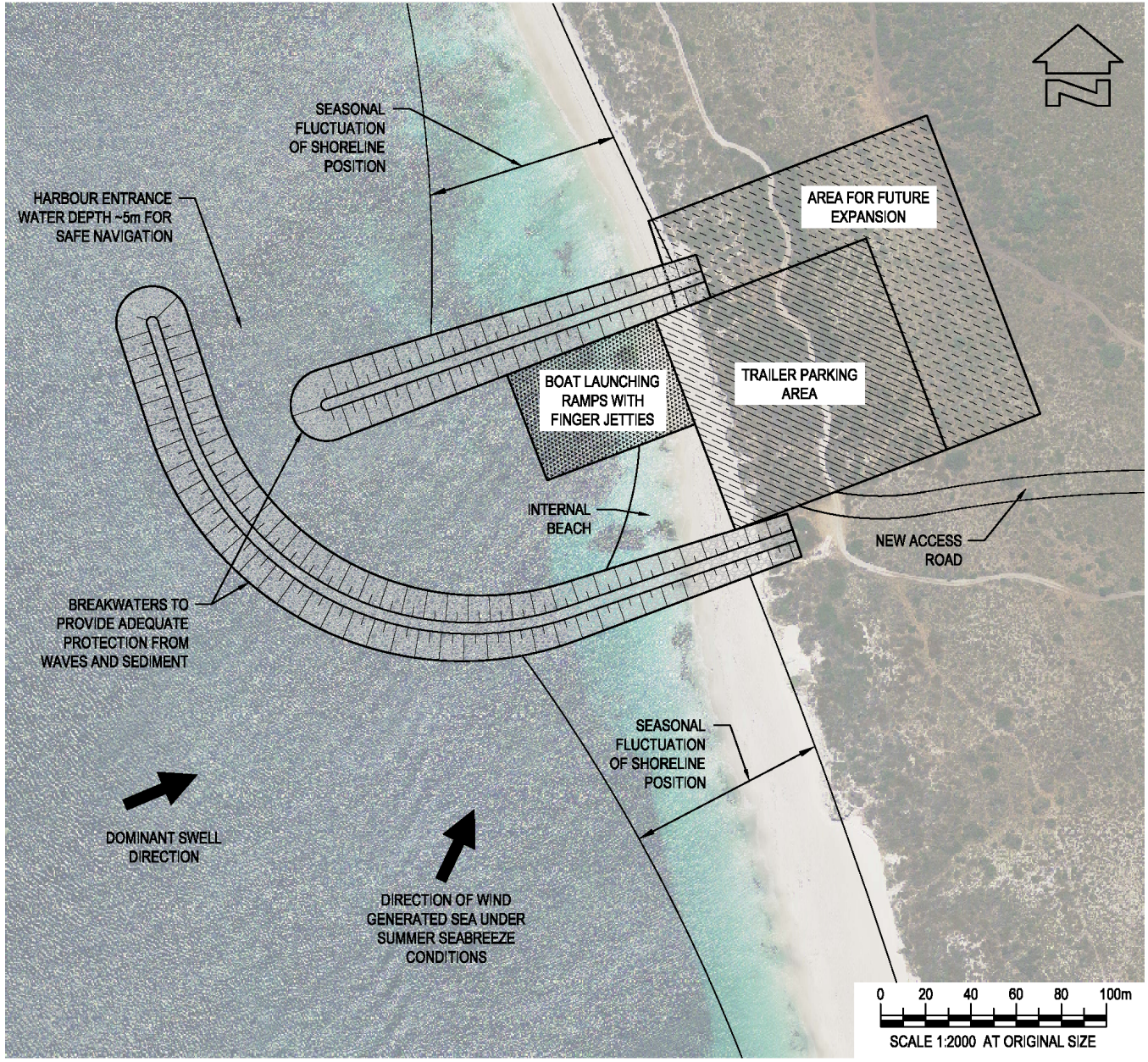
AT CORRECT SCALE THIS IS 100 mm



LOCATION
1:20,000

NOTES:

1. BREAKWATER REQUIRED TO PROVIDE ADEQUATE PROTECTION FROM WAVE CLIMATE.
2. LENGTH OF BREAKWATERS TO BE SUFFICIENT TO ACCOMODATE SEASONAL FLUCTUATIONS IN SHORELINE POSITION.
3. ENTRANCE LOCATED IN WATER DEPTH ~5m TO ALLOW SAFE NAVIGATION THROUGH ENTRANCE.
4. SEDIMENT AND SEA WRACK WILL REQUIRE MANAGEMENT.
5. NET LONGSHORE SEDIMENT TRANSPORT FROM SOUTH TO NORTH. REGULAR SAND BYPASSING WILL BE REQUIRED.



CONCEPT PLAN
1:2,000

AT CORRECT SCALE THIS IS 100 mm

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SHIRE OF GINGIN - BOAT LAUNCHING FACILITIES STUDY
SEABIRD CONCEPT

DECEMBER 2014
SCALE AT A3 AS SHOWN
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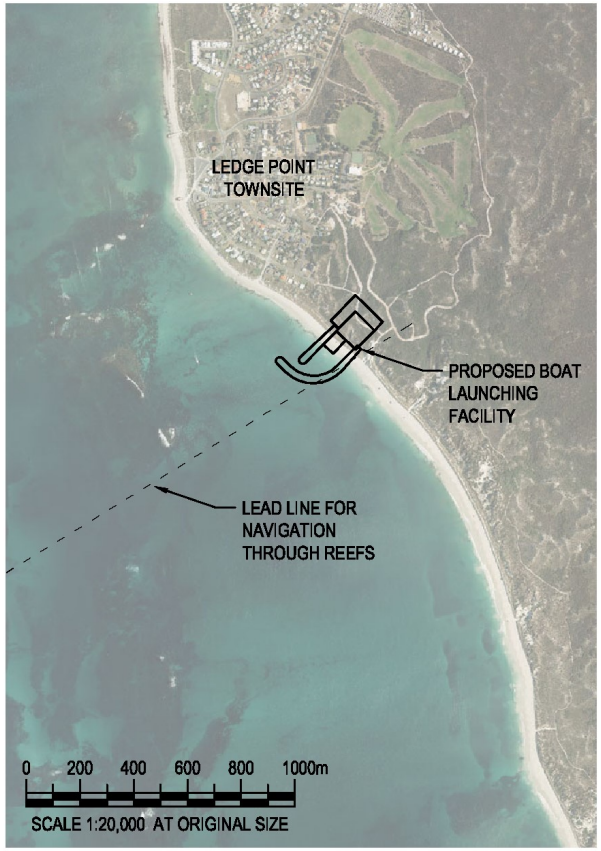
Appendix E Ledge Point Concept Plan

AT CORRECT SCALE THIS IS 100 mm



LOCATION
1:20,000

NOTES:

1. BREAKWATER REQUIRED TO PROVIDE ADEQUATE PROTECTION FROM WAVE CLIMATE.
2. LENGTH OF BREAKWATERS TO BE SUFFICIENT TO ACCOMODATE SEASONAL FLUCTUATIONS IN SHORELINE POSITION.
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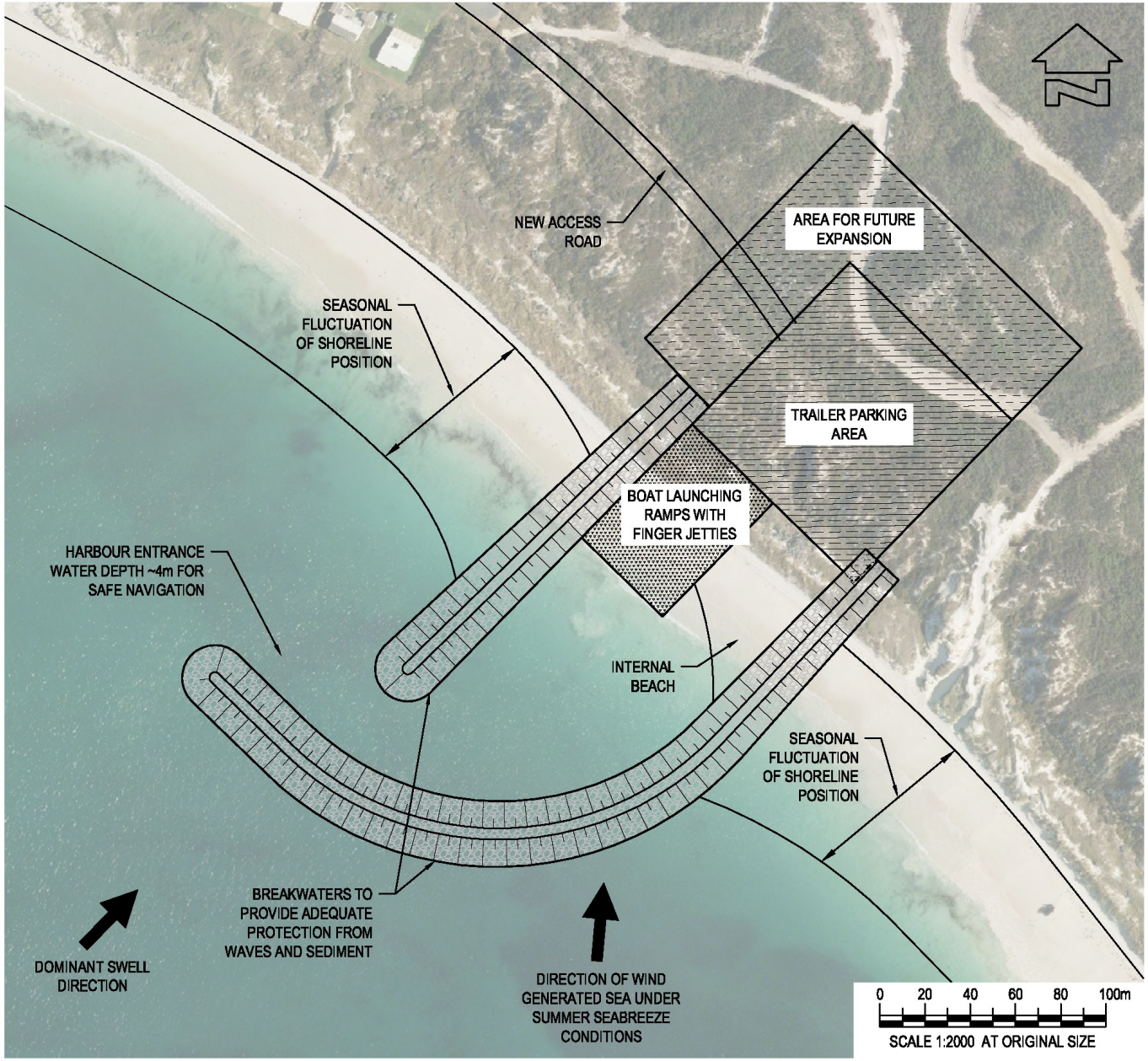

CONCEPT PLAN
1:2,000

AT CORRECT SCALE THIS IS 100 mm

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SHIRE OF GINGIN - BOAT LAUNCHING FACILITIES STUDY
LEDGE POINT CONCEPT

SCALE AT A3 AS SHOWN

DECEMBER 2014

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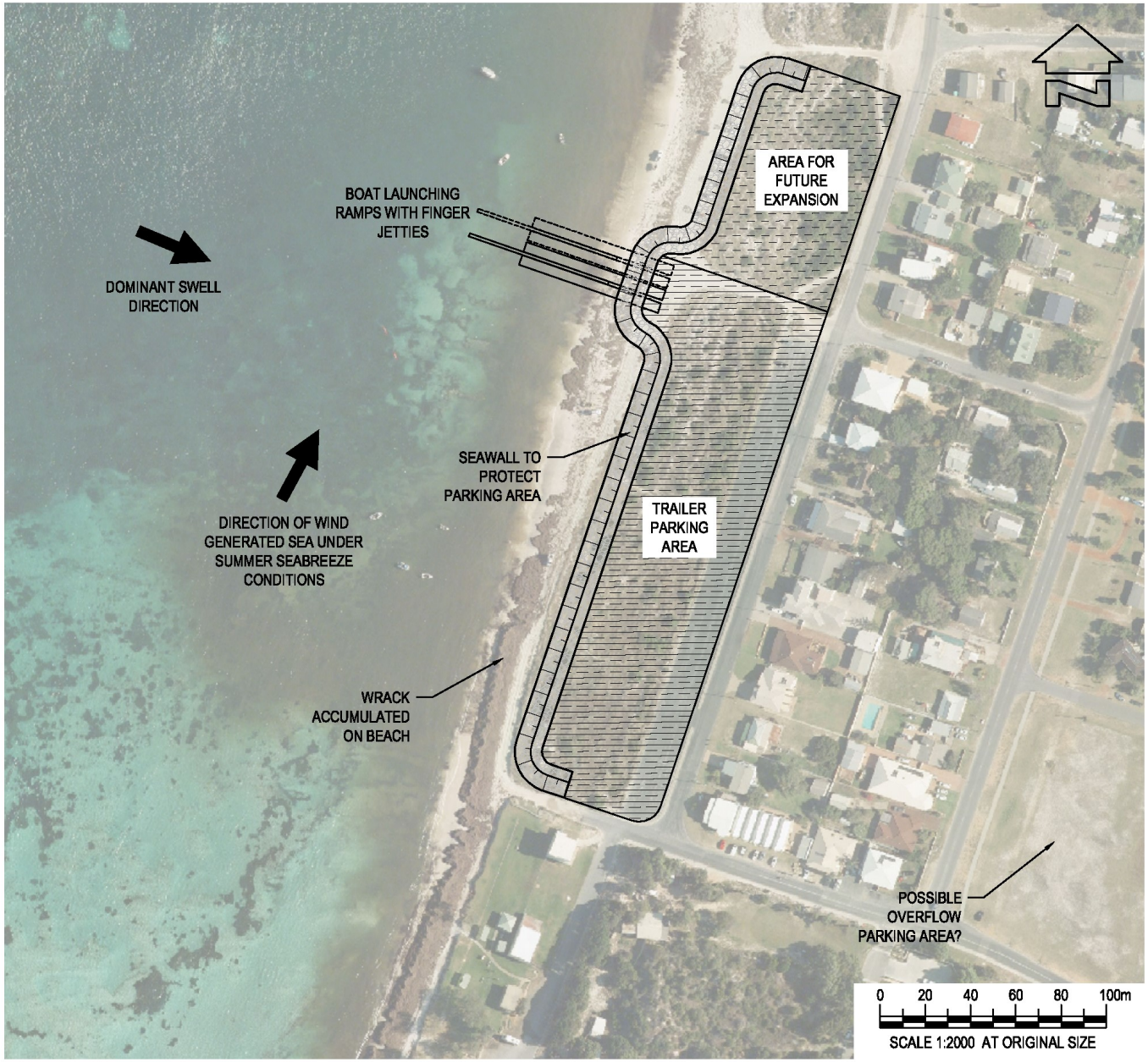
Appendix F Lancelin Concept Plan

AT CORRECT SCALE THIS IS 100 mm

LOCATION
1:20,000



CONCEPT PLAN
1:2,000

NOTES:

1. PROPOSED BOAT LAUNCHING FACILITY LOCATED AT SOUTHERN END OF BAY FOR PROTECTION FROM SWELL AND SEABREEZE.
2. ALTERNATIVE LOCATION MAY BE NEXT TO THE JETTY, BUT THERE IS MORE PROTECTION FROM THE SEABREEZE AT THE SOUTHERN END OF THE BAY.
3. SEDIMENT AND SEA WRACK WILL REQUIRE MANAGEMENT.

AT CORRECT SCALE THIS IS 100 mm

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SHIRE OF GINGIN - BOAT LAUNCHING FACILITIES STUDY
LANCELIN CONCEPT

SCALE AT A3 AS SHOWN

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