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R1546 Rev 7

December 2021

Smiths 2014 Pty Ltd

# Smiths Beach Coastal Hazard Assessment

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## Table of Contents

## Table of Figures



## Table of Tables

# 1. Introduction

## 1.1 Proposed Development

Smiths 2014 Pty Ltd (Smiths 2014) is looking to create a vibrant coastal tourist node through the development of Lot 4131 Smiths Beach Road, Yallingup and the associated foreshore. Smiths 2014 has assembled a team of planners, architects, environmental consultants, civil engineers, geotechnical specialists and coastal engineers to help plan the development.

The proposed development will consist of:

- Tourist development comprising hotel accommodation, restaurant and wellness centre;
- Campground;
- Community Hub comprising café, reception hall, surf lifesaving club. Cape to Cape Welcome Centre and general store/bakery;
- Holiday homes; and
- Universal Access Ramp to the sandy beach.

The site master plan developed by Smiths 2014 and its team is presented in the figure below.

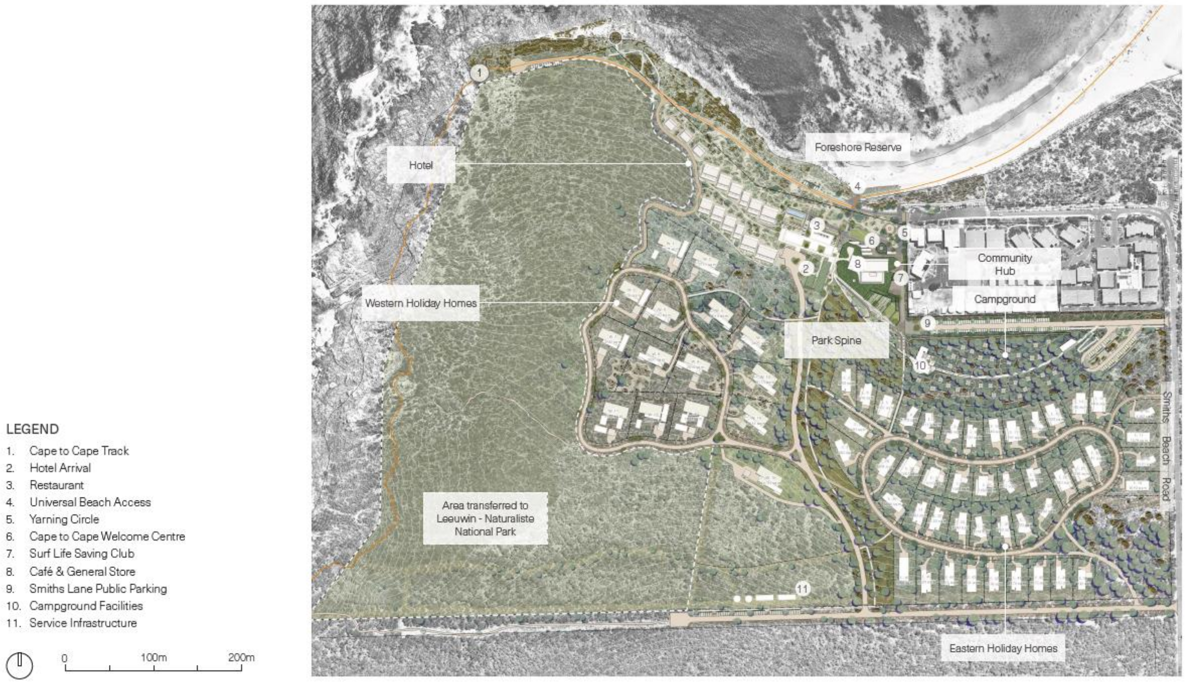



**Figure 1.1 Smiths Beach Development – Site Master Plan**

Smiths 2014 has engaged specialist coastal engineers M P Rogers & Associates Pty Ltd (MRA) to complete a coastal hazard assessment for the site and assist in the development of the Foreshore Management Plan (FMP). The coastal hazard assessment for the site is part of the requirements of the State Coastal Planning Policy (SPP2.6) and is an important component of the Coastal Hazard Risk Management and Adaptation Planning (CHRMAP).

Within Western Australia, SPP2.6 provides guidance on the assessment of the coastal hazards of erosion and inundation for developments located in close proximity to the coast. This guidance is provided in the form of a methodology to assess the potential extent of coastal hazard impacts, as well as for the development of a CHRMAP. Further details in this regard are also provided in the CHRMAP Guidelines (WAPC, 2019).

## 1.2 Site Setting

Smiths Beach is located near the town of Yallingup on the South West coast of Western Australia. The beach is very popular amongst tourists and locals. It is used for swimming, fishing, surfing, exercising and general recreation. The location of the development site Lot 4131 is shown in the figures below.

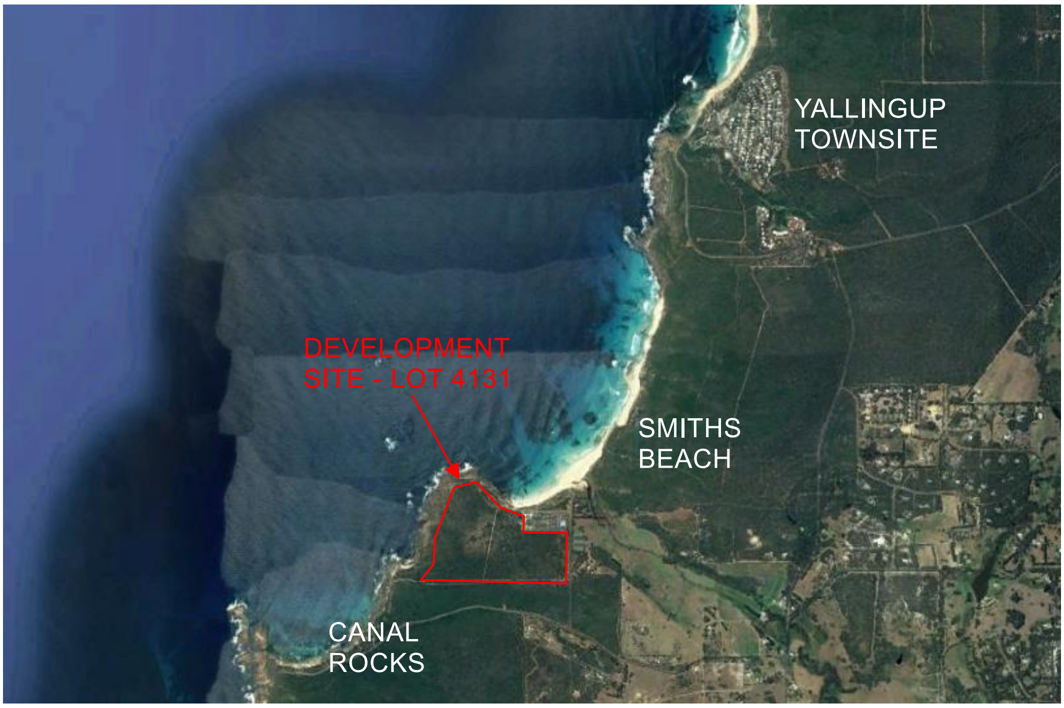



**Figure 1.2 Site Location**

Smiths Beach comprises sandy beaches to the east and a rocky coast and headland to the west. The rocky coast offers the site natural protection from erosion.

**Figure 1.3 Smiths Beach Looking East**

## 1.3 Existing Cadastral Boundaries

The existing cadastral boundaries are shown in the following figure. Much of the existing foreshore is Vacant Crown Land subject to the finalisation of a Native Title claim. Once finalised, the foreshore areas will be vested to various government agencies. Lot 4131 is freehold land owned by Smiths 2014.

As shown in Figure 1.4 most of the shoreline around Lot 4131 is a rocky coast which provides excellent protection against coastal erosion in the coming centuries. Only about 50 m of the shoreline is not fully exposed rock. This area is at the western end of Smiths Beach Road.


**Figure 1.4 Lot 4131 & Existing Cadastral Boundaries**

## 2. State Coastal Planning Policy (SPP2.6)

This coastal hazard assessment has been completed in line with the recommendations of the State Coastal Planning Policy (SPP2.6, WAPC 2013). SPP2.6 provides the methodology for completing an assessment of the potential impacts of coastal processes on development in Western Australia. For a rocky coast, the State Coastal Planning Policy requires that the allowance for current and future risk of erosion should be based on a geotechnical assessment of the rocky shoreline stability. The geotechnical assessment must include consideration of slope elevation, slope angle, durability of the material, consistency of the material, angle of bedding layers and thickness of bedding layers.

Consequently, Smiths 2014 commissioned Golder Associates to complete a comprehensive geotechnical investigation to examine the presence of durable rock beneath the dunes near the western end of the sandy beach. This will be discussed further in later sections.

# 3. City of Busselton Draft CHRMAP

As part of this assessment MRA reviewed the February 2021 draft Coastal Hazard Risk Management Adaptation Plan (CHRMAP) being prepared by the City of Busselton and the technical documents that have been used to support the CHRMAP. The technical documents reviewed include the Cape Naturaliste Settlements Coastal Vulnerability Assessment (Damara, 2017) and the Coastal Adaptation Strategy (Advisian, 2020).

## 3.1 Coastal Erosion Hazards

The technical work completed to inform the CHRMAP needed to cover the entire coastline managed by the City and consequently it was impractical to conduct site specific geotechnical investigations to explore the possibility of underlying rock beneath the dunes. As a result, the coastal hazard recommendations have been presented on the assumption that no underlying rock is present beneath the dunes at Smiths Beach.

The February draft CHRMAP recommended more detailed work on rock investigations and coastal modelling be completed for the Smiths Beach management unit. This more detailed work has been completed and is presented in this report.

As mentioned previously, Golder Associates completed a comprehensive geotechnical investigation around the Smiths Beach site and the drilling confirmed the presence of high strength rock in many places. The presence of this rock greatly reduces the risk of coastal erosion and therefore the erosion risks stated in the City's February 2021 draft CHRMAP need to be re-assessed with consideration of this important information.

## 3.2 Coastal Hazard Management Options

SPP2.6 states that coastal hazard adaption measures should be sought from the following coastal hazard risk management and adaption planning hierarchy on a sequential and preferential basis.

- Avoid
- Planned or Managed Retreat
- Accommodation
- Protection

The City completed a Multi-Criteria Analysis (MCA) for each management unit by assessing each adaption measure against an acceptability criteria, feasibility criteria and financial criteria. The outcome of the MCA concluded that a protection option is the most appropriate for Smiths Beach.

During the planning work by Smiths 2014, the need for a high quality universal access ramp to the sandy beach was identified. The location of the existing unpaved ramp at the western end of Smiths Beach Road is close to the proposed community hub and hotel. Smiths 2014 proposes to upgrade the existing beach access ramp to provide Universal Access and access for service and emergency vehicles to the beach.

This proposed upgrade means the ramp would have a 1 in 14 slope to meet universal access requirements and consequently be much longer than the existing ramp. The armouring of the upgraded ramp would also be improved to properly protect the Universal Access ramp to the sandy beach.

# 4. Horizontal Shoreline Datum

As per the SPP2.6, the Horizontal Shoreline Datum (HSD) is defined as the active limit of the shoreline under storm activity and should be determined against the physical features of the coast. The storm activity should be based on ocean forces and coastal processes, which have a one percent or one-in-one hundred probability of being exceeded in any given year over the planning timeframe.

MRA has calculated the horizontal shoreline datum for the site by simulating the one in one hundred year storm and the extent of erosion expected at the site. This work included the use of the Delft3D suite and the SBEACH computer models.

## 4.1 Delft3D Model Setup & Calibration

### 4.1.1 Swan Model

The Delft3D suite of models provides an integrated model approach that can be used to simulate wind fields, wave climates and water levels associated with various meteorological events. The Delft3D suite of models has been extensively used around the world and are recognised as high-quality models. The integrated modelling approach has been adopted for this study in order to best represent the physical processes that generate waves at the development sites. SWAN is a third-generation wave model which sits within the Delft3D suite. The model computes random, short-crested wind-generated waves in coastal regions and inland waters (Deltares, 2011).

The physical processes that lead to the generation of waves can operate on a significant spatial scale. Due to computational limitations it is not efficient to model large areas at high resolutions. Therefore, nested modelling techniques are implemented within the Delft3D model for this study.

### 4.1.2 Spatial Domain for Wave Model

Grid nesting allows sections of the overall grid to be modelled at significantly greater resolution to capture the key features and bathymetry surrounding the area of interest. The grids utilized in the model were taken from previous Swan modelling completed by MRA for nearby Canal Rocks (MRA, 2016). This enabled the wave model to be verified with wave measurements at Canal Rocks. The grid sizes and resolutions are presented in Table 4.1.

**Table 4.1 Wave Model Grid Size & Resolution**

| Grid | Area | Grid Size | Resolution |
|---|---|---|---|
| A Grid | Cape Naturaliste | 27.1 km x 69.9 km | 250 m x 250 m |
| B Grid | Yallingup Coastline | 7250 m x 6250 m | 50 m x 50 m |
| C Grid | Canal Rocks | 735 m x 755 m | 2 m x 2 m |

The model domains, and extent of the grids are presented in the figures below.

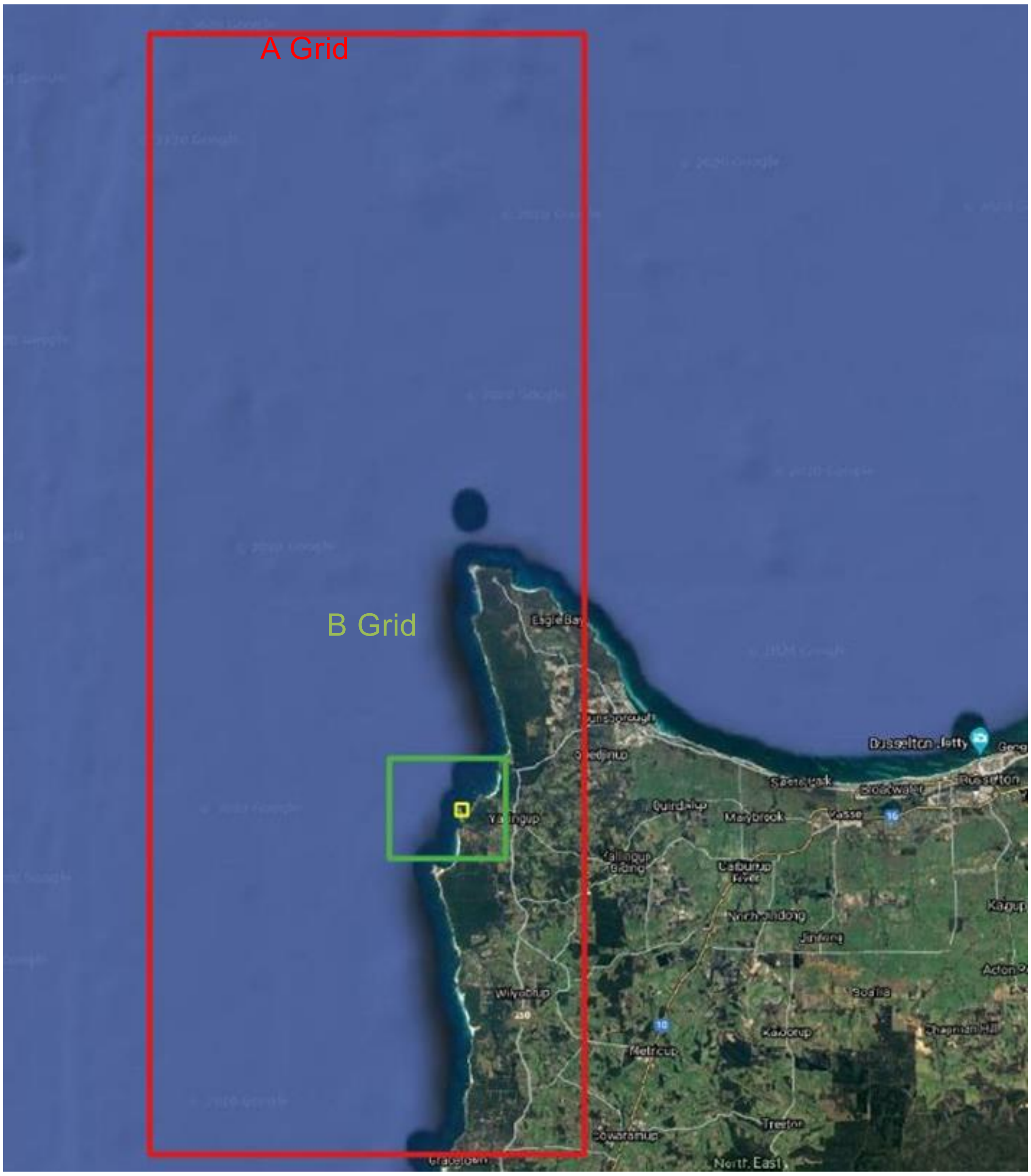



**Figure 4.1 Delft3D Wave Model Domains**


**Figure 4.2 Wave Model Domains (Grids B & C)**

The bathymetric and topographic data were sourced from local nautical charts and the Australian Bathymetry and Topography dataset obtained from Geoscience Australia (GA, 2015). The resulting model bathymetry is shown in the following figure.

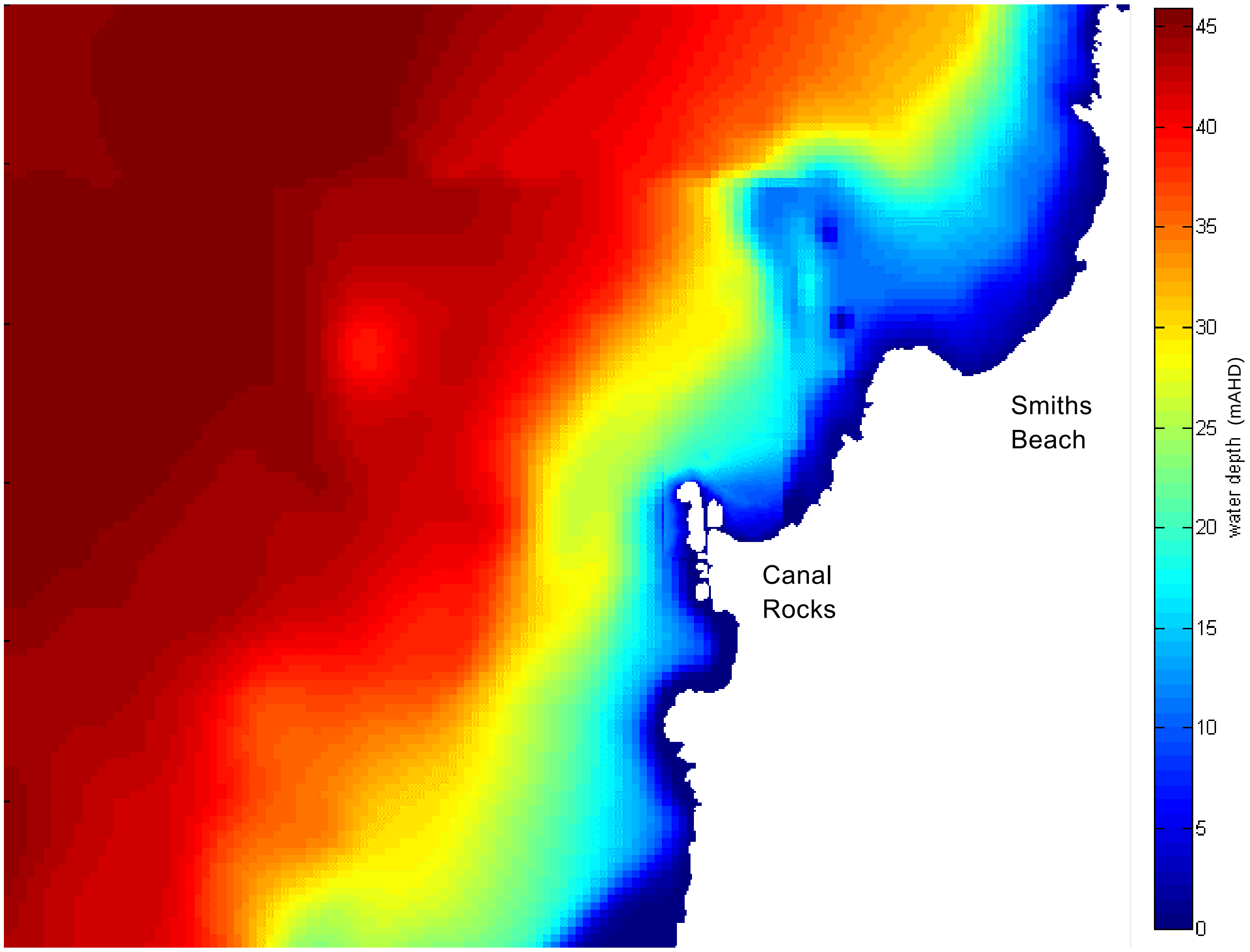



**Figure 4.3 Model Bathymetry (Grids B & C)**

### 4.1.3 Input Data

The following inputs were used in the model.

- Ocean Water Level
  The recorded water level within Port Geographe was used to set the water level of the model.

- Wind
  Wind was included in the model using wind data recorded by the Bureau of Meteorology (BoM) at Cape Naturaliste. The wind speed was corrected to the 10 m reference height which is required by the model.

- Waves
  Spectral wave data from the Cape Naturaliste Buoy was used on the outer boundaries of the model.

### 4.1.4 Validation

The model was validated with wave measurements previously taken by MRA at Canal Rocks in July 2016. This involved deploying an RBR logger for 2 hours to capture background swell conditions. The comparison between the modelled and measured significant wave heights at the location of the logger is presented in the following plot.

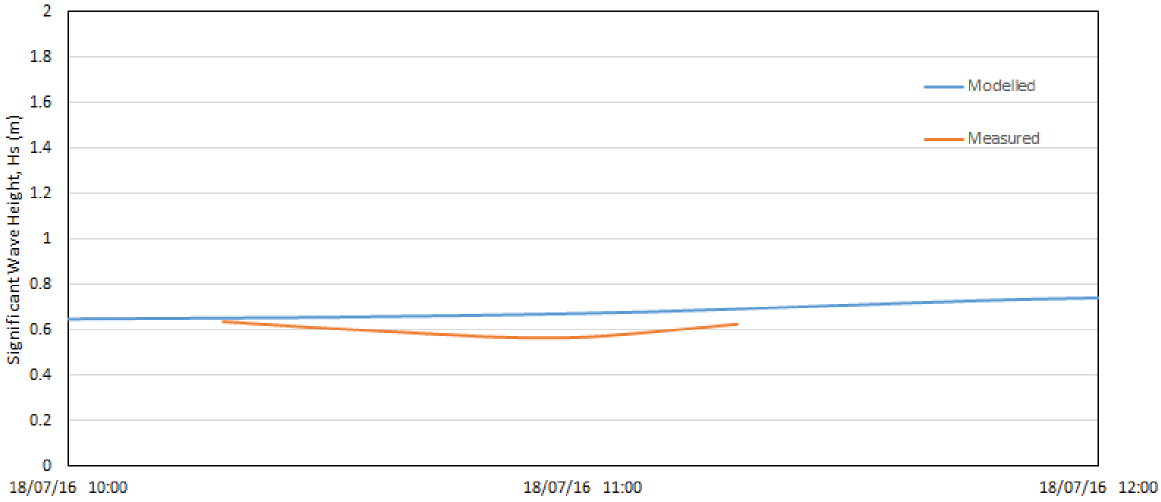



**Figure 4.4 Modelled & Measured Wave Heights at Canal Rocks**

The model compares very well to the RBR logger measurements, only slightly overestimating the wave heights.

## 4.2 Storm Event

As per the State Coastal Planning Policy, a 100 year ARI storm event for coastal erosion was modelled in the relevant grid domains. The significant wave height, peak period and water levels were taken from MRA's previous modelling completed in the South West Storm Selection Assessment for the Department of Transport (MRA, 2018), whilst the wind speed and direction were outputted from BoM's WAVEWATCH III model. These parameters were used as inputs in the calibrated Delft3D model to simulate the 100 year ARI storm event.

The wave conditions were inputted into the model on the western boundary of the A grid. The maximum input for the significant wave height during the storm event was 9 m. The figure below shows the significant wave heights experienced in the B grid during the event.

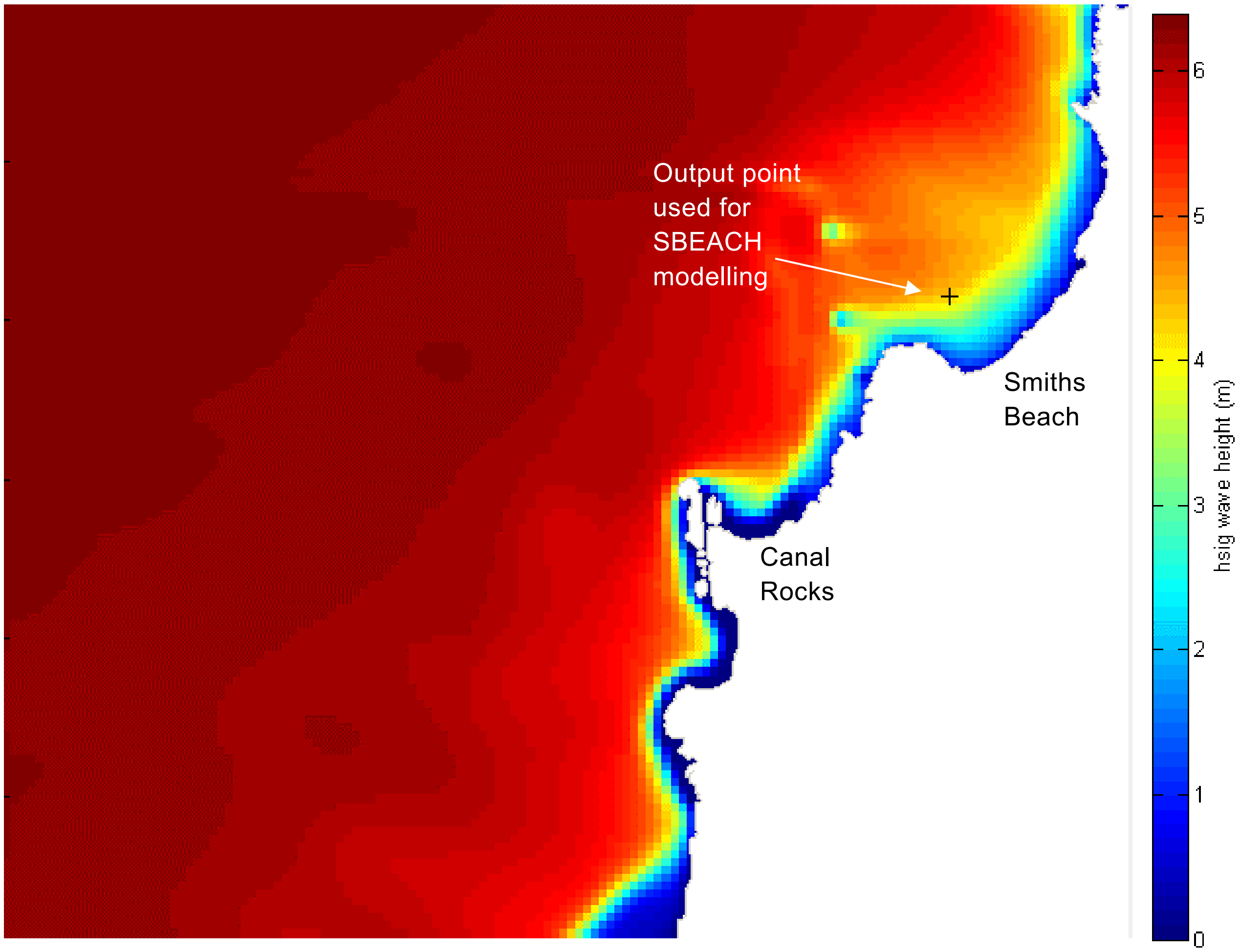



**Figure 4.5 Wave Heights During 100 Year ARI Event – Coastal Erosion**

The figure indicates that the offshore wave heights in the B grid experienced in the 100 year ARI event for coastal erosion can reach in excess of 6 m and the wave heights experienced closer to the shore can reach up to 4 m. The conditions experienced at a point nearshore have been used as inputs into the SBEACH model, which will be discussed in the next section.

## 4.3 SBEACH Model

The SBEACH computer model was developed by the Coastal Engineering Research Centre to simulate beach profile evolution in response to storm events. It is described in detail by Larson & Kraus (1989). Since this time, the model has been further developed, updated and verified based on field measurements (Wise et al, 1996).

The profile for the SBEACH analysis of the 100 year ARI event was positioned to pass through the Smiths Development site and extend out to approximately -10.7 mAHD (Figure 4.6). A hard bottom was added to the model to approximately represent the underlying rock present beneath the sandy beach.

**Figure 4.6 SBEACH Profile**

Wave heights, period and water levels were extracted from the Delft3D model at a depth of approximately -10.7 mAHD. The extracted wave heights, periods and water levels were then used as input parameters for the SBEACH Analysis. The results of the SBEACH analysis are displayed in the following figure.

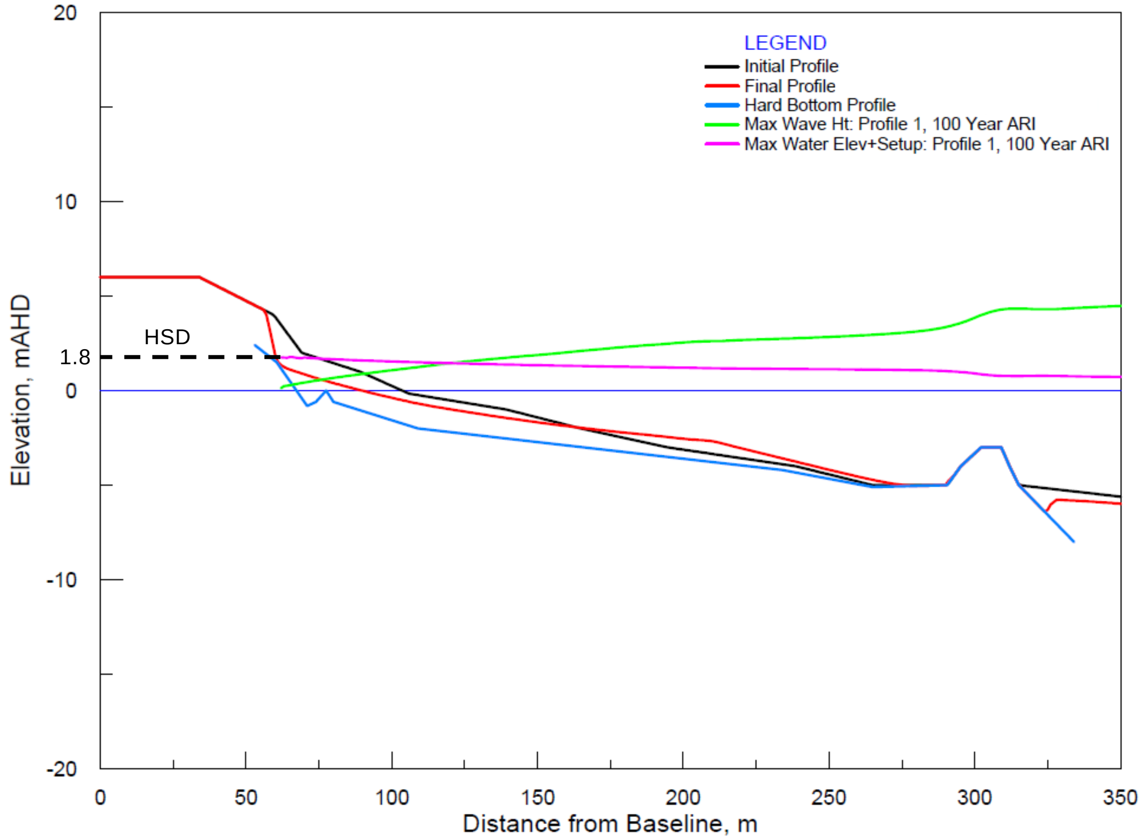



**Figure 4.7 SBEACH Results**

## 4.4 Resultant Horizontal Shoreline Datum

The HSD is taken as the highest elevation that the water level reaches at the shoreline during the design storm event. In the figure above, this is represented by the intersection of the pink and red profiles. The HSD for this section of coastline is therefore calculated as 1.8 mAHD.

The northern and western sides of Lot 4131 are rocky and more exposed to the high energy of the ocean. This rocky promontory provides significant shelter to the sandy beach adjacent to Lot 4131 that has its HSD = 1.8 mAHD.

Given this variability in wave conditions around the site, it was necessary to also calculate the HSD for the western and northern sides of the development. The methodology followed was consistent with the process discussed in this section. The table below provides a summary of the HSD values for the Smiths Beach development site.

**Table 4.2 HSD Values for Site**

| Location | HSD (mAHD) |
|---|---|
| Smiths Beach | 1.8 |
| Northern Side of Development | 2.1 |
| Western Side of Development | 2.8 |

The HSD line for the site is presented in the figure below.

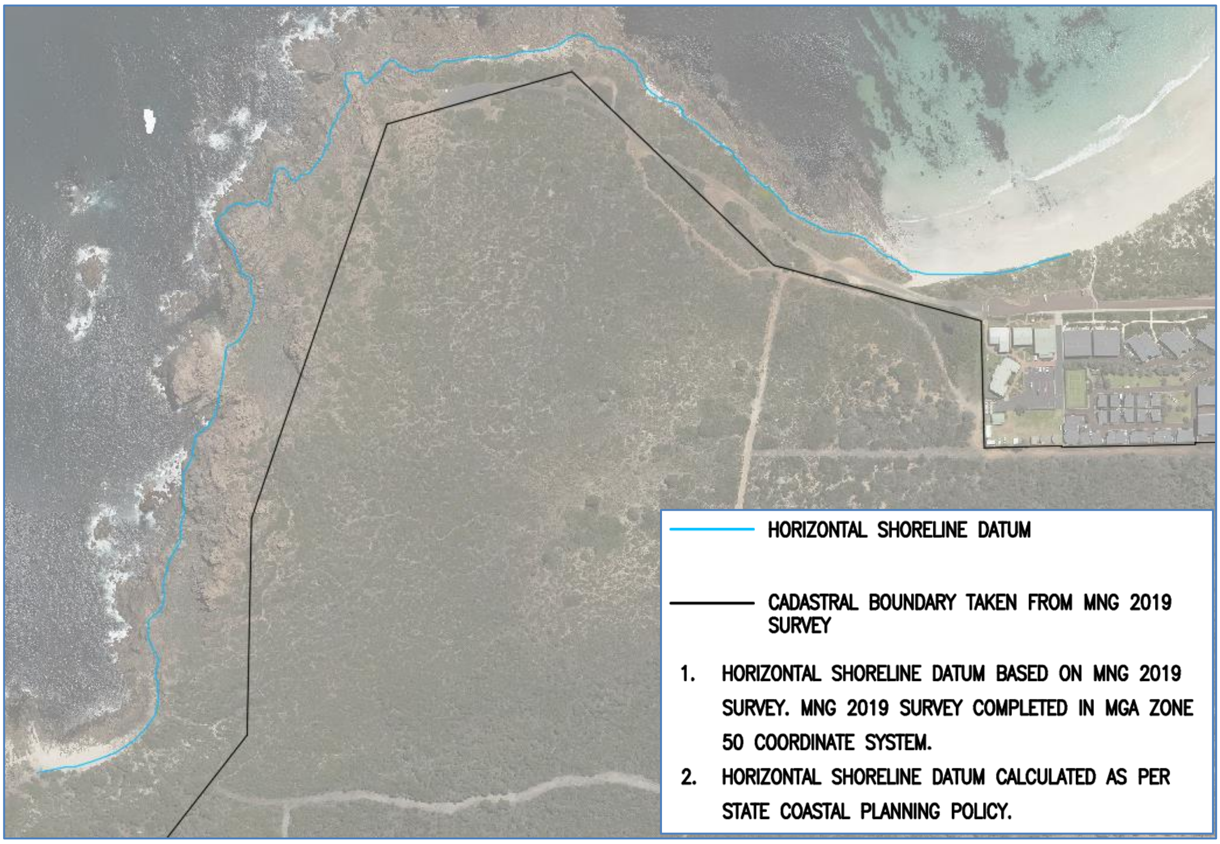



**Figure 4.8 HSD Line for the Smiths Beach Development**

# 5. Coastal Inundation Hazard

With respect to coastal inundation hazards, SPP2.6 requires that development consider the potential effects of an event with an AEP of 0.2% per year. This is equivalent to an inundation event with an ARI of 500 years. This is much more extreme than the ARI of 100 years commonly used in assessing river flooding.

Assessment of the inundation level requires consideration of peak storm surge, including wave setup. A storm surge occurs when a storm with high winds and low pressures approaches the coastline (refer Figure 5.1). The strong, onshore winds and breaking waves push water against the coastline (wind and wave setup) and the barometric pressure difference creates a region of high water level. These factors acting in concert create the storm surge. The size of the storm surge is influenced by the following factors.

- Wind strength and direction.
- Pressure gradient.
- Seafloor bathymetry.
- Coastal topography.

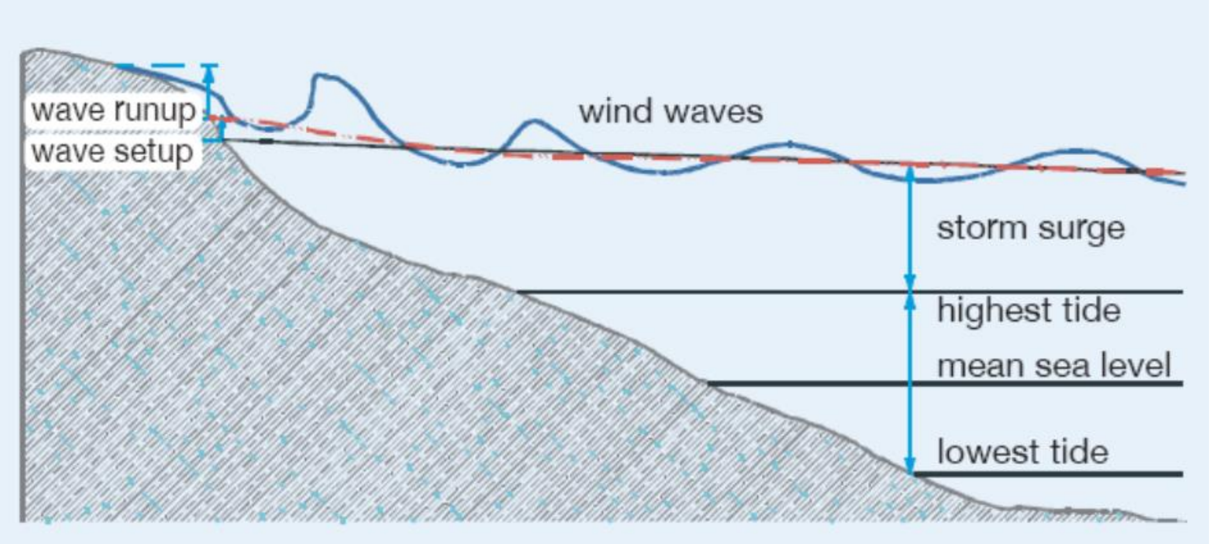



**Figure 5.1 Storm Surge Components**

MRA has previously completed an extreme analysis of the Port Geographe water level record (MRA, 2018). This analysis estimated the 500 year ARI water level at the tide gauge is approximately 1.75 mAHD.

As indicated in Figure 5.1, closer to the shore wave setup can increase the water levels. Dean and Walton (2008) provide a comprehensive review of wave setup on beaches, which confirms that the majority of setup occurs on the beach face. This is not entirely accounted for in the measurements at the Port Geographe tide gauge and therefore needs to be determined.

The SBEACH model was setup and run for the 500 year ARI water level, to translate the water level from the nearshore area to the shoreline to estimate the additional wind and wave setup. It was estimated that an additional setup in the order of 1.3 metres could be expected at the site.

This has been included in estimates of the appropriate inundation levels for the various planning timeframes, presented in Table 5.1.

### Table 5.1 Inundation Levels

| Component | Planning Timeframe | | | | |
|---|---|---|---|---|---|
| | 2021 | 2046 | 2071 | 2096 | 2121 |
| 500 year ARI peak steady water level at tide gauge (mAHD) | 1.75 | 1.75 | 1.75 | 1.75 | 1.75 |
| Allowance for nearshore setup - wind and wave (m) | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Allowance for sea level rise (m) | 0.00 | 0.14 | 0.38 | 0.67 | 0.97 |
| **Total Inundation Level (mAHD)** | **3.05** | **3.19** | **3.43** | **3.72** | **4.02** |

All of the proposed freehold development is considerably higher than the 4.02 mAHD inundation hazard. Consequently, the inundation hazard will be avoided. It should be noted that this more detailed coastal modelling provided S4 inundation levels slightly higher than in the February 2021 draft CHRMAP released by the City.

# 6. Coastal Erosion Hazard

## 6.1 Coastal Erosion Hazard Assessment

For a rocky coast, the State Coastal Planning Policy requires that the assessment of the coastal erosion hazard should be based on a geotechnical assessment of the rocky shoreline stability. The geotechnical assessment must include consideration of slope elevation, slope angle, durability of the material, consistency of the material, angle of bedding layers and thickness of bedding layers.

Consequently, Smiths 2014 commissioned Golder Associates to complete a comprehensive geotechnical investigation to examine the presence of durable rock around the site and beneath the dunes near the western end of the sandy beach.

## 6.2 Geotechnical Investigation

Golder Associates (Golder) carried out a geotechnical investigation around the proposed development site at Smiths Beach. The objectives of the investigation included the following.

- Assess surface and subsurface conditions, subsurface soil layer thickness, strength and other geotechnical characteristics.
- Assess the preliminary site for the development.
- Assess the surface level of the rock near the coast line that is considered to have sufficient durability to withstand the action of the ocean in the coming century.

The field work was completed between 10 December 2020 and 16 January 2021 and included drilling of hand auger boreholes, Perth sand penetrometer (PSP) and dynamic cone penetrometer (DCP) testing, diamond core boreholes, in situ permeability testing and the collection of samples for geotechnical laboratory testing (Golder, 2021).

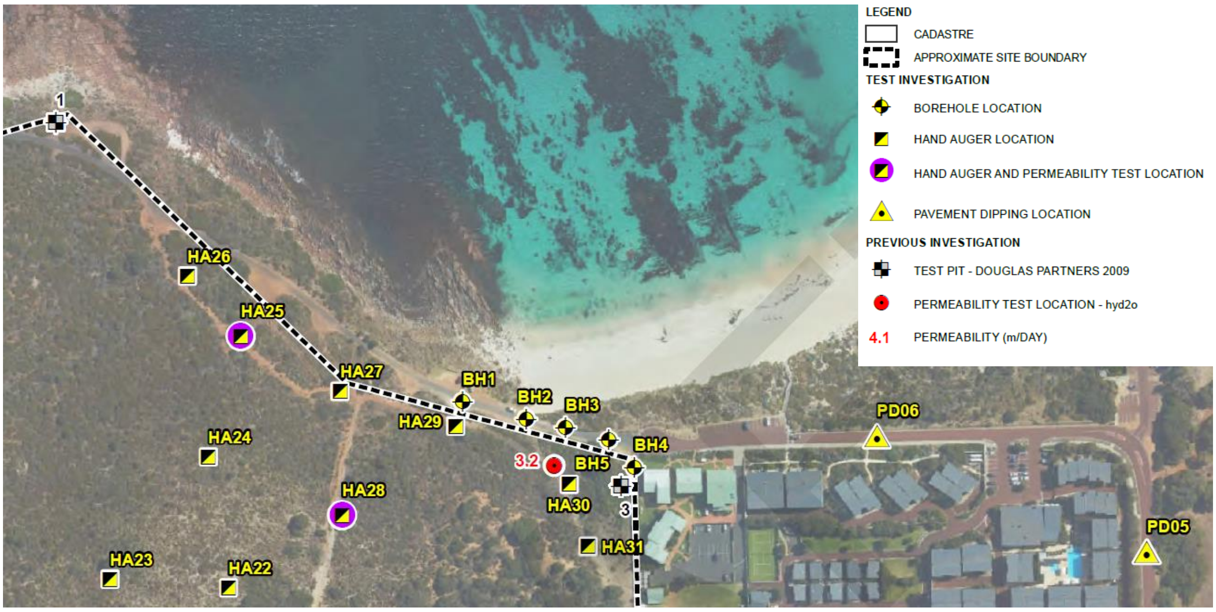
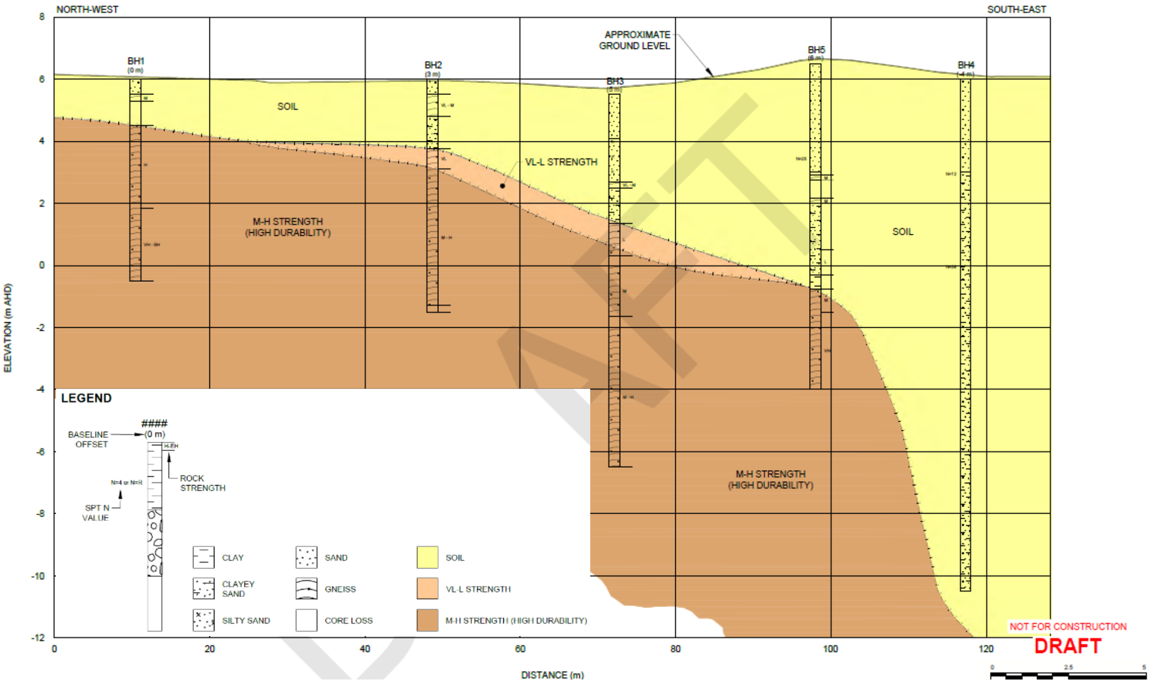



**Figure 6.1 Field Work Completed Around Smiths Beach**

MRA visited the development site in January 2021 during the drilling of boreholes (BH) 1 to 5. The objective of this drilling was to investigate whether buried rock could provide additional protection to the site. The investigation found that high strength gneiss rock sits at 4.5 mAHD at BH1 and 3.1 mAHD at BH2. Low strength gneiss sits at 1.35 mAHD at BH3, whilst medium to high strength gneiss sits at -0.75 mAHD at BH5. No rock was found during the drilling of BH4. The inferred subsurface section prepared by Golder is presented in the figure below.




## Figure 6.2 Inferred Subsurface Section

Additional drilling was completed in March 2021 on the beach near the proposed Universal Access beach Ramp. The results of this drilling will be used in the upgrade of the existing beach access ramp to a fully engineered, Universal Access Ramp to the sandy beach.

## 6.3 Coastal Erosion Hazard Assessment

The western and northern rocky coastlines of the development site have durable igneous rock fully exposed behind the HSD. A 50 m wide foreshore reserve would provide suitable protection to all development in these areas.

The proposed community hub and hotel development is near the junction of the rocky coastline and the sandy beach of Smiths Beach. The Universal Access Ramp would be built in this area and would extend from the exposed rocky shore and continue to the east of the proposed development.

The provision of the Universal Access Ramp to the beach will provide suitable protection to the proposed development. The question of whether natural rock exists below the adjacent dunes would no longer be relevant to the coastal erosion hazard. The eastern portion of the development near the sandy shoreline would be fully protected by the upgraded ramp. This outcome is in accord with the CHRMAP being prepared by the City which recommends to protect coastal assets.

MRA recommends that a foreshore reserve of 50 m from the HSD be adopted provided the Universal Access Ramp to the sandy beach is constructed.

# 7. Proposed Foreshore Reserve

## 7.1 Proposed Foreshore Responsibility

The proposed Foreshore Management Responsibility Plan prepared by Taylor Burrell Barnet is shown in Figure 7.1. It was developed by the Smiths 2014 team to define the proposed extent of the Department of Biodiversity, Conservation and Attractions (DBCA) and City's responsibility around the proposed development. The land to the west of the proposed residential area would be managed by DBCA and comprises National Parks, and a Foreshore Reserve. The foreshore fronting the development would be managed by the City and there is a small proportion of land managed under the proposed Community Scheme.

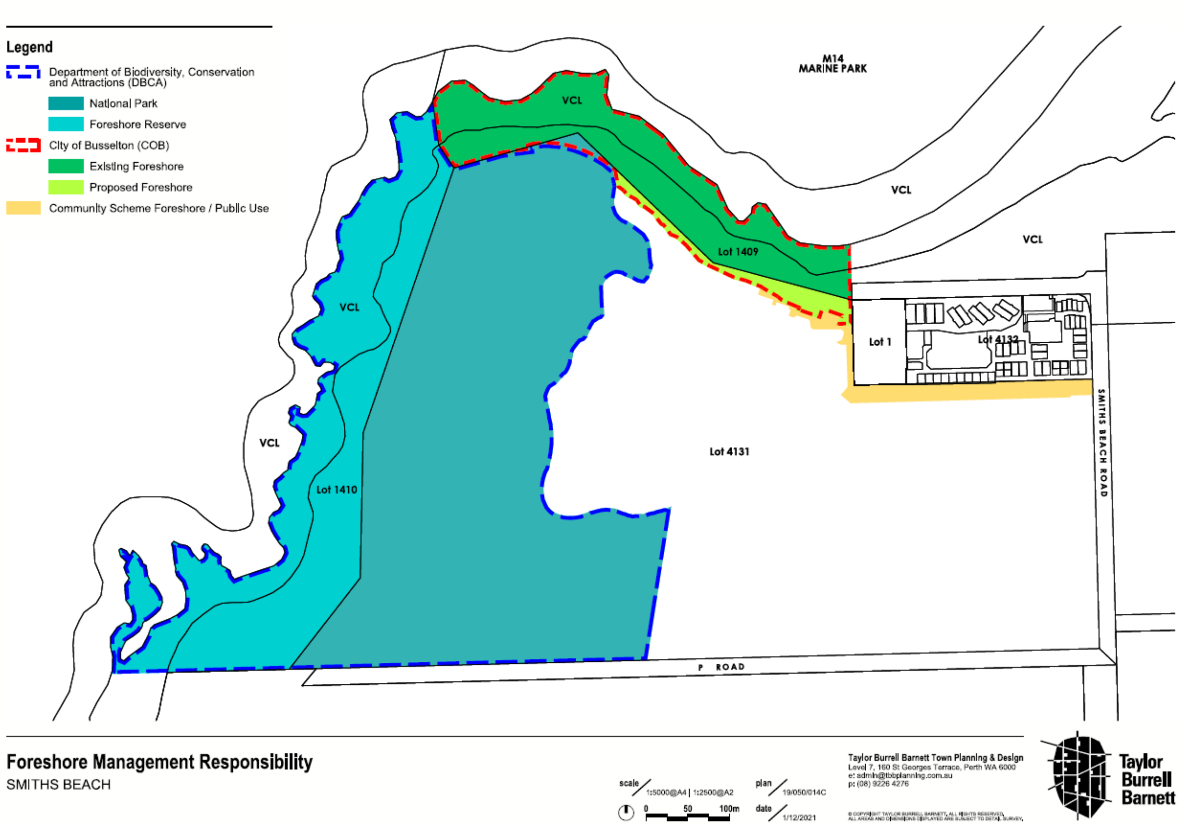


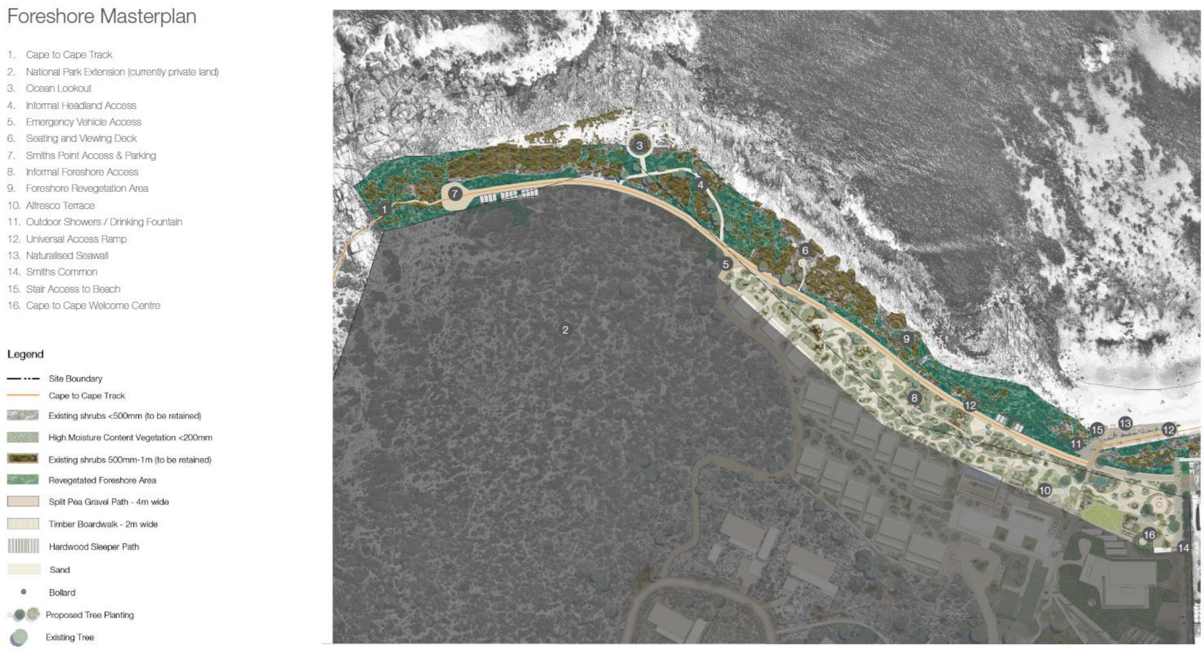

**Figure 7.1 Foreshore Management Responsibility**

## 7.2 Foreshore Management Plan

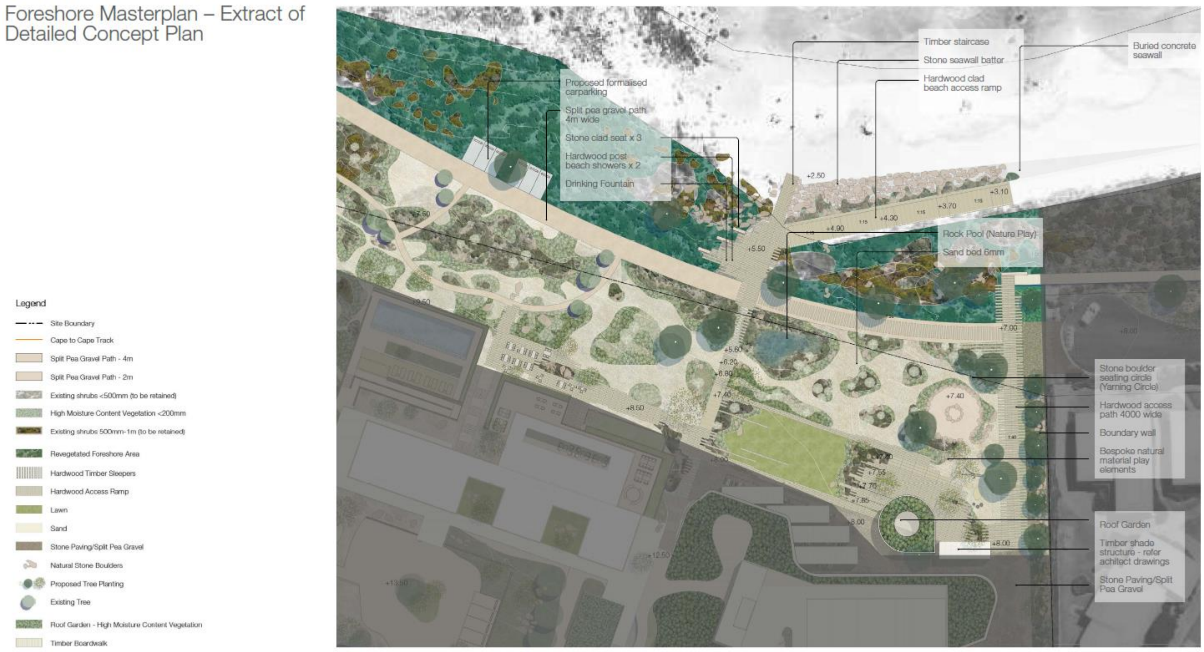
The proposed Foreshore Reserve extends 50 m to 70 m inland from the HSD. This is visually represented by the green and light green shaded areas in Figure 7.1.

The Smiths 2014 team has carefully considered the full range of uses for the foreshore area and prepared the proposed Foreshore Reserve Plan presented in Figure 7.2. Details are shown in Figures 7.3 and a foreshore illustration is presented in Figure 7.4.

The naturally rocky coastline augmented by the proposed Universal Access Ramp to the sandy beach will fully protect the adjacent development from the future coastal erosion hazard. It should be noted that within the foreshore reserve, infrastructure should generally be kept 10 m to 20 m behind the HSD to avoid impacts of overtopping now and into the future.




## Figure 7.2 Foreshore Reserve Plan




## Figure 7.3 Foreshore Detail Plan

**Figure 7.4 Foreshore Illustration**

# 8. Conclusions & Recommendations

Smiths 2014 is looking to create a vibrant coastal tourist node through the development of Lot 4131 and adjacent foreshore on the western portion of Smiths Beach.

The proposed development will consist of:

- Tourist development comprising hotel accommodation, restaurant and wellness centre;
- Campground;
- Community Hub comprising café, reception hall, surf lifesaving club. Cape to Cape Welcome Centre and general store/bakery;
- Holiday homes; and
- Universal Access Ramp to the sandy beach.

MRA was engaged by Smiths 2014 to complete a coastal hazard assessment for Smiths Beach and to assist in the production of a Foreshore Management Plan for the Smiths Beach development.

This work included the following:

- review of the City's February 2021 draft CHRMAP,
- wave modelling and calculating the HSD for the proposed development,
- review of the geotechnical investigations completed by Golder,
- complete a Coastal Hazard Assessment for the proposed development to the requirements of the State Coastal Planning Policy, and
- input into the widths of the Proposed Foreshore Reserve.

From all this work, MRA supports Smiths 2014 proposal of providing the Universal Access Ramp to the sandy beach for locals and visitors to use.

The entire proposed development will be behind natural rocky coasts and the proposed Universal Access Ramp to the sandy beach. MRA recommends defining the Proposed Foreshore Reserve so that the most landward extent sits at least 50 m inland from the HSD. Within the Foreshore Reserve infrastructure should generally be kept 10 m to 20 m behind the HSD to avoid impacts of overtopping now and into the future. This will avoid the future coastal erosion hazard.

MRA also recommends that all freehold development be located above 4.02 mAHD to avoid future coastal inundation hazard. The natural topography of the proposed development area is all above this level so the coastal inundation hazard will be avoided.

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