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Shellharbour Coastal Zone Management Plan

Date: April 2018
CERTIFIED VERSION

Shellharbour Coastal Zone Management Plan

Prepared for:	Shellharbour Council
Prepared by:	BMT WBM Pty Ltd (Member of the BMT group of companies)

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Document	R.N2271.003.02.CZMP.Final	**Client**	Shellharbour City Council
Title	Shellharbour Coastal Zone Management Plan	**Client Contact**	Cheryl Lappin, Andrew Williams
Project Manager	Verity Rollason	**Client Reference**	
Authors	Verity Rollason, Paul Donaldson	**Synopsis:** This Coastal Zone Management Plan outlines implementation details for the recommended actions for managing coastal risks in the Shellharbour LGA. The actions target those assets at immediate 'intolerable' risk from coastal hazards, with additional potential management options for assets at intolerable risk by 2100 detailed for use if and when required.	

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Contents

List of Figures

List of Tables

1 Introduction

1.1 Purpose of the Shellharbour Coastal Zone Management Plan

Shellharbour City Council (Council) is located on the south coast of New South Wales approximately 100 km south of Sydney and 10 km south of Wollongong. With the assistance of the NSW Office of Environment and Heritage (OEH), Council has prepared a Coastal Zone Management Plan (CZMP) to provide practical actions to address the risks to assets and land from coastal hazards (erosion, recession, inundation and slope instability) at present to 2100.

This CZMP covers the Shellharbour Local Government Area (LGA) coastline from Windang Island in the north to Bass Point in the south, over a distance of 7 km. The entrance to Lake Illawarra is located immediately north of Windang Island, and the coastal zone formally extends the length of the Lake foreshore. Lake Illawarra and its foreshore are covered by a separate CZMP, and therefore is not included in this Shellharbour CZMP.

Key beaches covered by this Shellharbour CZMP include Warilla Beach, Shellharbour North Beach, Shellharbour Boat Harbour, Nuns Beach, and Shellharbour South Beach. While the beaches are backed by urban development, the coastline has largely retained its natural character. For example, much of Bass Point is a nature reserve, protecting a variety of endangered ecological communities and other important habitats.

The main coastal hazards addressed by this CZMP are:

- ***Erosion*** of the beach and dunes during storms;
- ***Recession*** (or retreat) of the shoreline due to projected sea level rise, which will occur as periodic erosion that progressively reduces the beach and foredune width;
- ***Inundation*** and overtopping of coastal barriers by waves during storms, which will increase in frequency and depth with rising sea levels; and
- ***Slope Instability***, typically occurring as debris slides or rock falls, at specific locations on the coast.

Coastal hazards such as erosion and wave overtopping have threatened Shellharbour's coastline in the past, most notably at Warilla Beach. Structures such as the seawall along the southern half of Warilla Beach are evidence of the historical response to coastal risks.

The CZMP has been prepared in accordance with the *Coastal Protection Act, 1979*, its associated *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013), and other relevant NSW legislation.

While this CZMP must consider risks to 2100, the plan is focussed upon actions that can be implemented over the next 5-10 years. For risks not expected to occur until 2050 or beyond, risk mitigation options and triggers for their implementation are provided, but it is unlikely these options will need to be implemented over the 5-10 year life of this CZMP.

This CZMP is the first iteration of the coastal plan to preserve and enhance the values of the Shellharbour open coastline. It is expected that this CZMP, and the hazards and management options studies that support it, will be revised at regular intervals (5-10 years) to capture updated coastal processes data, advances in hazard assessment techniques, updated assessment of coastal

risks, new approaches to managing existing assets and new funding opportunities for implementing actions.

1.1.1 Objectives of the Shellharbour CZMP

The objectives for the Shellharbour CZMP identified by Council are below.

Hazard Management

- Recognise and accommodate natural coastal processes, hazards and climate change in the planning and management of the Shellharbour coastline;
- Manage threats from coastal hazards to existing development and to ensure that new development is not exposed to such threats;
- Act in accordance with its responsibilities under the *Local Government Act 1993*, *Coastal Protection Act 1979*, SEPP 71, NSW Coastal Policy, in good faith and with appropriate duty of care;
- Establish relevant timeframes for ongoing review of coastline management in the City to reflect improved scientific understanding of coastal processes, particularly sea level rise and storm intensity/frequency;
- Develop and communicate appropriate emergency response programs for areas likely to be affected by coastal hazards.

Planning

- Link Council's coastal zone management planning with other planning processes in the coastal zone to facilitate integrated coastal zone management;
- Provide adequate planning controls to protect new development from anticipated coastal hazards;
- Reduce risks where immediate and long term coastal hazards affect existing development.

Environment

- Protect and enhance coastline biodiversity through the conservation of high value coastal ecosystems and habitat areas (including for listed threatened/endangered species and ecological communities);
- Rehabilitate priority degraded coastal ecosystems along the coastline;
- To protect and enhance the aesthetic qualities of the coastline.

Community and Infrastructure

- Protect and preserve beach amenity, maintain and improve public access arrangements to beaches and estuary foreshores and headlands, support recreational uses and protect the cultural and heritage environment;
- Adopt a risk management approach to managing risks to public safety and assets and pressures on coastal ecosystems; including avoiding risks where feasible and mitigation where risks cannot be reasonably avoided; adopting interim actions to manage high risks while long-term options are implemented;
- Involve the community in the preparation of the CZMP, including making information relating to the plan publicly available;

- Prioritise management actions based on public benefit; including cost-effectively achieving the best practical long-term outcomes;
- Ensure the ecologically sustainable development and use of the Shellharbour coastline;
- Base decisions for managing risks to public safety and built assets, pressures on coastal ecosystems and community uses of the coastal zone in Shellharbour on the best available information and reasonable practice, including adopting an adaptive management approach;
- Develop specific management actions for Shellharbour South Beach based on the scenario that the approved proposed Shell Cove Marina development is in place.
- 'Where actions are proposed on Crown land, consideration of Aboriginal Land Claims lodged under the NSW *Aboriginal Land Rights Act 1983* will need to be undertaken. Any works will need to be compliant with the Commonwealth *Native Title Act 1993*.'

1.2 Area covered by the Shellharbour CZMP

The study area for this Shellharbour Coastal Zone Management Plan extends from Windang Island in the north to Bass Point in the south. As in Figure 1-1, from north to south the beaches and embayments include:

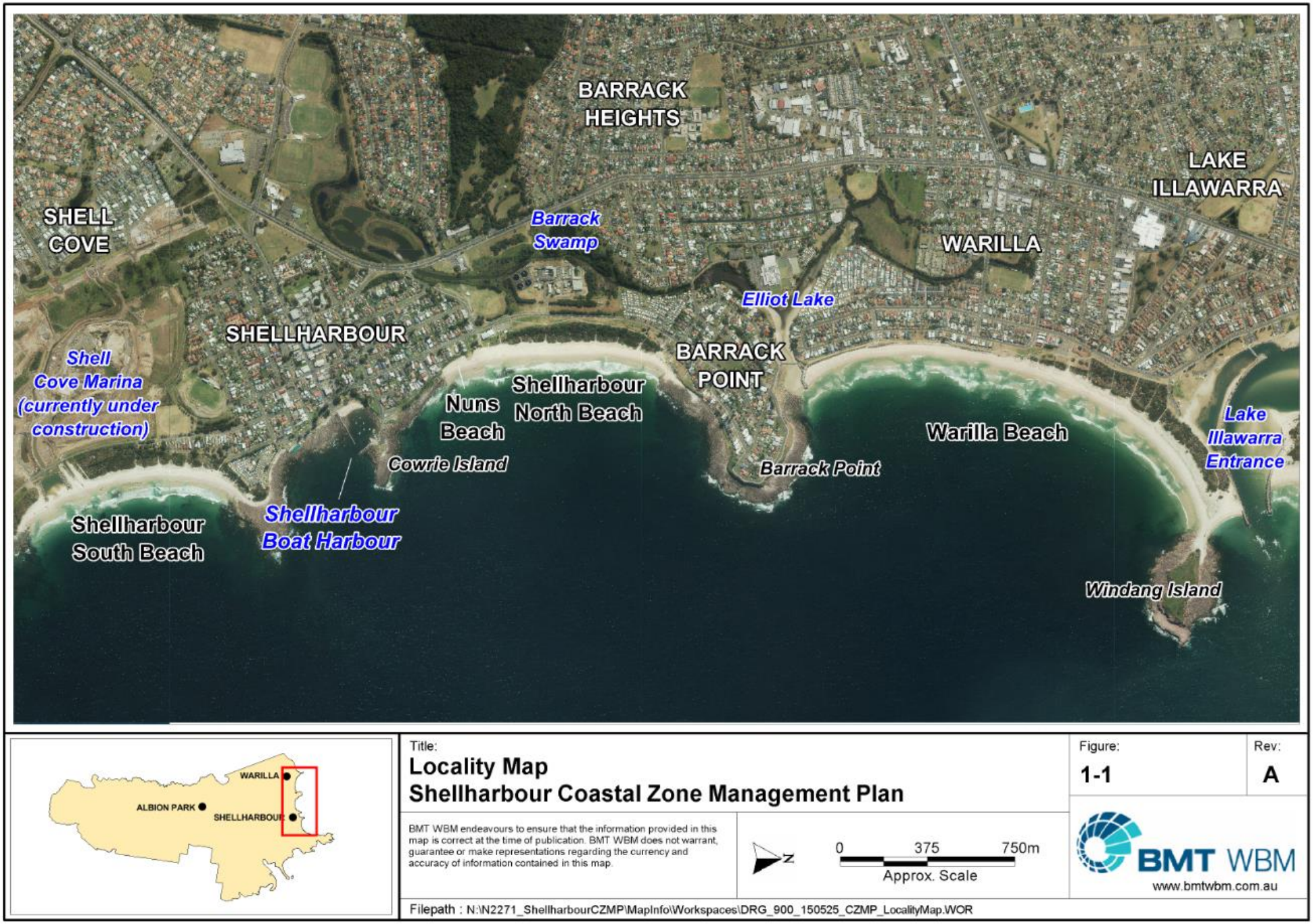
- **Warilla Beach**, extending 1.9 km from the isthmus connecting to Windang Island, to the trained entrance of Elliot Lake in the south;
- **Shellharbour North Beach**, extending 850 m from Barrack Point in the north to a small rock outcrop at the southern end, separating it from Nuns Beach;
- **Nuns Beach**, a small pocket beach of 120 m between the small rock outcrop and rock platform that extends southwards to connect with Cowrie Island, and attached headland in the south;
- **Shellharbour Boat Harbour** between Cowrie Island and the Shellharbour Tourist Park and Shellharbour Reserve headland. The heritage listed inner harbour of Shellharbour Boat Harbour is formed by two rock breakwaters, enclosing 100 m of sandy beach. The remaining 150 m of the shoreline is an exposed rock platform with a thin veneer of sand at the waterline; and
- **Shellharbour South Beach**, which extends southwards 1 km from the headland at the Shellharbour Tourist Park to merge with the landward end of the 2.5 km long Bass Point, and its rocky foreshore. Two new rock training structures for Shell Cove Marina at the southern end of the beach are expected to influence the shoreline alignments there.

The beaches are exposed to a high energy wave climate, typically of the NSW open coastline. The study area landward of the beaches comprises residential, recreational and environmental lands, including beachfront residential lots.

Coastal waterways entering the ocean via the Shellharbour beaches include trained coastal lake inlets (i.e. Lake Illawarra and Elliot (Little) Lake) and an intermittently open and closed swamp entrance (Shellharbour Swamp).

The coastal zone of Shellharbour LGA formally includes the foreshores of Lake Illawarra from the southern training wall westward to Haywards Bay; Elliot Lake estuary; and the shoreline south of Bass Point including Killalea Lagoon and beaches (The Farm and Mystics). These areas are excluded from this Shellharbour CZMP (although certain management strategies may still positively benefit the management of these shorelines), because:

- Lake Illawarra Estuary is the subject of a separate CZMP, which is currently being completed by the Lake Illawarra Estuary Management Committee (EMC). The Lake Illawarra EMC collaboratively manages the Lake and members on the committee include Shellharbour and Wollongong City Councils and a number of State government agencies. Risks arising from coastal inundation are also managed through the Lake Illawarra Floodplain Management Plan process;
- Elliot Lake already has a separate Estuary Management Plan (WBM Oceanics, 2003) that provides actions to address community use, hazards and ecological risks for the lake; and
- Killalea Lagoon and Beaches lies within the Killalea State Park which is Crown land managed by the NSW Crown Holiday Parks Trust.


BARRACK HEIGHTS
LAKE ILLAWARRA
SHELL COVE
Barrack Swamp
WARILLA
Elliot Lake
SHELLHARBOUR
BARRACK POINT
Shell Cove Marina (currently under construction)
Shellharbour North Beach
Nuns Beach
Warilla Beach
Lake Illawarra Entrance
Cowrie Island
Barrack Point
Shellharbour South Beach
Shellharbour Boat Harbour
Windang Island
WARILLA
ALBION PARK
SHELLHARBOUR
Title:
Locality Map
Shellharbour Coastal Zone Management Plan
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.
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1.3 The Coastal Management Process in NSW

The *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013) ('the CZMP Guidelines') specify the requirements for preparing a coastal zone management plan in accordance with the *Coastal Protection Act 1979*, including requirements additional to those specified in the Act. The CZMP Guidelines outline the hazards to be investigated and the timeframes for the hazard assessments and management actions (typically being the immediate, 2050 and 2100 timeframes). The stages for preparing the Shellharbour CZMP are illustrated in Figure 1-2.

Under Section 733 of the *Local Government Act 1993*, councils are taken to have acted in 'good faith' and thus receive an exemption from liability for land affected by coastal hazards where their actions substantially accord with the principles contained in the specified manual, in this case being the CZMP Guidelines.

A summary of legislation relevant to managing the coastal zone in NSW is provided in Appendix A of the Shellharbour Coastal Zone Management Study ('the Options Study') (BMT WBM, 2015). A description of how this CZMP addresses the Principles for Coastal Management and the minimum requirements for preparing CZMPs as outlined in the CZMP Guidelines is also provided in Appendix A of the Options Study.

Subsequent steps for the CZMP include:

- Public exhibition of the draft CZMP, then update the CZMP with relevant Council, community and state agency comments;
- Submission of the final CZMP to the Minister for Environment for certification, and if certified, Council to gazette the plan; and
- Review of the CZMP on a regular basis (5-10 years).

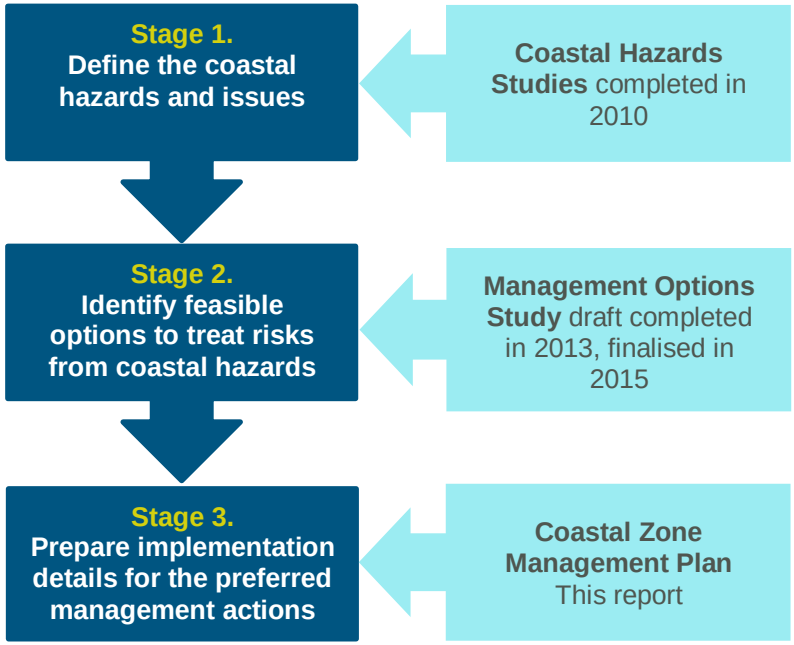


Figure 1-2 Stages of Preparation of this CZMP

1.3.1 Recent Reforms to the Coastal Management Process

1.3.1.1 Stage 1 Coastal Reforms

The NSW Government is currently undertaking reforms to the Coastal Management Framework in NSW. Stage 1 of this process commenced in 2012 including (OEH, 2016):

- The repeal of the NSW Sea Level Rise Policy Statement 2009 in September 2012;

- Update of the CZMP Guidelines in April 2013 to remove reference to the Sea Level Rise Policy Statement and associated benchmarks, with the remainder of the document unchanged;
- Amendments to the *Coastal Protection Act 1979* commenced in January 2013, most notably relating to the erection of temporary coastal protection works by public and private landholders;
- The Code of Practise under the Coastal Protection Act 1979 for temporary coastal protection works was finalised in August 2013, and included a revised listing of Authorised Locations (or "hot spots") in NSW, of which there are none in Shellharbour LGA; and
- A planning circular regarding Section 149 Planning Certificates was released for comment in November 2013.

1.3.1.2 Stage 2 Coastal Reforms

On 13 November 2015, the NSW Government commenced Stage 2 of its coastal management reforms by releasing a draft framework for coastal management for public consultation. The documents were out for public comment until 29th February 2016, and include (OEH, 2016):

- a draft Coastal Management Bill;
- an Explanation of Intended Effect for the proposed new Coastal Management State Environmental Planning Policy (SEPP); and
- key elements of a draft coastal management manual.

With the Stage 2 coastal reforms now underway, the Minister has again commenced certification of CZMPs that accord with the current guidelines.

The intention is to submit this CZMP for certification under the existing legislation. The NSW Government has indicated that existing certified CZMPs will be able to be fast-tracked into the new framework, to capitalise on existing valid work completed to date, and to retain momentum that has been gained in preparing existing CZMPs.

1.4 Previous Studies Supporting this CZMP

1.4.1 Coastal Hazards Analysis

The extent of the coastal hazards at the immediate, 2050 and 2100 timeframes was defined for the Shellharbour CZMP study area in the *Shellharbour Coastal Hazards Analysis* (SMEC, 2010). SMEC (2010) applied a standard approach to the estimation of coastal hazards as follows:

- The immediate erosion hazard was derived by considering the historical beach volume data (available from photogrammetry), and ranged from 120 m^3/m to 230 m^3/m at different beaches;
- Analysis of historical shoreline movement concluded that all beaches are currently stable, and so long term (historical) recession was not added to future recession calculations;
- Recession by 2050 and 2100 due to sea level rise was calculated using the Bruun Rule. The calculation was based upon topographic and bathymetric data from the study area, and used the sea level rise projections based upon the latest science available at the time of 0.4 m by 2050 and 0.9 m by 2100 above 1990 levels (refer discussion in Section 1.4.1.1);

- Wave run up was calculated using numerical wave modelling, with inputs including wave data from Port Kembla, sea level rise projections based upon the latest projection available at the time, and ocean water levels prescribed for the NSW coast by OEH (see OEH, 2013); and
- Slope instability risk was assessed at three specific sites only, being two at Barrack Point (slopes parallel to Shell Cove Road and cliffs adjacent headland Parade) and another at Cowrie Island (between Town Street and Surf Road). Risk assessments for slope instability hazards were conducted in accordance with the method set out in the *Landslide Risk Assessment Procedures* in Australian Geomechanics, Volume 42, Number 1, March 2007.

1.4.1.1 A Note on Sea Level Rise

Council has a legal imperative to consider sea level rise, as it is a known and measured coastal process that will affect the likely occurrence and severity of coastal hazard impacts. Under Section 733 of the *Local Government Act 1993* (the LG Act), Council has a duty of care to inform its local constituents of known risks and receives an exemption from liability for acting in good faith with respect to known hazards (including coastal hazards). Under Section 733(4) of the LG Act, Council is considered to have acted in good faith where decisions are made substantially in accordance with the relevant manual for the hazard, in this case, the CZMP Guidelines.

The incorporation of sea level rise into the assessment of coastal hazards is a requirement of the CZMP Guidelines upon which the LG Act exemption from liability is based. Similarly, object (h) of the *Coastal Protection Act 1979* is "to encourage and promote plans and strategies for adaptation to coastal climate change impacts, including projected sea level rise".

The *NSW Sea Level Rise Policy Statement 2009* was repealed in September 2012. This means that prescribed state-wide sea level rise benchmarks no longer apply to coastal hazard assessments, such as this CZMP. The NSW Government indicated that local councils "have the flexibility to determine their own sea level rise projections to suit their local conditions" (NSW Environment and Heritage, 2012), although it is unclear if or how local councils may be equipped to do this. In lieu of prescriptive sea level rise benchmarks, the Office of Environment and Heritage (OEH) suggest that councils should adopt sea level rise values that are "widely accepted by competent scientific opinion" (OEH, 2013).

At the time of preparation of the Shellharbour Coastal Hazards Analysis (SMEC, 2010) that supports this CZMP, the sea level rise projections that were 'widely accepted by competent scientific opinion' were that given by the former Sea Level Rise Policy Statement, being 0.4 m and 0.9 m rise above 1990 mean sea level by 2050 and 2100, respectively. These projections were based upon the latest reports by the IPCC (2007) and CSIRO (2007) available at that time. The NSW Chief Scientist and Engineer (2012) assessed the former NSW Sea Level Rise Policy Statement levels and advised that the science informing the policy levels was adequate.

The global projections for sea level rise are largely unchanged between the IPCC (2007) and IPCC Synthesis Report in 2014. The CSIRO also released new regional projections for Australia in 2015, including the east coast. These projections suggest a 'likely' range for sea level rise of 0.45 to 0.88m by 2090 for the highest emission scenario, along which sea level rise is currently

tracking. The minor discrepancy between the sea level rise projections adopted in the hazard studies supporting this CZMP and the latest projections is unlikely to substantially affect the actions prescribed in this CZMP for the next 5-10 years. At the next update for this CZMP, any revisions to sea level rise projections will be incorporated into the hazard estimates at that time.

1.4.2 Coastal Zone Management Study

The *Shellharbour Coastal Zone Management Study* ('the Options Study') (BMT WBM, 2015) outlines a range of management options to treat coastal risk. The Options Study is a companion document to this CZMP, and is provided in Appendix A of this document. The CZMP Guidelines and principles require a risk-based approach to managing coastal hazards. The risk-based approach used for this Shellharbour CZMP was adapted from the Australian Standard Risk Management Principles and Guidelines (AS/NZS ISO 31000:2009), and is explained in detail in the Options Study (Appendix A). As stated in AS/NZS ISO 31000:2009, risk is defined as the combination of likelihood and consequence.

Risk = Likelihood x Consequence

During the Options Study, the likelihood of the coastal hazards was determined based upon a review of the SMEC (2010) study. The potential consequence of coastal hazards was assessed considering the natural, economic, social, and cultural heritage values of existing assets and land that may be affected. By combining the likelihood and consequence of the coastal hazards, the level of risk to specific land and assets in the coastal zone was identified.

Management options were developed to treat the areas and assets at high and extreme risk from coastal hazards, as documented in the Options Study. Management options were differentiated between existing assets and future assets (or redevelopments), as they require different approaches, funding mechanisms and community priorities for implementation.

In terms of community use and ecological health, a broad assessment of the community and ecological values associated with the Shellharbour coastal zone was conducted as part of the Options Study. This guided a broad list of actions in the CZMP to preserve ecological health and community use of the Shellharbour coastal zone.

1.4.2.1 Summary of Assets at Risk

The outcome of the risk assessment for coastal hazards conducted as part of the Options Study highlighted a number of assets at extreme or high risk from coastal hazards, at the present time or in the future. Assets at high or extreme risks from erosion are presented in Table 1-1. Only the sewer pipeline / outlet at Nuns Beach was found to have a high to extreme risk from inundation. The risk assessment was based upon assets identified within estimated coastal hazard extents only. A complete list of assets likely to be affected by coastal risks is given in the Asset Risk Registers in the Options Study.

The slope instability risk assessment was conducted at three geo-hazard locations including Barrack Point (Hazard Zone 1 and 2) and the rocky slopes located immediately south of Nuns Beach (Hazard Zone 3). A high risk zone

was mapped for all three locations. A high risk to property and life was identified at a property in Hazard Zone 3 (only) due to soil slip hazard. Loss of life risks were tolerable at all three hazard zones (see SMEC, 2010).

1.5 Aligning the CZMP with Council's Integrated Planning and Reporting Framework

The NSW Government's Stage 2 Coastal Reforms have indicated there will be a transition to incorporating coastal zone management planning within the local government Integrated Planning and Reporting (IPR) framework. This aims to mainstream coastal management into councils' overall service delivery and asset management responsibilities. It is also likely that this approach will improve the level of implementation of CZMPs.

Asset Management, Delivery and Operational actions of Council are distilled from the key objectives selected for Shellharbour by the community, as listed in the Shellharbour City Community Strategic Plan 2013 to 2023.

To co-align actions in this CZMP with the IPR framework and the community objectives underpinning it, the Implementation Schedules of this CZMP have been designed to:

- Demonstrate the alignment between the CZMP actions, the activities in the current Delivery Program 2013-2017, and the key objectives and strategies of the Community Strategic Plan;
- Provide details (responsibility, performance measures, estimated costs/resource requirements) to enable Council to easily include or implement CZMP actions within their Operational Plan;
- Flag a timeframe to implement the CZMP action in accordance with the IPR reporting period, such that:
  - Immediate Actions should be implemented during the current Operational Plan (i.e. 2015-16),
  - Short term actions should be implemented during the current Delivery Program (2013-2017) where possible; and
  - Long term actions should be implemented within the next 10 years, and can be integrated into later Delivery Programs.

Table 1-1 Assets at Extreme or High Risk from Coastal Erosion

Asset Type	Location	Extreme or High Erosion Risk		
		Present Day	2050	2100
Beaches, Dunes & Accessways	All beaches.	All beaches	All beaches	All beaches
Residential Development	9 lots - Wollongong St (Nuns Beach), 1 lot Towns St (Boat Harbour). By 2050 add 1 lot Towns St (Boat Harbour), 13 lots - Boollwaroo Pde (South Beach). By 2100 add 3 lots - Osborne Pde / Little Lake Cres (Warilla Beach), 5 lots - Wollongong St (Nuns Beach), 1 lot Towns St (Boat Harbour), 4 lots - Boollwaroo Pde (South Beach). Also, unknown risk for 52 (plus) lots - Little Lake Cres (Warilla Beach)[1], 5 (plus) lots - Junction Road (far north North Beach)[2].	10 lots (+ 57 lots unknown)	24 lots (+ 57 lots unknown)	37 lots (+ 57 lots unknown)
Surf Clubs	By 2050 Shellharbour SLSC & Seaspray Function Centre (North Beach)	*None*	1	1
Tourist Parks	Shellharbour Beachside Tourist Park (South Beach). Also unknown risk to Shellharbour Beachside Tourist Park on Boat Harbour[2].	1	1	1
Reserves and Recreational Lands	Little Park & Facilities (Boat Harbour), Bassett Park & Facilities (South Beach). By 2050 add Warilla Beach Reserve & Facilities, Bradsley Park & Facilities (southern North Beach). Unknown risk for Shellharbour Reserve (Boat Harbour)[2].	2 (2 - unknown)	4 (2 - unknown)	4 (2 - unknown)
Stormwater - Outlets and Pipes	South Beach (outlet). Unknown risk to services associated with Little Lake Cres (Warilla Beach)[1], Junction Road (far north North Beach)[2], Shellharbour Reserve (Boat Harbour)[2].	1 outlet (plus unknowns)	1 outlet (plus unknowns)	1 outlet (plus unknowns)
Sewer Infrastructure (Sydney Water)	North beach (sewer pipe/outlet), Nuns Beach (sewer mains). By 2050 add Boat Harbour (sewer mains). By 2100 add Warilla Beach (sewer line). Also, unknown risk to services associated with Little Lake Cres (Warilla Beach)[1], Junction Road (far north North Beach)[2], Shellharbour Reserve area (Boat Harbour)[2].	1 outlet, 1 main (plus unknowns)	1 outlet, 3 mains (plus unknowns)	1 outlet, 6 mains (plus unknowns)
Water Infrastructure (Sydney Water)	By 2050 Nuns Beach (water main). Also, unknown risk to services associated with Little Lake Cres (Warilla Beach)[1], Junction Road (far north North Beach)[2], Shellharbour Reserve area (Boat Harbour)[2].	*None* (plus unknowns)	1 main (plus unknowns)	1 main (plus unknowns)

Level of risk is "unknown" where:

[1] Assets are located immediately landwards of Warilla seawall that may or may not, be built to suitable engineering standard to provide protection from erosion; or

[2] Assets are located immediately landward of a section of shoreline that is potentially erodible, but that was not assessed in the hazard study.

1.6 Integration with other Government Agencies

Consultation with other NSW Government agencies has been an important component in developing this CZMP. Section 55C of the *Coastal Protection Act 1979* requires that a CZMP must not contain proposed actions or activities to be carried out by any public authority or relating to any land or other assets owned or managed by a public authority, unless the public authority has agreed to the inclusion of those proposed actions or activities in the plan. Proposed options were discussed with stakeholders during a workshop to gauge any possible issues. Formal written agreement for specific actions will be sought to support the submission of the Draft CZMP to the Minister.

1.7 Community Consultation

Community consultation is vital when developing a CZMP, and in gaining support for its implementation. A range of activities were conducted throughout the course of this project to engage with the general community, Council, the state agencies and other stakeholders. A summary of the consultation activities undertaken in preparation of the draft Shellharbour CZMP is provided in the Options Study. The draft CZMP was placed on public exhibition.

2 Implementation Schedules

This chapter outlines a practical and realistic program of activities that can be achieved within the next 5-10 years. Where possible, realistic maintenance and monitoring costs over that period are included.

The preferred actions were selected based upon their technical feasibility, affordability, environmental and social benefit, and Council and community priorities for the next 5-10 years. A map illustrating the Shellharbour CZMP is provided in Figure 2-1.

For risks not expected to eventuate for 50 years or more, a risk mitigation option(s) has been identified along with a trigger for implementing the option, but it is unlikely these options will need to be actioned over the life of the plan (5-10 years). The pathway for managing future risk is discussed in Chapter 3.

2.1 Responsibilities

Council is primarily responsible for the implementation of this CZMP. The success of implementation, however, will be highly dependent on support from the local community and government agencies. Responsibilities for each action are given in the implementation tables.

2.2 Timeframes

The design life of this CZMP is 10 years. This is the maximum period that can be planned for in the local government budgetary context. Each action within the plan has a suggested initiation date within the next 5 years. In reality, external forces may inhibit this timeline, such as available Council resources and funding grant success. Opportunities to implement actions ahead of schedule may also arise. A process for regular review of the Plan to track implementation of actions is described in Chapter 4.

The CZMP covers a 10 year period, as key influencing factors may change over this period, including:

- Understanding of coastal processes (including monitoring data such as beach survey, wave data, ocean water level data including sea level rise, etc);
- Magnitude of sea level rise projections;
- Community values and aspirations;
- Government regulations;
- Technology and approaches (e.g. hazard assessment methods; management approaches); and
- Funding opportunities.

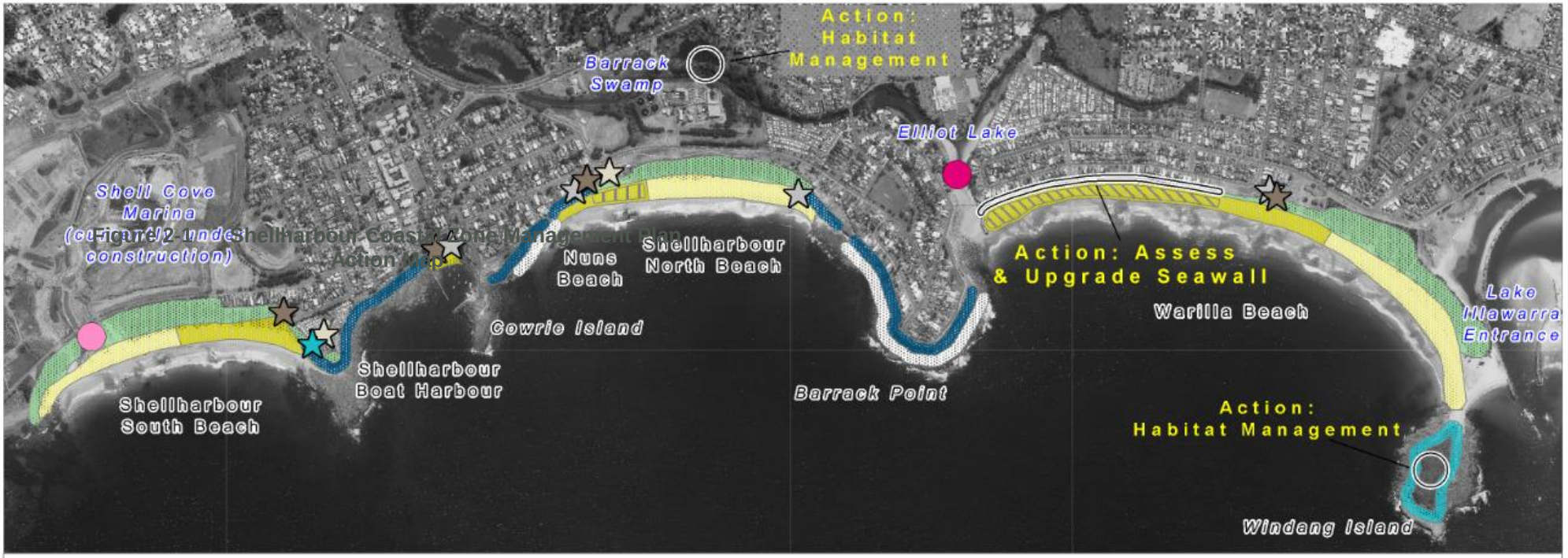
The CZMP should be substantially revised within 10 years to incorporate such changes, including re-assessment of coastal risks and appropriate management responses. At this time, options and triggers suggested in this Plan for assets at future risk shall also be revised.

2.3 Funding Opportunities

A range of grant funding opportunities are available to assist with actions in a certified CZMP. These may be sought and used to implement the actions by

different units within Council. This is in addition to the existing budgets and resources of Council that are available when implementing actions in the Delivery Program and Operational Plan. The following grant funding opportunities and other potential revenue streams may be investigated by Council when implementing actions in this CZMP:

- NSW Government Coastal Management Program (administered by OEH);
- NSW Government Estuary Management Program (administered by OEH);
- NSW Government Floodplain Management Program (administered by OEH);
- South East Local Land Services Grant Programs;
- NSW Government Public Reserves Management Fund (PRMF) Program (administered by DoI – Crown Lands & Water);
- Federal and State Government Emergency Management Funding; Disaster Relief Funding;
- Federal and State Government Climate Change adaptation programs;
- New Council levies or increased land rates, which may include the Coastal Protection Service Charge to maintain (but not construct) new coastal protection works including beach nourishment works, see *Coastal Protection Service Charge Guidelines* (DECCW, 2010); and
- Revenue generated through hire, rental or other commercial partnerships with Council (e.g. for the SLSCs).



LEGEND

Actions for All Beaches

- (H) (M) *(Priority for Action: High, Medium)*
- Beach Access Management**
- Monitor Beach Sand Volumes
- Use Dredged Sand to Supplement the Beach
- Dune Management
- Geomorphic and Geotechnical Hazard Zoning
- Conduct Periodic Inspections of Coastal Slopes
- Combined Flood Studies

Actions for Public Assets

- Append AMP*: Transport & Stormwater
- Append AMP*: Community Buildings
- Append AMP*: Recreation Infrastructure
- Recommend Sydney Water Append AMP*
- Coastal Hazard Construction Checklist***
- Heritage Decision Support Tool***
- Materials and Design for Saltwater Intrusion***

Actions for Private Property

- LEP Update***
- Amend the DCP to Include Controls for Coastal Risks***

Actions for Whole LGA

- Community Education***

** (AMP) Asset Management Plan*
*** Mapping not available*
**** Action not mappable*

Title:

Shellharbour Coastal Zone Management Plan Action Map

N

0 375 750m

Approx. Scale

Figure: 2-1

Rev: A

BMT WBM
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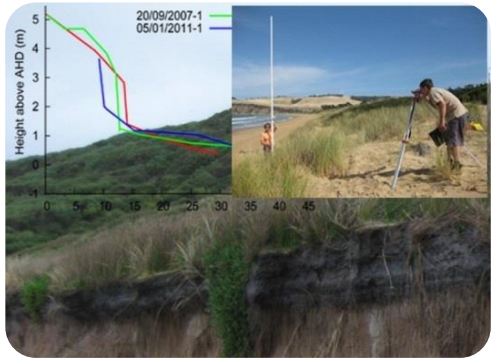
2.4 Implementation Action Plan

2.4.1 Monitor Beach Sand Volumes

Activity	Actions	Performance Measure	Responsibility
Monitor Beach Sand Volumes	Develop and deliver a monitoring program for beach condition and volume, to determine when trigger points are reached and improve data for future revision of coastal hazard studies. • Utilise outputs from existing NSW Government programs, e.g. 3 yearly LiDAR and aerial photography/photogrammetry collection. • Undertake monitoring after storm events. Check beach condition if real time $H_s \geq 3$ m at Port Kembla and/or ocean tide ≥ 2.2 m Bundeena local datum (1.3 m AHD). Conduct monitoring if erosion is evident (refer Figure 3-2 decision support tool for monitoring of trigger points). • Review monitoring data immediately on collection to check if asset trigger points have been reached (e.g. with a GIS based database). • Monitor realignment and possible recession of the shoreline on both sides of the marina entrance. • Use sand from possible future dredging operations of the entrance channel to supplement the beach on the two sides of the marina entrance.	Monitoring program developed by 2016. Number of times Monitoring program delivered.	SCC: Amenity and Assets, with assistance from Environment Existing NSW Government Programs
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.2	**High Priority** • Warilla SLSC and adjacent parkland • Warilla Beach seawall (numerous transects along wall) • Shellharbour SLSC (North Beach) • Nuns Beach • South Beach – northern end, various transects between Caravan Park and South Beach carpark • Shellharbour South Beach – southern end • Shellharbour Boat harbour **Medium Priority** • Remaining beach locations *Installation of stakes at trigger point is recommended for assets of high priority.*	Staff time. Link with existing NSW Government monitoring programs (e.g. OEH LiDAR, aerial photography collection).	Immediate: 2016 / 2017 Operational Plan for development of program. Short term (2017-2021 Delivery Program) to commence program.

Further Information



- Investigate the use of drones to collect and process data for high priority beaches/sites after severe storm events (e.g. ADS80 Aerial Photogrammetry).
- Collaborate with NSW Government (OEH) where storm erosion is severe across a large region.
- Use traditional survey techniques to monitor key sites/assets when erosion is evident, if most cost/time effective.
- Survey should be collected in front of Council assets for which a trigger has been identified (see Asset Management).
- Where traditional survey is used, survey cross sections should run perpendicular to the beach/shoreline, and be measured to the waterline (refer to TASMARC Survey Instructions – Levelling (2012) for example guidance). Aside from survey collected at assets, survey should be collected at regular intervals along the beach (~100 m), or in line with cross section profiles used in the historical photogrammetry.
- In the future, 'trigger points' may be set as part of conditions of consent for developments on private land. It is currently unclear who will be responsible for monitoring 'trigger points' for private property. As part of preparing the monitoring program, consider how future monitoring needs for private residents may overlap, be incorporated, or contribute (physically or financially) to the beach monitoring program.

2.4.2 Append Asset Management Plans: Transport Assets, Public Buildings, Recreation Assets and Facilities

Activity	Actions	Performance Measure	Responsibility
Append Asset Management Plans	• Document in the Asset Management Plan the hazard type (erosion/recession, inundation, wave runup) and timeframe for impact (immediate, 2050, 2100) for all transport assets, public buildings and other significant public assets affected by coastal hazards (See hazard mapping or Asset Risk Registers). • For minor recreational facilities not expected to last > 25 years, consider immediate risks only. • Determine an appropriate hazard management action for assets at immediate risk, then assets at risk by 2050 (which may include relocation before an event, retrofit/redesign, manage to fail, or sacrifice and rebuilding after impacts), and document this in the Asset Management Plan(s). • Include the hazard management action in the asset replacement cost. • Implement the action when the asset is due for replacement, or when a specified hazard trigger point is reached (which may be after the impact for minor facilities). • Inform the Monitoring program of triggers for assets.	Coastal Hazards actively considered in replacement / upgrade of transport assets, community buildings and other infrastructure.	SCC: Amenity and Assets where they are Council owned/managed assets, or other relevant asset managers for e.g. DoI – Crown Lands & Water
IPR Ref.	**Locations[#]**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.3 Strategy 2.3.6 **Focus Area 3** Objective 3.1 Strategy 3.1.1 Strategy 3.1.2 **Focus Area 1** Strategy 1.2.2	**Transport Assets** include: Major Roads, Minor Roads, Car parks, Stormwater outlets and pipes, Footpaths, Cycleways/Shared paths. **SLSC at High Risk from Erosion**: By 2050, Shellharbour SLSC and Seaspray Function Centre at Shellharbour North Beach. **Tourist Parks at High Risk from Erosion:** Shellharbour Beachside Tourist Park at Shellharbour South Beach. **Minor recreational facilities** (for which only "immediate" coastal hazards are relevant) may include: beach accesses, viewing platforms, walkways, picnic tables, seating, etc.	Staff time or Minor consultancy ($10,000) to assist with asset database. **Funding Options**: NSW Coastal Management Program, Federal / State Climate Change adaptation programs.	Immediate: 2016 / 2017 Operational Plan; Ongoing.

Further Information

Hazard management action may include:

- Relocation (as the first preference, see note below);
- Retrofit/redesign (which may include protection, see below);
- Use of relocatable structures;
- Manage to fail; or
- Sacrifice of asset, then replacement landward of immediate impact area, when damages occur (likely to only be appropriate for minor recreational facilities such as beach accesses).

Preferably, major assets should be relocated outside of hazard impact zones, which allows natural beach movement and reduces impact on adjacent land uses. For example, for car parks or tourist parks, facilities can be relocated and sites reconfigured, retaining the general amenity of the asset without the need for protection, and allowing some loss of land within the park.

Where relocation is not feasible, any decision to "protect" an asset should involve careful consideration of adjacent land uses, and consultation with other Council and state departments (see Coastal Hazard Construction Checklist). Protection structures may cause erosion of adjacent land. Where the structure additionally protects adjacent land, shared funding arrangements may be available (e.g. private landholders or other asset owners such as Sydney Water). Future coastal infrastructure works (e.g. seawalls, groynes, boat ramps) must be designed and built to coastal engineering standards

Appropriate triggers for erosion/recession management may include:

- When sand volume in front of the asset is less than or equal to the design storm bite, as defined in the Shellharbour coastal hazard study (120 – 230 m^3), commence funding, approvals etc for asset replacement; then
- When the zone of reduced foundation capacity (as determined by a suitably qualified structural / geotechnical engineer) is reached, commence asset replacement.

An appropriate trigger for inundation will relate to the frequency of inundation that can be tolerated, whilst still maintaining public safety.

[#]Refer to Asset Risk Registers (see the Options Study – Figure 5-7, Appendix A) for all transport and community assets at risk from erosion; and from wave runup at present to 2100; or, refer to Coastal Hazards Mapping.

2.4.3 Recommend Appending Asset Management Plans Sydney Water Assets

Activity	Actions	Performance Measure	Responsibility
Recommend Appending Asset Management Plans: Sydney Water Assets	Provide coastal hazards information Sydney Water, to support them to document in their Asset Management system the hazard type (erosion/recession, inundation, wave runup) and timeframes for impact (immediate, 2050, 2100) for all water and sewer assets in the coastal zone. Establish a working group with Sydney Water (and other service providers as required), to assist each other in managing assets at risk from coastal hazards. Encourage Sydney Water to: • use hazard likelihoods as part of calculating asset replacement costs and timeframes; • determine suitable future action for assets at high risk (which may include relocation, retrofit/redesign or manage to fail); and • document the preferred action in Asset Management Plan for implementation, either when the asset is due for replacement, or a hazard impact occurs.	Hazard mapping and asset risk register information has been provided to Sydney Water. Sydney Water has agreed to use hazard information in their asset management.	SCC Amenity and Assets to convene working group, and provide hazards information to Sydney Water Sydney Water is responsible for updates to Asset Management Plans *(written agreement for this action required)*.

IPR Ref.	Locations	Cost / Resources / Funding Option	Timeframes
Focus Area 2 Objective 2.3 Strategy 2.3.2 Strategy 2.3.6. Objective 2.1 Strategy 2.1.3	**Water infrastructure at High Risk from erosion** By 2050: Nuns Beach (1) **Sewer infrastructure at High Risk from erosion** Present: North Beach (1), Nuns Beach (1) By 2050: Boat Harbour (2) By 2100: Warilla Beach (3)	Staff time	Immediate: 2016 / 2017 Operational Plan

Further Information

None.

2.4.4 LEP Update

Activity	Actions	Performance Measure	Responsibility
LEP Update	Amend LEP to include a Coastal Risk Planning Area Map of the area subject to coastal hazards. Amend the LEP to include an "interim" geotechnical hazard area that covers cliffs/headlands within the mapped slope instability 'critical zone' (see SMEC, 2010, Appendix E). Update LEP Coastal Risk Planning Area Map and geotechnical hazard map whenever hazard mapping is revised (i.e. after Geomorphic and Geotechnical Hazard Zoning action is completed). Where necessary and feasible, consider rezoning of land to provide retreat buffers for migration of beach and other coastal / wetland ecosystems (see Investigate Habitat Preservation Options).	The LEP Coastal Risk Planning Area has been included in the LEP, based on existing (SMEC, 2010) coastal hazard mapping. The LEP coastal and geotechnical hazard Maps have been revised based on Geomorphic and Geotechnical Hazard Zoning action	SCC: City Planning
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.3 Strategy 2.3.2	**High Priority** All coastal locations where there is a defined hazard zone, including: • Warilla Beach • Shellharbour North Beach • Nuns Beach • Shellharbour Boat Harbour • Shellharbour South Beach • 'Critical zone' on cliffs or headlands (see SMEC, 2010). **Medium Priority** All defined hazard zones identified by the Complete Geomorphic and Geotechnical Hazard Zoning action	Staff time	Immediate: 201 6 / 2017 Operational Plan; Ongoing

Further Information

- Council will need to determine which hazard lines are appropriate to use for the Coastal Risk Planning Area map, as part of the proposed LEP amendment.
  Mapping options for the coastal risk planning areas include: coastal erosion/recession (ZSA) or zone of reduced foundation capacity (ZRFC) lines; and immediate, 2050 or 2100 hazard lines.
- Where possible Council should also use the most up to date coastal hazard mapping to ensure that appropriate land zoning is retained or indeed rezoned, for areas at risk from hazards. At the time that the land zone are revised as part of a review of the LEP, land that is known to be at high or extreme risk from coastal hazards, particularly where such land is currently vacant (i.e. greenfield sites), should be rezoned to Environmental Management, Environmental Conservation, Public Recreation or similar. Rezoning of vacant lands at risk ensures that land is not flagged for development in the future.
- Rezoning of land should be investigated for consideration for the low lying back beach areas (e.g. Elliot Lake) adjacent to high value coastal ecological communities to allow for future migration in response to climate change and sea level rise (see also Habitat Preservation Options).
- Once the Geomorphic and Geotechnical Hazard Mapping action is completed, which shall define the geotechnical hazard zones, plus revise the coastal hazard zones to capture all areas of erodible beach and dune (i.e. that currently sits outside of the SMEC 2010 hazard mapping), the LEP Coastal Risk Planning Area Map should be revised, and a geotechnical hazard area map included in the LEP.

2.4.5 Amend the DCP to Include Coastal Risk Planning Provisions

Activity	Actions	Performance Measure	Responsibility
Amend the LEP and DCP to Include Controls for Coastal Risks	Amend the Shellharbour DCP to: • Detail controls for managing development within the Coastal Risk Planning Area. The DCP shall aim to minimise or avoid risk to life and property, including adverse impacts to neighbouring public or private property. • Require a geotechnical assessment for new development or extensions proposed on cliffs or headlands within the mapped slope instability 'critical zone'* (see SMEC, 2010, Appendix E). The DCP shall require any risk of triggering of slope instability to be checked. The DCP shall aim to limit the financial losses of the impacts of coastal hazards on property, while still providing for the development of coastal land in a manner that is appropriate to the expected hazard impact over the lifespan of the new development. The controls aim not to unnecessarily sterilise land prior to coastal hazard impacts.	The DCP has been amended to include provisions for Coastal Risk. The DCP has been amended to provide interim control for geotechnical hazard. Number of DAs approved that meet required Coastal Risk Planning DCP objectives.	SCC: City Planning
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.3 Strategy 2.3.2 Objective 2.1 Strategy 2.1.3 Secondary: Objective 3.2 Strategy 3.2.1	DCP applies to all future developments (infill, re-developments, greenfields) within the Coastal Risk Planning Area. DCP applies to interim "critical zone" slope instability area. **Highest Priority:** Redevelopments at Nuns Beach and South Beach	Staff time	Immediate: 2016 / 2017 Operational Plan; Ongoing

Further Information

The following controls are recommended for the Coastal Risk Planning Area:

- For subdivisions, the building envelope, services (water, sewer, electricity, stormwater etc), and other structures (roads, retaining walls, etc) be located outside of the coastal risk planning area.
- New buildings, additions to existing buildings (which includes replacement/refurbishment of existing floor area) to be located outside of the coastal risk planning area wherever possible.
- New buildings and additions only permitted within the coastal risk area, where:
  - A report is provided from a suitably qualified structural engineer certifying either:
    - Building footings (including strip-footings and piers) are designed to provide safe bearing below or beyond the zone of reduced foundation capacity (as calculated specifically for the proposed site); or
    - The building is designed to be easily removed or relocated, once a specified 'trigger' is reached. The 'trigger' would be set as part of the conditions of consent for the development; or
    - If erosion protection measures are proposed, they be located wholly within the private property boundary of the proponent (i.e. not on adjacent public or private land); and be designed to avoid adverse impacts to adjacent property, and
    - Vehicle access and services are located outside of the coastal risk planning area.
  - Ancillary structures (e.g. swimming pools, retaining walls, decks) shall only be permitted within a coastal risk planning area if they are designed to be structurally separate from the existing building, to be easily removed / relocated if threatened by erosion.
  - Where a 'trigger point' is set in the conditions of consent, this may trigger actions such as: further investigation of the coastal hazard; landward relocation of the structure; or cessation of occupation and removal of the structure and stabilisation of land.
  - The 'trigger point' may relate to an amount of beach erosion (volume of sand or distance) seaward of the building/structure envelope, the zone of reduced foundation capacity, or other measurable factor relating to coastal hazard. The 'trigger point' should be designed to provide sufficient time for inhabitants to evacuate and the building / structure be removed / relocated. This aims to avoid uncontrolled collapse of the building / structure that would pose a risk to life and / or property.
  - Responsibility for monitoring the 'trigger point' should be specified as part of the conditions of consent. This may include financial contribution from the proponent for monitoring to be conducted within an existing Council program.

The DCP should continue to be amended as new hazards information is made available, approaches to controlling development and coastal risks are improved, and feedback from the community and council regarding the practicality of implementing the DCP provisions is gathered.

2.4.6 Coastal Hazard Checklist for Council Works

Activity	Actions	Performance Measure	Responsibility
Coastal Hazard Construction Checklist for Council Works	Prepare a checklist / policy for internal use by Council when replacing or building new infrastructure; or preparing a Review of Environmental Factors (REF), Plan of Management (POM), Masterplan etc in the coastal zone. The checklist shall identify: • Where to access coastal hazard information; • List of structures that must be designed and constructed to coastal engineering standards; • Other officers/departments to be consulted (i.e. coastal management program staff); • Other agencies required to give concurrent consent (e.g. DoI - Crown Lands & Water); and • Controls/measures to reduce coastal risks. For replacement / new works, the measures should consider the lifespan of the proposed structure and apply coastal risk controls accordingly, such as: • assets that have an intended lifespan of 50-100 years, and/or are extremely costly (e.g. stormwater assets) should be located outside of the coastal risk planning area wherever possible; • assets with a lifespan of 10-20 years, and/or that are relatively inexpensive (e.g. beach viewing platforms, accesses) may be permitted within the immediate hazard area. Council should flag the asset as sacrificial (in the AMP), to be replaced landward once impact occurs. • Recommended controls/measures to replicate those in proposed Coastal Risk DCP chapter.	A Checklist / Policy has been prepared. Number of times the Policy has been used.	SCC: Amenity and Assets To be utilised by all departments, especially: • Amenity and Assets • Services • Parks, Aquatics, Landfill & Stadium • City Planning
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.3 Strategy 2.3.6 Strategy 2.3.2 **Focus Area 3** Objective 3.1 Strategy 3.1.1 Strategy 3.1.2	Future council assets, replacement council assets, Community or Crown Land in the coastal zone (*see Asset Risk Registers in the Options Study – Figure 5-7, Appendix A)*	Staff time, or Minor consultancy ($5,000).	Immediate 2016 / 2017 Operational Plan; Ongoing

Further Information

Recommended controls/measures may include:

- Assets constructed to be readily relocated, either prior to a storm (e.g. lifeguard towers), when an impact occurs (e.g. stormwater outlets progressively shortened as beach erosion occurs); or at a specified 'trigger point';
- Assets designed with foundations to provide bearing capacity below the zone of reduced foundation capacity, or otherwise designed to withstand erosion impacts; or
- In the case of essential services where there is no viable alternative location, coastal protection works may be appropriate. The structures must be designed by a suitably qualified coastal engineer, include measures to reduce or ameliorate adverse impacts to adjacent public or private land caused by the structure; and provide for public access and amenity wherever possible.

Triggers for asset relocation may include:

- A predicted storm event (e.g. $H_s \geq 3$ m and / or ocean water level ≥ 1 in 1 year ARI of 1.3 m AHD + SLR);
- When a specified sand volume has been eroded, as measured seaward from the asset;
- When a specified distance is reached, as measured seaward from the asset to the erosion escarpment (e.g. 4m AHD); or
- When the zone of reduced foundation capacity is reached, as measured seaward from the asset to the erosion escarpment.

2.4.7 Dune Management

Activity	Actions	Performance Measure	Responsibility
Dune Management	Implement the Shellharbour Coastal Dune Management Plan which includes: • Weed control actions; • Rehabilitation planting actions; • Flora surveys / mapping actions; • Public access actions; • An action to build relations with other landholders; • Monitoring actions; and • Review actions. Undertake regular review of the Coastal Dune Management Plan to ensure that dune rehabilitation actions: • Consider ecology, beach amenity, social, coastal processes and coastal hazard objectives; • Promote best practice dune rehabilitation techniques; and • Align with community values and expectations. Continue to support existing and new voluntary Landcare (Dune care) programs.	Number of actions in the Dune Management Plan completed. Also, number of new dune care programs established.	SCC: Environment and Parks, Aquatics, Landfill and Stadium for implementation of Coastal Dune Management Plan, and creating and / or managing dune care groups.
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.1 Strategy 2.1.2 Strategy 2.1.4 *Secondary:* **Focus Area 1** Objective 1.1 Strategy 1.1.2	All Council beaches	Existing staff and budget, plus seek collaboration with other agencies or new grants. **Funding Options:** NSW Coastal Management Program, Collaboration with or new funds through NSW Government Public Reserves Management Fund (PRMF) Program (administered by DoI - Crown Lands & Water and South East Local Land Services Grant Programs)	Immediate 2016 / 2017 Operational Plan; Ongoing

Further Information

Dune management (voluntary or otherwise) should aim to care for and control dune vegetation to meet both hazard protection aims (i.e. retaining a sand buffer for erosion and reduce windblown sand) and amenity aims (e.g. low growing species to promote views, allowing for sufficient beach width for community use, promoting natural coastal processes to occur; discouraging inappropriate use of dunes etc.).

This action may include:

- Collaboration between landholders (e.g. Council, Crown Lands);
- Trials/pilot programs for best practise methods;
- Inspection of dunes after erosion events to remediate storm impacts (see Figure 3-1 decision support tool for storm event monitoring).

There is scope for encouraging members of local Surf Life Savings Clubs to join voluntary dunecare groups and take ownership for dune management.

2.4.8 Beach Access Management

Activity	Actions	Performance Measure	Responsibility
Beach Access Management	Improve, maintain and rationalise beach accesses to protect beach / dune health and provide high quality and safe public access to the beach. This may include the following tasks: • Investigate the accesses to determine which to maintain and which to close; • Formalise and upgrade preferred beach access paths; • Close and rehabilitate unnecessary or informal paths; • Consolidate the number of private accessways by negotiation with beachfront residents to create shared paths. Remove informal / illegal private paths; and • Inspect the condition of accesses after storms. Temporarily close unsafe, damaged or eroded accessways, and repair as soon as practicable. Refer to decision support tool for monitoring beach accesses after storms in Figure 3-1. *Refer also to Coastal Public Safety Risk Assessment: Shellharbour LGA (SLSNSW, 2015) for foreshore access recommendation targeting public safety.*	Number of beach accessways maintained or upgraded.	SCC: Assets and Amenities, with input from City Services, and Parks, Aquatics, Landfill & Stadium, in consultation with DoI – Crown Lands & Water where beach accesses are located on Crown managed land *Supported by* SCC: Executive Manager / Public Officer, for closing beach access ways if required during a 'coastal erosion emergency' (see Shellharbour Coastal Emergency Action Sub Plan for details)

IPR Ref.	Locations	Cost / Resources / Funding Option	Timeframes
Focus Area 1 Objective 1.2 Strategy 1.2.1 **Focus Area 3** Objective 3.1 Strategy 3.1.1 Strategy 3.1.2 *Secondary ref:* **Focus Area 4** Objective 4.2 Strategy 4.2.6	**High Priority** • Warilla Beach (north end) • Nuns Beach **Medium Priority** • Remaining Council managed beaches.	Staff time and existing budget. Seek additional funding. **Funding Option:** NSW Coastal Management Program, NSW Government Public Reserves Management Fund (PRMF) Program (administered by DoI - Crown Lands & Water, South East Local Land Services Grant Programs.)	Immediate 2016 / 2017; Ongoing.

Further Information

Additional considerations include:

- Investigate internet / smart phone / tablet based packages to log beach access inspections and upload details to the Asset Management Plan, and forward repairs and maintenance requirements to works crews.
- Utilise novel approaches to reduce informal pedestrian traffic on dunes and beaches, e.g. by fencing formal paths; placing beach showers at the end of preferred pedestrian paths, etc.
- Investigate materials for beach accessways that are more resilient to storm damage.
- For temporary closure of accessways, use approaches that reduce the ability for informal access around the damaged path, e.g. fencing or other obstructions. Informal trampling around closed paths often increases the damage footprint.
- Increase resources for compliance and repairs.

Note: an inventory of accessways (location, construction type) will need to be collated and added to the Asset Management Plan, see Append Asset Management Plan: Recreation infrastructure. A detailed listing of existing foreshore accessways can be found in the Surf Life Saving Coastal Public Safety Risk Assessment Shellharbour LGA (SLSNSW, 2015).

2.4.9 Use Dredged Sand to Supplement the Beach

Activity	Actions	Performance Measure	Responsibility
Beneficial Use of Dredged Sand	When dredging of the entrance to Lake Illawarra or Elliot Lake occurs, place dredged sand onto Council beaches to enhance sand reserves to buffer erosion and to improve beach amenity.	Lake entrance dredge material used for beach management purposes	SCC: Amenity and Assets (under existing arrangements with NSW Government) *Supported by:* Environment and City Development (for new planning and approvals), in consultation with DoI – Crown Lands & Water who assess/authorise dredging proposals where they occur on Crown Land (including submerged Crown Land)
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 1 Objective 1.2 Strategy 1.2.1 **Focus Area 2** Objective 2.3 Strategy 2.3.6	**High Priority**: • Warilla Beach, in front of seawall **Medium Priority**: • Investigate the feasibility of use of dredged sand on North Shellharbour Beach (e.g. in front of Surf Life Saving Club).	Existing arrangements for periodic maintenance dredging of Lake Illawarra channel. **Funding Options:** Partnership with the Estuary Management Committee, NSW Coastal Management Program, Crown Lands Grant Programs (e.g. *Rescuing our Waterways* or similar programs).	Opportunistically whenever entrance dredging is undertaken

Further Information

This option involves opportunistically nourishing Warilla Beach, and possibly North Shellharbour Beach, whenever sand is dredged from the entrance to Lake Illawarra or Elliot Lake, as part of future entrance and/or channel maintenance works.

This option has been undertaken with success in the past (2007) where sand from the entrance to Lake Illawarra was placed on Warilla Beach, at relatively low cost. The need for dredging is not predictable because entrance shoaling is driven by variable meteorological conditions. Further, the recent training works at the entrance have reduced the likelihood of entrance closure and therefore the need for dredging, in turn reducing the availability of dredged sand.

Over the long term, this option will not be able to mitigate the loss of sand from Warilla Beach and more frequent exposure of the seawall as a result of sea level rise.

2.4.10 Assess and Upgrade Warilla Seawall

Activity	Actions	Performance Measure	Responsibility
Assess and Upgrade Warilla Seawall	Assess the seawall at Warilla Beach to: • determine the seawall's current condition and ability to provide future protection from erosion, recession and wave overtopping, and • detail required upgrades, recommend funding options and appropriate trigger for these (see suggested trigger in Further Information). The assessment may require excavation of seawall sections. This could be supplemented with non-invasive (geophysical) techniques. Recommended seawall protection upgrades should be designed and constructed to coastal engineering standards. Future upgrades should also provide for an improvement in public access and amenity. Costing and funding options for upgrades should be provided, including consideration of contributions from all land / asset owners who will benefit from the upgrades. Council should engage the community with regards to selecting an appropriate management action for the Warilla seawall. This should include, but not be limited to, the foreshore residents	Seawall condition has been assessed, Seawall added to appropriate AMP, program of upgrades developed. % of upgrades underway by 2025.	SCC: Amenity and Assets *Supported by:* Environment and City Development (for planning and approvals)

IPR Ref.	Locations	Cost / Resources / Funding Option	Timeframes
Focus Area 2 Objective 2.3 Strategy 2.3.6 **Focus Area 3** Objective 3.1 Strategy 3.1.2	Warilla Beach Seawall *Note: numerous residential allotments and public/private facilities are protected by this seawall, all of which would benefit from upgrading this structure, including 52 (plus) residential lots, Little Lake Cres, cycleway/walkway, stormwater assets, sewer assets and water services.*	Consultancy for condition and upgrade assessment ($40,000), plus minor consultancy for consultation ($10,000) **Funding Options:** NSW Coastal Man't Program; State or Federal Climate Change adaptation programs, emergency man't programs.	Short term (2017-2021 Delivery Program) for assessment. Upgrades commenced by 2026.

Further Information

The seawall condition audit should follow on from the assessment by Council (Illiffe 2006) and include targeted excavations to confirm the construction details of the wall. Use of supplementary non-invasive methods, such as ground penetrating radar (GPR) should be considered to reduce the number of excavations required. Recent attempts to use GPR on Warilla Beach yielded limited results. However, use of GPR has been highly successful in imaging cross section profiles of buried seawalls for the purpose of identifying crest height, slope and toe depth on the Gold Coast, QLD (see http://www.goldcoast.qld.gov.au/whole-of-coast-seawall-investigations-25971.html; refer also to BMT WBM, 2015).

The seawall assessment should also detail the upgrade and maintenance needs (including raising the structure to manage wave overtopping with sea level rise) to meet current coastal engineering standards under present and future sea level conditions.

An appropriate trigger to commence planning and funding for upgrades may be when sand volume in front of the wall is 55 m3 (see Section 3.2.1 for further details), with upgrades to be constructed when the seawall is next exposed, reducing the need for excavation.

Indicative costing and potential funding arrangements should also be provided for any recommended upgrades and maintenance options. This will include any new or existing legislative arrangements for part funding from benefiting landholders (which may include other state departments where public assets are also protected).

2.4.11 Geomorphic and Geotechnical Hazard Zoning

Activity	Actions	Performance Measure	Responsibility
Revise Hazard Lines Based on Geological Data	This action consists of transitional mapping between active beach and geotechnical hazard areas, by • Defining the extent of erodible beach and dune that may be exposed to coastal hazard, but which lies outside of the existing SMEC (2010) coastal hazard mapping. This may include sections of perched beach and dune sediments, overlying a rocky platform (e.g. Nuns Beach), • Extending the coastal hazard lines along open beach sections, tapered off at known bedrock constraints; • Complete coastal slope instability hazard zoning for land use planning purposes for all coastal cliff and headlands areas. The assessment may include geophysical investigation (see further information). Geotechnical hazard zoning must be completed in accordance with the AGS (2007a and 2007b) *Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning.*	Hazard lines have been revised for high priority sites. Geological data is available for future revisions of hazard lines at remaining sites.	SCC: City Planning, Amenity and Assets, with input from Environment and in consultation with DoI – Crown Lands & Water where investigations are to occur on Crown Land managed by DoI – Crown Lands & Water
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.3 Strategy 2.3.2	**High Priority**: • Shellharbour North Beach, north and south end (including the car park and residential property at northern North Beach) • Nuns Beach (assessing both coastal and geotechnical risks) • Shellharbour Boat Harbour (including the recreation foreshore assets and reserve lands) • South Beach, north end (including Shellharbour Beachside Tourist Park). • Coastal cliffs and headland slopes between Barrack Point and Cowrie Island (i.e. Hazard Zone 1, 2 & 3, as mapped in SMEC, 2010) **Medium Priority**: • South Beach, south end • Remaining coastal cliff and headland areas	$60,000 for external consultancy to conduct investigation, and hazard line revision at all sites (cost for a single site will be less). **Funding Option:** NSW Coastal Management Program; Federal and Govt. Emergency Management Funding; Disaster Relief Funding	Short term (2017-2021 Delivery Program)

Further Information

This action requires two elements.

1. The coastal hazard lines need to be extended across areas of known erodible substrate that currently lie outside of the hazard mapping by SMEC (2010).

Field based geomorphological survey plus geotechnical investigation (e.g. geophysical survey, borehole drilling) in areas of complex coastal geology with high value assets, would be used to define the full extent of erodible shoreline. The coastal erosion and recession hazard lines can then be extended along all erodible areas.

Erosion and recession modelling may also be needed to define hazard extents for beach areas partially protected from protruding headlands (e.g. Nuns Beach, Boat Harbour); and/or beach areas that overly extensive rocky platform (e.g. Shellharbour Reserve), or cobble and/or boulders (e.g. northern North Beach). Modelling aims ensure that erosion hazard is not overstated in areas where local and regional scale geomorphic features (e.g. headlands and rocky platforms) provide some partial protective capacity.

2. Coastal slope instability hazard zoning is required for known areas of bedrock, particularly at the cliffs and headlands. This should include areas of known hazard (i.e. Hazard zones 1, 2 and 3 in SMEC, 2010) and presumed hazard (especially Nuns Beach).

Slope instability hazard zoning was beyond the scope of the SMEC (2010) assessment. It would assist in managing that hazard, through planning controls, signage etc.

2.4.12 Community Education

Activity	Actions	Performance Measure	Responsibility
Community Education	Undertake a variety of education activities to: • Improve community understanding of coastal processes, hazards and risks, and management responses in the CZMP, which may include awareness activities following storms, a community beach monitoring program, beach signage, targeted seminars such as for real estate agents, internal staff education and so on (see further information); • Enhance appreciation of environmental, heritage and social values associated with Councils beaches, headlands and coastal waterways; • Implement aquatic and recreational safety signage recommendations from the Surf Life Saving NSW Coastal Public Risk Assessment for Shellharbour LGA (SLSNSW, 2015); • Install signage warning for rock falls / slope instability danger at priority sites; • Prepare guide for private landowners near cliffs on how to complete routine inspections for maintaining the performance of built structures. Guidance on inspection, monitoring and maintenance requirements should be based on detailed recommendations in SMEC (2010, Appendix E).	Number of events held and attendees. Number of articles in various forms of media. Number of hits to relevant webpages / sites.	SCC: City Planning, City Development *Supported by:* Amenity and Assets (for installation of signage).
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.2 Strategy 2.2.1 Objective 2.3 Strategy 2.3.5 **Focus Area 4** Objective 4.1 Strategy 4.1.2	**Coastal Hazards:** Whole LGA; all beaches **Rock fall signage - High Priority**: Steep south of Cowrie Island (Hazard Zone 1) and the coastal cliffs of Barrack Point (Hazard Zone 3); **Medium Priority**: Remaining coastal cliff and headland areas **Landowner Inspection Brochure - High Priority**: Hazard Zone 1 –between Town St and Surf Rd; Hazard Zone 2 – parallel to Shell Cove Rd; Hazard Zone 3 – cliffs below Headland Pde, Barrack Point. **Medium Priority**: Remaining coastal cliff and headland areas.	Staff time, existing budget plus seek additional funding for materials, programs, signage, printing etc. **Funding Options:** State / Federal education, environmental, and / or climate change grant programs.	Short term (2017-2021 Delivery Program)

Further Information

Education elements should include:

- Information about coastal hazards and risks to build community acceptance and resilience for coastal risk management. This may include updates on CZMP implementation. Timing for activities should take advantage of large coastal storms / erosion when people are most engaged in coastal science.
- Develop a Community Beach Sand Monitoring Program. This may involve placing stakes as trigger markers for 'at-risk' assets / sites. Traditional ground survey and photographs would be collected (perpendicular to the stake in a seaward direction). Monitoring would be led by Council staff with community volunteers. The data could be uploaded to Council's website and combined with outputs from the Monitoring of Sand Volume action, and freely available sea level information etc.
- Teach the value of dune vegetation to provide a buffer to storms.
- Seminars for real estate agents and conveyancers to explain the DCP coastal risk planning provisions and Section 149 notifications, to improve information flowing to buyers and sellers of coastal property regarding development potential of land.
- Internal training for the different departments of Council about coastal hazard zones and the CZMP, to support greater consideration and preparedness for coastal hazards in Council's activities.
- Continue education programs about local coastal environmental and heritage values (including Aboriginal heritage), to foster community stewardship of Shellharbour's coast.

A variety of communication methods may be adopted, such as:

- Online tools (e.g. Council website, Facebook, Twitter etc,);
- Media (e.g. monthly Sustainable Shellharbour newsletter, brochures at visitor information centres, local radio and television interviews etc.);
- Educational messages (e.g. signage at beach, headlands);
- Targeted programs (e.g. school holiday activities, volunteer groups, internal Council staff, Real Estate Agents and Conveyancers etc.).

2.4.13 Habitat Management

Activity	Actions	Performance Measure	Responsibility
Habitat Management	Protect, maintain and enhance coastal ecological communities, through activities such as: • regeneration, • monitoring; • weed management; • water quality protection; and • acid sulphate soil management. Commence actions to improve the resilience of high value communities to sea level rise, by: • Improving the mapping of distribution of coastal habitats; • Monitoring invasion of other communities (e.g. weeds, mangroves); • Monitoring the migration of communities with SLR; • Improving the connectivity between habitats and removing obstacles (e.g. open drains, roads), to assist natural transition and migration with SLR; • Conserving undeveloped buffers for landward migration of wetland communities. This may be achieved through updating planning controls and/ or acquiring land; and • Consider pilot programs (in partnership with State Gov't) to improve approaches for building habitat resilience to sea level rise.	An action plan to manage habitat is completed. Number of staff who know about the action plan.	SCC Amenity and Assets (to implement actions from new and existing plans), *With input from:* • Environment • Parks, Aquatics, Landfill & Stadium • City Planning In consultation with DoI – Crown Lands & Water where works are to occur on Crown Land managed by DoI – Crown Lands & Water
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.1 Strategy 2.1.2	• Bass Point Reserve - Littoral Rainforest, Bangalay Sand Forest and other high value habitats (managed under the Ecological and Bushfire Management Plan, Bass Point Reserve) • Windang Island - Themeda Grassland (managed under the Ecological and Bushfire Management Plan, Windang Island Reserve) • Elliot Lake catchment – fringing Coastal Saltmarsh, wetlands including constructed wetlands (e.g. as per the Myimbarr Wetland Plan of Management) • Freshwater Wetland communities.	Staff time with budget allocation, or external consultancy $25,000 **Funding Options:** South East Local Land Services Grant Programs, OEH or other state grant programs.	Short term (2017-2021 Delivery Program)

Further Information

- Coastal wetland communities are particularly vulnerable to sea level rise. Saltmarsh grows adjacent to in intertidal habitats with a low profile. As such, a rise in sea level has the potential to impact on large areas of this habitat. Saltmarsh is prone to coastal squeeze, where located adjacent to development which may prevent landward migration as sea levels rise. Other urban and agricultural impacts will also reduce saltmarshes resilience to sea level rise, particularly including the loss of connectivity, altered sediment dynamics and increased nutrient runoff.

Freshwater Wetlands may also be affected by increased inundation, saline intrusion, mangrove invasion and potential changes to groundwater level and quality as a result of sea level rise. Sea level rise actions proposed for these habitats should focus on conserving buffers adjacent to these wetlands for future natural landward migration, increasing rehabilitation efforts through planting, weed management, water quality protection, grazing management and acid sulphate management and improving connectivity between these communities (i.e. restoration). These actions may assist natural transition as a result of sea level rise whilst maintaining the important functions of floodplain wetlands.

Although some of the wetland areas within the Elliot Lake catchment are constructed systems, they still provide important habitat value for local fauna and flora requiring management (e.g. as documented for the Myimbarr Wetlands in SCC (2014)).

2.4.14 Conduct Periodic Inspection of Coastal Slopes

Activity	Actions	Performance Measure	Respon-sibility
Conduct Periodic Inspections of Coastal Slopes	Complete periodic inspections (~5 years) of all the coastal cliffs and headland slopes. Inspections should be made by a suitably qualified geotechnical practitioner. Information collected should then be used by Council to: • Determine degree and extent of slope deterioration; • Identify potential slope hazards, such as unstable blocks, which pose risks to the area above/below the slope; • Implementation of remedial actions in a timely manner; • Manage risks more efficiently; • Adjust Council's regulatory requirements for future planning and development of the area, if required.	Geotechnical inspection of coastal cliffs/slopes is completed ever 5 years. Number of adverse geotechnical findings acted on.	SCC: Amenity and Assets In consultation with DoI – Crown Lands & Water where geotechnical investigations are undertaken on Crown Land managed by DoI – Crown Lands & Water
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Time-frames**
Focus Area 1 Objective 1.1	**High Priority**: • Coastal cliffs and headland slopes between Barrack Point and Cowrie Island (i.e. Hazard Zone 1, 2 & 3, as mapped in Appendix E of SMEC, 2010) **Medium Priority**: • Remaining coastal cliff and headland areas	Consultancy required. **Funding:** Federal and State Government Emergency Management Funding; Disaster Relief Funding	Short term (2017-2021 Delivery Program)

Further Information

Refer to the recommendations for geotechnical hazard management in the Shellharbour Coastal Slope Instability Investigation (SMEC, 2010; Appendix E).

2.4.15 Combined Flood Studies

Activity	Actions	Performance Measure	Respon-sibility
Combined Flood Studies	Conduct a flood study to determine the combined impact of elevated ocean water levels and catchment rainfall. Prepare a Floodplain Risk Management Plan to determine flood planning levels and monitoring of inundation required for the catchment.	Study funded and completed by 2020	SCC: Amenity and Assets
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Time-frames**
Focus Area 2 Objective 2.3 Strategy 2.3.2 Objective 2.1 Strategy 2.1.3 **Focus Area 4** Objective 4.2 Strategy 4.2.6	**High Priority**: • Elliot Lake Catchment (currently in preparation).	$50,000 **Funding:** NSW Floodplain Management Program.	Short term (2017-2021 Delivery Program)

Further Information

None

2.4.16 Materials and Design for Saltwater Intrusion

Activity	Actions	Performance Measure	Respon-sibility
Materials and Design for Saltwater Intrusion	Investigate appropriate designs and materials for services affected by saltwater (inundation, spray), such as stormwater, water and wastewater infrastructure. Update the Asset Management Plan or other appropriate Council Policy to provide for the use of designs and materials in asset replacement.	Investigation completed. % of materials used in delivery programs by 2025	SCC: Amenity and Assets Provision of advice to Sydney Water for sewer and water.
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Time-frames**
Focus Area 2 Objective 2.3 Strategy 2.3.6 **Focus Area 3** Objective 3.1 Strategy 3.1.2	All stormwater, water, and sewer assets impacted by coastal inundation and projected sea level rise	Staff time or minor research consultancy (~$5,000). **Funding:** Federal or State climate change adaptation programs.	Long term (10 year financial plan)

Further Information

None

2.4.17 Heritage Decision Support Tool for Managing Erosion Impacts

Activity	Actions	Performance Measure	Responsibility
Heritage Decision Support Tool for Managing Erosion Impact (to Aboriginal and Non-Indigenous Items)	Develop a decision support tool (or similar) for managing known and unknown heritage items that are uncovered and/or damaged by coastal hazards. This action shall include: • close consultation with Local Aboriginal Groups, NPWS, relevant OEH officers, and South East Local Land Services, and a heritage consultant; • mapping of known aboriginal sites (e.g. AHIMS database) and European heritage items (as per LEP) with the coastal zone, that may be potentially exposed to coastal hazards; • mapping / cataloguing of previously unrecorded aboriginal sites, when they are uncovered by erosion (considering confidentiality requirements); • determining the actions to take when aboriginal sites become uncovered, which may include relocating, re-burying, sacrificing or protecting the object; • determining the actions to take when built/European heritage sites become damaged by coastal processes; and • providing clear direction as to the consultation and approvals required to undertake the remedial action. Note: refer to the Aboriginal and Heritage Culture Toolkit in completing this action.	A decision support tool has been created Number of times the tool has been referenced by responsible staff. Number of times the tool has been used	SCC: City Planning
IPR Ref.	**Locations**	**Cost / Resources / Funding Option**	**Timeframes**
Focus Area 2 Objective 2.3 Strategy 2.3.5	Action will cover Indigenous Heritage Items and Non-indigenous Heritage Items at all beaches.	Staff time or external consultancy $25,000 **Funding Options:** South East Local Land Services Grant Programs, other relevant State grant funding programs.	Long term (10 year financial plan)

Further Information

The Shellharbour coastline is rich in indigenous and non-indigenous heritage. Managing heritage locations (known and unknown) under threat from coastal hazards may become a particular challenge for Council. Development of a decision support tool will ensure proper management occurs once a site becomes uncovered (e.g. midden) or damaged (e.g. breakwater).

In developing the heritage decision support tool, consideration should be given to the following:

- type, location and significance of affected heritage item;
- Consultation with public authorities, land/asset managers;
- opportunity to retain the heritage value, once item/object becomes uncovered and/or damaged;
- Opportunity for compensatory heritage (e.g. planting new Norfolk Island Pines);
- coastal processes and hazards occurring at site of heritage item, and the likelihood of the hazard impact recurring;
- long term management intent for the areas where the affected heritage item is located. For example, if the management intent for a beach compartment is to 'accept impacts' of sea level rise, thus allowing the beach to retreat landward over time, then relocating or sacrificing the heritage object may be the preferred approach (should this be appropriate for the type of heritage item affected). Conversely, where protection of a coastal compartment is the preferred long term management intent, then protection or reburying the heritage item should be considered as an option (again, if appropriate).

3 Pathway to Managing Future Risk

3.1 Approach to Managing Future Risks

As detailed during the Options Study (BMT WBM, 2015), the risk assessment outlined the level of risk to specific assets at the immediate, 2050 and 2100 timeframes. The Asset Risk Registers are provided in the Options Study (see Table 5-7 in the Options Study, provided in Appendix A of this document). Prioritising which risks to treat was based upon Council's (and the community's) tolerance to risk, as shown in Table 3-1. Extreme and high risks are considered intolerable, requiring treatment as a priority over lower levels of risk.

For coastal risks with long timeframes, a second prioritisation exists relating to the estimated timeframe of impact, as described in Table 3-2. Extreme and high risks at the present day require immediate treatment. However, risks identified as extreme or high by 2050 or later may still be considered tolerable in the present day. It is unlikely that action on these risks will be required over the life of this initial CZMP (5-10 years).

Identifying a management option(s) with a trigger for implementation at the present time enables Council and others to be prepared should an extreme or high risk present itself earlier than anticipated, but does not commit Council or others to a specific course of action. Reaching the trigger point shall indicate that the risk is imminent and a decision is necessary at that time. This approach avoids costly, large-scale, difficult and / or unpalatable actions being implemented until it is certain that they are needed.

Table 3-1 Risk Tolerance Scale

Risk Level	Action required	Tolerance
Extreme / High	Eliminate or Reduce the risk or Accept the risk provided residual risk level is understood	**Intolerable**
Medium	Reduce the risk or Accept the risk provided residual risk level is understood	**Tolerable**
Low	Accept the risk	**Acceptable**

Table 3-2 Prioritisation for Risk Treatment Based upon Estimated Timeframes

Timeframe for Extreme / High Risks	Treatment Approach
Present Day	• Implement no regrets actions • Implement site specific management actions as required
2050	• Implement no regrets actions • Identify potential management option(s) • Identify trigger for implementation, should the option(s) be required.
2100	

The time period between now and when a risk becomes certain can be used to increase information / data upon which to base future decisions and improve certainty regarding the likely impacts of coastal hazards (particularly sea level rise). This period may also see an improvement in management approaches and /or funding to treat particular risks.

A key part of the strategy for managing future risks is setting a trigger for action that allows enough time for Council, the community and stakeholders to select the preferred action, and gather the funds and approvals necessary to implement it. Appropriate trigger values for the coastal hazards are detailed in Table 3-3, Section 3.2.

3.2 Trigger Points for Action

The majority of actions in this CZMP involve planning for implementation of a more substantial action, as and when needed in the future.

An important element of planning for future action is setting a 'trigger point' for when the action is needed. A key strategy in this CZMP is appending Council's Asset Management Plans (AMP) to include details of the coastal hazard and likely timeframe of impact for those assets that are shown to be potentially affected. The next element of this strategy is to determine an appropriate hazard management action, include the costs for the action within the asset replacement value, and implement the action when the asset is due for replacement.

However, there may be instances where the hazard impact may occur before scheduled asset replacement occurs. In this case, an alternative 'trigger point' is needed to flag when a hazard impact is imminent and asset replacement needs to be brought forward to avoid the hazard impact occurring.

Therefore the relevant AMP should also make note that hazard management action should occur either:

- When the asset is due for replacement (i.e. it is being replaced anyway); or
- When a 'trigger point' relating to the hazard is reached.

The trigger point needs to allow sufficient time for action to be taken, prior to a hazard impact occurring. Indeed there will be two triggers relating to the hazard:

- the first trigger, or "Planning Trigger", will flag that the hazard is imminent and funds (and approvals etc.) for asset replacement need to be set aside,
- the next trigger or "Implementation Trigger" shall flag that asset replacement must commence, to avoid detrimental impact.

Recommended trigger points for the various hazards are listed in Table 3-3, and explained in more detail below.

3.2.1 Recommended Trigger Points for Erosion and Recession Hazards

Recommended 'trigger points' for assets at risk from erosion or recession listed in Table 3-3 are described below.

- The Planning Trigger point may be '*when sand volume in front of the asset is less than or equal to the storm demand*' relevant to that beach (as based upon the design storm demand from SMEC (2010)). Beach survey data (which should be collected as part of the Monitoring of Beach Volume action recommended in this CZMP) can be used to calculate the cross-sectional area of sand in front of an asset, then multiplied by 1 m length of beach to give a volumetric value.
- The Implementation Trigger point should flag the structural stability and safety of the asset. The zone of reduced foundation capacity (ZRFC) or similar measure of the geotechnical stability of the soil beneath a site in proximity to the eroded beach is an appropriate trigger. As guided by Nielsen, *et al*. (1992), the ZRFC should be assessed by a suitably qualified geotechnical engineer, and calculated taking into account the soil type and substrate beneath the asset (i.e. 'heterogeneous sand' should not be assumed when calculating the ZRFC for use as a 'trigger point'). The inspection should also include a certification of the safety of the asset and stability of the site. At that time when the site can no longer be considered safe, as certified by an appropriately qualified engineer, implementation of the chosen action should commence.
- In some instances, the minimum storm demand volume or ZRFC may already be breached at present. A suitably qualified geotechnical or structural engineer should assess the stability of the asset, and triggers for asset replacement set accordingly (e.g. the site may be assessed as stable for some time, or need action immediately).

Table 3-3 Recommended Trigger Points: Erosion, Recession and Inundation

Hazard	Planning Trigger: *Prepare funds etc for Action.*	Implementation Trigger: *Implement Action to avoid unacceptable impact.*
Erosion and Recession	Sand volume measured from the asset in a seaward direction, of: • Warilla: 120 m^3/m • Warilla Seawall: 55 m^3/m • Shellharbour North & South: 200 m^3/m	Eroded beach face moves within safe foundation zone, as specifically calculated for the site/asset by qualified geotechnical / structural engineer
Inundation, wave runup	Frequency of inundation is a nuisance, (as determined on a site by site basis, e.g. 1/yr; 1/month etc)	Frequency of inundation is intolerable (i.e. disruptive, dangerous and / or costly, as determined on a site by site basis, e.g. 1/yr; 1/month etc.)

3.2.2 Recommended Trigger Points for Wave Runup and Inundation Hazards

The 'trigger point' may relate to a frequency of inundation of a particular asset, and this will be site specific. For example, inundation or wave runup through an amenities block may not be an issue if it occurs infrequently (e.g. yearly), but will become disruptive and dangerous should it occur regularly (e.g.

weekly). Similarly, inundation of an electrical substation is unlikely to be tolerable even infrequently.

Again, two phases of the trigger should be set, and may both be related to inundation frequency as suggested in Table 3-3. For example, the Planning Trigger point may be when inundation becomes a nuisance, or even the first occurrence of inundation; the Implementation Trigger point may be when the frequency of inundation becomes disruptive or dangerous. It is noted that no assets have been identified with intolerable levels of risk from wave runup under the immediate timeframe.

3.2.3 Recommended Trigger Point for Storm Event Monitoring

Storm events may be an appropriate trigger for actions that involve monitoring, for example, to trigger:

- An inspection of beach accessways after a storm (for closure and maintenance);
- Moving a relocatable lifeguard tower off the beach before a storm; or
- Traffic management where a roadway is inundated by an adjacent stormwater outlet or creek during an ocean storm.

There is already very good measurement of ocean water levels, including tide, storm surge and sea level rise. The data is freely available online, such as the tide gauge network run by OEH through the Manly Hydraulics Laboratory (MHL). Similarly, the NSW offshore Waverider Buoy network managed by MHL is also excellent, and real time data is available freely online.

Council may use these existing resources to flag the occurrence of an ocean storm event. A coastal storm at Shellharbour may be defined by:

- A significant wave height (H_s) of ≥ 3m (see You and Lord, 2008) at Port Kembla, which is likely to occur once a year, or more during stormy periods; and / or
- An ocean water level (including tide) of 2.2 m ISLW (~1.3 m AHD) at Bundeena/Port Hacking, being the approximate 1 in 1 year average recurrence interval (ARI) water level (MHL, 2011). Higher water levels may also be useful triggers, depending on the asset, and are available from MHL (e.g. see MHL, 2011).

Port Kembla has the nearest waverider buoy to the Shellharbour coastline. The ocean tidal gauge at Bundeena in Port Hacking is recommended for monitoring purposes because it captures the ocean tidal level (unlike other closer tidal gauges that are located within coastal lake or river entrances, and do not capture the full ocean tidal signature).

For triggers that require prediction of storm events (e.g. for moving relocatable infrastructure before a storm), Council may use the Bureau of Meteorology (BOM) coastal storm warnings in combination with real time wave measurements, and tide prediction and measurements available from MHL. Communication via Council lifeguards and the public will also be important for assessing sites affected by coastal storms.

Decision support tools to assist Council in deciding when to conduct monitoring of beach volumes or asset triggers (see Figure 3-2), or for checking damage to beach accessways (see Figure 3-1) are provided below.

Table 3-4 Recommended Trigger Points: Storm Events

Event	Pre-storm Trigger	Post-storm Trigger
Coastal Storm (i.e. large waves, tides)	• When BOM issues a Coastal Storm Warning for the Illawarra; • When H_s ≥ 3 m at Port Kembla waverider buoy • When the predicted tide ≥ 2.2 m local datum at Bundeena (Port Hacking).	• When H_s* ≥ 3 m at Port Kembla, and/or • When ocean water level at Bundeena* ≥ 2.2 m Local Datum (~ = 1 yr ARI at present); or • Based upon measured data available online at MHL

** Note: H_s or HSIG= significant wave height; ARI = average recurrence interval; MHL = Manly Hydraulics Laboratory, see mhl.nsw.gov.au; BOM = Bureau of Meteorology, see bom.gov.au; Bundeena / Port Hacking tidal gauge is recommended as it is an ocean tidal gauge (nearer tidal gauges are within Lake Illawarra or Elliot Lake). Port Kembla has the closest waverider buoy to the Shellharbour coastline.*

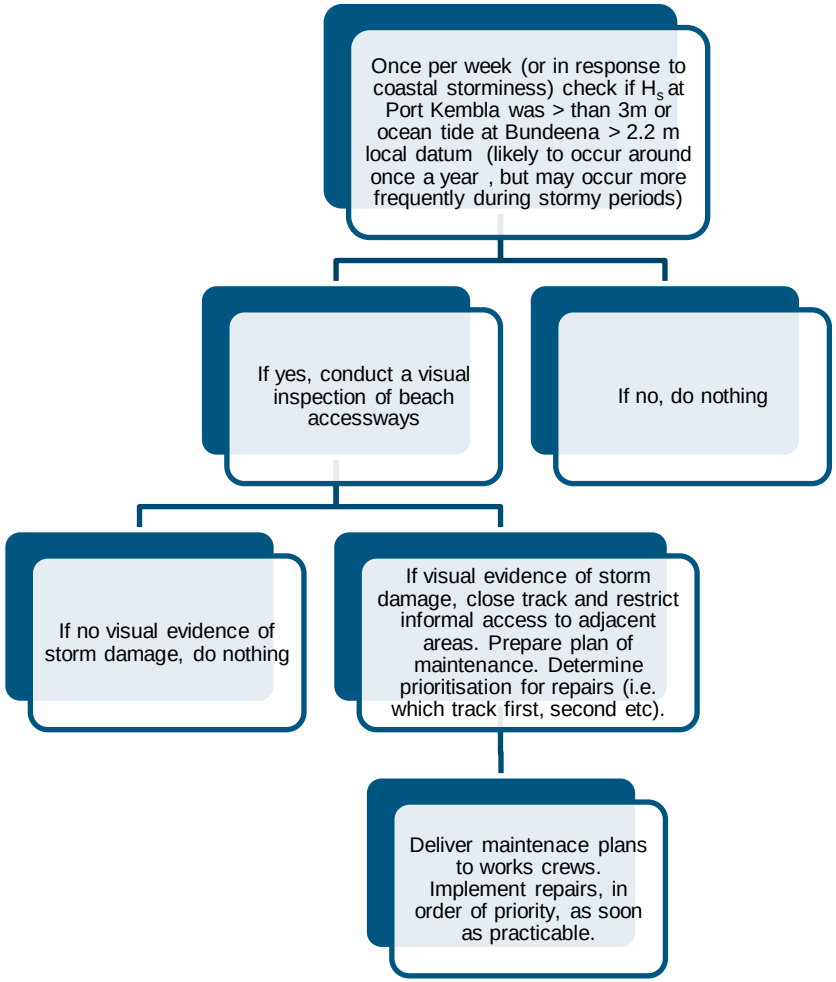


Figure 3-1 Recommended Approach to Monitoring Beach Accessways for Storm Damage

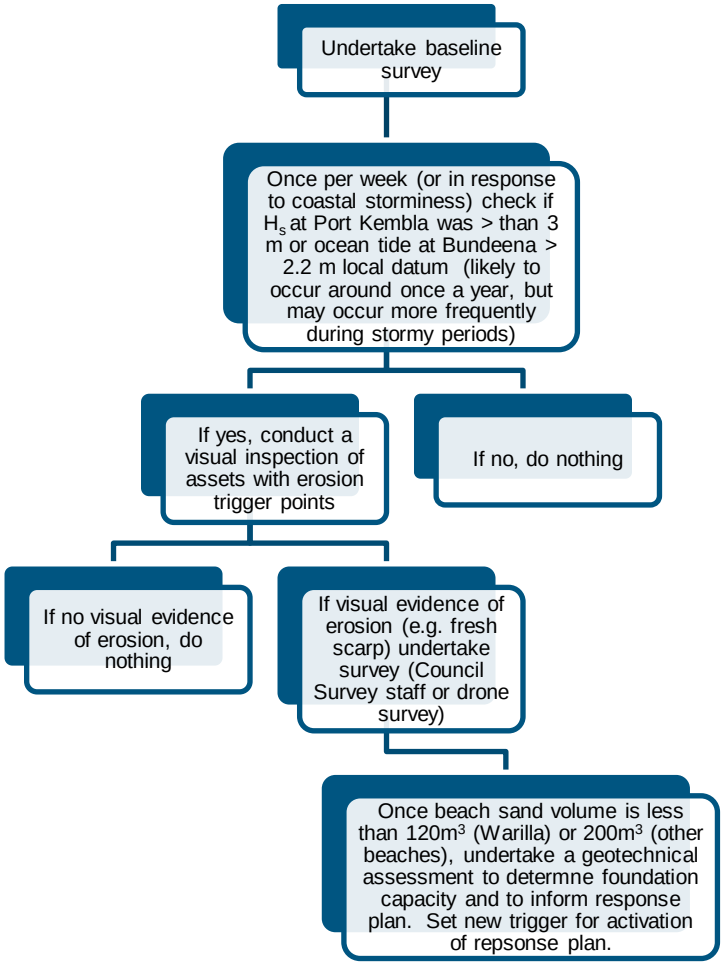


Figure 3-2 Recommended Approach to Monitoring Trigger Points for Assets, Beach Volumes

4 Plan Monitoring and Revision

The Shellharbour CZMP requires evaluation and reporting regarding the success of its implementation, and thus the success of managing existing and future coastal risks. Where implementation performance is sub-optimal, the evaluation process should identify contingencies to remedy the situation.

This CZMP is the first of many iterations of a coastal plan for the Shellharbour open coastline. It is intended that the Plan, and the studies that underpin it, shall be revised every 5-10 years.

4.1 Annual Communication and Implementation Audit

The importance of internal communications within Council cannot be over-emphasised in the success or otherwise of CZMPs. To support the integration of this CZMP with Council's day to day operations, it is recommended that 12 months after the CZMP is adopted, and subsequently at yearly intervals, key Council Staff responsible for its implementation in partnership with the regional OEH Coastal representative, undertake an internal workshop to gauge the status of adoption of the CZMP and general understanding of its objectives through Council. The workshop would include a refresher of the CZMP contents, to reinvigorate existing staff and for new staff.

4.2 Annual Report: Linking Review of Implementation of CZMP Actions with the IPR Framework

Council delivers an Annual Report to document its progress in implementing the Delivery Program and Operational Plan activities over each financial year period. Performance measures are included for each action in the Operational Plan.

The timeframe specified for each action in the Implementation Schedules of this CZMP can be used to feed actions into Council's Operational Plan, Delivery Program, or longer term Financial Plan. The performance measures given in the Implementation Schedule shall also be used to gauge whether the actions have been implemented or not, which can then be reported in the Annual Report. This provides for a yearly evaluation of the implementation

Where CZMP actions have not been included in the IPR Framework, an annual evaluation of those actions by Council's Environment team is recommended.

If it is determined that an action has not been implemented in accordance with the nominated performance indicator and timeframe, then one or both of the following contingencies should be adopted:

- Determine the cause for the delay in implementation. If delays are funding based, then seek alternative sources of funding. If delays are resource-based, seek additional assistance from stakeholder agencies and / or consider using an external consultancy to coordinate implementation of the action(s); and

- Modify and update the CZMP to reflect a timeframe for implementation of the action that is more achievable. The revised Plan would need to be endorsed by all relevant stakeholders and agencies responsible for implementation.

4.3 Bringing the Plan into the new CMP Framework

As noted in Section 1.3.1.2, the NSW Government is currently undertaking reforms of the Coastal Management Framework in NSW. The intention is to submit this CZMP for certification under the existing legislation. It will then be necessary for this CZMP to be integrated into the new format by 2021. The NSW Government has indicated that existing certified CZMPs will be able to be fast-tracked into the new framework, to avoid discarding the existing valid work and retain momentum for existing actions.

Under the new framework, CZMPs will become coastal management programs (CMPs), to be implemented via local councils' Integrated Planning and Reporting (IPR) Framework. Links between actions in this CZMP and the objectives of Council's existing Delivery Program have been given in the Implementation Schedule, to assist in transferring this CZMP into the new format.

4.4 Plan Review: Success of CZMP Actions in Mitigating Risk

After 5 years, a review should be conducted to measure the performance of the Plan in terms of actually managing and reducing the risks to the community associated with existing and future coastal hazards. That is, 'how has the Plan made a difference?' and 'has the level of residual risk been reduced?'. Given that the CZMP will need to be brought into the new CMP format by 2021 (see Section 4.3 above), this review and update could be conducted at that time.

The main mechanism for gauging whether the overall outcomes of the Plan have been achieved, or not, is to re-evaluate the risks through a follow-up risk assessment process. As for the first risk assessment, all relevant mechanisms in place that assist with managing future risks and increasing Council's and the community's resilience should be included when assessing the level of risk.

There are two specific questions to be answered:

- Has the level of risk changed? (including for those risks in this plan that are currently assessed as low)?; and
- Have the extreme or high risks been adequately managed / mitigated? (i.e., has the level of risk been reduced to a tolerable level through management?).

If it is determined that the risks have not been adequately managed or mitigated, or that new intolerable risks have arisen, then the following contingencies should be adopted:

- Carry out a formal review of the implemented management strategies, identifying possible avenues for increasing the effectiveness of the strategy in managing the risks along the coastline (including new risks);
- Commence implementation of additional management strategies that may assist in meeting the objectives of the Plan (possibly 'fast-tracking' some longer term strategies as necessary); and

- Reconsider the urgency of management for key risks. For example, accommodating future changes may no longer be feasible, and upscaling from passive to active management may be needed, e.g. shifting from development controls to planned retreat, asset relocation etc.

Any such changes to the Plan would need to be endorsed by the stakeholders and relevant government agencies, as well as the public.

5 References

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Appendix A Shellharbour Coastal Zone Management Study

BMT WBM

Shellharbour Coastal Zone Management Study

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FINAL REPORT

Shellharbour Coastal Zone Management Study

Prepared for:	Shellharbour City Council
Prepared by:	BMT WBM Pty Ltd (Member of the BMT group of companies)

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Synopsis: The Shellharbour Coastal Zone Management Study outlines potential options for treating risks from coastal hazards to economic, community and environmental assets and lands along the Shellharbour. The report presents a summary of coastal processes and hazards operating in Shellharbour, the legislation governing coastal zone management, the coastal hazards risk assessment and an investigation of management options for the various land and assets.

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Contents

List of Figures

List of Tables

Contents

1 Introduction

1.1 Background

Shellharbour City Council (Council) is located on the south coast of New South Wales, approximately 100 km south of Sydney and 10 km south of Wollongong. The Shellharbour coastline study area for the purpose of this plan extends from Windang Island in the north to Bass Point in the south, covering a length of 7 km (see Figure 1-1). The Shellharbour coastline includes open coast pocket beaches as well as cliffs and bluffs, and is directly exposed to the offshore wave climate typical for NSW.

Key coastal locations include Warilla Beach, Shellharbour North Beach, Shellharbour Boat Harbour, Nuns Beach, and Shellharbour South Beach. The village of Shellharbour is located immediately landward of Shellharbour Boat Harbour. The entrance to Lake Illawarra is located immediately north of Windang Island. Lake Illawarra is managed by the Lake Illawarra Authority (LIA), although the land immediately adjacent to the Lake remains subject to Council's governance.

While the beaches are backed by urban development, the coastline has largely retained its natural character. For example, much of Bass Point is a nature reserve, protecting a variety of endangered ecological communities and other important habitats. Coastal hazards such as erosion and wave overtopping have threatened Shellharbour's coastline from time to time (both built and environmental assets), most notably at Warilla Beach. Structures such as the seawall along the southern half of Warilla Beach are evidence of the historical response to such risks.

Council resolved to prepare a Shellharbour Coastal Zone Management Plan (CZMP) to investigate a suite of options to manage the risks arising from coastal hazards at present to 2100, in accordance with the latest guidance of the NSW Government in the *Coastal Protection Act 1979* and *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013).

1.2 Context of the Shellharbour Coastal Zone Management Study

The Shellharbour Coastal Zone Management Plan (CZMP) (completed after this study) provides a formal framework for managing the risks from coastal hazards to existing and future development and community assets and values in Shellharbour. In order to support the development of the Shellharbour CZMP, two preceding steps were required:

(1) The Shellharbour Coastal Hazards Analysis (completed by SMEC, 2010), which identified the likely extent of coastal risks that may affect the Shellharbour coastline now and in the future (including projected sea level rise), and

(2) The Shellharbour Coastal Zone Management Study (this report), which analyses the priority coastal risks and identifies practical management options to address such risks.

All stages of the preparation of the Shellharbour CZMP, including this study, are being prepared to meet the requirements of the *Coastal Protection Act 1979* and associated *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013), as outlined in Section 2.1.

The Shellharbour CZMP is intended to be approved by the NSW Office of Environment and Heritage in accordance with the minimum requirements for preparing coastal zone management

plans, submitted to the Minister for Environment for certification, and adopted and gazetted by Council.

A Risk Management Framework has been used to identify the risks from coastal hazards and analyse the level of risk based upon the likelihood and consequence of the coastal hazards. Use of a risk based approach is a requirement of the *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013). The likelihood of the hazards was determined based upon a review of the methodology and assumptions used to assess coastal hazards in the Shellharbour Coastal Hazards Analysis (SMEC, 2010). The likelihood, consequence and overall level of risk from coastal hazards identified through the risk assessment are documented within this report.

This report also presents and assesses a range of management options for addressing the priority coastal risks. The preferred actions to address a coastal risk (based upon the analysis of costs and benefits across a range of social, environmental and financial criteria) will be selected for inclusion in the Shellharbour CZMP.

Community access and recreation are important considerations in the coastal zone and are required to be considered within the *Guidelines for Preparing Coastal Zone Management Plans*. This study also provides direction to managing recreational and community amenity where these aspects are affected by or affect the extent of coastal hazards.

In the case of the occurrence of beach erosion emergencies, a Coastal Erosion Emergency Action Sub Plan has been prepared in accordance with the *Coastal Protection Act 1979* (and associated OEH (2010) Guide Note for these plans), and is provided in Appendix I.

1.3 Objectives for the Management of Shellharbour's Coastal Zone

Council has defined the following objectives for managing the Shellharbour coastal zone based upon the key hazards of the coastline, the NSW Coastal Management Principles given in OEH (2013) and the principles of the NSW Coastal Policy 1997:

Hazard management

- Recognise and accommodate natural coastal processes, hazards and climate change in the planning and management of the Shellharbour coastline;
- The CZMP will include strategies to deal with threats from coastal hazards to existing development and to ensure that new development is not exposed to such threats;
- To act in relation to coastline hazards in accordance with its responsibilities under the Local Government Act 1993, Coastal Protection Act 1979, SEPP 71, NSW Coastal Policy, in good faith and with appropriate duty of care;
- Establish relevant timeframes for ongoing review of coastline management in the City to reflect improved scientific understanding of coastal processes, particularly sea level rise and storm intensity/frequency;
- Develop and communicate appropriate emergency response programs for areas likely to be affected by coastal hazards.

Planning

- Link Council's coastal zone management planning with other planning processes in the coastal zone to facilitate integrated coastal zone management;
- Provide adequate planning controls to protect new development from anticipated coastal hazards;
- Reduce risks where immediate and long term coastal hazards affect existing development.

Environment

- Protect and enhance coastline biodiversity through the conservation of high value coastal ecosystems and habitat areas (including for listed threatened/endangered species and ecological communities);
- Rehabilitate priority degraded coastal ecosystems along the Shellharbour coastline;
- To protect and enhance the aesthetic qualities of the Shellharbour coastline.

Community and Infrastructure

- Protect and preserve beach amenity, maintain and improve public access arrangements to beaches and estuary foreshores and headlands, support recreational uses and protect the cultural and heritage environment;
- The CZMP will adopt a risk management approach to managing risks to public safety and assets and pressures on coastal ecosystems; including avoiding risks where feasible and mitigation where risks cannot be reasonably avoided; adopting interim actions to manage high risks while long-term options are implemented;
- Involve the community in the preparation of the CZMP, including making information relating to the plan publicly available;
- Management actions in the CZMP will be prioritised based on public benefit; including cost-effectively achieving the best practical long-term outcomes;
- To ensure the ecologically sustainable development and use of the Shellharbour coastline;
- Base decisions for managing risks to public safety and built assets, pressures on coastal ecosystems and community uses of the coastal zone in Shellharbour on the best available information and reasonable practice, including adopting an adaptive management approach;
- Develop specific management actions for Shellharbour South Beach based on the scenario that the approved proposed Shell Cove Marina development is in place.

1.4 Study Area

The study area for this Shellharbour Coastal Zone Management Study extends from Windang Island in the north to Bass Point in the south. As in Figure 1-1, from north to south the beaches and embayments include:

- **Warilla Beach**, extending 1.9 km from the isthmus connecting to Windang Island, to the trained entrance of Elliott Lake in the south;
- **Shellharbour North Beach**, extending 850 m from Barrack Point in the north to a small rock outcrop at the southern end, separating it from Nuns Beach;
- **Nuns Beach**, a small pocket beach of 120 m between the small rock outcrop and rock platform that extends southwards to connect with Cowrie Island, and attached headland in the south;
- **Shellharbour Boat Harbour** between Cowrie Island and the Shellharbour Tourist Park and Shellharbour Reserve headland. The heritage listed inner harbour of Shellharbour Boat Harbour is formed by two rock breakwaters, enclosing 100 m of sandy beach. The remaining 150 m of the shoreline is an exposed rock platform with a thin veneer of sand at the waterline; and
- **Shellharbour South Beach**, which extends southwards 1 km from the headland at the Shellharbour Tourist Park to merge with the landward end of the 2.5 km long Bass Point, and its rocky foreshore.

The beaches are exposed to a high energy wave climate, typically of the NSW open coastline. The study area landward of the beaches comprises residential, recreational and environmental lands, including beachfront residential lots.

Coastal waterways entering the ocean via the Shellharbour beaches include trained coastal lake inlets (i.e. Lake Illawarra and Elliott (Little) Lake) and an intermittently open and closed swamp entrance (Shellharbour Swamp).

The coastal zone of Shellharbour LGA formally includes the foreshores of Lake Illawarra from the southern training wall westward to Haywards Bay; Elliott (Little) Lake estuary; and the shoreline south of Bass Point including Killalea Lagoon and beaches (The Farm and Mystics). These areas are excluded from this Shellharbour CZMP (although certain management strategies may still positively benefit the management of these shorelines), because:

- Lake Illawarra Estuary is the subject of a separate CZMP, which is currently being completed by the Lake Illawarra Estuary Management Committee (EMC). The Lake Illawarra EMC collaboratively manages the Lake and members on the committee include Shellharbour and Wollongong City Councils and a number of State government agencies. Risks arising from coastal inundation are also managed through the Lake Illawarra Floodplain Management Plan process;
- Elliot Lake already has a separate Estuary Management Plan (WBM Oceanics, 2003) that provides actions to address community use, hazards and ecological risks for the lake; and
- Killalea Lagoon and Beaches lies within the Killalea State Park which is Crown Land managed by the Killalea State Park Trust.

Title:

Study Locality

Figure: 1-1

Rev: A

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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0 0.75 1.5km

Approx. Scale

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1.5 Community Involvement in Preparing this Study

The development of a coastal zone management plan requires the involvement of stakeholders and the community who utilise the coastline in many different ways, including state agencies, other stakeholders groups, community groups and residents, all who may be directly or indirectly affected. Consultation is necessary to ensure that the plan is acceptable to the local community, within financial and technical constraints. A careful and comprehensive consultation process has therefore been conducted to ensure community values and priorities have been incorporated into preparing and selecting the management strategies that will form the Shellharbour CZMP. Consultation activities conducted as part of this study are outlined below.

At the commencement of the Management Study phase of the CZMP, a variety of community and stakeholder engagement activities were conducted to advertise the preparation of a CZMP and to further explore community values and priorities for assets and land in the Shellharbour coastal zone. Activities were as follows:

- A project webpage was constructed, and included an online survey. The webpage and online survey was then cross-advertised on Council's website, to elicit a wider response;
- A Frequently Asked Questions (FAQ) colour brochure was also produced, along with a media release, to promote the project and to advertise the community sessions. The FAQ brochure was also made available for download from the project webpage;
- The Community Drop-in Session was held at the Seaspray Function Centre at Shellharbour North Beach. At the session the community were invited to talk directly with the study team and Council and share their views regarding coastal hazards. A paper form of the online survey and feedback form was also provided at the session for the community; and
- A range of stakeholders and state agencies (the NSW Office of Environment and Heritage, Lake Illawarra Authority, the NSW Department of Primary Industries: Fisheries, Council staff and others) were also invited to a presentation about the commencement of the project. After the presentation an informal question and answer discussion with attendees was held, to discuss and highlight any key values or issues that may be important in preparing the plan.

The outcomes of the online survey and community briefings and sessions were used to provide specific information regarding community use in the coastal zone, and to determine the values (social, recreational, cultural, ecological and economic) of the Shellharbour coastline, as the basis for assessing the 'consequence' of coastal hazards, as part of the risk management approach. Outcomes of the consultation are discussed and utilised in Section 5.3 and 5.5.1, and listed in Appendix C.

A Risk Assessment Workshop was conducted involving staff from the various departments in Council (strategic planning, development assessment, engineering, parks and recreation, and environment officers) and other relevant state agencies (LIA, DPI Fisheries, OEH) and community representatives (University of Wollongong). The Risk Assessment Workshop enabled clarification of consequence values ascribed to coastal assets and land, discussion of existing management activities being undertaken, and to gauge a preference for management direction for the CZMP.

The next stage of consultation was to present the management options in the Draft Coastal Zone Management Study to the community, and other state agencies and stakeholders. The consultation conveyed the costs and benefits of the different options (such as technical feasibility, financial constraints etc.) to the community, to ensure they are well informed when determining a preference for options. The feedback gathered about the level of community acceptability for the options forms one of the considerations in selecting the actions to be implemented in the CZMP.

The final stage of consultation shall be to place the Shellharbour CZMP on public exhibition, during which the actions recommended in the plan will be presented to the. Any final feedback regarding the recommended actions will be considered and incorporated into the final Plan, where appropriate.

2 Legislative Framework for Coastal Management

2.1 Preparation of Coastal Zone Management Plans

The requirements for the preparation of coastal zone management plans is outlined in the *Coastal Protection Act 1979* and the *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013) (the CZMP Guidelines). The Shellharbour CZMP has been prepared in accordance with these requirements, as tabulated in Appendix A Section A.1.3, as well as other legislation and guidelines applicable to managing the coastal zone of NSW (see Section 2.2).

The stages for preparing the Shellharbour Coastal Zone Management Plan are illustrated in Figure 2-1. This Shellharbour Coastal Zone Management Study forms Stage 2 of the CZMP process.

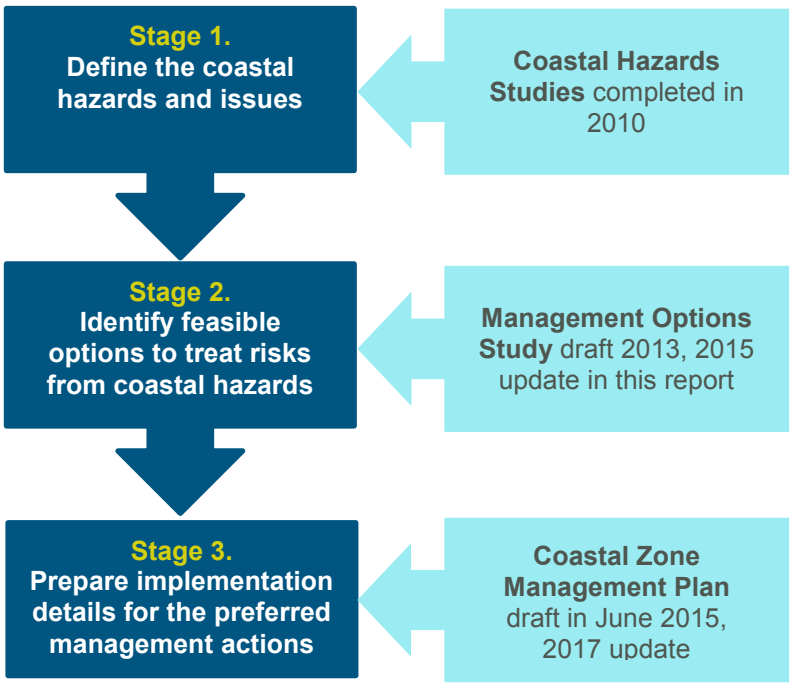

Figure 2-1 Stages of Preparation of this CZMP

Following on from the preparation of the draft CZMP document, subsequent steps for the CZMP include:

- Public exhibition of the draft CZMP, then update of the CZMP with relevant Council, community and state agency comments;
- Submission of the final CZMP to the Minister for Environment for certification, and if certified, Council to gazette the plan; and
- Review of the CZMP on a regular basis (5-10 years).

2.2 Legislation, Policies and Guidelines Applicable to the Coastal Zone in NSW

Coastal management in New South Wales is guided by

- *Coastal Protection Act, 1979* and its supporting *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013);
- *Environmental Planning and Assessment Act 1979;*
- *State Environmental Planning Policy No. 71 – Coastal Protection;*
- *Local Government Act 1993*; and
- NSW Coastal Policy (1997).

Other legislation and guidelines relevant to the coastal zone include:

- *State Environmental Planning Policy Infrastructure 2007*;
- Shellharbour Local Environment Plan 2013;
- Shellharbour Development Control Plan 2013;
- *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (DP, 2010),
- *Coastal Risk Management Guide – Incorporating sea level rise benchmarks in coastal hazards assessments* (DECCW, 2010)
- Coastal Design Guidelines for NSW (DP, 2003).
- *Crown Lands Act 1989*;
- Plans of Management made under the *Crown Lands Act 1989* or *Local Government Act 1993*;
- The Illawarra Biodiversity Strategy;
- The Southern Rivers Catchment Action Plan; and
- Illawarra Natural Resource Management Action Plan 2010.

A summary of the range of legislation relevant to managing the coastal zone in NSW is provided in Appendix A.

While a detailed review is not applicable within this document other legislation that may be applicable in managing the coastal zone, may include: the *Environment Protection and Biodiversity Conservation Act 1999*; the *Threatened Species Conservation Act 1995*; the *Fisheries Management Act 1994*; the *National Parks and Wildlife Act 1974*; the *Water Management Act 2000*; and others.

2.3 NSW Coastal Reforms

In September 2012, the NSW Government embarked on further reforms to the NSW coastal management process. Stage 1 of the Coastal Reforms included the following:

- The NSW Sea Level Rise Policy Statement (2009) was repealed, with local councils instead advised they "have the flexibility to determine their own sea level rise projections to suit their local conditions" (NSW Environment and Heritage, 2012);
- Certification of CZMPs was put on hold until the coastal reforms were progressed;
- Amendments were made to the Coastal Protection Act 1979 and a new code of practise for 'temporary' (previously termed 'emergency') coastal protection works was completed; and
- In April 2013, the CZMP Guidelines were revised by OEH to remove reference to the Sea Level Rise Policy Statement (in Coastal Management Principle 1). In lieu of prescriptive sea level rise benchmarks, OEH states that councils should adopt sea level rise values that are "widely accepted by competent scientific opinion" (OEH, 2013).

In February 2013, Council chose to suspend preparation of the Shellharbour CZMP until Stage 2 of the NSW Coastal reforms had commenced, and better support to councils in preparing CZMPs was provided.

In November 2014, the NSW Government released Stage 2 of its Coastal Reforms, involving:

- A proposed new Coastal Management Act to replace the existing Coastal Protection Act;
- Investigation of sustainable funding arrangements for coastal management activities;
- Better support for Council decision making; and
- Re-commencement of the certification of CZMPs by the Minister for Environment, with "hot spot" locations to submit their CZMPs to the Minister by June 2015.

With the release of Stage 2 reforms and the renewed impetus on coastal planning, Council has re-commence preparation of the Shellharbour CZMP, involving updates to this report and completion of a Shellharbour Coastal Zone Management Plan.

2.3.1 A Note on Sea Level Rise Projections used for the Shellharbour CZMP

Council has a legal imperative to consider sea level rise, as it is a known and measured coastal process that will affect the likely occurrence and severity of coastal hazard impacts. Under Section 733 of the *Local Government Act 1993* (the LG Act), Council has a duty of care to inform its local constituents of known risks and receives an exemption from liability for acting in good faith with respect to known hazards (including coastal hazards). Under Section 733(4) of the LG Act, Council is considered to have acted in good faith where decisions are made substantially in accordance with the relevant manual for the hazard, in this case, the CZMP Guidelines.

The incorporation of sea level rise into the assessment of coastal hazards is a requirement of the CZMP Guidelines upon which the LG Act exemption from liability is based. Similarly, object (h) of the *Coastal Protection Act 1979* is "to encourage and promote plans and strategies for adaptation to coastal climate change impacts, including projected sea level rise".

The *NSW Sea Level Rise Policy Statement 2009* was repealed in September 2012. This meant that prescribed state-wide sea level rise benchmarks no longer applied to coastal hazard assessments, such as the Shellharbour Coastal Hazards Analysis (SMEC, 2010) that supports the

development of the Shellharbour CZMP. The NSW Government indicated that local councils "have the flexibility to determine their own sea level rise projections to suit their local conditions" (NSW Environment and Heritage, 2012), although it is unclear if or how local councils may be equipped to do this. In lieu of prescriptive sea level rise benchmarks, OEH suggest that councils should adopt sea level rise values that are "widely accepted by competent scientific opinion" (OEH, 2013).

At the time of preparation of the Shellharbour Coastal Hazards Analysis (SMEC, 2010), the sea level rise projections that were 'widely accepted by competent scientific opinion' were that given by the former Sea Level Rise Policy Statement, being 0.4 m and 0.9 m rise above 1990 mean sea level by 2050 and 2100, respectively. These projections were based upon the latest reports by the IPCC (2007) and CSIRO (2007) available at that time. The NSW Chief Scientist and Engineer (2012) assessed the former NSW Sea Level Rise Policy Statement levels and advised that the science informing the policy levels was adequate.

The global projections for sea level rise are largely unchanged between the IPCC (2007) and and IPCC Synthesis Report in 2014. The CSIRO also released new regional projections for Australia in 2015, including the east coast. These projections suggest a 'likely' range for sea level rise of 0.45 to 0.88m by 2090 for the highest emission scenario, along which sea level rise is currently tracking. The minor discrepancy between the sea level rise projections adopted in the hazard studies supporting this CZMP and the latest projections is unlikely to substantially affect the actions prescribed in this CZMP for the next 5-10 years. At the next update for this CZMP, any revisions to sea level rise projections will be incorporated into the revision of hazard estimates at that time.

2.4 Council Integrated Planning and Reporting Framework

The NSW Office of Environment and Heritage (OEH) has indicated that through the Stage 2 coastal reforms there will be a transition to incorporating coastal zone management planning within the local government Integrated Planning and Reporting (IPR) Framework. This aims to mainstream coastal management into councils' overall service delivery and asset management responsibilities. It is also likely that streamlining actions in the CZMP with the service delivery and asset management process of Council will improve implementation of CZMPs. The IPR process is explained below.

In 2009 the NSW Government introduced an Integrated Planning and Reporting framework (IPR) so that councils can determine and reflect the community's aspirations within their short, medium and long term plans, guiding their yearly and longer term budgets and activities. This framework requires councils to plan funding priorities and service levels in partnership with their community for a sustainable future.

Councils must prepare a number of integrated plans which provide the detail on how the council intends to deliver works and services in the short and long term. The integrated plans for Shellharbour as shown in Figure 2-2 include:

- a long term community strategic plan, *Shellharbour Community Strategic Plan 2013 - 2023* which is developed in consultation with the community and outlines the community's long term aspirations over the next 10 years (see Section 2.4.1);

- a four year delivery program (Delivery program 2013-2017) that outlines the Strategies that Council will undertake to achieve the *Community Strategic Plan;*
- a one year operational plan (Operational Plan 2015-2016) that outlines Council's intended actions, performance measures and estimated budgets to achieve its principal activities over the coming financial year; and
- a long term financial and resourcing strategy, *Draft Long Term Financial Plan 2015/26 – 2024/25*, which contains information on the money, assets and people required by Council to progress with Strategies within the Delivery Program and move towards achieving the community Objectives.

Councils progress in achieving the Strategies and Actions within the Delivery Program and Operational Plan are reported quarterly, biannually and annually over each financial year period.

The Implementation Schedules of the CZMP (refer BMT WBM, 2015) were therefore designed to demonstrate alignment between the actions and activities in the current Delivery Program and Operational Plan 2013-2017, and provide appropriate details for inclusion of actions in subsequent, relevant documents.

Figure 2-2 Shellharbour's Integrated Planning and Reporting Framework

2.4.1 Shellharbour City Community Strategic Plan: 2013 - 2033

Council completed a Community Strategic Plan (CSP), in partnership with the community, to outlines the vision residents have for the City's future. A range of engagement activities were completed for the development of this CSP, to identify the aspirations of the Shellharbour City residents. The CSP identifies 10 Objectives that focus on the key themes of community, environment, economy and leadership, and the Strategies required to achieve them. The objectives are listed in Table 2-1. The IPR Framework is based around community's aspirations and needs for the future, as identified in this CSP.

Table 2-1 Objectives: Shellharbour City Council Community Strategic Plan

Key Area	Objective
Community	Vibrant, safe and inclusive City
	Active and health community
Environment	Protects and promotes its natural environment
	Practices sustainable living
	A liveable City that is connected through places and spaces
Economy	Infrastructure is planned and managed in a way that meets the community's needs
	Supported by a strong and local economy with business and employment opportunities
	Welcomes, engages and attracts visitors
Leadership	Led by a Council that effectively represents the community
	Supported by a Council that is responsive, accountable and financially viable

3 Coastal Processes and Hazards Summary

3.1 Introduction

Coastal processes (natural and human influenced) are the principal source of risk in the coastal zone, as such processes can generate significant hazards to human use and development of coastal land and assets. Coastal processes interact with the geologic structure of the coastline to shape the morphology of beaches over various timescales, from hours and days to years and decades. Processes and interactions include:

- Regional geology and geomorphology;
- Waves;
- Water levels (from tides and during storms);
- Coastal entrances (of creeks, lagoons, lakes and estuaries);
- Waterborne sediment transport;
- Windborne sediment transport;
- Stormwater runoff; and
- Climate change, particularly sea level rise, which will affect all of the above coastal processes.

Coastal hazards formed by the interaction of coastal processes with human use of coastal land include:

- Beach erosion (during the short term storm event or events in close succession) and dune slope instability;
- Shoreline recession (relating to a long term sediment deficit, if one exists, and due to sea level rise in the future at all beaches);
- Coastal inundation (during high tides combined with storms and sea level rise), which can manifest as wave overtopping of the open coastline, or inundation of land behind the open coastline via coastal creeks and estuaries and stormwater systems connecting to the ocean;
- Cliff instability and geotechnical hazards, which depending upon the dominant processes causing cliff retreat may be enhanced by sea level rise;
- Coastal entrance instability around intermittently closed lagoons such as Shellharbour Swamp on Shellharbour South Beach;
- Erosion at stormwater outlets / drainage lines; and
- Sand drift, where windborne sediment transport may engulf back beach areas causing a minor to major nuisance to back beach development and beach use/users, and/or a loss of sediment from the sub-aerial beach.

A brief summary of these elements is provided herein.

3.2 Beach Geomorphology

Regional geology determines the orientation of the coastline, the width and slope of the continental shelf, the type and location of headlands, reefs and other structures, embayment width and sediment grain size and type. The interaction of waves, tides and sea level changes with regional geology, and determines the shape of past, present and future shorelines and coastal barriers.

The shoreline of Shellharbour comprises sandy beaches (Warilla, Shellharbour North, Nuns, and Shellharbour South), exposed rock platforms (Cowrie Island and adjacent headland, Shellharbour Boat Harbour, Bass Point) and headlands and cliffs (Windang Island, Barrack Point, Bass Point, and headlands bounding Shellharbour Boat Harbour). Shellharbour's beaches are separated by prominent headlands, and the beach compartments formed by the headlands are said to be largely self-contained (SMEC, 2010). This is assumed to imply that the beaches have limited sand reserves that are largely retained within the individual compartments, with little (if any) sediment transport between the beaches (except perhaps under large wave conditions when significant offshore and longshore mobilisation of sediments can occur).

The beaches are all oriented towards the east-south-east, with Warilla Beach facing slightly more south and Shellharbour South Beach facing slightly more north. The majority of the shoreline is fully exposed to the predominant south easterly wave climate, except in the lee of prominent headlands. Bass Point, extending some 2.5 km eastward, is said to significantly reduce the incoming wave energy at the shoreline of Shellharbour South Beach, by as much as 70 to 40 % from south to north (PBP, 2006). Windang Island also provides some protection to Warilla Beach from wave energy arriving from north / north easterly directions. Given the short, pocket nature of the beaches and high energy wave climate, the sandy beaches tend to exhibit a single transverse or rhythmic sand bar, cut frequently along the beach by rip currents.

SMEC (2010) analysed the available geotechnical information to determine the depth/distance to bedrock that may constrain erosion or retreat of beaches. Data was only available at Shellharbour North Beach (in the vicinity of the Surf Club) and Shell Cove Marina entrance (proposed for the centre of Shellharbour South Beach). Also taken into account was the visible presence of rock platforms along and underlying Shellharbour Boat Harbour and the adjacent Nuns Beach. Nuns Beach is also constrained by bedrock behind the beach, which limits beach erosion but also enables the entire sand reserve to be stripped from the beach in certain conditions.

There are a number of prominent man-made features either existing or proposed that also control the geomorphology of Shellharbour's coastal zone, including:

- a training wall (rock groyne) on the northern bank of Elliott Lake's entrance, which was constructed in the late 1960s in concert with the seawall (see below), and was recently extended into the surfzone, to a total of 80 m in length;
- the seawall along the southern half of Warilla Beach that extends 1 km from the Elliott Lake training wall northwards, constructed in the 1960s following severe storm erosion. The seawall limits landward movement of the beach to protect a number of private residences and the public promenade / cycleway. The beach typically remained lowered with limited sand in front of the seawall, until nourishment occurred in both 2001 and 2007 using marine sand from the flood tide delta of the Lake Illawarra entrance channel;

- entrance training walls at Lake Illawarra, comprising a low rock wall between Windang Island and the northern end of Warilla beach across the tombolo, a southern training wall in two segments (a 450 m curve well inside the entrance then a 350 m relatively straight section extending from the entrance into the surfzone immediately behind, and now connected with, the Windang Island tombolo), and a northern training wall that is a curving 350 m structure from the dunes on Windang beach into the surfzone. The southern and northern training walls are substantial;
- the concrete and rock breakwaters forming Shellharbour Boat Harbour, which significantly reduce wave energy for the short sandy beach within the breakwaters; and
- proposed entrance breakwaters for Shellharbour Swamp (on Shellharbour South Beach) to form a marina for the Shell Cove development (refer Figure 3-1). It is unknown when these breakwaters will be constructed in the future.

Figure 3-1 Cove Marina Concept Design (Source: SCC)

3.3 Wave Climate

Wave climate in NSW is driven by the major climatic patterns off the coast, which generate waves, namely (Short and Trenaman, 1992; Short, 2007):

- Tropical cyclones (November to May), tracking towards the Tasman Sea (usually well offshore of the coast) that may generate north easterly waves;
- East coast cyclones (typically May, June and July), said to generate the strongest winds, heaviest rainfall and largest waves experienced on the NSW Coast. These small intense storms may form anywhere along the coast, generating waves from south easterly to easterly directions;
- Mid-latitude cyclones (occur throughout the year particularly March to September) form in the Southern Ocean and Tasman Sea and generate the predominant south easterly swell experienced along the coast. Mid-latitude cyclones form closer to the southern Australian continent in winter than summer, thus typically forming higher waves in winter;
- The subtropical anticyclone produces fine, warm weather on the NSW coast, and particularly during summer, may generate weak north east to easterly swells; and
- Onshore sea breezes forming in summer on hot days (as the land heats faster than the ocean, causing hot air to rise over the land and cooler air from the ocean to move in to replace it), which when persistent over days may generate weak north east to east wind waves.

Wave statistics (height, period) from both the Sydney wave rider buoy (which also records wave direction) and Port Kembla wave recorder from Manly Hydraulics Laboratory (MHL) (and funded by OEH) were utilised in the Shellharbour Coastal Hazards Analysis (SMEC, 2010). Previous analysis by BMT WBM of wave statistics from the Sydney wave rider buoy provided by MHL has found that the highest waves occur from March to July, with the lowest wave heights in spring, and this reflects the dominance and overlap of the wave generation sources outlined above.

Wave data from Port Kembla indicated the average significant wave height to be 1.6 m (SMEC, 2010), and this is consistent with data from Sydney. Wave direction is predominantly south-south east throughout the year, with up to 70% of waves arriving from the south east quadrant. This relates to the persistent occurrence of mid latitude cyclones year round. Wave directions shift to arrive more frequently from the east to east-north-east during summer, when tropical cyclones and north-east wind generation patterns occur. The dominance of south easterly waves along the NSW coast is an important mechanism in the generation of the dominant northerly littoral drift, as discussed below.

3.3.1 Wave Climate Variability

Throughout the wave record, the predominant wave direction has remained south east along the NSW coast, however, there are likely to be subtle shifts in the wave climate (wave height, wave direction) between years and even decades that relates to the intensity and frequency of storms (affecting wave height) and storm generation sources (affecting wave direction).

Variability in the wave climate is to be expected as the waves are generated by the larger climatic patterns. Variability in climate over inter-annual periods (2 – 7 years) in Australia is known to be

related to the El Nino Southern Oscillation (ENSO), and there is correlation between ENSO and wave climate variability over inter-annual cycles also. Climate variability at decadal time scales (10-30 years) is also an intrinsic characteristic of the Australian regional climate (Power *et al.*, 1999). A period of dramatic erosion and shoreline retreat over the 1950s and 1970s is well documented, since which time a relatively calmer period of beach recovery and lower storminess persisted to around 2007.

Such shifts in wave climate may manifest on the shoreline as a period of erosion or accretion, and variation in the direction and rate of alongshore sediment transport, both within an embayment (manifesting as "beach rotation") and between embayments. A series of storms (and associated water levels) over months to years and even decades will have a cumulative effect upon the shoreline, which may result in greater erosion than a single severe storm alone. Periods of higher or lower storminess in the wave climate (and subsequent cycles of erosion and accretion) can be expected to continue in the future.

3.4 Water Levels

Elevated water levels during a storm may comprise the following elements:

- **Barometric pressure set up** of the ocean surface due to the low atmospheric pressure of the storm;
- **Wind set up** due to strong winds during the storm "piling up" water onto the coastline;
- **Astronomical tide,** particularly the Highest Astronomical Tide that may reach up to 1.1 m AHD;
- **Wave set up**, which is the super elevation of the water surface due to the release of energy by breaking waves. It is directly related to wave height, so will be greater during storm conditions; and
- **Wave run up**, which is the vertical distance of the uprush of water from a breaking wave on the shore, and the key process causing overtopping of coastal barriers (dunes, seawalls etc.).

It is generally considered that the highest elevated water levels would occur for a limited time only (several hours) around the high tide.

Sea level rise will also contribute to elevated ocean water levels in the future, and must be considered in any assessment of inundation hazard.

3.5 Sediment Transport

3.5.1 Longshore Sediment Transport

Waves approaching the shoreline from an oblique angle generate a current alongshore which transports sediment. Depending on the prevailing wave direction, the longshore sediment transport may be directed either north or south along the coast. Longshore sediment transport (also commonly referred to as littoral drift) occurs predominantly in the mid to outer surfzone (3 – 12 m depth), diminishing in strength with distance offshore into deeper water.

On NSW beaches, including Shellharbour, net longshore sediment transport is directed to the north, due to the predominant south east wave climate relative to the general north to south orientation of the coastline.

3.5.2 Cross Shore Transport

During storms, increased wave heights and elevated water levels cause sand to be eroded from the upper beach/dune system (often termed 'storm bite') and transported in an offshore direction, typically forming one or more shore-parallel sand bars. As the sand bars build up, wave energy dissipation within the surfzone increases and wave attack at the beach face reduces. During calmer weather, sand slowly moves onshore from the nearshore bars to the beach forming a wave-built berm under the action of swell waves. From the berm, wind blows sand to form incipient dunes and foredunes.

On stable beaches such as those in Shellharbour, cross-shore transport does not represent a net loss or gain of sand from the overall beach system. While it may take several years, the sand eroded in the short-term during severe storms is returned to the beach and dune by persistent swell waves and wind, and there is overall balance.

3.5.2.1 Rip Currents

Rip currents facilitate the offshore flow of water from the surf zone, which has been delivered by onshore breaking waves. Rip currents are dominant upon high wave energy beaches, and can form at any location along the beach. During large waves, fewer rips form at greater distance apart, however, the currents are wider and stronger. Topographically constrained rip currents form at headlands or adjacent to reefs, to facilitate the offshore flow of water from breaking waves at the headland constraint.

Rip currents contribute to the extent of beach erosion during severe storms both in terms erosion of the upper beach face at the landward end of the current, as well as transporting offshore the sand mobilised by wave breaking.

3.5.3 Longshore and Cross Shore Transport at Headlands and Other Structures

Longshore transport along longer uninterrupted embayments for example Perkins Beach just north of the Shellharbour LGA, tends to be more continuous over time (months, years). For pocket beaches, such as found in Shellharbour, sediment movement past headlands, reefs and man-made structures, tends to occur as episodic 'slugs' of relatively large quantities of sand, requiring short term storm events (hours to days) with high wave energy to activate sand transport past the headland or reef, and into the next embayment.

While the average net longshore flow of sand may bypass a headland or reef over a period of years, thus maintaining beach stability, in the short term there is potential for imbalance in the sediment stores on an individual beach. For example, the downdrift beach may appear eroded, as potentially large quantities of sand moved away by longshore transport and bypassed into the next embayment during the storm are not immediately replaced by sand bypassing into the beach from the updrift embayment. The starvation of sediment from the beach in this instance may appear as short term erosion of the shoreline. For stable embayments such as Shellharbour's beaches, the

longshore transport into and out of the compartment is equal over the long term, enabling an overall balance in the cycle of storm erosion and recovery.

3.5.4 Influence of Man-made Structures on Warilla Beach

Warilla Beach is backed by a man-made seawall structure that connects from the Elliott Lake entrance training wall for around 1 km northwards to Strong Reserve. It is a sloped rock rubble structure that was constructed after a severe erosion event(s) in the 1960s threatened sewerage infrastructure and private residences (Iliffe, 2006).

Seawalls can interact with longshore and cross shore sediment transport to exacerbate erosion as follows.

- Erosion may be exacerbated at the end of the seawall, either because the wall is unnaturally holding the shoreline in a more seaward position than would otherwise occur (on a receding shoreline), or by transferring wave energy and storm demand to adjacent areas, enhancing erosion of adjacent soft sediments (on a stable shoreline); and
- There may be lowering of the beach in front of the seawall, which has been observed over the 1990s at Warilla Beach. This may be due to the alignment of the seawall being too far seaward or a sign that Warilla has experienced long term recession (so the beach does not recover after storms to accrete sediment over the structure). Both of these scenarios result in the seawall being frequently exposed, with the demand for sediment being met by erosion at the base of the structure.

Nourishment of Warilla Beach using dredge spoil from Lake Illawarra (marine sand from the flood tide delta) occurred in 2001 and 2007, with the placement of 100,000 m^3 then 200,000 m^3 in those years respectively. The program has been highly successful, and the beach is presently accreted and the seawall largely covered by sand.

The entrance training walls at Lake Illawarra have modified the northern end of Warilla Beach. The training walls have stabilised the position of the entrance to one location, directing the entrance channel to the north of Windang Island. Previously, under certain environmental conditions the lake entrance broke out to the south of Windang Island across the tombolo and northern end of Warilla Beach. It is noted here that the substantial sand extraction reported in AWACS (1991) did not occur across the northern extent of Warilla Beach, which instead is demonstrated in the photogrammetric data back to 1948 to have been a 2 -3 m berm. This provides good evidence that entrance breakouts to the south of Windang Island were a natural phenomenon of the untrained Lake Illawarra entrance, and not a result of human influences (refer to Section 3.9.1.1 for further discussion).

The construction of the southern training walls has enabled the dunes at the northern end of Warilla Beach to stabilise, resulting in accretion of sediment and establishment of dune vegetation in the northern dunes, which are now slowly progressing towards Windang Island across the tombolo. The photogrammetric data clearly shows the increase in height and width of the dunes at the northern end of Warilla adjacent to the tombolo, from a low berm around 2 m in height to dunes of 5 -6 m in height. The tombolo currently extends in width to the southern entrance training wall, across the smaller tombolo training wall.

2000: entrance to south of Windang Is

2009: entrance works complete

Figure 3-2 Lake Illawarra Entrance - historical changes (Source: OEH)

Warilla Beach is also influenced by the entrance training wall at Elliott Lake. The original configuration of the structure was built in the 1960s, at the same time as the seawall, and recently extended to 80 m (in 2007). The structure, in combination with the seawall, will have significantly stabilised the southern end of Warilla Beach. Prior to these structures, the natural entrance of Elliott Lake was likely to have been highly dynamic, with the breakout location potentially shifting to the north particularly during flood outflows from the Lake.

WBM (2003) noted that training of the Elliott Lake entrance has enabled regular tidal fluctuations, allowing the growth of mangroves but also, promoting the ingress of marine sand well into the entrance channel and north and south arms of the lake. This is because the flood (incoming) tide is of shorter duration and therefore greater velocity than the ebb (outgoing) tide, therefore marine sand is transported into the entrance under flood tide velocities, but velocities of the outgoing tide are insufficient to transport the sand out of the entrance. Periodic flooding events in Elliott Lake enable outflows of sufficient velocity to scour marine sand from the entrance and associated channels. Once flooding has ceased, marine sand ingress begins as tidal conditions again dominate the entrance hydrodynamics.

3.5.5 Influence of Proposed Structures on Shellharbour South Beach

Two breakwaters are proposed to provide a permanent, deep entrance into Shellharbour Swamp (which shall become the Shell Cove marina), as shown in Figure 3-1. The northern breakwater will extend for approximately 450 m and will be curved at its seaward end (to assist in interrupting the ingress of sediment into the marina entrance). The position of the northern breakwater is planned to be approximately in line with the road bridge across Shellharbour Swamp's channel on Boollwaroo Parade. The southern breakwater is intended to be shorter (~300 m) and straight. The existing frontal dune shall be extended southwards to the northern breakwater, and profiled to a height of 4.5 m (slightly lower than the existing dune), and the beach nourished for 120 m to the breakwater.

AWACS (1995) conducted an investigation of the impact of the proposed Shell Cove Marina breakwaters, involving physical modelling. The study indicated that the main breakwater would be expected to realign the beach planform, resulting in a 14 m landward shift (retreat) of the centre of the beach and a 44 m seaward shift (accretion) of the southern shoreline immediately adjacent to

the breakwaters. The realignment would be the result of change wave patterns in the beach sections adjacent to the structures, and so a change in longshore and cross-shore currents.

3.5.6 Sea Level Rise and Headlands, Structures and Reefs

Sea level rise will tend to exacerbate the interruption effect on littoral drift of natural headlands and man-made structures (e.g. Lake Illawarra's training walls). Erosion at the southern end of beaches would be exacerbated as it requires greater wave activity to bypass intervening headlands and man-made structures. Likewise, further accretion at the northern ends of the beaches will occur, as additional sediment would be trapped by the headland.

Seawalls, which form hard structures on the shoreline, are likely to act similarly to headlands as sea level rises. Where a seawall is separated from the ends of the beach, the seawall may form a headland and compartmentalise the beach, or may be outflanked by erosion at the edge of the seawall. Where a seawall is attached to bedrock constraints such as at Warilla, the seawall will constrain recession but will become exposed as the limited sediment reserves are eroded from in front of the seawall by the action of waves at higher water levels. There may also be edge effect adjacent to the wall as recession progresses past the structure. Outflanking of a seawall structure would likely destabilise the structure.

At reefs in the nearshore zone, sea level rise will result in impacts at the shoreline in lee of the reefs. The wave dissipation and refraction at the reefs would be lessened due to the greater water depths over the reef with sea level rise. The result is enhanced wave activity at the shoreline and subsequent erosion of tombolos, salients and sand lobes that had formed previously in the lee of the reef.

3.5.7 Aeolian (windborne) Sediment Transport

Aeolian, or windborne, sediment transport originates from the dry upper beach face and berm and unvegetated incipient dunes and foredunes, supplying sediment to foredunes further landward (predominantly under the influence of onshore winds). Dune vegetation combined with Aeolian transport is the key builder of foredunes, as the vegetation assists to capture and stabilise windblown sediment. The captured sediment is stored within the beach system, rather than lost to landward areas via further windborne transport. Thus, windborne transport typically contributes positively to the growth of incipient foredunes and storage of sediment in vegetated foredunes, providing protection during periods of beach erosion.

Loss or damage to vegetation on sand dunes, such as by the creation of informal tracks by walkers or four-wheel drive vehicles, and weeds such as Bitou Bush, may initiate sand blowouts and destabilisation of the dune system. For example, a relatively minor dune blowout was evident during the inspection of Warilla Beach by SMEC in 2009 (as reproduced in Figure 3-3), following storms in March and May of that year. Major dune blowouts may have consequences where significant volumes of sand are being lost inland, and the dunal buffer for storm erosion is diminished.

Figure 3-3 Minor Sand Blowout, Warilla Beach (from SMEC, 2010)

3.6 Coastal Entrances

There are three notable coastal entrances along the Shellharbour coastline:

- Shellharbour Swamp on Shellharbour South Beach is an intermittently closed and open lake or lagoon (ICOLL) at present, but is the site of the proposed marina development for Shell Cove. The marina development would involve construction of two entrance breakwaters traversing from the swamp into the surfzone and deepening of the swamp entrance channel to provide for boating and marina facilities (refer Figure 3-1). The construction would change the system from a mostly closed lagoon to a permanently open, tidal, marine waterbody;
- Elliott Lake, which drains the back beach areas of Warilla to the north and Shellharbour North Beach to the south. The lake remains permanently open due to an 80 m rock groyne on the northern side of the entrance (which is tied into the seawall along the southern end of Warilla Beach), and natural bedrock along the southern bank and headland;
- Lake Illawarra, which has two significant training walls on both sides of the entrance that direct the lake's entrance north of Windang Island. Prior to this, Lake Illawarra occasionally broke out across the far northern end of Warilla Beach (see Figure 3-2), and this would previously have had a substantial impact upon the character of Warilla Beach's northern end.

The hazards associated with coastal entrances, including erosion at estuary entrances, shoaling in estuary entrances, and inundation in various conditions are discussed in subsequent sections.

3.7 Climate Change

The key climate change impact of relevance to the assessment of future coastal hazards is sea level rise.

The Shellharbour Coastal Hazards Analysis utilised benchmarks of 0.4 m and 0.9 m rise above 1990 mean sea level, which were prescribed in the NSW Government's former Sea Level Rise Policy Statement. While the Sea Level Rise Policy Statement was recently repealed, the Chief Scientist and Engineer (2012) has stated that the way the science was used to determine the NSW Sea Level Rise Policy Statement benchmarks is adequate (refer Section 2.3). Until such time as new sea level rise projections are released (such as through the IPCC and / or CSIRO, as expected in late 2014), there is no justifiable basis for using alternative estimates for planning and land management purposes.

Climate modelling for the NSW Coast by McInnes *et al*. (2007) provides somewhat inconclusive projections, suggesting potential increases or decreases in wave heights. Furthermore, McInnes *et al*. (2007) suggests a potential shift in wave direction of ~ 4° to the east, which remains within natural variability of wave direction.

3.8 Storm Erosion Hazard

Beach erosion is typically defined as the quantity of sand transported offshore during the high waves and water levels of a storm, or series of frequent storms. For planning purposes, more so than the quantity of sediment eroded, it is the potential distance of landward movement of the shoreline that is of key importance. This potential landward extent of the beach must be understood in order to provide an appropriate setback for back beach development.

It is also important to note that the erosion that occurs during a storm is not permanently lost from the system. The sand eroded during a storm is typically located offshore in sand bars, where it is then slowly reworked back onto shore under the action of swell waves. Once at the beach berm, sand is blown by the wind into the dunes, rebuilding the dune and repairing the beach. While beach erosion is not necessarily a permanent issue for stable beaches (even as beach recovery may take many years), the erosion events can permanently destabilise and undermine back beach development (e.g. houses, surf clubs, cycleways etc.).

As noted by numerous authors including SMEC (2010), the quantity of sand eroded, or more importantly, the extent that the erosion escarpment moves landward during any one storm is dependent upon:

- The state of the beach prior to the storm (i.e. accreted, eroded or average), which may account for the frequent occurrence of storms prior;
- wave height and direction;
- water level (due to the combination of tide, storm surge and wave set-up);
- the duration of the storm water levels and wave heights; and
- the strength and location of rip currents (as noted above, rip currents tend to become more widely spaced, but the current becomes wider and stronger during high waves).

SMEC (2010) utilised the available photogrammetric (beach survey) data to derive storm demand (or storm cut) quantities for Shellharbour's beaches, as reproduced in Table 3-1.

Table 3-1 Design Storm Erosion Demand for Shellharbour's Beaches from SMEC (2010)

Beach Name	Design Storm Cut (m^3/m)
Warilla (northern end)	120
Warilla (centre)	150-160
Warilla (southern end)	55 (due to constraint of seawall)
Shellharbour North	200
Shellharbour South (northern end)	230
Shellharbour South (south, to immediately north of proposed marina entrance)	190

The approach taken to estimate the erosion volumes given in Table 3-1 is as follows. The photogrammetric data at each beach was analysed to determine the maximum landward position of the erosion escarpment, by tracking the movement of the 3.5 m contour for Warilla Beach and 3.0 m contour at Shellharbour South and Shellharbour North Beaches (these contours were found to best represent the movement of the dune face). To determine a storm erosion volume, the volume difference between the maximum landward position and the previous date of photogrammetry was calculated. This was 1973 to 1974 for Warilla and Shellharbour North Beaches to represent the 1974 storms, and 1993 and 2001 for Shellharbour South Beach, to represent the 1997 storms.

It should be noted that there are significant limitations in the use of consecutive dates of photogrammetry to represent the storm erosion volume for a single storm. The key limitation is that the dates of photogrammetric data may be one to many years apart, and so it is very questionable that the change between such dates truly represent a storm event (which may occur over days). This limitation is very evident where the 1993 to 2001 photogrammetric data has been used to represent a storm in 1997. Furthermore, this method cannot account for the state of the beach in the photogrammetry data used to represent the pre-storm state. For example, 1973 was also a relatively stormy year, and for some beaches this data represents an already eroded beach. Therefore, the volume calculations between 1973 and 1974 may potentially under-represent the full potential for erosion, or more importantly, landward set back of the beach during longer stormy periods.

Another key assumption by SMEC (2010) in defining the land area potentially affected by both the storm erosion hazard and recession hazard is that the Warilla Beach seawall is and will continue to provide adequate storm protection. The basis for this assumption and its implications for coastal hazards management are discussed in detail in Section **5.2**.

The limitations in methodology and assumptions can be adequately accounted for when determining the likelihood of the erosion hazard zones, as explained in Section **5.2**.

3.8.1 Dune Slope Instability

The slope instability hazard comprises both:

- the instability of rocky cliffs and bluffs that, depending upon the key mechanism for cliff retreat, may be exacerbated by wave attack; and
- Slumping of unconsolidated dune sands at erosion escarpments following beach erosion.

Erosion escarpments on beaches following a storm event may be near to vertical, and of substantial height depending upon the height of the dune eroded. Subsequently, it can be reasonably expected that this near vertical escarpment will slump back to a slope equivalent to the natural angle of repose of sand (approximately 1.5 Horizontal to 1 Vertical), assuming that the entire dunal volume is composed of sand. Structures located on dunes immediately behind the erosion escarpment may still be at risk following the event, due to dune slumping.

Nielsen *et al.* (1992) outlined the zones in front and behind the erosion escarpment on a dune face that would be expected to be under direct attack, or slump to become unstable following a storm erosion event (see Figure 3-4), as follows:

- *Zone of Wave Impact:* the area under direct attack from waves during the storm, i.e. the area landward of the erosion escarpment that essentially comprises the beach erosion hazard zone;
- *Zone of Slope Adjustment:* the area landward of the vertical erosion escarpment crest that may be expected to collapse after the storm event;
- *Zone of Reduced Foundation Capacity:* the area landward of the zone of slope adjustment that is unstable and expected to have reduced bearing capacity for buildings due to being in proximity to the adjusted or storm erosion escarpment; and
- *Stable Foundation Zone:* the area of the dune landward of the above zones that is considered unaffected by the storm erosion event, and within which no special foundations are required.

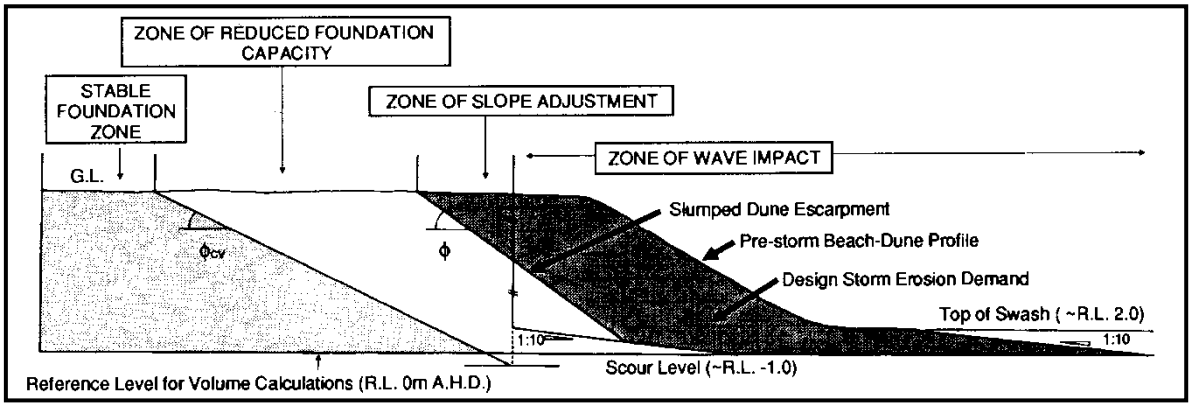

Figure 3-4 Design Profile and Zones of Instability for Storm Erosion (From Nielsen *et al.*, (1992)

The width of these zones will vary along the beach with dune height and dune sediment type. The width of the zone of reduced bearing capacity behind the top of an erosion escarpment is dependent upon the height of the dune above mean sea level and the type of dunal material, as different substrates will have a different angle of repose.

Therefore the zone of reduced foundation capacity measured and mapped in SMEC (2010) is indicative at best, as it assumes a consistent dune height and dunal material (i.e. sand). Detailed geotechnical assessments are required for all future development near to an identified erosion hazard zone in order to accurately determine foundation capacity and building design requirements.

3.9 Long Term Recession Hazard

Long term recession is defined as a permanent loss of sediment from the coastal system. That is, unlike beach erosion events in which the sediments are retained and are slowly returned to the beach overtime, recession occurs where the sand transported from the beach is never fully returned.

It is important to distinguish between the permanent loss of sediment from the beach system, and the periodic imbalance in sediment supply that may occur on stable beach systems. A stable beach system may "lose" sediment over the short to medium term when it is transported offshore and/or into the next beach compartment, at which point the beach may appear significantly eroded. Such eroded states can last for some time (years) depending upon the wave climate conditions. But over time, the sediment is returned to the beach from adjacent beach compartments and onshore transport, retaining a relatively equal quantity of sediment. It is noted that even the transgression of marine sand into estuary entrances is balanced overtime, as such sediments are returned into the surfzone during breakouts and flood events.

In contrast, for a beach experiencing long term recession the sediment volume transported out of the system (via longshore and cross-shore processes) is greater than the sediment volume transported into the system over the long term. Receding beaches characteristically have a prominent erosion escarpment that slowly moves landward and rarely appears to recover after storm events.

The mechanisms that result in long term recession of beaches most notably include:

- Interruption of the natural sediment transport pathways due to the emplacement of structures such as groynes, breakwaters and even seawalls. Over long periods (100 years +) the coastal system can adapt to such structures, but there may be significant recession impacts in the intervening period; and
- Sea level rise.

Aeolian (windborne) sediment transport was also noted as a possible mechanism for permanent loss of sediment from the beach by SMEC (2010). Aeolian processes are notable at large, active transgressive dune fields (for example, Stockton Beach in Newcastle), although in such cases the coastal system has typically adapted to this as a natural pathway for sediment movement into adjacent beaches. Furthermore, sediment lost into unvegetated dunes is often returned under the opposing wind conditions (for example, strong easterly winds in summer are matched by strong westerly winds in winter). For small pocket beaches such as Shellharbour where sediment supply and dunal reserves are fairly limited, Aeolian transport is unlikely to be a significant component of the sediment transport system.

3.9.1 Historical Long Term Recession

The analysis of long term recession provided in the Shellharbour Coastal Hazards Analysis considered both the horizontal movement of dune contours over time and changes in dune volumes over time, from the photogrammetric data. SMEC (2010) concluded that, based upon the existing data, all of the beaches are presently stable. Indeed, review of the photogrammetric data illustrates stability of Warilla Beach, particularly at its northern end, which was previously stated to be experiencing long term recession.

3.9.1.1 Long Term Stability and Changes on Warilla Beach

The AWACS (1991) report stated that extensive sand extraction from the dunes at Warilla Beach between the 1940s and 1970s resulted in the destabilisation of the dunal barrier across the northern end of the beach and tombolo, and allowed the entrance of Lake Illawarra to breakout in this region. Furthermore, AWACS (1991) stated that as a result of the sand extraction, the denuding of the dunes at the northern end of the beach promoted sand drift across the tombolo, causing infilling of the entrance to Lake Illawarra. The infilling of sand into Lake Illawarra was stated to have caused up to 800,000 m^3 of loss of sand from the sub aerial beach system and resulting in ongoing erosion of Warilla Beach.

Review of the photogrammetric data by BMT WBM for this study does not support this view, and provides an alternative picture of the natural coastal system of Warilla Beach as presented below.

For the southern end of the beach to the public reserve (vacant land) north of Bucknell Street, review of the photogrammetric data particularly between 1948 and 1966 does not illustrate a lowering of the dunes in this region, except at the two most southern profiles. The dunal height through this area remains at around 7 m from 1948 to present.

From the vacant land northwards to just before the last residential property, the dune height of the back beach area remains similar to present (8- 9 m), with some minor lowering most likely relating to residential development, rather than major sand extraction. There is evidently loss of the immediate frontal dune between 1948 and 1961, with further loss to 1966, seen as a landward shift of the dune face of some 20 m over that period. It is very likely that the loss of this dune occurred due to erosion from the documented storms during that time, rather than sand extraction.

The 1948 photogrammetry clearly illustrates that the central portion of the beach for 800 m north of the front line of houses did have dunes of around 10 – 14 m in height (except for a 150 m section of lower dunes in the vicinity of the surf club). The photogrammetric data shows substantial lowering of the dunes across this section, variously between 1948 and 1961, 1961 and 1966, or after 1966 to the present height of around 5 m. This provides strong evidence of the extraction of sand from the dunes across the central portion of the beach.

The 1948 photogrammetric data, however, illustrates that the northern section of the beach and tombolo did not have dunes of this height or width. In 1948, the dunes ranged from a narrow 5 m frontal dune (connected with the dunes to the south) to a low 2 m berm adjacent to the tombolo to Windang Island. The review of 1948 aerial photographs provided by SMEC (2010) further supports this view, identifying “an old channel entrance of Lake Illawarra is noticeable around the northern third of Warilla Beach”. SMEC (2010) also note that the “Lake Illawarra entrance reaches the

northern half of Warilla Beach". Indeed, the photogrammetric data illustrates the growth in width and height of dunes at the northern end of Warilla Beach, as this area has been stabilised by the training walls of Lake Illawarra.

The data strongly suggest that the northern section of Warilla Beach was influenced by the Lake Illawarra entrance for many years prior to the construction of the training walls, including washover of the tombolo and occasional breakouts of the entrance channel through this area. This refutes the suggestion of AWACS (1991) that the extraction of sand from Warilla's dunes enabled a destabilisation of the dunes, allowing the Lake to breakout to the south of Windang Island, and therefore, sand to be transported from the lowered dunes into the entrance of the Lake, promoting marine sand ingress into the entrance channel and substantial loss and erosion of sand from Warilla Beach. The photogrammetric data does illustrate two sections of around 100 m and 200 m respectively where the dunes were lowered to around 2 m by 1966, but by 1973-4, dune heights had returned to a height of around 4 m. During that time, these sections may have promoted entrance breakouts, but by 1973-4, this phenomenon was largely resolved by accretion of the dunes.

The photogrammetric and aerial photography data illustrate that Lake Illawarra entrance influenced the northern end of Warilla beach before 1948 (and the period of sand extraction), and therefore, any ingress of sand into the Lake's entrance was a natural phenomenon that the coastal system was adapted to. Indeed, it could be suggested that training of the entrance has ceased the delivery of marine sands into Warilla Beach that would previously have occurred when flood outflows broke through to Warilla.

It is interesting to note from the photogrammetric data that after the construction of the seawall in 1966, the beach in front of the wall never appeared to recover until very recently (2007 to 2011). At present, accretion and heightening of the beach in front of and onto the seawall is evident. It is suggested that recent campaigns to nourish the beach with sand dredged from Lake Illawarra have been successful in promoting healthy sand reserves on the beach and seawall at present.

3.9.2 Future Recession due to Sea Level Rise

It is well appreciated that the shoreline will move upward and landward in response to a rise in sea level. The response of the entire shoreline moving upward and landward is evidenced in the geologic record, for example, the inner sand barriers of the north coast of NSW that were formed by the previous high sea level around 120,000 years ago when the sea level was some 5 m higher than present. With a higher water level, waves act upon a higher part of the shoreline and initially erode that section of shoreline, with the formation of the beach berm and incipient dunes shifting further landward and upward in response to the higher water level.

The extent of recession of the shoreline caused by a rise in sea level is commonly approximated using the Bruun Rule (1962), as shown in Figure 3-5. The Bruun Rule is a simplistic estimation of the recession hazard, and has considerable limitations. Most notably, the Bruun Rule only considers cross-shore change and does not account for longshore sediment transport (within or between embayments) or structural features of the shoreline such as headlands, reefs, rock platforms and underlying bedrock, and man-made structures such as training walls, groynes, or seawalls that may influence the geomorphologic response to sea level rise.

SMEC (2010) applied the Bruun Rule (1962) to estimate shoreline recession due to sea level rise, noting the limitations of this calculation. The sea level rise values of 0.4 m by 2050 and 0.9 m by 2100 above the 1990 mean sea level (previously prescribed by the NSW Government) were used in the calculations. Shoreline recession due to sea level rise at each beach is given in Table 3-2. As seen below, the extent of landward movement of the shoreline is dependent upon the slope of the nearshore zone, with steeper slopes promoting lesser recession, and vice versa.

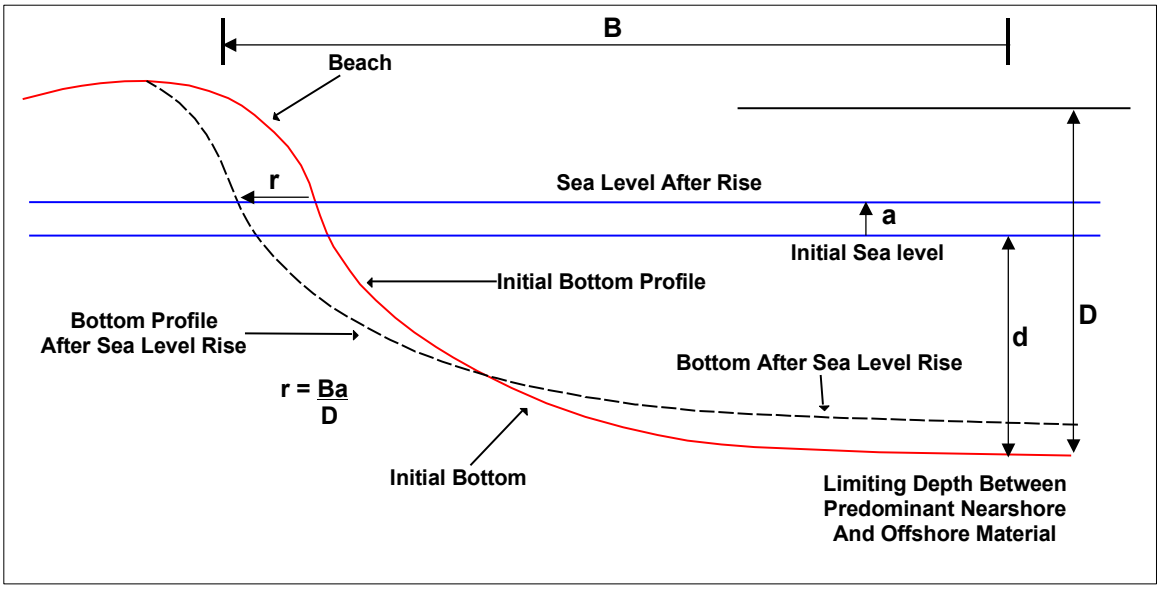

Figure 3-5 Bruun (1962) Concept of Recession due to Sea Level Rise

Table 3-2 Estimated Shoreline Recession at Shellharbour's Beaches (from SMEC, 2010)

Beach	Recession (m)		Estimated Equilibrium nearshore slope
	2050 (0.4 m SLR)	2100 (0.9 m SLR)	
Warilla (northern end)	26.4	59.4	1:66
Warilla (centre)[1]	23.3	52.4	1:58
Warilla (southern end)[1]	24.8	55.8	1:62
Shellharbour North	21.6	48.6	1:54
Shellharbour South (northern end)	17.2	38.8	1:43
Shellharbour South (southern end)	12.4	28	1:31

[1] *Assuming no seawall.*

3.10 Coastal Inundation and Wave Overtopping

The coastal inundation hazard comprises:

- elevated ocean levels due to astronomical tide, inverted barometric setup and wind setup (storm surge) and wave setup that may inundate estuary foreshores, lake and lagoon foreshores (closed or open) and low lying back beach areas hydraulically connected to the ocean;

- a dynamic component due to wave breaking and run up that may overtop of coastal barriers, such as (dunes, seawalls, cliffs and so on); and
- Sea level rise will also contribute to elevated ocean water levels in the future, and must be considered in any assessment of inundation hazard.

Wave run-up may not present a hazard unless the run-up is overtopping coastal barriers at a rate or volume that would cause a significant impact to pedestrians or land and assets behind.

The assessment of coastal inundation in the Shellharbour Coastal Hazards Analysis (SMEC, 2010) concentrated upon the wave run up hazard on the open coast only, and did not include consideration of the impact of elevated ocean water levels on inundation in estuaries that are connected to the ocean. Wave run up was only calculated and mapped for the present time period by SMEC (2010). No estimation of potential wave run up level with sea level rise was provided.

Wave run-up was calculated by summing nearshore wave set-up, maximum offshore water levels, and maximum wave run up from the Automated Coastal Engineering Software (ACES). The following parameters were used:

- The 0.1 % AEP ocean water level of 1.48 m was applied as the maximum water level;
- The 0.1 % AEP wave height of 11 m from Port Kembla was used in calculations of wave set-up and wave run-up; and
- The 0.1 % AEP wave height was translated to the nearshore zone at relevant beach locations using SBEACH modelling software, and then the nearshore incident wave height used to calculate wave run up in ACES and wave-set up.

The results for maximum wave run up and the 2% wave run-up level the relevant beach locations from SMEC (2010) are provided in Table 3-3 (noting that the 2% run up level refers to the level exceeded for 2% of the time for the same wave conditions, and is typically used for hazard definition purposes).

SMEC (2010) also undertook a detailed assessment of wave run up at 27 locations around Bass Point, considering the 1 in 100 year (1% AEP) storm event. The assessment considered the present day and future timeframes of 2050 and 2100 including sea level rise (at benchmark levels). For a bedrock coastline such as Bass Point there will not be landward translation of the shoreline as observed for sandy shorelines, therefore it is possible to map future wave run up levels with some certainty. The assessment considered maximum wave run up from those wave directions that were found to generate the highest waves at the shoreline (through nearshore wave modelling). The range of wave run up levels was from 4.4 m to 9.1 m AHD for the present day scenario. For 2050 and 2100 including sea level rise (of 0.4 m and 0.9 m respectively), wave run up ranged from 5.0 m to 9.8 and from 5.5 m to 10.3 m respectively.

Given that Bass Point is largely a nature reserve and a quarry site and that a storm event that could result in such run up levels is infrequent and of short duration (because the maximum run up level is dependent upon the peak of the high tide), the risk from run up levels would generally be considered to be low.

Table 3-3 Present Day Wave Run up levels for the 0.1 % AEP (1000 year ARI) storm event (from SMEC, 2010)

Beach	Maximum Wave Run up	2% Wave Run up
Warilla (northern end)	4.886	4.496
Warilla (centre)[1]	8.949	7.489
Warilla (southern end)[1]	6.697	5.847
Shellharbour North	5.363	4.893
Shellharbour North (northern end)	6.176	5.476
Shellharbour Boat Harbour	4.731	4.451
Shellharbour South	4.59	4.27

3.10.1.1 Inundation within Lake Illawarra

A draft Lake Illawarra Floodplain Risk Management Plan and Floodplain Risk Management Study was completed by Cardno (2011a, 2011b). The Cardno (2011a) report provides guidance for management of flood risk including inundation from ocean water level events for the foreshores of Lake Illawarra within the Shellharbour LGA, and therefore, no further consideration of this hazard is required in the Shellharbour CZMP. The Cardno (2011a, 2011b) reports outline the risks to properties on the foreshores of Lake Illawarra within the Shellharbour LGA, considering catchment rainfall, elevated ocean water level events, changes in rainfall due to climate change, and rises in sea level. In addition, Cardno (2010) investigated the inundation from ocean water level events at present and at 2050 and 2100 including sea level rise. The studies by Cardno (2010, 2011a, 2011b) illustrate that inundation due to a 1 in 100 year rainfall event is greater than inundation from a 1 in 100 year elevated ocean water level event. Cardno (2011a, 2011b) also investigated inundation levels for the likely combination of catchment rainfall and elevated ocean water level events including sea level rise. Cardno (2011a) summarise Lake Illawarra inundation as follows:

"Floodwaters within the Lake and its surrounding floodplain are characterised by slow velocities and a near horizontal water surface. Closer to the Lake entrance inlet, the floodwaters accelerate into the entrance channel to pass under the Windang Road Bridge and out to the Tasman Sea. The high velocities in the entrance channel scour sediment from the entrance channel, widening and deepening the channel as the flood progresses, with the channel width limited by the training walls. The rate and depth of flooding of the Lake and its foreshores are controlled not only by the rate of catchment runoff but also to a large extent by the size and degree of shoaling of the Lake entrance channel at Windang and the coincident ocean level".

3.11 Coastal Entrance Hazards

Hazards relating to coastal entrances include:

- Erosion within and adjacent to natural entrances during entrance breakouts;
- Coastal Inundation within estuaries during high ocean water levels; and

- Entrance conditions, particularly the formation and height of entrance berms and marine sediment ingress, at present and in the future with sea level rise.

For typically closed entrances such as Shellharbour Swamp, the existing and future berm height and closure characteristics may modify the extent of inundation in back beach areas during closed entrance conditions. For future time periods, berm heights are expected to increase by an amount roughly equal to the rise in sea level. Until the Shell Cove Marina entrance breakwaters are constructed at Shellharbour Swamp, there is the potential for scouring of the entire entrance area and migration along the beach. The extent of this hazard was not quantified or mapped by SMEC (2010), although it would be expected that this hazard will be mitigated by the marina construction in the future.

For typically open entrances such as Elliott Lake, and presumably Shellharbour Swamp in the future once the Shell Cove marina is constructed, the training walls limit the migration along the beach of the entrance position over time, thereby limiting the potential for erosion adjacent to these entrances. At both Elliott Lake and Lake Illawarra, the marine tidal deltas have extended much further into the estuaries as a result of entrance training. For Lake Illawarra, this was expected to occur (and indeed, has occurred) in response to the finalisation of the training walls. For Elliott Lake, marine sands have extended well into the northern and southern arms of the estuary in the nearly 50 years since entrance training works (WBM, 2003).

In the future with sea level rise, it is expected that the marine tidal delta in Elliott Lake and Shellharbour Swamp will migrate further inland in a similar process and manner as landward transgression of the shoreline, increasing the length of shoaling at the entrance. Depending on the geological controls at the entrances, for example the existence of bedrock below the entrance channel, the entrances may potentially close. For the larger Lake Illawarra entrance, constriction due to entrance training is expected to promote continued scour within the entrance, which is deposited at the landward end of channel at the entrance to the main body of the lake. Theories vary with respect to the sea level rise response of entrances such as Lake Illawarra that are continuing to scour, and it is currently thought that such entrances will continue to scour with sea level rise.

The Shellharbour Coastal Hazards Analysis (SMEC, 2010) did not provide guidance as to the potential height and extent of inundation within estuary entrances during elevated ocean water levels. It was assumed that this component of estuary hazard would be defined during flood studies for the various catchments, as under NSW Government legislation and guidelines flood studies are required to include design ocean still water levels plus wave set up and future sea level rise. Until a flood study is completed, a coastal inundation water level (excluding wave run up) can provide such an interim flood level for Council when considering development in the catchment. Existing or future inundation water levels excluding wave run up were not provided by SMEC (2010). For Elliott Lake, a flood study is yet to be completed. As described in Section 3.10.1.1, the inundation hazard within Lake Illawarra is already being managed through the floodplain risk management process. A flood study was completed for Shellharbour Swamp with respect to the Shell Cove Marina development.

3.12 Seawall Condition and Performance

The Warilla Beach seawall was constructed as an ad-hoc response to storm events up to 1966 that threatened private properties and sewerage infrastructure. The seawall was constructed by dumping rock along the toe of the erosion scarp at the back of the beach from 1966 to 1968 (Illiffe, 2006). Subsequent maintenance to upgrade and extend the seawall occurred following storms in 1974, 1975 and 1978 (AWACS, 1991). Since 1980, maintenance works have tended to involve additional rock fill and strategic placement of rock boulders to stabilise the seawall (Illiffe, 2006). While the boulder size and design (particularly the core and toe of the structure) of the seawall is not considered to be consistent with current coastal engineering standards (including the absence of a geotextile underlay to prevent fines washing through the wall under direct wave action), the seawall has served its purpose to provide protection to back beach assets (Illiffe, 2006). Importantly, Council has consistently maintained the wall to continue to provide such protection.

AWACS (1991) conducted a structural investigation of the seawall, including excavation at a series of locations along the wall to determine the construction material and shape. AWACS (1991) found that:

- The slope of the revetment is satisfactory, and consistent with the criteria for stable slopes;
- The core material is undersized compared with the criteria for engineered seawalls;
- The crest level of the seawall is typically above the minimum acceptable criteria, and in the few locations below the acceptable level, action to increase the crest elevation would be completed easily; and
- The toe level and design is not to engineering standards and presents the greatest risk of failure of the seawall. Adequate engineering design would require that graded toe platform of rock armour be constructed, extending 5 m seaward from the wall and buried to –1m AHD or deeper, and to a thickness up to 3 m.

The AWACS (1991) report found that massive failure of the seawall is likely under severe storm conditions. Iliffe (2006) also found that, should the beach and seawall be subject to a series of severe storms, the risk of rock falls from the structure potentially resulting in injury or death was high, and the risk of damage to property from failure of the rock wall was high. Iliffe (2006) noted that under existing beach and wave conditions, such rock falls or collapse is considered highly unlikely.

SMEC (2010) provided advice on more appropriate design conditions for the seawall based on the expected 1 in 100 year storm event. SMEC (2010) found that armour stones should have a median weight of about 4.5 tonnes, and a layer thickness of around 2.4 metres. The underlayer should be about 1.1m thick and comprise stone of median weight 450kg. At present, there are few armour stones that would exceed 1 tonne (AWACS, 1991). SMEC (2010) also recommended that the toe of the revetment comprise a three rock wide berm, at a level that is approximately one metre below Lowest Astronomical Tide (LAT). At present there is no rock toe berm at the base of the seawall, which would seriously compromise the integrity of the wall should there be significant scour of the seabed. SMEC (2010) recommends that the existing seawall be replaced with a new wall that meets the engineering standards set out in their document.

Despite the obvious limitations of the existing seawall, SMEC (2010) assumed that the seawall would continue to provide adequate protection by 2050 and 2100 and limit the potential for beach recession due to sea level rise. It is noted that sea level rise will result in an increase in the ability for storms to attack back beach areas, which would increase the exposure and frequency of wave attack on the seawall. It is therefore imperative that ongoing maintenance of the existing seawall structure (which will need to include substantial improvements to the toe of the structure to mitigate the potential for undermining and collapse when the structure is exposed) be included as a management strategy within this CZMP, to ensure that the Warilla seawall continues to protect back beach assets at 2050 and 2100. The current strategy of nourishment is useful in providing for beach amenity and prolonging the occurrence of exposure of the seawall. Nourishment alone would not provide the structural maintenance required to sustain the seawall into the future, as sea level rise is likely to expose the wall on a more frequent basis (for which, nourishment requirements would be prohibitively exhaustive and expensive). Regardless, beach nourishment should form part of the maintenance strategy particularly to preserve beach amenity.

3.13 Cliff Slope Instability Hazard

The potential for cliff instability (and the rate of cliff retreat) is dependent upon a range of factors, including weathering rainfall, surface water infiltration groundwater movement and earthquakes/tremors, which may result in instability at the crest of a cliff (and therefore may not relate to oceanic processes), as well as wave attack and sea level rise that may affect the toe of a cliff.

Anthropogenic factors such as land use change and removal of vegetation may enhance the potential for cliff instability.

SMEC (2010) undertook a slope stability assessment of the cliffs and headlands within the Shellharbour LGA. Three locations were investigated in detail:

(1) Between Town Street and Surf Road, north of the Boat Harbour;

(2) Parallel to Shell Cove Road at the northern end of Shellharbour North Beach; and

(3) Below Headland Parade, Barrack Point.

SMEC (2010) found that the most commonly occurring failure mechanisms at these sites were block falls relating to the undercutting of the cliff from wave and tidal action. There was also some evidence of landslip, as well as overburden creep downslope.

Critical zones were identified by SMEC (2010) for these three sites, being a 20 m, 10 m and 20 m setback from the top of the cliff slopes, respectively. These setbacks coincide with existing dwelling structures at sites 1 and 2, while at site 3, the presence of the road (Headland Parade) immediately behind the top of the cliff ensures that private dwellings are landward of the setback line. SMEC (2010) recommend that any new development within the critical zone is referred to a geotechnical expert for feasibility, risk assessment and triggering of slope instability. SMEC (2010) also recommend that slope hazard zonings be used for landuse planning purposes as a mechanism for limiting exposure of future risks to geotechnical hazards.

4 Community Use Assessment

The Shellharbour coastline is an important feature in the local community environment of the Shellharbour region. Shellharbour Boat Harbour forms the iconic historical centre of coastal activity, while Warilla Beach, Shellharbour North Beach and Shellharbour South Beach provide sandy shorelines for local community and tourism enjoyment. Warilla is likely to be one of the more frequented surfing locations, although all the beaches offer swimming and surfing and other recreational opportunities and are well frequented. A summary of facilities located along the Shellharbour coastline is provided in Appendix B.

Some general information regarding the conditions of the Shellharbour beaches suitable for water-based recreation is provided by Surf Lifesavings Australia via their Beachsafe website, and has been summarised and included in Table 4-1. In addition to this, an on-line community survey was conducted as part of this study to capture information on community usage of the coastal zone. The results of the survey are provided in Appendix C, and are summarised below.

4.1 Community Use Survey

The online community use survey had 31 responses by August 2012. The responses provided useful and site-specific information for this assessment. It is apparent that Shellharbour's coastline is an important social and recreational feature of the local community and tourism industry of the region.

4.1.1 Warilla

Eighteen survey entries were recorded for Warilla Beach, the highest of all Shellharbour beaches. Overwhelmingly, respondents said that they use Warilla Beach on a daily basis, mostly for walking/running, swimming and surfing. Fishing from Warilla Beach is also popular.

The most popular features of Warilla Beach include the recreational facilities around Elliott Lake, as well as the protected waters of the tidal inlet, which makes it ideal for young families. The cycleway and parking are also popular.

In terms of potential improvements, respondents suggested that access through the dunes at the northern end of the beach could be improved, while some facilities, such as the surf club, could be rejuvenated. There was also a call for more sand on the beach, to hide the seawall and enhance the visual amenity of the beach.

4.1.2 North Beach / Nuns / Shellharbour

Eight survey entries were received for North Beach, with most respondents indicating that they utilise the beach on a daily basis. Major activities include swimming and surfing. The amenities of the surf club and the open space behind the beach were seen at key attributes, especially the lawn area. Only minor improvements to recreational facilities were suggested, as well as greater flexibility regarding life guard hours.

Table 4-1 Beachsafe Information provided Surf Lifesaving Australia (beachsafe.org.au)

	Warilla	Shellharbour North/Nuns	Boat harbour	Shellharbour South
Beach Conditions	The northern half of the beach is backed by the entrance training wall then natural dunes, which have been stabilised to form a large park, with the Warilla SLSC and a car park located toward the southern end. High rock seawall and bike path that backs the southern 1 km of beach terminating at a groyne at the creek mouth. The inner bar is usually attached to the beach and cut by 6-8 rips, with their intensity, decreasing toward each end.	Shellharbour SLSC (formed in 1936) is located at the southern end. The beach is backed by a low vegetated foredune, then a road and bike path. The waves produce 6-8 rips across the usually attached bar, while permanent rips flow out against the rocks at either end.	Within the actual Shellharbour is a 60 m long stretch of protected sand. Two attached breakwaters and a 40 m wide entrance protect the cluster of moored boats and the beach, with conditions usually calm inside	A caravan park lies behind the northern rocks, with a beach car park on the southern side. The road to Bass Point runs between the low dune and Shellharbour Swamp, with the usually dammed mouth breaking out across the southern end of the beach during rain. Usually maintains a continuous attached bar, cut by up to six rips during higher southeast swell when a strong rip can develop against the northern rocks, and during summer northeast wave conditions.
Swimming	A potentially hazardous beach with rips dominating the surf. Lifeguards also patrol the northern end between Christmas and Easter.	The southern end of the north beach is patrolled and provides the best location for swimming.	The harbour beach is unsuitable owing to boat traffic, the rock pool is not only safe but also patrolled by a lifeguard from Christmas to Easter.	The southern beach is patrolled and provides the best location for swimming.
Surfing	Beach breaks occur along the beach, however at high tide waves crash on the southern seawall. The south side of Windang Island has a good left that can hold most swell up to 5 m and offers a prime big wave spot.	Beach breaks along main beach, while off the southern rocks is a hollow right-hander called Cowries, which works best in moderate east to southeast swell.	no surf in the harbour but there is a right off the pool called The Pool and a left called Shatters	-
Fishing	Good gutters are common along the northern part of the beach, as well as the southern creek	Good rock platforms at the ends of each beach, plus beach gutters following high seas, while the harbour has a boat ramp		
Parking	Sealed, 20 places	Sealed, 100 places		-

4.1.3 South Beach

Five survey responses were received for South Beach, with most visiting the beach on a weekly basis. Key activities for South Beach include walking/running, swimming, surfing and playing with children. Respondents particularly appreciate the fewer number of people at South Beach, with it feeling more natural and undisturbed. Respondents are also keen to avoid any significant changes to the beach amenity and environment, especially regarding further development. Some minor improvements to facilities were recommended.

4.2 Beach Amenity and Values

Overall, the beaches of Shellharbour provide different experiences for the local community. The expanse of Warilla Beach is valued for walking and exploring in the dunes, North Beach is valued for its open space, swimming and surf club facilities, and South Beach is valued for its more natural appeal and fewer visitors.

4.3 Public Access and Amenities

There is generally sufficient public access and facilities in the coastal zone of Shellharbour. Despite some recommendations through the community survey, much of the facilities and access (including seating, picnic facilities, landscaping, weed management, parking, footpaths, signage and roadways) have been upgraded over the last 2 -3 years, as part of the SFMP (2004), and so the facilities are currently in good to very good condition. A summary of public facilities based upon the SFMP (2004) and recent landscaping works is provided in Appendix B.

4.4 Recreational Usage of the Coastal Zone

The SFMP provided an initial insight into recreational use of the Shellharbour region including the coastline, based upon a survey conducted on behalf of Council in 1996. Results from the survey are reproduced from the SFMP (Rigall and Associates, 2004) in Table 4-2.

The survey results are divided across age group and recreational activity. The survey indicated a third of respondents utilised local beaches over summer, with a relatively small percentage indicating surfing as a frequent recreational activity (7%). Other popular activities such as cycling (49%), walking (61%), fishing (35%) and jogging (11%) are very likely to encompass the open coast and estuary regions, although the specific locations for such activities are not explicitly noted in the survey. These activities correlate with the findings of the small community use survey conducted as part of this study (results presented in Appendix C).

The SFMP outlines the following recreational usage of Shellharbour Boat Harbour (Rigall and Associates, 2004):

- Cowrie Island and causeway are primarily used for boat launching, walking, surfing, fishing, swimming, cleaning fish and boat maintenance.
- The Beverly Whitfield Pool is used by local residents, caravan park visitors and other visitors to the area.

- Little Park Area: bandstand, picnic facilities, beach, are an attractive feature for picnickers and in particular young families, an important public space due to its location near the Shellharbour village CBD and its cultural heritage.
- The Shellharbour Boat Ramp / Australian Volunteer Coast Guard (AVCG) provides easy launching and convenient parking. The proximity to the AVCG and the lack of other launching facilities in the area make this a popular boat launching facility, especially on weekends.
- Walkway / cycleway: frequently used by local residents and visitors to the area
- Snorkelling: clean water, a variety of marine life and the sheltered harbour allow snorkelling in the area.
- Sunbaking: clean sandy beaches and headlands sheltering sunbathers from strong winds encourage sunbathing.
- Surfing: a variety of reef and beach breaks and exposure to various swell directions, make the area a very popular surfing destination for residents and tourists alike.

At the Bass Point Reserve, the Beaky Bay picnic area, Bushranger's Bay and coast from Beaky Bay to shipwreck point are sites with a high level of recreational use mainly for fishing, diving, walking and picnicking (Manidis Roberts, 2000).

Table 4-2 Recreational Usage of the Shellharbour Region and Coast (from SFMP, 2004)

Involvement in past 12 months	Age Group and % Involved in Past 12 Months					
	5 – 14 (N=271)	15 – 24 (N=223)	25 – 39 (N=371)	40 – 54 (N=276)	55+ (N=237)	Total (N=1377)
Fishing	52.0	33.4	38.9	29.5	18.4	**35.2**
Jogging	13.6	22.1	11.7	7.3	1.8	**11.2**
Made general use of outdoor areas, ovals, fields etc	31.0	33.6	24.3	20.6	14.9	**24.7**
Push bike riding	86.4	62.4	47.9	35.5	12.5	**49.3**
Rollerblading	54.6	15.8	4.6	1.3	0.4	**14.8**
Swimming in council's pools*	91.4	62.3	60.8	41.5	21.7	**56.5**
Surfboard riding	7.8	16.0	8.0	1.9	0.0	**6.6**
Used a beach last summer*	82.8	79.6	70.2	57.6	30.7	**64.9**
Used a local park	90.6	59.9	78.4	69.5	57.6	**72.5**
Walking for fitness/leisure	52.2	58.8	61.6	66.7	67.2	**61.3**
* Relates only to the 13 weeks of summer						

Visits to the area in 1994/95 ~ 253 000, 1995/96 ~ 283 000 and 1996/97 ~ 274 000.
Source: (SFMP04)

4.5 Cultural and Heritage Values

There are a few key areas within the Shellharbour LGA coastline that have significant Aboriginal and Non-Indigenous cultural heritage values.

The entire Shellharbour Boat Harbour foreshore and breakwaters below Wollongong Street are zoned as a Heritage Conservation Area. Shellharbour Boat Harbour and the nearby Shellharbour Village give a unique insight into the history of the area. Shellharbour's Boat Harbour walls are now over a century old. During the era when shipping was the main method for transportation of goods in NSW (prior to trains), the safe port and loading jetty were heavily utilised. For a short period after trains became the dominant transport mechanism for goods and people, the growth of Shellharbour waned, until coal was discovered in the region. After this, a steady rate of growth has continued to the present.

Shellharbour's breakwaters provide a significant and culturally valuable, visual reminder of the establishment of Shellharbour. Within Little Park at Shellharbour, there are also a number of Norfolk Island Pines and Moreton Bay Figs that are listed as Heritage Items of Regional Significance, as another marker of coastal settlement.

Aboriginal heritage, such as associated with the Shellharbour Boat Harbour, Tourist Park and Bass Point, is significant and diverse. There are thought to be many specific sites of archaeological significance (e.g. middens) as well as many other areas of cultural significance (e.g. special places) within the coastal areas of Shellharbour.

Bass Point is an important heritage site and is listed on the State Heritage Register as a place of significance due to its Aboriginal and European values (including pre and post contact history) and its natural and maritime heritage. Bass Point is of high significance to the Aboriginal people of NSW, especially the Elouera people who are the traditional custodians of the land, as a place where indigenous people have lived and continued to have strong links with the land. The site is said to have been occupied from around 20,000 years before European settlement, and is said to be one of the most significant archaeological sites in NSW as it is a rare example of established occupation. It is also one of the earliest places to be investigated, with archaeological excavation commencing in the 1960s. There are thought to be numerous midden sites and one camping/meeting place. The maritime area of Bass Point is also highly valued for the many shipwrecks located in the surrounding waters (Manidis Roberts, 2000). Of these, six shipwrecks and their associate artefact scatter have been properly recorded, dating from 1879 (NSW Environment and Heritage, 2012).

Both the marine and land based areas of Bass Point are highly valued, as they support a diversity of common, rare and endangered fauna and flora species. Bass Point contains diverse headland vegetation and littoral rainforest (protected under SEPP 26), and other Endangered Ecological Communities. The Bass Point Marine Area supports a significant but fragile Sea Grass habitat (NSW Environment and Heritage, 2012).

In order to assist Council to manage Bass Point Reserve, an Ecological Assessment and Plan of Management for the reserve has been compiled for Council by EcoLogical Australia (2012). The plan provides a framework for protecting and enhancing the native vegetation and habitats in the reserve particularly relating to bushfire hazards and other threats to ecological and cultural values;

and for maintaining the recreational spaces of the reserve. . Bass Point Recreational Reserve, Bushrangers Bay Aquatic Reserve and Bass Point Marine Area are currently heritage listed by the Australian Heritage Commission (Manidis Roberts, 2000).

5 Coastal Risk Assessment

5.1 Application of the Risk Framework to Coastal Management

A risk-based framework is a robust methodology for dealing with outcomes that are uncertain or have limited data, or for impacts with uncertain timeframes. This approach is therefore particularly applicable to coastal hazards impacts and the impacts of predicted sea level rise, where there is considerable uncertainty regarding when and if impacts will manifest. Uncertainties associated with future climate change presents huge challenges to local government and the wider community, who need to consider and manage future risks. Decisions made today are likely to have ramifications for up to 100 years or more (depending on the development), so consideration of an extended timeframe is essential, even though risks may not manifest for several decades.

The Risk Assessment process utilised for the Shellharbour CZMP is adapted from the Australian Standard Risk Management Principles and Guidelines (AS/NZS ISO 31000:2009), as described below and presented schematically in Figure 5-1. The use of a risk-based approach for managing coastal hazards is a requirement of the new CZMP guidelines, and accords with current international best practice for natural resource management.

- **Establish the Context –** the requirements of a coastal zone management plan set by NSW Legislation and Guideline documents provides the context for the risk assessment and intended outcomes. The purpose and context for the Shellharbour CZMP, including the management objectives derived from the NSW Coastal Policy, are outlined in Section 1.2.
- **Identify the Risks –** the risks arise from the coastal hazards, as defined in the Guidelines for Preparing Coastal Zone Management Plans (OEH, 2013) and the Coastline Management Manual (1990), namely, beach erosion and recession, coastal inundation, entrance instability, sand drift, and erosion at stormwater outlets. Hazards were identified as part of the Shellharbour Coastal Hazards Analysis (SMEC, 2010), as summarised in Chapter 3. The risks shall impact upon coastal values, which include ecological, cultural, recreational and economic values, as identified during literature review and consultation with the local community, the Committee and key stakeholders. Community uses and values are summarised in Chapter 4 and Section 5.3.
- **Analyse the Risks –** this involves considering the **likelihood** and **consequence** of the identified risks, to determine the overall level of risk (high, medium, low).

  The **likelihood** of risks is largely related to the extent of coastal hazards, now and in the future. The likelihood of erosion and recession at the immediate, 2050, 2100 timeframes was determined through an assessment of the SMEC (2010) Shellharbour Coastal Hazards Analysis and is summarised in Section 5.2.

  The **consequence** of the risks will largely relate to the extent of existing or future development and the values (e.g. aesthetic, recreational, and ecological) associated with land and assets within the coastal zone. The coastal assets mapping and incorporation of community consultation outcomes was used to determine consequence of coastal risks in Section 5.3.

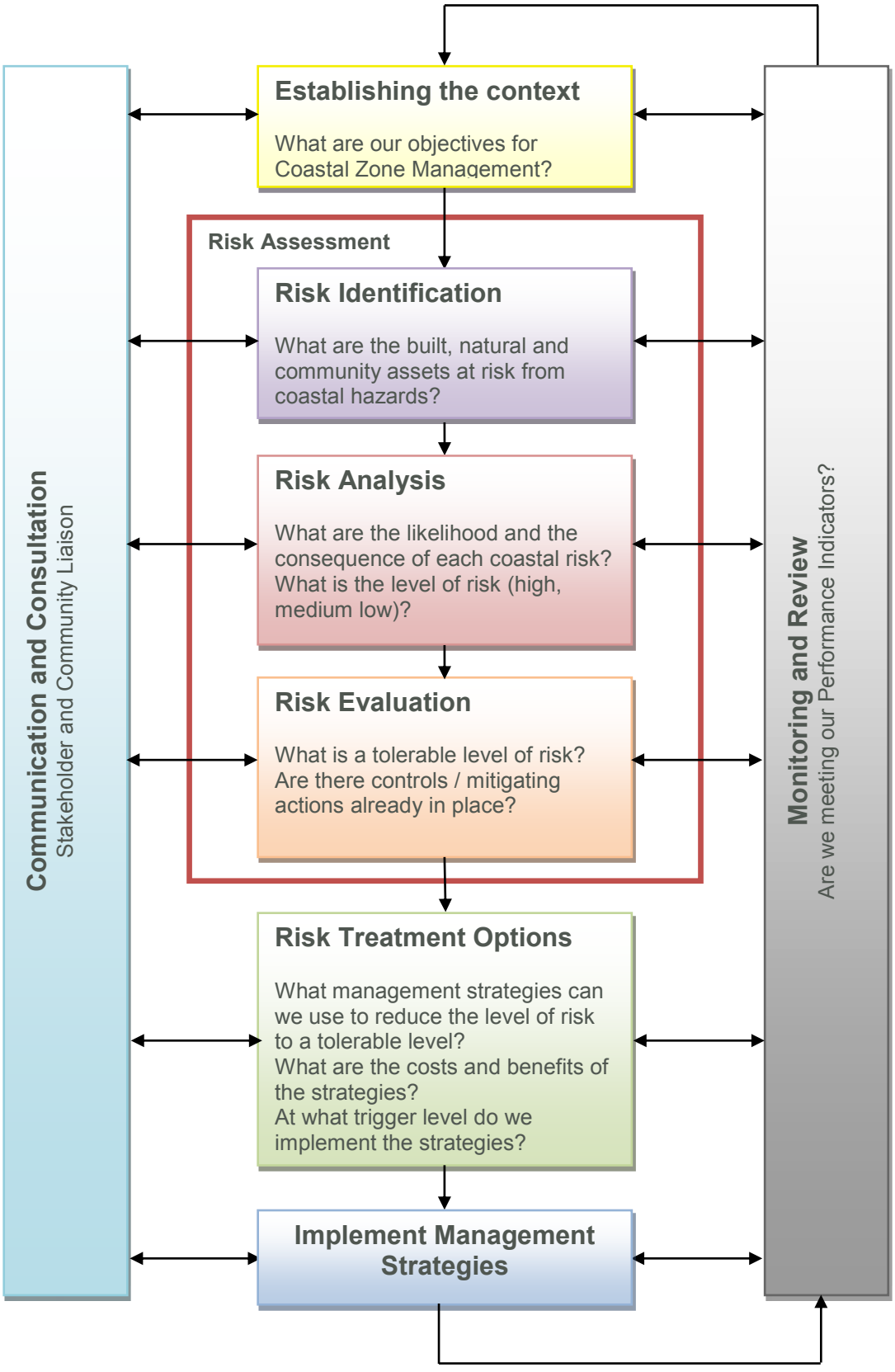

Figure 5-1 Risk Management Framework (ISO 31000:2009) adapted to Coastal Zone Management

The consequence and likelihood were combined (using GIS processing) to determine and map the *level of risk* for assets and land in the coastal zone. The level of risk was revised to include existing controls that may reduce the level of risk (Section 5.5.1). Risk mapping is provided in Appendix E to H and it has been used to develop a register of assets and their level of risk over the immediate to 2100 timeframe, for internal use by Council.

- **Evaluate the Risks –** in consultation with Council and other state agencies, the level of risk that is deemed acceptable, tolerable and intolerable was determined. The evaluation criteria determine the intolerable risks that must be treated as a priority and to which management effort shall be directed, refer Section 5.6.
- **Treat the Risks –** the process of developing coastal management options is directly related to reducing or eliminating intolerable risks where possible. Tolerable (low) risks can be flagged for monitoring, with no further resources necessary. Management options can be designed to reduce the likelihood of the risks (e.g. planning setbacks to reduce the likelihood of shoreline recession impacts), or reduce the consequence of the risk (e.g. emergency management to reduce the consequence of shoreline recession) or both. Management options first need to be technically viable for the study area. A cost benefit analysis is then used to determine which of the risk treatments will provide the greatest benefit (relative to cost) in treating the highest priority risks. Management options are outlined and analysed in Chapter 6.

  For existing development given the uncertainty and timeframes over which hazards may manifest, a trigger for implementing the options has been flagged. Setting triggers ensures the management option and associated resources are not utilised until it is absolutely necessary to do so, which is particularly important for difficult and costly, but necessary, options. This is described further in Section 6.2.
- **Implement Management Strategies (Risk Treatments) –** The coastal zone management plan provides the forum to detail how the recommended management options (risk treatments) shall be implemented (costs, timeframes etc.) and funded. Ongoing monitoring and review of both the risks and management options is also detailed. Plan implementation will be detailed once preferred management options have been selected.

5.2 Analysis of Risk Likelihood

5.2.1 Likelihood Scale

Coastal hazards are considered to be the event that is analysed through risk management. In this case, both ‘likelihood’ and ‘consequence’ of the hazards needs to be analysed. The hazards definition phase of the NSW coastal management process is suited to defining the ‘likelihood’ or probability of occurrence of coastal hazards, through the analysis of coastal processes and historical beach responses, and to account for uncertainty in both the occurrence of hazards and shoreline response to sea level rise.

A scale of ‘likelihood’ or probability of occurrence for a hazard impact based upon the Australian Standard for Risk Management (AS/NZS ISO 31000:2009) and its companion document (HB 436:2004), is given in Table 5-1. This likelihood scale has been developed over the course of the many other coastal zone management studies that we have conducted in NSW. The scale is

tailored to both the long timeframes for coastal planning (up to 100 years) and the potential for relatively infrequent, but damaging events that can occur within that timeframe (i.e., 1 in 100 year storms).

Table 5-1 Risk Probability / Likelihood Scale For Coastal Hazards

Probability	Description
Almost Certain	There is a high possibility the event will occur as there is a history of periodic occurrence
Likely	It is likely the event will occur as there is a history of casual occurrence
Possible	There is an approximate 50/50 chance that the event will occur
Unlikely	There is a low possibility that the event will occur, however, there is a history of infrequent and isolated occurrence
Rare	It is highly unlikely that the event will occur, except in extreme circumstances, which have not been recorded historically.

5.2.2 Assigning Likelihood to Coastal Hazards

At all timeframes for Shellharbour, an erosion impact zone and a 'zone of reduced foundation capacity' zone were defined. The likelihood ascribed to the lines is listed in Table 5-2 and described below.

For the present timeframe, the assigning of likelihood to the 2010 hazard lines aims to incorporate the methodology and assumptions used to define these lines. Given the assessment methodology utilised, it was determined that the occurrence of the erosion impact zone is 'possible'. The analysis utilised two consecutive dates of photogrammetric data to represent the erosive capacity of a single storm. As detailed in Section 3.8, there are limitations to this methodology, most notably, that the dates of photogrammetry may be years apart. It is thus considered 'possible' that such an event will occur in the future, and there is a history of such erosion occurring in the past

An additional allowance for reduced foundation capacity was provided above the immediate erosion hazard line. It was considered 'unlikely' that erosion would reach this extent, although this may occur at isolated locations at infrequent periods along the beach. Indeed, the photogrammetric data is likely to identify such infrequent and isolated locations, but these may not be evident given the approach applied to measuring erosion potential.

For the present timeframe, a 'rare' likelihood has been ascribed to the 2050 erosion line. While it would not be expected that such an extent of erosion would occur at the present, there is a rare chance that this could occur. Such an assessment aims to recognise that there is limited beach erosion (photogrammetric) data upon which to derive a hazards assessment. It is conceivable that such dramatic events have occurred historically, but that volumetric data was not able to be recorded. The 'rare' likelihood line may be thought of as similar to the Probable Maximum Flood event that is utilised in flooding assessments.

Under the same rationale as used to define likelihood for the immediate erosion zone and zone of reduced foundation capacity at present, it is expected that the 2050 erosion zone is 'possible' and the 2050 zone of reduced foundation capacity is 'unlikely' at 2050, as in Table 5-2.

By the 2050 timeframe when the effects of sea level rise have begun to manifest as recession of the sandy shoreline, it is reasonable to state that the occurrence of the hazard extents estimated for the present day will have become more likely or frequent, such that the immediate erosion zone is 'almost certain' at 2050 (and indeed, that shoreline position may even have been outstripped by recession). And once again, at 2050, impacts beyond the 2050 erosion line would still be relatively infrequent and isolated, such that the occurrence of the 2100 erosion extent would be considered 'rare'.

This approach for future time periods thus incorporates the key concept associated with sea level rise, whereby the likelihood of an erosion or inundation impact increases over time and with proximity to the ocean. So as sea level rise progresses to 2100, further recession of the sandy shoreline is expected to have occurred. Once again, the probability of experiencing erosion to the defined 2050 and 2100 lines will have increased, and the same rationale for 'likelihood' is applied to the 2100 hazard lines, as given in Table 5-2.

The possibility that sea level rise will not manifest is also catered for within this approach: at each timeframe, it is not assumed that the relevant hazard line for that timeframe is absolutely certain or even 'almost certain'. The possibility that sea level rise will not occur needs also be considered when developing future management options. This is done through prescribing likelihood to hazard extents, as well as setting triggers for implementation of management actions (refer Section 6.2) that are event based rather than time based.

The likelihood values were assigned spatially (within GIS) to each of the relevant hazard zones mapped in the Shellharbour coastal zone.

Table 5-2 Approach to the Erosion and recession hazards

Probability	Immediate	2050	2100
Almost Certain		Immediate Erosion	2050 Erosion
Possible	Immediate Erosion	2050 Erosion	2100 Erosion
Unlikely	Immediate Erosion + ZRFC	2050 Erosion + ZRFC	2100 Erosion + ZRFC
Rare	2050 Erosion + ZRFC	2100 Erosion + ZRFC	

Note: The 'likely' probability level has not been used for simplicity

5.2.2.1 Likelihood of Coastal Inundation

A coastal inundation hazard line was only provided for the run-up event at the immediate time period. A future inundation hazard, or coastal inundation hazard at the present or future was not defined in the SMEC (2010) study (see discussion in Section 3).

A robust assessment methodology and conservative input parameters (0.1% AEP values) were used to assess the wave run up hazard extent. The difference in water level between the 1% AEP and 0.1% AEP is small at only 0.04 m, but the difference in wave height for these events is of the order of 2 m, which may potentially add around 0.3 m in water level, in addition to wave run up. Furthermore, the maximum wave run up level was applied, which would have very infrequent occurrence during a storm event. The likelihood of the immediate wave run up level is therefore considered to be 'rare', based upon the definition given in Table 5-1.

For future time periods, with the occurrence of sea level rise, the likelihood of this wave run up level is expected to become more frequent. Given that it is uncertain where the shoreline position will be at 2050 and 2100 (and indeed, the height of dune or other coastal barriers at that time that may protect the shoreline from wave overtopping) it is considered misleading to assess the risk from future wave run up along the sandy shoreline.

The impact of wave run up should therefore be captured within the future erosion hazard extents. Consideration of management of wave run up shall be included in the development of management actions for erosion and recession, in Chapter 6.

It should also be noted that the coastal inundation hazard is different from permanent inundation due to sea level rise. The coastal inundation hazard refers to elevated water levels during a coastal storm which then recedes, compared with those areas of land that shall be permanently inundated with sea level rise. Permanent inundation will be taken into consideration where feasible and relevant in developing management options, in Chapter 6.

5.3 Analysis of Risk Consequence

5.3.1 Consequence Scale

The other component of risk is *consequence*. The consequence of impact from coastal hazards largely relates to the land affected by hazards, such as existing or future development and other assets and their values (i.e. aesthetic, recreational, ecological, cultural and economic). The type and duration of impact needs to be considered when assessing the consequence of the different coastal risks (e.g. short term periodic inundation compared with long term permanent loss of land with recession).

A consequence scale was developed based upon the study teams past experience in coastal zone management projects that is relevant to both the type of impact to coastal land and assets and its effect across the entire community, and the timeframe (up to 100 years) for coastal risk planning. The consequence scale follows a triple bottom line approach, to determine the consequence to society, environment and economy. The consequence scale is given in Table 5-3.

To remain consistent with terminology in Standards Australia (2004) *Handbook Risk Management Guidelines Companion*, which accompanies the Risk Management Principles and Guidelines, terminology of 'catastrophic', 'major', 'moderate', 'minor', and 'insignificant' was adopted for the consequence scale.

All of the consequence categorisations are focused upon the risk to the whole of Shellharbour LGA in terms of social, economic or environmental impacts. The values ascribed within the 'economy'

scale relate to damages to property, infrastructure or the local economy. It should be noted that the economic cost of options or impacts of options to beach amenity, environment and so on have been not yet been considered, and will be done so as part of a 'fine filtering' process for preferred options.

Table 5-3 Consequence Scale for Assessing Coastal Risk

Consequence	Society / Community	Environment	Economy
Catastrophic	Widespread permanent impact to community's services, wellbeing, or culture (e.g., > 50 % of community affected), or national loss, or no suitable alternative sites exist	Widespread, devastating / permanent impact (e.g. entire habitat destruction), or loss of all local representation of nationally important species (e.g. endangered species). Recovery unlikely.	Damage to property, infrastructure, or local economy > $20 million*
Major	Major permanent or widespread medium term (somewhat reversible) disruption to community's services, wellbeing, or culture (e.g. up to 50 % of community affected), or regional loss, or Only a few suitable alternative sites exist	Widespread semi-permanent impact, or widespread pest / weed species proliferation, or semi-permanent loss of entire regionally important habitat. Recovery may take many years.	Damage to property, infrastructure, or local economy >$5 million - $20 million
Moderate	Minor long term or major short term (mostly reversible) disruption to services, wellbeing, or culture of the community (e.g., up to 25 % of community affected), or sub-regional loss, or Some suitable alternative sites exist	Significant environmental changes isolated to a localised area, or loss of regionally important habitat in one localised area. Recovery may take several years.	Damage to property, infrastructure, or local economy >$500,000** - $5 million
Minor	Small to medium short term (reversible) disruption to services, wellbeing, finances, or culture of the community (e.g., up to 10 % of community affected), or local loss, or many alternative sites exist	Environmental damage of a magnitude consistent with seasonal variability. Recovery may take one year.	Damage to property, infrastructure, or local economy >$50,000 - $500,000
Insignificant	Very small short term disruption to services, wellbeing, finances, or culture of the community (e.g., up to 5 % of community affected), or neighbourhood loss, or numerous alternative sites exist	Minimal short term impact, recovery may take less than 6 months, or habitat affected with many alternative sites available.	Damage to property, infrastructure, or local economy >$50,000

5.3.2 Assigning Consequence from Coastal Hazards

A variety of coastal "assets" representing various land uses, facilities and features (including environmental features) of the coastal zone were identified based upon Geographical Information Systems (GIS) processing of:

- spatial mapping of aerial photography, land zoning, and cadastre;
- existing mapping of stormwater assets, wastewater and water supply assets, heritage items, parks, vegetation (priority habitat corridors, EECs etc.), public buildings, cycleways, roads (arterial through to minor / local roads), railways and other major infrastructure etc.; and
- information and values associated with assets (social, cultural, recreational, and economic) from various reports and consultation with the community.

The different types of assets identified in the coastal zone are listed in

Table 5-4. Indeed, given the small size of the coastal zone, specific assets are also listed.

Consequence values were assessed separately for the erosion and recession hazard and the coastal inundation (wave run up) hazard because the types of impacts are different, even though the value of the land may be the same. The impact of erosion and recession is somewhat permanent and irreversible for built assets, although the sandy beach may recover from short term erosion. Once recession has undermined a building on a sandy dune, the loss of the building is permanent, and the building (and its location) must be abandoned permanently. In contrast, coastal inundation resulting in flooding of property is a short term reversible phenomenon, as the water recedes after the storm ebbs.

Consequence values were initially ascribed based upon the outcomes of the Risk Assessment Workshop, which involved a range of Council staff, state agencies and other stakeholders. Attendees were required to work in groups to arrive at consensus regarding the value or consequence of each asset. While generally consensus was reached, there were a range of varied opinions in particular cases, as outlined below:

- Assigning a consequence from erosion and recession to beaches is particularly challenging. In general, it was agreed that the social importance of beaches was major, but the processes by which erosion may have a consequential impact were somewhat unclear. Some responses were based on assuming that 'the beach will still be there', regardless of the risk at hand or the potential for management intervention (both good and bad), attributing a minor value. But respondents then found they were unable to justify stating that the potential for economic impacts to a SLSC was 'major', when the beach for which the SLSC had formed was given only 'minor' value. In the majority of instances, the value placed on beaches was subsequently raised. Further to this, the groups noted there were relatively few SLSCs and other public building type facilities along the coastline, and this may raise the relative value of such assets.
- For sewer pipelines and outfalls, questions were raised regarding the depth of these assets below the ground, which may substantially reduce the likelihood of impact. In most cases a 'major' consequence was still ascribed, to flag the need for gathering further information about such assets and their potential for impact.

Table 5-4 Consequence Ascribed to Coastal Assets and Land

Shellharbour Coastal Zone	Consequence of Erosion and Recession	Consequence of Wave Run Up / Occasional Inundation
Beaches and Dunes		
Warilla Beach	Major	Insignificant
Shellharbour North Beach, Nuns Beach	Moderate	Insignificant
Shellharbour Boat Harbour (including heritage walls & boat ramp)	Major	Major
Shellharbour South Beach	Moderate	Insignificant
Coastal Dunes (Warilla Northern End, Shellharbour North, Shellharbour South)	Minor	Insignificant
Major Public Buildings, Facilities		
Warilla Beach SLSC	Moderate	Moderate
Shellharbour SLSC & Sea Spray Function Centre	Moderate	Moderate
Shellharbour Beachside Tourist Park (and pipe assets)	Moderate	Moderate
Beverley Whitfield Pool	Moderate	Moderate
Residential Properties		
Osborne Pde, Little Lake Cres	Major	Major
Boollwarroo Pde	Major	Major
Little Lake Cres behind Warilla Seawall	Major	Major
Shell Cove Road	Major	Major
Stormwater, Water, Wastewater		
Sewer pipeline, Warilla Beach (behind seawall)	Major	Major
Sewer pipelines: Osborne Pde (Warilla)	Major	Major
Sewer pipelines/outlet (from STP),Shellharbour North Beach	Catastrophic	Catastrophic
Water mains: Nuns Beach	Moderate	Moderate
Sewer mains: Nuns Beach, Shellharbour Boat Harbour Foreshore	Moderate	Major
Stormwater Outlet: Shellharbour Foreshore, Shellharbour Tourist Park (South Beach)	Major	Major
Roads, Carparks, Cycleway		
Warilla Beach SLSC Carpark	Minor	Insignificant
Warilla Cycle path	Minor	Insignificant
Shellharbour North Cycle path	Minor	Insignificant
Shellharbour SLSC Carpark	Minor	Insignificant
Little Park Carpark	Minor	Insignificant
Little Park Cycle path	Minor	Insignificant
Shellharbour South Beach Cycle path	Minor	Insignificant
Shellharbour South Beach Carpark	Insignificant	Insignificant

Shellharbour Coastal Zone	Consequence of Erosion and Recession	Consequence of Wave Run Up / Occasional Inundation
Junction Rd (and stormwater pipe assets)	Insignificant	Insignificant
John St (and car park)	Insignificant	Insignificant
Bass Point Tourist Rd	Insignificant	Insignificant
Town Street and Carpark	Minor	Insignificant
Public Reserves / Recreation Lands		
Warilla Beach Reserve and Picnic Tables	Moderate	Insignificant
Eric Creary Park	Minor	Insignificant
Bardsley Park	Moderate	Insignificant
Little Park	Major	Insignificant
Bass Point Reserve	Major	Insignificant
Heritage		
Shellharbour Conservation Area	Major	Major
Community Facilities		
Warilla Beach SLSC Toilets	Minor	Insignificant
Shellharbour SLSC Toilets	Minor	Insignificant
Eric Creary Park Toilets	Minor	Insignificant
Little Park Rotunda	Minor	Insignificant
Little Park Toilets	Minor	Insignificant
Shellharbour South Beach Amenities	Minor	Insignificant

- It was generally agreed that the consequence of impacts to residential properties would have a ‘major’ economic impact, even where the impact to the rest of community is minor. The key site of concern is the properties behind the seawall at Warilla Beach. Communicating the potential risk to residents at Warilla Beach relating to failure of the seawall will be an important aspect of the management approach.
- Likewise, there were some concerns raised over the high social importance of car parks along the beach, which can provide key access points for the community. In the end, the low environmental and economic values governed a general agreement that the consequence to such assets was minor (and indeed, impacts are likely to be able to be accommodated without substantial future planning or funding).
- Aboriginal heritage items were noted as a major asset that cannot be explicitly described through this process. The items (and general locations) were noted for future consideration in the development of management options.
- Non-indigenous heritage items were also noted for their high social (and tourism) value. Norfolk Island Pines were raised as a potential issue. It was agreed that the trees should not form a significant focus for financial resources, but it was noted from community engagement (including

local Councillors) that a replacement program or similar management action would be essential to managing likely community expectation to protect the value of trees.

The consequence values obtained through the Risk Assessment Workshop were summarised and refined based upon feedback from the community relating to coastal values, and review of existing reports where relevant. The coastal assets and consequence values are listed in

Table 5-4. It should be noted that not every asset may be affected by both erosion and recession and coastal inundation (wave run up).

5.4 Analysis of the Level of Risk

Within a risk assessment approach, risk is defined as *likelihood X consequence*. A risk matrix defining the level of risk from the various combinations of likelihood and consequence was developed specifically for this CZMP, as given in Table 5-5. The risk matrix was not drawn from any existing Council risk frameworks, because the timeframes for the assessment of coastal hazards spans 100 years (as has also been taken into consideration in developing the consequence and likelihood scales used in the assessment).

Risk maps for the Shellharbour coastal zone demonstrating the level of risk to assets from coastal hazards have been prepared. The likelihood and consequence values were assigned spatially (in GIS) to the hazard zones and assets, respectively. Through GIS processing, the two spatial values (consequence and likelihood) were combined to produce an overall level of risk, using the risk matrix scores in Table 5-5.

Risk Maps for Erosion and Recession for the immediate, 2050 and 2100 timeframes and for Wave Run Up for the immediate period are provided in Appendix E to H of this report. A series of Asset Risk Register Tables has been compiled, for use during the selection of management options phase of the project.

Table 5-5 Risk Matrix for Coastal Hazards

		CONSEQUENCE				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
LIKELIHOOD	**Almost Certain**	**Medium**	**Medium**	**High**	**Extreme**	**Extreme**
	Likely	**Low**	**Medium**	**High**	**High**	**Extreme**
	Possible	**Low**	**Medium**	**High**	**High**	**Extreme**
	Unlikely	**Low**	**Low**	**Medium**	**High**	**Extreme**
	Rare	**Low**	**Low**	**Low**	**Medium**	**High**

5.5 Risk Evaluation

5.5.1 Existing Controls

A detailed review of the existing legislation in Chapter 2 included discussion of the LEP, DCPs, POMs and existing coastline management plans and the extent to which actions in these documents may also mitigate coastal hazards. During the Risk Assessment Workshop, attendees also compiled a list of existing actions that Council and others are undertaking that may mitigate coastal hazards. A summary of existing controls is given in Table 5-6. There are many different actions that have been undertaken in the past and present, and this should provide some confidence to Council about their existing capacity to manage coastal risks.

Some of the actions in Table 5-6 do not necessarily treat coastal hazards directly, but the action improves the capacity or provides supporting information for managing coastal risks. Those actions that provide specific controls are outlined in more detail in the following sections. One direct action that is likely to align well with actions in this CZMP, as specified from the Shellharbour Climate Change Adaptation Action Plan (SKM, 2009), is to "Develop a program to monitor asset condition in response to changing sea level and rainfall intensities; review existing design standards for resilience to predicted climate change". This action aims to address the risk of failure of the Warilla Beach seawall due to climate change.

Table 5-6 Existing Actions in the Coastal Zone of Shellharbour

Plans & Strategies	Development Assessment	Communication / Education	Engineering, Infrastructure	Studies, Research, Monitoring
Shellharbour Heritage Conservation Area	DCP with provisions for Little Lake Crescent (See Section 5.5.1.1)	Communication Strategy and budget	Dune Rehabilitation Works (Warilla 2009 and ongoing, Shellharbour South Beach)	Coastal Hazards studies in 1991, 2005, 2010.
Shellharbour Foreshore Management Plan	DCP with provisions for Shell Cove Road (See Section 5.5.1.1)	Community consultation for coastal hazards study, CZMP	Warilla Seawall	Lake Illawarra Entrance Works (modelling, construction, monitoring)
Draft SLEP: Clause 5.5	Lake Illawarra FRMP		Elliott Lake Entrance works	Illawarra Biodiversity Strategy
Lake Illawarra Strategic Plan	Existing Flood Study for Elliott Lake		Training wall from beach to Windang Island	Shellharbour Climate Change Adaptation Action Plan
Council's Asset Management Plan	Section 149 Certificates (flooding and coastal)		Two "nourishment" episodes using sand from Lake Illawarra entrance on Warilla Beach	Elliott Lake Biodiversity Strategy
Bass Point Reserve POM			Breakwall to protect Shellharbour Boat harbour heritage walls	Cultural Heritage studies at Elliott Lake, Shellharbour Tourist Park
EPA Licence for STP				

5.5.1.1 Shellharbour Development Control Plan 2013: Provisions for Little Lake Crescent, Warilla Beach

The properties immediately landward of the Warilla Beach seawall (Odd numbered properties from 17 to 123 Little Lake Crescent, Warilla Beach) are currently subject to controls upon development through the Shellharbour Development Control Plan 2013 (Shellharbour DCP). The controls apply with respect to the rear boundary of the properties and the "line of low hazard". This line is defined as the 2% Annual Exceedance Probability (AEP) storm applied to an eroded sub-beach, plus an allowance for rapid beach readjustments, as defined by AWACS (1991).

The Shellharbour DCP provides a Rear Building Line and the line of low hazard as a distance measured from the rear boundary of each property, and in Maps associated with the DCP. Registered survey of existing and proposed structures relative to the line of low hazard, the rear boundary of the property and the rear building line is required with any development assessment. It is noted in the DCP that "*Council cannot guarantee that compliance with this section will eliminate all risk from coastal hazard*".

The Shellharbour DCP is considered to provide a sound basis for controlling development behind the Warilla seawall. The DCP is also explicit regarding the risk to landowners behind the Warilla seawall, and requirements/specifications for consideration as part of any 'Major Proposal' development applications. Similarly, the DCP lists specific requirements for Minor Proposals, involving extensions, additions and garages.

There is potential for conflict with the existing landowners now that a more recent hazards study has been compiled by SMEC (2010). The SMEC (2010) study assumes that the seawall provides adequate protection to these properties (unlike the prior AWACS 1991 advice) and so dramatically reduces the hazard footprint. If this study were to be used as the basis for the Shellharbour DCP, there is a greater land area that could potentially be developed by property owners. This is alarming, considering the risk of failure of the seawall. There is also potential that adopting the SMEC (2010) hazard lines may shift liability back to Council. In this case, it is recommended that the existing Shellharbour DCP and use of AWACS (1991) as the basis for the DCP continue to be applied, until revised hazard estimates that incorporate the risk of failure of the seawall are developed.

5.5.1.2 Shellharbour Development Control Plan 2013: Provisions for Shell Cove Road, Barrack Point

The properties adjacent to the east facing coastal cliff embankment on Barrack Point (even numbered properties from 4 to 44 Shell Cove Road, Barrack Point) are currently subject to controls upon development through the Shellharbour DCP. The intent of these controls is to maintain geotechnical stability and access to views.

The Shellharbour DCP provides details of the preferred main building areas and ancillary building area, with controls for the types of development permitted within these areas. Council may also require a geotechnical assessment to be carried out for proposed permissible development within each area, if they consider the proposed works to be at risk from embankment failure.

5.5.1.3 Shellharbour Development Control Plan: Floodplain Risk Management Controls

Chapter 24 – Floodplain Risk Management of the Shellharbour DCP (supported by Appendix 11 – Floodplain Risk Management) provides general provisions relating to flood prone or potentially flood prone land. These controls are intended to be updated with specific provisions relating to individual catchments as catchment specific floodplain risk management plans are adopted. At present, only one catchment has specific controls, being for Lake Illawarra. The controls identified in the FRMP for Lake Illawarra are incorporated into Schedule 2 of Appendix 11 to Shellharbour DCP. The Lake Illawarra FRMP is considered suitable for managing risks arising from coastal inundation within Lake Illawarra.

Elliott Lake – Little Lake Flood Study was completed by Cardno in 2006. The flood study is not accompanied by a Floodplain Risk Management Plan (FRMP) thus far, and there are no specific provisions within the DCP related to this catchment. Cardno (2006) is likely to provide the best available information for determining flood hazard in the Elliott Lake catchment at the present time. The FRMP for Elliot Lake is currently being prepared. No Flood Study (and hence no FRMP) has been completed for Shellharbour Swamp (Shell Cove) catchment. As such, for Elliott Lake and Shellharbour Swamp (Shell Cove) catchments, the general floodplain risk management provisions in the DCP apply. Given that no advice regarding inundation levels from ocean water level events was provided with the SMEC (2010) study, there is currently no interim advice for coastal inundation that could be utilised until site specific FRMPs are completed.

Chapter 24, supplemented with Appendix 11, provides Floodplain Risk Management controls for development, car parking, fencing and filling in the floodplain. The format of the DCP with regards to floodplain related control includes:

- objectives, which represent the outcomes that Council wished to achieve from each control;
- performance criteria, which represent a means of assessing whether the desired outcomes will be achieved; and
- controls, which are preferred ways of achieving the outcome.

Controls relevant to each catchment are described within a matrix format for those catchments that have a completed FRMP. In the absence of a FRMP (e.g. Elliot Lake), a General Schedule (Schedule 1) is prescribed.

The type and stringency of controls are graded relative to the severity and frequency of potential flood events, which is described by the flood risk precincts defined in a catchment. In lieu of a FRMP or flood study to determine these flood risk precincts, a site specific flood study or flood risk report by a suitably qualified civil engineer may be required to be submitted with any development applications in known or potential flood liable land. This process provides for adequate definition of flood risks to guide controls on development, although there is potential that some potentially flood liable land will not be captured by this process.

The general provisions of the Flood DCP are considered to provide adequate interim controls until such time as site specific FRMPs are completed.

5.5.2 Outcomes of the Risk Assessment

As an outcome from the Risk Assessment, a series of maps illustrating the level of risk (extreme, high, medium and low) has been created for the immediate, 2050 and 2100 timeframes, for the erosion and recession hazard and coastal inundation hazard (immediate timeframe only). Linear assets such as sewer pipelines are also risk colour coded on these maps. The maps are provided in Appendices E to H.

The risk levels for each asset in the Shellharbour LGA coastal zone that may be affected by coastal hazards, for the immediate, 2050 and 2100 timeframes have also been listed as an Asset Risk Register table (Table 5-7). Where an asset showed a range of risk levels at one timeframe (e.g. a sewer rising main or surf club has both 'medium' and 'low' risk, depending on distance from the shoreline), the highest level of risk has been assigned in the risk tables. This is because for assets such as buildings and sewer pipes, once one part of the asset is undermined by erosion, the entire asset is compromised. That is, the trigger for implementing management action must occur prior to any impact, and this is signalled by that part of the asset at highest risk. This approach has been applied within property boundaries even where a building is not shown in the mapping (e.g. residential property, caravan parks). This is because such lands, by nature of their zoning, may be developed in the future, and therefore the highest potential hazard is flagged to ensure consideration of the hazard when using the land.

This approach has also been applied to parks and reserve lands. While such assets are largely still functional even if affected by coastal hazards, this approach ensures the hazard is considered when managing the asset, or in developing management actions for coastal hazards.

It should be noted that the Warilla Beach SLSC building is not included in the consequence or risk registers because it is not expected to be affected by coastal hazards by 2100, based upon the hazard mapping compiled by SMEC (2010) in the Shellharbour Coastal Hazards Analysis. The carpark, amenities and land seaward of the SLSC building are included in the analyses, as these assets may be affected.

The risk maps and Asset Risk Register table formed the basis for developing management options. Management options for treating the intolerable risks (see below) are presented and assessed in the following Chapter.

Table 5-7 Shellharbour Coastal Zone Asset Risk Register

Shellharbour Coastal Zone Asset	*Consequence of Erosion and Recession*	*Consequence of Wave Run Up / Inundation*	Risk at 2012	Risk at 2050	Risk at 2100	2012 Inundation Risk
Beaches and Dunes						
Warilla Beach	*Major*	*Insignificant*	High	Extreme	Extreme	Low
Shellharbour North Beach, Nuns Beach	*Moderate*	*Insignificant*	High	High	High	Low
Shellharbour Boat Harbour (including heritage walls & boat ramp)	*Major*	*Major*	High	Extreme	Extreme	Medium
Shellharbour South Beach	*Moderate*	*Insignificant*	High	High	High	Low
Coastal Dunes (all beaches)	*Minor*	*Insignificant*	Medium	Medium	Medium	Low
Major Public Buildings, Facilities						
Warilla Beach SLSC	*Moderate*	*Moderate*	(1)	(1)	(1)	(1)
Shellharbour SLSC & Sea Spray Function Centre	*Moderate*	*Moderate*	Low	High	High	Low
Shellharbour Beachside Tourist Park (and pipe assets)	*Moderate*	*Moderate*	High	High	High	Low
Beverley Whitfield Pool	*Moderate*	*Moderate*				Low
Residential Properties						
Wollongong Street - Nuns	*Major*	*Major*	High	Extreme	Extreme	Medium
Osborne Pde, Little Lake Cres - Warilla	*Major*	*Major*		Medium	High	
Boollwarroo Pde - South	*Major*	*Major*	Medium	High	Extreme	
Little Lake Cres (behind Warilla Seawall) - Warilla	*Major*	*Major*	(2)	(2)	(2)	
Towns Street - Boat Harbour	*Major*	*Major*	High	High	Extreme	Low
Stormwater, Water, Wastewater						
Sewer pipeline, Warilla Beach (behind seawall)	*Major*	*Major*				Medium
Sewer pipelines: Osbourne Pde (Warilla)	*Major*	*Major*	Low	Medium	High	
Sewer pipelines/outlet (from STP), North Beach	*Catastrophic*	*Catastrophic*	Extreme	Extreme	Extreme	High
Water mains: Nuns Beach	*Moderate*	*Moderate*	High	High	High	
Sewer mains: Nuns Beach, Shellharbour Boat Harbour Foreshore	*Moderate*	*Major*	Low	Medium	High	Medium
Stormwater Outlet: Shellharbour Foreshore & Shellharbour Tourist Park (South Beach)	*Major*	*Major*	High	Extreme	Extreme	Medium
Roads, Carparks, Cycleway						
Warilla Beach SLSC Carpark	*Minor*	*Insignificant*	Low	Low	Medium	Low
Warilla Cyclepath	*Minor*	*Insignificant*	Low	Low	Medium	Low
Shellharbour North Cyclepath	*Minor*	*Insignificant*		Low	Medium	Low
Shellharbour SLSC Carpark	*Minor*	*Insignificant*	Low	Medium	Medium	Low
Little Park Carpark	*Minor*	*Insignificant*	Low	Medium	Medium	Low
Little Park Cyclepath	*Minor*	*Insignificant*	Low	Low	Medium	Low
Shellharbour South Beach Cyclepath	*Minor*	*Insignificant*	Low	Medium	Medium	Low
Shellharbour South Beach Carpark	*Insignificant*	*Insignificant*	Low	Low	Low	Low
Little Lake Cres (behind Warilla Seawall)	*Major*	*Major*	(2)	(2)	(2)	
Junction Rd - North Beach	*Insignificant*	*Insignificant*	Low	Low	Low	Low
Woolongong St - Nuns Beach	*Insignificant*	*Insignificant*	Low	Low	Low	
Beach Rd - North Beach	*Insignificant*	*Insignificant*	Low	Low	Low	
John St (and car park)	*Insignificant*	*Insignificant*	Low	Low	Medium	Low
Bass Point Tourist Rd	*Insignificant*	*Insignificant*	Low	Low	Medium	Low
Town Street and Carpark	*Minor*	*Insignificant*				Low
Public Reserves / Recreation Lands						
Warilla Beach Reserve and Picnic Tables	*Moderate*	*Insignificant*	High	High	High	Low
Eric Creary Park	*Minor*	*Insignificant*	Low	Medium	Medium	Low
Bardsley Park	*Moderate*	*Insignificant*	High	High	High	Low
Little Park (Boat Harbour)	*Major*	*Insignificant*	High	Extreme	Extreme	Low
Bassett Park (South Beach)	*Major*	*Insignificant*	High	High	Extreme	Low
Heritage						
Shellharbour Conservation Area	*Major*	*Major*	High	Extreme	Extreme	Medium
Community Facilities						
Warilla Beach SLSC Toilets	*Minor*	*Insignificant*	Low	Low	Low	Low
Shellharbour SLSC Toilets	*Minor*	*Insignificant*	Low	Low	Medium	Low
Eric Creary Park Toilets	*Minor*	*Insignificant*	Low	Low	Medium	Low
Little Park Rotunda	*Minor*	*Insignificant*	Low	Low	Low	Low
Little Park Toilets	*Minor*	*Insignificant*	Low	Low	Low	Low
Shellharbour South Beach Amenities	*Minor*	*Insignificant*	Low	Medium	Medium	Low

(1) Warilla Beach SLSC is currently outside of the 2100 Hazards zones, but has been flagged for future development

(2) No risk because of hazard assumption by SMEC (2010) that seawall remains in place despite the wall not meeting current engineering standards

5.6 Risk Tolerance and Priority for Treatment

Determining which risks to treat as part of the CZMP is based upon Council's (and the community's) tolerance to risk. In most cases it would be expected that low risks can simply be monitored, rather than demanding valuable management resources, while extreme or high risks require more immediate management attention. A risk tolerance scale is used to determine which risks/locations/assets must be addressed as a priority.

The risk tolerance scale for this project is given in Table 5-8. This scale was determined to be appropriate for use in discussion with Council and the state agencies during the Risk Assessment Workshop. This scale determined that the extreme and high risks must be treated as a priority, medium risks should be treated where resources are available (or incidentally treated by an action for another risk) and low risks are acceptable and require monitoring only (which shall be conducted as a matter of course in the plan).

In addition to the tolerability of risk, the need for management action can also be prioritised to some degree by the estimated timing for the risks, i.e. immediate, 2050 or 2100. As detailed in Table 5-9, present day risks must be treated as a priority, while for 2050 and 2100 risks, a management option(s) is identified along with a trigger for implementing the option, but there may be no need to implement these options over the life of the plan (5-10 years). Identifying a management option(s) with a trigger for implementation at the present time enables Council and others to be prepared should a risk present itself earlier than anticipated, but does not commit Council /others to such a decision until monitoring indicates the risk is certainly going to occur and a decision is necessary.

"No regrets" actions should be undertaken at the present time, which shall assist to prepare for future implementation of an action and / or prolong the need for more substantial and costly actions. In many cases, the "no regrets" actions provide sufficient guidance or management for future risks. For example, the Audit of Existing Council Assets enables Council to determine the suitability of relocating or retrofitting a pump station or pipeline, taking into account the workings of the sewerage system as well as the coastal hazards constraints. In this case, the future options need not be identified, as they will be determined through the "no regrets" actions.

Such an approach avoids costly, large-scale, difficult and / or unpalatable actions being implemented until it is certain that they are needed. The time until a risk becomes certain shall be used to increase information / data upon which to base decisions and certainty regarding the likely impacts of coastal hazards (particularly sea level rise), and may also see an improvement in management approaches and /or funding to treat particular risks. Much of this information can be gathered through implementing the monitoring strategy and "no regrets" actions. It is expected that at the 5-10 year review of the CZMP, the new information can be incorporated into the risk assessment and the options for future risks can be reviewed and revised as necessary.

For each of the intolerable risks at all timeframes, 'no regrets' options were investigated as the first option, and a trigger for implementation of more detailed studies / actions also derived. In this case, the monitoring options are pivotal to the management of coastal hazards, as monitoring provides the mechanism for regular checking of likely impact (or risk) for which more substantial action is required.

Table 5-8 Risk Tolerance Scale

Risk Level	Action required	Tolerance
Extreme / High	Eliminate or Reduce the risk or Accept the risk provided residual risk level is understood	**Intolerable**
Medium	Reduce the risk or Accept the risk provided residual risk level is understood	**Tolerable**
Low	Accept the risk	**Acceptable**

Table 5-9 Prioritisation for Risk Treatment Based upon Estimated Timeframes

Timeframe for Extreme / High Risks	Treatment Approach
Present Day	• Implement no regrets actions • Implement site specific management actions as required
2050	• Implement no regrets actions • Identify potential management option(s) • Identify trigger for implementation, should the option(s) be required.
2100	

6 Management Options

Management options are principally focused on treating erosion and recession hazards and inundation hazards associated with coastal storms combined with long term sea level rise, over both the short and long term. The range of options outlined in this chapter have been compiled from various sources including the NSW Coastline Management Manual (1990), *NSW Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013), the *First Pass National Assessment of Climate Change Risks to Australia's Coast* (2009), the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (2009) and other coastal management plans and studies.

Risks associated with Future Development are different from risks to Existing Development, and therefore different management approaches are required. Figure 6-1 provides a conceptual framework for application of coastal management tools, as explained below. Following this are descriptions of some 23 options that have been considered and reviewed as part of this CZMP.

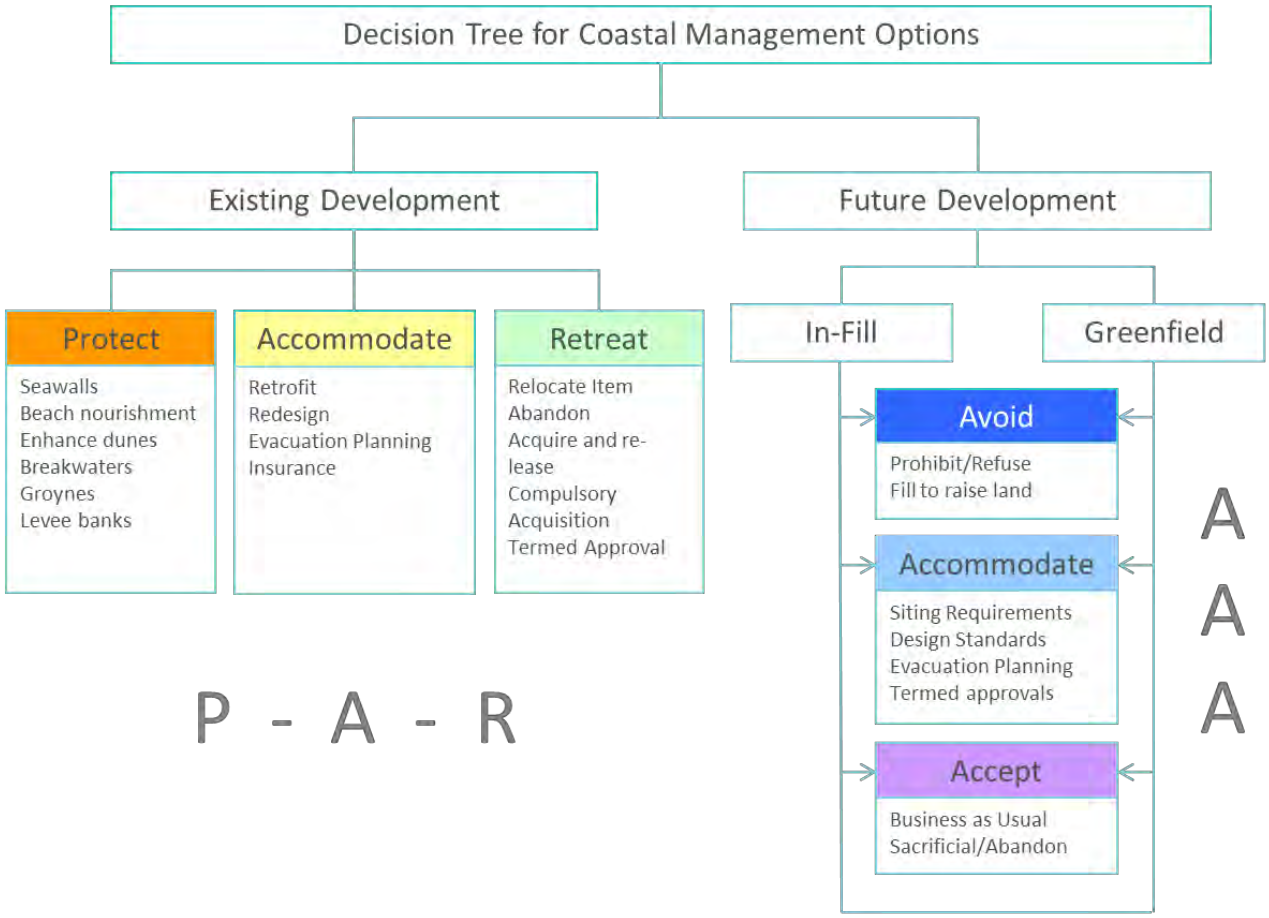

Figure 6-1 Conceptual Framework for Application of Coastal Management Options

*For **Future development***, the management approaches are as follows:

Avoid the risk, by not permitting vulnerable developments within high-risk areas (considered over the full design life of the development);

Accommodate the risk by including provisions that reduce the consequence of impacts (e.g. having minimum floor levels to reduce property damage resulting from future coastal inundation); or

Accept the risk where appropriate to the level of risk over the design life of the development.

Existing development is typically much harder to manage as works and infrastructure are already in place that limits the opportunity for effectively 'avoiding' or 'accommodating' the risk. Thus, risk management options become either 'protecting' / 'defending' the land or asset, or 'accepting' the potential for damage or loss given the expected timeframe and likelihood of impact. Replacement structures should either be relocated landward, thus progressively retreating from high-risk areas; or redesigned to accommodate the risk, where appropriate. Options for managing existing development therefore include the following approaches:

Protect existing coastal development (private or public) from erosion and recession and / or storm inundation and wave overtopping. Protection may be in the form of hard coastal defence structures (e.g. seawalls, groynes, offshore breakwaters or reefs, artificial headlands) or soft engineering measures (e.g. beach nourishment). Some protection works can cause impacts to adjacent areas ('offsite impacts'), and therefore, the decision to implement a 'protect' option must consider all potential impacts;

Retreat development, which is a 'no defence' approach that aims to preserve beach / shoreline amenity by allowing natural retreat of the foreshore alignment due to coastal processes, particularly in response to future sea level rise. The options for existing development involve relocating or sacrificing infrastructure, public assets or private property, if and when impacts occur. The retreat option may include compensation to private property owners for a depreciation in landuse value, where feasible and appropriate; and

Accommodate the risk, which aims to retrofit (or redevelop) existing infrastructure, public assets and private property in a manner that minimises damage and other losses from potential impacts (e.g. stronger foundations).

For existing development, it is essential to identify 'trigger points' for future action rather than recommending immediate management action. This approach defers any mitigative action until an identified point or event is reached in the future (such as the erosion reaches a distance from the development, a frequency of inundation or water level etc.). Once this is reached, the appropriate action (protection, accommodation, or retreat) should then be implemented.

Setting a trigger point is not an excuse to "do nothing", i.e. undertake no coastal management action at the present time. Planning controls, "no regrets" actions and preliminary investigations

must still be undertaken to effectively reduce the scale and cost of risk treatment required in the future. That is, setting triggers without taking action in the present timeframe to reduce the intensity of assets and values within known risk areas only enhances the difficult and costly actions required from future generations. Setting triggers must be accompanied by actions now to prepare the funding and resources required and to reduce the scale or costs of impacts in the future.

No regrets and Preliminary Actions have been devised to support the implementation of P-R-A and A-A-A options associated with existing and future development, and their triggers in the immediate timeframe. Such options offer a range of assessments and works to provide further information (including approvals) required prior to implementing larger scale options for specific assets, particularly where a more costly or difficult option may be needed. The 'no regrets' options also include activities that will improve resilience and preparedness for coastal risks, without limiting the ability to change a management approach and without negative long term impact should risks change in the future.

6.1 Potential Management Options

Detailed descriptions of the 23 potential options for managing coastal risks along the Shellharbour coastline are provided in Appendix D. A summary of the potential applicability of these options to Shellharbour is given in Table 6-1.

Table 6-1 Applicability of Management Options to Shellharbour

Management Option	Potential Applicability at Shellharbour
Coastal Hazards DCP	Yes, covering all land subject to coastal hazards
Beneficial Use of Dredged Sand	Yes, opportunistically at Warilla Beach in front of seawall
Beach Scraping	Limited opportunity, maybe at Nuns Beach
Dune Rehabilitation and Management	Yes, covering all existing coastal dunes
Seawalls	Rebuild of Warilla Beach seawall to engineering standards; maybe wall at back of Nuns Beach
Beach Nourishment	Warilla Beach (in front of seawall), Nuns Beach, South Beach (to build hind dune in front of houses)
Offshore Breakwaters	No
Groynes	No
Sacrifice Land or Assets	Yes, public land, coastal dunes and parks
Relocate Assets	Yes, all services and facilities assets not behind the seawall
Acquisition	No, as not currently financially viable. This option has been used successfully for four lots on Little Lake Crescent Warilla Beach to create Leggett Park in the past.
Buy Back / Lease Back	Unlikely, maybe at southern end of Boollwarroo Parade
Redesign or Retrofit	Yes, water and wastewater assets, some community assets
Integration of CZM Planning Within Council	Yes, integrating all Council departments and responsibilities

Management Option	Potential Applicability at Shellharbour
Asset Management Planning	Yes, covering all Council assets
Audit of Existing Council Assets	Yes, for assets in high risk coastal hazard areas
Community Education	Yes, for whole LGA
LEP Review and Rezoning	Limited opportunity for rezoning of greenfield site
Monitoring	Yes, especially at key hotspot locations for impacts on existing assets
Infrastructure Design Elements	Yes, mostly for stormwater and water / wastewater infrastructure
Combined Flood Studies	Yes, for Elliott Lake as a priority
Habitat Management	Yes, for Bass Point Reserve and coastal dune areas
Heritage Management	Yes, for whole LGA

6.2 Triggers for Implementation

It is apparent from the risk assessment that some intolerable risks are not expected to eventuate until 2050 or 2100. In this case, implementing a management action now, particularly where the option is difficult or costly, may be premature and cannot account for the uncertainty of when or to what extent the hazard may actually eventuate in the future.

While a decision as to the future intent is necessary at the present timeframe for intolerable risks, the action may not require implementation at present. Fisk and Kay (2010) provide a method for setting triggers for climate change adaptation actions along a time continuum. The trigger points are set to flag the 'level of acceptable change' where more aggressive or decisive actions must be implemented in order to avoid an undesirable impact. The trigger setting method is demonstrated in Figure 6-2.

Unlike flooding risks which may occur at any time, recession and erosion tends to occur over years with preceding events causing progressive beach erosion, thus giving warning of an imminent threat. These time warnings can be used to advantage for implementing management options, particularly where the action may be costly or difficult for community to accept or implement.

A triggered approach avoids actions being implemented until they become necessary, with time in the interim to improve data regarding the impact, source funding and prepare approvals, designs etc. It also recognises that some hazards or climate change impacts may not actually eventuate (given the uncertainty in projections of sea level rise and the methods of determining shoreline response to sea level rise). If this is the case, then the community has not been unnecessarily burdened by having to adopt costly management responses. Until the trigger is reached, 'no regrets' options should be implemented to reduce the burden of management for future generations (e.g. reducing the intensity of development in at risk areas, etc.).

The approach therefore adopted within this plan is to apply 'no regrets' actions at the current timeframe and to set triggers for implementing actions for existing developments.

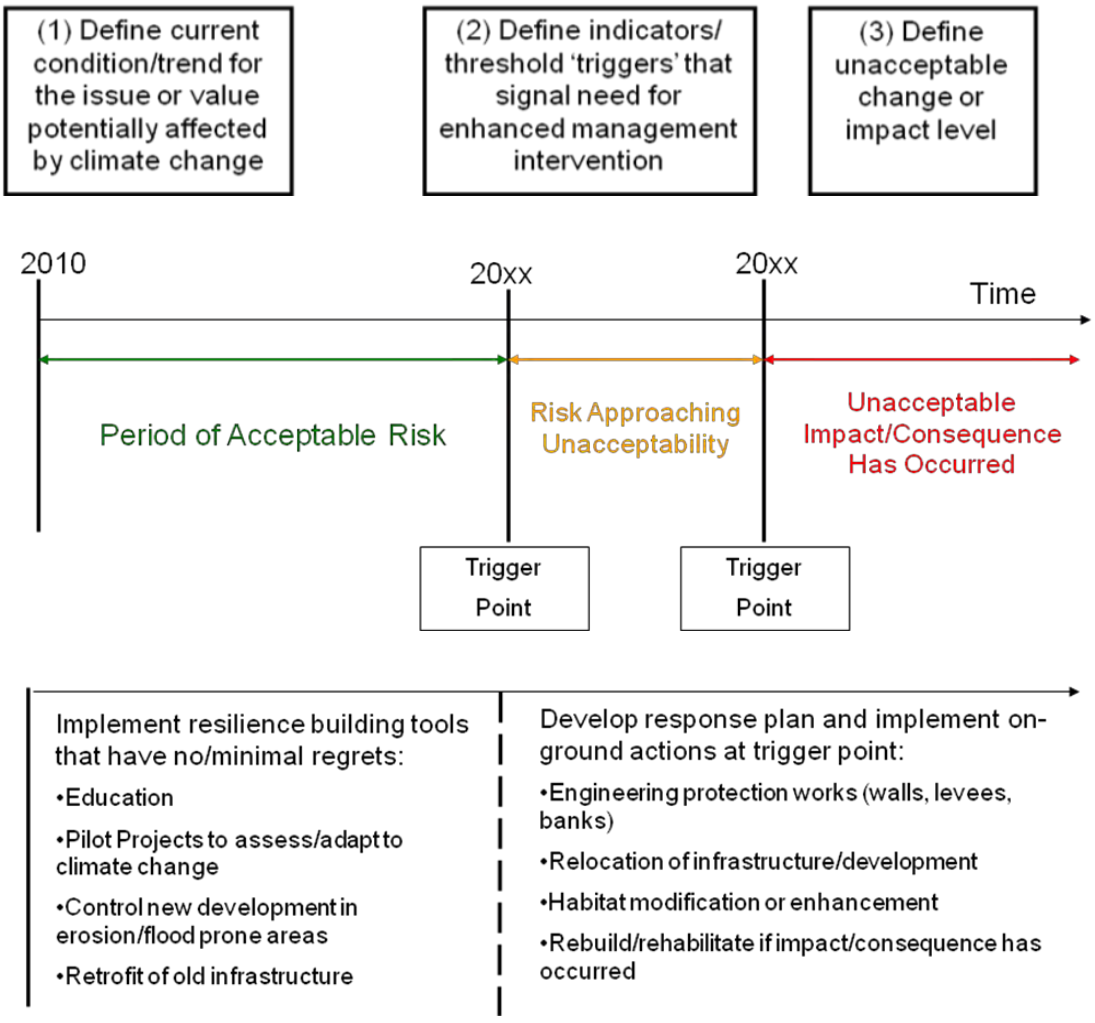

Figure 6-2 Continuum Model for Climate Change Adaptation Action

6.3 Options Assessment: Coarse Filtering of Options

From the detailed descriptions for the management options (Appendix D) and the summary of potential suitability of the options for application at Shellharbour (Table 6-1), it is apparent that some options are clearly appropriate, others are suitable at specific sites (and not other sites), and some options are generally considered unsuitable.

Rather than undertaking a detailed assessment of every option at every location, an initial 'coarse' filter has been applied to the options, to indicate:

- **"GO"** where an option is suitable with minimal trade-offs, and so will be recommended in the plan with no further cost-benefit analysis required;
- **"SLOW"**, where an option may be suitable at specific sites, but should be subject to a more detailed assessment at individual assets / locations ('fine' filtering); and
- **"STOP"** where an option is not suitable at any locations, and no further consideration of the option should be given (i.e. excluded) in the plan.

A rapid analysis tool for assessing cost-benefit has been developed that is suitable for the coarse filtering, as presented in Table 6-2. The criteria are assessed using a “traffic light” colour system to clearly display if an aspect of the option should be cause to “stop”, “slow” and proceed with caution, or “go” with little if any trade-offs expected. The following criteria are considered:

- Capital Cost and Recurrent Cost, with “high” to “low” limit values based upon an order of magnitude difference in expenditure, which would require investigations and approvals by Council before proceeding;
- Environmental or Social Impact, to identify where the option may have trade-offs upon the surrounding environment, including beach amenity and access;
- Community Acceptability, which shall also depend on direct community feedback during consultation;
- the ability for the option to be Reversible / Adaptable in the Future, which is particularly relevant where there is considerable uncertainty and or long time frames for a future impact;
- Effectiveness over time, to consider where an option presents a long term solution or a short term solution that would require additional management action or upgrades in the future;
- Legal / Approval Risk, to highlight the legislative and approval requirements (or impediments) to implementing an option within the current legal framework;
- The technical viability, to highlight where certain options may or may not be technically feasible but would require significant engineering (or other) investigations and construction / implementation capabilities; and
- The availability of a viable funding or financing model to implement the solution, accounting for the constraints of Council’s existing budget, available state or federal grants programs and priorities.

The results of the coarse filtering of options are provided in Table 6-3.

Table 6-2 Rapid Cost Benefit (Traffic Light) Assessment Criteria

	Capital Cost	Recurrent Costs	Environmental or Social Impact	Community Acceptability	Reversible / Adaptable in Future	Effectiveness over time	Legal / Approval Risk	Technical Viability	Funding / Financing Availability
STOP	Very Expensive ($300K to millions)	Very Expensive ($300K to millions)	Will impact negatively on environment, community or beach amenity	Unlikely to be acceptable to community and politically unpalatable. Extensive community education, endorsement by Minister(s) and Council required	Option is irreversible once implemented; option limits alternative options in future	Option does not provide a long term solution, only effective over short term	Will require an EIS and/or Government approval to implement. There is a residual risk that approval will not be able to be obtained for the proposed works/strategy	Is unlikely to be technically viable without substantial engineering (or other) design investigations and capabilities for implementation	Funding / Financing of the option is beyond the means of Council, and unlikely to be supported by state or federal government
SLOW	Moderately expensive (e.g. $30,000 - $300,000)	Moderately expensive (e.g. $30,000 - $300,000)	No net impact	Would be palatable to some, not to others (50/50 response). Briefing by Councillors, GM and community education required	Option is reversible or adaptable but at considerable cost / effort	Option is only a short term solution but has other benefits; or option requires further resources / changes to be effective over long term	Will require Government approvals to be implemented. Generally these approvals would likely to be granted assuming requirements are met	Is likely to be technically viable at the site, but would require further investigations to clarify.	Funding / Financing of the option is possible, but will require further negotiations and approval from state or federal government
GO	Little to no cost (< $30,000)	Little to no cost (< $30,000)	Will benefit environment, community or beach amenity (e.g. improve beach access, recreation, habitats etc)	Is very politically palatable, acceptable to community. Minimal education required	Option can be easily adapted for future circumstances or should impacts not occur, option would not negatively impact future generations	Option provides a long term solution	No or minimal government approvals required to implement	Is technically viable at the site / location	Funding / Financing of the option is available through existing Council budget and/or very likely to be supported by an existing government grant program

Table 6-3 Coarse Filtering of Management Options

Option	Treats Erosion	Treats Recession	Treats Wave Overtopping	Treats Inundation	Capital Cost	Recurrent Costs	Environmental or Social Impact	Community Acceptability	Reversible / Adaptable in Future	Effectiveness over time	Legal / Approval Risk	Technical Viability	Funding /Financing Availability	Score (Go = 1, Slow = 0, Stop = -1)	Progress to CZMP	Comments / Priority Locations
Coastal Hazards DCP	✓	✓	✓		GO	GO	GO	SLOW	GO	GO	GO	GO	GO	8	YES	
Beneficial Use of Dredged Sand	✓				GO	GO	GO	GO	GO	STOP	GO	GO	GO	7	YES	Warilla only
Beach Scraping	✓		✓		GO	GO	SLOW	SLOW	GO	STOP	GO	GO	GO	5	NO	Better to focus resources on use of dredged sand, given its availability.
Dune Management	✓		✓		GO	GO	GO	GO	GO	SLOW	GO	GO	GO	8	YES	
Seawall upgrade at Warilla	✓	✓	✓		SLOW	SLOW	GO	GO	GO	SLOW	GO	GO	GO	6	YES	Upgrades may exceed $300 K, but still cheaper than purchase of properties at risk. Option is valid.
Seawalls: new structures	✓	✓	✓		STOP	STOP	SLOW	SLOW	SLOW	SLOW	SLOW	SLOW	STOP	-3	NO	May be suitable at specific locations in future
Beach Nourishment	✓	✓	✓		STOP	STOP	GO	GO	GO	SLOW	STOP	SLOW	STOP	-1	NO	May be suitable at Warilla, Nuns in future, once used of dredged sand is no longer viable
Offshore Breakwaters	✓				STOP	STOP	STOP	STOP	STOP	STOP	STOP	STOP	STOP	-9	NO	
Groynes	✓				STOP	STOP	STOP	STOP	STOP	STOP	STOP	STOP	STOP	-9	NO	
Sacrifice Land or Assets	✓	✓	✓	✓	GO	GO	GO	SLOW	STOP	GO	GO	GO	GO	6	As required, based on erosion impacts	Suitable for low key facilities and open space land
Relocate Assets	✓	✓	✓	✓	SLOW	GO	GO	GO	GO	GO	SLOW	SLOW	GO	6	As required, based on asset man't and audit outcomes	Do when assets need replacing to minimise $

Option	Treats Erosion	Treats Recession	Treats Wave Overtopping	Treats Inundation	Capital Cost	Recurrent Costs	Environmental or Social Impact	Community Acceptability	Reversible / Adaptable in Future	Effectiveness over time	Legal / Approval Risk	Technical Viability	Funding /Financing Availability	Score (Go = 1, Slow = 0, Stop = -1)	Progress to CZMP	Comments / Priority Locations
Acquisition	✓	✓	✓	✓	STOP	GO	GO	SLOW	SLOW	GO	SLOW	GO	STOP	2	NO	Not suitable due to high capital cost across multiple properties, and no available funding.
Buy Back / Lease Back	✓	✓	✓	✓	SLOW	SLOW	GO	SLOW	GO	GO	SLOW	GO	STOP	4	NO	Currently no funding model to support this option.
Redesign or Retrofit	✓	✓	✓	✓	SLOW	GO	GO	GO	GO	SLOW	GO	SLOW	GO	6	As required, based on asset man't and audit outcomes	Do when assets need replacing to minimise $
Integration of CZM Planning Within Council	✓	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	GO	GO	8	YES	
Asset Management Planning	✓	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	GO	GO	8	YES	All public assets, such as roads, community buildings, recreation facilities etc.
Audit of Existing Council Assets	✓	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	GO	GO	8	YES	Assets at highest risk at present and by 2050
Community Education	✓	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	GO	GO	8	YES	
LEP Review and Rezoning	✓	✓	✓	✓	GO	GO	GO	SLOW	GO	GO	GO	GO	GO	8	YES	Limited opportunity
Monitoring	✓	✓	✓	✓	GO	SLOW	GO	GO	GO	GO	GO	GO	GO	8	YES	Suitable at all beaches, particularly at key assets.
Infrastructure Design Elements	✓	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	SLOW	GO	7	YES	Applicable to all stormwater, wastewater and water assets subject to saltwater inundation.
Combined Flood Studies				✓	SLOW	GO	GO	GO	GO	GO	GO	GO	GO	8	YES	Elliott Lake
Habitat Management	✓	✓	✓	✓	GO	GO	GO	GO	GO	SLOW	GO	GO	GO	8	YES	Limited areas
Heritage Management	✓	✓	✓	✓	GO	GO	GO	GO	GO	GO	SLOW	GO	GO	8	YES	Minimal impact expected

6.4 Summary and Recommended Actions

The results of the coarse filtering (Table 6-3) indicate that most of the options are 'no regrets' actions that are relatively cheap and unobtrusive to implement, as well as providing Council and others with far better information and planning resources to manage future coastal risks and implement management action as and when needed in the future. The options considered to be suitable for implementation in the CZMP have been indicated with a "yes" in Table 6-3. Timeframes and other details for implementing the preferred options are given in the Shellharbour Coastal Zone Management Plan (BMT WBM, 2015).

In terms of relocating or redesigning assets, these actions are dependent upon the outcomes of the Asset Management Planning and Audit actions. For example, there are a number of Council's wastewater and water assets at risk from coastal hazards. It is not possible to retrofit all of these assets immediately, and indeed, the assets may still have functionality for many years. The Asset Management Planning and Audit, and Infrastructure Design Elements options provide the blueprint for either retrofitting or relocating the assets in the future. Importantly, the retrofit or relocation may occur when asset replacement is required. The definition of appropriate triggers for implementation is also required in case impacts on existing coastal assets manifest before the end of an asset's practical life.

Groynes and Offshore Breakwaters are not suitable at Shellharbour for managing erosion or recession. These structures are costly to design, implement and maintain because they are located within the surfzone, which is a highly dynamic, energetic and potentially destructive environment. Further, these types of structures may not provide protection from recession due to sea level rise, unless they are substantially upgraded in the future (and even then, there is a possibility that they may not be effective). Therefore, they have been ruled out from further consideration in this plan.

Acquisition and Buy/Back / Lease Back options are not considered suitable at this time (or at least over the next 5-10 years), largely because there is no funding or financing model available to councils to implement this action, particularly for multiple properties. Similarly, Seawalls and Beach Nourishment are not considered suitable for this CZMP due to the funding constraints (and lack of available sand resources), but may be suitable at particular locations in a future CZMP.

Beach scraping has not been considered further for the Shellharbour CZMP, as it is considered better use of resources to focus efforts on the existing sources of dredged sand and approval arrangements (Lake Illawarra, Elliott Lake) for assisting beach width.

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Appendix A Legislation Summary

A.1 Coastal Protection Act 1979

The *NSW Coastal Protection Act 1979* (the CP Act) provides guidance on the use, occupation and development of the coastal zone in NSW. The CP Act was amended in 2002 to better reflect the purpose of the *NSW Coastal Policy* (1997) and to incorporate the principles of ecologically sustainable development.

The objects of the CP Act provide for the protection of the coastal environment of the State for the benefit of both present and future generations. The objects of the CP Act and how they are addressed by the Shellharbour CZMP is listed in Table A-1.

The CP Act allows the Minister for the Environment to direct a council with land within the coastal zone to prepare a Coastal Zone Management Plan, and gives directions as to how such Plans shall be prepared, approved, gazetted and amended where necessary.

The CP Act also requires Coastal Zone Management Plans to incorporate provisions for emergency beach erosion management and to provide for the unobstructed access to the coastline (beaches, headlands, waterways) by the public.

Table A-1 Objects of the Coastal Protection Act 1979 and How they are Addressed by this CZMP

Specific Objectives of the CP Act	Addressed by this CZMP
(a) to protect, enhance, maintain and restore the environment of the coastal region, its associated ecosystems, ecological processes and biological diversity, and its water quality	Environmental values have been considered and actions developed for restoration and rehabilitation of important habitats.
(b) to encourage, promote and secure the orderly and balanced utilisation and conservation of the coastal region and its natural and man-made resources, having regard to the principles of ecologically sustainable development	The CZMP balances natural and anthropogenic demands on the environment and resources. Sustainability and conservation of environmental, social and economic values is paramount in the development of actions and works.
(c) to recognise and foster the significant social and economic benefits to the State that result from a sustainable coastal environment, including: (i) benefits to the environment, (ii) benefits to urban communities, fisheries, industry and recreation, (iii) benefits to culture and heritage, (iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water,	All relevant values have been considered as part of the risk assessment process, with consequences related to environmental, social and economic factors. Actions within the CZMP include protection and restoration of important habitat areas as well as preservation of social and cultural values.
(d) to promote public pedestrian access to the coastal region and recognise the public's right to access	Existing parklands along the foreshore are protected in the CZMP, with associated social values including pedestrian access maintained in the future.

Specific Objectives of the CP Act	Addressed by this CZMP
(e) to provide for the acquisition of land in the coastal region to promote the protection, enhancement, maintenance and restoration of the environment of the coastal region	Significant coastal habitat areas within the study area for this Shellharbour CZMP are in public ownership (e.g. Bass Point), with proposed actions for preservation and restoration.
(f) to recognise the role of the community, as a partner with government, in resolving issues relating to the protection of the coastal environment	Community engagement is to be undertaken as part of the integrated CZMP process.
(g) to ensure co-ordination of the policies and activities of the Government and public authorities relating to the coastal region and to facilitate the proper integration of their management activities	The gazettal of the CZMP enables local planning instruments to become more aligned and integrated with the relevant State Government policies and directives, reflecting these policies and directives within applicable heads of consideration for future development assessment.
(h) to encourage and promote plans and strategies for adaptation in response to coastal climate change impacts, including projected sea level rise	The Shellharbour sea level rise policy has been included within relevant analyses and outcomes therefore account for such changes in the future.
(i) to promote beach amenity	Existing amenity of Shellharbour beaches is maintained within the CZMP.

Section 55C of the CP Act lists the specific matters to be dealt with in coastal zone management plans. These matters are outlined in Table A-2, along with a description of how they have been satisfied by the Shellharbour Coastal Zone Management Plan.

Table A-2 Coastal Protection Act 1979 Section 55C matters to be dealt with in CZMPs

Specific matters to be dealt with in CZMPs	Addressed by this CZMP
(a) protecting and preserving beach environments and beach amenity,	Foreshore amenity is to be maintained through protection of significant recreation areas.
(b) emergency actions carried out during periods of beach erosion, including the carrying out of related works, such as works for the protection of property affected or likely to be affected by beach erosion, where beach erosion occurs through storm activity or an extreme or irregular event,	Emergency works required before, during or after periods of beach erosion are detailed in both the Emergency Action Sub Plan to this report, and in specific beach access management actions in the CZMP.
(c) ensuring continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion,	Access along existing public lands is to be maintained and protected.
(d) where the plan relates to a part of the coastline, the management of risks arising from coastal hazards,	Open coastal hazards have been considered (see SMEC Hazards Study, as summarise in Section 3 and the Risk Assessment conducted for this study, in Section 5).

Specific matters to be dealt with in CZMPs	Addressed by this CZMP
(e) where the plan relates to an estuary, the management of estuary health and any risks to the estuary arising from coastal hazards,	Not relevant to this CZMP.
(f) the impacts from climate change on risks arising from coastal hazards and on estuary health, as appropriate,	Climate change, and in particular, sea level rise, has been included in the assessment of coastal hazards (see SMEC Hazards Study, as summarise in Section 3 and the Risk Assessment conducted for this study, in Section 5).
(g) where the plan proposes the construction of coastal protection works (other than temporary coastal protection works) that are to be funded by the council or a private landowner or both, the proposed arrangements for the adequate maintenance of the works and for managing associated impacts of such works (such as changed or increased beach erosion elsewhere or a restriction of public access to beaches or headlands).	No new coastal protection works are proposed, however, the as-required retrofitting and replacement of existing structures is included to maintain existing environmental, social and economic values. Maintenance of such structures is to be the responsibility of the asset owner.

A.1.1 Changes to the CP Act via the Coastal Protection and Other Legislation Amendment Bill 2010

Amendments were made under Part 2A of the CP Act to establish a joint state-local body called the NSW Coastal Panel. The NSW Coastal Panel shall act as a consent authority for coastal protection development applications where a council does not have a certified CZMP and / or requires further technical assistance in assessing such development applications. The Coastal Panel shall also assist the Minister when requested, such as for reviewing CZMPs.

Amendments were made in Section 55M of the CP Act and *SEPP (Infrastructure) 2007* (Clause 129A) that permit any person, including private landholders, to carry out development for the purposes of a seawall or beach nourishment with consent (i.e., they must submit a development application), see *SEPP Infrastructure 2007* Section 129A(1). Consent for such works is contingent on the application demonstrating that potential offsite impacts can be managed (for example, with beach nourishment). The private landholders who submit such applications would fully fund the coastal protection works, with no requirement for councils or the state to assist with funding. Amendments were made to Part 79C of the *Environmental Planning and Assessment Act 1979* (EPA Act) and *SEPP (Infrastructure) 2007* (Clause 129A) that require a consent authority, in determining a development application for coastal protection works, to take into consideration the provisions of any coastal zone management plan that applies to the land to which the development application relates (in addition to matters given in Clause 8 of SEPP 71). In this case, development applications may be refused where such works are not stated to be an action in the adopted CZMP. If there is no CZMP in place, the NSW Coastal Panel shall determine the development (see *SEPP Infrastructure 2007* Section 129A(2)).

For public authorities (e.g. Council), new coastal protection works (termed waterway or foreshore management activities) are permitted without consent under *SEPP (Infrastructure) 2007* (clause 129), provided the public authority considers the provisions of any CZMP relating to the land, or where there is no CZMP, notifies the NSW Coastal Panel and takes into consideration any response received from them within 21 days of notification. Temporary protection works under the meaning of the CP Act are not development to which this clause applies. However, there are no authorised locations for temporary coastal protection works in the study area for this CZMP (see the Code of Practise for the CP Act).

Amendments were made to Section 553B of the *Local Government Act 1993* (LG Act) to allow local councils to levy a Coastal Protection Service Charge to maintain and repair coastal protection works or to manage the impacts of coastal protection works. The charge covers Council's costs for maintaining the works and restoring the beach if the works cause erosion (which may include beach nourishment). Eligible coastal protection works for the CPSC include:

- works voluntarily constructed by a benefiting landowner (or landowners);
- works constructed jointly by a public authority (e.g. Council) with voluntary contributions from benefiting landowners;
- works that existed before section 496B of the LG Act commenced, where the landowner or a previous landowner voluntarily agree (in writing) to pay the CPSC; and
- works that existed before section 496B of the LG Act commenced, where the landowner has voluntarily agreed to upgrade the works. A pro-rata CPSC then applies, based on the incremental additional costs of maintaining the works and managing their off-site impacts.

Where works are implemented by a Council and the Council chooses to contribute to the cost of the works then the Council also must accept liability for a portion of the future coastal protection service charge for maintenance for the life of the works.

The annual charge is attached to the land title and becomes the responsibility of all future land owners for the life of the protection works. The amount of the charge is regularly reviewed depending on the cost of maintaining the works and in ameliorating any adverse impacts. The *Coastal Protection Service Charge Guidelines* provide further guidance, including how it can be used to fund the protection of private property by those property owners deemed to benefit from the works and how the amount of the rate should be calculated over the design life of the works.

Amendments were made under Part 4C of the CP Act outlining emergency coastal protection works that landholders or public authorities are permitted to carry out. The *Coastal Protection Amendment Act 2012* has now modified the allowances for such works, as detailed below.

All of the above changes provide a mechanism for Councils to allow the construction of protection works on private land to protect private property, and defer the responsibility and costs for construction to the land owners. Further, Councils can ensure that maintenance and amelioration of any adverse impacts is also borne by the land owners into the future, through the Coastal Protection Service Charge. There is no responsibility on local government or State Government to bear any of the cost for protecting private property.

A.1.2 Coastal Protection Amendment Act 2012

This Act permitted modifications to Part 4C of the CP Act relating to coastal protection works. The key change was renaming such works from 'emergency' to 'temporary' protection works, to enable authorised landholders to erect such works regardless of the impending occurrence of a storm, in response to coastal erosion. The works are not permitted on estuarine foreshores.

A Code of Practise is associated with the placement of temporary coastal protection works was revised in 2013. The Code of Practise outlines the height, materials and form for the placement of temporary coastal protection works, and the procedure for removal and remediation of such works. The Code of Practise contains a Schedule listing those locations at which temporary works are authorised. It is assumed that temporary works are not permitted at locations not listed in the Schedule.

The Amendment Act 2012 also simplified the process for landholders to gain approval to erect such works. Private landowners are now permitted to place temporary coastal protection works on their land without approval or a certificate from the local council or state government. Private landowners are also permitted to place these works on public land, provided they obtain a certificate for these works, and may keep such works in place for up to 2 years.

The fines for inappropriate placement of sand or sandbags (such as associated with the erection of temporary coastal protection works) have been halved, to reflect the lesser nature of such incidences. The heavy fines for placement of other non-beach materials (e.g. rocks, car bodies, bricks etc.) remain as per the 2010 CP Act amendments.

OEH or Councils (if they have authorised officers for this task) may order the removal of the temporary protection works where it is evident that such works are having detrimental impacts upon adjacent land or on beach amenity.

A.1.3 Guidelines for Preparing Coastal Zone Management Plans

The requirements for the preparation of coastal zone management plans is outlined in the *Coastal Protection Act 1979,* which references the adopted guidelines for preparation for such plans, that being the *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013) (the CZMP Guidelines). This CZMP has been prepared in accordance with these requirements, namely:

- this CZMP addresses the coastal management principles espoused in the CZMP guidelines, as outlined in Table A-3; and

the minimum requirements for preparation of coastal zone management plans that are documented in the CZMP Guidelines have also been satisfied by this CZMP as outlined in

- Table A-4.

Under Section 733(4) of the *Local Government Act 1993*, Council is considered to have acted in good faith where decisions are made substantially in accordance with the relevant manual for the hazard, which are in this case the CZMP Guidelines.

Table A-3 Coastal Management Principles addressed by the Shellharbour CZMP

	Coastal Management Principles (OEH, 2013)	Addressed by this CZMP
Principle 1	Consider the objectives of the *Coastal Protection Act 1979* and the goals, objectives and principles of the NSW Coastal Policy 1997	Refer Section 2.1 of this document.
Principle 2	Optimise links between plans relating to the management of the coastal zone	For managing hazards, incorporation of existing controls, that is, actions already being undertaken in the coastal zone, is an intrinsic part of the risk assessment process, and is documented in Section 5.5.1. Likewise, existing controls for community use are detailed in Chapter 4.
Principle 3	Involve the community in decision-making and make coastal information publicly available	Considerable consultation has been conducted through the course of the preparation of the CZMP, as discussed in Section 1.5.
Principle 4	Base decisions on the best available information and reasonable practise; acknowledge the interrelationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach	The risk based approach is an internationally recognised framework for natural resources management because it incorporates the best available information and its uncertainty. Management options recognise the overlap between flooding and oceanic processes through estuaries, streamlining management into one approach. The adopted Risk Management Framework intrinsically requires ongoing monitoring of risks and review and tailoring of risk treatments (management options).
Principle 5	The priority for public expenditure is public benefit; public expenditure should cost effectively achieve the best practical long-term outcomes	High level cost benefit analysis for management options has recognised the public benefit as priority for management options.
Principle 6	Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risk where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented	The CZMP has been prepared using the ISO 31000:2009 Risk Management Principles and Guidelines. Risks to public safety and assets have been analysed and mapped. Evaluation of the tolerability of risks has been evaluated. In certain cases risks that cannot be reasonably treated must be accepted. A trigger based approach to implementation has been applied.
Principle 7	Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions	The adaptability of management options to future circumstances was a consideration in selection of preferred options. A trigger based approach has been applied that recognises risks that are expected to increase over time.

	Coastal Management Principles (OEH, 2013)	Addressed by this CZMP
Principle 8	Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems	The CZMP includes actions for rehabilitation of degraded coastal ecosystems, and provision to improve resilience of existing high value ecosystems.
Principle 9	Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy	Public access along foreshore reserves is maintained and protected. CZMP includes actions to incorporate coastal hazards into future plan-making/review for community access plans (i.e. POMs).
Principle 10	Support recreational activities consistent with the goals of the NSW Coastal Policy	Certification of the CZMP will provide mechanism for inclusion of coastal hazards and the outcomes of this CZMP when planning for recreational activities within and around the waterway.

Table A-4 CZMP minimum requirements

Minimum Requirement	Addressed by this CZMP
A description of how the relevant Coastal Management Principles have been considered in preparing the plan	Refer to Table A-3 of this document.
A description of the community and stakeholder consultation process, the key issues raised and how they have been considered	Community and stakeholder consultation was conducted in preparing this CZMP as detailed in Section 1.5 of this document. Outcomes of the consultation were used in developing risk priorities and refining recommended management actions in this document. Continued involvement and information sharing during the implementation of this CZMP is recommended in Action: Community Education (refer CZMP document).
A description of how the proposed management options were identified, the process followed to evaluate management options, and the outcomes of the process	Refer to Section 6 of this document.

Minimum Requirement	Addressed by this CZMP
Proposed management actions over the CZMP's implementation period in a prioritised implementation schedule which contains: • proposed funding arrangements for all actions, including any private sector funding • actions to be implemented through other statutory plans and processes • actions to be carried out by a public authority or relating to land or other assets it owns or manages, where the authority has agreed to these actions (section 55C(2) (b) of the *Coastal Protection Act 1979*) • proposed actions to monitor and report to the community on the plan's implementation, and a review timetable	Refer to the Implementation Schedules provided in the CZMP document
Plan to be prepared using a process that includes: • evaluating potential management options by considering social, economic and environmental factors, to identify realistic and affordable actions • consulting with the local community and other relevant stakeholders. The minimum consultation requirement is to publicly exhibit a draft plan for not less than 21 days, with notice of the exhibition arrangements included in a local newspaper (section 55E of the *Coastal Protection Act 1979*) • considering all submissions made during the consultation period. The draft plan may be amended as a result of these submissions (section 55F of the *Coastal Protection Act 1979*).	Refer to Section 6 of this document. Community and stakeholder consultation conducted in preparing this CZMP is detailed in Section 1.5 of this document.

A.2 The NSW Coastal Policy 1997

The NSW Coastal Policy 1997 (the Policy) sets the strategic framework for coordinated, integrated and ecologically sustainable development of the coast. The Policy details nine goals and associated objectives and strategic actions for achieving ecologically sustainable development in NSW. Preparation of coastal zone management plans is one of the strategic actions given by the Policy, with the plans to be consistent with the Policy's goals and objectives.

The Shellharbour Coastal Zone Management Plan meets the nine goals and objectives of the NSW Coastal Policy as outlined in Table A-5.

Table A-5 NSW Coastal Policy goals and relevance to this CZMP

Coastal Policy Goals	Addressed by this CZMP
To protect, rehabilitate and improve the natural environment	Environmental values are to be protected and important areas rehabilitated through proposed actions of the CZMP.

Coastal Policy Goals	Addressed by this CZMP
To recognise and accommodate natural processes and climate change	Strategic planning actions that support planned retreat are to be considered and investigated further as a response to future climate change and sea level rise once triggers for further action have been reached.
To protect and enhance the aesthetic qualities	Environmental and recreational features of Shellharbour's beaches are to be preserved by maintaining and protecting foreshore lands and facilities, including associated aesthetic values.
To protect and conserve cultural heritage	Cultural heritage is recognised through the environmental and social values that have formed essential components of the coastal risk assessment for this Plan.
To promote Ecologically Sustainable Development (ESD)	The four principles of ESD have been considered in development of the CZMP. ESD is promoted through the preservation of existing environmental and social values and taking a longer-term sustainable focus for strategic planning.
To provide for ecologically sustainable human settlement	Future urban expansion is restricted due to existing development and environmental constraints. The CZMP includes strategic planning for consideration of planned retreat to maintain ecological sustainability in the future.
To provide for appropriate public access and use	Public access and use of facilities along public foreshore lands are to be maintained and protected, with foreshore structures retrofitted and replaced on an as-needed basis to preserve existing amenity.
To provide information to enable effective management	The CZMP includes monitoring of environmental conditions and asset conditions to inform future decision making (linked to triggers for further actions). Future re-assessment of risks is included in CZMP to ensure currency in response to monitoring outcomes.
To provide for integrated planning and management	The CZMP includes actions for improving the integration of coastal hazards into Council's planning framework, including development controls, policies and plan-making/reviews.

A.3 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (the EPA Act) is the key NSW legislation for planning and land use. The EPA Act provides a system of environmental planning and assessment for NSW, and involves developing plans to regulate competing land uses, through 'environmental planning instruments'.

The EPA Act establishes three types of environment planning instruments (EPIs):

- Local Environmental Plans;
- Regional Environmental Plans (now deemed as SEPPs); and
- State Environmental Planning Policies.

The objectives of the EPA Act are to encourage:

- proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment;
- promotion and co-ordination of the orderly and economic use and development of land;
- protection, provision and co-ordination of communication and utility services;
- provision of land for public purposes;
- provision and co-ordination of community services and facilities;
- protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats;
- ecologically sustainable development;
- the provision and maintenance of affordable housing;
- promotion of the sharing of the responsibility for environmental planning between the different levels of government in the State;
- provision of increased opportunity for public involvement and participation in environmental planning and assessment.

Approval processes for "development" and "works" in NSW are provided for in Part 4, Part 5 and Part 5A of the EPA Act. Key provisions are outlined briefly below.

Part 4 – Development Assessment

Part 4 of the EPA Act lays out the legislative regime for the standard process for lodgement and consideration of development applications. Part 4 processes essentially apply where the local authority (Council) is the consent authority. The majority of land based development within the study area will fall within Part 4 of the EPA Act.

The controls and permissibility for development of particular sites and / or uses are found in the Local Environment Plan (LEP) and Development Control Plan (DCP) (see sections below).

Section 79C under Part 4 of the *Environmental Planning and Assessment Act 1979* outlines matters for consideration for a consent authority (typically Council) in determining a development application to include the provisions of any coastal zone management plan (within the meaning of the Coastal Protection Act 1979) that apply to the land to which the development application relates.

Part 5 – Environmental Assessment

Part 5 outlines the requirements for determining authorities to consider the environmental impact of activities, through an environmental assessment for the proposed activity. The environmental assessment shall outline the effect of the activity on critical habitat, endangered fauna, vulnerable species, conservation agreements (under the *National Parks and Wildlife Act 1974*), plans of management, wilderness areas (under the *Wilderness Act 1987*) and joint management

agreements and bio-banking agreements under the *Threatened Species Act, 1995*, and any other legislation pertaining to the proposed activity.

Part 5 of the Act applies to proposed activities that are permissible without development consent under Part 4 of the EPA Act but require approval from a Minister or Public Authority, or is proposed to be carried out by a Minister or Public Authority (and Council is classified as a Public Authority).

Part 5 obliges the "determining authority" for the proposal to consider the environmental impact of any activity. A determining authority is the public authority which is required to approve an activity, and can also be the public authority proposing to carry out the activity. For example, Council is permitted to undertake certain environmental management activities under SEPP (Infrastructure) 2007 without development consent, however will still need to complete an environmental assessment (typically, a Review of Environmental Factors) under Part 5 of the EPA Act. In certain cases where an activity is considered to be "designated development", an Environmental Impact Statement (EIS) is required.

Part 5A (Development by the Crown) essentially provides a legislative regime for consideration of Development Applications made by, or for and on behalf of, the Crown.

The remaining parts of the EPA Act relate to: Part 6 – Implementation and Enforcement; Part 7 – Finance and Part 8 – Miscellaneous.

A.4 State Environmental Planning Policy No. 71 – Coastal Protection

State Environmental Planning Policy No. 71 – Coastal Protection (SEPP 71) aims to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast. SEPP 71 aims for development in the NSW coastal zone to be appropriate and suitably located, in accordance with the principles of the Ecologically Sustainable Development (ESD). The policy provides for: the protection of and improvement to public access compatible with the natural attributes coastal foreshores; and protects and preserves Aboriginal cultural heritage, visual amenities of the coast, the beach environment and amenity, native coastal vegetation, marine environment of New South Wales, and rocky platforms.

SEPP 71 applies to all lands within the coastal zone of NSW, which is defined on gazetted maps under the SEPP, therefore, all of the land in the study area for this CZMP. SEPP 71 provides matters for consideration in clause 8 that are to be taken into account: by a council when preparing its LEP for land within the coastal zone; and by a consent authority (e.g. council) when determining a development application on land within the coastal zone.

SEPP 71 also outlines the conditions for which the Minister for Planning becomes the consent authority for 'significant coastal development', that is, development on land within 100 metres of and below mean high water mark of the sea, a bay or an estuary. Development applications received by Council on such lands must be sent to the Director-General of Planning, and Council is required to take any additional matters specified by the Director-General into account when determining the application (in addition to the 'matters for consideration' given in Clause 8).

SEPP 71 also outlines development controls in Part 4 for which consent cannot be granted to applications that, in the opinion of the consent authority:

- will or is likely to impede or diminish to any extent the physical, land based right of access of the public to or along the coastal foreshore;
- where effluent is proposed to be disposed of by means of a non-reticulated system, will or is likely to have a negative effect on the water of the sea or any nearby beach, or an estuary, a coastal lake, a coastal creek or other similar body of water, or a rock platform; or
- will or is likely to, discharge untreated stormwater into the sea, a beach, or an estuary, a coastal lake, a coastal creek or other similar body of water, or onto a rock platform.

A master plan is to be adopted by Minister for Planning (or otherwise waived the need for a master plan as per Clause 18), prior to Council granting consent for subdivision of land:

- within a residential zone or rural residential zone if part or all of the land is in a 'sensitive coastal location'; or
- within a residential zone that is not within a 'sensitive coastal location' into more than 25 lots, or 25 lots or less, if the land proposed to be subdivided and any adjoining or neighbouring land in the same ownership could be subdivided into more than 25 lots; or
- within a rural residential zone that is not identified as a sensitive coastal location into more than 5 lots.

SEPP 71 defines 'sensitive coastal location' to mean land within:

- 100 metres above mean high water mark of the sea, a bay or an estuary;
- a coastal lake, or within 100 m of the water's edge of a coastal lake;
- a declared Ramsar Wetland, or within 100 m of a declared Ramsar Wetland;
- a declared World Heritage Property, or within 100 m of a declared World Heritage Property;
- a declared aquatic reserves under the *Fisheries Management Act 1994*, or within 100 m of such;
- a declared marine park under the *Marine Parks Act 1997*, or within 100 m of a marine park;
- coastal lakes (which includes all four of Gosford's Coastal lagoons), Ramsar wetlands and World Heritage areas;
- marine parks and aquatic reserves under the *Fisheries Management Act*; land within 100 metres of any of the above;
- within 100 m of land reserved under the *National Parks and Wildlife Act 1974*;
- within 100 m of SEPP 14 Coastal Wetlands; and
- residential land within 100 metres of SEPP 26 Littoral Rainforests.

A.5 SEPP (Infrastructure) 2007

SEPP (Infrastructure) 2007 (SEPP Infrastructure) provides a consistent planning regime for infrastructure and the provision of services across NSW, including consultation with relevant public authorities during the assessment process. The intent of SEPP Infrastructure is to support greater

flexibility in the location of infrastructure and service facilities along with improved regulatory certainty and efficiency for the State.

Division 25 of SEPP Infrastructure outlines development permitted with and without consent for the purpose of 'waterway or foreshore management activities', which are defined as:

'(a) riparian corridor and bank management, including erosion control, bank stabilisation, resnagging, weed management, revegetation and the creation of foreshore access ways, and

(b) instream management or dredging to rehabilitate aquatic habitat or to maintain or restore environmental flows or tidal flows for ecological purposes, and

(c) coastal management and beach nourishment, including erosion control, dune or foreshore stabilisation works, headland management, weed management, revegetation activities and foreshore access ways, and

(d) coastal protection works, and

(e) salt interception schemes to improve water quality in surface freshwater systems, and

(f) installation or upgrade of waterway gauging stations for water accounting purposes.

Development for the purpose of waterway or foreshore management activities may be carried out by or on behalf of a public authority (e.g. Council) without consent on any land, which may include:

- construction works;
- routine maintenance works;
- emergency works, including works required as a result of flooding, storms or coastal erosion (noting that this excludes emergency coastal protection works within the meaning of the Coastal Protection Act 1979);
- environmental management works; and
- new coastal protection works on the open coast or entrance to a coastal lake (despite Clause 129A, see below), provided the public authority considers the provisions of any CZMP relating to the land on which the works are proposed, or where there is no CZMP, notify the NSW Coastal Panel and take into consideration any response received from them within 21 days of notification. The 'new coastal protection works' excludes beach nourishment or sand placement, presumably so that councils can undertake beach nourishment without requiring such action to be a stated action in the CZMP or gaining approval from the Coastal Panel.

Thus in the study area, Council is permitted to undertake activities such as beach nourishment, environmental rehabilitation, seawalls (provided this is consistent with the CZMP) etc., provided they undertake a Review of Environmental Factors (REF) (under Part 5 of the EPA Act) and gain any approvals / licences required under any other Acts relating to the land or works (e.g. *Crown Lands Act 1989*, *Fisheries Management Act 1994*, *Water Management Act 2000* etc.).

Under Clause 129A of SEPP Infrastructure, development for the purposes of a seawall or beach nourishment may be carried out by any person with consent on the open coast or entrance to a coastal lake. In determining the application, the consent authority must consider the provisions of

any CZMP relating to the land on which the works are proposed, the matters stated in Clause 8 of SEPP 71, and any guidelines for assessing and managing the impacts of the works issued by the Director-General (noting that preconditions for granting consent for coastal protection works are stated in Section 55M of *the Coastal Protection Act*).

A.6 Illawarra Regional Strategy 2006-31

The Illawarra Regional Strategy was prepared by the Department of Planning in 2005 and applies to the local government areas of Kiama, Shellharbour and Wollongong. The Illawarra Regional Strategy ensures that for the projected housing and employment needs of the Region's population over the next 25 years, adequate land is available. The Illawarra Regional Strategy also sets out a range of actions that protect the Region's natural features such as the Illawarra Escarpment, Lake Illawarra and the Minnamurra Estuary.

The specific regional infrastructure requirements identified in the State Infrastructure Strategy 2006–07 to 2015–16 is also incorporated in the Illawarra Regional Strategy. The Illawarra Regional Strategy continues to inform future infrastructure investment priorities for the Illawarra region and ensures that future population growth is supported by services and associated infrastructure.

Shellharbour has taken the major responsibility for regional greenfield land releases over the last 30 years at Albion Park, Blackbutt, Flinders and Shell Cove. As the current estates reach completion, the focus for Shellharbour will shift towards urban renewal opportunities around towns and centres such as Oak Flats.

An appropriate mix of housing will be provided to cater for future household needs. As a general indication, dwelling split targets that cater for the demographic differences of Shellharbour Council are as follows: 60% detached houses; 38% medium density; and 2% high density.

A large proportion of public housing in Warilla is ageing and costly to maintain and does not cater for the needs of the client base. Councils will be encouraged to recognise the development potential of the Department of Housing properties when undertaking local strategic planning.

Given the development pressures for the Shellharbour region specified in the Illawarra Regional Strategy, it will be important to ensure that coastal hazards such as inundation and recession are accounted for through the development assessment process.

A.7 Shellharbour Local Environment Plan 2013

The Shellharbour Local Environment Plan 2013 ('SLEP 2013') has been prepared under the direction of the State Government to all local councils, as per the *Standard Instrument (Local Environmental Plans) Order 2006*. This Plan repeals the following environmental plans (with the exception of land identified as "Deferred matter" under clause 1.3 (1A)):

- Shellharbour Local Environment Plan 2000; and
- Shellharbour LEP Rural Local Environment Plan 2004.

The SLEP 2013 provides local environmental planning provisions for land in Shellharbour LGA in accordance with the relevant standard environmental planning instrument under Section 33A of the EPA Act. The SLEP 2013 outlines particular aims for the use and development of land in

Shellharbour, which is governed by land zoning in the LEP. Those aims that are relevant to coastal hazards are:

"(c) to protect, enhance and maintain significant landscapes with visual, scenic, historical, ecological or conservation values, including the Illawarra Escarpment, Lake Illawarra and the coastline, for the benefit of present and future generations" and

(i) to minimise risk to the community in areas subject to environmental hazards, particularly flooding, coastal inundation, bushfires, acid sulphate soils and unstable land."

The SLEP 2013 sets out the zonings that are applied to land in the LGA on the Land Application Map associated with the SLEP, and the objectives and permitted development (with or without consent) given for each land zone. The SLEP also guides the assessment and approval for Development Applications for lands within the LGA. Land use zones specified in the SLEP 2013 are given in Table A-6. For each of these zones, the LEP specifies:

- Objectives for development within the zone;
- Development that may be carried out without consent;
- Development that may be carried out only with consent; and
- Development that is prohibited.

Table A-6 Land Zones in the Shellharbour LEP 2013

Rural Zones	Residential Zones	Business Zones	Industrial Zones
RU1 Primary Production	R2 Low Density Residential	B1 Neighbourhood Centre	IN1 General Industrial
RU2 Rural Landscape	R3 Medium Density Residential	B2 Local Centre	IN2 Light Industrial
RU6 Transition	R5 Large Lot Residential	B3 Commercial Core	
		B4 Mixed Use	
		B5 Business Development	
		B7 Business Park	
Special Purpose Zones	**Recreation Zones**	**Environment Protection Zones**	**Waterway Zones**
SP1 Special Activities	RE1 Public Recreation	E1 National Parks and Nature Reserves	W1 Natural Waterways
SP2 Infrastructure	RE2 Private Recreation	E2 Environmental Conservation	W2 Recreational Waterways
		E3 Environmental Management	
		E4 Environmental Living	

In terms of managing coastal hazards, the LEP contains 'Part 5.5. Development within the Coastal Zone', which is a compulsory clause for all LEPs that apply to land within the coastal zone. Part 5.5 sets objectives and matters for consideration by the consent authority prior to granting consent to development on land wholly or partly within the coastal zone. The objectives include implementing the principles of the NSW Coastal Policy.

A.8 Shellharbour Development Control Plan 2013

The Shellharbour Development Control Plan (DCP 2013) supports implementation of the SLEP 2013 by providing additional controls on development. This DCP was updated in 2013, and includes controls relating to residential, commercial and industrial development, as well as other general provisions.

With respect to coastal hazards, the SCP 2013 addresses coastal erosion, coastal cliff instability and coastal inundation as follows:

- Residential building lines and boundary setbacks are prescribed in Chapter 3 (Section 3.2) "to reduce the likelihood of any risk from coastal processes, such as erosion", but also including embankment instability associated with the coastal cliffs and bluffs. Specific provisions are provided for Little Lake Crescent on Warilla Beach and Shell Cover Road on Barrack Point.
- Floodplain risk management controls are provided in Chapter 24, with general and specific provisions for all potentially flood prone land detailed in Appendix 11.

The controls have been reviewed for their provision of existing management action or control, as part of the risk assessment (Section 5.5.1).

A.9 Crown Lands Act 1989

The *Crown Lands Act 1989* (CL Act) provides for the administration and management of Crown land for the benefit of the people of NSW. The CL Act provides principles for the proper assessment, development, reservation or dedication and conservation of Crown Lands.

Waterbodies such as beaches and foreshores and estuaries / creeks / lagoons below the mean high water mark are designated as Crown Land and managed by the Department of Primary Industries Crown Lands Division (CLD). In addition to this, there are other Crown reserves in the coastal zone for which Council may be the reserve trust manager or trustee appointed by the Minister for Lands to care, control and manage the land in accordance with its public purpose and the principles of Crown Lands management (Section 11 of the Act).

The principles of Crown Land management as defined in Section 11 of the Act are: environmental protection principles be observed in relation to the management and administration of Crown land; natural resources of Crown Land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible; public use and enjoyment of Crown lands be encouraged; where appropriate, multiple uses of Crown land be encouraged; and where appropriate, Crown Land be used and managed in such a manner that the land and its resources are sustained in perpetuity.

In addition to these principles, the objectives of the Coastal Crown Lands Policy 1991 apply to Crown lands within the coastal zone. The policy sets specific objectives for conserving the

environmental and cultural qualities of coastal Crown Land, retaining in public ownership coastal lands that are environmentally sensitive and / or required for public purpose, and providing use of coastal crown lands for recreation, tourism, residential and commercial development with due regard to the nature and consequences of coastal processes.

For all Crown land reserves, a Plan of Management (POM) is required to be prepared and adopted (in accordance with Division 6 of the *Crown Lands Act 1989*). The POM shall identify the key attributes and values of the area, general physical improvements to enhance the values and specify the permissible uses for the reserve.

A.10 Local Government Act 1993

The *Local Government Act 1993* (the LG Act) creates local governments and grants them the power to perform their functions, which involve management, development, protection, restoration, enhancement and conservation of the environment for the local government area. The functions of the local government are to be performed in a manner that is consistent with and promote the principles of ecologically sustainable development.

The service functions of local councils (defined in Chapter 6 of the Act) includes the classification, use and management of public land, including the objectives for management of the Community Land owned by a Council (i.e. that is not Crown Land).

Plans of Management for Community Land need also to be prepared under Section 35 of the Act. Section 35 of the act provides that community land only be used in accordance with the Plan of Management applying to the parcel of community land; any law permitting the use of the land for a specified purpose or otherwise regulating the use of the land; and the provisions of Division 2 Chapter 6 of the Act.

Community land can be divided into a range of categories under Section 36 of the Act, and each of these categories has their own core objectives specified under the Act. The division of community lands is important as the Act requires Council to only grant a lease, licence or another estate (other than in respect of public utilities) for a purpose consistent with the core objectives of the category of that community land.

A.10.1 Shellharbour Foreshore Management Plan 2004

The Shellharbour Foreshore Management Plan (SFMP) 2004 was developed in accordance with the *Local Government Act 1993*, NSW Coastal Policy 1997 and other objectives from relevant legislation. The development of the SFMP ensures the conservation of the foreshore whilst at the same time encouraging and supporting appropriate public use. It covers an area of the Shellharbour Foreshore from Bardsley Park (adjacent to the Shellharbour Surf Club) to Shellharbour South Beach, excluding the Shellharbour Beachside Tourist Park (caravan park). The plan establishes a framework and strategic direction for managing the Shellharbour Foreshore and facilitates the creation of a unique identity for the area.

The SFMP identified significant issues for the plan's area, although coastal hazards and sea level rise were not included as an issue. The SFMP largely focuses upon a range of works to improve public facilities and access, including landscaping, weed management, seating, stairs and other

accessways, signage and improvements to footpaths and roadways. A series of masterplans accompany the plan detailing where and how the facilities and landscaping shall be installed. The majority of the proposed works have been implemented. In this regard, the SFMP is considered to substantially address issues and management of public access and amenity and community use for the area of foreshore covered by the plan.

The foreshore management plan does not appear to account for coastal hazards that may impact the study area (and public access and facilities) over the immediate timeframe. It would not be expected that a foreshore management plan incorporates provision for sea level rise as the expected lifespan for facilities is much less than the 2050 to 2100 timeframes used for sea level rise planning.

A.10.2 Bass Point Reserve Plan of Management

The Bass Point Reserve Draft Plan of Management (BPPOM) was prepared by consultants Manidis Roberts in August 2000 for Bass Point Reserve and the southern section of neighbouring Shellharbour South beach and foreshore. The BPPOM details all issues relevant to the site, provides strategies for long term management of the Reserve and ensures the protection while still allowing for reasonable recreational activity. The BPPOM does not provide actions to address coastal hazards.

A.11 The NSW Coastal Planning Guideline: Adapting to Sea Level Rise

The NSW Coastal Planning Guideline: Adapting to Sea Level Rise (the Planning Guideline) describes how sea level rise should be considered in land use planning and development assessments. The Planning guideline supported the former NSW Government Sea Level Rise Policy Statement (2009), although the provisions within it in remain relevant to any sea level rise projection that may be applied. The Planning Guideline outlines six coastal planning principles for adapting to climate change, including:

- assessing and evaluating the coastal risks accounting for sea level rise;
- advising the public as to coastal risks to facilitate informed land use planning and development decision making;
- avoiding the intensification of land use in coastal risk areas through appropriate strategic and land use planning;
- considering options to reduce the intensity of land use in coastal risk areas;
- minimising exposure of development to coastal risks; and
- implementing appropriate management responses and adaptation strategies that consider the environmental, social and economic impacts of such responses.

In evaluating coastal risk areas, the Planning Guideline defers to the DECCW (2010) *Coastal Risk Management Guideline* (see discussion below). The coastal risk areas should be identified through specific local studies, at which point they should be mapped in LEPs, regardless of current land zoning.

The Planning Guideline advises that strategic land use planning shall discourage intensification of development in coastal risk areas. For example, changing land use from rural to urban or increasing housing density shall be avoided in high risk areas due to the potential future risk to life, property and the environment. As changes to land use may affect the future development potential of an area, the Guideline recommends these changes be applicable to the level of risk. Where possible, new coastal subdivisions and urban developments shall be located outside the 2100 coastal risk area.

The Guideline makes reference to the *Coastal Design Guidelines for NSW* (2003) for strategic land use planning (height, scale and setback), retaining foreshores and headlands in public ownership and protecting from storm events and sea level rise.

A.12 Coastal Risk Management Guide – Incorporating sea level rise benchmarks in coastal hazards assessments

The *Coastal Risk Management Guide – Incorporating sea level rise benchmarks in coastal hazards assessments* (DECCW, 2010) states that the identified risk area for coastal planning is to include the existing coastal hazards region plus an additional area affected by sea level rise.

The guideline also indicates that the defined coastal inundation hazard should include sea level rise projections as part of the assessment. Design Still Water Levels to be used in such assessments are provided in the document. The guidance from that document was largely incorporated into the *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013).

A.13 Illawarra Biodiversity Strategy

The Strategy aims to guide a program for biodiversity management for the Wollongong, Shellharbour and Kiama councils over the next five years. The Strategy outlines how the three Illawarra Councils will help meet national and state biodiversity targets and respond to regional issues by identifying key priorities for the next five years. The Strategy provides a co-ordinated and regional approach to biodiversity conservation identifies biodiversity priorities to guide the Illawarra Councils and promotes the conservation of biodiversity across the Illawarra. It also identifies predicted threats to biodiversity as a result of climate change.

The Strategy is divided into two parts; Volume 1 provides a brief overview of the key issues values and threats, and the details of the action plan and Volume 2 provides the detail on the values, threats and methods used to assess them. Table A-7 provides a list of the EECs and the prioritisation of those communities based on an assessment of the level of threat to the community, and population status. The priority of sites for bush regeneration works in the Shellharbour coastal zone are presented in Figure A-1, and include:

- Bass Point Reserve – Highest Priority
- Warilla Beach and Dunes, Shellharbour North Beach and Dunes, and Shellharbour Swamp – Moderate Priority.

Table A-7 Prioritisation for Shellharbour EECs

Endangered Ecological Community (EEC)	Priorities
Bangalay Sand Forest	High
Coastal Saltmarsh	High
Freshwater Wetlands on Coastal Floodplains	High
Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion	Highest
Illawarra Subtropical Rainforest in Sydney Basin Bioregion	Highest
Littoral Rainforest (TSC Act); Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (EPBC Act)	High
Melaleuca armillaris Tall Shrubland	Highest
River-flat Eucalypt Forest on Coastal Floodplains	High
Robertson Basalt Tall Open-forest	High
Robertson Rainforest	High
Southern Highlands Shale Woodlands	High
Swamp Oak Floodplain Forest	High
Swamp Sclerophyll Forest on Coastal Floodplains	High
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Highest

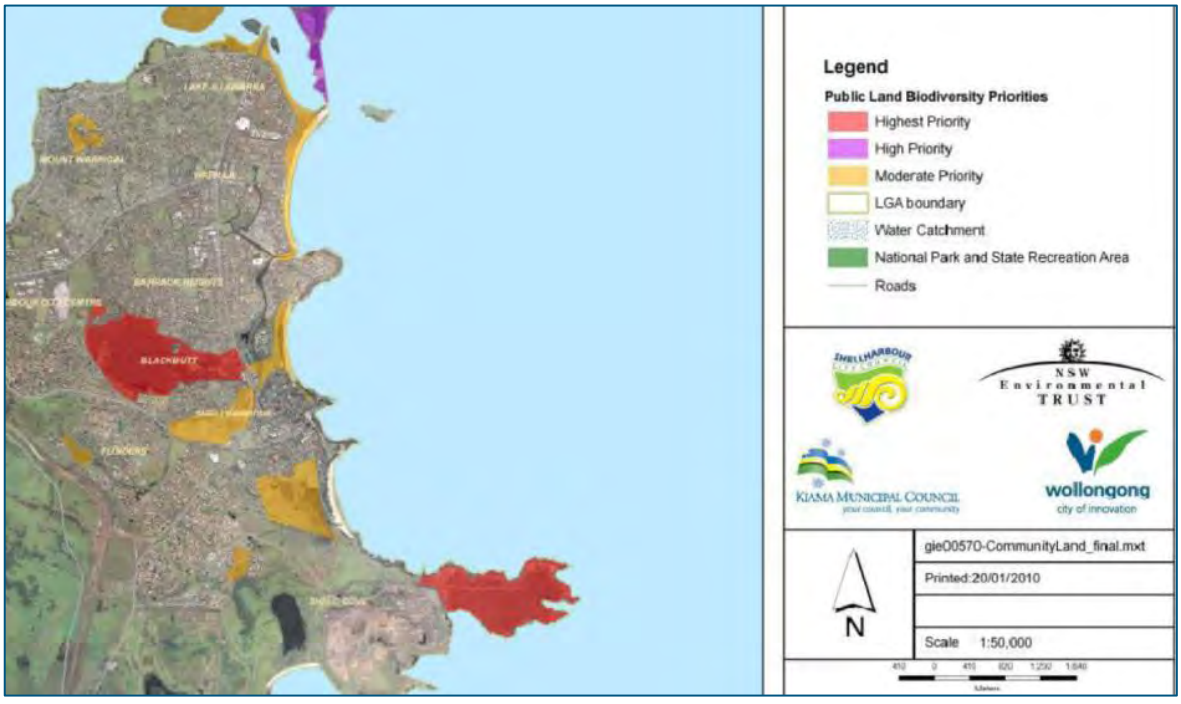


Figure A-1 Bush Regeneration Priorities

A.14 Southern Rivers Catchment Action Plan

The Southern Rivers Catchment Action Plan (SRCAP) identifies the desired condition of natural resources and sets out priority targets towards achieving this condition over ten years. The

Coastal and Marine program includes all waters to three nautical miles offshore. This coast and marine program was developed with input from many partners, such as Local Government, Landcare and Coastcare groups, and builds on the information contained within the blueprints of the South-East and Southern Catchment Boards. This section describes the state of the region's coastal and resources, the continuing pressure on these, and the way the catchment action plan directs effort to improve their condition. The preparation of the coastal zone management plan aligns with the following targets.

CM1 By 2016, the condition of coastlines will be maintained or improved through the development and implementation of natural resource management plans.

CM4 By 2016, active management will protect or improve key aquatic habitat areas (including for listed threatened/endangered species and ecological communities) in partnership with relevant authorities and user groups.

CM4 By 2007, a research strategy will be developed to improve the scientific knowledge and understanding of coastal, estuarine and marine environments and processes; to be progressively implemented by 2016.

A.15 Illawarra Natural Resource Management Action Plan 2010

The Illawarra Natural Resource Management (NRM) Action Plan provides a coordinated approach for all natural resource work within the region through partnerships and collaborations with community groups, individuals, industry and government. The Action Plan defines the priorities and outcomes to be achieved for NRM in the Illawarra for the next decade. It guides the allocation of investments from the CMA and other agencies to help direct effort and funding to where it is most needed and also supports partners working together on collaborative projects to achieve common goals, or to achieve goals across a number of target areas. The Illawarra local targets addressing the CAP Coastal and Marine targets that are aligned with the preparation and implementation of a coastal zone management plan are outlined below.

The Illawarra local targets addressing CM1:

- By 2013 enhance community skills, knowledge and engagement to protect coastal values (e.g., through information exchange forums, educational and leadership programs).

Illawarra local targets addressing CM5:

- By 2011 completion of the Coast, Estuary and Marine research strategy.
- By 2016 a minimum of one project commenced for high priority knowledge gaps identified through the research strategy and marine environment report. In partnership with research institutes.

Appendix B Summary of Facilities in the Shellharbour Coastal Zone

Shellharbour North Beach (Including Nuns Beach)

Access

- Various points of access to the beach via Junction Road and Wollongong Street.
- Two new concrete ramps and concrete stairs for beach access at Bardsley Park *(L01/01).*

Amenities

Bardsley Park (56-60 Wollongong Street, Shellharbour) has five barbeque shelters, a children's playground, a small beach with a vegetated foredune, four showers and an area of marine rock platform.

Recreational Uses

Bardsley park is used for picnicking and playground activities and the small beach is used for swimming, surfing and sunbathing and all areas including the rock platform have some degree of pedestrian traffic.

Cowrie Island to Shellharbour Reserve

Amenities

Cowrie Island and causeway (eastern end of Towns Street) includes public seating, boat launching ramps, slipways and a winch house, a jetty, a breakwater, car park, a marine rock platform and some landscaping.

Grey Park and Little Park includes picnic tables and shelters, a playground, seating, public amenities, a rotunda, boat harbour, boat trailer parking, boat wash down bay, break water, vehicle access and parking, lighting, pathways, Coast Guard facilities, bike rack, landscaping, significant trees, beach and marine rock platform.

The Beverly Whitfield Pool (east of 1 Boollwarroo Parade) area has picnic tables and shelters, BBQ facilities, public seating, public amenities, lifeguard facilities, vehicle access and parking, pathways and areas of grass and marine rock platform.

Recreational Uses

Cowrie Island and causeway are primarily used for boat launching, walking, surfing, fishing, swimming, cleaning fish and boat maintenance.

Grey Park and Little Park are used for a range of purposes, however the main activities are vehicle access and parking (including boat trailer parking), picnicking and other uses associated with the Little Park facilities.

The main uses of the Beverly Whitfield Pool area are swimming, vehicle access and parking, picnicking and walking.

Bass Point Reserve

Amenities and Access

- Car Park spaces at the Reserve entrance, Maloneys Bay, Beaky Bay and Bushrangers Bay,
- Picnic tables at Maloney's and Beaky Bay,
- Barbeque facilities at the Reserve entrance, Maloneys Bay, Beaky Bay and Bushrangers Bay,
- Toilets; septic system at the Reserve entrance and pit toilets at Beaky Bay,
- Rubbish bins,
- Water tank at Beaky Bay,
- Viewing area and stairways to foreshore at Bushranger's Bay.

Warilla Beach

Access:

Various access points to the beach,

Amenities:

Toilet block, access ramp, bench seats, public showers, fencing, car park at Bucknell Street, barbecue facilities.

Appendix C Community Survey Responses

Table C-1 Responses to the Community Survey

		What activities do you do at this beach?														
Name the Beach you are describing (Please complete a separate survey for each beach)	How often do you visit this beach?	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running	Sunbathing	Sight seeing	Playing with children	Kite surfing	Nature appreciation (bird watching, whale watching etc)	Other (please specify)	What other things are good about this beach? e.g. safe for children to swim/play, good facilities, good parking and access, good surfing, quiet and undisturbed, natural vegetation etc	What would you like to keep the same about this beach?	What changes would improve this beach?
North Beach	Daily	Walking		Swimming	Surfing		Running	Sunbathing				Nature appreciation (bird watching, whale watching etc)		Surfclub ,toilets,parking,surfing,swimming ,clean	Toilets ,surfclub ,parks ,keep building persona of the envoriment, building code not to change	Sand dunes vegetation, access times for dogs, fitness classes not to use amenities buildings for classes, more bbq area like blacks beach
North Beach	Daily			Swimming										Good surrounds. Safe rated beach, good parking, playground area, patrolled during summer months, active surf club	All of above	Cycle way, pinic tables, open area showers, larger public ammenities block,
North Beach	Daily			Swimming	Surfing								Surf Club Patrols	Location,Parking,	Touch nothing, but possibly improve public seating etc.	More seating and covered area, bbq for public use
North Beach	Weekly			Swimming	Surfing		Running	Sunbathing						Patrolling surf club. Generally a small surf Family friendly environment	As above	Walking/Bike path from Shellharbour Village retail area to Warilla beach. Cafe facilities on the beach Clean change room facilities
North Beach	Daily	Walking		Swimming	Surfing			Sunbathing						Good lawn area for viewing beach goers (including kids swimming/surfing), nice picnic areas, protected beach	Leave lawn area open to beach	Improved outside showers, retaining wall for lawn
North Beach	Daily		Picnicking / BBQs	Swimming	Surfing		Running					Nature appreciation (bird watching, whale watching etc)		Plenty of grassed area, cared for by Shellharbour SLSC members Parking Safe swimming	The grassed area	More Boardwalks in front of SLSC

Community Survey Responses

		What activities do you do at this beach?														
Name the Beach you are describing (Please complete a separate survey for each beach)	How often do you visit this beach?	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running	Sunbathing	Sight seeing	Playing with children	Kite surfing	Nature appreciation (bird watching, whale watching etc)	Other (please specify)	What other things are good about this beach? e.g. safe for children to swim/play, good facilities, good parking and access, good surfing, quiet and undisturbed, natural vegetation etc	What would you like to keep the same about this beach?	What changes would improve this beach?
Shellharbour	Daily	Walking		Swimming	Surfing		Running	Sunbathing						The beach is quite safe on most days and facilitates are reasonable.		It needs a kiosk. There should be greater flexibility regarding life guard hours. Ideally, there is a need to stay open longer on good days and also there is no need to 2 life guards when the seas are flat (easily over 50% of the time). The money spent on 2 life guards each day coudl be better used.
Shellharbour	Daily	Walking		Swimming	Surfing				Sight seeing				Surf life saving activities	Good parking, easy access to the beach, public facilities.		Weed beds that are located at the front of the surf club & Bardsley Park need to be removed and replaced with a retaining wall so there is lawn right to the sand -this will give an even surface & a much better look.
South Beach	Once a year						Running						Walk my dogs	undisturbed, parking, close proximity, not alot of people in morning.	access, limited devlopment	further fencing and dune care. As a young child I participated in dune care tree planting as part of the local school program, would be good to see such programs continue today.
South Beach	Weekly	Walking		Swimming	Surfing				Sight seeing	Playing with children		Nature appreciation (bird watching, whale watching etc)		not many people easy parking	no further development along the beach front	add a lifesaving service
South Beach	Weekly	Walking							Sight seeing	Playing with children		Nature appreciation (bird watching, whale watching etc)		The natural beauty. The lifestyle - we can walk from town right along the beach towards Bass Point. It will be a tragedy to rip up the beach for the marina.	The beach itself, including the inlet (under the bridge). It's a lovely place to take young children, in its current form. I do not want it ripped up for the marina and I do not want any sea walls to be constructed. Also, it's extremely important that the aboriginal middens are promoted. They don't even seem to be marked out for the public to pay respects to our local indigenous history.	More children's play equipment, bbqs, simple shade structures, including on the southern side of the bridge. Nothing fancy is needed. Markings for the aboriginal middens.
South Beach	Daily	Walking		Swimming	Surfing	Fishing	Running							1.Less populated 2. Generally safe to swim in 3. Easy access. 4. Clean water and sand	As per question 4	Leave as is! A marina will cause great changes and potential to erosion as stated in early survey on an introduced change on the beach.
South Beach	Weekly	Walking		Swimming	Surfing	Fishing	Running	Sunbathing		Playing with children				good views to bass point, clear water, access directlty to bass point such as the shallows make the beach great for walking, lack of persons. close to my house	everything	possibly remove dogs from the beach

Community Survey Responses

		What activities do you do at this beach?														
Name the Beach you are describing (Please complete a separate survey for each beach)	How often do you visit this beach?	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running	Sunbathing	Sight seeing	Playing with children	Kite surfing	Nature appreciation (bird watching, whale watching etc)	Other (please specify)	What other things are good about this beach? e.g. safe for children to swim/play, good facilities, good parking and access, good surfing, quiet and undisturbed, natural vegetation etc	What would you like to keep the same about this beach?	What changes would improve this beach?
Warilla	Daily				Surfing									access the the bridge at southern end is difficult if you are coming from the little park other wise the bridge has been a big asset	maintain the sand reserve on the beach by maintaining the entrance to the Little Lake by periodically pushing the sand back onto the beach	maintaining the dunes at the northern end by cleaning out all the weeds and rubbish.
Warilla	Daily	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running		Sight seeing	Playing with children	Kite surfing		Surf Club and Patrol	Open aspect and Cycleway	Maintain the amount of sand on the beach	More sand placed back on the beach from the lake Upgrade the surf club to allow a kiosk
Warilla	Daily			Swimming		Fishing								Natural headland and windang island	Ammount of sand	More sand and better tracks to beach
Warilla	Daily	Walking							Sight seeing					Walkway along the beach	The open views from walk way	Walk way along the northern part with a view of the beach. The current track is unsafe and tomany trees on both side of the track near the surf club. New surf club with kiosk
Warilla	Daily	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running							Safe swimming in little lake	Sand on the beach, no rock wall	Less sand in little lake and a walk way along the lake. Better access from the beach to little lake from warilla side. Better lifegaurd tower Kiosk or food shop
Warilla	Daily	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running							Safe Swimming, Fishing	Amount of sand that is now on the beach must maintain this	Beter tracks at northerend, less bushs and more grass and picnic areas along the beach. Showers and new toilets block at northern end. Kiosk or better surf club
Warilla	Weekly	Walking		Swimming						Playing with children				Grass and New Picnic area in the center of beach, always being used need more along the beach	Sand at southern end, need to maintain this	New Picnic areas Better track New cycle way with views at northern end
Warilla	Daily		Picnicking / BBQs	Swimming										Sand at southern end, need to maintain this New Picnic area in the center of beach, always being used need more along the beach, one at north end on the dune system would be great and beter walkways to the northern part	Grassed areas	Better walkways to beach, More Sand at southern end New Picnic area in the center of beach, always being used need more along the beach, need on the beach at northern end. Better lifegaurd towers at north and southern ends Better surf club Kiosk
Warilla	Daily			Swimming	Surfing	Fishing	Running							Sand at southern end, council needs to maintain this by placing sand from entrance back on the beach	Open space Walk way/ Cycle way View Surf from car	Facilities need upgrades such as surf club and toilet block and walking track and beach access

Community Survey Responses

		What activities do you do at this beach?															
Name the Beach you are describing (Please complete a separate survey for each beach)	How often do you visit this beach?	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running	Sunbathing	Sight seeing	Playing with children	Kite surfing	Nature appreciation (bird watching, whale watching etc)	Other (please specify)	What other things are good about this beach? e.g. safe for children to swim/play, good facilities, good parking and access, good surfing, quiet and undisturbed, natural vegetation etc	What would you like to keep the same about this beach?	What changes would improve this beach?
Warilla	Weekly	Walking		Swimming		Fishing			Sight seeing					safe for children to swim/play	Open space and sand at southern end	More sand on the beach, Dredge sand from lake and place back on the beach
Warilla	Daily				Surfing									The Surf and able to view the surf from your car	The open aspect with no trees	Better facilities such as kiosk and showers. Access at northern end in bad
Warilla	Daily	Walking			Surfing	Fishing	Running		Sight seeing	Playing with children			Surf Club	Sand at southern end, Surf is allways great Safe swimming at north and south ends when surf is large	The sand at southern end, maintain by dredging lake	Better facilities such as showers and toilets. Better walk ways at north end and showers. Surf club needs improving to provide food.
Warilla	Daily	Walking	Picnicking / BBQs	Swimming	Surfing	Fishing	Running	Sunbathing	Sight seeing	Playing with children	Kite surfing	Nature appreciation (bird watching, whale watching etc)	Patrol, Surf Club	Open Space, Views from cycle way	Open space to maintain views, Grassed areas	Better beach access esecially at northern end, Facilities at northern end. Upgrade to surf club.
Warilla	Weekly	Walking		Swimming	Surfing		Running			Playing with children				Great long beach		Please spend some money on the area it one of the best beaches on the coast but no one goes past Wingdang. you cant see the beach. give Shellharbour a rest and spend some money down here.
Warilla	Weekly	Walking		Swimming	Surfing		Running			Playing with children				Great long beach		Please spend some money on the area it one of the best beaches on the coast but no one goes past Wingdang. you cant see the beach. give Shellharbour a rest and spend some money down here.
Warilla	Weekly	Walking		Swimming		Fishing	Running	Sunbathing		Playing with children			Surf Club activities	Its our local beach and its beautiful, parking and facilities are great. Need to ensure we don't lose the beach to the rising water levels.		
Warilla	Weekly	Walking	Picnicking / BBQs	Swimming	Surfing		Running			Playing with children				The safety is the main reason for attending this beach. This is becuase the beach is patrolled. Also making me 2 young children aware of beach safety.	Keep it patrolled is the main key for me.	I would like to see the Warilla Barrack Point Surf Life Saving Club up graded. It looks out dated and need improvement not just as a club but as a community focal point.
Warilla	Daily	Walking		Swimming	Surfing	Fishing	Running		Sight seeing	Playing with children				Cycleway along the beach, The sand that has been replaced on the southern end of the beach and should be continued to be replaced with sand from the lake.	The open aspect from the cycleway	Build a better surf club to allow better recreational enjoyment, Continue to transfer sand from the lake to the beach.

Appendix D Descriptions of Management Options

Coastal Hazards DCP Chapter

Apply controls to developments (infill, greenfields, re-developments) as appropriate to the expected life of the development and the likely impact from coastal hazards.

Type of Option

Avoid/Accommodate/Accept: Development of Existing and Future Sites

Details

A Coastal Hazards Development Control Plan (DCP) chapter is an option to manage existing development as well as future development, as development applications are made for existing and undeveloped sites. Development applications may consist of:

- complete redevelopment of an existing structure, including subdivision; or
- major alterations or refurbishments to existing structures; or
- subdivision and/ or new developments on previously undeveloped land.

The re-development of existing developments offers an opportunity to apply development controls that mitigate or accommodate coastal risks to an extent that is consistent with the expected lifespan of the development and the level of risk over that lifespan.

The Coastal Hazards DCP chapter is aimed at managing the Erosion and Recession and wave overtopping hazards. The wave overtopping component of the Coastal Inundation Hazard lies within the erosion hazard footprint. The backwater inundation component of the Coastal Inundation Hazard can be managed through floodplain development controls, as the hazards are similar in impact. Erosion, recession and wave overtopping impacts are different to flooding impacts, and so cannot be managed by existing floodplain controls.

The following recommendations are made for preparing a Coastal Hazards DCP chapter to manage future and re-developments. The actual format and content of a Coastal Hazards DCP would be determined by Council at the time of its preparation.

Determine Development Controls applicable to the Level of Risk and Type of Development.

The DCP chapter would apply to all land potentially affected by coastal erosion and recession (which may be specified as a Coastal Risk Planning Area that accompanies the Local Environment Plan). Therefore, it is recommended that the criteria specified within the DCP chapter be applicable to the development type and level of risk to the land.

The development controls should relate to the probable hazard extent (i.e. almost certain, likely, unlikely, rare) over the expected lifespan for the proposed development type. Development controls should relate alterations and additions to existing buildings, in addition to re-developments or new developments. For coastal hazards,

the likelihood of impact (and so, level of risk) increases over time in relation to sea level rise. Therefore, the expected life of the development can be used to determine at what timeframe (i.e., immediate (e.g. 2012), 2050 and 2100) the hazard should be applicable to the proposed development. The type of development shall then determine the probability of hazard (i.e. almost certain, likely, unlikely, rare) that is applicable to the hazard. The expected life for particular types of development should be determined by Council. A suggested timeframe and hazard probability for different developments is given in Table D-1.

Given that development controls would apply to the entire Coastal Risk Area, this approach ensures that land is not unnecessarily sterilised, nor is unsuitable land (re-)developed inappropriately. Should residential or other property be damaged during a storm event, the development controls ensure rebuilding of the site is subject to consideration of the probable hazard extent, which may mean the same type of development is no longer appropriate. Examples for land use categories and the different timeframes and hazard zones applied is given below.

- A **residential development** may be expected to exist on a site for up to 100 years. Therefore, the hazard extents by 2100 would apply. In determining controls, the 'unlikely' line at 2100 is considered to be the defining line landward of which residential property may be permitted. This line is consistent with the Department of Planning's 2100 Coastal Risk Area extent. The unlikely hazard line incorporates both the potential for storm erosion accounting for rip cells, different wave directions and so on that may occur at any location along a beach plus sea level rise induced shoreline recession based upon the NSW Government's sea level rise benchmarks.
- **Essential facilities and infrastructure** may also be expected to be on a site for 100+ years and by its very nature needs to be conservatively sited for coastal risks. Again, the hazard extents by 2100 should apply. In determining controls, the 'rare' line at 2100 is considered to be the line landward of which development may be permitted without controls. The 'rare' line is similar to the PMF used in flooding, and is thus is an appropriate hazard boundary for ensuring essential services are located beyond potential impact risk area. The only exception to this may be stormwater outlets which by their very nature are located on the shoreline. Consideration for impacts can be included in the structure design.
- Refurbishment of a **surf club** may have an expected design life of 40 -50 years, thus the 2050 hazard lines shall apply. To ensure that the lifeguarding services are easily and appropriately provided, but that the club can be utilised for other activities (including commercial functions such as function centres, restaurants, cafes and so on), it is recommended that the club house is sited further landward than lifeguard towers / sheds, which can be relocatable or sacrificial. By their very nature, lifeguard towers must be located close to the shoreline in order to meet their purpose. Such structures can be designed to accommodate the high probability of impact, for example, being designed to be sacrificial (i.e. simple structures that are expected to be damaged, then replaced swiftly when impacts occur) or relocatable (i.e. can be moved prior to a storm event, but also provide power, water and so on). Recreational facilities such as picnic shelters are expected to have a short lifespan. In both cases, the immediate hazard probability zones may apply, rather than the more conservative 2100 estimates.

Table D-1 Suggested Timeframe and Hazard Likelihood for Development Types (adapted from Coffs Harbour CZMP)

Land Use Categories	Hazard Timeframe	Examples
Residential	2050	Attached dual occupancy; Bed and breakfast establishment; Boarding houses; Camp or caravan park site – long-term sites only (1); Child care centre; Community facility (other than Essential and Sensitive Facilities); Detached dual occupancy; Dwelling; Dwelling-houses; General store; Group homes; Home industry; Home Occupation; Multiunit housing; and Utility installations (other than Essential Facilities, e.g. non-submersible or readily removed components of sewage pumping stations)
Commercial, Industrial	2050	Abattoir; Brothel; Bulky goods salesroom; Business premises; Entertainment facility; Heliports; Hotel; Industry; Light industry; Medical centre; Motel; Motor showroom; Office premises; Passenger transport terminal; Permanent group home; Place of worship; Recreation facility; Restaurant; Rural industry; Sawmill; Service Station; Shop; Transport terminal; Vehicle body repair workshop; Vehicle repair station; Veterinary clinic; Veterinary hospital; and Warehouse or distribution centre.
Subdivision	2100	Subdivision of land which involves the creation of new allotments
Essential Community Facilities	2100	Community facility which may provide an important contribution to the notification and evacuation of the community during flood events; Hospitals, SES, Ambulance, Police and Fire Stations.
Sensitive Facilities	2100	Communications facility; Hazardous industry or storage establishment; Offensive industry or Storage establishment; Liquid fuel depot; Educational establishments, Nursing homes, Housing for Aged, Disabled and Special Care Homes, Transitional Group Homes
Concessional Development: Additions/ Alterations/ Extensions	Immediate	An addition or alteration to an existing dwelling or building
Recreational and Non-urban	Immediate	SLSC buildings; Beach kiosks/ pavilions; Marina; Recreation areas and minor ancillary structures (e.g. toilet blocks or kiosks); Retail plant nursery; Wharfs; Boardwalks
Tourist Related Development	Immediate	Camp or caravan site – short term sites (1) only; Ecotourism, Holiday cabins; and Tourist facility
Infrastructure	Immediate	Infrastructure that is required to provide public utilities to the community such as roads, water and sewer supply, gas, power and communication services.

Specify Assessment or Performance Criteria for the Development (based on Risk Level and Development Type)

A DCP may provide guidance, specific development standards, prescriptive controls or performance criteria that would accord with the requirements of the special LEP Clause: Coastal Risk Planning Area, or compulsory Clause 5.5. of the LEP. It is recommended that the criteria specified within the DCP chapter be applicable to the development type and level of risk to the land, such as in Figure D-1. Example considerations include:

- **Setbacks for development** landward of either a specified hazard zone (e.g. "unlikely" hazard line), proposed seawall alignment or other line (e.g. a Foreshore Building Line);
- Only **temporary or re-locatable structures** are permitted to be located in hazard areas seaward of a setback or building line;
- **Minimum floor levels**, and guidance on either filling of land or use of foundation piles to accommodate current and future hazard from inundation;
- **Maximum floor area** for buildings and for alterations and additions;
- **Foundation capacity requirements**, triggering a geotechnical assessment for depth to bedrock, to provide for foundation piles down to bedrock that increase ability of the structure to withstand erosion and wave processes;
- Particularly where foundation capacity cannot be provided (based on a geotechnical assessment), alternative/additional criteria that may be applied includes:
    - **Alternative building design**, for structures to be temporary, sacrificial or relocatable, as considered suitable for the type of development (e.g. relocatable structures are likely to be suitable for SLSCs, lifeguard towers, caravan park cabins etc.);
    - **Alternative locations** for the structure (particularly for public assets, or for private assets within property boundaries);
    - **Distance-Based Development Approvals**, which provides new developments/ redevelopments with consent until the eroding shoreline (or wave overtopping height / frequency) reaches a certain distance to the property, at which point the development may have to be abandoned (to allow retreat). This may apply where the risk over the expected life is high, but development could be accommodated until that time.

The criteria set within the Coastal Hazards DCP chapter offers a method to control the expansion (or even require a reduction) in development footprints for existing sites applying for redevelopment in high hazard areas. A DCP does not prohibit existing landholders from remaining on their land until such time as an impact occurs. However, the Coastal Hazards DCP chapter may specify that further expansion of the development footprint (e.g. extensions or renovations, subdivision, change of use) is not permitted, thereby avoiding the intensification of asset values and therefore risk in high hazard areas over time.

Development Activity	Hazard Timeframe	Controls	Rare	Unlikely	Almost Certain
Residential (New dwelling)	**2050**	Floor Level			
		Setback			
		Carpark			
		Structural Soundness			
		Coastal Impact			
		Evacuation			
		Management and design			
Commercial, Industrial	**2050**	Floor Level			
		Setback			
		Carpark			
		Structural Soundness			
		Coastal Impact			
		Evacuation			
		Management and design			
Subdivision	**2100**	Floor Level			
		Coastal Impact			
		Evacuation			
		Management and design			
Essential Community Facilities	**2100**	NA			
Sensitive Facilities	**2100**	NA			
Concessional Development (Additions/ Alterations/ Extensions)	**Immediate**	Floor Level			
		Setback			
		Carpark			
		Structural Soundness			
		Coastal Impact			
		Evacuation			
		Management and design			
Recreational and Non-urban	**Immediate**	Floor Level			
		Setback			
		Carpark			
		Structural Soundness			
		Coastal Impact			
		Evacuation			
		Management and design			
Tourist Related Development	**Immediate**	Floor Level			
		Carpark			
		Structural Soundness			
		Coastal Impact			
		Evacuation			
		Management and design			
Infrastructure	**Immediate**	Coastal Impact			
		Structural Soundness			
		Management and design			

Development not permitted

Development permissible with the use of strict design criteria

NA: not applicable

Figure D-1 Example Prescriptive Controls Matrix for Development Types in Different Hazard Areas (adapted from Coffs Harbour CZMP)

Advantages of Option	Disadvantages of Option
Life of developments is prolonged as the development controls ensure development is compatible with the risk level on the land.	May be difficult to implement for redevelopments where owners have an expectation to have the same rights for a new building as they had with the old building.
Applying controls does not affect future ability to retreat from (or protect) properties.	
Development controls facilitate a reduction in the intensity of development and therefore risk levels overtime.	
The development controls can be revised in the future in line with improved estimation of coastal hazards and level of risk.	
The controls facilitate the use of land parcels in an appropriate form until such time as hazard impacts manifest (i.e. land is not unnecessarily sterilised where impacts may not manifest for many years; or rebuilding is not permitted where damage from coastal processes has occurred)	
The sandy beach is retained because it can recede naturally	
For Distance-based Approvals, the property owners are aware of lifespan and risk to their development, so there is no need for compensation. This is low cost to the general community.	May be difficult for owners to abandon developments with Distance-based approvals when required (e.g. where new owners are not aware of the requirements, where a development has lasted for a long time such that the approval requirements are forgotten, etc.).
Low cost option for general community and Council. Costs for implementing controls are borne by the property owner, but are included as properties are redeveloped, which is likely to be lower in cost than retrofitting or retreating from a development.	

Potential Applications at Shellharbour

- All land in the Shellharbour LGA potentially affected by erosion and recession hazards (including wave overtopping) from present to 2100 (the Coastal Risk Planning Area).
- DCP 2013 accompanying the Shellharbour LEP 2013 will need to be updated to include a section for Coastal Hazard controls.

Beneficial Use of Dredged Sand

This option involves placing dredged sand material from Lake Illawarra entrance onto Warilla Beach, especially to cover the seawall.

Sand dredged in Lake Illawarra entrance has previously been placed on Warilla Beach

Type of Option

Protect: Existing Assets over short term

Details

This option involves opportunistically nourishing Warilla Beach whenever sand is dredged from the entrance to Lake Illawarra as part of future entrance opening and/or channel maintenance works. The option requires assessment of the best location for placement of dredge spoil (e.g. on the sub-aerial beach face or in surfzone) to determine sand placement with the greatest benefit to Warilla Beach's sand reserves and the protection of the seawall. Over the long term this option will not be able to mitigate the loss of sand from Warilla Beach and more frequent exposure of the sea wall as a result of sea level rise.

The need for dredging within Lake Illawarra entrance is not predictable because excessive sand build-up within the entrance is primarily driven by persistent adverse meteorological conditions. The Lake Illawarra Entrance Opening Policy requires that the entrance will be artificially opened (in the event that it is closed) once lake levels reach a trigger level. The recent training works at the entrance have reduced the likelihood of entrance closure and as such, there is a relatively slim chance of significant entrance dredging (and thus opportunity for nourishment of Warilla Beach) in the foreseeable future.

Sand within the 'drop-over' (i.e. as the entrance channel enters the main lake body, current velocities slow down and therefore sand falls out of suspension to form a shoal before a 'drop over' into deeper water) is a potential source of sand, as this area may require dredging for navigability.

Advantages of Option	Disadvantages of Option
The option has been undertaken opportunistically in the past with success, For example, 200,000 m^3 of dredges sand from Lake Illawarra (as part of entrance capital works) was placed on Warilla Beach for a cost of $1.6 million in 2007.	Short to medium term solution – the placement of dredged sands in some cases does not increase the volume of sand within a system overall (simply is a relocation of existing reserves).
The option is relatively low cost, especially when compared with more substantial options for Warilla Beach (e.g. relocation of structures, protection works or major beach nourishment)	The use of dredged sand reserves is not sufficient to redress recession due to sea level rise in the long term.
Option ensures that dredged material from coastal entrances to estuaries is retained within the natural coastal system where is may provide a natural buffer to storm processes (over the short term)	

Potential Applications at Shellharbour

- Warilla Beach, Surf Club at North Shellharbour Beach.

Beach Scraping

Beach scraping or nature assisted beach management.

Beach Scraping at Byron (New Brighton Beach), NSW

Type of Option

Protect: Existing Assets over short term

Details

The option involves managing beach sands through re-contouring and scraping sand into the upper beach. The objective is to redistribute sand from areas of accretion to depleted areas or areas at risk, to assist in the accumulation of sand within dunes. Re-contouring of dunes should be undertaken to a level that also mitigates wave overtopping, where possible. For example, low areas along a dune barrier could be re-contoured to increase the height, providing a consistent shoreline barrier.

Beach scraping is carried out when the beach begins to recover following beach erosion events, as sand is accreted in thin layers above the intertidal zone and moved above the area of fair weather wave action (i.e. into dunes). The dunes then form a buffer against storm erosion and wave overtopping. Beach management should be undertaken in combination with dune revegetation (see option) to minimise wind-blown sand losses.

Activities to re-contour eroded dune escarpments following storm erosion for public safety are not part of this management option, but rather, form emergency action subplan works.

Advantages of Option	Disadvantages of Option
Relatively cost effective and unobtrusive – single scraping events are ~ $5,000 - $10,000.	Short term solution - beach scraping does not add to overall sand volumes on the beach.
Over the short term, promotes the building of dunal buffers behind the beach	

Potential Applications at Shellharbour

There would be limited potential for application of this at Shellharbour. The only location that might be considered is Nuns Beach, in order to create a more substantial dune at the rear of the beach in front of existing properties (see photo adjacent).

Dune Management

Implement dune care / revegetation programs in locations where vegetation is degraded, limited or overcome by weeds.

Revegetation of a dune using native species

Type of Option

Protect / "No Regrets": Existing Assets over short term

Details

Dune care programs allow for ongoing retention of sand by dune vegetation, which may otherwise be blown out of the beach system. This ensures sand volumes are retained on the beach to buffer landward areas from erosion during storm events over the short term. The increase of dune height which occurs as dune species capture sediments within the beach system additionally provides a higher barrier to mitigate wave overtopping effects.

The dune care programs should be accompanied by community education regarding the role of dunes and dune vegetation to provide a buffer to storms, in addition to ecological benefits. Dune rehabilitation incidentally resolves and prevents issue relating to sand drift.

The option involves the establishment of a formal dune care program through Council, with volunteers through Landcare.

Advantages of Option	Disadvantages of Option
In short term, ensures sand is retained in beach system to buffer from storm erosion	Short term only - will not manage long term recession as dunes will continue to erode. Recession will outpace dune building over the long term.
Additional environmental benefits where native species are used	
No irreversible long term impacts	
Can form part of other long term solutions (e.g. stabilising sands placed as beach nourishment).	

Potential Applications at Shellharbour

- On-going maintenance of dunes at all beaches is considered appropriate.

Seawalls

This option involves the construction of a seawall at the back of the beach to hold the shoreline in its current position.

Seawall on Stockton Beach, Newcastle, showing lack of beach at high tide

Type of Option

Protect: Existing Assets

Details

A seawall can be built along an entire beach embayment, or a section of the beach. If built for a section of beach, the seawall design must be "tied" to bedrock or otherwise designed to minimise erosion at the end(s) of the structure.

Seawalls can be constructed from a variety of materials, particularly rock, concrete armour units or sand filled geotextile bags. The most effective designs are sloped with a rough surface, which minimises wave run up and overtopping. The design can incorporate other elements such as walkways / cycleways, steps and seating, and parapets.

Rock armour seawalls are the most common because they are well understood from a design perspective, easy to construct, typically absorb wave events bigger than the design condition with comparatively little damage, the slope and roughness of the rock placement reduces wave run up and overtopping, and repairs and upgrading are relatively straightforward.

Seawall costs are of the order of $5,000 - $10,000 per metre length of wall, not including the costs of beach nourishment, ongoing maintenance and future upgrading. If the seawall is intended to be abandoned at some time in the future, the costs for removal and repair of the beach must also be considered as part of this option. Restrictions on re-development (i.e. DCP) should be applied until protection works are in place.

Advantages of Option	Disadvantages of Option
Holds shoreline in current position over medium term. (i.e. the land behind the beach is protected at the sacrifice of the beach)	Loss of the sandy beach as sea levels rise and the shoreline retreats – there is no beach.
May be appropriate where the land and assets behind the beach are more valuable (economically or otherwise) than the beach in front.	Expensive capital outlay ($ millions) plus ongoing maintenance. Maintenance costs will also include re-design in the future to accommodate to sea level rise. Need beach nourishment in the future to provide a sandy beach, increasing cost of the option.
	Cannot be built at an individual property scale because the beach and land will continue to erode next to seawall. Must be built along lengths/major segments of beach.

Advantages of Option	Disadvantages of Option
	In cases where private property is protected, it may be considered unreasonable to spend public money on protection of private property, especially if the public beach amenity will be sacrificed due to the seawall.

Other Considerations

- Recent changes to NSW legislation enable private property owners to submit applications to construct seawalls. The applicant must show that adverse impacts (e.g. edge erosion effects, erosion of beach in front of the wall) will be remediated. The seawall must be constructed on the applicant's land.
- Council can apply a Coastal Protection Service Charge in perpetuity to the property land title that is protected by the wall (i.e. the private or public property owner), to fund ongoing maintenance of the seawall (including beach nourishment).
- Recent NSW legislation clearly indicates seawalls that protect private property shall be funded by those landholders benefiting from the wall. This may include state agencies, e.g. RTA Roads, etc. The NSW Government places a low priority on allocating funding to protection options for private property.
- Council may choose to fund those sections of wall that protect Council-owned assets (road ends, reserves, public buildings and infrastructure) in partnership with other benefiting owners (which may include private residents).
- Protect of a roadway or service infrastructure (e.g. sewer, water) may be required to keep a private residence serviced, in which case, the seawall should be funded by the private property owner, even though it may be constructed on public property in agreement with Council.

Potential Applications at Shellharbour

- Warilla Beach: There is already an existing seawall (rock armour revetment) at Warilla Beach. Although the structure has not been constructed to current engineering standards, it has provided protection from and withstood significant storms in the past. To gain a better understanding of the structure and its ability to provide ongoing future protection, a detailed condition audit should be undertaken. The condition audit should follow on from the assessment by Council (refer Iliffe, 2006) and include excavation to confirm the construction details, particularly toe depth and design of the structure. The audit should clarify the potential integrity of and protection that may be provided by the existing structure; and take into consideration sea level rise (due to which it is likely the structure will be more regularly exposed /uncovered and therefore subject to more frequent wave attack). Upgrades and maintenance to the Warilla revetment should be undertaken based upon the recommendations of the condition audit, as well as continuing to maintain and repair as appropriate following damage from major storms.
- Nuns Beach: a continuous wall between the rocky end points, with construction following a trigger of erosion into the existing dune that would threaten existing development.

Beach Nourishment

Placement of sand in the surf zone, on the upper beach face or dunes, to re-establish a sandy beach.

Nourishment of Beach with sand, UK

Type of Option

Protect: Existing Assets

Details

Beach nourishment often involves placement of beach sands on the upper beach face and dunes, to re-establish a sandy beach after a storm event and to provide a sediment supply for subsequent storm events. Nourishment can also involve the placement of sands offshore of a beach within the surf zone, where it is reworked naturally onto shore by swell waves. Nourishment can address wave overtopping in the design profile adopted for placement of sand in dunes. Another option for nourishment (currently untested) is building large hind dunes (i.e. behind the frontal dune) to provide a future sand buffer and sediment input.

Where the objective is to increase the overall beach width, the whole profile must be nourished from the offshore base of the profile (10 – 15 m water depth) to the dune. Nourishment costs have been estimated at around $25/m^3, with typical volumes of up to 200 m^3/m length of beach required to restore or widen the beach by 20 m (equating to a cost of at least $5,000/m). Suitable sand sources need to be available in the local area for large scale beach nourishment, otherwise, costs may be significantly higher. This option may be limited to localised spots or to protect individual assets on an as needs basis.

The first nourishment event is typically larger, followed by ongoing smaller nourishment episodes (as required to maintain the agreed level of protection/amenity). As sea level rises and the shoreline attempts to retreat, if the beach alignment and width is to be maintained in its current form, nourishment requirements and therefore cost will substantially increase.

Advantages of Option	Disadvantages of Option
Retains a sandy beach in current position	Very expensive option ($1- 2 million for first episode, $1 million for ongoing episodes), with typical costs of $25/m^3 of sand.
Largely retains beach amenity	Needs to be continually repeated (i.e. every 5-10 yrs now, may be once a year by 2100 due to shoreline retreat in response to sea level rise)
	Suitable sand sources need to be available in the local area, otherwise the option is not economically viable.

Other Considerations

- In NSW, there has historically been a government stance against the sourcing of sand from offshore, and sand for nourishment must be sourced from licensed sand extraction operations on land.
- Under NSW legislation, Council can apply a Coastal Protection Service Charge to landholders who directly benefit from this action where private property (e.g. residences) or state-owned assets (e.g. RTA road, State railway) is being protected by nourishment or the nourishment is addressing the impacts of a protective structure on beach amenity or adjacent property. The percentage of the levy individuals can be required to pay for this option relates to the extent of property protected. Council may also contribute where the community is considered to benefit from retaining the sandy beach.

Potential Applications at Shellharbour

- Warilla Beach, in front of the seawall (either in its current condition or improved condition);
- South Beach (northern end), to form a large hind dune to provide additional sand reserve.

Offshore Breakwaters

Construct a nearshore artificial reef or breakwater in the surfzone to reduce shoreline wave impacts.

Type of Option

Protect: Existing Assets

Details

Example emergent breakwaters at Elmer, UK. The low wave energy environment of the UK coast is suited to such options

Artificial reefs can be submerged (such as multi-function reefs) or emergent (such as detached breakwaters or islands, see adjacent photo). They can be constructed from a range of materials and in a range of shapes, sizes and locations depending on the outcome required. Emergent reefs effectively block wave energy, absorbing wave impact on their seaward side. They create a lower wave energy environment on the beach immediately in the lee of the reef, thus sand will accrete and form a salient (or wider 'bump') along the beach. They are rarely favoured in Australia due to their obtrusive appearance and interference with beach surf conditions.

Submerged reefs act to refract waves and cause waves to break in the lower water depths over the reef, also reducing wave energy on their leeward (landward) side. They are less effective than an emergent reef as they do not block the waves entirely. During storm events, water depths over a submerged reef may be sufficient to allow waves up to several metres in height to pass over the reef without breaking, reducing their effectiveness in protecting the beach from erosion. They do offer the opportunity for other objectives such as creating marine habitat and improving surfing conditions. An example of an artificial submerged reef is at Narrowneck, Gold Coast. Artificial reefs have not always been successful in improving surfing conditions, for example, the geotextile bag reef built at Boscombe, Bournemouth UK.

Both types of structures are more suited to embayed coastlines where there is little to no alongshore sediment transport, to reduce the potential for impacts on the beach further downdrift of the structure. They are difficult to design and operate effectively across a range of wave directions and conditions and varying water levels.

Advantages of Option	Disadvantages of Option
Suitable to protect short sections of shoreline only (salient only forms behind the reef).	Very expensive to build and maintain ($ millions), because the structure must be built in a high wave energy and water environment.
The location of bedrock close to the surface provides an opportunity to reduce scour and slumping of the reef once constructed, reducing maintenance costs	Multi-function (e.g. surfing reefs) have not been successful in other locations because the design for surfing is different to the design needed to protect the shore during storms.
	Will not stop impacts of sea level rise unless the reef is continually raised, meaning ongoing expense, more $$. (ability of reef to dissipate waves is reduced due to higher water levels over the reef with sea level rise)

Other Considerations

- Costs (capital and maintenance) are usually well beyond the resources of an individual or group of individuals and such structures elsewhere in Australia and around the world are constructed as a part of a regional strategy with Local, State or National funding.

Potential Applications at Shellharbour

- There are no suitable locations in Shellharbour for such structures as a solution for beach erosion management.

Groynes

Construction of a groyne or series of groynes perpendicular (90°) to the shoreline to capture longshore sediment transport and build a beach.

Groyne field, Portugal

Type of Option

Protect: Existing Assets

Details

Groynes are shore normal structures constructed from the beach through the surf zone to a sufficient depth to stop or restrict the movement of sand around the end of the structure. They can be constructed from a range of materials and in a range of shapes, sizes and locations depending on the outcome required.

They are usually employed on high littoral drift coastlines to trap sand on the updrift side to provide a sand buffer to protect property and assets behind the beach. However, the groyne will cause erosion on the downdrift side until full bypassing of the groyne occurs. A number of groynes (in a 'groyne field') may be needed along the beach, to continually trap longshore drifting sands and reduce erosion effects at the end of the groyne field. This substantially changes the nature and appearance of the beach.

On coastlines with little or no longshore sediment transport, the groynes need to be closely spaced and (usually) nourished to provide the required sand buffer between the groynes. As such they are obtrusive and expensive by comparison with seawalls or nourishment options.

Advantages of Option	Disadvantages of Option
Retains a sandy beach in current position over the short term	Substantially change in nature and appearance of the beach - groynes are obtrusive.
	Very expensive to build ($ millions), as groynes need to be built in the surfzone. Cost is well beyond the means of individual or local Council. Such structures elsewhere in Australia and around the world are constructed as a part of a regional strategy with Local, State or National funding.
	Unlikely to be effective for long term sea level rise (groynes don't increase sediment budget for beach)

Potential Applications at Shellharbour

- There are no suitable locations for this option in the Shellharbour LGA coastal zone to manage beach erosion or recession due to sea level rise.
- The proposed breakwaters for Shellharbour Swamp will behave as a groyne.

Sacrifice Land or Assets

Accept loss of land or assets following the hazard event (i.e., once affected, the assets or land is not replaced or relocated).

House intended for demolition after abandonment, USA

Type of Option

Planned Retreat: Existing Assets

Details

Planned retreat such as by sacrificing the land or assets affected by recession is the most effective option for retaining a beach over the long term. This is because the beach can move landward without obstruction. Repairs and removal of assets as they are damaged forms part of this option, to ensure ongoing public safety and beach access.

This option may be particularly suitable for the following land uses.

- **Parks, public open space, private recreation (e.g. golf courses, football fields) and coastal dunes**, as the remaining land is still able to be used even if it is reduced in size through erosion. Existing recreational infrastructure such as picnic shelters, footpaths, BBQs and amenities buildings would be relocated as impacts occur.
- For **certain heritage items** (e.g. ocean pools, jetty foundations, rock boat ramps etc.) inundation by seawater enables "submergence" as a viable long term option to preserve the heritage asset.
- For **creek / lagoon entrances**, the impact of erosion and recession due to sea level rise upon the entrance is best managed by allowing the system to respond naturally, without intervention. This will manifest as increasing flood levels behind a closed entrance. Constraints upon entrance changes (e.g. landward migration of the berm) due to surrounding land uses should also be managed.
- **Local roads** or **car parks** where alternative routes and access to residential property is available, allowing the road to be lost to erosion.

Recent economic analysis of Thirroul Beach, Wollongong, has shown that the asset of greatest economic value to a locality is the beach itself (Gillespie Economics, 2011). There are many intangible economic benefits associated with both resident and visitor use of the beach, including cafes, restaurants, kiosks, accommodation and many other activities (surfing lessons and tours, fishing tours and so on) adjacent to the beach. Tourism is a particularly important industry for regional towns and villages, and most tourism is based around access to and enjoyment of the beach.

The cost of sacrificing assets and parkland adjacent to the beach as the shoreline retreats will most likely be outweighed by the economic as well as social and environmental gains from ensuring a sandy beach is retained.

Advantages of Option	Disadvantages of Option
The sandy beach asset is retained because it can recede naturally.	Private landholders are not compensated for the loss of land or property.
Residents and visitors (including the tourism industry) benefit from continuing access to a sandy beach.	The community may lose other public facilities or valued parkland
Particularly suitable for park land and low cost facilities (e.g. access ways, walkways)	
Provides a long term solution	

Potential Applications at Shellharbour

- Public open space and parkland behind:
    - Warilla Beach North coastal dune;
    - North Beach coastal dunes and parkland;
    - South Beach coastal dunes and caravan park, where assets such as cabins, amenities etc. can be relocated within the property boundary.

Relocate Assets

Relocate structure / service / asset outside of hazard zone.

House being relocated out of hazard area

Type of Option

Planned Retreat: Existing Assets

Details

The relocation of assets allows beach amenity to be retained because the shoreline can retreat without obstruction. This is an effective option for retaining a beach over the long term. Relocation will be suitable for:

- Easily relocatable structures (e.g. cabins in caravan park, lifeguard towers);
- Assets with a value far lower than the value of beach amenity (e.g. public amenities building);
- Locations where it is technically and financially impractical to design a structure to withstand erosion/inundation, for example, for pump stations or water pipelines;
- Infrastructure such as stormwater outlets, where the outlet may need to be relocated further landward to avoid ongoing damage from wave action and erosion of surrounding land.

Relocation would be undertaken either:

- when an asset needs to be replaced, or
- when the hazard impact is imminent (as determined through monitoring).

Implementing this option when public asset replacement is required enables rejuvenation of a failing asset for the public in combination with the reduction of risk from coastal hazards (e.g. a SLSC, new stormwater treatment outlet onto beach). This is a “win-win” solution for community. Plus, the cost of mitigating erosion impacts through relocation is shared with the cost of asset replacement. This reduces the overall cost compared with relocating an existing asset that has remaining life / functionality.

Maintenance for roadway or other assets in the short term prior to relocation must avoid the use of hard protection works (e.g. dumping of rock, use of concrete, etc.) that will negatively affect beach amenity. Soft protection works (e.g. geotextile sand bags) are to be utilised.

Advantages of Option	Disadvantages of Option
The sandy beach is retained because it can recede naturally.	A suitable alternative location must exist
Residents and visitors (including the tourism industry) benefit from continuing access to a sandy beach	Private landholders must pay for the relocation of private buildings (and which may not yet need replacement / are still functional)

Advantages of Option	Disadvantages of Option
The relocation can mean a brand new building / road / facility in replacement of an old one. Costs are reduced where the relocation is conducted when the asset reaches the end of its life and requires replacement in any case.	Depending on the structure requiring relocation, the option may be high cost, but will generally be lower than structural protection and maintenance alternatives.
Provides a long term solution	

Potential Applications at Shellharbour

Where these assets are not located behind a seawall:

- Caravan Park (caravan or cabin structures within the property boundary)
- Lifeguard Towers
- Cycleways / Walkways
- Stormwater Outlets
- Water and Wastewater assets (pump stations, pipelines)
- Surf Club

Acquisition

Private properties at highest risk are bought at market rates and then demolished to become public land.

Type of Option

Planned Retreat: Existing assets

Details

This option involves the purchase of private property at risk by Council / State / Federal governments, where funding is made available for the purchase. Once the property is purchased, it is demolished and returned to public land, regardless of timeframe before hazards may occur. Acquisition can be voluntary or compulsory. The purchase price shall be based on market value. This means that should the owners wait until erosion impacts manifest before accepting the offer, the purchase price may be lower (for voluntary acquisitions).

The acquisition to enable removal of private properties allows beach amenity to be retained because the shoreline can retreat without obstruction. This is the most effective option for retaining a beach over the long term. Furthermore, this option enables owners to be appropriately compensated. This option has been successfully implemented with the acquisition of four lots in Little Lake Crescent on Warilla Beach to create Leggett Park.

Advantages of Option	Disadvantages of Option
The public retains a sandy beach and gains public land. Residents and visitors (including the tourism industry) benefit from continuing access to a sandy beach	The public (Council/State Gov't) must fund full purchase price up-front. This is unlikely to be possible for multiple properties, apartment blocks etc. (see Other Considerations).
Private property owners are adequately compensated	Some may consider it unfair to spend public funds on private property.
Particularly suitable for individual properties (where adjacent land uses would otherwise be permitted to retreat to retain beach amenity)	Many freehold coastal land owners will never accept the arrangement voluntarily. There is a preference to protect freehold land.
Provides a long term solution	

Other Considerations

- The Coastal Lands Protection Scheme has been used to purchase isolated residential blocks but is predominantly used for rural land repurchase and addition to national park estate.
- NSW Government annual funding for the Coastal Lands Protection Scheme and Coastal Management Program is very limited. Typically, the fund is not sufficient for purchase of multiple properties.
- This option has been offered in other locations along the NSW coastline with limited success. While the option provides an incentive to relocate outside of the hazard area, coastal land is typically viewed as too valuable and the risks too remote.

Potential Applications at Shellharbour: This option is unlikely to be implemented due to the constraints on State government funding.

Buy Back / Lease Back

Private properties at highest risk are bought at market rates, then rented out at market rates, until the hazard impact is imminent. When hazard is imminent, the property is demolished and land returned to the public.

Type of Option

Planned Retreat - Existing Assets long term solution

Details

This option would involve Council applying for funding through typical mortgage arrangements to acquire affected property(s) at market rates, on a voluntary or compulsory basis. The property would then be leased out at market rates until such time as the hazard impact is imminent. At that time, the development shall be demolished and land returned to Community Land, to enable continued retreat of shoreline and for use by the community. Council would absorb any profit/loss over that period.

By offering the market rate for a property, the purchase price shall be discounted in accordance with the length of time remaining before the property becomes uninhabitable due to erosion. This is necessary because the option is dependent upon Council leasing the property at market rates to assist loan repayments in the period prior to erosion impacts. Therefore, those owners who sell earlier will be better compensated than those who wait until impacts are imminent. The existing owners may lease back their property from Council until the hazard is imminent, and continue to enjoy the benefits of their coastal property without bearing the risk from coastal hazards.

A mechanism for enabling Council “first right of refusal” when properties are put on the market (i.e. Council has the first option to purchase the property), would assist in implementation of this strategy.

The sacrifice of private properties allows beach amenity to be retained because the shoreline can retreat without obstruction. This is the most effective option for retaining a beach over the long term. Furthermore, this option enables owners to be appropriately compensated.

Advantages of Option	Disadvantages of Option
Private property owners are appropriately compensated.	There are currently no State or Federal Government funding arrangements in place to support implementation of this option by councils.
The public retains a sandy beach and gains public land.	Council / State government must commit to mortgage arrangements over the long term.
Residents and visitors (including the tourism industry) benefit from continuing access to a sandy beach	Erosion may occur earlier than planned, reducing the return from rent.

Advantages of Option	Disadvantages of Option
Leasing at market rates reduces the mortgage costs to Council. Current rental return of 3-4%/yr.	Many freehold coastal land owners will never accept the arrangement voluntarily – preference to protect freehold land.
Mortgage means government does not have to fund the whole purchase at once.	
Provides a long term solution	
Any surplus rental payments beyond the loan repayment period can help fund further property buy-back.	

Other Considerations

- State or Federal assistance, such as through providing low interest loans and deposit payments to councils, is required to assist Council in purchase of multiple properties in key locations.
- Low interest loans would enable the majority of the mortgage repayments to be funded by rental return.
- Further negotiations with State and Federal governments, such as through a case study scenario, is required to implement this option on a larger scale / across many properties.
- At the present time, this option has not been tested in the context of coastal zone management (although, properties are regularly purchased by RTA and rented out well in advance of highway developments).
- Should no action be taken at present, it is likely that State or Federal government funding to assist in the full purchase of properties in the future may not exist, as such funds will be under high demand across the country as sea level rise impacts occur.

Potential Applications at Shellharbour

This option provides a technically feasible outcome that can cater for environmental provisions and meets community concerns regarding potential future land devaluation as the shoreline starts to recede. For financial reasons, however, this option is unlikely to be practically implemented by Council given limitations on finances and suitable government grant funding. If it were to become feasible in the future, it could be considered for private properties at risk along Boollwarroo Parade behind the northern end of South Beach.

Redesign or Retrofit

Make modifications to an existing structure or rebuild a structure with suitable design to withstand hazard impacts.

Type of Option

Accommodate – short or long term, existing assets.

Details

Where relocation of a structure is not possible due to other site constraints, further redesign or retrofit options may need to be considered. Retrofit refers to modifications to an existing structure, while redesign refers to replacement of an existing structure in its present location with a structure that has been designed to withstand coastal hazard impacts. Thus, the redesign or retrofit should include provisions for managing wave overtopping and inundation, as well as erosion and recession impacts.

This option is not suitable for residential dwellings at high risk in the immediate timeframe (i.e. seaward of the immediate 'unlikely' hazard zone).

Aspects that may be included in the retrofit or redesign of a structure may include:

- **Foundation piles to bedrock** (done retrospectively or as structure is built),
- **floor levels** (raising of an existing structure, or as new structure is built),
- **changing of site use** to ensure lower floors may withstand occasional wave inundation and occupied /inhabited areas are elevated,
- **relocatable structures**, such as lifeguard towers, caravan park cabins etc., that are designed to be moved prior to storms, but still provide water, power, sewer etc.

Redesign or retrofit is applicable to structures such as the boat harbour breakwaters, where it is not appropriate or possible to relocate the structure further landward. Similarly, other assets where there are relocation constraints may also be suitable for redesign or retrofit in their current location.

In some cases this option can be implemented when asset replacement is required, enabling a rejuvenation of a failing asset in combination with the reduction of risk from coastal hazards (e.g. a new SLSC, improved roadway, new stormwater outlet). The cost of mitigating erosion impacts through redesign may be shared with the cost of asset replacement. This reduces the overall cost now and in the future, as retrofitting an existing asset is far more costly than implementing the risk treatment as it is being built.

Relocatable structures are relatively inexpensive, especially compared with hard structures (e.g. foundation piles to bedrock). Ongoing monitoring is essential to ensure that later changes (renovations, supply of services, ancillary structures/landscaping etc.) do not compromise the speedy and efficient removal/return of the structure during and following storm events.

A mix of relocatable structures and solid structures outside the hazard zone may provide the best outcome, e.g. a relocatable tower for lifeguard services and a surf club building landward of the hazard zone for storage, function rooms, club services etc.

Advantages of Option	Disadvantages of Option
Allows extended life for existing assets or replacement assets	Over long term, modifications will not be able to reduce likelihood that impacts will occur.
Does not limit the ability to retreat and remove structure in future – i.e., the option is adaptable to future scenarios.	Increased frequency of impacts in future may still require retreat at some point in future.
	Design modification may be more expensive than retreat and remove the asset – this should be determined through Asset Management Planning (see Option) for public buildings / infrastructure

Potential Applications at Shellharbour

Most Suited

- Stormwater Outlets
- Water and Wastewater Assets (pump stations, rising mains)
- Low key community facilities (lifeguard towers, caravan park cabins, etc.)

Possibly Suited

- Residential properties (depending upon site constraints), e.g. requirements for foundations to bedrock.

Coastal Hazard Construction Checklist

Prepare a checklist / policy for internal use by Council for replacing, repairing, protecting or building new infrastructure in the coastal zone. The checklist shall augment the self-assessment (REF) process. The checklist shall identify:

- Other Council officers to be consulted for activities in the coastal zone;
- Other agencies required to give concurrent consent (e.g. Crown Lands, MPA, NPWS);
- Where to access hazard mapping / information; and
- Controls / measures to reduce coastal risk to the new construction (could be based upon DCP), for example, setbacks appropriate to design life of asset.

Type of Option

No Regrets / Preliminary Action: Existing and Future Development

Details

It is important that the potential for coastal hazards impacts is taken into consideration when Council conducts works where development consent is not required (for example, works under SEPP (Infrastructure) 2007, or environmental assessments such as REFs). This is also the case for strategic planning and major infrastructure design (e.g. major upgrades or new additions to road, stormwater networks and so on), and preparation of Plans of Management and Masterplans.

This strategy involves the following actions:

- **Prepare a checklist to capture the following activities by Council when they occur in the coastal zone:**
  - Council works not requiring development consent (e.g. SEPP (Infrastructure) 2007 activities) and Part 5 assessments (e.g. REFs);
  - Preparation and revision of Community & Crown Land Plans of Management, Masterplans and DCPs;
  - Council's strategic planning (e.g. designing new road networks, stormwater networks)
- **Conduct internal training to educate the different Council departments about coastal hazards zones, the CZMP, and internal policy/checklist** to support greater consideration of coastal hazards and development controls in GLC planning, engineering works and other activities;

Advantages of Option	Disadvantages of Option
Easy to implement as the hazard information is already available to Council	
Low cost option, as conducted as part of normal Council activities	
Ensures funds are not ill spent in at risk locations / assets	
Avoids actions that are inconsistent with the intent of the CZMP, for example, seawall construction in inappropriate locations.	

Potential Applications at Shellharbour

All of Council Assets, including:

- larger Council assets such as roads, stormwater infrastructure, buildings; and
- small Council assets such as car parks, beach viewing platforms, amenities etc.

Council and Crown Land to which the Crown Lands Act 1989 or Local Government Act 1993 applies.

Asset Management Planning

Identify and document the risk (low to high), type of hazard (erosion or inundation) and timeframes for impact (immediate, 2050, 2100) for all assets (including heritage assets) in Council's Asset Management Plan. Account for such coastal risks when prioritising asset maintenance and replacement.

Type of Option

No Regrets / Preliminary Action: Existing Development

Details

Council's Asset Management Plan shall be updated to make note of which assets lie within a coastal hazard area, detailing: the **type of hazard** i.e. erosion, recession, or inundation; and the **estimated risk over each timeframe** (i.e. immediate, 2050, 2100). This information shall then be included as part of prioritising asset replacement and developing maintenance schedules. Any management actions that are specified in the CZMP should also be noted upon the Asset Management Plan, for inclusion in asset replacement calculations. For example, local roads or facilities that are specified as sacrificial by the CZMP should be noted as "managed to fail". This action shall support the implementation of "relocate" or "retrofit / redesign" activities at the time that asset replacement is required. The Asset Management Plan shall also include outcomes from the Audit of Existing Council Assets option that will further identify appropriate management for assets, i.e. relocate, redesign, relocatable, or manage to fail.

At the present time, the management of assets does not take into consideration the risk to an asset from coastal hazards when prioritising asset replacement or maintenance, nor are replacement assets flagged as requiring redesign to accommodate coastal hazards. Implementing this action will be particularly important for the larger, more costly assets such as stormwater infrastructure, sewer and water infrastructure and public buildings, where sufficient prior planning (e.g. 3 – 10 years+) is required to secure adequate funding for asset replacement.

Maintenance for assets in the short term prior to sacrifice/ relocation (e.g. to provide continued services to residences) must avoid the use of hard protection works (e.g. dumping of rock, use of concrete, etc.) that will negatively affect beach amenity. The requirement for use of soft protection works (e.g. geotextile sand bags) should also be noted in the Asset Management Plan.

Advantages of Option	Disadvantages of Option
Easy to implement as the hazard information is already available to Council.	
Enables coastal hazards to be flagged in Council decision making processes	
Ensures funds are not ill spent in at risk locations / assets	

Advantages of Option	Disadvantages of Option
This preliminary step is required prior understanding best future management approach (i.e. redesign, relocate, managed to fail)	

Potential Applications at Shellharbour

All Council assets, including:

- larger Council assets such as public buildings, stormwater infrastructure, sewer and water infrastructure, boat harbour breakwater, roads and heritage items, and
- smaller Council assets such as shared paths / cycleways, parks and associated facilities, amenities etc.

Audit of Existing Council Assets

Conduct audit of substantial public buildings (SLSCs, amenities), infrastructure (seawalls, breakwaters, water, stormwater, wastewater, local roads), and other assets (caravan parks with cabins, etc.) to determine future action (relocate or redesign/retrofit), based upon land availability for relocation, foundation capacity, and location needs of the asset type.

Warilla Beach seawall is a priority for auditing and assessment

Type of Option

No Regrets / Preliminary Action: Existing Development

Details

This option shall determine the most suitable future action to address coastal risks for Council's assets and specify this in the Asset Management Plan. In addition to including coastal hazards as part of Asset Management prioritisation, it will be important to investigate the constraints upon the site or asset to determine the appropriate replacement option, that being to either:

- relocate the asset;
- replace the asset in its current location with a redesigned or relocatable asset; or
- accept the loss of the asset without replacement (i.e. manage to fail).

The replacement option (i.e. "relocate", "redesign/retrofit", "relocatable" or "manage to fail") should be signalled in the Asset Management Plan, so that appropriate approvals and funding can be sourced well in advance of either the occurrence of a hazard impact or when asset replacement is due. It may also be the case that for some assets consideration of the entire network link will be necessary, for example, for roadways or parts of the wastewater network.

In general, it is recommended that **relocation** of an asset be implemented in preference to other options. This is because relocation permits the beach to naturally retreat so that the sandy beach is retained. Furthermore, relocation of an asset does not impact upon or constrain the approach to managing adjacent assets, which may include private assets, public reserves, important habitat or the beaches themselves. For less costly assets such as lifeguard towers, accepting that the structure is sacrificial or relocatable (after or before a storm event, respectively) may also be cost effective solution that permits future beach retreat and does not constrain options for adjacent assets.

Constraints upon ability to relocate an asset will include:

- the availability of land in an alternative location for the asset (particularly for roadways, water and sewer assets, this may require consideration of battle-axe arrangements or alternatives to provide rear-lane access, facilitated through Council) or;

- the need for proximity to the coast for the asset (e.g. SLSC / Lifeguard tower);
- the foundation capacity of the site, based upon the depth to bedrock to provide suitable foundations to withstand erosion;
- the floor level height required to withstand wave overtopping;
- the ability to provide the same service from the asset with a relocatable instead of permanent structure; and
- the cost of the structure such that damage can be accepted and a replacement structure built, as a cost effective alternative solution compared with providing foundation stability (for example, this is likely to be a suitable approach for a lifeguard tower or viewing platform etc.).

Advantages of Option	Disadvantages of Option
Provides preliminary information required to determine more substantial management action (i.e. relocate vs retrofit).	
Low cost option, which may save money for future investments.	
Ensures substantial public investments are not made in high risk locations.	

Potential Applications at Shellharbour

Most Suited

- Warilla Beach seawall: As noted for the Seawall option, a detailed condition audit should be undertaken that includes excavation to confirm the construction details, particularly toe depth and design of the structure. The audit should clarify the potential integrity of and protection that may be provided by the existing structure and take into consideration sea level rise (due to which it is likely the structure will be more regularly exposed /uncovered and therefore subject to more frequent wave attack). Upgrades and maintenance to the Warilla revetment should be undertaken based upon the recommendations of the condition audit, as well as continuing to maintain and repair as appropriate following damage from major storms.
- Wastewater, stormwater and water infrastructure assets at high or extreme risk by 2050.
- Substantial / expensive public buildings / assets at high or extreme risk by 2050 (e.g. SLSCs, caravan parks).
- Those assets within the 2050 ‘unlikely’ erosion and recession zone (i.e., at all risk levels) likely to be replaced or built within next 10 years that have a long expected lifespan (> 50 years).

Possibly Suited

- Where Council’s resources are available, the audit could be extended to include those assets at high or extreme risk by 2100.

The risk register tables (compiled from the risk mapping) indicate those assets at high and extreme risk by 2100.

Revise Hazard Lines Based on Geological Data

Snapshot of Hazard Lines, Number One Beach

Using geophysical assessment and interpretation of geological data, update the hazard lines to capture (or exclude) erodible areas at the ends of beaches.

Type of Option

No Regrets / Preliminary Action: Existing (and Future) Development

Details

A key limitation of most hazards assessments is that there is typically little to no geotechnical information regarding depth to bedrock along the beaches. Bedrock at suitable depth may constrain the extent of erosion, or provide for suitable foundations for existing or future structures.

This option shall involve:

- assessment of the location and extent of bedrock particularly at the ends of the beaches, then
- update of the existing hazard lines to tie into stable bedrock at the ends of the beaches.

The existing Shellharbour hazard lines (from SMEC, 2010) end before the bedrock ends of the beach. As such, there are likely to be assets that lie outside of the hazard zones, but which are in fact subject to coastal risk (e.g. Nuns Beach, northern end of Shellharbour North Beach). The information shall also be used to constrain the hazard lines for future revisions of the coastal hazards assessment.

Appropriate methods for determining the location and depth of bedrock may include:

- Geophysical survey, such as using ground penetrating radar, seismic or resistivity techniques
- Review of existing geological data, particularly the available coastal quaternary geology dataset
- Ground truthing to confirm assumptions and to clarify materials in areas unable to be resolved through geophysical survey or existing data.

This option will not replace the need for site-specific geotechnical assessments for development applications, but may provide useful information within Council, to cross-check against such assessments.

Advantages of Option	Disadvantages of Option
Provides preliminary information required to determine more substantial management action (i.e. relocate vs retrofit).	
Low cost option, which may save money for future investments	
Provides enhanced information for use in defining the erosion and recession hazard	

Potential Application at Shellharbour

High Priority:

- Shellharbour North Beach, north and south end (including the car park and residential property at northern North Beach)
- Nuns Beach (assessing both coastal and geotechnical risks)
- Shellharbour Boat Harbour (including the recreation foreshore assets and reserve lands)
- South Beach, north end (including Shellharbour Beachside Tourist Park).

Medium Priority:

- South Beach, south end.

Community Education

Conduct community activities to provide information about coastal risks and intended actions, to build community acceptance and resilience for managing future impacts.

Type of Option

No Regrets / Preliminary Action: Existing and Future Development

Details

To support the implementation of actions within the CZMP, there will need to be ongoing community education about coastal risks and the intended future response. It is important that the community understand the risks from coastal hazards, how such risks may change in the future with sea level rise, and how Council and others propose to manage the impacts. Education regarding coastal risks and intended management responses should be repeated frequently (e.g. every 1 – 2 yrs.).

This action supports the overarching approach to implement "no regrets" actions now and delay more difficult or costly actions for when impacts are imminent. There may be many years before impacts eventuate. Over that time, the community should be informed about the risks from coastal hazards, consulted about the management options and their costs and benefits, so they understand the reasons for selecting a particular management action. This will be particularly important when the action will be challenging to implement but provides the best long term outcome. Through education, difficult or costly management actions will have been signalled many years in advance, so the community will be better prepared to accept and implement the action at the time it is required.

Education regarding the likelihood and consequence of coastal risks, with regular updates as improved information becomes available, is also required to build the resilience of the community for when impacts occur. Education enables the community to make their own judgements regarding how they perceive the risk from coastal hazards, and prepare or make decisions accordingly (e.g. selling a property versus choosing to accept the risk many years in advance of the likely impact).

Advantages of Option	Disadvantages of Option
Improves resilience and preparedness of community for future when impacts do occur.	
Improves acceptability of more difficult or costly actions, as community will have had time to understand the options, their costs / benefits, and the reason for the selecting a particular action.	
Improves the implementation of appropriate options in the future by preparing community (thereby avoiding reactive management decisions)	

Potential Applications at Shellharbour: Entire LGA.

LEP Review and Rezoning

Retaining existing zoning or rezoning of land to more appropriate zoning, to ensure the land is not developed inappropriately in the future.

Type of Option

No Regrets / Preliminary Action: Future Development

Details

At the time that land zones are revised as part of a review of the Local Environment Plan, land that is known to be at high or extreme risk from coastal hazards, particularly where such land is currently vacant (greenfield sites), should be rezoned (or existing zoning retained) to Environmental Management, Environmental Conservation, Public Recreation or similar. Rezoning / zoning of vacant lands at risk ensures the land is not considered for development at any time in the future.

Advantages of Option	Disadvantages of Option
Avoids inappropriate development of high risk vacant land.	Compensation of existing landholders may be required where rezoned land is not in government ownership.
Low cost option, as is conducted as part of normal Council business.	
Reduces the overall level of risk to land by reducing the potential for intensification of land value.	

Potential Applications at Shellharbour

- During LEP reviews or when land rezoning is proposed with development applications, the most current hazard information and monitoring data for land should be used to identify at risk land for rezoning (or to keep appropriate zoning).

Monitoring

Collect long term baseline and storm event data for beach condition and erosion volumes, to determine when risks approach unacceptable levels; and to improve data for review of hazard estimates.

Type of Option

No Regrets / Preliminary Action: Existing Development

Details / Actions

Monitoring can be conducted for multiple purposes with regards to managing coastal risk.

The general approach adopted for the management of existing assets and infrastructure at risk is to wait until the risks have materialised to a level that is no longer considered tolerable (i.e. it reaches a 'trigger' level) before acting. Monitoring of key indicators is therefore necessary in order to determine when the 'trigger' has been reached.

Monitoring of beach profiles and volumes is necessary to determine likely beach erosion extents in response to storms and to identify any underlying recession signals. In addition, monitoring of triggers at specific assets should be undertaken and reviewed regularly to determine when a trigger is reached.

The results of monitoring should be published, for example, in yearly State of the Environment reports and with reviews of the CZMP (every 5 – 10 years). When the CZMP is reviewed, monitoring results also provide suitable data to re-run the risk assessment and revise management responses if the risk level changes (i.e. an increase or decrease in level of risk) or where a management action has not been effective.

Recommended Program for Beach Erosion Monitoring

- The exact methodology applied will depend upon resources available to Council. Available methods continue to advance, and at the current time include ADS80 Aerial Photogrammetry via drone aircraft, land based LiDAR via hand-held staff, in addition to traditional survey.
- Should Council use traditional survey techniques, survey profiles should be established at regular intervals (~100 m) along key section of foreshore and/or in front of significant assets (e.g. roads, foreshore dwellings, SLSCs). The profiles must run perpendicular to the beach/shoreline with regular survey points measured to the waterline (refer to TASMARC Survey Instructions – Levelling (2012) for example guidance). Preferably, profile measurements should coincide with the existing photogrammetry profiles at the beaches.
- For asset monitoring (e.g. roads) the survey profile data should be used to calculate the distance between the erosion escarpment and the asset. Monitoring of triggers at specific assets should be immediately analysed upon collection of beach survey data, to determine if and when a trigger is reached.
- The beach profile monitoring should be augmented with 2-3 yearly LiDAR data collection runs (priority) and 1-2 year aerial photography (secondary) that is conducted by the NSW Government. The survey

profiles can be used to extract topographic information from both datasets, for comparison with the land based surveys.

- Initially, surveying of profiles at 6 and12 months and after storms, then after storms only thereafter. Offshore Hs > 3 metres is considered to be a storm wave condition, and real time wave height data can be accessed via the MHL website.
- Immediately following large storm events, survey should also be conducted along any debris lines that are preserved. This data provides information regarding the actual extent of wave run up during storms.

Community Monitoring Points for Educational Purposes:

There is an opportunity to utilise monitoring programs as a community education tool. This should include:

- placing survey markers (e.g. posts or stakes with signage), or utilising existing coastal structures as visible markers around which the community can see changes to the beach after seasonal and storm fluctuations, and sea level rise induced recession in the future.
- Council taking photographs of prominent foreshore structures over time, for example, stormwater outlets, Forster seawall, beach access points, and/or foreshore dwellings (e.g. at southern Boomerang Beach). The photos should be taken from the same aspect every 6-12 months, and after storms. The photos should then be stored on a Council managed database that is accessible to the public (for example, through the use of free programs such as Google maps), with an advertised link from Council's website. Community groups such as dune care, foreshore residents and/or school groups should also be encouraged to collect photographs for the database. Overtime, the photo database will provide compelling public educational material regarding the short and long term changes in beach state.

Rely on NSW Government Programs for Ocean Water Level Monitoring, Wave Monitoring

- Long term ocean tidal gauges and wave recorders are already managed and analysed by Manly Hydraulics Laboratory. Council can access this information freely. The information can be incorporated into community educational material to demonstrate the occurrence of sea level rise to date, coastal storms etc.

Advantages of Option	Disadvantages of Option
Monitoring provides essential data regarding coastal processes, to assess the likelihood of coastal impacts particularly at key beaches / assets (for triggers).	Monitoring may be costly and time consuming.
At the time for review of the CZMP, monitoring results will provide key data to re-run the risk assessment to determine changes to risk levels (increase or decrease) and revise risk treatment.	
Monitoring results enable Council to determine the effectiveness / appropriateness of management actions to manage coastal risks over time	
Monitoring provides an opportunity to educate the community regarding coastal processes	

Potential Applications at Shellharbour

The Shellharbour coastline is not extensive, and there are only a limited number of specific 'hot spot' locations where existing assets are at notable risk (now or in the future). Key locations recommended for regular beach survey are listed in Table D-2.

Table D-2 Key locations for monitoring

Warilla SLSC and adjacent parkland
Warilla Beach seawall (various transects along wall)
Shellharbour SLSC (North Beach)
Nuns Beach
Boat harbour
South Beach – northern end, various transects between Caravan Park and South Beach carpark

Infrastructure Design Elements

Investigate appropriate design elements for stormwater, water and wastewater infrastructure for periodic inundation with seawater and / or wave action and adopt these design elements as assets are replaced.

Stormwater Outlet at Shellharbour Boat Harbour

Type of Option

No Regrets / Preliminary Action: Existing and Future Development

Details

This option aims to support the replacement of stormwater, wastewater and water assets (as specified through the Asset Management Plan) with structural elements that are better able to withstand the effects of seawater. The option should be implemented with the following steps:

- Investigate the height/level within stormwater pipes connected to the ocean (i.e. via outlets) to determine the extent within the pipe system of permanent inundation with sea level rise; and periodic inundation with storms plus sea level rise.
- Update Asset Management Plan, particularly asset replacement timeframes and costs, based on timeframes for inundation impacts (especially stormwater systems that may become unviable due to inundation) and degradation of elements due to seawater (including the outside of wastewater and water pipes and pump stations). (This is in addition to notation for erosion hazards that may damage or undermine infrastructure, refer Asset Management Planning option).
- Identity appropriate materials for use in all stormwater, wastewater and water assets that better withstands seawater impacts, and use when assets require replacement. This may include for example the use of tidal flaps on stormwater outlets to stop backwater inundation from entering the stormwater system.

Advantages of Option	Disadvantages of Option
Assessment is targeted towards managing seawater impacts to materials	
Seawater inundation impacts within systems are assessed	
Cost savings are achieved for replacing an assets with appropriate design elements, rather than after an impact occurs	

Potential Applications at Shellharbour

- Stormwater assets connected to the ocean / estuaries and wastewater, water and stormwater pipes within the ‘unlikely’ coastal inundation hazard by 2050.

Combined Flood Studies

Update or commence flood studies and floodplain risk management plans at all catchments that are impacted by coastal inundation (particularly catchments with development / assets at risk) to determine the combined impact of elevated ocean water levels and catchment rainfall and determine flood planning levels.

Elliot Lake is surrounded by development that may be subject to flooding and coastal storm inundation

Type of Option

No Regrets / Preliminary Action: Existing and Future Assets

Details

This option involves the following steps:

- Conduct a Flood Study assessment for the combined impact of catchment flooding and oceanic water level events, including the NSW Sea Level Rise Policy Statement benchmarks (currently under review) and latest ocean water level scenarios;
- Use the outcomes of the combined flood modelling to update the Flood Risk Mapping (low, medium and high flood risk precincts) and determine flood planning levels for development;
- Apply development controls prepared for the individual catchment (i.e. through the Floodplain Risk Management Plan process) ;and
- Conduct monitoring of inundation, as recommended by the Floodplain Risk Management Plan.

Advantages of Option	Disadvantages of Option
Relatively low cost option (compared with the cost of flood damage to new developments)	Costs associated with engaging external consultants to undertake flood mapping and risk management studies. Note that dollar for dollar funding would be available from the NSW Government through their floodplain risk management program.
Provides more accurate information to residents regarding inundation risks from the ocean and / or rainfall, plus sea level rise.	
Provides more accurate information for planning to control development of flood prone land – due to coastal inundation or catchment rainfall	

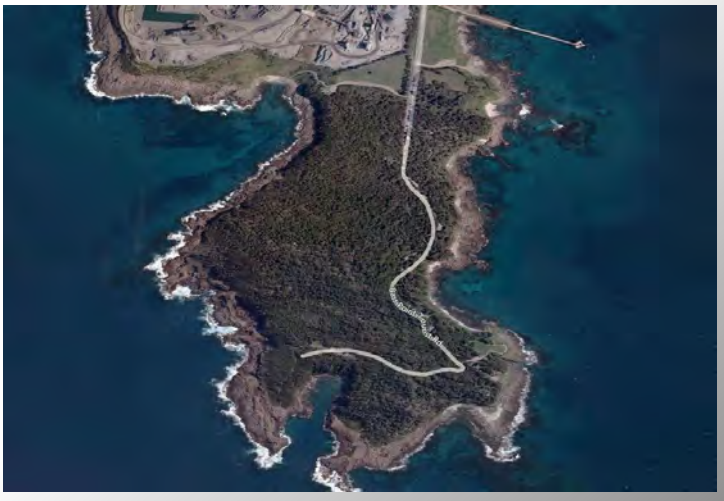
Potential Applications at Shellharbour

Most Suited: Elliott Lake.

Possibly Suited: Shellharbour Swamp, if required following completion of Shell Cove development.

Habitat Management

Assess all EECs and important habitat areas within hazard zones and determine appropriate action to ensure suitable areas are retained, and build their resilience to coastal hazards and sea level rise. This includes important habitat along the coastal strip (dunes, etc).



Bass Point Reserve: high priority for the Illawarra Biodiversity Strategy

Type of Option

"No Regrets" / Preliminary Actions: Existing Assets

Details

This option involves combining coastal hazards mapping with ecological habitat / vegetation mapping, to:

- Identify important flora/fauna species that, due to their limited distribution, will need to be translocated;
- Prioritise rehabilitation requirements based upon the relative threat to distributions from coastal hazard impacts, to ensure lower risk distributions are protected and enhanced;
- Identify and protect buffers around important habitats that will enable migration in response to hazard impacts (for example, undisturbed land that is landward of dune habitats); and
- Update planning controls to incorporate additional allowance for migration of habitats with sea level rise.

The outcomes of the audit should also feed into existing biodiversity strategies (e.g. Illawarra Biodiversity Strategy Bass Point POM). Hazard impacts investigated should include permanent inundation, increased frequency of oceanic inundation and recession due to sea level rise.

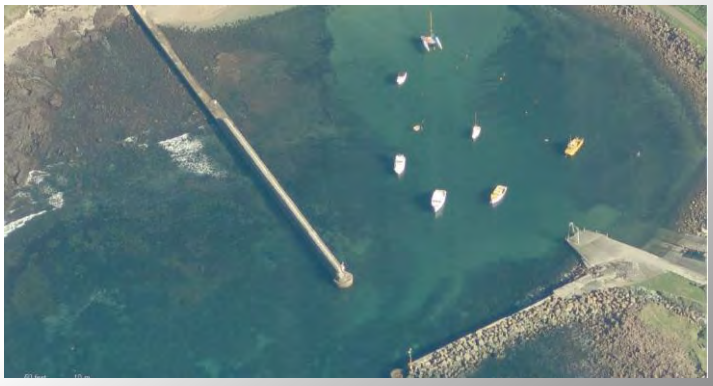
Advantages of Option	Disadvantages of Option
Ensures prioritisation for habitat management and considers potential impacts of sea level rise and coastal hazards	
Focuses finite environmental management resources towards habitats as appropriate to their level of resilience to climate change	
Identifies buffers which is a relatively low cost action for improving the resilience of habitats	

Potential Applications at Shellharbour

- Bass Point Reserve (currently State Heritage Listed); Warilla Beach northern dunes, any Endangered Ecological Communities identified in the coastal zone through Council mapping.

Heritage Management

Develop a decision framework for managing Aboriginal and Non-Indigenous Heritage Items discovered / uncovered as a result of coastal hazards.



Shellharbour Boat Harbour breakwaters are heritage listed

Type of Option

"No Regrets" / Preliminary Actions: Existing Assets

Details

In cooperation with local Aboriginal Groups, NPWS and OEH, prepare a Decision Framework for managing heritage sites and items that are uncovered by erosion or affected by inundation where such sites are previously unrecorded. The plan should provide clear direction as to the consultation and approvals required and options relevant to the type of item. This may include relocating the item, burying the item (for example as is done for midden sites), sacrificing the item or protection of the item (as is done for midden sites also), requiring the relevant approvals (e.g. an Aboriginal Heritage Impact Permit under the *National Parks and Wildlife Act, 1974* where harm to an Aboriginal object or place cannot be avoided). This option therefore requires the following steps:

- consult with Local Aboriginal Groups as to the preferred methods for managing different types of heritage assets;
- develop a decision framework giving a clear pathway of action and approvals to manage sites as they are uncovered by hazards impacts.

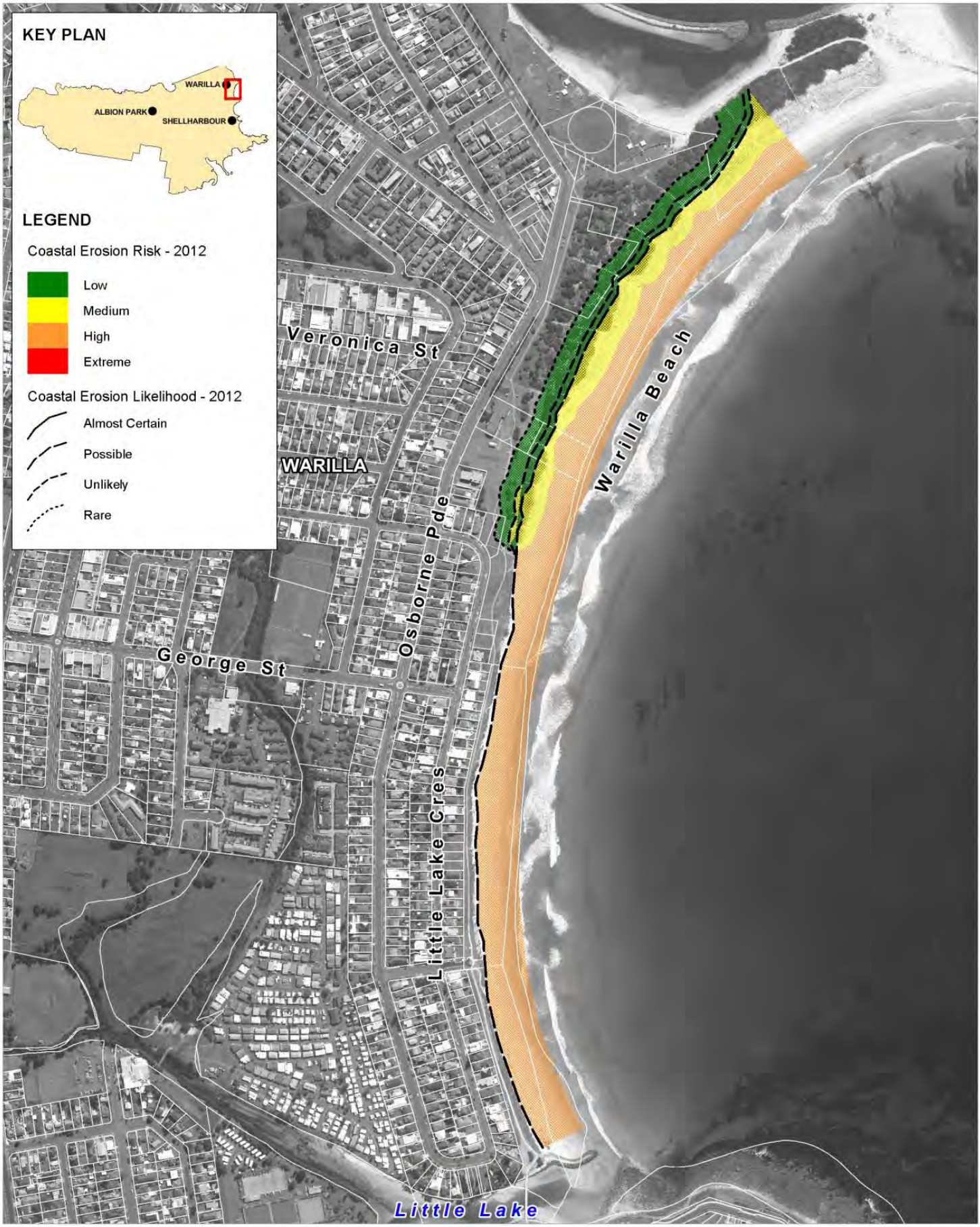
All aboriginal sites are protected under the National Parks and Wildlife Act 1974, whether known or unknown.

Advantages of Option	Disadvantages of Option
Option enables pre-planning and consideration of appropriate management response for different asset types, well in advance of impacts.	Unable to provide preventative / pre-emptive asset management, as assets may not be found until impacts occur.
Enables appropriate actions to be smoothly implemented at the time assets are uncovered.	

Potential Applications at Shellharbour

Whole LGA coastline

Appendix E Immediate Coastal Erosion Risk Maps



Title:

Erosion and Recession Risk Map
Immediate Planning Horizon - Warilla Beach

Figure: **E-1**

Rev: **A**

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Approx. Scale

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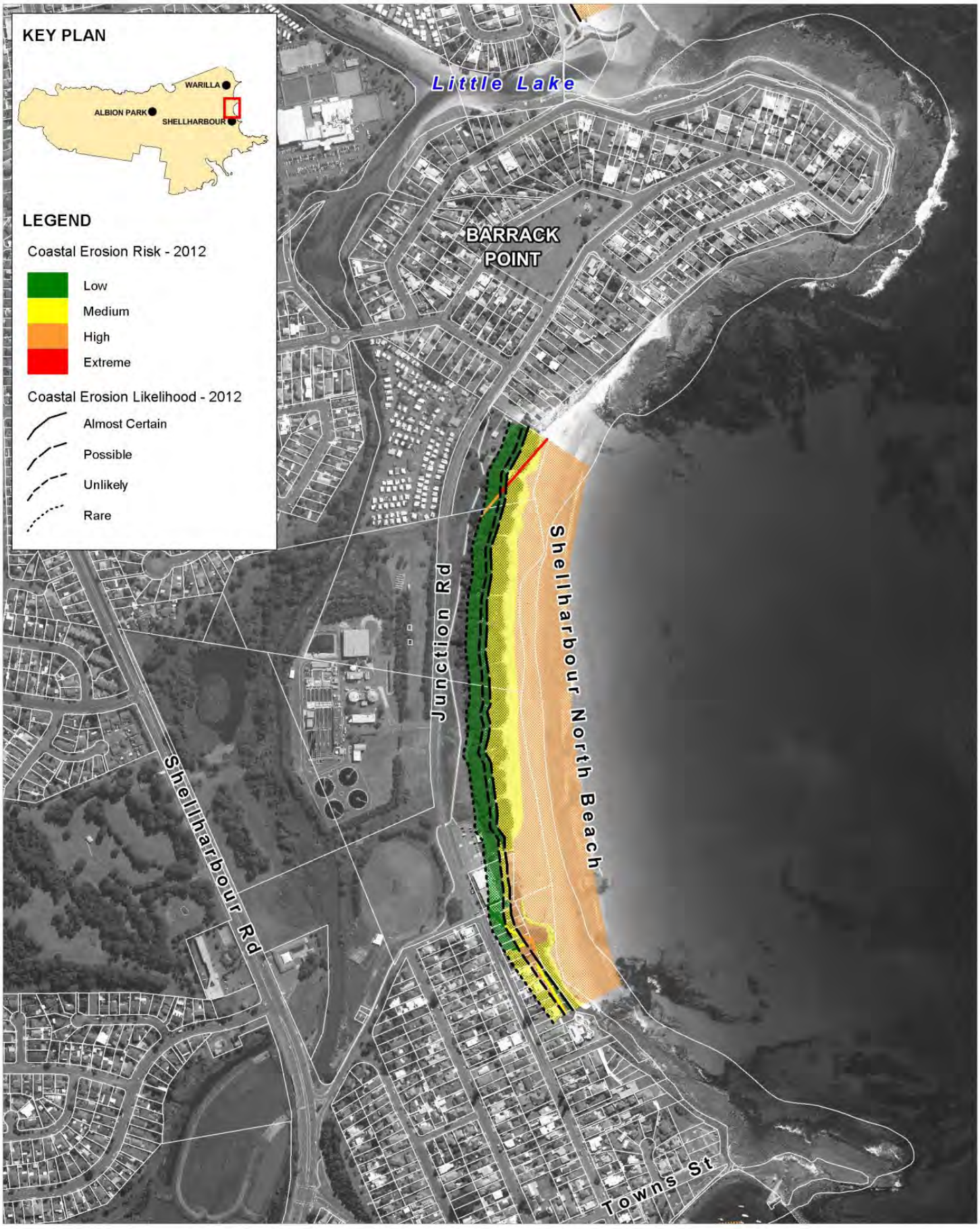

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Erosion and Recession Risk Map
Immediate Planning Horizon - Shellharbour North Beach

Figure: **E-2**

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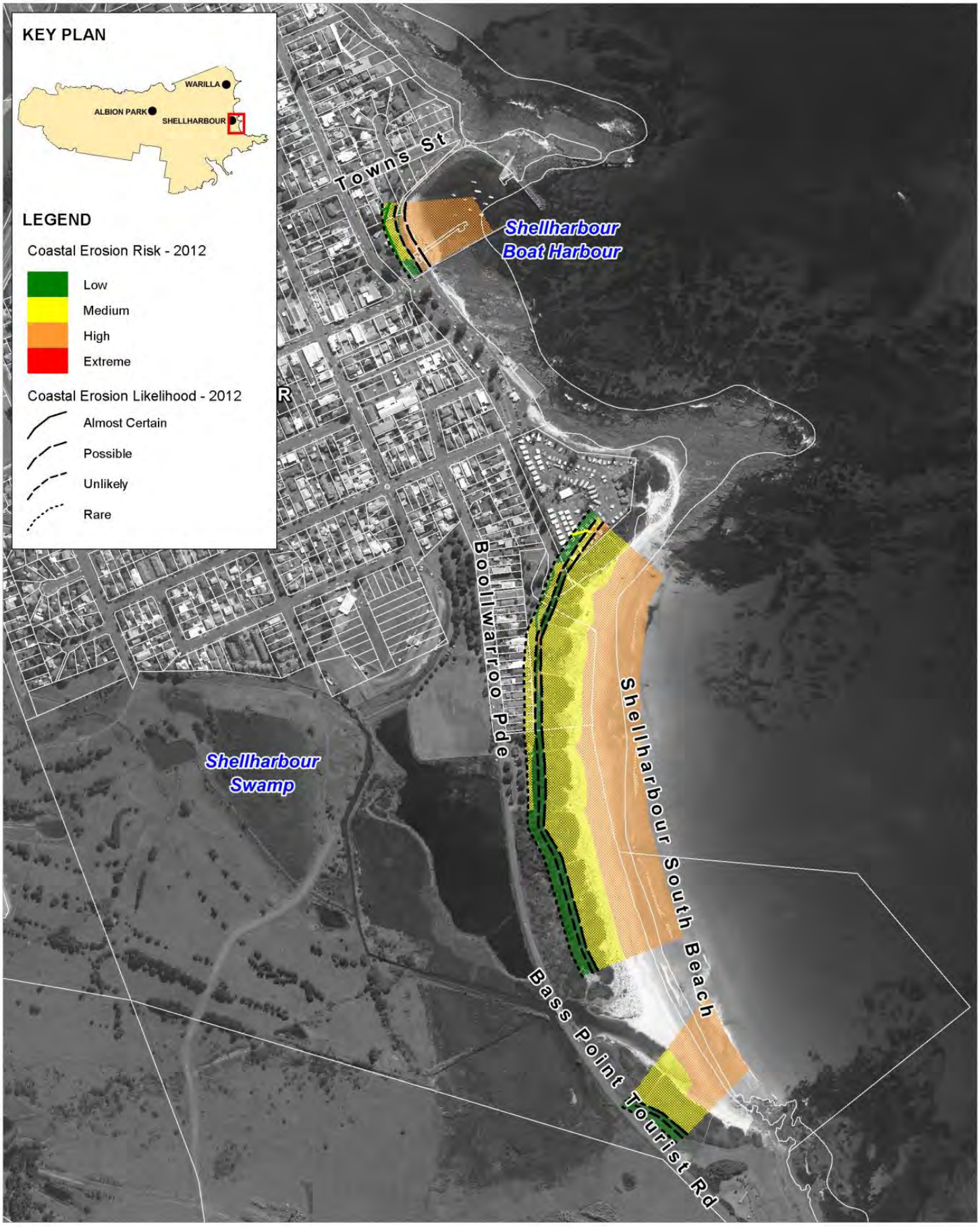

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Erosion and Recession Risk Map
Immediate Planning Horizon - Shellharbour South Beach

Figure: **E-3**

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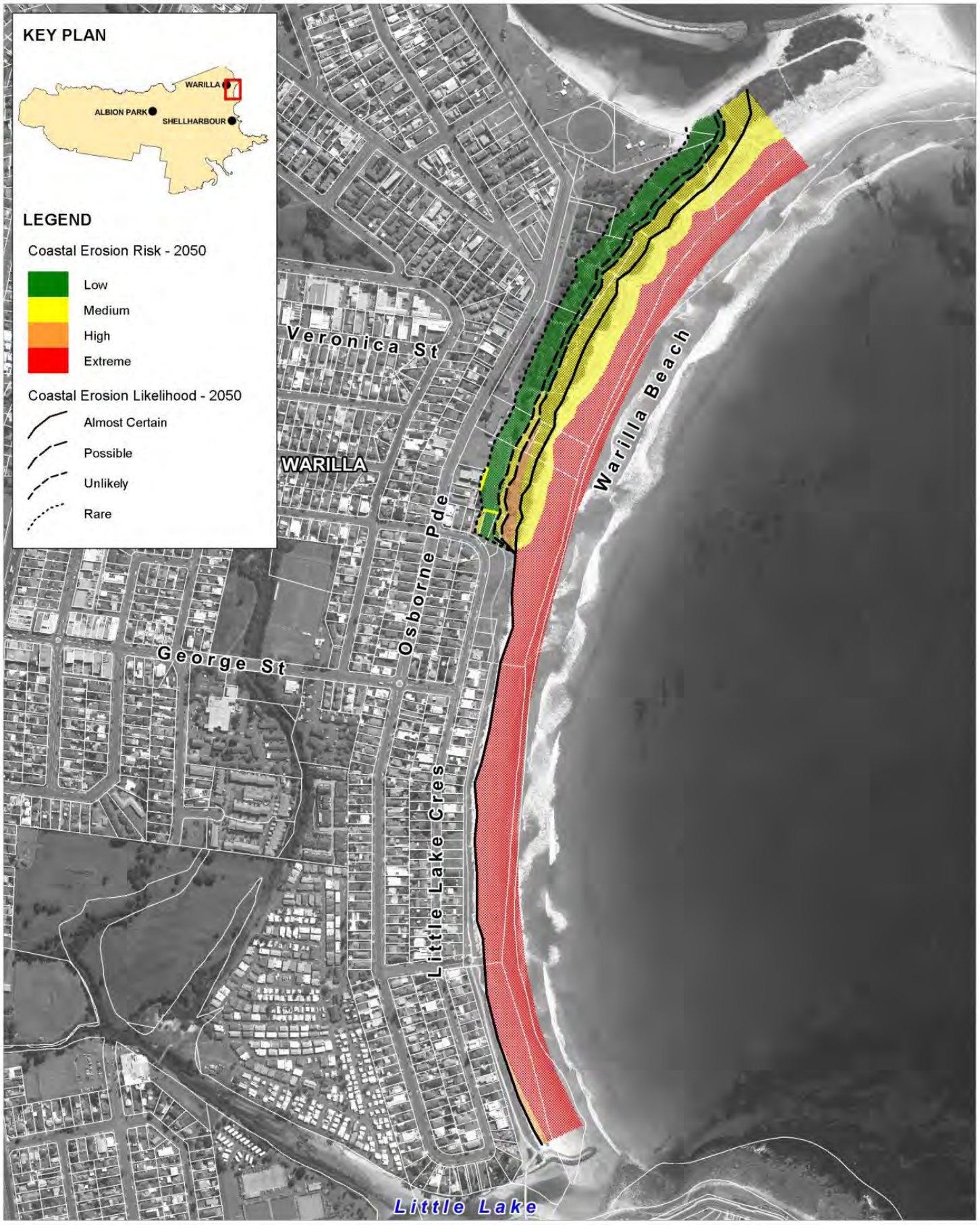
Appendix F 2050 Coastal Erosion Risk Maps



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2050 Planning Horizon - Warilla Beach

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2050 Planning Horizon - Shellharbour North Beach

Figure: **F-2**

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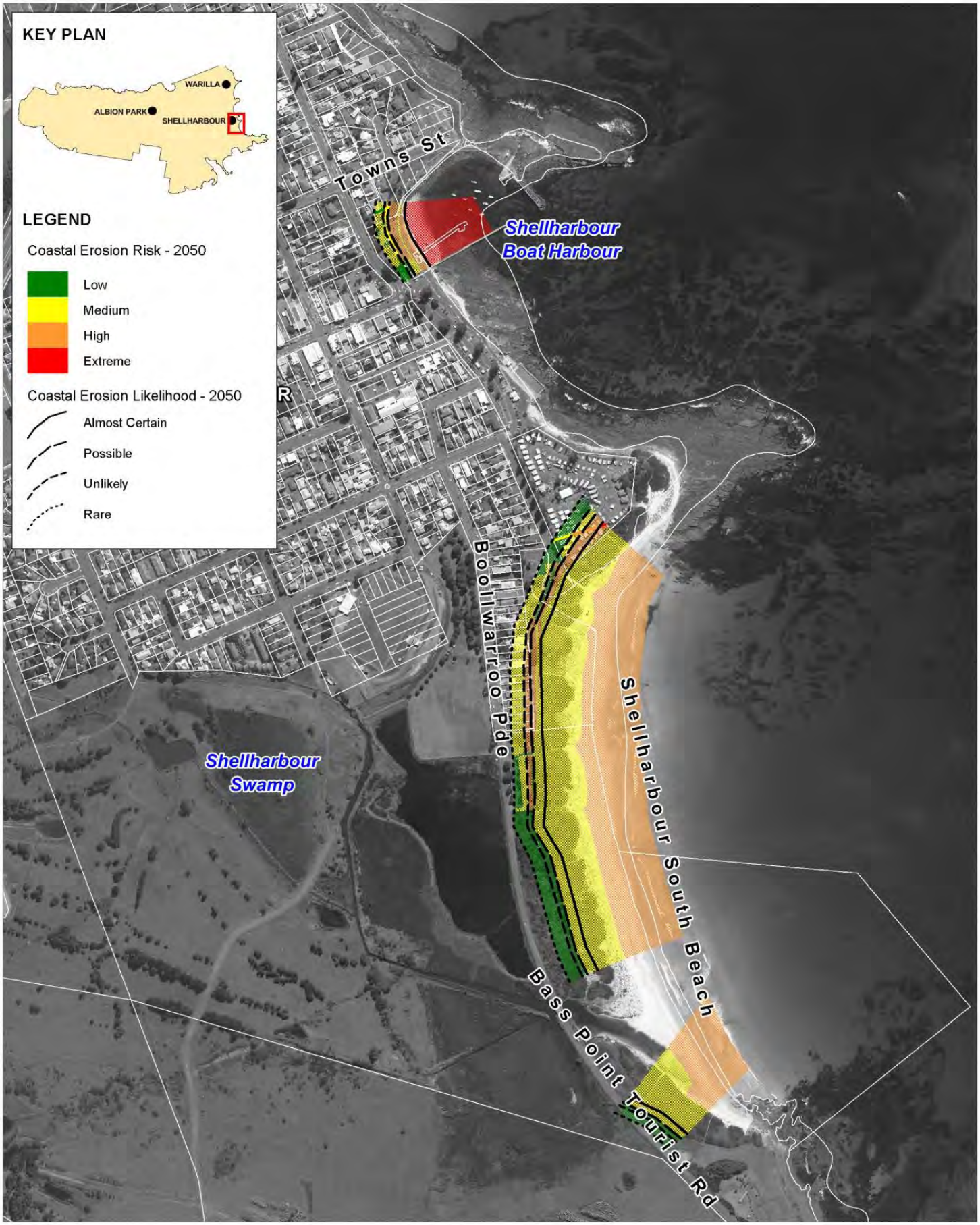

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Erosion and Recession Risk Map
2050 Planning Horizon - Shellharbour South Beach

Figure: **F-3**

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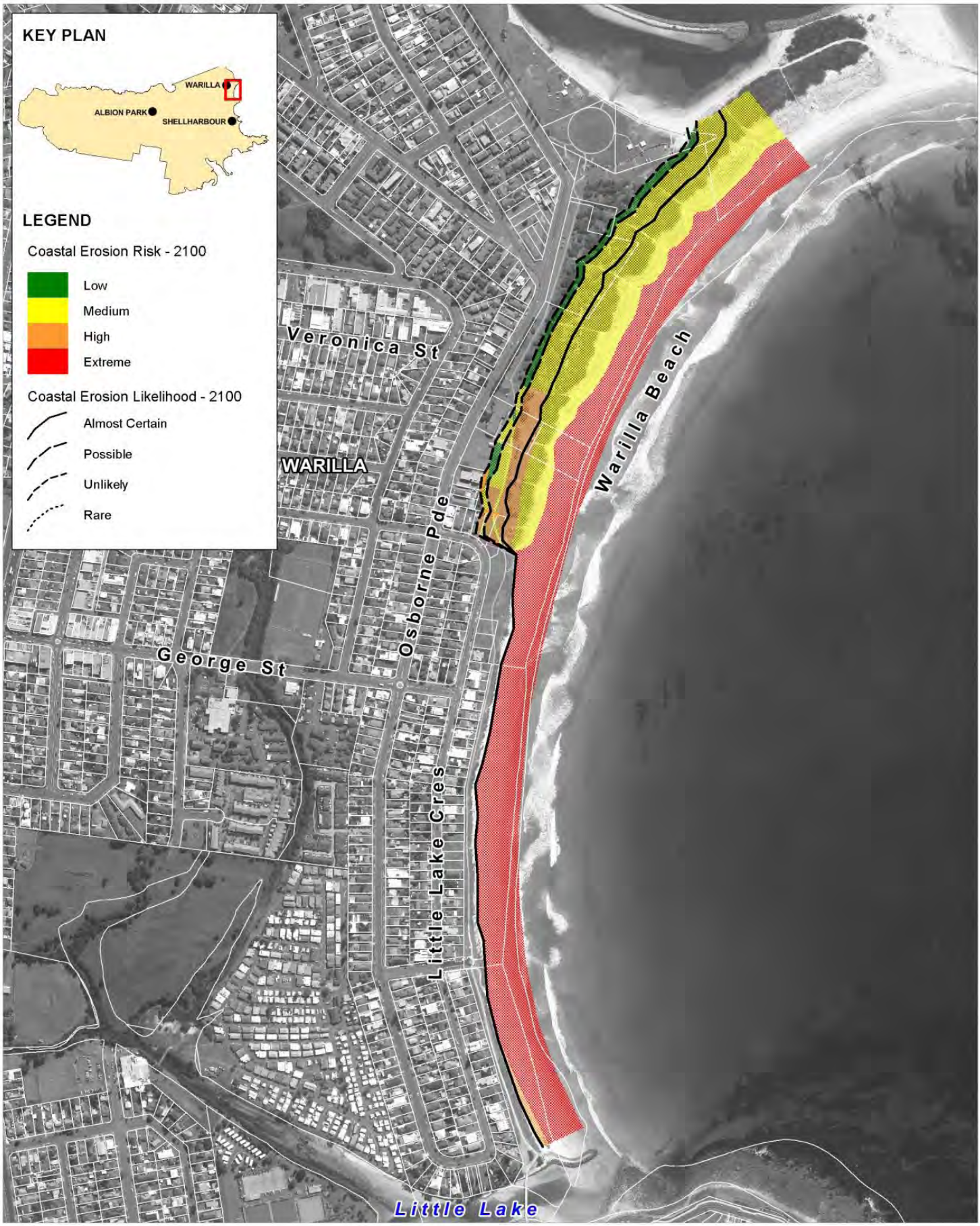
Appendix G 2100 Coastal Erosion Risk Maps



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Erosion and Recession Risk Map
2100 Planning Horizon - Warilla Beach

Figure: G-1

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Erosion and Recession Risk Map
2100 Planning Horizon - Shellharbour North Beach

Figure: G-2

Rev: A

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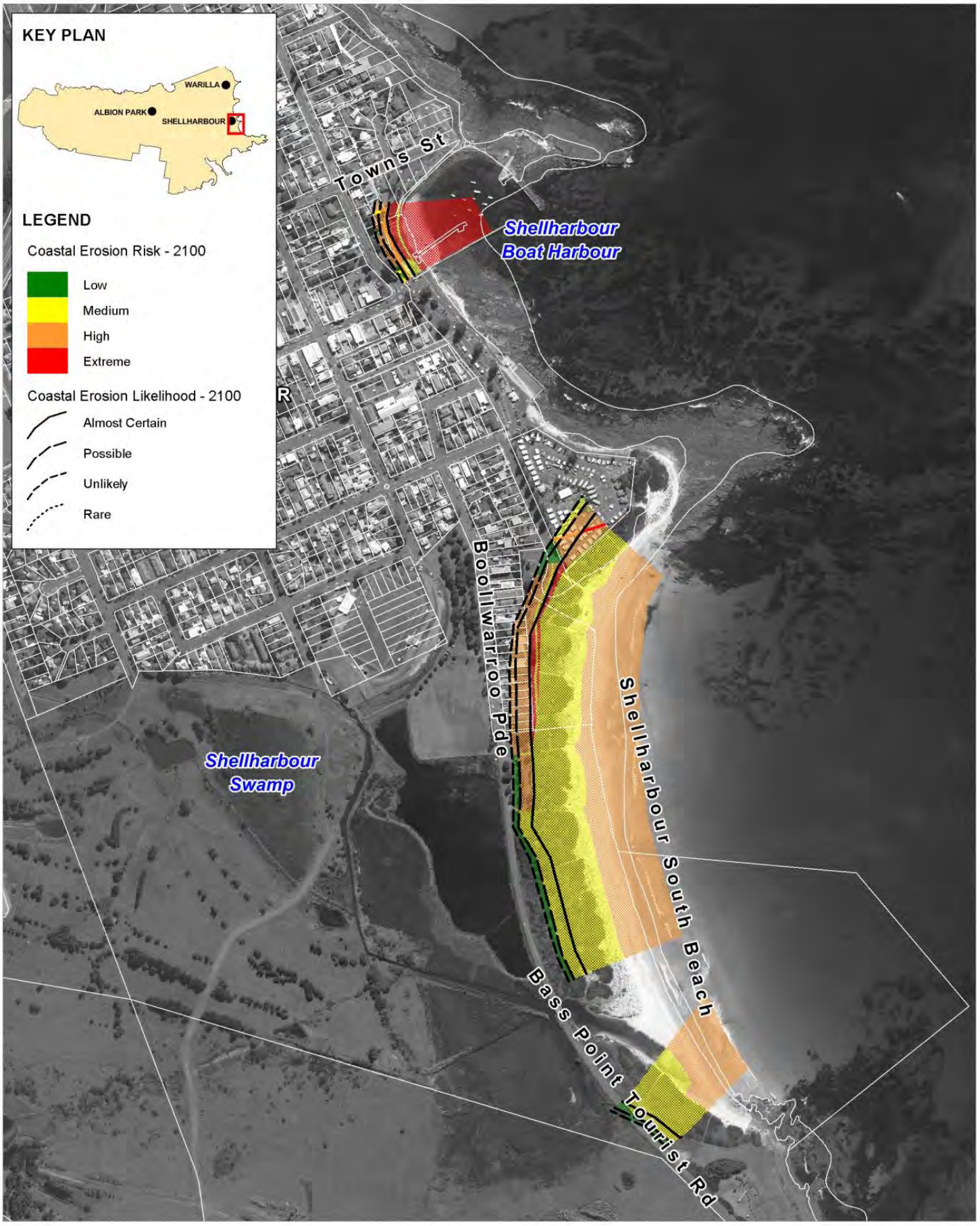

Title:

Erosion and Recession Risk Map
2100 Planning Horizon - Shellharbour South Beach

Figure: G-3

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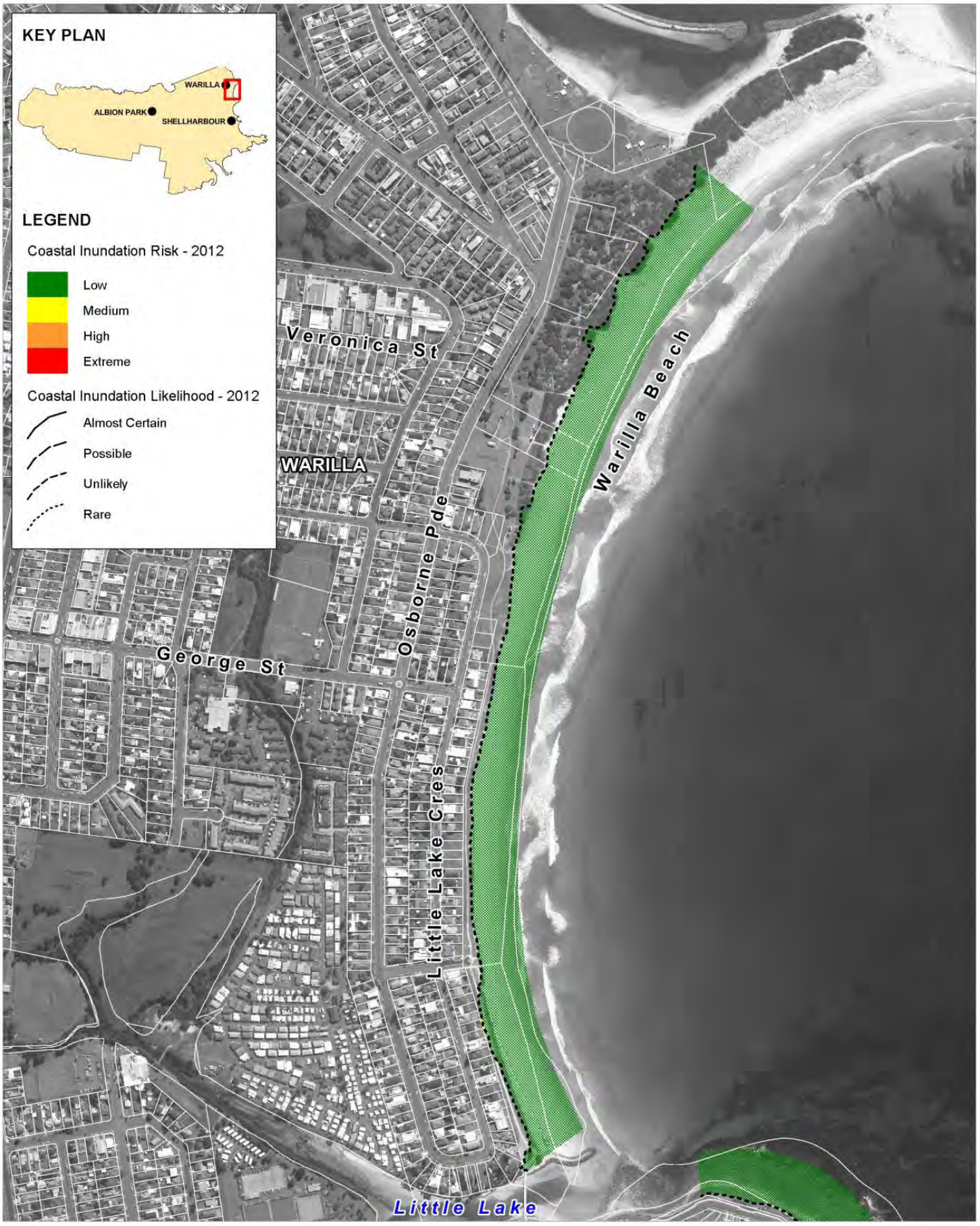
Appendix H Immediate Coastal Inundation / Wave Runup Risk Maps



Title:

Coastal Inundation Risk Map
Immediate Planning Horizon - Warilla Beach

Figure: **H-1**

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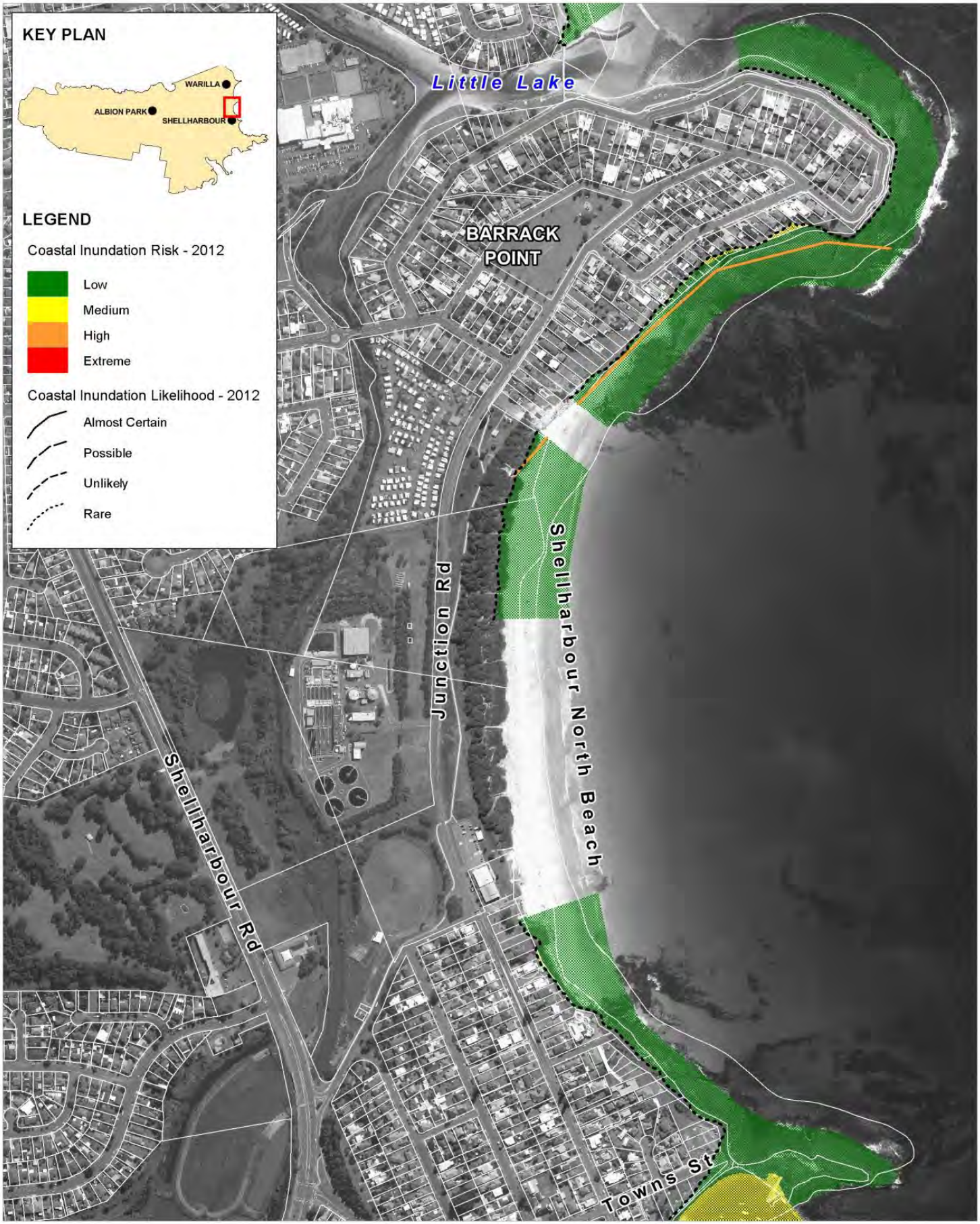

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Coastal Inundation Risk Map
Immediate Planning Horizon - Shellharbour North Beach

Figure: **H-2**

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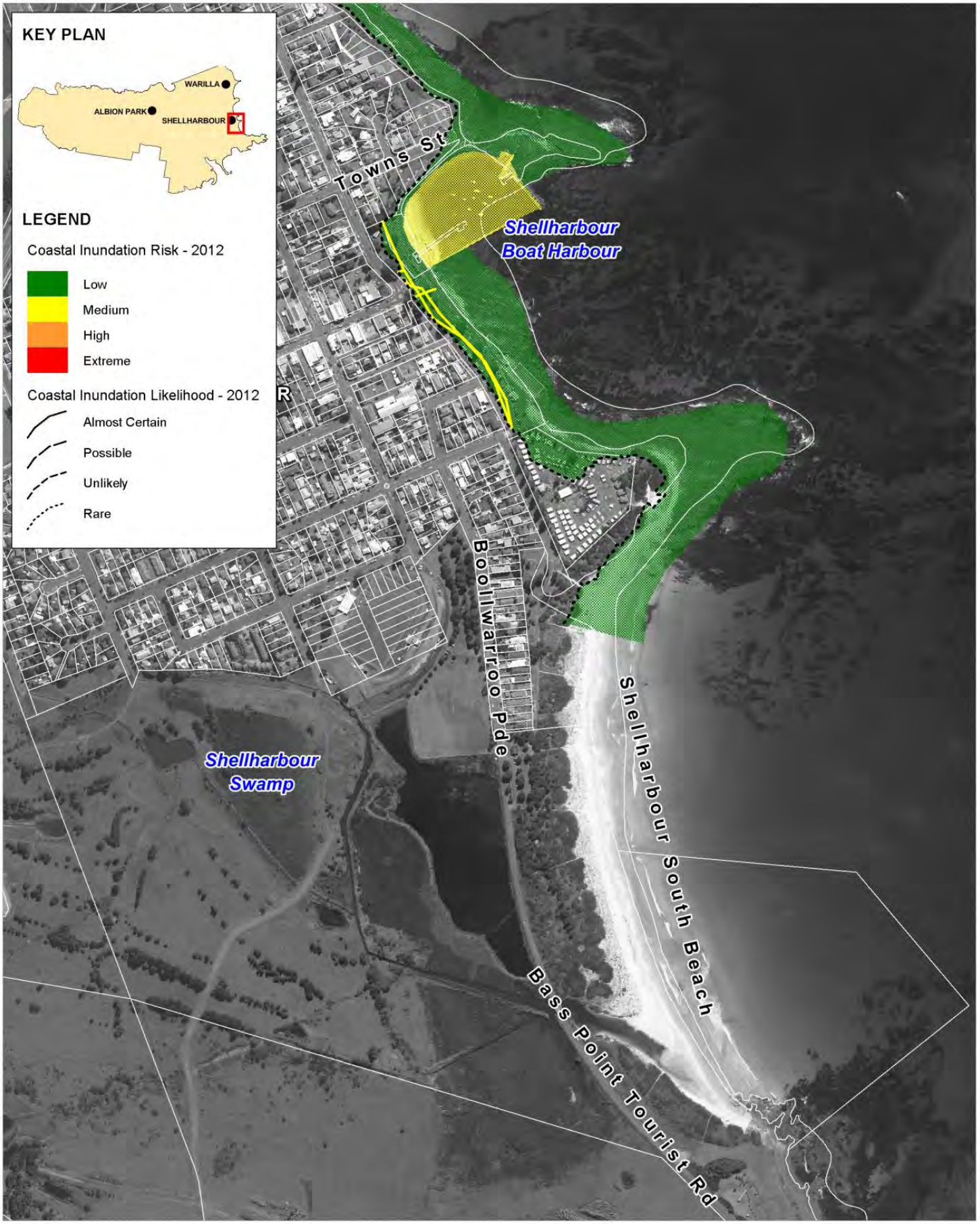

Title:

Coastal Inundation Risk Map
Immediate Planning Horizon - Shellharbour South Beach

Figure: **H-3**

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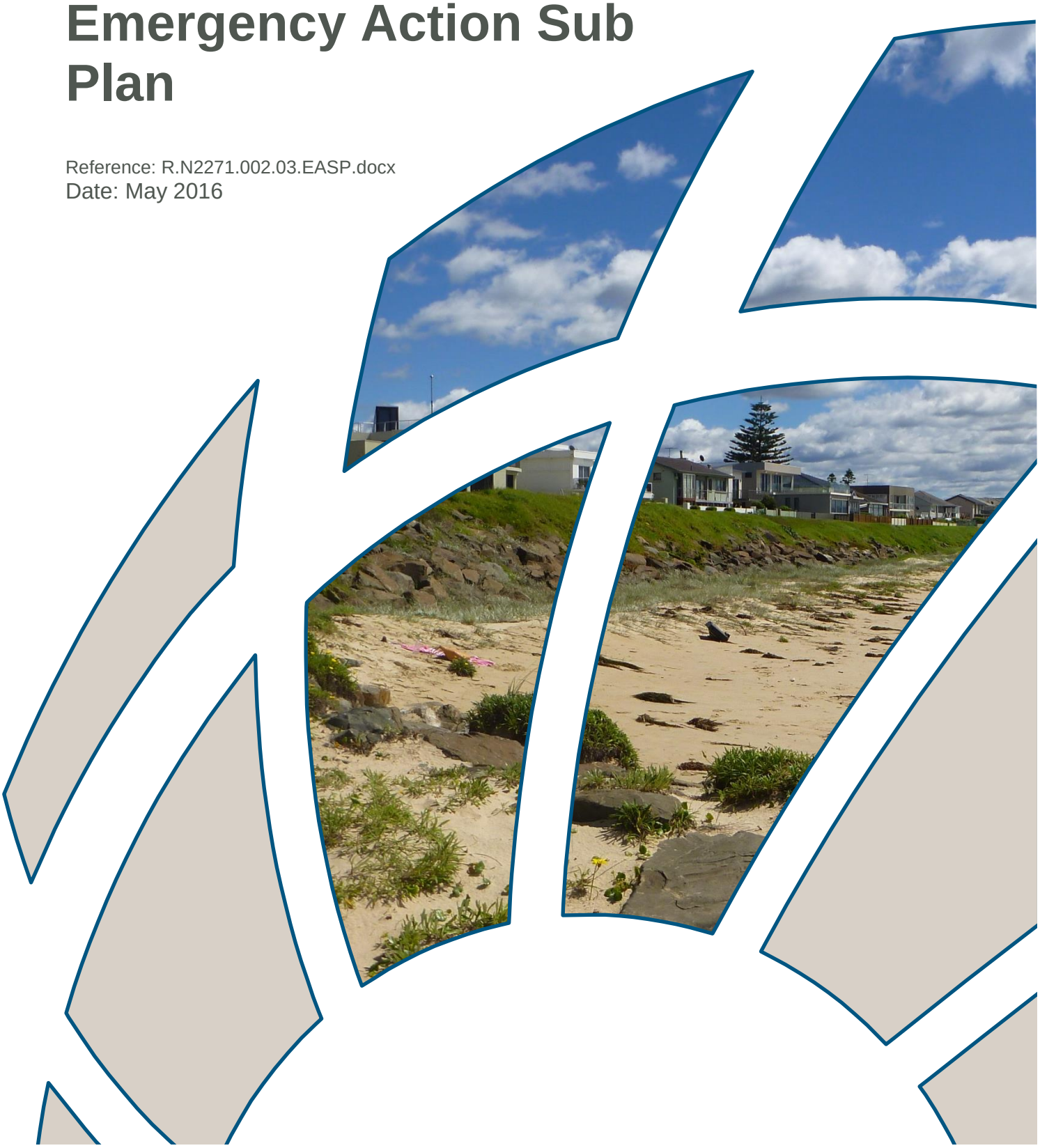
Appendix I Coastal Erosion Emergency Action Sub Plan

BMT WBM

Shellharbour Coastal Erosion Emergency Action Sub Plan

Reference: R.N2271.002.03.EASP.docx
Date: May 2016



Document Control Sheet

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Document:	R.N2271.002.03.EASP.docx
Title:	**Shellharbour Coastal Erosion Emergency Action Sub Plan**
Project Manager:	Verity Rollason
Author:	Verity Rollason
Client:	Shellharbour City Council
Client Contact:	Cheryl Lappin
Client Reference:	

Synopsis: **This Shellharbour Coastal Erosion Emergency Action Sub Plan forms an Appendix to the Shellharbour Coastal Zone Management Plan. This sub-plan outlines actions to be performed before, during and after an erosion emergency event and the roles and responsibilities for coastal erosion emergencies.**

REVISION/CHECKING HISTORY

Revision Number	Date	Checked by		Issued by	
0	Jan 2013	PEH		VPR	
1	Feb 2013	PEH		VPR	
2	June 2015	VPR		VPR	
3	May 2016	VPR		VPR	

DISTRIBUTION

Destination	Revision										
	0	1	2	3	4	5	6	7	8	9	10
Shellharbour City Council	1e	1e	1e	1e							
BMT WBM File	1e	1e	1e	1e							
BMT WBM Library	1e	1e									

Contents

List of Tables

Acronyms

CP Act	*Coastal Protection Act 1979*
Coastal Erosion EASP	Coastal Erosion Emergency Action Sub-plan
EMPLAN	Illawarra Emergency Management Plan, 2013.
LEMC	Local Emergency Management Committee
LEMO	Local Emergency Management Officer
LEOCON	Local Emergency Operations Controller
OEH	Office of Environment and Heritage
SCC	Shellharbour City Council
SEOCON	State Emergency Operations Controller
SERM	State Emergency and Rescue Management
SERM Act	*State Emergency and Rescue Management Act 1989*
SES	State Emergency Service

1 Introduction

1.1 Coastal Zone Management Planning

The process for managing coastal hazards and coastal risks along the New South Wales coast is through the preparation of Coastal Zone Management Plans. Through the development and subsequent implementation of these plans, the coastal hazards are identified and, as appropriate, the risks are addressed through a range of planning, design and protection measures. The plans should provide for the need for unplanned protection works to manage coastal erosion to be reduced and the risk to life and property managed. In this way, the likelihood and consequence of emergencies resulting from erosion during storm events is minimised (as is consistent with the risk management approach including prevention and mitigation measures detailed in the Local Disaster Plan). The residual risks to properties, assets and life until such time as the key elements of the plan have been adopted or as a result of potential unforeseen outcomes or storm severity are covered by this Coastal Erosion Emergency Action Subplan (Coastal Erosion EASP).

A Coastal Erosion EASP is a required component of the preparation of a Coastal Zone Management Plan (CZMP) as set out in the NSW *Coastal Protection Act 1979* (the CP Act). Section 55C(1)(b) of the CP Act states a CZMP must provide for *'emergency actions carried out during periods of beach erosion, including the carrying out of related works, such as works for the protection of property affected or likely to be affected by beach erosion, where beach erosion occurs through storm activity or an extreme or irregular event'.* Section 4 of the CP Act states that the part of a CZMP that deals with the matters specified in Section 55C(1)(b) is an emergency action subplan (OEH 2011, page 1).

1.2 The Role of the Coastal Erosion Emergency Action Sub-plan

"The emergency action sub-plan forms an integral component of a CZMP. It outlines a council's intended response to a coastal erosion emergency and explains ways in which and where beachfront property owners can place emergency coastal protection works according to the Coastal Protection Act 1979 (CP Act),"

"Section 55C(2)(a) of the CP Act requires that CZMPs ***must not*** *include matters dealt with in any plan made under the State Emergency and Rescue Management Act 1989 (SERM Act) in relation to emergency responses"* (OEH 2011, page 1).

The roles and responsibilities of government agencies, councils and other relevant organisations during severe storm events (including events that cause erosion) are detailed in Section 2.19 of the NSW State Storm Plan (SES, 2013).

1.3 Extent of the Coastal Erosion Emergency Action Sub-plan

The OEH Guide (2011) advises that *"The minimum area to be covered by an emergency action sub-plan would be either:*

- *any area defined by a direction from the Minister according to Section 55B of the CP Act; or*
- *all beachfront margins where erosion is likely to threaten public and private infrastructure or assets.*

The sub-plan may also cover areas of the coastline accessed or utilised by the general public where there is an identified threat posed by erosion, e.g. walking tracks through coastal parkland."

No direction has been issued under Section 55B for the Shellharbour Local Government Area (LGA) coastal zone. The extent of this Coastal Erosion EASP is, therefore defined as the coastal margins of the ocean beaches and headlands within the LGA boundaries, extending from Windang Island in the north to Bass Point in the south and including Warilla Beach, Shellharbour North Beach, Shellharbour Boat Harbour and Shellharbour South Beach.

1.4 Minimum Requirements for Emergency Action Sub-plans

The Coastal Erosion EASP must be consistent with and not duplicate or contradict any plans prepared under the *State Emergency and Rescue Management Act 1989* (SERM Act). The relationship between these two planning frameworks is indicated in Table 1 which has been adapted from OEH, 2011 (page 14).

Table 1-1 Contents of Coastal Erosion EASP and SERM Act plans (adapted from OEH, 2011)

Coastal Erosion EASP	SERM Act Plans
Any coastal protection works or other actions to be carried out by council when coastal erosion is imminent or occurring, or in recovering from coastal erosion.	Actions in relation to the prevention of, preparation for, response to and recovery from emergencies, excluding permanent or temporary coastal protection works.
Any additional requirements for landowner placement of temporary coastal protection works beyond those in the *Coastal Protection Act 1979* (e.g. constraints on access and the location of works)*	Actions are consistent with the NSW State Storm Plan and the NSW Storm Emergency Sub Plan.

IMPORTANT NOTE

No locations for temporary coastal protection works in accordance with the CP Act and the Code of Practise associated with temporary works are currently identified in the Shellharbour LGA.

Council is advised to refer regularly to the Code of Practise as and when it is updated (refer www.environment.nsw.gov.au/coasts/coastalmgtdocs.htm), to check for additions to the authorised locations that may be in the Shellharbour LGA.

The minimum requirements for a Coastal Erosion EASP are set out in the NSW Government Guideline (OEH, 2011) which reflects the requirements expressed in the CP Act. These are:

- describing intended emergency actions to be carried out during periods of beach erosion, such as coastal protection works for property or asset protection, other than matters dealt with in any plan made under the *State Emergency and Rescue Management Act 1989* relating to emergency response (sections 55C(1)(b) and (g) of the CP Act *1979*); and
- describing any site-specific requirements for landowner emergency coastal protection works describing the consultation carried out with the owners of land affected by a subplan.

2 Emergency Planning Hierarchy

2.1 Response Operations by the NSW State Emergency Service

There is a clear hierarchy in planning and responsibility that applies to emergency management in NSW, including those emergencies resulting from a storm or disaster as defined at clause 6.1.3 of the NSW State Storm Plan (September, 2013).

The various roles and responsibilities are defined in the NSW Storm Plan and within the Illawarra Emergency Management Plan (EMPLAN), March 2013. Shellharbour City Council lies within the Illawarra Emergency Management Area. Responsibilities for various hazards relating to the open coast are as follows:

- the combat agency for Flood risks (riverine or flash) is defined in the EMPLAN in Part 5 (Page 36) to be the NSW State Emergency Service (SES);
- the combat agency for Severe Storm and/or Strong Winds and/or Storm Surge and/or Coastal Erosion is defined in the EMPLAN in Part 5 (Page 37) to be the NSW SES; and
- the combat agency for Tsunami Hazards is designated in the EMPLAN in Part 5 (Page 37) to be the NSW SES up to Level 3 then the State Emergency Operations Controller (SEOCON).
- As the lead combat agency, response operations by the NSW SES will begin on the receipt of an Australian Government Bureau of Meteorology (BoM) watch or warning (e.g. Severe Thunderstorm Warning, Tropical Cyclone Watch), or following impact of a storm not covered by a formal warning; (The Bureau of Meteorology is responsible for issuing warnings for Floods, Severe Storms, Strong Wings, Storm Surge and/or Coastal Erosion).
- The NSW SES Region and Local Controllers are responsible for ensuring, as detailed in SES region and Local Flood Plans, that the residents of the region and local areas are aware of the flood, tsunami or severe storm threat and how to protect themselves against it;
- Although NSW SES is the combat agency for storms, they are not responsible for commanding, controlling and conducting physical mitigation works (clause 2.2.32 of the NSW State Storm Plan (September 2013)), which is the responsibility of Council;
- The Local Emergency Operations Controller (LEOCON) or the responsible combat agency can activate response arrangements detailed in the EMPLAN.

Therefore, the EMPLAN informs this Coastal Erosion Emergency Action Sub-plan (ie the Coastal Erosion EASP is a subplan to the EMPLAN).

The role of Council in a storm emergency is to command, control and conduct physical mitigation works that may be requested by the SES to assist with the emergency relief or to activities (including protection works) to protect assets under local government (Council) control.

Where any proposed protection works to manage coastal erosion emergency events require development approval, Council must only undertake such works during an emergency where the consent has been obtained in advance. Where the works are exempt (such as minor works or emergency works to protect a road or stormwater system under SEPP (Infrastructure) 2007)

Council must first undertake an assessment to determine that the works will not result in a significant adverse environmental impact. Before undertaking any works, Council must also confirm that the works proposed are in accordance with the currently gazetted or adopted Coastal Zone Management Plan. There are no protection works proposed for emergency management purposes under this Coastal Erosion EASP that require development consent.

Following the emergency, Council is involved in the remediation of damage or hazards and the reinstatement of the dunes, beaches and accessways in an appropriate and safe manner. This will include works of varying priorities and timeframes in accordance with usual Council maintenance procedures.

2.2 Other Coastal Erosion Emergency Response Operations

Where a coastal erosion emergency arises from storm events other than those outlined in Section 2.1, the responsibility to manage rests with Council. Such an event could arise, for example, from a period of high tides and large swell which result in substantial erosion to the back of the beach. For these conditions, it is likely that the resulting erosion would be substantially less than that which would result from a severe declared storm event (unless such an event was to occur immediately following a severe storm event).

It is not possible to determine a trigger for such an occurrence, and therefore, the determination to invoke this Coastal Erosion EASP (in this case by Council) would need to be based on monitoring of the beach state (and assessment by Council officers). In such a case, the Coastal Erosion EASP would be implemented following a request from the designated Council Officer.

2.3 Assets and Development at Threat

The extent of coastal hazards within the Shellharbour LGA coastal zone is defined in the Shellharbour Coastal Hazards Analysis (SMEC, 2010). This study maps the landward extent of erosion hazards that may be anticipated for the present, 2050 and 2100 timeframes. The landward extent of erosion hazards are defined in Map Figures within the SMEC (2010) report and form the basis for defining the extent of the erosion hazard at present.

Within the Shellharbour LGA coastal zone the extent of beach erosion at present is typically restricted to the sandy beach, incipient dunes and foredune crest of the beaches. Significant encroachments of the storm erosion extent threatening existing development include the following locations:

- Warilla Beach, particularly in relation to the performance of the existing seawall structure at the southern end of the beach;
- Shellharbour North Beach;
- Nuns Beach (southern end of Shellharbour North Beach); and
- Northern end of Shellharbour South Beach;

At these locations, development and areas that may be impacted during an erosion emergency generally consist of:

- promenades, seawalls and cycleway;
- caravan parks (Shellharbour South Beach)
- private properties (Shellharbour South Beach);
- SLSCs (Shellharbour North Beach)
- stormwater assets (Warilla Beach);
- defined beach and dune access tracks under care and control of Council; and
- the beaches and dunes.

These exist within an area of known high hazard and are either designed to accommodate the erosion events (such as the stormwater outlets), or are temporarily affected by erosion, limiting their use by the community (such as the promenades, beaches and accessways). In each case the opportunity to protect the asset prior to an erosion event is low and the risk to life during an event is low. Similarly, the opportunity to undertake temporary emergency works during an event is low and the preferred approach is to assess and repair the asset following the event. In most instances this becomes a routine maintenance role.

The landward extent of the erosion hazard as considered in this Coastal Erosion EASP may increase into the future as sea level rises. The impacts on the future revisions of the Coastal Erosion EASP should take this into account at each plan review.

3 Emergency Responses

3.1 Communication

3.1.1 Storm Emergency

Where coastal erosion is anticipated as a result of a watch or warning issued by the BoM, the responsibility for communicating the potential hazards defaults to the SES as the combat agency. Activation of the EMPLAN would trigger this Coastal Erosion EASP. Council would assist in the provision of information on the current state of beaches as well as potential for impacts on beach access. Internally, Council staff with relevant responsibilities should be placed on standby and commence monitoring the impacts. As described in Section 2.19 of the SES (2013), Local Surf Life Saving Clubs (SLSC) should be contacted with a view to distribute advice contained in the Bureau's weather warnings to people on Surf Life Saving patrolled beaches when dangerous surf conditions are predicted and to close patrolled beach water areas when dangerous conditions caused by storms occur.

As the emergency progresses Council is required to continue monitoring these areas and updating information through the LEOCON as appropriate. Where specific hazards are resulting in damage, Council will provide this information to the SES and for distribution through the media or directly to community as appropriate.

Following the emergency, Council is responsible for advising the current state of beaches and recreation areas in the Council area (when/if they are re-opened for the public). Where residual hazards remain to be addressed, Council should take appropriate action to convey this to local communities including the use of closures, signage and the release of media bulletins via the SES.

3.1.2 Non Storm Erosion Emergency

Where the emergency does not trigger the State Storm Plan or EMPLAN, Council is responsible for initially monitoring the progress of erosion and subsequently implementing this Coastal Erosion EASP. The roles and responsibilities of Council in communicating the emergency to the community remain the same except that information needs to be provided by Council directly through the media rather than through the SES as outlined in Section 3.1.1 above.

3.2 Landowner Initiated Actions

3.2.1 Temporary Coastal Protection Works

Temporary coastal protection works are only permitted under the CP Act at locations listed in Schedule 1 of the Code of Practice accompanying the CP Act, none of which exist in the Shellharbour LGA. Schedule 1 of the Code of Practice accompanying the CP Act was revised in April 2013, in line with the recent amendments to CP Act implemented by the *Coastal Protection Amendment Act 2012*. As part of that revision, the following main changes were made:

- updating the authorised locations where temporary works can be placed to reflect all areas where properties are currently known to be at risk from erosion;

- removal of safety requirements, as landowners should manage safety risks to meet the requirements under the NSW Work Health and Safety Act 2011;
- increasing the allowable height of the works from 1.5 to 2.2 metres;
- allowing temporary works to be placed in front of any existing works (previously prohibited);
- relaxing the specifications for the sand used in sandbags; and
- requiring all sandbags to have a volume of 0.75 cubic metres when filled and to be made from geotextile fabric (no longer allowing smaller woven polypropylene bags), as the smaller bags previously permitted may be too readily damaged and become dangerous.

There are currently no locations in the Shellharbour LGA coastal zone at which temporary coastal protection works (CP Act, Part 4c Sand/Sandbags) are permitted.

Council is advised to update this Coastal Erosion EASP in consultation with relevant landowners if the erosion hazard increases and/or if any further changes to the Code of Practice occur in the future.

3.2.2 Permanent Protection Works

Property owners, such as those at locations within the immediate erosion hazard line, are permitted to submit development applications to install permanent protection works, provided such works are consistent with the certified Shellharbour CZMP.

At present, the Shellharbour CZMP does not indicate the need for new permanent protection works in the Shellharbour LGA. Upgrades to the existing Warilla seawall are recommended only.

3.3 Council Actions Prior to a Coastal Erosion Emergency

The following activities would be undertaken by Council prior to the emergency:

- Contribute to community storm education initiatives, and assist the NSW SES with community awareness programs to ensure people in locations potentially threatened by coastal erosion understand the threat and its management;
- Provide NSW SES with copies of coastal hazard studies and management plans to assist with emergency planning and intelligence development;
- Where the likelihood of an emergency event is identified (e.g. Storm warnings or damaging wave warnings from the BoM), the local Lifeguards (or appropriate council representative) will inform the local Surf Life Saving Clubs. The Council Lifeguards and / or the local SLSCs will then take the appropriate action in terms of closing the beaches and/or access roads;
- Where difficulties/damage are known to exist on beach accessways and these are likely to be exacerbated by storm erosion, then Council at their discretion may close those walkways and place appropriate signage;
- Commence monitoring the effects of the erosion on assets and development potentially at threat; and

- As appropriate, the Council Coastal Erosion EASP controller (CEEASP Controller) will initiate the Coastal Erosion EASP.

3.4 Council Actions During a Coastal Erosion Emergency

The following activities would be undertaken by Council during the emergency:

- Subject to the availability of adequate resources, assist NSW SES with reconnaissance to identify storm damage; traffic management on Council managed roads; resources (e.g. plant, equipment and personnel); and removal of tree and other debris from Council managed road and public land during clean-up operations;
- Distribute advice contained in weather warnings to people on beaches when dangerous surf conditions are predicted via Council lifeguards;
- Close beach water areas when dangerous conditions caused by storms occur and notify the NSW SES and Surf Life Saving NSW;
- Council activities during a coastal erosion emergency should focus on the safety of Council staff who may be working under adverse weather conditions;
- Where damage to walkways is identified and/or reported to Council, as practical take appropriate action to close off the accessways by installing temporary fencing / signage and/or advising the local community of the hazards at the first opportunity;
- Where damage to assets is identified through monitoring, assess the damage and any opportunities for limiting further damage that may be appropriate during the event. This may include consideration of constructing emergency physical mitigation works to protect public property in accordance with the *Environmental Planning and Assessment Act 1979* and as detailed in the adopted Shellharbour CZMP and Coastal Erosion EASP;
- Where repairs are permissible and may be readily and safely undertaken, this will be done at the first opportunity; and
- At the appropriate time the CEEASP controller will determine that the emergency has passed and that the remediation stages of the plan are to commence.
- Note that no actions undertaken by Council during a coastal emergency event should conflict with other agency actions, such as those SES.

3.5 Council Actions Following the Cessation of a Coastal Erosion Emergency

The following activities would be undertaken by Council following the emergency, within their usual maintenance programs:

- Following the erosion emergency, Council will undertake an inspection of all beach accessways, beaches and dunes to establish any damage to the access or dangers to the public in accessing and using the beach and dune areas;

- Where an accessway is considered unsafe, action will be taken to close the access (top and/or bottom) and to place appropriate signage warning the access is unsafe for use;
- Prioritise the work required to repair and reopen any damaged or unsafe beach accessways in accordance with the Council maintenance works schedule;
- Where an erosion escarpment has been created at the back of the beach (height greater than 1.5 m[1]), document the extent of the escarpment and at the earliest opportunity undertake a risk assessment of the likely hazard to beach users (both to persons on the beach and to persons on the dune above the scarp) from collapse of the erosion scarp;
- Where the risk is deemed unacceptable, at the earliest opportunity undertake appropriate mitigation works which may include:
    - regrading the escarpment to a stable slope (following approval from Council's Design section);
    - fencing and signposting escarpments, to discourage public access (top and/or bottom) until such time as the beach recovers naturally; and
    - keeping the beach closed until such time as the risk has reduced to an acceptable level.
- At the appropriate time the CEEASP controller will declare the emergency has finished and the Coastal Erosion EASP is no longer operative.

[1] A height of 1.5 m is specified due to the public safety risk (for example, from a fall or trip from this height or scarp collapse). The action required may simply be to fence off the escarpment until such time as the beach recovers naturally.

4 Responsibilities

Specific responsibilities under the Coastal Erosion EASP are tabulated in Table 4-1.

Council (through the nominated CEEASP controller) must tabulate relevant Council positions and responsibilities for implementation and execution of the Coastal Erosion EASP. This will require an up-to-date list (names and contact numbers) for relevant contacts to be maintained by Council and updated as positions or responsibilities change. This list is to be readily available within Council and communicated to each of the nominated contact persons following any update.

Table 4-1 Specific Responsibilities in implementation of the Coastal Erosion EASP

Position	Responsibilities
Combat Agency NSW State Emergency Service	Facilitate damage control for storms and with the legislative requirement to protect people from danger, to maintain their safety and health and manage the media during severe weather events.
Local Council	Responsible for commanding, controlling and conducting physical mitigation works. This includes assisting NSW SES with reconnaissance, installing fencing and signage in areas affected by erosion resulting in unsafe conditions, and construction of emergency mitigation works during or after a storm event in accordance with the *Environmental Planning and Assessment Act 1979* (NSW).
Local Emergency Operations Controller (LEOCON)	Execution of the Local EMPLAN, including aspects relating to coastal erosion
Council Coastal Erosion EASP controller (CEEASP Controller)	Liaison with LEOCON during storm emergency. Implementation of the Coastal Erosion EASP during non-storm erosion emergency
Group Manager City Services	Monitoring repair of beaches and dunes.
Group Manager Parks and Sporting Facilities	Closure of Beaches and the ocean pool as appropriate. Post storm remediation.
Council Media Liaison Officer	Distribution of warnings and closures via the media.

5 Plan Review

This Coastal Erosion EASP should be maintained as required and reviewed at intervals not exceeding 5 years from its initial adoption. Earlier review may be triggered by:

- occurrence of a coastal erosion emergency that exceeds the defined hazard extent outlined in the Shellharbour Coastal Hazards Analysis (SMEC, 2010) to redefine the extent of the area covered by this EASP;
- revision of the NSW State Storm Plan and / or the EMPLAN (revised each five years) to ensure the plan remains consistent with their objectives;
- changes to the CP Act or associated guidelines or Code(s) of Practise;
- unsatisfactory outcomes or concerns following a coastal erosion emergency; or
- proposed changes to the adopted Shellharbour Coastal Zone Management Plan.

6 References

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