PORT MACQUARIE HASTINGS

Lake Cathie

Coastal Zone Management Plan

APRIL 2016

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PREPARATION, REVIEW AND AUTHORISATION

Revision	Date	Prepared by	Reviewed by	Approved for Issue by
2016	05/04/2016	G Cameron (PMHC)	T Molloy (PMHC)	M Rogers (PMHC)

NOTE: Port Macquarie-Hastings Council revised this document in 2016 following advice from the Minister for the Environment. The exhibition version of this document was initially prepared by SMEC Australia in 2013. This version has been altered by PMHC with SMEC's permission but has not been checked or approved by SMEC. The information within this document is and shall remain the property of **SMEC Australia and Port Macquarie Hastings Council.**

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1 INTRODUCTION

1.1 Area Covered by this Plan

Lake Cathie is located in the Port Macquarie – Hastings Local Government Area (LGA). The southern part of Port Macquarie and the coastal townships of Lake Cathie and Bonny Hills are located along Lighthouse/ Lake Cathie/ Rainbow Beach between Tacking Point and Grants Head. The Intermittently Closed and Open Lake or Lagoon (ICOLL), from which the town of Lake Cathie takes its name, is part of a wider system that includes Cathie Creek and Lake Innes to the north. Management of the Lake Cathie estuary is not part of this Coastal Zone Management Plan (CZMP). An opening strategy for the lake entrance was adopted by Council in 1995 and reviewed in 2000. A hydrodynamic model was developed by BMT WBM in 2011 to assist in management of the Lake Cathie ICOLL.

Lake Cathie Beach is approximately 2 km long and backed by residential development along Illaroo Road, and by Johnathon Dixon Reserve which is seaward of development along Chepana Street. The study area for this CZMP is shown in **Figure 1**

Figure 1 Coastal Zone Management Plan Study Area

2 PREPARATION OF CZMP

2.1 Governing Legislation

Part 4A, Section 55 C (1) of the *Coastal Protection Act 1979* lists matters to be dealt with in coastal zone management plans:

A coastal zone management plan must make provision for:

> *(a) protecting and preserving beach environments and beach amenity, and*
>
> *(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, and*
>
> *(c) ensuring continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion, and*
>
> *(d) where the plan relates to a part of the coastline, the management of risks arising from coastal hazards, and*
>
> *(e) where the plan relates to an estuary, the management of estuary health and any risks to the estuary arising from coastal hazards, and*
>
> *(f) the impacts from climate change on risks arising from coastal hazards and on estuary health, as appropriate, and*
>
> *(g) where the plan proposes the construction of coastal protection works (other than emergency 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).*

2.2 Background to CZMP

Preparation of this CZMP and supporting documents (as referred to below) was overseen by the Hastings LGA Coast & Estuaries Sub-Committee which has representatives from Council, Government agencies and community groups.

2.2.1 Coastal Hazard Study

The Lake Cathie Coastal Hazard Study was completed by SMEC in 2008 and was revised in 2010 to take into account the sea level rise planning benchmarks contained in the *NSW Sea Level Rise Policy Statement 2009.* While the current NSW Government has unendorsed the Sea Level Rise Policy (benchmarks), this is the best available information and all work has been undertaken on this basis.

2.2.2 Stage 1 Management Study

The *Stage 1 Lake Cathie Coastline Management Study* was completed by SMEC in 2009. As documented in Section 5 of the Study, various consultation activities (including meetings, presentations and a community survey) were undertaken to obtain information on: community values and views, experiences that illustrate how the coastline is used and valued, and the nature of threats to those values; and suggestions on potential management options. The *Stage 1 Management Study* provided a preliminary

assessment of 13 potential options and a 'Triple Bottom Line' ranking of these options (i.e. taking into account economic, social and environmental factors).

The *Stage 1 Management Study* was exhibited from 27 July 2009 to 7 October 2009 and a community open day was held on 13 August 2009. In addition, a public discussion forum was provided via web access on *PMHC Listening*. A total of 344 submissions were received, of which 227 were in a generic letter form. Key issues arising from consultation as part of the Study exhibition were documented in a Report to Council on 16 December 2009. With regard to coastal management options, there was:

- Support for Planned Retreat: *a number of submissions support planned retreat as the preferred management option. These submissions point to the impact of engineered protection works on beach amenity, object to the public purse funding protection of private coastal property and advocate retreat options as the only sensible long term solution to coastal erosion. It is considered that planned retreat is a valid long term management option that requires further consideration as proposed by this* [Council] *report.*
- Strong support for the Revetment, Groyne and Beach Nourishment Option: *based on the submissions the combination of revetment, groyne and beach nourishment options is the most favoured. Given the uncertainty of the impact that protection options may have on the Lake Cathie Estuary further study and modelling should be undertaken prior to confirming any combination of these works. Even with more detailed modelling it may not be possible to predict impacts particularly with any groyne(s) and therefore such an option would be likely to be undertaken on a trial basis with a temporary structure used to determine long term impacts. Protection options are a high cost with significant ongoing maintenance costs that are beyond the financial capacity of Council to fund. Accordingly it is proposed to investigate resident funding options as recently proposed by the State Government.*

At the meeting of 16 December 2009, Council adopted the *Stage 1 Management Study* and, following consideration of issues raised during public exhibition, resolved to prepare a *Stage 2 Coastline Management Study* to further examine the following options*:*

1. Planned Retreat
2. Beach Nourishment
3. 400 m Revetment for Illaroo Road
4. Groyne

The *Stage 1 Management Study* defined Planned Retreat as services relocation, development controls, voluntary purchase and property acquisition.

2.2.3 Stage 2 Management Study

The *Stage 2 Management Study* (SMEC 2012) provided a detailed assessment of the four management options including a number of beach nourishment volumes to provide different levels of beach amenity and a revetment in combination with beach nourishment.

The *Stage 2 Management Study* was exhibited from 2 April to 8 June 2012. Responses to 'frequently asked questions' and a fact sheet were updated during the course of the exhibition and made available on Council's Website, together with an online questionnaire. Details of the exhibition, the fact sheet and a copy of the questionnaire were mailed to all landowners in Lake Cathie. An information session was held on 10 May 2012, attended by 69 members of the community.

A total of 4652 submissions were received (1711 from outside the LGA), of which 4598 were proforma submissions, including Council's questionnaire. Key issues arising from consultation for the *Stage 2 Management Study* were documented in a Report to the

Hastings LGA Coast & Estuaries Sub-Committee on 16 July 2012, with the Committee's recommendation included in a report to Council on 25 July 2012. With regard to the preferred coastal management option, the submissions received were overwhelmingly in support of a revetment with beach nourishment. Council resolved to adopt this option on 25 July 2012 and this CZMP documents how this management option will be implemented.

There was little support in the submissions for funding of the coastal protections works by the affected residents. However a large portion of benefit is directly attributable to the affected residents. Residents will benefit from the protection works and receive increased property values following construction of the revetment. Therefore a component of funding could come from benefiting residents and not be confined to grants and ratepayers.

As noted in section 2.2.7 Social and Economic Analysis, the Balmoral Group undertook a *Cost-Benefit Analysis of Coastal Management Options for Lake Cathie* which provided a review of the cost benefit undertaken as part of the *Stage 2 Management Study.*

2.2.4 Social and Economic Analysis

In July 2015, the Balmoral Group were commissioned by the NSW Office of Environment and Heritage (OEH) to undertake a *Cost-Benefit Analysis of Coastal Management Options for Lake Cathie* (Lake Cathie CBA) and a *Socio-Economic Profile of Lake Cathie.* These reports were completed in December 2015. The Lake Cathie CBA provided a more robust analysis of cost benefit for coastal management options than that contained in the Stage 2 Management Study.

2.2.4.1 Cost-Benefit Analysis of Coastal Management Options

The *Lake Cathie CBA* included an assessment of the following five (5) coastal management options:

1. Status Quo (or 'Business as Usual') base case scenario
2. Planned retreat;
3. Beach nourishment;
4. Construction of a revetment; and
5. Construction of a groyne.

Variations to each scenario were considered and the following list details the final options assessed.

Option 1: Base Case or 'Business as Usual'

Option 2: Planned Retreat:

Option 2.1 Service relocation at year 20

Option 2.2 Opportunistic Property purchases

Option 2.3 Property acquisition at year 1 – full title

Option 2.4 Property acquisition at year 1 - easement

Option 3: Beach Nourishment:

Option 3.1 To 'move' hazard line seaward of Illaroo Road

Option 3.2 To 'hold' hazard line in current position

Option 4: Revetment:

Option 4.1 Revetment

Option 4.2 Revetment + beach nourishment (to mitigate storm impacts – based on sand availability)

Option 4.3 Revetment + beach nourishment to maintain beach amenity

Table 1 sets out the Benefit to Cost Ratio results from the Lake Cathie CBA.

Table 1 Benefit Cost Ratios by Option

Option	Benefit Cost Ratio 20 Years	Benefit Cost Ratio 50 Years
1 - Base Case; Business as Usual	0.00	0.00
2.1 - Planned Retreat: Service Relocation Yr 20	9.91	1.93
2.2 - Planned Retreat: Opportunistic Purchase	0.17	0.07
2.3 - Planned Retreat: Acquisition Yr 1	0.09	0.03
2.4 - Planned Retreat: Easement Acquisition Yr 1	0.25	0.08
3.1 - Beach Nourishment: Move PRP	0.50	3.24
3.2 - Beach Nourishment: Hold PRP	0.86	5.32
4.1 - Revetment	0.45	3.45
4.2 - Revetment: Mitigate Recession	0.36	2.60
4.3 - Revetment: Maintain Amenity	0.48	2.65

The Lake Cathie CBA report concluded that:

> *'Over a 50-year period, the options expected to yield the greatest net social benefits for the community are the two beach nourishment options. However beach nourishment options entail a significant degree of risk and uncertainty due to the availability of sand and do not guarantee that assets will be protected or that losses will be prevented. The option of building a revetment was only marginally behind beach nourishment in terms of net social benefits. The four planned retreat options yielded either a very low net benefit, or net cost to the community.'*

2.2.4.2 Socio-Economic Profile

The *Socio-Economic Profile of Lake Cathie* report was completed by the Balmoral Group and included with the Lake Cathie CBA report.

The report found that Lake Cathie is similar to many rural coastal communities. A relatively high share of Lake Cathie residents are in older age groups, with 27% of the population over the age of 60. Participation in the labour force is moderate at about 56% among people 15 years of age and older.

Industry in Lake Cathie is diversified, and shows little reliance on coastal amenities. Individual and household incomes compare favourably to Port Macquarie-Hastings (similar or slightly better), but are surpassed throughout NSW as a whole.

2.2.5 Geotechnical Investigation - Indurated Sands

In January 2014 Regional Geotechnical Solutions completed a geotechnical assessment of the *Lake Cathie Indurated Sands*. The report was completed to assess the geotechnical characteristics of the indurated sand profile to assist in future coastal recession studies.

The investigation revealed subsoil conditions comprising Aeolian sand deposits that include a broad zone of indurated sands that have formed in-situ, overlying and sometimes incorporating marine sand and gravel deposits that in turn overlay residual clays or weathered dolerite. The degree of cementing (and also the strength) within the indurated sand lenses was found to be highly variable (point load index strength test results ranging from extremely low to medium). The results of weathering tests indicated that the indurated sand material broke down rapidly upon simulated weathering.

2.2.6 Lake Cathie Hazard Study Review

In January 2014, Cardno were commissioned by Council to undertake a review of the Lake Cathie Hazard Study. The *Lake Cathie Hazard Study Review (Hazard Review)* was completed in September 2014 and included a review of;

- the geotechnical investigation results (see above),
- a conceptual sediment transport model of the subject coastline, and
- photogrammetric analysis of the exposed coffee rock.

The objective of the review was to assess the suitability of the current erosion hazard projections and subsequent hazard lines adopted by Council

The conceptual sediment transport model was produced to formalise current understanding of system processes and dynamics, identify linkages of processes across discipline boundaries, and identify the bounds and scope of the system. The model found that Lake Cathie Beach is impacted by three main sediment transport processes:

- **Longshore sediment transport** affects Like Lake Cathie Beach like most drift-aligned open coast beaches in northern NSW. The predominant driver of longshore transport is waves arriving obliquely to the coast. These waves move sand alongshore outside the surf zone. The resulting estimate of potential longshore sediment transport is a net northwards drift in the range of 40,000 to 75,000 m^3 per year. When the entrance is open the open entrance, longshore sediment transport results in entrance infilling. This means that the region to the immediate north of the entrance is partially denied a sediment source whilst the entrance is open.

- **Cross-shore sediment transport** in the form of storm induced beach erosion generally occurs during periods of elevated waves and water levels. During these periods beach sands are mobilised by waves and swash and transported seaward. Whilst a small quantity of this sand may be lost to various offshore sinks, the majority of it is re-worked back onshore gradually in the weeks and months following the storm event. This process is highly visible and demonstrates the dynamic nature of the beach. The open entrance condition is unlikely to have a significant impact upon cross-shore sediment transport outside of its immediate vicinity.

- **Aeolian transport** is potentially another significant process. Onshore winds can blow sand inland off the beach so it cannot be reached by wave action. The results indicate that the predominant wind directions are southwesterlies and north-easterlies, and that onshore winds from the south-east are not a significant component of the local wind climate. This indicates that aeolian sediment transport from onshore winds may not necessarily form a significant component of the overall sediment transport dynamics at the study area.

The photogrammetric analysis included a re-analysis of the previously calculated (SMEC) storm bite and long term shoreline recession, as well as an assessment of the historical movement of the leading (seaward) edge of the coffee rock escarpment.

The Hazard Review concluded that:

1. The results of the geotechnical report indicate that the indurated sand layers are generally of low strength and susceptible to weathering and erosion. Additionally, the indurated sand lenses are limited in their spatial extent and founded at a relatively high level within the dunal system. Consequently, the report authors believe that there is insufficient justification for a reconsideration of the SMEC (2008 and 2010) hazard lines on the basis of this new geotechnical information.

2. The long term shoreline recession rate adopted by SMEC shows good agreement with the independent analyses, and implicitly includes any resistance provided by the indurated sands. Consequently, the report does not suggest the 0.2 m/year shoreline recession adopted by SMEC to be unnecessarily or unrealistically conservative.
3. The report's estimated historical mean translation rate for the indurated sand layer at the study site is 0.18 m/year; similar to the 0.2 m/year shoreline recession rate adopted by SMEC (2008 and 2010).
4. Whilst the adoption of the Nielsen et al (1992) method for determination of historical storm bite is most likely conservative to some degree, it is not unreasonably so. Given the established low strength of the indurated sands and the absence of other applicable tools it is appropriate for this application.
5. Based on the analyses conducted, there is insufficient justification to re-calculate hazard projections and reproduce hazard mapping for the present day, 2050 and 2100 scenarios.

2.2.7 Stormwater Diversion Analysis

In 2015 Port Macquarie-Hastings Council undertook an analysis of the stormwater system along Chepana Street and Illaroo Road to determine the feasibility of redirecting the existing stormwater that currently discharges to Lake Cathie Beach. The purpose of removing the beach stormwater outlets is to prevent localised erosion of the beach at each outlet.

In order to remove the stormwater outlets, the stormwater system would need to be split into two (2) catchments. The Chepana Street catchment would need to be redirected west to Lake Cathie. The stormwater system in Illaroo Road would need to be redirected north to the Lake Cathie entrance.

The two (2) existing outlets at Middle Rock Road (southern end of Chepana Street) cannot be effectively redirected.

The following is a summary of the analysis of the two (2) catchments:

Catchment 1 - Illaroo Road Stormwater Re-Alignment
The analysis showed that the stormwater could be diverted with the removal of two (2) existing beach stormwater outlets, the installation of approximately 330m of new underground pipe and one (1) new outlet. The estimated cost is $270,000.

The proposed Illaroo Road revetment wall has been designed to incorporate the two existing stormwater outlets. The revetment wall will control stormwater and prevent erosion due to stormwater. Provided the revetment is constructed in the short term the re-alignment of stormwater within catchment 1 would have limited benefit. However, on the basis that funding of the revetment has not been confirmed it is proposed that the Illaroo Road Stormwater Re-Alignment be included as a contingency action in the plan pending confirmation of the timing of the construction of the revetment.

Catchment 2 - Chepana Street Stormwater Re-Alignment
The analysis of catchment 2 considered the removal of five (5) beach stormwater outlets and the installation of approximately 970m of new underground pipe and one (1) new outlet. The realignment would require deep excavation through Ocean Drive (up to 5m) which would prove difficult for construction and disruptive to traffic.

In addition, the realignment would direct a significant stormwater catchment (Chepana Street) into the creek near the Lake Cathie Community Hall. The existing creek catchment (at the stormwater outlet point) is approximately 20ha and the proposed Chepana Street

catchment is approximately 11ha (total 31ha). This increase in catchment has the potential to increase flooding, erosion, and environmental issues in the creek. An allowance has been included in the cost estimate for a flood/environmental study and flood/erosion mitigation works should this realignment proceed. The estimated cost for the realignment of catchment 2 is $1,500,000.

The proposed underground pit and pipe system would only cater for events up to the 5 year storm. Any storm events in excess of this will continue to flow overland via streets to the existing outlet locations on the coast (i.e. major storm events cannot be re-directed to the west). Due to the high cost and inability to cater for major storm events it is not proposed to include Chepana Street Stormwater Re-Alignment as an action in the plan. However the realignment should be included for reassessment when undertaking a future review of this CZMP.

2.3 Coastal Management Principles, Goals and Objectives

The 2010 *Guidelines for Preparing Coastal Zone Management Plans* (referred to hereafter as the *Guideline*) set out ten principles for preparing CZMPs. The first principle is to consider the objectives of the *Coastal Protection Act 1979* and the goals, objectives and principles of the *NSW Coastal Policy 1997* and the *NSW Sea Level Rise Policy Statement 2009*. As noted in **Section 2.2.1** the *NSW Sea Level Rise Policy* is no longer NSW Government Policy. Section 3 of the *Coastal Protection Act 1979* sets out objectives which are to provide for the protection of the coastal environment of the State for the benefit of both present and future generations. The overriding vision of the 1997 *NSW Coastal Policy* is the ecologically sustainability of the NSW Coast. This Policy has nine goals.

Table 2 lists the goals, objectives and principles contained in the above legislation, policy and guideline and indicates how these have been considered in the preparation of the Lake Cathie CZMP. Many of the principles, goals and objectives are similar and have been grouped against the *Guideline* principles in **Table 2**.

The objective of the former NSW Government's *Sea Level Rise Policy Statement 2009* is to see coastal communities adapt to rising sea levels in a manner that minimises the resulting social disruption, economic costs and environmental impacts. As noted earlier, the sea level rise benchmarks contained in this Policy were adopted in the *Hazard Study* and, accordingly, were taken into account in assessing risks associated with coastal hazards.

2.4 Lake Cathie CZMP Goals

Consistent with Council's Community Strategic Plan, the goals of the Lake Cathie CZMP are as follows. Actions to achieve these goals are presented in **Appendix A**

- Protect and restore natural areas through stormwater and foreshore management.
- Provide community access and opportunities to enjoy our natural environment through reserve improvements, continuing public access and beach nourishment.
- Plan and take action to minimise the impact of natural events and climate change through further investigations, contingency measures and construction of a revetment to protect private development and Illaroo Road.
- Manage development outcomes to minimise the impact on the natural environment through development controls.

Table 2 Coastal Management Principles, Goals and Objectives in CZMP Preparation

Guidelines for Preparing CZMPs Principles	Coastal Protection Act Objectives	NSW Coastal Policy Goals	How Principles, Goals and Objectives have been considered
1. Consider the objectives of the *Coastal Protection Act 1979* and the goals, objectives and principles of the *NSW Coastal Policy 1997* and the *NSW Sea Level Rise Policy Statement 2009. Note: NSW Sea Level Rise Policy is no longer State Government Policy.*	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.	Providing for ecologically sustainable development and use of resources.	Any sand dredged/ excavated from the Lake Cathie entrance would be placed on the beach adjacent to Illaroo Road, see Action 4.1 **Appendix A**.
	To recognise and foster the significant social and economic benefits to the State that result from a sustainable coastal environment, including: - benefits to the environment, and - benefits to urban communities, fisheries, industry and recreation, and - benefits to culture and heritage, and - benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water.	Providing for ecologically sustainable human settlement in the coastal zone. Protecting and enhancing the aesthetic qualities of the coastal zone.	Construction of a revetment along Illaroo Road would maintain pedestrian and vehicle access along the road and protect private property along Illaroo Road. Beach nourishment is proposed to mitigate the adverse impacts of the revetment on coastal processes, visual amenity and beach amenity, and hence recreation **Section 5.2.1**.
	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.	-	n/a
	-	Protecting and conserving the cultural heritage of the coastal zone.	Legislation relating to the protection of sites and places of significance applies to the CZMP actions.
2. Optimise links between plans relating to	To ensure co-ordination of the policies and	Providing for integrated planning and	Actions to be implemented through other plans and

Guidelines for Preparing CZMPs Principles	Coastal Protection Act Objectives	NSW Coastal Policy Goals	How Principles, Goals and Objectives have been considered
the management of the coastal zone.	activities of the Government and public authorities relating to the coastal region and to facilitate the proper integration of their management activities.	management of the coastal zone	programs are indicated in **Appendix A**
3. Involve the community in decision-making and make coastal information publicly available.	To recognise the role of the community, as a partner with government, in resolving issues relating to the protection of the coastal environment	Providing information to enable effective management of the coastal zone.	Information provided and consultation activities carried out to assist in development of the CZMP were summarised in **Sections 2.2.2** and **2.2.3**. The *Stage 1 and 2 of the Management Study* provides more details.
4. Base decisions on the best available information and reasonable practice; acknowledge the interrelationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach.	-	Recognising and accommodating the natural processes of the coastal zone.	The *Hazard Study* and *Management Studies* provide information on coastal processes. The *Hazard Study* and *Management Studies* document the data, guidelines and other information that was used to assess coastal hazards and management options to address these hazards. Appendix A includes actions to undertake further investigations to increase knowledge on coastal processes affecting Lake Cathie Beach and to refine the assessment of coastal hazards. Beach nourishment is proposed to mitigate the impacts of the revetment on coastal processes.
5. The priority for public expenditure is public benefit; public expenditure should cost-effectively achieve the best practical long-term outcomes.	-	-	**Section 5.3** outlines funding options including contributions from benefitting landowners.

Guidelines for Preparing CZMPs Principles	Coastal Protection Act Objectives	NSW Coastal Policy Goals	Comment
6. Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risks where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented.	-	-	The Emergency Action Plan (EAP), , identifies actions to manage risks to public safety in the event of a coastal erosion emergency. **Appendix A** lists interim development controls and contingency measures to manage risks prior to construction of a revetment.
7. Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions.	To encourage and promote plans and strategies for adaptation in response to coastal climate change impacts, including projected sea level rise.	-	Sea level rise benchmarks were adopted in the *Hazard Study*. The type of revetment proposed (sloping rock rubble structure) could be extended or raised if required in the future to address risks from rising sea levels or coastal erosion risks to the south of the structure. Beach nourishment forms part of the adopted option and has the flexibility to be undertaken when and where needed.
8. Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems.	To protect, enhance, maintain and restore the environment of the coastal region, its associated ecosystems, ecological processes and biological diversity, and its water quality.	Protecting, rehabilitating and improving the natural environment of the coastal zone.	Stormwater management and foreshore management actions have been included as part of the CZMP, see **Appendix A**
9. Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy.	To promote public pedestrian access to the coastal region and recognise the public's right to access	Providing for appropriate public access and use.	The revetment design would include provision for public access.
10. Support recreational activities consistent with the goals of the NSW Coastal Policy.	To promote beach amenity	as above	Beach nourishment is proposed, see **Section 5.2.1**, with the aim of maintaining beach amenity and hence associated appropriate recreational uses.

3 COASTAL VALUES, USES AND ACCESS

A summary of coastal values and uses associated with the Lake Cathie area, as identified in the *Stage 1 and Stage 2 Management Studies*, follows. The significance of some values has been recognised through inclusion in natural and cultural heritage listings under environmental legislation and/ or mapping under environmental planning instruments. Public access for community uses is also summarised below.

3.1 Coastal Values

Listed ecological communities: *Littoral Rainforest* around Middle Rock; *Coastal Saltmarsh* which covers much of the area surrounding the lake waterbody, as well as the margins of Cathie Creek; *Swamp Sclerophyll Forest* on low-lying areas upstream of the Ocean Drive Bridge; and *Swamp Oak Floodplain Forest* around the perimeters of Lake Cathie. The estuary is also a mapped *Coastal Wetland*.

Habitat: Diversity of habitats for shore and water birds (open water, sand shoals, shallow mud flats and exposed sand/ mud flats) including threatened and protected migratory species such as the Little Tern and Pied Oystercatcher. Seagrass meadows and aquatic habitat for species of recreational and commercial value, e.g. crustaceans including school prawns, blue swimmer crabs and mud crabs and a wide variety of estuarine fish such as sea mullet, whiting, flathead and bream (BMT WBM 2011).

Visual amenity: Lake Cathie is framed by a backdrop of forested hills, the tranquil waters of the lake, beach dunes including coffee rock platforms, and natural landscapes on both the northern and southern sides of the village.

Aboriginal cultural heritage: In the vicinity of Lake Cathie, 23 Aboriginal sites or places having been recorded including a scarred tree, middens, open camp sites and isolated finds. Lake Cathie is part of the Birpai Nation. Aboriginal families have been involved in commercial fishing at Lake Cathie since 1920 (Umwelt 2004).

Community values: The main attributes of the Lake Cathie area were identified as the natural environment and lifestyle. The natural environmental values as seen by the community included the ocean, beach, estuary and lake, the littoral rainforest, climate, the beauty of the area and the view of the ocean. Lifestyle attributes were identified as the relaxed coastal environment, the quietness, the ambience, its peacefulness, living close to the water, the community, the village atmosphere, a place to raise kids and the recreational opportunities.

3.2 Community Uses

Community uses of the coastal zone include:

- Swimming and surfing - family orientated swimming and wading downstream of the Ocean Drive Bridge which is the most intensively used area of the lake. Swimming at the beach and surfing. Middle Rock provides reasonable waves during east and south east swells (Short 2007).
- Walking along the beach and foreshore reserves as well as bushwalking in the vicinity of Lake Cathie.
- Nature observation, including bird watching.
- Fishing – popular areas are at ‘the drain’ and either side of Ocean Drive Bridge. Prawning when the entrance is open, at which time good gutters form either side of the entrance for beach fishing (Short 2007).

- Boating upstream of the Ocean Drive Bridge - paddle craft and small power boats in deeper areas.
- Beach driving - permitted north of Dirah Street and south of Middle Rock subject to a Council permit (Short 2007).

3.3 Public Access

Picnic areas and carparks are located at Middle Rock Point, Johnathon Dixon Reserve, Foreshore Reserve (off Ocean Drive) and Aquatic Reserve on the southern side of the entrance.

Pedestrian access paths are located along the beach, with timber stairs at steeper points. Viewing platforms overlook the Lake Cathie entrance and the beach at Johnathon Dixon Reserve.

Four-wheel-drive access is provided just north of Dirah Street and at the end of Middle Rock Road.

A boat launching ramp is located at Jabiru Reserve on the north-western side of the Ocean Drive Bridge.

4 COASTAL HAZARDS AND RISKS

4.1 Coastal Hazards

The *Coastal Hazard Study* identified the principal hazards affecting the beach at Lake Cathie. A summary of these hazards is provided below.

Short-term Coastal Erosion, primarily due to:

- Severe storms, when a large volume of sand is transported offshore by waves and currents. Wave transformation modelling indicated a nearshore significant wave height of 1.5 to 1.9 m at Lighthouse/ Lake Cathie Beach for a 100 year Average Recurrence Interval (ARI) storm wave event from the south-east, i.e. a major storm event likely to cause coastal erosion.
- Slope instability due to slumping of the dune erosion escarpment. At Lake Cathie, the underlying strata consists of consolidated or *indurated* sands (coffee rock), which would be more resistant to slumping than typical unconsolidated beach sand.
- The behaviour of the Lake Cathie entrance, i.e. changes in the location of entrance breakouts. However, based on observations and examination of the photogrammetric data, it would appear that the lake entrance location has been confined to the area comprising the existing entrance berm.

Long Term Coastline Recession, primarily relating to:

- Sediment budget where the rate of sand loss exceeds the rate of sand supply to the area of coastline - A review of photogrammetric data found an average historical shoreline recession rate of between 0.1 and 0.3 m/year for Lake Cathie Beach. Sediment loss mechanisms may include:
  - alongshore losses (e.g. more sand moving out of the system to the north than is replaced from the south)
  - offshore losses (i.e. as noted above, under storm conditions sand is transported offshore and some may not be returned to the beach during calmer conditions)
  - movement of sand into the Lake Cathie entrance and reworking of some of this by flood tide currents so that it is transported beyond the entrance area
  - past sand mining activities and aeolian losses (e.g. sand transported inland by winds, following removal of vegetation for sand mining).
- Climate change, where a higher sea level may result in the foreshore of a natural beach being translated further inland, and result in an increased potential for beach erosion on a developed beach where the shoreline is held in a fixed position by a seawall. Climate change may also affect wave climate, e.g. changes in the direction, frequency and severity of ocean storms. Sea level rise and changed weather patterns would also affect coastal habitats.

Oceanic inundation due to wave overwash:

- Dune heights along the Lake Cathie foreshore are well above the estimated maximum wave run-up level at Lake Cathie, hence wave overtopping and coastal inundation are not an issue for development on the open coast. However, wave overwash of the beach berm at the lake entrance would be a frequent event.

4.2 Risk Assessment

The following parameters were adopted in the *Hazard Study* for the risk assessment:

- A design storm erosion demand (or storm bite) of 130 m^3/m run of beach. This is less than the 200 to 250 m^3/m storm bites which have been measured and are usually adopted for NSW open coast beaches, due to the assumption that the coffee rock outcrops visible along the beach would provide some resistance to erosion.
- An average rate of sand loss of 0.2 m/year or 1.5 m^3/m run of beach per year (taking into account that some of the historical recession may be due to past sea level rise).
- The 2009 NSW Government's former sea level rise planning benchmarks of 0.4 m (from 1990 to 2050) and 0.9 m (from 1990 to 2100), relative to 1990 mean sea level. This equates to the adopted shoreline recession distances due to sea level rise shown in **Table 3** and average recession rates of 3.0 m^3/m run of beach per year to 2050, increasing to 3.5 m^3/m run of beach per year by 2100.

The distances in **Table 3** are based on the assumption that the shoreline is comprised of erodible material. Mapping of coastal quaternary geology by the Department of Primary Industries (2008) indicates that development at Lake Cathie is located on unconsolidated marine sands and indurated sands (coffee rock) with the only bedrock to the south of the village, outcropping at Middle Rock.

Table 3 Long Term Shoreline Recession due to Sediment Loss and Sea Level Rise

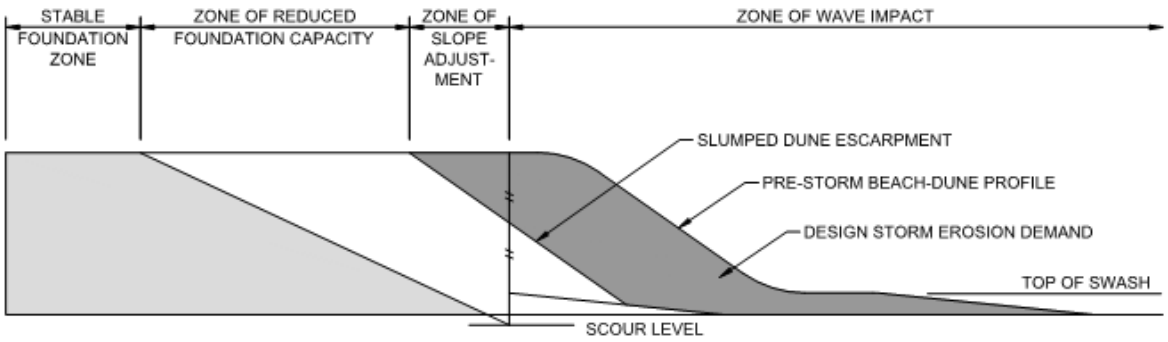
	2050	2100
Long-term recession due to sediment loss	9 m	19 m
Long-term recession due to sea level rise	17 m	42 m
Total	**26 m**	**61 m**

As shown in **Table 3**, the Lake Cathie Beach is subject to recession regardless of the postulated increase in sea level. Accordingly, the risks associated with this hazard need to be considered irrespective of shoreline recession due to sea level rise.

The parameters discussed above were used to produce the:

- Present day (immediate) hazard line, i.e. position of back beach escarpment (after this has slumped to a stable angle of repose) following erosion of 130 m^3/m of sand from the beach.
- 2050 and 2100 hazard lines taking into account long-term recession (due to sand loss and sea level rise) and storm demand.

The limit of the Zone of Reduced Foundation Capacity (ZRFC) was estimated as being 13 to 14 m landward of the hazard lines, based on the schematic shown in **Figure 2**, which relates to an area of unconsolidated sands where building foundations may become unstable. The ZRFC varies in response to dune height and sand/ soil properties. In addition, the likely recovery of the beach following a major storm, or series of storm events, also needs to be considered. See **Appendix B** for the hazard maps.



After: Nielsen *et al* 1992

Figure 2 Hazard Zones

4.3 Coastline Management Issues

4.3.1 Community Issues

The main issues (in order of importance) at Lake Cathie, identified in the *Stage 1 Management Study* through a residents' survey, were:

- erosion and erosion control (overwhelmingly the main issue)
- safe beach access
- maintaining recreational amenity
- soil/ sand stability at stormwater outlets
- property values
- increased tourism
- revegetation/ weeds

4.3.2 Built Assets at Risk

The following assets have been identified from the hazard maps as being at risk for the planning periods indicated in **Table 4**. This includes assets at risk due to wave impact and/ or coastal erosion during a major ocean storm event and, as indicated, assets that may be at risk due to reduced bearing capacity for foundations in the ZRFC.

Table 4 Assets at Risk over Various Planning Periods due to a Major Storm Event

Immediate Risk	2050	2100
Illaroo Road Due to the above, vehicle access and services to 14 dwellings is at risk Along Illaroo Road, 17 dwellings (including the eastern most lot in Bundella Avenue) may be at risk of structural damage due to reduced foundation capacity	17 dwellings along Illaroo Road and services to these dwellings An additional dwelling on Bundella Avenue may be at risk of structural damage due to reduced foundation capacity	Around Illaroo Road including the eastern end of Bundella Avenue, an additional 15 dwellings may be at risk Along the northern part of Chepana Street, around 40 dwellings may be at risk The remainder of dwellings along Chepana Street may be at risk of structural damage due to reduced foundation capacity

5 COASTLINE MANAGEMENT ISSUES AND RECOMMENDATIONS

5.1 Built Assets at Highest Risk

As noted in **Section 2.2.3**, on the 25 July 2012, following consideration of submissions on the *Stage 2 Management Study*, Council adopted a revetment and beach nourishment as the management option for Illaroo Road (the area at highest risk from coastal hazards). Interim development controls (see **Section 5.2.4.3**), pending construction of a revetment were also adopted.

On 20 April 2016 Council considered revisions in response to a review by the Minister for the Environment and adopted this CZMP.

5.2 Key Measures to Mitigate Coastal Hazards/Risks

The *Guidelines* state that CZMPs are to achieve a reasonable balance between any potentially conflicting uses of the coastal zone. The following measures are intended to provide a balance between mitigating hazards and conflicts/ impacts on coastal values, uses and access.

5.2.1 Beach Nourishment

If sufficient nourishment sand volumes were available they may assist in addressing loss of the beach in front of the revetment and end effects. The Lake Cathie CBA noted that 'beach nourishment options entail a significant risk and uncertainty due to the availability of sand and does not guarantee that assets will be protected or that losses will be prevented'.

It was estimated that 46,000 m^3 of sand would be required initially and, on average, every 10 years to account for future losses due to sediment loss and sea level rise, based on the parameters adopted in the *Hazard Study*.

It is proposed that Council will continue to undertake periodic dredging of Lake Cathie Lagoon and to place dredged/excavated sand from the Lake Cathie entrance on the beach adjacent to Illaroo Road. As an indication of the volume of sand that may be available in the Lake Cathie entrance, approximately 25,000 m^3 was removed in 2005 and ongoing in 2014. GHD (2004) estimated that dredging the entrance would be required every 5 to 10 years. However, at times, this volume of marine sand may not be available from the entrance due to recent dredging and entrance breakouts. For example, WMA (1994b) estimated that the average volume of sand scoured from the entrance during a breakout was approximately 18,000 m^3. More recently modelling by BMT WBM (2011) predicted the cumulative volume of sand scoured from the entrance at the end of the fourth day following breakout. For initial lake water levels of 1.4 m AHD, 1.6 m AHD and 1.8 m AHD, the estimated volumes were approximately 30,500 m^3, 37,500 m^3 and 46,000 m^3 respectively. It is unlikely that larger volumes of sand would be available for beach nourishment due to the volumes scoured from the entrance during breakouts and environmental factors associated with dredge depths and extents. Dredging would also be constrained by financial factors.

Beach nourishment using only sand removed from the Lake Cathie entrance (seaward of the bridge) does not introduce an additional volume of sand, as this sand is part of the active beach system. As noted by (WMA, 1994a), closure of the lake is preceded by the build-up of marine sand in the entrance which progressively restricts tidal flow. The berm then progressively builds under wave action.

If the beach was in an eroded state and nourishment was not possible prior to a major storm event, the foreshore would be subject to the impacts described above. In addition, the longevity of beach nourishment is dependent on weather conditions with sand being transported offshore and alongshore by waves and currents. The cost of importing nourishment sand to mitigate storm erosion impacts and recession due to net sediment loss and sea level rise over the 50 year planning period is likely to be cost prohibitive.

5.2.2 Revetment Construction

Detailed design of the rock revetment was completed by Aurecon in June 2015. The design includes a 440m long rock revetment, pedestrian footpath along the top of the wall, vehicle/pedestrian access to the beach, and landscaping. The design also considered 'end effects' and stormwater outlets. A *Construction Environmental Management Plan (CEMP)* and an *Operational Environmental Management Plan (OEMP)* have also been prepared.

The detailed cost estimate for construction of the revetment wall is $8.1 million.

5.2.2.1 Potential Conflicts/ Impacts

The following information is from the *Stage 2 Management Study* and identifies potential conflicts with/ impacts on coastal values, uses and access associated with construction of a revetment.

Whilst revetments perform well in arresting the continued recession of the foreshore and storm erosion, they often exacerbate erosion of the area immediately seaward of the structure and have 'end effects' (i.e. increased erosion at the transition between the hard structure and erodible foreshore). Given the erosive (and receding) environment at Lake Cathie, construction of a revetment is likely to result in the development, over time, of an artificial headland which would adversely impact the visual appearance and amenity of the beach. Development of an artificial headland would occur as erodible material is removed from in front of, and at the ends of, the revetment. This would also create stability issues and, as recession of the foreshore occurs, the revetment is likely to be outflanked at some point in the future. The outflanking mechanism is likely to require a future extension of the revetment to protect infrastructure to the south, such as the public carpark at Johnathon Dixon Reserve. The Lake Cathie entrance would also be affected by end effects, accelerating loss of the beach berm. These impacts would be exacerbated by sea level rise.

Public access may be compromised by construction of a revetment and the beach may be lost adjacent to the revetment. Figure 3 shows an indicative alignment for the revetment and the existing beach access points affected. Recreational use (swimming, surfing and beach fishing etc.) would be impacted due to changes in sand distribution. For example, over time, there may be no beach seaward of the revetment and the character of the entrance area may also change. Impacts on recreational use may have flow on effects to tourism income.

Construction of a revetment would replace the vegetated dune slope and an essentially sandy habitat with a rocky habitat at Illaroo Road. It may also replace an intertidal habitat with a sub-tidal habitat. End effects could result in loss of dune vegetation to the south and scouring of the entrance berm. This may encourage the entrance to break out to the south and may result in the entrance being mostly open (rather than intermittently closed and open). This would increase salinity and tidal influences and may affect the life cycles of crustaceans and fish. Loss of the beach and changes to the entrance may also affect shore and wading bird habitats.

Figure 3 Existing Access and Indicative Revetment Alignment

5.2.2.2 Timing for Revetment Construction

The following revetment construction timing options were considered.

Option 1: construction as soon as funding is available (assumes funding becomes available prior to any major storm erosion event). This is Council's preferred option. Alternative triggers are outlined below.

Option 2: construction when a significant erosion escarpment forms (taken to be if the escarpment begins receding landward, approaching the Illaroo Road carriageway); and/ or significant undercutting of the coffee rock occurs and the collapse of some sections of coffee rock is possible.

Option 3**:** construction when the erosion escarpment/ undercutting of coffee rock threatens the stability of the Illaroo Road carriageway.

Various advantages and disadvantages are associated with each option. In general, the further landward the revetment is constructed, the more likely it would be to remain partially buried (at least in the short-term) by beach nourishment sand and only be fully exposed during storm events.

Less excavation for the revetment would be required if construction was delayed until the coffee rock was undermined and had collapsed/ eroded further inland. Delaying construction would also allow for shoreline monitoring to provide better estimates of storm demand and sand loss, and to consider future updates on estimates of climate change induced sea level rise.

However, delaying construction of protection works is likely to result in higher construction costs and would mean interim development controls for properties fronting Illaroo Road would be in place for a longer period of time.

5.2.2.3 Content of Operational Environmental Management Plan

An Operational Environmental Management Plan (OEMP) was completed by Aurecon in June 2015 and deals with ongoing impacts and maintenance activities required as a result of the construction of a revetment.

The OEMP addresses Section 55C(1)(g) of the *Coastal Protection Act 1979* (see **Section 2.1**) and cover matters such as:

- Regular inspections to assess the impacts of the revetment on the beach, including end effects.
- Measures to be taken to address adverse impacts on beach access, beach amenity, foreshore reserves and public safety.
- Inspections after major storm events to:
  - assess the impact of storm erosion on beach access, beach amenity, foreshore reserves and public safety and identify required maintenance works
  - assess any structural damage to the revetment as a result of wave impact and identify any required maintenance works.

The type of maintenance works and frequency of maintenance are dependent on the frequency and severity of ocean storms experienced. It is estimated that, on average, maintenance of the revetment would be required every five (5) years and beach nourishment would be required every ten years.

5.2.3 Short Term Beach Management

PMHC recognises the need to manage the Lake Cathie beach as a whole beach compartment and will continue to undertake necessary works to manage existing beach areas to provide a safe environment for the wider community.

PMHC will continue to implement actions detailed in **Appendix A - Implementation Plan**, however until funding is available to construct the revetment wall, PMHC will manage the beach as follows:

- Monitor the beach for erosion hazards following storm events. Refer to the *Lake Cathie Coastal Zone Management Plan - Emergency Management Plan* (2013) for more details.
- Continue to implement Interim Controls, pending Construction of the Revetment, adopted by Council at the meeting on 25 July 2012. Refer section 5.8.3.
- Continue to undertake periodic dredging of Lake Cathie and to place dredged/excavated sand from the Lake Cathie entrance on the beach adjacent to Illaroo Road. Refer to **Appendix A - Implementation Plan**
- Foreshore management as detailed in **Appendix A - Implementation Plan**
- Construction of Illaroo Road Stormwater Realignment as detailed in **Appendix A - Implementation Plan.**

5.2.3.1 Management Triggers and Response

Table 5 below details the explicit triggers and management strategies necessary for short term management of the beach.

Table 5 - Short Term Management Triggers and Management Strategies

Trigger	Response
Routine inspection of beach and dune.	▪ Visual inspection of beach area before and after storm events, noting any obvious damage, erosion issues. ▪ Undertake necessary repairs based on observations noted from the inspection.
Routine inspection identifies erosion to dune.	▪ Ensure dune is safe using plant and equipment if necessary. ▪ Install signage and barriers if necessary. ▪ Formal survey of beach profile and beach scarp.
Routine inspection identifies damage to vegetation.	▪ Install signage and barriers if necessary. ▪ Undertake re-vegetation works if necessary.
Inspections identify the presence of feral animal species inhabiting the dune vegetation.	▪ Consult with Port Macquarie Hastings Council Rangers to determine most appropriate action for animal.
Significant erosion begins receding landward, approaching the Illaroo Road carriageway.	▪ Undertake necessary repairs using plant and equipment if necessary. ▪ Install signage and barriers if necessary. ▪ Limit traffic access (eg. one way) if necessary.
Erosion undercutting of coffee rock threatens the stability of the Illaroo Road carriageway.	▪ Undertake necessary repairs using plant and equipment if necessary. ▪ Install signage and barriers if necessary. ▪ Limit traffic access (eg. one way) if necessary

Trigger	Response
Management strategies at the southern end near Chepana Street.	▪ Visual inspection of beach area before and after storm events, noting any obvious damage, erosion issues. ▪ Undertake necessary repairs based on observations noted from the inspection. ▪ Undertake necessary repairs using plant and equipment if necessary.

5.2.4 Development Controls

5.2.4.1 NSW Coastal Planning Guideline

The *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (DoP 2010) sets out strategies that could be employed to address coastal hazards including:

- configuring the development site layout to minimise exposure to coastal risks e.g. ensuring that buildings and infrastructure are placed in low risk areas on the site and provide open space and landscaping between buildings and areas of higher hazard risk
- constructing buildings or structures that are easily decommissioned, disassembled or relocatable either on-site or off-site as required
- providing for safe exit routes during storm events.

It should be noted that in some instances a site may be deemed unsuitable for further development, as illustrated in the guideline and reproduced in ***Figure 4*** and time and/ or 'trigger' limited development consent conditions could be applied to allow ongoing sustainable use of coastal areas until such time as coastal risks threaten life and property.

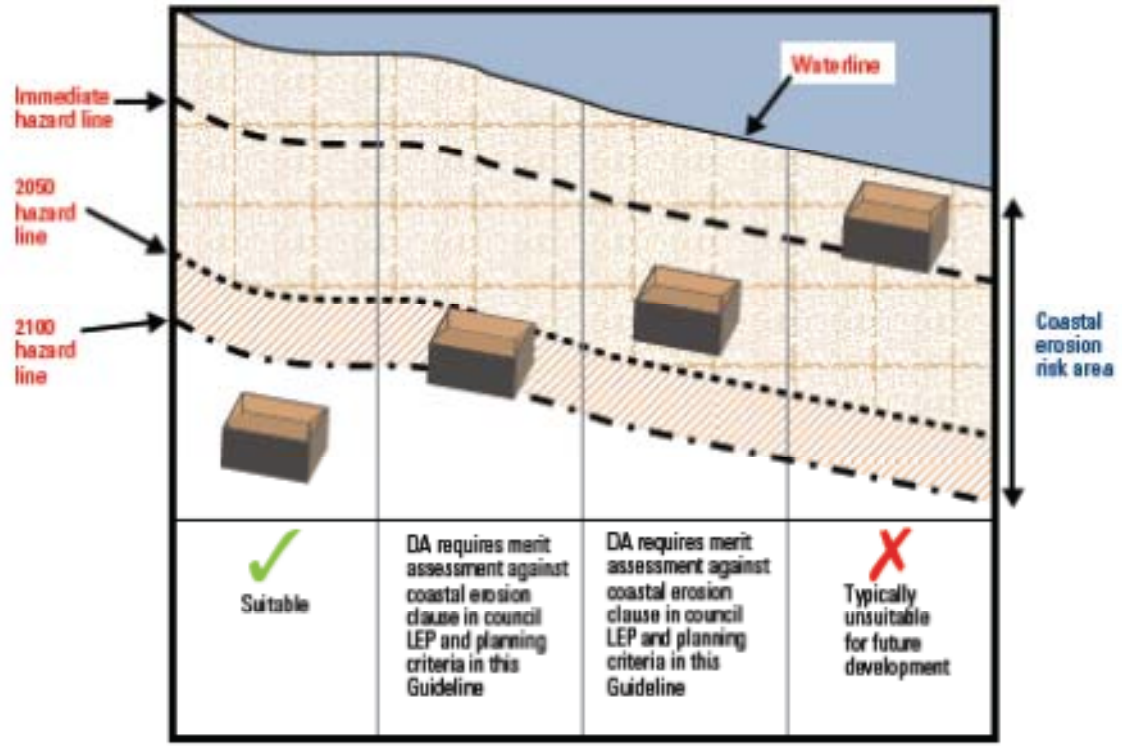


Figure 4 Coastal Hazard Planning Areas and DA Assessment

5.2.4.2 Port Macquarie-Hastings LEP and DCP

The Port Macquarie Hastings Local Environmental Plan (PMH LEP 2011) contains provisions for areas affected by coastal erosion.

PMH LEP 2011 Clause 7.6 (3):

Development consent must not be granted to development on land to which this clause applies [shown on the Coastal Erosion Map – see **Figure 5]** unless the consent authority has considered whether the development:

(a) will significantly adversely affect coastal hazards, and

(b) will result in significant detrimental increases in coastal risks to other development or properties, and

(c) will significantly alter coastal hazards to the detriment of the environment, and

(d) incorporates appropriate measures to manage risk to life from coastal risks, and

(e) avoids or minimises exposure to coastal hazards, and

(f) makes provision for relocation, modification or removal of the development to adapt to coastal hazards and sea level rise planning benchmarks for New South Wales.

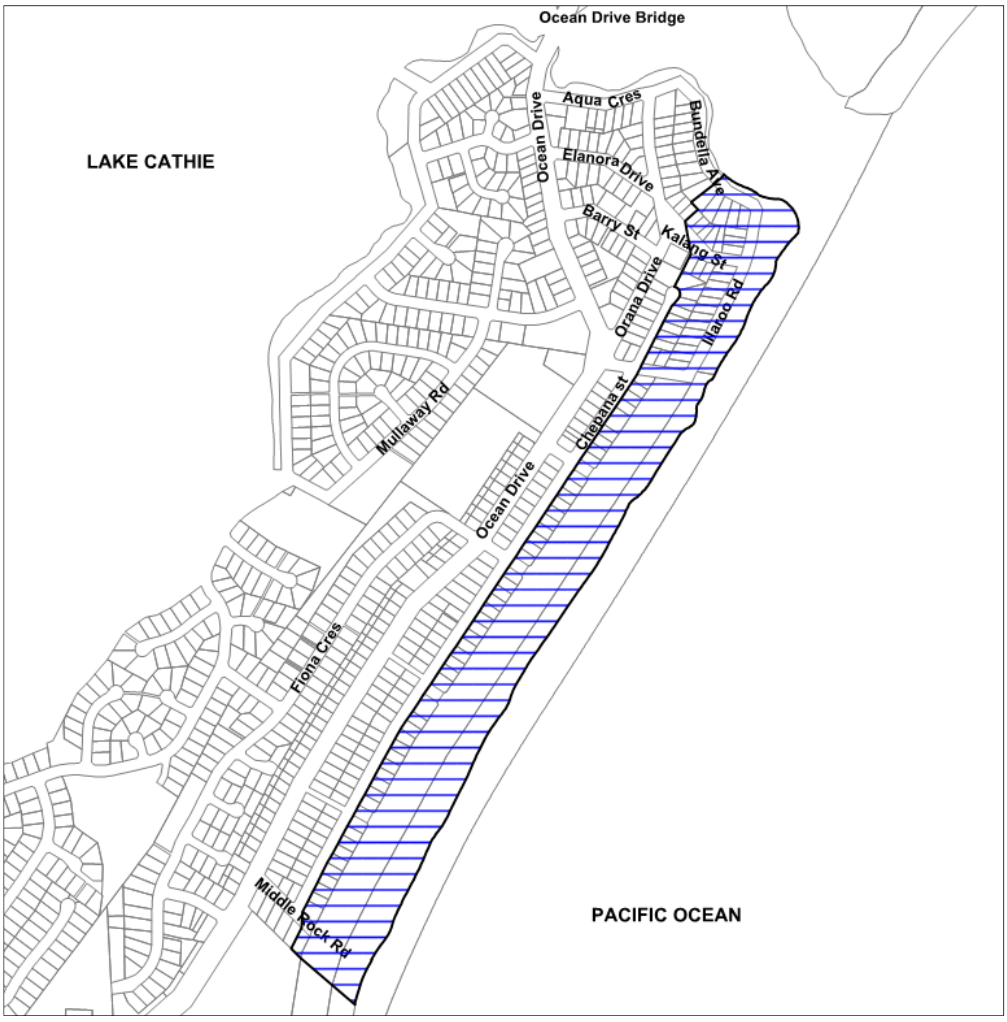


Figure 5 Coastal Erosion Map – Port Macquarie-Hastings LEP 2011

5.2.4.3 Interim Controls Pending Construction of the Revetment

At the meeting on 25 July 2012, Council resolved to:

Lift the current prohibition on development for properties forward (seaward) of the 2050 zone of slope adjustment and apply the following interim controls for this area pending the adoption of the Lake Cathie Coastline Management Plan and construction of the revetment.

> *a) Additions to existing dwellings (excluding detached garages and outbuildings) be limited to a maximum 10% increase in floor area.*
>
> *b) Any redevelopment or reconstruction above 10% being undertaken as relocatable structures.*
>
> *c) New detached garages and outbuildings being relocatable structures.*
>
> *d) No subdivision including strata subdivision.*

Apply the following interim controls for properties behind the (landward) 2050 zone of slope adjustment and forward of the 2050 zone of reduced foundation capacity.

> *a) Additions to existing dwellings (excluding detached garages and outbuildings) be limited to a maximum 10% increase in floor area or provide for foundation footings to extend into the stable foundation zone.*
>
> *b) All new buildings (that are not relocatable) be subject to a requirement for foundation footings to extend into the stable foundation zone.*

Suggested development controls for a relocatable building are as follows:

- designed and constructed so that it can be easily removed from the site by road vehicle.
- the plans and specifications for the building must include an adequate description of the removal process.
- a certificate is to be provided from a structural engineer as to the adequacy of the building to be easily dismantled and readily removed.
- approval will be granted on the understanding that any consent will be subject to the proviso that should the erosion escarpment come within close proximity (distance to be determined) of any building then the development consent will cease and relocation will be required.
- no works are to be carried out on the property which might hinder the easy relocation of the building. Such works might include the construction of walls, fences, screens, enclosures, brick veneering, landscaping etc.

PMHC has developed a guideline for residents and developers that further explains these controls.

5.2.4.4 Section 149 Notification

Planning certificates are issued under Section 149 of the *EP&A Act 1979* and contain notifications on matters which Council is aware of as affecting an allotment. Schedule 4 of the *EP&A Regulation 2000* sets out matters to be included in Planning Certificates. This includes whether or not the land is affected by a policy that restricts the development of the land.

Legislative amendments under the *Coastal Protection Amendment Act 2012* remove the requirement for councils to include information on the category of coastal hazard risk on Section 149(2) certificates (e.g. whether an allotment is affected by the immediate, 2050 or 2100 hazard line).

Council will include notations relating to coastal risks in accordance with legislative requirements and its Duty of Care to disclose information on critical hazards to land owners and prospective purchasers.

5.3 Funding

Funding for implementation of the CZMP will generally be sought from the NSW State Government's Coastal Management Program. However funding under the Coastal Management Program alone will not be sufficient for the construction of a revetment. Council will investigate various funding models and will undertake engagement with prospective funding partners with a view to seeking relevant agreements to meet financial obligations for initial capital works and ongoing maintenance. The construction of the revetment will not be able to be programmed into Council's Integrated Planning and Reporting framework until satisfactory funding arrangements have been identified.

Based on detailed design cost estimate, by Aurecon in 2015, (Lake Cathie Revetment Investigation and Design, Detailed Design Report), the capital cost of the revetment is $8.1 million. However, final costs would be subject to actual tendered costs that include variables such as the availability of suitable local quarry rock at the time of construction and market forces at the time of tendering the construction work.

As indicated in Section 5.2.3 any sand dredged from the Lake Cathie ICOLL entrance would be placed along the Illaroo Road foreshore. Periodical dredging of the entrance is included in Council's 2007 *Dredging Strategy*. If grant funding for dredging works was unavailable or dredging requirements did not align with the need for beach nourishment, there would be additional maintenance costs associated with impacts such as the following, which are likely to increase in severity over time, due to shoreline recession:

- reduced beach width/ loss of the beach in front of the revetment
- accelerated erosion at Johnathon Dixon Reserve at the end of the revetment
- accelerated erosion of the entrance beach berm and associated impacts on the Lake Cathie ICOLL opening and closing regime

Various mechanisms exist under the *Local Government Act 1993* that enables Council to make special charges and levies on properties benefitting from coastal protection works. A revetment would protect the foreshore properties at risk along Illaroo Road and provide certainty to owners. Benefits to the 17 affected property owners would include:

- continued vehicle access to properties
- market values maintained due to removal of coastal hazard risk
- minimisation of development constraints associated with coastal hazards

Section 5.2.2.2 indicates three (3) triggers for construction. Each of these options would maintain public access along Illaroo Road. As noted in the *Draft guidelines for assessing the impacts of seawalls* (DECCW 2010b) if a revetment was located and designed such that public vehicle and/ or pedestrian access was maintained, some public benefit would result and hence private/ public cost-sharing could be considered.

Maintenance costs were included in the *Stage 2 Management Study* for the purposes of options comparison over a 50 year planning period. Maintenance of the revetment was assumed to be necessary on average every 5 years, with costs assumed to be 3.5% of the capital cost, i.e. approximately $103,000/5yr or $1,030,000 over 50 years. Maintenance costs were not reviewed in detail as part of the *Lake Cathie Revetment Investigation and Design, Detailed Design Report* and accordingly maintenance costs would need to be confirmed when construction costs are confirmed.

6 COASTAL ZONE MANAGEMENT PLAN

Coastal Zone Management measures are separated into Physical Works and Planning Controls and Policies.

6.1 Recommended Coastal Zone Works

The following Coastal Zone works are recommended for implementation as part of the Coastal Zone Management Plan.

W1. Revetment

Construct rock revetment wall adjacent to Illaroo Road

Estimated cost $8.1M.

W2. Periodic Dredging of Lake Cathie and Ongoing Beach Nourishment

Continue dredging of Lake Cathie in accordance with the Dredging Strategy (2007).

Estimated cost $300,000 per event.

Continue to place dredged/excavated sand from the Lake Cathie entrance on the beach adjacent to Illaroo Road.

Estimated cost include above.

W3. Stormwater Management

Continue to upgrade the stormwater outlets to the beach.

Estimated cost $20,000.

Redirect stormwater to minimise the direct outflow of stormwater onto the beach.

Illaroo Road only included as a contingency pending confirmation of the timing of the construction of the Revetment.

Estimated cost $272,000.

W4. Foreshore Management

Continue to control/ remove bitou bush along with regeneration/ revegetation with locally indigenous vegetation species.

Estimated cost $5,000 pa.

Fence off regeneration areas south of Johnathon Dickson Reserve to prevent trampling and hence assist in vegetation establishment.

Estimated cost included above.

Install educational signage on the importance of dune vegetation.

Estimated cost $5,000.

Batter back any storm erosion escarpment that forms at Foreshore Reserve (or in other locations) to ensure public safety and maintain park amenity.

Estimated cost varies.

W5. Public Access

Continue to monitor and rehabilitate informal beach access tracks.

Reduce erosion escarpments at the base of beach accessways and carry out any necessary repairs following storm erosion.

Estimated cost varies.

6.2 Planning Controls and Policies

The following Planning Controls and Policies are recommended for implementation as part of the Coastal Zone Management Plan.

P1. Short Term Beach Management

Monitor the beach for erosion hazards following storm events and continue to undertake periodic dredging of Lake Cathie.

Estimated cost - staff time and included in item 5 above.

P2. Development Controls

Continue to implement Interim Controls Pending Construction of the Revetment adopted by Council at the meeting on 25 July 2012

Review area subject to controls following construction of the revetment and when the hazard lines are reviewed.

Estimated cost - staff time.

P3. Contingency Measures

Develop a Servicing Strategy in the event services are threatened by erosion.

Estimated cost - staff time.

Designate Aqua Crescent/ Bundella Avenue and Illaroo as a one-way loop in a Local Area Traffic Management Plan in the event that damage to the road reserve occurs as a result of erosion events.

Estimated cost - staff time.

P4. Reserve Improvements

Prepare a master plan for foreshore reserves (Aqua Reserve, Foreshore Reserve and Johnathon Dixon Reserve).

Estimated cost $60,000.

6.3 Implementation Plan

The recommended actions for implementation as part of this Plan are shown in **Appendix A Implementation Plan**. Council would be responsible for implementing the actions. The CZMP does not propose actions for any public authority other than Council.

The priority classification shown in the Implementation Plan has been developed in consideration of the implications associated with each option. The adopted prioritisation is as follows:

(High) Represents tasks with a high priority, where a delay in implementing the recommendation has the potential to prejudice related planning matters or expose residents to significant risks.

(Medium) Represents tasks with a medium priority, where a delay in implementing the recommendations has some potential to expose residents to moderate risks.

(Low) Represents tasks with a lower priority that are less urgent, which should proceed at some time over the next 3 to 6 years, but may be dependent on the outcomes of other strategies.

7 REVIEW OF CZMP

This CZMP is to be reviewed periodically following the completion of various actions; and as more data on coastal processes and climate change becomes available; and in response to changes in Government policy. This would include:

- Review of long-term risks associated with coastal hazards as more data becomes available e.g: sufficient record of directional wave data from the waverider buoy at Coffs Harbour (which would be representative of the directional wave climate along the NSW mid-north coast), additional bathymetry and updates on climate change induced sea level rise.
- Based on the above, review of the hazard lines shown in **Appendix B** and section 149 Certificate notations.

A review in 2021 is suggested to consider the progress of key actions, with subsequent reviews at no longer than 10 year intervals to ensure the plan remains contemporary and in accordance with any necessary changes to legislation, community expectations and improvements to our knowledge and understanding of the environmental factors and processes of relevance to Lake Cathie.

Any major amendments to the CZMP would be publicly exhibited for community comment and progress on the implementation of the CZMP would be included in Council's Annual Corporate Report.

8 REFERENCES

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WMA (1994b), *Cathie Creek Maintenance Dredging Environmental Review*.

APPENDIX A - IMPLEMENTATION PLAN

Strategy	No.	Action	Method of Implementation	Indicative Cost*	Priority
Revetment	W1.1	Call tenders and construct revetment.	As part of this plan when funding obtained.	$8.1m	Medium
	W1.2	Finalise private/public cost-sharing arrangements.	As part of this plan upon completion of tender process when costs are confirmed.	Staff time	High
	W1.3	Carry out post-storm assessments to identify revetment maintenance requirements and actions to address exacerbated erosion in front of, and at the ends of, the revetment.	As per OEMP	Staff time	High
Periodic Dredging of Lake Cathie and Ongoing Beach Nourishment	W2.1	Continue dredging of Lake Cathie in accordance with the Dredging Strategy (2007).	In accordance with the Dredging Strategy (2007). Ongoing, occurs approx every 10 years.	Approx $300,000 per occurrence	High
	W2.2	Continue to place dredged/excavated sand from the Lake Cathie entrance on the beach adjacent to Illaroo Road.	In accordance with the Dredging Strategy (2007). Ongoing, occurs approx every 10 years	Included in 4	High
	W2.3	Amend 2007 Dredging Strategy to specify the disposal location for the dredging as the Illaroo Road foreshore only.	Amend 2007 Dredging Strategy accordingly	Staff time	High

Strategy	No.	Action	Method of Implementation	Indicative Cost*	Priority
Stormwater Management	W3.1	Continue to upgrade the stormwater outlets to the beach e.g: placement of rock at outlets to reduce beach scour.	As part of this plan. As funding is available through annual works program and/ or grant programs.	$20,000	Medium
	W3.2	Redirect Illaroo Rd stormwater to minimise the direct outflow of stormwater onto the beach. Illaroo Road only included as a contingency pending confirmation of the timing of the construction of the Revetment. Estimated cost $272,000.	As part of this plan. As funding is available through annual works program and/ or grant programs.	$270,000	Medium
Foreshore Management	W4.1	Continue to control/remove bitou bush along with regeneration/ revegetation with locally indigenous vegetation species.	As part of Council's Bush Regeneration and LandCare activities	$5,000/ annum Assumes work by volunteers	Medium
	W4.2	Fence off regeneration areas south of Johnathon Dickson Reserve to prevent trampling and hence assist in vegetation establishment.	As part of Council's Bush Regeneration and LandCare activities	Included in 7.1	Medium
	W4.3	Design, fabricate and install educational signage on the importance of dune vegetation in stabilising the dune system which provides a buffer to storm erosion.	As part of DuneCare program	$5,000	Low
	W4.4	Batter back any storm erosion escarpment that forms at Foreshore Reserve (or in other locations) to ensure public safety and maintain park amenity.	Through Reserve Master Plan	Dependent on storm frequency and severity	High

Strategy	No.	Action	Method of Implementation	Indicative Cost*	Priority
Public Access	W5.1	Continue to monitor and rehabilitate informal beach access tracks	As part of Council's Bush Regeneration and LandCare activities	Included in 7.1	High
	W5.2	Reduce erosion escarpments at the base of beach accessways and carry out any necessary repairs following storm erosion	Through Reserve Master plan	Dependent on storm frequency and severity	Medium
Short Term Beach Management	P1.1	Monitor the beach for erosion hazards following storm events and continue to undertake periodic dredging of Lake Cathie. .	As Part of this plan	staff time and included in item 4 above	High
Development Controls	P2.1	Continue to implement Interim Controls Pending construction of the Revetment adopted by Council at the meeting on 25 July 2012	Development Application process	Staff time	High
	P2.2	Review area subject to controls following construction of the revetment and when the hazard lines are reviewed. Note that the 50 year impact line would move over time due to shoreline recession (and possibly affect additional properties, e.g. along Chepana Street).	Section 149 notification. Ongoing for areas which are not protected by the revetment.	Staff time	High
Contingency Measures	P3.1	Develop a Servicing Strategy in consultation with other service providers in the event that access and services to Illaroo Road properties are threatened by coastal erosion, prior to construction of a revetment.	As part of this plan.	Staff time	Medium

Strategy	No.	Action	Method of Implementation	Indicative Cost*	Priority
	P3.2	Designate Aqua Crescent/ Bundella Avenue and Illaroo as a one-way loop in a Local Area Traffic Management Plan in the event that damage to the road reserve occurs as a result of erosion events and the road pavement width needs to be reduced to maintain safe access, prior to the construction of a revetment.	As part of Local Area Traffic Management Plan.	Staff time	Medium
Reserve Improvements	P4.1	Prepare masterplan for foreshore reserves (Aqua Reserve, Foreshore Reserve and Johnathon Dixon Reserve), incorporating the following improvements: - additional lighting at Johnathon Dixon Reserve and in the vicinity of the Foreshore Reserve barbeque facilities - upgrade Johnathon Dixon Reserve to relieve pressure on Foreshore Reserve by providing shade, shelter and play areas. Upgrades should allow for revetment end effects.	As part of preparation/ review of Community/ Crown Land Plan of Management	$60,000	Low

* costs are indicative only and are dependent on tender processes, detailed design, market forces at the time of implementation, and other factors.

APPENDIX B - HAZARD MAPS

Figure 6 Maximum Wave Runup

Figure 7 Present Day Hazard Zones

Figure 8 2050 Hazard Zones

Figure 9 2100 Hazard Zones

APPENDIX C - ILLAROO ROAD STORMWATER RE-ALIGNMENT