



DRAFT WOOLI BEACH COASTAL ZONE MANAGEMENT PLAN

Clarence Valley Council

June 2018

Final

PA1063

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This Plan was certified by the Minister on ^{20 August}~~XX XXXX~~ 2018.

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FOREWORD

The original CZMP was prepared by Haskoning Australia up to the revision issued to Clarence Valley Council (CVC) on 1 March 2016. Subsequent revisions have been undertaken by CVC, as such the document is no longer under SMEC quality or document control and any changes or revisions made have not been checked or confirmed by SMEC staff for accuracy.

Changes to the CZMP were made by CVC in response to feedback from the NSW National Parks and Wildlife Service, NSW Office of Environment and Heritage (Regional Operations Group), Department of Industry-Lands and Council resolution in respect of the Draft CZMP, and subsequent revision/s, particularly description of the beach nourishment scheme, clarifying the role of development controls and minor adjustments to management actions were made in response to feedback from NSW OEH, the NSW Coastal Panel and the NSW Minister for the Environment in August 2017.

SUMMARY

Wooli Beach has a long history of coastal recession and as a consequence the village of Wooli is currently at significant risk from coastal erosion and longer-term recession. Assessment of coastal hazard concludes that beach recession will continue resulting in landward migration of the shoreline. Under these forecast conditions, or in the event of a design 100 year ARI storm event, public and private assets are expected to be subjected to direct impact from coastal processes in the future. The significance of the risks from coastal hazard at Wooli have been recognised by the NSW Government classifying part of Wooli Beach as a coastal erosion 'hotspot'.

The Wooli community highly value the beach amenity and there is a strong preference for management responses that offer resilience for the beach and village while retaining beach amenity. As such, actions proposed under this CZMP are aimed at reducing risks to public safety and assets due to the threat from coastal hazards, while seeking to maintain a relatively natural beach without large scale 'hard' engineered works. The threat to human life will largely be managed through implementation of an Emergency Action Sub Plan and community education. Threats to existing development and infrastructure will be managed through existing planning controls and legislation. In the event that development and infrastructure is at immediate risk of collapse due to coastal erosion or recession, it may need to be relocated or removed due to danger to public safety and/or the environment.

Preparation of revised development controls, applying to new development via the Clarence Valley Local Environmental Plan and Clarence Valley Development Control Plans, will be assigned a high priority. It is essential that future development is appropriately managed cognisant of the risks to the subject lands from coastal hazards into the future.

A Beach Nourishment Scheme (BNS) comprising periodic sand back-passing and supplementary beach scraping will provide an additional buffer and buy additional time for existing land, built assets and infrastructure identified to be a current or future hazard risk. The BNS is intended to reduce, but not eliminate risk, initially for the southern part of Wooli village where private land and assets are at greatest current threat from coastal erosion. This action is not a long term protective measure and will rely on a monitoring program to understand how these works perform. It is uncertain how effective the proposed scheme will be in mitigating coastal hazard threat until a trial campaign is implemented and monitored. Implementation of the BNS is acknowledged to have environmental consequences due to the proposed sourcing of sand from Wooli Beach located within the Solitary Islands Marine Park. However, nourishment will reduce the risk of harm to the high conservation value dune ecosystem fronting the southern part of Wooli village. In the circumstances, the BNS is considered to be the most sustainable and feasible solution to buy additional time and reduce threat to land and assets.

A coordinated monitoring program is proposed to enable the success of the BNS to be determined and provide data to indicate when modifications to the BNS may be required through an adaptive management approach. Beach scraping is proposed to supplement the BNS and a range of other complementary management actions are proposed to reduce the current level of risk whilst having an eye to the future so that current

management does not threaten the viability of future management responses nor increase the risk to human life, and public and private assets. These additional management measures include development controls, dune and beach access management, conservation of Aboriginal heritage, services contingency strategy, CZMP implementation and review and trigger actions. Importantly, development controls will enable continued use of private land where development is compatible with coastal hazard.

The management actions under this CZMP will be revised by the end of 2021 by which time the CZMP will need to be transitioned into a coastal management program under the new *Coastal Management Act, 2016*. Figures S.1 and S.2 provide an indication of how the management actions will apply to Woolli Beach and adjacent land and waters.



Figure S.1
Management actions for Woolli Beach
(Refer to table 3 for full details)

Legend

 Aerial Photo June 2010 © NSW Land Property Information

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Date: 06/08/2016

0 350 700 Metres

Approx scale 1:21,000 @ A3 Portrait



Projection: GDA 1994
MGA Zone 56



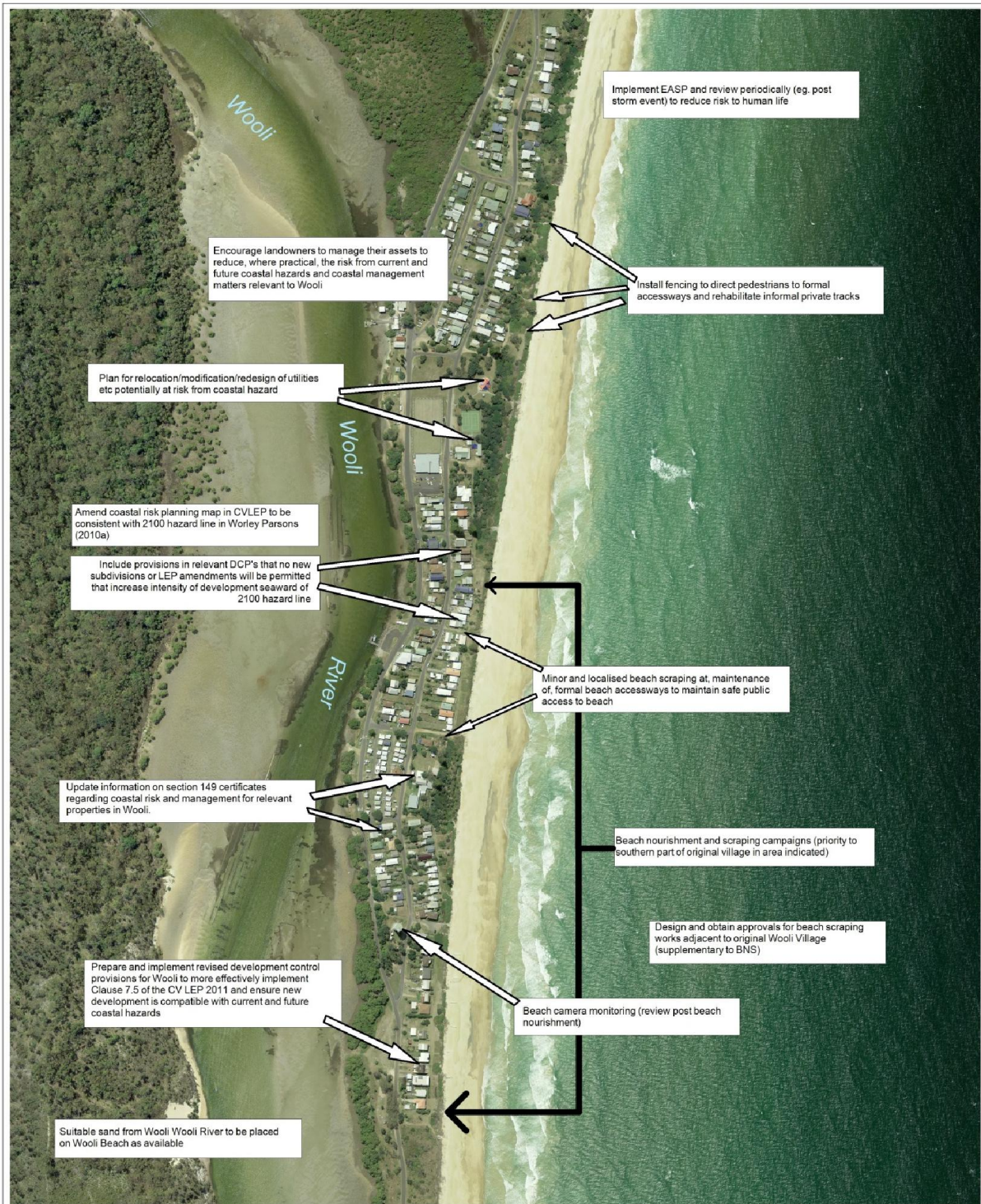


Figure S.2
Management actions for the original Woolli village and adjacent land and water
(Refer to table 3 for full details)

Legend

 Aerial Photo Sept 2012 ©
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1 INTRODUCTION

1.1 Background

The beach fronting the original Woolli village is one of two coastal erosion ‘hotspots’ within the Clarence Valley Local Government Area (LGA) and one of 15 hotspots along the NSW coast, as identified by the Office of Environment and Heritage (OEH 2015). The original village is located on a narrow spit between the ocean and the Woolli Woolli River, with a newer subdivision located to the north (refer to **Figure 1**).

Since the mid-1990s several investigations have been carried out and reported by Clarence Valley Council (CVC) for the Woolli coastal zone. These investigations have generally been made as incremental steps towards completion of a Coastal Zone Management Plan (CZMP or equivalent) for either the Woolli Woolli River or Woolli Beach. A Coastline Management Plan (CMP) was adopted for Woolli in 1998 (PBP 1997b). This was subsequently reviewed and a new *Draft Woolli Village Coastline Management Plan*, including a Draft Emergency Action Sub-Plan (EASP) was completed in 2010 (WP 2010c).

Following exhibition of the 2010 CMP, Council adopted a revised EASP in February 2012 and in July 2012 resolved to revise the 2010 Draft CMP. This CZMP has been prepared in accordance with the OEH (2013) *Guidelines for Preparing Coastal Zone Management Plans* (referred to hereafter as the *Guidelines*). A revised Draft EASP, consistent with this CZMP, has also been prepared (see **Appendix A**).

Council resolved, in June 2015, to endorse a Draft CZMP and seek certification under the *Coastal Protection Act 1979* (the ‘Act’) from the NSW Minister for the Environment. The OEH subsequently advised Council that the June 2015 Draft CZMP did not comply with certification requirements and a number of actions to address this were recommended.

Council considered OEH’s advice and resolved in December 2015 to modify the Draft CZMP by removal of actions seeking to extract sand from the Yuraygir National Park and investigation of a land swap, and inclusion of beach scraping as a supplementary component of the beach nourishment scheme.

Modifications to the Draft CZMP (and Appendices) consistent with that resolution have been made to the minimum extent necessary.¹

The CZMP was again submitted to the Minister for Environment for certification on 21 November 2016. The Minister referred the CZMP to the NSW Coastal Panel for advice under the Act, and responded to council on the 7 August 2017 outlining further recommended changes which have now been incorporated into this final CZMP for certification.

¹ The Appendices were prepared to support preparation of the Draft CZMP, in particular to provide technical assessment of a range of management options (eg Appendix G, H and I). Consultation with other public authorities on the Draft CZMP resulted in some of the options being modified or deleted from the final CZMP. In order to maintain the integrity of these supporting documents they have not been amended to reflect the final CZMP (other than Appendix J). Further, an explanatory note has been included on the cover page of relevant Appendices.

1.2 Purpose of Coastal Zone Management Plan

The purpose of this CZMP is to:

- Describe proposed actions to be implemented by CVC, other public authorities, and the Woolli community to address the priority management issues of:
 - risk to public safety and built assets from coastal hazards
 - pressures on coastal ecosystems
 - impacts associated with community use of the coastal zone.
- Provide a mechanism for implementing actions, developed by CVC through the CZMP planning processes that support the *NSW Coastal Policy 1997* and satisfy the requirements of Part 4A of the *Coastal Protection Act 1979* (refer to **Appendix B** for management principles, goals and objectives under the *Coastal Policy, Act and Guidelines*).
- Assist and guide CVC, and other public authorities, in implementing their related planning actions by establishing clear links between the CZMP and other planning instruments, strategic plans and management programs.

1.3 Principles of the Coastal Zone Management Plan

The NSW Governments Guidelines for Preparing Coastal Zone Management Plans (OEH, 2013) require that ten Coastal Management Principles inform strategic considerations in evaluating potential coastal management actions and be reflected in draft CZMPs. **Table 1** documents these Principles and how the management actions within this CZMP relate to the Principles.

1.4 Area Covered by Coastal Zone Management Plan

The area covered by this CZMP is the beach between Jones Point in the south and Wilsons Headland in the north, see **Figure 1**. This area includes the following public lands:

- Yuraygir National Park (NP), north and south of the Woolli village.
- Solitary Islands Marine Park (SIMP) which extends from MHWL seaward, and includes the Woolli Woolli River up to the tidal limit.
- Crown reserves that form part of the Clarence Coast Reserve Trust and other Crown land including the Clarence Coast Regional Crown Reserve.

1.5 Scope, Life and Reporting for Coastal Zone Management Plan

This CZMP relates to management of coastal issues and hazards affecting Woolli Beach. The CZMP analyses hazards over planning periods up to the year 2100, based on the *Woolli Beach/ Village Review of Coastal Hazards* (WP 2010a) and the understanding of natural processes and coastline responses likely to apply during the planning periods. However, this CZMP will need to be transitioned into a coastal management program under the *Coastal Management Act 2016* by December 2021 if council wishes to retain a certified plan for the management of Woolli Beach that meets

relevant legislative requirements. Among other matters the review will need to consider the effectiveness of management actions implemented since commencement of this Plan.

Implementation of the CZMP will be supervised by a sub-committee of those associated with CVC Coast and Estuary Management Committee. Progress reporting on the implementation of the CZMP will be through existing annual statutory reporting requirements such as those associated with CVC's Operational Plan.

Table 1 - CZMP Principles and relationship to management actions

Guideline Principles		Coastal Zone Management Plan Actions
1. Consider the objectives of the Coastal Protection Act 1979 and the goals, objectives and principles of the NSW Coastal Policy 1997	2. Optimise links between plans relating to the management of the coastal zone.	<ul style="list-style-type: none"> * Amend Coastal Risk Map in CV LEP * Update DCP provisions * Continue to implement Yuraygir Nat Park (YNP) & Solitary Islands Marine Park (SIMP) plans * Conserve Aboriginal heritage values
	3. Involve the community in decision-making and make coastal information publicly available.	<ul style="list-style-type: none"> * Consult community in LEP/ DCP reviews * Section 149 advice – current/ future risk * Community/ Coastal Communities Protection Alliance (CCPA) continue beach monitoring * Review CZMP in 10 years
	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.	<ul style="list-style-type: none"> * Update LEP/ DCP provisions * Review Sea Level Rise (SLR) Policy * Town Services Contingency Strategy * Direct persons to public beach access * Review CZMP in 10 years
	5. The priority for public expenditure is public benefit; public expenditure should cost-effectively achieve the best practical long-term outcomes.	<ul style="list-style-type: none"> * Private and public funding of Beach Nourishment Scheme (BNS) proposed * Determine equitable apportionment private/ public funding for BNS * CCPA contribution to beach monitoring
	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.	<ul style="list-style-type: none"> * Implement Emergency Action Sub-Plan * Update LEP/ DCP provisions * BNS to manage highest risk to assets * Alternative actions if sand volume from BNS falls below trigger value (additional nourishment and/ or groynes etc) * Beach access repairs - public safety
	7. Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions.	<ul style="list-style-type: none"> * Update LEP /DCP provisions * Review SLR Policy * Section 149 advice – current/ future risk * Town Services Contingency Strategy * Opportunistic use of sand from river * Beach/ nearshore monitoring program * Alternatives if BNS target not met * Review CZMP in 10 years
	8. Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems.	<ul style="list-style-type: none"> * Dune management activities continued * Implement YNP and SIMP plans

	<p>9. <i>Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy.</i></p>	<ul style="list-style-type: none"> * Beach access repairs - public safety * Maintain pedestrian and 4WD accesses * Access for temporary coastal protection works via designated access (see EASP)
	<p>10. <i>Support recreational activities consistent with the goals of the NSW Coastal Policy.</i></p>	<ul style="list-style-type: none"> * Beach access repairs - public safety * Maintain pedestrian and 4WD accesses * Implement YNP and SIMP plans



Figure 1 – Woolli Land Management Categories

1.6 Supporting Information

1.6.1 Background Reports

The background reports referred to in **Section 1.1** are available on CVC's website or by contacting CVC. They are summarised in **Appendix C** and listed below:

- *Wooli Beach Coastline Study—Stage 1 and 2 Hazard Definition* (PBP 1997a)
- *Wooli Beach Coastline Management Plan* (PBP 1997b)
- *Wooli River Floodplain Management Plan* (PBP 1999)
- *Wooli Wooli River Estuary Management Plan* (WBM 2009)
- *Wooli Beach/ Village Review of Coastal Hazards* (WP 2010a)
- *Wooli Village Coastline Management Strategy Update and Options Review* (WP 2010b)
- *Wooli Village Draft Coastline Management Plan* (WP 2010c)
- *Wooli Beach Nourishment and Sand Sourcing Investigation* (RHDHV 2015).

1.6.2 Consultation Activities

Community and stakeholder consultation on coastal zone management issues and options has been ongoing since the mid-1990s and is summarised below. Further information can be found in **Appendix D**.

- 1997 Coastline Management Plan: public meetings, focus group meetings and questionnaire surveys.
- 2010 Draft Coastline Management Plan: community 'drop in day', mail-out to property owners, Birrigan-Gargle Local Aboriginal Land Council (LALC) and other public authorities as part of public exhibition.
- Consultation post 2010 to date: coastal zone management information in community newsletter, formation of Coastal Communities Protection Alliance (CCPA) Inc.–Wooli and working partnership with CVC including joint meetings and teleconferences, ongoing involvement of OEH coastal technical officers, and discussions with the NSW Coastal Panel.

1.6.3 Other Supporting Information

The main CZMP report (this report) provides an overview of the important aspects of the CZMP development and intended actions. As required by the *Guidelines*, information supporting the CZMP can be found in the appendices as follows.

Emergency Action Sub-Plan (EASP)	Appendix A
Coastal Zone Management Principles, Goals and Objectives	Appendix B
Summary of Background Reports	Appendix C
Community and Stakeholder Consultation	Appendix D
Coastal Environment and Community Uses	Appendix E
Coastal Hazards and Risks Assessment	Appendix F
Evaluation of Management Options	Appendix G
Description of 2015 CZMP Actions	Appendix H

1.7 Woolli Beach Coastal Zone Management Plan Objectives

The Woolli Beach CZMP objectives are to:

- Reduce the current (present day) level of erosion risk to properties along Woolli Beach from minor and moderate storm events.
- Prepare for emergency coastal erosion situations resulting from severe storm events.
- Increase community knowledge of coastal processes, coastal hazards and associated risks.
- Increase the understanding of the mechanisms affecting beach condition (e.g. effectiveness of management interventions in maintaining a sufficient volume of sand, where required, to reduce the level of risk to properties from minor to moderate storm events).
- Maintain and enhance beach and foreshore amenity and provide appropriate beach access for both recreational activities and maintenance/ management activities.
- Develop a strategy to mitigate projected future risks by ensuring that new development and infrastructure are either located outside the area at risk or are designed and managed to be compatible with the coastal hazard risk.
- Continue and enhance the working relationship between the CCPA, the broader Woolli community, CVC and the NSW Government, particularly OEH, during implementation of the CZMP and achievement of the above objectives.

2 COASTAL HAZARDS AND RISKS

2.1 Coastal Hazards

Wooli is subject to the following coastal hazards.

- **Coastal erosion:** up to 15 m of beach dune eroded during individual major storm events in 1994, 1995 and 1996 based on aerial photography (PBP 1997a).
- **Shoreline recession:** median recession rate between 1942 and 2006 of 0.3 to 0.4 m/yr for the majority of Wooli Beach, with a higher rate of 0.5 m/yr fronting the Wooli Spit as determined from photogrammetry (WP 2010a).
- **Coastal entrance instability:** The narrow sand spit which separates the Wooli Wooli River from the sea is vulnerable to the erosive forces of floodwaters and potential break-through of a new entrance (WP 2010a).

The impacts of climate change, and in particular projected sea level rise (SLR), need to be taken into account in defining future hazards as they have the potential to exacerbate the coastal hazards described above. CVC has adopted SLR planning benchmarks for 2050 and 2100, of 40 cm and 90 cm respectively (increase above 1990 mean sea levels). **Appendix F** provides more detail on coastal hazards.

2.2 Hazard Mapping

Figure shows hazard mapping for the original Wooli village. Hazard mapping for the entire Wooli Beach embayment is included in **Appendix F**. This shows the estimated location of the back beach escarpment following erosion during a 100 year Average Recurrence Interval (ARI) storm event.

2.3 Assets at Risk

Based on the hazard mapping (WP 2010a), the following assets are at risk over the specified timeframes, assuming historical shoreline recession continues and sea level rises in line with the benchmarks adopted by CVC.

- **Immediate risk:** 44 dwellings, one business, four foreshore reserve areas.
- **2050:** 94 dwellings, two businesses, six foreshore reserve areas, public buildings, and infrastructure including the Wooli water tower, Wooli Public School, South Terrace roadway and the Marine Rescue building.
- **2100:** 159 dwellings (out of 183 in the original Wooli village), six businesses, public buildings, and nearly all roads, public reserves and services.

Note that with the exception of the Marine Rescue building, all built assets at immediate and future risk are located within the original Wooli village, along with foreshore reserves in this location. In addition to this, the hazard mapping shows that the section of dune to



the north and fronting the newer Wooli subdivision and southern half of Yuraygir National Park would be at risk by 2100.

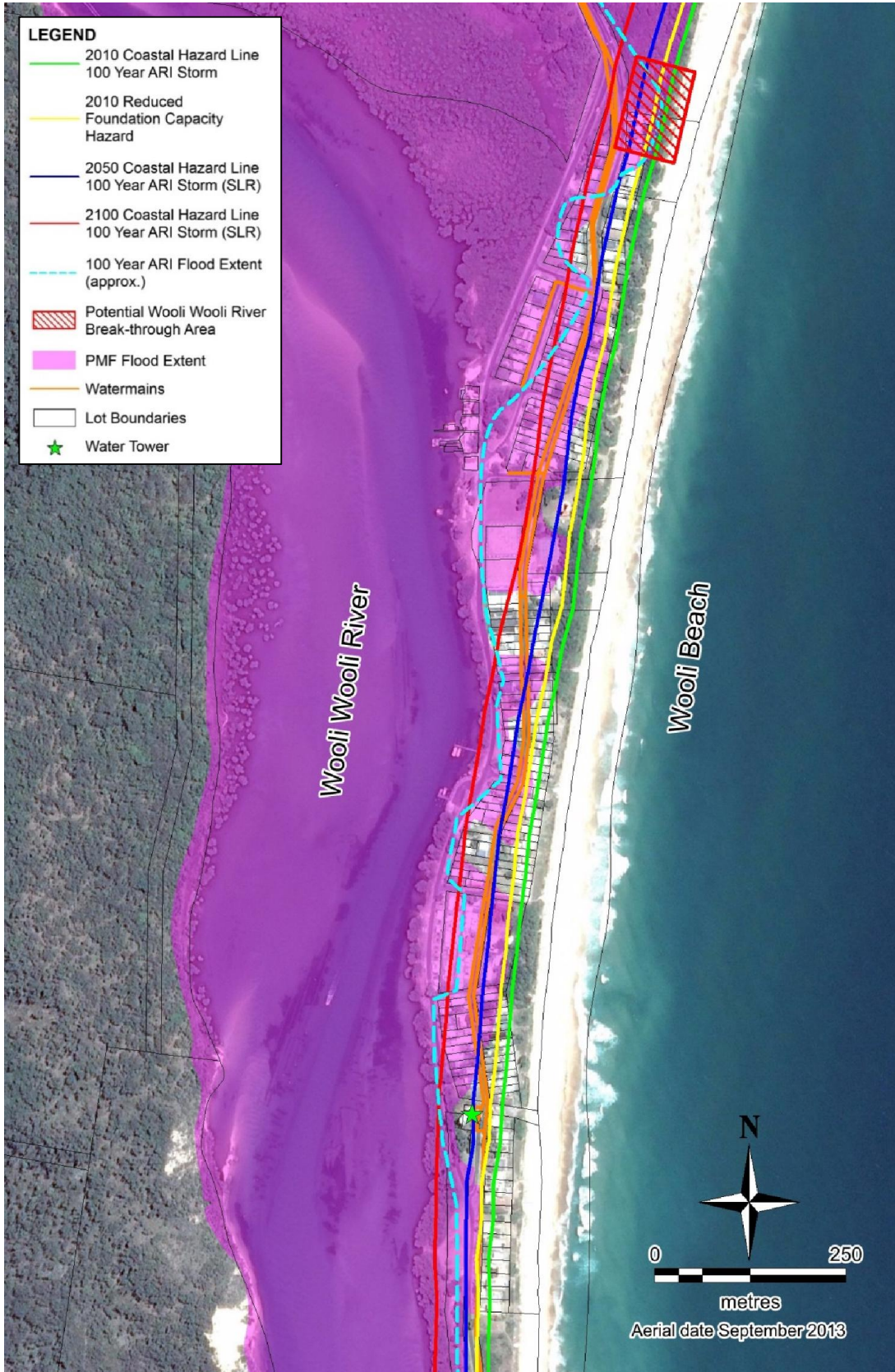


Figure 2 - Original Woolli Village Hazard Mapping

2.4 Risk Levels

By 2100, in the absence of protection works, the hazard mapping indicates that the shoreline of the original Woolli village would potentially erode back to the eastern bank of the Woolli Woolli River in a 100 year ARI event. No structures or rock protection works are proposed to reduce coastal hazards as they are not consistent with the beach amenity and character of Woolli village, and community feedback (see **Appendix D**) has identified a preference for actions that provide additional resilience to the village against the current storm erosion hazard while maintaining beach amenity.

Based on the probability of major storm events occurring over the next 50 years and the likely consequences of a range of ARI events (5, 10, 20, 50 and 100 yr ARI events), risks levels associated with coastal assets were assessed as follows:

- low for the vegetated dune
- medium for beach accessways
- high for foreshore reserves
- high for dwellings currently at most risk (located at or less than 17.5 m from the dune crest)
- medium for the remainder of foreshore dwellings at risk.

Appendix F provides details on coastal hazards and associated risks.

3 COASTAL VALUES AND ISSUES

3.1 Beach Amenity, Community Uses and Public Access

Wooli Beach extends from Wilson Headland for 6.6 km to the trained entrance of the Wooli Wooli River. Jones Beach is located south of the river entrance and is 750 m long. Wooli Beach is fully exposed to waves, while Jones Beach is in the lee of a rocky reef that extends off Jones Point which affords some protection from dominant swell and wave action from the south-east direction. The dune system fronting the original Wooli village is narrow but north of Wooli increases in width to Wilsons Headland. Beach amenity is highly valued by the Wooli community.

Issues affecting beach amenity include coastal erosion, with severe erosion having occurred in 1954, 1974, 1996 and 2009. Refer to **Section 2.3** for details on risks to built assets from coastal hazards. Wooli is also impacted by flooding from the Wooli Wooli River and indirectly by flooding in the Coldstream River catchment (WP 2010b).

The Wooli coast provides opportunities for swimming, surfing, snorkelling (Jones Beach), fishing, walking (beach and foreshore reserves), 4WDing on the beach and nature appreciation. There are 13 formal public access points to Wooli Beach including four for 4WD vehicles, see **Figure .** Refer to **Appendix E** for more information on community uses. Issues associated with community uses and public access include:

- design, safety and maintenance of formal beach access points
- public safety during/ following erosion events (i.e. collapse of dune escarpment)
- informal pedestrian access from individual properties or by beach goers through the frontal dune and associated erosion and potential for dune blow-outs
- damage to the incipient dune from 4WDs (WP 2010b).

3.2 Coastal Ecosystems

The natural values of the marine and estuarine ecosystems in the vicinity of Wooli have been recognised by their inclusion in the Solitary Islands Marine Park. The significance of the coast and lands surrounding Wooli has been recognised by inclusion in Yuraygir National Park.

Remnant coastal vegetation at Wooli includes banksia forest which in some places supports littoral rainforest species (Peter Parker Environmental Consultants 1997). Mangrove communities along the Wooli Wooli River grade to saltmarsh, with swamp forest further inland, with these communities classified as *State Environmental Planning Policy (SEPP) No. 14 Coastal Wetlands*. Six Endangered Ecological Communities (EECs) are considered to occur at Wooli:

- Lowland Rainforest on Floodplain
- Littoral Rainforest
- Coastal Saltmarsh
- Swamp Oak Floodplain Forest
- Swamp Sclerophyll Forest on Coastal Floodplains
- Freshwater Wetlands on Coastal Floodplains (CVC 2006).

See **Appendix E** for more information on ecological systems.

Issues affecting coastal ecosystems at Woolli include:

- vegetation damage (informal access/ 4WDs) and clearing (unauthorised clearing of reserves for views and grassed/ mown areas, reducing the extent of stabilising dune vegetation)
- weeds (garden 'escapees' and species previously used for dune stabilisation, e.g. the noxious weed Bitou Bush)
- bushfires (damage to dune vegetation along South Terrace) WP (2010b).

3.3 Cultural Heritage

Byrne (1985) identified the coast and coastal wetlands as zones of high Aboriginal archaeological sensitivity. This includes:

- foredunes/ backdunes especially near swamps/ lagoons and estuaries; and
- high ground near swamps/ estuaries in the coastal floodplain. Refer to **Appendix E** for more information.

Issues affecting Aboriginal cultural heritage include potential damage to recorded and unrecorded Aboriginal sites from coastal erosion, informal access, and new development or redevelopment, especially any activities involving earthworks.

There are no heritage items or heritage conservation areas identified for the Woolli village in the *Clarence Valley Local Environmental Plan 2011 (CV LEP 2011)* or items listed on the State Heritage Register under the *Heritage Act 1977*.

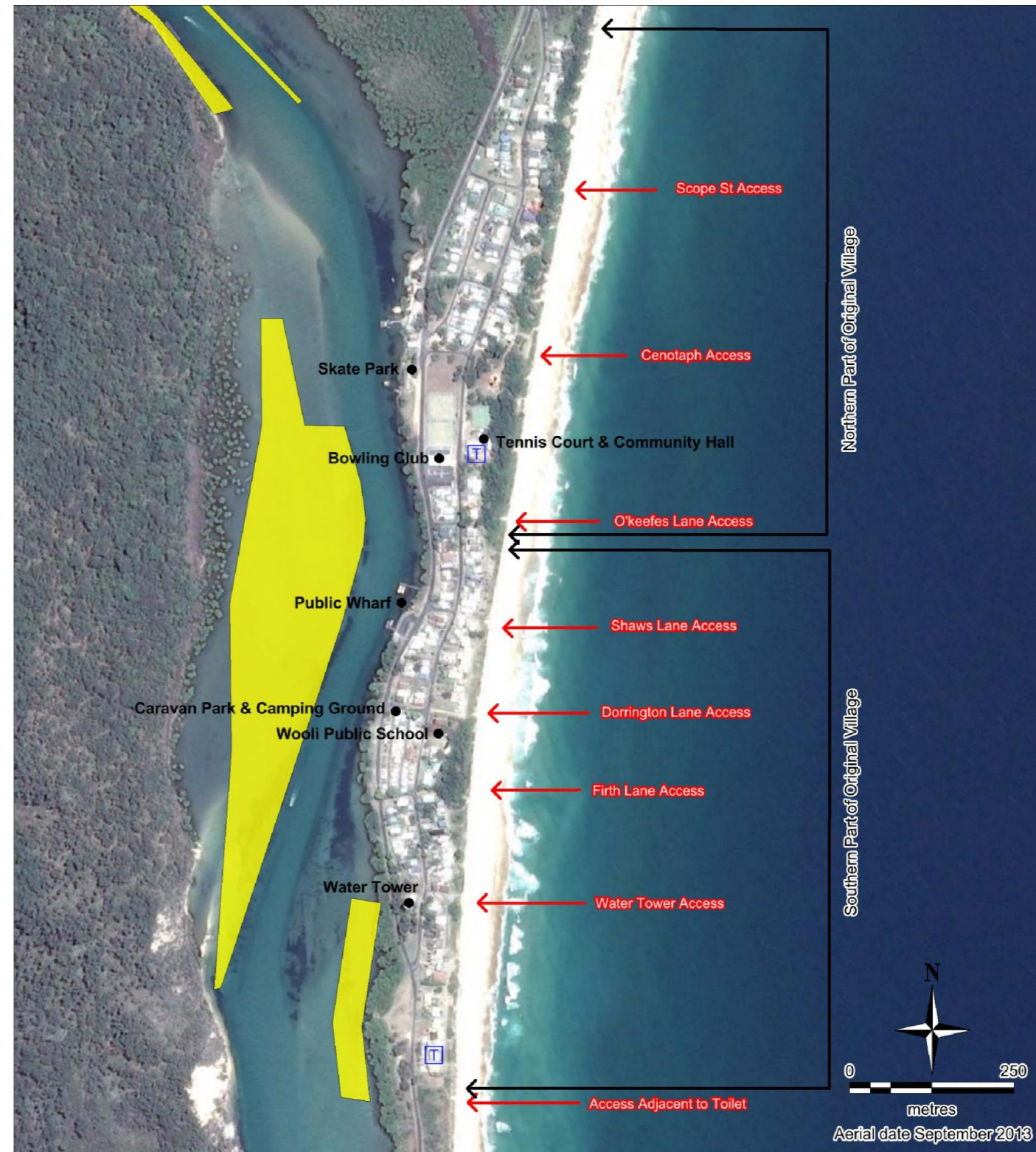
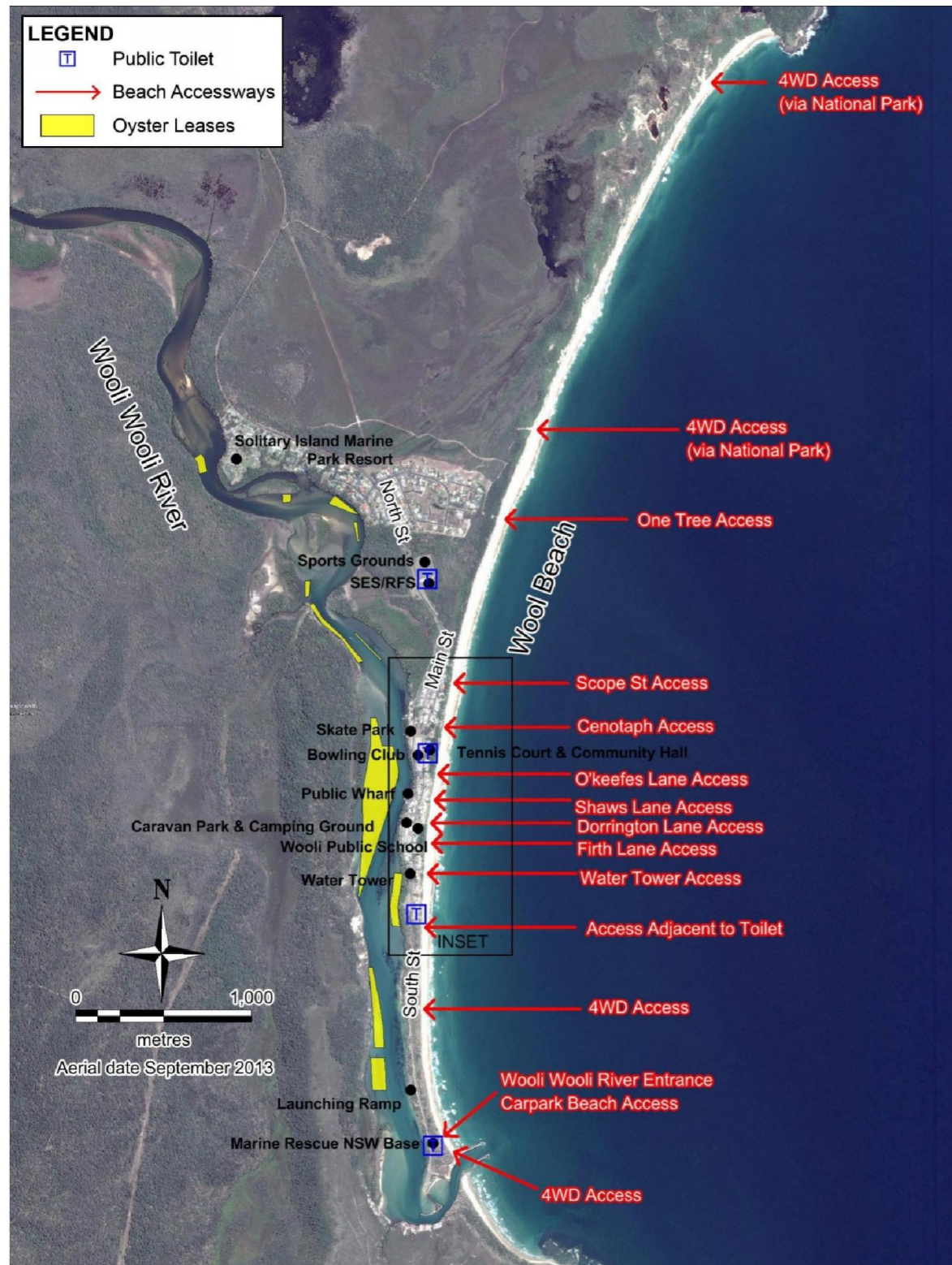


Figure 3 - Community and Other Uses

4 MANAGEMENT OPTIONS

4.1 Options Investigated

Since 1997, the following management options have been considered:

- Property relocation, voluntary purchase or acquisition
- Public assets/ services relocation/ modification
- Land swap
- Planning and development controls
- Beach monitoring to gain a better understanding of coastal hazards
- Seawall (full length)
- Seawall (partial)
- Groyne field and nourishment
- Massive beach nourishment (sand sourced outside Wooli area)
- Beach nourishment (sand from Wooli Wooli River and dune fields)
- Beach sand back-passing (moving sand from northern to southern part of beach)
- Beach scraping (moving sand across the beach from the swash zone to the dune)
- Dune management

4.2 Option Identification and Evaluation

The management options listed in **Section 4.1** were identified through the coastal zone management process for the 1997 and 2010 CMPs and the recent sand sources study. They were evaluated in terms of whether they were considered feasible, reasonable and whether it was likely implementation could be funded. A summary is provided below.

- Generally all options were considered feasible (technically and physically possible to safely implement and maintain).
- Built structures were not considered reasonable based on cost and environmental and beach amenity impacts. Massive beach nourishment was rejected primarily on cost.
- Options involving residents moving were generally not considered reasonable due to social impacts, however there has been some cautious community support for investigation of a future public/ private land swap to allow people to stay within the Wooli community, should other options only mitigate the hazard threat over the short term, and on the basis that any land swap was implemented as a lower priority.
- Public assets and services modification and/ or relocation were considered reasonable and likely to be funded by relevant service providers.
- Beach nourishment, particularly sand back-passing, supplementary beach scraping and dune management were considered reasonable and affordable. Beach nourishment utilising sand from offshore sand sources or from Yuraygir

National Park is not proposed in this Plan. The Wooli Dune Care group has been very active since 2012 in dune rehabilitation and revegetation.

- Beach monitoring was also considered reasonable and affordable with CVC and the CCPA already proactive in this area and undertaking various beach survey and monitoring activities.
- Planning and development controls have been applied since the 1990s and reviewed in response to coastal study report findings. Further refinement of LEP mapping and development controls is proposed as a High priority (see **Table 3**).

Refer to **Appendix G** for more information on options identification and evaluation.

4.2.1 Additional Management Options

Council has prepared and endorsed an Emergency Action Sub Plan following issue of a Ministerial Direction to prepare a Sub Plan in 2011. That Sub Plan has been revised and updated following feedback from NSW Police and NSW State of Emergency Services. Emergency management aims to reduce risk to public safety as a result of erosion emergencies.

Community education is a key component of managing coastal hazard in the Wooli community. The CZMP recognises the value of maintaining communication and educational opportunities. Both emergency management and community education are assigned a Very High priority in the Plan (see **Table 3**).

4.3 Wooli Beach Coastal Hazard Management Actions

Management of coastal hazard risks in this CZMP will be achieved through implementation of four key strategies being:

1. Beach nourishment scheme, with supplementary beach scraping
2. Planning and development controls
3. Emergency management
4. Community education

Each of these strategies is discussed below in sections 4.3.1 to 4.3.4.

4.3.1 Beach Nourishment Scheme

A Beach Nourishment Scheme (BNS), primarily comprising sand back-passing and including supplementary beach scraping, is identified as a key management option to attempt to reduce the current level of risk to built assets from coastal erosion thus seeking to prolong occupation of the Wooli Spit into the future pending the intensity and frequency of future storm events, and sea level rise impacts. Technical details and merit considerations of the different sand management and beach nourishment options are provided in Appendices G and H.

The Woolli community have shown strong support for nourishment options in an attempt to 'hold the line'. Council has commissioned assessment of sand sourcing and management options and their feasibility to inform this management response at Woolli Beach.

Implementation of sand management actions and/or beach nourishment with sand material is considered to be financially feasible and will be compatible with maintaining beach amenity and coastal processes. However, the effect of implementing these options is vulnerable to fluctuating environmental factors, including but not limited to frequency and severity of storm events. Hence, these options are considered worth pursuing at this stage, however given their susceptibility to short and longer term environmental conditions the design of a nourishment scheme needs to identify if and when such a scheme (or the utility of the extraction or placement of sand) needs to be discontinued.

BNS Design Objective

The existing beach and dune profile seaward of the Woolli village is estimated to be of sufficient sand volume to protect the seaward properties in the village from a design 50-year ARI storm event. Appendix H describes an approach for a BNS at Woolli to "hold the line" against sediment budget recession and protect the original Village from a 50 year ARI storm event.

However, there is uncertainty on whether or not the desired sand volumes can be obtained and how successful the BNS will be in achieving the desired 50 year ARI beach erosion hazard reduction objective. Only once a nourishment campaign is implemented and monitored for some time will the level of success of the management strategy be apparent. Implementation of the BNS as proposed does not provide protection to all beachfront properties against storm events greater than the design 50-year ARI storm.

In light of uncertainty, the objective of the BNS in this CZMP is specifically to:

Attempt to "hold the line" against underlying long-term coastline recession over the short-medium term, by attempting to maintain a nominal '50-year ARI' storm event buffer to reduce risk to development and infrastructure from a very large storm event, or series of large storm events.

It is hoped this objective can be achieved by using sand to periodically replenish the beach to account for the sediment budget deficit in future years over the short to medium term. This approach does not consider sea level rise (SLR) directly, as it focuses only on current risk and the long term sustainability of the proposed BNS will only be able to be determined through active and long term monitoring.

BNS Physical Works

The concept design of the BNS is basically a sand back-passing scheme (refer Appendix H for details). Subject to gaining relevant approvals, sand will be won from the intertidal zone (between high and low water mark) along the northern part of Woolli

Beach. Sand will be transported southwards along the beach using vehicles or pumps, to be deposited on the beach adjacent to the original village.

The nourishment profile can be supplemented with localised beach scraping in front of the original village in order to retain as much as possible adjacent to the dune where it is less susceptible to wave impacts including from average conditions or small storm events. Nourishment sand placed onto the beach and the intertidal zone may be moved to the back of the beach by machinery to build dune volume and height if required. The detailed components of the BNS will be developed via completion of the CZMP management strategy 1 “Beach Nourishment Scheme (BNS) Pre-implementation”.

BNS Design Risks

The objective of the BNS is to attempt to “hold the line” against underlying long-term coastline recession adjacent Woolli village over the short-medium term, by attempting to maintain a nominal ‘50-year ARI’ storm event buffer to reduce risk to development and infrastructure from a very large storm event, or series of large storm events.

However, there are risks to the success of this objective as follows:

- a. Even if the required volumes of sand are available for nourishment, there is significant uncertainty on how long the nourished profile will last under the influence of natural coastal processes. Only once a nourishment campaign is implemented and monitored for some time will the level of success of the management strategy be apparent for the period subject to monitoring.
- b. If the BNS is successfully implemented to provide nourishment volume to mitigate risk from a 50 year ARI erosion event, there still remains a risk to lands and assets from coastal erosion events greater than 50 year ARI, such as 70 or 100 year ARI events.
- c. It is possible that maintenance of the desired 50 year ARI storm event buffer may not be achievable due to sand or resource shortages, or the impact of coastal processes resulting in the removal of the nourishment sand. Under these circumstances, the level of coastal erosion and recession risk to development and infrastructure will increase accordingly and the Woolli Beach management strategy will become increasingly reliant on development controls as the primary form of risk management.
- d. If sea level continues to rise as projected, it will become increasingly difficult to maintain a 50 year ARI storm buffer adjacent the Woolli Village into the future beyond the short to medium term (5-10 years). The BNS will provide some buffer to underlying long-term recession, coastal erosion events, and sea level rise induced recession but will have reduced effectiveness with projected future increases in sea level.

The volume of sand won from the northern end of the beach or other sources, such as any opportunistic dredging of the Woolli River, and interactions of coastal processes on the beach profile will determine the capacity to maintain the desired dune and beach volume, and hence how frequently sand nourishment will be undertaken. The BNS design described in Appendix H identifies that 60,000m³ of sand would be required

every five years for nourishment adjacent to the 800-metre section at the southern end of the original village.

To obtain 60,000m³ of sand it is likely that a significant additional off-beach source site/s will need to be accessed. Legislative, policy and/or financial limitations suggest that such additional off-beach sources will not be accessible within the term of this management plan, unless sand is sourced from land based quarries. Hence, it is likely that a lesser sand volume will be accessible for the BNS.

The implementation of a BNS should, therefore, seek to obtain as much sand as is possible for nourishment purposes through sand back-passing to maintain a 50 year ARI erosion event buffer, acknowledging that achieving and maintaining this buffer profile may not be achievable. Only once a detailed nourishment proposal is completed, nourishment campaign implemented, and monitoring program implemented, will the actual success of the strategy be understood.

Monitoring of sand volumes and related investigations before and post-nourishment will inform how the nourishment material is impacted by coastal processes. It will also inform future nourishment campaigns and management of the BNS, including the need to identify if nourishment is no longer feasible to continue. Detailed design of the BNS will be required to identify such thresholds and monitoring requirements and Appendix H offers some technical considerations and suggestions in this regard. If the BNS is no longer feasible then other actions such as geotextile groynes and/or additional beach nourishment will need to be investigated in association with a review of this Plan (refer to Management Strategy 13 in **Table 3**).

The management actions in Section 5 provide for a range of complementary actions to further guide financing, environmental assessment, design, implementation, and monitoring the outcomes of the BNS.

Benefit-Cost of Beach Nourishment Scheme

The cost of the sand back-passing component of the BNS is estimated at between \$720,000 and \$2.0 million per nourishment campaign for nourishment quantities between 20,000 m³ and 60,000 m³ respectively. A minor discount (approximately 5% on these estimates) applies to all renourishment rounds accounting for setup premiums at Campaign 1. Monitoring in the first three years after sand placement is estimated at \$350,000 (i.e. approximately \$116,700 per year). It is assumed that existing monitoring and data collection will be ongoing under current funding arrangements (i.e. has not been accounted for in the BNS costs).

Available sand volumes and nourishment requirements will be determined through beach survey and beach monitoring. As indicated in Section 4.3 it is likely that sand volumes sourced through sand back-passing will tend to be closer to the lower end of the range of nourishment quantities used in this assessment of benefit:cost.

Table 2 provides a summary of the dollar costs and benefits of the BNS over the next 50 years (assuming maintenance of the '50-year ARI' buffer over that period). Note that this does not take into account inflation, fluctuations in property values and changes to beach visitation levels. Nor does it take into account the impact of projected sea level rise on the longevity of the beach nourishment sand.

Sea level rise is expected to result in an increase in the underlying long-term coastal recession rate of the Woolli Beach dune system and beach profile. In-order to 'hold the line' against coastal recession, more nourishment material would be required into the future. This would significantly increase the costs of the nourishment if a 50 year ARI buffer is to be maintained into the future under sea level rise projections. Therefore, the analysis is more relevant to current day. Refer to **Appendix I** for more information, including a discussion on intangible benefits and costs.

Table 2 - Summary of Potential Benefits and Indicative Costs over 50 Years

Assets at Risk	Benefits Maintained ¹	Notes
2013 land value of private property (at immediate risk and at risk by 2050)	\$27,404,000	Improvements: dwellings, landscaping etc would increase value substantially.
2013 land value of public reserves (at immediate risk and at risk by 2050)	\$1,176,800	Improvements: accessways, park furniture and structures would increase value.
Value of beach (based on recreation and tourism value, Raybould <i>et al</i> 2013)	\$12,600,000	'Intrinsic', scenic and ecological values would increase this value which is based on the value of visitation by residents and tourists.
TOTAL BENEFIT	\$41,180,800	
Risk Management	Cost over 50 yrs	
Beach Nourishment Scheme	\$17,900,000 to \$18,700,000 ²	Does not include ongoing monitoring and data collection under current funding arrangements. Does not include cost of other beach management activities, e.g. dune rehabilitation.
TOTAL COST	\$17,900,000 to \$18,700,000	
BENEFIT COST RATIO	2.2 – 2.3	Where this ratio exceeds 1:1 a project is typically deemed to be financially feasible.

¹assumes design sand volumes are available into the future.

²costs to place 60,000m³ (every 5 yrs) to 20,000m³ (every 20 months) respectively.

4.3.2 Beach Scraping

Beach scraping (or beach skimming) is a management option aimed at reducing the level of risk to built assets and the vegetated foredune from small erosion events, and can assist to improve and maintain beach amenity following erosion events.

Beach scraping acts to speed up natural dune building processes, and when accompanied by dune revegetation and stabilisation efforts can provide increased dune volume to mitigate coastal hazard risk. Sand is scraped from the intertidal area, and is transported or pushed landward to the dune system, where it is placed against or in front of the existing dune to increase dune width and height (if desired).

Technical details and merit considerations of the different sand management and beach nourishment options are provided in Appendices G and H.

Implementation of beach scraping is considered to be financially feasible as it is a relatively low cost activity. However, the success of implementing this option is vulnerable to fluctuating environmental factors, including but not limited to the frequency and severity of storm events, or beach erosion cycles.

Council resolved in August 2017 to pursue a one-off beach scraping project with funding and technical support through the NSW Governments Coastal Management Program . Beach scraping does not add new sand to the system, but rather moves sand from the intertidal area up to the back beach area, hence it cannot be relied on to significantly reduce the existing coastal hazard threat to development and infrastructure.

Beach scraping is proposed to supplement the BNS in-front of the original village in order to retain as much sand as possible adjacent to the dune where it is less susceptible to wave impacts during average conditions or indeed small storm events. In addition, beach scraping is also proposed to be completed when beach or public access conditions warrant such action (refer to Management Strategy 1 and 10 in **Table 3**). Monitoring of sand volumes and related investigations before and post beach scraping will inform whether future beach scraping campaigns are feasible.

The management actions in Section 5 provide for a range of complementary actions to further guide financing, environmental assessment, design, implementation, and monitoring the outcomes of beach scraping.

4.3.3 Wooli Beach Emergency Management and Development Control

Implementation of the BNS with accompanying actions including beach scraping and dune management will provide an increased buffer to development and infrastructure along the seaward margins of Wooli Spit. However, as previously described under section 4.3, even if the BNS is successful in maintaining dune buffer to protect against a 50 year ARI storm event, a risk still exists to built assets from storms larger than 50 year ARI.

Emergency Management

Appendix F describes that 44 residential houses, one business, and four foreshore reserve areas are currently at risk from a 100 year ARI erosion event, as being located within the 'Immediate' risk area.

Should an extreme storm event such as a 100 year ARI storm, or series of very large storms impact Woolli Beach there may be impact to those developments and infrastructure. In this circumstance, it will be necessary to implement the EASP to ensure the risk to public safety is adequately managed.

Where coastal storm events or coastal erosion events (which occur without a storm actually occurring) impact Woolli Beach it may also be necessary to implement the EASP. The EASP provides for a range of management measures to be undertaken by council and other agencies in managing risk to people and coastal assets associated with coastal hazards. The full EASP is located at Appendix A.

In the event that a coastal storm or erosion event damages development or infrastructure it may be necessary to require the removal or relocation of these assets if the risk to occupants, public safety and/or the environment is deemed to be unacceptable.

Planning and Development Controls

Development and infrastructure located adjacent to Woolli Beach in the coastal hazard area is at current or future risk from coastal hazards and projected future increases in sea level. Hence, it is necessary to prepare and implement appropriate planning provisions, development controls and planning advices.

Clause 7.5 of the CV LEP 2011 requires consideration of coastal risk for any development proposed in the coastal risk area as shown on the 'Coastal Risk Planning Map' under the CV LEP 2011. Further, potential impacts on new development from coastal hazards and vice versa must be considered for coastal vulnerability areas mapped in accordance with the *Coastal Management State Environmental Planning Policy 2018*.

This Plan contains actions to limit intensification of development, prepare development controls and provide updated planning advice for land subject to current or future coastal hazard at Woolli (see **Table 3**). Intensification of development through new subdivision or redevelopment of existing sites within the coastal risk area should not be supported in most circumstances as it adds to the level of risk within the area that already contains more risk than Council would prefer to be managing.

New provisions for relevant Council Development Control Plans (DCP) will be prepared that reflect latest knowledge of the coastal hazard and issues that need to be considered under the CV LEP 2011 and Coastal Management SEPP. In general terms the objectives of these DCP provisions will be to reduce the impact of coastal hazards, including potential damage to property and assets, for land within the coastal risk area adjacent to Woolli Beach, to ensure development is compatible with coastal hazards

over the life of the development, to ensure adequate emergency planning arrangements, to consider impacts on beach amenity and coastal processes, and to improve public awareness of coastal hazards and associated risks adjacent to Woolli Beach. Provisions are likely to cover issues such as what type of development are suited to different hazard zones, siting of development, building type and construction (including foundation design), adaptation of buildings in response to changing coastal hazard risk, alterations and additions to existing dwellings/buildings, beach amenity, dune management when development located on the dune, emergency planning and on-site waste water management.

Council currently includes advice on planning certificates issued under the *Environmental Planning and Assessment Act 1979* in relation to land within the coastal risk area that the land is subject to coastal hazard. This Plan includes action to update the advice to reflect the coastal risk (either current or future coastal hazard) consistent with the latest hazard study and guidance issued by the NSW Department of Planning and Environment (refer to **Table 3**). This advice is intended to provide sufficient notice of the hazard to prospective land purchasers so that they can make properly informed decisions when land is offered for sale.

4.3.4 Woolli Beach Community Education

The Woolli community has an increased level of awareness about coastal hazards and management resulting from the process of preparing this CZMP since 2010. The Coastal Communities Protection Alliance (Woolli) Inc (CCPA) formed following preparation of the draft Woolli Village CZMP in August 2010. Since that time, the CCPA and CVC have worked closely together on a range of issues affecting Woolli Beach. This has further improved the level of knowledge within the community in relation to coastal processes, coastal hazards affecting Woolli Beach and coastal management.

Community education is a key component of the coastal hazard management strategy in this CZMP. Management Strategy 6 is the primary community education action, however other management strategies will also require community consultation and education in their implementation.

Education of the community will also occur through community consultation opportunities that are built into the process of:

- determining a suitable funding strategy for the life of the BNS (Management Strategy 1)
- prior to and during beach scraping and BNS works (Management Strategy 2)
- before, during and after emergency events (Management Strategy 5)
- seeking comment on LEP and DCP amendments (Management Strategy 7)
- planning for services relocation (Management Strategy 8)
- liaison with Dunecare (Management Strategy 9)
- project specific and Dunecare liaison (Management Strategy 10)
- transition to alternative beach management actions if required (Management Strategy 13), and
- preparation of a plan of management for CCRT managed reserves adjacent to Woolli Beach (Management Strategy 14).



In addition, public dissemination of beach and nearshore monitoring results (Management Strategy 3 and 4) as well as provision of advices on planning certificates issued in association with sale of real estate (Management Strategy 7) offer further opportunities to raise public awareness of how coastal processes work, how coastal hazards are expected to affect Woolli Beach and how these hazards are being managed.

5 COASTAL ZONE MANAGEMENT PLAN ACTIONS

Management Actions are summarised in **Table 3**. Further information and a description of each action can be found in **Appendix H**. While **Figures S.1 and S.2** in the Summary provide a diagrammatic representation of where the different management actions will apply

Table 3 indicates how each action will be implemented, many of which will be under existing plans or programs. Where actions are implemented under this CZMP, costs and potential funding arrangements are included. Where an equal cost is indicated for CVC and OEH, it is suggested this action will be implemented under the NSW Government's Coastal Management (CM) Program. It is recognised that there is no certainty of funding being available, or necessarily offered, through this Program for particular projects. Funding implementation of this CZMP may require pursuit of different funding sources to those indicated due to a range of circumstances that may apply from time to time.

Funding for the BNS will be apportioned in consideration of the benefits it provides to both private and public lands. A special levy or charge applied under the *Local Government Act 1993* to benefiting landowners is one method to assist in funding implementation of the Scheme. Other funding and financing options have been investigated by the NSW Government as part of the Stage 2 Coastal Reforms and hence, additional or alternative funding options may be available to implement this CZMP, including the BNS.

CVC is responsible for implementing actions under this CZMP and will consult with relevant stakeholders. These may include:

- Birrigan-Gargle Local Aboriginal Land Council (LALC)
- Clarence Coast Reserve Trust (CCRT)
- Coastal Communities Protection Alliance Inc – Wooli (CCPA)
- Department of Education & Communities (Dept. Education)
- Department of Industry – Lands and Water (Crown Lands Division) (DoI)
- Department of Primary Industries (DPI), Fisheries Division (Fisheries)
- Local Land Services North Coast (LLS)
- Manly Hydraulics Laboratory (MHL)
- Marine Estate Management Authority (MEMA)
- National Parks and Wildlife Service (NPWS)
- Office of Environment and Heritage (OEH)
- Private landowners (mainly in terms of the EASP)
- State Emergency Services (SES)
- Telstra, Essential Energy and other service providers
- Wooli Dune Care
- Yaegl Traditional Owners Aboriginal Corporation

In principle agreement to the actions in the Draft CZMP affecting the interests of other public authorities was sought as part of the exhibition of the Draft CZMP. Feedback from authorities has resulted in modifications to the Draft CZMP as indicated in the 'Background' earlier. Correspondence from other public authorities in regard to the modified Draft CZMP is included in **Appendix J**.

Table 3 - CZMP Implementation Schedule

Management Strategy	Action	Implementation through other plan/ program/ legislation or potential funding arrangements ¹ under CZMP	Priority	Timeframe/ Frequency
<u>MS1</u> Beach Nourishment Scheme (BNS) Pre-implementation	Detailed design of BNS (including sand back-passing and supplementary beach scraping)	\$20,000 CVC/ \$20,000 OEH application submitted to OEH	High	2019-2020
	Implement beach scraping works for southern 800 metres of Wooli village frontage	\$50, 000 (CVC/CCPA) / \$50, 000 (OEH)	High	2018 - 2019
	Design and obtain approvals for beach scraping swale infill works adjacent to original Wooli village	\$7,500 CVC / \$7,500 OEH application submitted to OEH and CVC staff time not costed	High	Scraping swale infill works to be undertaken when the beach profile displays a low swale adjacent to the main dune and a higher berm level at the front of the beach
	Environmental impact assessment	\$40,000 CVC/ \$40,000 OEH application submitted to OEH	High	2019 - 2020
	Approvals documentation	CVC staff time not costed	High	2019 - 2020
	Detailed funding plan over likely life of BNS	CVC staff time not costed	High	2018 - 2020
<u>MS2</u> BNS Implementation	Implement beach nourishment and beach scraping campaigns	CVC/ OEH/ benefiting landowners	High	2018 and up to every 5 years thereafter
<u>MS3</u> BNS Monitoring	Nearshore wave and current monitoring	\$25,000 CVC/ \$25,000 OEH	High	2020-2022 (continuous)
	Sand tracing	\$150,000 CVC/ \$150,000 OEH	High	2020-2022 (2-3 campaigns/yr)

Table 3 - CZMP Implementation Schedule (cont'd)

Management Strategy	Action	Implementation through other plan/ program/ legislation or potential funding arrangements ¹ under CZMP	Priority	Timeframe/ Frequency
<u>MS4</u> Routine Beach Monitoring	Beach camera monitoring	current activity by CCPA	High	Ongoing - to be reviewed post beach nourishment
	Beach surveys (including beach pole monitoring)	current activity (quarterly) by CCPA	High	Ongoing post storm with current frequency to be reviewed post beach nourishment
	Photogrammetry	OEH through CM Program	High	2018 and every 1-2 years thereafter
	Offshore wave data collection	OEH/ MHL through CM Program	High	Ongoing
	LiDAR (alternative to photogrammetry)	LPI through current program	Low	2018 and 1-2 years thereafter (if photogrammetry unavailable)
<u>MS5</u> Emergency Management	Implement EASP and review periodically (e.g. post storm event)	Clarence Valley DISPLAN	Very High	Review when hazard lines and risk assessments are updated and in accordance with process in EASP
<u>MS6</u> Community Education	Update community on CZMP implementation and coastal management matters relevant to Wooli	Local community newsletter and CCPA	Very High	Ongoing
	Encourage landowners to manage their assets to reduce, where practical, the risk from current and future coastal hazards and coastal management matters relevant to Wooli	EASP and local community newsletter	Very High	Ongoing

Table 3 - CZMP Implementation Schedule (cont'd)

Management Strategy	Action	Implementation through other plan/ program/ legislation or potential funding arrangements ¹ under CZMP	Priority	Timeframe/ Frequency
<u>MS7</u> Planning and Development Controls	Amend coastal risk planning map to be consistent with 2100 hazard line in WP (2010a).	<i>Clarence Valley (CV) LEP 2011</i>	High	2018 - 2019
	Update information on Planning Certificates	<i>Environmental Planning and Assessment (EP&A) Act 1979 and Regulation 2000</i>	High	2018 - 2019
	Subdivisions or LEP amendments that propose to increase intensity of development seaward of the 2100 hazard line are discouraged	<i>Consideration of planning proposals and Development Applications</i>	High	Ongoing
	Prepare and implement revised development control provisions for Woolli to more effectively implement Clause 7.5 of the <i>CV LEP 2011</i> .	<i>Clarence Valley DCP 2011 and EP&A Act 1979</i> for new development proposals/ Development Applications (DAs)	High	2018 - 2019
	Review Sea Level Rise Policy	CVC Policy Register	Medium	When new data is available, when State Government policy changes and/or as specified in the Policy
<u>MS8</u> Town Services Contingency Strategy	Plan for relocation/ modification/ redesign of utilities etc potentially at risk	not costed, requires input of Telstra, Essential Energy & other service providers	Medium	2021
<u>MS9</u> Beach and Dune Management	Suitable sand from Woolli Woolli River to be placed on Woolli Beach	CVC/ NSW Government Rescuing our Waterways Program (or equivalent)	Low	If/ when dredging required for safe navigation
	Beach and dune rehabilitation, revegetation and weed control	CVC/CCRT through Dune Care, Yuraygir NP and SIMP management programs	High	Ongoing (note plans/ programs may need review following implementation of BNS)

Table 3 - CZMP Implementation Schedule (cont'd)

Management Strategy	Action	Implementation through other plan/ program/ legislation or potential funding arrangements ¹ under CZMP	Priority	Timeframe/ Frequency
<u>MS10</u> Beach Access Management	Minor and localised beach scraping at, and maintenance of, formal beach accessways	EASP (and CZMP)	High	Ongoing (when public safety is unacceptable and sufficient sand is on the beach)
	Install fencing to direct pedestrians to formal accessways and rehabilitate informal 'private' tracks	Dune Care Program and in conjunction with beach scraping and BNS works	Medium	2018 (with beach scraping project) and ongoing in conjunction with specific projects
	Manage vehicle access	Beach Access or Vehicles on Beaches Policy (or similar)	High	Ongoing
<u>MS11</u> Conservation of Aboriginal sites	Protect/ conserve known and unknown middens etc	<i>EP&A Act 1979 and Regulation 2000 and National Parks and Wildlife Act 1974</i>	High	Ongoing
<u>MS12</u> CZMP Implementation and Review	Supervision of BNS implementation by sub-committee of CVC Coast and Estuary Management Committee	staff/public authority/volunteer time not costed	High	After certification of CZMP
	Revise/ update CZMP	CVC/ OEH through CM Program	Medium	Once actions are implemented, if significant issues arise (including if BNS is ineffective) or by December 2021 to transition to a CMP (whichever occurs first)
	Prepare a revised coastal hazard study	\$25,000 CVC / \$25,000 OEH	Low	Part of future CMP preparation
<u>MS13</u> Trigger Actions	If the BNS is deemed to be no longer feasible then investigate other actions, such as geotextile groynes and/ or additional beach nourishment	cost dependent on design CVC/ OEH/ benefiting landowners	Low	If BNS trigger point reached (i.e. less than 155,000 m ³ of sand in front of southern part of original village) or BNS determined not to be feasible due to available resources or other logistical reasons

MS14 CCRT Reserve Planning	Prepare integrated plan of management for CCRT reserves adjacent to Woolli Beach	CCRT/CVC <i>Crown Lands Act 1989</i>	High	Prior to implementation of BNS (not including beach scraping works)
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¹ *Funding sources are indicative and subject to change dependent on the availability of funding programs, success of funding applications to external funding bodies and budget allocation from time to time.*



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DRAFT WOOLI BEACH COASTAL ZONE MANAGEMENT PLAN APPENDICES

Clarence Valley Council

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APPENDICIES

APPENDIX A DRAFT EMERGENCY ACTION SUB-PLAN
APPENDIX B CZM PRINCIPLES, GOALS AND OBJECTIVES
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APPENDIX I BENEFIT-COST ANALYSIS AND CZMP FUNDING
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Drafted by H Nelson
Checked by G Blumberg
Date/initials check 27/04/15, 11/05/15
Approved by G Blumberg
Date/initials approval 14/08/15

FOREWORD

The original CZMP Appendices was prepared by Haskoning Australia up to the revision issued to Clarence Valley Council (CVC) on 21 August 2015. Subsequent revisions have been made to the cover pages of relevant appendices by CVC, as such the document is no longer under SMEC quality or document control and any changes or revisions made have not been checked or confirmed by SMEC staff for accuracy.

Changes to the CZMP were made by CVC in response to feedback from the NSW National Parks and Wildlife Service, NSW Office of Environment and Heritage (Regional Operations Group) and Council resolution in respect of the Draft CZMP, and subsequent revision/s, particularly description of the beach nourishment scheme and clarifying the role of development controls.



APPENDIX A DRAFT EMERGENCY ACTION SUB-PLAN

WOOLI BEACH Emergency Action Sub Plan

A Sub Plan of the Woolli Beach Coastal Zone Management Plan



Source: *The Daily Examiner*, 26 May 2009

FINAL DRAFT July 2015
To be reviewed no later than July 2020

AUTHORISATION

This Wooli Beach Emergency Action Sub Plan is a sub plan of the Wooli Beach Coastal Zone Management Plan. It has been prepared in accordance with the NSW Governments Coastal zone management guide note – Emergency action subplans (OEH, 2011). This Sub Plan has been endorsed by Clarence Valley Council. This 'Final Draft' version is to be referred to the NSW Office of Environment and Heritage/Minister for the Environment for certification or endorsement as part of the Wooli Beach Coastal Zone Management Plan under the provisions of the *Coastal Protection Act 1979*.

Council endorsement

(Mr Scott Greensill)
General Manager
Clarence Valley Council
Dated:

NSW Office of Environment & Heritage endorsement

(??)
Director
Office of Environment & Heritage
Dated:

DISCLAIMER

This report has been prepared by and for the exclusive use of Clarence Valley Council. Clarence Valley Council accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

Acknowledgement

The July 2015 version of this Plan was prepared by Clarence Valley Council after adapting the original text of the Draft Woolli Beach Emergency Action Plan prepared by WorleyParsons in August 2010. This 2015 Final Draft Sub Plan adapts, and uses a similar structure to, the 2012 version.

Certification

This Sub Plan was certified, under the *Coastal Protection Act 1979*, by the NSW Minister for the Environment on _____.

Cover Photo

Council staff and Woolli community representatives inspect Woolli Beach and the storm erosion escarpment at the One Tree beach access point following the May 2009 storm event. (Source: *The Daily Examiner*, 26 May 2009)

VERSION HISTORY

The following table lists all previously endorsed versions of the Sub Plan.

Plan	Endorsed	Endorsed By/Date
Wooli Beach Emergency Action Subplan (March 2012)	February 2012	Clarence Valley Council only At the 21 February 2012 Council meeting (Council resolution 12.011/12)
Wooli Beach Emergency Action Sub Plan (March 2015)	June 2015	Clarence Valley Council only At the 23 June 2015 Council meeting (Council resolution 07.013/15)
Wooli Beach Emergency Action Sub Plan (July 2015)		

AMENDMENT LIST

Proposals for amendment to this Sub Plan are to be forwarded to:

General Manager
Clarence Valley Council
Locked Bag 23
GRAFTON NSW 2460.

Amendments promulgated are to be certified below when entered:

Amendment Number	Description	Updated by	Endorsed Date

DISTRIBUTION

This Sub Plan is primarily utilised internally by Clarence Valley Council and hence, the Plan will be available in electronic format to third parties either via the Clarence Valley Local Emergency Management Committee or via Council's website, www.clarence.nsw.gov.au.

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FINAL DRAFT

1. INTRODUCTION

Adverse weather systems can produce storms that generate strong winds, large waves and elevated ocean water levels along the NSW coastline. These conditions are generally short lived but can result in extensive erosion along sandy beaches, and seawater inundation where waves can overtop coastal dunes or sea defence barriers.

Extreme beach erosion or seawater inundation (or overtopping) can directly threaten assets and infrastructure on or adjacent to an active beach.

Erosion can occur either through erosion of the dunal system as a result of undermining, or indirectly because the foundation capacity of the remaining dune adjacent to the eroded area has been reduced. Erosion can also lower the beach berm (a nearly horizontal plateau on the beach face or backshore, formed by the deposition of beach material by wave action, or by means of a mechanical plant as part of a beach recharge scheme), often resulting in a tall, unstable, near-vertical back-beach erosion escarpment. Damaged berms can also present hazards for beach users.

Even without severe coastal storms, an erosion escarpment can erode and migrate landward or oceanic inundation can occur. Relatively minor wave action coinciding with high spring tides can induce erosion and undercut an erosion escarpment or promote waves to overtop the shoreline (oceanic inundation).

A council's long-term strategy for managing these threatening processes should be documented in a coastal zone management plan (CZMP). An emergency action subplan (EASP) forms an integral component of a CZMP. It outlines a council's intended response to a coastal erosion emergency and in certain locations explains ways in which and where beachfront property owners can place temporary coastal protection works (TCPW) according to the Coastal Protection Act 1979 (CPA). (OEH, July 2011)

1.1 Context and associated Plans and Guidelines

This Emergency Action Sub Plan (EASP) has been prepared in accordance with provisions of the *Coastal Protection Act 1979* and is intended to supplement the implementation of the Woolli Beach CZMP. This EASP for Woolli Beach should be read in conjunction with the following associated plans and guidelines:

- *NSW State Storm Plan (SES 2013) – A sub plan of the State Emergency Management Plan (2012) prepared under the State Emergency Service Act 1989 (NSW) and authorised in accordance with the State Emergency and Rescue Management Act 1989 (NSW).*
- *NSW State Flood Sub Plan (SES, 2015) – A sub plan of the State Emergency Management Plan (2012) prepared under the State Emergency Service Act 1989 (NSW) and authorised in accordance with the State Emergency and Rescue Management Act 1989 (NSW).*
- *Clarence Valley Local Disaster Plan (DISPLAN) for the Clarence Valley Council Local Government Area (CVC, 2014)*

- *Clarence Valley Local Flood Plan (June 2012) – A Sub-Plan of the Clarence Valley Local Disaster Plan (DISPLAN).*
- *Coastal zone management guide note – Emergency action subplans (OEH, July 2011)*
- *Guide to the Statutory Requirements for Emergency Coastal Protection Works (OEH, 2013b)*
- *Code of Practice under the Coastal Protection Act 1979 (OEH, 2013).*

Arrangements detailed in this EASP will be undertaken by Clarence Valley Council based on the assumption that the resources upon which the EASP relies are available when required. This EASP does not prevent additional action/s being undertaken by other authorities, or combat agencies, such as the NSW State Emergency Service, in accordance with relevant Emergency Management Plans and/or DISPLANS.

This EASP should be reviewed periodically in conjunction with revisions of the State Storm Plan, the State Flood Sub Plan, Council's DISPLAN, Clarence Valley Local Flood Plan, a future CZMP and following a coastal erosion emergency event as defined in **Section 1.2**, or within five (5) years of the date of endorsement if any of these circumstances do not arise.

1.2 Purpose of Emergency Action Sub Plan

The objective of this EASP is to document the actions that Clarence Valley Council and/or landowners will or can undertake in response to a coastal erosion emergency situation at Woolli Beach. This includes actions performed by Council/landowners whether associated with action under any plan made under the *State Emergency and Rescue Management Act 1989 (SERMA)* or not. However, in accordance with section 55C(2)(a) this Plan will not include matters dealt with in any plan made under the SERMA in relation to emergency responses by Council/landowners.

To achieve this objective action is required in emergency planning/preparedness, response and recovery phases of an emergency. The primary focus of Council will be to prevent harm to, or loss of human life. Secondly, Council will seek to ensure public assets, such as formal beach access, roads and/or infrastructure are managed in a safe manner. Private property management has a lesser priority and in this regard Council will facilitate authorised and lawful actions by landowners once Council's priority obligations are fulfilled. This is consistent with standard emergency management procedure.

This EASP will document emergency management arrangements for the coastal erosion hot spot at Wooli Beach, being the beach opposite the Main Street & Riverside Drive intersection south to the Wooli Wooli River, plus the length of Beach to the northern side of the new residential area, in the vicinity of the beach access known locally as 'One Tree' (see Figure 1).

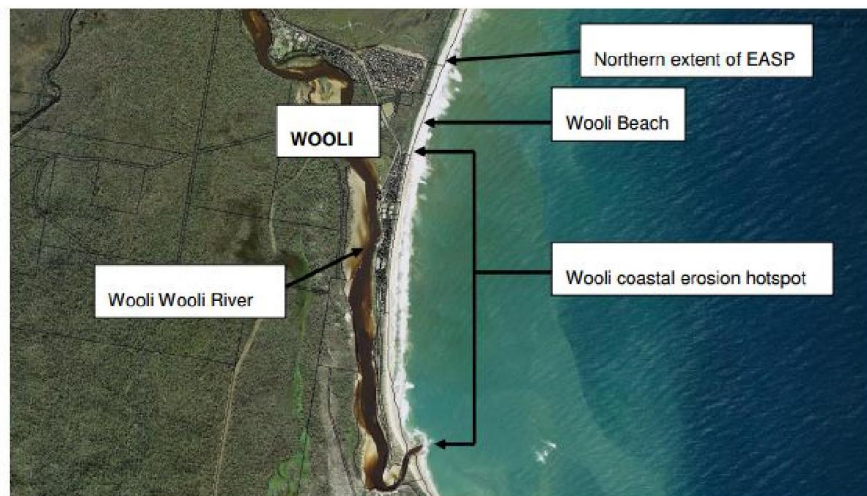


Figure 1 – Area covered by this EASP and length of beach covered by the Wooli Beach coastal erosion 'hotspot'.

A "coastal erosion emergency" is classified (for the purposes of this EASP) as an oceanic event that could result in lowering of beaches, high unstable erosion escarpments and/ or direct threats to public and private assets from undermining or wave action. A coastal erosion emergency could occur due to a combination of elevated ocean water levels and waves that are not generated by a severe weather event that would otherwise trigger actions under the State Storm Plan or State Flood Sub Plan.

1.3 Assets potentially affected by Beach Erosion

Wooli Beach suffered severe storm damage in 1954, 1974, 1996 and 2009. More recent erosion events have eroded the frontal dune leaving a high, steep escarpment along much of the beachfront. The steep escarpment has been less prone to slumping in recent years and a foredune deposit has formed adjacent to the base of the dune escarpment. The foredune has assisted in resisting wave impacts on the main dune in recent weather events (prior to March 2015).

A review of coastline hazard lines for Wooli (WorleyParsons, 2010a) identified that 44 lots are located in the zone of wave impact for a severe storm (although a few dwellings on these lots are located landward of the immediate impact line). The immediate hazard zone (IHZ) extends 20-25 metres (dependent on dune height in AHD) landward of the dune escarpment (WorleyParsons, 2010a). The majority of these beachfront properties are located south of the Wooli Bowling Club. In addition, monitoring by Council since 2007 indicates approximately 25 beachfront dwellings may be partially located within the 'zone of reduced foundation capacity' (generally less than 18m from the dune crest, WorleyParsons, 2010a), and hence are susceptible to structural damage due to the reduced bearing capacity of sand in this zone. Of these properties, eight(8) most at risk were located between 11.5 and 14m from the dune crest.

Management of the impacts of coastal erosion at Wooli is further complicated as the village is not serviced by reticulated sewerage. On-site effluent management systems are located on each property containing development. Many of these systems and associated disposal areas (as applicable) are located on the seaward side of beachfront dwellings along the frontal dune. Erosion that enters private lands or other lands containing effluent systems is likely to adversely impact such systems with implications for occupants as well as public and environmental health.

In addition to wave impacts from coastal storms, Wooli is subject to flooding from the Wooli Wooli River. During a 1% or 2% Annual Exceedance Probability (AEP) flood event, inundation of Wooli Road (in the vicinity of the Wooli Sportsground) is estimated to be 0.35m. In a more severe event, the road would be cut between the northern portion of Wooli and the original village.

In addition, flooding in the adjacent catchment, which typically occurs a day or more after a major coastal storm event, can cut road access at Sandy Crossing and Whites Bridge, isolating Wooli from between a few hours to a few days. This occurred following the storm in late May 2009.

The latest review of coastal hazards at Wooli Beach (WorleyParsons, 2010a) as well as the Wooli Beach Coastline Study (1997) endorsed the finding of an earlier Public Works (1989) report, *Wooli Coastal Process Investigation*, that if the frontal dune were ultimately to disappear there is potential that the ocean could breakthrough to the River during times of high seas and river flooding in the future. See **Appendix 1** for a map showing the potential break through location.

Council infrastructure may also be at risk in some locations. In the short term this is expected to be confined to pedestrian and 4WD beach access ways. Continued landward recession of the dune escarpment would affect road assets, public infrastructure and services, in the longer term.

1.4 NSW Emergency Management Plans

1.4.1 NSW State Storm Plan

The NSW State Storm Plan documents emergency action with regard to storms, including coastal erosion.

1.4.2 NSW Flood Sub Plan

The NSW State Flood Sub Plan documents emergency action with regard to flooding, including oceanic or seawater inundation.

1.5 Clarence Valley Local Flood Plan

The 2012 *Clarence Valley Local Flood Plan* [sub-plan of the *Clarence Valley Local Disaster Plan (DISPLAN)*], being a Plan prepared under the SERMA, guides emergency activities in the event of flood and/or coastal erosion.

SES advise that NSW SES Local Flood Emergency Sub Plans are always active; however SES response operations for storms including coastal erosion will begin on receipt of an Australian Government Bureau of Meteorology weather warning. This may be indicated by:

- Severe Weather Warning for hail, flash flooding, damaging surf; or
- Tropical Cyclone Watch or Warning [clause 6.1.3(a), page 32, NSW State Storm Emergency Sub Plan (September, 2013)].

Alternatively, NSW SES response operations may begin following impact of a storm not covered by a formal warning [clause 6.1.3(b), page 32, NSW State Storm Emergency Sub Plan (September, 2013)].

The Local Flood Plan also covers resupply of settlements which become isolated. All of Wooli is affected by the Probable Maximum Flood (apart from the foredune). In a 1% AEP flood event, Wooli Road, some properties to the east of Wooli Road and some properties to the west of Main Street (at the northern end of the original Wooli Village) are affected.

Flood evacuation triggers (i.e. flood heights) are still to be determined for Wooli. However, the northern and southern portions of Wooli can be cut off from each other before over-floor flooding of dwellings occurs.

Emergency assistance in flooding and storm events is available to residents by phoning the State Emergency Service (SES) on 132 500. Details of road closures are also available at www.myroadinfo.com.au. In the event that power and phones are out, the Wooli Post Office is the point of contact for residents.

In addition to the role of Council in a 'coastal erosion emergency' the SES will respond as the combat agency when the weather warning triggers or other circumstances (as mentioned earlier) apply. The role of the SES is to coordinate SES units, activities of support agencies, provide information, protect life through warning, rescues and evacuation, and provide other assistance such as coordinate the lifting/ relocation of readily moveable household items and commercial stock and equipment.

When a BoM warning has not been issued, and the SES has not mobilised in response to an imminent storm, Council's role is essentially the same as the SES's role as the Wooli Beach CZMP does not propose property protection works. An event that prompts an SES response under the Local Flood Plan may still require certain actions to be undertaken by Council.

1.6 Code of Practice for Temporary Coastal Protection Works

A Code of Practice (OEH, 2013), under the *CPA 1979*, and a Guide to Statutory Requirements for TCPW (OEH, 2013b) details the requirements for 'temporary coastal protection works' placed by landowners in terms of installation/construction, maintenance, removal and safety. Essentially, these provisions are intended to provide advice to landowners who wish to undertake temporary action to reduce erosion impacts on their property (in place of lodging a development application) while ensuring risks to public safety and incidental erosion of adjoining land are minimised.

Under the Code works can be comprised of either placement and maintenance of sandbags up to 1.5 metres in height or the placement of sand against the seaward side of the erosion escarpment.

Any works performed by landowners on public land must be in accordance with a certificate issued under Part 4C, Division 2 of the *CPA 1979* and Regulations, the Code of Practice (OEH, 2013) and the Guide to Statutory Requirements (OEH, 2013b). Sand bags used for TCPW can only be made of geotextile complying with the specifications in OEH (2103) and shall not exceed a volume of 0.75m³ when filled. It needs to be recognised that placement of TCPW in compliance with the Code will not guarantee protection of property from the impacts of an erosion event. TCPW are not a long term option for managing the risks associated with coastal hazards.

Access to the Beach to undertake TCPW must be via the 4WD beach access off South Terrace (see Figure 2) as the 'Authorised beach access' specified in the Code of Practice (OEH, 2013).

Landowners of beachfront properties with residential, commercial or community buildings need to be made aware of the potential to undertake TCPW and requirements for such actions in the planning/pre-storm phase.

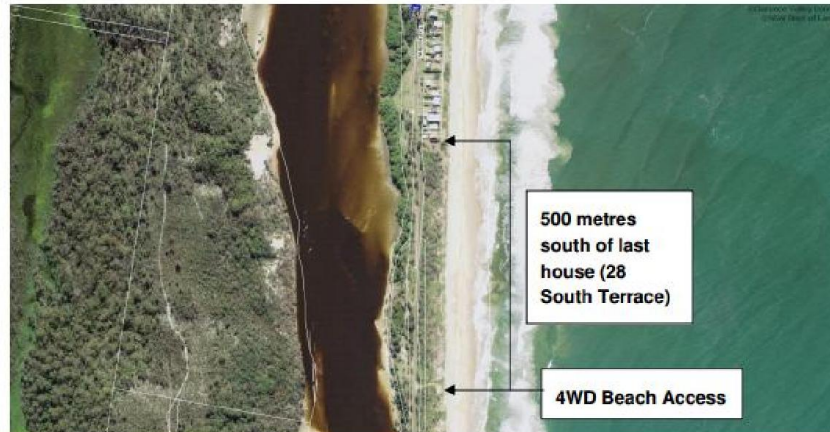


Figure 2 – Location of 4WD Beach Access on South Terrace, Wooli.

Placement of any coastal protection works by a landowner/s other than in accordance with a certificate under Part 4C, Division 2 of the *Coastal Protection Act 1979* or in accordance with the Code of Practice for TCPW on private land, on or adjacent to the beach at Wooli, need prior development consent under the provisions of the *Environmental Planning and Assessment Act 1979* and *Clarence Valley Local Environmental Plan 2011*.

Note: The Coastal Protection Act 1979 specifically excludes placement of rocks, concrete, construction waste or other debris for temporary coastal protection works. These materials are not permitted, as without adequate and site-specific consideration they can exacerbate erosion of beaches and adjacent land, present a public safety risk and may be difficult to remove. Significant penalties apply for using unlawful materials, and an order may be issued requiring these materials to be removed at the expense of the person(s) who placed them. (OEHL, 2013b)

2 EMERGENCY ACTION SUBPLAN

For each phase of emergency management the triggers for response and emergency actions under this EASP are outlined in Table 1. **Table 1** also lists actions to be taken by Council prior to triggers being met. It is envisaged that the SES would be involved if a significant number of dwellings or persons at Wooli were threatened and/or a coastal erosion event coincided with a major flood event, whether or not evacuation from the original Wooli Village was required. Any arrangements for evacuation would need to be coordinated by SES. A diagrammatic representation of the actions in Table 1 is shown in **Appendix 2**.

Table 1. Woolli Beach Emergency Action Sub Plan

NOTE: Actions are separated into Pre-Planning, Pre-Storm, Storm and Post-Storm phase stages to assist Council's management of coastal erosion emergency event management. Whilst actions are listed in an order it is not necessary that each action is taken after another (especially in the same phase or stage) and different actions will often need to be implemented concurrently by the relevant designated officer/s or their delegate/s.

Category	Trigger	Responsible Council Officer	Action /Reporting
Pre-Planning	Pre-planning for possible storm event should be undertaken as soon as possible	CVC WHS Officer	WBPLAN 1. Coordinate preparation of WHS procedures (including risk assessment and Safe Work Method Statement) with relevant CVC Managers and WHS Officer for dealing with storm debris (including materials containing asbestos) and access to the beach for sandbag/sand installation or any post-storm activities, eg clean up and repair of beach accesses. Training for personnel involved in such works to be provided (as relevant).
		CVC Environmental Planning Coordinator	WBPLAN 2. Compile phone numbers of relevant contacts in case of a storm event (e.g. internal Council contacts, OEH, SES, NSW Police, coastal/geotechnical engineer (not CVC-employee), other relevant stakeholders - Wooll Post Office, Wooll Motel, Wooll Bowling Club and owners of land (containing a dwelling/s) within the immediate hazard zone) similar to shown in Section 3. The completed contact list (including owner/s, names and phone numbers) shall be attached as a Schedule to the final Plan (for CVC use only and will not be provided on publicly available versions of this EASP). (NOTE: Schedules attached to this EASP are not part of the formal EASP and can be modified according to operational needs without the need to formal amendment of the EASP under the Coastal Protection Act 1979 and associated procedures).
		CVC Environmental Planning Coordinator	WBPLAN 3. Make landowners of land (containing a dwelling) within the immediate hazard zone aware of the Woolli hazard lines and zone of reduced foundation capacity (ZRFC) and where their properties/dwellings are positioned in relation to these - advise owners of properties affected by the immediate hazard line that their dwellings and/or outbuildings

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Category	Trigger	Responsible Council Officer	Action /Reporting
			would be at risk of damage or destruction in a severe storm event – advise residents and non-resident owners of actions that could be taken in advance to reduce losses (e.g. make arrangements to move valuables, secure outdoor furniture, etc, consider options and requirements for placement of TCPW (including storage of materials and certification prior to placing TCPW on public land), seek engineering report on structural adequacy if in ZRFC, review effluent management, and monitor ocean and property conditions, weather warnings and follow the advice of CVC and/or SES)
		CVC Environmental Planning Coordinator	WBPLAN 4. Survey the location of the landward edge of the dune escarpment at least annually and update list of properties/landowners in immediate hazard zone (IHZ) and ZRFC in Schedule 1 (this Schedule is for CVC use only and will not be provided on publicly available versions of this Subplan). (NOTE: Schedules attached to this EASP are not part of the formal EASP and can be modified according to operational needs without the need to formal amendment of the EASP under the Coastal Protection Act 1979 and associated procedures).
		CVC Environmental Planning Coordinator	WBPLAN 5. Issue updated advises to landowners of properties affected by IHZ or ZRFC (as above) where ownership or circumstances have changed or at least once every 5 years. When applicable suggest that landowner/s seek independent geotechnical engineering advice in relation to the potential impact on any structure from changing geotechnical conditions, and review status of any development consent containing triggers for relocation or removal of assets.
		CVC Environmental Planning Coordinator	WBPLAN 6. Survey the height of the dune adjacent to the Main Street/Riverside Drive intersection following significant erosion events or at least once every five(5) years as an indicator of the changing potential for dune break-through.
		CVC Environmental Planning Coordinator	WBPLAN 7. Develop media advice pro-forma/s for different phases of emergency management under this EASP consistent with Part 4 Preparation of the Clarence Valley Local DISPLAN. CVCs Environmental Planning Coordinator (and an alternate) shall be the

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Category	Trigger	Responsible Council Officer	Action /Reporting
			preferred contact for all enquiries from landowners and emergency agencies during and following a Council-managed coastal erosion emergency event. Contact details (email, direct phone number and mobile number) shall be provided to relevant persons/agencies/media on all media communications. The aim is to ensure consistent messages and continuity of contact to reduce stress for persons involved in such events.
		CVC Environmental Planning Coordinator	WBPLAN 8. Notify landowners (including any holders of Part 4C certificates for TCPW on public land) that access to the beach for the purposes of placing and managing TCPW shall be via the 4WD Access off South Terrace (see Figure 2) subject to being in a safe standard. (NOTE: Implementation of Actions WBSTORM 4, WBSTORM 5 or WBSTORM 6, or other circumstances, may require closure of the 4WD access from time to time for unknown periods)
		CVC Environmental Planning Coordinator	WBPLAN 9. Advise SES of CVC Coast and Estuary Committee meeting agendas and request Council to consider adding SES to the membership of this Committee for its 2018-2020 term.
		CVC Environmental Planning Coordinator	WBPLAN 10. Liaise with SES to prepare and distribute a local Coastal Erosion Guide (based on the SES Coastal Erosion Guide) to the local community.
		Manager Open Spaces and Facilities	WBPLAN 11. Ensure rigid barriers and beach closed signs (10) and road closed signs (4) are stored at the Wooli CVC depot premises sufficient to enable effective closure of all Council-managed pedestrian and 4WD beach access points to/from Wooli Beach and any affected roads or vehicle access tracks adjacent thereto.

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Category	Trigger	Responsible Council Officer	Action /Reporting
Pre-storm Phase	Significant offshore wave height is in the range of 3m to 5m and tides exceeding 1.8m are predicted at Fort Denison	CVC Environmental Planning Coordinator	WBPPE 1. Undertake web-based monitoring and reporting of weather, wave forecasts (Bureau of Meteorology/National Weather Service website) and beach conditions on a daily basis and record findings.
	Significant offshore wave height exceeds or is forecast (by Bureau of Meteorology) to be in the range of 5m to 7m and tides exceeding 1.8m are predicted at Fort Denison OR storm surge of at least 0.5m	CVC Environmental Planning Coordinator	WBPPE 2. Undertake web-based monitoring and reporting of weather, wave forecasts (Bureau of Meteorology/National Weather Service website) and beach conditions on a 12-hourly basis, eg 0600 and 1800 hrs, and record findings.
		CVC Environmental Planning Coordinator	WBPPE 3. Notify Manager Civil Services, Manager Open Spaces and Facilities and Manager Environment, Development and Regulated Services that a coastal erosion event is likely and for relevant Managers to make plans for post-event response, as applicable.
		CVC Environmental Planning Coordinator	WBPPE 4. Advise local community contacts and other stakeholders (see Section 3) of the likelihood of coastal erosion and provide updates (using pro-forma advices) so they can advise residents in the event that phones/power is cut.
		CVC Environmental Planning Coordinator	WBPPE 5. Advise Wooli residents/landowners (priority to owners of properties with dwellings in immediate hazard zone) of the likelihood of coastal erosion and actions they should take (e.g. monitor ocean and property conditions, weather warnings and comply with advice of CVC and/or SES., move valuables, install TCPW if safe and any necessary approval is current, dismantle outbuildings and/or securely store items/goods or yard furnishings).

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Category	Trigger	Responsible Council Officer	Action /Reporting
		LEMO/Executive support officer	WBPPE 6. Notify all appropriate persons including the Local Emergency Management Committee (LEMC) members, Mayor, OEH, SES Incident Controller, LEOCON, CVC staff, experienced coastal/geotechnical engineer (non-CVC) and have them on alert for an emergency meeting.
Storm Phase	A significant erosion escarpment forms (taken to be if the escarpment begins receding landward and is less than 10m from a built asset); Or There is a predicted increase in storm threat by a current BoM warning (ie waves predicted to exceed 7m and tides exceeding 1.8m OR storm surge greater than 0.7 metres)	CVC Environmental Planning Coordinator	WBSTORM 1. Increase frequency of monitoring web-based weather forecast information (eg Bureau of Meteorology/National Weather Service website) on a minimum 8-hr basis (eg 0600, 1400, 2200 hrs) and keep records of any weather warnings and/or reports of erosion.
		CVC Environmental Planning Coordinator	WBSTORM 2. Landowners/residents (as at Action WBPPE 5) informed (using pre-forma advices) of increased threat and advised to take action to reduce risk to life and property, continue to monitor ocean and property conditions, weather warnings, comply with advice from CVC and/or SES and to make preparations for potential evacuation. (NOTE: Council will not issue any direction to evacuate. Such direction would be issued by SES, if applicable)
		LEMO/Executive support officer	WBSTORM 3. Notify all appropriate persons including the Local Emergency Management Committee (LEMC) members, Mayor, OEH, SES Incident Controller, LEOCON, CVC staff, experienced coastal/geotechnical engineer (non-CVC) and have them on alert for an emergency meeting.
		Manager Open Spaces and Facilities	WBSTORM 4. Close the beach at all public access points (pedestrian and vehicular) managed by CVC by placing rigid barriers and erect 'Closed Beach' signs/s.
		Manager Open	WBSTORM 5. Close any vehicular access track or road that is immediately adjacent to, and

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Category	Trigger	Responsible Council Officer	Action /Reporting
		Spaces and Facilities/Manager Civil Services	directly leads to, an access point/s closed under Action WBSTORM 4 above by placing rigid barriers and erect 'Closed Road' signs/s.
		Manager Open Spaces and Facilities	WBSTORM 6. Prevent public access/use while beach or public accessways are deemed to be unsafe by closure of formal public access tracks. Safety to be assessed by a CVC Engineer or Health and Building Surveyor (as relevant) with suitable qualifications and experience (or a consultant where Council does not have expertise in house). Minor beach scraping works to enable continued and safe public access may be implemented adjacent to the public beach access points where adequate sand and funding is available. (NOTE: Potential for asbestos to be present on the beach if structures (including fences) have been washed or fallen onto the beach as a result of erosion or storm conditions)
		Manager Open Spaces and Facilities	WBSTORM 7. Vehicular access to the beach (for authorised vehicles only) during a coastal erosion emergency event shall be via the 4WD beach access off South Terrace, Woolli (refer to Figure 2) only where safe to access. If not safe, then close/barricade off the access. If necessary, minor scraping works (to the minimum extent necessary) may be undertaken to make beach access safe by adding natural beach sand material to the access point where adequate sand and funding is available.
		Manager Environment & Open Spaces	WBSTORM 8. Monitor erosion escarpment position (using photos or measurements), location and any 'rip head' formation and forward these to the CVC Environmental Planning Coordinator.
	A significant erosion escarpment forms (taken to be if the escarpment begins receding landward and is less than 5m from a built asset)	LEMO/Executive support officer	WBSTORM 9. Arrange emergency meeting with LEMC, Mayor, OEH, SES, CVC staff, a professional engineer (not CVC-employed) and any other relevant stakeholders to determine whether evacuation measures should be implemented – report on current situation – record outcome. (NOTE: Any evacuation shall be undertaken under direction of the SES in accordance with the Clarence Valley Local Flood Plan)

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Category	Trigger	Responsible Council Officer	Action /Reporting
		CVC Environmental Planning Coordinator	WBSTORM 10. Regularly monitor web-based weather forecast information (eg Bureau of Meteorology/National Weather Service website) on a minimum 8-hr basis (eg 0600, 1400, 2200 hrs) and keep records of any weather warnings/ reports of erosion
		CVC Environmental Planning Coordinator	WBSTORM 11. Organise site inspection by a professional engineer experienced in coastal engineering for post-event assessment and reporting.
		Manager Open Spaces and Facilities	WBSTORM 12. Take photos and/or observations (at least every 6-8 hrs) of the erosion escarpment and beach features and forward to CVC Environmental Planning Coordinator for reporting. Liaise with a professional engineer experienced in coastal engineering (not a CVC-engineer) for advice on updated reports.
Post-storm Phase	Storm has abated and it is safe to conduct post-storm activities	CVC Environmental Planning Coordinator	WBPOST 1. Advise Manager Civil Services, Manager Open Spaces and Facilities and Manager Environment, Development and Regulated Services (as applicable) to assess damage, repair needs and/or post-storm management to public property, roads, services, parks/reserves, on-site effluent management systems, public beach access points, dwellings, etc.
		CVC Environmental Planning Coordinator	WBPOST 2. Organise professional engineer (not CVC-employed) to be available to assess private dwelling-houses, other non-Council buildings, and Council assets in imminent danger of collapse due to proximity to eroded dune escarpment or within ZRFC, and to assess potential dune modification or management to provide acceptable public safety and to determine safety for continued occupation of buildings (see also Actions WBPOST 3, 11 and 14).
		CVC Environmental	WBPOST 3. Advise landowners of properties impacted or threatened by coastal erosion

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Category	Trigger	Responsible Council Officer	Action /Reporting
		Planning Coordinator	during the storm and/or thereafter, eg due to residual dune slumping, to seek independent advice from a qualified coastal or geotechnical engineer to assess damage/threat/remedial measures needed (see also Actions WBPOST 2 and 11).
		CVC Environmental Planning Coordinator	WBPOST 4. Arrange for an identification survey of the beach levels and other features e.g. erosion escapements, dune blow outs, dune height adjacent to Main Street/Riverside Drive intersection, location of dwellings to dune, etc
		CVC Environmental Planning Coordinator	WBPOST 5. Document location of dwellings in relation to the dune escarpment and update Schedule 1 and issue updated advice to affected landowners.
		CVC Environmental Planning Coordinator	WBPOST 6. Liaise with OEH to determine any changes to the coastline and any new areas at risk
		CVC Environmental Planning Coordinator	WBPOST 7. Review the Woolf Beach Emergency Action Subplan (EASP) and following debrief meeting (see Action WBPOST 16) seek endorsement of any changes by both Council and OEH.
		CVC Environmental Planning Coordinator	WBPOST 8. Review and collate all records of the storm event, actions taken prior to and during storm event, lessons learned, photos of the event and retain for future reference. Report and discuss outcomes at debrief meeting (see Action WBPOST 16).
		CVC Environmental Planning Coordinator	WBPOST 9. Review the Woolf Beach Coastal Zone Management Plan in consultation with other stakeholders.
		Manager Environment, Development and	WBPOST 10. Council staff and/or private consultants to inspect lands containing effluent management systems that may be adversely impacted by erosion and make recommendations as necessary to reduce potential environment or public health impacts.

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Category	Trigger	Responsible Council Officer	Action /Reporting
		Regulated Services	
		Manager Environment, Development and Regulated Services	WBPOST 11. Council staff to determine the need for issue of orders relating to the structural integrity and continued occupation of damaged structures, especially dwellings, in association with advice from non-CVC engineer (see also Action WBPOST 2).
		Manager Open Spaces and Facilities	WBPOST 12. Coordinate general cleanup and restoration works to public beach accesses/4WD access and remove any hazardous materials from the beach in accordance with adopted SWMS (see Action WBPLAN 1 and WBPOST 12). <i>(NOTE: Potential for asbestos to be present on the beach if structures (including fences) have been washed or fallen onto the beach as a result of erosion or storm conditions)</i>
		Manager Open Spaces and Facilities	WBPOST 13. Vehicular access to the beach after an erosion event shall be via the 4WD beach access off South Terrace (refer to Figure 2) or alternatively the vehicle access adjacent to the northern breakwall. The closest, safest access shall be chosen at the time. If necessary, minor scraping works (to the minimum extent necessary) may be undertaken to make beach access safe by adding natural beach sand material adjacent to the access point where adequate sand and funding is available. <i>(NOTE: Potential for asbestos to be present on the beach if structures (including fences) have been washed or fallen onto the beach as a result of erosion or storm conditions)</i>
		Manager Open Spaces and Facilities	WBPOST 14. Erect relevant safety warning signs and barricading where unstable dune escarpments present a public safety hazard. In high use areas consider options to collapse the erosion escarpment to a more stable slope using machinery and after consultation with OEH, Crown Lands, adjacent landowners and a professional engineer experienced in coastal engineering (not CVC-employed)

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Category	Trigger	Responsible Council Officer	Action /Reporting
		Manager Open Spaces and Facilities	WBPOST 15. Maintain closure of public and vehicular access while beach, accessways or parts of Reserve are deemed to be unsafe. Safety to be assessed by a CVC Engineer or Health and Building Surveyor (as relevant) with suitable qualifications and experience (or a consultant where Council does not have expertise in house). Minor beach scraping works to enable continued and safe public access may be implemented where adequate sand and funding is available. <i>(NOTE: Potential for asbestos to be present on the beach if structures (including fences) have been washed or fallen onto the beach as a result of erosion or storm conditions)</i>
		LEMO/Executive support officer	WBPOST 16. Coordinate a debrief meeting as soon as practical post-event with the LEMC, relevant Council Managers and other CVC staff involved in response, SES (including local Yuraygir Controller), and OEH. Document recommended changes to the EASP.

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3 CONTACT LIST FOR EMERGENCY ACTION SUB PLAN

The following list of contacts indicates the range of persons that should be included on a contact list for the purposes of implementing this EASP.

A completed list shall be prepared and maintained periodically and attached as a Schedule to this EASP for internal CVC staff use only due to confidentiality of contact information.

(NOTE: Schedules attached to this EASP are not part of the formal EASP and can be modified according to operational needs without the need to formal amendment of the EASP under the Coastal Protection Act 1979 and associated procedures).

Title/Contact	Name	Phone Number
CVC Environmental Planning Coordinator (and alternate):		
CVC Mayor:		
CVC Manager Civil Services (and delegate):		
CVC Manager Environment, Development and Regulated Services (and delegate):		
CVC Manager Open Spaces and Facilities (and delegate):		
CVC LEMO/Executive support officer (and alternate):		
SES Region controller:		
OEH representative (and alternate):		
Wooli Post Office:		
Wooli Motel:		
Wooli Bowling Club:		
NSW Police (Wooli Station):		
Consultant Coastal Engineer (TBA):		
Owners of land in IHZ (east side of Main Street as per Schedule 1)		

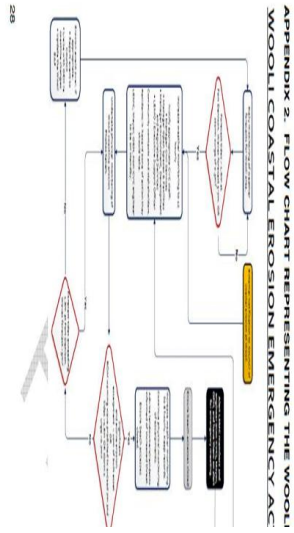
4 REFERENCES

- Clarence Valley Council (2014) Local Disaster Plan (DISPLAN) for Clarence Valley Council Local Government Area. February 2012 (incorporating minor updates of May 2013 and October 2014).
- OEH (2011) *Coastal zone management guide note: Emergency action subplans* (July 2011)
- OEH (2013) Code of Practice under the Coastal Protection Act 1979 (August 2013)
- OEH (2013b) *Guide to the Statutory Requirements for Temporary Coastal Protection Works* (August 2013)
- SMEC Australia (2013) *Brooms Head Beach Coastal Processes and Hazard Study. Project No 30011071, April 2013. Prepared for Clarence Valley Council*
- SES (2012) Clarence Valley Local Flood Plan – A sub plan of the Clarence Valley Local Disaster Plan (DISPLAN), June 2012.
- SES (2013) NSW State Storm Plan - A Sub Plan of the State Emergency Management Plan (EMPLAN), September 2013.
- SES (2015) NSW State Flood Sub Plan – A Sub Plan of the State Emergency Management Plan (EMPLAN), March 2015.
- WorleyParsons 2010a, *Wooli Beach Village Review of Coastal Hazards*
- WorleyParsons 2010b, *Wooli Village Coastline Management Strategy Update and Options Review*

APPENDIX 1

POTENTIAL LOCATION OF RIVERBANK/DUNE BREAKTHROUGH – WOOLI BEACH





APPENDIX B CZM PRINCIPLES, GOALS AND OBJECTIVES

NOTE: This Appendix was prepared to provide technical assessment to support the preparation of the Draft CZMP. Consultation with other public authorities on the draft CZMP raised a number of issues or concerns. In consideration of these concerns, Council resolved in December 2015 to remove actions proposing the extraction of sand from Yuraygir National Park as part of the beach nourishment scheme and investigation of a land swap scheme as part of the final, Council-endorsed Draft CZMP. The National Parks and Wildlife Service and Department of Primary Industries – Lands do not agree to the respective actions. Any reference to these actions in this Appendix has been retained to ensure the integrity of the original draft Appendices while noting that the final, Council-endorsed Draft CZMP has not included these actions.

Coastal Zone Management Principles

The 2013 OEH *Guidelines for Preparing Coastal Zone Management Plans* 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*.

Section 3 of the *Coastal Protection Act 1979* sets out objectives 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.

The proposed BNS acknowledged to be inconsistent with the NSW Coastal Policy 1997, in particular Strategic Action 5.2.9, due to the proposal to source sand from within Yuraygir National Park. CVC considers that this inconsistency is justified in the circumstances of the case. Current legislation would require amendment in order to enable the sand extraction and revocation of part of the Yuraygir National Park. This would appear to be the most efficient solution as Strategic Action 5.2.9 of the NSW Coastal Policy would still ensure environmental impact assessment if the land has a different tenure, eg Crown land.

Table B.1 summarises CZMP principles, goals and objectives.

Matters to be dealt with in Coastal Zone Management Plans

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

- (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).

Table B.1 Coastal Zone Management Principles, Goals and Objectives

Guidelines for Preparing CZMPs Principles	Coastal Protection Act Objectives	NSW Coastal Policy Goals
<p>1. Consider the objectives of the <i>Coastal Protection Act 1979</i> and the goals, objectives and principles of the <i>NSW Coastal Policy 1997</i>.</p>	<p>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.</p>	<p>Providing for ecologically sustainable development and use of resources.</p>
	<p>To recognise and foster the significant social and economic benefits to the State that result from a sustainable coastal environment, including:</p> <ul style="list-style-type: none"> - 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. 	<p>Providing for ecologically sustainable human settlement in the coastal zone. Protecting and enhancing the aesthetic qualities of the coastal zone.</p>
	<p>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.</p>	<p>-</p>
	<p>-</p>	<p>Protecting and conserving the cultural heritage of the coastal zone.</p>
<p>2. Optimise links between plans relating to the management of the coastal zone.</p>	<p>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.</p>	<p>Providing for integrated planning and management of the coastal zone.</p>
<p>3. Involve the community in decision-making and make coastal information publicly available.</p>	<p>To recognise the role of the community, as a partner with government, in resolving issues relating to the protection of the coastal environment.</p>	<p>Providing information to enable effective management of the coastal zone.</p>

Guidelines for Preparing CZMPs Principles	Coastal Protection Act Objectives	NSW Coastal Policy Goals
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.
5. The priority for public expenditure is public benefit; public expenditure should cost-effectively achieve the best practical long-term outcomes.	-	-
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.	-	-
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.	-

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.
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.
10. Support recreational activities consistent with the goals of the NSW Coastal Policy.	To promote beach amenity.	as above

APPENDIX C SUMMARY OF BACKGROUND REPORTS

NOTE: This Appendix was prepared to provide technical assessment to support the preparation of the Draft CZMP. Consultation with other public authorities on the draft CZMP raised a number of issues or concerns. In consideration of these concerns, Council resolved in December 2015 to remove actions proposing the extraction of sand from Yuraygir National Park as part of the beach nourishment scheme and investigation of a land swap scheme as part of the final, Council-endorsed Draft CZMP. The National Parks and Wildlife Service and Department of Primary Industries – Lands do not agree to the respective actions. Any reference to these actions in this Appendix has been retained to ensure the integrity of the original draft Appendices while noting that the final, Council-endorsed Draft CZMP has not included these actions.

Wooli Beach Coastline Hazard Definition Study (Patterson Britton & Partners (PBP) 1997a)

This report defined coastal hazards at Wooli Beach. It noted that long term retreat of Wooli Beach by as much as 23 m had occurred between 1942 and 1984. Sediment movement leaving the compartment was stated to be 10 times greater than that entering the compartment, which was resulting in beach recession. Recession was reported to have occurred at a similar rate before and after the construction of training walls at the Wooli Wooli River entrance in the 1970s. Following the construction of the training walls, Jones Beach was reported to have accreted 30 m between 1972 and 1984.

A comparison of hydrographic surveys, concluded that:

- A net balance of 10,700 m³ of sand had accumulated in the entrance area of the lower estuary between 1963 and 1972, resulting in an average loss of depth of approximately 0.1 m.
- A net balance of 7,900 m³ of sand had accumulated in the lower reaches between the [former] fishing cooperative facilities and the entrance bend (approximately 900 m) over the period between 1981 to 1992. This volume represented an average loss of depth of 0.07 m in this area (900 m long by 125 m wide).
- The entrance training works had not had an impact on the sedimentation and the 'natural' accumulative rate was previously determined by the Geological Survey to be 1,100 m³/yr.

Wooli Beach Coastline Management Plan (PBP 1997b)

The former Ulmarra Shire Council adopted this Coastline Management Plan in March 1998, with the main action for managing coastline hazards at Wooli based on property relocation and buy-back. Beach scraping, dune rehabilitation and development controls were also included as management actions.

However by the time of the 2010 CMP review (details follow in this Appendix) no houses had been voluntarily moved or offered to Council for sale, and only limited beach scraping and complementary dune management programs had been implemented.

Wooli Wooli River Floodplain Management Plan (PBP 1999)

This Plan identified preferred options to address the flood hazard at Wooli including the following:

- Evacuation planning.
- Wooli Wooli River entrance works (options to be considered for further investigation and modelling were construction of a flood overflow across Jones Beach, removal of the monument area, removal of the existing low wall at the entrance and changing the direction of flow of the river mouth).
- Dredging (dredging the Wooli Wooli River from the entrance to the bowling club to increase the conveyance capacity of the river channel following preparation of a dredge plan, assessment of environmental impacts and investigations into the potential use of dredged material to mitigate dune erosion on Wooli Beach).

Wooli Wooli River Estuary Management Plan (BMT WBM 2009) and Wooli Wooli River Estuary Processes Study (WBM 2006)

The processes study included discussion on sediment transport and riverbank conditions. The river entrance was trained in the early 1970s and the earliest aerial photographs indicated that the entrance was in its current location, fixed to the south by coffee rock cliffs. However, the entrance location has altered over geological timescales.

Sediments in the river were described as being transported by tide, ocean swell, wind waves and freshwater flows. Ocean swell breaking near the entrance was reported to entrain marine sand, which was carried upstream by flood tides. Some of this sand was also noted to be re-entrained by ebb tides and flushed out of the estuary. Freshwater flows resulted in transport of sand and mud mainly as bedload, which is discharged into the ocean. Wind waves were noted as contributing to the reworking of the sands, particularly in the lower estuary.

Shoal patterns in many parts of the lower estuary were reported as remaining relatively stable over the last 50 years. Similarly, undisturbed river banks were relatively stable. However, where the wave climate had been altered as a result of recreational craft or human intervention had changed bank conditions (such as removal of riparian vegetation), bank erosion had occurred.

The Management Plan identified 22 strategies including to:

- Dredge navigation channels as required and as funding permitted (i.e. small scale dredging to provide a minimum navigation depth at an indicative cost of \$500,000 per dredging campaign).
- Renew, rationalise and install recreational facilities [some of which have been completed] such as additional picnic facilities, fish cleaning tables, boat-holding/ access pontoon adjacent to the boatramp, defined cycle/ walking track along South Terrace, interpretive signage and seating, additional boatramp at the northern end of Wooli Village.

Wooli Beach/ Village Review of Coastal Hazards (Worley Parsons (WP) 2010a)

This report reviewed and updated the coastal hazard lines previously defined by PBP (1997a). The storm demand for a 100 year Average Recurrence Interval (ARI) event was determined to be 220 m³/m. This value was estimated by Gordon (1987) for open beach rip heads on the exposed NSW coast, and was considered to be conservative in the absence of definitive information from available beach profile data. A comparison between the coastal hazards from the 1997 study and the updated 2010 study was provided in the report and is reproduced in **Table C.1**.

Table C.1 Comparison of 1997 and 2010 Investigations on Coastal Hazards

	1997 (PBP)	2010 (WP)
Beach Erosion		
Storm Demand	Unspecified	220 m ³
Average Landward Retreat	20 m (including slope readjustment)	20 to 25 m
Long Term Recession		
Average Long Term Recession	0.4 m/yr	0.4 m/yr (0.0 to 0.5 m/yr)
Photogrammetry Data	1942 to 1996	1942 to 2006
Climate Change		
SLR Projections (2050 / 2100)	0.22 m / 0.44 m	0.4 m / 0.9 m
Active Beach Slope	1 in 50	1 in 40
SLR Recession (2050 / 2100)	11 m / 22 m	17 m / 42 m

Source: WP 2010a

Wooli Village Coastal Management Strategy Update and Options Review (WP 2010b)

This study reviewed options for coastal management strategies at Wooli Village and described the features of the study area around Wooli Village. The management strategies suggested in the report did not consider physical works south of the bowling club because the 2100 year hazard line approaches Wooli Wooli River, and in the long term the spit would not exist.

Wooli Village Draft Coastline Management Plan (WP 2010c)

This Plan proposed planned retreat to be implemented through environmental planning and development controls, and potential relocation of existing private and public assets at risk, to address the immediate and medium term coastline hazards affecting Wooli. A key component of the relocation scheme was investigating the potential for a land swap mechanism utilising Crown land in Wooli.

Activities Undertaken Since 2010

Since exhibition of the 2010 Draft CMP activities to support development of a new CZMP have included:

- Beach and dune surveys to establish baseline data for future monitoring.
- Housing inventory to help inform development controls and to integrate with other planning objectives.
- Further development of draft DCP controls.
- Beach monitoring (in partnership with the Wooli CCPA) including funding from the NSW Government.

- Monitoring cameras – installed by the Woolli CCPA with Council commitment to maintenance and reporting.
- Adoption of an Emergency Action Sub-Plan (EASP) (CVC 2012).
- Completion of a sand sourcing study by Royal HaskoningDHV (RHDHV 2015), see below.

Investigation of Feasibility of Utilising Sand Sources for Beach Nourishment in Vicinity of Woolli, NSW (RHDHV) 2015)

This study examined small and large potential sand sources. This covered sand sources in the Woolli Woolli River, at the northern end of Woolli Beach and in the adjacent dunes near Wilsons Headland, and offshore sand reserves off Woody Head and Cape Byron, between Wilsons Headland and North Solitary Island, and further offshore extending to 35 m water depths on the general vicinity of the Woolli Embayment. Surface sediment samples were collected at sites along the Clarence Valley coastline to characterise native beach and nourishment sand compatibility.

Expert advice on plant logistics was obtained on winning and transporting sand to Woolli Beach and other affected regional beaches for quantities of sand ranging from less than 10,000 m³ to 2,000,000 m³. The most feasible sand sources for moderate scale nourishment of Woolli Beach (provisional estimate 60,000 m³) were found to be back-passing from the northern portion of the beach (within Solitary Islands Marine Park (SIMP) and Yuraygir National Park) supplemented by dry-winning of sand from the adjacent dunes near Wilsons Headland (within Yuraygir National Park). This dual source was costed at between approximately \$26 and \$33/m³ depending on the sourcing split and subject to design development.

The proposed BNS is acknowledged to be inconsistent with the NSW Coastal Policy 1997, in particular Strategic Action 5.2.9, due to the proposal to source sand from within Yuraygir National Park. CVC considers that this inconsistency is justified in the circumstances of the case, as the sand located in the sand dunes adjacent to the northern end of Woolli Beach appears to be suitable quality, quantity and otherwise feasible to extract, transport and nourish Woolli Beach where current risk to private and public assets from coastal hazards is significant.



APPENDIX D COMMUNITY AND STAKEHOLDER CONSULTATION

CVC Coast and Estuary Management Committee

Preparation of this CZMP was overseen by the CVC Coast & Estuary Management Committee which has representatives from Council, Government agencies, the Coastal Communities Protection Alliance (CCPA) Inc – Wooli, and the general community.

Investigations for the management of coastal hazards at Wooli Beach have been ongoing since the mid-1990s, as has consultation which is discussed below.

1997 Coastline Management Plan

Consultation for this plan comprised the following.

- Two public meetings at Wooli in 1996 (advised by mail-out to foreshore property owners and notices to the general community provided to the Wooli Progress Association, Bowling and Recreation Club, Main Street Store, Kiosk and Hotel). Approximately 63 people attended the first meeting and 23 the second meeting.
- A series of focus group discussions at Wooli in 1997.
- Survey questionnaire to all private property owners (of the 187 questionnaires sent out, 107 were returned – note that some people/ families own more than one residence in Wooli and so the response rate was likely to be higher than indicated).

2010 Wooli Village Coastal Management Plan

The 2010 Coastal Management Plan (CMP) was based on a review of the 1997 Plan with consultation comprising:

- presentation to the CVC Coast and Estuary Management Committee in July 2010
- community drop-in-day at Wooli in September 2010
- public exhibition of Draft Plan.

The 2010 Draft CMP was publicly exhibited for approximately 35 days and resulted in 114 written submissions comprising 109 from the community and five from NSW agencies. All owners of land within Wooli as well as the Birrigan-Gargle Local Aboriginal Land Council (LALC) and relevant NSW agencies were invited to make comment through direct mail-out. This was supplemented by public display of documentation in Council offices and suitable business premises in Wooli. A summary of the issues raised and preliminary consideration is included in a report to Council, dated 17 July 2012. At that meeting Council resolved to further refine the Draft CMP, consistent with the direction indicated in the report to Council.

The exhibition of the Draft CMP was the catalyst to re-activate the Wooli community and their interest in coastal management issues. Perhaps the most significant outcome of that process was formation of the CCPA Inc.–Wooli as well as reinvigoration of the Wooli Dune Care Group. The CCPA promptly requested greater contact with, and input to, Council in regard to coastal management for Wooli Beach and the village. Council responded to that demand and a dialogue was quickly established between the CCPA, acting on behalf of its members, and Council.

This productive conversation ultimately led to CVC staff attending a CCPA meeting at Woolli in June 2012 to discuss a process for preparation of a revised CMP. Shortly after that meeting Council resolved to prepare a fresh CZMP.

Council had already been active in utilising the community-published *Woolli-Minnie Water-Sandon Community Newsletter* to engage with the local community on a range of planning matters, including progress on preparation of the Draft CMP and related documents. The method of engagement or consultation continued after the exhibition of the Draft 2010 CMP to provide the opportunity for non-CCPA members to be kept up-to-date on progress.

Consultation July 2012 to present

Council and the CCPA had developed a productive working partnership by July 2012 and since that time a working dialogue has been maintained with contact being made with the CCPA and local community on a needs basis. The range of matters that have been the subject of consultation with the CCPA and the Woolli community has included (in no order of priority):

- data collection and monitoring of coastal processes
- design of monitoring programs and seeking funding opportunities (private and government)
- data sharing
- discussing the scope, structure and implementation of a revised CZMP (including beach protection strategies)
- liaising on the placement of beach monitoring poles (both CCPA and Dune Care)
- assisting risk assessment and safe work procedures for beach survey work (including Council funding of training for community volunteers at quad bike handling course)
- dissemination of information on NSW Coastal Reforms
- assisting with provision of materials for the Woolli Dune Care's sand trapping program
- review/ updating of Council's public website pages for the Woolli CZMP
- inclusion of CCPA Executive member on Council's Coast and Estuary Management Committee
- potential for community involvement in data gathering and CZMP implementation and scope of technical briefs for further investigations at Woolli, e.g. Woolli sand sources investigation study.

Opportunities for informal and opportunistic engagement with residents and visitors, for example during field survey and monitoring works by Council staff, has assisted with provision of updates on beach behaviour and the coastal zone management planning process for Woolli Beach. In addition, Council has periodically provided information on coastal management news for publication in the *Woolli-Minnie Water-Sandon Community Newsletter* and these articles have always invited enquiry from the community.

This ongoing and continuing dialogue, including active involvement of OEH technical coastal officers, has contributed to an improved understanding of technical coastal issues and Government coastal policy within the Woolli community, and provided the opportunity for Council to clarify the intent of draft management actions contained in the 2010 Draft CMP. The Council and CCPA have worked together with the intention of improving coastal management and associated outcomes for Woolli, whilst recognising the need to progress preparation of a revised Draft CZMP. This community awareness, understanding and the working partnership with Council made a positive impression on the NSW Coastal Panel during their visit to Woolli in February 2015. Representatives of the CCPA made a deputation and actively participated in discussions with NSW Coastal Panel members, OEH and CVC staff during that visit. The opportunity for CCPA representatives to liaise with consultants undertaking the Woolli sand sources investigation study was also provided in February 2015. OEH coastal staff have advised that the cooperation between the CCPA and Council is encouraging and unique.

CVC has also contacted NPWS (Yuraygir National Park), DPI-Marine Parks (Solitary Islands Marine Park), Commonwealth Department of the Environment (Solitary Islands Marine Reserve) and DoI - Lands for advice on their requirements in relation to sourcing and placing sand within land/ submerged land under the management of these agencies.

Other Coastal Information Dissemination

In addition to the above consultation and engagement, Council has provided information on coastal hazard and coastal planning matters to customers, including the Woolli community as follows.

- Section 149 Planning Certificates – advice on coastal hazards, Council policy, coastal protection works and charges, and limitations on complying development.
- Council Website – copies of the CMP (PBP 1997) adopted 1998, the 2010 WP reports (including a Draft CMP), development controls for coastal risk under Councils LEP and DCP, and the Woolli Beach Emergency Action Sub-Plan (EASP).
- EASP Implementation – liaison with local SES Controller to assist with monitoring and relay of information during coastal storm events.
- Customer enquiries – responding to enquiries about coastal hazards at Woolli (current and future) and development control provisions.
- Development advice - to landowners, proponents, surveyors, architects, etc on specific development proposals.

2015 Coastal Zone Management Plan

Consultation for this CZMP will comprise:

- presentation to the CVC Coast and Estuary Management Committee
- public meeting and drop-in session at Woolli
- public exhibition of Draft CZMP.

APPENDIX E COASTAL ENVIRONMENT AND COMMUNITY USES

NOTE: This Appendix was prepared to provide technical assessment to support the preparation of the Draft CZMP. Consultation with other public authorities on the draft CZMP raised a number of issues or concerns. In consideration of these concerns, Council resolved in December 2015 to remove actions proposing the extraction of sand from Yuraygir National Park as part of the beach nourishment scheme and investigation of a land swap scheme as part of the final, Council-endorsed Draft CZMP. The National Parks and Wildlife Service and Department of Primary Industries – Lands do not agree to the respective actions. Any reference to these actions in this Appendix has been retained to ensure the integrity of the original draft Appendices while noting that the final, Council-endorsed Draft CZMP has not included these actions.

ADDITIONAL NOTE: Further to the above NOTE it is advised that the National Parks and Wildlife Service confirm that they do not support revocation of part of Yuraygir National Park as the most efficient solution to sourcing sand for the beach nourishment scheme. The final CZMP does not propose any revocation of part of the Yuraygir National Park in order to source sand for beach nourishment or other purposes.

Land Use and Zoning

Figure E.1 shows the location of National Park, Marine Park, Crown land and Council managed lands in the vicinity of Wooli.



Figure E.1 Land Tenure and Management

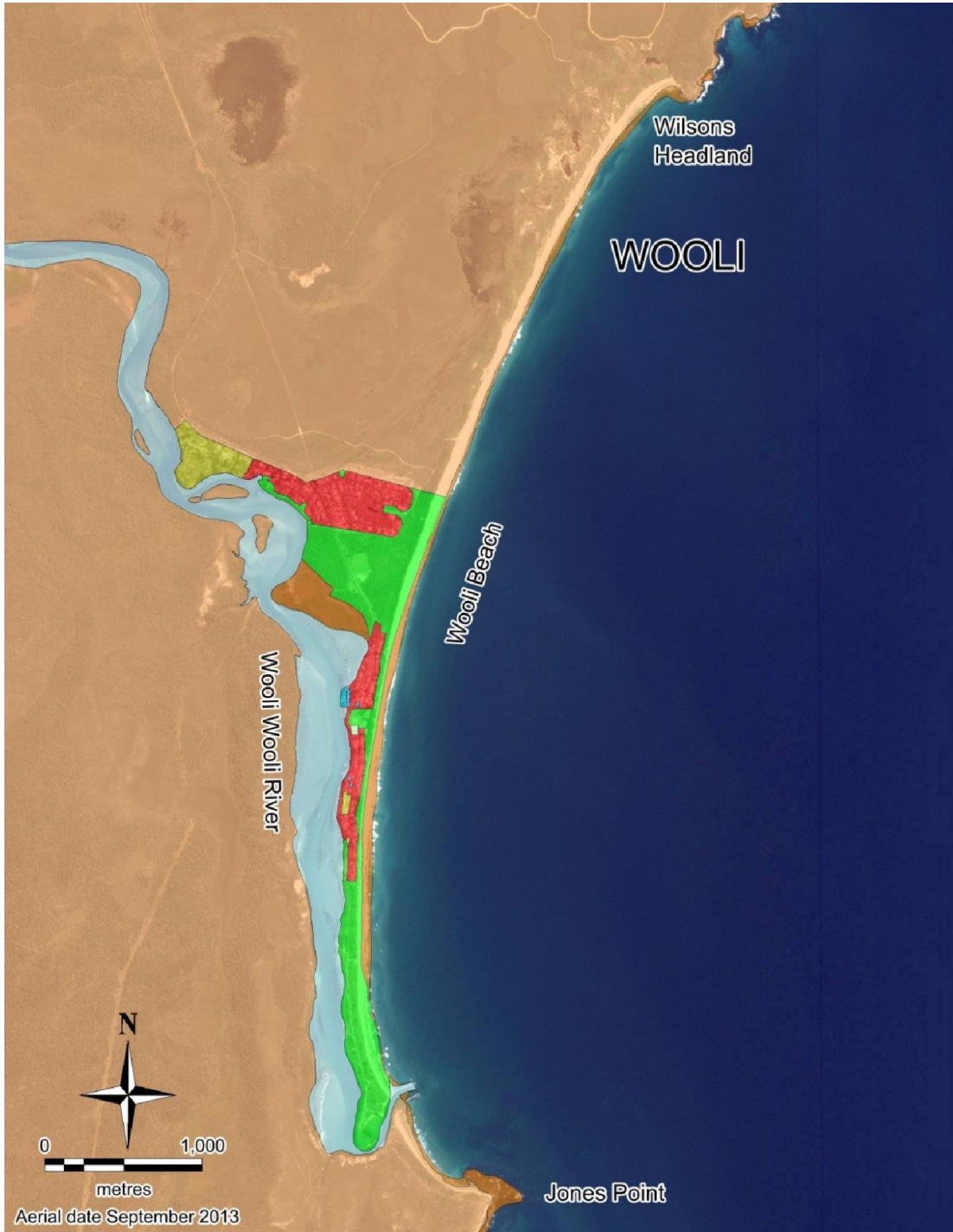


Figure E.2 Land Use Zoning

Separate plans guide the management of Yuraygir National Park (YNP) and the Solitary Islands Marine Park (SIMP) under the *National Parks and Wildlife Act 1994* and *Marine Estate Management Act 2014* respectively. The boundary between YNP and SIMP is the MHW. The *Clarence Valley Local Environmental Plan (CV LEP 2011)* guides land use at Woolli and the Crown reserves are managed by the Clarence Coast Reserve Trust (CCRT) under the *Crown Lands Act 1989*.

The NSW Coastal Policy 1997, in particular Strategic Action 5.2.9, states that sand extraction will not be permitted in coastal national parks. In order to enable any sand extraction revocation of part of the Yuraygir National Park would appear to be the most efficient solution. Strategic Action 5.2.9 of the NSW Coastal Policy would still ensure environmental impact assessment if the land has a different tenure, eg Crown land, and sand extraction would not be effectively blocked through existing legislative provisions, eg *Environmental Planning and Assessment Act 1979* (section 92), *State Environmental Planning Policy (Infrastructure) 2007* (clause 129A) and *State Environmental Planning Policy No 71 – Coastal Protection* (clause 8) that call up the NSW Coastal Policy.

As shown in **Figure E.2**, under the *CV LEP 2011*, Woolli Beach is zoned E2 Environmental Conservation, the foreshore reserves RE1 Public Recreation and the residential area R2 Low Density Residential. Building heights along the beachfront are restricted to 6.5 m, with building heights a maximum of 9 m for the rest of Woolli. The Woolli Woolli River is zoned W1 Natural Waterways, with a small strip of W3 Working Waterways adjacent to water-based businesses.

Jones Beach is a Sanctuary Zone under the *SIMP Zoning Plan 2002*, with the remainder of the offshore area in the vicinity of Woolli being a Habitat Protection Zone. **Figure E.3** shows zoning under the *SIMP Zoning Plan 2002*.

Issues

- Existing land tenure, management and associated legislation to be considered in drafting and implementation of proposed management actions.
- Current legislation and/or National Park estate boundaries would require amendment in order to enable sand extraction for the BNS (as proposed) and revocation of part of the Yuraygir National Park would appear to be the most efficient solution as Strategic Action 5.2.9 of the NSW Coastal Policy would still ensure environmental impact assessment if the land has a different tenure, eg Crown land.
- Confirm the seaward boundary of the Yuraygir National Park and the landward boundary of the Solitary Islands Marine Park and any other administrative boundaries in the vicinity of Woolli Beach to ensure proper consideration of administrative and legislative requirements.

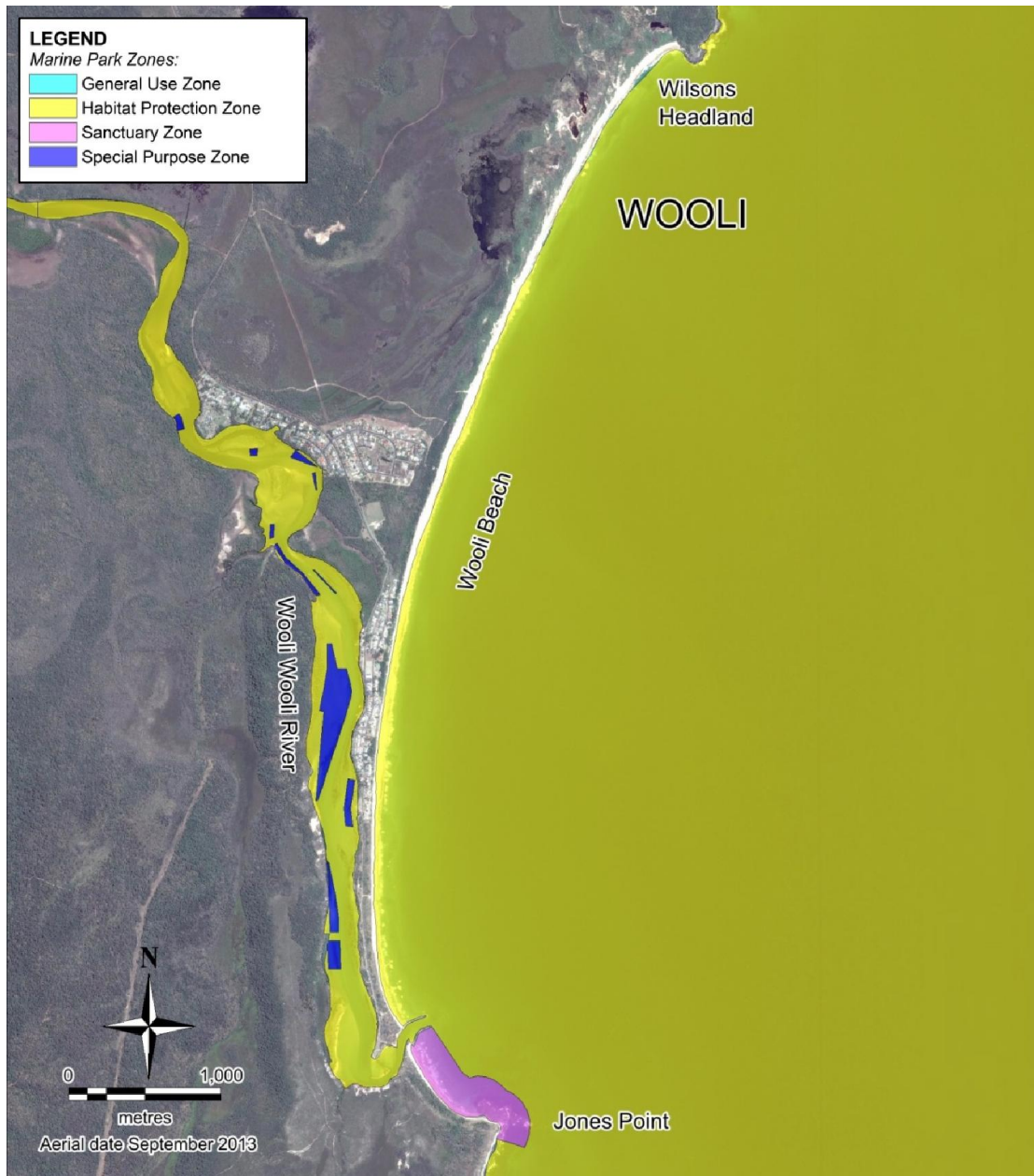


Figure E.3 Marine Park Zoning

Beach, Dune and River

Woolli Beach extends from Wilson Headland for 6.6 km to the northern breakwater of the trained entrance to the Woolli Woolli River. Jones Beach, to the south of the southern breakwater is 750 m long. From approximately 4 km upstream of the Woolli Woolli River entrance, the floodplain is restricted by sand hills and indurated sand cliffs to the west (up to 10 m high). The narrow, 3 km long spit to the east separates the ocean from the Woolli Woolli River (WP 2010b).

Beach dune heights along the spit are much lower than the sand hills to the west of the river, generally around 4 m to 6 m above Australian Height Datum (AHD) (AHD is approximately equal to mean sea level). At the northern end of the original Woolli Village the beach dunes are only 2 m to 3 m AHD (WP 2010b). North of Woolli, the dune system increases in width towards Wilson Headland (in places extending 500 m inland) and is backed by a low swampy area (PBP 1997a).

The entire Woolli Beach is well exposed to waves, which combine with fine sand to produce an energetic double bar system. The inner bar is usually attached with rips cutting across it every 300 m to 400 m, while the outer bar has more widely spaced rips. Jones Beach is a moderate energy, east-northeast facing beach. It is in the lee of a rocky reef that extends off the point. Wave height increases up the beach with a permanent rip against the southern Woolli Woolli River entrance wall (Short 2006).

Issues

- beach erosion (severe erosion in 1954, 1974, 1996 and 2009)
- dwellings located within hazard zones (25 identified in 1997, compared with 44 in 2010 affected by the immediate hazard line)
- pollution (potentially from onsite effluent disposal if impacted by erosion)
- water (vulnerability of water storage tower to coastal erosion as it is located on Woolli Spit)
- flooding (Woolli is subject to flooding from the Woolli Woolli River and when flooding is occurring in the adjacent Coldstream River catchment, road access to Woolli can be cut for up to a few days) (WP 2010b).

Native Vegetation

A vegetation survey was undertaken in 1997 (Peter Parker Environmental Consultants) for the 1997 CMP and flora and fauna surveys were undertaken in 2002 and 2005 by Land and Marine Management Strategies (LAMMS) as background to Crown Reserves Plans of Management.

Within Woolli Village remnant vegetation is fragmented into patches dominated by coast banksia *Banksia integrifolia*, broad-leaved paperbark *Melaleuca quinquenervia* and Port Jackson Fig *Ficus rubiginosa*. However, in some locations the banksia forest supports littoral rainforest species.

Vegetation types in the vicinity of Woolli are shown in **Figure E.4**.

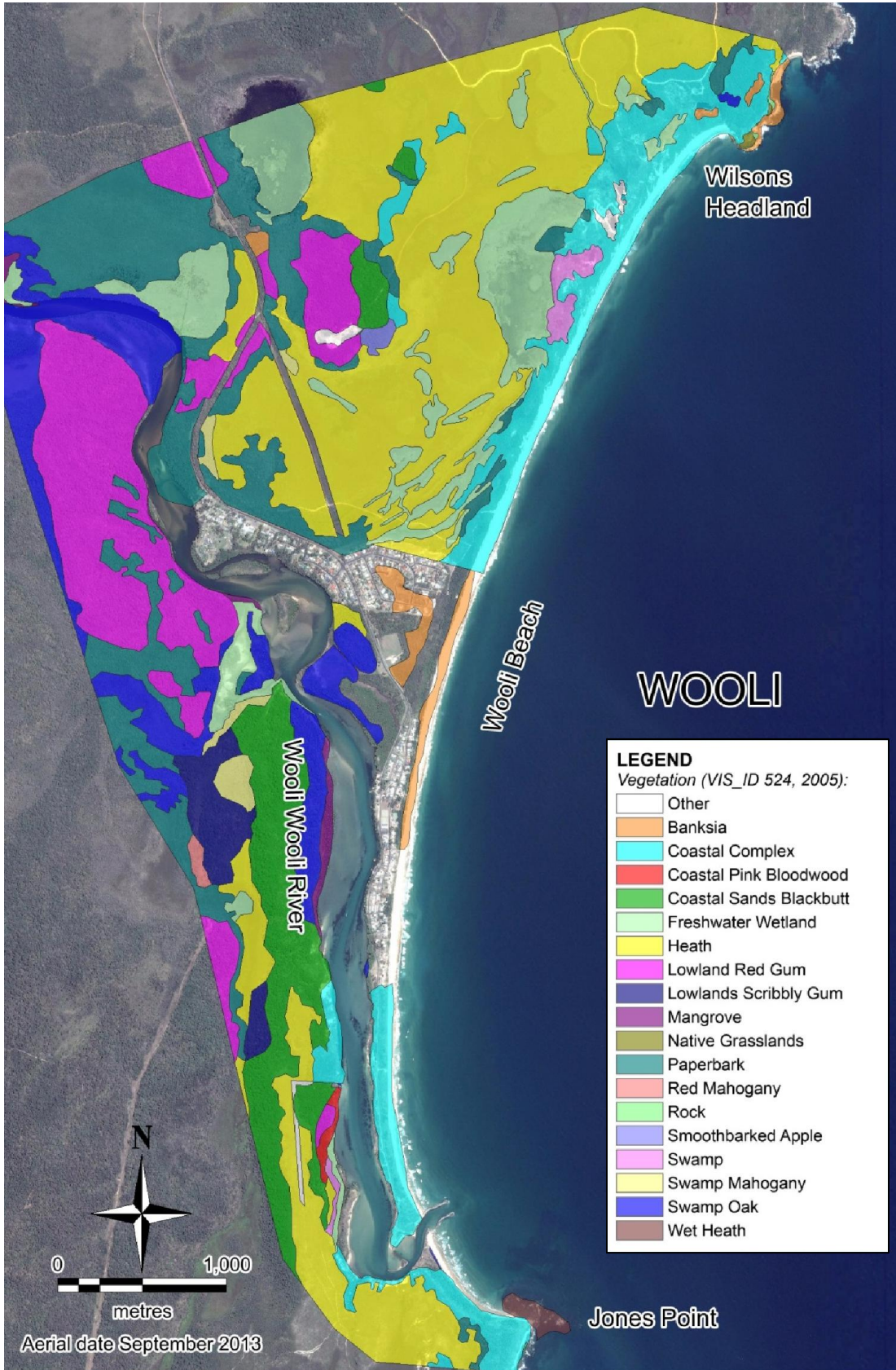


Figure E.4 Vegetation Types

Along the Woolli Woolli River, grey mangrove *Avicenna marina* occurs in more saline conditions than the river mangrove *Aegiceras corniculatum*, while milky mangrove *Excoecaria agallocha* occurs on the landward side of both species. Vegetation then grades from saltmarsh (including marine couch *Sporobolus virginicus* var. *minor*), to swamp forest further inland (Peter Parker 1997).

Vegetation Species and Communities of Conservation Significance

Six Endangered Ecological Communities (EECs) are considered to occur at Woolli:

- Lowland Rainforest on Floodplain
- Littoral Rainforest
- Coastal Saltmarsh
- Swamp Oak Floodplain Forest
- Swamp Sclerophyll Forest on Coastal Floodplains
- Freshwater Wetlands on Coastal Floodplains (CVC 2006).

LAMMS (2002) recorded one species, *Maundia triglochinosoides* (found in swamps or shallow freshwater), listed as vulnerable under the *Threatened Species Conservation Act (TSC) 1995* north of Woolli Road in the Woolli Centenary of Federation Reserve. In addition LAMMS (2005) recorded the endangered *Sophora tomentosa* (a shrub/ small tree) at the southern end of Woolli Spit. A further 10 species of conservation significance were recorded, including *Jacksonia stackhousii* (a shrub) which is at the southern limit of its distribution at Woolli (CVC 2006).

The area of mangroves, saltmarsh, sedgeland and swamp oak forest, adjacent to the Woolli Woolli River and between the northern and southern portions of Woolli is listed as *a State Environmental Planning Policy (SEPP) No. 14 Coastal Wetland*, See **Figure E.5**. In addition, mangroves are protected under the *Fisheries Management Act 1994*.

Figure E.5 also shows key habitat corridors in the vicinity of Woolli.

Issues

- vegetation damage (informal access/ 4WDs) and clearing (unauthorised clearing of reserves for views and grassed/ mown areas, reducing the extent of dune stabilising vegetation)
- weeds (garden 'escapees' and species previously used for dune stabilisation, e.g. the noxious weed Bitou Bush)
- Bushfires (damage to dune vegetation along South Terrace) (WP 2010b).



Figure E.5 Wetlands and Key Habitat Corridors

Foreshore and Beach Uses

The foreshore reserves and the beach provide opportunities for a variety of informal recreational activities including:

- swimming, surfing, sunbaking
- snorkelling (Jones Beach)
- walking on the beach and along foreshore reserves
- 4WDing on the beach
- fishing from the beach
- nature appreciation/ viewing the beach.

Public Access

Public Reserves adjacent to the beach at Wooli consist substantially of four Crown Reserves as described below. Clarence Valley Council (CVC) administers the CCRT which is the appointed Trust manager. Along with accessways from the end of several streets, these reserves provide access along and to the beach as follows.

- Williams Crescent Public Reserve in the northern part of Wooli is Council owned 'community' land and east of this at One Tree is Crown Reserve R1003020.
- Crown Reserve R1003020 is made up of parcels between the northern and southern portions of Wooli (Wooli Centenary of Federation Reserve) and the coastal strip adjacent to the northern portion of Wooli. This is reserved for public recreation and coastal protection and includes the Wooli Sportsground.
- Crown Reserve R56099 is comprised of three parcels on Wooli Spit (CWA Park and Wooli Lions Club) between the Wooli Wooli River and beach and is reserved for public recreation. This area contains the community hall, pre-school, tennis courts, cenotaph and Wooli bowling greens.
- Crown Reserve R97501, comprised of three parcels, is located either side of R56099 between the northern end of Wooli Spit and South Terrace and is reserved for sand drift.
- Crown Reserve R41752 is comprised of three parcels fronting properties on South Terrace and both sides of South Terrace and is reserved for public recreation (South Terrace Reserve). This contains Harold Lloyd Park, the boat ramp and a bike path (WP 2010b).

There are 13 formal access points to Wooli Beach including four 4WD tracks as shown in **Figure E.6**. The number of formal beach accessways is considered adequate.

There are also a number of access points to the Wooli Wooli River for foreshore recreation and boating. Use of the Wooli Wooli River includes oyster farming.

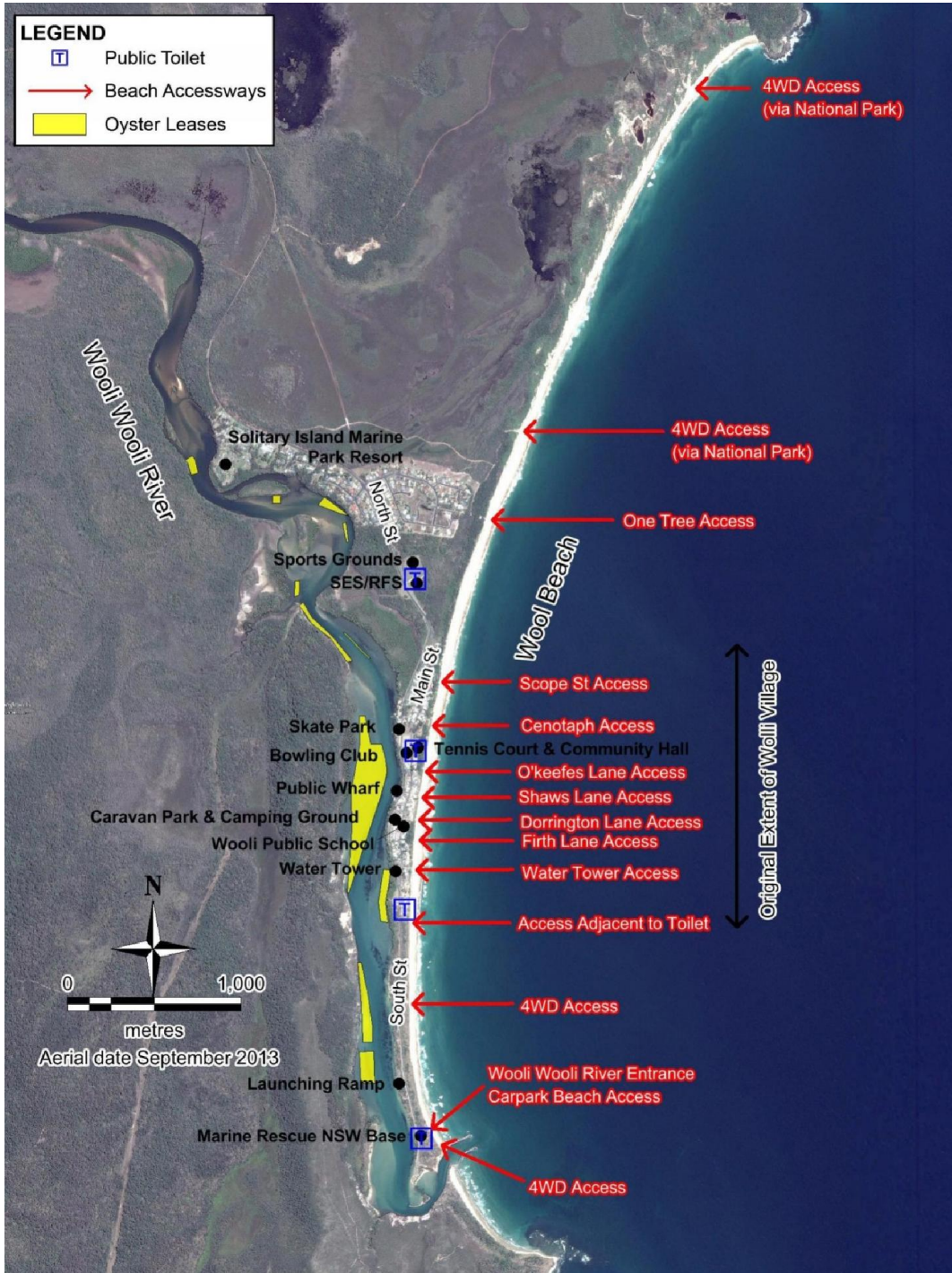


Figure E.6 Community and Other Uses

Issues

- design, safety and maintenance of formal beach access points
- public safety during/ following erosion events (i.e. collapse of dune escarpment)
- informal pedestrian access from individual properties or by beach goers through the frontal dune and associated erosion and potential for dune blow-outs
- damage to the incipient dune from 4WDs (WP 2010b).

Beach accessways have been subject to damage from erosion in the past. CVC formalised most of the public access points with large sandbags in 2006 to reduce erosion and provide safer and more secure beach access. Some accessways have degraded due to wear and tear, vandalism and erosion and maintenance is required (see **Plate E.1**). **Plate E.2** shows foreshore reserve and vegetation damage resulting from an unauthorised pedestrian access over the dune crest and erosion escarpment.



Plate E.1 Cenotaph Access



Plate E.2 Informal Access (CVC 2007)

Cultural Heritage

Wooli is an Aboriginal word meaning “Cedar Tree”. Aboriginal people from Yaegl country often camped in the Wooli area as the surrounding waters were known to contain a good source of food. European settlement resulted in conflict and a large-scale massacre of Aboriginal people was recorded in the 1920s at Lake Hiawatha to the north of Wooli. The Wooli Coastal Reserve and surrounding area contain a number of recorded Aboriginal sites including stone tool workshops, scarred trees, burials, middens and campsites (CVC 2006, WP 2010b).

A recent search of the Aboriginal Heritage Information System (AHIMS) indicated that 11 sites have been recorded in the vicinity of Wooli. Byrne (1985) identified four middens on the Wooli coast: one at the northern end of the spit, one at the northern end of the beach and two further north near Wilsons Head. Two of the middens at the northern end of the beach contained flaked-stone artefacts. Rooke (undated) noted that an area within the southern part of the original village contains sites under investigation for listing. CVC also needed to manage and reduce harm to a midden before and during construction of the South Terrace shared pedestrian-bicycle path.

Early European settlement in Woolli focused on oyster farming and fishing, with oyster leases dating back to 1885. Up until the 1890s there were few visitors to the Woolli Woolli River but by the early 1900s holiday makers from the surrounding Clarence Valley region started visiting the area. Woolli was officially declared a village in 1923 (CVC 2006, WP 2010b). Sand mining occurred during the 1960s and 1970s immediately north of the spit and into Yuraygir National Park (NPWS 2003 and DECC 2007).

Areas of Aboriginal Archaeological Sensitivity

Byrne (1985) identified the coast and coastal wetlands as zones of high archaeological sensitivity: i.e. foredunes/ backdunes especially near swamps/ lagoons and estuaries, and high ground near swamps/ estuaries in the coastal floodplain.

Non-Indigenous Heritage

There are no heritage items or heritage conservation areas identified for Woolli Village in the *CV LEP 2011* or items listed on the State Heritage Register under the *Heritage Act 1977*.

Issues

Issues affecting Aboriginal cultural heritage include potential damage to recorded and unrecorded Aboriginal sites from coastal erosion, informal access, and new development or redevelopment, especially any activities involving earthworks. It is likely that middens within areas sand mined would have been destroyed by those mining activities.



APPENDIX F COASTAL HAZARDS AND RISKS

The following summary of coastal hazards is largely reproduced from WP (2010b) as indicated in italics, supplemented information from the sand sourcing study (RHDHV 2015).

Coastal Erosion

From a review of aerial photography (April 1993 to June 1996) covering three significant storm events (i.e. March 1994, March 1995 and May 1996), erosion of the most developed area of Woolli Beach varied between 7.5 m and 15 m as a lateral movement in the erosion escarpment and between 75 and 150 m³/m as a beach volume loss (PBP 1997a). Undeveloped northern areas of Woolli Beach were found to respond differently to the southern beach areas. While southern areas displayed erosion there was actually a buildup of sand in the northern areas. This trend was reversed in the early 1980s with storms causing more erosion in the northern areas of the beach compared to the southern areas (PBP 1997a).

Since 1997, no major storm erosion events were identified in the updated photogrammetry analysis (i.e. up to 2006). However, the escarpment continued to recede during this time. Additionally there was a succession of significant ocean storms, in particular a severe storm event during late May 2009. A site inspection found that these storms left particular areas of the beach in a highly eroded state. Only limited beach recovery following the storms was observed at the time of the inspection in December 2009 (WP 2010a).

Analysis of more recent photogrammetry (2010 and 2013) for the sand sourcing study (RHDHV 2015) indicated that the beach prograded significantly between 2006 and 2013. This suggests that sand bypassing of the Woolli Woolli River entrance training walls may have re-established or increased over the past five years or so. Alternatively longer term weather systems may have changed, resulting in a localised accumulation of sand in the vicinity of Woolli Village. What is known is that the training walls were constructed in the early 1970s. These would have initially blocked all or some of the sand supply but eventually full sand bypassing would occur. Depending on the seaward extent of the walls, the rate of sand supply along the coast and cross-shore distribution of the sand as it moves along the coast, this may take many decades to re-establish.

Shoreline Recession

Cadastral and photogrammetric data show that shoreline recession has occurred at Woolli Beach over the last century. This recession has been fairly uniform over the length of the beach with the exception of localised fluctuations near the dune field at the northern end of the beach and localised progradation at Jones Beach (close to the entrance training wall), and at Woolli Beach (immediately north of the training wall) in the 1980s (PBP 1997a).

The recession at Woolli can be attributed to a deficit in the alongshore transport of sand which may be in the range of approximately 10,000 to 30,000 m³/yr (Department of Mineral Resources 1985, PBP 1997a). Windborne losses to the dune field at the northern end of the beach are likely to account for < 1,000 m³/yr and loss of sand to the flood tide delta inside the Woolli Woolli River for < 500 m³/yr. Losses offshore during extreme storm events are also possible but were not quantified (PBP 1997a).

Photogrammetry indicated that the Woolli Beach shoreline receded, on average, between 0.3 and 0.5 m/yr from 1942 to 1996 (PBP 1997a). Analysis of a longer record of photogrammetry profiles (1942 to 2006) [reported in the Woolli Beach/ Village Review of Coastal Hazards (WP 2010a)] shows a median recession rate of between 0.3 and 0.4 m/yr for the majority of Woolli Beach, with a higher rate of 0.5 m/yr recession fronting the southern end of the Woolli Spit. At the southern and northern ends of the beach the analysis indicated a generally prograding trend.

Coastal Entrance Behaviour

In the mid 1980s, drilling work undertaken by the Department of Mineral Resources revealed that the entrance to Woolli Woolli River had at one stage been 2 km north of its present day location. Radiocarbon dating established that infilling of the entrance began around 8,000 years ago, ceasing approximately 3,500 years ago. Consequently, the river breached the barrier and a new entrance formed approximately 700 m to the south and then migrated southwards to its present position (PBP 1997b).

Prior to construction of the Woolli Woolli River training walls, flood waters would overtop the sand spit at the entrance and scour out an enlarged passage for flood water to the ocean. Subsequent coastal wind and wave action would see the spit re-build until the next flood or fresh occurred. Over long dry spells the tidal entrance channel would significantly reduce in size. The entrance works were constructed between January 1970 and December 1971 (and modified in 1974) to stabilise the entrance location and provide safe navigation for fishing vessels (PBP 1997b). Prior to establishment of the Solitary Islands Marine Park, a commercial fishing industry operated from the Woolli Woolli River.

The narrow sand spit which separates the Woolli Woolli River from the sea is vulnerable to the erosive forces of floodwaters and potential break-through of a new entrance. Estimated peak flood levels at 11 Main Street were 2.41 m AHD in the 1954 flood and 2.36 m AHD in the 1974 flood (PBP 1997b). As noted in the Woolli Beach/ Village Review of Coastal Hazards (WP 2010a), the area at most risk is the northern end of the original Woolli Village. In this location, the 1% Annual Exceedance Probability (AEP) flood extent approaches the immediate coastal hazard line and overlaps the 2050 hazard line.

Impact of Climate Change

CVC adopted a Climate Change Policy in May 2010. The Policy was reviewed and amended in March 2013 (CVC, 2013) in response to the NSW Government's withdrawal of the NSW Government recommended benchmarks for sea level rise (including the NSW Sea Level Rise Policy Statement). CVC has now adopted sea level rise benchmarks for 2050 and 2100, of 40 cm and 90 cm respectively (increase above 1990 mean sea levels). The Policy requires that these benchmarks, as well as other climate change benchmarks, are incorporated in decision-making.

These projections or benchmarks, together with the long term recession rates, were used to produce the 2050 and 2100 hazard lines. Note that recession rates due to sediment loss transition to zero at Wilson Headland in the north and Jones Point in the south (WP 2010a).

Hazard Mapping

Refer to **Figure F.1** for location of the 2010, 2050 and 2100 hazard lines for the northern part of Wooli Beach and **Figure F.2** for the southern part of Wooli Beach. **Figure F.3** shows the location of a potential break through of the Wooli Wooli River.

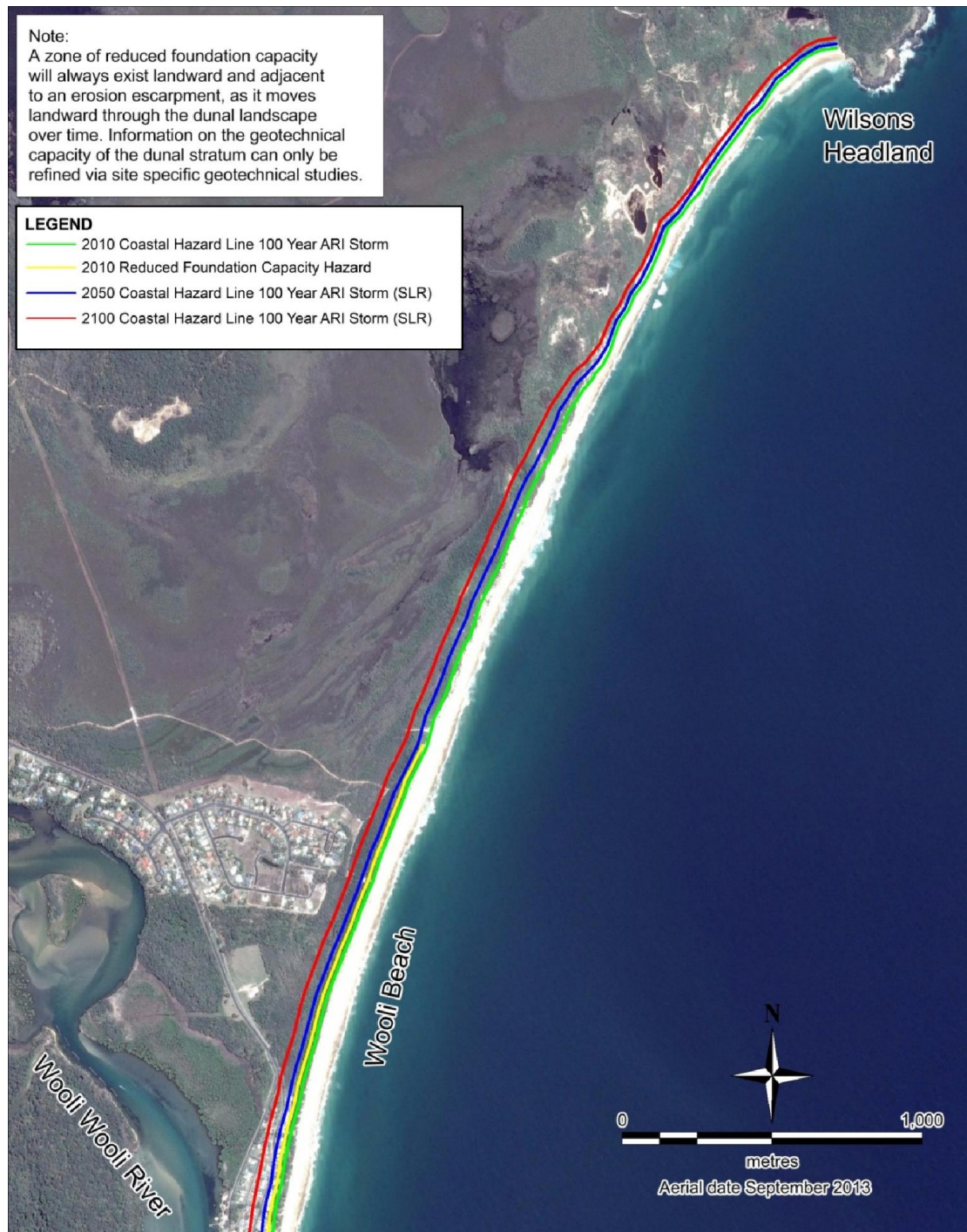


Figure F.1 Current and Projected Coastal Hazard Lines North Wooli Beach

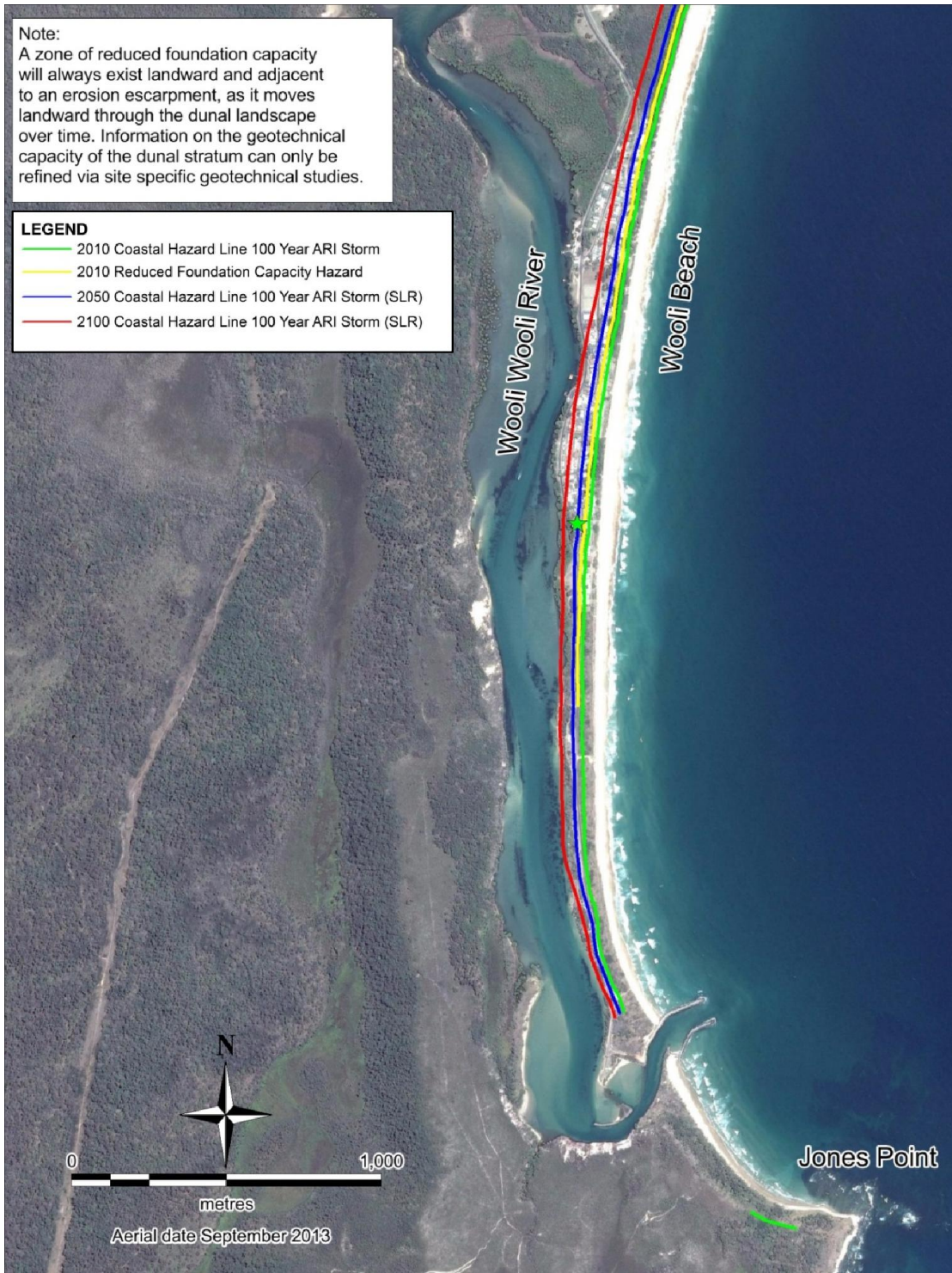


Figure F.2 Current and Projected Coastal Hazard Lines South Woolli Beach

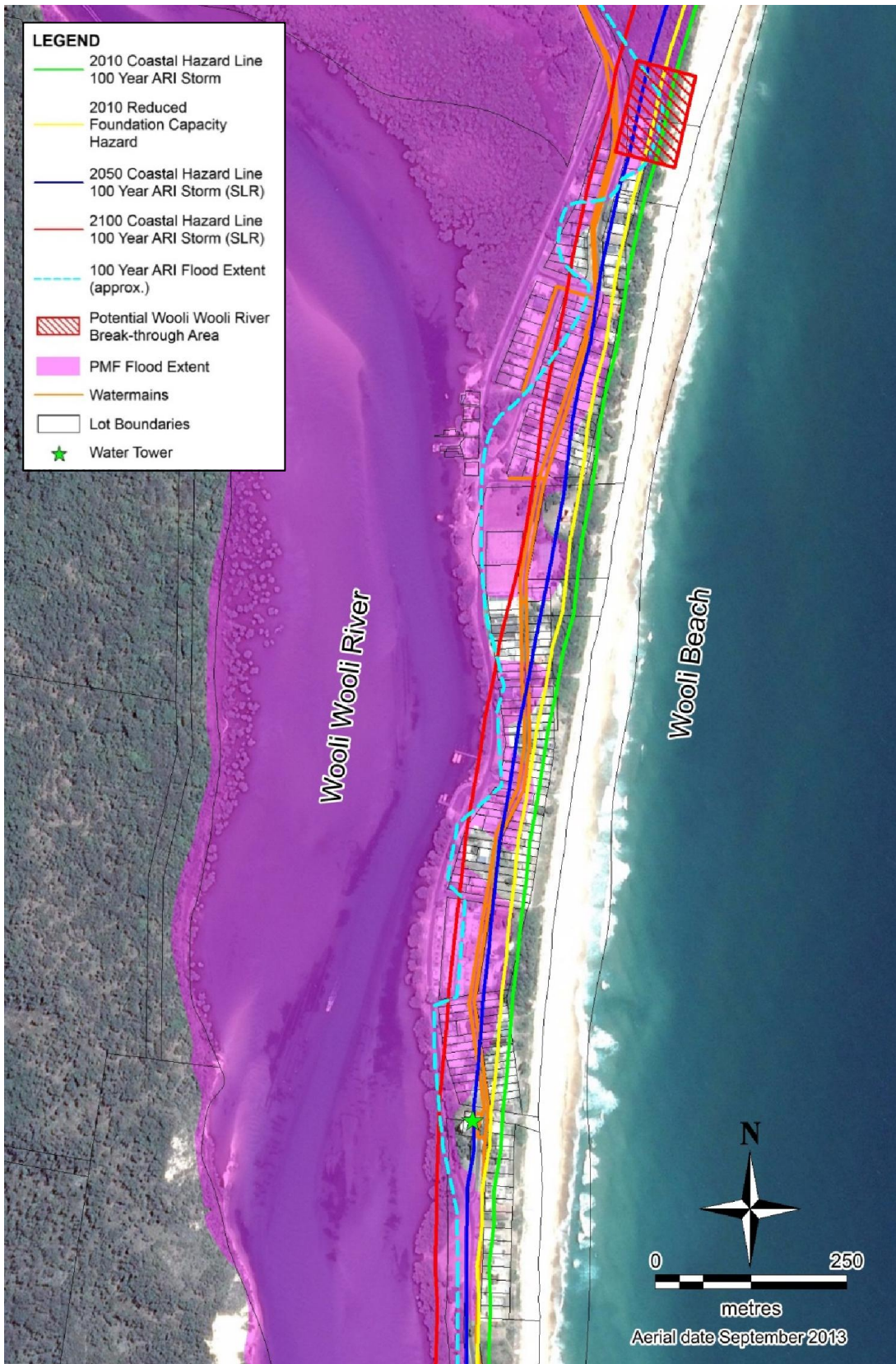


Figure F.3 Woolli Village Current and Projected Coastal Hazard Lines

Risks to Public Safety

During and following storm erosion events members of the public and foreshore property owners can be at risk if:

- observing beach conditions from the dune which is susceptible to erosion and collapse without warning during a storm event
- attempting to prevent damage to dwellings and other structures from coastal erosion
- collapse of the steep erosion escarpment to a more stable angle of repose following a storm event.

The Emergency Action Sub-Plan (EASP) (**Appendix A**) includes actions relating to community education on coastal erosion and emergency actions to mitigate risks to the public.

Assets at Risk

Figure F.3 shows hazard mapping for the original Woolli Village. From a review of data provided by Council in 2010, there were 422 rateable properties at Woolli. Of these properties, 182 were located in the original Woolli Village. From a review of accommodation data (Yuraygir First National, www.ycoast.com.au), 46 residential properties were holiday rentals with 36 of these located in the original Woolli Village (WorleyParsons 2010b).

CVC provides potable water to Woolli through a reticulated system with water pumped from Lake Hiawatha to a storage tower located on Woolli Spit. Water mains are shown in **Figure F.3**. Effluent disposal is by on-site management systems. Formal beach accessways were shown in **Appendix E** along with other public assets including the primary school and community hall.

Table F.1 lists the number of residential properties, businesses and public land affected by the hazard lines north of and including the bowling club for Woolli Spit (original Village). No properties in the northern section (new subdivision area) are affected by coastal hazards. As shown, 62 properties are affected by coastal hazards north of (and including) the bowling club in the original Woolli Village. Only 18 properties north of the bowling club in the original Woolli Village are unaffected by coastal hazards by 2100, however, these properties are subject to flood hazards. All 103 properties south of the bowling club are affected by coastal hazards, as shown in **Table F.2**. South Terrace is one of the areas most affected with 13 of the 14 dwellings located seaward of the immediate hazard line. Most dwellings along the dune in the two southern blocks of Main Street are also seaward of the immediate hazard line.

Table F.1 Assets at Risk from 100yr ARI Event – Original Village North of and including Bowling Club

Asset Type	Hazard Zone (cumulative totals)			
	Immediate	2050 (incl. SLR)	2100 (incl. SLR)	Unaffected
Residential	-	30	60	9
Business ¹	-	1	2	9
Public Land ²	4	5	6	0
Major Infrastructure			water main Main St and cross roads	-
Totals (excl. public land)		31	62	18

After: WP 2010b

1. Business includes the Post Office which is affected by the 2100 year hazard line.
2. Public land includes individual reserves.

Table F.2 Assets at Risk from 100yr ARI Event – Original Village South of Bowling Club

Asset Type	Hazard Zone (cumulative totals)			
	Immediate	2050 (incl. SLR)	2100 (incl. SLR)	Unaffected
Residential	44	64	99	-
Business	1	1	4	-
Public Land ¹	2	4	4	-
Major Infrastructure		Marine Rescue Building Wooli Public School water tower water main South Terrace Main Street	Marine Rescue Building Wooli Public School water tower water main South Terrace Main Street and cross streets	-
Totals (excl. public land)	44	64	102	

After: WP 2010b (updated due to double lot now being separately titled)

1. Public land includes individual reserves.

Risk Probability

The likelihood of storms of various magnitudes being experienced over a 50 year time period is provided in **Table F.3**, based on IPCC descriptors (2010). A 50 year time period has been selected as the design life of development and infrastructure, i.e. after which development and infrastructure is assumed to be replaced and located outside hazard zones.

The information in **Table F.3** is based on an average fair weather pre-storm coastal profile fronting the original Woolli Village (developed from 2010 photogrammetry), with storm erosion distributions for events more frequent than 100 year ARI based on Gordon (1987) and applying the Nielson *et al* (1992) Wedge Failure Plane Model. The estimate of distance eroded does not include an allowance for long term recession and recession due to SLR. WP (2010a) reported an average long term recession of 0.4 m/yr for the original Woolli Village excluding SLR recession. SLR recession projections are 17 m and 42 m from 1990, for 2050 and 2100 respectively.

Table F.3 Probability of Storm Events being Experienced in next 50 Years

ARI Storm Event	Estimated Volume Eroded m ³ /m	Estimated ¹ Distance Eroded	Cumulative Probability %	³ Likelihood
100	220	17.5	40	about as likely as not
50	195	13.5	64	about as likely as not
20	155	8	92	very likely
10	125	4	99	virtually certain
5	100	² 0	100	virtually certain

1. Horizontal distance from dune crest to landward edge of Zone of Slope Adjustment
2. Erosion escarpment not expected to reach crest
3. IPCC descriptors.

Risk Consequences

Table F.4 (after Rollason *et al* 2010) indicates the consequences of coastal hazard risks for Woolli over the next 50 years.

Table F.4 Risk Consequences over next 50 Years

¹ Consequence	Coastal Erosion Event	Additional Assets Impacted for each event
Catastrophic	100 year ARI storm event with ongoing beach recession and SLR	roads, most dwellings in original village, water tower, water mains, coastal patrol, school, community hall, tennis courts, bowling club, post office etc
Major	50 or 100 year ARI storm event ²	up to 25 dwellings in original village, most of South Terrace roadway
Moderate	20 year ARI storm event ²	foreshore reserves, coastal patrol
Minor	10 year ARI storm event ²	landward edge of foreshore reserves, beach accessways
Insignificant	5 year ARI storm event ²	part of vegetated dune

1. Rollason *et al* 2010

2. Not taking into account ongoing beach recession and SLR

Risk Levels

Based on the risk level matrix (**Table F.5**), risks levels associated with coastal assets over the next 50 years are estimated as follows:

- low for vegetated dune
- medium for beach accessways
- high for foreshore reserves
- high for dwellings most at risk and South Terrace roadway
- medium for remainder of dwellings at risk



Table F.5 Risk Level Matrix

		Consequence				
		insignificant	minor	moderate	major	catastrophic
Likelihood	virtually certain (5yr ARI)	low	medium	high	extreme	extreme
	virtually certain (10yr ARI)	low	medium	high	extreme	extreme
	very likely (20yr ARI)	low	medium	high	high	extreme
	about as likely as not (50yr ARI)	low	medium	medium	high	extreme
	about as likely as not (100yr ARI)	low	medium	medium	medium	high

APPENDIX G EVALUATION OF MANAGEMENT OPTIONS

NOTE: This Appendix was prepared to provide technical assessment to support the preparation of the Draft CZMP. Consultation with other public authorities on the draft CZMP raised a number of issues or concerns. In consideration of these concerns, Council resolved in December 2015 to remove actions proposing the extraction of sand from Yuraygir National Park as part of the beach nourishment scheme and investigation of a land swap scheme as part of the final, Council-endorsed Draft CZMP. The National Parks and Wildlife Service and Department of Primary Industries – Lands do not agree to the respective actions. Any reference to these actions in this Appendix has been retained to ensure the integrity of the original draft Appendices while noting that the final, Council-endorsed Draft CZMP has not included these actions.

Options Identification and Evaluation

A summary of all options identified and evaluation with regard to the *Guidelines* criteria is provided in **Table G.1**. Note that this evaluation is for individual options, whereas previous plans and studies have recommended a combination of options.

The following definitions or clarifications provided in the *Guidelines* apply to **Table G.1**.

Feasible	Technically and physically possible to safely implement and maintain.
Reasonable	Consistency with Coastal Management Principles; social, environmental and economic impacts; community and stakeholder support.
Coastal Management (CM) Program Funding Availability	The scale of management options should be consistent with the amount of funding reasonably likely to be available over the CZMP's implementation period. In relation to Coastal Management (CM) Program funding, this should be within the range of past grants for similar projects. Grants worth \$0.8 million were awarded for a total of 12 projects under the CM Program in 2014-2015 (or an average of \$66,667/ project). Grant funding is usually provided on a 1 State: 1 Local Government basis.

The 1997 management options were identified with reference to the Coastline Management Manual (NSW Government 1990) and evaluated with reference to community views, advantages and disadvantages including environmental impacts, and indicative costs.

The 2010 management options were based on a review of the 1997 management options and evaluated with reference to:

- certainty in protecting assets at risk to 2050
- maintenance of environmental values and consistency with ESD values
- confidence in predicting impacts
- benefit-cost based on estimated option capital and maintenance costs and value of land protected.

A summary of the 2010 WP options review, including indicative costs and benefit-cost ratios is provided in **Table G.2**. Note that this assessment does not take into account the value of Woolli Beach that would be adversely impacted by coastal protection structures or maintained by beach nourishment. More recent research (Raybould *et al* 2013) has developed a dollar value for Woolli Beach which would be reflected in a lower benefit-cost ratio for protection structures and higher benefit-cost for beach nourishment.

Beach nourishment options were refined through the sand sources study (RHDHV 2015 – see **Tables G.3** and **G.4**) and evaluated in terms of:

- likely available volume of sand to meet storm demand
- compatibility of the sand source with the native beach sand at Woolli (used to determine the volume of material needed from the sand source to provide equivalent storm demand volume on the beach)
- cost of winning and transporting nourishment sand to Woolli Beach.



Table G.1 Summary of all Management Options and Evaluation

Management Option	Description	*Risk Reduction (100 year ARI event unless specified)	**Likely Adverse Environmental Impacts	Feasible?	Reasonable?	CM Program Funding Available?	Comments
2015 Sand Sourcing Study							
Beach nourishment	sand from offshore sources	medium term (if sufficient sand available)	significant	yes	?	no	Not consistent with current NSW Government policy and cost prohibitive
	sand from Yuraygir National Park	medium term (based on likely volume available)	significant	yes	?	?	Not permissible under NP&W Act & inconsistent with NSW Coastal Policy - requires legislative remedy. Potential source site in degraded area due to Bitou Bush infestation, sand re-introduced to beach embayment and only affordable sand source of suitable quantity.
Sand back-passing	move sand along beach from north to original Woolli Village	short term for minor storm events (does not address net sand loss from embayment)	minor	yes	yes	yes	Community support
Geotextile groynes and Sand back-passing	contain sand in front of properties	short term for minor storm events (does not address net sand loss from embayment)	minor	yes	yes	yes	Nominal expected design life for geotextile groynes 10-15 yrs

Table G.1 Summary of all Management Options and Evaluation (cont'd)

Management Option	Description	*Risk Reduction (100 year ARI event unless specified)	**Likely Adverse Environmental Impacts	Feasible?	Reason- able?	CM Program Funding Available?	Comments
Monitoring	photogrammetry, beach surveys, LiDAR, sand tracing offshore wave monitoring, nearshore wave & current monitoring, beach photo log	N/A	N/A	yes	yes	yes	Support for detailed research in 20 submissions on 2010 CMP
2010 Coastal Zone Management Study							
Levee & Beach Nourishment	levee at potential river breakthrough point and road raising for flood access	Long term for road access to original village	potentially acceptable to significant	yes	yes	yes	Note: levee would be eligible for funding under Floodplain Management Program
	initial nourishment using sand dredged from Wooli Wooli River	short term for minor storm events (limited sand volume, may not be compatible with beach sand)	potentially acceptable	yes	yes	yes	Support in 35 submissions on 2010 CMP RHDHV (2015) found only small quantities of sand available from river
	ongoing nourishment by sand back-passing (as above)	short term for minor storm events (does not address net sand loss from embayment)	minor	yes	yes	yes	Support in submissions on 2010 CMP
Property Purchase/ Acquisition	voluntary purchase or acquisition	long term	significant (social impact)	yes	?	no	No community support or interest in the past

Table G.1 Summary of all Management Options and Evaluation (cont'd)

Management Option	Description	*Risk Reduction (100 year ARI event unless specified)	**Likely Adverse Environmental Impacts	Feasible?	Reason- able?	CM Program Funding Available?	Comments
Planning & Development Controls	over time development moved landward of hazard lines/ out of area at risk or modified to be compatible with hazard	long term	potentially acceptable (social impacts)	yes	yes	N/A	1997 opposition to building restrictions
Investigate Land Swap	assess potential voluntary relocation of private dwellings at risk to vacant public land	N/A investigation only	potentially acceptable (social & environmental impacts)	yes	yes	yes (for investigation)	In 2010, generally no support in 65 CMP submissions Currently some support if implemented as a future option
Asset Relocation & Servicing Strategy	relocate public assets at risk & modify/ move/ redesign services		minor	yes	yes	yes (for strategy)	Progressive and planned modification in response to changing risk
Dune Management	see beach scraping below	possibly short term for minor events (does not address net sand loss in front of properties)	minor	yes	yes	yes	Support in 43 submissions on 2010 CMP

Table G.1 Summary of all Management Options and Evaluation (cont'd)

Management Option	Description	*Risk Reduction (100 year ARI event unless specified)	**Likely Adverse Environmental Impacts	Feasible?	Reasonable?	CM Program Funding Available?	Comments
Options put forward by community							
Wooli Wooli River Entrance Works	Modify/ remove training walls (based on assumption they block sand movement)	possibly short term for minor events <u>if</u> embayment still in adjustment to construction of walls in 1970s	potentially acceptable (restore natural system but impact on boating)	yes	?	no	Support in 32 submissions on 2010 CMP Detrimental to boating access and safety Recent beach condition suggests sand bypassing may have re-established or increased (could also be due to longer term weather systems)
Sandbagging/ beach scraping	Temporary protection measure	short term for minor storm events no change to sand volume in beach profile	minor	yes	yes	yes	Support in 31 submissions on 2010 CMP

Table G.1 Summary of all Management Options and Evaluation (cont'd)

Management Option	Description	*Risk Reduction (100 year ARI event unless specified)	**Likely Adverse Environmental Impacts	Feasible?	Reason- able?	CM Program Funding Available?	Comments
1997 Coastline Management Plan							
Seawall (full length)	entire original Woolli Village 1.7 km long	long term	significant (including erosion at ends)	yes	?	no	1997 - polarised strong support and strong opposition (due to impact on beach amenity) less support for full seawall if not entirely Government funded Support in 25 submissions on 2010 CMP combined with beach nourishment
Seawall (partial)	three segments, total 1.5 km long (excludes protection for public reserves)	long term	significant (including erosion at ends)	yes	?	no	1997 – less support than full seawall more 'end effects' compared to full seawall
Groyne Field & Nourishment	six groynes fronting village and six transition groynes to north	possibly long term	significant (including erosion to north)	?	no	no	1997 – general lack of support
Property Relocation & Buy-back	move dwellings landward on block & future purchase when relocated dwellings become at risk	long term	potentially socially acceptable short term, significant social impacts long term	yes	?	no	1997 – generally low support no interest since this action was adopted in 1998
Massive Beach Nourishment	sand sourced from outside Woolli Beach embayment	medium term (if sufficient sand available)	significant	yes	?	no	1997 – indifferent response

Table G.1 Summary of all Management Options and Evaluation (cont'd)

Management Option	Description	*Risk Reduction (100 year ARI event unless specified)	**Likely Adverse Environmental Impacts	Feasible?	Reason- able?	CM Program Funding Available?	Comments
Beach Scraping & Vegetation Regeneration	move sand across beach from beach berm to frontal dune	possibly short term for minor storm events no change in volume of sand in beach profile	minor	yes	yes	yes	1997 - strong support

* short term (immediate hazard), medium term (2050), long term (2100)

** significant (would require EIS), potentially acceptable (depending on environmental/ social impact assessment), minor (permissible under SEPP infrastructure)

Table G.2 Options Assessment Matrix (WorleyParsons 2010b)

Options Review	Current Cost	Cost \$Millions (current)	Property Protection Benefit	Benefit \$Millions (current)	Certainty in protecting assets at risk to 2050	Maintenance of environmental values and consistency with ESD principles	Confidence in predicting impacts	NPV or B-C 7% discount rate over 40yrs	B-C Ratio
Levee/ Revetment + Beach Nourishment	levee/ revetment and road raising	0.9	2007 value of land at risk over next 40 years north of bowling club	13.8	X <ul style="list-style-type: none"> - maintenance nourishment - does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost offshore and along shore + additional sand to account for sea level rise - community perception in 1997 that nourishment would be a waste of money - requires ongoing commitment to maintenance nourishment over 40 years 	X <ul style="list-style-type: none"> - dredging/ beach nourishment - possible impact on shorebird habitat - impact on natural values from removal of sand from National Park/ Marine Park, inconsistent with legislation objectives 	high – subject to detailed investigations	-\$9.1 to -\$33.3M	0.6 to 0.3
	Initial maintenance nourishment by dredging Woolli Woolli River (30,000 m ²)	0.3							
	maintenance nourishment by moving sand from northern end of Woolli Beach to northern end of original Woolli Village (70,000 m ² /3yrs)	1.1/3yrs							
	new water tower	0.5							
	subdivide and provide services to school site and Woolli sportsground (say 55 lots)	3.3							
	relocate public assets and private dwellings stn of bowling club (or property purchase at 2x TMV)	2.0							
Property Purchase/ Acquisition	land value original village north of bowling club	13.8			✓ <ul style="list-style-type: none"> - removes assets at risk within next 40 years from storm erosion and coastline recession 	✓ <ul style="list-style-type: none"> - allows for natural coastal processes 	high	-\$35.7M	N/A
	land value original village stn of bowling club	29.1							
	new water tower	0.5							
Planning + Development Controls	new water tower	0.5			✓ <ul style="list-style-type: none"> - does not address existing properties at risk - over time removes assets at risk from storm erosion and coastline recession 	✓ <ul style="list-style-type: none"> - allows for natural coastal processes 	high	-\$0.5M	N/A
Land Swap/ Asset Relocation + Servicing Strategy	subdivide and provide services to school site and Woolli sportsground (say 55 lots)	3.3			✓? <ul style="list-style-type: none"> - removes assets at risk from storm erosion and coastline recession - potential breakthrough of Woolli Woolli River still an issue 	✓ <ul style="list-style-type: none"> - allows for natural coastal processes 	high	-\$6.3M	N/A
	relocate public assets and private dwellings	2.9				X <ul style="list-style-type: none"> - requires clearing of vegetation for new subdivision 			
	new water tower	0.5							
	move/ modify/ redesign services	unknown							
Dune Management	see Beach Scraping + Vegetation Regeneration for comments								

Notes: NPV (net present value), B-C benefit-cost

Indicative costings are based on the following rates:

- beach scraping	\$5/m ²
- dredging	\$10/m ²
- spreading and shaping nourishment material	\$10/m ²
- subdivision development	\$60,000 per lot
- relocation of dwellings etc	\$30,000 per property (note that some dwellings/ structures are not relocatable, rebuilding has not been taken into account in costings)

Table G.2 Options Assessment Matrix (WorleyParsons 2010b) (cont'd)

1997 Options	Current Cost	Cost \$Millions (current)	Property Protection Benefit	Benefit \$Millions (current)	Certainty in protecting assets at risk to 2050	Maintenance of environmental values and consistency with ESD principles	Confidence in predicting impacts	NPV of B-C 7% discount rate over 40yrs	B-C Ratio
Seawall (full length)	capital cost averaged annual maintenance cost	17.7 0.28/yr	2007 value of land at risk over next 40 years	45.2	√ X - provides terminal protection from coastal erosion/ shoreline recession for private and public assets in the original village - exacerbated erosion at either end of seawall increases likelihood of breakthrough of Woolli Woolli River which would isolate the original village, also potential to exacerbate erosion in front of new subdivision	X - loss of beach amenity and eventually beach - visual impact of rock wall	high (seawall) medium (breakthrough potential)	\$15.2	1.6
Seawall (partial)	capital cost averaged annual maintenance cost	15.8 0.25/yr	2007 value of private land at risk over next 40 years	42.9	√ X - provides terminal protection from coastal erosion/ shoreline recession for private properties in the original village - exacerbated erosion at either ends of seawall would affect public assets and increases likelihood of breakthrough of Woolli Woolli River, also potential to exacerbate erosion in front of new subdivision	X - loss of beach amenity and eventually beach - visual impact of rock wall	high (seawall) medium (breakthrough potential)	\$15.9	1.7
Groyne Field + Nourishment	capital cost averaged annual maintenance cost (based on recent work, the 1997 capital costs for this option appear low)	18.5 0.44/yr	2007 value of land at risk over next 40 years	45.2	X - does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost along shore + additional sand to account for sea level rise - limited effectiveness of groyne field in reducing storm erosion and sea level rise recession - breakthrough of Woolli Woolli River still a potential issue	X - compartmentalisation of beach - significantly altered beach state and surf character - visual amenity impacts - impact on National Park/ Marine Park values if used as source for nourishment sand, inconsistent with legislation objectives	medium – complexity of coastal processes impacts on prediction of effectiveness and impacts on beach either side	\$8.5	1.3
Property relocation + Buy-back	(see Property Purchase/ Acquisition for costs etc)								
Massive Beach Nourishment	capital cost averaged annual maintenance cost maintenance cost	18.4 0.94/yr	2007 value of land at risk over next 40 years	45.2	X - does not provide terminal protection - relies on maintenance of sand buffer by replacing sand lost along shore + additional sand to account for sea level rise - requires ongoing commitment to maintenance nourishment - breakthrough of Woolli Woolli River still a potential issue	√ X - maintains beach amenity - impact on National Park/ Marine Park values if used as source for nourishment sand, inconsistent with legislation objectives	high	-\$10.2	0.8
Beach Scraping + Vegetation Regeneration	capital cost averaged annual maintenance cost	0.2 0.16/yr			X - does not provide terminal protection but prevents blowouts which are more susceptible to storm erosion	√ - maintains stabilised dune providing visual amenity and habitat benefits	high	-\$6.2	

Notes:

- costs based on updating \$1997 to \$2010
- for net present value analysis, maintenance taken to occur at 20 year intervals for seawall options, 10 year intervals for options involving beach nourishment and two year intervals for beach scraping/ vegetation regeneration option and 2007 land values used for benefits
- the benefit-cost ratio does not take include a monetary amount for the substantial environmental costs that would result from these options and assumes property values would be maintained

Table G.3: Cost of nourishment program to provide storm erosion buffer

		Equipment and Cost			Wooli Beach Nourishment for storm buffer			
		Proposed Equipment	Cost of Mobilisation / Demobilisation (\$)	Cost of Dredging and Placement (\$/m ³)	Required volume of sand for nourishment (m ³) ³	Actual volume of sand accounting for overfill factor (m ³)	Total cost to dredge actual volume of sand (\$)	Unit rate for required volume of sand (\$/m ³)
Borrow Material Small Source	Wooli Wooli River sand shoals near upstream Caravan Park	CSD IHC B500 and trucks	\$1,188,235	\$37.33/m ³	6,300 ⁴	6,300 m ³ dredged and 630 m ³ placed on beach	\$1,423,414	\$2,259.39
	Wooli Wooli River Sand Shoals between Marine Rescue and Lower Boat Ramp	CSD IHC B500	\$1,635,294	\$22.92/m ³	10,400 ⁴	10,400 m ³ dredged and 8,000 m ³ placed on beach	\$1,873,662	\$234.21
	Dune behind the northern end of Wooli Beach¹	CSD IHC B750	\$2,976,471	\$21.78/m ³	60,000	63,000	\$4,348,611	\$72.48
	Pit behind the northern end of Wooli Beach¹	CSD IHC B750	\$2,976,471	\$21.78/m ³	60,000	300,000	\$9,510,471	\$158.51
	Beach backpassing¹	Excavator, articulated trucks and dozer	\$70,000	\$23.00/m ³	30,000 ⁴	33000	\$829,000	\$27.63

Table G.3: Cost of nourishment program to provide storm erosion buffer (cont'd)

		Equipment and Cost			Wooli Beach Nourishment for storm buffer				
		Proposed Equipment	Cost of Mobilisation / Demobilisation (\$)	Cost of Dredging and Placement (\$/m ³)	Required volume of sand for nourishment (m ³) ³	Actual volume of sand accounting for overfill factor (m ³)	Total cost to dredge actual volume of sand (\$)	Unit rate for required volume of sand (\$/m ³)	
Borrow Material Large Source	Woody Head Lobe		TSHD capacity 2,900 m ³	\$3,300,000	\$40.32/m ³	60,000	Unstable ₄		
	Wilson's Headland to North Solitary Island Lobe	Southern Region	TSHD capacity 10,000 m ³	\$12,264,706	\$10.26/m ³	60,000	150,000	\$13,803,706	\$230.06
		Northern Region	TSHD capacity 10,000 m ³	\$12,264,706	\$10.26/m ³	60,000	Unstable ₅		
	Cape Byron Sand Lobe	Water depth 10 to 25 m	TSHD capacity 10,000 m ³	\$3,835,000 ₂	\$5.4/m ³ ₂	60,000	Unstable ₅		
		Water depth 30 to 40 m				60,000	Unstable ₅		
	Dredging in offshore water depths greater than 35 metres		TSHD capacity 10,000 m ³	\$12,264,706	\$10.43/m ³	60,000	180,000	\$14,142,106	\$235.70

1. Extraction of sand from any of these sources, where located within the Yuraygir National Park, is recognised as being inconsistent with the NSW Coastal Policy 1997, in particular Strategic Action 5.2.9.
2. Priced based on cost estimates in 2006 and transport from Cape Byron Sand Lobe to Byron Bay (PBP, 2006). Additional cost involved in transporting material to Wooli Beach.
3. Required volume of sand for nourishment at Wooli Beach based on nourishment to offset Coastline Recession at the southern 800 m of Wooli Village with 5 years between nourishment campaigns.
4. Available volume is less than required volume.
5. Unstable means the nourishment overfill factor exceeds 10 as described in USACE (2002), i.e. 10 m³ of nourishment sand required to behave as 1 m³ of native sand on the eroding beach due to sand grain size and grading differences.

Table G.4 Cost of large scale nourishment program

Volume (m ³)		Woody Head Lobe	Wilson's Headland to North Solitary Island Lobe		Cape Byron Sand Lobe		Dredging in offshore water depths greater than 35 metres
			Southern Region	Northern Region	Water depth 10 to 25 m	Water depth 30 to 40 m	
	Proposed Equipment	TSHD capacity 2,900 m ³	TSHD capacity 10,000 m ³		TSHD capacity 10,000 m ³		TSHD capacity 10,000 m ³
	Cost of Mobilisation / Demobilisation	\$3,300,000	\$12,264,706 ₁		\$3,835,000		\$12,264,706 ₁
	Cost of Dredging and Placement	\$40.32/m ³	\$10.26/m ³		\$5.40/m ³		\$10.43/m ³
	Alternate Equipment	TSHD capacity 20,000 m ³ (economic for volumes greater than 400,000 m ³)	TSHD capacity 20,000 m ³ (economic for volumes greater than 1,000,000 m ³)				TSHD capacity 20,000 m ³ (economic for volumes greater than 1,000,000 m ³)
	Cost of Mobilisation / Demobilisation	\$14,852,941	\$14,852,941				\$14,852,941
	Cost of Dredging and Placement	\$13.13/m ³	\$7.32/m ³				\$7.43/m ³
500,000	Total Cost	\$21,417,941	\$17,394,706		\$6,535,000		\$17,479,706
	Unit Rate	\$42.84/m ³	\$34.79/m ³		\$13.07/m ³		\$34.96/m ³
1,000,000	Total Cost	\$27,982,941	\$22,172,941		\$9,235,000		\$22,282,941
	Unit Rate	\$27.98/m ³	\$22.17/m ³		\$9.24/m ³		\$22.28/m ³
2,000,000	Total Cost	\$41,112,941	\$29,492,941		\$14,635,000		\$29,712,941
	Unit Rate	\$20.56/m ³	\$14.75/m ³		\$7.32/m ³		\$14.86/m ³

1. The relatively high mobilisation/ demobilisation costs for dredging the Wilsons Headland to North Solitary Island Lobe and at depths greater than 35 m are due to a larger capacity 10,000 m³ TSHD, required to operate at the deeper bed levels, which currently must be sourced from outside Australia. At the time of the Cape Byron Sand Lobe investigation a large TSHD was available in Australia or could potentially be shared with other large dredging projects. Large dredgers were generally operating around Australia during, and in the lead up to the mining boom.

APPENDIX H DESCRIPTION OF 2015 CZMP ACTIONS

NOTE: This Appendix was prepared to provide technical assessment to support the preparation of the Draft CZMP. Consultation with other public authorities on the draft CZMP raised a number of issues or concerns. In consideration of these concerns, Council resolved in December 2015 to remove actions proposing the extraction of sand from Yuraygir National Park as part of the beach nourishment scheme and investigation of a land swap scheme as part of the final, Council-endorsed Draft CZMP. The National Parks and Wildlife Service and Department of Primary Industries – Lands do not agree to the respective actions. Any reference to these actions in this Appendix has been retained to ensure the integrity of the original draft Appendices while noting that the final, Council-endorsed Draft CZMP has not included these actions.

Background

In consideration of the community feedback on the 2010 CMP, CVC (2012) resolved to revise the Draft Plan based on the following principles:

- *A greater emphasis on an ongoing, evolving rather than a static plan based on continual data capture.*
- *A greater emphasis on structured and ongoing data collection and analysis to inform beach processes and option development (similar to above).*
- *Ongoing assessment of a wider range of management options with specific options being discarded or embraced based on the data collection and other merit considerations.*
- *Confirm dune management and rehabilitation as ongoing management options.*
- *Implementation of the emergency action plan.*
- *Refinement of development controls that:*
 - *recognise the hazard*
 - *applies to new development*
 - *provides greater clarity and certainty*
 - *minimises individual and community exposure to risk*
 - *integrates with broader planning objectives*
 - *are monitored and revised over time.*

No structures or rock protection works are proposed as they are not consistent with the beach amenity and character of the Woolli village. Beach amenity is highly valued by the Woolli community and community feedback has identified a preference for actions that provide additional resilience to the village against storm erosion and coastal recession. A Beach Nourishment Scheme (BNS) is a key action of the CZMP.

Private Property Risk and Response Categories

Based on the premise that the BNS would hold the foreshore in more or less its existing alignment, and that the benefits of the scheme can be considered exceed the costs (see **Appendix I**), coastal 'protection' works are considered technically feasible and cost-effective for the immediate hazard. However, the proposed BNS would afford limited 'protection' for a current 100 year ARI and more extreme events, and due to the location of the original Woolli Village on a sand spit, is not considered feasible (i.e. would not provide sufficient 'protection') or cost-effective in the longer term, i.e. beyond the 2050 planning period.

Based on the implementation of the BNS, the risk and response categories for private property are shown in **Table H.1**.

Table H.1 Private Property Risk and Response Categories

Risk Category	Description	Cumulative Residential Properties Affected	Response Category	Description	Residual Risk
1	Immediate risk of coastal erosion	44	A	Coastal protection works considered technically feasible and cost-effective	at risk in events more severe than 50 yr ARI
2	Likely to be affected by coastal erosion and recession by 2050	94	B	Coastal protection works considered technically feasible but not cost-effective	no change to assessed risk (may be reduced by BNS)
3	Likely to be affected by coastal erosion and recession by 2100	159	C	Coastal protection works not considered technically feasible	no change to assessed risk

Actions to Manage Immediate Coastal Hazard Risks

Suitable Dredged and Excavated Sand to be Placed on Wooli Beach

Any sand extracted from the Wooli Wooli River, Wooli embayment or nearby terrestrial environments, e.g. as spoil from dredging or other public infrastructure projects, should be deposited onto Wooli Beach adjacent to the southern end of the Village where that sand is compatible with the beach sand. The priority placement area is the section of beach where private dwelling houses are closest to the dune escarpment.

Beach Nourishment Scheme

Description

The approach for a BNS at Wooli would be to “hold the line” against sediment budget recession and protect the original Village from a 50 year ARI storm event. The approach does not consider sea level rise (SLR) directly but focuses on current risk and would be implemented as follows:

1. Commence “well structured” and “targeted” beach and inshore/ nearshore monitoring immediately including beach and hydrographic survey and sand tracing.
2. Design BNS, undertaken environmental assessment, seek solution to legislation/ policy barriers and obtain approvals etc.

3. Undertake Nourishment Campaign 1 involving the placement of 60,000 m³ of sand on the beach within 3 years to account for sediment budget recession over the subsequent 5 years. This would ensure the average volume of sand in front of the southern 800 m of the Village (**Figure H.1**) is 195 m³/m, which is the estimated 50 year ARI storm demand (Gordon, 1987). Sand volume is measured within the Zone of Slope Adjustment taken to cut ground level at the seaward walls of buildings.
4. Continue to monitor the beach profile and undertake sediment tracing.
5. Undertake Nourishment Campaign 2 involving the placement of 60,000 m³ of sand ± surplus/deficit from previous campaign to ensure an average volume of 195 m³/m in front of the southern 800 m of the Village (**Figure H.1**), 5 years after Nourishment Campaign 1.
6. Continue monitoring and Nourishment Campaigns at 5 year intervals with nourishment expected to extend into the northern half of the village in approximately 20 years, depending on shoreline recession.
7. Implement a Trigger Action Plan if the 5-period moving average (minimum 5 years) of the total volume of sand in front of the southern 800 m of the village falls to less than 155,000 m³. The Trigger Action Plan involves one or more of the following:
 - a. increased beach nourishment
 - b. inclusion of trial geotextile container groyne(s) with beach nourishment
 - c. initiation of land swap scheme
 - d. other possible actions determined at the time.

Beach scraping, which is the cross-shore relocation of sand from the upper swash/ lower berm to the incipient dune/ foredune to accelerate beach recovery after an erosion event on a large scale, is omitted from the project for now since its benefit is not yet suitably established. In response to community feedback on the Draft CZMP Council has resolved to support small scale beach scraping works when the beach profile displays a low swale adjacent to the main dune and a higher berm level at the front of the beach. In these circumstances, it is considered that the main dune is more susceptible to erosion and these relatively minor works are intended to reduce that risk. Design and approvals will be necessary before any works can be undertaken. Large scale beach scraping could be revisited at a later time.

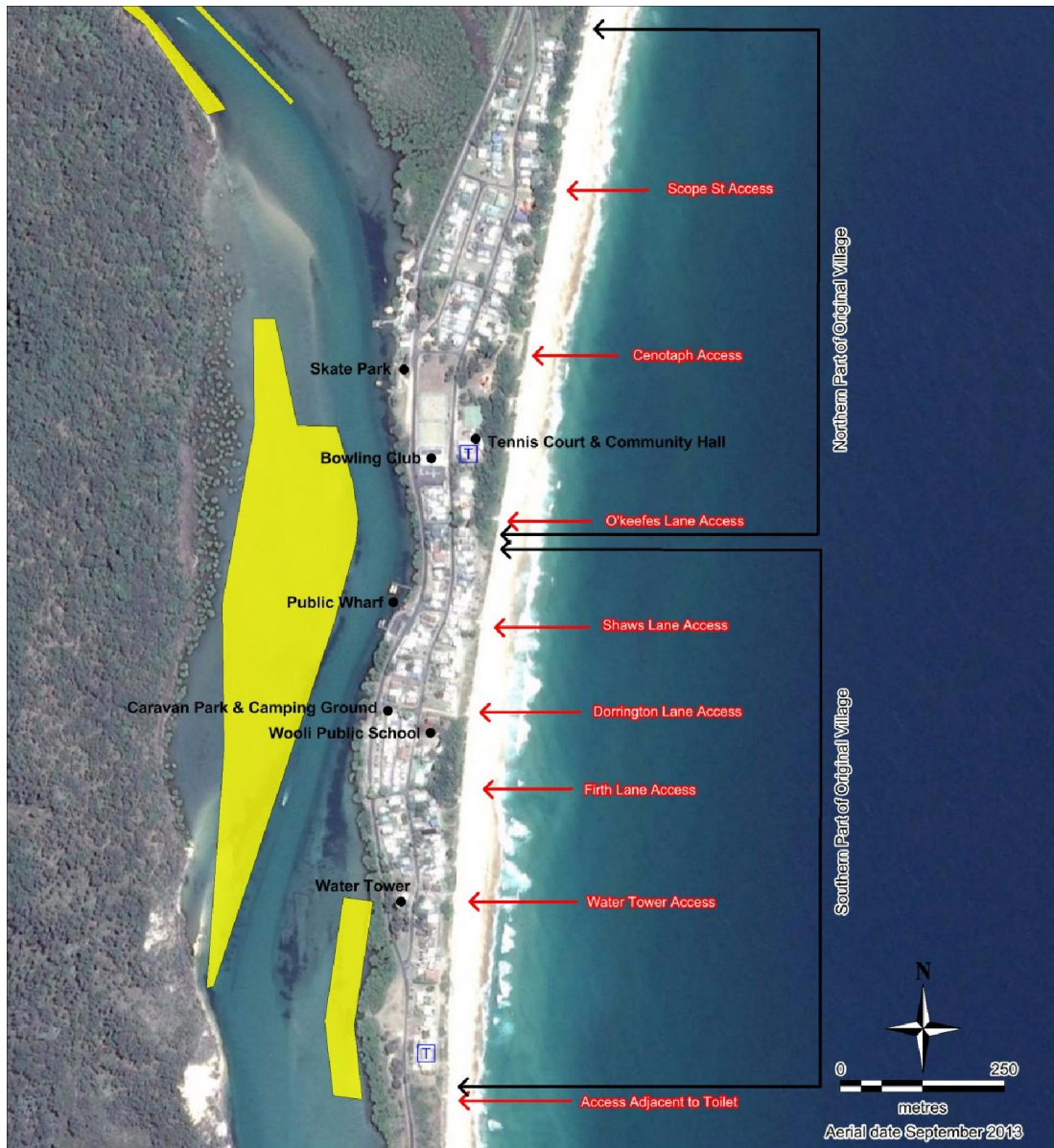


Figure H.1 Original Woolli Village showing northern and southern parts for application of Beach Nourishment Scheme

While SLR and its predicted recession has been excluded from the analysis which underpins the above approach at the request of CVC and OEH, any SLR recession which does occur would be accounted for since the program effectively maintains a storm buffer irrespective of the mechanism for long term shoreline retreat.

Technical Basis

Monitoring is required to determine the current beach condition prior to any beach nourishment. After beach nourishment, monitoring would continue to determine:

- rate of recession in the nourishment area;
- rate of recession/ accretion outside of the nourishment area;

- the influence of SLR on total recession;
- direction of sand movement;
- effectiveness of sand nourishment; and
- volume of sand required and program confirmation for subsequent nourishment campaigns.

The period of time until Nourishment Campaign 1 is based on an assessment of available photogrammetry. **Figure H.2** plots the total volume of sand in front of the southern 800 m of the Village over a number of periods of available photogrammetry. A linear trend line is fitted to the data to extrapolate the current (2015) best estimate “average” volume of sand in front of the southern 800 m of the Village above 0 m AHD, which is forecast to be approximately 166,000 m³ in total, or 208 m³/m. Such an approach filters out short term effects such as storm erosion, assuming that this is mostly naturally restored, except for ongoing long term sediment budget losses. Storm erosion for a 50 year ARI storm event is estimated at 195 m³/m above MSL (after Gordon 1987) and the rate of budget recession adopted as 4 m³/m/yr as reported in WP (2010) from analysis of photogrammetry between 1942 and 2006. Therefore, on average, it would be expected that the southern 800 m of the Village is protected against a 50 year ARI storm event for the next 3 years, after which the Nourishment Campaigns would commence. $[(208-195) \div 4 = 3.25]$.

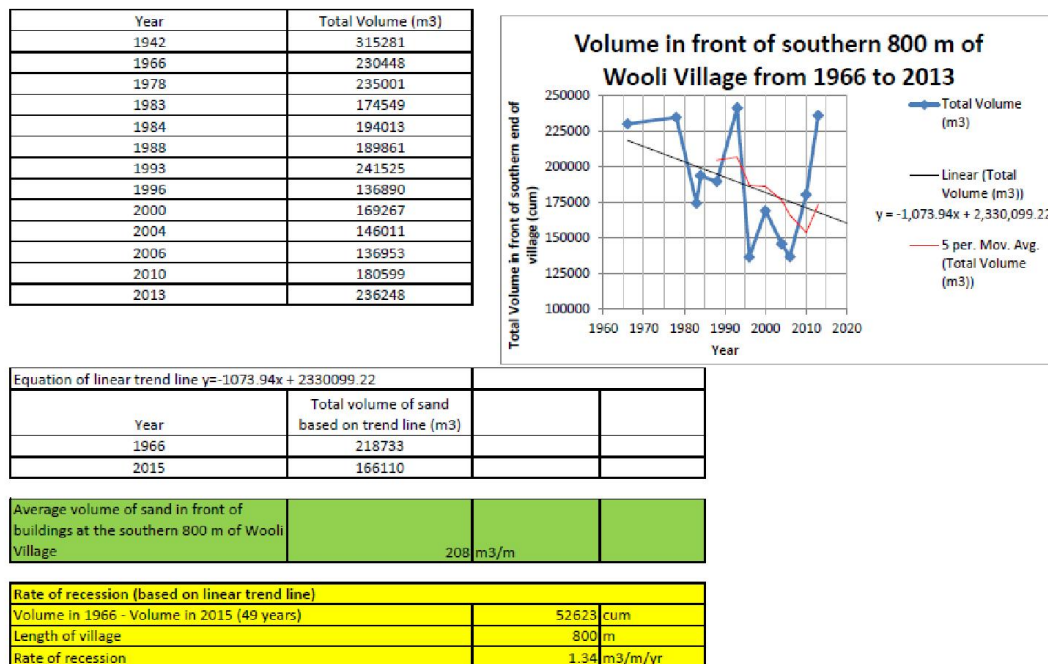


Figure H.2 Assessment of photogrammetry over southern 800 m of Wooli Village

The volume of sand in the nourishment campaigns is based on the budget recession rate above, a nourishment interval of 5 years, a beach length of 800 m, a taper length of 0.25 times the beach nourishment length at both ends of the nourishment profile (suggested as a minimum in USACE 2002) and a subaqueous placement equal to 2 parts for every 1 part of subaerial placement. This equates to a nourishment volume of 60,000 m³ (assuming a splayed taper at each end of the nourishment profile) over the