BYRON SHIRE COUNCIL

Coastal Zone Management Plan for the Brunswick Estuary
Issue No. 5.1, April 2018

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COASTAL ZONE MANAGEMENT PLAN FOR THE BRUNSWICK ESTUARY

Issue No. 5.1
APRIL 2018

Document Amendment and Approval Record

Issue	Description of Amendment	Prepared by [date]	Checked by [date]	Approved by [date]
1	Draft Estuary Management Plan	B. Fitzgibbon (7/10/2008)	Lizard (11/10/08) S. Gornall (21/10/08)	BSC (13/11/2008)
2	Final Estuary Management Plan (#824178 PDF) – Adopted by Byron Shire Council on 13 November 2008, Res 08-701	B. Fitzgibbon (9/01/2009)	S. Gornall (9/01/2009)	S. French (21/01/2009)
3	Final Estuary Management Plan re-named as Coastal Zone Management Plan for the Brunswick Estuary, Res 10-575 – Addendum 1 (#998403 Word, #1006451 pdf),	G. McLean (31/08/2010)	B.Fitzgibbon (31/08/2010)	B. Fitzgibbon (31/08/2010)
4	Per Council Res 12-606, Implementation Schedule (Table ES.1 and 5.1) amended – Addendum 2 (E2012/882 Word)	C Knight (09/08/12)	M Chapman (28/08/2012)	S French (28/08/2012)
5	Coastal Zone Management Plan for the Brunswick Estuary, review and update of Issue No. 5 (#E2017/66846)	C Dowsett (14/06/17)	S. French (16/06/17)	S. French (27/06/17)
5.1	Coastal Zone Management Plan for the Brunswick Estuary, review and update of Issue No. 5 (#E2017/66846) minor amendments due to public agency comments (E2018/34867).	C. Dowsett (24/04/18)	C. Dowsett (24/04/18)	S. French (24/04/18)

Note: This document was adopted by Byron Shire Council as a resolution of Council on 13 November 2008. Byron Shire Council has prepared this document with financial assistance from the NSW Government through the Office of Environment and Heritage. This document does not necessarily represent the opinions of the NSW Government or the Office of Environment and Heritage.

FOREWORD

The estuaries of New South Wales are a highly prized natural resource. They offer immense value from an ecological, social and economic perspective. Estuarine foreshores are desirable places on which to live and work and their waterways are popular for a wide variety of active and passive recreational pursuits.

NSW has over 130 estuaries that vary in size from small coastal creeks and lagoons to large lakes and rivers. Similarly, the State's estuaries vary widely in their natural attributes, degree of development, and their use and productivity.

In recognition of the ecological, social and economic importance of this State's estuaries and concern about their degradation, the NSW Government has developed the Coastal and Estuary Grants Program. The primary objective of this program is to support local government in managing the risks from coastal hazards, restoring degraded coastal habitats and improving the health of NSW estuaries, wetlands and littoral rainforests.

Under the Government's Coastal and Estuary Grants Program, financial and technical assistance is provided to local councils to prepare and implement coastal zone management plans (CZMPs) for estuaries within their local government area. The *Guidelines for Preparing Coastal Zone Management Plans* by the Office of Environment and Heritage (2013) provides guidance and the management process for preparing coastal zone management plans for estuaries.

The Brunswick Estuary on the far north coast of NSW is a special place to the local community and is highly valued for its natural, cultural and ecological attributes.

This CZMP for the Brunswick Estuary has been prepared by Byron Shire Council and presents the methodology and mechanism for Council to manage the estuary into the future.

The CZMP is founded on the Brunswick Estuary Study (2002) which outlines the physical, chemical and biological processes within the estuary and the impact of human activities on these processes. The precursor of the CZMP is the Brunswick Estuary Management Study and Plan (2007), which identifies and prioritises estuary management issues, values, objectives and strategies.

With increased knowledge and through on-going monitoring our understanding of the Brunswick Estuary and estuaries in general will improve. Accordingly, the CZMP for the Brunswick Estuary will need to be reviewed and amended to account for changing environmental conditions, community desires and management responses.

Richard Hagley

NSW Office of Environment and Heritage

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1.1 History of the CZMP

This *Coastal Zone Management Plan for the Brunswick Estuary (Issue No. 5)* has a long history and was previously called the *Brunswick Estuary Management Plan*. The Brunswick Estuary Management Plan (BEMP) was finalised in October 2008 and adopted by Byron Shire Council (Council) on the 13 November 2008. The BEMP was submitted to the then Minister for Climate Change and the Environment, the Hon Carmel Tebbutt MP, on 4 February 2009 for approval under Section 55G of the *Coastal Protection Act 1979* (the Act).

On 25 June 2010 Council received a request from the Department of Environment, Climate Change and Water (now the Office of Environment and Heritage) to rename the BEMP to the "*Coastal Zone Management Plan for the Brunswick Estuary (CZMP)".* This amendment was applied on 31 August 2010 and the CZMP was finalised. The CZMP was re-submitted on the 16 September 2010 to the then Minister for Climate Change and Environment, Frank Sartor for approval under the Act.

In January 2011 amendments to the Act took effect and ministerial certification of the plan was required, as opposed to approval. The Office of Environment and Heritage (OEH) assessed the CZMP as part of the certification process requesting additional information including written correspondence with public authorities involved in the plan affected by proposed actions to give consent. OEH also requested Council re-submit the CZMP to the new Minister for the Environment Robyn Parker. In addition, due to the significant period of time passing, dates of the management actions and strategies were unrealistic.

Final amendments were made to the CZMP and Council re-submitted the CZMP on 30 August 2012 (Issue 4).

In July 2013, new statutory Guidelines for Preparing Coastal Zone Management Plans were introduced by OEH, replacing the Estuary Management Manual (NSW Government 1992) for which the CZMP was developed in accordance with. Along with the introduction of these guidelines the NSW coastal legislation was reformed at a similar time thereby contributing to the slow progression of the CZMP through the ministerial certification process.

In 2016, Council enquired as to the status of the CZMP in the certification process as a significant amount of time had passed since submission. Unfortunately, the CZMP was deemed to be too out of date for certification. In order to seek ministerial certification, the plan required a complete review and update and re-submission prior to the repeal of the current coastal legislation which occurred on 3 April 2018 (refer to **Appendix A**).

1.2 Review and Update of the CZMP

In January 2017, Council undertook a complete review and update of the CZMP in effort to re-submit the plan for ministerial certification before the legislation repeal date.
This CZMP (Issue No.5.1) is the product of the review and update of the previous Issue No. 4.
The process of the review and update of the CZMP undertaken by Council is outlined in **Table 1-1** below.

Table 1-1 – Outline of the review and update of the CZMP**.**

Review and Update	
Objective	Method
1. To gather sufficient information on the status of the Brunswick Estuary and to determine whether many of the management strategies proposed in the implementation schedule of CZMP (Issue No. 4, 2012) adopted in 2008 have been completed, are presently underway, or are not relevant anymore.	A complete audit of all the management strategies outlined in the CZMP (Issue No. 4, 2012) was undertaken by Council using desktop analysis of Council documents, liaising with various Council departments and discussion with public agencies and stakeholders.
Site Survey	
Objective	Method
1. To gain an understanding of the present day issues facing the Brunswick Estuary and determine the locations where on-ground works (such as bank stabilisation works and/or riparian vegetation) are required. 2. To investigate whether bank erosion site allocated in the CZMP (Issue 4, 2012) are still experiencing significant and active bank erosion.	A three day vessel based site survey of the Brunswick Estuary was completed in the tidal reaches of Simpson Creek, Marshalls Creek and the main arm of the Brunswick River (incl. Salt Water Creek). The method involved recording the condition of the creek and river bank at areas where bank erosion was visible, recommending a management response and assigning an action with a priority ranking. The site survey was completed twice to ground truth the sites and ensure management responses were assigned realistic and implementable actions and priorities.
Update of CZMP document	
Objective	Method
1. To update the document to reflect the outcomes of the audit and site survey completed. 2. To set realistic and current timeframes and estimated costs for implementation of strategies. 3. To update the document to reflect changes in legislation, government agencies, polices and more recent technical information available.	An editorial update was completed with new chapters included in the revised document, and information updated or deleted if not relevant. This update included, but was not limited to: 1. Update of all public agencies proposed to undertake actions/strategies for implementation. 2. Update of all policies, legislation and coastal framework. 3. Update of the cost of management strategies proposed to reflect time passed and increase in cost estimates. 4. Update of timeframes and proposed dates for commencement of each management strategy. 5. A description of how the CZMP meets the minimum requirements of the Guidelines for Preparing Coastal Zone Management Plans under Act.

Complete results of the Audit and Site Survey are presented in **Appendix B**.

1.3 Management Area

The CZMP has been prepared for the Brunswick Estuary and its tributaries, located in Northern New South Wales (NSW) approximately 800 kilometres north of Sydney. The management area includes the tidal waters, foreshores and adjacent lands of the Brunswick Estuary which is located within the Byron Shire Local Government Area (LGA) and falls within the Cape Byron Marine Park. The Cape Byron Marine Park was declared in November 2002.

The estuary drains a catchment area of about 228 km² and has a waterway area of 2.2 km² extending from the ocean entrance at Brunswick Heads upstream to the tidal limits. The extent of the Brunswick River catchment is shown in **Figure 1-1**. This report focuses on the tidal waters, foreshores and adjacent lands of the Brunswick Estuary, extending from the ocean entrance at Brunswick Heads upstream to the tidal limits. The extent of the estuary is shown **Figure 1-2**.

A more detailed description of the management area is described in **Section 3**.

1.4 Purpose of the CZMP

The purpose of this CZMP is to set in place policies, strategies and actions for Council's long term future management of the Brunswick Estuary. To do this, the CZMP draws upon information gained from previously completed estuary process studies, management studies, and public and expert consultation. The CZMP considers this information and presents management strategies for the balanced and integrated management of the estuary and its resources.

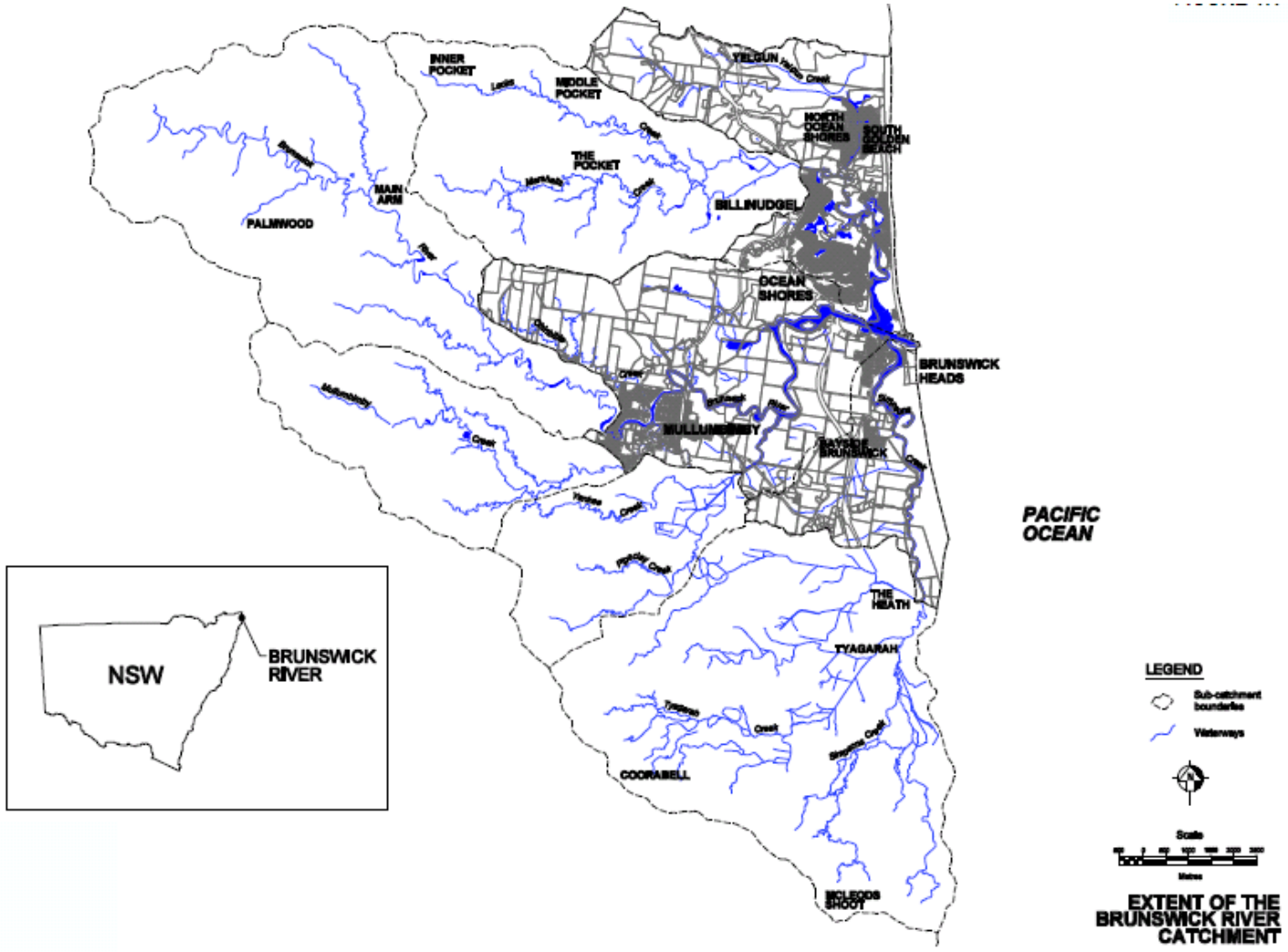


Figure 1-1 – Extent of the Brunswick River Catchment

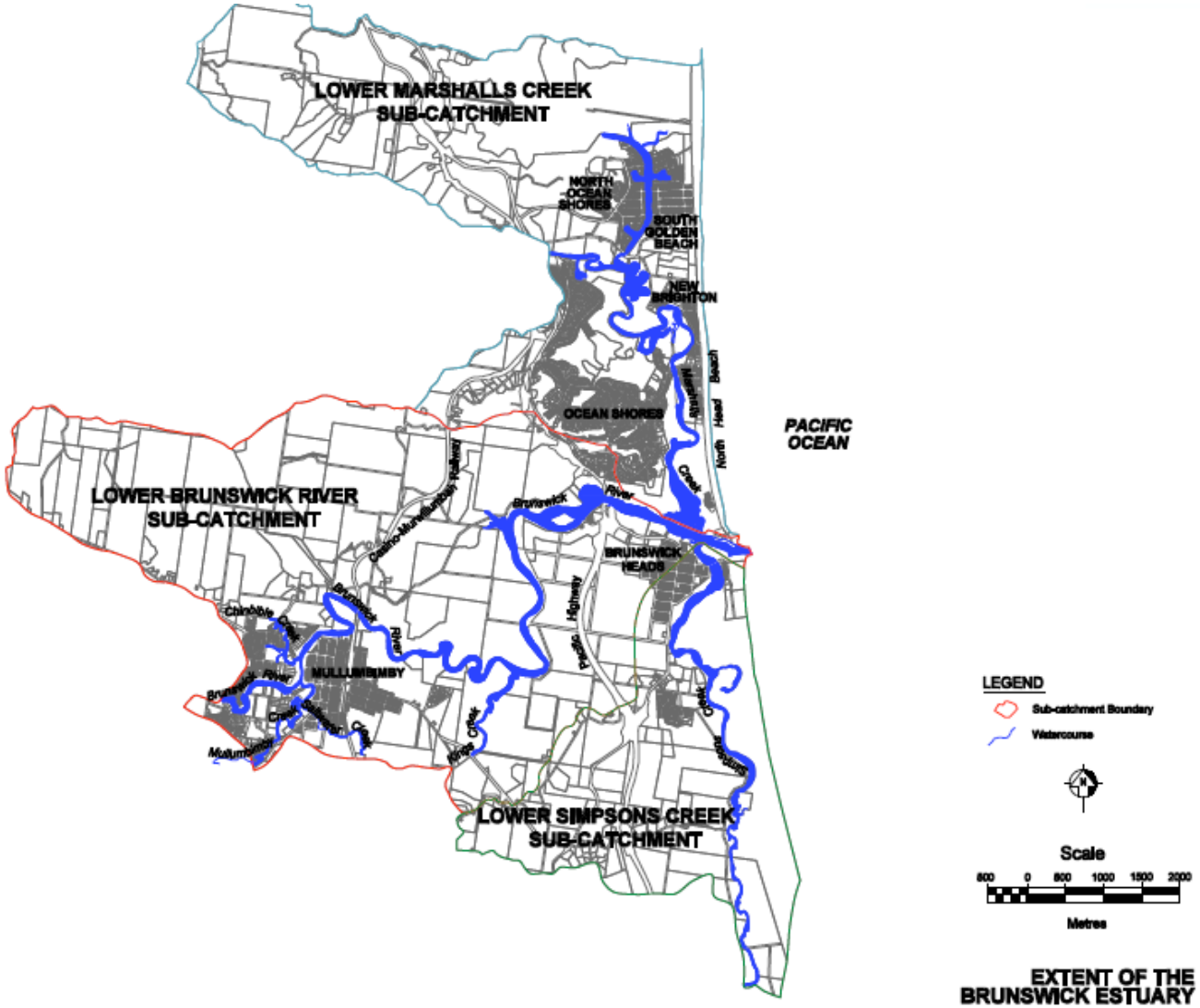


Figure 1-2 – Extent of the Brunswick Estuary

2 The Estuary Management Framework

2.1 Estuary Management Process

The NSW Coastal Protection Act 1979 provides for the 'protection of the coastal environment of the State for the benefit of present and future generations'.
The objects of the Act relate to such matters as:

- the protection and rehabilitation of coastal environments
- the ecologically sustainable development and use of the State's coastal resources
- the promotion of amenity and public access to the coast
- ensuring the co-ordination of the policies and activities of the Government and public authorities in order to facilitate the proper integration of their management activities in the coastal zone, and
- to encourage the development of adaptation strategies in response to coastal climate change impacts such as sea level rise.

Under Part 4A of the Act, CZMPs can be prepared by local Government with the support of OEH. The plans are required to consider the management of threats to estuary health, as well as the potential impacts of climate change, and must be prepared in consultation with the key stakeholders and the community.

In 1992, the NSW State Government introduced an Estuary Management Policy aimed at managing the growing pressures on estuarine ecosystems. The Estuary Management Policy provided for the assessment of all estuarine uses, the resolution of conflicts, and the goal of producing a unified and sustainable Estuary Management Plan for each estuary (NSW Government, 1992). The Estuary Management Policy was implemented on the Brunswick Estuary through a process which involved the establishment of a Brunswick Estuary Management Committee (hereafter referred to as "the Committee") which was to be chaired by Byron Shire Council. The Committee was responsible for carrying out the steps in the process toward development and finalisation of an Estuary Management Plan.

In February 2003, amendments to the Coastal Protection Act, 1979, came into effect. One of the amendments relates to the need for preparation of CZMPs. These plans (once complete) need to be referred to the Minister for the Environment for approval and if approved must be published in the Government Gazette.

The development of the CZMP and illustration of the coastal zone management process and the requirements is presented in and **Figure 2-1** and **Table 2-1**.

It is noted that the first step of the process was completed under the previous 1992 Estuary Management Manual, however, the CZMP (Issue 5) has been reviewed and updated in accordance with the 2013 Guidelines.

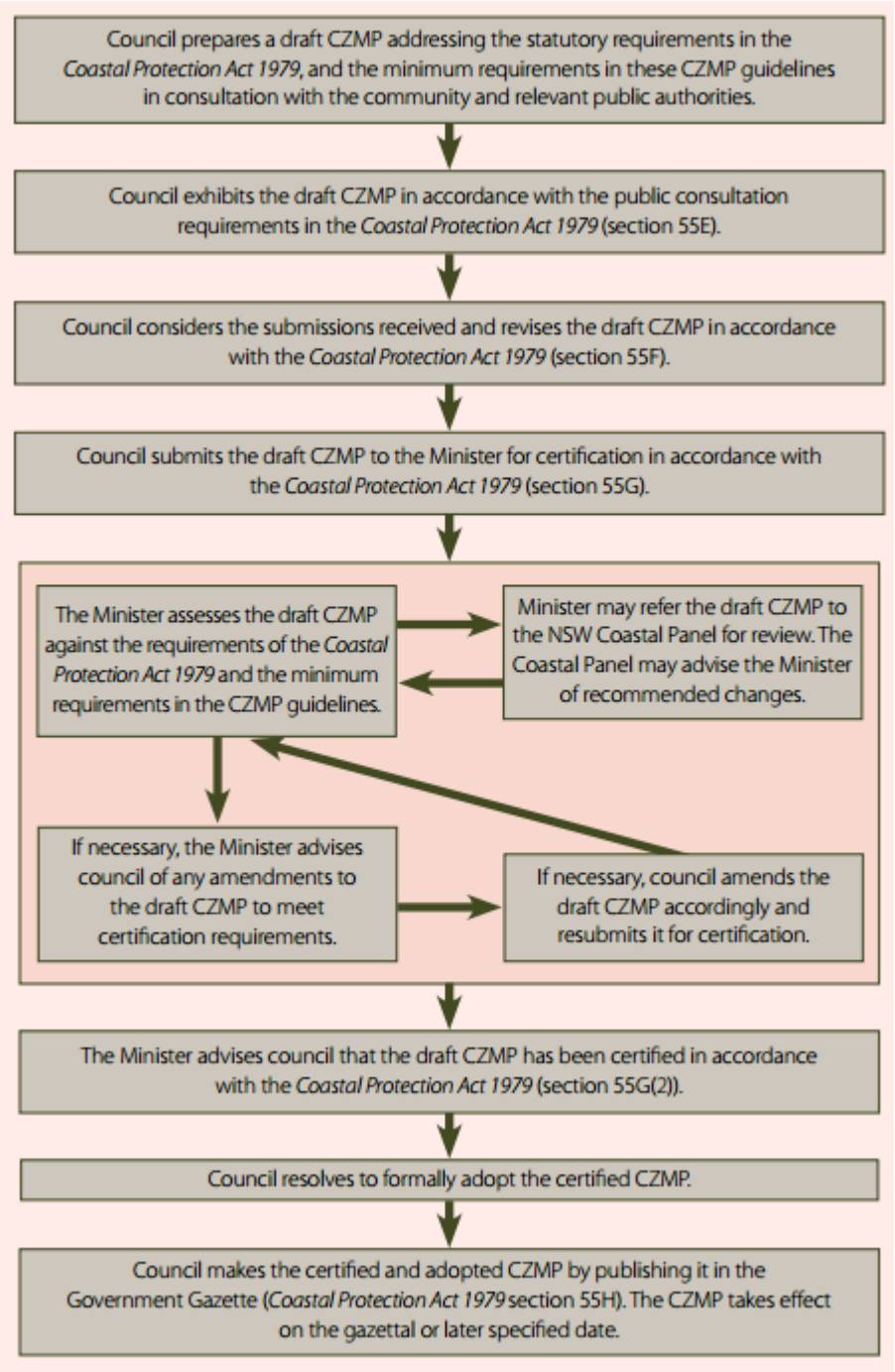


Figure 2-1 CZMP preparation and certification process from the Guidelines for Preparing Coastal Zone Management Plans (OEH, 2013).

Table 2-1 – Completed stages of the CZMP preparation process

Stage	Stage	Status of the CZMP for the Brunswick Estuary
1	Council prepares a draft CZMP addressing the statutory requirements in the *Coastal Protection Act 1979*, and the minimum requirements in the 2013 Guidelines in consultation with the community and relevant public authorities.	Brunswick Estuary Management Committee established in June 1997. Data compilation study Brunswick Catchment Report completed in 1998 (Alderson & Associates, 1998). Estuary process and estuary management study completed in 2002 which produced the comprehensive Brunswick Estuary Management Study (MHL, 2002). Draft Brunswick Estuary Management Study and Plan developed through consultation with the Committee (Patterson Britton and Partners, 2004).
2	Council exhibits the draft CZMP in accordance with the public consultation requirements in the *Coastal Protection Act 1979* (Section 55E).	Draft Brunswick Estuary Management Study and Plan publicly exhibited from 6 January 2006 until 31 March 2006.
3	Council considers the submissions received and revises the draft CZMP in accordance with the Coastal Protection Act 1979 (section 55F).	Public submissions and responses were received up until the end of March 2016. Council subsequently compiled and assessed the submissions to establish key issues of concern, documenting the Brunswick Estuary Management Plan Public Exhibition Report (V. 2, August 2006). The plan was amended and completed as a final draft in 2007. However, as it was a large complex document, Council resolved in Dec 2007 to produce a "slimline" version of the Brunswick Estuary Management Study and Plan. The extracted slimline document was named the Brunswick Estuary Management Plan (BEMP). The draft BEMP was finalised on 7 October 2008 and adopted by Council on 13 November 2008.
4	Council submits the draft CZMP to the Minister for certification in accordance with the Coastal Protection Act 1979 (section 55G).	BEMP submitted for approval under the Act on 4 February 2009. The BEMP was renamed CZMP on 31 August 2010. CZMP re-submitted for approval under the Act on 16 September 2010. Amendments made to CZMP and re-submitted on 30 August 2012. Reviewed and updated in 2017 – 2018 for re-submission and Ministerial certification.

The guidelines identify a series of Coastal Management Principles that were developed to inform strategic coastal zone management.

Table 2-2 outlines each of the Coastal Management Principles that have been addressed in this CZMP and provides cross references to the relevant report section. This CZMP endeavours to

address these principles to the fullest extent possible within the scope of works for the project, acknowledging that the principles were released after commencement of this project.

Table 2-2 – Consideration of the Coastal Management Principles

Coastal Management Principle	Consideration by the CZMP	Report Section
Principle 1 Consider the objectives of the Coastal Protection Act 1979 and the goals, objectives and principles of the NSW Coastal Policy 1997.	The CZMP was prepared under guidance of the Estuary Management Manual and is in accordance with principles and objectives of the Estuary Management Policy, 1992. However, it is also consistent with the goals and objectives of the Act and the NSW Coastal Policy 1997.	Refer - Section 1, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)
Principle 2 Optimise links between plans relating to the management of the coastal zone.	The relationship between the CZMP and existing plans and strategies is covered in depth in the Brunswick Estuary Management Study and Plan (2007)	Refer - Section 6, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)
Principle 3 Involve the community in decision making and make coastal information publicly available.	Extensive community consultation was developed and completed during the formation of the CZMP.	Appendix E Refer - Section 2, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)
Principle 4 Base decisions on the best available information and reasonable practise; acknowledge the inter-relationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach.	The Brunswick River Estuary Study (2002) provides scientific understanding of the hydraulic, sedimentation, water quality and ecological processes within the estuary, and the impacts of human activities on these processes. The Brunswick Estuary Management Study and Plan (2007) identifies the essential features and the current uses of the estuary, and determines the overall objectives required for management of the estuary. The Management Study and Plan identifies options for meeting these objectives, and determines hydraulic and ecological impacts of the proposed options.	Refer - Brunswick River Estuary Study, Summary Report (2002) Refer - Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)

Coastal Management Principle	Consideration by the CZMP	Report Section
Principle 5 The priority for public expenditure is public benefit; public expenditure should cost effectively achieve the best practical long-term outcomes.	The Management Study and Plan priorities the variety of management strategies that have been determined to address the management objectives for the estuary. The actions/strategies aim to protect significant areas of the estuary and improve aspects of the estuary to make it more suitable for existing and future waterway users. The proposed actions have been prioritised to address the issues facing the estuary and are cost effective, realistic and implementable. As the CZMP was prepared under the Estuary Management Manual, a triple bottom line assessment or cost benefit analysis has not been undertaken on the management options presented.	Refer - Section 9, Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)
Principle 6 Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risk where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented.	Risk to public safety, assets, and ecological health have been assessed in a largely qualitative fashion, through the consideration of estuary processes and management Issues.	Refer - Brunswick River Estuary Study, Summary Report (2002) and Brunswick Estuary Management Study and Plan, Issue No. 5 (2007)
Principle 7 Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions.	Management actions have been broadly prioritised based on their expected performance in reducing the identified risks (i.e. water quality, riparian vegetation loss, user conflicts etc). The CZMP will be monitored and reviewed consistent with an adaptive management framework as strategies are implemented and the project is executed.	See Section 3.4 and 3.5
Principle 8 Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems.	A primary management objective of the CZMP is to improve estuary ecological health and biodiversity though the implementation of management actions and strategies such as bank stabilisation works, revegetation and research and monitoring.	Section 3.4 and Section 4

Coastal Management Principle	Consideration by the CZMP	Report Section
Principle 9 Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy.	The CZMP seeks to The CZMP presents specific management actions to be implemented to promote recreational amenity and public access to the coast.	Section 2 and Section 4
Principle 10 Support recreational activities consistent with the goals of the NSW Coastal Policy.	The CZMP seeks to promote improved coordination between initiatives of various agencies to provide for recreational amenity in the study area. The CZMP presents specific management actions to be implemented to improve the recreational amenity of the estuary and foreshore areas.	Section 2 and Section 4

2.2 Strategic Vision

This CZMP aims to:

1. Promote the aim of the previous NSW Estuary Management Policy which is "to achieve integrated, balanced, responsible and ecologically sustainable use of the state's estuaries within an overall catchment management perspective". To facilitate and guide the long-term sustainable use of the Brunswick Estuary system as an integral component of the State's natural systems which supports a great diversity of terrestrial and estuarine species, human activities and cultural and social values.

2. Address the minimum requirements of the Guidelines for Preparing CZMP's (OEH, 2013) by supporting the goals and objectives of the NSW Coastal Policy 1997, and the objects of the *Coastal Protection Act 1979*.

2.3 Goals

The CZMP presents specific management measures that can be implemented to address the key issues confronting the future management of the estuary as identified in the "Brunswick River Estuary Study" (Byron Shire Council, 2002) and the Brunswick Estuary Management Study and Plan (BSC, 2007). The CZMP also documents the essential features that make the estuary unique and prioritises objectives and options for the future management of the estuary. Potential strategies for achieving these objectives are listed, along with any impacts that these strategies may have on critical estuary processes.

While the Brunswick River Estuary Study was completed back in 2002, and the Brunswick Estuary Management Study and Plan completed in 2007, it is considered that the vast majority of the identified issues still remain relevant today upon which the objectives and management strategies of this CZMP are built.

The CZMP documents the strategies and actions that will achieve the following specific objectives:

(i) protect, rehabilitate and improve the natural estuarine environment

(ii) manage the estuarine environment in the public interest to ensure its health and vitality

(iii) improve the recreational amenity of estuarine waters and foreshores

(iv) recognise and accommodate natural processes and climate change

(v) ensure the ecological sustainable development and use of resources.

The CZMP has been structured to provide a list of strategic measures that can be implemented across the management area defined in **Figure 1-2** in order to meet the objectives determined by legislative guidelines and through consultation with key stakeholders. Management Strategies are detailed in **Section 4**.

2.4 Duration

The CZMP should be reviewed on a cycle of five to ten years. The CZMP may be amended at an earlier date if circumstances change such as legislative changes, new knowledge of climate change, or if new data becomes available on estuarine science/management that may affect the CZMP.

Under the provisions of the *Coastal Management Act 2016*, once the CZMP is approved by the Minister for the Environment it remains in force until 31 December 2021 when it may be transitioned into a Coastal Management Program (CMP), should Council choose to embark on this process.

2.5 Management Agencies and Legislation

2.5.1 Agencies

The prime responsibility for the implementation of this CZMP is held with Byron Shire Council, in consultation with the Byron Shire community. However, as the Brunswick Estuary falls within the Cape Byron Marine Park, the Cape Byron Marine Park Zoning Plan provides an important statutory planning document, with DPI Fisheries (Marine Parks) playing an important role as a management authority of the estuary.

Technical and funding assistance for implementation of the Plan is provided by the NSW Office of Environment and Heritage.

There are other organisations and/or divisions that have a direct responsibility for the implementation of this CZMP and the complete list is considered to include:

- Byron Shire Council
- Department of Industry – Crown Lands and Water (DoI Crown Lands & Water)
- NSW Crown Holiday Parks Trust
- Department of Primary Industries – Fisheries and Marine Parks (DPI Fisheries)
- Brunswick Valley Landcare

Other organisations with activities and responsibilities relevant to management of the Brunswick Estuary and its catchment include:

- Bundjalung of Byron Bay Aboriginal Corporation (Arakwal)
- Roads and Maritime Services
- Department of Planning
- National Parks and Wildlife Service
- Telstra
- Department of Industry - Resources and Energy

- Department of Finance, Service and Innovation
- Health Commission of NSW
- North Coast Local Land Services
- North Coast Weeds

2.5.2 Planning Controls

Land use in the Brunswick Estuary is controlled by a range of legislation, planning instruments and regulations, which are administered by government agencies at both the local and state level. The following sections provide a summary of the environmental and land use Acts and Regulations applicable within NSW. In addition to these Acts and Regulations there are also State Environmental Planning Policies (SEPP), regional environmental plans (REPs), local environmental plans (LEPs), development control plans (DCPs), and regional vegetation management plans (RVMPs).

A summary of environmental and land use legislation applicable within NSW is provided in **Appendix C.**

2.5.3 Relationship to Other Plans and Strategies

There is a large variety of existing and current plans and strategies relevant to the management of the Brunswick Estuary. The relationship between the CZMP and these documents is covered in depth in the Brunswick Estuary Management Study and Plan (2007).

These documents are listed below:

- Byron Shire Council Operational Plan (2016/17)
- Byron Shire Council Delivery Program (2013 – 2017)
- Byron Local Environmental Plan 1998
- Byron Local Environmental Plan 2014
- Byron Development Control Plans 2010
- Byron Development Control Plans 2014
  - DCP (2014) Part E: Chapter E3 – Mullumbimby
  - DCP (2014) Part E: Chapter E4 – Brunswick Heads
  - DCP (2010) Chapter 6: Bayside Brunswick Estate
- Byron Shire Bike Strategy and Action Plan (Bike Plan) 2008
- Draft Northern Rivers Catchment Action Plan 2013-2023
- Brunswick Heads Settlement Strategy 2004
- Mullumbimby Settlement Strategy 2003
- Byron Rural Settlement Strategy 1998
- Byron Rural Land Use Strategy 2016
- Byron Shire Urban Stormwater Management Plan 2002
- Cape Byron Marine Park Planning Scheme 2006
- Cape Byron Marine Park Zoning Plan
- Brunswick Wastewater Management Strategy
- Byron On-site Sewage Management Strategy 2002

- Byron Shire Sustainable Agriculture Strategy 2004
- Byron Biodiversity Conservation Strategy 2004
- Brunswick Heads Foreshore Reserves Strategic Plan 2008
- Plan of Management for Brunswick Heads Foreshore Public Reserves at Brunswick Heads 2014
- Ferry Reserve Holiday Park – Plan of Management 2014 (GF81R265, DOC14/065107)
- Massy Greene Holiday Park - Plan of Management 2014 (09/19253, DOC14/065103)
- Terrace Reserve Holiday Park - Plan of Management 2014 (10/05985, DOC14/065099)

2.5.4 Supporting Documents

The Development of the Brunswick Estuary Management Plan has been preceded by the completion of the following documents which provide the information from which this Plan directly draws.

- Brunswick Catchment Report (1998) - was completed for the Brunswick Catchment Management Committee and includes an extensive compilation of data and studies undertaken in the Brunswick River catchment and estuary.
- Brunswick River Estuary Study (2002) - outlines all the hydraulic, sedimentation, water quality and ecological processes within the estuary, and the impacts of human activities on these processes.
- Brunswick Estuary Management Study and Plan (2007) - identifies the essential features and the current uses of the estuary, and determines the overall objectives required for management of the estuary. The Management Study and Plan identifies options for meeting these objectives, and determines hydraulic and ecological impacts of the proposed options.

3 About the Management Area

3.1 Key Features and Values

The Brunswick Estuary comprises three primary arms, namely:

- the main arm, which includes the Brunswick River and Kings Creek, both of which have their headwaters to the west of Mullumbimby and flow east to the ocean at Brunswick Heads
- the north arm, which is known as Marshalls Creek
- the south arm, known as Simpsons Creek.

The ecological value of the estuary is unique. This is because the Lower Brunswick River and Marshalls and Simpsons Creeks all fall within the Cape Byron Marine Park. This makes the waterway significant in both a local and regional sense.

Similarly, the Tyagarah and Brunswick Heads Nature Reserves are important coastal mainland reserves on the far north coast of NSW. Together with the Broken Head Nature Reserve, these three reserves form the Byron Coast Group of Nature Reserves. They are regionally significant as wildlife corridors for north-south migration along the NSW coast (NPWS, 1998).

The Marshalls Creek Nature Reserve borders the mid-to upper areas of Marshalls Creek. In addition, there are significant areas of wetland along both Simpsons and Marshalls Creeks, and along the lower Brunswick River (refer Figure 3-1). As shown in **Figure 3-1** three pockets of littoral rainforest exist to the west of Marshalls Creek. These areas are protected under SEPP legislation, which highlights their significance at both a state and regional level.

Aboriginal people have lived on the north coast of NSW for thousands of years. A significant number of Aboriginal sites and places are known throughout the valley and especially around Byron Bay and Brunswick Heads where there is remaining evidence of campsites and associated middens or feasting grounds suggesting a population of many hundreds prior to European arrival.

The features which define the natural and cultural significance of an estuary are those which make the estuary important in a local, regional or national sense. During the development of the CZMP a list of features was outlined for each of the following categories of estuary attributes:

- Aesthetic attributes
- Ecological attributes
- Social attributes
- Economic attributes.

Ecological, aesthetic and some social attributes are highly valued while economic attributes were assigned a low value. This reflects the predominantly natural characteristics of the estuary catchment and highlights the importance placed by the Committee on the ecological attributes of the estuary and the adjoining estuarine catchment.

Further details and description on the location and setting, history and natural and cultural significance of the estuary is outlined in **Appendix D**.

Figure 3-1 – Extent of wetland and littoral rainforest protected by SEPP legislation

3.2 Key Impacts and Activities

The primary human impacts have been the modification of the hydrology and hydrochemistry of the estuary, as well as the degradation and loss of habitat for riparian and estuarine organisms

(MHL, 2002). Critical activities that are having or have had adverse impacts on the estuary include:

- non-point source discharges from urban and rural areas
- point source discharges, such as occur from time to time from WWTWs located along the estuary
- clearing of catchment and riparian vegetation
- urban and rural development
- sewer system overflows
- the draining of wetlands
- dredging
- flood mitigation works
- the construction of canals, jetties and training walls.

Further detail on the impact of human activities on key estuary processes, current uses and climate change can be found in **Appendix D**.

3.3 Management Issues

The identification of the key issues confronting the future management of the estuary is an essential step in developing the CZMP. The key issues identified through the "Brunswick River Estuary Study" (BSC, 2002) were presented to the Committee and a group of key stakeholders through a consultation program during the development of the "Brunswick Estuary Management Study and Plan" (2007). The consultations that lead to the adoption of key issues for the management of the Brunswick Estuary are outlined in **Appendix E**.

The adopted key issues for the Brunswick Estuary are identified in the Brunswick Estuary Management Study and Plan (2007) and are described, in order of rank, in **Table 3-1**. These issues have the potential to compromise the sustainable management of the Brunswick Estuary into the future. During the review and update of the CZMP, these issues were assessed for relevance and significance in the present day, and were deemed just as important in 2017 as they were when identified more than 10 years ago (refer to **Table 3-1**).

Table 3-1 – Adopted key issues for the Brunswick Estuary

Rank	Adopted Key Issue	Description
1	Historical and future development	There are problems associated with past developments, such as encroachment into the riparian buffer zone (e.g., The Terrace Caravan Park) and clearing of vegetation, and concerns regarding future urban expansion and infrastructure development. The Kallaroo Circuit Bund and Capricornia Canal at North Ocean Shores also pose issues associated with poor water quality as a result of low estuarine flushing. 2017 comment: Issue still relevant and of key importance. Water quality in Capricornia Canal of concern due to limited flushing. The area is highly urbanised with stormwater contributing to decreased water quality through a small drain which connects canal to the main arm of Marshalls Creek. A research project was suggested to be undertaken to investigate the water quality in the canal but has not yet been completed. Currently it is unknown what the quality of water is in the area and how much pollutant and nutrient load flows into Marshalls Creek. Clearing of riparian vegetation is still a concern in the urban areas where landowners have cleared mangroves and/or other vegetation to create grassed areas, built revetment walls and built waterway access platforms.

Rank	Adopted Key Issue	Description
2	Poor water quality	Poor water quality within the estuary is primarily caused by pollutants within agricultural runoff, sewer overflow, stormwater runoff and effluent. The Mullumbimby, Brunswick Heads and Ocean Shores STPs contribute a significant nutrient load to the estuary, particularly during wet weather flows. Pollution from accidental spillage from transport has occurred in the past. 2017 comment: Issue still relevant and of key importance. Apart from the completion and operation of the new Brunswick Valley STP at Vallances Road and resultant improvements to STP water quality, it is very unlikely that broader issues relating to water quality and impacts on the estuary have changed by any significant measure. Stormwater is still a significant problem contributing to nutrient loads and pollutants from industrial runoff.
3	Foreshore access	Limited foreshore access, particularly adjacent to caravan park camping areas, causes conflicts between users (walkers versus campers). Coupled with this is the lack of connectivity between Crown Reserves. 2017 comment: Issue still relevant and of key importance. User conflict is a growing issue due to the amount of people undertaking passive recreation within the area. There are also growing numbers of businesses (such as kayak tours) accessing the estuary and competing for space (with potential impacts to seagrass and saltmarsh areas). An emerging and growing issue within the area (and within the Shire as a whole) is illegal camping. As noticed during the vessel based site survey there are numerous places where people camping illegally are trampling on the bank vegetation and causing bank erosion (along with other impacts such as rubbish and untreated effluent).
4	Loss and condition of riparian vegetation and aquatic vegetation	Clearing for development and agriculture has caused a progressive reduction in the extent and condition of riparian vegetation. There is a need for the preservation and rehabilitation of existing riparian vegetation. In particular, the mid- and upper Brunswick Estuary, which has large areas of agricultural rural land, has lost significant areas of riparian vegetation as a result of agricultural clearing practices. Pollution incidents, sedimentation and waterway use are threatening important aquatic habitats such as seagrass beds, mangroves, saltmarsh communities and wetlands. There are particular concerns regarding the loss of seagrass beds in Lower Marshalls Creek. 2017 comment: Issue still relevant and of key importance. The area of riparian vegetation is considered to have largely unchanged or decreased. There are still large expanses along the Mid to Upper Brunswick River where riparian buffers are missing or are very sparse.
5	Bank erosion	Increased bank erosion, failure of remedial measures and unsightly and unsafe erosion protection measures are particularly evident along the mid-Brunswick River, adjacent to the Rugby Club and the Ferry Reserve Caravan Park. There are significant areas of bank erosion along the mid-Brunswick River. This is coupled with the loss of riparian vegetation in this area. 2017 comment: Issue still relevant and of key importance. Bank erosion is rife within the Main Arm of the Brunswick River, particularly in the mid to upper Brunswick estuary as outlined in the results from vessel based site survey. There are now bank erosion sites in all reaches of the estuary (Brunswick River, Simpsons Creek and Marshalls Creek). If left unstabilised, areas eroding banks contribute to poor water quality due to increasing turbidity through suspended solids.

3.4 Management Objectives

The primary objective of the CZMP for the Brunswick Estuary is to provide a range of management options or strategies for maintaining and improving estuary condition and function. These options should include measures that will protect the essential features of the estuary (e.g. the primary estuary processes), resolve key issues and improve opportunities for estuary usage. However, prior to developing specific management measures aimed at achieving these goals, it is necessary to identify a set of specific management objectives.

Accordingly, a list of management objectives were identified based on a review of background documents, consultation with the Committee and key stakeholders, and outcomes from land use and estuary use assessments that were carried out as part of the project. The objectives were discussed and prioritised and, from the Committee's perspective, the highest ranked objectives were considered to be the need to:

- improve water quality
- improve estuary ecological health and biodiversity
- conserve Aboriginal and heritage sites
- determine sustainable tourism
- control and manage development.

As an outcome from a Committee workshop held on 29 April 2005, a finalised set of adopted management objectives was confirmed for the estuary. This involved extensive discussion of management issues and resulted in the adopted list of management objectives.

The adopted management objectives were then used to develop strategies and actions for the sustainable management of the estuary and adjoining catchment. These strategies are linked to the key issues identified. The provisional list of potential management strategies was then presented to the Committee in a workshop involving a discussion of the technical reasons for implementing particular strategies and the benefits that would accrue from implementation. The outcome from the workshop was the development of a list of measures and strategies for inclusion within the CZMP.

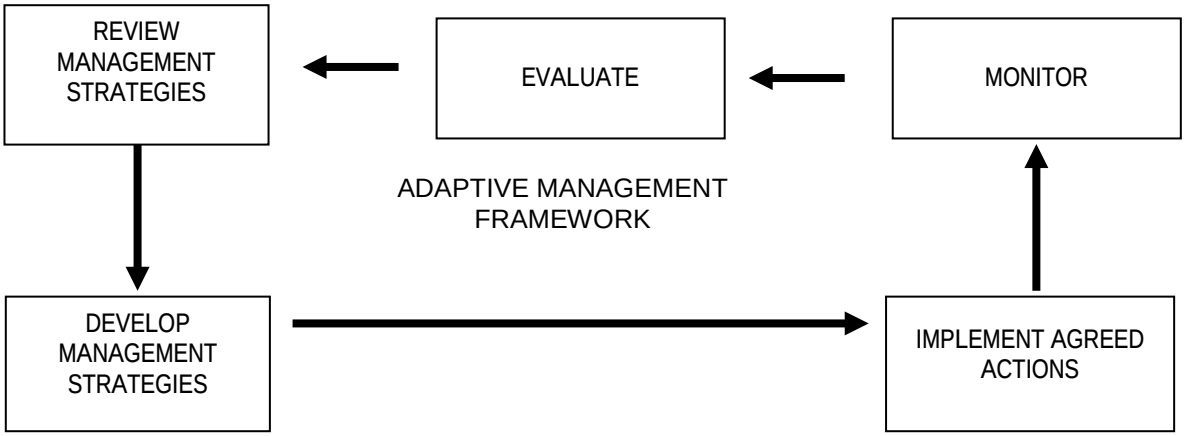
This CZMP does not attempt to address the coastal hazard of tidal inundation at this time. Future reviews of the CZMP may incorporate tidal inundation risk and corresponding management measures.

3.5 Monitoring and Review

The estuary management planning process is consistent with an adaptive management framework. The benefits of such an approach include:

- the assessment of ecosystem health
- evaluation of the success of management programs and adoption of appropriate management responses
- increased scientific understanding of the estuarine ecosystem
- education of the community.

Monitoring and evaluation of the CZMP implementation is critical to the overall success in the estuary management planning process. The main components of the adaptive management framework are represented conceptually in the following diagram.



The CZMP will be monitored as strategies are implemented and projects are executed. Council will aim to conduct an update of the implementation schedule and strategies annually. The CZMP will undertake a comprehensive review within a 5 year time frame prior to 2021 at which time the plan may be transitioned to a CMP. This transition to a CMP is most likely to occur in 2019 as it will require a significant length of time (up to 2 years). The process of transitioning the CZMP to a CMP will involve new community consultation, engagement with stakeholders and identification of management issues, objectives and strategies.

4 Management Strategies

A variety of strategies have been determined to address the management objectives for the estuary. These actions encompass structural and non-structural measures aimed at protecting significant areas and improving aspects of the estuary to make it more suitable for existing and future waterway users. Many of these options were suggested by Committee and community members during the consultation phases of the study.

Where possible, the actions aim to harness the natural attributes of the catchment and are sympathetic to the interests of existing land users. The recommended strategies are presented in the following section under the following categories and have been assigned a category identifier as indicated in the brackets ( ):

(1) Planning controls and policies (P)

(2) Economic incentives and cost-sharing arrangements (C)

(3) Regulation (R)

(4) On-ground works - bank erosion, riparian revegetation and public access management (B)

(5) Investigation and research (IR)

(6) Monitoring (M)

(7) Education and public relations (E)

Each strategy has been assigned a priority ranking and time frame for implementation. All strategies are **pending available funding and resources** with priority rankings defined and colour coded as follows:

- Priority 1 Implementation should proceed within the next seven years and is required to address issues considered to require more attention.

- Priority 2 Implementation should proceed at some time during the next seven to fifteen years and is required to address issues that can be “lived with” over the medium term.

- Priority 3 Implementation should proceed at some time in the future (15+ years) and are less urgent, being for the long term benefit of the estuary.

4.1 Planning Controls and Policies

4.1.1 Priority One Strategies

Recommended Strategy
P1. COUNCIL PLANNERS TO ENSURE FUTURE RESIDENTIAL REZONINGS INCLUDE FORESTED BUFFER ZONES BETWEEN AGRICULTURAL AND NEW RESIDENTIAL LANDS
Description of Task

Actions required:

1. Council planners to ensure that future residential rezonings include forested buffer zones between agricultural and new residential lands at:
   - Ann Street, Mullumbimby
   - Bayside Brunswick
   - Existing residential-zoned land on Main Arm Road, Mullumbimby
   - Clays Road / Coral Avenue
   - Left Bank Road, Mullumbimby.
2. Involve local Landcare groups to create buffers between existing town / agricultural boundaries
3. Investigate the introduction of farm forestry planting incentives for land owners. Planting could be tax deductible if linked to other agricultural production
4. Encourage rural landholders to prepare Property Vegetation Plans with the North Coast Local Land Services

Land use conflict is real and needs to be managed now and into the future. Adequate planning is the most successful way to ensure that town and agricultural uses can co-exist. The intention of this Strategy is to reduce the conflicts between agriculture and adjoining landowners through planning for adequate buffers between conflicting uses. Buffers should be required as part of any rezoning of rural land to a residential zone. Property Vegetation Plans and Landcare activities may also be useful tools to achieve buffers between agriculture and the adjoining residential land.

Incorporating buffers to manage land use conflicts will remain the primary planning tool when undertaking future residential rezonings. Whether or not these areas are planted out depends on (i) what can be negotiated with the landowner/developer at the time and (ii) having a framework in place for future management of these buffer areas. General riparian planting and habitat corridors are also of great significance and need to be implemented via a co-ordinated approach to minimise land use conflicts and ensure environmental rehabilitation and enhancement.

Increasing catchment vegetation will assist in reducing the rate of runoff, improving the quality of catchment runoff as well as filtering the runoff thereby reducing the overall sediment and pollutant load to the estuary.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Underway (<25% completion)

Recommended Strategy
P2. PREPARE THE NORTH BYRON COASTAL CREEKS FLOOD STUDY TO INCORPORATE THE IMPACTS OF CLIMATE CHANGE
Description of Task
Actions required: 1. Prepare the North Byron Coastal Creeks Flood Study incorporating modelling of Marshalls, Simpsons and Brunswick Catchments. The study is to consider the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton and South Golden Beach. 2. Develop a Flood Risk Management Study and Plan for these areas. 3. Incorporate the impacts of climate change into the Flood Risk Management Study and Plan based on Council's adopted climate change parameters. The impacts of climate change are to be incorporated into a Flood Risk Management Study and Plan based on the adoption of climate change parameters outlined in Byron Shire Council's Climate Change Strategic Planning Policy, adopted in 2008 and last updated in 2014.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$75,000
Grant/Funding Options	Floodplain Management Grant Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Underway (<25% completion)

4.1.2 Priority Two Strategies

Recommended Strategy
P3. INVESTIGATE OPTIONS FOR FURTHER INTEGRATION OF COASTAL CROWN LAND MANAGEMENT WITHIN THE BRUNSWICK ESTUARY FORESHORE RESERVES SYSTEM
Description of Task
Actions required: 1. Liaise with the DoI Crown Lands & Water to identify all Crown Reserves within the Brunswick Estuary that do not have a current Plan of Management 2. Prepare draft Plans of Management within an integrated estuary / foreshore reserve system 3. Undertake community consultation to obtain community feedback on draft Plans of Management 4. Finalise reports. There are a number of Crown Reserves throughout the Brunswick Estuary that do not currently have a Plan of Management. It is important that these are managed in a co-ordinated manner to ensure there are no negative impacts on estuary health and that the Plans of Management provide appropriate space for the proposed access paths in the "Draft Foreshore Access Concept Plan". It is important that the community is involved in the preparation of any plans to ensure that there is community support for their use. The Plans will ensure connectivity of habitats, the regeneration of vegetation and protection of catchment vegetation. This is particularly important for the large area of Crown land upstream of the Ferry Reserve Caravan Park.

Implementation of Task	
Lead Agency	DoI Crown Lands & Water
Total Cost Estimate	$71,500
Grant/Funding Options	Public Reserves Management Fund (Dept. of Industry - Lands)
Projected Date for Commencement	Within 7 - 15 years
Status	Underway (<25% completion)

Recommended Strategy
P4. PREPARE A WATER-SENSITIVE URBAN DESIGN POLICY FOR THE BYRON SHIRE

Description of Task

Actions required:

1. Council to prepare a draft WSUD Policy in consultation with State Agencies, industry and the community
2. Undertake public exhibition of draft policy document
3. Finalise WSUD Policy
4. Council adoption of WSUD policy
5. Developers advised of new policy and provided with fact sheets on key techniques
6. Implementation of WSUD Policy

Water Sensitive Urban Design (WSUD) is a design approach that integrates stormwater management with the urban water cycle. Some WSUD techniques include the use of rainwater tanks, water-efficient fixtures, grassed swales replacing kerb and gutter, bio-retention systems, vegetated filter strips to remove pollutants from stormwater flows, riparian zone protection and revegetation.

Byron Shire Council has developed Comprehensive Guidelines for Stormwater Management (2014) recommends a number of WSUD type strategies such as rainwater tanks and on-site retention. The plan also recommends that Council policies should be improved to reduce the amount of hard surfaces. A WSUD Policy would formalise these requirements and detail the range of WSUD techniques that can be incorporated into new developments to increase infiltration, reduce the quantity and improve the quality of stormwater runoff.
The use of such techniques would greatly reduce the impacts on receiving waters within the Brunswick Estuary. The implementation of such a policy is in line with the NSW Government's Building Sustainability Index (BASIX) requirements.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$18,750
Grant/Funding Options	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

4.1.3 Priority Three Strategies

Recommended Strategy
P5. DEVELOP AN ACID SULFATE SOILS MANAGEMENT PLAN FOR THE CATCHMENT

Description of Task

Actions required:

1. Undertake a soil survey of the area to the north and south of the Brunswick River, and the Marshalls Creek sub-catchment in accordance with Recommended Strategy IR5
2. Undertake water quality monitoring to determine sites of acid runoff
3. Prepare whole-farm plans for properties on high risk ASS
4. Review and assess Marshalls Creek Floodplain Management Plan to identify areas with high probability for development
5. Develop ASS Management Plan in accordance with the NSW Acid Sulfate Soil Manual
6. Establish ASS demonstration sites, such as at the Kallaroo Circuit Bund / Capricornia Canal area
7. Organise awareness and education activities such as field days, information bulletins and newsletters.

There is currently no detailed information on the actual distribution of ASS in the Brunswick estuarine system. The OEH Acid Sulfate Soil Risk Maps are useful for estimating the possible extent of ASS in the area, but are not reliable as a basis for making an ASS Management Plan (ASSMP).

There are two other management strategies recommended within the plan implementation strategy that will provide the appropriate level of baseline information required to prepare an ASSMP. The first strategy relates to a drain mapping exercise to be undertaken throughout the estuary, and the second relates to the undertaking of a soil survey throughout the catchment to determine the actual areas of PASS (Potential Acid Sulfate Soils). These two strategies (IR5 and IR6) will need to be addressed prior to the development of the ASSMP.

The ASSMP should outline the strategies to manage the potential impacts of development works and catchment activities that are likely to disturb acid sulfate soils. The ASSMP needs to specify all potential environmental impacts, performance criteria, and mitigation strategies, together with relevant monitoring and reporting requirements. Where an undesirable impact or unforeseen level of impact occurs, the appropriate corrective action should be implemented.

The plan will:

- reduce the risk of disturbance of PASS
- reduce acid runoff to the estuary and resultant fish kills
- provide guidance and support for best practice agricultural activities
- improve understanding of the basic principles of acidification.

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	$60,000
Grant/Funding Options	Floodplain Management Grant Program (OEH)
Projected Date for Commencement	Within 15+ years
Status	Not started (0% completion)

4.2 Economic Incentives

4.2.1 Priority Two Strategies

Recommended Strategy
C1. INTRODUCE A COMMUNITY ENVIRONMENTAL GRANTS SCHEME
Description of Task

Actions required:

1. Investigate and determine the possibility of introducing an Environmental Grants Scheme similar in nature to Tweed Shire Council – River Health Grants
2. Secure initial funding for start-up of scheme
3. Establish continued funding and potential long-term funding options.
4. Introduce grants scheme to community.
5. Publish media article advising rural land owners of Environmental Grants Scheme and how to apply
6. Implement Environmental Grants Scheme through the BSC website.

For many landowners start-up costs for on-ground works is the hardest step and the limiting factor in initiating environmental works. It would be advantageous if Council could more actively encourage on-ground works by landowners through the establishment of an Environmental Grants Scheme. Tweed Shire Council has grants for works in areas adjacent the river bank that will lead to improvements in water quality and stream health. Grants are available for work such as stock fencing, erosion control, revegetation and weed management.

Council would ultimately act as a funding body for administering the grants with assistance from local Landcare groups who would provide educational support to applicants.

Community recognition of individuals who undertake use of the grants scheme by employing environmentally responsible practices on their property may include an annual awards ceremony facilitated by the Council and/or recognition on the website.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$12,000
Grant/Funding Options	Environmental Trust (OEH); Small Grants for Rural Communities
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

4.3 Regulation

4.3.1 Priority One Strategies

Recommended Strategy
R1. LOBBY FOR REVIEW OF SPEED LIMITS WITHIN THE BRUNSWICK RIVER AND MARSHALLS CREEK
Description of Task
Actions required: 1. Council to lobby Roads and Maritime Services to review speed limits within the Lower Brunswick Estuary. 2. Prepare community information brochures on new speed restriction zones. 3. Prepare media release advising of new speed restriction zones. 4. Install signs in prominent foreshore locations clearly specifying new speed restrictions. The Brunswick River attracts significant numbers of recreational boats, particularly during peak tourist seasons. The estuary is popular for swimming, snorkelling, beach going and other passive recreational uses. However, it is also popular for motorised boating, passive and unpowered watercraft use (e.g. Stand Up Paddle Boards) and recreational fishing. There are currently no speed restrictions on the lower Brunswick River as far upstream as the confluence with Kings Creek. There are some restrictions in Simpsons Creek downstream from the footbridge. There are a significant number of passive recreational uses being undertaken in the lower reaches of the river (especially in Marshalls Creek and between Marshalls Creek and Torakina Beach) In addition to the potential for user conflicts, there is a significant collision risk in the high use lower reaches of the estuary. It is not uncommon to see in the high use lower reaches of the estuary. It is not uncommon to see boats speeding past snorkelers, paddle boarders, or swimmers at close proximity and this risk needs to be addressed. It is recommended that the speed limits for the lower Brunswick River be reviewed. This strategy is in accordance with the Marine Parks Operational Plan of Management for the Cape Byron Marine Park (MPA, 2004b) which endorses that speed limits should be reviewed in consultation with NSW Roads and Maritime Services. A review of boat speeds should also consider boat wake and its contribution to riverbank erosion, such that any speed reduction should also aim to minimise the impact of boat wake on riverbanks and estuarine ecology.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
R2. INVESTIGATE POTENTIAL ILLEGAL ROCK ARMOURING IN ALL REACHES OF THE BRUNSWICK ESTUARY, AND ENFORCE COMPLIANCE AS APPROPRIATE
Description of Task
Actions required: 1. Council and DoI Crown Lands & Water to investigate sites of potential illegal rock armouring (Sites SI01, BR06, BR09, BR11, BR12, BR17) 2. Council to liaise with DoI Crown Lands & Water (for sites located on Crown land) and review development approvals documentation to determine whether ad-hoc rock armouring has appropriate Council and/or DoI Crown Lands & Water approval 3. Undertake enforcement action where appropriate 4. Encourage land owners to undertake recommended bank stabilisation options Illegal ad-hoc rock armouring is still prolific along the banks of the Brunswick River, and is and is a compliance issue for DoI Crown Lands & Water where construction works take place on and/or directly/indirectly impact upon Crown land. However, many of the areas have been stabilised by the rocks in areas where riparian vegetation is lacking. If rock armouring is to be removed then it may be necessary to undertake revegetation works in parallel with removal. Council and DoI Crown Lands & Water to undertake a collaborative approach towards investigating and enforcing compliance matters. Landowners should also be educated and encouraged to undertake best practice river bank and riparian restoration works, such as increasing riparian vegetation and restricting cattle access to river banks (*Refer to G2).*

Implementation of Task	
Responsible Agency	Byron Shire Council and DoI Crown Lands & Water
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 3 years
Status	Progressing (25% - 75% completion)

Recommended Strategy
R3. INVESTIGATE AND UNDERTAKE COMPLIANCE ACTION ON ILLEGAL CAMPING ALONG ALL REACHES OF THE BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Byron Shire Council and DoI Crown Lands & Water to investigate and undertake compliance action on illegal camping along all reaches of the Brunswick Estuary
2. Undertake enforcement action where appropriate.
3. Explore options to enhance regulatory compliance role within Byron coastal/estuary reserve system.
4. Encourage land owners to limit illegal camping by fencing off areas, or advising regulatory authorities when illegal camping is observed.

During the Site Survey (*Refer - Appendix B*), it was apparent that access to the waterway and riverbank in some areas was unrestricted even though the areas were private property, Council or Crown Land. Illegal overnight camping was evident along Simpsons Creek (Sites SI03 and SI04) and the Brunswick River (Site BR17) where areas of riparian vegetation have been damaged by trampling and vehicle access.

Potential impacts of camping in undesignated areas include:

- Trampling and removal of riparian vegetation
- Creation of erosion areas of river bank
- Rubbish pollution of waterways
- Effluent pollution of waterways
- Potential unsocial behaviour and impediment of areas for general public day-use.

Implementation of Task

Lead Agency	Byron Shire Council and DoI Crown Lands & Water
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 7 years
Status	Underway (25% completion)

Recommended Strategy
R4. INVESTIGATE AND ENFORCE ENCROACHMENT OF BUILT STRUCTURES AND CLEARING OF RIPARIAN VEGETATION AT AREAS ADJACENT BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Byron Shire Council and DoI Crown Lands & Water to investigate illegal landowner development (built structures) and riparian vegetation clearing along all reaches of the Brunswick Estuary
2. Undertake enforcement action (where appropriate)
3. Explore options to enhance regulatory compliance role within Byron coastal/estuary reserve system
4. Landowners to remove structures and restore riparian vegetation buffer (where appropriate)

There are various instances of riparian vegetation clearing, installation of private revetment works and construction of in-stream water access structures adjacent reaches of the Brunswick Estuary (specifically at sites SI01, MA01 and MA06). At Site MA01, Marshalls Creek floating pontoons and concrete formwork are present at most properties. In some instances these structures may be approved by Council and/or DoI Crown Lands & Water, however, many may not and an investigation of Development Approvals is required. Where construction works have occurred on Crown land, then DoI Crown Lands & Water will be the lead agency in effecting compliance where there is no appointed Trust manager.
This management strategy should be undertaken in parallel with *E3* to raise awareness through a community education program advising the value of the estuary, riparian vegetation and the impact of human activities on estuary processes.

Implementation of Task

Responsible Agency	Byron Shire Council and DoI Crown Lands & Water
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 3 years
Status	Not started (0% completion)

4.4 On-Ground Works – riverbank stabilisation, revegetation and repair

Riverbank stabilisation can be achieved by implementing a number of approaches varying from structural protection through to non-structural adaptive land use planning controls, including:

- Construction of protective works
  - hard structural options
  - soft structural options
  - combined hard and soft options
- Non-structural options
  - improved catchment management
  - adaptive hazard management.

The appropriateness of a particular management measure depends to a large extent on the level of existing development likely to be affected and the financial resources of the community. For instance, a threatened area characterised by intense urban use and substantial infrastructure may require heavy bank protection, whereas rural areas may approach the issue with a much larger range of management options. Whatever the case, the CZMP should be flexible and allow for conditions to be varied subject to monitoring of the hazard.

4.4.1 Land Authorisations

Where works are proposed under the *Crown Lands Act 1989* on Crown land, not under Council Trust management, an appropriate authorisation from DoI Crown Lands & Water will be required prior to the works commencing. Authorisation may be provided by way of a licence or potentially the appointment of Council as the reserve manager to streamline future management arrangements. Adequate lead time (at least six months) is required for the Department to assess and issue authorisations (licences) for works on Crown land. For indicative purposes, where authorisations are likely to be required from the Department, this has been noted against specific recommended strategies.

It is also acknowledged that a large section of the Brunswick Estuary is the subject of a Native Title Claim by the Arakwal People and engagement with the Bundjalung of Byron Bay Aboriginal Corporation (Arakwal) should be undertaken throughout the implementation of the CZMP. Where actions are proposed on Crown land, consideration of Aboriginal Land Claims lodged under the NSW *Aboriginal Land Rights Act 1983* will need to occur. In addition, any works will need to be compliant with the Commonwealth *Native Title Act 1993*. Hence, a cultural assessment may be required for any proposed works on riverbanks and areas of significance.

Hard Structural Options

Hard structural alternatives are primarily applied to banks requiring significant stabilisation and erosion protection. A physical barrier is constructed on the riverbank to absorb the erosive energies of the river and physically hold back the toe or slope of the bank.

If properly designed, many of the “hard” structures catalogued below can potentially eliminate erosion problems along the protected area. However, they can also alter the hydrodynamics of the river and thus modify patterns of erosion and accretion along its banks. This is especially true immediately downstream of the structure, where increased flow and sediment load due to the works can exacerbate already present erosion problems or in fact create new ones.

From a design perspective, structural protection must be able to cater for the application of surcharge loads and the dissipation of pore pressure, as well as protecting the bankline from surface and toe erosion. Similarly, erosion at the ends of structural protection (outflanking) is a common failure mode and must be guarded against.

In addition to downstream problems, the potential negatives in an area proposed for hard structure stabilisation are numerous, including structure failure due to unexpected toe scour, loss of aesthetics, reduction in the amount of viable habitat and often the high cost of construction and maintenance.

In particular, any major change to the river bank could have a significant affect on the local terrestrial and aquatic habitats, and may inhibit future vegetation development. The riparian habitat is an important interface between the aquatic and terrestrial environments, and its establishment and development should be encouraged.

Hard structural modifications to a river bank would require a permit under the Fisheries Management Act, 1994. All factors needs to be carefully examined when weighing the costs and benefits of any proposed hard structural option. Hard structural bank stabilisation options and comparative costs for each option over typical river bank heights (~5 metres) are shown below in **Table 4-1**.

Table 4-1 – Approximate cost ranges for ‘hard’ bank stabilisation options

Option	Description of Hard Structural Options	Min Cost ($/m)	Max Cost ($/m)
A	Rock revetment with buried toe apron	1875	2500
B	Rock revetment with self launching toe apron	1500	2250
C	Gabion wall on a reno mattress toe apron	3125	4375
D	Masonry or block wall	1875	3125
E	Structural membrane	1875	2500
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	1000	1500
G	Top-up of existing revetment with additional rock material and bank regrading	375	625
H	Rock supported toe and bank regrading	1250	1875
I	Localised rock protection and anchoring of valuable trees or vegetation	10000	12500

A detailed description of a range of hard structural bank stabilisation options, including their advantages and disadvantages is provided in Appendix F.

Soft Structural Options

Soft structural alternatives may also be employed for erosion protection, but can be additionally targeted at foreshore enhancement for flora and fauna and for recreational access, particularly where there is the opportunity to combine bank protection with foreshore landscaping / habitat enhancement. They can be extremely useful in areas where erosion problems exist at or above the waterline, though these methods will not generally aid in the prevention of deep seated bank failures.

However, methods such as regrading combined with revegetation can significantly improve the stabilisation of existing steep and unstable banks.

Vegetation, in particular, can play a significant role in bank stabilisation. The binding root systems of riparian vegetation act to prevent soil erosion from river banks by increasing bank strength. Vegetation also lowers natural groundwater levels, and thus reduces the susceptibility of banks to seepage failures. Surface runoff can be intercepted and slowed by vegetation and its associated natural debris. This acts to dissipate the energy of the flow, allowing sediments to be deposited before entering the waterway.

Soft structural bank protection options and comparative costs for each option for typical river bank heights are shown in **Table 4-2**.

Table 4-2 – Approximate cost ranges for 'soft' bank stabilisation options

Option	Description of Soft Structural Options	Min Cost $	Max Cost $
J	Cutting of trees and roots along riverbank	250 each	2500 each*
K	Large organic debris or trees	1500/tree	2500/tree**
L	Gravel or cobble fillet on berm	125/metre	250/metre
M	Gravel or cobble fillet behind a rock toe	250/metre	750/metre
N	Mangrove planting behind a rock toe	250/metre	375/metre
O	Mangrove planting behind a wave wall	375/metre	625/metre
P	Vegetation in riparian corridor	10/tree	62.5/tree
Q	Regrading of riverbank	25/metre	250/metre***
R	Creation of sandy beaches	1250/metre	1875/metre****
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	-	100 /metre^2
T	Timber groynes (piles) – costs vary dependant on size required	10/metre	100/metre
U	Formalisation of public access (recycled plastic stairs)	1500/metre	2000/metre

*Depending on size and accessibility
**May be obtained for minimal cost from clearing projects (such as highway upgrade)
***Plus revegetation required
****Typically $75,000 to $120,000 each beach

The costs presented are indicative only and are likely to vary on a site by site basis subject to the design requirements, availability of materials, and ease of construction.

A detailed description of a range of soft structural bank stabilisation options, including their advantages and disadvantages, can be found in F.

Cost Estimates

The costs presented in this CZMP are indicative only, based on a per metre or per tree basis. The costs have not been presented on a per site basis, as detailed surveys of each site have not been completed and size is unknown. The estimates derive from the Brunswick Estuary Management Study and Plan (2007) and are based on Patterson Britton & Partner's experience and judgement as a firm of practising professional engineers familiar with the construction industry. The estimates comprise material costs, labour and machinery costs, however, do not include items such as design fees, project management fees, authority approval fees, contractors risk and project contingencies (e.g. to account for construction and site conditions, weather conditions, ground conditions and unknown services).
The construction cost estimate by Patterson Britton & Partners is not to be relied upon in any way. If a reliable cost estimate is required, then an appropriately qualified Quantity Surveyor should be engaged.
The original estimates from 2007 have been increased by 25% to account for an approximate average annual inflation rate of 2.5% over 10 years.

Combined Soft and Hard Stabilisation Options

A combination of hard and soft options can be an effective and aesthetic way to provide erosion protection. It provides the instant fix of hard structural works whilst allowing vegetation integral to river health and function to establish and improve long-term bank stability.

In general, there are two primary configurations for these combinations:

- hard structural options below normal water levels and soft options along the upper banks
- hard structural options on entire bank, through which vegetation can grow

With the former, the hard structure acts as a foundation upon or behind which bank regrading and/or revegetation can be undertaken. The latter provides a stable matrix for the direct planting of vegetation.

Appendix F provides a detailed description, including conceptual designs for each of the recommended bank stabilisation options. These options may be used in isolation or in combination to provide a stable bank.

Figure 4-1 to Figure 4-4 present the results of the Site Survey undertaken in January 2017 of the Brunswick River, Simpsons Creek and Marshalls Creek. The Site Survey has identified many new sites within the estuary that require on-ground works comprising bank stabilisation (hard, soft or combination), revegetation of the riparian buffer zone, or repair of existing structures (such as revetment walls). The 2005 site survey of the river found no reported bank erosion sites in Marshalls Creek, in comparison to 2017 site survey which found 7 sites requiring some kind of on-ground work (bank stabilisation, repair or riparian revegetation) in order to improve the ecological condition and stability of the riparian zone and estuarine waters.

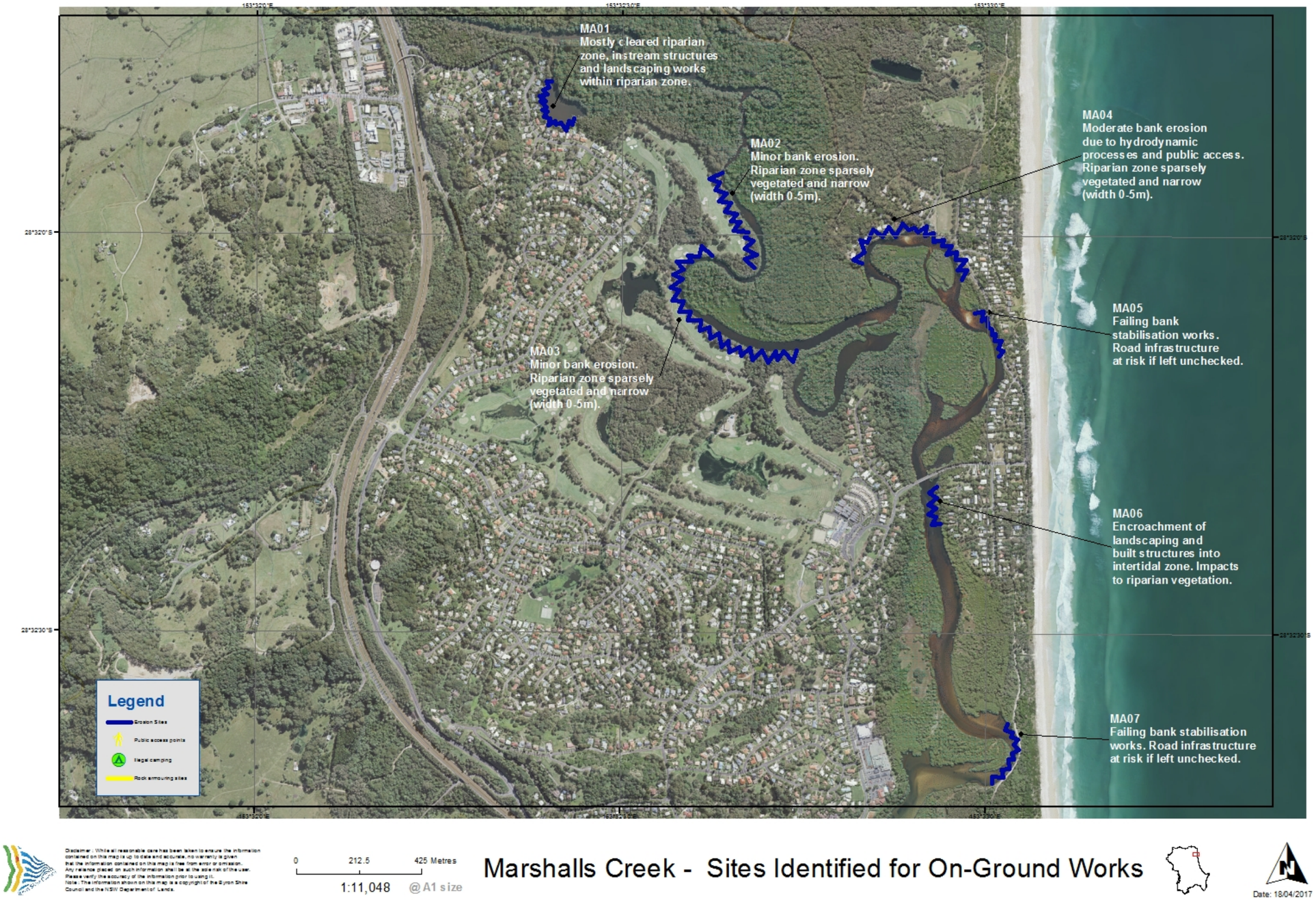


Figure 4-1 – Sites identified for on-ground works, Marshalls Creek

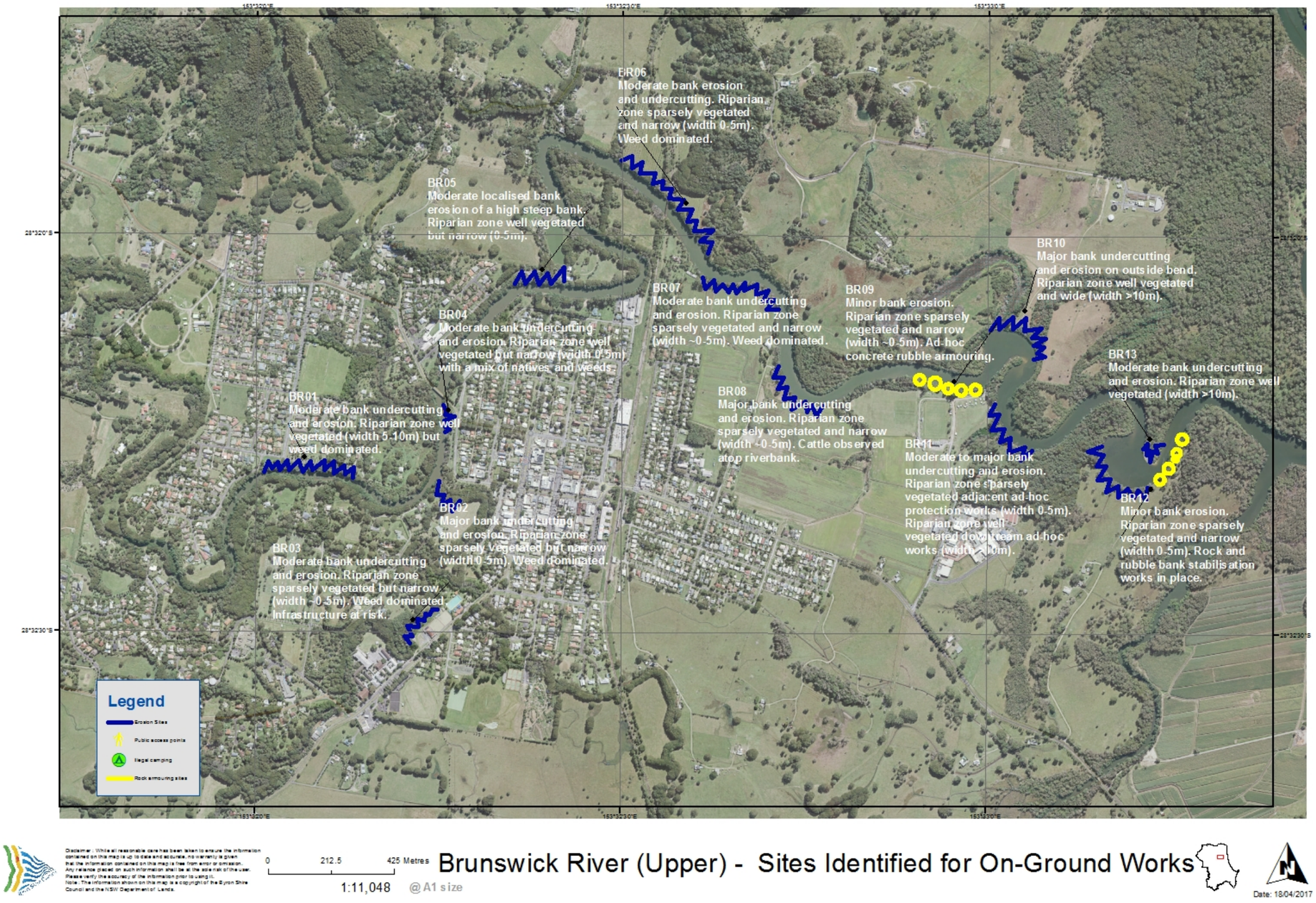


Figure 4-2 – Sites identified for on-ground works, Brunswick River (Upper Catchment)

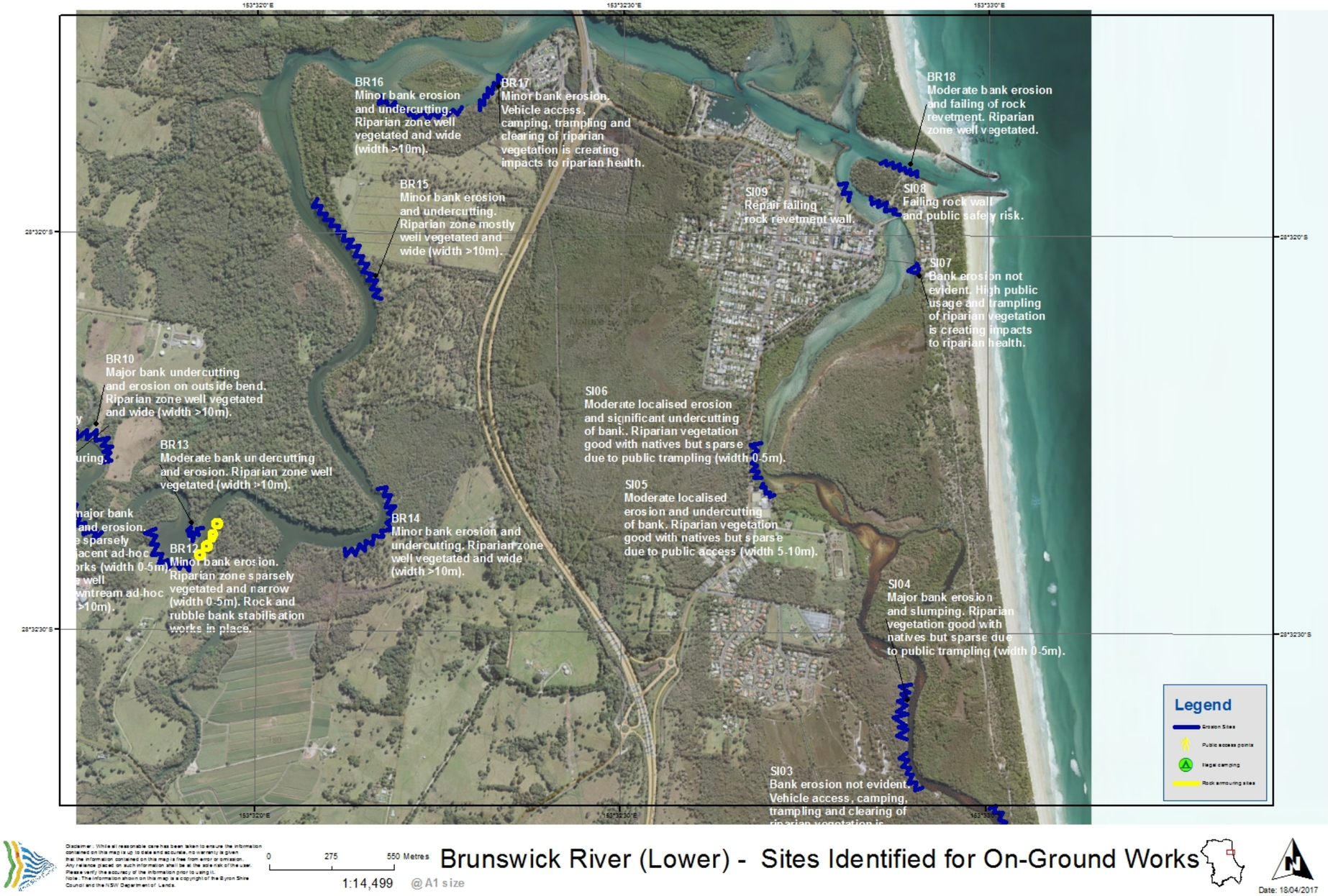


Figure 4-3 – Sites identified for on-ground works, Brunswick River (Lower Catchment)

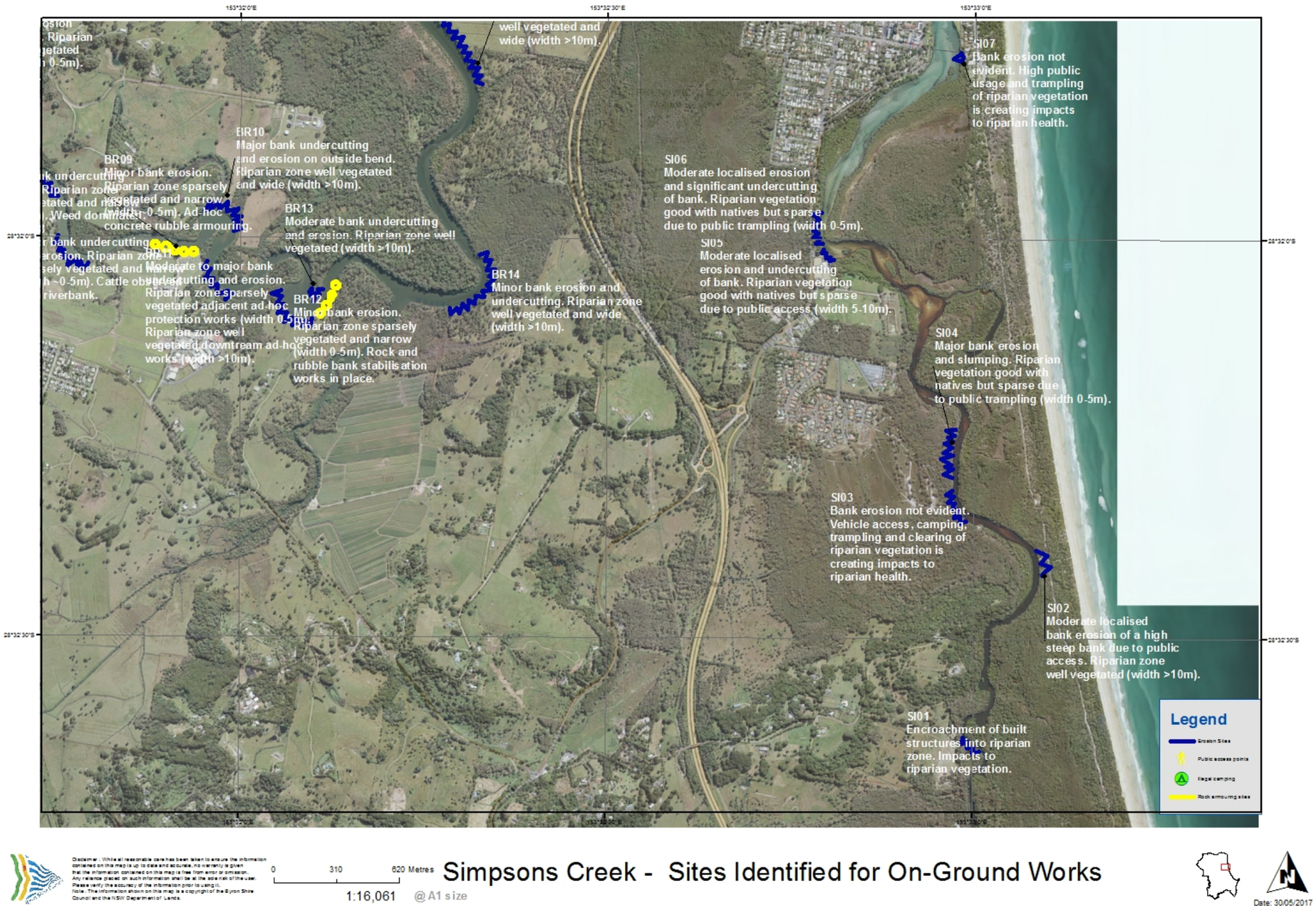


Figure 4-4 – Sites identified for on-ground works, Simpsons Creek

4.4.2 Priority One Strategies

Recommended Strategy
B1. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AT SITES SI03 AND SI04, SIMPSONS CREEK AND SITE BR17, BRUNSWICK RIVER
Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Formalise or restrict public access in consultation with landowner and key stakeholders
3. Compliance action on illegal camping (*Refer - Recommended Strategy R3*).
4. Undertake revegetation works to increase riparian vegetation buffer.

At site SI03 the riparian vegetation has been damaged by camping, human use and vehicle access. The riverbank is stable at present with bank erosion not evident, however, the riparian buffer zone is sparsely vegetated and narrow. Trampling of vegetation and rubbish is the primary issue of the site, and compliance enforcement of camping is the primary management response required.

Photo – Site SI03 showing campers and cleared riparian vegetation

The primary cause of erosion at site SI04 is the lack of riparian vegetation caused by uncontrolled public access. Illegal camping is evident at this site with camping structures in the vegetation and stairs installed down the riverbank. The area is a private property, however, access is not controlled. The ad-hoc public access has caused significant active erosion and slumping of the relatively high and steep riverbank. This has significantly compromised the ecological integrity and bank stability of the site.

Recommended management measures at this site include compliance enforcement of illegal camping and management of public access and riparian revegetation. Formalising public access (or restricting it) at this site will allow the riparian vegetation to rehabilitate thus helping to restabilise the eroding river bank. Bioengineered bank stabilisation works (such as coir logs) may also be appropriate to stabilise eroding bank toe until the native vegetation re-establishes.

Photo – Site SI04 showing camping structures

Site BR17 is just up from Riverside Crescent and is a heavily used general public access area for deployment of watercraft and illegal overnight camping. The site has some localised minor bank erosion and bank under-cutting with ad hoc protection works present. Vehicle access, camping, trampling and clearing of riparian vegetation is creating impacts to riparian health.

Photos – Site BR17

Potential options are illustrated below.

Option	Description	Indicative Cost ($)
P	Vegetation in riparian corridor	$10 - $62.50 per tree
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	$100 per square metre
U	Formalisation of public access (recycled plastic stairs)	$2000 per metre

Implementation of Task	
Lead Agency	Byron Shire Council (SI03 & SI04); DoI Crown Lands & Water (BR17)
Supporting Agency	DoI Crown Lands & Water
Total Cost Estimate	Dependent on size of area to be revegetated.
Grant/Funding Options	NSW Environmental Trust; NSW Coastal and Estuary Grants Program
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B2. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION, FORMALISATION OF PUBLIC ACCESS AND REVEGETATION) AT SITES SI05 AND SI06, SIMPSONS CREEK

Description of Task

Actions required:

1. Confirm land tenure and responsible agencies
2. Develop precinct plan, concept designs and costing's
3. Prepare detailed designs
4. Undertake bank stabilisation works
5. Undertake revegetation works to increase riparian vegetation buffer.

Site SI05 is directly adjacent the Brunswick Heads Bowling Club and is a heavily used public access area with a rope swing into the river from the large Eucalypt tree. There is public access induced localised erosion and natural undercutting along the river bank into the coffee rock. The site is adjacent the main road and cars use the off-road area to park for access to the creek. The area has good native vegetation including established large trees, however, the access to the river needs to be formalised to prevent further erosion and trampling of riparian vegetation. The large gum tree is stabilising a large part of the river bank in this area and if erosion and undercutting continues it could be lost, thereby threatening the existing public walkway.

Photos - Site SI05 with rope swing and mangroves upstream and downstream

Site SI06 is an existing site of the previous CZMP (Issue No. 4, 2012) and management of this site still remains. There is ad-hoc public access at this site which impacts riparian vegetation and is causing undercutting of the riverbank. The site is adjacent the main road and cars use off-road area to park for access to the creek. The erosion at this location is impacting an Aboriginal midden present within the riverbank and is threatening the existing public cycleway / footpath that runs adjacent to the watercourse. The riparian vegetation is predominantly native, however, sparse due to trampling by public. Mangroves are present upstream and downstream of the area and there a few mangroves trying to establish in the footprint area.

It is therefore a high priority to ensure that the ad-hoc public access, active erosion and undercutting does not continue. Due to the proximity of site SI05 and site SI06, development of a Precinct Plan is recommended in order to design the most appropriate combination of bank stabilisation works, formalisation of public access, bollarding of the car park area and planting of the riparian buffer zone. It is a large area and heavily used by the community for deploying watercraft, therefore, community consultation is essential.

Site SI06 forms part of the Simpsons Creek Reserve and management actions are outlined in the Brunswick Heads Foreshore Reserves Plan of Management at Brunswick Heads adopted by the NSW Crown Holiday Parks Trust in 2008. Specific actions applicable to this site include:

1. Restore damage to the banks of Simpsons Creek Foreshore
2. Consider creation of a specific location for kayak / canoe launching
3. Maintain the existing pedestrian pathway and improve signposting
4. Restrict vehicular access in areas where there is potential to cause damage to natural features

Photos - Site SI06 showing public cycleway and trampled access.

Potential options are illustrated below.

Option	Description	Indicative Cost ($)
K	Large organic debris or trees	$1500 - $2500 per tree
P	Vegetation in riparian corridor	$10 - $62.50 per tree
U	Formalisation of public access	$ 1500 - $ 2000 per metre

Implementation of Task	
Lead Agency	NSW Crown Holiday Parks Trust or Byron Shire Council – to be confirmed.
Supporting Agency	DoI Crown Lands & Water
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B3. REPAIR BANK STABILISATION WORKS AT SITE SI08 AND SI09, SIMPSONS CREEK
Description of Task

Actions required:

1. Confirm land tenure and responsible agencies
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake bank stabilisation works.

Site SI08 is on the right bank of Simpsons Creek downstream of the road bridge where the existing rock wall is failing and in need of repair as it creates a public safety risk. Rocks are unstable and the exposed bank is slippery and prone to failure in places. This is a high public usage site where swimming and day-use activities occur all year round. The length of the wall in need of repair is potentially up to 200m.

Photo – SI08 failing rock wall

Site SI09 is on the left hand side of Simpsons Creek directly opposite site SI08. The rock retaining wall is downstream of the Pirate Ship and has rotated to over vertical in places. Section of the wall may be at risk of collapse. This area is heavily used by the general public, and people often sit atop the wall unaware of the potential dangers.
SI09 presents a public safety risk and amenity issue and if left unchecked, may collapse in the near future creating a significant risk to public safety.

Photo - Si09 failing rock wall

Potential options for repair of the wall at this location are presented below.

Option	Description	Indicative Cost ($)
D	Masonry or block wall	$1875 - $3,125 per metre
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	$1000 - $1500 per metre
G	Top-up of existing revetment with additional rock material and bank regrading	$475 - $625 per metre

Implementation of Task	
Lead Agency	DoI Crown Lands & Water (SI08); NSW Crown Holiday Parks Trust (SI09)
Supporting Agency	DoI Crown Lands & Water
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B4. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT MA04 (CASSONS LANE), MARSHALLS CREEK
Description of Task

Actions required:

1. Develop Precinct Plan, concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Undertake revegetation works to increase riparian vegetation buffer.

This site has active erosion and significant undercutting of the river bank with the public road at risk. There are significant ad-hoc public access issues and zero riparian buffer in areas. The site in question is a large precinct from encompassing Cassons Lane to the Yum Yum Tree café. There are a lot of ad hoc bank stabilisation works present and no formal access points to the creek. The area is also at risk of tidal inundation hazard and bank erosion hazard to public assets. Due to the large precinct in need of works, development of a Precinct Plan is recommended in order to design the most appropriate combination of bank stabilisation works, formalisation of public access and planting of the riparian buffer zone. It is a large area and heavily used by the New Brighton community for deploying watercraft, therefore, community consultation is essential.
At the time of updating this CZMP, Brunswick Valley Landcare was successful in obtaining funding for some erosion control using coir logs, plantings and bush regeneration. This funding and project will enhance the area in question, and may reduce erosion in some areas, however, is unlikely to remove the necessity for hard bank stabilisation works in certain locations of the precinct.

Potential options are illustrated below.

Option	Description	Indicative Cost ($)
A	Rock revetment with buried toe apron	$1875 - $2,500 per metre
B	Rock revetment with self launching toe apron	$1500 - $2,250 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	$100 per metre^2

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B5. REPAIR BANK STABILISATION WORKS AT SITE MA05, MARSHALLS CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

This site is adjacent the main public road and thoroughfare (River Rd) into New Brighton where some areas of the existing bank stabilisation works have collapsed and need to be repaired. There is also limited riparian vegetation buffer due to the road in such close proximity. Rock works needs to be extended and constructed to the top height of the bank on level with the road.

Potential options are presented below.

Option	Description	Indicative Cost ($)
G	Top-up of existing revetment with additional rock material and bank regrading	$375 - $625 per metre
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	$1000 - $1500 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B6. REPAIR BANK STABILISATION WORKS AT SITE MA07, MARSHALLS CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

This site is similar to Site MA05 adjacent the main public road (River Rd), however, this section of the public road is gravel and to the south of New Brighton town in leading into the Public Reserve. Therefore, this road is not the main thoroughfare in an out of town and as such not as heavily used by the community. There is localised erosion and undercutting of the bank, with failing of the rock revetment wall up to 50 m in length.

Potential options are presented below.

Option	Description	Indicative Cost ($)
G	Top-up of existing revetment with additional rock material and bank regrading	$375 - $625 per metre
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	$1000 - $1500 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

B7. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT BR03, MULLUMBIMBY CREEK

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Undertake revegetation works to increase riparian vegetation buffer.

At this site the creek bank is only stabilised by weeds which could give way in a high flow event. There is no established native vegetation and the eroding bank is extremely close to the boundary of public assets – Council Swimming Pool and Mullumbimby Ex-Services Bowling Club. The built assets are at risk if erosion continues or worsens.

Potential options are illustrated below.

Option	Description	Indicative Cost ($)
A	Rock revetment with buried toe apron	$1875 - $2500 per metre
B	Rock revetment with self launching toe apron	$1500 - $2250 per metre
H	Rock supported toe and bank regrading	$1250 - $1875 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B8. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT SITE BR08, BRUNSWICK RIVER
Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake bank stabilisation works
5. Undertake revegetation works to increase riparian vegetation buffer.

This site is an existing site of the previous CZMP (Issue No. 4, 2012) and management of this site is still unresolved and the issue remains. This site has major bank undercutting and erosion and a narrow and sparse riparian vegetation buffer. The primary cause of erosion at site BR08 is channel meander migration, accelerated by the lack of riparian vegetation and possibly wave action from the wind and boats. This has resulted in a relatively high and steep exposed bank. The adjacent sugar cane crop is potentially under threat in the longer term. This site has a good intertidal bench for construction of rock and large woody debris (LWD), gravel/cobble fillets or rock revetment. Establishment of a wide riparian buffer, replanted with native riparian vegetation should be accompanied with restricting cattle from accessing the riverbank.

Potential options are presented below.

Option	Description	Indicative Cost ($)
H	Rock supported toe and bank regrading	$ 1250 - $1875 per metre
K	Large organic debris or trees	$ 1500 per tree
L	Gravel or cobble fillet on berm	$ 125 - $250 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree
Q	Regrading of riverbank	$25 - $250 per metre

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B9. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT BR10 (BRUNSWICK VALLEY STP, VALLANCES RD), BRUNSWICK RIVER

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

Bank stabilisation works were completed at this site (adjacent the Brunswick Valley, Vallances Rd STP), however, the previous rock protection works have failed and slumped into the river. It would appear the design of these rock works was inappropriate for the location being the outside bend of a river. Re--stabilisation by means of an alternative method should be considered as part of the design process. Management of this site is considered a high priority for action due to the extensive and continuous erosion of the riverbank.

Potential options are illustrated below.

Option	Description	Indicative Cost ($)
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	$1000 - $1500 per metre
G	Top-up of existing revetment with additional rock material and bank regrading	$375 - $625 per metre
K	Large organic debris or trees	$1500 - $2500 per tree
T	Timber groynes (piles)	$10 - $100 per metre

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on option
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
B10. MONITOR EROSION AT SITES BR02, BR13, BR14, BR15 AND BR16, BRUNSWICK RIVER
Description of Task

Actions required:

1. Undertake site survey and assessment of river (once a year or after a major flood event)
2. Monitor erosion.

Erosion and undercutting at these sites is not significant or active, however, may become so in the future and monitoring should be undertaken. At these sites there is either good riparian vegetation present and no public assets at risk, or the site might have a poor riparian zone but it is not considered justifiable to undertake works at the site in the foreseeable future.

BR02 is located at the confluence of Mullumbimby/Salt Water Creek and has severe but very localised erosion and very narrow riparian zone dominated by Camphor Laurel. Even though there is major bank undercutting at this site it is currently not considered justifiable to install any bank stabilisation works and should be monitored for erosion regularly.

Site BR13 is located in a deep channel area. There is moderate bank undercutting and erosion, with an undisturbed native (including saltmarsh communities) and well vegetated riparian zone (>10m width). Channel meander is active resulting in bank erosion and collapse, however, it is not currently considered justifiable to install any bank stabilisation works at this site. It is a hard site to access site and at present there are no structures being threatened by the erosion.

Site BR14 has low banks and only minor undercutting with good native riparian vegetation present (>10m width). There is no risk to infrastructure or assets and currently it is not considered a priority for bank stabilisation works, however, should be monitored.

There is no active erosion present at BR15 and the presence of large woody debris has contributed to stabilise the bank. The riparian vegetation is good at this site, other than the narrow zone adjacent the cleared paddock.

Erosion and undercutting at site BR16 is no longer an issue as the mature trees have also fallen in the water and stabilised the bank. Mangroves and seagrass have recruited to the area further stabilising the bank.

It is useful to note that some sites were outlined in the previous CZMP (Issue No. 4, 2012) and the erosion has been stabilised by natural processes at some sites (fallen large trees and/or mangrove/seagrass recruitment) in the years preceding.

Photo - Site BR02 showing high steep collapsing bank.

Photos - Site BR13 showing moderate bank undercutting and erosion.

No photos of Site BR14

Photos - Site BR15 showing the presence of large woody debris.

Photos - Site BR16 showing the presence of fallen mature trees.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	-
Projected Date for Commencement	Within 3 years
Status	Underway (25% completion)

4.4.3 Priority Two Strategies

Recommended Strategy
B11. UNDERTAKE ON-GROUND WORKS (FORMALISE PUBLIC ACCESS AND REVEGETATION) AT SI07, SIMPSONS CREEK
Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works
4. Formalise public access
5. Undertake revegetation works to increase riparian vegetation buffer.

This site is adjacent Brunswick Heads Scout Hall where significant but very localised bank erosion and slumping is occurring due to high usage by the public. Some works have been completed with a retaining wall and stairs constructed from the Hall down to the beach area. Due to public usage, the riparian vegetation is entirely missing or is in poor condition. The site would benefit greatly by improving the formalisation of public access to the beach and river bathing area, bank stabilisation works and restoration of the riparian vegetation buffer.

Potential options are presented below.

Option	Description	Indicative Cost ($)
K	Large organic debris or trees	$1500 - $2500 per tree
N	Mangrove planting behind a rock toe	$250 - $375 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree
S	Coir logs (incl. erosion control matting and tubestock sedge planting)	$100 per metre^2
U	Formalisation of public access	$ 1500 - $ 2000 per metre

Implementation of Task	
Lead Agency	The Scout Association of Australia, NSW
Supporting Agency	DoI Crown Lands & Water
Total Cost Estimate	Dependent on options
Grant/Funding Option	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy

B12. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AT SITES BR04 AND BR06, BRUNSWICK RIVER

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate (BR06)
2. Undertake revegetation works to increase riparian vegetation buffer
3. Monitor erosion at site.

Site BR04 is located upstream approximately 100 m from the Mullumbimby Bridge. There is moderate bank undercutting and erosion evident with a steep bank and a large scalloped area. The riparian zone is well vegetated but narrow in width with a mix of natives and weeds. There are no public assets at risk. Increasing the width of the riparian zone is considered the most suitable management response for this site given the current condition.

Photos – Site BR04 showing large scalloped erosion area and undercutting.

Site BR06 is located upstream and downstream of the Mullumbimby train line river crossing and is approximately 400 m in length, extending 100 m downstream of the train line. Ad hoc revetment works have been recently installed in the form of a rock ramp to the river. There is moderate bank erosion and undercutting along a large section and a narrow riparian zone adjacent to cow paddocks. The riparian zone is Camphor Laurel dominated. Should the large Camphor Laurel trees fall into the river in the future, large sections of relatively unvegetated riverbank will be exposed to further erosion and slumping.
It is not currently considered justifiable to install bank stabilisation works at this site, however, erosion should be monitored and efforts made to increase the width and native condition of the riparian zone to improve ecological connectivity, value, and riverbank stability over the medium to longer term.
The private landholder will need to be engaged to determine their willingness to support riparian revegetation and cattle exclusion (if it is to be successful).

Potential options are presented below.

Option	Description	Indicative Cost ($)
P	Vegetation in riparian corridor	$10 - $62.50 per tree

Photos – Site BR06 showing rock ramp revetment/pathway.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy
B13. UNDERTAKE ON-GROUND WORKS (STRUCTURAL BANK STABILISATION AND REVEGETATION) AT SITE BR07, BRUNSWICK RIVER

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake bank stabilisation works
5. Undertake revegetation works to increase riparian vegetation buffer.

Site BR07 is an existing site of the previous CZMP (Issue No. 4, 2012) and management of this site is still unresolved and the issue remains. Similar to site BR08 however, the bank undercutting and erosion is only moderate and not major. The riparian zone is narrow and sparsely vegetated, dominated with weeds. The primary cause of erosion at site BR07 is channel meander migration, accelerated by the lack of riparian vegetation and possibly wave action from the wind and boats. This has resulted in a relatively high and steep exposed and eroding bank. If the erosion process continues the narrow strip of riparian vegetation will be lost into the river. This site has a good intertidal bench for construction of rock and large woody debris (LWD), gravel/cobble fillets, bank regrading, and/or or rock revetment. In parallel with hard bank stabilisation work, a wide riparian buffer, replanted with native riparian vegetation should be established.

Potential options are presented below.

Option	Description	Indicative Cost ($)
L	Gravel or cobble fillet on berm	$125 - $250 per metre
Q	Regrading of riverbank	$25 - $250 per metre
P	Vegetation in riparian corridor	$10 - $62.50 per tree

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	Dependent on options
Grant/Funding Options	NSW Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy

B14. REPAIR BANK STABILISATION WORKS (TRAINING WALL) AT BR18, BRUNSWICK RIVER

Description of Task

Actions required:

1. Develop concept designs and costing's
2. Prepare detailed designs
3. Undertake bank stabilisation works.

This area is on the right bank of the Brunswick River along the training wall where the existing rock wall is failing and in need of repair. There is moderate bank erosion and if left unchecked, the rock wall may unravel further leading to larger erosion scallop. The failing rock wall presents a public safety risk and is contributing to general degradation of the riparian zone in this area. The length of the wall is potentially up to 100m that is in need of repair. To reduce the overall construction costs it would be beneficial to try and reuse the existing rock material.

Potential options are illustrated below.

Option	Description	Indicative Cost ($)
F	Revetment reconstruction with existing materials and a new underlayer / geotextile	$1000 - $1,500 per metre
G	Top-up of existing revetment with additional rock material and bank regrading	$375 - $625 per metre

Implementation of Task

Lead Agency	NSW Crown Holiday Parks Trust
Supporting Agency	DoI Crown Lands & Water
Total Cost Estimate	Dependent on option
Grant/Funding Options	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy

B15. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AT SITE MA02 AND MA03, MARSHALLS CREEK

Description of Task

Actions required:

1. Engage landowner to determine willingness to participate
2. Develop concept designs and costing's
3. Prepare detailed designs
4. Undertake revegetation works to increase riparian vegetation buffer.

These sites are located within the grounds of the Ocean Shores Country Club, in the upper Marshalls Creek area. There are small areas of localised erosion and under-cutting of the bank is some spots. Site MA02 has a steep river bank and MA03 has a very low riverbank. Riverbanks at both sites are fairly stable due to the presence of large native trees, however, the buffer of riparian vegetation is very narrow. Planting of a larger riparian buffer is recommended over an entire stretch of approximately 400 m (inclusive of both sites).

Photo – Site MA03 with low stable river bank and narrow riparian zone..

Potential options are presented below.

Option	Description	Indicative Cost ($)
P	Vegetation in riparian corridor	$10 - $62.50 per tree

Implementation of Task

Lead Agency	Brunswick Valley Landcare; Byron Shire Council
Support Organisation	Ocean Shores Country Club
Total Cost Estimate	Dependent on options
Grant/Funding Options	Habitat Action Grants Program
Projected Date for Commencement	Within 7 - 15 years
Status	Underway (25% completion)

4.4.4 Priority Three Strategies

Recommended Strategy
B16. UNDERTAKE ON-GROUND WORKS (REVEGETATION) AND MONITOR EROSION AT SITES BR01 AND BR05, BRUNSWICK RIVER

Description of Task

Actions required:

1. Undertake site survey and assessment of river
2. Engage landowner to determine willingness to participate (BR05)
3. Monitor erosion
4. Undertake revegetation works to increase riparian vegetation buffer.

There are a few sites along the Brunswick River which have eroded over the recent years but which appear to have currently stabilised somewhat. BR01 has moderate bank undercutting, slumping and erosion. The riparian zone is well vegetated (5-10m width) but is dominated with weeds. There are many Camphor laurels along the river bank and if they give way, then could cause significant bank collapse. There are no public assets at risk at BR01 and it is not currently justifiable to install any bank stabilisation works at this site. The site should be monitored on a yearly basis (or following 'major' flood events) and further efforts made to increase the width and condition of the riparian vegetation zone.

Site BR05 has a very high and steep bank with evidence of bank erosion and slumping. The riparian vegetation zone is well vegetated but narrow (0-5m width). At this moment there are no public assets at risk and it is not considered justifiable to install any bank stabilisation works at this site given the difficulty of the site. Along with BR01, this site should be monitored and effort applied to increase the width and condition of the riparian zone. .

Potential options are presented below.

Option	Description	Indicative Cost ($)
P	Plant riparian vegetation buffer	$10 - $62.50

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	Operational
Grant/Funding Options	NA
Projected Date for Commencement	Within 15+ years
Status	Underway (25% completion)

4.5 On-Ground Works – other

4.5.1 Priority One Strategies

Recommended Strategy
G1. REVIEW AND REASSESS THE MAIN ARM EFFLUENT REUSE SCHEME (MERS)

Description of Task

Actions required:

1. Undertake a review of the Recycled Water Management Strategy
2. Continue liaising with farmers to identify potential for future upgrades
3. Reassess the Recycled Water Management Strategy and consider options

Byron Shire Council, in collaboration with local farmers, reuses 70% of the effluent discharged into the Brunswick River from the existing Mullumbimby sewage treatment plant. The project currently diverts effluent for reuse on two properties growing dairy and beef cattle. The system allows farms access to recycled water for irrigation use, thus reducing extraction of water from the Brunswick River and subsequently reducing the release of effluent into the river. The system is designed to be expandable, allowing more farms to be added as required.

However, over the past 3 years recycled water used by the two local farmers has declined significantly. In the case of one farmer this is due to the cost of electricity and a decline in farming operations. To date BSC has found no new customers along the pipeline route.
BSC is currently undertaking a review of its Recycled Water Management Strategy which is due to be completed in 2017. The review will build on the experience gained over the last 15 years of recycled water use.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$50,000
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
G2. MARK NAVIGATIONAL HAZARDS, INCLUDING OYSTER LEASES AND STP OUTFALLS

Description of Task

Actions required:

1. Develop consultation program to obtain details of existing navigational hazards
2. Undertake consultation program with waterways users and Maritime NSW to identify all navigational hazards
3. Mark all navigational hazards, including oyster leases, STP outfalls and tree snags.

The waterway users consulted during the '2002 Waterway Usage Survey' noted that the oyster leases and some tree snags were causing a navigational hazard. However, the exact number and specific location of each hazard was not noted. Therefore, this strategy will ensure that all of the hazards are identified through a consultation program and subsequently marked to improve safety on the waterways.

Implementation of Task	
Lead Agency	Roads and Maritime Services
Total Cost Estimate	$7,500
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.5.2 Priority Two Strategies

Recommended Strategy
G3. WORK WITH LANDHOLDERS TO REVEGETATE AND/OR FENCE THE RIPARIAN ZONE ALONG ALL WATERWAYS WITHIN THE BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Identify priority areas for revegetation and/or fencing within the immediate estuarine catchment using vegetation mapping
2. Review works completed and assess priority riparian areas for revegetation and/or fencing
3. Liaise with landholders to determine their willingness to be involved in riparian corridor revegetation and/or fencing within their properties
4. Undertake revegetation and/or fencing of riparian corridors in consultation with landholders
5. Educate landowners and encourage undertaking best practice river bank and riparian restoration works.

There are extensive reaches of rural riparian land that have been cleared for agricultural purposes along the Brunswick Estuary. Many of these areas are prone to bank erosion and require revegetation of the riparian buffer zone. Some areas also have unrestricted stock access. Trampling of banks by livestock causes severe degradation of riverbanks accelerating erosion and increasing sediment loads to the waterways. Fencing off creek and riverbanks to control stock access would significantly reduce bank erosion and foster vegetation regeneration along the riverine corridor. Riparian vegetation provides a filter for catchment runoff thereby reducing nutrient and sediment loads entering waterways.

Byron Shire Council and Brunswick Valley Landcare have completed mapping and field truthing of the Brunswick catchment over the preceding years and many works involving riparian planting and bank stabilisation works have been completed and are ongoing (subject to funding availability). Brunswick Valley Landcare always encourage fencing and preservation of existing riparian vegetation, and some landowners are willing to undertake works, but costs can be too high for others. Therefore this strategy needs to be implemented through collaboration with landowners and Byron Shire Council and Brunswick Valley Landcare sourcing funds for revegetation and fencing works with owner contribution as well.

Potential options are presented below.

Option	Description	Indicative Cost ($)
P	Vegetation in riparian corridor	$10 - $62.50 per tree
-	Fencing	$50 per metre

Implementation of Task	
Lead Agency	Byron Shire Council and Brunswick Valley Landcare
Total Cost Estimate	Dependent on option
Grant/Funding Opportunities	NSW Environmental Trust; Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

4.5.3 Priority Three Strategies

Recommended Strategy
G4. MAP AND ERADICATE WEED INFESTATIONS BY SURVEY, EDUCATION AND WEED MANAGEMENT PROGRAMS
Description of Task

Actions required:

1. Seek funding through grants and work with local Landcare groups to identify, survey and map areas for abundance and distribution of environmental weeds
2. Identify weed "hotspots" and priority areas for action
3. Target those weeds that pose a social, environmental or economic threat to the catchment values
4. Co-ordinate weed management programs in alignment with the North Coast Regional Strategic Weed Management Plan & Biosecurity Act / Regulations (2015)
5. Remove weeds applying an Integrated Pest Management approach to the manage weeds based first on prevention and when needed, a control (biological, cultural, physical or mechanical intervention). Saving a registered herbicide application as a last resort

There is a considerable amount of Council-owned land that is affected by weed invasion. Any weed control strategy needs to consider Council's regulatory requirements, flora and fauna habitat requirements, adjacent land uses, soil stability and maintenance of water quality.

The "Brunswick River Estuary Study" (2002) and Byron Shire Council identified Camphor laurel as the most conspicuous weed in the lower Brunswick Catchment. Byron Shire Council mapped the spread of this species in 1999 and found that its spread along the Main Arm of the Brunswick Estuary and throughout the catchment is extensive. There are, however, a number of other conspicuous and less conspicuous weeds throughout the catchment, but are often localised in their distribution. Weed mapping was completed 2011 by Brunswick Valley Landcare as part of the 'Brunswick River Reach Estuary Plan' and vegetation mapping was completed by Byron Shire Council in 2015. Due to the length of time since weed mapping was undertaken and possible change in property ownership, it would be beneficial to undertake a more recent surveillance of weeds within the catchment.

The NSW North Coast Weeds Advisory Committee has developed a "North Coast Regional Strategic Weed Management Plan 2017 - 2022". Reference to this strategy, applicable legislation and the 'Byron Biodiversity Conservation Strategy' (2004) should be undertaken in developing any Weed Management Program for areas within the Brunswick Estuary Catchment.

Implementation of Task	
Lead Organisation	Byron Shire Council
Total Cost Estimate	$20,500
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.6 Investigation and Research

4.6.1 Priority One Strategies

Recommended Strategy

IR1. DETERMINE CURRENT STATUS OF RECREATIONAL AND COMMERCIAL ACTIVITIES AND THEIR IMPACTS ON ESTUARY HEALTH AND USER VALUES AND DEVELOP A GUIDANCE DOCUMENT FOR THE SUSTAINABLE MANAGEMENT OF THE ESTUARY

Description of Task

Part A: Determine current status of recreational and commercial activities and their impacts on estuary health and user values.

Actions required:

1. Determine environmental and social values of the estuary and establish baseline conditions of estuary health (seagrass beds, mangroves saltmarsh etc)*
2. Undertake a basic impact assessment of recreational and commercial activities on estuary health
3. Undertake a basic impact assessment of recreational and commercial activities on user values of the estuary
4. Determine current status of recreational and commercial activities and their impacts on estuary health and user values
5. Assess different scenarios based on increased activities
6. Establish management actions and measures to ensure the sustainable management of recreational and commercial activities on the health and user values of the Brunswick Estuary

**Outcomes and results of Recommended Strategies M1 and IR4 can be used to inform this impact assessment (if implemented)*

Part B: Develop and implement a guidance document for assessment and sustainable management of commercial activity licences and activities in the Brunswick Estuary

Actions required:

1. Review outcomes of impact assessment (Part A) and establish assessment criteria for the sustainable management of licences
2. Develop a specific Guidance Document for use by Public Agencies to assess the licencing of existing and future commercial activities
3. Create an Memorandum of Understanding (MOU) between agencies involved in Commercial Activity Licences (Byron Shire Council, DPI Fisheries and DoI Crown Lands & Water).

Tourism numbers are on the increase in Brunswick Heads, with recreational and commercial activities putting increasing pressure on the natural environment, predominantly over the holiday period. Even passive activities such as kayaking and stand up paddle boarding can lead degradation of seagrass beds, saltmarsh areas, and riverbanks through trampling and ingress/egress of these non-motorised vessels. This increase in activities, whether recreational or commercial, can also lead to user conflicts over limited space at boat ramps and decrease in the overall amenity of the estuary.

The aim of this management strategy is to firstly determine the environmental/social values of the estuary and present ecosystem health through a basic review of literature, studies and any outcomes/results of the implementation of Management Strategies M1 and IR4. Once knowledge of the existing health and user values of the estuary is known, a basic impact assessment can then be completed. This assessment will help determine the current status of recreational and commercial activities and their impacts on estuary health and user values. An assessment of different scenarios should then be undertaken to predict potential impacts to estuary health and used values, and to inform the implementation of management actions (such as amending the number of Commercial Activity Licences). The intent of this action to help understand the limit or carrying capacity of the estuary to increased usage and may help agencies better manage commercial licencing into the future and to ensure the sustainable management of estuary.

The second part of this strategy is to develop a Guidance Document for use by Public Agencies, which will help guide agencies in licensing commercial activities based on potential environmental and social impacts. This document will help guide the sustainable management of commercial activities on the Brunswick River and estuary as a whole. An outcome of the development of the Guidance Document will be to form an MoU between agencies involved, in order to proactively manage licensing, ensure licence conditions are met and monitor and mitigate potential impacts from activities.

Implementation of Task	
Lead Agency	Byron Shire Council; DPI Fisheries (pending funding or resources available)
Supporting Agency	DoI Crown Lands & Water
Total Cost Estimate	Operational
Grant/Funding Opportunities	Coastal and Estuary Grant Program (OEH; NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
IR2. INVESTIGATE WATER QUALITY ISSUES IN THE CAPRICORNIA CANAL SYSTEM
Description of Task

Actions required:

1. Advise Southern Cross University of post-graduate research project to investigate water quality issues in the Capricornia Canal system
2. Undertake water quality modelling and any necessary field sampling
3. Write up report on findings and provide to Byron Shire Council for consideration and action.

The flow of deoxygenated water from the swamplands to the north of North Ocean Beach during or following a flood is a natural phenomenon. However, its impact on aquatic life within Capricornia Canal is exacerbated by the Kallaroo Circuit Bund. The bund regulates water from the north, while the restricted channel to the south of the canal regulates water to Marshalls Creek.

As deoxygenated water will continue to flow from the swamplands in the future, improving the flow through the canal and into Marshalls Creek will allow more time for this “toxic” water to become oxygenated / assimilated prior to reaching Marshalls Creek. A modelling exercise is required in order to determine the water quality issues within Capricornia Canal This may be undertaken by a post-graduate student at the university to minimise the cost of this project.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$12,000
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

IR3. UNDERTAKE POINT SOURCE SAMPLING AT THE STORMWATER OUTFALL(S) ADJACENT TO THE MILL STREET INDUSTRIAL AREA, THE FORMER BRUNSWICK HEADS TIP SITE AND BOAT HARBOUR / MARINA TO DETERMINE POTENTIAL SOURCES OF TRACE METAL AND CHEMICAL TOXIN INPUT TO THE ESTUARY

Description of Task

Actions required:

1. Undertake point source sampling at stormwater outfalls adjacent to the Mill Street industrial area, the former Brunswick Heads Tip site and the marina to determine presence of trace metal discharges (particularly lead and copper) in stormwater discharge
2. Identify those industries that may produce trace metals as a by-product of their operations or whether there are pre-1970s' painted buildings within the complex
3. Issue warning letters and/or penalty notices to non-compliant businesses / activities
4. Distribute industry-specific information brochures (such as EPA guidance) to all businesses to encourage "Cleaner Production"
5. Introduce rewards and issue penalties for best and unacceptable practices, respectively
6. Undertake point source sampling one month after warning letters / penalty notices have been issued.

The drainage mapping provided by Byron Shire Council does not clearly show how the Mill Street Industrial area is drained and where the outfall(s) is (are) located. However, based on the stormwater drainage layout for the surrounding area, it is likely that there is only one outfall for the industrial site. This could potentially make it difficult to determine which specific industry is discharging pollutants.

However, sampling the outfall will confirm whether trace metals are present in the stormwater discharging from this site. Sampling could be undertaken as a stormwater audit similar to that undertaken in the Byron Bay industrial area.

The source of lead from the Mill Street Industrial Area may be from old buildings on the site that were painted pre-1970s with lead-based paint. This may be leaching into the stormwater system. It is likely that copper contamination within the marina is derived from the anti-fouling paint used on the hull of boats. These industries should be given industry-specific "Cleaner Production" brochures. Information that can help industries decrease environmental pollution can be found on the NSW Environmental Protection Authority's website.

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	$4,200
Grant/Funding Opportunities	NSW Environmental Trust; Coastal and Estuary Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.6.2 Priority Two Strategies

Recommended Strategy
IR4. UNDERTAKE BENTHIC HABITAT MAPPING TO PROVIDE ASSESSMENT OF THE HEALTH OF THE ESTUARY

Description of Task

Actions required:

1. Advise Southern Cross University of research project in the Brunswick Estuary
2. Undertake benthic habitat mapping of seagrass, mangrove and saltmarsh communities in the Brunswick Estuary (based on the methods used by DPI and the most recent mapping completed)
3. Write up report on findings and provide to Byron Shire Council for consideration
4. Use results for consideration of other research activities to improve the health of ecosystems in the Brunswick Estuary
5. Habitat mapping to compliment and assist in interpretation of the results of the Ecohealth Program (*Refer - Recommended Strategy M1*).

Benthic habitat maps are an important and essential means of providing marine resource assessments for coastal management. Mapping of benthic habitats is critical to improve our understanding of ecosystems dynamics and the relationships between biota and habitats in the Brunswick Estuary. The estuary is part of the Cape Byron Marine Park and contains various ecosystems such as seagrass meadows, oyster reefs, mangroves and saltmarsh. Understanding the status and condition of estuarine habitats is an important step in being able to assess trends in time and to set management actions to improve the health of the estuary. There is currently very little comprehensive spatial information about the extent of marine habitats and the condition of marine resources along the coast of NSW (refer to the DPI website). The most recent mapping of the Brunswick River is based on aerial footage (dated 2000) and a field survey undertaken in 2004 by the then Department of Industry and Investment.

An update of this mapping will help compare the present extent and condition of ecosystems and habitats within the Brunswick Estuary, and also help monitor the effectiveness of management strategies implemented. Updated mapping can also compliment and assist in the interpretation of results from the implementation and delivery of the Ecohealth Program (*Refer - Recommended Strategy M1*), and initiate further research projects to improve the health of the estuary (such as the installation of oyster reefs, *see note below*).

The overall objective of the mapping project will be to determine if seagrass beds, mangroves, saltmarsh etc. are continuing to decline or recover as these ecosystems are a marker for water quality and habitat disturbance.

Note: Presently there is a push to install hard substrates within estuaries to provide a surface upon which oyster spat can settle and grow and re-establish reefs. Oysters are great filters of estuaries and have been known to filter all the water in the estuary every 3 days. There are still a few oyster reefs in the Brunswick Estuary, which would be great to identify and expand upon them. The reefs also provide great habitat for other biota.

Implementation of Task	
Lead Agency	Byron Shire Council and the DPI Fisheries
Total Cost Estimate	$15,000
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 - 15 years
Status	Not started (0% completion)

Recommended Strategy
IR5. UNDERTAKE DRAIN MAPPING WITHIN THE NORTH AND SOUTH OF THE BRUNSWICK RIVER AND THE MARSHALLS CREEK SUBCATCHMENT AREA

Description of Task

Actions required:

1. Review 1:25,000 aerial photographs and topographic surveys to determine location of existing drainage, including landholder drains and union drains
2. Devise code for depth, width and height of spoil mound to the nearest one metre
3. Undertake ground truthing to confirm existing length, width and depth of drains
4. Develop GIS layer detailing locations and characteristics (width, depth and spoil height) of drainage within the Marshalls Creek subcatchment area.

Sulphide derived acidification is likely to be due to drainage of land subject to acid sulfate soils transported by drains to the estuary. As previously mentioned in strategy P5, an Acid Sulfate Soil Management Plan (ASSMP) is required for the estuary. However, at present there is insufficient information on the extent of acid sulfate soils and agricultural drains throughout the catchment. A drain mapping exercise will assist in providing a basis for the development of an ASSMP for the catchment.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$17,500
Grant/Funding Opportunities	Floodplain Management Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy
IR6. UNDERTAKE A SOIL SURVEY OF POTENTIAL ACID SULFATE SOILS (ALONG MARSHALLS CREEK, SIMPSONS CREEK AND THE BRUNSWICK RIVER

Description of Task

Actions required:

1. Undertake a detailed topographical survey of those areas identified by the OEH Acid Sulfate Soil Risk Maps as areas of PASS
2. Identify those areas less than 5m AHD
3. Undertake a field and vegetation survey of low-lying areas to determine presence of acid scalds, iron staining, jarosite and death of vegetation
4. Determine borehole locations for soil sampling
5. Undertake soil sampling
6. Develop GIS layer to be used by Council staff when assessing development applications, etc.
7. Data to be used in development of an Acid Sulfate Soils Management Plan (*Refer - Recommended Strategy P5).*

There is currently no detailed data on acid sulfate soils in the Brunswick Estuary. These soils are naturally sediment deposited under estuarine conditions. When exposed to oxygen through drainage or disturbance, these materials produce sulphuric acid and often releasing toxic quantities of metals. Because of it estuarine origin, acid sulphate soil material is only found at very low elevations, generally <1 m AHD. The geomorphic data used for creating the OEH Acid Sulfate Soil Risk Maps does not provide reliable information for the development of an ASS Management Plan for the area. It is therefore essential that a suitable soil survey is undertaken to map the actual distribution of PASS in the Brunswick estuarine system.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$26,500
Grant/Funding Opportunities	Floodplain Management Grants Program (OEH)
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.6.3 Priority Three Strategies

Recommended Strategy
IR7. CONDUCT AUDIT OF ALL WEIRS AND PUMPS ON ALL STREAM CATCHMENTS IN THE BRUNSWICK CATCHMENT TO ACCURATELY ASSESS THEIR IMPACT

Description of Task

Actions required:

1. Obtain DPI records on all pumps within the Brunswick Estuary
2. Identify all weirs, pumps and water extractions within the estuary using DPI records, WaterNSW (for pump records and licenced weirs) and previous studies
3. Audit all structures by boat and by foot (as necessary) using a GPS system to record their location
4. Identify those having the greatest impact on catchment flows, fish migration and infiltration through consultation with the NSW DPI Fisheries
5. Determine potential management actions / options for reducing the impact of existing structures on catchment flows and infiltration
6. Consult with community on proposed management actions
7. Undertake improvement / modification works
8. Monitor flows to assess effectiveness of modified structures; this may be achieved by integrating with existing Landcare programs to estimate stream flows in the catchment, and to also estimate the impact on fish migration upstream.

Weirs appear to have a severe impact, particularly in low flows. There is limited data on weirs, pumps and water extractions within the Brunswick catchment. A survey of structures restricting tidal flow was undertaken on the NSW Coast by Williams and Watford (1996). The study identified ten structures within the Brunswick Estuary. However, as that was twenty years ago, there may have been some changes since the survey was undertaken. The study should, however, be used as a baseline for auditing the weirs throughout the estuarine catchment.

A survey of two catchment streams was undertaken as part of the 'Brunswick River Estuary Study' (MHL, 2002). However, the variation in pump and weir numbers found in this survey on two similar branches of the river suggests that a separate survey is required for each waterway in the catchment to obtain an accurate assessment of their numbers, location and impacts. This study found up to six structures within one catchment stream, which suggests that the Williams and Watford (1996) study did not identify all the structures that are now present along the tributaries of the Brunswick Estuary. Similarly, the number of pumps identified during the 2002 study was significantly greater than that recorded on the DPI database of pumps and is possibly due to stock and domestic use for which DPI would likely not have records.

More recently, DPI completed an audit of waterway assets in 2004/05. While it attempted to be exhaustive in the assessment, it was limited by time and access in some cases. It is therefore recommended, given the small size of the catchment, that a comprehensive ground truthing assessment be undertaken. Once a GIS layer has been developed it could overlay with fish barriers. This would help to know where pumps may be impacted if the upstream water level is drawn down.

Implementation of Task	
Lead Agency	Byron Shire Council
Support Agency	DPI Fisheries, Water NSW
Total Cost Estimate	$5,500

Grant/Funding Opportunities	NSW Recreational Fishing Trust; Habitat Action Grants Program
Projected Date for Commencement	Within 10 years
Status	Not started (0% completion)

Recommended Strategy
IR8. ASSESS THE DISTRIBUTION AND ABUNDANCE OF FISH STOCKS IN THE BRUNSWICK ESTUARY

Description of Task

Actions required:

1. Advise Southern Cross University of research project initiative
2. Develop research question
3. Undertake survey of fish abundance within the Brunswick River
4. Collate information and report on fish abundance
5. Undertake survey of fish abundance in three to five years' time to determine any changes in species or distribution
6. Undertake management actions as necessary to control recreational fishing.

The "Brunswick River Estuary Study" (MHL, 2002) found that there was a reported reduction in fish stocks as a result of recreational fishing. However, in the review and update of the CZMP (Issue No.5, April 2017) DPI Fisheries were not aware of any significant reduction in fish stocks in the Brunswick River (outcomes of the Audit – refer to Appendix B). In order to ascertain the distribution and abundance of fish stocks in the estuary, a project to monitor fish stocks is desirable and could be beneficial. Presently DPI Fisheries is moving away from monitoring with a focus more on research questions, leaving monitoring more for universities and private entities. A grant with a University would likely be the best option to verify any reduction in fish stocks, tied to a research question such as "*if we do X habitat improvement works, what will be the impacts on fish species diversity and abundance*".

An increase in fishing (recreational) pressure has been observed with a further increase likely with any upgrade to local boat launching facilities. Monitoring of mud crabs in marine park sanctuary zones (SZs) has indicated that crabs in SZ are significantly larger and more abundant than mud crabs in fished areas (comments from DPI Fisheries and outcomes of the Audit – *refer - Appendix B*). A research project may provide a better understanding of the impacts that recreational fishing is having on fish stocks, and the effect of the declaration of the Cape Byron Marine Park.

A monitoring project to better understand the distribution and abundance of fisheries resources in the Brunswick River and its tributaries is a desirable action to occur in the long-term and would be supported by DPI Fisheries, however, is subject to specific funding being available and resources to support the action. A project such as this could be combined with implementation of the Ecohealth Program (*Refer - Recommended Strategy M1*).

Implementation of Task

Lead Agency	DPI Fisheries
Total Cost Estimate	$18,000
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 10 years (subject to funding and resources to support the action)
Status	Not started (0% completion)

4.7 Monitoring

4.7.1 Priority One Strategies

Recommended Strategy
M1. DEVELOP AND IMPLEMENT THE ECOHEALTH PROGRAM IN THE BRUNSWICK ESTUARY REPORTING ON ESTUARINE AND FRESHWATER HEATH OF THE WATERWAY
Description of Task
Actions required: 1. Prepare media release advising community of the plan to establish water quality and ecosystem monitoring within the Brunswick Estuary (and other areas in the Byron LGA if applicable) 2. Develop and implement the Ecohealth Program (as part of the North Coast Bioregion Ecohealth Program) using sampling protocols and data analysis developed by OEH and the University of New England. 3. Undertake field sampling of ecohealth indicators at required intervals (annually) 4. Report on water quality and ecohealth indicators in regular 4 yearly report cards in the State of the Environment Report and on the Byron Shire Council website / local media. BSC does not currently have an active water quality program in the Brunswick Estuary. Sampling was ceased with the construction of the new STP at Vallances Road, Mullumbimby. Water quality in the estuary has no doubt improved significantly due to the reduction in STP wastewater nutrient loads, however, the current state of the quality of water is unknown as there has been no sampling undertaken in recent years (since 2009). The NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy 2010-2015 guides the monitoring, evaluation and reporting of natural resources in NSW. The strategy focuses on developing a link between local, regional, state and national data on natural resource management (NRM) that will inform the community about how we care for the natural resources of NSW (OEH accessed online at http://www.environment.nsw.gov.au/soc/NaturalresourcesMER.htm, 29 May 2017). Under the NSW MER strategy, a Northern Rivers Ecosystem Health Monitoring Program (Ecohealth) has been developed which is a comprehensive estuarine and freshwater monitoring program that reports on the health of waterways. It aims to bring together the aquatic sampling programs of local and state government and other stakeholders into one region-wide system. The program was designed by the University of New England with input from the Office of Environment and Heritage. Sampling is undertaken at certain locations and sites for an established set of criteria/parameters on a regular basis, similar to the 'South East Queensland Ecosystem Health Monitoring Project'. Waterway health is scored and presented in easily interpreted report cards.

Implementation of Task	
Lead Agency	Byron Shire Council
Support Organisation	Office of Environment and Heritage
Total Cost Estimate	$18,000 per year
Grant/Funding Opportunities	Coastal and Estuary Grants Program
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

4.8 Education and Public Relations

4.8.1 Priority One Strategies

Recommended Strategy
E1. EDUCATE COUNCIL PLANNING STAFF ON THE IMPACTS OF PLANNING DECISIONS ON ESTUARY WATER QUALITY
Description of Task
Actions required: 1. Develop a council staff education program that outlines the importance of estuary processes and the potentially adverse impacts of development (i.e., untreated and uncontrolled stormwater runoff, clearing of vegetation, sedimentation, etc.) 2. Undertake two one-day workshops with Council Planning staff. Raising awareness of the impacts of land use Planning decisions and development approvals through a council staff education program is an effective and relatively simple management action. A targeted education proG2 gram for Council Planners will raise their awareness of the negative impacts on the estuary as a result of vegetation clearing and untreated stormwater runoff from new developments. Ultimately, the implementation of this strategy should lead to better Planning decisions, improved water quality, retention of catchment and riparian vegetation and a reduction in pollutant and sediment loadings.

Implementation of Task	
Lead Agency	Byron Shire Council
Total Cost Estimate	$1,500
Grant/Funding Opportunities	-
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

E2. PREPARE AND UNDERTAKE A TARGETED EDUCATION PROGRAM FOR RURAL PROPERTY OWNERS TO MAKE THEM AWARE OF BEST PRACTICE CATCHMENT MANAGEMENT

Description of Task

Actions required:

1. Publish a media article inviting all rural property owners to workshops
2. Undertake workshops for rural property owners at local community hall
3. Distribute industry-specific education brochures to all landholders.

The rate at which sediments enter the estuary can be controlled in a number of ways. In addition to planning controls, such as restricting land clearing and development, and physical works such as bank stabilisation works and revegetation of riparian buffer strips, educating the community on desirable landuse practices and "best practice" catchment management methods will assist in reducing the overall sediment load to the estuary.

Byron Shire Council and Brunswick Valley Landcare are actively involved in community education activities and hold regular workshops, community events and vegetation planting days. Brunswick Valley Landcare have been working regularly with local landowners educating them on "best practice" catchment management methods such as:

- Minimisation of slope erosion
- Minimisation of gravel loss and bank erosion at river crossings
- Controlling cattle access to waterways
- Minimisation of vegetation clearing
- Replanting of native catchment riparian vegetation
- Appropriate application (timing and location) of fertilisers.

Most landowners along riparian zones are aware of the importance of riparian vegetation and "best practice" but lack the funds or extension support to get the correct works happening on the ground. In parallel with this strategy and holding regular education activities, there is a great need to allocate funds to on-ground works (*Refer – Recommended Strategy G*3), with sufficient funds allocated for follow-up maintenance work.

Implementation of Task

Lead Agency	Byron Shire Council and Brunswick Valley Landcare
Total Cost Estimate	$2,000
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

Recommended Strategy

E3. EDUCATE THE COMMUNITY ON THE IMPACTS OF HUMAN ACTIVITIES ON ESTUARY PROCESSES

Description of Task

Actions required:

1. Develop a community education program that outlines the importance of estuary processes and the potentially adverse impacts of human activities.

   The program should include:

   - the distribution of community information brochures
   - media exposure of events in which beneficial works are implemented within the estuary or along its shoreline
   - field days to show the benefits of works such as fencing-off of river and creek banks
   - regular newspaper articles detailing the activities of Byron Shire Council in implementing the plan.

2. Develop and distribute a brochure aimed at the whole community which describes the most pressing issues facing the future management of the estuary.

   The brochure should highlight issues such as:

   - The impact of untreated and uncontrolled stormwater runoff on estuary water quality
   - The impact of clearing of vegetation both along creek corridors and across the broader catchment
   - The impact of fertiliser use on lawns on estuary water quality and aquatic plant growth.

As outlined in the Site Survey undertaken for the revision and update of the CZMP, there were many suburban sites along the reaches of the estuary where property owners have cleared riparian vegetation and installed ad-hoc structures and pontoons (Sites SI01, MA01 and MA06). Raising awareness through a community education program advising the value of the estuary, riparian vegetation and, most importantly, the impact of human activities on the estuary is an effective and relatively simple management action. The education program should include fostering an understanding of estuarine ecology and awareness of key management issues as this will assist in ongoing effectiveness and reception of more specific initiatives such as the environmental report card, riparian and stormwater awareness campaigns.

It is recommended that the community education program should begin with a global brochure aimed at the whole community describing the key issues facing the estuary. This global brochure could then be followed up with handouts targeting selected community groups (e.g., riparian land owners, fishermen, sailing clubs, etc.) outlining simple actions that individuals can undertake to reduce the impact of human activities on estuary processes. An example of a brochure that could be distributed to households can be found in Appendix H.

Implementation of Task

Lead Agency	Byron Shire Council
Total Cost Estimate	$12,000
Grant/Funding Opportunities	NSW Environmental Trust
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

5 Implementation of the CZMP

The possible impacts on natural systems and human development resultant from Climate Change must be considered in the implementation of all management strategies recommended in this CZMP. In designing and/or implementing the recommended management strategies, an assessment of the impacts of Climate Change on each strategy must be incorporated into the design of that strategy, under consideration of the design life of that strategy using the most up to date information available.

Please refer to Appendix D for a description of the requirement for planning for climate change in the development and implementation of the strategies outlined in this CZMP.

5.1 Implementation Schedule

A detailed listing of the prioritised actions is provided in an Implementation Schedule, which has been developed in a similar fashion to a “capital works program”.

The Implementation Schedule has been prepared to assist in the process of acquiring funding to undertake the prioritised strategies and to assign responsibilities for completing associated tasks. The implementation schedule is provided as Table 5-1 and includes:

- a description of the proposed strategy
- the adopted priority ranking for each strategy, which effectively determines the expected date of commencement of works
- a list of sub-tasks to be undertaken to effect each specific strategy
- the party or government agency responsible for undertaking or coordinating the investigation / work
- an estimate of the cost to complete the strategy
- funding options for implementing the strategy
- status of the proposed strategy
- start time frame for implementation of the proposed strategy

5.2 Funding Options

Funds for natural resource management projects are scarce, and must be spent effectively and accountably. A number of the actions under consideration require substantial capital and/or maintenance costs and an expanded commitment of staff resources. Relatively high capital costs are, for instance for any structural controls that may be required to stabilise bank erosion.

The actions in the CZMP will require funds from Byron Shire Council budgets, from the recurrent funds in the OEH, DoP, and NSW DPI budgets, grants, industry contributions and in-kind contributions from the community.

A range of incentives such as taxes and subsidies, cross compliance programs, tradeable rights, market gains, etc., will assist in achieving changes in agricultural land practices. Cross compliance and rate reduction programs should be investigated first and would become part of formal agreements with landholders.

Section 94 contributions from new development along the estuary could also be used to assist with the funding of estuary management activities. The funds available from Section 94 will not necessarily be large, but they may be sufficient to provide seeding money to obtain further funds from elsewhere.

At the time of implementing a management strategy applicable funding may not be available and alternate funds/grant programs may need to be researched. The range of present available funding

options is listed below. A detailed description of each funding option and the timing for applications is included in Appendix G.

- NSW Environmental Trust
- North Coast Local Land Services Funding Programs
- Public Reserves Management Fund
- NSW Heritage Incentives Program
- NSW Coastal and Estuary Grants Program
- NSW Recreational Fishing Trust
- Habitat Action Grants Program
- NSW Maritime Infrastructure Program
- Small Grants for Rural Communities.

Table 5-1 – Implementation Schedule of Recommended Management Strategies

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
	PLANNING CONTROLS AND POLICIES					
P1	Council Planners to ensure future residential rezoning's include forested buffer zones between agricultural and new residential lands in Mullumbimby and Bayside Brunswick	1	1. Council planners to ensure that future residential rezoning's include forested buffer zones between agricultural and new residential lands at: - Ann Street, Mullumbimby; - Bayside Brunswick; Existing residential zoned land on Main Arm Road, Mullumbimby; - Clays Road / Coral Avenue; and, - Left Bank Road, Mullumbimby. 2. Involve local Landcare groups to create buffers between existing town / agricultural boundaries 3. Introduce farm forestry planting incentives for land owners. Planting could be tax deductible if linked to other agricultural production 4. Encourage rural landholders to prepare Property Management Plans with the North Coast Local Land Services.	Operational	Byron Shire Council	Underway
P2	Prepare the North Byron Coastal Creeks Flood Study to incorporate the impacts of Climate Change	1	1. Prepare the North Byron Coastal Creeks Flood Study incorporating modelling of Marshalls, Simpsons and Brunswick Catchments. The study is to consider the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton and South Golden Beach. 2. Develop a Flood Risk Management Study and Plan for these areas. 3. Incorporate the impacts of climate change into the Flood Risk Management Study and Plan based on Council's adopted climate change parameters.	$75,000	Byron Shire Council	Underway
P3	Investigate options for further integration of coastal Crown land management within the Brunswick estuary foreshore reserves system	2	1. Liaise with the DoI Crown Lands & Water to identify all Crown Reserves adjacent the Brunswick Estuary that do not have a current Plan of Management. 2. Prepare draft Plans of Management. 3. Undertake community consultation to obtain community feedback on draft Plans of Management. 4. Finalise reports.	$71,500	DoI Crown Lands & Water	Underway
P4	Prepare a WSUD Policy for the Byron Shire	2	1. Council to prepare a draft WSUD in consultation with State Agencies, industry and the community 2. Undertake public exhibition of draft document 3. Finalise WSUD Policy 4. Council adoption of WSUD policy 5. Developers advised of new policy and provided with fact sheets on key techniques 6. Implementation of WSUD Policy	$18,750	Byron Shire Council	Not started
P5	Develop an Acid Sulphate Soils Management Plan (ASSMP) for the catchment	3	1. Undertake a soil survey of the area to the north and south of the Brunswick River, and the Marshalls Creek sub-catchment 2. Undertake water quality monitoring to determine sites of acid runoff 3. Prepare whole farm plans for properties on high risk ASS. 4. Review and assess Marshalls Creek Floodplain Management Plan to identify areas with high probability for development. 5. Develop ASS Management Plan in accordance with the NSW Acid Sulfate Soil Manual. 6. Establish ASS demonstration sites, such as at the Kallaroo Circuit Bund / Capricornia Canal area. 7. Organise awareness and education activities such as field days, information bulletins and newsletters.	$60,000	Byron Shire Council	Not started
	ECONOMIC INCENTIVES AND COST-SHARING ARRANGEMENTS					
C1	Introduce a community Environmental Grants Scheme for implementing on-grounds works towards biodiversity conservation	2	1. Investigate and determine the possibility of introducing an Environmental Grants Scheme 2. Secure initial funding for start-up of scheme 3. Establish continued funding and potential long-term funding options. 4. Introduce grants scheme to community. 5. Publish media article advising rural land owners of Environmental Grants Scheme and how to apply 6. Implement Environmental Grants Scheme through the BSC website.	$12,000	Byron Shire Council	Not started
	REGULATION					
R1	Lobby for review of speed limits within the Brunswick River and Marshalls Creek	1	1. Council to lobby Roads and Maritime Services on review of speed limits within the Lower Brunswick Estuary. 2. Prepare community information brochures on new speed restriction zones 3. Prepare media release advising of new speed restriction zones 4. Install signs in prominent foreshore locations clearly specifying new speed restrictions.	Operational	Byron Shire Council	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
	REGULATION					
R1	Lobby for review of speed limits within the Brunswick River and Marshalls Creek	1	1. Council to lobby Roads and Maritime Services on review of speed limits within the Lower Brunswick Estuary. 2. Prepare community information brochures on new speed restriction zones 3. Prepare media release advising of new speed restriction zones 4. Install signs in prominent foreshore locations clearly specifying new speed restrictions.	NA	Byron Shire Council, DPI - Fisheries and DPI - Marine Parks	Not started
R2	Investigate and enforce potential illegal rock armouring in all reaches of the Brunswick Estuary	1	1. Council and DoI Crown Lands & Water to investigate sites of potential illegal rock armouring (Sites SI01, BR06, BR09, BR11, BR12, BR17) 2. Council to liaise with DoI Crown Lands & Water (for sites located on Crown land) and review development approvals documentation to determine whether ad-hoc rock armouring has appropriate Council and/or DoI Crown Lands & Water approval 3. Undertake enforcement action where appropriate 4. Encourage land owners to undertake recommended bank stabilisation options	NA	Byron Shire Council and DoI Crown Lands & Water	Progressing
R3	Investigate and undertake compliance action on illegal camping along all reaches of the Brunswick Estuary		1. BSC and DoI Crown Lands & Water to investigate illegal camping along all reaches of the Brunswick Estuary 2. Undertake enforcement action where appropriate 3. Explore options to enhance regulatory compliance role within Byron coastal/estuary reserve system. 3. Encourage land owners to limit illegal camping by fencing off areas, or advising regulatory authorities when illegal camping is observed	Operational	Byron Shire Council and DoI Crown Lands & Water	Underway
R4	Investigate and enforce encroachment of built structures and clearing of riparian vegetation at areas adjacent the Brunswick Estuary		1. BSC and DPI Fisheries to investigate illegal landowner development (built structures) and riparian vegetation clearing along all reaches of the Brunswick Estuary 2. Undertake enforcement action (where appropriate) 3. Landowners to remove structures and restore riparian vegetation buffer (where appropriate)	NA	Department of Primary Industries - Fisheries and Byron Shire Council	Underway
	ON-GROUND WORKS - riverbank stabilisation, revegetation and repair					
B1	Undertake on-ground works (revegetation) at bank erosion sites SI03 and SI04, Simpsons Creek and BR17, Brunswick River	1	1. Engage landowner to determine willingness to participate 2. Formalise or restrict public access in consultation with landowner and key stakeholders 3. Compliance action on illegal camping (refer to Management Strategy R3). 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council and DoI Crown Lands & Water	Not started
B2	Undertake on-ground works (structural bank stabilisation and revegetation) along Simpsons Creek at bank erosion sites SI05 and SI06	1	1. Develop precinct plan, concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works / formalise public access 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council, Department of Primary Industry - Lands and NSW Crown Holiday Parks Trust	Not started
B3	Repair bank stabilisation works along Simpsons Creek at bank erosion sites SI08 and SI09	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	DoI Crown Lands & Water	Not started
B4	Undertake on-ground works (structural bank stabilisation and revegetation) along Marshalls Creek at bank erosion site MA04	1	1. Develop precinct plan, concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works / formalise public access 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council	Not started
B5	Repair bank stabilisation works along Marshalls Creek at bank erosion site MA05	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Byron Shire Council	Not started
B6	Repair bank stabilisation works along Marshalls Creek at bank erosion site MA07	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Byron Shire Council	Not started

B7	Undertake on-ground works (structural bank stabilisation and revegetation) along Brunswick River at bank erosion site BR03	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works 4. Undertake revegetation works to increase riparian vegetation buffer	Dependent on option.	Byron Shire Council	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
B8	Undertake on-ground works (structural bank stabilisation and revegetation) along Brunswick River at bank erosion site BR08	1	1. Engage landowner to determine willingness to participate 2. Develop concept designs and costing's 3. Prepare detailed designs 4. Undertake bank stabilisation works 5. Undertake revegetation works to increase riparian vegetation buffer	Dependent on option.	Byron Shire Council	Not started
B9	Repair bank stabilisation works along Brunswick River at bank erosion site BR10	1	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	Byron Shire Council	Not started
B10	Monitor erosion along Brunswick River at sites BR02, BR13, BR14, BR15 and BR16	1	1. Undertake site survey and assessment of river 2. Monitor erosion.	Operational	Byron Shire Council	Not started
B11	Undertake on-ground works (structural bank stabilisation / formalise public access / revegetation) along Simpsons Creek at bank erosion site SI07	2	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works 4. Formalise public access 5. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	DoI Crown Lands & Water	Not started
B12	Undertake on-ground works (revegetation) and monitor erosion along Brunswick River at bank erosion sites BR04 and BR06	2	1. Engage landowner to determine willingness to participate (BR06) 2. Undertake revegetation works to increase riparian vegetation buffer 3. Monitor erosion at site.	Dependent on option.	Byron Shire Council	Not started
B13	Undertake on-ground works (structural bank stabilisation works and revegetation) along Brunswick River at bank erosion site BR07	2	1. Engage landowner to determine willingness to participate 2. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works 4. Undertake works to increase riparian vegetation buffer.	Dependent on option.	Byron Shire Council	Not started
B14	Repair bank stabilisation works along Brunswick River training wall at site BR18	2	1. Develop concept designs and costing's 2. Prepare detailed designs 3. Undertake bank stabilisation works	Dependent on option.	DoI Crown Lands & Water	Not started
B15	Undertake on-ground works (revegetation) along Marshalls Creek at sites MA02 and MA03	2	1. Engage landowner to determine willingness to participate 2. Develop concept designs and costing's 3. Prepare detailed designs 4. Undertake revegetation works to increase riparian vegetation buffer.	Dependent on option.	Brunswick Valley Landcare; Byron Shire Council	Not started
B16	Undertake on-ground works (revegetation) and monitor erosion along Brunswick River at bank erosion site BR01 and BR05 Undertake revegetation works to increase riparian vegetation buffer.	3	1. Undertake site survey and assessment of river 2. Engage landowner to determine willingness to participate 3. Monitor erosion 4. Undertake revegetation works to increase riparian vegetation buffer.	Operational	Byron Shire Council	Not started
	ON-GROUND WORKS - Other					
G1	Review and reassess the Main Arm Effluent Reuse Scheme (MERS)	1	1.Undertake a review of the Recycled Water Management Strategy 2. Continue liaising with farmers to identify potential for future upgrades. 3. Reassess the reuse strategy and consider options	$50,000	Byron Shire Council	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
G2	Mark significant navigational hazards	1	1. Develop consultation program to obtain details of all existing navigational hazards 2. Undertake consultation program with waterways users and Maritime NSW to identify all navigational hazards. 3. Mark all navigational hazards, including oyster leases, STP outfalls and tree snags.	$7,500	Roads and Maritime Services	Not started
G3	Work with landholders to revegetate and/or fence the riparian zone along all waterways within the estuary	2	1. Identify priority areas for revegetation and/or fencing within the immediate estuarine catchment using vegetation mapping 2. Review works completed and assess priority riparian areas for revegetation and/or fencing 3. Liaise with landholders to determine willingness to be involved in riparian corridor revegetation and/or fencing within their properties 4. Undertake revegetation and/or fencing of riparian corridors in consultation with landholders 5. Educate landholders and encourage undertaking best practice river bank and riparian restoration works.	Dependent on option.	Byron Shire Council	Not started
G4	Map and eradicate weed infestations by survey, education and weed management programs	3	1. Seek funding through grants and work with local Landcare groups to identify, survey and map areas for abundance and distribution of environmental weeds 2. Identify weed “hotspots” and priority areas for action 3. Target those weeds that pose a social, environmental or economic threat to the catchment values 4. Co-ordinate weed management programs in alignment with the North Coast Regional Strategic Weed Management Plan & Biosecurity Act / Regulations (2015) 5. Remove weeds applying an Integrated Pest Management approach to the manage weeds based first on prevention and when needed, a control (biological, cultural, physical or mechanical intervention). Saving a registered herbicide application as a last resort	$20,500	Byron Shire Council	Not started
	INVESTIGATION AND RESEARCH					
IR1	Determine current status of recreational and commercial activities and their impact estuary health and user values and develop a guidance document for the sustainable management of commercial activities	1	Part A: 1. Determine environmental and social values of the estuary and establish baseline conditions of estuary health (seagrass beds, mangroves saltmarsh etc)* 2. Undertake a basic impact assessment of recreational and commercial activities on estuary health 3. Undertake a basic impact assessment of recreational and commercial activities on user values of the estuary 4. Determine current status of recreational and commercial activities and their impacts on estuary health and user values 5. Assess different scenarios based on increased activities 6. Establish management actions and measures to ensure the sustainable management of recreational and commercial activities on the health and user values of the Brunswick Estuary Part B: 1. Review outcomes of impact assessment (Part A) and establish assessment criteria for the sustainable management of licences 2. Develop a specific Guidance Document for use by Public Agencies to assess the licencing of existing and future commercial activities 3. Create an Memorandum of Understanding (MOU) between agencies involved in Commercial Activity Licences (Byron Shire Council, DPI Fisheries and DoI Crown Lands & Water).	Operational	Byron Shire Council; DPI Fisheries; and DoI Crown Lands & Water	Not started
IR2	Investigate water quality issues in the Capricornia Canal system	1	1. Advise Southern Cross University of post-graduate research project to investigate the water quality issues in the Capricornia Canal system 2. Undertake water quality modelling and any necessary field sampling 3. Write up report on findings and provide to Byron Shire Council for consideration and action	$12,000	Byron Shire Council	Not started
IR3	Undertake point source sampling at stormwater outfalls adjacent to the Mills Street Industrial Area, the former Brunswick Heads Tip site and the marina to determine potential sources of trace metal and chemical toxin input to the estuary	1	1. Undertake point source sampling at stormwater outfalls adjacent to the Mills Street industrial area and the marina to determine presence of trace metal discharges (particularly lead and copper) in stormwater discharge 2. Identify those industries that may produce trace metals as a by-product of their operations or whether there are pre-1970s painted buildings within the complex 3. Issue warning letters and/or penalty notices to non-compliant businesses / activities 4. Distribute industry-specific information brochures (such as EPA guidance) to all businesses to encourage "Cleaner Production". 5. Introduce rewards and issue penalties for best and unacceptable practices respectively. 6. Undertake point source sampling one month after warning letters / penalty notices have been issued	$4,200	Byron Shire Council	Not started
IR4	Undertake benthic habitat mapping of ecosystems present in the Brunswick Estuary to provide baseline of current extent of ecosystems	2	1. Advise Southern Cross University of research project in the Brunswick Estuary 2. Undertake benthic habitat mapping of seagrass, mangrove and saltmarsh communities in the Brunswick River (based on the methods used by DPI and the most recent mapping completed) 3. Write up report on findings and provide to Byron Shire Council for consideration 4. Use results for consideration of other research activities to improve the health of ecosystems in the Brunswick Estuary 5. Habitat mapping to compliment and assist in interpretation of the results of the Ecohealth Program (M1).	$15,000	Byron Shire Council and DPI – Fisheries	Not started

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	COST	LEAD AGENCY	STATUS
IR5	Undertake drain mapping within the north and south of the Brunswick River and Marshalls Creek sub-catchments	2	1. Review 1:25,000 aerial photographs to determine locations of existing drainage, including landholder drains and union drains 2. Devise code for depth, width and height of spoil mound to the nearest 1metre 3. Undertake ground truthing to confirm existing, length, width and depth of drains 4. Develop GIS layer detailing locations and characteristics (width, depth and spoil height) of drainage within the Marshalls Creek sub-catchment area	$17,500	Byron Shire Council	Not started
IR6	Undertake a soil survey of PASS along Marshalls Creek, Simpsons Creek and the Brunswick River	2	1. Undertake a detailed topographical survey of those areas identified by the OEH Acid Sulfate Soil Risk Maps as areas of PASS 2. Identify those areas less than 5m AHD 3. Undertake a field and vegetation survey of low-lying areas to determine presence of acid scalds, iron staining, jarosite and death of vegetation 4. Determine borehole locations for soil sampling 5. Undertake soil sampling 6. Develop GIS layer to be used by Council staff when assessing development applications, etc. 7. Data to be used in development of an Acid Sulfate Soils Management Plan (Refer to P5).	$26,500	Byron Shire Council	Not started
IR7	Conduct audit of all weirs and pumps on all stream catchments within the Brunswick Estuary to obtain an accurate assessment of their numbers, locations and impacts	3	1. Obtain DPI records on all pumps within the Brunswick Estuary 2. Identify all weirs, pumps and water extractions within the estuary using DPI records and previous studies 3. Audit all structures by boat and by foot (as necessary) using a GPS system to record their location 4. Identify those having the greatest impact on catchment flows, fish migration and infiltration 5. Determine potential management actions / options for reducing the impact of existing structures on catchment flows and infiltration. 6. Consult with community on proposed management actions. 7. Undertake improvement / modification works. 8. Monitor flows to assess effectiveness of modified structures - this may be achieved by integrating with existing Landcare programs to estimate stream flows in the catchment.	$5,500	Byron Shire Council	Not started
IR8	Assess the distribution and abundance of fish stocks in the Brunswick Estuary	3	1. Advise Southern Cross University of research project initiative 2. Develop research question 3. Undertake survey of fish abundance within the Brunswick River 4. Collate information and report on fish abundance 5. Undertake survey of fish abundance in three to five years' time to determine any changes in species or distribution 6. Undertake management actions as necessary to control recreational fishing.	$18,000	DPI Fisheries	Not started
	MONITORING					
M1	Develop and implement the Northern Rivers Ecosystem Health Monitoring Program (Ecohealth) in the Brunswick Estuary reporting on the estuarine and freshwater health of the waterway	1	1. Prepare media release advising community of the plan to establish water quality and ecosystem monitoring within the Brunswick Estuary (and other areas in the Byron LGA if applicable) 2. Develop and implement the Ecohealth Program (as part of the North Coast Bioregion Ecohealth Program) using sampling protocols and analysis developed by OEH and the University of New England. 3. Undertake field sampling of ecohealth indicators at required intervals (annually) 4. Report on water quality and ecohealth indicators in regular 4 yearly report cards and the Byron Shire Council website, State of the Environment Report and local media.	$18,000*	Byron Shire Council	Not started
	EDUCATION AND PUBLIC RELATIONS					
E1	Educate Council planners on the impacts of planning decisions on estuary processes & water quality	1	1. Develop a council staff education program that outlines the importance of estuary processes and the potentially adverse impacts of development (i.e.: untreated and uncontrolled stormwater runoff, clearing of vegetation, sedimentation etc.) 2. Undertake two one day workshops with Council planning staff and external consultants	$1,500	Byron Shire Council	Not started
E2	Prepare and undertake a targeted education program for rural property owners to make them aware of best practice catchment management	1	1. Publish a media article inviting all rural property owners to workshops 2. Undertake workshops for rural property owners at local community hall 3. Distribute industry-specific education brochures to all landholders.	$2,000	Byron Shire Council and Brunswick Valley Landcare	Not started
E3	Develop a community education program that outlines the importance of estuary processes and the impacts of human activities on estuary processes	1	1. Develop a community education program that outlines the importance of estuary processes and the potentially adverse impacts of human activities (i.e.: untreated and uncontrolled stormwater runoff, clearing of vegetation) 2. Develop and distribute a global brochure aimed at the whole community describing issues facing the estuary. 3. Develop and distribute targeted brochures to selected community groups and estuary users (e.g. residents, tourists, recreational fishers) outlining potentially adverse impacts. 4. Organise media coverage of on-the-ground works as they are carried out and achievements in the implementation of this CZMP.	$12,000	Byron Shire Council	Not started

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APPENDICES

APPENDIX A – AGENCY CORRESPONDENCE

NSW GOVERNMENT | Office of Environment & Heritage

Our reference: DOC 16/211651
Contact: Ben Fitzgibbon

The General Manager
Byron Shire Council
PO Box 219
Mullumbimby, NSW 2482

Attention:
Chloe Dowsett (Coastal and Estuary Officer)
Via Email

Dear Chloe

Coastal Zone Management Plan for the Brunswick Estuary

I refer to your correspondence to Ben Fitzgibbon from the Office of Environment and Heritage (OEH) on 22 November 2015 requesting OEH advice on the status of the draft Coastal Zone Management Plan for the Brunswick Estuary (CZMP). I apologise for the delay in my response.

I acknowledge the significant efforts of council and the Byron Shire community in preparing the CZMP in 2012 for submission to the Hon. Robyn Parker on the 30 August 2012 for certification under the *Coastal Protection Act, 1979* (the 'Act'). I acknowledge that this has been a lengthy and uncertain process for council.

During late 2012 Minister Parker had temporarily ceased considering the certification of CZMPs pending the finalisation of amendments that were being made to the Act at that time. In July 2013 new statutory Guidelines for Preparing Coastal Zone Management Plans were published by OEH. The Act and supporting guidelines established new minimum requirements for the preparation of coastal zone management plans in NSW. Unfortunately, the CZMP was not certified prior to the commencement of the 2013 guidelines.

OEH Regional Operations Group have undertaken a brief review of the CZMP to consider its suitability for certification under the Act. Critically, we note that the CZMP is prepared under the outdated Coastline Management Manual (1992) and Estuary Management Policy (1992). In addition, the timeframes for implementation of the CZMP management actions are significantly outdated.

The CZMP is therefore not considered to be fit for certification in accordance with current NSW legislation and policy framework. In order to bring the CZMP up to current day requirements, the key areas to be addressed would include:

- policy and legislative framework
- the timeframes for implementation of management actions
- the implementation status of actions
- a description of how the CZMP meets the minimum requirements of the 2013 guidelines.

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- update names of public authorities

The Stage 2 coastal reforms are now finalised with the establishment of the new *Coastal Management Act, 2016*.

In the event that Council wishes to seek certification of the CZMP under the *Coastal Protection Act 1979*, the CZMP would need to be submitted to the Minister for Planning, the Hon. Rob Stokes MP, prior to or shortly after repeal of the Act which might be expected to occur in March 2017. Further the Minister has granted councils an additional six month extension to finalise a CZMP beyond the Act repeal date, should council choose this path. Under this option, should council achieve certification of the CZMP, it will remain valid until December 2021, at which time the CZMP will need to be transitioned into a Coastal Management Program under the new *Coastal Management Act, 2016*.

Alternatively, council may wish to prepare a Coastal Management Program for the Brunswick River Estuary in accordance with the *Coastal Management Act 2016*, and Coastal Management Manual (once finalised).

Under either of the aforementioned options, council will be eligible for funding and technical assistance through the NSW Estuary Management Program. Should you have any queries please don't hesitate to contact Ben Fitzgibbon (Senior Coast and Estuaries Officer) on (02) 66209323 or via email at ben.fitzgibbon@environment.nsw.gov.au.

Yours sincerely

DON ARNOLD
Regional Manager – North East Region
Regional Operations

APPENDIX B - AUDIT AND SITE SURVEY RESULTS

The objective of conducting an audit and site survey of the Brunswick Estuary was to gather sufficient information on the status of the Brunswick Estuary and whether many of the management strategies proposed in the implementation schedule of the current CZMP, adopted in 2008 have been completed, are presently underway, or are not valid anymore.

A general desktop audit of all the management strategies outlined in the CZMP was completed by undertaking a desktop analysis of Council documents, talking with various Council departments, public agencies and relevant stakeholders.

The list of relevant stakeholders consulted with during the audit process is outlined in table B1

Table B1 – Relevant Stakeholders

Stakeholder/Agency	Department	Correspondence
Byron Shire Council	Team Leader Planning Services	Email correspondence along with face to face meeting to discuss planning and policy projects completed.
Byron Shire Council	Flooding Engineer	Face to face meeting to discuss soil and water quality monitoring strategies, drain networks and flooding.
Byron Shire Council	Systems Environment Officer	Face to face tour of Sewage Treatment Plants (West Byron and Brunswick Valley), electronic information via email.
Byron Shire Council	Consultant Planner	Face to face meeting to discuss planning and subdivisions in Brunswick Heads and Mullumbimby
Byron Shire Council	Team Leader Water and Sewer	Email correspondence regarding work completed at the Sewage Treatment Plants
Byron Shire Council	Natural Habitat Officer	Face to face meeting to discuss terrestrial vegetation and riparian planting, initiatives and community consultation
Department of Primary Industries - Fisheries	Manager Fish Passage Unit (DPI)	Phone call and email correspondence regarding research and fisheries work completed.
Brunswick Valley Landcare	Natural Environment Officer	Email correspondence along with face to face meeting to discuss riparian vegetation projects completed.
Office of Environment and Heritage	Senior Coast and Estuaries Officer	Face to face meetings, email correspondence and vessel site survey to discuss overall health and status of the Brunswick Estuary.
Department of Industries – Marine Parks	Marine Park Authority	Phone call, email and face to face meeting to discuss Marine Park strategies
Roads and Maritime Services	Boating Services Officer	Phone call and email correspondence regarding boating and vessel speeds in the Brunswick Estuary.
Department of Industry – Lands	Crown Lands	Face to face meeting to discuss planning strategies and email correspondence.
National Parks and Wildlife Service	National Parks and Wildlife Service	Face to face meeting to discuss management strategies and email correspondence
Arakwal Corporation	Arakwal Corporation	Face to face meeting to discuss management strategies.

In parallel with the desktop audit, Council and OEH completed a three day site survey of the Brunswick Estuary by vessel to understand the present day issues facing the Brunswick Estuary

and re-survey the area to identify where bank erosion works and/or riparian vegetation works are required. The survey was conducted to the tidal reaches of Simpson Creek, Marshalls Creek and the main arm of the Brunswick River (incl. Mullumbimby Creek).

Survey methods involved recording the condition of the creek and river bank at areas where bank erosion is visible. Sites were then allocated and given a score for:

- Riparian bank vegetation – Very Poor, Poor, Fair, Good and Excellent
- Bank erosion and stability - between 1 (extensive) to 5 (not significant)

The categories used to record the condition of the creek and river bank at each site are presented in Table B2.

Table B2 –Condition Record Categories

Riparian Bank Vegetation				
Excellent	Good	Fair	Poor	Very Poor
Mainly undisturbed native vegetation. Little signs of alteration.	Mainly native vegetation. Little disturbance or no signs of recent disturbance.	Medium cover, mixed native and introduced or one side cleared and one side undisturbed.	Introduced ground cover, little native under- or over-storey. Mainly introduced vegetation.	Introduced ground cover with lots of bare ground, occasional tree. Also includes sites with concrete-lined channels.
Bank Erosion and Stability				
5	4	3	2	1
Stable: no erosion or sedimentation evident. No undercutting of banks, usually gentle bank slopes, and lower banks covered with root mat, grasses, reeds or shrubs.	Only spot erosion, little undercutting of bank, good vegetation cover, usually gentle bank slopes, no significant change to bank structure.	Localised erosion. Relatively good vegetation cover. No continuous damages to bank structure or vegetation.	Significant active erosion evident especially during high flows. Unstable excessive areas of bare banks, little vegetation cover.	Extensive or almost continuous erosion. Over 50% banks have some form of erosion; very unstable with little vegetation cover.

Specific remarks, recommended management response and action priority was also recorded for each site. The majority of the sites allocated in the CZMP were still experiencing significant and active bank erosion as management action (bank erosion work and site stabilisation) had not been implemented in the preceding years and the issues still remain. Along with the existing sites in the CZMP, new sites were designated where bank stabilisation works are warranted. Results of the audit and site survey are presented below In Table B3 and Table B4.

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
	PLANNING CONTROLS AND POLICIES								
P1	Incorporate 50metre wide undeveloped Conservation Zones along side all new development and sub-divisions adjacent to waterways within the revised Byron Shire LEP	1	1. Council planners to revise LEP such that 50 metre wide riparian buffers are provided adjacent to land already identified for potential rezoning and/or sub-division: - South of Ann Street, Mullumbimby - Clays Road / Coral Avenue, Mullumbimby - Bayside Brunswick, Brunswick Heads	NA	Byron Shire Council	2008	Underway	This strategy is no longer valid as conservation zones and buffers in the previous LEP have now been superseded by the E Zone Review Recommendations Report, standard LEP template and supporting legislative direction from NSW Government. Buffers do not feature in the criteria for applying E2/E3 zones in the current LEP (2014), with only land comprising riparian and estuarine vegetation on waterfront land or wetland areas (other than those mapped as SEPP 14 Coastal Wetlands – E2 zone) being eligible for an 'E3' zoning. Also, the "Riparian land and watercourses [local]" clause and overlay map, as exhibited in draft LEP 2012, is no longer available according to the above Recommendations Report. Although Waterfront land is defined under the *NSW Water Management Act 2000* as the bed of any river, lake or estuary and any land within 40 metres of the river banks, lake shore or estuary mean high-water mark, only the areas containing riparian or estuarine vegetation can be zoned E3.	DELETE
P2	Appoint an estuary co-ordinator to facilitate the implementation strategies over the next 5 years	1	1. Seek funding for new Estuary Co-ordinator position 2. Undertake recruitment for an Estuary Co-ordinator 3. Appoint Estuary Co-ordinator to work with Byron Shire Council	$ 300,000	Byron Shire Council	2010	Not started	The Coastal and Estuary Officer position at Byron Shire Council implements estuary projects and presently there is no allowance for budget to create a new estuary coordinator role. Should funding become available for this role or a new role to develop and implement CZMPs in the future, this strategy can be revisited.	DELETE
P3	Require developments in the locality of the Cape Byron Marine Park that have the potential to impact on the Park, to undertake appropriate environmental assessment	1	1. Marine Parks is to consult with Local and State Government Authorities and establish a referral procedure with respect to assessing applications for developments or activities within or adjacent to the Marine Park.	NA	Marine Parks & Byron Shire Council	2009	Complete	Byron Shire Council refers any projects or developments in the locality of the Cape Byron Marine Park that are likely to have an effect on the plants or animals or their habitats of the marine park as per the Marine Estate Management Act 2014 - Section 56.	DELETE
P4	Remove 2(t) zoning in Brunswick Heads at South Beach Road from the Byron Shire LEP	1	1. Council planners to revise LEP such that the 2(t) Tourist Area is removed from South Beach Road	NA	Byron Shire Council	2008	Underway	This strategy was specified as underway in 2012 but has not yet been completed. The land is still zoned 2(t) and is Crown Reserve. The zoning outcome for this site will be determined by the E Zone implementation process to commence shortly. This E Zone process is presently underway through on-going consultation with the State government and the timeframe for completion or outcome of this process is unknown and not within the control of Byron Shire Council. For this reason, it is considered that the strategy will be implemented in due course and is no longer warranted for inclusion in the newly revised CZMP.	DELETE
P5	Prepare a Strategic Plan for public lands between Ferry Reserve Caravan Park and Massey Greene Caravan Park, including the Sonny Coles Memorial Boat Ramp and Boat Harbour	1	1. Prepare draft Strategic Plan, including concept plans for management of individual areas, based on the issues facing management of the land. 2. Undertake community consultation by conducting community information events and distributing relevant information brochures. 3. Undertake environmental assessment of preferred concept plans. 4. Amend Draft Plan and associated concept plans in accordance with public submissions and environmental assessment outcomes. 5. Council to review and adopt the Strategic Plan. 6. Support the development and implementation of concept designs contained in the Strategic Plan.	$ 20,000	Byron Shire Council and Dept. of Industry - Lands	2008	Complete	The Brunswick Heads Foreshore Reserves Strategic Plan was endorsed by the former Department of Lands in August 2008. The Plan identifies opportunities for additional tourist facilities to provide an income source for improvements, environmental management and ongoing maintenance of the public open space system. There are also additional Plans of Management for the three holiday parks (refer to P13) and 4 public reserves in Brunswick Heads (Simpsons Creek Reserve, Banner Park, Terrace Park and Torakina Reserve, developed in 2014. It is noted that it is important to provide any linkages between the existing Plans of Management and the CZMP, if they compliment each other through mutually agreeable actions.	DELETE
P6	Ensure any major new tourism facilities in Brunswick Heads and Mullumbimby are consistent with the Byron Shire LEP and DCP, are in keeping with the cultural setting of the area, and mitigate any adverse impacts to the health of the Brunswick Estuary through measures such as appropriate stormwater and environmental management.	1	1. Council planners to ensure that any major new tourism facilities are consistent with the Byron Shire LEP and DCP, are in keeping with the cultural setting of the area, and mitigate any adverse impacts to the health of the Brunswick Estuary through measures such as appropriate stormwater and environmental management. 2. Council planners to consider the Nature Tourism Taskforce "Guidelines for Ecotourism Development Within the Northern Rivers NSW Region" (June 2001) for any new ecotourism facilities.	NA	Byron Shire Council	2009	Complete	Council planners refer to the *DCP (2010) Chapter D3 - Tourist Accommodation* when assessing tourism accommodation Development Approvals. Council also adopted Byron Shire Tourism Management Plan in 2008 (with a review due in 2018) to guide the development and marketing of tourism in the Shire. Council planners do not consider the Nature Tourism Taskforce "Guidelines for Ecotourism Development Within the Northern Rivers NSW Region" as they use other policies. In addition, the *DCP (2014) Chapter E4 - Brunswick Heads* aims to ensure development in Brunswick Heads is consistent with the low-key, family-friendly coastal village character of the area. *DCP (2014) Chapter E3 - Services* outlines the minimum requirements for stormwater management with additional information provided in the Comprehensive Guidelines for Stormwater Management (2014). Development adjoining and near the Brunswick River is outlined in DCP (2014) Chapter E4.2.3 and E4.2.5 which aims to ensure restoration and protection of the riverside environment and conservation of existing biodiversity.	DELETE
P7	Council Planners to ensure future residential rezonings include forested buffer zones between agricultural and new residential lands in Mullumbimby and Bayside Brunswick	1	1. Council planners to ensure that future residential rezonings include forested buffer zones between agricultural and new residential lands at: - Ann Street, Mullumbimby; - Bayside Brunswick; Existing residential zoned land on Main Arm Road, Mullumbimby; - Clays Road / Coral Avenue; and, - Left Bank Road, Mullumbimby. 2. Involve local Brunswick Valley Landcare groups to create buffers between existing town and agricultural boundaries 3. Introduce farm forestry planting incentives for land owners. Planting could be tax deductible if linked to other agricultural production 4. Encourage rural landholders to prepare Property Management Plans, Vegetation Management Agreements with Council and/or Property Vegetation Plans with the Northern Rivers CMA.	NA	Byron Shire Council	As required	Underway	Land use conflict is real and needs to be managed now and into the future. Incorporating buffers to manage land use conflicts will remain the primary planning tool when undertaking future residential rezonings. Whether or not these areas are planted out depends on (i) what can be negotiated with the landowner/developer at the time and (ii) having a framework in place for future management of these buffer areas. General riparian planting and habitat corridors are of great significance and need to be implemented via a co-ordinated approach to minimise land use conflicts and ensure environmental rehabilitation and enhancement.	REMAIN
P8	In drafting a new Byron Shire LEP, the Brunswick Estuary is to be zoned as a "W1 Natural Waterway" in accordance with the NSW Planning Reforms LEP Standard Template	1	1. Council planners to revise LEP such that the waterways of the Brunswick Estuary are all zoned as "W1 Waterways"	NA	Byron Shire Council	2008	Complete	The Brunswick River is zoned 'W1 - Natural Waterway' in the LEP (2014).	DELETE

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
P9	Review Draft Foreshore Access Concept Plan	1	1. Undertake community consultation of Draft Foreshore Access Concept Plan through public exhibition of the Draft Brunswick Estuary Management Plan. 2. Amend concept plan in accordance with public submissions. 3. Council to review and adopt amended Foreshore Access Concept Plan. 4. Support the development of a Foreshore Access Concept Plan for Brunswick Heads and Bayside Brunswick.	$ 20,000	Byron Shire Council	2010	Not started	A Draft Foreshore Access Concept Plan was developed as part of the CZMP for the Brunswick Estuary based on Byron Shire Council's Byron Shire Bike Strategy and Action Plan (Bike Plan) 2008 for the existing cycle route through Mullumbimby, Ocean Shores and South Golden Beach. This plan was developed during the formation of the CZMP and has not been advanced any further since conception. It is presently not a priority for Byron Shire Council but may be revisited in the future.	DELETE
P10	Revise the Mullumbimby DCP to reflect the recommendations within the Mullumbimby Settlement Strategy	2	1. Council planners to review and revise DCP to include a 50 metre wide riparian buffer between new developments and all waterways 2. Prepare revised draft DCP. 3. Undertake community consultation and public exhibition 4. Finalise and adopt revised DCP	NA	Byron Shire Council	2010	Complete	The DCP was reviewed and revised in 2014 and includes *Chapter E3 - Mullumbimby* which provides criteria and standards for future development in the Mullumbimby Urban Area consistent with the provisions of the LEP (2014).	DELETE
P11	Incorporate any remaining vacant foreshore Crown Land into a formal public land management regime and prepare Plans of Management for all Crown Lands within an integrated estuary / foreshore reserve system	2	1. Liaise with the Department of Lands to identify all Crown Reserves within the Brunswick estuary that do not have a current Plan of Management. 2. Prepare draft Plans of Management. 3. Undertake community consultation to obtain community feedback on draft Plans of Management. 4. Finalise reports.	$ 60,000	Dept. of Industry - Lands	2012	Underway	The Brunswick Heads Foreshore Reserves Strategic Plan was endorsed by the former Department of Lands in August 2008. The Plan identifies opportunities for additional tourist facilities to provide an income source for improvements, environmental management and ongoing maintenance of the public open space system. There are also additional Plans of Management for the three holiday parks (refer to P13) and 4 public reserves in Brunswick Heads (Simpsons Creek Reserve, Banner Park, Terrace Park and Torakina Reserve, developed in 2014. It is noted that it is important to provide any linkages between the existing Plans of Management and the CZMP, if they compliment each other through mutually agreeable actions.	DELETE
P12	Prepare a WSUD Policy for the Byron Shire	2	1. Council to prepare a draft WSUD in consultation with State Agencies, industry and the community 2. Undertake public exhibition of draft document 3. Finalise WSUD Policy 4. Council adoption of WSUD policy 5. Developers advised of new policy and provided with fact sheets on key techniques 6. Implementation of WSUD Policy	$ 15,000	Byron Shire Council (with assistance from Office of Environment and Heritage)	2010	Not started	DCP (2014) Chapter B3 - Services identifies the minimum requirements necessary for the management of water and stormwater and all development applications are assessed by Byron Shire Council engineers who provide constraints and conditions of approval. Additionally, Byron Shire Council has developed Comprehensive Guidelines for Stormwater Management (2014) which supplements the provisions contained in the DCP. As Byron Shire receives a high amount of rainfall and strives to always improve ecological sustainability, a WSUD policy is still considered to be a priority strategy. WSUD is being implemented in current projects such as rain gardens for first flush stormwater (e.g. Railway Car park Upgrade), however, it is based on individual practice and not a 'policy' for implementation in all projects.	REMAIN
P13	Prepare Plans of Management for Massey Greene and The Terrace Caravan Parks	2	1. Byron Shire Holiday Parks Reserve Trust to begin preparation of draft caravan park Plans of Management, incorporating improved foreshore access adjacent to parks 2. Undertake community consultation on draft plans of management 3. Finalise and adopt plans of management 4. Minister for Lands to adopt Plans of Management 5. Implement plans of management	$ 30,000	Department of Industry - Lands	2011	Complete	NSW Crown Holiday Parks Trust completed Plans of Management for Massey Greene and Terrace Reserve Holiday Parks (as well as Ferry Reserve Holiday Park) which were approved in 2014 and are available at the following website:http://nswchpt.com.au/approved-plans-of-management/ It is noted that it is important to provide any linkages between the existing Plans of Management and the CZMP, if they compliment each other through mutually agreeable actions.	DELETE
P14	Review the Marshalls Creek Floodplain Management Plan to incorporate the impacts of Climate Change (*in the interim, proposals for the rezoning of potentially flood liable land for development should give consideration to latest IPCC/CSIRO sea level rise projections available*)	2	1. Confirm predictions for sea level rise based on latest projections by the Intergovernmental Panel on Climate Change (IPCC) and the CSIRO. 2. Confirm projections for changes in storm intensity, frequency and expected rainfall. 3. Assess impact of projected sea level rise and storm intensity scenarios on estimated flood levels along Marshall Creek for design flood events. 4. Council planners to revise the existing Floodplain Management Plan prepared in 1997 to incorporate the projected impact of climate change, including sea level rise and changes in rainfall and storm intensity.	$ 20,000	Byron Shire Council	2011	Underway	This project is presently underway and is being completed by Byron Shire Council in a staged process. Stage 1 involves the preparation of the North Byron Coastal Creeks Flood Study incorporating modelling of the Marshalls, Simpsons and Brunswick Catchments. This study considers the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton, South Golden Beach and Billinudgel and is now complete. Stage 2 of the project involves developing a Flood Risk Management Study and Plan for these areas and will incorporate the impacts of Climate Change based on Council adoption of Climate Change Parameters (outlined in Byron Shire Council's Climate Change Strategic Planning Policy adopted by Council 2009 and last updated 2014. Stage 2 is anticipated to start mid 2017.	REMAIN and COMBINE P14, P15 and P16 and change to Priority 1
P15	Prepare a Floodplain Risk Management Plan for Mullumbimby that incorporates the impacts of Climate Change (*in the interim, proposals for the rezoning of potentially flood liable land for development should give consideration to latest IPCC /CSIRO sea level rise projections available*)	2	1. Confirm predictions for sea level rise based on latest projections by the Intergovernmental Panel on Climate Change (IPCC) and the CSIRO. 2. Confirm projections for changes in storm intensity, frequency and expected rainfall. 3. Assess impact of projected sea level rise and storm intensity scenarios on estimated design flood levels at Mullumbimby. 4. Council planners to prepare a Floodplain Risk Management Plan that incorporates the projected impact of climate change, such as sea level rise and changes in rainfall and storm intensity.	$ 25,000	Byron Shire Council	2011	Underway	This project is presently underway and is being completed by Byron Shire Council in a staged process. Stage 1 involves the preparation of the North Byron Coastal Creeks Flood Study incorporating modelling of the Marshalls, Simpsons and Brunswick Catchments. This study considers the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton, South Golden Beach and Billinudgel and is now complete. Stage 2 of the project involves developing a Flood Risk Management Study and Plan for these areas and will incorporate the impacts of Climate Change based on Council adoption of Climate Change Parameters (outlined in Byron Shire Council's Climate Change Strategic Planning Policy adopted by Council 2009 and last updated 2014. Stage 2 is anticipated to start mid 2017.	REMAIN and COMBINE P14, P15 and P16 and change to Priority 1

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
P16	Prepare a Floodplain Risk Management Plan for Brunswick Heads that incorporates the impacts of Climate Change (*in the interim, proposals for the rezoning of potentially flood liable land for development should give consideration to latest IPCC/CSIRO sea level rise projections available*)	2	1. Confirm predictions for sea level rise based on latest projections by the Intergovernmental Panel on Climate Change (IPCC) and the CSIRO. 2. Confirm projections for changes in storm intensity, frequency and expected rainfall. 3. Assess impact of projected sea level rise and storm intensity scenarios on estimated design flood levels at Brunswick Heads. 4. Council planners to prepare a Floodplain Risk Management Plan that incorporates the projected impact of climate change, such as sea level rise and changes in rainfall and storm intensity.	$ 25,000	Byron Shire Council	2011	Underway	This project is presently underway and is being completed by Byron Shire Council in a staged process. Stage 1 involves the preparation of the North Byron Coastal Creeks Flood Study incorporating modelling of the Marshalls, Simpsons and Brunswick Catchments. This study considers the areas of Mullumbimby, Brunswick Heads, Ocean Shores, New Brighton, South Golden Beach and Billinudgel and is now complete. Stage 2 of the project involves developing a Flood Risk Management Study and Plan for these areas and will incorporate the impacts of Climate Change based on Council adoption of Climate Change Parameters (outlined in Byron Shire Council's Climate Change Strategic Planning Policy adopted by Council 2009 and last updated 2014. Stage 2 is anticipated to start mid 2017.	REMAIN and COMBINE P14, P15 and P16 and change to Priority 1
P17	Develop an Acid Sulphate Soils Management Plan (ASSMP) for the catchment	3	1. Undertake a soil survey of the area to the north and south of the Brunswick River, and the Marshalls Creek sub-catchment 2. Undertake water quality monitoring to determine sites of acid runoff 3. Prepare whole farm plans for properties on high risk ASS. 4. Review and assess Marshalls Creek Floodplain Management Plan to identify areas with high probability for development. 5. Develop ASS Management Plan in accordance with the NSW Acid Sulfate Soil Manual. 6. Establish ASS demonstration sites, such as at the Kallaroo Circuit Bund / Capricornia Canal area. 7. Organise awareness and education activities such as field days, information bulletins and newsletters.	$ 50,000	Byron Shire Council (with assistance from Office of Environment and Heritage)	2011	Not started	To date there is still no detailed information on the actual distribution of ASS in the Brunswick estuarine system, and the Acid Sulfate Soil Risk Maps on the Office of Environment and Heritage website are useful but are not reliable enough for making an ASS Management Plan. Baseline information is required for implementation of this strategy, with two other strategies (G8 and IR5) required to be implemented prior to completion of this strategy. Byron Shire Council is keen to progress with this strategy should appropriate funding for the survey become available.	REMAIN
P18	Develop a new site specific DCP for Brunswick Heads	3	1. Liaise with Council planners, building inspectors, local developers and the community to set criteria for new development within the village. 2. Prepare Draft DCP. 3. Undertake community consultation and public exhibition 4. Finalise and adopt new DCP	$ 20,000	Byron Shire Council (with assistance from Office of Environment and Heritage)	2011/12	Complete	*DCP (2014) - Chapter E4 Brunswick Heads* applies to certain land known as the Brunswick Heads Urban Area and provides relevant criteria and standards for future development of this area. This includes criteria for development adjoining and near the Brunswick River which prescribes landscaping and a minimum set-back of 10m.	DELETE
	ECONOMIC INCENTIVES AND COST-SHARING ARRANGEMENTS								
C1	Introduce a community recognition and local awards scheme for efforts towards biodiversity conservation	2	1. Publish media article advising rural land owners of awards scheme and request nominations 2. Identify suitable nominees for recognition by undertaking site inspections of nominated properties 3. Invite all landholders to presentation via a media article and direct mail 4. Present awards to land holders 5. Encourage further nominations by fellow landholders	$ 10,000	Byron Shire Council	2010	Not started	This strategy is still valid in its ideas, however, it would be good to amend to a community incentive program similar in nature to Tweed Shire Council's (TSC) River Health Grants Program. TSC has grants for works in areas adjacent the river bank that will lead to improvements in water quality and stream health. Grants are available for work such as stock fencing, erosion control, revegetation and weed management.	REMAIN
	REGULATION								
R1	Remove foreshore debris associated with the oyster industry by compliance	1	1. Byron Shire Council to consult with NSW Department of Primary Industries and implement the recommendations in the Dept. Primary Industries Sustainable Aquaculture Strategy	$ 500	Byron Shire Council	2009	Underway	The site survey completed found that foreshore debris associated with the oyster industry did not appear to be a priority issue in the Brunswick Estuary anymore, however, debris from oyster leases is a concern for Dept. Primary Industries - Fisheries and for National Parks when it impacts on terrestrial Protected Areas. In these areas it is feasible that compliance of foreshore debris may be undertaken as part of the general patrol/compliance duties of agency officers. In other areas, the removal of foreshore debris could be simply implemented via a phone call to the Department of Primary Industries - Fisheries through the complaints system. For this reason, it is considered that this management strategy is no longer required.	DELETE
R2	Lobby for speed limits within the Brunswick River and Marshalls Creek	1	1. Council to lobby Roads and Maritime Services and the Marine Parks Authority on designating appropriate speed limits within the Lower Brunswick River. 2. Prepare community information brochures on new speed restriction zones. 3. Prepare media release advising of new speed restriction zones. 4. Install signs in prominent foreshore locations clearly specifying new speed restrictions.	NA	Byron Shire Council (with assistance from RMS and the Marine Parks)	2009	Not started	The objective of this strategy is to primarily improve safety for recreational vessels and watercraft on the waterway. However, the site inspection survey of the river revealed that vessel speed is a big issue in the Brunswick River, potentially exacerbating bank erosion from boat wake. First hand observations of kids in tinnies to the furthest upstream reach of Mullumbimby Creek speeding in shallow water, creating a large amount of wake. There are some speed restrictions in Simpsons Creek downstream from the footbridge. Other areas where speed restrictions should be considered include in Marshalls Creek and between Marshalls Creek and Torakina Beach. This objective is still very much warranted and should remain as a high priority for implementation. After an informal chat with Marine Parks it was decided that Council should lobby RMS for the "review of" speed limits and that Marine Parks could assist Council (be supportive of this action), however, would not be a "Responsible Agency".	REMAIN
R3	Investigate and enforce potential illegal rock armouring on the right bank of the mid-lower Brunswick River	1	1. Council enforcement officers to inspect sites of potential illegal rock armouring 2. Liaise with Office of Environment and Heritage and review development approvals paperwork to determine whether rock armouring has appropriate Council or Office of Environment and Heritage approval 3. Undertake enforcement action where appropriate 4. Encourage land owners to undertake recommended bank stabilisation options.	NA	Dept. Primary Industries - Fisheries (with assistance from Byron Shire Council)	2009	Not started	Illegal rock armouring is still prolific along the banks of the Brunswick River, however, many of the areas have been stabilised by the rocks in areas where riparian vegetation is lacking. If rock armouring is to be removed then it is necessary to undertake revegetation works or bank stabilisation works in parallel with removal. Dept. Primary Industries - Fisheries are responsible for compliance actions on any unauthorised rock armouring and undertake regular monitoring of the Brunswick Estuary. In addition to investigation of illegal rock armouring, investigation and enforcement of un-approved structures / development in the riparian buffer zone is a concern. Particularly at sites within SEPP 14 Coastal Wetlands, Key Fish Habitat and the Sanctuary Zone of the Cape Byron Marine Park. It is proposed that a new management strategy is created.	REMAIN and CREATE new R4

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
	ON-GROUND REHABILITATION - Bank Erosion Management								
B1	Remove unsightly rock armouring at Ferry Reserve Caravan Park and undertake bank stabilisation works	1	1. Present options for bank stabilisation, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option R = $140,000 * Option L = $28,000 * Option H&P = $210,000 *	Dept. of Lands	2010	Complete	This has been completed by Crown Lands and the boat ramp has been upgraded with gravel.	DELETE
B2	Repair reaches of failing rock wall along Simpsons Creek upstream and downstream of the road bridge	1	1. Present options for bank repair, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option D = $20,000 *	Dept. of Industry - Lands (with assistance from Byron Shire Council)	2009	Not started	There are a few areas of collapsed bank on the left bank of Simpsons Creek upstream and downstream of the road bridge. One such spot is downstream of the Pirate Boat along the foreshore training wall. This wall is heavily used by the general public, failing in some areas and is a public safety and amenity issue.	REMAIN
B3	Undertake bank stabilisation works along the left-bank of Simpsons Creek downstream from the Brunswick Heads Bowling Club (SITE 14)	1	1. Liaise with the local Arakwal Aboriginal Cooperative to establish the extent of the Aboriginal midden that is understood to exist in close proximity to the erosion scarp. 2. Establish the extent of the Aboriginal midden and use this to determine whether potential bank stabilisation measures can be implemented such that they avoid impacting on the midden. 3. Assuming a suitable stabilisation measure can be implemented, undertake detailed survey of river bank and river bed. 4. Prepare a concept design for the preferred bank stabilisation measure. 5. Present the concept designs to the local Arakwal Aboriginal Corporation and the community for comment 6. Undertake detail design of the preferred bank stabilisation measure incorporating comments and feedback from the presentation outlined under Item 5. 7. Prepare tender documentation and construct the proposed bank stabilisation works.	Option P = $4,000 * Option C = $25,000 * Option A = $14,000 *	Byron Shire Council	2009	Not started	Management of this SITE 14 is still unresolved and the issue remains. An Environmental Trust grant given to Byron Shire Council to implement bank stabilisation project at Simpsons Creek in Feb 2009, however, a significant amount of funds was also required from Byron Shire Council in addition to the grant. Due to unavailable costs, the grant was returned and the works were never completed. The area is still in need of bank stabilisation works as there is significant under-cutting of the bank and exposure of coffee rock. It is a primary unformalised public access area with heavy usage with limited riparian buffer zone due to the informal "car park" area. These issues are outlined in the Plan of Management for the Brunswick Heads Foreshore Public Reserves (prepared for the NSW Crown Holiday Parks Trust, 2014) therefore NSWCHPT will now become a co-responsible agency to implement action. Any proposed works will require close engagement with the Arakwal and Bundjalung People of Byron Bay. Refer to the Site Survey results for more detail.	REMAIN
B4	Undertake bank stabilisation works at bank erosion SITE 15	1	1. Present options for bank repair, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option P = $15,000 *	Byron Shire Council	2009	Not started	Management of this SITE 15 is still unresolved and the issue remains. The site is in need of bank stabilisation works due to active erosion from public access issues. Refer to the Site Survey results for more detail.	REMAIN
B5	Undertake bank stabilisation works at bank erosion SITE 1	2	1. Present options for bank repair, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option K = $70,000 * Option J = $56,000 * Option I = $70,000 * Option I & J = $126,000 *	Dept. of Industry - Lands (with support from Byron Shire Council and Brunswick Valley Landcare)	2011	Not started	Bank stabilisation works were never completed at this site, however, erosion and under-cutting has been stabilised by large woody debris lying instream. Mangroves and seagrass have recruited to the area and it is no longer a site of concern. Refer to the Site Survey results for more detail.	DELETE
B6	Undertake bank stabilisation works at bank erosion SITE 5	2	1. Present options for bank repair, including concept designs, to the community and Byron Shire Aboriginal Consultative Committee for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option H = $14,000 * Option F = $105,000 * Option E = $216,000 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2011	Not started	Management of this Site 05 is still unresolved and the issue remains. The illegal armouring of the bank is stabilising the bank and any removal of the rock armouring will have to be completed in conjunction with bank stabilisation works. Refer to Site Survey results for full details.	REMAIN
B7	Undertake bank stabilisation works at bank erosion SITE 6	2	1. Present options for bank repair, including concept designs, to the community and Byron Shire Aboriginal Consultative Committee for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option H = $280,000 * Option N = $28,000 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2011	Not started	Management of this Site 06 is still unresolved and unrestrained cattle access and a narrow riparian zone still remains. Refer to Site Survey results for full details.	REMAIN
B8	Undertake bank stabilisation works at bank erosion SITE 8	2	1. Present options for bank repair, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option K = $28,000 * Option J = $28,000 * Option I = $70,000 * Option I & J = $98,000 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2011	Not started	Management of this Site 08 is still unresolved and the issue remains. This site is of low priority public expenditure as it is well vegetated. Refer to Site Survey results for full details.	REMAIN

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
B9	Undertake bank stabilisation works at bank erosion SITE 9 and SITE 13	2	1. Present options for bank repair, including concept designs, to the community and Byron Shire Aboriginal Consultative Committee for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Erect fencing = $45,500 Option Q = $39,000 Option R = $280,000 Option R & Q = $364,500	Byron Shire Council (with support from Brunswick Valley Landcare)	2009	Not started	Bank stabilisation works were completed at Site 09 (adjacent the Brunswick Valley, Vallances Rd STP), however, the previous rock protection works have failed and the slumped into the river. The design of these rock works and placement within the bend of a dynamic river may have contributed to the failing of the rock work and re-stabilisation by means of an alternative stabilisation method may need consideration. Potential management response for works at SITE 09 includes a bio-engineering approach such as installation of timber piles. Management of Site 09 is of high priority and there may be funds available for this project in the near future. Management at Site 13 is still unresolved and the issue remains. Refer to Site Survey results for full details.	REMAIN and split Site 09 and Site 13.
B10	Undertake bank stabilisation works at bank erosion SITE 10	2	1. Present options for bank repair, including concept designs, to the community and Byron Shire Aboriginal Consultative Committee for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option H = $8,500 * Option F = $170,000 * Option E = $288,500 *	Byron Shire Council	2010	Not started	In 2011 the 'Brunswick River Reach Plan' was initiated as a Northern Rivers Catchment Management Authority funded project delivered by Brunswick Valley Brunswick Valley Landcare (Brunswick Valley Landcare). The plan addresses several high priority management recommendations outlined in the CZMP. A Site Action Plan has been developed for Site 10 (Mullumbimby Rugby League Football Club) in 2011 which addresses the key concerns for the site and actions to be implemented. The SAP recommends the replacement of the concrete and brick armouring with geofabric and rocks, as suggested in the CZMP. However, management of this SITE 10 is still unresolved due to the high cost and the issue remains.	REMAIN
B11	Undertake bank stabilisation works at bank erosion SITE 11 and SITE 12	2	1. Present options for bank repair, including concept designs, to the community and Byron Shire Aboriginal Consultative Committee for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option Q = $140,000 * Option P = $37,500 * Option Q & P = $187,500 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2010	Not started	Management of SITE 11 and 12 is still unresolved and the issue remains. Refer to Site Survey results for full details.	REMAIN
B12	Undertake bank stabilisation works at bank erosion SITE 2 and SITE 3	3	1. Present options for bank repair, including concept designs, to the community and Byron Shire Aboriginal Consultative Committee for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option K = $170,000 * Option N = $420,000 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2012	Not started	Management of SITE 02 and 03 is still unresolved and the issue remains. Refer to Site Survey results for full details.	REMAIN
B13	Undertake bank stabilisation works at bank erosion SITE 4	3	1. Present options for bank repair, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option K = $22,000 * Option J = $28,000 * Option I = $42,000 * Option I & J = $70,000 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2012	Not started	Management of this Site 04 is still unresolved and the issue remains. Refer to Site Survey results for full details.	REMAIN
B14	Undertake bank stabilisation works at bank erosion SITE 7	3	1. Present options for bank repair, including concept designs, to the community for comment 2. Prepare detailed designs. 3. Construct bank stabilisation works.	Option P = $4,200 *	Byron Shire Council (with support from Brunswick Valley Landcare)	2012	Not started	Management of this Site 07 is still unresolved and the issue remains. Refer to Site Survey results for full details.	REMAIN
	ON-GROUND REHABILITATION - On-the-Ground Works								
G1	Continue Mullumbimby Sewerage System Inflow and Infiltration Programme (Stage2 PRP No.6) in Mullumbimby to identify and undertake sewerage system upgrades where required	1	1. Continue Mullumbimby Sewerage System Inflow and Infiltration Program (Stage 2 PRP 6) 2. Examine expansion of pumping systems in priority catchments, as identified in the Inflow and Infiltration Program evaluation report (Rees 2005) 3. Review configuration of pumping systems in conjunction with the Vallances Road STP design.	$200,000	Byron Shire Council	Ongoing	Complete	Byron Shire Council has completed and finalised Stage 2 PRP 6 with the Environment Protection Agency (EPA). All raw sewage overflows to the Brunswick River due to stormwater inflow into the sewerage system has ceased. This was achieved by expansion of the pumping system capacity; reconfiguration of pumping systems to increase transport efficiency and the construction of the Brunswick Valley Sewage Treatment Plant (at Vallances Rd) and transfer pipelines. Work on reducing stormwater inflow into the sewage system is ongoing and included in the Byron Shire Council sewer maintenance operations. The Byron Shire Council maintenance team has also taken on responsibility for urban stormwater maintenance. Given the major elements of the original project have been completed; raw sewage overflows have been stopped and the sewer maintenance operations includes ongoing stormwater inflow prevention; this task is complete.	DELETE

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
G2	Council to fence and re-establish native vegetation on Council owned riparian land along the north bank of the mid-Brunswick River and south bank of the river adjacent to Mills Street Industrial Estate	1	1. Prepare a media release advising of Council's intention to fence its riparian land, including giving some background on the reasons for this action 2. Council to erect fencing and re-vegetate their own land on the north bank of the mid-Brunswick River 3. Council to erect fencing and re-vegetate their own land on the south bank of the upper-Brunswick River 4. Council to undertake education program for rural property owners on catchment practices and their impact on estuary processes, using Council sites as demonstration sites for best management practice	$ 220,000	Byron Shire Council (with assistance from Brunswick Valley Landcare)	2009	Underway	The Council owned riparian land along the north bank of the mid-Brunswick River is the Vallances Rd STP site where extensive riparian planting and revegetation works has been completed. This site is a fantastic demonstration site of wetland and riparian restoration and has created a place of high ecosystem value and amenity for the public. The south bank river site adjacent to Mills Street Industrial Estate is the Council Operational Land and leased "Horse Paddock". A Site Action Plan was developed in 2011 for this Operational Land (Horse Paddock) which addresses the key concerns for the site and actions to be implemented. Two funding applications have been successful for regeneration work on this property and fencing of the riparian buffer zone has been completed. Brunswick Valley Landcare has completed planting work on this site and the Byron Shire Council regeneration team have continued the work after the grants finished..	DELETE
G3	Install fencing at strategic sites where uncontrolled livestock access currently occurs	1	1. Identify priority areas where unrestricted livestock access appears to be contributing bank erosion. Determine these areas based on aerial photo interpretation, discussions with land holders and field ground-truthing. 2. Liaise with landholders to determine their willingness to be involved in riparian corridor fencing within their properties. 3. Identify priority riparian corridor fencing zones. 4. Source funds to fence priority riparian zones. 5. Undertake fencing of riparian corridors in consultation with land holders.	$ 200,000	Byron Shire Council (with assistance from Brunswick Valley Landcare)	2010	Underway	Byron Shire Council and Brunswick Valley Landcare have completed mapping and field truthing of the Brunswick catchment over the preceding years and works involving riparian planting and bank stabilisation works are ongoing and subject to funding available. Brunswick Valley Landcare always encourages fencing but has not had any contact with many property owners within the catchment (except the Mullumbimby Rugby Leagues Club) for the past 2 years. Installation of fencing requires large amounts of funding and/or financial contribution from landowners, and as such has been limited. This action may be best merged with a complete action for revegetation riparian planting and/or fencing of strategic sites along the entire estuary.	REMAIN
G4	Maintain and expand / upgrade the Main Arm Effluent Reuse Scheme (MERS)	1	1. Undertake concept design of reuse system 2. Undertake detailed design of expanded/upgraded system. 3. Construct new system. 4. Continue liaising with farmers to identify potential for future upgrades. 5. Reassess the reuse strategy and consider option of increasing reuse rates from the Mullumbimby-Brunswick Heads STP and/or commence reuse activities from the Ocean Shores STP	$1 million capital cost for Stage 1	Byron Shire Council	2011	Underway	Over the past 3 years recycled water used by the two local farmers has declined significantly. In the case of one farmer this is due to the cost of electricity and a decline in farming operations. No new customers have been found along the pipeline route. Council is currently undertaking a review of its recycled water management strategy which will be taken to Council in 2017. The review will build on the experience gained over the last 15 years of recycled water use.	REMAIN
G5	Upgrade the Brunswick Heads Boat Ramp parking facilities	1	1. Undertake survey to confirm the extent of the SEPP 14 wetland boundary in the vicinity of the boat launching ramp and existing car parking infrastructure. 2. Prepare concept design plans for preferred parking facility upgrade option. 3. Undertake assessment of environmental and social impacts associated with preferred option. 4. Exhibit preferred concept design and seek Council and community feedback (including Byron Shire Aboriginal Consultative Committee). 5. Undertake detail design of preferred option incorporating community comments. 6. Construct boat ramp parking area improvement works.	$100,000 *	Dept. of Lands (with support from Byron Shire Council)	2010	Underway	The Brunswick Heads Boat Harbour Master Plan Project is currently underway by Department of Industry - Lands. This includes plans for development of the car parking area and other infrastructure. The third workshop on project occurred in September 2016 and the project is progressing steadily. As part of Byron Shire Council vegetation mapping the wetland area adjacent the car park has been recently mapped and was endorsed as High Ecological Vegetation (HEV) in 2015, with SEPP14 wetlands within close proximity.	DELETE
G6	Mark significant navigational hazards	1	1. Mark, remove or otherwise address significant navigational hazards. 2. Undertake consultation program with waterways users and Maritime NSW to identify all navigational hazards. 3. Mark all navigational hazards, including oyster leases.	$ 6,000	Roads and Maritime Services	2009	Not started	Byron Shire Council asked RMS for comments in regards to this strategy, however, has not yet received response. As such, it is considered best practice to include the strategy in the revised CZMP.	REMAIN
G7	Work with landholders to revegetate the riparian zone along all waterways within the estuary	2	1. Identify priority areas for revegetation within the immediate estuarine catchment using Actual Land Use mapping and the Relative Ecological Values Matrix, in the Byron Biodiversity Conservation Strategy. 2. Supply tube sock to revegetate priority riparian areas, 3. Liaise with landholders and Brunswick Valley Brunswick Valley Landcare to revegetate priority zones. 4. Encourage landholders to conserve existing native remnant vegetation and to enter into Voluntary Conservation Agreements, Biodiversity Management Agreements or Property Management Plans.	$132,000	Byron Shire Council (with assistance from Brunswick Valley Landcare)	2009	Underway	During the 10 year period since the development of the recommended strategies outlined in this plan, Byron Shire Council and Brunswick Valley Landcare have implemented many on-ground works in rehabilitation and restoration of riparian vegetation along the waterways within the Brunswick catchment. There are still many areas that are prone to bank erosion and require revegetation of the riparian buffer zone, and identification of these priority areas is necessary. Byron Shire Council has recently completed vegetation mapping (2015) of the catchment and an assessment of works completed to date to identify priority areas for future works is necessary. Brunswick Valley Landcare locality groups have been working within the town of Mullumbimby (sites at Heritage Park, Brunswick Terrace and the Show Grounds) and also along most of Salt Water Creek. To date though Brunswick Valley Landcare have not completed any work with on private land in collaboration with private landholders. A large area adjacent the river at the Brunswick Valley STP (Vallances Road STP) has been extensively planted out and has been an extremely successful revegetation project with the creation of wetlands. This action may be best merged with a complete action for revegetation riparian planting and/or fencing of strategic sites along the entire estuary.	REMAIN
G8	Undertake drain mapping within the north and south of the Brunswick River and Marshalls Creek sub-catchments	2	1. Review 2004 1:25,000 aerial photographs to determine locations of existing drainage, including landholder drains and union drains 2. Code for depth, width and height of spoil mound to the nearest 1metre 3. Undertake ground truthing to confirm existing, length, width and depth of drains 4. Develop GIS layer detailing locations and characteristics (width, depth and spoil height) of drainage within the Marshalls Creek sub-catchment area	$ 14,500	Byron Shire Council (with assistance from Office of Environment and Heritage)	2010	Not started	This has not yet been completed, however, is still a strategy that Byron Shire Council would like to complete. Drain mapping will provide a basis for the development of an Acid Sulfate Soil Management Plan as acidification of the estuary is likely to be from transport of acidified water through the drainage network. This strategy is required to be completed prior to P17.	REMAIN

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
G9	Close and relocate the Mullumbimby and Brunswick Heads STPs to a new site in Vallances Road in accordance with the *Brunswick Area Sewerage Augmentation Report 2003*	3	1. Construct new Mullumbimby-Brunswick Heads STP at Vallances Road, Mullumbimby 2. Construct new wastewater transfer mains, effluent storage and other associated infrastructure (e.g. new and upgraded pumping stations, constructed wetlands etc.) 3. Construct effluent reuse pipeline from Ocean Shores STP 4. Commission new Mullumbimby-Brunswick Heads STP 5. Decommission Mullumbimby and Brunswick Heads STPs	$23.5 million capital cost	Byron Shire Council	2009	Complete	Byron Shire Council has retired and closed both the Mullumbimby STP and Brunswick Heads STP. Byron Shire Council relocated the Mullumbimby and Brunswick Heads STP to a new site at Vallances Rd in 2011 with formal commissioning of the Brunswick Valley STP occurring in February 2011. The new site has constructed eco-wetlands and large areas of riparian vegetation adjacent the Brunswick River and is a successful habitat restoration site. The wetlands act as a final filter system for water entering the river, and as such water quality has significantly improved.	DELETE
G10	Map and eradicate weed infestations by survey, education and weed management programs	3	1. Seek funding through grants, to identify and survey areas for abundance and distribution of environmental weeds. 2. Work with Landcare groups to identify, survey and map areas for abundance and distribution of environmental weeds, identifying weed "hotspots" 3. Co-ordinate weed management with other operating programs, such as that identified as a high priority within the NPWS Byron Coast Group of Nature Reserves Plan of Management (1998) and the North Coast Weeds Advisory Committee Weed Management Plans. 4. Remove weeds.	$ 17,000	Byron Shire Council (with assistance from North Coast Weeds Advisory Committee)	2011	Not started	Weed mapping was completed 2011 by Brunswick Valley Landcare as part of the 'Brunswick River Reach Estuary Plan'. Due to the length of time since this mapping was undertaken and possible change in property ownership, it would be beneficial to undertake a more recent surveillance of weeds within the catchment.	REMAIN
	INVESTIGATION AND RESEARCH								
IR1	Investigate water quality issues in the Capricornia Canal system	1	1. Advise Southern Cross University of post-graduate research project to investigate the water quality issues in the Capricornia Canal system 2. Undertake water quality modelling and any necessary field sampling 3. Write up report on findings and provide to Byron Shire Council for consideration and action	$ 10,000	Byron Shire Council	2009	Not started	Water quality is still one of the main issues in the Brunswick Estuary with a significant component contributed from storm water. Canal estates do not receive as much tidal flushing and water quality may deteriorate faster in these areas than in other areas of the estuary. There has been a lack of water quality monitoring in the Brunswick Estuary, due to the cessation of monitoring of STP outflows, as the STPs have been upgraded and water quality has improved since the construction of the new facility. Stormwater run-off is still an issue and is hard to pin point direct locations where contaminated water may enter the waterway. Implementation of a regular and long-term water quality monitoring program would be extremely beneficial to the Brunswick Estuary along with specific studies or research projects such as the investigation of water quality issues in the Capricornia Canal.	REMAIN
IR2	Undertake a strategic review / assessment of boat ramp facilities, user demand and safety issues	1	1. Council and Department of Lands to undertake an assessment of existing boat ramp facilities 2. Council and DOL to undertake user demand and safety survey of boat ramps and slipways throughout the estuary to determine key users of each facility 3. Council and DOL to determine required changes to user facilities to ensure user needs are met.	$ 5,000	Dept. of Industry - Lands (with assistance from Byron Shire Council)	2009	Not started	User demand for boat ramps in the Brunswick Estuary will continue to increase as tourism in the area increases along with both recreational and commercial activities on the estuary. The primary boat ramp for the Brunswick River is located at the Boat Harbour, with smaller ramps upstream (Ferry Reserve, private ramp and Mullumbimby). As the Brunswick Heads Boat Harbour Master Plan Project is currently underway by Department of Industry – Lands, a strategic assessment is assumed to have been completed as part of the project looking at facilities and user demand at the harbour. It is therefore considered appropriate to delete this action, however, due to the increased use of recreational and commercial activities on the river/estuary a new management action should be created to look at increased usage of the estuary on user value and social issues.	REMAIN
IR3	Undertake a field survey to ground truth the mapped extents where vegetation has been removed along the tributaries of the estuary	1	1. Undertake inspection of the mid- to upper Brunswick River, upper Simpsons Creek and mid-Marshalls Creek sub-catchments to ground truth the mapped extents 2. Revise GIS layer if changes have occurred since 2004 3. Use GIS layer and aerial photography to determine priority areas for revegetation	$ 1,500	Byron Shire Council	2009	Complete	Byron Shire Council has recently completed high resolution imagery to update vegetation mapping. The coastal areas of the Shire were updated in 2015 and GIS layers have been revised based on the new mapping. As part of this 2017 review and update of this CZMP for the Brunswick Estuary, a site inspection of the waterway was completed with priority areas for revegetation along tributaries of the estuary identified. Brunswick Valley Landcare also has significant knowledge of on-ground activities that have occurred in the area and where vegetation has been removed and needs to be replanted.	DELETE
IR4	Undertake point source monitoring at stormwater outfalls adjacent to the Mills Street Industrial Area, the former Brunswick Heads Tip site and the marina to determine potential sources of trace metal and chemical toxin input to the estuary	1	1. Undertake point source monitoring at stormwater outfalls adjacent to the Mills Street industrial area and the marina to determine presence of trace metal discharges (particularly lead and copper) in stormwater discharge 2. Identify those industries that may produce trace metals as a by-product of their operations or whether there are pre-1970s painted buildings within the complex 3. Issue warning letters and/or penalty notices to non-compliant businesses / activities 4. Distribute Department of Environment and Conservation's industry-specific "Cleaner Production" brochures to all businesses 5. Introduce rewards and issue penalties for best and unacceptable practices respectively. 6. Undertake point source monitoring one month after warning letters / penalty notices have been issued	$ 3,500	Byron Shire Council	2010	Not started	Stormwater run-off into the Brunswick Estuary is an on-going issue within the catchment and remains a priority for management presently and into the future. Point source monitoring of this area would be beneficial in addition to (or in parallel) with a dedicated water quality monitoring program. Monitoring of the industrial area Mill Street should not be the sole focus and a current assessment of potential sources of pollution is required to be done. This strategy should be undertaken in parallel with IR6 to identify all sources of pollution within the catchment (i.e. agricultural run-off, stormwater and STPs). Once point sources are identified, an attempt to reduce these sources can be made by encouraging better farming practices and better business practices etc.	REMAIN

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
IR5	Undertake a soil survey of PASS along Marshalls Creek, Simpsons Creek and the Brunswick River	2	1. Undertake a detailed topographical survey of those areas identified by the Office of Environment and Heritage Acid Sulfate Soil Risk Maps as areas of PASS 2. Identify those areas less than 5m AHD 3. Undertake a field and vegetation survey of low-lying areas to determine presence of acid scalds, iron staining, jarosite and death of vegetation 4. Determine borehole locations for soil sampling 5. Undertake soil sampling 6. Develop GIS layer to be used by Council staff when assessing development applications etc.	$ 22,000	Byron Shire Council (with assistance from Office of Environment and Heritage)	2020	Not started	To date there is still no detailed information on the actual distribution of acid sulfate soils (ASS) in the Brunswick estuarine system, and the Acid Sulfate Soil Risk Maps on the Office of Environment and Heritage website are useful but are not reliable enough for making an ASS Management Plan. A suitable soil survey is required to map the actual distribution of PASS in the Brunswick estuarine system to provide baseline information for implementation of strategy P17. Byron Shire Council is keen to progress this action when appropriate funding for the survey may become available.	REMAIN
IR6	Develop a water quality model as a predictive tool for the Brunswick Estuary and its tributaries	2	1. Determine the objectives for a water quality model as a predictive tool for the Brunswick Estuary and its tributaries under consideration of the 'South east Queensland Ecosystem Health Monitoring Program' and/or the DEFIRE Program being undertaken by ABER and Office of Environment and Heritage. 2. Engage an expert in water quality monitoring and model design to assess the current water quality monitoring program and make recommendations to Council on sampling locations and analytes best suited towards development of a Brunswick Estuary Water Quality Model. 3. Implement the revised water quality sampling regime and discontinue monitoring of those sites and/or analytes deemed irrelevant by the current program assessment. 4. Develop a Water Quality Model for the Brunswick Estuary and its tributaries	$ 40,000	Byron Shire Council (with assistance from Office of Environment and Heritage)	2010	Not started	Byron Shire Council does not currently have an active water quality program in the Brunswick Estuary. Sampling was ceased with the construction of the new STP at Vallances Road, Mullumbimby. Water quality in the estuary has no doubt improved significantly due to the reduction in STP wastewater nutrient loads, however, the current state of the quality of water is unknown as there has been no sampling undertaken in recent years (since approx. 2009). NSW has its own monitoring, evaluation and reporting of the condition of and pressures on natural resources called 'Ecohealth'. The Northern Rivers Ecosystem Health Monitoring Program (Ecohealth) is a comprehensive estuarine and freshwater monitoring program that reports on the health of waterways. It aims to bring together the aquatic sampling programs of local and state government and other stakeholders into one region-wide system. The program was designed by the University of New England and Office of Environment and Heritage. Sampling is undertaken at certain locations and sites for an established set of criteria/parameters on a regular basis, similar to the 'South East Queensland Ecosystem Health Monitoring Project'. Implementation of a long-term water quality and ecosystem health monitoring program such as Ecohealth in the Brunswick Estuary would be a fantastic project and is achievable with assistance from Office of Environment and Heritage in a 50% funding arrangement. It is important in this review for the management strategies to remain achievable and realistic, therefore, actions regarding water quality and monitoring have been grouped into two new strategies. One strategy will involve development and implementation of the Ecohealth program in the estuary as a long-term project. The Ecohealth program uses a combination of waterway health indicators that identify short-term (water chemistry), intermediate-term (zooplankton, macroinvertebrates), and long-term responses (fish, geomorphic and riparian vegetation) providing a robust program for quantifying waterway health and prioritising management actions. The second strategy will involve a mapping project of ecosystems (seagrass, oyster reefs and mangroves) and creation of oyster reefs within the estuary or other applicable research project initiatives to improve habitat within the estuary. Mapping will update any previous mapping of the Brunswick Estuary completed by Dept. Primary Industries as a way of monitoring the health of these systems that contribute to increasing biodiversity. The mapping project will aim to determine if seagrass beds, mangroves etc. are continuing to decline or recover as these ecosystems are a marker for water quality and habitat disturbance. Presently there is a push to install hard substrates within estuaries to provide a surface upon which oyster spat can settle and grow and re-establish reefs. Oysters are great filters of estuaries and have been known to filter all the water in the estuary every 3 days. There are still a few oyster reefs in the Brunswick Estuary, which would be great to identify and expand upon them. The reefs also provide great habitat for other biota.	REMAIN and COMBINE IR6, M1, M2, M3 and E6 into two new strategies - 1) Ecohealth Monitoring Program and 2) Mapping project and applicable research initiatives such as creation of oyster reefs.
IR7	Conduct audit of all weirs and pumps on all stream catchments within the Brunswick Estuary to obtain an accurate assessment of their numbers, locations and impacts	3	1. Obtain Office of Environment and Heritage records on all pumps within the Brunswick Estuary 2. Identify all weirs, pumps and water extractions within the estuary using Office of Environment and Heritage records and previous studies 3. Audit all structures by boat and by foot (as necessary) using a GPS system to record their location 4. Identify those having the greatest impact on catchment flows, fish migration and infiltration 5. Determine potential management actions / options for reducing the impact of existing structures on catchment flows and infiltration. 6. Consult with community on proposed management actions. 7. Undertake improvement / modification works. 8. Monitor flows to assess effectiveness of modified structures - this may be achieved by integrating with existing Brunswick Valley Landcare programs to estimate stream flows in the catchment.	$ 4,500	Byron Shire Council	2011	Not started	Dept. Primary Industries – Fisheries completed an audit of waterway assets in 2004/05 which attempted to be exhaustive in the assessment, but was limited by time and access in some cases. Given the small size of the catchment, it is recommended that a comprehensive ground truthing assessment be undertaken. This assessment would involve two people with kayaks going down all the 3rd order and above waterways (as Dept. Primary Industries does not manage 1st and 2nd order streams). This assessment will provide information on crossings in locations that Dept. Primary Industries does not have on database. WaterNSW can provide pump records with this information on a GIS layer that could overlay with fish barriers within the waterway. This would help to know where pumps may be impacted if we draw down the upstream water level. Water NSW can also provide information on licensed weirs in the Brunswick Catchment which would allow identification of where unlicensed weirs may be which are a few in numbers and generally located in the upper catchment.	REMAIN

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
IR8	Quantify the impacts of tourism on the Brunswick Estuary to determine the capacity of the estuary to accept / assimilate the impacts of increased tourism	3	1. Undertake water quality monitoring in line with the revised Council water quality monitoring program detailed in Section 4.1.7 to determine baseline conditions 2. Liaise with DPI - Marine Parks to obtain temporal and spatial information on fish communities 3. Liaise with DPI - Marine Parks and NSW Fisheries to obtain temporal and spatial information on SEPP 14 wetland distribution / extent 4. Review monitoring results against tourism data to determine any correlation with changes in water quality and increased tourist numbers	$ 10,500	Byron Shire Council (with assistance from Marine Parks and Dept. Primary Industries - Fisheries)	2012	Not started	Byron Shire Council does not currently have an active water quality program in the Brunswick Estuary. Sampling was ceased with construction of the new STP at Vallances Road, Mullumbimby. Water quality in the estuary has no doubt improved significantly due to the reduction in STP wastewater nutrient loads, however, the current state of the quality of water is unknown as there has been no sampling undertaken in recent years. NSW has its own monitoring, evaluation and reporting of the condition of and pressures on natural resources implemented by Office of Environment and Heritage. The department undertakes sampling at certain locations on a regular basis, similar to the SE Queensland Ecosystem Health Monitoring Project (called the Ecohealth Project). Development and implementation of a long-term water quality and ecosystem health monitoring program in the Brunswick Estuary would be a fantastic project and is achievable within a realistic budget and time frame. As far as quantifying the impacts of tourism on the estuary, this strategy would be best completed as a research project as an assessment of recreational and commercial activities and impacts of increased usage on the estuary. Outcomes of water quality monitoring, mapping of ecosystem health and any research completed on fish communities may help inform this impact assessment, however, it should be noted it may be hard to determine the overall carrying capacity of the system and attempt to correlate any changes in the estuary with increased tourism. Flooding and stormwater runoff have by far a greater impact on water quality issues in the estuary, than tourism and human usage. It is noted that, this original management action was primarily related to the impact of increased tourism on STP infrastructure. Presently there is concern (Council, Office of Environment and Heritage and Marine Parks) about the increase in commercial business activity such as kayak tours and/or Stand Up Paddle Board operators. There has been other research projects completed on the estuary, however, not specifically related to the impacts of tourism (to the best of our knowledge). In order to properly assess or consider the present and future impacts of commercial activities and increase visitors using the area, the ecological and social carrying capacity of the Brunswick Estuary system needs to be investigated. It is proposed that new management strategy be developed to understand the ecological and social carrying capacity of the Brunswick Estuary to help understand the impact of increase tourism and develop a policy / guidance document to be used by Public Agencies when assessing Commercial Activity Licences. This policy should aim to create a Memorandum of Understanding between Council, Marine Parks and Crown Lands to guide decision making and prevent unsustainable	REMAIN and AMEND into new Strategies
IR9	Verify the reported reduction in fish stocks	3	1. Undertake survey of fish abundance within the Brunswick River 2. Collate information and report on fish abundance 3. Undertake survey of fish abundance in 3 – 5 years to determine any changes in species or distribution 4. Undertake management actions as necessary to control recreational fishing	$ 15,000	Dept. Primary Industries (with assistance from DPI - Marine Parks)	2012	Not started	Marine Parks and Dept. Primary Industries - Fisheries are not aware of any significant reduction in fish stocks in the Brunswick River. Comments from Dept. Primary Industries -Fisheries note that this action will be difficult to complete due to the below: • Baseline data collection would need to start now as there is a lack of existing data to indicate present fish stocks • Sampling required every few months to account for seasonal variation, with sampling sites distributed across the catchment • Sampling would include presence/absence of fish stocks rather than population assessment and would need to be completed every few years • Large budget /considerable funding required • Difficult to implement further management actions regarding recreational fishing restrictions due to north and south arm of estuary already being a Marine Park • Unless fish stocks plummeted to dangerously low levels, further restrictions would probably not be endorsed Monitoring of fish stocks should occur but be undertaken in a professional manner. Dept. Primary Industries – Fisheries is moving away from monitoring and wants to focus more on research questions, leaving monitoring more for universities and private entities. A grant with a University would likely be the best option, tied to a research question such as "if we do X habitat improvement works, what will be the impacts on fish species diversity and abundance". Based on the outcomes of the audit and comments from Dept. Primary Industries and Marine Parks, this strategy can remain as an initiative for a University research project in the future or should considerable funding become available. It should be noted that Marine Parks would support the undertaking of research projects to better understand the distribution and abundance of fisheries resources in the Brunswick River and its tributaries. An increase in fishing (recreational) pressure has been observed with a further increase likely with any upgrade of local boat launching facilities. Monitoring of mud crabs in marine park sanctuary zones (SZs) has indicated that crabs in SZ are significantly larger and more abundant than mud crabs in fished areas.	REMAIN
	MONITORING								
M1	Continue and expand Council's monthly water quality monitoring program pending completion of a review of the program under consideration of the 'South east Queensland Ecosystem Health Monitoring Program' and toward developing a Brunswick Estuary Water Quality Model	1	1. Undertake sampling at existing sites 2. Add an additional sampling site and install monitoring device upstream of proposed Brunswick Heads-Mullumbimby STP discharge point 3. Undertake sampling and testing in accordance with the monitoring program.	$ 5,000	Byron Shire Council	2009	Not started	Refer to comments on IR6.	REMAIN and COMBINE IR6, M1, M2, M3, E3 and E6 into two new strategies.

TABLE B3 - RESULTS OF THE AUDIT

ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
M2	Upgrade Council's water quality monitoring program to include sediment core sampling for Enterococci and for heavy metals pending completion of a review of the program toward development of a Brunswick Estuary Water Quality Model	2	1. Upgrade Council's monitoring program to include; - bi-monthly monitoring of Enterococci in sediments in the upper estuary - Annual sediment core sampling at the marina, the former Brunswick Heads Tip site and the Mill Street Industrial Area	$7,500 (annual)	Byron Shire Council	2010	Not started	Refer to comments on IR6.	REMAIN and COMBINE IR6, M1, M2, M3, E3 and E6 into two new strategies.
M3	Undertake long-term (at least one year) flow-weighted sampling for nutrients and Enterococci in all freshwater tributaries of the Brunswick River pending completion of a review of Councils water quality monitoring program under consideration of the 'South east Queensland Ecosystem Health Monitoring Program' and toward development of a Brunswick Estuary Water Quality Model	3	1. Install auto samplers on each creek system 2. Undertake sampling during 5 dry weather and 5 wet weather flow events	$ 200,000	Byron Shire Council	2011	Not started	Refer to comments on IR6.	REMAIN and COMBINE IR6, M1, M2, M3, E3 and E6 into two new strategies.
	EDUCATION AND PUBLIC RELATIONS								
E1	Educate Council planners on the impacts of planning decisions on estuary processes & water quality	1	1. Develop a council staff education program that outlines the importance of estuary processes and the potentially adverse impacts of development (i.e.: untreated and uncontrolled stormwater runoff, clearing of vegetation, sedimentation etc.) 2. Undertake two one day workshops with Council planning staff	$ 1,000	Byron Shire Council	2009	Not started	This strategy is deemed to still be important and valid in its format to educate Council planners and external consultants on the importance of estuary processes and the potential negative impacts development/s in close proximity to the estuary may have on the waterway and surrounding riparian vegetation.	REMAIN
E2	Prepare and undertake a targeted education program for rural property owners to make them aware of best practice catchment management	1	1. Post "expression of interest" brochures / letters to all rural property owners to identify interested parties, availability and topics for discussion 2. Make follow-up phone calls to potential participants 3. Publish a media article inviting all rural property owners to workshops 4. Undertake workshops for rural property owners at local community hall 5. Distribute industry-specific education brochures to all landholders	$ 8,000	Byron Shire Council (with assistance from Office of Environment and Heritage and Brunswick Valley Landcare)	2010	Underway	Byron Shire Council and Brunswick Valley Landcare are actively involved in community education activities such as workshops, community events and vegetation planting days. Importantly most landowners along riparian zones are aware of the importance of riparian vegetation, but lack the funds or extension support to get the correct works happening on the ground. There is a great need to allocate funds to on-ground works and demonstration sites, and more support for on-ground work is vital (refer to Strategy C1), with sufficient funds allocated for follow-up maintenance work.	REMAIN
E3	Publish adopted Brunswick Ultimate Standard target values for water quality parameters for the estuary	1	1. Prepare media release advising community of the adopted Brunswick Ultimate Standards (BUS) 2. Report on water quality performance against the BUS in regular 4 yearly report cards and the Byron Shire Council State of the Environment Report	$ 500	Byron Shire Council	2009	Not started	Refer to comments on IR6.	REMAIN and COMBINE IR6, M1, M2, M3, E3 and E6 into two new strategies.
E4	Develop a community education program that outlines the importance of estuary processes and the impacts of human activities on estuary processes	1	1. Develop a community education program that outlines the importance of estuary processes and the potentially adverse impacts of human activities (i.e.: untreated and uncontrolled stormwater runoff, clearing of vegetation) 2. Develop and distribute a global brochure aimed at the whole community describing issues facing the estuary. 3. Develop and distribute targeted brochures to selected community groups and estuary users (e.g. residents, tourists, recreational fishers) outlining potentially adverse impacts. 4. Organise media coverage of on-the-ground works as they are carried out and achievements in the implementation of this Plan.	$ 10,000	Byron Shire Council	2010	Not started	Due to the transient nature of the population in the Shire and the increasing numbers of local and international tourists (day trippers and long-term holiday makers) it is vital to continue education programs on the importance of estuary processes. There is a significant increase in people using the estuary, with increasing numbers of businesses such as passive "eco kayaks tours", how have the ability to impact on seagrass and salt marsh areas. The issue of vessel speed and impact of boat wake on eroding banks is on-going and education of the local community is essential. It is imperative that social media and the Council website material are updated regularly providing advice and information on such issues. Presently there is the recurring issue of illegal camping adjacent the Brunswick estuary (and other areas of the Shire) which needs to be addressed.	REMAIN
E5	Raise awareness of the importance of riparian vegetation and riparian zones by providing fact sheets and conducting field days for riparian landholders at Council demonstration sites	2	1. Publish media article advising of completion of works at Council demonstration sites and advise of field days 2. Send invitations to all rural property owners to field days at demonstration sites 3. Undertake field days, taking the opportunity to distribute Land and Water Australia educational brochures by hand 4. Develop and distribute brochure to community that highlights the impact of stormwater pollution and vegetation clearing on estuary processes	$ 5,000	Byron Shire Council (with assistance from Office of Environment and Heritage and Brunswick Valley Landcare)	2010	Underway	Byron Shire Council and Brunswick Valley Landcare are actively involved in environmental weed education and community education activities such as workshops, community events and planting days promoting the restoration/revegetation of riparian vegetation. However, these are considered band aid solutions only as they produce minimal on-ground outcomes. A more active encouragement of physical works that are known to be successful in weed eradication and riparian revegetation is required (refer to Strategy E2). Due to the transient nature of the population in the Shire it is considered that community education resources and community education activities are vital and the on-going support (telephone, face to face, workshops etc.) for existing and new residents to Shire is essential.	REMAIN

TABLE B3 - RESULTS OF THE AUDIT									
ITEM	RECOMMENDED STRATEGY	PRIORITY RANKING	SUB-TASKS	ESTIMATED COST	SUGGESTED RESPONSIBILITY	PROJECTED START DATE	STATUS	AUDIT COMMENTS	AUDIT OUTCOMES
E6	Develop a 4 yearly environmental report card on all monitoring activities and the health of the estuary under consideration of the 'South east Queensland Ecosystem Health Monitoring Program' report cards.	2	1. Develop report card layout / structure 2. On a 4 yearly basis, compile all estuary water quality data from Byron Shire Council's water quality monitoring program, Marine Parks Authority monitoring and Waterwatch monitoring 3. Assess water quality monitoring data against BUS target values 4. Prepare report card detailing all water quality monitoring activities, including comparisons against BUS values 5. Prepare report card detailing all monitoring activities relating to ecological processes 6. Publish report card in local media	$ 12,000	Byron Shire Council (with assistance from Office of Environment and Heritage)	2010	Not started	Refer to comments on IR6.	REMAIN and COMBINE IR6, M1, M2, M3, E3 and E6 into two new strategies.

TABLE B4 - SITE SURVEY RESULTS

LOCATION	SITE ID	RIPARIAN BANK VEGETATION	BANK EROSION AND STABILITY	SITE COMMENTS	OVERALL REMARK	RECOMMENDED MANAGEMENT RESPONSE	MANAGEMENT ACTION PRIORITY AND JUSTIFICATION	INCLUDE IN IMPLEMENTATION SCHEDULE
BRUNSWICK RIVER	BR01	Poor	3	Moderate bank undercutting, slumping and erosion. Riparian zone well vegetated (width 5-10m) but weed dominated. No public assets or infrastructure at risk, and hard to access area. However, if Camphor laurel gives way, then could drag a lot of the bank in with it. It is not currently considered justifiable to install any bank stabilisation works at this site.	Moderate bank undercutting and erosion. Riparian zone well vegetated (width 5-10m) but weed dominated.	Increase riparian vegetation buffer. Monitor erosion at site.	Priority 3 - Riparian zone is vegetated. Erosion only moderate.	Yes - Combine BR01 and BR05 into one On-ground Works Management Strategy (B16)
BRUNSWICK RIVER	BR02*	Poor	2	Severe but very localised erosion and very narrow riparian zone dominated by weeds including Camphor laurel. It is not currently considered justifiable to install any bank stabilisation works at this site.	Major bank undercutting and erosion. Riparian zone sparsely vegetated but narrow (width 0-5m). Weed dominated.	Monitor erosion at site.	Priority 1 - Major bank erosion but very localised. Poor riparian vegetation. Low priority for works but high priority to monitor erosion	Yes - Combine sites BR02, BR13, BR14, BR15 and BR16 into one Strategy to Monitor erosion (B10)
BRUNSWICK RIVER	BR03	Poor	2	Boundary of Public assets (Swimming Pool and Bowling Club) at risk. Bank only stabilised by weeds which could give way in high flow event. No established native vegetation and eroding bank very close to assets.	Moderate bank undercutting and erosion. Riparian zone sparsely vegetated but narrow (width ~0-5m). Weed dominated. Infrastructure at risk.	River bank stabilisation works (structural works and revegetation).	Priority 1 - Significant community assets at risk in the event of increased erosion at this site.	Yes - On-ground Works Management Strategy (B7))
BRUNSWICK RIVER	BR04	Fair	3	Moderate bank undercutting and erosion. It is not currently considered justifiable to install any bank stabilisation works at this site.	Moderate bank undercutting and erosion. Riparian zone well vegetated but narrow (width 0-5m) with a mix of natives and weeds.	Increase riparian vegetation buffer. Monitor erosion at site.	Priority 2 - Easy access site. Only moderate bank erosion and fair riparian vegetation.	Yes - Combine BR04 and BR06 into one On-ground Works Management Strategy (B13)
BRUNSWICK RIVER	BR05*	Fair	3	Very high (~10m) and steep bank. Evidence of bank erosion and slumping. It is not currently considered justifiable to install any bank stabilisation works at this site.	Moderate localised bank erosion of a high steep bank. Riparian zone well vegetated but narrow (0-5m).	Increase riparian vegetation buffer. Monitor erosion at site.	Priority 3 - Moderate bank erosion and fair riparian vegetation. Difficult site to stabilise on outside bend.	Yes - Combine BR01 and BR05 into Management Strategy (B16)
BRUNSWICK RIVER	BR06*	Poor	3	Moderate bank erosion and undercutting along a large section of river bank (approx. 400 m) extending to 100m downstream of the Train Line. Narrow riparian zone adjacent cow paddocks. Ad hoc rock revetment recently installed. It is not currently considered justifiable to install any bank stabilisation works at this site.	Moderate bank erosion and undercutting. Riparian zone sparsely vegetated and narrow (width 0-5m). Weed dominated.	Increase riparian vegetation buffer. Monitor erosion at site.	Priority 2 - Moderate bank erosion and poor riparian vegetation.	Yes - Combine BR04 and BR06 into one On-ground Works Management Strategy (B12) Illegal Rock Armouring Management Strategy (R2).
BRUNSWICK RIVER	BR07*	Poor	2	Management of this site is still unresolved and the issue remains. Large stretch of bank erosion on inside bend. Site has a good intertidal bench for construction of rock/ large woody debris (LWD) fillets or rock revetment.	Moderate bank undercutting and erosion. Riparian zone sparsely vegetated and narrow (width ~0-5m). Weed dominated.	Revegetate, rock/LWD fillets or rock revetment.	Priority 2 - Moderate bank erosion, not major.	Yes -On-ground Works Management Strategy (B13))
BRUNSWICK RIVER	BR08*	Poor	1	Management of this site is still unresolved and the issue remains. Major bank erosions. Site has a good intertidal bench for construction of rock and large woody debris (LWD) fillets or rock revetment.	Major bank undercutting and erosion. Riparian zone sparsely vegetated and narrow (width ~0-5m). Cattle observed atop riverbank.	Revegetate, cattle fencing, rock/LWD fillets or rock revetment.	Priority 1 - Major bank erosion. Site easily accessed. Good bench for stabilisation works.	Yes - On-ground Works Management Strategy (B8)
BRUNSWICK RIVER	BR09*	Poor	4 (due to ad-hoc armouring)	A Site Action Plan was developed for this site (Mullumbimby Rugby League Football Club) in 2011 which addresses the key concerns for the site and actions to be implemented. The SAP recommends the replacement of the concrete and brick armouring with geofabric and rocks, as suggested in the previous CZMP. Management of this site is still unresolved due to the high cost and the issue remains.	Minor bank erosion. Riparian zone sparsely vegetated and narrow (width ~0-5m). Ad-hoc concrete rubble armouring.	River bank stabilisation works and restore riparian vegetation buffer.	Priority 1 - Bank erosion is mostly stabilised by ad-hoc works. Amenity and uncertain legality of the works is an issue.	Refer to Illegal Rock Armouring Management Strategy (R2).
BRUNSWICK RIVER	BR10*	Good	1	Bank stabilisation works were completed at this site (adjacent the Brunswick Valley, Vallances Rd Sewage Treatment Plant), however, the previous rock protection works have failed and slumped into the river. Management of this site is considered to be high priority for action due to the extensive and continuous erosion of the river bank.	Major bank undercutting and erosion on outside bend. Riparian zone well vegetated and wide (width >10m).	Re-do river bank stabilisation works.	Priority 1 - Major and extensive bank erosion of Council owned land. Repair of failed works considered a high priority.	Yes -On-ground Works Management Strategy (B9)
BRUNSWICK RIVER	BR11*	Poor (adjacent ad-hoc revetment). Excellent (downstream)	2	Management of this site is still unresolved and the issue remains. Low priority as well vegetated. While the downstream section of the site is moderately eroding it is backed by an extensive and mature native vegetation community. It is not currently considered justifiable to install any bank stabilisation works at this site.	Moderate to major bank undercutting and erosion. Riparian zone sparsely vegetated adjacent ad-hoc protection works (width 0-5m). Riparian zone well vegetated downstream ad-hoc works (width >10m).	Investigate ad hoc rock protection works for removal.	Priority 1 - Amenity and uncertain legality of the works is an issue.	Refer to Illegal Rock Armouring Management Strategy (R2).
BRUNSWICK RIVER	BR12	Poor	5 (due to rock/concrete armouring)	Ad-hoc potentially unapproved concrete bank stabilisation works have been in-situ for some time. Approved bank stabilisation works were also installed by landowner during 2013. Significant bank erosion is currently not occurring.	Minor bank erosion. Riparian zone sparsely vegetated and narrow (width 0-5m). Rock and rubble bank stabilisation works in place.	Investigate ad hoc rock protection works for removal. Increase riparian vegetation buffer.	Priority 1 - Uncertain legality of the works is an issue. Bank stabilisation works low priority.	Refer to Illegal Rock Armouring Management Strategy (R2).
BRUNSWICK RIVER	BR13*	Excellent	2	Management of this site is still unresolved and the issue remains. This is a deep channel area. The riparian vegetation is undisturbed, however, channel meander is active resulting in bank erosion and collapse. It is not currently considered justifiable to install any bank stabilisation works at this site	Moderate bank undercutting and erosion. Riparian zone well vegetated (width >10m).	Monitor erosion at site.	Priority 1 - Excellent riparian vegetation. Moderate bank erosion. Site access is very constrained from landward. Deep channel adjacent this site. Low priority for works but high priority to monitor erosion	Yes - Combine sites BR02, BR13, BR14, BR15 and BR16 into one Strategy to Monitor erosion (B10)
BRUNSWICK RIVER	BR14*	Excellent	4	Low banks and only minor undercutting. Not considered a priority as good native vegetation present and no risk to infrastructure or assets.	Minor bank erosion and undercutting. Riparian zone well vegetated and wide (width >10m).	Monitor erosion at site.	Priority 1 - Active erosion no longer evident. Low priority for works but high priority to monitor erosion	Yes - Combine sites BR02, BR13, BR14, BR15 and BR16 into one Strategy to Monitor erosion (B10)

TABLE B4 - SITE SURVEY RESULTS

LOCATION	SITE ID	RIPARIAN BANK VEGETATION	BANK EROSION AND STABILITY	SITE COMMENTS	OVERALL REMARK	RECOMMENDED MANAGEMENT RESPONSE	MANAGEMENT ACTION PRIORITY AND JUSTIFICATION	INCLUDE IN IMPLEMENTATION SCHEDULE
BRUNSWICK RIVER	BR15*	Good	3	Management of this site is still unresolved. However, the presence of instream large woody debris has stabilised the river bank. No active erosion is evident. The riparian zone adjacent the cleared paddock has only a narrow vegetation strip, otherwise the riparian vegetation is Good.	Minor bank erosion and undercutting. Riparian zone mostly well vegetated and wide (width >10m).	Monitor erosion at site.	Priority 1 - Bank erosion not currently an issue. Low priority for works but high priority to monitor erosion	Yes - Combine sites BR02, BR13, BR14, BR15 and BR16 into one Strategy to Monitor erosion (B10)
BRUNSWICK RIVER	BR16*	Excellent	4	Erosion and undercutting at this site is no longer an issue as the mature trees have fallen in the water and stabilised the river bank. Mangroves and seagrass have recruited to the area further stabilising the bank erosion.	Minor bank erosion and undercutting. Riparian zone well vegetated and wide (width >10m).	Monitor erosion at site.	Priority 1 - Bank erosion not currently an issue. Low priority for works but high priority to monitor erosion	Yes - Combine sites BR02, BR13, BR14, BR15 and BR16 into one Strategy to Monitor erosion (B10)
BRUNSWICK RIVER	BR17	Fair	3	Ad hoc bank protection works present. Area subject to high use by the public as an illegal camping area. Rubbish is dumped/left behind. Native vegetation has been cleared or trampled.	Minor bank erosion. Vehicle access, camping, trampling and clearing of riparian vegetation is creating impacts to riparian health.	Compliance enforcement of illegal camping. Riparian rehabilitation and increase riparian vegetation buffer.	Priority 1 - Illegal camping, rubbish dumping, and vegetation destruction. Uncontrolled access to riverbank impacting riparian zone.	Yes - On-ground Works Management Strategy (B1) and refer to Illegal Camping Management Strategy (R3) and Illegal Rock Armouring Management Strategy (R2).
BRUNSWICK RIVER	BR18	Fair	3	Failing rock wall creating public access and safety risk. If left unchecked, rock wall may unravel further leading to larger erosion scallop.	Moderate bank erosion and failing of rock revetment. Riparian zone well vegetated (width 5-10m).	Repair rock revetment wall	Priority 2 - Elevated public safety risk.	Yes - On-ground Works Management Strategy (B14)
MARSHALLS CREEK	MA01	Poor	4	Various instances of riparian vegetation clearing, various revetment works installed and in-stream water access structures. Floating pontoons and concrete formwork present at most properties.	Mostly cleared riparian zone, instream structures and landscaping works within riparian zone (0-5m).	Educate landholders on best practice riparian management (BSC). Continue to maintain foreshore video catalogue and patrol (DPI - Fisheries). Investigate illegal rock armouring and (potential) un-approved development and vegetation clearing.	Priority 1 - Continue ongoing foreshore catalogue and patrols. High priority to continue monitoring for effective management.	Yes - Refer Education Management Strategy (E3) and Illegal Rock Armouring Management Strategy (R2). Create new Investigation and Enforcement of Un-approved Development and Vegetation Clearing Management Strategy (R4)
MARSHALLS CREEK	MA02	Fair	3	Very narrow riparian vegetation buffer due to proximity to golf course. Steep but stable river bank (approx. 400 m stretch inclusive of MA03).	Minor bank erosion. Riparian zone sparsely vegetated and narrow (width 0-5m).	Increase riparian vegetation width.	Priority 2 - Only minor bank erosion. Site easily accessed.	Yes - Combine MA02 and MA03 into one On-ground Works Management Strategy (B15)
MARSHALLS CREEK	MA03	Poor	4	Very narrow riparian vegetation buffer due to proximity to golf course. Low and stable river bank (approx. 400 m stretch inclusive of MA02).	Minor bank erosion. Riparian zone sparsely vegetated and narrow (width 0-5m).	Increase riparian vegetation width.	Priority 2 - Only minor bank erosion. Site easily accessed.	Yes - Combine MA02 and MA03 into one On-ground Works Management Strategy (B15)
MARSHALLS CREEK	MA04	Poor	3	Active erosion and significant undercutting of river bank with public road at risk. Significant public access issues and zero riparian buffer in areas. Area at risk of tidal inundation hazard and bank erosion hazard to public assets. Large precinct in need of works and development of Master Plan for the area is recommended.	Moderate bank erosion due to hydrodynamic processes and public access. Riparian zone sparsely vegetated and narrow (width 0-5m).	Develop precinct plan. Formalise public access and carpark area. River bank stabilisation works and restore riparian vegetation buffer.	Priority 1 - Assets and infrastructure potentially at risk. Ad-hoc public access impacting riparian zone.	Yes - On-ground Works Management Strategy (B4)
MARSHALLS CREEK	MA05	Poor	3	Road immediately adjacent bank protection works. Some small areas of bank stabilisation works have collapsed and need to be repaired. Rock work needs to go to the top of the bank to stabilise road base. Limited area to plant out wider riparian buffer due to adjacent road.	Failing bank stabilisation works. Road infrastructure at risk if left unchecked. Riparian zone sparsely vegetated and narrow (width 0-5m).	Repair river bank stabilisation works.	Priority 1 - Infrastructure at risk.	Yes - On-ground Works Management Strategy (B5)
MARSHALLS CREEK	MA06	Poor	4	Privately owned lots with ad hoc revetment works and encroachment of private structures into riparian zone and waterway.	Encroachment of landscaping and built structures into intertidal zone. Impacts to riparian vegetation and limited vegetation zone (0-5m).	Educate landholders on best practice riparian management (BSC). Continue to maintain foreshore video catalogue and patrol (DPI - Fisheries). Investigate illegal rock armouring and (potential) un-approved development and vegetation clearing.	Priority 1 - Continue ongoing foreshore catalogue and patrols. High priority to continue monitoring for effective management.	Yes - Refer Education Management Strategy (E3) and Illegal Rock Armouring Management Strategy (R2). Create new Investigation and Enforcement of Built Structures and Vegetation Clearing Management Strategy (R4)
MARSHALLS CREEK	MA07	Poor	3	Rock revetment wall failing along approx. 50 m stretch of road asset. Road close to estuary bank. Road at risk if repairs not undertaken. Limited area to plant out wider riparian buffer due to adjacent road.	Failing bank stabilisation works. Road infrastructure at risk if left unchecked. Riparian zone sparsely vegetated and narrow (width 0-5m).	Repair failing rock revetment wall.	Priority 1 - Infrastructure at risk.	Yes - On-ground Works Management Strategy (B6)
SIMPSONS CREEK	SI01	Fair	3	Ad hoc rock armouring along river bank. Riparian zone sparsely vegetated and narrow (width 0-5m).	Encroachment of built structures into riparian zone. Impacts to riparian vegetation.	Educate landholders on best practice riparian management (BSC). Continue to maintain foreshore video catalogue and patrol (DPI - Fisheries). Investigate illegal rock armouring and (potential) un-approved development and vegetation clearing.	Priority 1 - Continue ongoing foreshore catalogue and patrols. Continue monitoring for effective management.	Yes - Refer Education Management Strategy (E3) and Illegal Rock Armouring Management Strategy (R2). Create new Investigation and Enforcement of Built Structures and Vegetation Clearing Management Strategy (R4)
SIMPSONS CREEK	SI02	Good	2	Informal public access point in the Nature Reserve used for watercraft access between estuary and beach. Access creating significant localised erosion.	Moderate localised bank erosion of a high steep bank due to public access. Riparian zone well vegetated (width >10m).	N/A – Do not want to acknowledge this area as a formal entrance to Simpsons Creek. With less usage, area will hopefully rehabilitate over time.	No action	N/A

TABLE B4 - SITE SURVEY RESULTS

LOCATION	SITE ID	RIPARIAN BANK VEGETATION	BANK EROSION AND STABILITY	SITE COMMENTS	OVERALL REMARK	RECOMMENDED MANAGEMENT RESPONSE	MANAGEMENT ACTION PRIORITY AND JUSTIFICATION	INCLUDE IN IMPLEMENTATION SCHEDULE
SIMPSONS CREEK	SI03	Very poor	4	Riparian vegetation has been damaged by camping, human use and vehicle access. River bank is stable at present, therefore, trampling of vegetation and rubbish is primary issue of site. Riparian zone sparsely vegetated and narrow (width 0-5m).	Bank erosion not evident. Vehicle access, camping, trampling and clearing of riparian vegetation is creating impacts to riparian health.	Compliance enforcement of illegal camping. Riparian rehabilitation and increase riparian vegetation buffer.	Priority 1 - Illegal camping, rubbish dumping, and vegetation destruction. Uncontrolled access to riverbank impacting riparian zone.	Yes - On-ground Works Management Strategy (B1) and refer to Illegal Camping Management Strategy (R3)
SIMPSONS CREEK	SI04*	Good	2	Illegal camping evident, camping structures in vegetation and stairs installed down river bank. Active erosion occurring with major slumping of the river bank. Area is private property.	Major bank erosion and slumping. Riparian vegetation good with natives but sparse due to public trampling (width 0-5m).	Compliance enforcement of illegal camping. Riparian rehabilitation and increase riparian vegetation buffer.	Priority 1 - Active erosion occurring and uncontrolled access to riverbank impacting riparian zone. Illegal camping, rubbish dumping, and vegetation destruction.	Yes - On-ground Works Management Strategy (B1) and refer to Illegal Camping Management Strategy (R3)
SIMPSONS CREEK	SI05	Good	3	Public access induced erosion of steep bank due causing localised erosion and undercutting of riverbank. High public usage due to rope swing in tall Eucalypt. Continued erosion and undercutting could threaten the large Eucalypt tree stabilising the riverbank.	Moderate localised erosion and undercutting of bank. Riparian vegetation good with natives but sparse due to public access (width 5-10m).	Develop precinct plan. Formalise public access and carpark area. River bank stabilisation works and restore riparian vegetation buffer.	Priority 1 - Active erosion occurring and uncontrolled access to riverbank impacting riparian zone.	Yes - On-ground Works Management Strategy (B2)
SIMPSONS CREEK	SI06*	Good	3	Management of this site is still unresolved. Ad-hoc public access induced erosion of steep bank and freshwater seepage through coffee rock causing localised erosion and significant undercutting of the river bank. Site is adjacent the main road and cars use off-road area to park for access to the creek. Midden present and being impacted. Sparse riparian vegetation due to trampling by public. Mangroves present upstream and downstream of the area and a few mangroves trying to establish in footprint area.	Moderate localised erosion and significant undercutting of bank. Riparian vegetation good with natives but sparse due to public trampling (width 0-5m).	Develop precinct plan. Formalise public access and carpark area. River bank stabilisation works and restore riparian vegetation buffer.	Priority 1 - Active erosion occurring and uncontrolled access to riverbank impacting riparian zone.	Yes - On-ground Works Management Strategy (B2)
SIMPSONS CREEK	SI07	Fair	3	Public foreshore access issue due to high usage. Retaining wall and stairs works have already been completed. Riparian vegetation has been damaged by public usage. River bank is stable at present.	Bank erosion not evident. High public usage and trampling of riparian vegetation is creating impacts to riparian health.	Formalise public access and restore riparian vegetation buffer.	Priority 2- High public usage and trampling of riparian vegetation is creating impacts to riparian health.	Yes - On-ground Works Management Strategy (B11)
SIMPSONS CREEK	SI08	Fair	3	Failing rock wall creating public access and safety risk. If left unchecked, rock wall may unravel further leading to larger bank erosion.	Failing rock wall and public safety risk.	Repair failing rock revetment wall.	Priority 1 - public safety risk	Yes - On-ground Works Management Strategy (B3)
SIMPSONS CREEK	SI09*	Fair	3	Failing rock wall to the north of the Pirate Ship along the Simpsons Creek entrance training wall. This area is a heavily used public pathway to the mouth of Simpsons Creek and presents a public safety risk and amenity issue. If left unchecked, rock wall may unravel further leading to larger bank erosion.	Failing rock wall and public safety risk.	Repair failing rock revetment wall.	Priority 1 - public safety risk	Yes - On-ground Works Management Strategy (B3)

*Existing site or management strategy in the CZMP for the Brunswick Estuary (Issue No. 4, August 2012)

153°32'0"E
153°32'30"E
153°33'0"E
28°32'0"S
28°32'30"S

MA01
MA02
MA04
MA03
MA05
MA06
MA07
BR16
BR17
BR18
SI09
SI08
BR15
SI07
BR06
BR05
BR07
BR10
BR09
BR08
BR13
BR11
BR14
SI06
SI05
BR04
BR01
BR02
BR12
BR03
SI04
SI03
SI02
SI01

Legend

- Erosion Sites
- Public access points
- Illegal camping
- Rock armouring sites

0 42,000 84,000 Metres

1:35,000 @A1 size

Site Survey of the Brunswick Estuary

Date: 13/04/2017

APPENDIX C – ENVIRONMENTAL LAND USE AND LEGISLATION

Environmental and Land Use Legislation

A summary of the environmental and land-use legislation applicable within NSW is provided in Table C1**.** These pieces of legislation grant certain powers to local government. However, they also act to either, limit the powers which may be exercised by local government under the *Environmental Planning and Assessment Act 1979*, or to impose additional requirements such as the referral of certain applications to State agencies.

The large number of potentially relevant Acts clearly indicates that the amount of regulation is extensive. On this basis, attempts to enforce Total Catchment Management (TCM) principles and objectives by using the range of legislation can prove a difficult proposition. As a consequence, mechanisms for implementation of TCM based on community participation and partnerships between local government and landowners are likely to achieve more rapid results than the enforcement of current legislation.

Table C1 – Summary of Legislation

Legislation	Jurisdiction	Organisation
Coastal Protection Act 1979	State	Office of Environment and Heritage
Crown Lands Act 1989	State	Department of Industry - Lands
Environmental Planning and Assessment Act 1979	State	Department of Planning and Environment
Protection of the Environment Operations Act 1997	State	Environment Protection Authority
Fisheries Management Act 1994	State	Department of Primary Industries - Fisheries
Local Government Act 1993	Local government	Office of Local Government
Local Government Amendment (Ecologically Sustainable Development) Act 1997	Local government	Office of Local Government
Marine Parks Act 1997	State	Department of Primary Industries - Marine Parks Authority
National Parks and Wildlife Act 1974	State	Office of Environment and Heritage
Native Vegetation Act 2003	State	Office of Environment and Heritage
Roads Act 1993	State	Roads and Maritime Service
Rural Fires Act 1997	State	Rural Fire Service
Soil Conservation Act 1938	State	Office of Environment and Heritage
Threatened Species Conservation Act 1995	State	Office of Environment and Heritage

Legislation	Jurisdiction	Organisation
Water Management Act 2000	State	Department of Primary Industries - Water
Water Act 1912	State	Department of Primary Industries - Water

State Environment Planning Policies

There exists a large number of State Environment Planning Policies (SEPPs) relevant to the management of the Brunswick Estuary. The relationship between the CZMP and these policies is covered in depth in the Brunswick Estuary Management Study and Plan (2007). These documents are listed below.

- SEPP 4 - Development without Consent
- SEPP 14 - Coastal Wetlands
- SEPP 26 - Littoral Rainforests
- SEPP 44 - Koala Habitat Protection
- SEPP 62 - Sustainable Aquaculture
- SEPP 71 - Coastal Development
- NSW Wetlands Management Policy 2010
- NSW State Rivers and Estuaries Policy 1992
- Healthy Rivers Commission - Independent Review of the North Coast Rivers: Final Report 2003.

Presently the NSW Government is embarking on a series of reforms to provide a strategic framework for coastal. The coastal reforms will introduce a number of important legislative and policy reforms. Specifically, the package includes a proposed Coastal Management Act and a proposed Coastal Management SEPP which will combine SEPP 14, SEPP 26 and SEPP 71.

Cape Byron Marine Park

Cape Byron Marine Park was declared on 1 November 2002. Part of this declaration was that all tidal waters of Brunswick River and tributaries were to be included in the marine park. Cape Byron Marine Park is a multiple-use park which in practice means that within the park's boundary various levels of protection are applied, depending on the importance of each area. Following an extensive period of public consultation and investigations into the habitats of the declared area, the Marine Parks Amendment (Cape Byron) Regulation 2006 enacted the Zoning Plan which delineated the various zones and the activities suitable in each.

Within the Brunswick Estuary three of the four zones are present: Sanctuary Zones, Habitat Protection Zones and Special Purpose Zones (see Figure C1). As well as the Zoning Plan, a statutory requirement of the declaration of a marine park is that an Operational Plan be established which outlines the management approach to specific activities that could threaten the environmental health of the park.

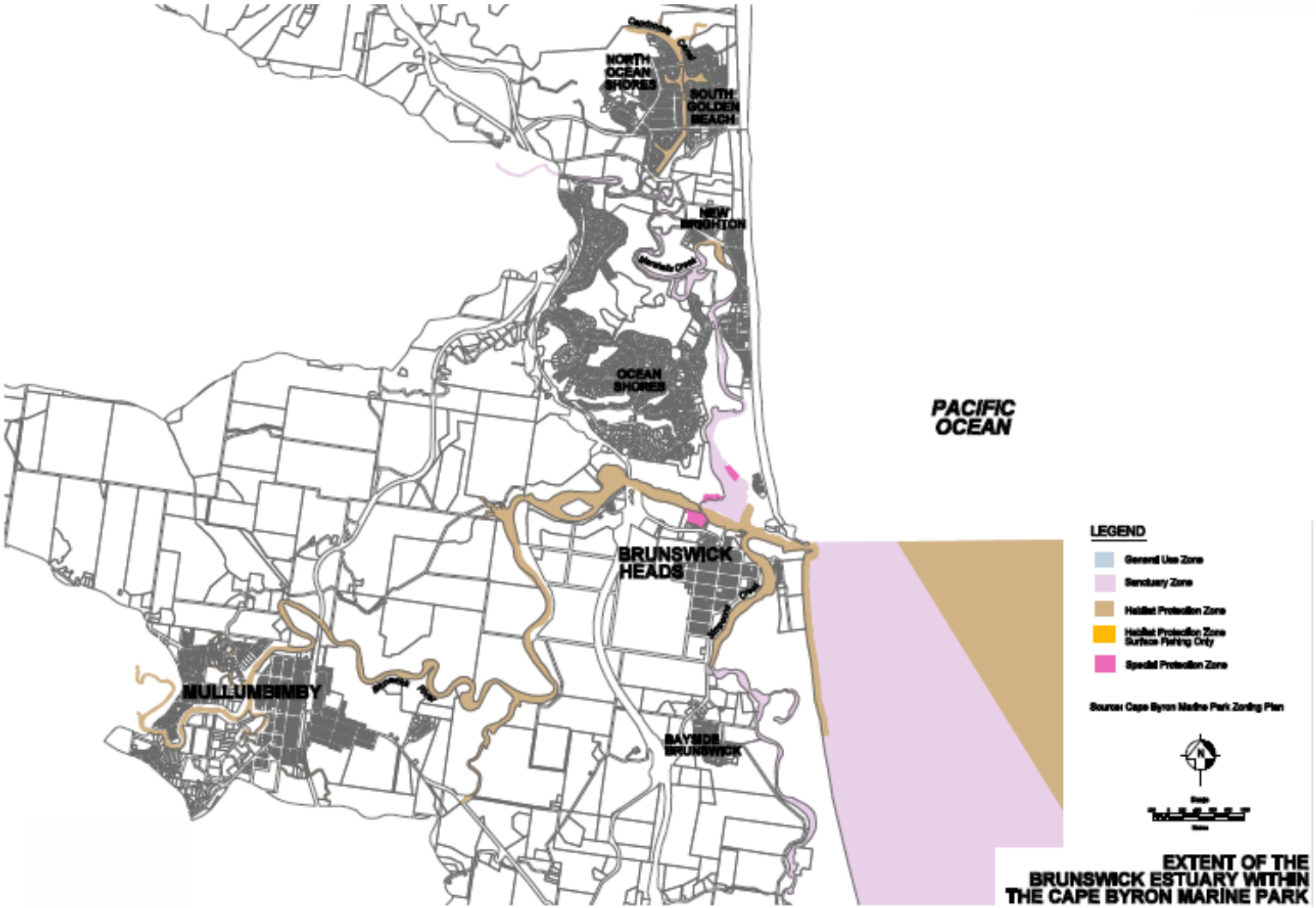


Figure C1 - Extent of the Brunswick Estuary within the Cape Byron Marine Park

APPENDIX D - DETAILED DESCRIPTION OF THE SITE

Location and Setting

As with many estuaries in northern NSW, the Brunswick River has an open entrance with training walls and twin breakwaters. The main landscape components of the estuary are also common to other coastal locations in northern NSW. Nearby examples include the Evans River and the Tweed River.

The Brunswick Estuary comprises three primary arms, namely:

- the main arm, which includes the Brunswick River and Kings Creek, both of which have their headwaters to the west of Mullumbimby and flow east to the ocean at Brunswick Heads
- the north arm, which is known as Marshalls Creek
- the south arm, known as Simpsons Creek.

The ecological value of the estuary is unique. This is because the Lower Brunswick River and Marshalls and Simpsons Creeks all fall within the Cape Byron Marine Park. This makes the waterway significant in both a local and regional sense.

Similarly, the Tyagarah and Brunswick Heads Nature Reserves are important coastal mainland reserves on the far north coast of NSW. Together with the Broken Head Nature Reserve, these three reserves form the Byron Coast Group of Nature Reserves. They are regionally significant as wildlife corridors for north-south migration along the NSW coast (NPWS, 1998).

In addition, there are significant areas of wetland along both Simpsons and Marshalls Creeks, and along the lower Brunswick River (refer Figure D1). As shown in Figure D1, three pockets of littoral rainforest exist to the west of Marshalls Creek. These areas are protected under SEPP legislation, which highlights their significance at both a state and regional level.

Figure D1- Extent of Wetlands and Littoral Rainforest protected under SEPP legislation

The significant physical and biological features of the Brunswick Estuary as measured by the NSW Office of Environment and Heritage are as follows:

- Catchment Area - 228 km^2
- Waterway Area - 2.9 km^2
- Seagrass Area - 0.036 km^2
- Mangrove Area - 1.23 km^2
- Saltmarsh Area - 0.31 km^2

The “Byron Flora and Fauna Study” (LES, 1999) found that the Byron Local Government Area supports amongst the highest number of threatened flora and fauna species in NSW. This high number of threatened species is a reflection of the significance of the region as a “biodiversity hot-spot” and the impact of past land use practices. This significance is compounded by the area’s importance as a tourist centre and place to live. Australian Bureau of Statistics data indicates that at the time of the 2011 Census, the combined population of Mullumbimby, Brunswick Heads, South Golden Beach, New Brighton and Ocean Shores was 9,678. This population and the influx of tourists to the area during holiday periods inevitably place pressure on the natural attributes of the estuary that make it an attractive place near which to live and visit.
The main land uses in the Brunswick catchment are associated with farming and include cattle grazing, pasture growth, horticulture, sugar cane and tea plantations. Almost one third of the catchment is forested and is either managed by the National Parks and Wildlife Service through the Office of Environment and Heritage, or is under private ownership. The main urban centres are Mullumbimby, Brunswick Heads, Ocean Shores (including New Brighton the South Golden Beach) and Billinudgel. Tourism activities are centered around Brunswick Heads.

The main arm of the Brunswick River is approximately 20 kilometres long. The town of Brunswick Heads is located at the entrance to the estuary and Mullumbimby is situated near the tidal limit, about 14 kilometres from the ocean. Marshalls Creek extends north from Brunswick Heads and has a tidal length of about 9 kilometres. The villages of Ocean Shores and New Brighton, and the canal estate of South Golden Beach, are all located along the foreshore of Marshalls Creek. Simpsons Creek extends south from Brunswick Heads to Tyagarah. It has a tidal length of about 11 kilometres and traverses mostly uncleared Crown land that adjoins the coast.

Tidal Prism data for the Brunswick Estuary and its tributaries showing average flow of volumes for the flood and ebb tides is presented in the Table D1.

Table D1 – Tidal Prism Data

Site No.	Site Name	Flood (m3 x 106)	Ebb (m3 x 106)
3	Brunswick River Entrance	2.00	2.08
7	Brunswick River - Upstream Kings Creek	0.49	0.45
9	Marshalls Creek	0.15	0.07
15	Simpsons Creek	0.25	0.15
18	Kings Creek	0.13	0.10

Source: OEH Brunswick River Tidal Data Collection April to November 2007 (MHL, 2008)

Large areas of wetland are located along the estuary shoreline. These wetlands are particularly concentrated to the north and east of Ocean Shores, in the Lower Brunswick River and along much of Simpsons Creek. They form an important component of the estuary and are protected under State Environmental Planning Policy No.14 - Coastal Wetlands (SEPP 14).

History

Aboriginal people have lived on the north coast of NSW for thousands of years. The original inhabitants of the Brunswick Valley are from the Bundjalung Tribe. A significant number of Aboriginal sites and places are known throughout the valley, and especially around Byron Bay and Brunswick Heads where there is remaining evidence of campsites and associated middens or feasting grounds suggesting a population of many hundreds prior to European arrival. These sites and places are of significant cultural value and importance to Bundjalung people.

It is to be noted that a great deal of land originally occupied by these people now lies beneath the sea, submerged following the end of the last Ice Age. Thus, sites which have been investigated by historians date to more recent times, i.e., to after approximately six thousand years ago.

Native Title

A large section of the catchment that adjoins the Brunswick Estuary is the subject of a Native Title Claim by the Arakwal People. The Arakwal People are the traditional owners of this area and have registered a claim on the land with the Native Title Tribunal. The extent of the claim is shown in Figure D2. It covers all of the area south from the Brunswick River and includes the entire catchment of Simpsons Creek and all of the southern floodplain of the Brunswick River.

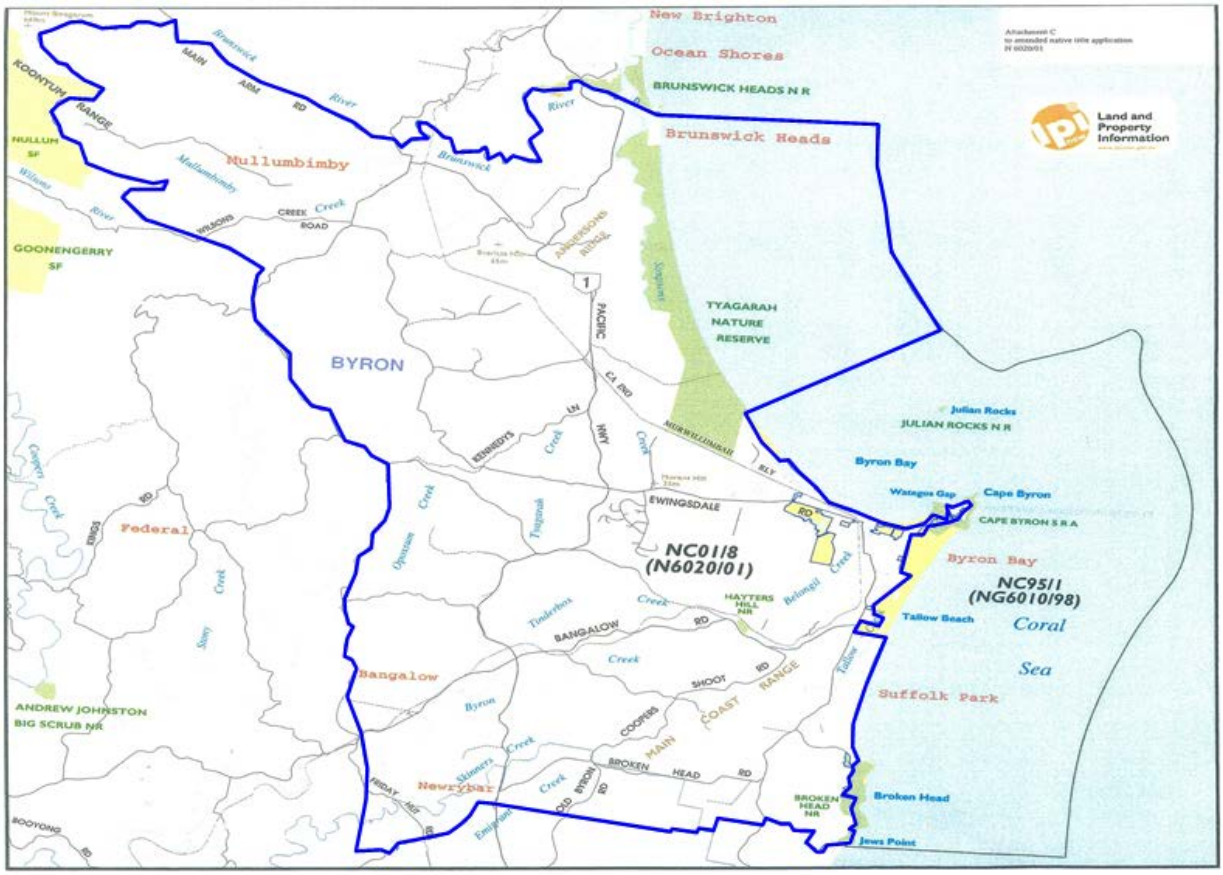


Figure D2 – Extent of Arakwal Native Title Claim within the Brunswick Estuary

The first recorded European settlement of the Brunswick River occurred in 1849. It was at this time that Steve King and the Boyd brothers set up camp and commenced logging for cedar along the banks of the Brunswick River (Mills, undated).

By the early 1850s, Brunswick Heads had become an established seaport for transporting cedar to Sydney. Due to the abundance of timber species in the area that were suitable for boat building and repair, a large boat building industry developed at Brunswick Heads. As the industry grew, a camp site was established near the tidal limit of the Brunswick River. This gradually grew to become a village, and eventually the township of Mullumbimby. Wholesale clearing of lowland forests occurred from the 1870s onwards (Mills, undated).

Brunswick Heads was used as a port until the first Byron Bay jetty was completed in 1888. However, the Brunswick River maintained its importance as a link to other centres as it provided quick access to the sea for small boats that transported supplies to and from neighbouring townships, including Mullumbimby. Following the damage to the second Byron Bay jetty in the 1954 and 1960s' storms, the Byron Bay fishing fleet moved to Brunswick Heads. In the late

1960s, construction of the Brunswick breakwaters marked the start of the Brunswick Heads commercial fishing port.

Dairy farming began in 1881 and thrived in the early 1890s. Other industries to develop included banana and sugar cane plantations. As farming developed in the Brunswick Valley, families began to flock to Brunswick Heads for holidays to enjoy the relaxed coastal lifestyle.

Natural and Cultural Significance

The features which define the natural and cultural significance of an estuary are those which make the estuary important in a local, regional or national sense. Based on work completed in preparing the "Brunswick River Estuary Study" (MHL, 2002), it was possible to develop a provisional list of estuary features that can be considered as being of value to the estuary. A list of features was developed for each of the following categories of estuary attributes:

- Aesthetic attributes
- Ecological attributes
- Social attributes
- Economic attributes.

Proformas were prepared listing the special features for each of the above categories and were distributed to the Brunswick Estuary Management Committee.

The attributes were ranked in order of their local significance and the respondents also highlighted a range of additional attributes that could be considered in the assessment.

Based on the value assessment described above, the essential features of the estuary were determined to be, in order of ranking:

Ecological Attributes	**Aesthetic Attributes**
1. Cape Byron Marine Park **2.** Swamp forest **3.** Riparian vegetation / corridors **4.** Nature Reserves (habitat for terrestrial fauna) **5.** Seagrass beds, mangroves and saltmarsh communities **6.** Threatened terrestrial flora and fauna **7.** SEPP 14 wetlands **8.** Intertidal shoals **9.** Nursery ground for fish **10.** SEPP 26 rainforest **11.** Biodiversity	**1.** Terrestrial flora and fauna **2.** Areas of wide open waterway **3.** Areas of narrow waterway **4.** Scenic amenity / vista / backdrop **5.** Aquatic flora and fauna
Social Attributes	**Economic Attributes**
1. Foreshore access **2.** Aboriginal sites **3.** Swimming / snorkelling **4.** Slipway and boat ramps **5.** Recreational fishing **6.** Recreational use of foreshore areas (caravan parks) **7.** Sites of heritage significance	**1.** Tourism **2.** Commercial oyster industry **3.** Professional fishing **4.** Charter vessels on river and on ocean (fishing and whale watching) **5.** Non-commercial recreation **6.** Boat hire **7.** Scenic beauty

8. Boat harbour **9.** Recreational boating (power, passive) **10.** Commercial use of foreshore	**8.** Nature-based activities

Ecological, aesthetic and some social attributes are highly valued while economic attributes were assigned a low value. This reflects the predominantly natural characteristics of the estuary catchment. It also highlights the importance placed by the Committee on the ecological attributes of the estuary and the adjoining estuarine catchment.

Current Condition of the Management Area

The Impact of Human Activities on Estuary Processes

Urban areas within the Brunswick catchment are primarily located adjacent to the estuary. As is the case with many estuaries on the north coast of NSW, human activities are having a negative impact on key estuary processes. The critical activities that are having or have had adverse impacts on the estuary include:

- non-point source discharges from urban and rural areas
- point source discharges, such as occur from time to time from WWTWs located along the estuary
- clearing of catchment and riparian vegetation
- urban and rural development
- sewer system overflows
- the draining of wetlands
- dredging
- flood mitigation works
- the construction of canals, jetties and training walls.

The primary human impacts have been the modification of the hydrology and hydrochemistry of the estuary, as well as the degradation and loss of habitat for riparian and estuarine organisms (MHL, 2002).

Stormwater Runoff

Urbanisation in towns adjacent to the estuary has resulted in the creation of large areas of impervious surfaces (e.g., roads, footpaths, and the roofs of buildings) which decrease rainfall infiltration, increase runoff volumes and accelerate overland flow velocities (EPA, 1996).

Stormwater from the urban areas surrounding the Brunswick River, Marshalls Creek and Simpsons Creek has the potential to cause a range of direct and indirect impacts on human health and safety and the aquatic environment. The potential impacts on aquatic ecosystems are currently not well known but may include:

- increased frequency of disturbance, which is likely to reduce the diversity of macro-invertebrates and favour more resilient species
- hindering the drift of macro-invertebrates through the water column and substrate by reducing the inter-flood period, possibly hindering recolonisation
- disrupting spawning cycles for some native fish species which are often triggered by seasonal floods (EPA, 1996).

Stormwater from the catchment may contain a range of pollutants which ultimately end up in the waterways. Pollutants may include nutrients, bacteria, trace metals, oil and grease. Nutrients in stormwater may be derived from garden fertilisers, animal feedlots, construction activities, animal waste and washing powders.

Investigations undertaken for the Brunswick River Estuary Study (MHL, 2002) indicated that intense localised rainfall over Mullumbimby township causes an initially high runoff of urban stormwater that may dominate nutrient loading to the upper estuary during and immediately following the rainfall event. Although these inputs may be hydrologically important to the water budget of the upper estuary after rainfall, their contribution to the nutrient budget is only minor compared to both STP and diffuse catchment inputs (MHL, 2002). The increased nutrient inputs stimulate algal growth, which may cause an imbalance in estuarine flora and fauna, and a negative impact on species such as seagrasses.

Agriculture and Forestry

Land clearing results in erosion and siltation, nutrient inputs, turbidity increase, and in some cases, acid runoff. The use of herbicides and pesticides contributes to the nutrient load and organic pollutants. Agriculture and forestry also contribute to changed runoff rates, the loss of vegetation and habitats and the presence of invasive exotic weeds and pests. The loss of riparian vegetation, in particular mangroves and littoral rainforest, reduces important breeding and feeding habitats for fish and birds.

The Simpsons Creek sub-catchment and the middle reaches of the Brunswick River have been cleared extensively for agricultural purposes, and approximately half of all other waterways throughout the Brunswick Estuary are extremely disturbed. The clearing of riparian vegetation results in more pollutants and sediment entering the estuary as the buffering capacity of the riparian zone is severely reduced. The loss of riparian vegetation has also caused riverbank instability and accelerated erosion as the plant roots, that previously bound the soil together, are no longer present.

Dredging and Waterway Structures

Dredging campaigns in the Brunswick Estuary have historically been undertaken to improve the navigability of the estuary entrance for the commercial fishing fleet. Generally, the benefits have been short-lived with the dredging channels quickly filling in due to sediment deposits from the high littoral transport system along the coastline. Dredging activities have, however, changed the tidal prism of the Brunswick Estuary and have therefore altered the salinity regime, increased turbidity, and reduced areas of important habitat, such as shallow water, seagrass and intertidal mud banks.

In addition, flood mitigation activities, bank stabilisation works, boat ramps, jetties and training walls may have increased acid sulfate soil (ASS) production and resulted in the smoothing of shorelines and loss of intertidal areas. Such structures may also have had an impact on the water balance in the estuary resulting in salinity and flow changes. The construction of Capricornia Canal and the Kallaroo Circuit Bund may have resulted in reduced tidal flushing and lower dissolved oxygen levels in the upper Marshalls Creek section of the estuary, resulting in fish kills and loss of habitat for wader birds.

Development Pressures

Byron Shire Council's Brunswick Village Settlement Strategy (2004a) indicates that there will be a significant increase in the population of towns within the Brunswick catchment over the next 20 years. Urban and rural development has caused an increase in nutrient loading and other pollutants to the estuary from sewage effluent, wet weather sewer overflows and stormwater runoff. Turbidity and litter have also become a problem. Canal development, such as has occurred at Ocean Shores, and road construction have resulted in the loss of critical riparian and wetland habitats. These habitats are of particular ecological value to the estuary.

Flood Mitigation and Navigation

Dams, culverts, floodgates and weirs present barriers to fish and other organisms. Modifications upstream may reduce freshwater flows and allow salt water to intrude into freshwater creeks and wetlands. Investigations by Williams & Watford in 1996 identified the presence of nine barriers in the Brunswick Estuary that could adversely impact on fish and other aquatic fauna; however the location of the weirs was not accurately recorded. In 2005 a weir on the main arm of the Brunswick Estuary at Coral Avenue, Mullumbimby, was fixed to reduce the barrier to fish passage.

Current Uses

Actual Land Use

The primary land use within the Brunswick catchment is farming, with tea tree plantations, cattle farming and sugar cane on the flat eastern lowland areas and bananas and forestry on the steeper western areas. Many of the larger farms have now been subdivided into small land holdings or rural residential lots.

Land uses across the lower catchment area comprise a mix of urban residential, rural areas and Nature Reserves. The urban residential areas are generally located at Brunswick Heads, Mullumbimby, New Brighton, South Golden Beach, Ocean Shores and North Ocean Shores. More recently, urban residential expansion has occurred in Mullumbimby (Tallowood Ridge), while residential subdivision approved at South Golden Beach and Bayside Brunswick (south of Brunswick Heads) has yet to proceed.

The distribution of existing land uses within the immediate catchment of the estuary is shown in Figures D3 to D5. There are substantial vegetated areas of land that are zoned for environmental protection or national park/nature reserve, as well as for rural/ agricultural purposes. These areas include large tracts of land along the western bank of Simpsons Creek upstream from Bayside Brunswick, and to the north of Mullumbimby.

Those areas that are zoned as National Parks and Nature Reserve (LEP 2014 Zone E1), Wetlands (LEP 1988 Zone 7(a)) and Coastal Habitat (LEP 1988 Zone 7(b)) are well vegetated.

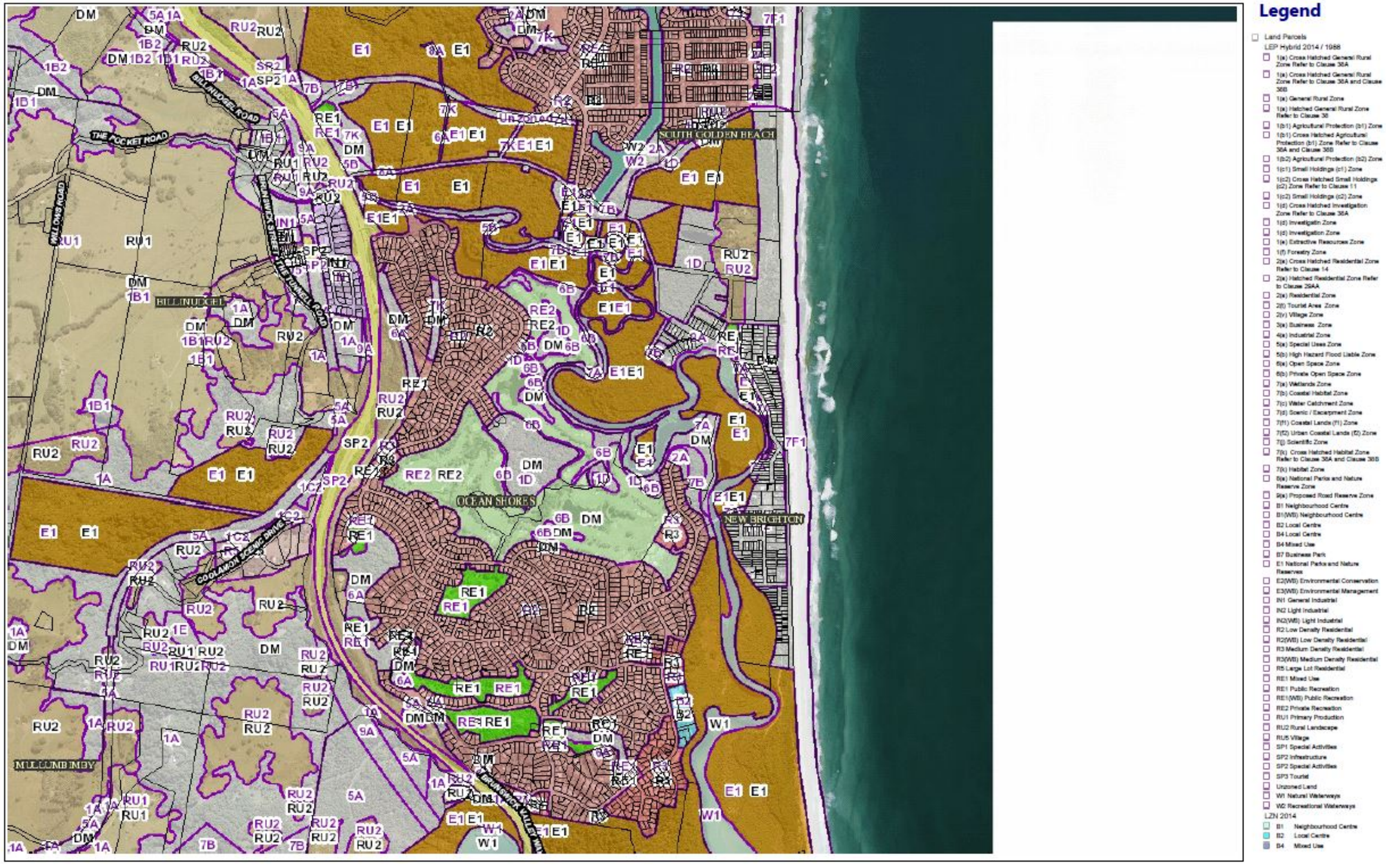


Figure D3 - Land Use Zoning within the Brunswick Estuary – Upper Catchment Area

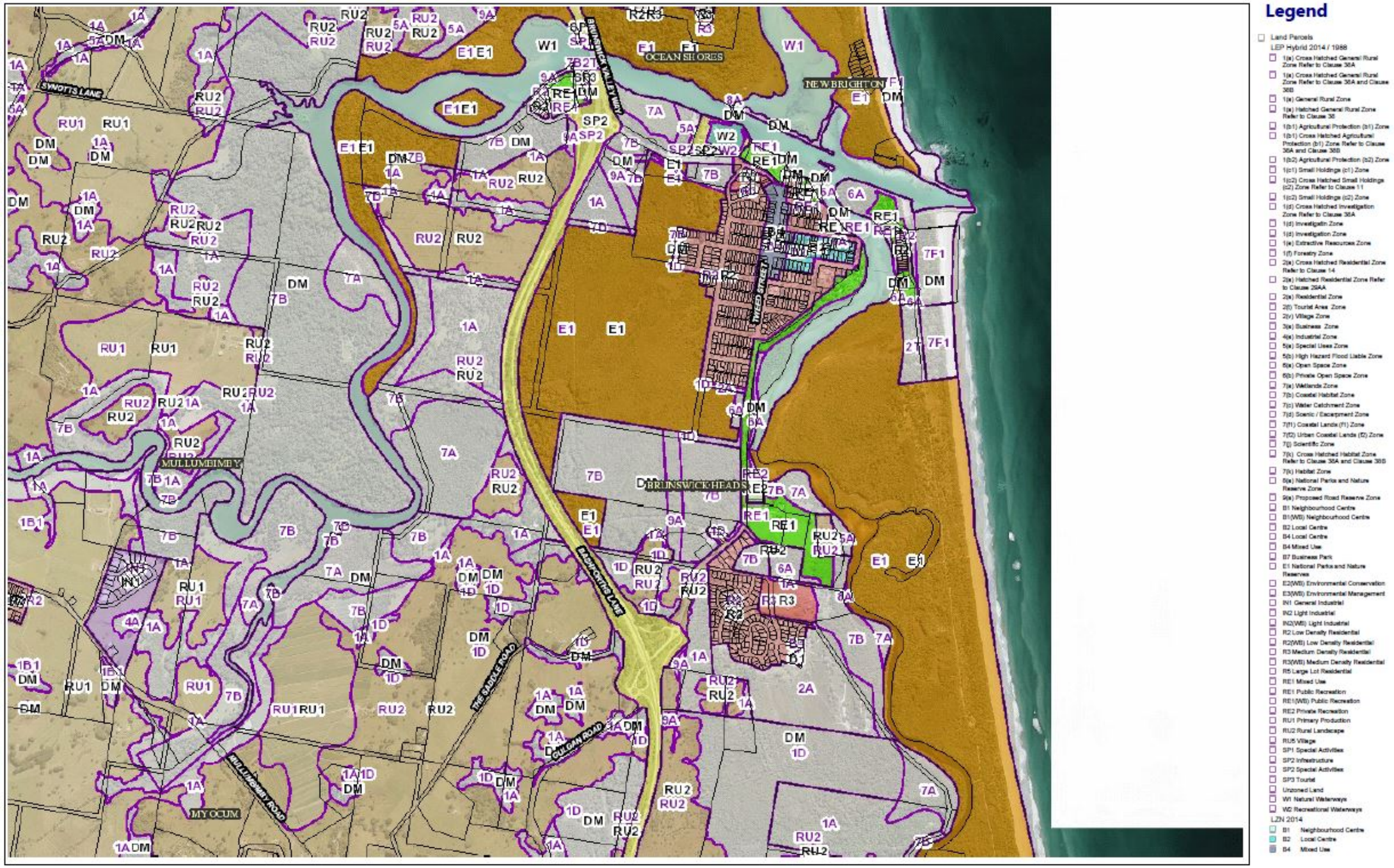
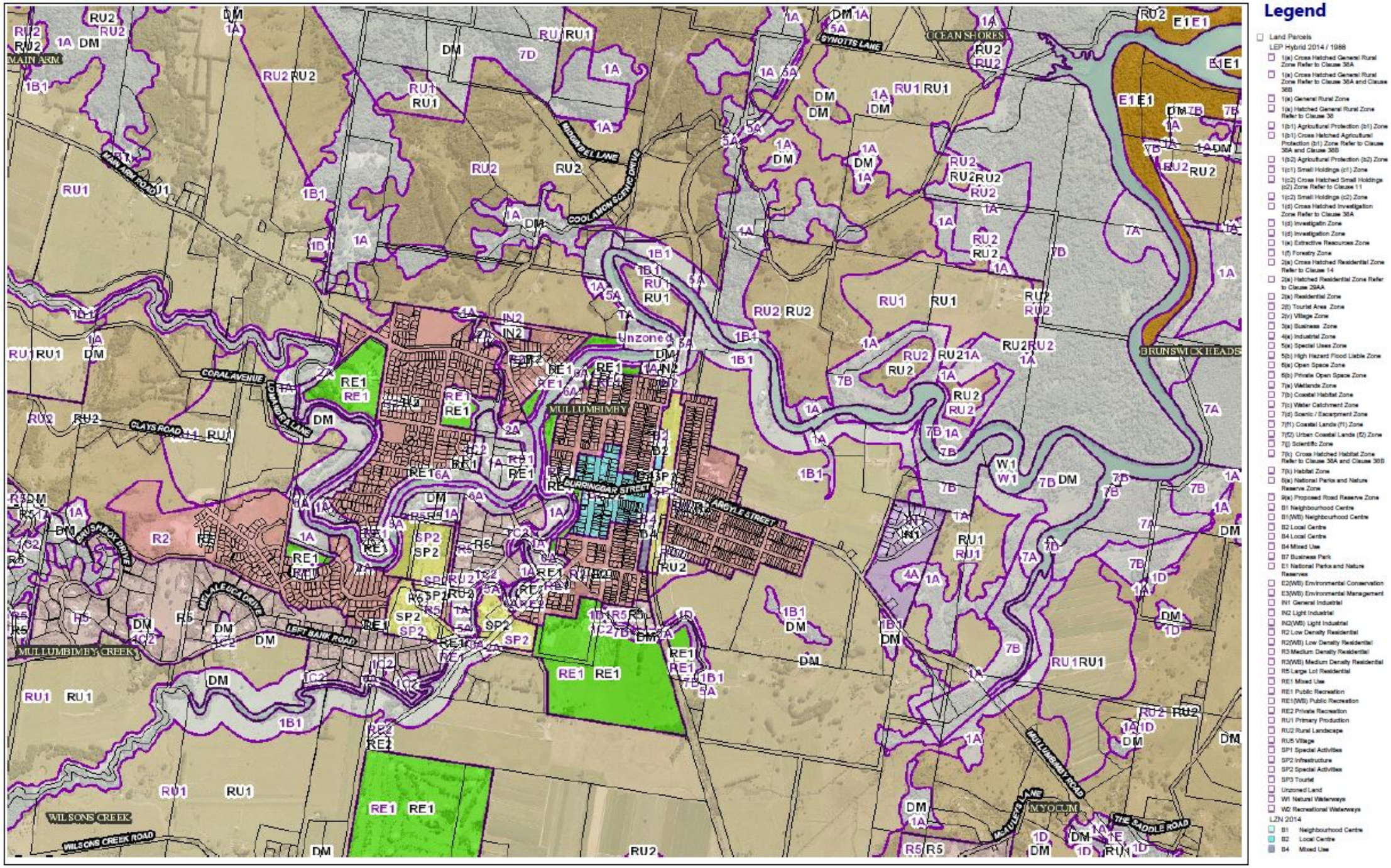


Figure D4 - Land Use Zoning within the Brunswick Estuary – Lower Catchment



Legend

- Land Parcels
- LEP Hybrid 2014 / 1988
- 1(a) Cross Hatched General Rural Zone Refer to Clause 38A
- 1(a) Cross Hatched General Rural Zone Refer to Clause 38A and Clause 38B
- 1(a) General Rural Zone
- 1(a) Hatched General Rural Zone Refer to Clause 38
- 1(b1) Agricultural Protection (b1) Zone
- 1(b1) Cross Hatched Agricultural Protection (b1) Zone Refer to Clause 38A and Clause 38B
- 1(b2) Agricultural Protection (b2) Zone
- 1(c1) Small Holdings (c1) Zone
- 1(c2) Cross Hatched Small Holdings (c2) Zone Refer to Clause 11
- 1(c2) Small Holdings (c2) Zone
- 1(d) Cross Hatched Investigation Zone Refer to Clause 38A
- 1(d) Investigatin Zone
- 1(d) Investigation Zone
- 1(e) Extractive Resources Zone
- 1(f) Forestry Zone
- 2(a) Cross Hatched Residential Zone Refer to Clause 14
- 2(a) Hatched Residential Zone Refer to Clause 29AA
- 2(a) Residential Zone
- 2(t) Tourist Area Zone
- 2(v) Village Zone
- 3(a) Business Zone
- 4(a) Industrial Zone
- 5(a) Special Uses Zone
- 5(b) High Hazard Flood Liable Zone
- 6(a) Open Space Zone
- 6(b) Private Open Space Zone
- 7(a) Wetlands Zone
- 7(b) Coastal Habitat Zone
- 7(c) Water Catchment Zone
- 7(d) Scenic / Escarpment Zone
- 7(f1) Coastal Lands (f1) Zone
- 7(f2) Urban Coastal Lands (f2) Zone
- 7(i) Scientific Zone
- 7(k) Cross Hatched Habitat Zone Refer to Clause 38A and Clause 38B
- 7(k) Habitat Zone
- 8(a) National Parks and Nature Reserve Zone
- 8(a) Proposed Road Reserve Zone
- B1 Neighbourhood Centre
- B1(WB) Neighbourhood Centre
- B2 Local Centre
- B4 Local Centre
- B4 Mixed Use
- B7 Business Park
- E1 National Parks and Nature Reserves
- E2(WB) Environmental Conservation
- E3(WB) Environmental Management
- IN1 General Industrial
- IN2 Light Industrial
- IN2(WB) Light Industrial
- R2 Low Density Residential
- R2(WB) Low Density Residential
- R3 Medium Density Residential
- R3(WB) Medium Density Residential
- R5 Large Lot Residential
- RE1 Mixed Use
- RE1 Public Recreation
- RE1(WB) Public Recreation
- RE2 Private Recreation
- RU1 Primary Production
- RU2 Rural Landscape
- RU5 Village
- SP1 Special Activities
- SP2 Infrastructure
- SP2 Special Activities
- SP3 Tourist
- Unzoned Land
- W1 Natural Waterways
- W2 Recreational Waterways
- LZN 2014
- B1 Neighbourhood Centre
- B2 Local Centre
- B4 Mixed Use

Figure D5 - Land Use Zoning within the Brunswick Estuary – Western Catchment Area

Future Land Uses which may Impact on Estuary Processes

Future land use has the potential to impact on significant estuary processes. For example, changes in land use from forest or wetland to agricultural or residential areas could degrade water quality, lead to increased sedimentation or cause the extinction of aquatic organisms in the immediate vicinity.

The *Marine Parks Act 1997* compels consent authorities in determining a Development Application (DA) to consult with the Marine Parks Authority if there is any foreseeable impact on the plants, animals, or habitats of the Marine Park. As a rule of thumb, any DA lodged for land located within 100m of a Marine Park is referred to Marine Parks for its consideration. The Cape Byron Marine Park extends from the estuary mouth upstream to the approximate tidal limit of the Brunswick River, Marshalls and Simpsons Creeks.

Most significantly, clearing of vegetated land for urban development or rural pasture could increase sediment loads to the waterway, which could adversely impact on aquatic habitats such as seagrass beds. Increased deposition of sediment in the waterways may also compound navigation problems at the marine and fluvial deltas within the Brunswick River and Marshalls Creek.

Similarly, future land use changes to vegetated areas adjacent to the waterways may result in degradation of creek / river banks and threaten water quality and sedimentary processes. Without careful management, clearing of vegetation adjacent to waterways for rural pastures removes stabilising vegetation from the banks resulting in bank erosion and increasing sediment loads to the estuary.

In addition, trampling of bank by livestock causes severe degradation of riverbanks, accelerating erosion and increasing sediment loads to the waterways. Livestock access to the waterway may also impact on water quality processes due to the potential for increased distribution of nutrient to the creeks, resulting in a decline in water quality. This is particularly an issue in the more poorly flushed upper reaches of the Brunswick River and Marshalls Creek.

Runoff from urban areas often carries pollutants due to fertilisers from these sources applied to gardens, detergents used to wash cars, and oil and grit from roads. Water quality processes may also be threatened by increased urban development in the catchment due to increased urban runoff and stormwater reaching the waterways. In particular, increased nutrient loads from these sources can cause a decline in water quality resulting in algal blooms.

Future Land Use in the Upper Catchment of the Brunswick Estuary

There is a small pocket of well vegetated land in the south of North Ocean Shores, immediately to the east of Capricornia Canal, which is currently zoned for residential purposes (2a). If this land is cleared for development, it is likely to result in additional sedimentation to the waterway, and may increase the risk of bank erosion along this stretch of the bank.

There are large tracts of land currently zoned for rural purposes (LEP Zones RU1, R5, 1(c1) and 1(c2)) in the upper catchment area of the estuary which are currently well vegetated. If these are cleared for agricultural purposes, this may result in increased rates of runoff down the catchment. However, the areas to the far north-west of North Ocean Shores are separated from Marshalls Creek by a ridge line in the south and by Billinudgel Nature Reserve to the east. It is therefore unlikely that the clearing of this land will have an effect on estuary processes.

The majority of land zoned for rural purposes in the upper catchment area to the west of South Ocean Shores is on a ridge line. Due to the topography at this location, it is likely that this will increase the rate of runoff down the catchment if these areas are cleared. Some of this land has been cleared as a result of the Pacific Highway upgrade from Brunswick Heads to Yelgun through this part of the catchment.

Future Land Use in the Lower Catchment of the Brunswick Estuary

The majority of land within the upper Simpsons Creek catchment area has already been cleared for agricultural purposes. Approximately 22 hectares of land to the south of Bayside Brunswick is zoned for residential purposes, which has concept approval for 163 lots that have yet to commence. The future development of this land may lead to increased stormwater runoff to, and potential water quality impacts on, Simpsons Creek.

Therefore, it is critical that Council ensure that appropriate stormwater controls are implemented on site both during construction and operation of the development. The majority of the Simpsons Creek subcatchment is also mapped as an area of PASS and may therefore result in leaching of acid runoff to the waterway if these soils are exposed. Water quality is already a serious issue of concern in Simpsons Creek, and the clearing of this land could contribute to reduced water quality in this part of the Cape Byron Marine Park.

Future Land Use in the Mid Catchment of the Brunswick Estuary

The majority of land within the mid-Brunswick catchment area has already been cleared for agricultural purposes. There are a few pockets of land zoned for “rural” purposes within the mid-Brunswick catchment that are well vegetated.

- #### Residential Land off Left Bank Road, Mullumbimby

In the Upper Brunswick catchment (Zone 7), there is residential zoned land to the west of Mullumbimby off Left Bank Road which is approximately 50% subdivided (130 lots out of a potential 260 lots). As land in this precinct can be fully serviced there is currently a planning proposal to rezone an additional 7ha for residential purposes, potentially yielding an additional 60 lots.

- #### Rural Land to the North of Mullumbimby

To the north of Mullumbimby there are still some large tracts of vegetated land zoned for rural purposes. The majority of this land is on high ground and joins the scenic escarpment zone to the north west of Mullumbimby. If this land is cleared for agricultural purposes, it will increase the rate of runoff down the catchment. This could lead to increased sediment and nutrient loads to the upper estuary, and will subsequently have a negative impact on water quality processes within the estuary. Increased sediment loads may also smother aquatic habitats such as seagrass beds, thereby impacting on ecological processes.

Furthermore, if the vegetation within the riparian corridor is cleared in the upper estuary, this may lead to unstable banks and the increased risk of bank erosion. This is of most concern on the left bank of the Brunswick River immediately downstream of the Mullumbimby STP where there is existing vegetation on the outside of the meander bend.

- #### Residential Land on Main Arm Road, Mullumbimby

In the north of Mullumbimby, there are approximately three hectares of undeveloped existing residential-zoned land on Main Arm Road, immediately adjacent to Chinbible Creek. This land may also be developed in the future, but is subject to access being acceptable and resolution of the flood boundary. Although it is already cleared of vegetation, this parcel of land currently provides a buffer between the town and agricultural land to the north, and also a riparian buffer between the creek and existing residential development. Development of this land in the future may result in an increase in stormwater runoff and sediment loads to the estuary. This may have a negative impact on water quality in the upper estuary.

Management of stormwater runoff from new developments is critical to improving water quality within the estuary. The recommendations within the ‘Byron Urban Stormwater Management Plan’ to use rainwater tanks, retain stormwater on site and minimise the amount of impervious areas on new developments should therefore be supported and implemented. Water Sensitive Urban Design (WSUD) techniques such as source control, wastewater reuse, the utilisation of natural flow paths and infiltration (e.g., permeable pavements, swales and bio-retention devices) should be used wherever possible. To assist developers in understanding these techniques, Council should develop a Water Sensitive Urban Design Policy.

- Old Fin's Restaurant

The Old Fin's Restaurant site, adjacent to the Brunswick River, is currently unused. The 'Brunswick Heads Foreshore Reserves Strategic Plan' (2008) includes a draft Master Plan for this area. The Master Plan proposes the building be improved to incorporate a restaurant, function room and conference centre. The development of the proposal for this site will require further consultation with relevant stakeholders including Byron Shire Council, state government agencies and community groups. Suggestions have previously been made that this site be incorporated into the Crown Lands Reserve.

Potential Future Land Use

There are a number of areas within Brunswick Heads, Mullumbimby and Ocean Shores that are currently being investigated to assess their potential future use.

- Investigation Zone at New Brighton

There is a large parcel of well vegetated land zoned as 'Deferred Matter' in LEP 2014 (Zone 1(d) Investigation Zone in Byron LEP 1988) to the north of New Brighton (Zone 1), between New Brighton and Redgate Roads. The surrounding land use is primarily residential, nature reserve and coastal lands. If this area were to be rezoned as for environmental protection purposes, this would have a positive impact on estuary processes. However, if it were to be rezoned for residential or rural purposes, it is likely to be cleared of vegetation resulting in increased rates of runoff, an increase in the risk of bank erosion, and increased sediment and nutrient loads, potentially smothering aquatic habitats and reducing water quality.

- Investigation Zone Adjacent to Marshalls Creek at Ocean Shores

In Upper Marshalls Creek there are a number of areas identified as Investigation Zones 1(d). One such area adjacent to Marshalls Creek is identified as a Deferred Matter' in LEP 2014. This site presently has no access, is flood prone and is an integral component of the river reserve and fauna habitat. It is heavily forested with layered wet forest species. It is most likely that this will be rezoned as for environmental protection' purposes, and will contribute to one of the overall objectives of the CZMP for the Brunswick Estuary – to "protect and enhance the riparian zone". This potential rezoning will have a positive impact on estuary processes as riparian vegetation will be retained, maintaining a stable bank and habitat corridor.

- Investigation Zone within Ocean Shores Golf Course

There are several areas within Zone 2 that are identified as 'Deferred Matter' in LEP 2014, within the Ocean Shores Golf Course lands. These areas are likely to be rezoned for either 'Private Open Space' or 'Environmental Protection' purposes, which would have a positive impact on estuary processes.

- Residential land in Bayside Brunswick

The "Brunswick Heads Settlement Strategy" states that Brunswick Heads will be capable of accommodating the additional predicted population until 2008 if the remaining residential zoned land in Bayside Brunswick is developed as a new High School. If it is subdivided for residential purposes, it will be capable of accommodating the additional predicted population until 2015. The only major parcel of land within Brunswick Heads that may be rezoned in the future lies to the south of Bayside Brunswick. However, this land is currently constrained by significant areas of coastal heath and is partly flood prone. It is likely that this will be rezoned for 'Environmental Protection' purposes, which would have a positive impact on estuary processes.

- Land to the South of Ann Street, Mullumbimby

In the south east of Mullumbimby, there is a parcel of land to the south of Ann Street and down to Saltwater Creek. This low lying land has already been cleared, and has been identified as being flood prone with drainage issues. In the long term, however, and subject to the outcomes of a Floodplain Management Plan for Mullumbimby, approximately 5 hectares of this land that is below the 100 year flood level may be suitable for low-yield residential development. The 'Mullumbimby Settlement Strategy' (2003) recommends that if developed, a 50-metre vegetated

riparian buffer zone be retained. This will minimise the impacts of this potential development on the estuary.

It is critical that the impacts of this development (including its sewer network) on the estuary be minimised. Additional stormwater runoff generated from this new development should be managed appropriately using WSUD techniques to ensure there is no impact on estuarine water quality.

There are no other significant concerns regarding rezoning applications within the Brunswick Estuary Catchment area.

Conflicts of Estuary Use

The waterways and associated catchment areas are highly valued by the community for passive and active recreational use as well as for their ecological attributes. Uses include:

- Walking, riding and nature watching
- swimming and snorkelling
- recreational fishing
- recreational boating
- oyster farming
- commercial fishing.

Due to the variability in the range of activities that are undertaken on and adjacent to the estuary, there can be conflicts between users and conflicts between adjoining landowners and users. A brief summary of these conflicts is provided in the following sections.

Waterway Conflicts

In the past, conflicts have occurred between parties involved in the following estuary uses or adjoining land uses:

- swimming/snorkelling and boating
- recreation and agricultural activities
- power boating and passive recreation, including fishing and use of non-motorised vessels

During holiday periods, some tourists who operate power boats impact on other recreational users. In addition, the increased number of waterway users during this period results in overcrowding of the waterway and causes conflicts between users. One of the most notable conflicts occurs between power boat users and rock fishers.

The main facilities for waterway usage are limited to the boat harbour and slipway, and the two boat ramps in the lower estuary at Brunswick Heads Park and Ferry Reserve. As a result, there is often overcrowding of parking areas and congestion at the boat ramps.

Foreshore Access

The foreshores of the estuary have the potential to allow connectivity between public lands for passive recreational users. Planning and management of public foreshore access should not compromise the integrity of riparian vegetation or cultural values. The provision of public access to foreshores is consistent with the NSW Coastal Policy and Section 55c of the *Coastal Protection Act, 1979*. On public lands, strategic plans should provide for public foreshore access, and on private lands, there need to be buffers for the provision of public foreshore access when new or redevelopment of freehold foreshore lands occurs.

The three holiday parks, Ferry Reserve, Massey Greene and Terrace Reserve, are now the responsibility of, and managed by, the NSW Department of Industry – Lands (Crown Lands).
At present there are a number of areas where conflicts occur between foreshore users. These conflicts include:

- private land use on public foreshores, such as encroachment by camping activities into the public foreshore corridor at the edge of caravan park properties
- maintenance of riparian buffers
- appropriate use of foreshore areas.

The southern foreshores of the river at Brunswick Heads are open to a high degree of access. Over recent years, a number of plans have been developed to manage this access. These plans include:

- a plan for parking at the main boat ramp;
- a Foreshore Access and Parking Control plan; and,
- a Brunswick Heads Foreshore Reserves Strategic Plan

The Foreshore Reserves Strategic Plan is intended to guide future development and management of public foreshore lands to meet future community and visitor needs, under the principles of environmental, economic, and social sustainability (DoL, 2008).

Climate Change

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). It may be due to natural internal processes or external influences, or to persistent anthropogenic induced changes in the composition of the atmosphere or in land use.

However, not all changes in climate are due to natural processes. Through a range of activities since the industrial era of the mid-19th Century, such as accelerated use of fossil fuels and broad-scale deforestation and land use changes, humans have also contributed to an enhancement of the natural greenhouse effect. This enhanced greenhouse effect results from an increase in the atmospheric concentrations of the so-called greenhouse gases, such as carbon dioxide and methane. The Greenhouse Effect is widely understood to be responsible for the observed increase in global mean temperatures ('global warming') during the course of the 20th Century.

Global warming has the potential to cause sea level rise (SLR) and to alter rainfall and storm intensity. SLR projections of 0.4 m by 2050 and 0.9 m by 2100 were previously adopted by the NSW Government for planning purposes (DECCW, 2009), and although the formal endorsement by the government has now been repealed, these values have been adopted in this study.

Coastal communities and environments are particularly vulnerable to climate change due to the potential for:

- permanent coastal inundation;
- increasing coastal hazards associated with changing weather patterns (such as coastal erosion, tidal inundation and coastal flooding including impacts of SLR); and
- extreme weather events.

In 2007 the CSIRO completed a study on coastal climate change projections and in particular regional sea level rise for Wooli in northern NSW (and Batemans Bay in southern NSW). CSIRO (2007) predicts global sea level rise of 0.18 to 0.59m by 2095 (relative to 1990 values) with a possible contribution from ice sheet melt of 0.1 to 0.2m, and notes that the increase in sea level will not occur uniformly across the globe due to spatial variations in the thermal expansion of the ocean.

CSIRO (2007) suggests that future sea level rise along the NSW coast will be slightly higher than the global average projections. This prediction is correlated to an expected strong warming of the sea surface temperatures in the region and a strengthening of the East Australian Current (CSIRO, 2007).

The CSIRO (2007) predictions for sea level rise at Wooli relative to global sea level change are:

2030	0 to 0.04 m with Mark 2 GCM model
	0.04 to 0.08 m with Mark 3 GCM model
2070	0 to 0.04 m with Mark 2 GCM model
	0.08 to 0.12 m with Mark 3 GCM model

If the high range scenario is considered for 2070, a local variation for the Wooli region of +0.12m relative to global sea level by 2070 is possible. It is noted from CSIRO (2007) that a decreasing trend in local sea level increase northward of Wooli was predicted with the Mark 3 GCM model, with values around the Byron Shire in the range of 0 to 0.08.

The upper range values predicted by both IPCC (2007) and CSIRO (2007) reflect the possible significant rise of sea level in the Northern Rivers region. A summary of the high range predictions from the IPCC and CSIRO are provided in the table below.

Scenario	**Year**	**Value**
IPCC and CSIRO adopted 'High' range sea level rise scenario	2100	0.59m
IPCC and CSIRO adopted 'High' range polar ice melt contribution	2100	0.2m
CSIRO local sea level changes for Byron Shire region[1]	2100	0.12m
Upper bound sea level rise (NB: not considered a maximum value)	**2100**	**0.91m**

[1] *CSIRO (2007) predictions for increases in sea level beyond the global average for the Byron Bay region are between 0 and 0.08m by 2070. As this prediction is to 2070 it is herein considered prudent to CZMP for a sea level rise increase for the Byron region on top of the global average of 0.12m by the year 2100.*

Impacts on the Brunswick Estuary

Examples of specific impacts resultant from climate change that may occur in the Brunswick Estuary Catchment include:

- inundation of wetlands and marshes
- changes to water availability and quality
- changes in habitat and species distributions
- lower oxygen levels in wetlands
- ocean acidification (due to higher concentrations of carbon dioxide in the atmosphere)
- impacts from higher intensity rainfall and flooding
- impacts from more severe coastal storms.

These impacts may occur simultaneously with other existing stressors, such as population growth. Natural systems will no doubt endure extreme stress in adapting to the impacts of climate change, and may lose their ability to provide the essential services to the local, regional, and global environment observed today.

The tidal limits of the Brunswick Estuary and its tributaries will migrate inland as sea levels rise. An increase in sea level, therefore, has vast consequences for the flora and fauna of the catchment as low lying biological communities will migrate up-slope to adapt to habitat loss by inundation, and to accommodate changes in salinity levels in surface and ground waters.

Sea Level Rise

The rate at which sea levels rise will have a great influence on the success of the migration of communities such as saltmarsh and seagrass. For those communities living on or close to the limit of their survival threshold, rapidly rising sea level may result in their demise as limited

suitable habitat is lost. The considered impacts from sea level rise on the Brunswick Estuary are as follows:

- Wetlands that are already under threat from urban development, pollution, and drainage may become more vulnerable with sea level rise and changes to salinity levels. Changes in sea level and salinity will result in community structure shifts and possibly broad scale decline in the health and function of coastal wetlands.
- Mangrove transgression could also occur at the expense of threatened saltmarsh communities which are highly productive habitat for many invertebrates, fish and birds.
- Flood plains will become more frequently inundated during flood events, this has consequences for biological communities living at the edge of their tolerance levels.
- The riparian zone will endure additional erosive stress under rising sea levels as estuary waters reach further up the estuary banks, eroding soils and inundating habitat currently located above the tidal range.
- Greater water depths in the estuary may affect benthic processes, such as denitrification and oxygen reduction, and will result in a vertical accretion of marine and fluvial deltas (Haines, 2006).

Temperature

The considered impacts from increasing average air and sea temperatures on the Brunswick Estuary are as follows (adapted from Haines, 2006):

- Potential change in the distribution and composition of estuarine vegetation communities such as mangroves and wetlands.
- Increase in pelagic and possibly benthic primary productivity resulting in a decrease in dissolved oxygen levels in the water column. Increased primary productivity will result in changes to food web balances for higher trophic order organisms such as zooplankton, fish and birds.

Rainfall

Recent observations indicate a decline in rainfall in eastern Australia. Although much variation exists in predictions on future rainfall patterns for the area, it is assumed, under a precautionary approach, that annual rainfall will be less, rainfall intensity greater, and drought more frequent in the Brunswick Catchment. The considered impacts from rainfall variations on the Brunswick Estuary are as follows:

- Reduced annual rainfall will result in a reduction of total catchment runoff leading to greater average salt penetration into the estuary.
- More intense rainfall may increase sediment loadings into the estuary during the event; however, average yearly sediment loadings may be less due to a decline in average yearly rainfall.
- Increases in storm severity, and in particular rainfall intensities and wind strengths, will exacerbate the erosive forcing of flood events as runoff and floods become more severe.
- Overall reduced pollutant loads, including nutrients, due to decreased total catchment runoff. Increased extreme rainfall and subsequent nutrient runoff during the warmer months may exacerbate eutrophication (Haines, 2006).
- Increase in drought may affect the viability of riparian vegetation and wetlands. Drought will correlate with a reduction of organic matter and nutrient input into the system, thus affecting food chain processes (Haines, 2006).

Importantly, any adaptation that natural systems undergo may be inhibited by human infrastructure such as causeways, urban development, flood levees and foreshore revetment walls. It is, therefore, crucial that future decisions on land use management in the Brunswick Catchment are made under consideration of the implications of climate change on the ecosystems and habitats of the estuary and surrounding catchment.

Human Settlements

The primary concern for human settlements is that coastal foreshore and floodplain development will increasingly become subject to flooding as a consequence of sea level rise due to global warming. Altered weather patterns may intensify storms and increase the severity of floods due to increased wind speeds and rainfall intensities respectively. Sea level rise may also affect the operation of floodgates and the drainage efficiency of low lying agricultural lands. All of these changes have significant consequences for human settlements.

Managing for Climate Change

Planning Approaches

In recognition of scientific evidence indicating a change in the global climate there exists an immediate need to suitably plan for the probable impacts associated with such a change. It is therefore imperative to plan appropriately by putting in place strategies and actions to attempt to mitigate the risk to human settlements and the environment associated with climate change. In 2009 Council adopted a *Climate Change Strategic Policy*, which provides climate change flood planning scenarios for the years 2050 and 2100. The 2050 flood planning scenario is to be used for any Council strategic, infrastructure and operational planning document or designs that may be affected by climate change. In terms of land use planning, the 2050 flood planning scenario will apply to most development except for land release areas, certain rezoning/LEP amendment proposals and special purpose and critical facilities.

Climate Change and the CZMP for the Brunswick Estuary

The key points of the *Climate Change Strategic Policy* with direct relevance to this CZMP for the Brunswick Estuary are as follows:

1. That the climate change parameters adopted by Council be incorporated into this CZMP. Incorporation of the parameters into this CZMP requires that:
    a. In developing any CZMP, strategy, policy, or on-ground rehabilitation solution as recommended in this CZMP, where potentially affected by climate change, consideration must be given to the effect of rising sea levels, reduction in annual rainfall, increases in rainfall and storm intensity, and increases in temperature on that management strategy for the design life of that management strategy.
    b. The development and implementation of any management strategy in this CZMP is, therefore, required to as best as possible, incorporate measures that aim to reduce the impacts associated with climate change on that strategy, and on the estuarine processes that may be negatively (or positively) affected by that strategy under climate change for the design life of that strategy.
2. That the climate change parameters be reviewed and/or updated upon release of updated information from the IPCC, CSIRO and/or OEH.

Climate Change, Development and Infrastructure in the Brunswick Catchment

The impact of floods and flood liability on coastal development, including projected climate change implications, are best addressed by Council through the implementation of recommendations made in Floodplain Risk Management Plans. These plans are developed in accordance with the NSW Government's Floodplain Development Manual (NSW Government, 2005) and are typically based on flood modelling that takes account of sea level rise projections.

Byron Shire Council already has a Floodplain Management Plan for Marshalls Creek which was adopted by Council in 1997. The Plan does not, however, reflect contemporary approaches for addressing the potential for climate change to influence the sustainability of development on or adjacent to estuary floodplains and does not incorporate current knowledge on the possible rate and level of sea level rise. Council has embarked on preparing a North Byron Coastal Creeks Flood Study incorporating modelling of the Marshalls, Simpsons and Brunswick catchments. This

study considers the areas of Mullumbimby, Brunswick heads, Ocean Shores, New Brighton, South Golden Beach and Billinudgel. The modelling and study is now complete and development of a Flood Risk Management Study and Plan for these areas will commence in the near future. This study will incorporate the impacts of climate change using the climate change parameters endorsed by Council.

To ensure adequate consideration is given to future climate change, appropriate provisions must be applied within the relevant local planning instruments. The imprecise nature of the climate change predictions does, however, render considerations from a planning perspective difficult.

Accordingly, measures to aid the future sustainability of ecosystems and development in the Brunswick Catchment must be rigorously applied and broadly include:

- Incorporation of buffers between biological communities and development to allow migration of the biological communities
- Ensuring appropriate land use zonings to minimise future risk to development and the environment, and to protect valuable ecosystems
- Ensuring appropriate flood plain development which seeks to minimise the risk to the development and the environment.

It may be necessary to undertake more detailed assessments to determine those areas and ecosystems that will most likely be affected by climate change. By identifying 'significant' areas, more appropriate management decisions may be applied to ensure human impacts on the environment under a changing climate are minimised as much as possible.

Coastline Hazard Assessment

A Byron Shire Coastline Hazards Assessment Update (CHA) was completed by BMT WBM in 2013 provides a revision of coastal hazard extents defined for specific designated parts of the Byron LGA coastal zone updating previous hazard studies. Tidal inundation has been considered in the Brunswick Estuary, however, more work is required to be done in this area such as a design storm tide in combination with flood scenarios. Inundation levels of land adjacent to the Brunswick River within the lower estuary associated with a design storm tide (design storm tide plus a wave set-up component, plus future SLR) has been mapped for the immediate, projected 2050 and 2100 year scenarios. Design elevated water levels are based on Council's policy for the 100 year design elevated ocean levels at estuary mouths for flood planning scenarios with storm surge events and climate change. From this mapping, it can be seen that northern parts of Brunswick Heads become progressively vulnerable to inundation over time as a result of SLR (Figure D6). Road infrastructure and some development land along the landward parts of New Brighton are also increasingly vulnerable to storm tide inundation over time.

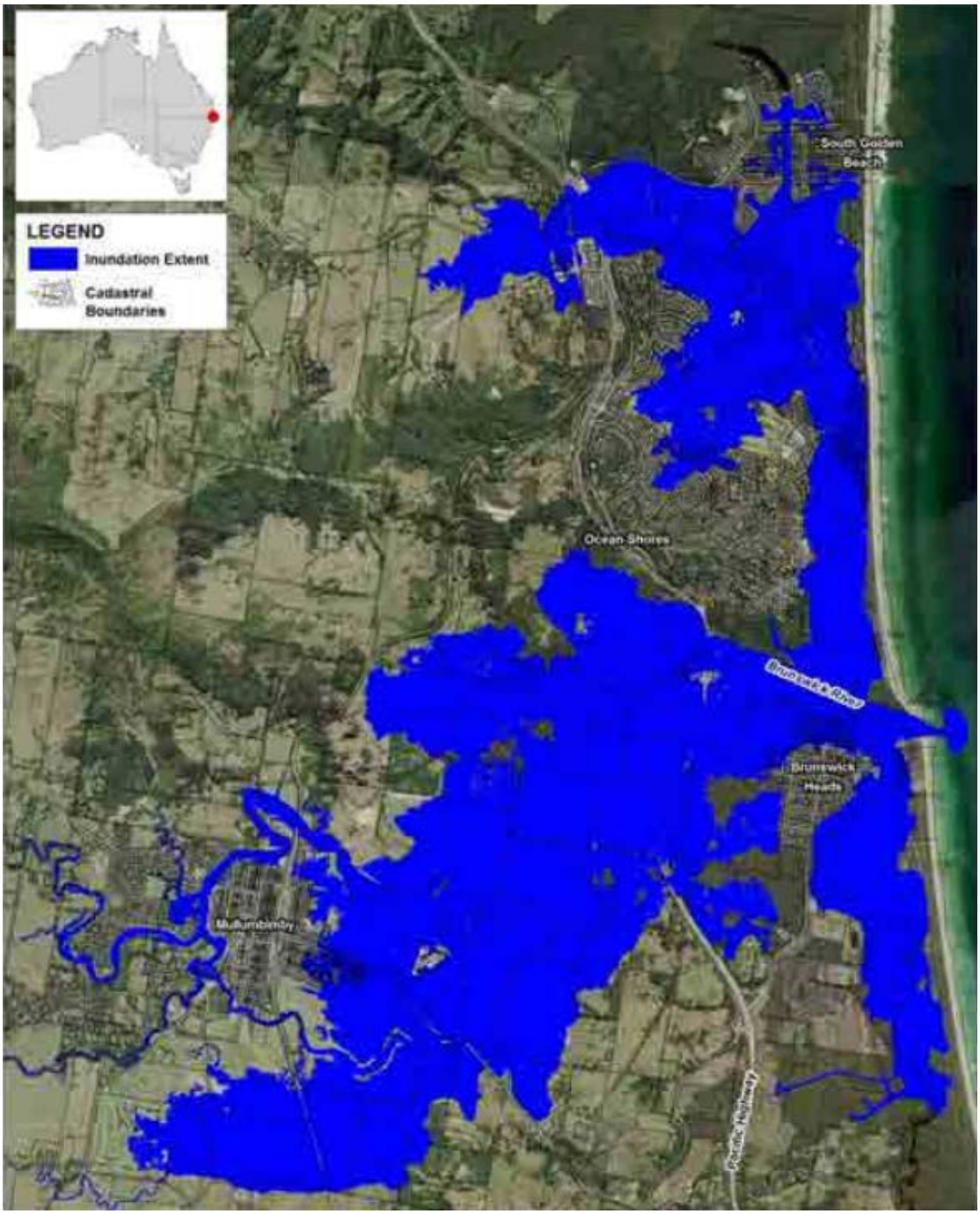


Figure D6 - Brunswick River estuary storm tide inundation: ‘2100’ 100 Year ARI

APPENDIX E – COMMUNITY CONSULTATION AND ADOPTION OF KEY ISSUES

Consultation

In recognition of the importance of engaging the community, an extensive consultation program was developed. The primary aim of the consultation program was to ensure that all issues that could confront the future management of the estuary were identified.

The consultation process was extended to extract views and ideas on appropriate measures for estuary management. It also involved the identification of the major attributes of the estuary and an assessment of these to determine which attributes are essential to maintaining or improving estuary processes. The program of consultation involved the following:

- Consultation with key stakeholders and community groups including government organisations and individuals
- Participation in site inspections with Committee members, aimed at identifying areas of the estuary in need of rehabilitation or further study
- Workshops with the Committee and Key Stakeholders which aimed to:
    - reaffirm the key issues identified in the Brunswick River Estuary Study, and from site inspections
    - identify essential features and attributes of the estuary
    - rank the key issues confronting the estuary and to assign a value to the attributes and essential features of different sections of the estuary
    - identify, confirm and rank an acceptable series of management objectives
    - identify potential strategies and works that would enable better management of the estuary
    - resolve actions and timing for the implementation of agreed strategies.

Public Exhibition of Draft Document

The Draft “Brunswick Estuary Management Study and Plan” was prepared throughout 2005 in consultation with representatives from Byron Shire Council’s Estuary Management Committee. The Draft Study and Plan was considered by Council at its meeting on 12 December 2005, whereupon it was agreed that the Draft Study and Plan should be placed on public exhibition for a period of three months. Accordingly, the “Draft Brunswick Estuary Management Study and Plan” was placed on public exhibition from 6 January to 31 March 2006.

Submissions on the Draft Study and CZMP were compiled and assessed to establish the key issues of concern to those who reviewed the document while it was on public exhibition. In addition, issues raised at the Council meeting held on 12 December 2005 were also highlighted and considered. Amendments were subsequently applied to the draft before the “Final Draft Brunswick Estuary Management Study and Plan” was finalised in October 2007. Since October 2007, the “Final Draft Brunswick Estuary Management Study and Plan” was condensed and slim lined to become the “Draft Estuary Management Plan” in 2008. The “Draft Estuary Management Plan” was adopted by Council in November 2008 and became the “Final Estuary Management Plan” in January 2009. It was renamed as the Coastal Zone Management Plan for the Brunswick Estuary in October 2010 (refer to Section 1 for further details on the history of the CZMP).
It was decided in 2017 during the review and update process of the CZMP that even though a significant length of time has passed since exhibition of the CZMP, the key management issues and management responses were same, therefore, secondary public exhibition of the CZMP was not required. The adopted key issues for the Brunswick Estuary are identified in the Brunswick Estuary Management Study and Plan (2007) and are described, in order of rank, in Table E1 below. These issues have the potential to compromise the sustainable management of the Brunswick Estuary into the future.

Table E1 - Adopted key issues for the Brunswick Estuary

Rank	Adopted Key Issue	Description
1	Historical and future development	There are problems associated with past developments, such as encroachment into the riparian buffer zone (*e.g., The Terrace Caravan Park*) and clearing of vegetation, and concerns regarding future urban expansion and infrastructure development. The Kallaroo Circuit Bund and Capricornia Canal at North Ocean Shores also pose issues associated with poor water quality as a result of low estuarine flushing.
2	Poor water quality	Poor water quality within the estuary is primarily caused by pollutants within agricultural runoff, sewer overflows, stormwater runoff and effluent. The Mullumbimby, Brunswick Heads and Ocean Shores STPs contribute a significant nutrient load to the estuary, particularly during wet weather flows. Pollution from accidental spillage from transport has occurred in the past.
3	Foreshore access	Limited foreshore access, particularly adjacent to caravan park camping areas, causes conflicts between users (*walkers versus campers*). Coupled with this is the lack of connectivity between Crown Reserves.
4	Loss and condition of riparian vegetation	Clearing for development and agriculture has caused a progressive reduction in the extent and condition of riparian vegetation. There is a need for the preservation and rehabilitation of existing riparian vegetation. In particular, the mid- and upper Brunswick Estuary, which has large areas of agricultural rural land, has lost significant areas of riparian vegetation as a result of agricultural clearing practices.
5	Reduction in aquatic habitat	Pollution incidents, sedimentation and waterway use are threatening important aquatic habitats such as seagrass beds, mangroves, saltmarsh communities and wetlands. There are particular concerns regarding the loss of seagrass beds in Lower Marshalls Creek.
6	Bank erosion	Increased bank erosion, failure of remedial measures and unsightly and unsafe erosion protection measures are particularly evident along the mid-Brunswick River, adjacent to the Rugby Club and the Ferry Reserve Caravan Park. There are significant areas of bank erosion along the mid-Brunswick River. This is coupled with the loss of riparian vegetation in this area.
7	Poor communication / education	The community needs to have an understanding of estuary processes and be made aware of the need to manage the estuary in a co-ordinated manner. Effective management of the estuary requires consultation and better communication with the community about the impact of their actions on the health of the estuary.
8	Potential for increasing tourism	There is a need to maintain a balance between encouraging tourism growth to improve the local economy and limiting tourism to maintain the cultural setting and the health and sustainability of the estuary.
9	Fragmentation of habitat (biodiversity)	The extent of riparian vegetation has been reduced by clearing, resulting in fragmentation of wildlife corridors. Expansion of Brunswick Heads to the west has caused clearing of woodland and heath, and the construction of the Pacific Highway bypass has fragmented habitat and reduced coastal woodland and swamp forest. The small and fragmented nature of SEPP 26 littoral rainforests poses significant concerns regarding its future. The Tyagarah and Brunswick Heads Nature Reserves are small isolated remnants of natural ecosystems which are highly susceptible to the impacts of human activities.
10	Waterway usage conflicts	There are perceived conflicts between waterway users, particularly in the lower estuary at the tourist centre of Brunswick Heads. Boating impacts include bank erosion, pollution and vegetation disturbance. There are also aesthetic problems with foreshore debris associated with oyster cultivation. There is a need for improved facilities in the lower estuary to relieve congestion.
11	Suitability of existing boating facilities	The Brunswick Heads Park boat ramp and associated facilities require upgrading, and the Ferry Reserve boat ramp is too short. A new ramp is required at Mullumbimby. Additional facilities, including parking, are required to control overcrowding and reduce congestion.
12	Damage to cultural heritage	The location of all Aboriginal and heritage sites is not known. Conservation of existing sites and the identification and protection of Aboriginal sites affected by natural processes and human activities are required. There also needs to be an ongoing commitment to the Heads of Agreement between Byron Shire Council and the Arakwal Aboriginal Corporation.
13	Declining fish stocks and fish kills	There is a perceived decline in fish stocks related to water quality issues and netting practices. Recreational fishing and waterway usage may also be causing a reduction in fish stocks. Floodwaters from swamp areas reduce dissolved oxygen levels and have caused fish kills in Capricornia Canal, as has runoff from areas of exposed ASS.
14	Sediment quality (“hotspots”)	Trace metal concentrations are high in estuarine sediments around the Mills Street Industrial Estate and the boat harbour. There are also high concentrations of nutrients / pathogens in sediments in the upper estuary around the Mullumbimby STP as well as the Mill Street Industrial area, the former Brunswick Heads Tip site and the boat harbour. Faecal coliform concentrations within sediments in the upper estuary could have health implications for people swimming or fishing in the upper estuary, particularly around Coral Avenue.
15	Reduction in catchment vegetation	Clearing of vegetation in the catchment has resulted in modified runoff patterns, loss of habitat and riparian buffer zones, and increased bank erosion. Loss of vegetation in the catchment also results in higher runoff rates, erosion, export of pollutants, and increased sedimentation and turbidity of the estuary.
16	Reduced navigability	There are restrictions to navigability of the entrance bar, the lower and upper Brunswick River main arm and Simpsons and Marshalls Creeks due to shallow depths. There is significant shoaling at the entrance bar and training works have redistributed the shoaled sediment. Shoaling at the entrance bar causes dangerous swells, resulting in a navigational hazard. Unmarked hazards reduce navigability in the main arm.
17	Acid sulfate soils	Acid runoff from agricultural, urban and general drainage works impacts on water quality, particularly along Marshalls Creek and Capricornia Canal. Despite much of the estuary shown as areas of ASS probability, there is no Acid Sulfate Soil Management CZMP. There is insufficient consolidated data on soils to develop an ASS Management CZMP.
18	Flooding	High order flood events result in significant scour around the entrance. There are possible impacts of the Readings Bay training walls on flooding behaviour, particularly adjacent to Marshalls Creek. There is also some concern about flooding and its impact on the estuarine environment. Recent flooding in June 2005 inundated areas of Brunswick Heads, New Brighton and South Golden Beach.
19	Implementation of compliance	A lack of government resources means that it is difficult to ensure compliance of environmental planning policies and legislation.

Rank	Adopted Key Issue	Description
20	Sedimentation	Sedimentation is an ongoing process that affects water quality, ecological health, tidal flushing and navigability. Sedimentation is due to input of marine sediment at the entrance and fluvial inputs in the upper reaches, the latter increased by human activities in the catchment and causing redistribution of fluvial / marine sediments in the mid-estuary.
21	Alteration to natural flows	River training works have channelised lower estuary flows, but have had limited effect on tidal flushing. The training walls and breakwaters have reduced the input of marine sand, reduced the limit of active marine sand progression into Marshalls Creek and redistributed sediment in Readings Bay. Flushing upstream of the Kallaroo Circuit Bund is low.
22	Commercial usage	There is concern about the impact of an increase in the number of boats and foreshore industries on water quality and contributing to problems associated with waterway usage conflicts.

Management Objectives

The primary objective of the CZMP is to provide a range of management options or strategies for maintaining and improving estuary condition and function. These options should include measures that will protect the essential features of the estuary (e.g. the primary estuary processes), resolve key issues and improve opportunities for estuary usage. However, prior to developing specific management measures aimed at achieving these goals, it is necessary to identify a set of specific management objectives.

Accordingly, a list of management objectives were identified based on a review of background documents, consultation with the Committee and key stakeholders, and outcomes from land use and estuary use assessments that were carried out as part of the project. The objectives were discussed and prioritised and, from the Committee's perspective, the highest ranked objectives were considered to be the need to:

- improve water quality
- improve estuary ecological health and biodiversity
- conserve Aboriginal and heritage sites
- determine sustainable tourism
- control and manage development.

Additional management objectives were also identified in the process. These included the need to:

- protect and enhance the riparian zone
- determine sustainable tourism
- maintain and enhance visual aesthetics
- control and manage development
- improve education
- integrate planning policies, regulations and legislation to manage the estuary
- encourage passive recreational use of waterways, including use of non-moorised vessels
- maintain environmental flows.

As an outcome from a Committee workshop held on 29 April 2005, a finalised set of adopted management objectives was confirmed for the estuary. This involved extensive discussion of management issues and resulted in the adopted list of management objectives presented in the Table E2.

Table E2 - Adopted management objectives for the Brunswick Estuary

MANAGEMENT OBJECTIVES	ISSUE CATEGORY	COMMITTEE WORKSHOP RANKING
⇒ IMPROVE WATER QUALITY	WATER QUALITY	**1**
⇒ IMPROVE ESTUARY ECOLOGICAL HEALTH AND BIODIVERSITY	ECOLOGICAL	**1**
⇒ CONSERVE ABORIGINAL AND HERITAGE SITES	HUMAN USAGE	**1**
⇒ DETERMINE SUSTAINABLE TOURISM	HUMAN USAGE	**1**

MANAGEMENT OBJECTIVES	ISSUE CATEGORY	COMMITTEE WORKSHOP RANKING
⇒ CONTROL AND MANAGE DEVELOPMENT	HUMAN USAGE	**1**
⇒ REDUCE NUTRIENT, SEDIMENT AND PATHOGEN LOADINGS	WATER QUALITY / WASTEWATER	**2**
⇒ IMPROVE MONITORING	WATER QUALITY	**2**
⇒ REDUCE SEWAGE EFFLUENT RELEASES AND IMPROVE SEWAGE TREATMENT	WATER QUALITY / WASTEWATER	**2**
⇒ REDUCE BANK EROSION	PHYSICAL	**2**
⇒ PROTECT AND ENHANCE TERRESTRIAL HABITATS AND COMMUNITIES	ECOLOGICAL	**2**
⇒ PROTECT AQUATIC HABITATS	ECOLOGICAL	**2**
⇒ PROTECT AND ENHANCE RIPARIAN ZONE	ECOLOGICAL	**2**
⇒ IMPROVE THE QUALITY OF WATERWAY FACILITIES	HUMAN USAGE	**2**
⇒ IMPROVE EDUCATION	HUMAN USAGE	**2**
⇒ INTEGRATE PLANNING POLICIES, LEGISLATION AND REGULATIONS TO MANAGE THE ESTUARY	HUMAN USAGE	**2**
⇒ REDUCE TRACE METAL INPUT	WATER QUALITY	**3**
⇒ IMPROVE FORESHORE ACCESS	HUMAN USAGE	**3**
⇒ MAINTAIN AND ENHANCE VISUAL AESTHETICS	HUMAN USAGE	**3**
⇒ ENCOURAGE PASSIVE RECREATIONAL USE OF WATERWAY, INCLUDING USE OF NON MOTORISED VESSELS	HUMAN USAGE	**3**
⇒ MAINTAIN ENVIRONMENTAL FLOWS	WATER QUALITY	**3**
⇒ MANAGE CONTAMINATED SEDIMENTS	WATER QUALITY / SEDIMENT QUALITY	**4**

Management Targets

The adopted management objectives were used to develop strategies and actions for the sustainable management of the estuary and adjoining catchment. These strategies can be linked to the key issues identified. The linkages between the identified issues, the key attributes and the adopted management objectives are represented in the table below.

A provisional list of potential management strategies was presented to the Committee at the workshop that was held on 29 April 2005. The presentation also included a discussion of the technical reasons for implementing particular strategies and the benefits that would accrue from implementation. This was based on the scientific information contained in the "Brunswick River Estuary Study" (MHL, 2002). The outcome from the workshop was the development of a list of measures and strategies for inclusion within the CZMP.

TABLE E3 - LINKAGES BETWEEN KEY ISSUES, ESSENTIAL FEATURES AND MANAGEMENT OBJECTIVES

KEY ISSUES (ranked)	ESSENTIAL FEATURES (R) = regionally valued feature		ADOPTED MANAGEMENT OBJECTIVES
HISTORICAL AND FUTURE DEVELOPMENT	⟷	• Scenic amenity / vista / backdrop • In-absentia values • Nature reserves (R) • Cape Byron Marine Park (R)	⇒	• CONTROL AND MANAGE DEVELOPMENT • INTEGRATE PLANNING POLICIES, LEGISLATION AND REGULATIONS TO MANAGE THE ESTUARY • MAINTAIN AND ENHANCE VISUAL AESTHETICS
POOR WATER QUALITY	⟷	• Swimming / snorkelling	⇒	• IMPROVE WATER QUALITY • REDUCE NUTRIENT, SEDIMENT AND PATHOGEN LOADINGS • IMPROVE MONITORING • REDUCE SEWAGE EFFLUENT RELEASES AND IMPROVE SEWAGE TREATMENT • REDUCE TRACE METAL INPUT • MAINTAIN ENVIRONMENTAL FLOWS
FORESHORE ACCESS	⟷	• Foreshore access (R) • Recreational use of foreshore areas (caravan parks)	⇒	• IMPROVE FORESHORE ACCESS
LOSS AND CONDITION OF RIPARIAN VEGETATION	⟷	• SEPP 26 rainforest (R) • Riparian vegetation / corridors (R) • Swamp forest (R) • Threatened flora and fauna (R)	⇒	• PROTECT AND ENHANCE RIPARIAN ZONE • PROTECT AND ENHANCE TERRESTRIAL HABITATS AND COMMUNITIES
REDUCTION IN AQUATIC HABITAT	⟷	• Aquatic flora and fauna • Cape Byron Marine Park (R) • SEPP 14 wetlands (R) • Seagrass beds, mangroves and saltmarsh communities	⇒	• PROTECT AQUATIC HABITATS
BANK EROSION	⟷	• Scenic beauty	⇒	• REDUCE BANK EROSION
POOR COMMUNICATION / EDUCATION	⟷	• Nature-based activities	⇒	• IMPROVE EDUCATION
POTENTIAL FOR INCREASING TOURISM	⟷	• Tourism (R) • Houseboat tourism • Boat hire	⇒	• DETERMINE SUSTAINABLE TOURISM
FRAGMENTATION OF HABITAT	⟷	• Terrestrial flora and fauna (R)	⇒	• PROTECT AND ENHANCE TERRESTRIAL HABITATS AND COMMUNITIES

KEY ISSUES (ranked)	ESSENTIAL FEATURES (R) = regionally valued feature	ADOPTED MANAGEMENT OBJECTIVES
WATERWAY USAGE CONFLICTS	• Non-commercial recreation (R) • Recreational fishing (R) • Recreational boating (R) • Professional fishing • Charter vessels	• ENCOURAGE PASSIVE RECREATIONAL USE OF WATERWAY INCLUDING NON-MOTORISED VESSELS
SUITABILITY OF EXISTING BOATING FACILITIES	• Slipway and boat ramps	• IMPROVE THE QUALITY OF WATERWAY FACILITIES
DAMAGE TO CULTURAL HERITAGE	• Aboriginal sites (R) • Sites of heritage significance (R)	• CONSERVE ABORIGINAL AND HERITAGE SITES
DECLINING FISH STOCKS AND FISH KILLS	• Nursery ground for fish (R)	• IMPROVE ESTUARY ECOLOGICAL HEALTH AND BIODIVERSITY • PROTECT AQUATIC HABITATS
SEDIMENT QUALITY	• Aquatic flora and fauna (R)	• MANAGE CONTAMINATED SEDIMENTS
REDUCTION IN CATCHMENT VEGETATION	• Biodiversity (R)	• IMPROVE ESTUARY ECOLOGICAL HEALTH AND BIODIVERSITY
REDUCED NAVIGABILITY	• Boat harbour	• REDUCE NUTRIENT, SEDIMENT AND PATHOGEN LOADINGS
ACID SULFATE SOILS	• Aquatic flora and fauna (R)	• MANAGE CONTAMINATED SEDIMENTS
FLOODING	• Areas of narrow waterway	• INTEGRATE PLANNING POLICIES, LEGISLATION AND REGULATIONS TO MANAGE THE ESTUARY
IMPLEMENTATION OF COMPLIANCE	• Commercial use of foreshore	• MAINTAIN AND ENHANCE VISUAL AESTHETICS
SEDIMENTATION	• Sedimentation	• REDUCE NUTRIENT, SEDIMENT AND PATHOGEN LOADINGS
ALTERATION TO NATURAL FLOWS	• Areas of wide open waterway	• CONTROL AND MANAGE DEVELOPMENT
COMMERCIAL USAGE	• Commercial oyster industry • Commercial use of foreshore	• INTEGRATE PLANNING POLICIES, LEGISLATION AND REGULATIONS TO MANAGE THE ESTUARY

APPENDIX F – BANK STABILISATION OPTIONS

Full Bank Protection

Full protection of the bank usually involves covering the effected bank with an erosion resistant surface, be it rock or some other material. Full bank protection options are outlined below.

OPTION A - Rock Revetment with Buried Toe Apron

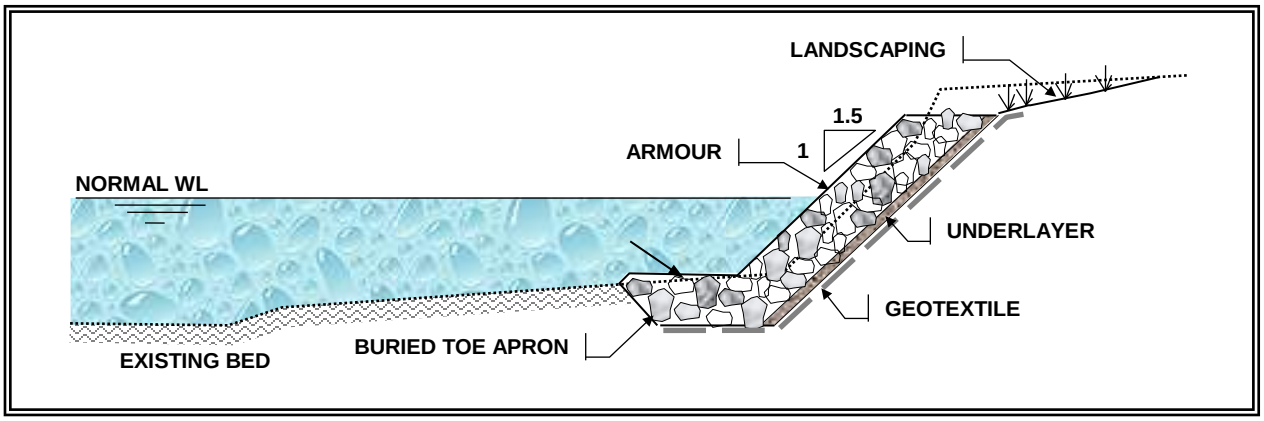


Figure A: Rock Revetment with Buried Toe Apron – *Option A*

- Directly protect affected bank with a sloping rock revetment.
- Wall design typically incorporates armour layer, under layer of smaller units and geotextile to prevent fines washing through the revetment.
- A toe apron is required to protect against toe scour and is buried to minimise impacts on stream conveyance.
- Upper bank landscaping improvements could be incorporated.

ADVANTAGES:

- flexible and durable in design
- simple and low maintenance
- provides some new habitat value

DISADVANTAGES:

- high cost
- difficult to construct below water level
- artificially hardens soft banks
- decreases access to water
- most vulnerable area (toe) is out of sight
- changes existing habitat by excluding riparian vegetation
- does not allow for significant vegetation to be incorporated
- if not properly designed hydraulically, may result in changes flow patterns and erosion problems elsewhere

OPTION B - Rock Revetment with Self Launching Toe Apron

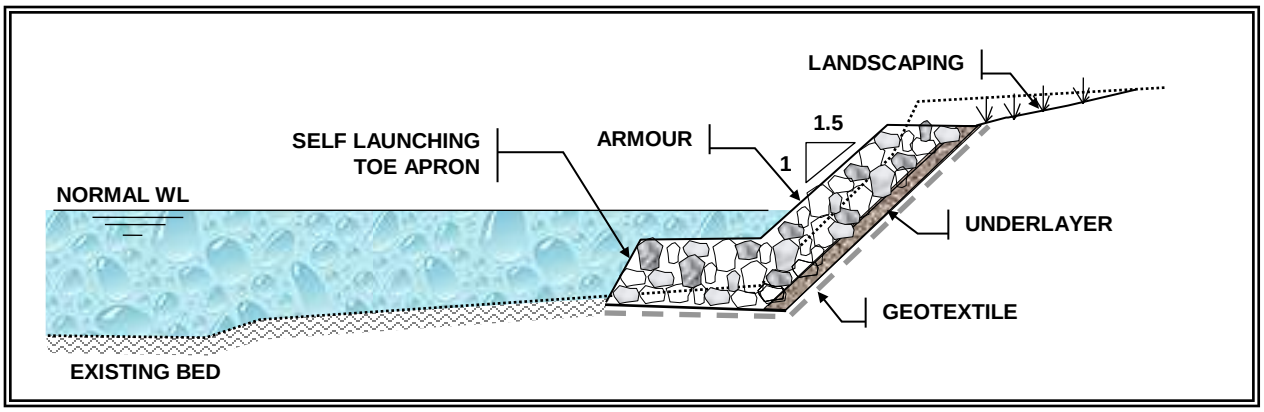


Figure B: Rock Revetment with Self-Launching Toe Apron – *Option B*

- Directly protect affected bank with a sloping revetment.
- Wall design typically incorporates armour layer, underlayer of smaller units and geotextile to prevent fines washing through the revetment.
- The toe apron is placed directly on the current bed level to facilitate underwater construction. In the event of bed scour the toe apron will collapse into the scour hole forming a natural inverse armour and filter layer.
- Upper bank landscaping improvements could be incorporated.

ADVANTAGES:

- flexible and durable in design
- simple and low maintenance
- self-positioning
- provides some habitat value

DISADVANTAGES:

- high cost
- difficult to construct below water level
- impedes into conveyance area
- possible hazard to water users (eg. swimmers, boaters)
- artificially hardens soft banks
- decreases access to water
- most vulnerable area (toe) is out of sight
- changes existing habitat by excluding riparian vegetation
- does not allow for significant vegetation to be incorporated
- if not properly designed hydraulically, may result in changes flow patterns and erosion problems elsewhere

OPTION C - Gabion Wall on Reno Mattress Toe Apron

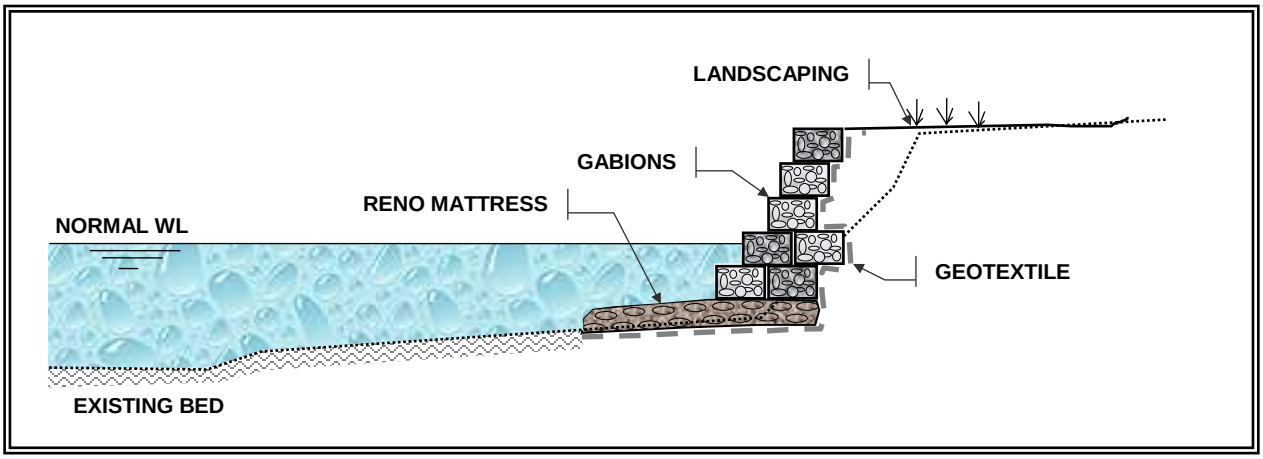


Figure C Gabion Wall on Reno Mattress Toe Apron – *Option C*

- Stone filled wire baskets which enable a smaller size and thickness of rock than conventional rock protection.
- Baskets are stacked to form a stable, protective wall.
- Reno mattress is used to provide a flexible toe protection.
- Upper bank landscaping improvements could be incorporated.

ADVANTAGES:

- mainly used where conventional armour rock is not readily available
- greater accuracy of placement possible
- some habitat value
- can be designed to have long life with minimal maintenance

DISADVANTAGES:

- construction difficulties below water level
- artificial hardening of soft banks
- reduced access to water
- damaged structure may be costly to repair
- changes existing habitat by excluding riparian vegetation
- does not allow for significant vegetation to be incorporated
- if not properly designed hydraulically, may result in changes flow patterns and erosion problems elsewhere
- wire baskets may corrode in an estuarine environment

OPTION D – Masonry or Block Wall

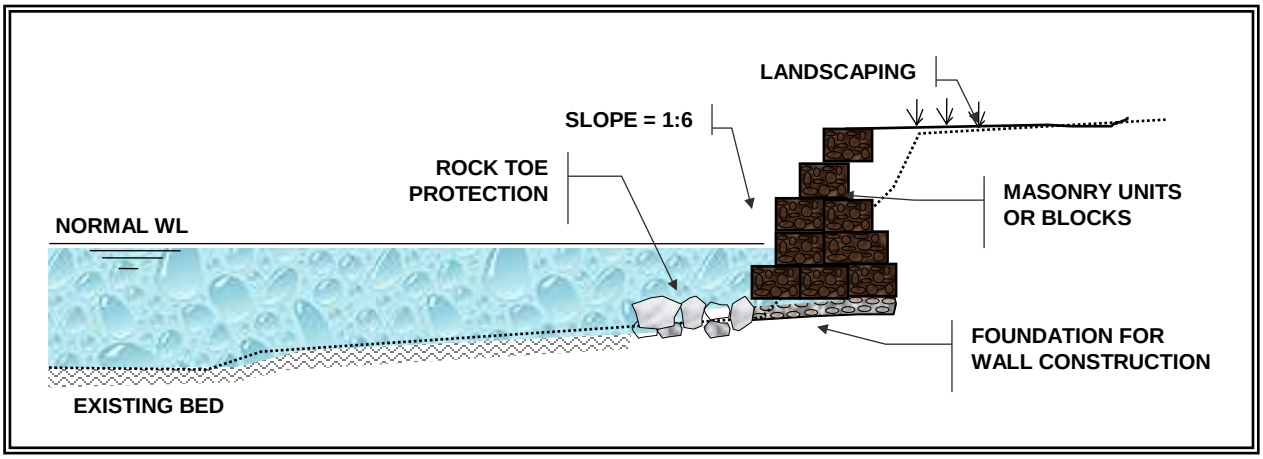


Figure D Masonry or Block Wall– *Option D*

- Masonry or block wall constructed to provide vertical bank and toe scour protection
- Toe protection facilitated by rock placement of toe of wall
- Upper bank landscaping improvements could be incorporated

ADVANTAGES:

- Vertical wall may be placed in location so as not to impede on conveyance area or private land

DISADVANTAGES:

- Hardening of soft banks
- Diminishing access to water
- Limited flexibility
- Foundation required as base for wall, difficult to construct, will require a cofferdam
- Very limited habitat value

OPTION E - Structural Membrane

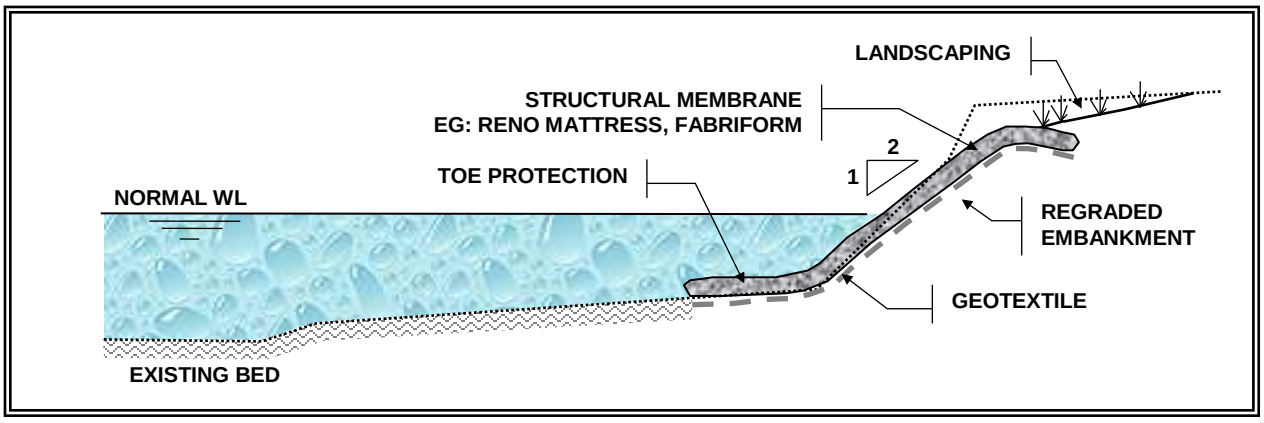


Figure E: Structural Membrane – *Option E*

- A flexible rock filled mattress or a concrete mattress consisting of a grout injected nylon cushion.
- Mattress forms a laminate over the regraded embankment.
- Reno mattress is lined with geotextile to prevent fines washing through the mattress.
- Upper bank landscaping improvements could be incorporated.

ADVANTAGES:

- can be used where conventional rock armour is not readily available
- semi-flexible protection (ie. not solid structure)
- does not intrude into waterway
- can provide scope for upper bank landscaping improvements

DISADVANTAGES:

- does not provide structural stability to bank slope (ie. scour protection only)
- construction difficulties below water level
- hardening of currently soft banks
- regraded slope may intrude onto private land
- any loss of covering may lead to more severe erosion
- not suited to areas of wave activity (eg. long wind fetches and/or heavy boat action)
- changes existing habitat by excluding riparian vegetation
- does not allow for significant vegetation to be incorporated
- if not properly designed hydraulically, may result in changes flow patterns and erosion problems elsewhere

OPTION F - Reconstruct Revetment using Existing Materials

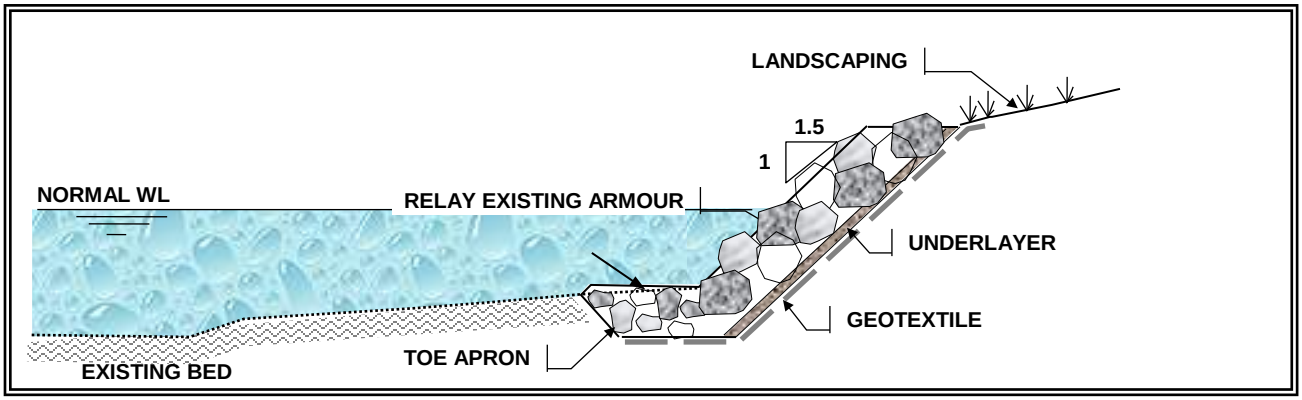


Figure F: Reconstruct Revetment using Existing Materials – *Option F*

In some sections of the river, historic rock revetments are in evidence. However, for a number of reasons, mostly due to poor design and/or poor construction, some sections of this bank protection is no longer effective. As such, options have been investigated for repairing existing bank protection. In some locations, the existing bank protection materials are inappropriate, and construction of an entirely new revetment, or similar, would be necessary to achieve the desired bank protection.

This option can be adopted where the existing revetment utilises the correct materials, but the construction has been poor. For example, where large armour stone have been placed directly on banks with no sub-layer or geotextile protection, the existing stones can be removed, an appropriate substructure constructed, and the armour stones then replaced.

In this way, savings can be made as primary armour stones do not need to be purchased.

OPTION G - Top-Up Existing Revetment with Additional Material

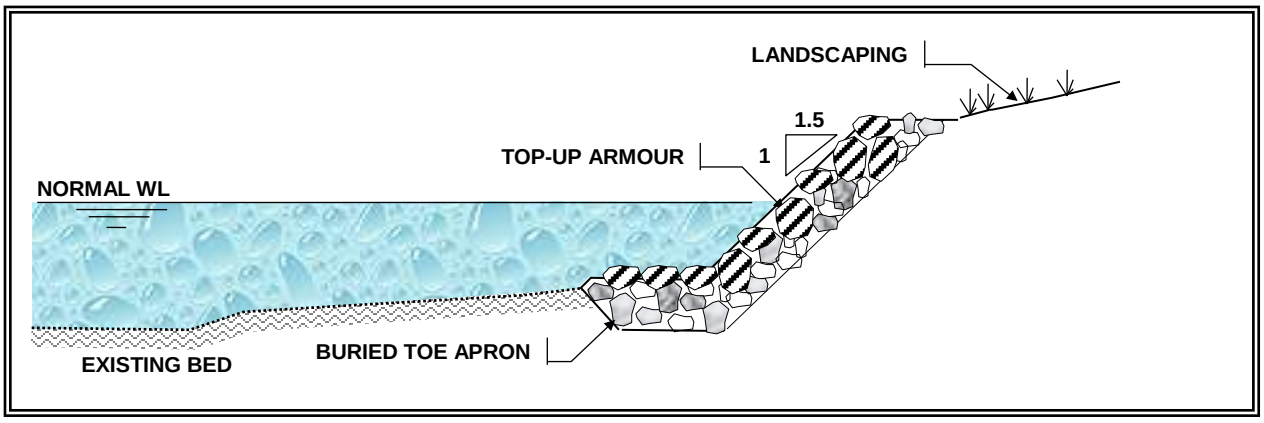


Figure G: Top-up Existing Revetment with Additional Material – *Option G*

Where the existing revetment is effective to some degree, but simply doesn't have enough material to be completely effective at preventing bank erosion, additional armour material can be placed directly onto the bank without the need for reconstruction of the complete revetment.

This option would involve minimal cost, as the additional rock could simply be dumped into the required location without need for precision placement.

OPTION H – Rock supported toe and bank regrading

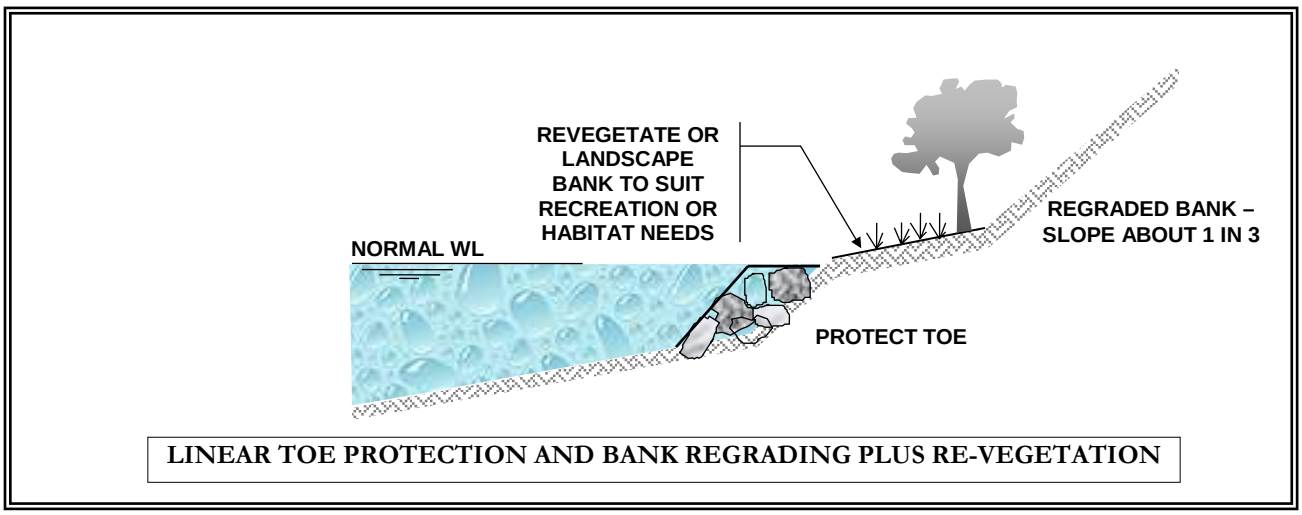


Figure H: Bank Regrading – *Option H*

- Vegetate bench for habitat or provide for recreation, eg: walkway
- Width to suit function of bench
- Can incorporate planform features such as a small beach front for boating access

ADVANTAGES:

- Access to water can be provided
- Vegetation can provide wildlife habitat
- Improves conveyance area for all but low flows

DISADVANTAGES:

- Construction of toe protection below water level
- Regraded slope may impede on private land

OPTION I - Local rock protection and anchoring of valuable trees / vegetation

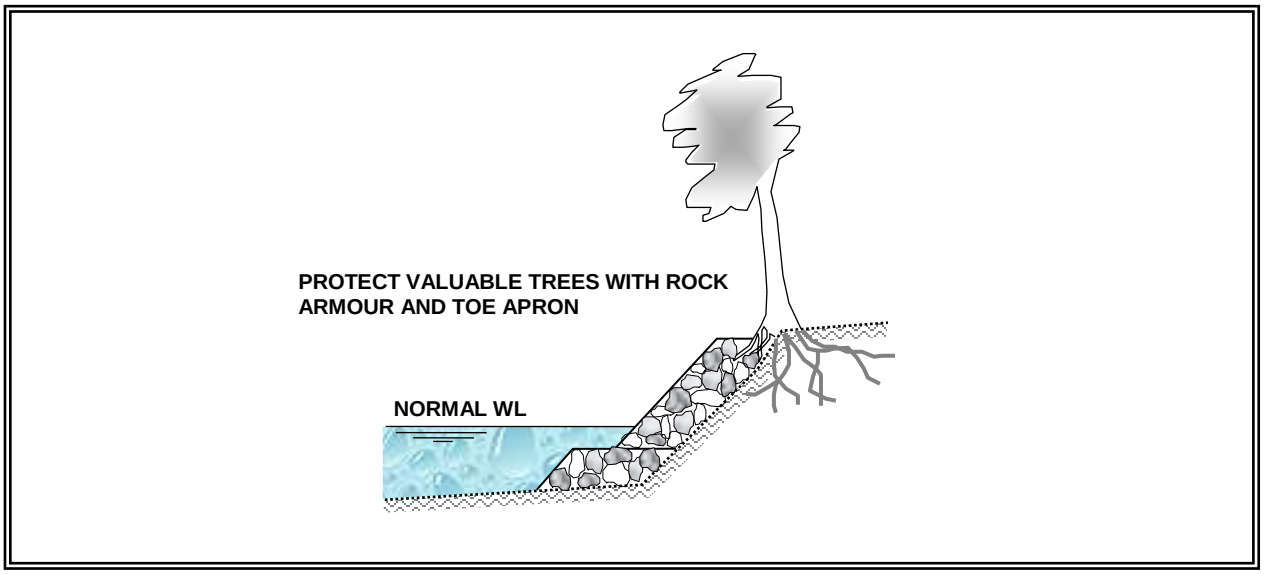


Figure I: Local Rock Protection and Anchoring of Valuable Trees – *Option I*

Protect valuable threatened trees with rock armour surrounding the exposed roots. The rock armour should include a toe apron to prevent undermining and should be cut into the bank at the sides to prevent outflanking.

ADVANTAGES:

- protects valuable trees
- can provide additional habitat value

DISADVANTAGES:

- hardens previously soft banks
- not a long-term solution (ie. high maintenance costs and risk of failure)
- if not properly designed hydraulically, may result in changes flow patterns and erosion problems elsewhere

OPTION J - Cutting of trees and roots

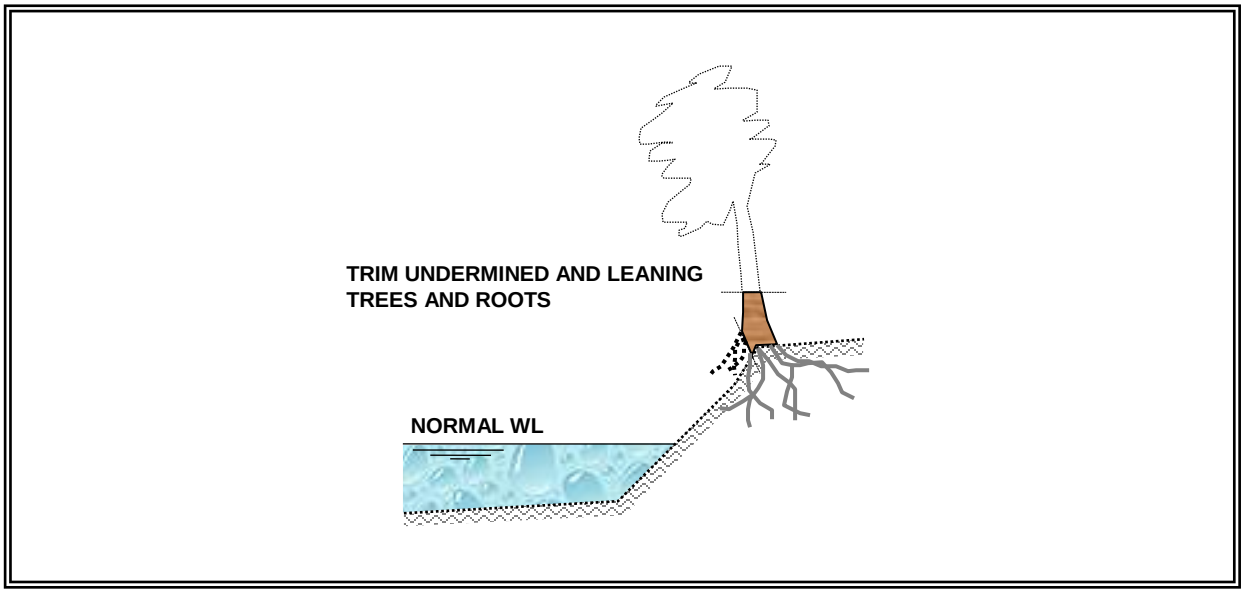


Figure J: Cutting of Trees and Roots – *Option J*

Cutting of trees and roots which are under immediate threat of erosion

- Cut and trim trees that have become undermined or are leaning, to remove the threat to public safety and to avoid the potential for local bank scour or failure. Any tree cutting should be complementary to a program of riparian vegetation enhancement.
- Cutting or lopping of river bank trees requires a permit from DLWC under the Native Vegetation Conservation Act, 1997, while lopping or removal of mangroves requires a permit from NSW Fisheries

ADVANTAGES:

- can minimise scour in the area where the trees were located
- reduces threat to public safety due to falling trees
- eliminates threat of navigation hazard
- logs and brush from tree could be utilised in landscaping / habitat restoration programs
- significantly lower cost than the removal of a fallen tree from the river.

DISADVANTAGES:

- reduces aesthetic value
- damages habitat

OPTION K - Large Organic Trees or Debris

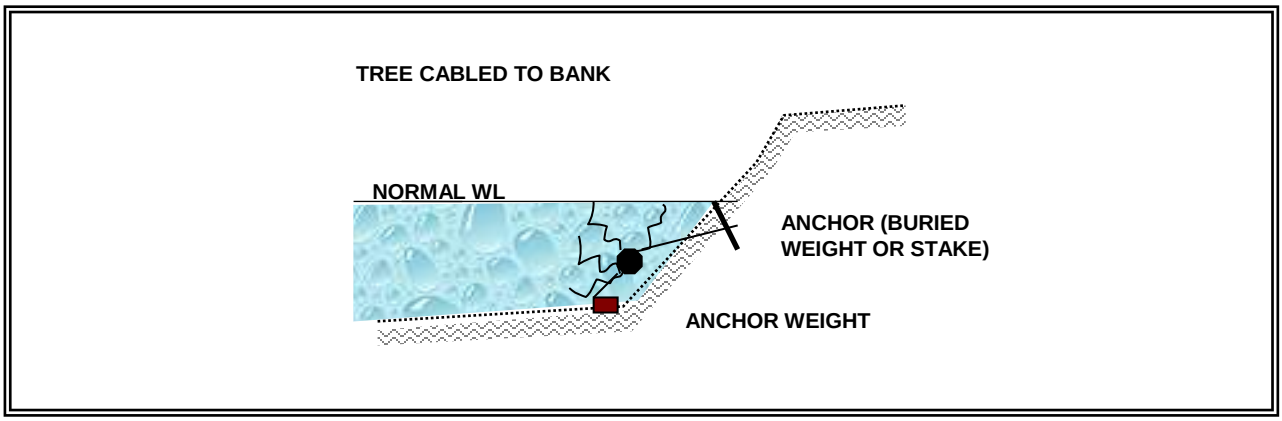


Figure K - Large Organic Trees or Debris – *Option K*

Organic debris is aligned along the toe of the bank and is held in place with an anchor weight on the existing river bed and anchor staked into the bank

- Re-organise existing large tree debris within channel to protect toe
- Trim large root wads and branches and align trees along the toe in a head to tail fashion
- Tie trees to bank by means of a cable attached to a deadman anchor (concrete block) on the bed and an anchor or stake buried into the bank
- Short lengths of protection may lead to local scour – suggested minimum length is three channel widths

ADVANTAGES:

- utilises existing debris and cleans up channel
- helps to trap sediment and establish a natural vegetated bank
- diverse habitat value

DISADVANTAGES:

- only applicable to straight reaches

OPTION L - Gravel or cobble fillets on berm

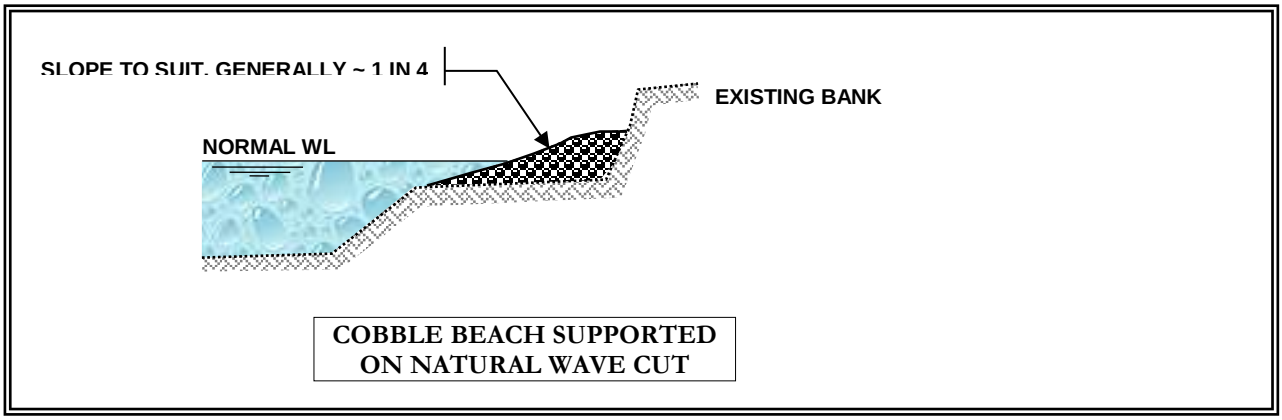


Figure L: Gravel or Cobble Fillet on Berm – *Option L*

Where wave action has eroded the riverbank at the water level, and bank recession has resulted in a shallow underwater bench, a fillet of cobbles or gravel could be placed on the bench to prevent further wave attack of the bank. It is important that the cobble fillet extend to above the wave run-up level, otherwise the overall integrity of the option would be compromised.

- Fill existing sub- or inter- tidal benches with a cobble/gravel fillet to absorb wave energy.

ADVANTAGES:

- simple but effective solution to wave erosion problem
- vegetation can be planted to provide habitat and further stabilisation, eg mangroves (salty), and phragmites (brackish)
- create valuable intertidal habitat
- can improve access to water

DISADVANTAGES:

- only applicable where there is a significant low tide bench in front of the bank
- appropriate only where banks are relatively low
- not suited to deep-seated failures
- flood velocities must not be high (ie, less than 1.5 m/sec)

OPTION M - Gravel or cobble fillets behind a rock toe

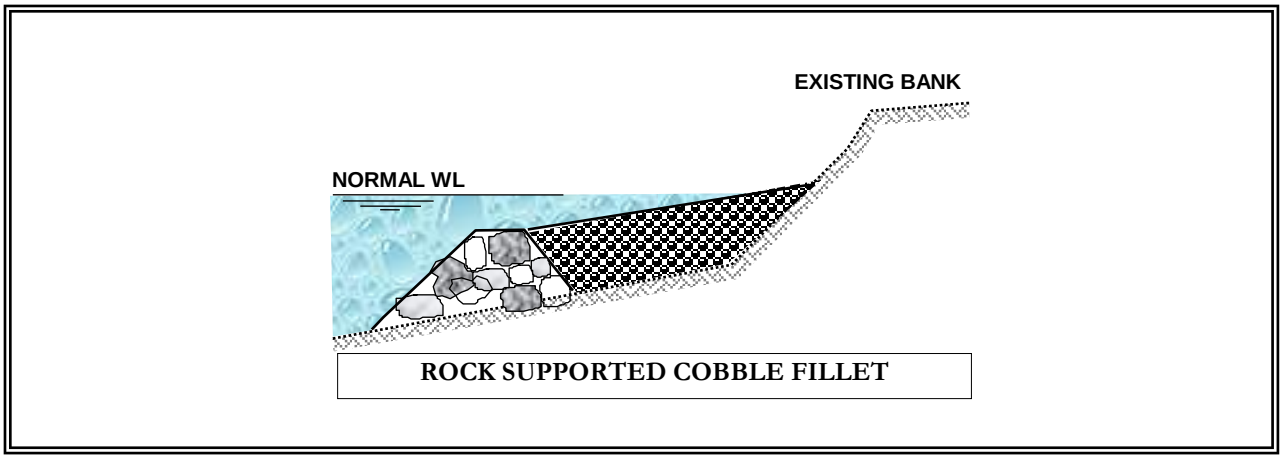


Figure M: Gravel or Cobble Fillet behind Rock Toe – *Option M*

For sections of the riverbank which are affected by wave erosion at the water level but an underwater bench is not present, a gravel or cobble fillet can be adopted, as above, but supported by a small rock toe.

- Create an artificial bench supported by a rock berm or and possibly vegetate to absorb wave energy.

ADVANTAGES:

- simple but robust solution to mild wave erosion problem
- vegetation can be planted to provide habitat and further stabilisation, ie mangroves or phragmites
- create valuable intertidal habitat
- can improve access to water

DISADVANTAGES:

- requires shallow water at low tide
- appropriate only where banks are relatively low
- must be no toe scour potential

OPTION N - Phragmites or Mangrove Planting Behind Rock Toe

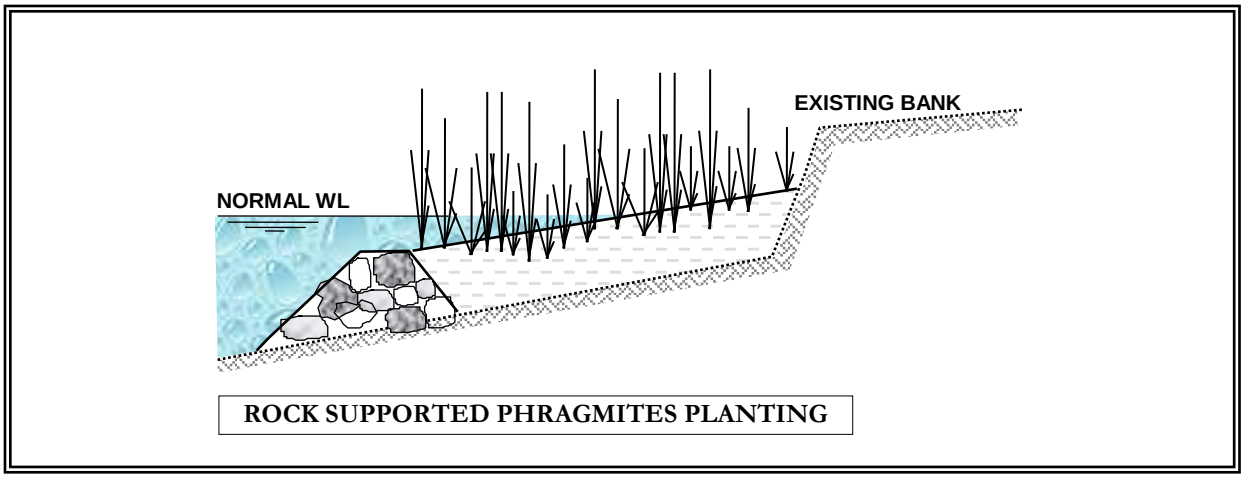


Figure N: Phragmites / Mangrove Planting behind Rock Toe – *Option N*

As an alternative to cobble fillets, phragmites can be planted in front of the eroding bank to provide protection against wave attack. Phragmites provide an effective resistance against waves reaching the bank. The effectiveness of stands of lush phragmites in protecting the adjacent bank can be seen at a number of locations around the Tweed estuary. A layer of granular material would be required to plant the phragmites into. This material would then require support by way of a small rock toe.

Intertidal phragmites plantings could be carried out in combination with additional revegetation of the riverbank. Specific species should be planted in combination with phragmites so that the phragmites would not become over-shadowed. Alternatively, if existing river bank vegetation is retained, overhanging trees would need to be trimmed in order to maintain phragmites.

ADVANTAGES:

- simple solution to wave erosion problem
- create valuable intertidal habitat
- aesthetically pleasing
- can improve access to water

DISADVANTAGES:

- appropriate only where banks are relatively low
- flood velocities must not be too high (ie, up to 2 m/s)
- not suitable in areas of pronounced river bed scour

OPTION O - Phragmites or mangrove planting behind a wave wall

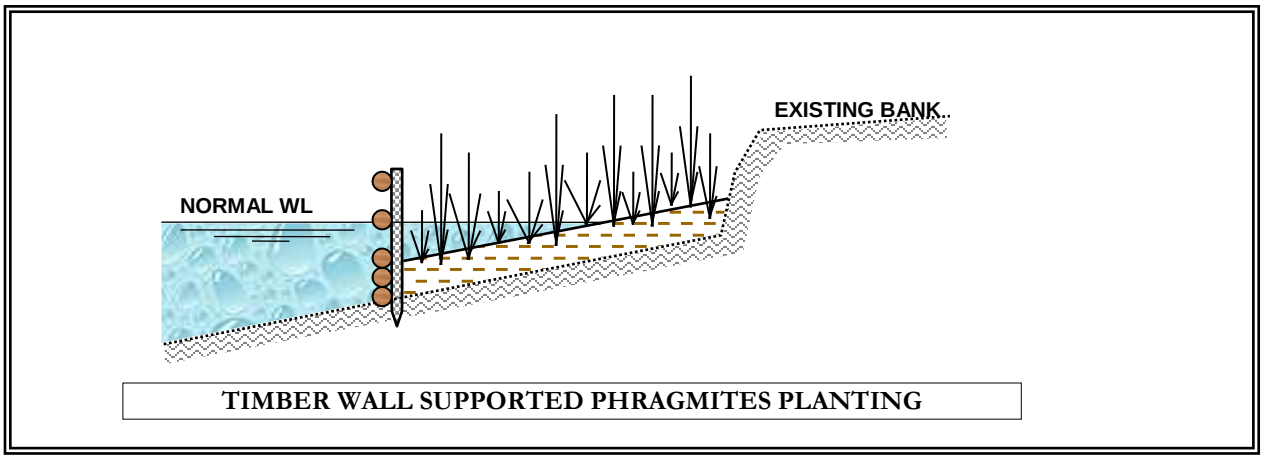


Figure O: Phragmites or mangroves behind Wave Wall – *Option O*

Where the underwater bank is relatively steep, or the wave energy relatively high, phragmites can be planted behind a wave wall. The lower portion of the wave wall would provide an effective toe for the granular material in which the phragmites are planted, while the upper portion of the wall would provide some energy dissipation of waves approaching the riverbank.

Intertidal phragmites plantings could be carried out in combination with additional revegetation of the riverbank. Specific species should be planted in combination with phragmites so that the phragmites would not become over-shadowed. Alternatively, if existing river bank vegetation is retained, overhanging trees would need to be trimmed in order to maintain phragmites.

ADVANTAGES:

- simple solution to mild wave erosion problem
- can improve access to water
- timber wall protects phragmites more than rock toe option – assists establishment of phragmites
- can be used for steeper underwater slopes
- create valuable intertidal habitat

DISADVANTAGES:

- appropriate only where banks are relatively low
- flood velocities must not be too high (ie, up to 2 m/s)
- not suitable in areas of pronounced river bed scour

OPTION P – Plant Riparian Vegetation

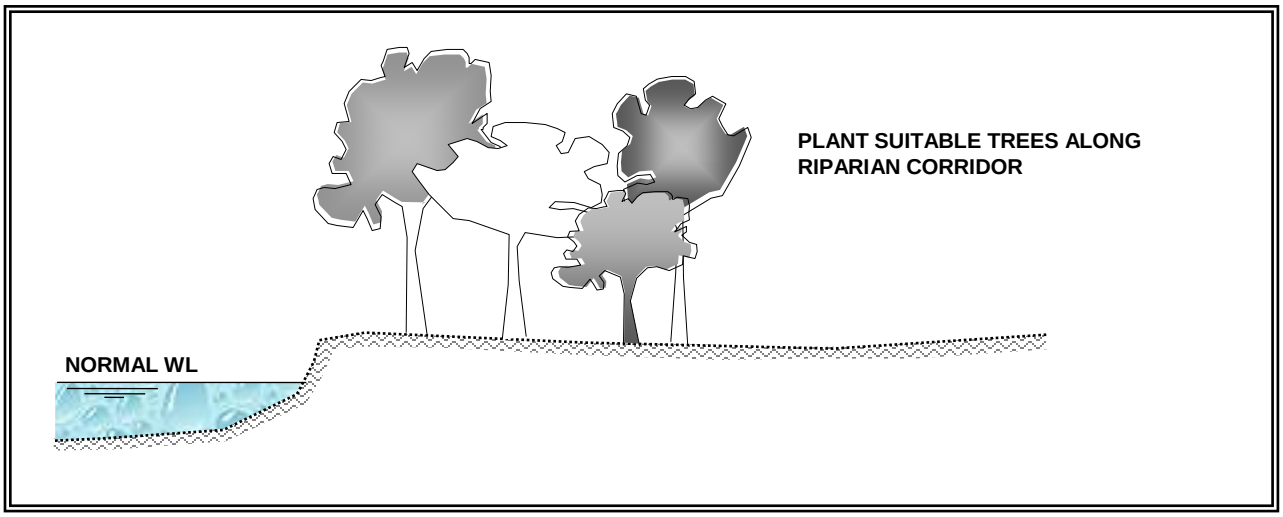


Figure P: Plant Riparian Vegetation – *Option P*

Riparian vegetation has significant potential to reduce bank erosion. As stated earlier, the root system of riparian vegetation acts to bind together the bank soil structure, making it more resilient to scour, seepage and slumping. In addition to the structural benefits, planting riparian vegetation introduces significant habitat values, aesthetic values and a valuable buffer / filter strip between the land and the waterway. Such vegetated filter strips have been shown to reduced surface runoff pollutants (ie, sediment and nutrients) entering the waterway.

At suitable locations, appropriate tree species could be planted to improve the overall stability of the river bank along the riparian corridor.

ADVANTAGES:

- aesthetic improvement
- relatively inexpensive
- provides increased protection through the following processes:
  - ⇒ leaves and branches of low-growing foliage help to dissipate flow at the surface of the soil, thereby reducing the erosive flow along the riverbank. This can ultimately result in sediment deposition around plants, eventually increasing further colonisation and diverting flow
  - ⇒ a shallow root mat (as provided by most grasses) can armour the soil surface, preventing disaggregation and subsequent loss of sediment
  - ⇒ deeper roots can reinforce soil as well, aiding in the prevention of deep-seated geotechnical failures
  - ⇒ deep roots can also provide an effective path for drainage, thereby reducing the "drawdown" effect and slumping (as a result of falls in river water level)

DISADVANTAGES:

- Care needs to be taken with species selection to ensure appropriate native vegetation for any given situation
- Will require maintenance for up to three years to ensure adequate establishment of vegetation
- could be damages by extreme event
- not applicable to oversteepened banks
- may require river bank regrading
- could be damaged by storm events or bushfire

- ⇒ extensive tree planting helps to control riverbank soil moisture, reducing the risk of excessive pore pressure in wet conditions and reducing the likelihood of soil shrinkage and cracking during extended dry conditions
- ⇒ many vegetative types are self maintaining, regrowing after damage and filling any gaps in the protection
- ⇒ commercial products such as reinforced turf are also available

- surface runoff is intercepted and dissipated by vegetation, leading to potential deposition of sediment (soil building) and filtering of soil-bound pollutants (nutrients, pesticides, petrochemicals etc)

- may obscure views of the waterway

OPTION Q - Bank regrading

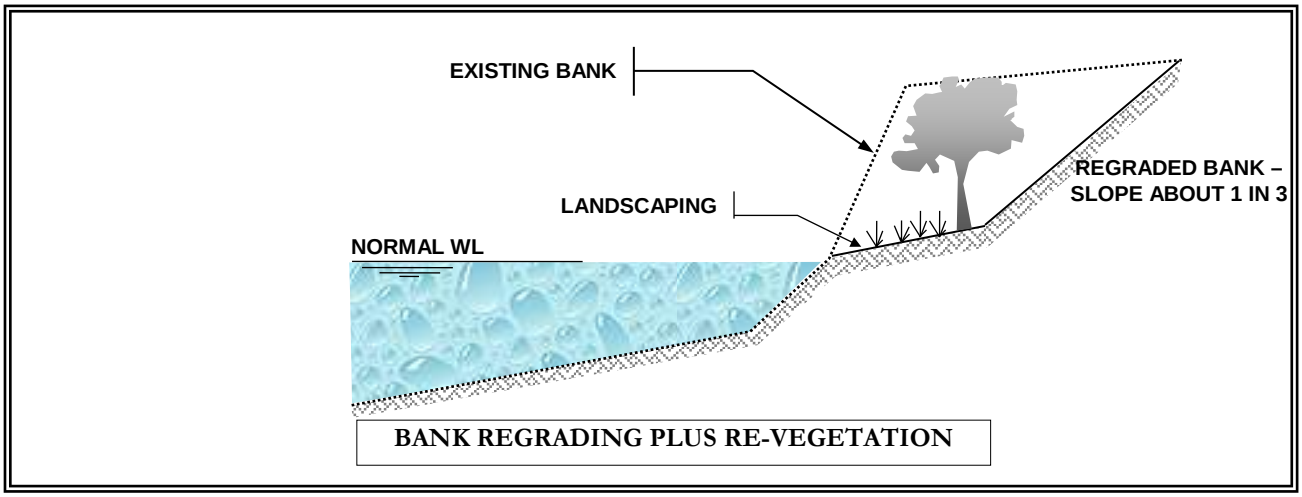


Figure Q: Bank Regrading – *Option Q*

Overly steep banks have a greater tendency to collapse, under the weight of surcharge loading, or through groundwater seepage. Regrading of an upper slope can also be adopted for banks experiencing toe scour, however, under such circumstances, the toe of the slope would need to be additionally protected (refer previous options).

- Vegetate bench for habitat or provide for recreation, eg walkway.
- Width to suit function of bench.
- Can incorporate planform features such as a small beach front for boating access.
- Cost depends on height of bank to be regraded.

ADVANTAGES:

- relatively simple and inexpensive process
- reduces the slope of the bank, thereby decreasing its likelihood of failure.
- provides area for vegetation
- aesthetically attractive

DISADVANTAGES:

- may initially damage habitat
- requires sufficient strip of riparian land

OPTION R - Create sandy beaches

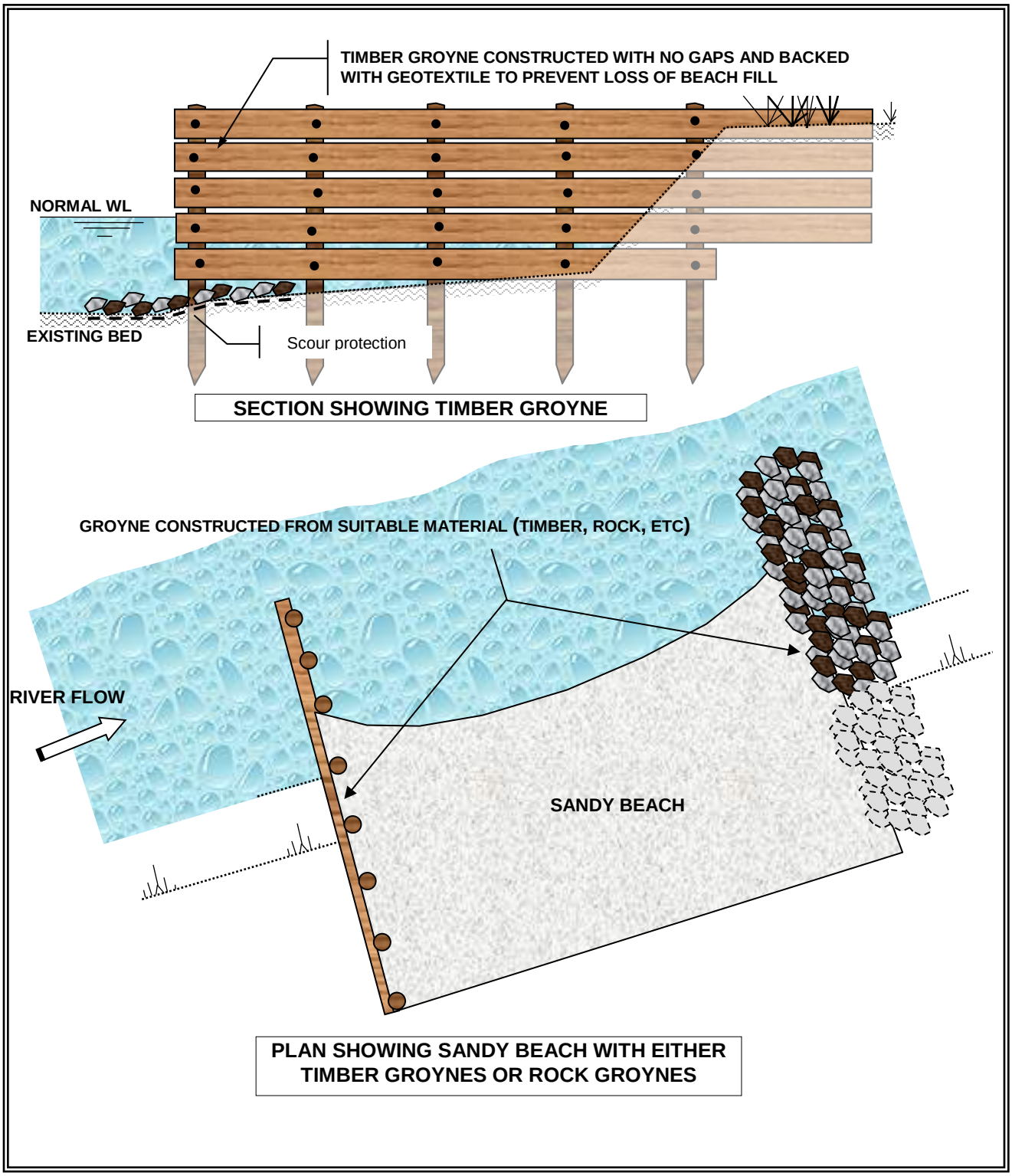


Figure R: Create Sandy Beaches – *Option R*

Sandy beaches can be created in areas of existing bank erosion, particularly areas of wave induced erosion. Firstly, banks are regraded on shallow slopes (typically 1 in 7 to 1 in 10), and a layer of sand, approximately 0.5 metres thick is placed from below low

water to above the wave run-up level. Groynes are usually required to prevent the sand from being transported away from the site under combined wind wave and tidal / flood current conditions.

ADVANTAGES:

- reduces the slope of the bank, thereby decreasing its likelihood of failure.
- provides area for recreation – multi-functional
- aesthetically attractive
- can be adopted in more erosive sites than other non-structural options
- cheaper than full bank revetment options

DISADVANTAGES:

- may initially damage habitat
- requires sufficient strip of riparian land
- associated costs can be high

OPTION S - Coir Logs

Coir logs are densely packed densely packed and biodegradable coconut fibre tubes anchored to the toe of riverbanks to provide short-term protection while vegetation is established. Coir logs are secured along river banks to help prevent scour and erosion. They create a soft toe armour that provides short-term protection and encourages revegetation landward of the log. Vegetation landward of the log slows water velocity and aids accretion of sediment at the toe of the bank.
Coir logs are may be used to stabilise banks that are undergoing erosion due to uncontrolled access (either boat launching, human or animal trampling), toe erosion with upper bank failure, and erosion by wind waves.
Installation of coir logs is usually combined with revegetation works.

ADVANTAGES:

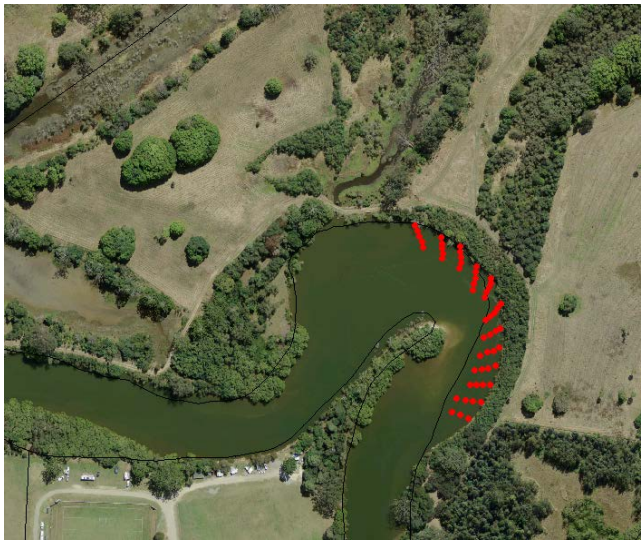
- creates habitat and stabilises the bank with vegetation
- inexpensive, light weight and easy to install
- flexible to curve around banks and vegetation

DISADVANTAGES:

- not for regions of high flow velocity
- susceptible to undercutting and removal
- may locally enhance wave reflection and scour where the wind waves and wake occur

OPTION T - Timber Groynes

This method of bank stabilisation involves driving timber piles into the river bed and alignment of bank to minimise near bank flows and to trap sediment for vegetation establishment. Piles are usually installed from a barge using an excavator mounted pile driver. Each pile is ideally 4-6m long and installed a minimum 2m into the lower bank, however, can depend on the bathymetry of the river bank.
Piles are placed in tight rows with the space between piles less than 10cm. Rows of piles are oriented upstream at an angle of approximately 30 degrees from the bank. There should be overlap between rows such that the river bank is not exposed to wave action.
Use of timber piles is considered preferable when woody debris is a natural feature of the river and rock (particularly boulders and cobble) is generally absent.



OPTION U – Formalisation of public access

Public access formalisation using recycled plastic material works well in estuary conditions compared to the active open swash zone. Recycled plastic step treads aren't structural and need a structural support like composite fibre or the like to support the plastic and have been used recently by Ballina Shire Council at the Pat Morton Lookout, Lennox Head.

Example picture of recycled plastic walkway to a bathing area.

Aluminium grade portable stairs can be designed to be rigid and adjustable with features to accommodate a variety of waterfront applications. Marine grade aluminium steps can be used in areas of steep gradients and can be removed/lifted away, are on a hinge and are cheap to replace if bent in the active swash zone.

Example picture of aluminium grade stair case.

APPENDIX G - FUNDING OPTIONS

NSW DEC Environmental Trust

The Environmental Trust is an independent statutory body which funds environmental restoration, rehabilitation, research and education projects that benefit the environment of New South Wales, as well as land acquisition for the national parks estate. The Trust provides grants in the following categories:

- Restoration and Rehabilitation
- Education
- Research
- Eco Schools
- Saving Our Species Partnership
- Protecting our Places
- Lead Environmental Community Program
- Emergency Pollution Cleanup Program

The Environmental Trust is administered by the Office of Environment and Heritage (OEH).

The most applicable grants for implementing works in the CZMP relate to Research, Restoration and Rehabilitation, and the Lead Environmental Community Program.

The aim of the Environmental Research program is to support applied research projects that help address environmental problems in NSW.
The objectives of the program are to:

- Generate new knowledge or information to facilitate local solutions to environmental problems
- Discover new methods of operation for NSW industries that are less harmful to the environment and enhance public good
- Knowledge and advance techniques to solve general environmental problems in NSW
- Assess and evaluate application of innovative solutions to decrease environmental degradation in NSW

The aim of the Restoration and Rehabilitation Program is to facilitate projects run by community organisations and government entities working to prevent or reduce environmental degradation of any kind. Through these projects, we also aim to improve the capacity of communities and organisations to protect, restore and enhance the environment.

The LECG Grants Program aims to assist eligible lead environmental community organisations build the capacity of the NSW community to protect and conserve our environment. The program provides grants to assist eligible lead environmental community organisations in NSW to deliver community education and/or capacity building activities that:

- actively involve the community in projects to protect and enhance the natural environment
- raise community awareness, understanding and information-gathering of environmental issues with a view to bringing about behavioural change across the community
- empower the local community to take an active role in decision-making by building community skills and capacity and providing a greater sense of community ownership of our environment
- assist the community to deliver activities that support the government's environmental objectives.
- The program will support new or existing educational activities that develop or widen the community's knowledge, skills, and participation in protecting the environment and undertaking sustainable behaviour.
- Conservation Volunteers Australia

Conservation Volunteers Australia works in partnership with Regional Bodies, Local Councils, National Parks and community groups across Australia to increase community involvement in practical NRM activities. In addition to providing teams of managed volunteers, CVA is now able to offer project partners training and support in volunteer risk management.

http://www.environment.nsw.gov.au/grants/envtrust.htm

North Coast Local Land Services

The functions of the LLS include (but are not limited to):

- Preparing a Catchment Action plan (CAP) and associated investment strategies that integrate and enhance the Catchment Blueprints and the regional vegetation management plans;
- Managing incentive programs to implement the CAP;
- Providing all landholders with access to data and relevant information to prepare Property Vegetation plans (PVPs);
- Allocating funds to support the development of PVPs - including incentives; and,
- Providing education and training on natural resource management, especially in vegetation management.

The North Coast LLS delivers a number of funding programs to implement projects that contribute to targets in the Northern Rivers Catchment Action Plan. Opportunities for project delivery are competitive, and are advertised on the North Coast's website at http://northcoast.lls.nsw.gov.au/.

Public Reserves Management Fund (Department of Industry - Lands)

The Public Reserves Management Fund provides loan monies and limited grants to trust boards. These funds are available for improvement works to Crown reserves and provide for both capital development and maintenance projects.

NSW Heritage Incentives Program

The NSW Heritage Incentives Program supports the community's identification, conservation, management and promotion of NSW heritage.
Quick Summary of the 8 Heritage Incentive Programs

- Site works and presentation projects - called every two years.
- Heritage study and promotion projects - called every two years. Aboriginal heritage projects - applications can be made at any time.
- Conservation management plans on items of State heritage significance - $2,500 per project. Applications can be made at any time.
- Special purpose small grants and loans projects - upper limit of $5,000 per project but subject to special conditions. Applications can be made at any time.
- Local government heritage management - three year service agreements to local councils for heritage advisory services, heritage studies, local heritage funds, etc. Applications can be made at any time.
- Support to heritage related organisations - for example, the National Trust.
- Local history and archives projects run by the Royal Australian Historical Society - once a year, applications closing in May each year.

NSW Coastal and Estuary Grants Program (OEH)

Under the Coastal and Estuary Grants Program, the NSW Government provides technical and financial support to local government, to assist in managing the coastal zone. For these investigations and activities outlined a 50% subsidy is available administered by the Office of Environment and Heritage (OEH). Activities eligible for subsidy include data collection and review, surveys, the undertaking of estuary process and estuary management studies, the preparation, display and review of estuary management plans, and the undertaking of management activities recommended in the plan, including works, public awareness programs, monitoring activities, etc.

The objectives of the Coastal and Estuary Grants Program are to support local government in:

- managing the risk from coastal hazards
- coastal erosion
- restoring degraded coastal habitats
- improving the health of NSW estuaries, wetlands and littoral rainforests.

Funding Coastal and Estuary Planning is available for to:

- develop a Coastal Management Program (CMP)
- transition a Coastal Zone Management Plan (CZMP) to a CMP
- undertake investigation and designs or cost benefits analyses for infrastructure works recommended in a certified CZMP or CMP.

Funding for implementing works is available for:

- erosion reduction management and beach nourishment
- action ton reduce future risk from coastal hazards
- habitat restoration and conservation

This funding program is the primary source of monies that is available and will be sourced by BSC for the implementation of works outlined in the management strategies in this CZMP. Funding closes 30 June 2017.

http://www.environment.nsw.gov.au/coasts/coastalgrants.htm

NSW Recreational Fishing Trust

When fishing in NSW waters, both freshwater and saltwater, recreational fishers are required by law to pay the NSW Recreational Fishing Fee. All money raised by the NSW Recreational Fishing Fee is placed into the Recreational Fishing Trusts and spent on improving recreational fishing in NSW.

Funding is available for a wide range of projects:

- recreational fishing education fishing workshops
- fishing access and facilities fishing platforms
- research on fish and recreational fishing
- recreational fishing enhancement fish aggregating devices
- aquatic habitat rehabilitation and protection (Separate funding - see below)
- enforcement of fishing rules fisheries officers

http://www.dpi.nsw.gov.au/fishing/recreational/recreational-fishing-fee/licence-fees-at-work/apply-for-funds

Habitat Action Grants Program

Angling clubs, individuals, community groups, local councils and organisations interested in rehabilitating fish habitats in freshwater and saltwater areas throughout NSW can apply for grants.
Habitat rehabilitation projects which may be funded include:

- removal or modification of barriers to fish passage
- rehabilitation of riparian lands (river banks, wetlands, mangrove forests, saltmarsh)
- re-snagging waterways with timber structure
- removal of exotic vegetation from waterways
- bank stabilisation works
- reinstatement of natural flow regimes

These grants are available around August each year.

http://www.dpi.nsw.gov.au/fishing/habitat/rehabilitating/ahr-grants-program

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/589761/Recreational-Fishing-Trusts-funding-guidelines-Jan-2016-Final.pdf

NSW Maritime Infrastructure Program

The Maritime Infrastructure Program (MIP) enables the NSW Maritime Authority, by funding waterway infrastructure, to greatly improve amenities for the boating public and marine sector on New South Wales waterways. Projects eligible for funding could include; the provision of public sewage pump out sites; boat ramps; public wharves/jetties; installation of navigation aids; installation of public moorings.

Under MIP, the NSW Maritime Authority will allocate funds to projects which demonstrate a positive contribution to the Program's objective. More favourable consideration will be given to projects which represent best available solutions to the problems they are addressing, are cost effective, have a level of financial contribution and are for the benefit of the boating community and marine sector. Funds will be allocated on a priority basis taking into account issues raised by the boating community, and assessments of safety, environmental, amenity and socio-economic benefits. There will be in the order of $2 million available annually, through the NSW Maritime Authority, for funding various projects approved under MIP. The size of the Program will be dependent on the financial contribution from the proponents.
Applications for regional MIP projects are called mid year in June/July and closing dates notified in regional papers. Applications for 2005 MIP projects close on 15 August 2005.

Small Grants for Rural Communities

The Foundation for Rural and Regional renewal promotes the regeneration and development of rural and regional Australia in social, economic, environmental and cultural areas. The Foundation is interested in funding projects which stimulate the renewal of whole communities and which tackle one or more of the following issues:

- The development of innovative business ventures with a view to sustainable economic, environmental and social benefits.
- Support indigenous Australians to realise their economic and social aspirations.
- Support people, including youth, to access education and training which will lead to improved job prospects, reduce unemployment and enhanced leadership skills.
- Recognise and enhance the role of women in rural community building, farm management and business development.
- Recognise and enhance the role of volunteers in building the capacity of rural communities.
- Cultural projects which result in an increased sense of belonging to the local community and/or create employment.

Projects which enhance the community wellbeing of a region through the improved use of community resources, for example in areas such as business planning, project management, community planning skills. leadership training, mentoring, networking, partnership building
This program will offer about $5,000 per year in grants to benefit people in rural and remote communities. Small, well targeted grants can be useful to small rural and remote communities.

APPENDIX H - EXAMPLE COMMUNITY EDUCATION BROCHURE

EXAMPLE OF A COMMUNITY INFORMATION SHEET

CLEAN CREEKS AND RIVERS BEGIN AT HOME

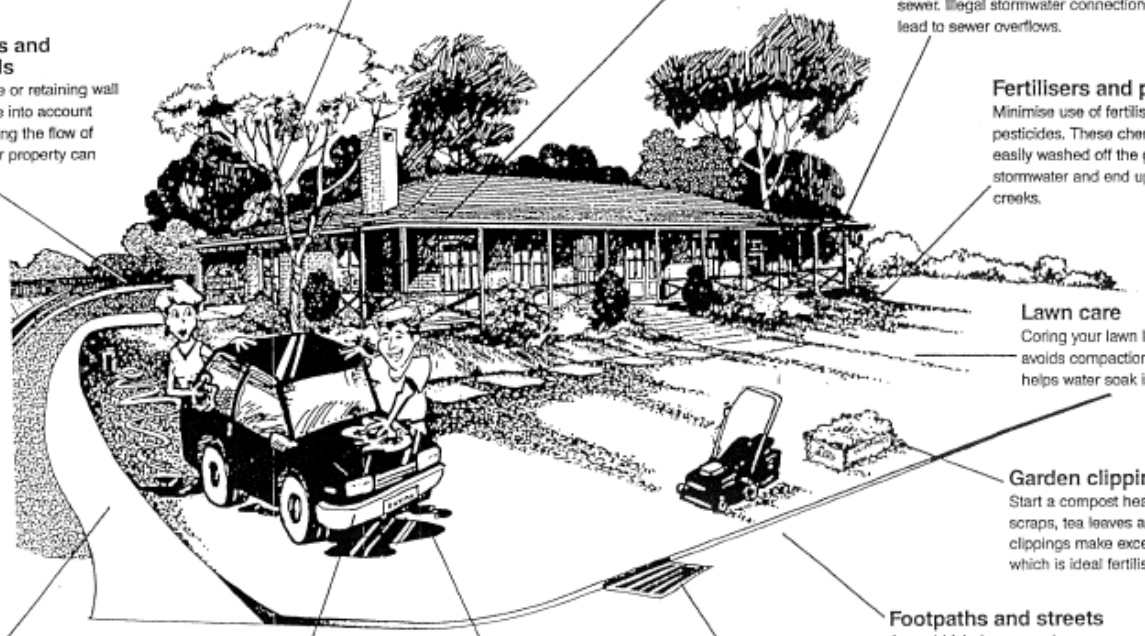
Dob in a dumper
If you know of, or see anyone dumping chemicals, oils, greases or other industrial wastes into the sewer please contact the "Dob in a Dumper" 24 hour hotline 269 5678.

Garage and shed
Unwanted household or garden chemicals should never be placed down the sewer or the stormwater drains. Check with your Council for local disposal depots or contact the State Pollution Control Commission on 265 8888 if you have particularly large quantities.

Gullies
Make sure your household gully grate (usually outside the kitchen or bathroom) is above ground level so rain water doesn't flow into it.

Gutters and downpipes
Roof gutters and downpipes should connect to stormwater drains not the sewer. Illegal stormwater connections lead to sewer overflows.

Fences, gates and retaining walls
Choose fence, gate or retaining wall designs which take into account water flow. Managing the flow of stormwater on your property can avoid damage.



Fertilisers and pesticides
Minimise use of fertilisers and pesticides. These chemicals are easily washed off the garden by stormwater and end up in local creeks.

Lawn care
Coring your lawn lets it breathe and avoids compaction. Coring also helps water soak in, reducing runoff.

Garden clippings
Start a compost heap. Vegetable scraps, tea leaves and grass clippings make excellent compost which is ideal fertiliser for gardens.

Footpaths and streets
Any rubbish, leaves or dog droppings in the street end up in stormwater drains causing blockages or pollution problems.

Paved areas
Keep paved areas to a minimum. If you are constructing a path or paving a patio or pool surround, choose a design or surface which lets stormwater soak in.

Washing the car
Wash your car on a grassy area. Sudsy water which flows down the gutter ends up in your local creek. Increased nutrients from detergents cause a lot of problems in our

Cars, trucks and motor bikes
If you do your own oil change don't pour oil down the gutter or into the ground. Dispose of the oil in a sealed container in the garbage or in a special Council cleanup.

Stormwater grates
Everyone can help by keeping stormwater grates clear of litter, leaves and stones. Blocked drains can lead to local flooding.