

# **Coastal Zone Management Plan for the Tomaga River Estuary**



**FINAL**

February 2015

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Prepared on behalf of Eurobodalla Shire Council by Hydrosphere Consulting.

Project Team:

Hydrosphere Consulting - Mick Howland, Robyn Campbell, Katie Pratt, Uriah Makings

Eurobodalla Shire Council – Norm Lenehan, Emma Patyus

Office of Environment and Heritage – Danny Wiecek

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Suite 6, 26-54 River Street  
PO Box 7059, BALLINA NSW 2478  
Telephone: 02 6686 0006  
Facsimile: 02 6686 0078

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**PROJECT 14-017 – CZMP FOR TOMAGA ESTUARY**

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## EXECUTIVE SUMMARY

The Tomaga Estuary Management Study and Estuary Management Plan which was adopted in 2005 identified on-ground projects and initiatives aimed at protecting and restoring key environmental assets and social amenity. Many of the high priority projects have been implemented, including erosion control works, weed control and water quality monitoring programs. This revised management plan recognises the achievements of the 2005 EMP and identifies new management issues that have developed since the original plan was adopted, with the overarching aim to maintain the plan as a current and ongoing management tool for the estuary. As part of the review of the 2005 EMP, the new (2013) State government requirements for coastal zone management have been addressed. This Coastal Zone Management Plan (CZMP) for the Tomaga River Estuary supports the goals and objectives of the *NSW Coastal Policy 1997* and assists in implementing integrated coastal zone management for the Tomaga River Estuary.

The study area comprises the tidal waterways, foreshore and adjacent land of the Tomaga River Estuary including the entrance and tributaries. The Tomaga River Estuary catchment consists of extensive areas of forest, crown land, public land, tourist facilities, grazing land, Aboriginal land and residential developments. The estuary is a Habitat Protection Zone as part of the Batemans Marine Park.

Preparation of this CZMP included consultation with community and agency stakeholders. The main theme raised by the community stakeholders was the desire to protect the existing natural character and beauty of the area and maintain the highly valued passive recreational opportunities.

The key management issues identified for this CZMP are:

- Erosion of the spit caused by the natural meander of the river but exacerbated by pedestrian access and related activities causing loss of vegetation. Managing the threat of river breakout through the spit and maintaining the current form of the spit and the estuary mouth at the southern end of Tomakin Beach are key priorities for the community;
- There are some areas of river bank in need of rehabilitation and protection due to livestock access and grazing, poor condition or lack of riparian vegetation, steepness of banks, lack of buffer zones, boat wash, wind, flooding and natural river meander;
- The protection of Aboriginal heritage sites is considered to be an important objective for the CZMP, given the spiritual and cultural significance of the estuary and the current and past impacts on sites due to bank erosion;
- Even though the measured extents of seagrass and saltmarsh have increased in recent years, there are still a number of threats to estuarine vegetation that require careful management to ensure on-going protection for these important habitats. These include damage to seagrass, livestock grazing, trampling and clearing as well as horse-riding, pedestrian and cycle traffic on saltmarsh;
- The available water quality data suggest that the lower and mid estuary is generally suitable for primary contact recreation with reduced quality following periods of high rainfall. The upper estuary may be susceptible to pollution from potential sources of faecal contamination; and
- There are conflicts relating to waterway access and boating resulting in erosion and impacts on estuarine vegetation.

The management issues have been grouped into 5 key strategies. The strategies and recommended approach are listed below.

1. Management of erosion of the spit:
  - Removal of any redundant fencing materials and waste and fencing on river side;

- Re-construction of the existing dune ridge fencing to restrict pedestrian access across the dune, including sediment trap fencing;
- Ongoing weed management and revegetation with appropriate species on the river side;
- Signage installed at the base of existing tracks and access points to discourage pedestrian passage over the dune;
- Construction of a viewing platform at a high point on the northern end of the spit;
- Implement an information and education campaign to residents, tourist facilities and schools to raise awareness of the erosion risk and the adopted approach; and
- Assess the morphology of the spit with topographic survey every two years; and
- Commence a consultative process with community and agency stakeholders to review the status of the spit over time (potentially annual meetings) and develop a management plan if the risk of breakthrough is considered to increase.

## 2. River bank rehabilitation:

- Areas of severe erosion in high value areas should be rehabilitated in the short-term. These include the left river bank at Tomakin and the midden near the Tomaga River Tourist Park. In addition, continued monitoring and assessment of erosion risk is recommended every 3 years.

## 3. Protection of estuarine and foreshore vegetation:

- Protection of saltmarsh areas;
- Ongoing regulation of illegal vegetation removal;
- Education of residents regarding the value of estuarine vegetation and human impacts;
- Ongoing weed management and revegetation of foreshores;
- Ongoing monitoring and assessment of estuarine vegetation extent and condition and regular update of estuarine vegetation mapping as part of the MER program; and
- Ongoing assessment of impacts of sea level rise and development of mitigation strategies to manage sea level rise.

## 4. Water quality management:

- Continuation of the MER-based water quality monitoring program; and
- Additional monitoring, particularly event-based data collection (following wet weather events).

## 5. Management of conflicts between recreational activities and ecological values:

- Construction of an viewing platform at the northern end of the spit;
- Maintenance and consolidation of waterway access from river banks in Tomakin; and
- Installation of a new fishing platform at Jack Buckley Park.

The recommended management actions have been compiled into a ten year implementation schedule as shown in Table 1 with responsibilities and indicative costs estimated over the ten year implementation period. The total cost of the CZMP implementation is estimated to be approximately \$996,000 over ten years. The actions will be delivered through a combination of Council, State Government and grant funding (where available). The delivery of the actions may be influenced by the availability of this funding as well as human resources.

Table 1: CZMP Implementation Program

Action / Year (Note 1)		Ten year total (\$'000)	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1.1	Control pedestrian access on spit	15,000	15,000									
1.2	Install educations and information signs on spit	4,000	4,000									
1.3	Education and awareness program - spit erosion	4,000	1,000			1,000			1,000			1,000
1.4	Ongoing weed removal and revegetation of spit (Note 2)	150,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
1.5	Construct viewing platform at the northern end of the spit	50,000				50,000						
1.6	Monitor and assess spit profile and success of management measures	10,000				5,000					5,000	
1.7	Consultative process with community and agency stakeholders and development of a responsive management plan	10,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2.1	Scour protection at stormwater outlets	20,000	5,000	15,000								
2.2	Trial mangrove plantings, toe protection and bank revegetation	20,000	10,000	10,000								
2.3	Extend rock revetment at each end between drainage channels at Jack Buckley Park	30,000			30,000							
2.4	Bank erosion at kayak camp	20,000			20,000							
2.5	Work with landowners to install livestock exclusion fencing, revegetate buffer zone (Note 3)	500,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
2.6	Monitor extent and severity of bank erosion	10,000					5,000					5,000
2.7	Landholder education about grazing practices	-	Included in current funded programs									
3.1	Protection and rehabilitation of Saltmarsh EEC (Tomakin Club)	2,000	2,000									
3.2	Protection and rehabilitation of Saltmarsh EEC (north of Mossy Point)	3,000	3,000									

Action / Year (Note 1)		Ten year total (\$'000)	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
3.3	Prevent access through Saltmarsh EEC (between Tomakin Caravan Park and IGA)	3,000	3,000									
3.4	Ongoing regulation of illegal vegetation removal	-	Included in current funded programs									
3.5	Education regarding the value of estuarine vegetation and human impacts (Note 4)	-	Included in current funded programs									
3.6	Ongoing weed management (Note 4, 5)	50,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
3.7	Update mapping and regular monitoring of location and condition of estuarine vegetation as part of MER program	-	Included in current funded programs									
3.8	In consultation with RMS, consider the strategic placement of seagrass markers in the lower estuary	10,000						10,000				
4.1	Continue implementation of current water quality monitoring program as part of MER program	-	Included in current funded programs									
4.2	Design and implement an event-based monitoring program to assist in identification of potential pollution sources	15,000			15,000							
4.3	Assess need for water quality improvement measures	-	Not estimated									
5.1	Upgrade Tomakin boat ramp and car park.	-	Included in current funded programs									
5.2	Install fishing platform at Jack Buckley Park	20,000				20,000						
6.1	Annual review of CZMP progress	-	Included in current funded programs									
6.2	Ten year review of CZMP	50,000										50,000
Total		996,000	116,017	98,019	138,021	149,023	78,025	83,027	74,029	73,031	78,033	129,035

## Notes:

- Years correspond to end of financial year i.e. 2016 is Year 1 (start 1st July 2015, end 30th June 2016) etc.
- ESC has received funding under the South-east LLS Coastal Wetlands Project to treat Prickly pear, Bitou bush and Asparagus fern on the spit (\$3,850 in 2014/15) to be matched with in-kind contributions from Coastcare. This grant also funds revegetation of 600 plants for the area between the Tomakin boat ramp to the wall at Jack Buckley Park.
- LLS Extension Officers to liaise with landowners and develop projects. Cost allows for fencing, riparian buffer zone vegetation to a width of 40m at each erosion site. Maintenance beyond 3 years is not included.
- Council has received seven estuary program grants between 2006 and 2014 for Shire-wide initiatives such as environmental education, weed control and river bank revegetation.

5. ESC has received funding from Crown Lands for control of Weeds of National Significance on Crown tenure along the Tomaga River (\$3,000) with funds matched by ESC Invasive species team.





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## **1. INTRODUCTION**

The Tomaga River Estuary is located on the south coast of New South Wales, approximately 15 km south of Batemans Bay within Eurobodalla Shire.

This Coastal Zone Management Plan (CZMP) for the Tomaga River Estuary provides a ten year strategic plan for the implementation of key actions that are recommended to achieve the objectives for management of Tomaga River Estuary.

### **1.1 2005 Estuary Management Plan**

The Tomaga Estuary Management Study and Estuary Management Plan (EMP, Amog, 2005) was completed under the direction of Eurobodalla Shire Council (ESC) and the Tomaga Estuary Management Committee (now disbanded) following the planning process for estuary management prescribed in the NSW Government's 1992 Estuary Management Manual. The Plan formulated actions that would assist in maintaining the identified values of the estuary being natural beauty, unspoiled environment, recreation, residential lifestyle, cultural heritage and flora and fauna.

The Tomaga EMP adopted in 2005 identified on-ground projects and initiatives aimed at protecting and restoring key environmental assets and social amenity. Some of the high priority projects have been implemented, including erosion control works, weed control and water quality monitoring programs (refer Section 2).

### **1.2 Purpose of this Review**

In 2013/14, ESC received funding through NSW Government Estuary Management Program to undertake a thorough review of the Tomaga EMP to assess what has been completed and what remains to be done, consider any change of land use within the catchment and capture changing community views on management of the estuary.

This review has engaged the community and other stakeholders to determine the current priority issues and identify new management actions. This review was completed in consultation with the NSW Office of Environment and Heritage (OEH). This revised management plan recognises the achievements of the 2005 EMP and identifies new management issues that have developed since the original Plan was adopted, with the overarching aim to maintain the Plan as a current and ongoing management tool for the estuary.

### **1.3 Coastal Zone Management Process**

Coastal councils are now required to prepare CZMPs in accordance with the Minister's guidelines adopted in 2013 under section 55D of the *Coastal Protection Act, 1979*. As part of the review of the 2005 EMP, these new requirements have been addressed. This CZMP for the Tomaga River Estuary supports the goals and objectives of the *NSW Coastal Policy 1997* and assists in implementing integrated coastal zone management for the Tomaga River Estuary.

The main aim of the CZMP is to protect and enhance the key values of this area by increasing resilience of the coastal zone and addressing key threats through efficient, effective and timely management. This will be achieved through the implementation of integrated, balanced, responsible strategies to restore and maintain the ecological sustainability and local character of the estuary as well as the recreational and commercial activities associated with it. The CZMP provides links to other related management strategies which will assist in achieving the objectives of the CZMP.



This CZMP was prepared in accordance with Part 4A of the *Coastal Protection Act, 1979* and the CZMP guidelines (OEI, 2013a). The guidelines include minimum requirements for CZMPs (refer Appendix 1) which relate to:

- Preparation of the CZMP;
- Coastal risk management;
- Coastal ecosystem health; and
- Community uses of the coastal zone.

The coastal risk management components are being addressed through Council's Shire-wide CZMP and Tomaga flood study. As such, these components of the CZMP guidelines will not be directly addressed through this CZMP but will be referred to as relevant. The coastal ecosystem health and community use components of the guidelines constitute the main components of this CZMP for the Tomaga River Estuary.

## 1.4 The Study Area

The study area comprises the tidal waterways, foreshore and adjacent land of the Tomaga River Estuary including the entrance and tributaries (refer Figure 1). Emphasis is placed on the estuary, however, consideration is also given to the wider catchment areas where it affects the estuarine processes and natural resources.



**Figure 1: The Tomaga CZMP Study area (Tomaga River catchment)**

For the purposes of this study, the waterway has been divided into three distinct areas shown on Figure 1:

- Lower estuary (ocean to George Bass Drive bridge);
- Mid estuary (George Bass Drive to approximately half way to the tidal limit); and



- Upper estuary (from end of the mid estuary zone to the tidal limit).

Upstream of the tidal limit, the estuary is fed by freshwater tributaries extending into the upper catchment.

The Tomaga River Estuary is a mature, wave dominated barrier estuary (as classified by Roy *et al.*, 2001). The entrance, which separates the townships of Mossy Point to the south and Tomakin to the north, is permanently open and untrained. The entrance is protected by two large natural rock outcrops. A large vegetated sand spit extends from Tomakin to the entrance at Mossy Point.

The estuary has a catchment area of 98 km<sup>2</sup> made up of Jeremadra Creek catchment (32.4 km<sup>2</sup>), Mogo Creek catchment (28.7 km<sup>2</sup>), Tomaga River catchment (19.9 km<sup>2</sup>) and Tomaga River (17.0 km<sup>2</sup>). There are two major tributaries, Jeremadra Creek and Mogo Creek, with the tidal limits extending approximately 2.3 km into each of these tributaries (11 km from the ocean) as shown on Figure 1 (Amog, 2005).

The estuary is well mixed by tidal currents and contains extensive intertidal habitats. Tomakin Beach and the entrance sand flats are important recreational areas and the lower estuary is an important recreational boating area. As well as the tidal waters, the estuary environment includes the intertidal mudflats, sandflats, mangrove forests, saltmarshes, estuarine freshwater swamps and riparian forests (waterway edge forests) such as swamp-oak woodlands. Major habitats of the estuary are:

- Well-developed intertidal habitats of mangroves, saltmarsh and sand banks;
- A prominent sand dune system at the mouth known as “the spit”;
- Extensive seagrass beds throughout the estuary extending into the extreme upper estuary; and
- Well-developed riparian forest of casuarinas along sections of the upper estuary.

The upper catchment is mostly State Forest with the only developed area being the town of Mogo on the Princes Highway. The lower estuary has residential and recreational developments, the mid-section of the estuary is forested and above Jeremadra Creek the land adjacent to the estuary is used for grazing.

## 1.5 Management Context

The Tomaga River Estuary catchment consists of extensive areas of forest, Crown land, Council reserve, tourist facilities, grazing land, Aboriginal land and residential developments. The estuary is a Habitat Protection Zone as part of the Batemans Marine Park. The estuary is managed and regulated by the following agencies and government authorities:

- ESC is responsible for the management of public spaces, assets and facilities around the Tomaga River Estuary;
- The NSW Department of Trade and Investment - Crown Lands (Crown Lands) is responsible for the sustainable management of the Crown land estate which encompasses the dry land and the submerged land of the State's waterways 5.5 km out to sea and includes the ocean floor, most coastal estuaries, many large riverbeds and some coastal wetlands;
- Operational land under Forestry Corporation of NSW jurisdiction is managed by the Southern Region - Batemans Bay office;
- NSW Marine Parks is responsible for administering the *Marine Parks Act 1997*, *Marine Parks Regulation 2009* and *Marine Parks (Zoning Plans) Regulation 1999* in Batemans Bay Marine Park. Marine Parks are a declared area in which activities are managed for the purpose of conserving marine biodiversity. Ownership and tenure of lands and waters within a marine park do not change with the declaration of a Park, however the authority works with many regulatory authorities to achieve its goals of conserving marine biodiversity;
- The NSW Department of Primary Industries – Fishing and Aquaculture (Fisheries NSW) regulates fishing, fish kills, invasive species and species, populations and communities listed as threatened

under the *Fisheries Management Act 1994* and oyster leases present in the estuary via delegations under the Act;

- Navigation infrastructure, oil spill and vessel based pollution and boating is managed by NSW Roads and Maritime (RMS) department;
- The Mogo Local Aboriginal Land Council (LALC) owns approximately 7 ha of estuarine foreshore and maintains and manages Aboriginal heritage interests in the area;
- The Southern Rivers Catchment Management Authority (SRCMA) has played a key role in the management of natural resources such as the Tomaga River Estuary and surrounding lands. The SRCMA has been working in cooperation with ESC, the oyster industry and NSW Department of Primary Industries to deliver incentives aimed at improving biodiversity values and water quality through better industry practices. In January 2014, South East Local Land Services (LLS) was established integrating the catchment management authority, livestock health and pest authority and some agricultural advisory services of the NSW Department of Primary Industries; and
- The Office of Environment and Heritage (OEH) works with local councils and communities to maintain or improve the health of estuaries. OEH supports local government through the coastal zone management program which now includes both coastline management planning and estuary management planning.

Council, government agencies and statutory bodies are implementing management programs in parallel with the preparation of this CZMP. Many of these initiatives are related to the management of the Tomaga River Estuary, foreshore areas and coastline. A summary of related management plans is given in Appendix 2. This CZMP will complement existing and proposed plans of management including:

Council programs and strategies include (refer Appendix 2):

- ESC Local Environmental Plan (2012);
- ESC Community Strategic Plan, Delivery Program and Operational Plan;
- Southern Rivers CMA Catchment Action Plan;
- Regional sea level rise strategic planning (in preparation);
- Eurobodalla Shire Coastal Zone Management Plan (in preparation);
- Tomaga Catchment Floodplain Risk Management Study and Plan (planned);
- ESC Rural Lands Strategy (current);
- ESC Waterways Infrastructure Strategy (2002);
- *ESC On-Site Sewage Management Code of Practice* (2013); and
- *ESC Acid Sulfate Soils Manual and Policy* (2002).

Agency programs in the broader, Southern Rivers area include:

- Batemans Bay Marine Park Operational Plan and Zoning Plan;
- Forestry Corporation of NSW management plans; and
- *Southern Rivers CMA Catchment Action Plan* (SRCMA, 2013) and transition to Local Land Services.

## 2. REVIEW OF 2005 EMP ACTIONS

The existing EMP has been operational for nine years with many of the actions recommended in that plan substantially completed or on-going.

The EMP documented management issues derived from background documentation, community consultation activities and input from the Estuary Management Committee. The main goal of the plan was to address these issues and a risk management approach was used to assign a priority to the identified goals.

The objectives of the 2005 plan were to:

1. Manage the spit to minimise likelihood of breakthrough and to minimise impact on users and the environment if breakthrough does occur
2. Moderate erosion of reclaimed land at Jack Buckley Memorial Park
3. Moderate erosion due to stream meandering
4. Protect foreshore habitat
5. Maintain acceptable nutrient and faecal coliform inputs
6. Manage threatened bird species on the spit
7. Maintain acceptable sediment inputs
8. Resolve conflicts between users
9. Manage invasive species
10. Minimise pollutants entering estuary
11. Protect seagrass
12. Moderate erosion due to boat wake and propeller wash
13. Ensure water quality is adequately monitored
14. Maintain the perceived unspoilt nature of the Tomaga River Estuary

A number of options to address the objectives were discussed in the Plan. The Plan focussed on options which were considered to be economical and relatively effective. Options that would assist in achieving a number of objectives were also given a higher priority.

The Implementation Table detailing the actions in the 2005 EMP and their current status is given in Appendix 3.

### 2.1 Summary of Completed Actions

Many of the actions from the 2005 EMP have been substantially completed or are ongoing (option number from 2005 EMP is provided here):

- 7.5.1, 7.9.4 - Fencing along dune crest of spit, terrace of coir logs, weed removal, revegetation and signage to reduce erosion of spit;
- 7.3.1, 7.3.2, 7.4.1 - Rock revetment at Jack Buckley Park and coarse grass planting;
- 7.4.2 - Rock revetment upstream of George Bass Drive Bridge (RMS);
- 7.4.3, 7.10.1, 7.10.2, 7.10.4, 7.15.2 - Revegetation and weed management by ESC and Coastcare groups;
- 7.5.3, 7.5.4, 7.8.2 - Livestock fencing in upper estuary in key fish habitat areas (Fisheries NSW/Crown Lands);

- 7.6.1, 7.12.1, 7.14.1, 7.14.3 - Ecosystem health report cards including water quality monitoring and macrophyte mapping in accordance with the NSW Natural Resources monitoring, evaluation and reporting (MER) program;
- 7.6.4 - 2010 ESC community education program about stormwater runoff;
- 7.6.5 - Adoption of the shire-wide Residential Zones DCP including requirements for water sensitive urban design;
- 7.9.2 - RMS representatives are actively liaising with boat users and Council;
- 7.9.3, 7.13 - 4 knot speed limit now gazetted throughout estuary;
- 7.10.1, 7.10.2, 7.10.4 - Bitou bush and prickly pear removal; and
- 7.5.4, 7.6.6, 7.15.2 - Riparian vegetation management has been undertaken by SRCMA/LLS in the upper estuary and by ESC near the entrance and on the spit.

Further discussion is provided in Section 8 and Appendix 3. Completed on ground works are shown on Figure 2 (Lower Estuary), Figure 3 (Mid Estuary) and Figure 4 (Upper Estuary).





Figure 2: Locations of on-ground works implemented since 2005 – lower estuary



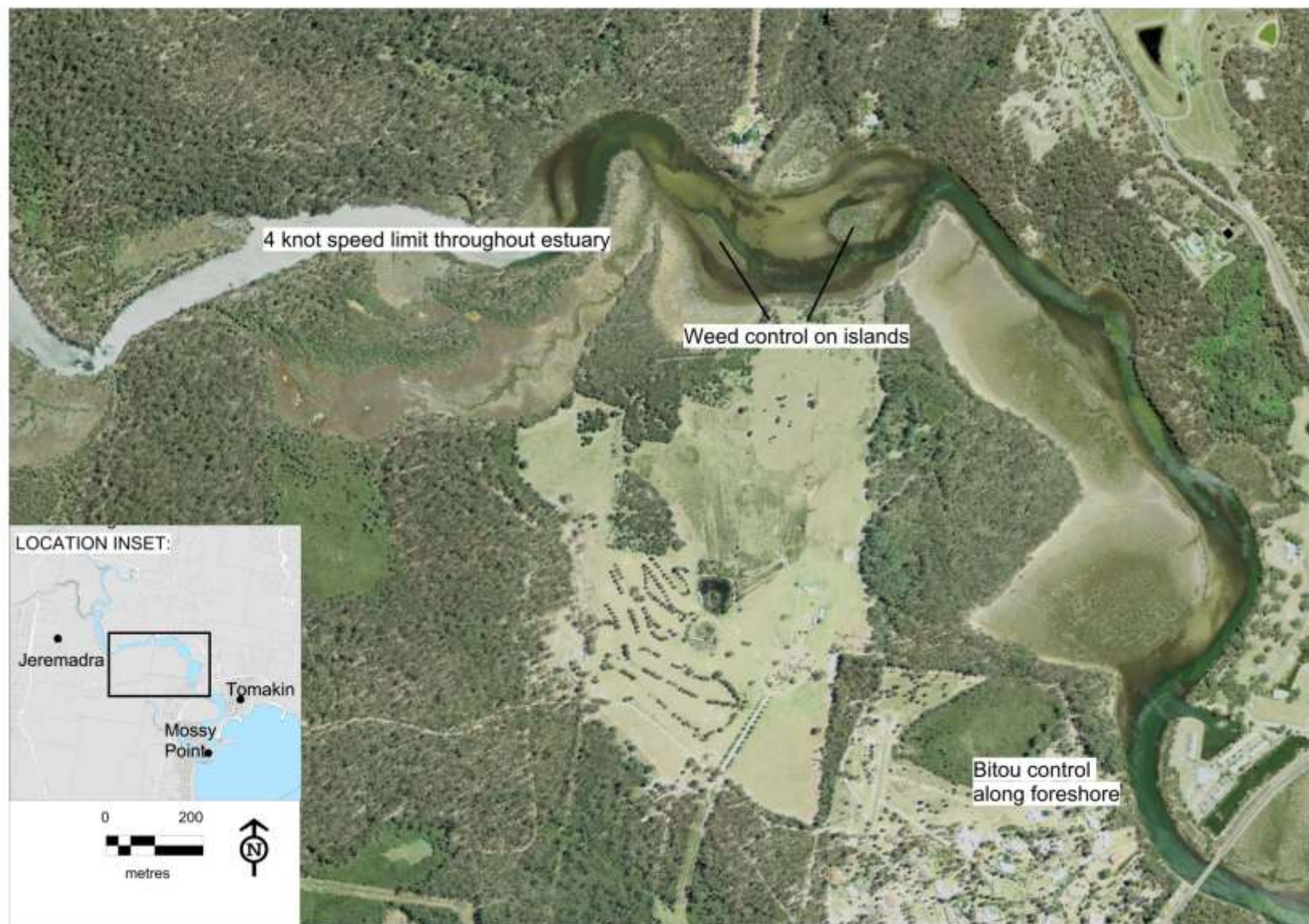


Figure 3: Locations of on-ground works implemented since 2005 – mid estuary



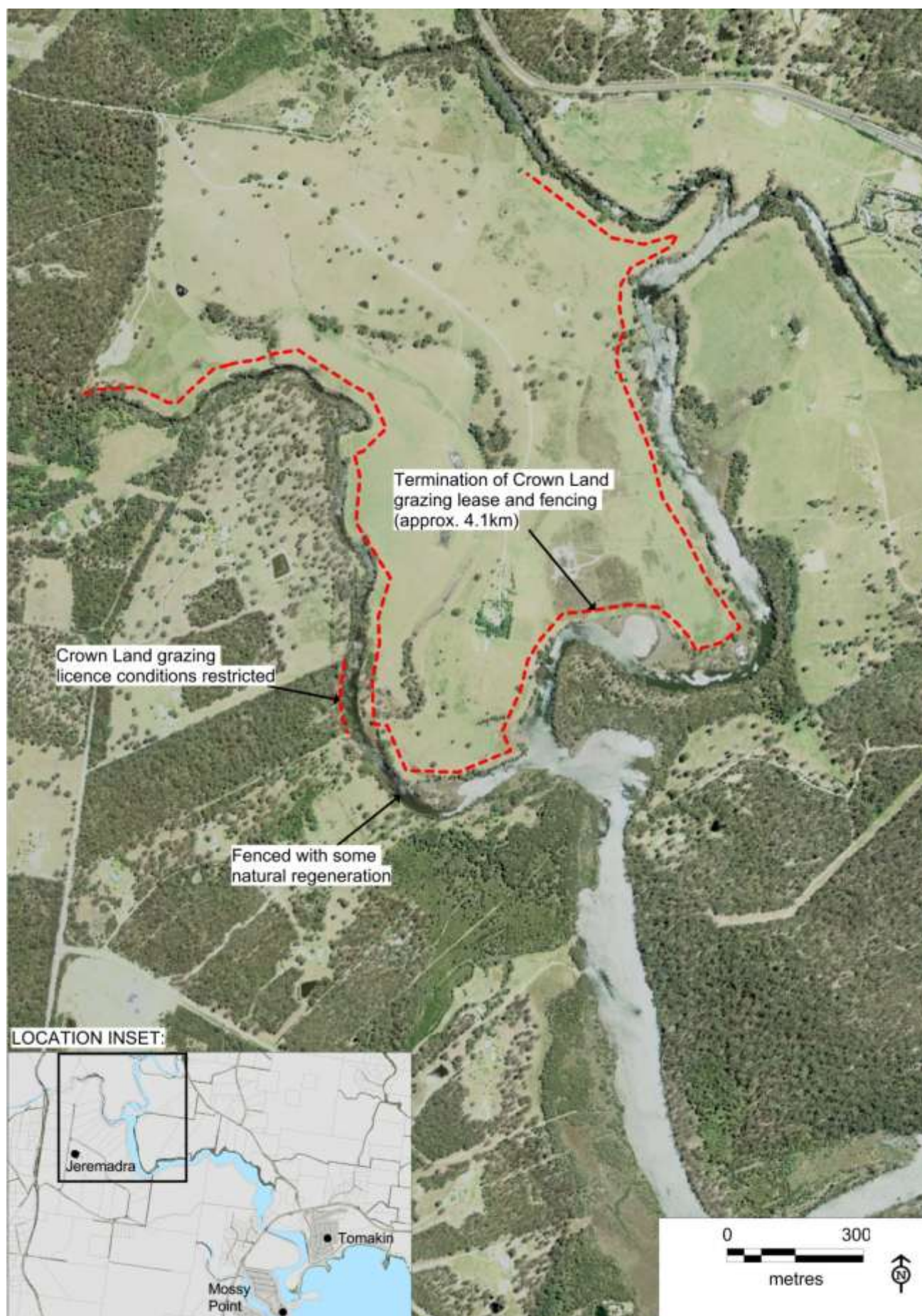


Figure 4: Locations of on-ground works implemented since 2005 – upper estuary

Many of the actions from the 2005 EMP are on-going and remain relevant to the future management of the estuary. This CZMP includes some of these on-going actions (with some modifications).

Appendix 3 provides a summary of the previous EMP actions, with current status, reasons for any variation from the EMP recommendations as well as any recommendations for further related work. Most of the actions have been implemented or are no longer considered to be the most appropriate method of addressing the issues. Actions as identified from the 2005 EMP as incomplete or not undertaken are listed in Table 2.

**Table 2: Incomplete actions from 2005 EMP**

Action (Option no. from 2005 EMP)		Incomplete components	Comments
7.5.1	Reduce pedestrian traffic on the spit. Sand renourishment, fencing and replanting of blowout areas.	Sand renourishment	Refer Section 8.1.2.
7.2.3	Allow natural breakthrough of the spit, maintain main entrance. If breakthrough occurs either the old or new channel may take main flow; be flexible as to which to maintain based on natural processes. May require minor dredging to maintain navigability and access to Mossy Point boat ramp.	All	Breakthrough has not occurred since 2005.
7.3.1	Toe protection using timber logs (Jack Buckley Park)	All	A rock wall has been installed at the Park.
7.3.2	Control runoff through trenching, infiltration bed and planting with coarse grasses etc. (Jack Buckley Park)	Trenching and infiltration bed	Detailed evaluation revealed that planting alone is the most appropriate way to address the runoff. Coarse grasses planted behind wall.
7.4.2	Bank protection near George Bass Drive bridge with rock wall, gabion or riprap top. Stairs to access beach	Stairs not installed	Stairs were not considered to be required due to low pedestrian access. Erosion upstream of the rock wall is currently present.
7.4.3	Bank protection from Jack Buckley Memorial Park to Tomakin boat ramp. Grading and stabilisation of bank with either rock wall, dumped stone, large logs or gabion mattresses. Replanting exposed bank.	Rock wall and grading of bank considered to be too expensive and intrusive.	Coastcare revegetation work has been undertaken here.
7.5.1	Reduce pedestrian traffic on the spit (as per Objective 1). Establish board walk and steps as new access from river to beach	Board walk and steps	Signage provided for beach access. Additional control of pedestrian access is required.



<b>Action</b> (Option no. from 2005 EMP)		<b>Incomplete components</b>	<b>Comments</b>
7.5.2	Provide access to low tide beach near George Bass Drive with steps	All	Not implemented due to high capital and maintenance cost and low use for swimming.
7.5.4	Restore riparian vegetation: terminate Crown grazing leases along banks, exclude livestock, fencing, replanting, weed and pest control	Terminate Crown grazing leases	Some licence conditions have been reviewed by DPI-Crown Lands and one licence terminated. Some grazing of river banks is still occurring.
7.5.5	Monitor and protect intertidal wetlands with survey and photographic records on 3-5 year cycle	Photographic records	MER program to continue.
7.6.2	Monitor agricultural trends to determine if agriculture a potential future source of nutrient input and if so to encourage farmers to implement best agricultural practices	All	Upper estuary water quality suggests faecal contamination.
7.6.3	Encourage landholders to implement best acceptable practices for grazing – e.g. through extension officer, fencing incentives, etc. (see Option 7.5.4)	Extension officer	Funding has not been available. LLS programs may assist.
7.6.7	Environmental audits of facilities that may be contributing to nutrient or pollutant input (e.g. bowling club, golf course, zoo)	All	Not undertaken. Some pollution control works have been undertaken at Mogo Zoo.
7.6.8	Establish catchment sources of faecal coliform bacteria	All	Event-based monitoring (wet weather) has not been undertaken.
7.8.3	Encourage soil conserving agricultural practices	All	Funding not available. LLS programs may assist.
7.8.4	Ensure stormwater sediment traps are installed and properly maintained	Sediment traps have not been installed.	Not undertaken.
7.9.1	Introduce voluntary code of conduct for PWCs	All	Regulation by RMS including signage, boating maps and guidelines is ongoing.
7.11.1	Ensure no pollutants are entering the estuary from the “Koppers Log” site	All	Mogo plant is no longer functional and this action is no longer applicable.
7.11.2	Ensure acid sulphate soils do not pollute estuary	No event-based monitoring	ESC adopted its Acid Sulfate Soils Policy in October 2002. The MER program includes monitoring of pH.
7.12.2	Set up channel markers to assist boaters to avoid seagrass beds	Seagrass markers have not been installed.	Main navigation channel markers are installed and audited by RMS.

<b>Action</b> (Option no. from 2005 EMP)		<b>Incomplete components</b>	<b>Comments</b>
7.14.2	Monitor water quality after major rainfall events	All	Not undertaken.
7.14.4	Ensure appropriate data is collected and analysed, especially nutrients	Nutrients not monitored.	Water quality monitoring program to continue including measurement of chlorophyll a which is a suitable indicator of nutrient status. Therefore direct measurement of nutrients is not considered necessary.
7.15.1	Non-proliferation of signage	Signs were considered appropriate in some locations.	Signage may be necessary to improve success of some actions (e.g. access and erosion control).
7.15.3	Non-proliferation of rock walling	Rock revetment was considered appropriate in some locations.	Rock walls may be also appropriate in other locations, particularly if combined with estuarine and riparian vegetation.

### 3. CONSULTATION

ESC is committed to open and transparent communication with the public and government agencies in order to ensure that the community's views are appropriately reflected in strategic planning for the Shire. Community and stakeholder consultation is also a key component of the CZMP development process.

#### 3.1 Previous Consultation Activities

Preparation of the 2005 EMP included:

- A community questionnaire; and
- Liaison with the Estuary Management Committee – representatives from ESC, DIPNR (now OEH), NSW Maritime Authority (now RMS), other stakeholder groups and community representatives (now disbanded).

The outcomes of the consultation activities were used to determine the values for the estuary and develop the management objectives and strategies discussed in Section 2.

#### 3.2 Consultation Activities Undertaken for this CZMP

Preparation of this CZMP included (refer Appendix 4):

- Correspondence with community groups and government agencies to promote the project, encourage input and advertise the community meeting and field trip;
- A webpage on Council's website describing the project and consultation activities;
- A media release promoting the project and community activities;
- A community meeting at Tomakin to discuss issues, ideas and management priorities;
- A community field trip to the lower estuary to observe issues and discuss management priorities; and
- Ongoing liaison and correspondence with community groups and government agencies.

The main theme raised by the community stakeholders was the desire to protect the existing natural character and beauty of the area and maintain the highly valued passive recreational opportunities. The key issues raised by stakeholders through the above activities were:

- Erosion of the spit and threat of breakout (refer Section 6.4.1);
- Risk of pollution from Mogo Zoo (refer Section 6.3);
- Impacts of grazing on bank erosion and water quality (refer Sections 6.3, 6.4.2 and 6.10);
- Impacts of urban development and stormwater runoff (refer Section 6.8);
- Effectiveness and safety of the existing fencing at the spit (refer Section 8.1.1);
- Revegetation and weed removal activities at the spit (refer Sections 1.1.1 and 8.1.1);
- Navigation issues associated with shallow areas and seagrass beds (refer Section 7.3.3 and 7.3.5);
- Impacts of high tourist numbers on amenity and contribution to erosion (refer Section 6.4);
- Construction of boat ramps on private property (refer Section 7.3.4);
- Livestock grazing on mangroves and saltmarsh (refer Section 6.10);
- Impacts of pedestrian access on saltmarsh areas (refer Section 6.5.1);

- The need for safe fishing and waterway access points for the elderly;
- Erosion of river banks (refer Section 6.4.2); and
- Condition of Tomakin boat ramp (refer Section 7.3.4).

The draft CZMP will be placed on public exhibition and feedback invited from the community prior to Council adoption.

## 4. SUMMARY OF ESTUARY PROCESSES

### 4.1 Physical Characteristics

The key physical characteristics of Tomaga River Estuary are outlined in Table 3.

**Table 3: Tomaga River Estuary physical characteristics**

Characteristic	Data	Notes
Catchment area	98 km <sup>2</sup>	Refer Figure 1
Estuary area	1.81 km <sup>2</sup>	Includes areas mapped as open water, mangrove and saltmarsh areas.
Estuary volume	1,411 ML	Based on areas at 0.6 m AHD (Roper <i>et al.</i> , 2011 )
Average depth	1.04 m	Estimated by dividing the total volume at 0.6 m AHD by the total surface area of the estuary including mangrove areas but excluding saltmarsh (Roper <i>et al.</i> , 2011)
Estuarine Macrophytes	Seagrass extent: 0.293 km <sup>2</sup> Saltmarsh extent: 0.458 km <sup>2</sup> Mangrove extent: 0.351 km <sup>2</sup>	Based on 2012 mapping

Sources: Roper *et al.* (2011), 2012 mapping of estuarine macrophytes

### 4.2 Geomorphic Evolution

Geomorphic evolution of the estuary is discussed in Amog (2003 and 2005) and summarised below.

Coastal sediments are moved by wave action southwards down Tomakin Beach to the outer part of the Tomaga River entrance. Because of the dominant direction of the waves, which transport sand southward along the beach, the natural long-term position of the Tomaga River Estuary mouth has been at the southern end of Tomakin Beach (Figure 5). The offshore rock outcrops act as natural 'breakwaters' for the Tomaga River Estuary and Tomaga Beach largely confine longshore transport of sediment between the rocks so that longshore transport into the area would only be possible under very heavy wave action (Amog, 2003).

Coastal sediments are carried into the estuary by the incoming tide during normal flow conditions. During floods, the much stronger outgoing currents reverse the process, picking up sediment and moving it out of the estuary. The configuration of sandbanks around the mouth (Figure 6) is the result of river flow (and hence rainfall), wind and tidal patterns. The shoal at the southern end of the spit changes shape and location under the action of storm waves and currents flowing out of the Tomaga River. Consequently sandbanks near the entrance are continually changing (Amog, 2003). At times, this results in navigational problems in this area.



**Figure 5: Current location of Tomaga River Estuary mouth**

Source: 2010 aerial photography provided by OEH



**Figure 6: Lower estuary sand shoals**

The spit is a narrow sand dune deflecting the Tomaga River southward to its present entrance at Mossy Point. It is composed predominantly of marine sands, which have been deposited by the onshore movement of sand over the last 6,000 years (Amog, 2003). Overwash by storm waves and onshore storm winds have pushed the sand into a single dune with a current crest height 4 to 6 m above mean sea level (refer Section 6.4.1). Storms can also lead to removal of sand from the beach side of the spit. This is normally a temporary offshore movement of the sand that is replenished as the sand moves back onshore and wind moves it up

the beach. On the estuary side, floods can cause major movement of sand. In addition, tidal water movement is continually removing small amounts of sand from along the western side of the spit. During recent times, at least for the last 30 years, the northern end of the spit has been narrowing due to the migration of a bend in the lower estuary (caused by erosion of the bank under flood scour and wave and tidal action). The spit has now become so narrow in this area that breakthrough could occur either from the estuary during a flood, or from the ocean during a storm. This is further discussed in Section 6.4.1.

Along a number of sections of the upper estuary bank, undercutting is occurring on both sides of the bank. This undercutting is caused by a combination of natural stream meander, wave action, boat wash, lack of or removal of riparian vegetation and cattle grazing (refer Section 6.4.2).

### 4.3 Current Land Use and Zoning

The upper catchment is largely State Forest, the mid-estuary is dominated by cattle grazing and rural developments and the lower estuary includes the residential developments of Tomakin on the coastal sand plains and Mossy Point, which is generally situated on a low ridge between the Tomaga River and Candlagan Creek.

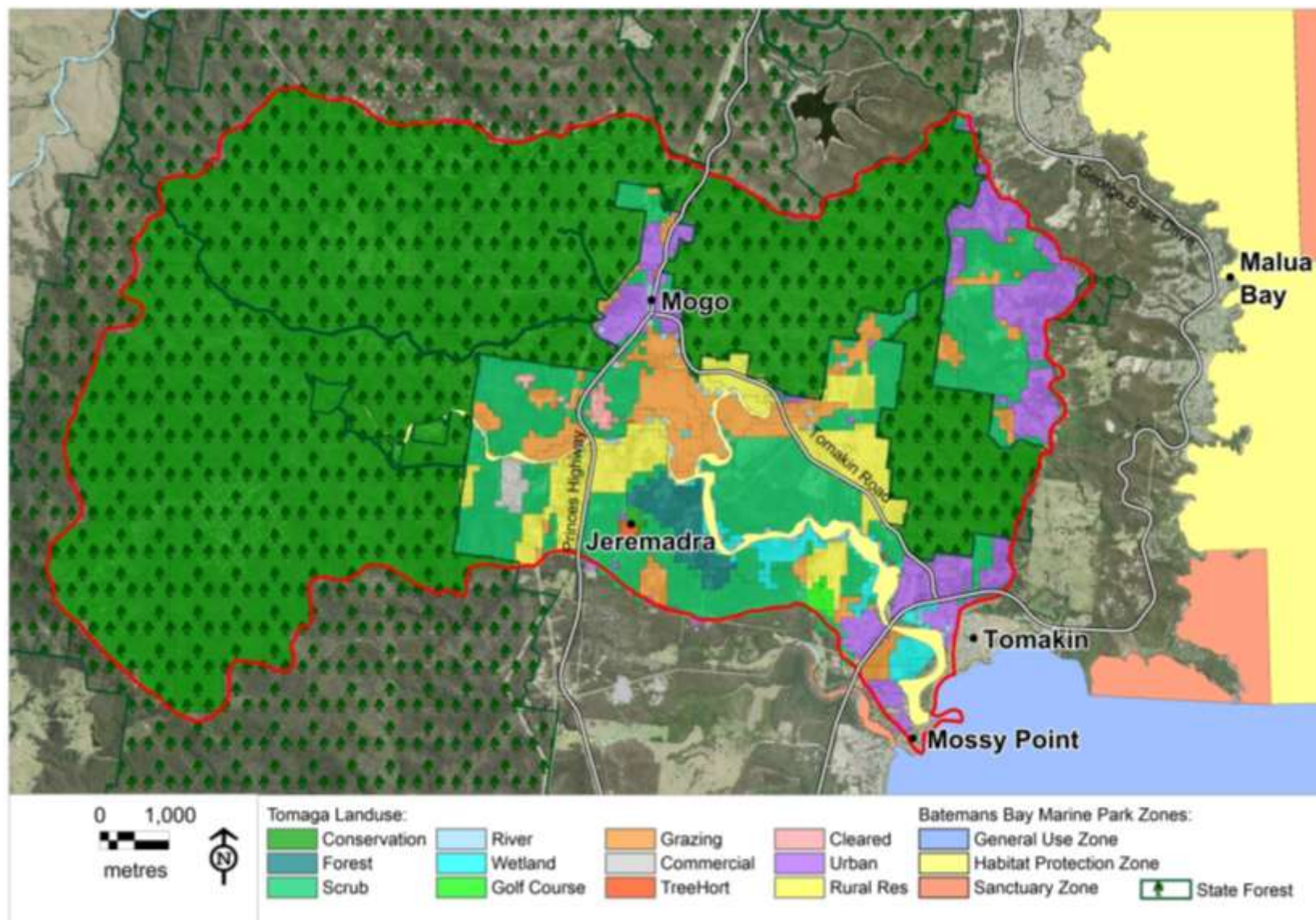
The Batemans Marine Park zoning came into effect in 2007, including a habitat protection zone (which provides for the protection of habitat and areas of cultural significance) throughout the Tomaga River. Tomakin Beach is in a general use zone providing for ecologically sustainable management.

Current land uses in the catchment are summarised in Table 4 and shown on Figure 7.

**Table 4: Tomaga catchment land use (based on 2014 CERAT mapping provided by OEH)**

Type	Area (ha)	% of total catchment
Conservation	6,116	66.3%
Scrub	1,283	13.8%
Urban	557	6.0%
Rural residential	437	4.6%
Grazing	433	4.7%
Wetland	127	1.4%
Forest	107	1.2%
River	98	1.1%
Commercial	26	0.3%
Cleared	24	0.3%
Golf course	16	0.2%
Tree Horticulture (TreeHort)	7	0.1%
<b>Total Area</b>	<b>9,231</b>	<b>100%</b>





**Figure 7: Major land uses of the study area**

Source: CERAT land use modelling supplied by OEH



## 4.4 Climate

The region experiences a temperate climate with mild maximum and low minimum temperatures. Rainfall is not predominantly seasonal but the majority of rain falls in the summer and autumn months. Average annual rainfall is 893 mm measured at the Batemans Bay (Catalina Country Club) weather station (since 1985). Average daily temperatures vary from 14°C to 26°C in summer and from 4°C to 18°C in winter. Mean wind speed is 14 km/h at 3pm, predominantly from the east, tending to the south in winter months (BOM, 2014).

## 4.5 Climate Change

Natural variations in temperature and rainfall in NSW are influenced by the naturally variable climate systems. Although there is natural variability in the climate, there is consensus among the majority of leading climate scientists that the rate and magnitude of climate change is outside the expected range of this natural variability. Climate change is an important consideration for strategic planning, particularly in coastal areas where the combined effects of sea level rise and increased storminess are considered key threats.

Sea level rise is anticipated to result in management issues including increased inundation of low lying lands, infrastructure and development and implications for drainage and flooding in urban areas. The issue of potential increased storminess is less well understood. It is generally anticipated that rainfall events will become more intense, even if average rainfall reduces, in response to climate change. This may result in effects such as more floods as well as greater capacity for erosion and runoff and pollution of waterways within the catchment. Locally, there will be impacts from climate change that are unavoidable such as sea level rise and changes to rainfall patterns and therefore long-term management planning needs to consider the likely changes to the estuary and the factors constraining adaptation to such change.

Average sea levels are projected to continue to rise throughout the 21<sup>st</sup> century. In 2009 the NSW Government released the *NSW Sea Level Policy Statement* and associated guidelines to assist coastal councils in their planning for sea level rise impacts. This broad policy was withdrawn in 2013, recognising that a single set of predictions may not satisfactorily reflect local conditions and that councils should adopt locally relevant projections as appropriate.

ESC and Shoalhaven City Council are currently undertaking a comprehensive assessment of the sea level rise science and local data, including advice on local sea level rise projections and their application using a risk management approach to dealing with the uncertainties. The councils have recently released a Draft *South Coast Regional Sea Level Rise Policy and Planning Framework* (Exhibition Draft, Whitehead & Associates, 2014) with the intention of using this framework as the basis for planning for sea level rise.

Historically, sea-level rise has been incorporated in a way which ties a given amount of sea level rise to a certain point in time. For example, common practice using the previous State government benchmarks relates to a 0.4 m sea-level rise (relative to 1990) to the year 2050 and a 0.9 m sea-level rise to the year 2100. The draft policy still nominates indicative scenarios for particular years, but recognises the uncertainty in the time frames at which a particular rise in sea level would be reached but accepts that sea level will continue to rise at accelerating rates (Whitehead & Associates, 2014). In the draft policy, strategic planning strategies are proposed for coastal hazard planning areas (to be determined as part of ESC's shire-wide CZMP). For assessment of sea level rise on waterway access and impacts on estuarine vegetation as part of this CZMP, the RCP8.5 (High) projection from this framework, has been utilised (refer Sections 6.5.3 and 7.3.5). The relevant high sea level rise projection is 0.98 m at 2100 relative to the beginning of 2015. With this strategy the policy states that rezoning to enable development is allowed, but steps must be taken to ensure that any long-term land use is fully adaptable to future sea-level rise (Whitehead & Associates, 2014).

This CZMP addresses the implications of sea level rise for estuarine ecosystem health and public access and amenity. With an increasing mean sea level, the elevations of the peaks of the high astronomical tides will also rise, meaning that susceptible areas will be inundated to greater depths and more frequently in future. Changes in salinity and water quality in estuaries may result and saline interfaces will migrate further

upstream over time. Erosion inside the Tomaga River Estuary may also be affected by sea level rise. The foreshores of the lower Estuary will be affected by recession and, potentially, a higher energy foreshore wave climate caused by deepening of water adjacent to the foreshore. A higher energy wave climate will tend to flatten sandy foreshores around the lower estuary (high rates of recession of unprotected sedimentary shorelines) (Whitehead & Associates, 2014). Coastal hazards will be addressed separately in Council's Shire-wide CZMP.

NOTE: Council adopted the following projections for sea level rise at its meeting held on 25 November 2014:

**PSR14/062 SOUTH COAST REGIONAL SEA LEVEL RISE PLANNING AND POLICY RESPONSE  
FRAMEWORK 14/336 MOTION** Councillor Pollock/Councillor Burnside

THAT Council:

1. Adopt the South Coast Regional Sea Level Rise Planning and Policy Response Framework endorsing the recommendations to adopt sea level rise associated with the following climate change scenario:

- RCP6.0 from the *Intergovernmental Panel on Climate Change Assessment Report 5(2012)*
- Levels assessed as having a 15% chance of being exceeded.

This is equivalent to a rise in sea levels of 72cm between 2015 and 2100.

## 4.6 Estuarine Hydrodynamics

The estuary catchment is small and steep sided so that rainfall rapidly drains into the estuary. Consequently, during periods of no rain, base flows are low and there will be very little flushing of the estuary by inputs from Jeremadra Creek, Mogo Creek and the Tomaga River. The virtual absence of fresh water flushing of the Tomaga River Estuary under these conditions means that water exchange in the estuary is largely due to tidal dispersion which is related to tidal velocity and the distance from the ocean. Tidal dispersion is largest at the mouth of the estuary, small in the mid-estuary and almost absent at the head of the estuary (Amog, 2003).

The Estuary Processes Study (EPS; Amog, 2003) presents the results of hydrodynamic modelling of the estuary and provides the following conclusions:

- Under non-flood conditions:
  - The tidal range decreases regularly for the first 6 km upstream from the ocean after which there is only a slight change;
  - Mean tidal levels increase regularly with increasing distance from the ocean;
  - Low water tide heights are highest in the upper estuary due to slack water. Conversely, the high water tide levels are highest in the lower estuary;
  - Except near the entrance, flood tide currents are stronger than ebb currents. Near the entrance they are equally strong; and
  - Maximum velocities for the estuary in both flood and non-flood conditions are generally observed close to the mouth and locally around bends.
- Under flood conditions:
  - Water levels are raised throughout the estuary with the steepest gradients occurring near the entrance;

- Overbank flows will occur in some locations upstream of the George Bass Drive Bridge during the 5 year flood (a 5 year flood event is a flood that can be expected to be equalled or exceeded every 5 years on average over a long period of time. A 5 year flood has a 20% probability of being exceeded in any year) and more generally on larger floods;
- During the 5 year flood and for larger floods the velocities and water levels are dominated by the river flow, although near the entrance tidal effects are still present during the 20 year flood (a flood that can be expected to be equalled or exceeded every 20 years on average); and
- During the 1 year flood both tidal and river flow effects are important.

Major pathways by which materials find their way into the estuary are from:

- Catchment input with stream flow;
- Coastal inputs with the tide;
- Runoff from rainfall;
- Storm water drains;
- Sewage surcharge;
- Commercial activities;
- Exchange with the atmosphere; and
- Decomposition of material in the sediments.

Materials are removed from the estuary by:

- Biological uptake;
- Flushing out to sea;
- Bonding to sediment particles;
- Loss to the atmosphere; and
- Chemical reactions.

## 4.7 Sedimentation

Sediment transport modelling undertaken for the EPS (Amog, 2003) provides the following conclusions:

- Sediment in the Tomaga River Estuary is mostly derived from the catchment, with sand below George Bass Drive Bridge mostly being derived from coastal sediment beds;
- Under non-flood conditions limited scouring of the streambed in the lower estuarine reaches is expected. The exact location of these scour patches will be influenced by the changing structure of the estuary bed and changing current velocities and tidal amplitude;
- Minor floods with a return period of one year will have little impact on bed structure;
- Floods with return periods of 5 years and greater will cause significant scouring. These floods result in the movement of sediment out of the estuary. This sediment will be a combination of material carried through the estuary from the catchment and material scoured from the streambed. With the tight bends and constrictions, scouring from the streambed will be greatest in the mouth area. During these floods material will be deposited as silt in the wetlands of the lower estuary. For floods with a return period of 5 years or greater there is sufficient velocities to cause scouring along the inside bank of the spit;

- Under non-flood conditions, flow velocities along the inside of the spit are not sufficient to scour the sand particles from the spit. However winds with a westerly component cause waves on the inside of the spit which can be responsible for stirring up the sediments. Water currents can then carry particles away. The rapid water movement around the bend at the upstream end of the spit will have sufficient velocity to cause scouring and sediment movement will occur along the inside of the spit;
- Sediment budget estimates indicate a net input of 1,800 m<sup>3</sup> of sediment a year into the estuary; and
- There is net accumulation of sand over most of the lower estuary from the mouth to the George Bass Drive Bridge and there may be a net loss of sediments upstream or in the deeper channels.

## 5. SUMMARY OF ESTUARY VALUES

The key values documented in the 2005 EMP relate to preservation of the natural beauty of the estuary, the mixture of seaside and rural lifestyle, maintaining water quality and ecosystem health and safe access to coastal waters. These values are still relevant and are summarised below and discussed in Section 6:

- Social and Recreational Values:
  - Tomaga River is considered an area of significant natural beauty;
  - River users value the unspoiled nature of parts of the Tomaga River Estuary;
  - Tomaga River provides opportunities for recreational fishing, boating (estuarine and offshore access), swimming and surfing at the entrance;
  - Recreational fishers value the river as it provides a peaceful relaxed fishing haven, closed to commercial fishing activity;
  - The ocean boat-launching ramp is considered by many to provide one of the best offshore most-weather ocean access bars in the Shire;
  - The residential centres at Tomakin and Mossy Point are closely associated with the estuary and coastal environment;
  - Residents value the lifestyle associated with living near the river and the coast; and
  - Tomakin and Mossy Point are significant retirement areas.
- Cultural Values:
  - The most prominent cultural values and sites around Tomaga River stem from the Aboriginal history and significance of the estuary and surrounding area to the Aboriginal people. A number of midden sites are located around the river and its banks; and
  - Non-Aboriginal historic sites relate to goldmining and timber production.
- Environmental Values:
  - The Tomaga River Estuary supports a very high diversity of birds typically dependent on the estuarine habitat for breeding, shelter and food. Also the adjacent riparian zone and forests have a high diversity of bush birds;
  - Endangered Ecological Communities (EECs) mapped within the study area include: Bangalay Sand Forest, Swamp Oak Floodplain Forest, Coastal Saltmarsh and River Flat Eucalypt Forest on Coastal Floodplains. These communities have been determined to be facing a very high risk of extinction in NSW in the near future using criteria prescribed in the *Threatened Species Conservation Act 1995*;
  - The Tomaga River Estuary has a large proportion of seagrass beds, swamps, saltmarsh and delta intertidal sandflats. These are important habitat for fish and particular highly valued nursery areas. The mangroves and saltmarshes are in very good condition and nearly all areas are mapped as State Environmental Planning Policy (SEPP) No 14 protected wetlands. Approximately 50% of the banks in the lower and mid-estuary are in SEPP 14 wetlands; and
  - As well as the mangrove and saltmarsh protected in the SEPP 14 wetlands the estuary has an extensive riparian *Casuarina* belt fringing much of the upper estuary;

- Commercial Values:
  - The Tomaga River Estuary is an important holiday destination for those people who do not wish to stay in a highly developed environment;
  - The estuary is a priority oyster aquaculture area (Sydney Rock Oysters);
  - Tourism is generated from day trippers and visitors to tourist facilities such as Mogo Zoo, The Moorings, Oaks Ranch, River Haven Tourist Park and Tomaga River Tourist Park.

The Batemans Bay Marine Park was gazetted in 2006. The Tomaga River is a Habitat Protection Zone and the coastal waters are a General Use Zone (refer Appendix 2). This zoning influences the type of recreational and commercial fishing permitted as well as developments within the marine park to ensure they concur with the objects of the zone and minimise impacts to key habitats. The provisions of the existing Recreational Fishing Haven in the Tomaga River continue to apply, including the use of recreational haul nets that are prohibited in other habitat protection zones.

## 6. ECOSYSTEM HEALTH STATUS AND PRESSURES

An understanding of coastal ecosystem health and the vulnerability of the system to pressures is required to provide a sound basis for designing management actions and understanding the effects of management practices. This section provides an assessment of the health of Tomaga River Estuary including:

- The health status; and
- The pressures affecting estuary health status and their relative magnitude.

The 2005 EMP and Estuary Processes Study provide extensive background information on the study area. The following sections provide a summary of the key estuary features and new data available since 2005.

### 6.1 2010 Condition Assessment

The NSW Natural Resources Monitoring, Evaluation and Reporting (MER) program provides information on natural resource condition and trends within catchments. The MER program collects data on NSW estuaries and reports on the condition of the various system components and pressures impacting on natural resources. Key indicators including water quality parameters, macrophyte and fish indicators are assessed and condition ratings are assigned for each round of sampling. The latest MER condition assessment for the Tomaga River was reported in Roper *et al.* (2011).

In Roper *et al.* (2011) the overall condition rating for the Tomaga River Estuary was assessed as “very good” from an average of all scores which ranged from good to very good water quality results and good and very good results for seagrass and saltmarsh increases in extent. Macroalgae, mangrove and fish data were not assessed for the Tomaga River Estuary during the 2010 MER assessment. The data are discussed further in Section 6.3 (Water Quality) and Section 6.5.1 (Estuarine Vegetation).

Roper *et al.* (2011) also reported on the main pressures affecting the health of the Tomaga River Estuary. Some pressure categories were assessed as being very low or low, such as low catchment clearing and low fishing pressure, tidal flow (flushing capacity) and very low disturbed habitat. Other pressures were assessed as moderate such as population density, sediment and nutrient inputs and freshwater flow. The overall pressure score was “low” for the estuary. Table 5 provides the MER pressure rating results for the Tomaga River Estuary in 2010.

**Table 5: 2010 pressure rating for Tomaga River estuary**

Indicator	Pressure Score	Pressure Index Rating	Pressure indicator notes
Cleared land	4	Low	7.5% - <21.7% catchment cleared
Population	3	Moderate	9.0 - <40.7 people / km <sup>2</sup>
Sediment input	3	Moderate	40 - <80% increase from natural
Nutrient input (TN)	3	Moderate	150 - <400% increase from natural
Freshwater flow	3	Moderate	Water extraction: 12.7 - <19.0% annual flow; Catchment runoff: 11.9 - <21.9% increase
Disturbed habitat	5	Very low	Structures: 0.008 - <4.1% of perimeter Aquaculture: 0.1 - <4.9% of area
Tidal flow	5	Very low	Entrance: level <1.4 m AHD
Fishing	5	Very low	<2.0 annual tonne/km <sup>2</sup>

Indicator	Pressure Score	Pressure Index Rating	Pressure indicator notes
Overall Pressure Index	4.0	Low	Average Score

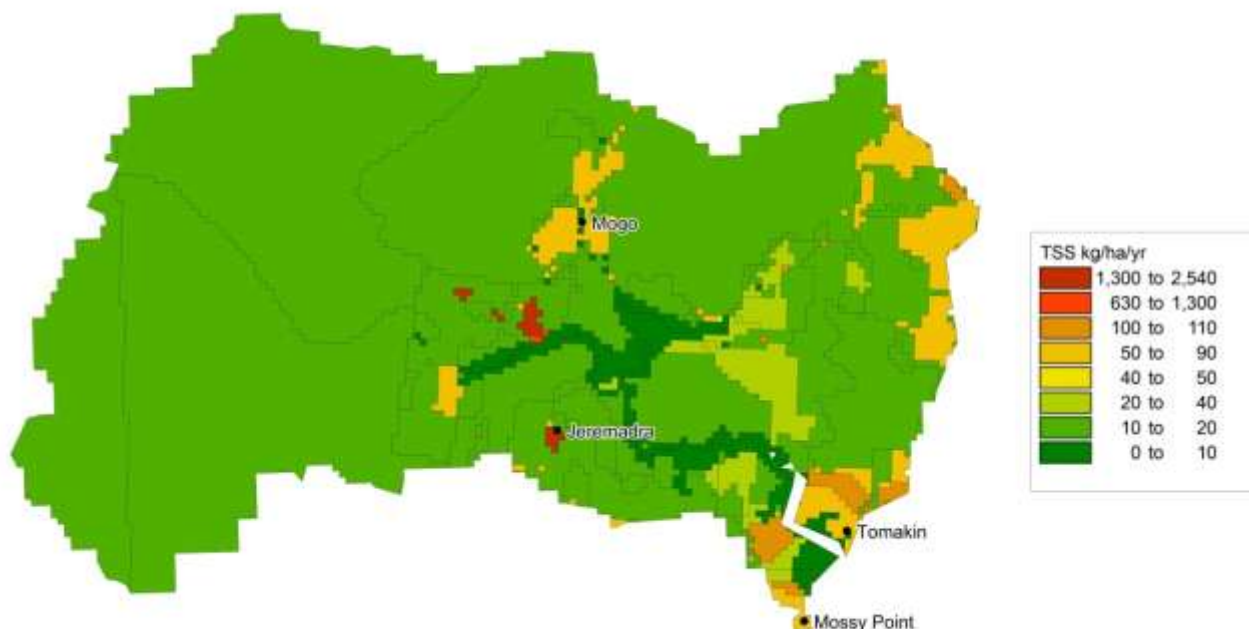
Source: Adapted from Roper *et al.* (2011)

## 6.2 Coastal Eutrophication Risk Assessment Tool (CERAT)

The Coastal Eutrophication Risk Assessment Tool (CERAT) can be used to better understand and predict the relationship between land use in catchments and its impact on estuaries and coastal lakes. OEH scientists have developed a risk assessment tool to help identify and prioritise land use planning decisions to protect and preserve the health of estuaries in NSW. The catchment models provide estimates of the amounts of nutrients and sediments exported from land-based activities, such as urban development, deforestation and agriculture.

Figure 8, Figure 9 and Figure 10 provide the spatial results of the latest update to CERAT modelling undertaken for the Tomaga River catchment for total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) respectively provided by OEH.

The model shows that the majority of the upper catchment, which is mostly forested, has low exports of sediment and nutrients. Areas categorised as 'cleared' or 'tree horticulture' in the upper estuary between Mogo and Jeremadra Creeks contained the highest levels of predicted pollutant export. Grazing land in the mid and upper estuary is predicted to contribute to moderate/high nutrient loads (TN and TP) but lower sediment loads than other land uses (e.g. urban). Urban areas in the lower, mid and upper estuary (in the vicinity of Mogo) are predicted to contribute relatively moderate loads of sediment and low to moderate loads of TN and TP to the estuary.



**Figure 8: Modelled TSS load**



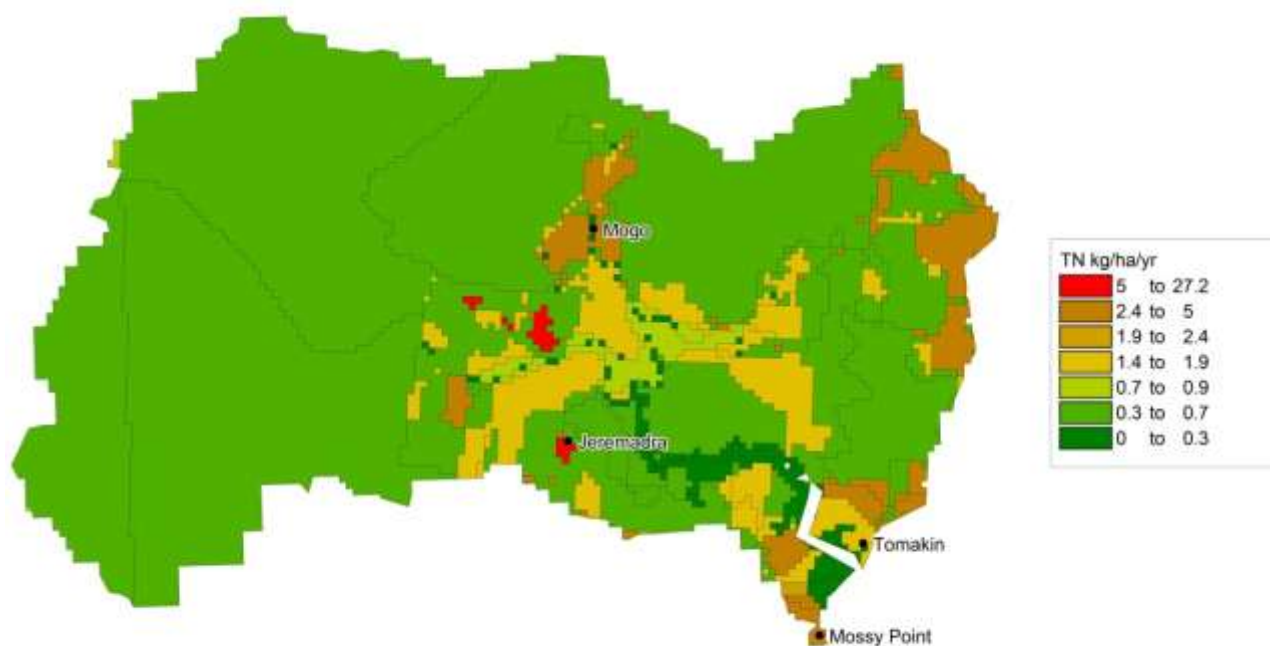


Figure 9: Modelled TN load

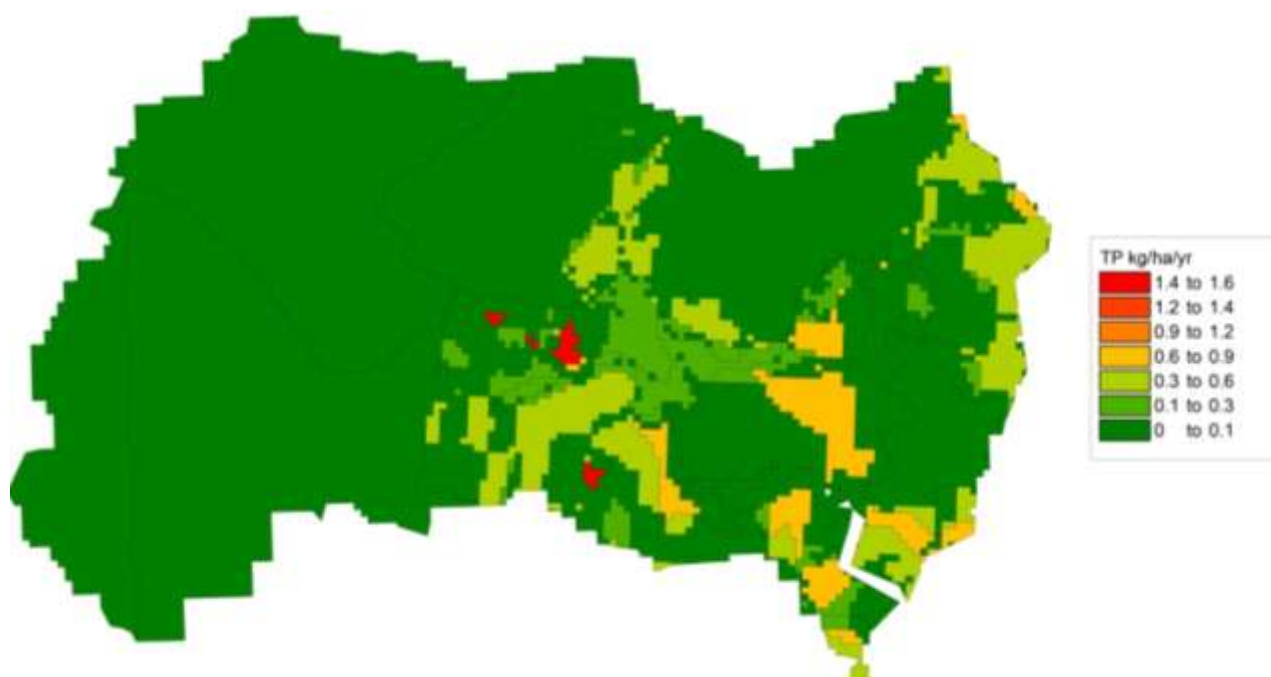


Figure 10: Modelled TP load

### 6.3 Water Quality

The water quality data available for the 2005 EMP related to ecosystem and human health indicators in the lower, middle and extreme upper estuary (freshwater for much of the time). The EMP (Amog, 2005) reported no major problems with water quality but noted that deterioration in water quality was observed after rainfall and data were not available for the upper estuary. Key issues (high or medium risk level based on risk assessment undertaken as part of the EMP) relating to water quality identified in the 2005 EMP were:

- Lack of appropriate water quality data;
- Impact of dead livestock;
- High sediment load from stormwater runoff for roads discharging directly into the estuary;
- Urban runoff from Mossy Point and Tomakin; and
- Water quality problems caused by livestock gathering along the bank and entering the water.

The 2005 EMP recommended the following actions:

- Ensure water quality data representing an upper estuary site is collected (potentially near the junction of Mogo Creek and the Tomaga River);
- The collection of nutrient data; and
- Water quality monitoring after major rainfall events.

Due to the low volume of freshwater input, catchment inputs are low and mixing and flushing of material from the estuary is driven by the tidal movement. The tidal dispersion pattern (refer Section 4.6) indicates that retention of pollutants particularly in the upper estuary may be a management issue for the Tomaga River Estuary.

Potential sources of pollutants to the Tomaga River Estuary are urban runoff (stormwater) from Tomakin, Mossy Point and Mogo, rural land (mostly grazing land with areas of cropping/horticulture). Faecal coliforms from pets, livestock and wildlife would be washed into the estuary by rainfall. Decomposition of this material and other organic material such as leaf litter would result in the reduced oxygen concentrations. Dead cows in the estuary and livestock access to banks have previously been identified as issues (Amog, 2003).

Council recognised the need to modify the existing water quality monitoring program to include information to determine whether ecosystem health is declining, being maintained or improving through estuary management planning initiatives. The new monitoring program commenced in February 2010 from a grant provided through the NSW Estuary Management Program and is broadly in line with the monitoring and reporting protocols of the MER Program (estuary theme). The program is reported in Wiecek (2012) and WBM (2011). Water quality condition ratings for the Tomaga River Estuary in 2010 (reported in Roper *et. al.*, 2011) are provided in Table 6.

**Table 6: Water quality condition rating of Tomaga River Estuary 2010**

Indicator	Condition Score	Condition Index Rating	Condition indicator notes
Chlorophyll a	4	Good	10 - <50 % exceedance of water quality guideline trigger levels
Macroalgae	No data		
Turbidity	5	Very good	< 10 % exceedance of water quality guideline trigger levels

Source: Adapted from Roper *et al.* (2011)

WBM (2011) reviews the water quality data collected for the Tomaga River Estuary since 2005, including the 2010 data collection program. Data sets include:

- Historic estuarine water quality data covering water quality parameters enterococci, water temperature, salinity, dissolved oxygen, total dissolved solids, pH and turbidity covering the period from 2005 to 2010. Traditionally, past monitoring was focussed upon public health, but in recent times, the focus has shifted to include estuary health; and

- Estuarine water quality data covering the 2010-2011 period for the water quality parameters enterococci, water temperature, salinity, dissolved oxygen, total dissolved solids, pH, turbidity and chlorophyll a.

WBM (2011) reports on three monitoring sites in the Tomaga River Estuary:

- Freshwater section (downstream of Mogo);
- Mid estuary (Oaks Ranch and Country Club); and
- Lower estuary (George Bass Drive bridge).

The median water quality values for physico-chemical parameters and enterococci were generally within guideline levels for the 2005-2010 data with the exception of the freshwater reach site which WBM (2011) concludes should not be included in the estuary monitoring program (as it lies upstream of the tidal limit and therefore outside of the estuary). Data representative of the middle estuary indicates water quality problems (median chlorophyll a value exceeds trigger value for middle salinity zone) however the sample size was small. In terms of percentage exceedance and overall ranking, the Tomaga River Estuary (lower and mid estuary sites) were ranked 'Good' for chlorophyll a (29% exceedance) and 'Very Good' for turbidity. The combined ranking was 'Good' (WBM, 2011).

WBM (2011) also found that the Tomaga River sampling program did not adequately characterise middle and upper salinity regimes and given that data from this estuary shows chlorophyll a exceeding the trigger value, and turbidity approximately at the trigger value, better characterisation of the health of the estuary was required. A new site representative of mid-estuarine water quality (in the vicinity of the oyster lease area) and a new low salinity site in the upper estuary (downstream of the confluence with Mogo Creek) were recommended with fortnightly summer sampling.

The MER protocols were used to prepare ecosystem health report cards for the Eurobodalla estuaries including Tomaga River as reported in Wiecek (2012). The results of Council's ecosystem health monitoring programs have been presented in report cards (Appendix 5) that grade the health of the estuaries from A (Very Good) to E (Very Poor). Individual sites within each estuary were also graded.

The report cards for the Tomaga River indicate periods of reduced water clarity (higher turbidity) but show a slight improvement in combined chlorophyll a grade between 2010/11 and 2011/12. Both of these years were wetter than recorded averages, especially the summers, with the 2011-12 summer being particularly cooler with higher than average rainfall. This may have contributed to high turbidity levels as well as improvements in chlorophyll a levels resulting from the reduced light penetration and the ability of algae to grow (Wiecek, 2012). Similarly, Wiecek (2012) notes that lower than average temperatures experienced over summer 2011/12 would have contributed to lower algae growth. Hence, longer term monitoring over various climatic conditions is required to predict any changes in ecosystem health.

The individual sites and reported grades are listed in Table 7. In 2011/12, water quality for recreational use at two of the three sampling locations was considered suitable for swimming most of the time, with the site most upstream of the estuary being the least suitable. This illustrates the water may be susceptible to pollution from potential sources of faecal contamination occasionally, particularly upstream. The site in the freshwater section recorded poor water quality. This site was replaced with the upper estuary site in the 2011/12 monitoring.

The current MER-aligned monitoring program is considered to provide a good assessment of ecosystem health throughout the Tomaga River Estuary and is consistent with other ecosystem health monitoring being undertaken by other NSW coastal councils and OEH. Repeated monitoring through time will allow for tracking of water quality trends and changes in condition on an estuary-wide scale.

**Table 7: Water Quality Report Cards**

Site	Site Location	Recreational Use (enterococci coliform indicator)	Chlorophyll a	Turbidity
2011/12 <small>(note 1)</small>				
1. Upper estuary	Downstream of confluence with Mogo Creek (as recommended by WBM, 2011)	69% of samples within guideline values	C (Fair)	D (Poor)
2. Mid-estuary	Oaks Ranch and Country Club	92% of samples within guideline values	B (Good)	C (Fair)
3. Lower estuary	George Bass Drive bridge	92% of samples within guideline values	B (Good)	C (Fair)
2010/11 <small>(note 2)</small>				
1. Upper river	Freshwater section (downstream of Mogo)	Not reported	E (Very Poor)	D (Poor)
2. Mid-estuary	Oaks Ranch and Country Club	Not reported	B (Good)	B (Good)
3. Lower estuary	George Bass Drive bridge	Not reported	B (Good)	B (Good)

Note 1: Based on chlorophyll a and turbidity data collected by Council between July 2011 and July 2012.

Note 2: Based on chlorophyll a and turbidity data collected by Council between February 2010 and January 2011.

A concern raised by the community was the impact of runoff from developments such as The Moorings, Mogo Zoo and new residential developments as well as farmland in the upper estuary. There is no event-based monitoring undertaken in the Tomaga River so it is difficult to isolate any particular causes of water quality degradation. To assist in identifying sources of pollution, an event-based monitoring program for selected sites would need to be designed and implemented.

While further detail on the location and magnitude of water pollution sources is desirable to better direct management effort, the absence of definitive information does not prevent the implementation of actions to improve management practices throughout the catchment.

## 6.4 Erosion

Key issues (high or medium risk level based on risk assessment undertaken as part of the EMP) relating to erosion and sedimentation identified in the 2005 EMP were:

- Erosion of the spit and threat of new channel forming;
- Erosion of the north bank from the Tomakin Caravan Park to Jack Buckley Memorial Park and from the Tomakin Jack Buckley Memorial Park to the Tomakin Boat Ramp;
- Erosion of south bank near George Bass Drive bridge;
- Erosion of reclaimed land at Jack Buckley Memorial Park;
- Erosion of bank upstream from The Moorings;
- Erosion of banks near oyster leases;
- No protection on stormwater outlet at The Moorings; and

- Erosion of banks near confluences of Tomaga River, Mogo Creek and Jeremadra Creek.

Causes of bank erosion are:

- Natural migration of the river;
- Scouring during floods;
- Wave action from wind and boats;
- Runoff flowing down the banks; and
- Mobilisation of sediment by human and animal traffic.

The presence of vegetation significantly inhibits erosion and the presence of dispersive soils facilitates erosion.

The EPS (Amog, 2003) identified areas where:

- Clearing of vegetation was contributing to erosion;
- Animal and/or human traffic contribute to erosion;
- Boat wash led to significant damage to the banks;
- Banks are steep and contributing to slumping and erosion; and
- Bank scour protection is required.

Various actions have been undertaken to control erosion of the spit and banks of the estuary as discussed in Sections 2, 8.1.1 and 8.2.1 and Appendix 2. The current issues related to erosion are discussed in the following sections.

#### 6.4.1 The Spit

The sand spit adjacent to the entrance has experienced erosion from both the ocean side and the river side (Figure 11). The extent of historical erosion has resulted in a risk that extreme flooding and/or wave erosion may cause a breach in the spit, redirecting the entrance and isolating the present entrance near Mossy Point. A sketch map by a surveyor in 1828 shows the Tomaga inlet to the north with a sand spit extending to the rocks at Mossy Point.



**Figure 11: Erosion of the spit (river side), fencing at base of dune and along ridge (May 2014)**



A 1994 river bank erosion study (Public Works, 1994) concentrated on the Tomakin Beach sand spit in response to community concern about the ongoing erosion of the spit. The study found that the spit had receded up to 20 m over 30 years (based on 1962 aerial photography) and that there is a threat of river breakthrough. The strong curvature of the river just upstream of the spit causes a concentration of flow



against the outside of the bend resulting in increased velocities and increased sediment carrying capacity causing erosion of the outside bend. This process, attributable to natural river migration, is an ongoing process. The study found that breakout would cause shoaling of the existing entrance, affecting boating navigation and waterway access from Mossy Point as well as loss of telecommunication services (Public Works, 1994). Erosion on the spit may be accelerated by pedestrian trampling of vegetation and disturbance of the dune profile, however the underlying dominant erosion processes are natural.

A comparison of the available historical aerial photography provided by OEH (between 1961 and 2014) is provided below.

**Table 8: Comparison of aerial photography of the spit**

	<p>1961:</p> <ul style="list-style-type: none"> <li>• River entrance at south of spit;</li> <li>• Wharves have been constructed at Mossy Point;</li> <li>• Vegetation has been cleared for development of Tomakin residential area; and</li> <li>• A dune scarp is present on the ocean side, particularly at the northern end Tomakin beach.</li> </ul>
	<p>1969:</p> <ul style="list-style-type: none"> <li>• Continued development of Tomakin and Mossy Point residential areas with minimal houses;</li> <li>• A training wall has been constructed along the spit from Tomakin boat ramp. This wall was apparently washed away in the 1974 floods (Amog, 2005);</li> </ul>



1975:

- The spit appears to be narrower which may be the result of major storms and beach erosion which occurred in 1974;
- A clear access track exists along the dune ridge; and
- Development of Tomakin and Mossy Point residential areas has continued; and
- Vegetation on the spit appears to be abundant.



1986:

- Vegetation on the spit appears to be abundant although the spit appears to have narrowed; and
- The dune ridge path is less visible.



2005:

- Vegetation appears more sparse at the narrowest point of the spit than in previous and recent photos; and
- The vegetation along the southern end of the spit is mature.



2014:

- Vegetation is still sparse at the narrowest point.

Source: Aerial photography provided by OEH.

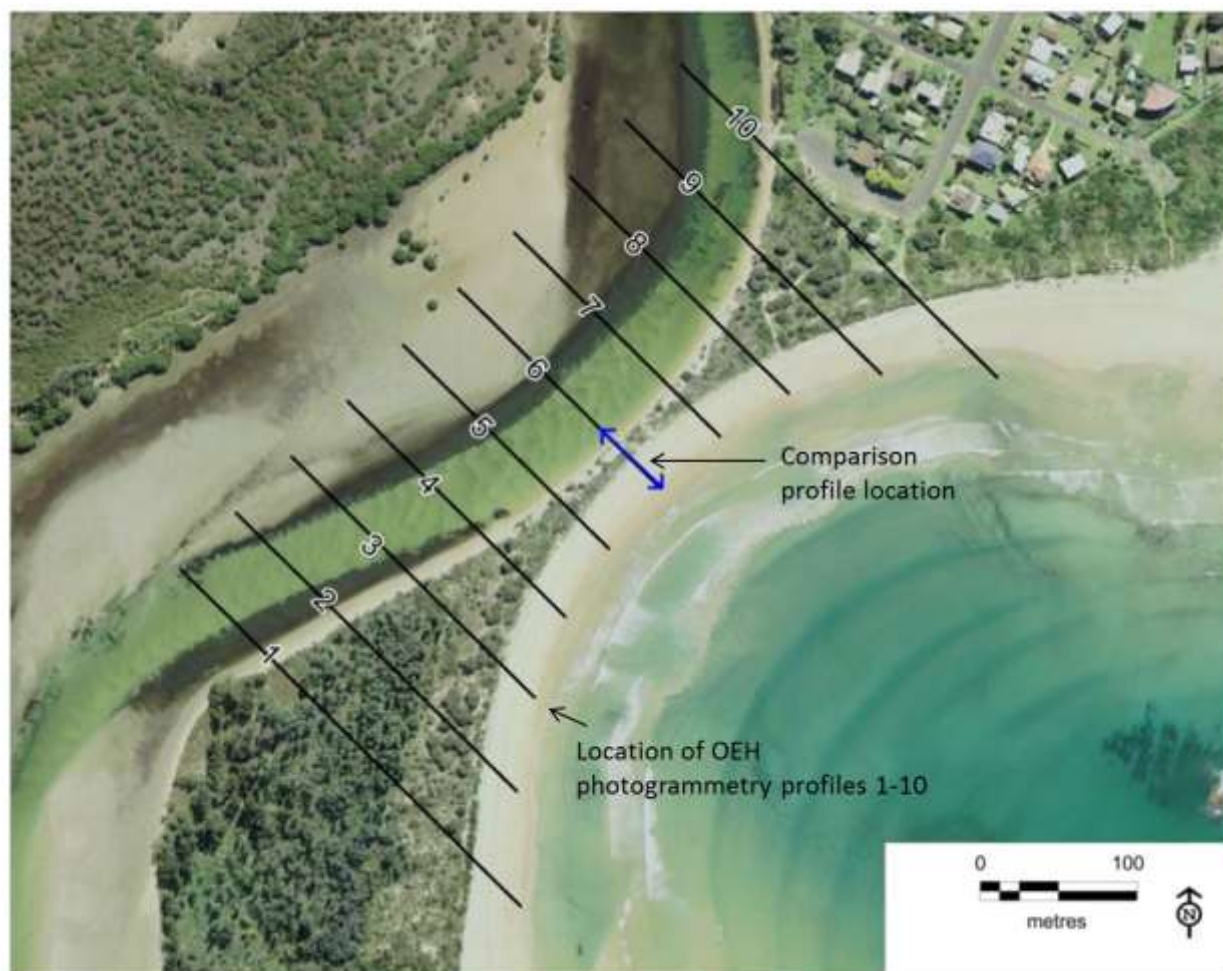
As part of the 1994 DPWS study, an intensive study of the spit was undertaken including an analysis of aerial photographs taken over a 32 year period. The study indicated that the bend of the river was eroding at rates ranging from 0.4 to 1.4 m/year up to 1980. The erosion rate dropped after this period and ranged from 0.3 to 0.7 m/year for the period 1980 to 1990. The study concluded that it would take approximately 30 years (from 1993) for the river to break through the spit.

The EPS presented a comparison of the spit profile at its narrowest point for 1993, 1996 and 2003. Considerable erosion was noted over this time period with the dune receding by 6.5 m at an elevation of 2 m AHD on the river side in 10 years. The crest of the dune had also moved approximately 5 m to the east and dropped in height by 2.4 m since 1993 (Amog, 2003).

In 2012, OEH completed photogrammetric analysis of the Tomakin spit for a number of years between 1962 and 2011. A series of 10 profiles were drawn along the spit comparing morphology in 1962, 1980, 1993, 2003 and 2011 (refer Appendix 6 for all profiles). As part of this CZMP, the latest information on spit morphology was used to make an assessment of the current status of the spit and any recent changes. OEH undertook a survey of the spit in early July 2014 to provide the current status (refer Appendix 7 for survey data). In order to compare profiles between years, the OEH 2014 survey cross sections were overlain with the OEH photogrammetry profile locations using GIS software to identify profiles at the same location. A 2014 profile was selected at the narrowest point along the spit that was within approximately 1 m of Profile 6 from the OEH analysis. Elevation data collected at this location in 2014 was then added to the OEH profile information from previous years. Figure 12 shows the location of the selected profile for comparison. Figure 13 presents the profile at this location for 1962, 1980, 1993, 2003, 2011 and the recent survey data for July 2014.

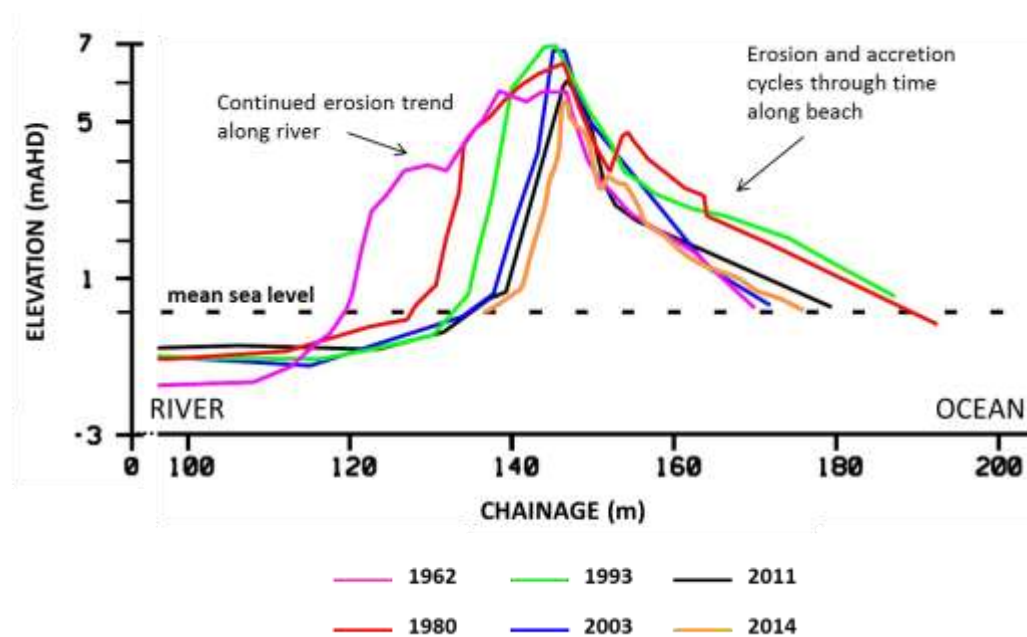
It is clear that the spit is eroding along the river side and this trend has continued throughout all years of analysis. This erosion trend is evident at the narrowest point shown in Figure 13, and across all the OEH profiles, although the effect is less pronounced at the most northern profiles (9 and 10) and the southern profiles (1, 2, 3 and 4) away from the main bend in the river (refer Appendix 6). In the 49 years between 1962 and 2011, the spit had eroded by approximately 20 m along the river side at the narrowest point. This distance increased by approximately another 3 m between 2011 and 2014, equating to an erosion rate of approximately 1 m/year. This was the same rate reported in the EPS for the years 1993 - 2003.





**Figure 12: Location of OEH photogrammetry profiles and 2014 comparison profile**

Source: 2010 aerial photograph provided by ESC



**Figure 13: Comparison of Tomakin spit morphology over time**

Source: 1962 – 2011 sourced from OEH photogrammetry, 2014 data added from latest OEH survey

Dune crest height appeared to increase between 1962 and 1993, but decreased significantly in subsequent years. The current crest height of 5.45 m at the narrowest point is approximately 1.35 m lower than the 1993 height of 6.8 m.

In contrast, the beach side of the spit has displayed varying patterns of erosion and accretion through time, with the current 2014 profile similar to the beach profile recorded in 2011 and 1962. Offshore sand movement during storms is the likely cause of temporary loss of sand from the beach. This sand then moves back to the beach areas during calmer weather. Weak longshore drift continues to move sand to the south and this is evident in the OEH profiles showing more accretion occurring in the southern profiles (Appendix 6).

Objective 1 from the 2005 EMP (Manage the spit to minimise likelihood of breakthrough and to minimise impact on users and the environment if breakthrough does occur) was considered to be the primary objective of the EMP. The Estuary Management Committee's preferred position was that the spit was managed to prevent a breakthrough. As a long-term solution, the EMP (Amog, 2005) recommended allowing the breakthrough to naturally occur coupled with ongoing maintenance of the main entrance as this option accepts the natural changes to the estuary and requires minimal work to maintain user expectations. Short-term solutions included in the Plan included sand renourishment and stabilisation through planting, fencing and signage to limit access with monitoring following storms. The renourishment was expected to provide better protection from breakthrough from the ocean although the Plan found that breakthrough from the estuary is still likely to occur in the long-term.

The outcome and timing of breakthrough of the spit is difficult to predict as it will depend on the movement of sand due to catchment flooding and coastal sand transport. However, if current rates of erosion at the river side continue, a break though is inevitable within the next 30 years.

Possible outcomes of spit breakthrough were discussed in the EPS (Amog, 2003) and are summarised below:

- The entrance relocates from the southern end of Tomakin Beach to the location of breakout. The resulting shoaling at the southern end is likely to close the present boating access from Mossy Point;
- The main river flow may follow either the old or new channel and this may fluctuate over time;
- A large movement of sand on to Tomakin Beach is likely to re-close the new mouth and river flows will return to the current position and entrance to the south;
- Two mouths may be maintained until the dominant mechanism of sand transport (catchment flooding or longshore drift) causes accretion at either mouth; and
- More frequent modification of the entrance and potentially seasonal opening and closing would affect safe access and ecology of the estuary due the fluctuations between a marine environment and an estuarine lake environment.

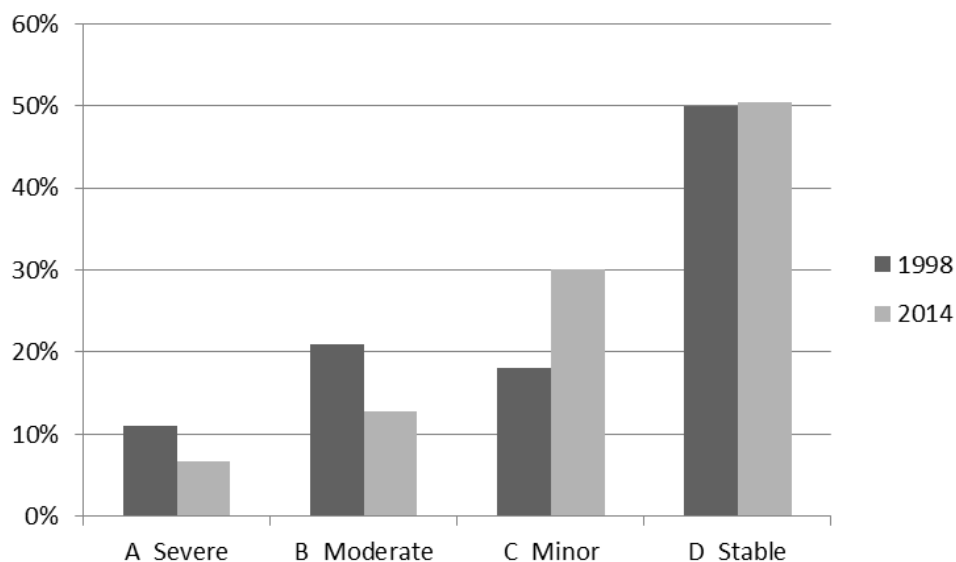
Given the historical natural position of the river channel, it is considered that the river is likely to continue to migrate in its existing form with an entrance at the lowest energy point of the beach (southern end of Tomakin Beach). However, if breakout does occur, the ultimate channel location will depend on the dominant mechanism of sand transport and timing will depend on catchment flows and ocean conditions at the time.

#### **6.4.2 Bank Erosion**

As well as the spit there is erosion of the estuary bank at Tomakin and generally throughout the estuary. In the lower and mid estuary, this erosion is generally on public land but if river movement continues in the present direction then residential properties may be impacted in Tomakin. In the rural areas, bank erosion has led to loss of grazing land and damage to fences (Amog, 2003).

An honours thesis prepared in 1998 also studied bank erosion on the Tomaga River up to the confluence with Mogo and Jeremadra Creeks (Bishop, 1998). This study found that approximately half of all river banks displayed signs of at least minor erosion. Approximately 11% of banks were considered to be undergoing 'severe' erosion, mainly in the lower reaches of the estuary, where banks are comprised of poorly consolidated marine sand. Moderately eroding banks were evenly distributed throughout the upper and lower estuary, comprising approximately 21% of the river bank. Stable banks comprised of bedrock or low, graded alluvial or sandy backs dominated the middle estuary.

Mapping prepared as part of the Bishop study was reviewed in 2014 by ESC and OEH to identify current areas of erosion and ground-truthed as part of the preparation of this CZMP. The current areas of erosion are shown on Figure 16 and Figure 17. Erosion control works have been installed in a number of locations throughout the estuary since the 1998 survey. As a result, many of the areas of severe erosion have been adequately controlled. There are also a number of areas upstream of the George Bass Drive Bridge where erosion ratings were reduced in severity in 2014. Figure 14 compares the 1998 bank erosion survey results to the 2014 review. The overall percentage of banks classified as having 'severe' or 'moderate' erosion has decreased by 4% and 8% respectively since 1998. There has been an increase in 'minor' erosion by approximately 12%, and the total length of 'stable' banks has roughly stayed the same with a slight increase of 0.5%, due to installation of sections of rock revetment.



**Figure 14: Comparison of 1998 and 2014 erosion survey results up to the confluence with Jeremadra and Mogo Creeks**

The current areas of severe or moderate erosion are listed in Table 9 including the natural and built assets affected and key causes of erosion. Example photos of some sites are shown in Figure 15. Site 1 (stormwater scour) is discussed in Section 6.8, Site 2 (the spit) is discussed in Section 6.4.1 and site 5 (midden) is discussed in Section 7.5.

In addition to the areas identified in Table 9, the banks of Mogo Creek immediately upstream of the confluence with the Tomaga River contain sections of moderate erosion and areas of stable foreshore. These areas were not able to be surveyed by boat due to shallow depths and therefore have not been mapped in this assessment.



Site 3



Site 3



Site 6 (Source: D. Wiecek, OEH)



Upper estuary

**Figure 15: Bank erosion sites**



**Table 9: Areas of severe or moderate erosion (note left and right bank has been assigned as if facing downstream)**

Location	ID	Length of erosion (rating)	Land use/ LEP Zoning	Ownership	Vegetation type/condition	Built assets within 50m of bank	Causes of erosion
<i>Lower estuary</i>							
Right bank, Mossy Point	1	229m (Mod)	Urban/wetland, E2 (Environmental Conservation), W1 (Natural Waterways)	Crown	Mangroves, fringing coastal vegetation medium-dense	Residential houses and property	Stormwater scour, waterway access, vegetation removal
The spit	2	272m (Mod), 309m (Sev)	River/Beach, E2	Crown	Mod section contains dune vegetation with weed encroachment and some saltmarsh. Severe section sparsely vegetated.	-	Flow scour from natural channel meander, exacerbated by pedestrian access, vegetation disturbance and waves. Refer Section 6.4.1
Left bank, Tomakin	3	317m (Mod)	Urban/Public Open space, E2, W1, RE1 (Public Recreation)	Crown/Council Road Reserve	Few individual mangroves, fringing coastal vegetation medium-dense	Residential houses and property	River meander, boat wake, waterway access, vegetation removal
Left bank, ends of Jack Buckley Park rock revetment	4	Approx. 20m at each end (Mod)	Public Open space, RE1, W1	Council Reserve	Grassed parkland (mown), small stand of trees (upstream end) and a few individual mangroves (downstream end).	Picnic shelters, basketball hoop	River meander, boat wake, waterway access, vegetation removal, end effect of rock revetment (continued scour with reduced sediment drift)
Left bank, Tomaga River Tourist Park	5	157m (Sev)	Aboriginal heritage/Tourism, E2, W1	Crown/Mogo LALC	Small area at west extremity mapped as SEPP 14, sparse fringing vegetation and grassed area	Caravan park cabins	River meander, boat wake, waterway access, vegetation removal, flow scour in floods, rabbit warrens.
Right bank, downstream George Bass Drive bridge	6	161m (Mod), 216m (Sev)	Bushland, E2, W1	Crown	EEC (Bangalay Sand Forest and Swamp Oak Floodplain Forest), SEPP 14, small area of mangroves and saltmarsh at eastern end.	-	River meander, boat wake, waterway access, vegetation removal, flow scour in floods

Location	ID	Length of erosion (rating)	Land use/ LEP Zoning	Ownership	Vegetation type/condition	Built assets within 50m of bank	Causes of erosion
<i>Mid estuary</i>							
Right bank, upstream George Bass Drive bridge	7	141m (Mod)	Urban, E2, W1	Crown	EEC (Bangalay Sand Forest), small area of mangroves.	-	River meander, boat wake, waterway access, vegetation removal, flow scour in floods, end effect of rock revetment
Left bank, The Moorings	8	133m (Mod)	Marina, E2, W1	Crown	Mangroves, EEC (Swamp Oak Floodplain Forest),	The Moorings	Boat wake, waterway access, vegetation removal, flow scour in floods
Left bank, Golf Course	9	237m (Sev)	Golf Course, E2, W1	Crown	EEC (Bangalay Sand Forest), small area of mangroves.	Golf clubhouse	River meander, boat wake, waterway access, vegetation removal, flow scour in floods
Left bank, Kayak Camp	10	73m (Mod), 36m (Sev), 342m (Mod)	Kayak camp, Bushland, W1, DM (Deferred Matter)	Crown, Private land	EEC (Swamp Oak Floodplain Forest)	-	Boat wake, river meander, waterway access, vegetation removal, flow scour in floods
Left bank, grazing land	11	67m (Sev), 64m (Mod)	Grazing , E2, W1	Crown Road Reserve	EEC (Swamp Oak Floodplain Forest), SEPP 14	-	Livestock, river meander, vegetation removal
Right bank, Jeremadra Creek	12	81 m (Mod)	Grazing , E2, W1	Crown	Pasture, no riparian vegetation	-	Livestock, river meander, vegetation removal, flow scour in floods
Right bank, grazing land Jeremadra Creek	13	119 m (Mod)	Grazing , E2, W1	Crown	Pasture with sparse mature trees in riparian zone	-	Livestock, river meander, vegetation removal, flow scour in floods
Right bank, grazing land downstream confluence with Mogo Creek	14	137m (Mod)	Grazing , E2, W1	Crown	Pasture with very sparse mature trees in riparian zone	-	Livestock, river meander, vegetation removal, flow scour in floods

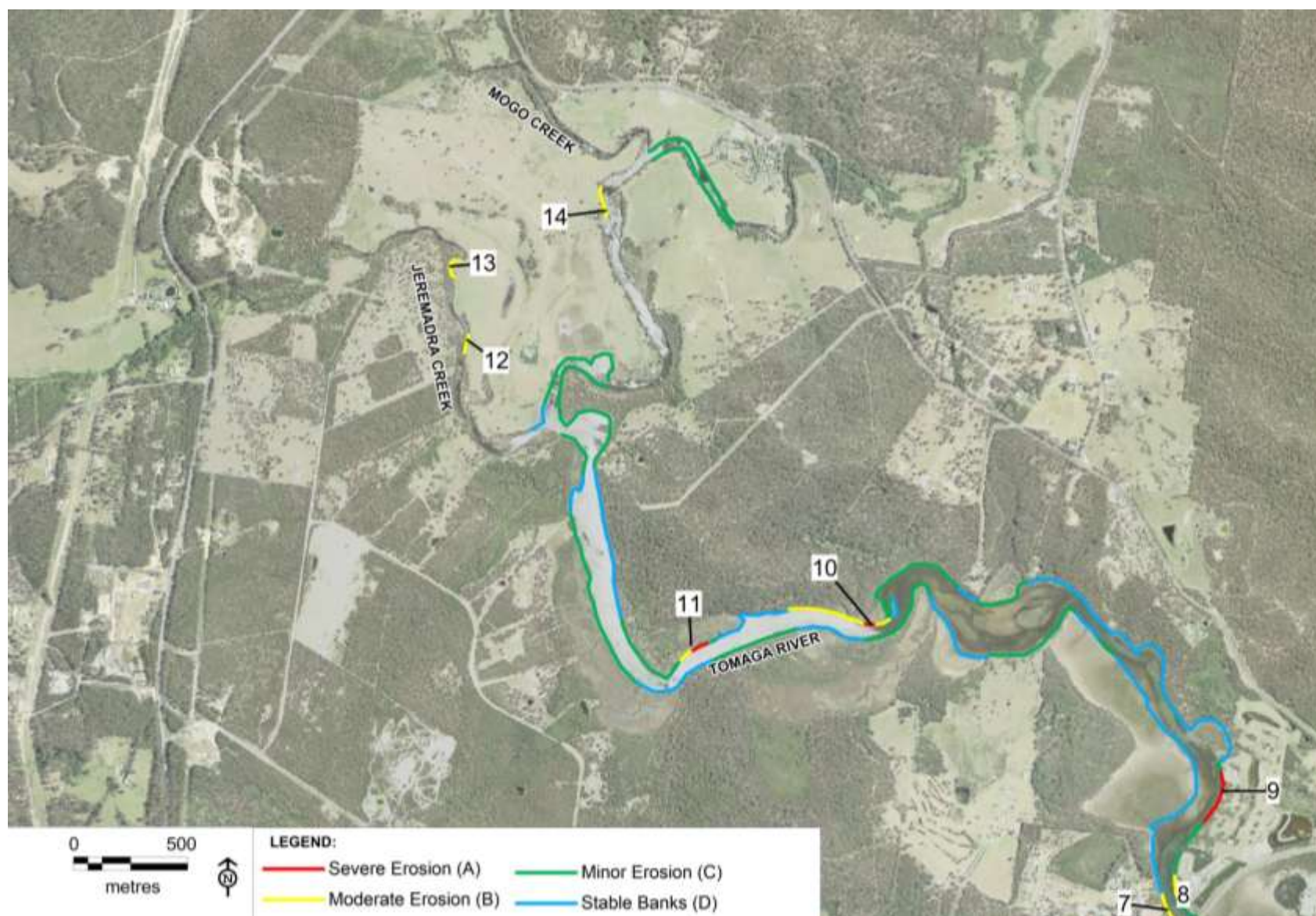
Mod = moderate erosion, Sev = severe erosion assessed in 2014, refer Figure 16 and Figure 17 for locations.



**Figure 16: Current areas of erosion lower estuary**

See Table 9 for descriptions of numbered sections.





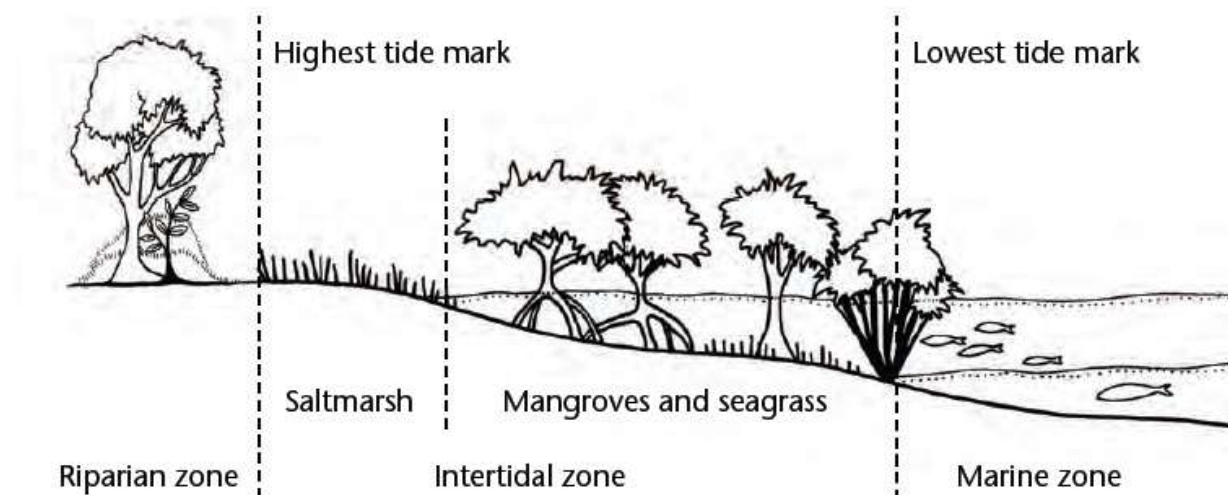
**Figure 17: Current areas of erosion in the mid-upper estuary**

See Table 9 for descriptions of numbered sections.

## 6.5 Vegetation

### 6.5.1 Estuarine Vegetation

Estuarine vegetation refers to seagrass, mangrove and saltmarsh plant communities within the estuary. Seagrass occurs in the intertidal or sub-tidal (marine) zone and is generally covered with water except during very low tides. Mangroves occur in the intertidal zone between low and high tide and saltmarsh communities occur mostly behind mangroves in the upper limits of the intertidal zone and are only inundated briefly on high tides (Figure 18). In an estuary, riparian vegetation is vegetation above the high tide level and generally does not include estuarine vegetation.



**Figure 18: Zonation of estuarine vegetation**

Source: OEH (2014)

Saltmarsh, mangrove and seagrass habitats are essential nursery areas for many species of commercially and recreationally important fish and crustaceans and the food they eat, contributing large amounts of organic material to the ecosystem. Depending on their type and location, they can reduce the effects of erosion due to waves or currents and help trap sediments. Saltmarsh and mangroves also act as a buffer and a filtration system for sediment and nutrients entering the waterway from the terrestrial environment. Natural events such as floods and storms can impact on seagrass, mangrove and saltmarsh. However, human actions such as river works, infrastructure, actions that exacerbate bank erosion, direct disturbance from boat propellers as well as urban runoff, grazing, vegetation clearing and vehicular access can also influence the distribution and abundance of estuarine macrophytes.

The available data on estuarine vegetation in the Tomaga River Estuary is discussed in Wiecek (2012). As part of the MER program (refer Section 6.1), estuarine vegetation change data was initially taken from the NSW State of the Catchment Technical Report Series, assessing the condition of estuaries and coastal lake ecosystems in NSW. The methodology used to derive change in vegetation extent is generally based around comparing the percentage change between surveys conducted in 1985 by Fisheries NSW and 2006 by the NSW Department of Primary Industries as part of the Comprehensive Coastal Assessment. The comparison between the two approaches provides a broad indication of change that is useful for determining whether further investigation and/or action is required, noting that there are well documented limitations when comparing between the two surveys, which are acknowledged on the relevant report cards produced for ESC (Wiecek, 2012).

Estuarine vegetation condition ratings for the Tomaga River Estuary in 2010 (reported in Roper *et. al.*, 2011) are provided in Table 6.

**Table 10: Estuarine vegetation condition rating of Tomaga River Estuary 2010**

Indicator	Condition Score	Condition Index Rating	Condition indicator notes
Seagrass	5	Very good	>10% gain in extent since last survey
Mangrove	Baseline only		
Saltmarsh	5	Very good	>10% gain in extent since last survey
Fish	No data		

Source: Adapted from Roper et al., 2011

Subsequent to the comparison between surveys undertaken in 1985 and 2006, ESC contracted Fisheries NSW to undertake additional estuarine vegetation surveys based on the latest aerial photography for Tomaga River Estuary (as well as other estuaries). This 2012 data set (shown in Figure 21) was subsequently used to compare against the 2006 data, providing greater confidence in the calculated extent of changes as they were mapped using the same methodology.

The 2010/11 report card for Tomaga shows a grade of A (Very good, >10% gain in extent) for seagrass and B (Good,  $\pm 10\%$  gain in extent) for saltmarsh with an overall estuary grade of B- (Good-Fair) for combined chlorophyll a, turbidity, seagrass and saltmarsh extents. A comparison of the percentage distribution between 2006 and 2012 data shows that seagrass coverage has increased by 34% and mangroves by 27% and saltmarsh by 3% (Wiecek, 2012). Wiecek (2012) recommended that Council continue to undertake additional mapping of estuarine vegetation.

Even though the measured extents of seagrass and saltmarsh have increased in recent years, there are still a number of threats to estuarine vegetation that require careful management to ensure on-going protection for these important habitats. Key issues (high or medium risk level based on risk assessment undertaken as part of the EMP) relating to estuarine vegetation identified in the 2005 EMP and considered to be relevant in 2014 are:

- Boat damage to seagrass, including propeller damage, anchoring and vehicle and foot traffic causing direct damage to plants (refer Section 7.4);
- Impact of livestock grazing on mangroves and saltmarsh, directly defoliating trees and trampling (refer Section 6.10);
- Introduced marine pests (e.g. *Caulerpa taxifolia*) (refer Section 6.5.7); and
- Impact of clearing, pedestrian and cycle traffic on saltmarsh and mangroves.

The construction of private jetties along the foreshore at Mossy Point has resulted in clearing of mangroves as shown in Figure 19. In addition, access tracks through mangroves have been established in this area.





**Figure 19: Clearing of mangroves and understorey at Mossy Point**

Source: D. Wiecek, OEH

Current examples of human impacts on saltmarsh are:

- Damage to Coastal Saltmarsh EEC caused by horse riding and motorbikes, in the mid-estuary upstream of George Bass Drive bridge. Figure 20 shows a section of the wide track devoid of vegetation through the saltmarsh. The track extends over a distance of approximately 1.4 km. The land is zoned E2 (Environmental Conservation) and is mapped as Coastal Saltmarsh EEC by ESC under the Eurobodalla LEP (2012). Estuarine vegetation mapping by Fisheries NSW does not include the track as part of saltmarsh mapping. Land ownership is split between Crown Land and private ownership. Changes due to sea level rise mean that saltmarsh migrating upslope will be further curtailed by the continued use of these tracks (refer Section 6.5.3);



**Figure 20: Track through Coastal Saltmarsh EEC, mid-estuary upstream of George Bass Drive Bridge**

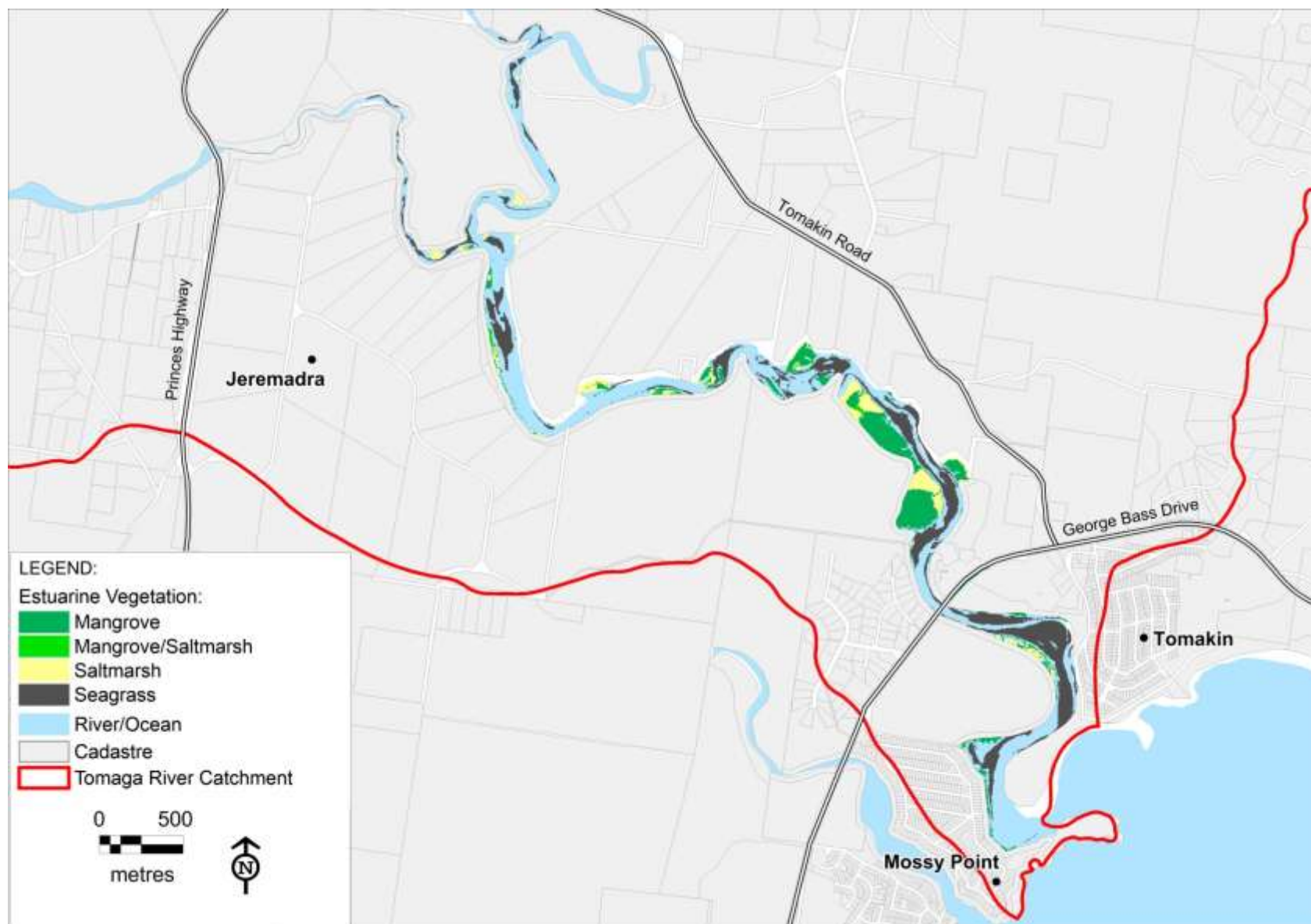


Figure 21: Estuarine macrophytes (2012 mapping provided by OEH)

- Damage to saltmarsh caused by illegal clearing north-west of the Tomakin Caravan Park and pedestrian access between the caravan park and the IGA supermarket (Figure 22). Due to safety issues with road crossing in this area, Council has provided alternative pedestrian access to the shopping centre consistent with approved safety standards. Therefore pedestrian access along this route through the saltmarsh is not required; and



**Figure 22: Track through Coastal Saltmarsh EEC, lower estuary upstream of Tomakin Caravan Park**

- The area in between the Tomakin Club and the river is currently used as overflow parking for the club. The land is partly owned by Mogo LALC and includes areas of saltmarsh which is being damaged by mowing and vehicular access (Figure 23).



**Figure 23: Saltmarsh land in front of Tomakin Club used for overflow parking**



### 6.5.2 SEPP 14 Wetlands

The location of wetland areas designated under *State Environmental Planning Policy No 14 - Coastal Wetlands* (SEPP 14) within the Tomaga River catchment are shown in Figure 24. The Policy was introduced in 1985 to protect coastal wetlands and stipulates planning and development controls under the *Environmental Planning and Assessment Act, 1979* to ensure that developments in or adjacent to wetlands have little impact on wetland values. Figure 24 highlights the significant areas of wetlands in the Tomaga River Estuary.

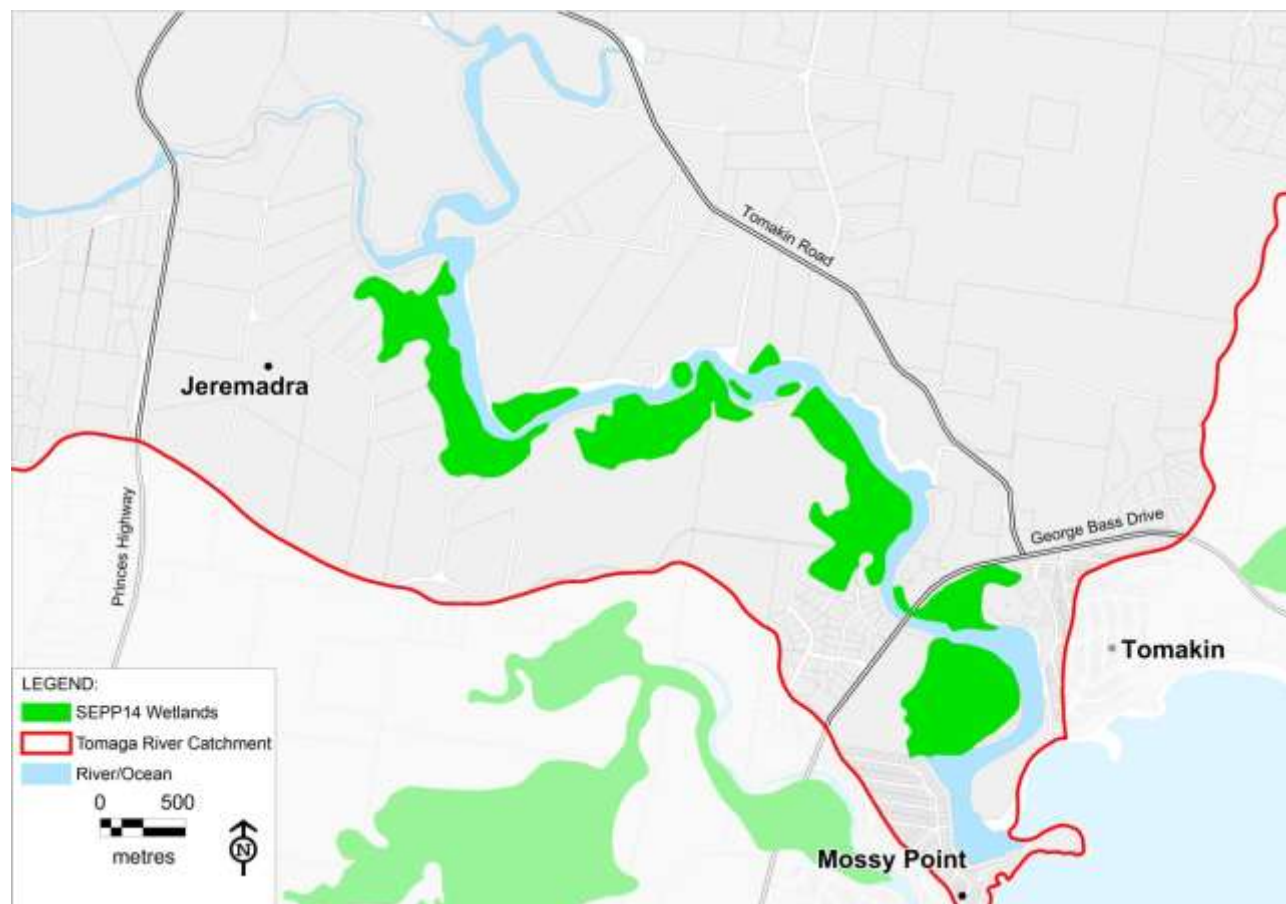


Figure 24: SEPP 14 Wetlands

### 6.5.3 Impacts on Estuarine Vegetation due to Sea level rise

Sea level rise is expected to increase the average water depth and extend tidal propagation in the Tomaga River Estuary with associated changes in salinity regime. It is anticipated that sea level rise will result in the landward recession of fringing estuarine wetland systems. The location of estuarine habitats such as mangrove stands and saltmarsh are controlled principally by tidal range and salinity influence and will gradually respond to changes in increases in average water levels and salinity. There is a risk that natural upslope migration of these wetlands will be curtailed by anthropogenic constraints such as roads, rock walls, retaining walls and urban development on the landward side (DECC, 2009). This impact has been named “Coastal Squeeze” by the Department of Climate Change (now OEH, DECC, 2009) (refer Figure 25 below). Under these conditions the landward side of these important habitats will be fixed but the lower margin will gradually be pared away, leading to a loss of habitat area.





**Figure 25: 'Coastal squeeze' under sea level rise: impact of development**

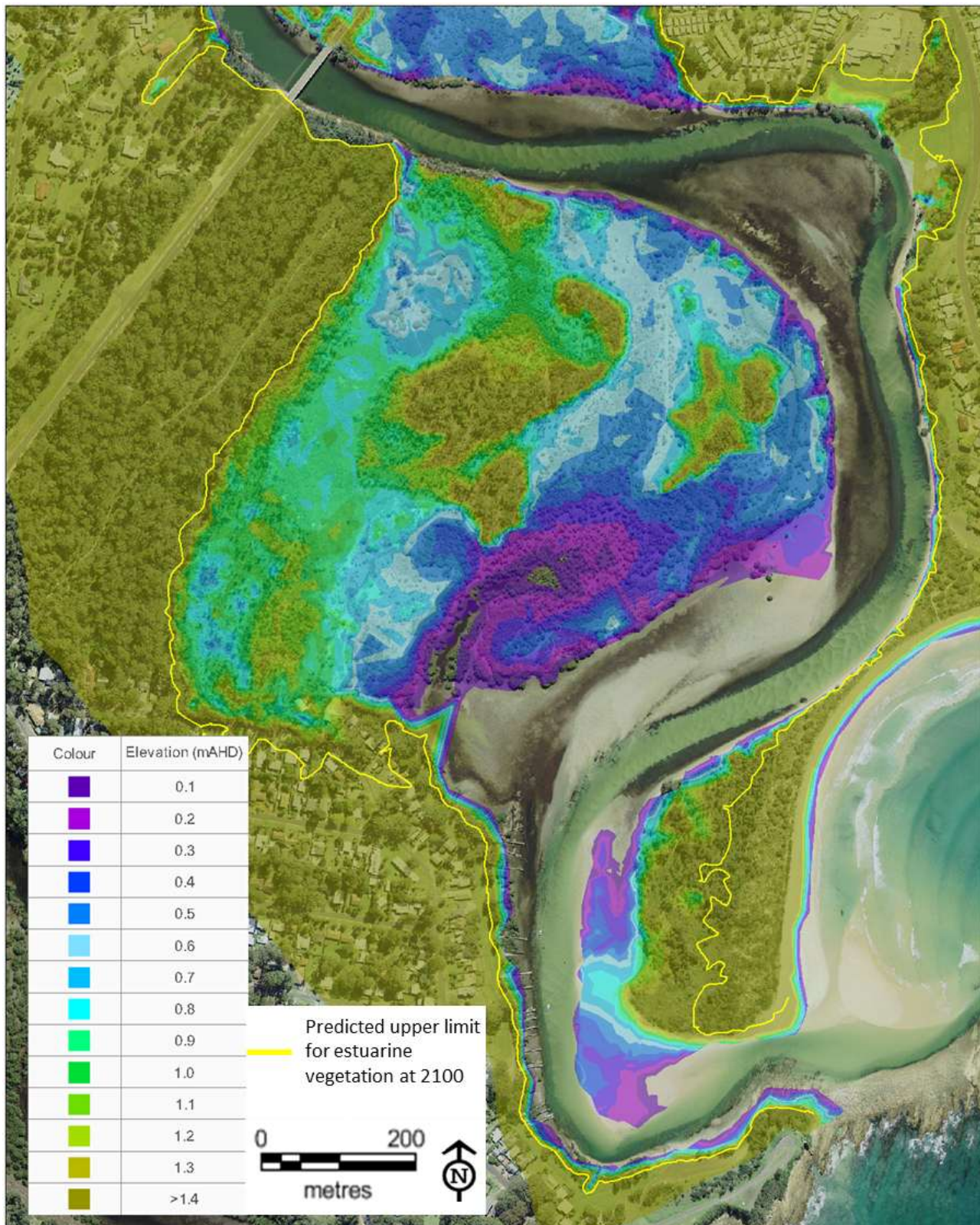
Source: DECC, 2009

To examine the likely migration of estuarine vegetation in the Tomaga River Estuary with sea level rise, and the impact of barriers to migration, an assessment was undertaken based on the tidal ranges of different vegetation types. The potential areas were then compared to the existing barriers to migration such as roads, tracks and built assets. This allowed for an estimate of the impact of sea level rise on future estuarine habitats in the study area.

The assessment contained a number of assumptions as follows:

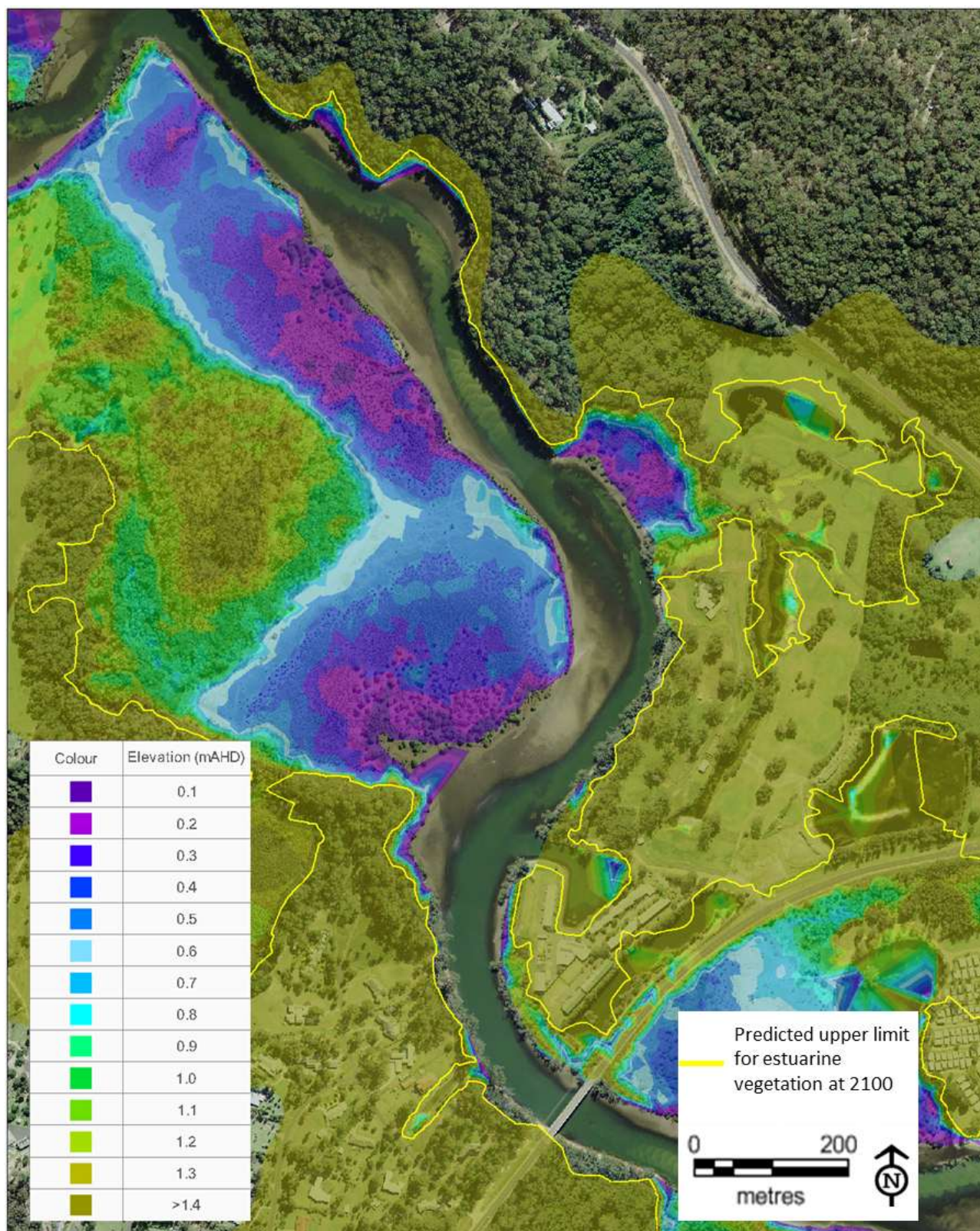
- Constraints to migration were assumed to be hard barriers (e.g. buildings, roads etc.);
- There was no consideration of management actions such as mowing of public park areas or active removal of vegetation. It has been assumed that estuarine vegetation would be allowed to colonise unconstrained areas including public reserves and private property; and
- The estimation of suitable tidal ranges for vegetation types was made by considering approximate known ranges for each vegetation community and adjusting these ranges to fit what is currently present in Tomaga River Estuary. Vegetation communities may have greater or lesser tolerance ranges than those assumed in this assessment.

Figure 26 and Figure 27 show the estimated potential upper limit for estuarine vegetation migration considering existing barriers and the sea level rise projection for 2100 (refer Section 4.5), as well as these areas without the barriers (unconstrained). The assessment was undertaken by evaluation of the elevation ranges currently occupied by estuarine vegetation (by interpretation of aerial photography) and comparison with the digital elevation model of the area. The influence of sea level rise was then determined by shifting the upper elevation limit of estuarine vegetation by the anticipated sea level rise described by the RCP8.5 (High) projection at 2100 (Whitehead & Associates, 2014).



**Figure 26: Potential areas for migration of estuarine vegetation types with sea level rise – lower estuary**





**Figure 27: Potential areas for migration of estuarine vegetation types with sea level rise – mid estuary**

## 6.5.4 Riparian Vegetation

Riparian vegetation is vegetation bordering a watercourse, above the high tide level. Riparian zone values and functions include bank stability and maintenance of soil structural integrity, land use buffering, water quality filtering, lowering water temperature (via shading), providing fisheries habitat (root masses and fallen logs/trees), providing terrestrial habitat and scenic amenity.

The 2005 EMP reported the results of a riparian vegetation mapping study undertaken by the then DLWC comparing riparian vegetation from 1977 and 1997 aerial photography. The study classified riparian vegetation as either dense, sparse or absent for 30 m and 100 m widths. Overall, in 1997 sparse riparian vegetation made up the majority of banks (60% within 30 m); dense vegetation accounted for (38% within 30m) and only 2% of banks were assessed as having no riparian vegetation at all (absent). Sparse vegetation was prevalent in the upper estuary upstream of the confluence with Jeremadra Creek. The mid estuary generally had dense riparian vegetation along most of the banks and this was often connected to large tracts of vegetation in the catchment. The lower estuary riparian vegetation was classified as sparse for all of the left bank below George Bass Drive bridge and the banks along Mossy Point urban areas close to the entrance. Immediately upstream of urban areas, on the right bank of the river, vegetation was classified as dense, extending up to the bridge. The study found that positive change had been seen over the 20 years from 1977 to 1997, with an overall increase of 5-10% in riparian coverage along the estuary.

Examination of recent aerial photos indicates that in general, riparian vegetation cover today is similar to what was assessed in 1997. Increases in riparian vegetation cover are evident in some locations including the area in the mid estuary on a sharp inside bend of the river. This area was mapped as having no vegetation in 1997, however, recent aerial photography clearly shows a band of dense vegetation approximately 30 m wide in this area. There have also been reports of clearing riparian vegetation at some locations in recent years (as discussed below).

The large areas of Crown Reserve bordering the estuary make up approximately 78% of river frontage land (refer Section 7.3.1) which (in theory) affords a level of protection for riparian vegetation along much of the waterway and an opportunity to carry out large-scale revegetation works on publicly owned land.

Today, a large proportion of the riparian vegetation along the Tomaga River has been mapped as either SEPP 14 Coastal Wetlands, Estuarine Vegetation (Mangroves/Saltmarsh) or Endangered Ecological Communities (EECs). Riparian vegetation mapped by ESC is shown on Figure 28. EECs and SEPP 14 wetlands occurring in riparian areas are also shown. Mangroves and Coastal Saltmarsh EEC are discussed in Section 6.5.1.

Under the 2012 LEP, riparian land along Tomaga River has been identified for protection. The objectives of the riparian lands clause in the LEP are to protect and maintain:

- Water quality within watercourses;
- The stability of the bed and banks of watercourses;
- Aquatic and riparian habitats; and
- Ecological processes within, and continuity between, waterways and riparian areas.

The LEP clause applies to land situated within the distances specified below in relation to the top of bank of the watercourse concerned:

- Riparian Category 1 watercourse – 40 metres
- Riparian Category 2 watercourse – 20 metres
- Riparian Category 3 watercourse – 10 metres



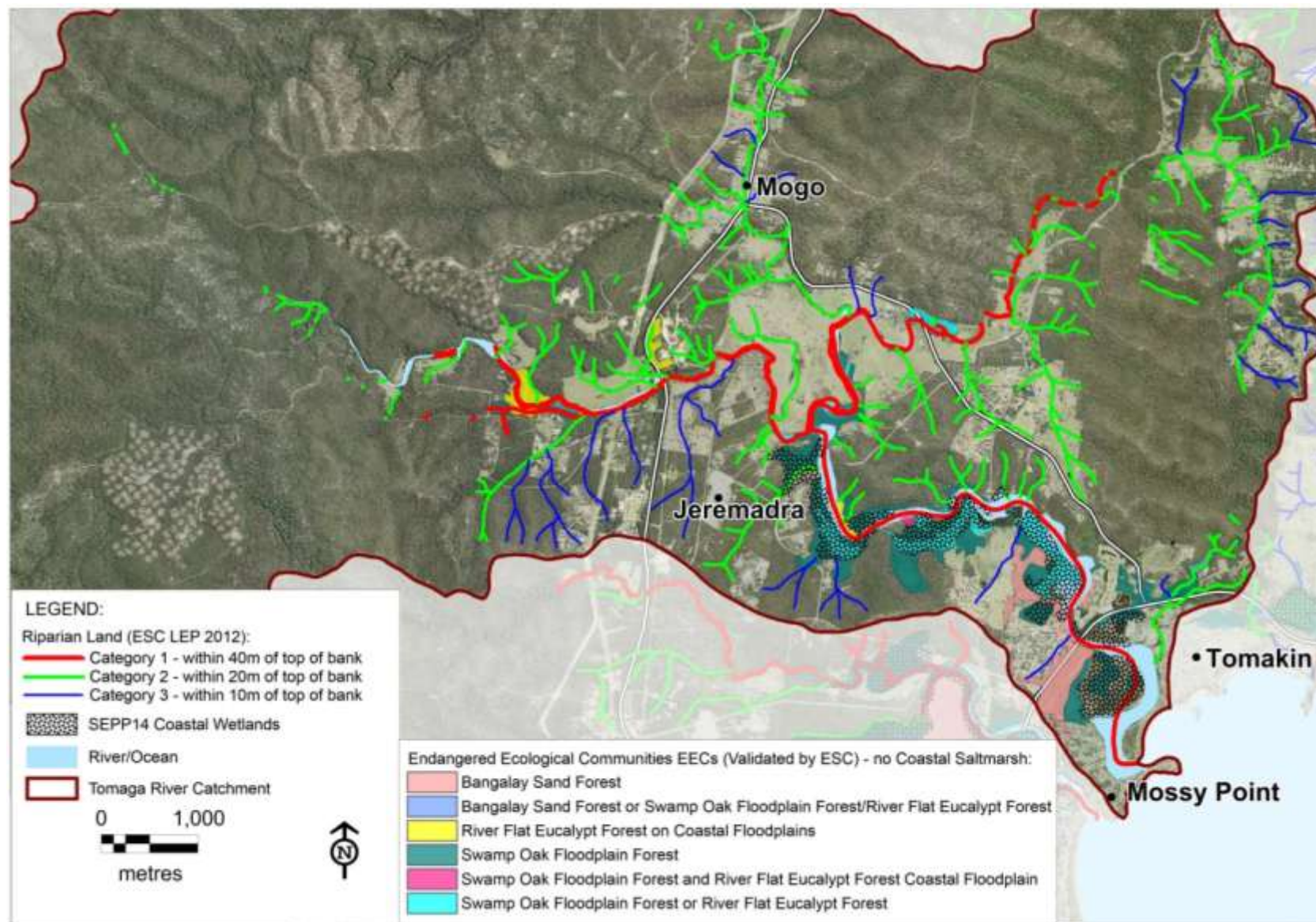


Figure 28: Riparian vegetation

The main trunk of Tomaga River and Jeremadra Creek are classified as Category 1, meaning the riparian land clause applies to all land within 40m of the top of bank of these watercourses. Mogo Creek and most tributaries of Tomaga and Jeremadra Creeks are Category 2, and the remaining tributaries are Category 3.

Key issues (high or medium risk level based on risk assessment undertaken as part of the EMP) relating to riparian vegetation identified in the 2005 EMP were:

- Vegetation clearing in riparian zones;
- Bank erosion destabilising vegetation; and
- Livestock access, contributing to vegetation damage through grazing and trampling and contributing to bank erosion (Figure 29).



**Figure 29: Livestock fencing with active grazing of buffer zone (May 2104)**

There are current examples of illegal vegetation clearing such as:

- Poisoning of the trees along the Jack Buckley Park rock revetment (Figure 30); and
- Removal of trees to improve views at Mossy Point. Council has installed a barrier and signage here (Figure 31).





**Figure 30: Trees adjacent to Jack Buckley Park have been poisoned (May 2104)**



**Figure 31: Illegal removal of trees at Mossy Point**

Source: D. Wiecek, OEH

### 6.5.5 Terrestrial Vegetation

Terrestrial vegetation refers to all non-aquatic and non-estuarine plant species occurring within the Tomaga River catchment. Large tracts of state forest, natural scrub, conservation and wetland areas comprise approximately 83% of the study area and extend to the banks of the Tomaga River in some sections (refer to Figure 40). Intact vegetation in catchment areas provides many important ecosystem functions, particularly the maintenance of good water quality. In this regard, Tomaga River is in a much better position than many estuarine systems on the NSW coastline that have a greater level of disturbance. Areas in the upper estuary, downstream of the Princes Highway display the highest level of vegetation clearing and these areas are used predominantly for grazing.

Under the 2012 LEP, parts of the study areas are classified as biodiversity areas (endangered ecological community or extant native vegetation). These are shown on Figure 32. EECs known to occur within the Tomaga River catchment include:

- Coastal Saltmarsh;

- Bangalay Sand Forest;
- Swamp Oak Floodplain Forest; and
- River Flat Eucalypt Forest on Coastal Floodplains.

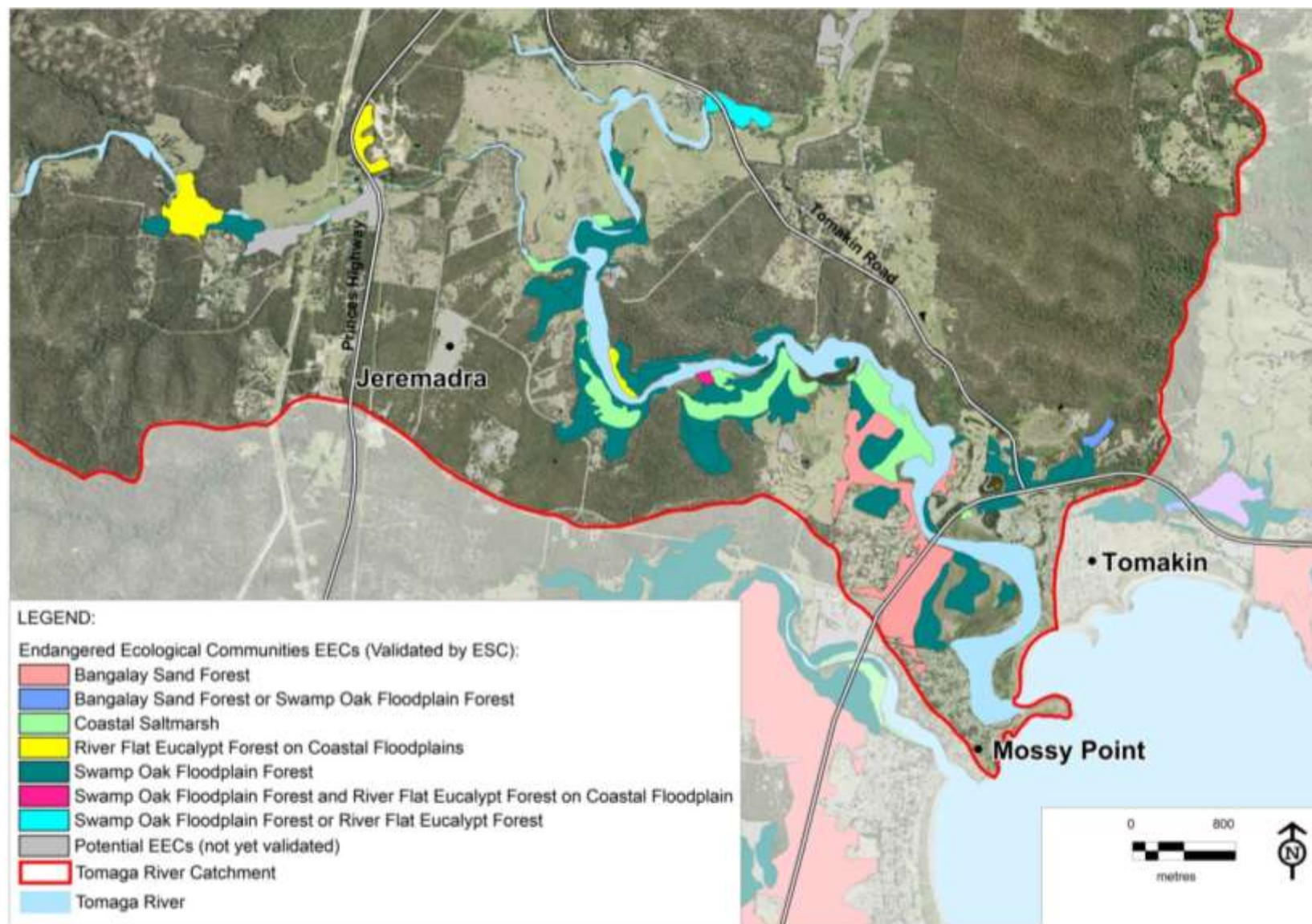


Figure 32: Known (validated) EECs and potential EECs (to be verified) mapped by ESC

### 6.5.6 Terrestrial Weeds

Key issues (high or medium risk level based on risk assessment undertaken as part of the EMP) relating to terrestrial weeds identified in the 2005 EMP were:

- Bitou bush infestation on the spit;
- Potential for invasive weeds (e.g. blackberry) in upper estuary;
- Prickly pear on peninsula.

Extensive weed control works have been undertaken throughout the riparian zones, foreshore areas and coastal dunes since the previous EMP. Works included:

- Control of Bitou bush, Prickly pear and asparagus fern at Tomakin Spit and areas of Swamp Oak Floodplain Forest and Saltmarsh EECs in the lower estuary;
- Revegetation of Tomakin spit and Council reserves in the lower estuary;
- Bitou bush control within foreshore areas upstream of George Bass Drive Bridge; and
- Weed control on islands in mid-estuary reaches of the Tomaga River

Weed encroachment is an ongoing issue that requires sustained management effort through time to effectively tackle the problem. In areas where regeneration of native vegetation communities is possible and achievable, the maintenance requirements should reduce through time as vegetation cover is established. In areas that are subject to disturbance and constant weed sources such as coastal dune environments and riparian vegetation in proximity to urban areas, weed management is expected to require continued effort. Effective management of weeds improves the amenity and community use of foreshore areas as well as improving ecosystem health and habitat value.



**Figure 33: Foreshore weeds at Mossy Point**

Source: D. Wiecek, OEH



### 6.5.7 Marine Pests

The 2005 EMP discussed the issue of introduced marine pests such as *Caulerpa taxifolia* (a sea weed developed overseas as an aquarium plant). The weed has rapid growth and is resistant to consumption by animals. The weed has been released in several NSW estuaries and is easily transported on boats and fishing equipment.

Fisheries NSW has developed a *Caulerpa* Control Plan and will continue to monitor estuaries where *Caulerpa* is known to occur (e.g. Batemans Bay). The current proximity of outbreaks to the Tomaga River Estuary creates a risk to the ecosystem and fishing activities in the estuary.

Fisheries NSW is involved in the development of the *National System of the Prevention and Management of Marine Pest Incursions* which aims to prevent the introduction and translocation of introduced marine species (by managing ballast water, biofouling and other vectors), provide a national emergency preparedness and response capacity for outbreaks and to manage and control introduced marine species that cannot be eradicated.

## 6.6 Estuarine Fauna

Key issues (high or medium risk level based on risk assessment undertaken as part of the EMP) relating to estuarine fauna identified in the 2005 EMP were:

- Declining fish catches – no data are available to identify whether fish populations are declining; and
- Threatened and endangered bird species on the spit (vulnerable to people, dogs, feral animals and natural predators).

### 6.6.1 Fishing and Aquaculture

Prior to the gazettal of the Marine Park, commercial fishing was allowed although very little commercial fishing could take place in the estuary due to its small size and shallow depth. The Tomaga River is now a recreational fishing haven. Recreational fishing is popular in the summer months when tourists target various fish, prawns and crabs. Fish caught in the estuary include Luderick, Dusky flathead, Sand whiting, Flounder, Trevally, Leatherjacket, Bream and Mullet. Crab trapping and prawning are also permitted within the Marine Park Habitat Protection Zone.

The estuary has been farmed for oysters since before 1940 (Amog, 2003). Areas of the Tomaga River within the Marine Parks Estate are used for oyster aquaculture (refer Figure 34). Currently 3.5 ha are mapped as priority oyster aquaculture area (Sydney Rock Oysters). The historical maximum lease area in the Tomaga River was 11 ha (DPI, 2014).

Bacteria, viruses, marine biotoxins and environmental pollutants may all impact on the suitability of oysters for human consumption. Most are a direct result of human activity with the exception of marine biotoxins. Sources that may pose a risk to food safety include sewerage systems and septic tank overflows and leaks, contaminated sediments, stormwater runoff and discharges from industrial premises or agriculture. The available water quality data for the Tomaga River Estuary are discussed in Section 6.3. Before harvesting the oysters are taken from the Tomaga River Estuary and transported to other estuaries where the water quality is higher (mostly Batemans Bay) for a period of cleansing before being sold for consumption.

The aim of the *Oyster Industry Sustainable Aquaculture Strategy* (OISAS, DPI, 2014) is that water quality, tidal range and flow in oyster growing areas is maintained and where possible improved to ensure the long-term security and sustainability of the NSW oyster aquaculture industry. The water quality objective and flow objective for areas identified as priority oyster aquaculture areas are:

- Protecting water quality for safe human consumption and viable production of edible oysters; and
- Maintain or rehabilitate estuarine processes and habitats.





**Figure 34: Oyster lease areas**

### 6.6.2 Barriers to Fish Passage

Instream structures restrict fish passage and river flows. A weir has been constructed in Jeremadra Creek (refer Figure 35) to prevent tidal intrusion. This weir is registered on the Fisheries NSW fish passage barrier database for further investigation and potential remediation (Industry and Investment NSW, 2009).



**Figure 35: Instream weir on Jeremadra Creek**

Source: T. Daly, DPI

### 6.6.3 Birdlife

The Tomaga River Estuary is home to a wide range of bird species utilising the area for both food and shelter. Land-based birds inhabit vegetation along the foreshore and riparian areas along the river and throughout catchment areas. Seabirds such as Silver gulls, Pelicans and Cormorants feed on fish and other aquatic animals in the lower estuary and adjacent beaches. Shorebirds including a number of listed threatened species forage along the sandbanks, mangroves and seagrass areas at low tide.

Threatened shorebird species known to occur at Tomakin Spit include: Hooded Plover (*Thinornis rubricollis*), Little Tern (*Sterna albifrons*), Pied Oystercatcher (*Haematopodidae longirostris*) and Sooty Oystercatchers (*Haematopodidae fuliginosus*). Larger predatory species (raptors) include the Eastern Osprey (*Pandion cristatus*) - which can be seen perched on tall trees or street lights and actively hunting small animals and fish (Amog, 2005).

Human use of the spit has resulted in impacts on the shorebirds that use the area for nesting, roosting and feeding (Amog, 2005). This was identified as a moderate risk issue in the 2005 EMP.

## 6.7 Acid Sulfate Soils

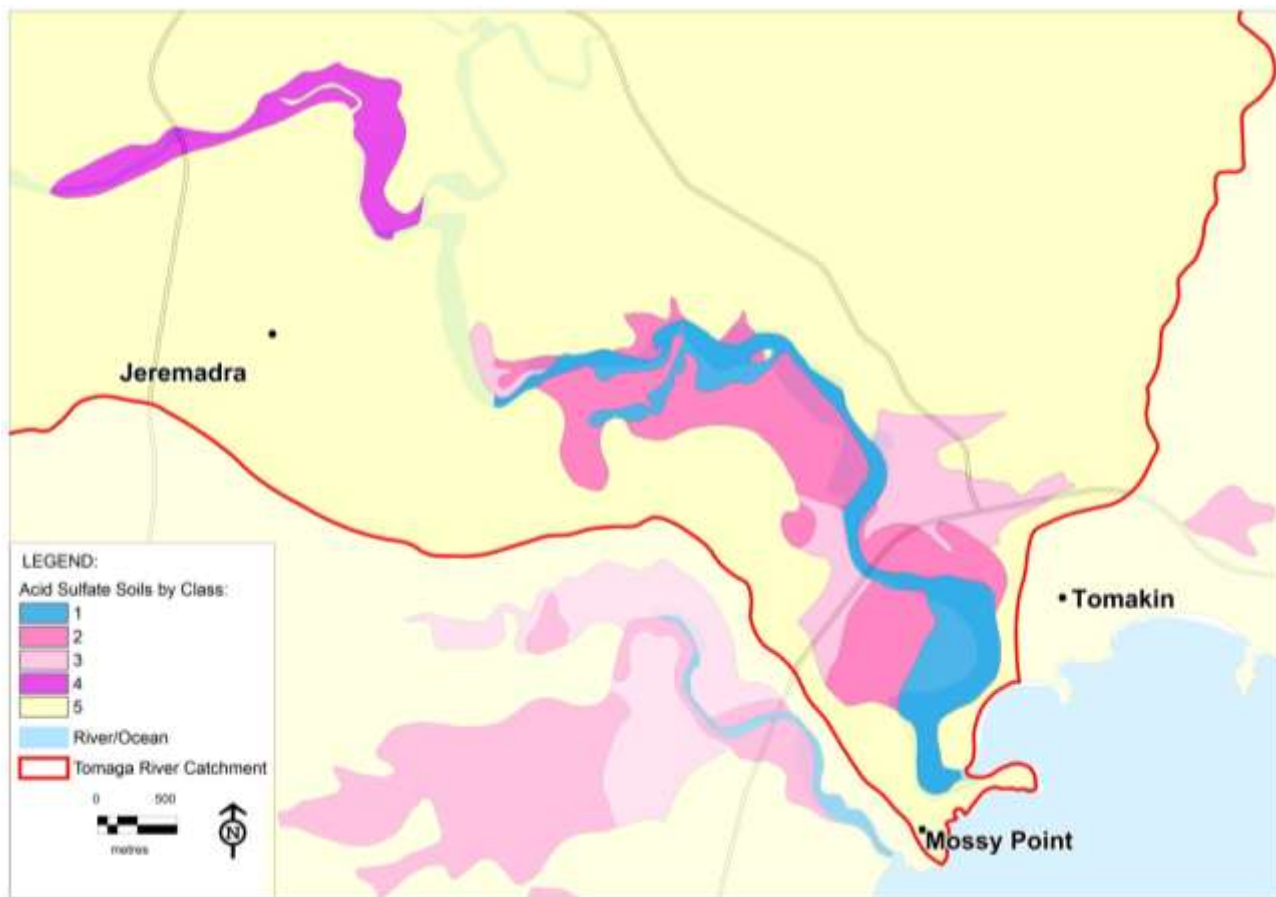
Acid Sulfate Soils (ASS) are acidic and sulfur rich soils found within the floodplain of coastal areas generally below 5m AHD. Potential Acid Sulfate Soils (PASS) is the common name given to soil and sediment containing iron sulfide (usually pyrite). They can become Actual Acid Sulfate Soils (AASS) and produce sulfuric acid if they become exposed to air through excavation or lowering of the water table.

The water quality impacts of Acid Sulfate Soil (ASS) runoff on the estuarine environments include low pH, high concentrations of dissolved iron, aluminium and other metals. Exposure to ASS runoff can impair gill function and increase susceptibility to disease in fish, particularly Epizootic Ulcerative Syndrome (EUS), otherwise known as Red Spot Disease. Major negative implications of ASS impacts include fish kills and major aquatic habitat changes, reduced plant growth (acid scalds), and corrosion of concrete, iron and steel structures.

Under the 2012 LEP, parts of the study areas are classified as ASS. These include (refer Figure 36):

- The lower and mid estuary and its foreshores are classified as Class 1, 2 and 3 ASS; and
- Jeremadra Creek and its foreshores from the confluence with the Tomaga River to upstream of the Princes Highway (Class 4 ASS – low risk).

Table 11 provides the development consent requirements for works on land classed as ASS.



**Figure 36: ASS Risk Maps**

**Table 11: Development consent required for the carrying out of works on land shown in ASS map**

Class of land	Works
1	Any works.
2	Works below the natural ground surface. Works by which the watertable is likely to be lowered.
3	Works more than 1 metre below the natural ground surface. Works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface.
4	Works more than 2 metres below the natural ground surface. Works by which the watertable is likely to be lowered more than 2 metres below the natural ground surface.
5	Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.

Source: Part 6.3 of Eurobodalla LEP (2012)



## 6.8 Urban Stormwater and Drainage

Urban drainage can affect estuarine processes through:

- Changes to the hydrologic characteristics (catchment hardening) of lands generating increased runoff and making them drain more quickly, partly due to the increased imperviousness, i.e. road, roofs, etc.;
- The use of hydraulically efficient stormwater pipe systems which remove stormwater to the waterways more quickly; and
- Changing the quality of stormwater runoff due to urban pollutant sources.

Stormwater from urban areas can often discharge significant loads of pollutants to receiving water bodies. These pollutants include litter, nutrients, sediment, oxygen-depleting substances and hydrocarbons, which are transported from the site by urban runoff or stormwater.

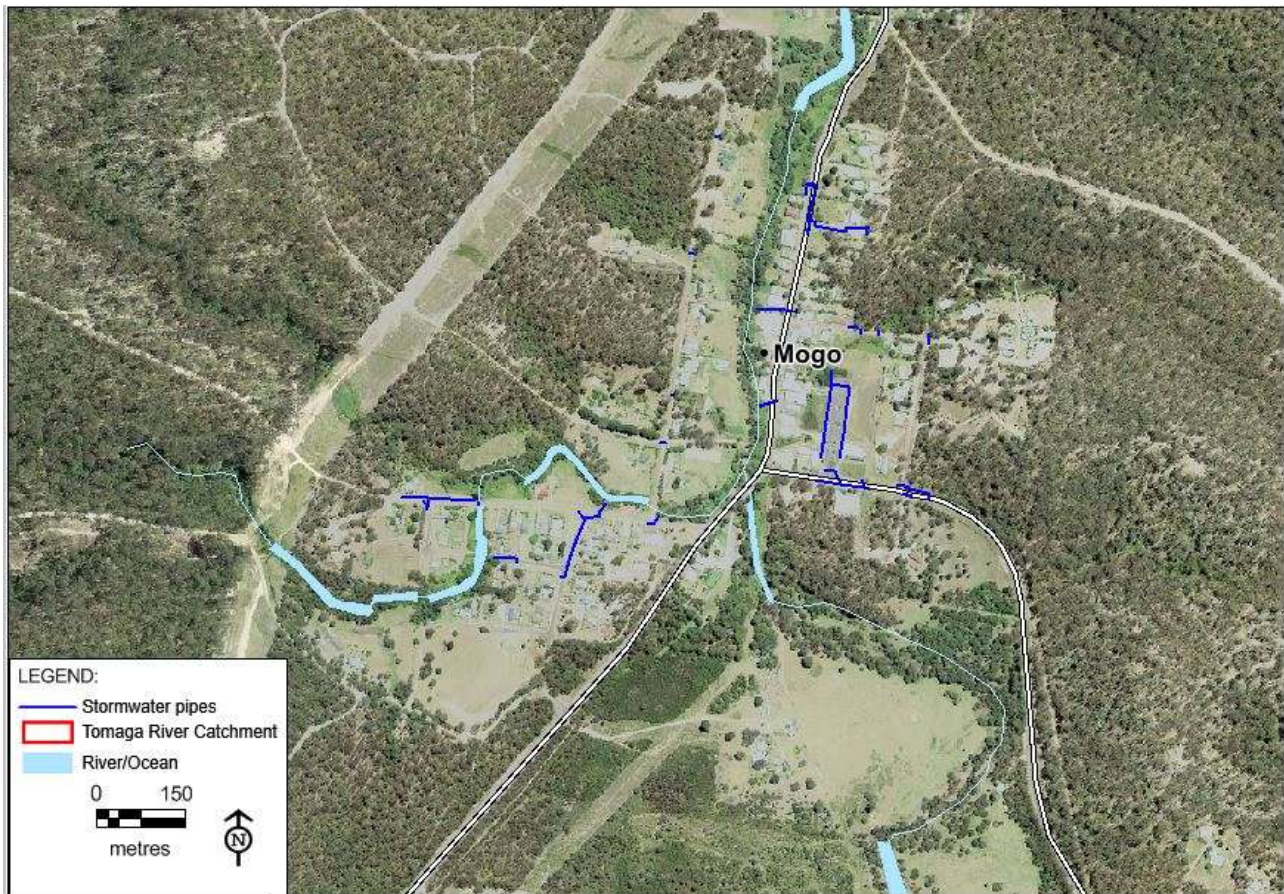
There are three urban stormwater sub-catchments within the study area in primarily residential areas – part of Tomakin, Mossy Point north (Figure 37) and Mogo (Figure 38). There are no stormwater pollution control devices in these catchments. Apart from the MER program and monitoring of the lower estuary, there are no data on the quality of stormwater runoff. Past water quality monitoring has found poor water quality downstream of Mogo particularly following rainfall events (WBM, 2011). This could indicate that urban runoff from the village is a factor in water quality decline, however from the available data is not possible to separate stormwater influences from diffuse catchment runoff and other potential point sources of pollution in the catchment.



**Figure 37: Tomakin and Mossy Point urban stormwater systems**

Stormwater asset mapping provided by ESC. Note that mapping of infrastructure may not be complete.





**Figure 38: Mogo urban stormwater system**

Stormwater asset mapping provided by ESC. Note that mapping of infrastructure may not be complete.

As discussed in Section 6.4.2, there are examples of scour of stormwater outlets contributing to bank erosion (e.g. site 1, Figure 39).



**Figure 39: Stormwater outlet at Mossy Point causing scour of bank**

Source: D. Wiecek, OEH



Stormwater from The Moorings and Tomakin IGA catchment is captured in a detention pond at the golf course or a holding pond (approximately 230 m long) adjacent to George Bass Drive. The runoff captured in the holding pond is used to hose down the IGA car park and subsequently drains back into the ponds. The captured runoff is also used to irrigate the golf course, gardens and wash-down car parking areas. There is minimal runoff from the site to the river.

## 6.9 Sewerage Systems

A centralised sewage treatment plant located north-east of Tomakin services all urban areas of the Tomaga catchment (Tomakin, Mossy Point and the village of Mogo). The STP provides secondary treatment and is based on the continuous extended aeration process. After disinfection the majority of the secondary treated water is returned to the environment through direct ocean discharge off the rock shelf between Wimbie Beach and Lilli Pilli Beach. The de-watered and stabilised biosolid is disposed of at Council's landfill.

The non-urban areas of the catchment (e.g. Jeremadra and Bimbimbie) are serviced by decentralised wastewater systems such as septic tanks. Treated effluent from the on-site sewerage system at Mogo Zoo is applied to land at the zoo for irrigation. ESC and Mogo Zoo are currently implementing actions to improve operation of the system and the quality of the runoff from the property.

## 6.10 Grazing/Agriculture

Livestock access to riparian zones and wetlands was identified as a key issue by stakeholders in the 2005 EMP. In the mid and upper estuary, cattle have direct access to the foreshore as the banks are not fenced or the fence has been constructed too close to the bank which results in loss of vegetation and bank erosion due to trampling (Figure 29). At the time of the 2005 EMP there was insufficient data to determine the impact on water quality from faeces and urine or nutrient impacts on seagrass.

A collaborative project between Industry and Investment NSW (I&I NSW) and NSW Land and Property Management Authority (LPMA) funded by NSW Catchment Action Program was carried out between October 2008 and October 2009. The program (Industry & Investment NSW, 2009) included the identification, prioritisation and inspection of Crown land bordering Key Fish Habitat (KFH) in the Clarence and Eurobodalla local government areas. Management actions included:

- Engaging with licensees to improve their capacity with regards to sustainable land management practices and aquatic habitat health;
- Providing incentive funding to the licensees to achieve significant outcomes for KFH; and
- Development of a new suite of grazing licence conditions to incorporate best management practice guidelines and improved compliance and monitoring opportunities for LPMA staff into new grazing licences.

Two priority KFH sites in the Tomaga catchment were included in the study (Table 12). The program has provided a framework for continued improvement in the management of grazing land including capacity building and education, licensee monitoring and reporting, licence administration and environmental assessment tools.

**Table 12: Priority Crown Land Grazing Leases and Key Fish Habitat sites in Tomaga River**

Site	Site Area (ha)	Riparian Length (m)	Key Threats	Management Actions Undertaken
Jeremadra Creek, Mogo	7.3	4,000	<ul style="list-style-type: none"> <li>• Livestock access to water body</li> <li>• Erosion</li> </ul>	<ul style="list-style-type: none"> <li>• Riparian livestock exclusion fencing (4km)</li> <li>• Grazing licence terminated</li> </ul>
Jeremadra Creek, Jeremadra	0.45	160	<ul style="list-style-type: none"> <li>• N/A</li> </ul>	<ul style="list-style-type: none"> <li>• Licence changed to environmental protection and sustainable grazing</li> <li>• Licence conditions reviewed</li> </ul>

Source: Industry & Investment NSW (2009)

There remains several areas of riparian zone which are affected by livestock access in the mid and upper estuary including in the above areas and follow up work is required with the landholders (refer Section 6.4.2).

## 7. COMMUNITY USES

ESC recognises the importance of community uses of the coastal zone. In the preparation of this CZMP, public access refers to the ability of the general public to gain appropriate access to public lands surrounding Tomaga River Estuary as well as the waterway.

This section provides an assessment of community uses in Tomaga River Estuary:

- The current access arrangements to beaches, headlands and waterways in the study area, their adequacy and any associated environmental impacts;
- Any potential impacts on these access arrangements; and
- The cultural and heritage significance of the study area.

### 7.1 Amenity

Scenic amenity is valued highly by the local community and visitors. Tomaga River Estuary is a beautiful place enjoyed by locals and tourists alike. Specific characteristics identified in the 2005 EMP and recent consultation activities include the need to preserve the feeling of natural environment and maintain the amenity of the area.

The maintenance and enhancement of the amenity of Tomaga River Estuary is important to maintain community enjoyment and tourism in the Eurobodalla Shire. The Eurobodalla coast is a popular tourist destination, marketed as the Nature Coast. Tourism is seasonally based around the strong summer period, with Easter as a second peak. Seasonal boating trends follow this pattern with offshore fishing influenced by the tuna season.

### 7.2 Recreational Uses

The Tomaga River Estuary is an important recreational destination for tourists and local residents and is used for fishing, swimming, boating and nature based activities.

The community questionnaire used in the development of the 2005 EMP identified the activities undertaken in the estuary. The most common activities were walking, swimming, relaxing, bank fishing, estuarine/boat fishing, sight-seeing and bird watching. Other activities identified were bait gathering, canoeing, picnics/BBQs, surf fishing near mouth and surfing at the river mouth.

Waterway use upstream of the Moorings is limited by shoals, the meandering channel and tidal conditions which limit boating access.

Some swimming locations in the Shire are monitored as part of the State of the Beaches program and reported annually. The program does not include any sites within the Tomaga River Estuary, with the nearest site on Broulee Beach to the south. However, water quality monitoring is undertaken by Council on a monthly basis at major estuaries including Tomaga. Data relating to recreational uses are discussed in Section 6.3. In 2011/12, water quality for recreational use in the mid and lower estuary was considered suitable for swimming most of the time, with upstream reaches being the least suitable.

### 7.3 Access

Whilst providing and maintaining access to public lands in coastal environments is important, access and use must be balanced by protection of the environment and the maintenance of public safety.

ESC recognises that:

- Access to and sympathetic use of publicly owned lands is desirable where it does not conflict with environmental management objectives;

- Uncontrolled public access has the potential to irreparably damage fragile estuarine environments; and
- Human safety is a prime consideration when planning access to estuaries.

### **7.3.1 Riverfront Land Tenure**

The left bank (north and east sides) of the estuary (Tomaga River, Jeremadra Creek and Mogo Creek) consists of (Figure 40):

- Freehold land in the upper reaches and at Tomakin;
- Crown road reserve (unformed road) along the middle reaches of the Tomaga River;
- Aboriginal land (Mogo LALC);
- Crown reserve – the spit and Jeremadra Creek;
- Council reserve along the lower estuary foreshore at Tomakin; and
- Smaller areas of Council reserve and State Forest along Mogo Creek.

The right bank of the estuary is predominantly Crown Reserve (the 30 m wide travelling livestock route from the coast to the Princes Highway), small areas of private land in the upstream reaches and a Council reserve which provides a buffer between private land holdings and the estuary.



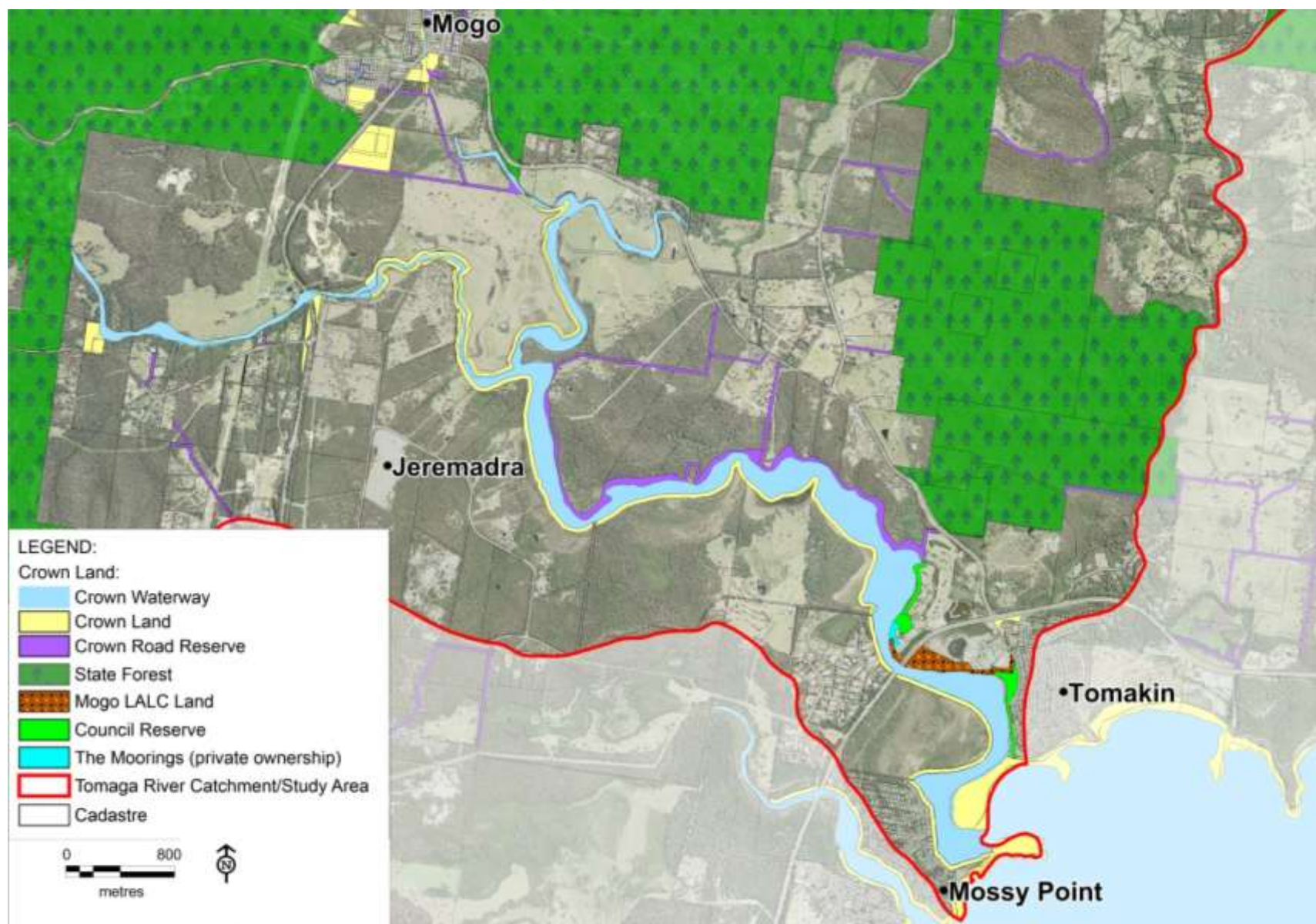


Figure 40: Tomaga River Land Tenure

### 7.3.2 Pedestrian Access

Recreational use of the spit is contributing to erosion of the spit due to pedestrian tracks as well as disruption to some species of migratory birds. Sand boarding on steeper banks also contributes to erosion. The 2005 EMP found that pedestrian access to the spit is accelerating the natural erosion process of the spit through trampling of the vegetation and destabilisation of the bank (Figure 41) although this is predominantly caused by eastward migration of the river meander.

Pedestrian access to other foreshore areas is causing similar issues with vegetation damage and bank erosion.



**Figure 41: Pedestrian access and sand boarding contributing to erosion of the spit (May 2014)**

### 7.3.3 Navigation

The estuary channel is generally shallow and extensively infilled with marine and river sediments. Immediately upstream from the entrance, the channel is characterised by reduced depth and sedimentation. This sediment may be scoured during major river floods but returns under tidal influences. This shoal area is seen as a barrier to boat navigation at low stages of the tide. The channel exit close to a natural rocky breakwater is also regarded as an issue as boats need to pass close to these rocks when travelling through the entrance (Amog, 2003).

Shoals and sedimentation in the mid and lower estuary can limit boat navigation within the waterway, particularly at lower tides and with larger vessels. Similarly, shoaling causes fluctuations in the width of the entrance and limits access to the ocean. However, the Tomaga River has one of the most stable bar crossings of all estuaries within the Shire although the entrance channel can be narrow and difficult to navigate. Despite this, the entrance can be unstable and dangerous during larger swells at the bar.

RMS representatives frequently patrol, monitor and assess the navigation channel and location of markers in the Tomaga River with consideration of depth and seagrass extent. RMS manages the placement of navigation aids (buoys, markers etc.) and waterway mapping to assist the boating public (refer Figure 42).

## Line symbols



## Restricted Waters



## Navigation Aids



## Restricted Activities and Cautions



## Boating Facilities



**Figure 42: Boating map for lower estuary**

Source: NSW Transport – Maritime (2013)



### 7.3.4 Foreshore Structures and Boating Access

#### Public Facilities

A public jetty is located at Pacific Street, Mossy Point and a boat ramp at Mossy Point provides access to the estuary and off-shore areas. The Tomakin boat ramp provides alternative access to the estuary and includes a fish cleaning table. The ESC Waterways Infrastructure Strategy (ESC, 2002a) found deficiencies in the Tomakin boat ramp and identified the need for surface and edge support improvements and remediation of hazardous gaps between the ramp surface and adjacent rocks (Figure 43). The Tomakin boat ramp and parking facilities are currently being upgraded by Council, although this has been delayed by the discovery of a suspected human bone sample in the car park. The area remains fenced off as the issue is unresolved.



**Figure 43: a: Mossy Point jetty and boat ramp and b/c: Tomakin boat ramp (May 2014)**

The boat ramps at Mossy Point and Tomakin are also used for launching personal watercraft. Another public jetty is located at the end of Pacific Street at Mossy Point.

The Waterways Strategy identified the need for

- Regular safety audits of public facilities and a "Condition Report" on the condition of Council's Waterway Infrastructure be included in the Annual Report and reviewed with that of previous years on a five year cycle; and
- Council prepares and adopts a comprehensive general maintenance program for all waterway structures under the care and control of Council and that a register be kept on work carried out.

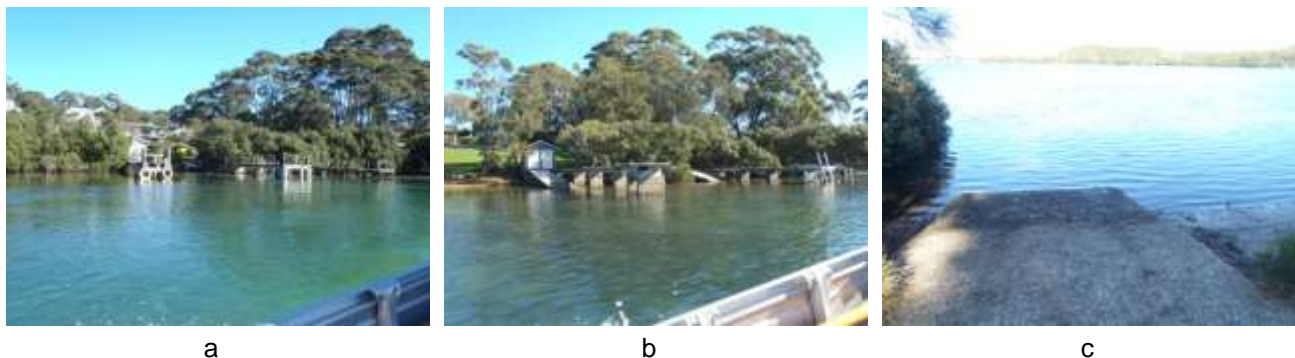
#### Private Facilities

Private jetties and boat sheds have been constructed along the river. Crown Lands is responsible for the licensing of foreshore structures and additional approval requirements now apply due to the Marine Park zoning. The majority of jetty and boatshed structures are located at Mossy Point just upstream of the public boat ramp. Eighteen jetty structures currently along the western foreshore at Mossy Point are located on Crown Reserves and extend up to 35 m from the bank to access navigable waters. The structures are also constructed within mangrove and seagrass beds. A small charter boat industry operates out of the Tomaga River with two fishing/diving charter vessels moored upstream of the Mossy Point boat Ramp.

The Moorings Resort has a private ramp and wharf which is also popular with hire boats, fishing craft and canoeists. Another ramp exists at the former Goldfields caravan park. Informal launching points have also been established at various locations along the river including at Tomakin east of Jack Buckley Park (since blocked with bollards), east of the Tomakin Social Club and at Tomakin Caravan Park. These ramps are in poor condition.



**Figure 44: Private waterway access – upper estuary (May 2014)**



**Figure 45: Foreshore structures – a/b: Mossy Point, lower estuary, c: Tomakin Caravan Park (May 2014)**

The Waterways Strategy also identified the need for

- Removal or prevention of use of unauthorised ramps and launching points. This would also help to concentrate usage of existing facilities that have been developed to have the least impact on the environment; and
- Suitable legal agreements covering the standard of construction and maintenance of any private structure within public areas.

### 7.3.5 Impacts on Waterway Access due to Sea Level Rise

Sea level rise has the potential to reduce community waterway access through increased frequency of inundation of shoreline access routes or infrastructure. The effects of sea level rise will generally take several decades to advance to the stage where a loss of amenity is significant enough to be regarded as an impact. Sloped structures such as boat ramps and access stairs are less likely to be affected by increasing sea levels, as access to the water's edge will remain possible in the long-term, although use of associated features may be affected. In other cases, where specific elevation thresholds may be exceeded due to sea level rise, there will become a time when this effect becomes significantly worse within a short period. Examples of this type of impact may include low-lying car parks, jetties or contained walking tracks at the water's edge.

An evaluation of the potential effects of sea level rise was undertaken through comparison of projected changes in mean sea level (Whitehead & Associates, 2014) discussed in Section 4.5, tidal plane information presented in the EPS and MHL (2012) and topographic elevations inferred from LiDAR surveys from 2011. No ground survey information of key infrastructure was available however comparison of the LiDAR data combined with site inspection provided sufficient understanding in order to determine the likely timeframe and implications of sea level rise impacts on community access infrastructure. The key community access infrastructure or features affected by sea level rise are summarised in Table 13 and are discussed below.

**Table 13: Community access infrastructure and features affected by sea level rise**

<b>Asset</b>	<b>Construction</b>	<b>Expected significant reduction in amenity</b>	<b>Nature of impact</b>	<b>Assumed asset lifespan and/or refurbishment timeframe</b>
Mossy Point boat ramp	Concrete slab Boat Ramp	2100+	Inundation of boat ramp and associated jetty	2040 (25 years)
Tomakin boat ramp	Concrete Boat Ramp	2100+	Inundation of boat ramp and fish cleaning facilities	2040 (25 years)
Pacific Street Wharf	Concrete piers and wooden deck	2050+	Inundation and waves over decking	2030 (15 years)
Tomakin timber stairs	Wood	2015 (currently occurring)	Inundation of lower landing and part of stairway during high tides.	2025 (10 years)
Estuary beaches constrained by landward banks	Natural	2015 (currently occurring)	Access along the length of beach is constrained by high water against the bank and access is further hampered by woody debris or other structures on the bank.	N/A

Both the Mossy Point and Tomakin boat ramps are unlikely to become unserviceable within the sea level rise scenarios considered (up to 0.98m rise by 2100), however both have associated assets that may become less useable over time. In the case of the Tomakin boat ramp, water levels around the fish cleaning table will be uncomfortably high in the future and long-term repositioning/elevation of this asset would be appropriate. Similarly, the Mossy Point boat ramp is unlikely to be compromised by sea level rise prior to 2100, however the associated wharf may become less useable at high tides and will probably require some degree of modification during future refurbishments to accommodate rising sea levels. Despite minor adjustments to related facilities, which would be undertaken as a matter of course during refurbishment/replacement activities, there are no indications that either boat ramp will become unserviceable due to rising sea levels in the long-term.

The Pacific Street wharf will have less freeboard with sea level rise and may become either inundated or subject to excessive waves, effectively reducing the utility of this asset during high tide events in future. Raising or replacement of the wharf in the long term will be required in order to preserve the utility of this asset. Similar issues are likely to occur for privately owned wharves in the same vicinity.

The lower steps and landing of the Tomakin timber stairs are currently influenced by high tides. Although access to the water is not compromised, any further access from the base of the stairs in either direction is limited by the steep banks and lack of high tide beach. Sea level rise will exacerbate this issue and reduce the tides stages at which suitable access beyond the steps can be achieved.

Other estuary beach locations also have reduced high tide access. This is largely due to erosion of the banks on the landward edge, which create steep banks leading to the water's edge and are often associated with fallen trees which further hinder longshore access. The key areas where this currently occurs in is in the vicinity of the timber stairs as well as some locations on the Spit. At the moment only high tide access is curtailed, however continuation of erosion and further squeezing of the high tide beach with sea level rise will mean that these issues are likely to be exacerbated in the future. At the spit, the fence line at the water's edge also contributes to reduced access along this reach.

## 7.4 Waterway Usage Conflicts

Boats can cause damage to seagrass beds through mooring damage, groundings, anchoring and propeller damage. Maritime boating maps (Figure 42) indicate areas of no anchoring although there are no seagrass markers in the estuary.

Personal water craft (PWC – jet skis, Waverunners and Sea Doos) are popular at the mouth of the river, with opportunities for open water wave jumping. This has caused conflicts with other waterway users (particularly surfers and swimmers) with access to the estuary and launching areas via the narrow entrance and surf break. PWCs are also as source of noise, with properties at Mossy Point affected during north-easterly winds in summer. PWC use is regulated by RMS with boating maps showing the areas for permitted and prohibited PWC use and handbooks describing regulations.

The 2005 EMP found that boat waves and propeller wash were contributing to erosion but were not significant compared to natural processes. Erosion concerns were also identified with unformed access to the waterway, trampling of bank vegetation, trail bikes and cubbyhouses.

The EMP also identified community concerns with personal watercraft users disturbing the peace and feeling of natural beauty in the area, as well as disregarding speed restrictions. Similarly, speeding and noise from powerboats was identified as an issue with canoeists in the upper reaches.

The 2005 EMP included a Water Users Management Plan incorporating environmental and habitat constraints, foreshore user and resident amenity and public boating facilities. The actions arising from that plan and the current status are:

- Instigate a 4-knot zone on the whole of the estuary (extend zone upstream of the Moorings) – now gazetted;
- Continue enforcement of PWC regulations – ongoing;
- Develop voluntary code of conduct for PWC users – not implemented as other waterway use guidelines are available from RMS;
- Monitor boat use and seagrass condition and install aquamarks to protect seagrass beds if necessary – not considered necessary to date.

## 7.5 Cultural and Heritage Environment

Cultural heritage is recognised as an important coastal zone management issue due to the long association of Aboriginal communities with the coastal zone over many tens of thousands of years. More recently, European settlement has also made extensive use of the coastal zone, resulting in a multi-layered pattern of cultural usage of coastal sites and resources.

The Tomaga River Estuary has spiritual and cultural significance for local communities. Both European and Aboriginal heritage sites and items exist in and around the estuary and their recognition and protection are important to the local community.

Aboriginal people have occupied the south coast region of New South Wales for at least 20,000 years. The Tomaga River Estuary lies within the country of the traditional Aboriginal owners the Yuin (Dharumba, Djirringanj, Brinja and Walbanga), which are made up of many language groups including the Dhawa and Dhurga. The estuaries, rivers, lakes and oceans provided traditional Aboriginal people with diverse food resources including fish, shellfish, sea mammals, seagrasses and seaweed. The natural resources of lands adjoining the marine environment also provided food, clothing, shelter, tools and areas for ceremonial purposes (Marine Parks Authority, 2010). The Mogo Local Aboriginal Land Council (LALC) represents the land interests of Aboriginal residents in the study area.



Certain local landscape features such as islands and mountains, as well as sites such as middens, camp grounds, ceremonial grounds and burial grounds hold special cultural associations for local Aboriginal people. Traditional knowledge about local plants and animals, including fish and other marine life, is still held by Aboriginal families across the region. The Tomakin area contains a number of important places for Aboriginal people - Barlings Beach, Barlings Island, Burri (Bevian) Swamp, Tomaga River and the surrounding bushland provide a resource rich, sheltered environment utilised by generations of Aboriginal families. The area continues to be utilised for family celebrations and as a base for fishing trips. As with other high points along the coast, Barlings Beach (Figure 47) features a 'lookout', used to spot fish entering the Bay (Donaldson, S., 2006). Barlings Beach Aboriginal Place was gazetted on 23 June 2000.

A number of midden sites are located around the river with some sites under threat from bank erosion. Eleven sites of cultural significance were identified in the 2005 EMP. The sites are mostly open camp sites or middens. Additional sites (scarred or burial trees) that may have existed along the banks of the estuary were suspected to have been lost due to bank erosion.

A search of the NPWS Aboriginal Heritage Information Management System (AHIMS) was conducted for the CZMP study area. The AHIMS search returned a total of 77 aboriginal sites and one Aboriginal Place (Barlings Beach) within the search area. Aboriginal sites and relics are protected under the National Parks and Wildlife Act 1974, and statutory responsibility for the sites and relics around the Tomaga River lies with the OEH. A licence must be obtained from OEH prior to carrying out any proposed works in relation to known Aboriginal sites.

The key issue relating to cultural heritage identified in the 2005 EMP was erosion of cultural heritage sites. Bank erosion was found to be impacting on recorded sites with canoes and burial trees in the upper estuary destroyed by erosion.

A midden on the north bank of the river near Tomakin Club/Tomakin Caravan Park is being damaged by erosion (Figure 46). LLS and LALC are currently implementing a project to control erosion of the midden (refer Section 8.2).



**Figure 46: Midden being damaged by erosion – Tomakin (May 2014)**

The Eurobodalla LEP 2012 identifies many heritage items in the study area as shown on Figure 47.

A search of the NSW Heritage Act did not reveal any listed items in the study area.





**Figure 47: Aboriginal and European Heritage sites in the vicinity of the study area**

Source: ESC LEP (2012)

## **8. ESTUARY MANAGEMENT ISSUES AND OPTIONS**

The information on estuary health status, community uses and the associated pressures provided in previous sections has been used to identify the key management issues for Tomaga River Estuary. The key management issues addressed in this plan are shown on the following figures.

The management issues have been grouped into 5 key strategies:

1. Management of erosion of the spit;
2. River bank rehabilitation;
3. Protection of estuarine and foreshore vegetation;
4. Water quality management; and
5. Management of conflicts between recreational activities and ecological values.

The existing approach and potential management options to implement the management strategies are discussed in the following sections. Existing management actions are shown on Figure 2, page 7.





Figure 48: Key estuary management issues – lower estuary



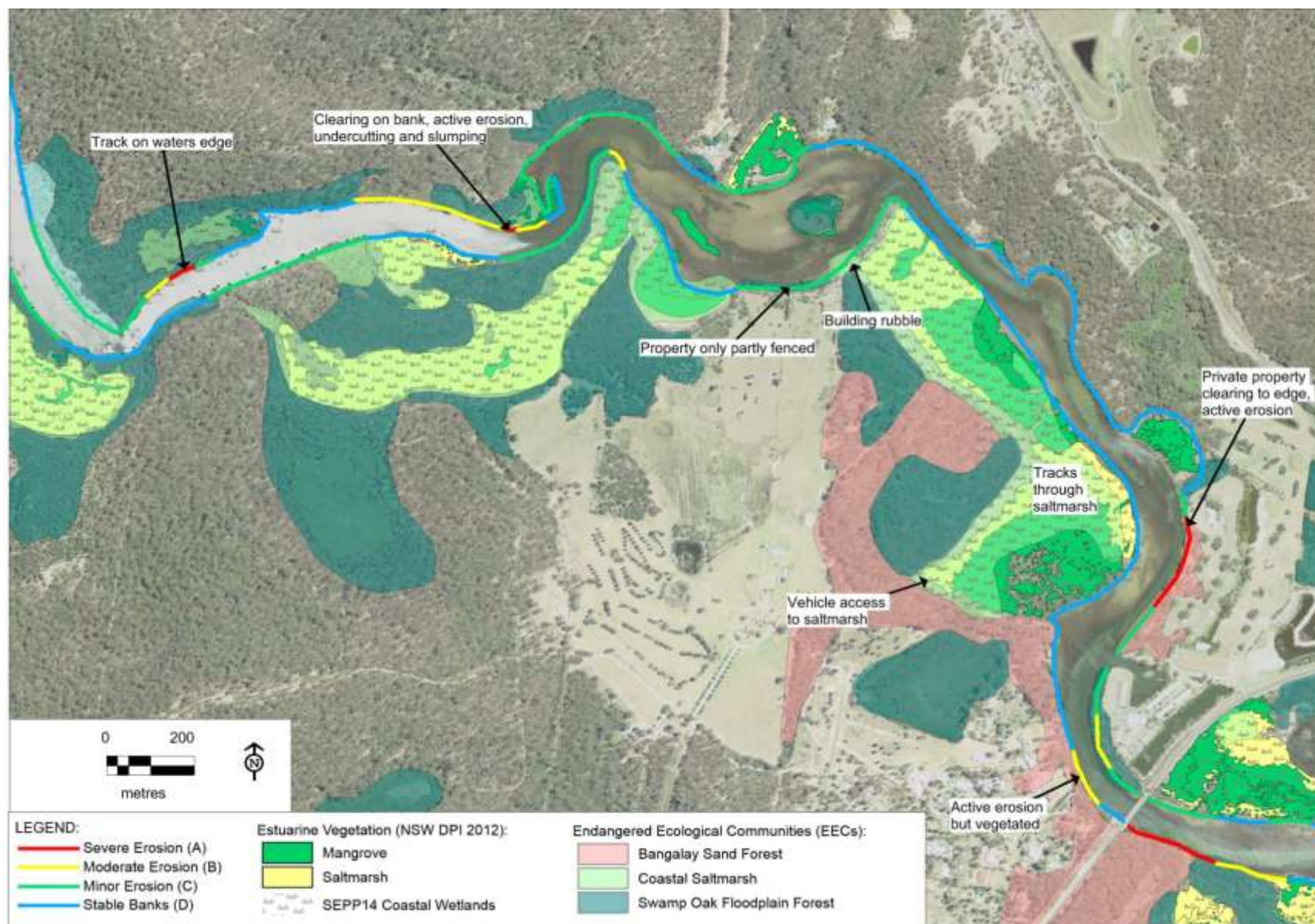


Figure 49: Key estuary management issues – mid estuary

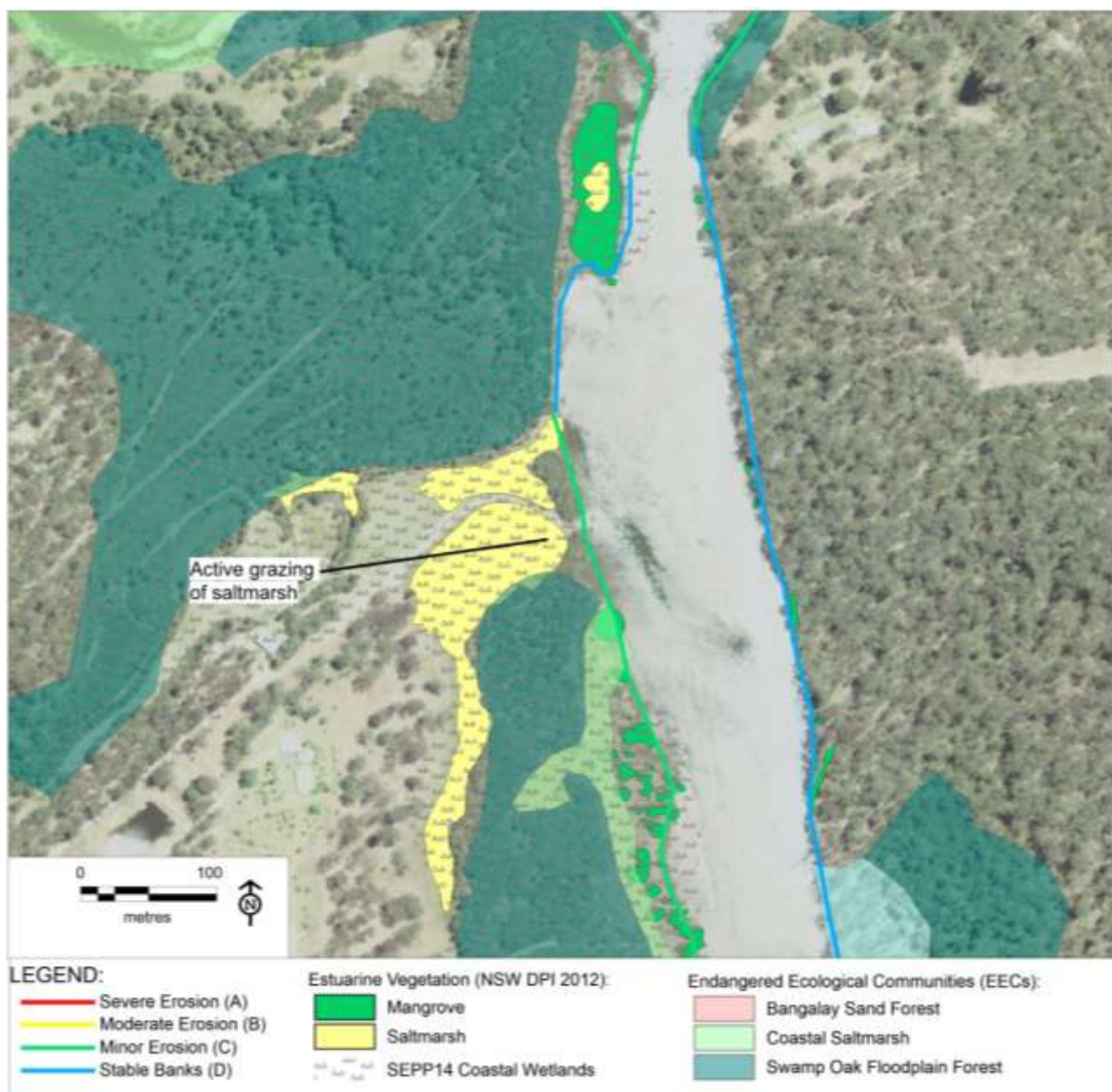


Figure 50: Key estuary management issues – upper estuary



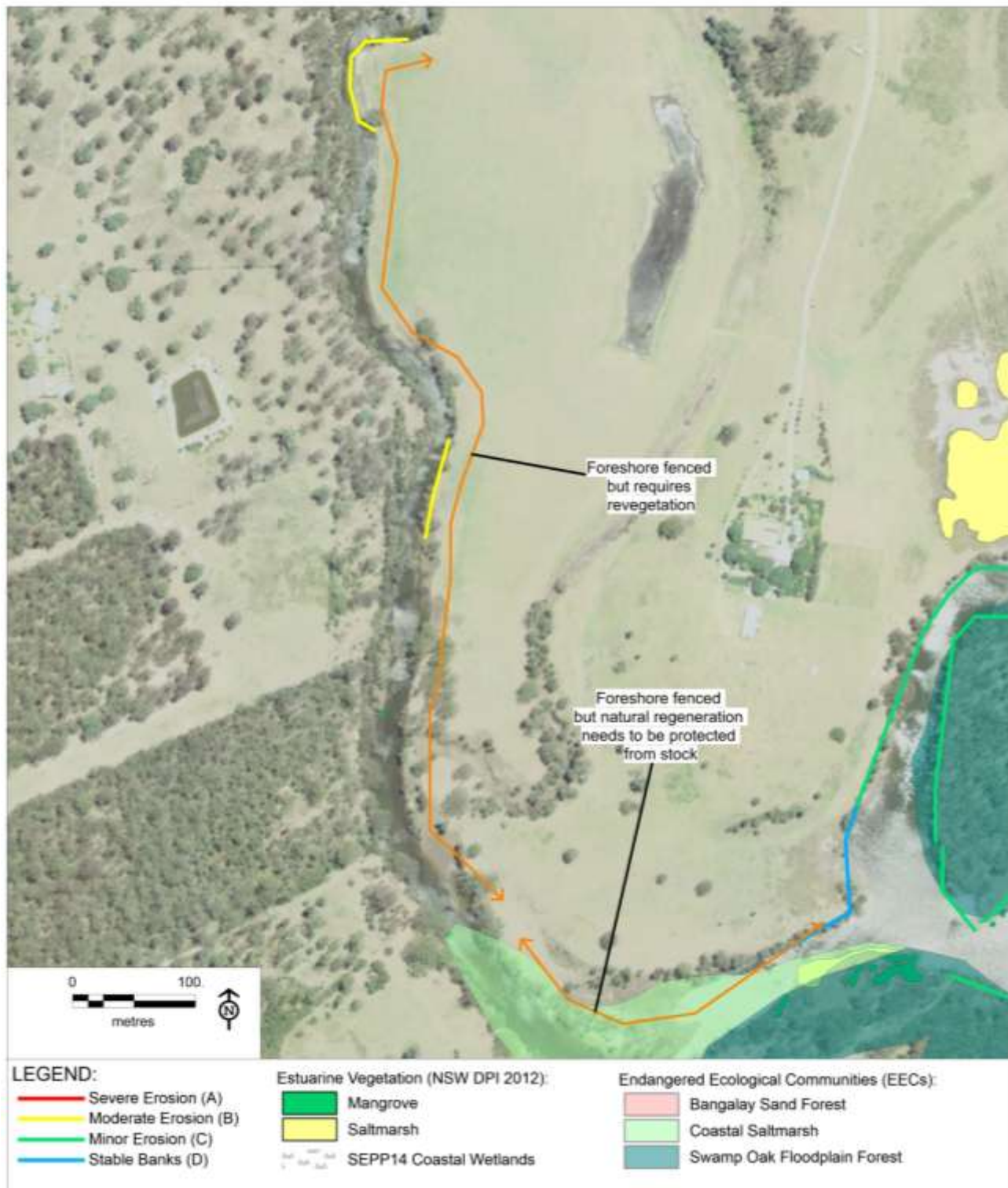


Figure 51: Key estuary management issues – upper estuary



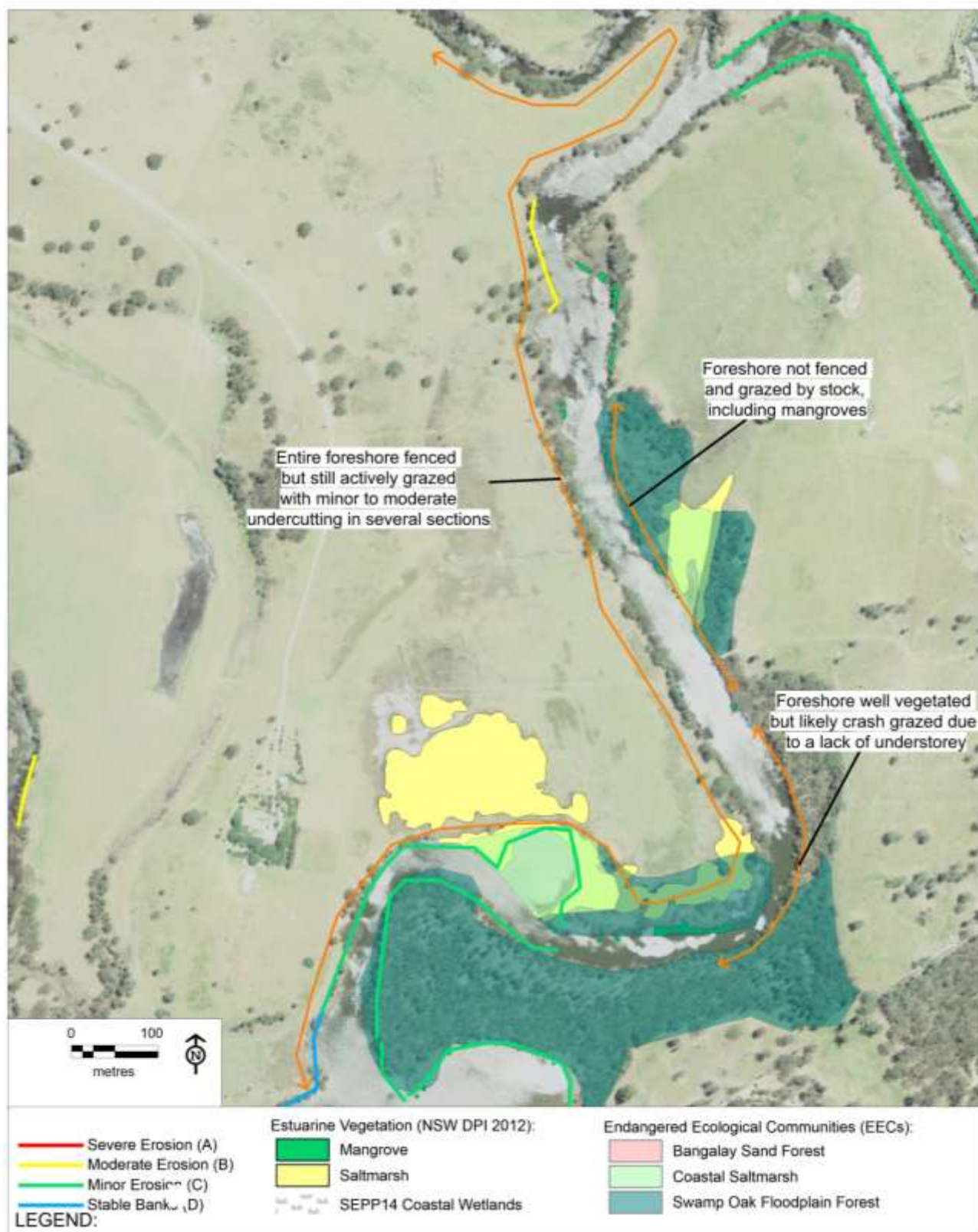


Figure 52: Key estuary management issues – upper estuary

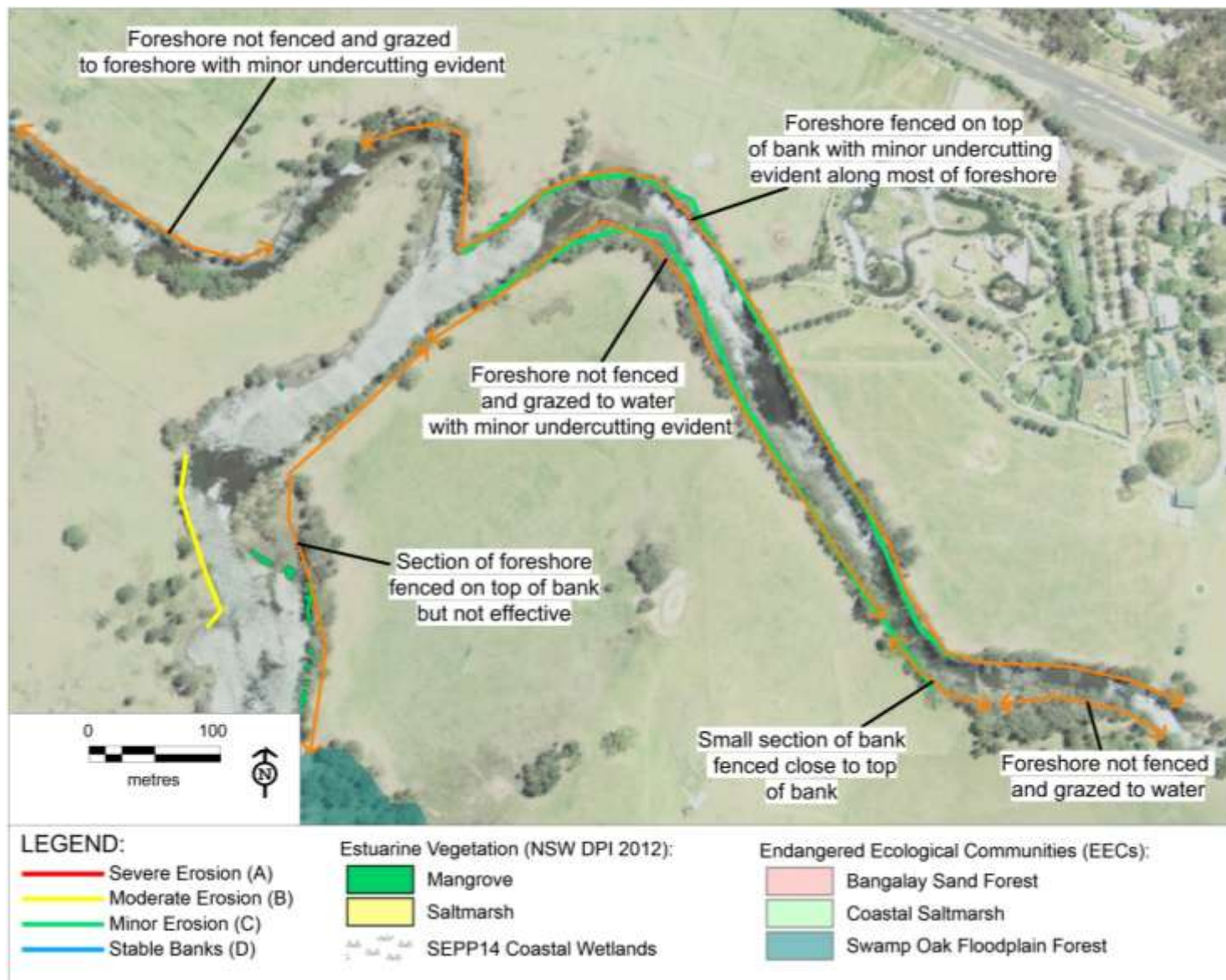


Figure 53: Key estuary management issues – upper estuary

## 8.1 Strategy 1 - Management of Erosion of the Spit

Erosion of the spit is caused by the natural meander of the river but exacerbated by pedestrian access and related activities causing loss of vegetation from the dune. Managing the threat of river breakout through the spit and maintaining the current form of the spit and the estuary mouth at the southern end of Tomakin Beach are key priorities for the community.

### 8.1.1 Existing Approach

The following actions have been undertaken to address erosion of the spit:

- Fencing – pedestrian exclusion fencing has been installed at the base of the spit on the river side, along the dune ridge and at the base of the dune on the ocean side. As the spit continually erodes, the fence on the river side has been progressively moved further east. The current fence is located parallel to the river (open at each end) approximately along the high tide mark. This fence is not effective in discouraging pedestrians from walking along the spit due to the open ends of the fence and lack of access on the river side (at high tide);
- Dune stabilisation – coir log terracing has been installed along the dune face. Some logs have collapsed and some logs and star pickets remain;
- Signage - A sign has recently been installed at the northern end of the spit to indicate the preferred pathway to the beach and avoid pedestrian access along the river side of the spit. However, this sign is not visible when walking along the river side and is therefore ineffective in discouraging access along the spit from this side; and
- Revegetation and weed removal – ESC and Coastcare have undertaken progressive removal of Bitou bush and prickly pear on the spit and attempted to revegetate the eroded areas. This is an ongoing process with only partial success to date.

### 8.1.2 Potential Additional Options

Potential options to address erosion of the spit including those discussed in the 2005 EMP are presented in Table 14.

**Table 14: Potential options to address erosion of the spit**

Option		Description	Pros	Cons	Comments
1A	Do Nothing	No additional action to control erosion. Natural river meander, catchment flooding and ocean storms will eventually cause spit breakthrough.	Allows nature to run its course.  Low cost	Continued erosion and potential breakthrough of the spit.  The preferred position of some members of the community is that the spit is managed to prevent breakthrough.	Will require development of a strategy to monitor and manage issues such as off-shore boating access, private waterway access and estuarine vegetation.



Option	Description	Pros	Cons	Comments
1B	Rock Training Wall	<p>A wall would be constructed at the eastern boundary of the channel. Additional engineering design is required, however a mid-tide height is considered to reduce costs, visual impacts and concentrate on protecting the toe of the spit (refer Figure 54). A higher wall would provide additional protection against floods but would increase costs and impacts.</p>	<p>A rock training wall would maintain the channel in its current position and provide toe protection for the spit. Access at low tide would be available along the river.</p> <p>Suitable rock footings would be required to maintain stability of the wall.</p> <p>Dredging may be required to re-align the channel and provide backfill and may need to be repeated depending on the occurrence of floods.</p> <p>The presence of a training wall would alter the appearance of the lower estuary.</p> <p>A substantial ocean event may still result in spit erosion from the ocean side</p> <p>Significant approval requirements and lead-time.</p> <p>Very high cost.</p>	<p>Hard options such as training walls are not preferred by the community and funding is not expected to be available from Council or external grants. This option is not recommended for these reasons.</p>

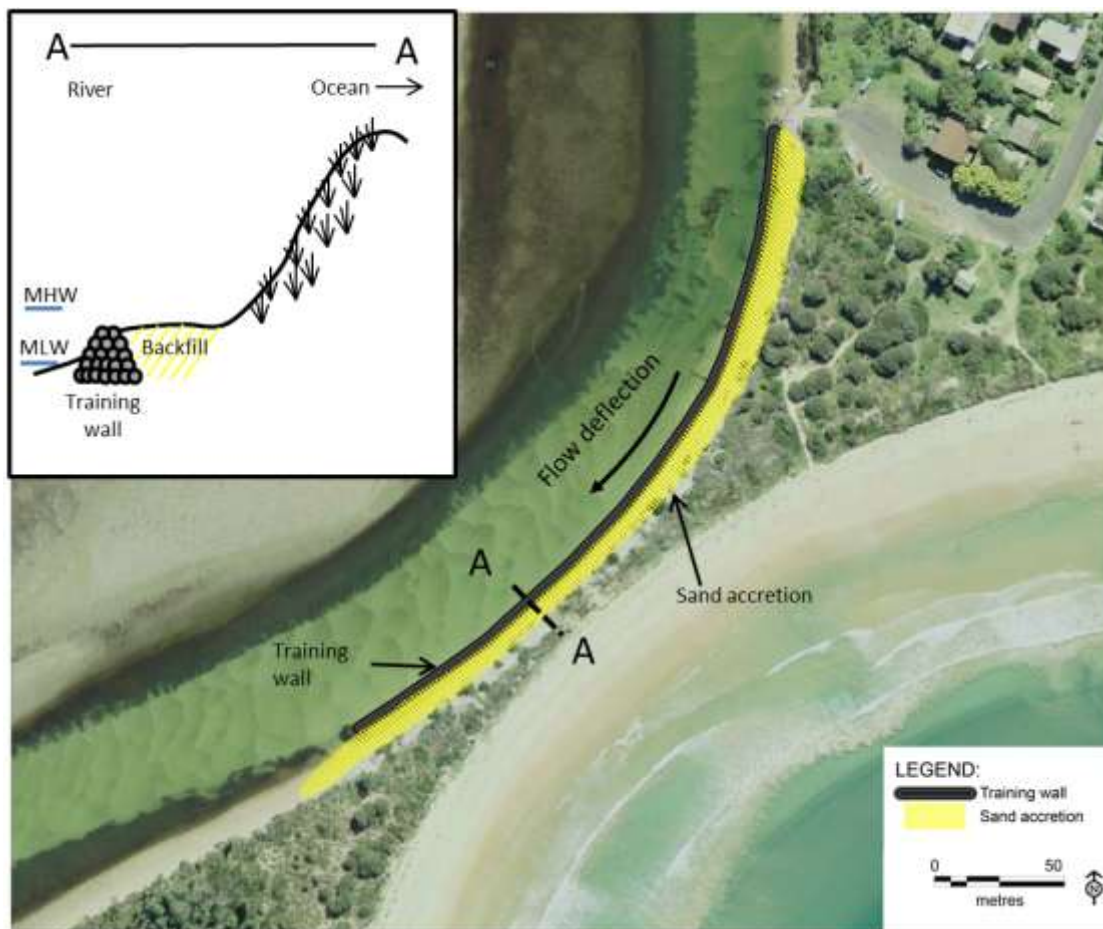


Figure 54: Option 1B - Training wall



Option	Description	Pros	Cons	Comments
1C	Groynes	<p>Either permanent groynes constructed of rock or temporary sand bag groynes around the narrowest point of the spit (refer Figure 55).</p>	<p>Groynes would assist in deflecting the channel and trapping sand to reduce erosion of the spit</p> <p>Potential impacts on navigability and estuarine vegetation.</p> <p>Erosion may be relocated to down drift of the groynes.</p> <p>Temporary groynes may be damaged by floods.</p> <p>A substantial ocean event may still result in spit erosion from the ocean side.</p> <p>Significant approval and timing requirements.</p> <p>High cost.</p>	<p>Hard options such as groynes are not preferred by the community and funding is not expected to be available from Council or external grants. This option is not recommended for these reasons.</p>

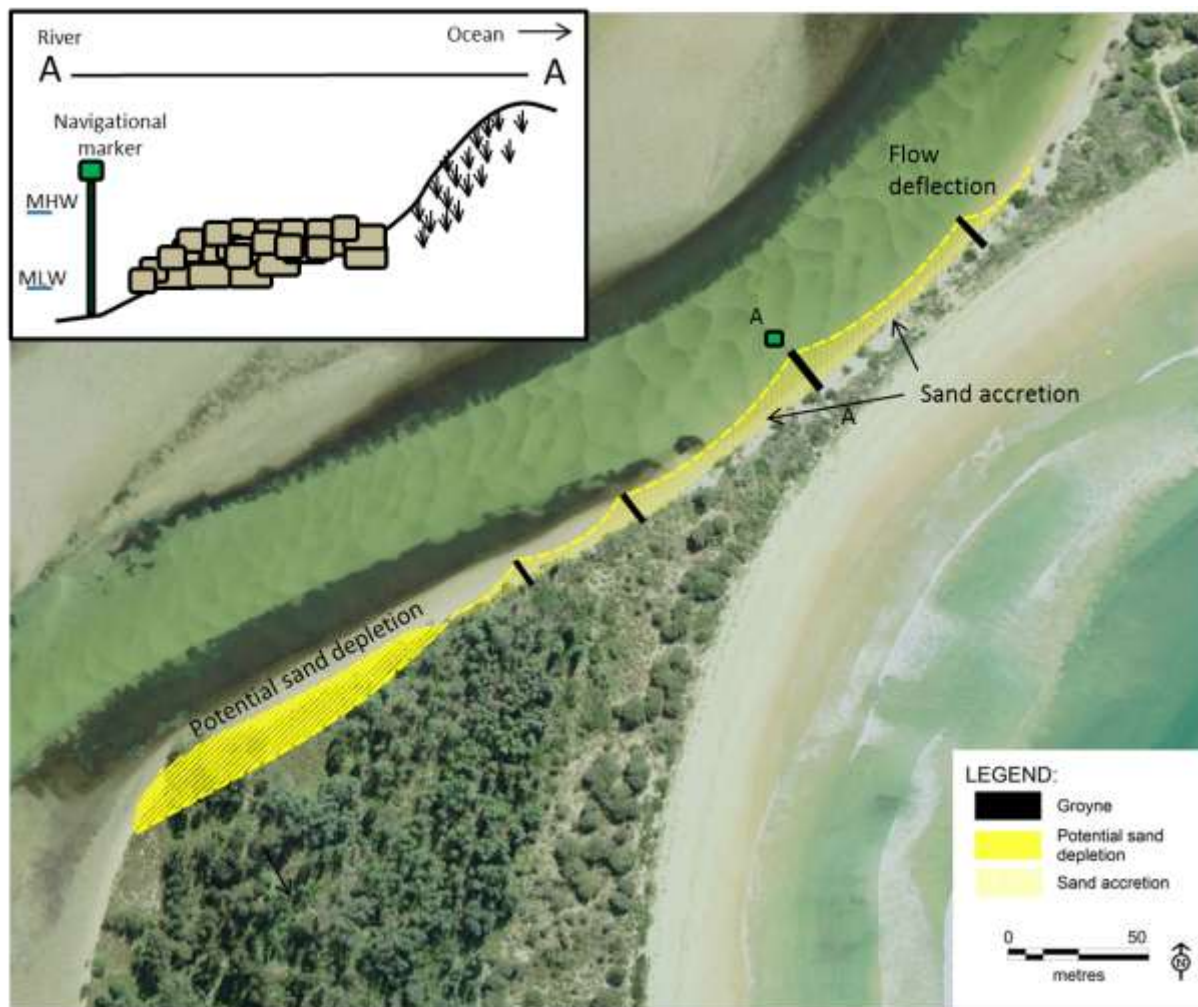


Figure 55: Option 1C - Groynes

Option		Description	Pros	Cons	Comments
1D	Extended erosion fencing	Continue the existing fencing across the spit at each end to discourage access along the river.	Would provide some reduction in pedestrian traffic. Low cost.	At high tide, pedestrian access would not be available on the river side.	Fencing in this location is unattractive and has not been effective.
1E	Modified dune ridge fencing	Refurbish dune ridge fencing to appropriate height and construction.	Visible deterrent to crossing dune.	A substantial ocean event or catchment flood will still result in spit erosion	The dune ridge fencing may limit access across the dune if appropriate height and construction (refer Figure 56).
1F	Remove fencing	Dismantle fences and remove old fencing, logs etc.	Improve appearance of spit	-	The fencing at the base of the dune on the river side is redundant and should be removed. (refer Figure 56).
1G	Signage	Education signage to advise of need to prevent trampling of spit and to direct pedestrians to beach via formed pathways.	Would provide some reduction in pedestrian traffic. Low cost.	Signs are unattractive. Signs can be ignored.	Signage should be used to support any management approach (refer Figure 56).
1H	Education and awareness	Distribution of information about issues and adopted management approaches to residents, schools and tourist facilities and published in local media.	Expected to be successful in informing many people. Low cost.	Information would be ignored by some people. Difficult to reach temporary visitors and tourists.	Education programs should be used to support any management approach.
1J	Formed pathways	Access ways in designated areas.	Would direct pedestrian access in areas of least impact. Would assist in preventing erosion of tracks Low cost.	-	New paths are not required as existing paths provide adequate to river and ocean. Existing path should be formalised and supported with signs, fencing and/or bollards and education.

Option		Description	Pros	Cons	Comments
1K	Viewing platform	Raised platform to provide views to ocean and river	<p>Would assist in keeping people off the dune and direct them along the desired tracks.</p> <p>Would enhance scenic amenity and provide focal point for pedestrians.</p>	<p>May be lost if breakthrough occurs.</p> <p>Ongoing maintenance cost.</p> <p>Due to the environmental and cultural heritage constraints in this area, there are potential delays/risks in approval for this work.</p>	A viewing platform is expected to improve the success of other pedestrian access control options. The platform could be located at any point along the spit but should be connected to pathways and be easily visible to direct pedestrians along formed pathways rather than disturbing other parts of the dune.
1L	Ongoing vegetation management	Progressive weed removal and replanting of appropriate species.	Community groups are active in this area.	Requires ongoing effort and resources.	Expected to slow down the rate of erosion if appropriate species are used and when combined with signage, exclusion areas and education (refer Figure 56).

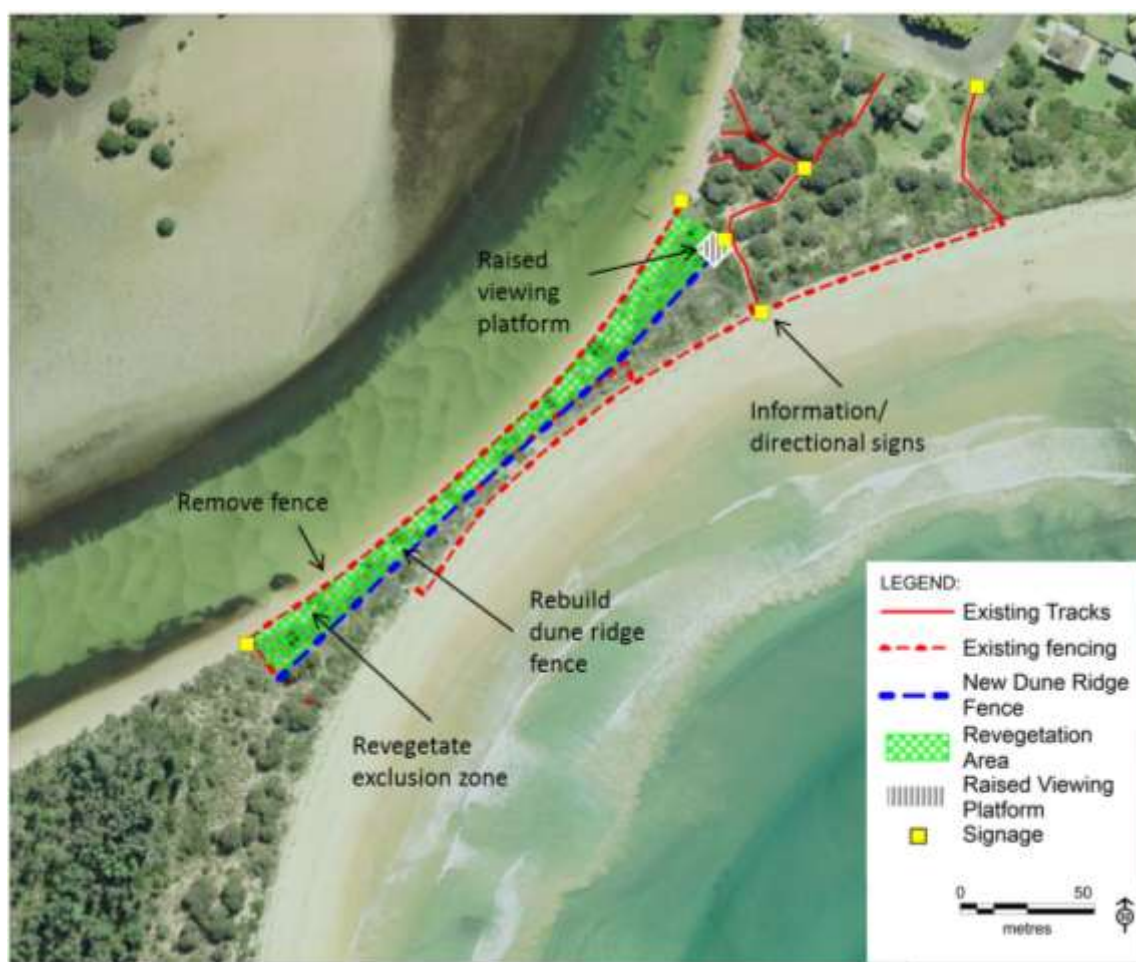
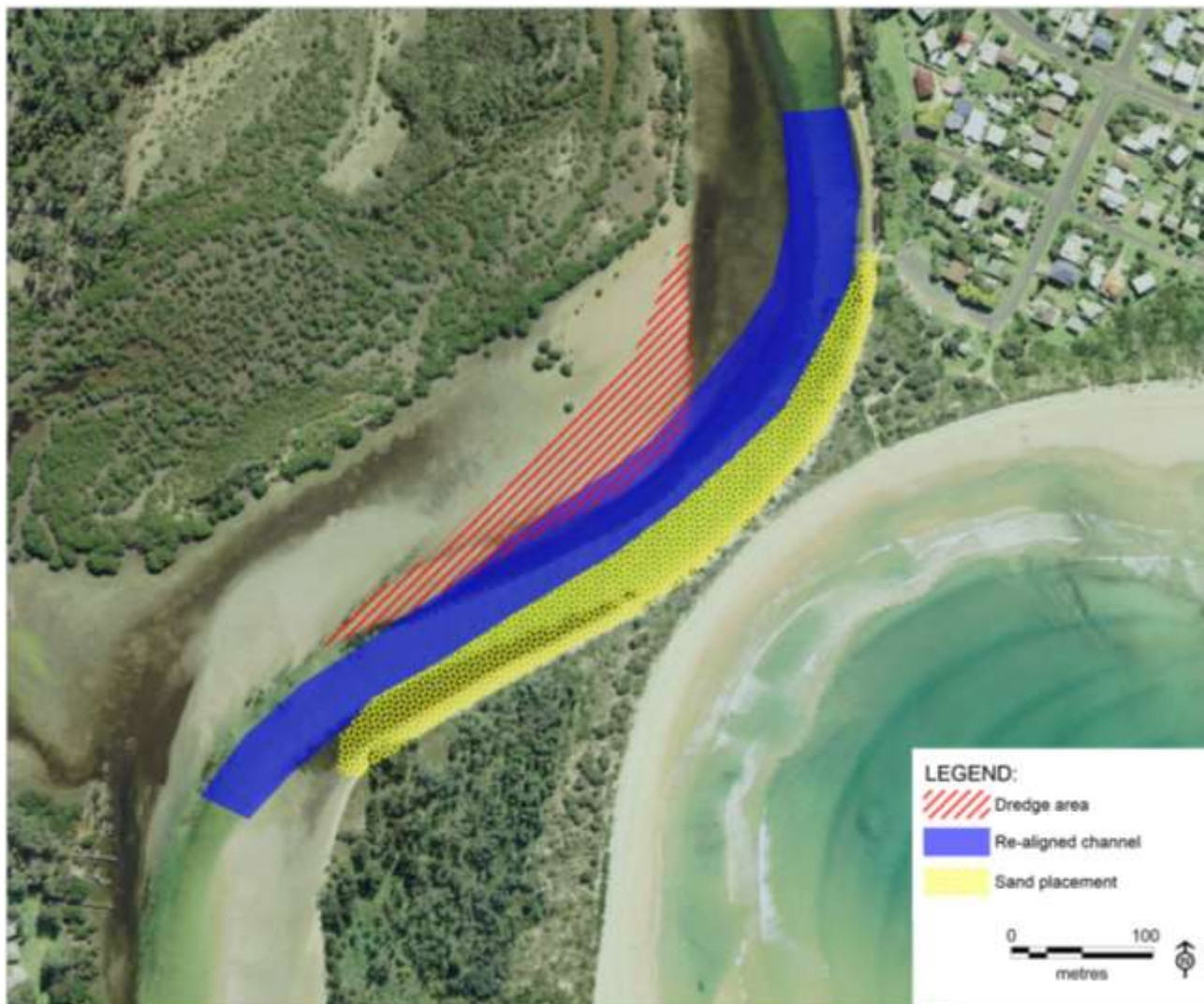


Figure 56: Options 1E, F, G, H, J, K and L – fencing, signage and revegetation



Note. Other locations for a viewing platform may be considered. Cultural heritage and environmental assessment is required.

Option		Description	Pros	Cons	Comments
1M	Realignment of channel	Dredging of shoal to west of spit and placement of sand to realign channel to the west, away from spit.	Temporary protection provided	<p>May not be successful in preventing erosion during large storms or floods. Sand is likely to erode with wind, floods and storms and dredging would need to be repeated on an ongoing basis.</p> <p>Minimal protection from boat wake.</p> <p>Potential impacts on estuarine vegetation and water quality from dredging within river.</p> <p>High cost.</p>	<p>Potentially successful if combined with other control measures.</p> <p>Funding is not expected to be available from Council or external grants and approval risk is considered to be high. This option is not recommended for these reasons.</p>





**Figure 57: Option 1M – dredging of shoal and realignment of channel**

Option		Description	Pros	Cons	Comments
1N	Dune Nourishment	Placement of additional sand on spit to increase height and width	Temporary protection provided	<p>May not be successful in preventing erosion during large storms or floods. Sand is likely to erode with wind, floods and storms and spit would need to be re-nourished on an ongoing basis.</p> <p>Sand needs to be sourced from river (dredging), beach scraping or off-site source.</p> <p>Minimal protection from meander and boat wake.</p> <p>Potential impacts on estuarine vegetation and water quality from dredging within river.</p> <p>Potential increase in sand shoaling and navigation problems if sand is sourced from outside the estuary/beach system.</p> <p>High cost.</p>	<p>Potentially successful if combined with revegetation.</p> <p>Funding is not expected to be available from Council or external grants and approval risk is considered to be high. This option is not recommended for these reasons.</p>
1P	Coastline protection	To be determined as part of the shire-wide CZMP	Not assessed	Not assessed	Not assessed

### 8.1.3 Management of Spit Breakthrough

The 2005 EMP recommended allowing the breakthrough to occur naturally and maintenance of the main entrance if breakout occurred. This approach was considered appropriate for the EMP as it accepted the natural changes to the estuary and would require minimal maintenance or cost and only if breakout occurred. The strategy in the 2005 EMP to maintain access from Mossy Point to the ocean was to dredge the channel following breakout.

The estuary is now a Habitat Protection Zone and developments such as entrance management works require concurrence from various agencies including Crown Lands, Marine Parks Authority, Fisheries NSW and ESC. This is likely to require extensive assessment of impacts on estuarine habitat, water quality, fisheries as well as disposal of the dredged sand. Approvals from Crown Lands (licensing under the *Crown Lands Act, 1969* section 34 licence for extraction of sand) and a Marine Parks Permit from the Marine Parks Authority are expected to be required. In addition, NSW Fisheries is the determining authority for dredging and reclamation in State waters including marine parks and opening and closing of coastal lakes in marine

parks requires consent under fisheries legislation (Part 7 of the *Fisheries Management Act, 1994*). Hence there is a considerable lead time before entrance management works could be undertaken and there is a risk that approvals would not be obtained without significant compensatory works.

Given the uncertainty with timing and impacts of spit breakthrough, as well as the extent and duration of change to the estuary that may result from a breakthrough, it is considered appropriate to implement an adaptive management approach involving monitoring of the spit, consultation with agency stakeholders and the community and development of a plan to be implemented in the event of breakthrough. Monitoring of spit morphology will identify timing requirements for this approach and it is suggested that a repeat survey of the spit profile every two years is appropriate in the short-term. The adaptive management approach would consider the prevailing regulatory requirements, community opinion, ecosystem status and need for action (including alternative ocean access points and implications for other infrastructure) at the time. An important consideration will be the information available on potential effects of sea level rise on overall estuary status as well as any outcomes from Council's shire-wide CZMP process.

#### 8.1.4 Recommended Management Approach

The objective from the 2005 EMP was to "Manage the spit to minimise the likelihood of breakthrough and to minimise impact on users and the environment if breakthrough does occur".

Other related objectives from the 2005 EMP are:

8. Resolve conflicts between users;
9. Manage invasive species; and
14. Maintain the perceived unspoilt nature of the Tomaga Estuary.

The spit has been eroding along the river side at a rate of 1 m/year between 1962 and 2014. Key causes of erosion are stream meandering, boat wash, pedestrian access and vegetation condition. The key potential impacts of spit breakthrough and relocation of the mouth to the northern end of the spit is the loss of boating access from Mossy Point to the ocean and the modification of the surrounding areas. At this stage, no other impacts on infrastructure have been identified. Existing actions such as control of pedestrian access, replanting and weed removal may have been partially successful in reducing erosion of the spit.

While the majority of the community has a strong desire to protect the current appearance and nature of the lower estuary, there are significant implications of attempting to control natural processes, including high cost, ongoing management and potential secondary effects. Hard channel control options listed in Table 14 such as training walls and groynes are likely to be effective in minimising the erosion due to river meander if engineered appropriately but are not favoured by the community and are not considered to be affordable with the current available funding mechanisms. These options also provide no protection from erosion from the ocean side. The softer approaches based on revegetation and pedestrian exclusion may assist in maintaining the current appearance of the spit and provide some protection against erosion but are not likely to be effective in the event of a large flood or ocean event. However, these options are relatively low cost and are expected to be well supported by the community. When supported by an adaptive management approach to management of the spit as discussed in Section 8.1.3, the continuation (with modifications) of the current approach is considered to be the most appropriate at this time.

The recommended approach for erosion of the spit and management of spit breakthrough is (refer Figure 56):

- Removal of any redundant and failing coir logs, fencing materials and waste from the spit, including fencing on river side;
- Review of condition and construction of the existing dune ridge fencing and reconstruction to restrict pedestrian access across the dune, including sediment trap fencing;

- Formalise access tracks with bollards and/or fencing;
- Ongoing weed management;
- Revegetation with appropriate species on the river side;
- Signage installed at the base of existing tracks and access points;
- Construction of a viewing platform at a high point on the northern end of the spit;
- Implement an information and education campaign to residents, tourist facilities and schools to raise awareness of the erosion risk and the adopted approach; and
- Assess the morphology of the spit with topographic survey every two years; and
- Commence a consultative process with community and agency stakeholders to review the status of the spit over time (potentially annual meetings) and develop a management plan if the risk of breakthrough is considered to increase.

## 8.2 Strategy 2 - River Bank Rehabilitation

There are some areas of river bank in need of rehabilitation and protection due to livestock access and grazing, poor condition of riparian vegetation, steepness of banks, lack of buffer zones, boat wash, wind waves, flooding and natural river meander.

The protection of Aboriginal heritage sites is considered to be an important objective for the CZMP, given the spiritual and cultural significance of the estuary and the current and past impacts on sites due to bank erosion.

### 8.2.1 Existing Approach

Various areas of river bank have been targeted by the relevant land managers with varying approaches to bank stabilisation:

- Jack Buckley Memorial Park rock wall (ESC);
- Rock armouring upstream of George Bass Drive bridge (RMS);
- Revegetation projects e.g. Tomakin by Coastcare;
- Bitou bush control along foreshore (ESC and Coastcare);
- Livestock fencing and modification of Crown grazing leases (Fisheries NSW and Crown Lands); and
- Education of land owners about mowing practices (saltmarsh protection etc.).

In addition, Council's Rabbit Control Program is the appropriate mechanism to address damage to river banks caused by rabbit warrens.

The 2005 EMP reports on the expected loss of some cultural heritage sites in the upper estuary due to erosion. South East LLS and the Mogo LALC have commenced a project to rehabilitate the midden in front of the Tomaga Caravan Park and Tomakin Club which is being eroded (Site 4). The proposed method includes installation of sand bagging, geofabric, mangrove and sedge planting, wave barrier fencing and revegetation of the banks to 20 m from the river. The project is being funded under the LLS South East Coastal Wetlands Project (supported by the Australian Government's Biodiversity Fund).

## 8.2.2 Potential Additional Options

This CZMP will focus on high priority areas as identified in Table 9. Management approaches will depend on the location and underlying cause of river bank erosion. Potential options to address bank erosion including those assessed in the 2005 EMP are detailed in Table 15.

**Table 15: Potential options to address bank erosion**

Option		Description	Pros	Cons	Comments
2A	Do Nothing	No additional action to control erosion	No cost	Continued erosion, reduction in water quality and impacts on estuarine vegetation. Loss of community land, facilities and private land. Destruction of cultural sites.	In some areas, erosion is natural and doing nothing may be appropriate. In other areas, doing nothing is not consistent with the values of the estuary. Continued monitoring and assessment of erosion risk is required to identify priority areas for rehabilitation.
2B	Bank stabilisation – hard options	Rock armouring, sand bags or groynes	Some ongoing protection from erosion. Can be applied where limited space exists	High cost. Groynes may affect boating access and may not provide protection during high tides or floods. Groynes are most effective where longshore sediment transport is high. In areas where the primary erosion mechanism is are wave wash and undercutting, groynes are less effective. Rock walls will alter the natural appearance of the area. Sand bags can be unsightly, they degrade and can be easily vandalised.	Rock armouring or sand bagging is an appropriate option for toe protection in areas of severe erosion or to protect from bank recession and loss of land.



Option		Description	Pros	Cons	Comments
2C	Bank stabilisation – mangroves	Planting of mangroves to trap sediment and riparian vegetation to stabilise banks	Low cost	Requires buffer area (approximately 10 m inland of bank) and intertidal beach area.  Weed management and maintenance required.	Mangrove planting has been successful in other estuaries (e.g. Shoalhaven) if combined with wave barrier.
2D	Fencing/ livestock exclusion	Barrier to livestock grazing and access to waterway	Successful protection from livestock trampling and grazing.	Requires landowner assistance.  High cost	Can be successful if adequate vegetated buffer distance is provided.
2E	Creation of vegetated buffer on banks	Provides filter for runoff and stabilisation of bank	Natural means of water quality improvement and bank stabilisation	Requires landowner assistance.  High cost.  Weed management and maintenance required.	Likely to be successful when combined with exclusion fencing.
2F	Education and enforcement – illegal clearing and poisoning	Provide information to landowners in high risk areas about effects of vegetation removal.	Low cost	Difficult to enforce.	Should be continued as part of Council's regulatory functions
2G	Education – agricultural impacts	Ongoing liaison and education regarding impacts of farming practices	Likely to be successful if funding/incentives available.	Requires landowner involvement	Education should be used to support any management approach.
2H	Control of runoff	Scour protection along drainage lines	Effective low cost option	-	Likely to be appropriate for scoured urban stormwater outlets.
2J	Formalised access	Provision of paths, steps, fishing platforms in designated areas	Effective in controlling access away from impacted areas.  Improved all-weather and all-ability access to waterway.  Can be combined with wind and boat generated wave barrier.	Can be high cost depending on usage requirements	May be appropriate in some areas to enhance public access.  The community stakeholders expressed a desire for safe fishing access from Tomakin for the elderly.
2K	Waterway signage	Information signs about impacts of boat wake, no-wash zones, speed etc.	Would provide some reduction in impacts.  Low cost.	Unattractive.  Difficult to see from boats.  Signs can be ignored.  2005 EMP discouraged proliferation of signage.	Appropriate signage should be used to support any management approach.

### 8.2.3 Recommended Management Approach

Related objectives from the 2005 EMP are:

2. Moderate erosion of reclaimed land at Jack Buckley Memorial Park;
3. Moderate erosion due to stream meandering;
4. Protect foreshore habitat;
7. Maintain acceptable sediment inputs;
9. Manage invasive species;
12. Moderate erosion due to boat wake and propeller wash; and
14. Maintain the perceived unspoilt nature of the Tomaga Estuary.

As discussed in Section 6.4, some areas of severe erosion have been adequately controlled (e.g. Jack Buckley Memorial Park) and some areas have reduced in severity. High priority areas for rehabilitation of the river bank are those currently affected by severe or moderate erosion in high value areas (cultural heritage sites, biodiversity areas, priority community access etc.) as shown in Table 9. The potential impact on built assets has also been considered.

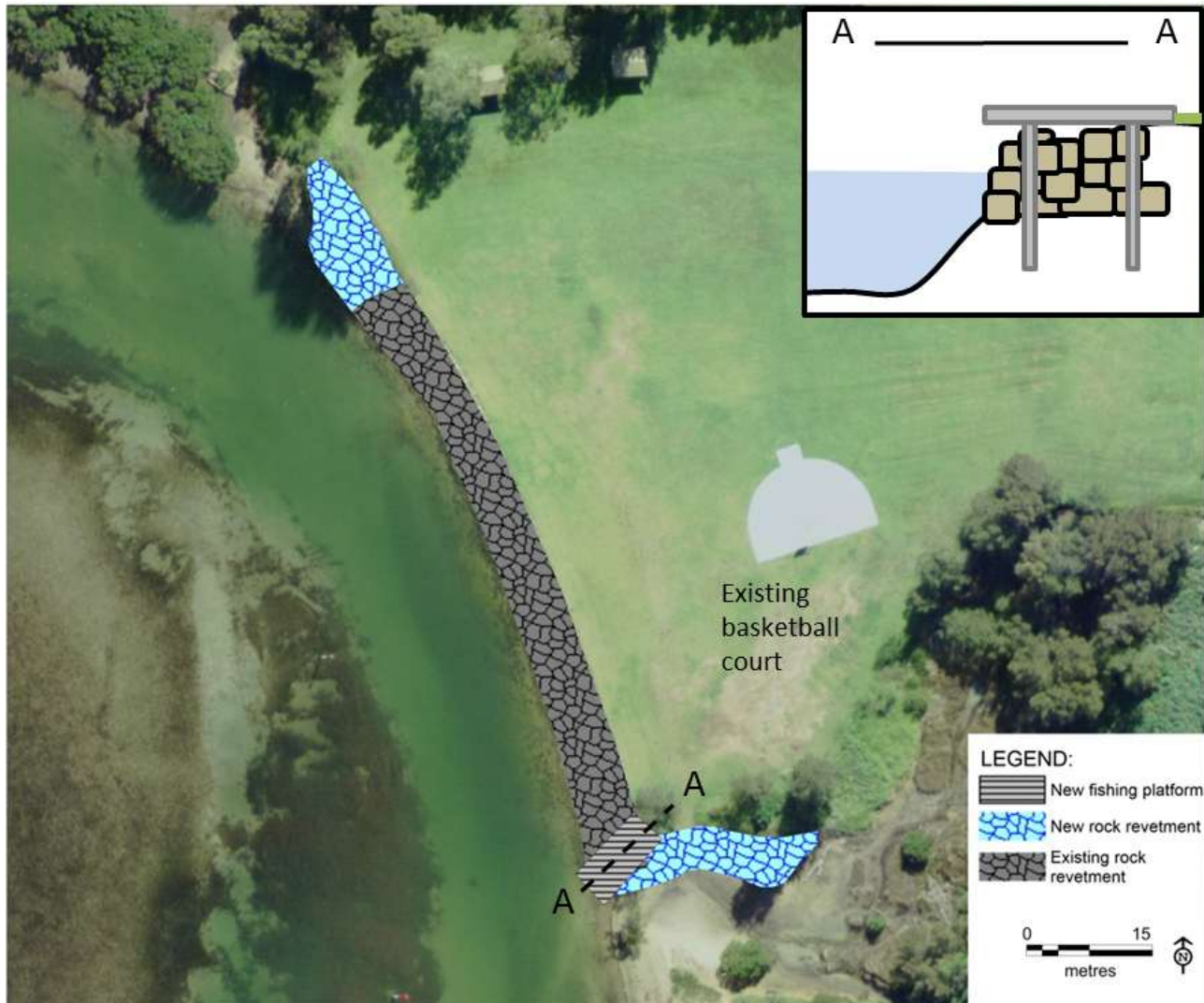
The recommended approach to rehabilitate the river bank in high priority areas to improve water quality and riparian condition is listed in Table 16. Areas of severe erosion in high value areas should be rehabilitated in the short-term (years 1-3). In addition, continued monitoring and assessment of erosion risk is recommended every 3 years.

**Table 16: Recommended priority areas and approach to rehabilitate bank erosion**

Location	ID *	Approach	Responsibility	Timing
<i>Lower estuary</i>				
Right bank, Mossy Point	1	Scour protection at stormwater outlets	ESC	Medium term
The spit	2	Refer Section 1.1.		
Left bank, Tomakin	3	Trial mangrove plantings in accordance with <i>Mangrove Planting on the Shoalhaven River, NSW – A Guide for Restoration of Tidal River Erosion</i> (Shoalhaven Riverwatch Inc.). Refer Figure 58. Maintain stair access but remove existing log walkway. Consider impacts of sea level rise on stair level.	ESC	Short term

**Figure 58: Trial mangrove planting**

Location	ID *	Approach	Responsibility	Timing
Left bank, ends of Jack Buckley Park rock revetment	4	Extend rock revetment at each end between drainage channels. Install fishing platform at an appropriate location considering navigation, environmental and cultural heritage constraints (refer Figure 59).	ESC	Medium term



**Figure 59: Jack Buckley Park – extension of rock revetment and fishing platform**

Note: Fishing platform is shown at southern end of Jack Buckley Park. Final location is to be determined with consideration of navigation, environmental and cultural heritage constraints

Location	ID *	Approach	Responsibility	Timing
Left bank, Tomaga River Tourist Park	5	As proposed by South East LLS and Mogo LALC (refer Section 8.2.1).	LLS, Mogo LALC	Short term
Right bank, downstream George Bass Drive bridge	6	Monitor extent of erosion	ESC	Medium term



Location	ID *	Approach	Responsibility	Timing
<i>Mid estuary</i>				
Right bank, upstream George Bass Drive bridge	7	Monitor extent of erosion and risk to private properties.	ESC	Ongoing
Left bank, The Moorings	8	Monitor extent of erosion and risk to private properties.	Private landholder, Mogo LALC	Ongoing
Left bank, Golf Course	9	Monitor extent of erosion and risk to private properties.	ESC	Ongoing
Left bank, kayak camp	10	Work with landowner to restore river bank with formalised access and restoration of bank	ESC, private landholder	Medium term
Left bank, grazing land	11	Monitor extent of erosion	ESC	Ongoing
Right bank, Jeremadra Creek	12	Livestock exclusion fencing, revegetation of buffer zone, landholder education	LLS, ESC, private landholder	Medium term
Right bank, grazing land Jeremadra Creek	13	Livestock exclusion fencing, revegetation of buffer zone, landholder education	LLS, ESC, private landholder	Medium term
Right bank, grazing land downstream confluence with Mogo Creek	14	Livestock exclusion fencing, revegetation of buffer zone, landholder education	LLS, ESC, private landholder	Medium term

\* Site ID refers to Figure 16 and Figure 17.

### 8.3 Strategy 3 - Protection of Estuarine and Foreshore Vegetation

Even though the measured extents of seagrass and saltmarsh have increased in recent years, there are still a number of threats to estuarine vegetation that require careful management to ensure on-going protection for these important habitats. These include damage to seagrass, livestock grazing and trampling and clearing, pedestrian, horse and cycle traffic on saltmarsh and mangroves.

#### 8.3.1 Existing Approach

Mapping and assessment of change in estuarine vegetation extents is used as part of the estuary health assessment in Council's MER program.

Extensive weed control works and revegetation have been undertaken throughout the riparian zones, foreshore areas and coastal dunes.

ESC has also undertaken education programs with various land owners regarding mowing of saltmarsh and recreational activities in sensitive intertidal habitat areas (e.g. horse-riding activities).

#### 8.3.2 Potential Additional Options

In addition to ongoing monitoring and assessment of estuarine vegetation extent and condition as well as education programs, options to protect estuarine and foreshore vegetation include erosion management options, provision of formalised access, control of livestock access and vegetation rehabilitation as

discussed in Sections 1.1 and 8.2. The various areas targeted for protection of intertidal vegetation will require a combination of these approaches.

It will also be important to ensure mapping is representative of all areas to be protected and updated on a regular basis. Areas of EEC (e.g. saltmarsh) require protection under legislation and identification and mapping is a key tool in any management approach.

Seagrass markers have been suggested as a way to redirect boats away from seagrass beds and prevent propeller damage. The channel is already marked with navigation markers and given the extent of seagrass, low depth and width of the existing channel, a significant number of seagrass markers would need to be placed at the current boundaries of seagrass beds to be effective. This may present a navigation safety hazard, would be a significant expense and would detract from the natural qualities of the area. Education programs (including signage at key locations) would assist in providing information about the value of estuarine vegetation and human impacts.

Section 6.5.3 identifies the potential areas for migration of fringing estuarine vegetation in future due to sea level rise. Future reviews of this CZMP should include a reassessment of the impacts of sea level rise on future estuarine habitats.

### 8.3.3 Recommended Management Approach

Related objectives from the 2005 EMP are:

4. Protect foreshore habitat
5. Maintain acceptable nutrient and faecal coliform inputs
7. Maintain acceptable sediment inputs
8. Resolve conflicts between users;
10. Minimise pollutants entering estuary
11. Protect seagrass
13. Ensure water quality is adequately monitored
14. Maintain the perceived unspoilt nature of the Tomaga Estuary

Some areas of vegetation protected under legislation are being damaged through human impacts such as horse-riding, motorbikes and mowing. An assessment of the potential impacts of sea level rise has shown that the majority of the current estuarine vegetation (saltmarsh, mangrove and seagrass) will have suitable areas for upslope migration as average tide levels rise, however existing barriers such as roads may constrain migration in some areas. The key issues contributing to threats to riparian and estuarine vegetation are bank erosion, livestock access to waterways, trampling of saltmarsh areas and disturbance from boat propellers.

The recommended approach to protection of estuarine and foreshore vegetation includes:

- Erosion management approaches discussed in Sections 1.1 and 8.2;
- Limited strategic placement of sea grass markers to limit visual impact and hazard to navigation should be considered in consultation with RMS ;
- Protection of saltmarsh area north of Mossy Point including closure of vehicular and horse riding access points, education signage, education of landowners and monitoring of saltmarsh condition;
- Prevention of pedestrian access through Saltmarsh EEC (between Tomakin Caravan Park and IGA);

- Ongoing regulation of illegal vegetation removal (Fisheries NSW is currently working with other councils in the region to develop a joint management strategy to address the illegal removal of marine vegetation. ESC may be able to adopt a similar approach in future);
- Education of residents regarding the value of estuarine vegetation and human impacts;
- Ongoing weed management and revegetation of foreshores;
- Ongoing monitoring and assessment of estuarine vegetation extent and condition;
- Protection of saltmarsh area in front of Tomakin club (refer Figure 60);



**Figure 60: Saltmarsh protection – Tomakin Club**

- Regular update of estuarine vegetation mapping as part of the MER program; and
- Ongoing assessment of impacts of sea level rise.

## 8.4 Strategy 4 - Water Quality Management

Water quality in the lower estuary is generally suitable for swimming most of the time, however, the upper estuary is susceptible to pollution from faecal contamination. The current MER-aligned monitoring program is considered to provide a good assessment of ecosystem health throughout the Tomaga River Estuary, however, the program is not designed to, and does not provide detailed information regarding specific pollution sources.

### 8.4.1 Existing Approach

ESC has implemented a water quality monitoring program based on the MER protocols in 2010/11 and 2011/12 with monitoring to continue in 2014/15 then every second year. Recreational water quality and ecosystem health indicators are reported in this program on a rolling 2-year basis with report cards available on Council's website.

Council implemented an urban stormwater education program in 2010. ESC is also working with Mogo Zoo to improve the operation of the on-site sewerage system and irrigation of treated effluent to reduce impacts of runoff to the river.

Management of river banks is occurring at many locations as discussed in Section 8.2 including fencing to restrict livestock access, revegetation of riparian zones, and bank erosion control. These actions directly contribute to the improvement of water quality in the estuary.

### 8.4.2 Potential Additional Options

Additional options described in previous sections to control erosion, improve grazing practices and rehabilitate riparian zones will contribute to improved water quality outcomes.

Additional monitoring, particularly event-based data collection (following wet weather events) will assist in identifying sources and causes of poor water quality.

Urban stormwater can be a source of contamination following wet weather. Installation of stormwater quality improvement devices (SQIDs) at major outlets would reduce pollution but would require ongoing maintenance to be successful. Monitoring is required to determine the high priority areas for SQIDs.

### 8.4.3 Recommended Management Approach

Related objectives from the 2005 EMP are:

4. Protect foreshore habitat
5. Maintain acceptable nutrient and faecal coliform inputs
7. Maintain acceptable sediment inputs
10. Minimise pollutants entering estuary
12. Moderate erosion due to boat wake and propeller wash
13. Ensure water quality is adequately monitored

The available water quality data suggest that the lower and mid estuary is generally suitable for primary contact recreation with reduced quality following periods of high rainfall. The upper estuary may be susceptible to pollution from sources of faecal contamination.

Longer term monitoring over various climatic conditions is required to adequately characterise water quality in the estuary and identify pollutant sources. The key objective is to maintain acceptable water quality throughout the estuary.



To assist in identifying sources of pollution, alternative monitoring methodologies would need to be designed and implemented such as event-based monitoring at selected sites. Considerations for design of an event-based program are:

- Sample site selection and timing of sample collection will be crucial in obtaining accurate results and eliminating factors of variation associated with tides and other pollution sources. Site selection should incorporate assessment of:
  - Agricultural drains (potential sources of acid sulphate soil runoff, nutrients, low dissolved oxygen, sediment, faecal contamination etc.);
  - Stormwater outlets (potential sources of sediment and nutrients etc.); and
  - Specific sites of concern to the community as appropriate.
- As a minimum, sampling should aim to capture at least four moderate to high rainfall events. After the initial seasonal sampling, review of results will determine further monitoring requirements;
- Water quality parameters to be assessed will be selected according to the type of pollution source under investigation. As a minimum the following parameters are suggested: pH, temperature, dissolved oxygen, salinity/conductivity, turbidity (water clarity indicator), chlorophyll a (indicator of nutrient status) and enterococci (faecal indicator). The direct measurement of nutrients is not considered necessary for assessing long-term ecosystem health providing that chlorophyll a is measured. However, the measurement of nutrient concentrations during event-based monitoring may provide further information to assist in the identification of likely sources of pollution, and should be considered where funding permits;
- Depending on the types of pollution being investigated, grab samples may be needed for analysis of enterococci (faecal indicators), chlorophyll a etc. which will require manual sampling in the field. An alternative (or complimentary method) is deployment of water quality data loggers at key sites in relation to potential sources. Data loggers would remain in place for a period of time continuously recording water quality for a range of physico-chemical parameters (e.g. turbidity, dissolved oxygen, pH, temperature, salinity). However, the significant additional cost of data loggers may prevent their implementation if equipment is not currently owned and available for Council use; and
- Specific methodologies would need to be developed and incorporated into a sampling program that is suitable for implementation considering logistical and safety constraints associated with weather-dependant sampling. The availability of grant funding and Council resources may determine the timing of the sampling program.

## **8.5 Strategy 5 - Management of Conflicts between Recreational Activities and Ecological Values**

The key conflicts relate to waterway access and boating resulting in erosion and impacts on estuarine vegetation.

### **8.5.1 Existing Approach**

Options currently addressing boating impacts are:

- Control of boat wake – 4 knot speed restrictions have been implemented, no-wash areas and channel markers are shown on navigation maps; and
- Regulation and management by RMS representatives.

In 2014/15, ESC will upgrade the Tomakin boat ramp to a higher standard with the current capacity (single lane) with improved parking facilities.

The following actions will be addressed as part of the ESC Waterways Strategy:

- Removal or prevention of use of unauthorised ramps and launching points. This would also help to concentrate usage of existing facilities that have been developed to have the least impact on the environment; and
- Suitable legal agreements covering the standard of construction and maintenance of any private structure within public areas.

Erosion management is discussed in Section 8.2.1.

### 8.5.2 Potential Additional Options

Education programs and signage as discussed in Sections 8.1.2 and 8.2.2 can assist with reducing conflicts by improving knowledge and awareness.

A key goal of this CZMP is enhancing the recreational opportunities of the estuary while protecting ecological health. Options include:

- Management of shoaling – dredging to deepen and widen the channel. The issues associated with dredging are discussed in Section 8.1.2 and 8.1.3. Dredging is not recommended at this time; and
- Improved access arrangements – for fishing, pedestrians and the elderly (Section 8.2.2) which may be appropriate in some areas.

### 8.5.3 Recommended Management Approach

Conflicts between the protection of ecological values and recreational amenity include the management of seagrass and boating access, motorised water craft and boat wash contributing to bank and spit erosion, pedestrian access and related activities on the spit causing erosion and uncontrolled access to the waterway contributing to bank erosion.

Related objectives from the 2005 EMP are:

1. Manage the spit to minimise likelihood of breakthrough and to minimise impact on users and the environment if breakthrough does occur;
4. Protect foreshore habitat
5. Maintain acceptable nutrient and faecal coliform inputs
7. Maintain acceptable sediment inputs
8. Resolve conflicts between users;
10. Minimise pollutants entering estuary
12. Moderate erosion due to boat wake and propeller wash
13. Ensure water quality is adequately monitored
14. Maintain the perceived unspoilt nature of the Tomaga Estuary

The recommended approach to enhance recreational amenity and opportunities while protecting ecological values includes:

- Construction of an viewing platform at a high point on the northern end of the spit (refer Section 8.1.4, Figure 56);

- Maintenance and consolidation of waterway access from river banks in Tomakin (refer Section 8.2.3, Figure 58, erosion site 3). At this site, it is recommended that waterway access via the timber stairs be retained and the log pathway be removed; and
- New fishing platform at Jack Buckley Park as part of erosion control works (refer Section 8.2.3, Figure 59, erosion site 4). This would offset the loss of access at site 3 and provide a safe, all-age and mobility impaired fishing access point. Works below the mean high water mark will require consent from DPI (NSW Marine Parks).

## 9. THE MANAGEMENT PLAN

The potential management options have been evaluated and prioritised in Section 8 by considering a number of factors including:

- Expected success in resolving the management issues;
- Cost of implementation;
- Expected level of community support and acceptance of the action; and
- Environmental impacts (both positive and negative).

### 9.1 Management Actions

The recommended actions are described in Table 17 and shown on the following figures. Actions consist of a combination of studies, investigations and on-ground works. Some actions require additional design or assessment prior to implementation of on-ground works.

The recommended management actions have been described in terms of:

- Action description – an outline of the scope of works required; and
- Priority – based on the assessed risk, each action has been assigned a priority (high, medium or low) or is an ongoing project;
- Responsibility – responsibilities for implementation of the management strategies have been assigned to the relevant land manager. In addition, support from various other local government and non-government organisations and groups including industry bodies, private landholders and community groups will be essential in the implementation of the plan to assist in implementation of the action, either through their regulatory role or land management function or as a potential funding or information source;
- Cost Estimate – a broad estimate of costs for implementation over the 10 year life of the plan is provided. Cost estimates provided in the action descriptions are preliminary only and based on the best available information;
- Potential Funding – the CZMP strategies are expected to be funded through Council and State Government contributions, monetary grants and in-kind contributions. However, the availability of Council resources, particularly funding for new assets, will depend on existing budget commitments and work programs. Identification of grants and successful application is an important component of this CZMP. A summary of potentially relevant and available grant schemes is given in Appendix 8. It is important to note that many grants and funding sources are only available up to a limited budget and as such, the available grants are changing from year to year. It will be necessary to keep abreast of current funding availability throughout the implementation of the CZMP. In most cases it is expected that in-kind contributions will be provided by Council.

Where actions are implemented through a concurrent program, additional expenditure and funding have not been included. Where a study/review is required to determine the appropriate level of expenditure, the cost of the review has been estimated in the action planning. Implementation costs should be confirmed by the results of the review; and

- Timing – based on the priorities developed in this CZMP, timeframes for management actions have been developed for a ten year period. This CZMP and the progress of the management actions should be reviewed to ensure the actions remain relevant and the implementation of the plan is being achieved.





Figure 61: On-ground management actions – lower estuary



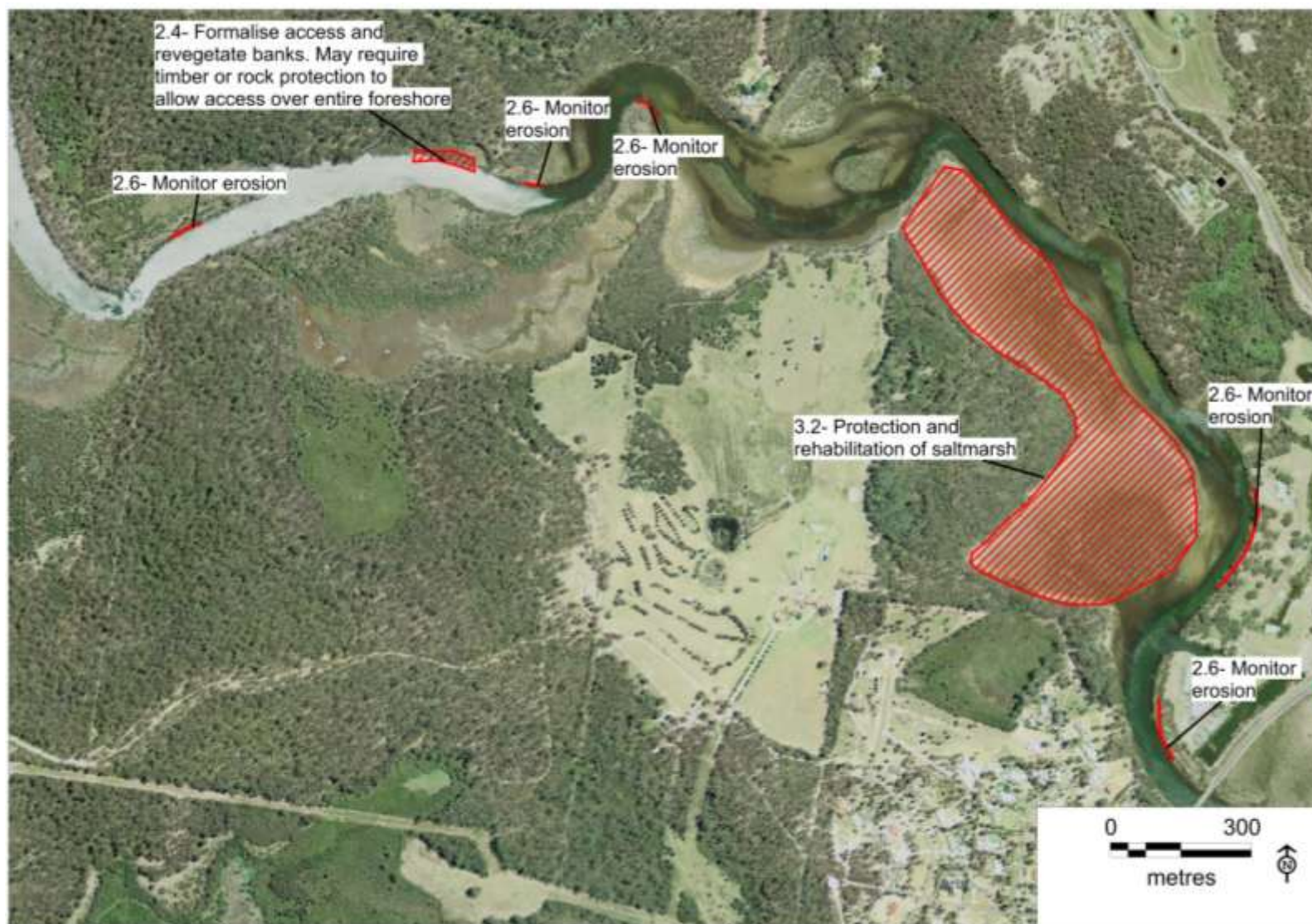


Figure 62: On-ground management actions – mid estuary

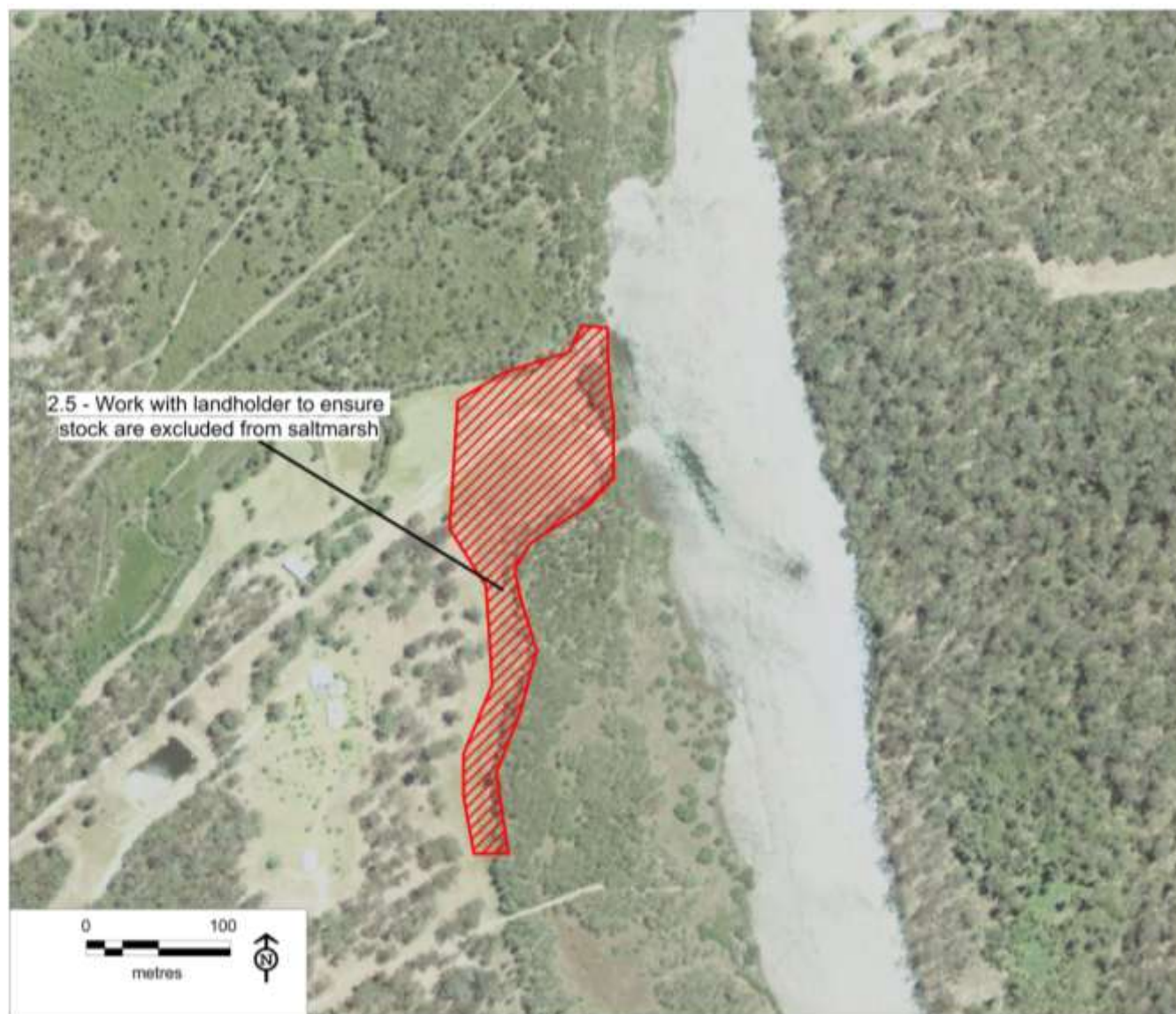


Figure 63: On-ground management actions – upper estuary



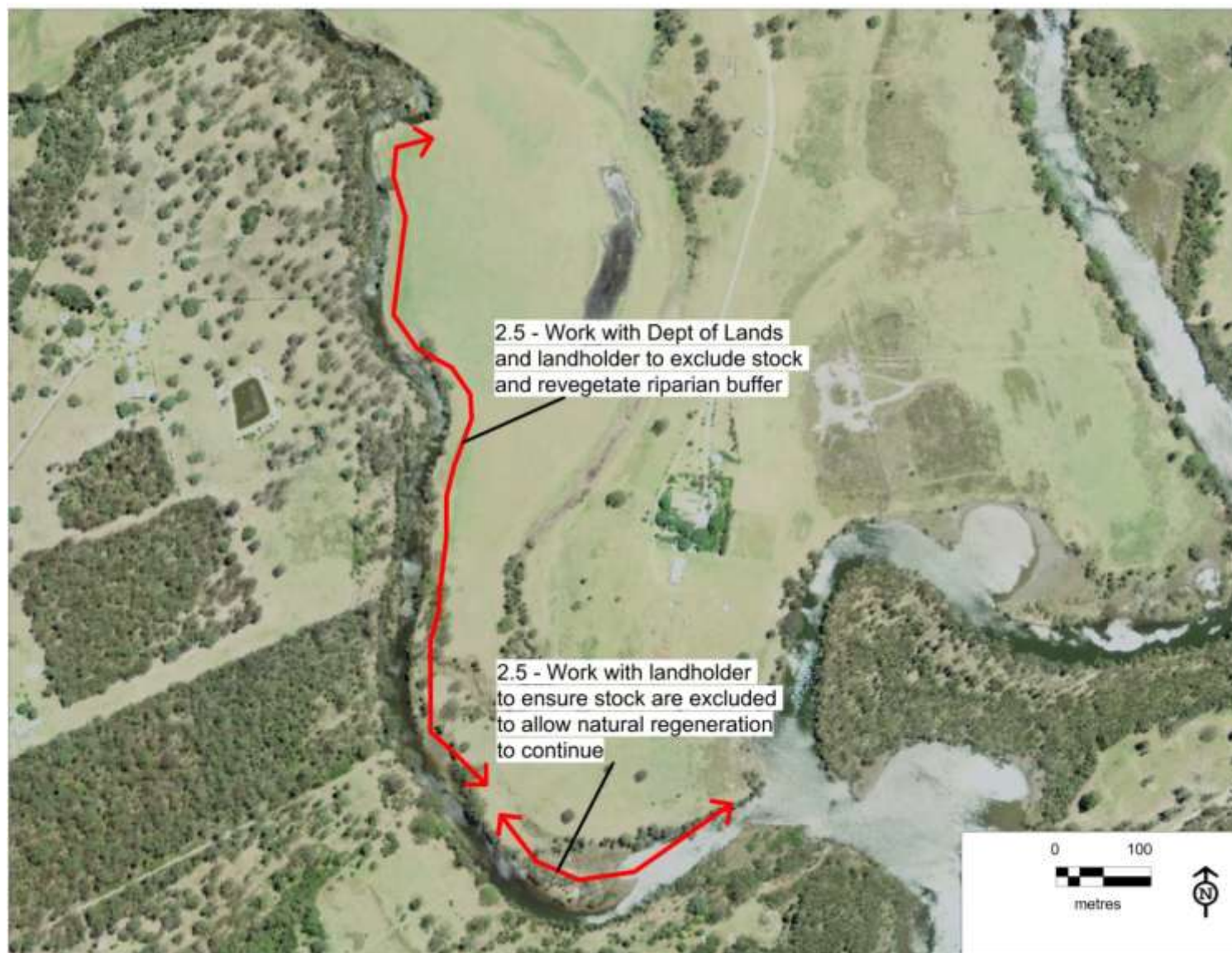


Figure 64: On-ground management actions – upper estuary



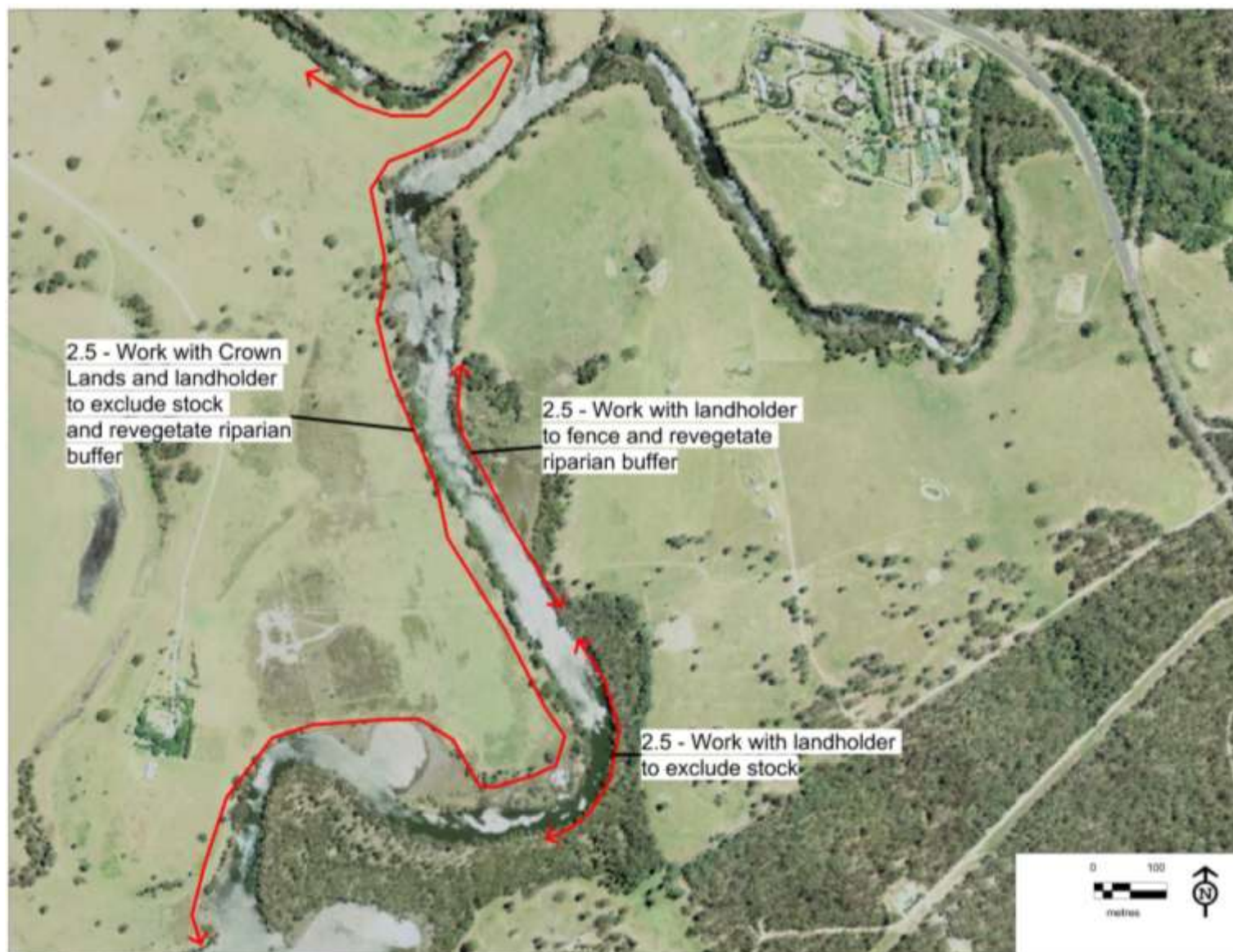


Figure 65: On-ground management actions – upper estuary

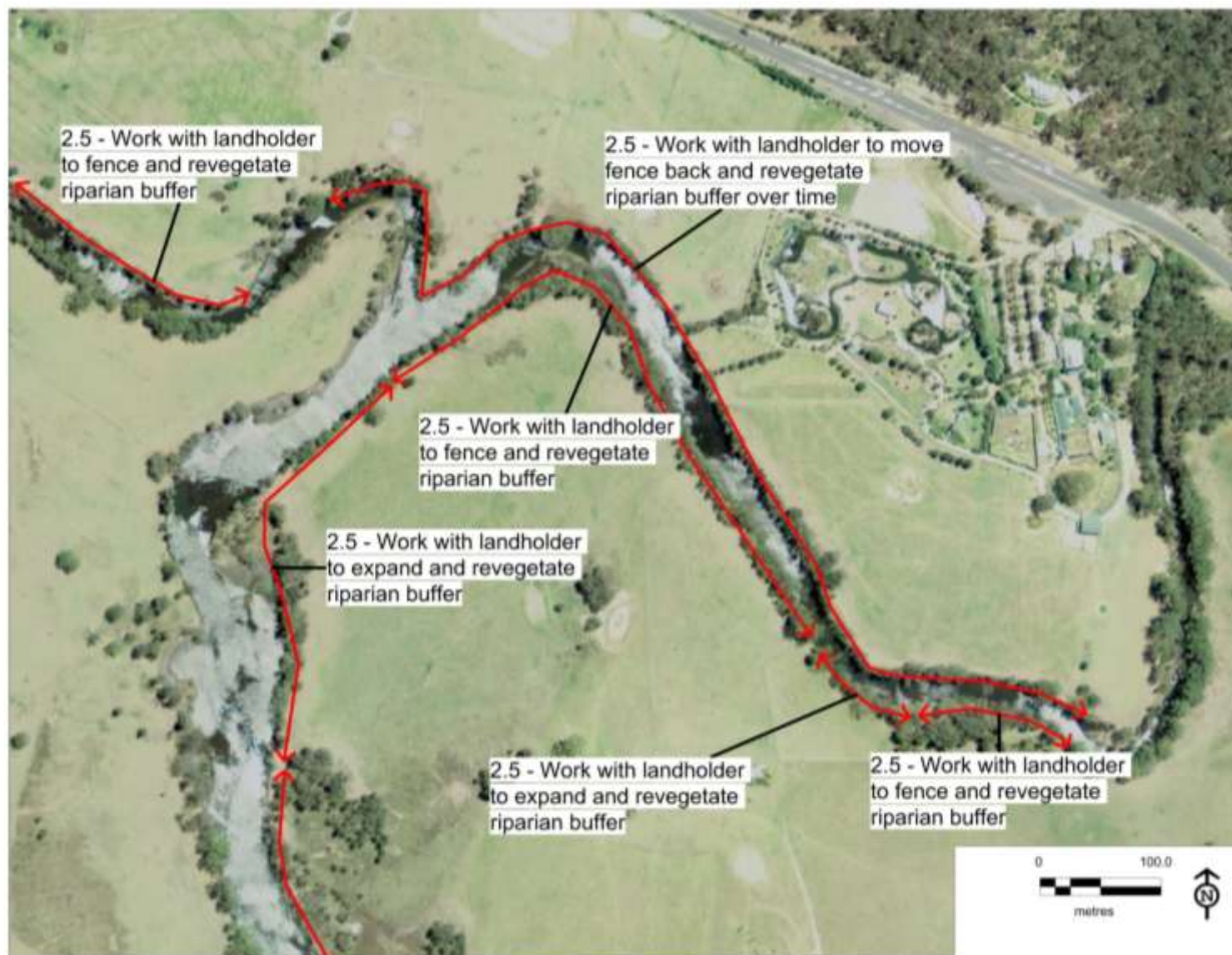


Figure 66: On-ground management actions – upper estuary

Table 17: 2014 CZMP Management Actions

<b>Strategy 1: Management of erosion of the spit</b>						
<b>Action</b>		<b>Priority</b>	<b>Responsible Body</b>	<b>Cost</b>	<b>Potential Funding (Note 1)</b>	<b>Timing</b>
1.1	Control pedestrian access – remove old and redundant fencing components and logs from river side, relocate and extend dune ridge fencing (refer Section 8.1.4 and Figure 56)	High	ESC	\$15,000	ESC, NSW Estuary Management Program	Short term
1.2	Install education and information signs (refer Section 8.1.4 and Figure 56)	High	ESC	\$4,000 (assume 2 signs)	ESC, NSW Estuary Management Program	Short term
1.3	Education and awareness program – develop information brochures and distribute to residents, schools and tourist facilities (refer Section 8.1.4)	High	ESC	\$1,000 every 3 years	ESC, NSW Estuary Management Program	Short term
1.4	Ongoing weed removal and revegetation of spit (refer Section 8.1.4 and Figure 56)	Ongoing	ESC	\$15,000 p.a.	LLS, Coastcare, ESC (Note 2)	Ongoing
1.5	Construct viewing platform at a high point on the northern end of the spit (refer Section 8.1.4 and Figure 56)	Medium	ESC	\$50,000	ESC	Medium term
1.6	Monitor and assess the spit profile (by either ground survey or photogrammetry assessment), the success of management measures and/or entrance response following breakthrough (at least every five years)	Ongoing	ESC	\$5,000 every five years	NSW Estuary Management Program, ESC (in kind)	Ongoing
1.7	Undertake a consultative process with community and agency stakeholders to review the status of the spit over time (as required) and develop a management plan if the risk of breakthrough is considered to increase	High	ESC	\$1,000 p.a.	ESC	Ongoing



<b>Strategy 2: River bank rehabilitation</b>						
<b>Action</b>		<b>Priority</b>	<b>Responsible Body</b>	<b>Cost</b>	<b>Potential Funding (Note 1)</b>	<b>Timing</b>
2.1	Scour protection at stormwater outlets: <ul style="list-style-type: none"> <li>Consultation with stakeholders (landowners, NSW Fisheries), design, environmental assessment and Fisheries approvals (if required).</li> <li>Reconstruction of outlet pipe, precast headwall, compaction of sub-grade, foundation preparation, geotextile and rock apron (2m x 2m approximately) of 100 - 300mm nominal diameter rip rap, 300mm thick.</li> </ul>	High	ESC	\$20,000 for 2 sites	ESC	Short term
2.2	Trial mangrove plantings, toe protection and bank revegetation (refer Figure 58)	High	ESC	\$20,000	ESC, NSW Estuary Management Program	Short term
2.3	Extend rock revetment at each end between drainage channels at Jack Buckley Park (refer Figure 59).	Medium	ESC	\$30,000	ESC, NSW Estuary Management Program	Short term
2.4	Bank erosion at kayak camp – formalise access and restore banks (potentially log structure and revegetation).	Medium	ESC and landowner	\$20,000	ESC, NSW Estuary Management Program	Medium term
2.5	Work with landowners to install livestock exclusion fencing, revegetate buffer zone and keep livestock out of fenced areas.	Medium	LLS, private landholder	\$50,000 p.a.	LLS, private landholder (Note 3)	Ongoing
2.6	Monitor extent and severity of bank erosion every 5 years to identify priority areas. Include known existing sites of erosion (refer Figure 16 and Figure 17).	Ongoing	ESC	\$5,000 every 5 years	ESC	Ongoing
2.7	Landholder education about grazing practices	Medium	LLS and landowners	Existing programs	LLS	Ongoing



<b>Strategy 3: Protection of estuarine and foreshore vegetation</b>						
<b>Action</b>		<b>Priority</b>	<b>Responsible Body</b>	<b>Cost</b>	<b>Potential Funding (Note 1)</b>	<b>Timing</b>
3.1	Protection and rehabilitation of Saltmarsh EEC (Tomakin Club) – fencing or bollards (refer Figure 60) and ongoing monitoring of saltmarsh condition	High	ESC, Fisheries NSW	\$2,000	LLS, ESC, NSW Estuary Management Program	Short term
3.2	Protection and rehabilitation of Saltmarsh EEC (north of Mossy Point) - closure of vehicular and horse riding access points, education signage, education of landowners and monitoring of saltmarsh condition	High	ESC, Fisheries NSW	\$3,000	LLS, ESC, NSW Estuary Management Program	Short term
3.3	Prevent access through Saltmarsh EEC (between Tomakin Caravan Park and IGA)	High	Private landholder	\$3,000	LLS, ESC, NSW Estuary Management Program	Short term
3.4	Ongoing regulation of illegal vegetation removal	High	ESC	Included in current programs	ESC	Ongoing
3.5	Education regarding the value of estuarine vegetation and human impacts – develop information brochures and distribute to residents, schools, tourist facilities, hire boat operators. Include on signage to be installed at the spit (Action 1.2).	High	ESC, Fisheries NSW, OEH	Included in current programs	OEH Environmental Education Programs, NSW Estuary Management Program	Ongoing
3.6	Ongoing weed management – removal of noxious weeds from foreshores and revegetation	Ongoing	ESC	\$5,000 p.a.	LLS, Coastcare, ESC, NSW Estuary Management Program (Note 4, 5)	Ongoing
3.7	Update mapping and regular monitoring of location and condition of estuarine vegetation as part of MER program. Monitor migration due to sea level rise.	Ongoing	ESC, OEH	Included in MER program	ESC, NSW Estuary Management Program	Ongoing

<b>Strategy 3: Protection of estuarine and foreshore vegetation</b>						
<b>Action</b>		<b>Priority</b>	<b>Responsible Body</b>	<b>Cost</b>	<b>Potential Funding (Note 1)</b>	<b>Timing</b>
3.8	In consultation with RMS, consider the strategic placement of seagrass markers in the lower estuary.	Medium	ESC, RMS, Fisheries NSW	\$10,000	DPI – Fisheries Habitat Action Program, NSW Estuary Management Program	Medium
<b>Strategy 4: Water quality management</b>						
4.1	Continue implementation of current water quality monitoring program as part of MER program and review of results.	High	ESC	No additional costs	ESC, NSW Estuary Management Program	Ongoing
4.2	Design and implement an event-based monitoring program to assist in identification of potential pollution sources. Considerations for design of the program are discussed in Section 8.4.3.	Medium	ESC	\$15,000	ESC, NSW Estuary Management Program	Short-term
4.3	Based on results of MER program and event-based monitoring (Action 4.2), assess need for water quality improvement measures including drain management and SQUIDs.	Medium	ESC	Not identified	NSW Estuary Management Program	Medium-term
<b>Strategy 5: Management of conflicts between recreational activities and ecological values</b>						
5.1	Upgrade Tomakin boat ramp and car park.	High	ESC	\$77,000	ESC (Note 6)	Short term
5.2	Install fishing platform/boardwalk at Jack Buckley Park (refer Figure 59). Locations and constraints to be considered when funding is available.	Medium	ESC	\$20,000	ESC, DPI – Fisheries Habitat Action Program	Medium term

<b>Monitoring and Review Actions</b>						
<b>Action</b>		<b>Priority</b>	<b>Responsible Body</b>	<b>Cost</b>	<b>Potential Funding (Note 1)</b>	<b>Timing</b>
6.1	Review of CZMP progress: Review and document the implementation progress and effectiveness of the proposed actions as part of Council's annual State of the Environment Reporting	Ongoing	ESC	Included in existing Council reporting	-	Annual
6.2	<p>Ten year review of CZMP: The CZMP and the specified management actions will be reviewed to ensure they are being achieved and are resulting in the desired outcomes. A ten year review (or earlier if warranted by legislative or management changes or improved scientific understanding) of the CZMP will consider:</p> <ul style="list-style-type: none"> <li>Results of the annual reviews (Action 6.1);</li> <li>Any barriers identified to the effective implementation of actions or overall success of actions;</li> <li>Any new or updated scientific knowledge;</li> <li>Data provided by the data collection and monitoring actions (Actions 1.6, 2.6, 3.7, 4.1, 4.2); and</li> <li>Prevailing community attitudes, government policy, strategic planning and estuary management issues.</li> </ul>	High	ESC, OEH	\$50,000	OEH Coastal or Estuary Management Program, ESC	Year 10

## Notes:

1. Refer Appendix 8 for potential grant funding
2. ESC has received funding under the South-east LLS Coastal Wetlands Project to treat Prickly pear, Bitou bush and Asparagus fern on the spit (\$3,850 in 2014/15) to be matched with in-kind contributions from Coastcare. This grant also funds revegetation of 600 plants for the area between the Tomakin boat ramp to the wall at Jack Buckley Park. This is to complement some of the weed control works being conducted by Coastcare under the estuary program. ESC has also received several grants from the NSW Estuary Management Program in previous years.
3. LLS Extension Officers to liaise with landowners and develop projects. Cost allows for fencing, riparian buffer zone vegetation to a width of 40m at each erosion site. Maintenance beyond 3 years is not included.
4. ESC has received funding under the South-east LLS Coastal Wetlands Project which includes revegetation of 600 plants for the area between the Tomakin boat ramp to the wall at Jack Buckley Park. This is to complement some of the weed control works being conducted by Coastcare under the estuary program.
5. ESC has received funding from Crown Lands for control of Weeds of National Significance on Crown tenure along the Tomaga River (\$3,000) with funds matched by ESC Invasive species team.
6. Council has committed funds in the 2014/15 budget





## 9.2 Implementation Program

The recommended management actions have been compiled into a ten year implementation schedule as shown in Table 18 with responsibilities and indicative costs estimated over the ten year implementation period. The total cost of the CZMP implementation is estimated to be approximately \$996,000 over ten years. The actions will be delivered through a combination of Council, State Government and grant funding (where available) and the delivery of the actions may be influenced by the availability of this funding as well as human resources.

Table 18: CZMP Implementation Program

Action / Year (Note 1)		Ten year total (\$'000)	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1.1	Control pedestrian access on spit	15,000	15,000									
1.2	Install educations and information signs on spit	4,000	4,000									
1.3	Education and awareness program - spit erosion	4,000	1,000			1,000			1,000			1,000
1.4	Ongoing weed removal and revegetation of spit (Note 2)	150,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
1.5	Construct viewing platform at the northern end of the spit	50,000				50,000						
1.6	Monitor and assess spit profile and success of management measures	10,000				5,000					5,000	
1.7	Consultative process with community and agency stakeholders and development of a responsive management plan	10,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
2.1	Scour protection at stormwater outlets	20,000	5,000	15,000								
2.2	Trial mangrove plantings, toe protection and bank revegetation	20,000	10,000	10,000								
2.3	Extend rock revetment at each end between drainage channels at Jack Buckley Park	30,000			30,000							
2.4	Bank erosion at kayak camp	20,000			20,000							
2.5	Work with landowners to install livestock exclusion fencing, revegetate buffer zone (Note 3)	500,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
2.6	Monitor extent and severity of bank erosion	10,000					5,000					5,000
2.7	Landholder education about grazing practices	-	Included in current funded programs									
3.1	Protection and rehabilitation of Saltmarsh EEC (Tomakin Club)	2,000	2,000									
3.2	Protection and rehabilitation of Saltmarsh EEC (north of Mossy Point)	3,000	3,000									

Action / Year (Note 1)		Ten year total (\$'000)	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
3.3	Prevent access through Saltmarsh EEC (between Tomakin Caravan Park and IGA)	3,000	3,000									
3.4	Ongoing regulation of illegal vegetation removal	-	Included in current funded programs									
3.5	Education regarding the value of estuarine vegetation and human impacts (Note 4)	-	Included in current funded programs									
3.6	Ongoing weed management (Note 4, 5)	50,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
3.7	Update mapping and regular monitoring of location and condition of estuarine vegetation as part of MER program	-	Included in current funded programs									
3.8	In consultation with RMS, consider the strategic placement of seagrass markers in the lower estuary	10,000						10,000				
4.1	Continue implementation of current water quality monitoring program as part of MER program	-	Included in current funded programs									
4.2	Design and implement an event-based monitoring program to assist in identification of potential pollution sources	15,000			15,000							
4.3	Assess need for water quality improvement measures	-	Not estimated									
5.1	Upgrade Tomakin boat ramp and car park.	-	Included in current funded programs									
5.2	Install fishing platform at Jack Buckley Park	20,000				20,000						
6.1	Annual review of CZMP progress	-	Included in current funded programs									
6.2	Ten year review of CZMP	50,000										50,000
Total		996,000	116,017	98,019	138,021	149,023	78,025	83,027	74,029	73,031	78,033	129,035

## Notes:

- Years correspond to end of financial year i.e. 2016 is Year 1 (start 1st July 2015, end 30th June 2016) etc.
- ESC has received funding under the South-east LLS Coastal Wetlands Project to treat Prickly pear, Bitou bush and Asparagus fern on the spit (\$3,850 in 2014/15) to be matched with in-kind contributions from Coastcare. This grant also funds revegetation of 600 plants for the area between the Tomakin boat ramp to the wall at Jack Buckley Park.
- LLS Extension Officers to liaise with landowners and develop projects. Cost allows for fencing, riparian buffer zone vegetation to a width of 40m at each erosion site. Maintenance beyond 3 years is not included.
- Council has received seven estuary program grants between 2006 and 2014 for Shire-wide initiatives such as environmental education, weed control and river bank revegetation.

5. ESC has received funding from Crown Lands for control of Weeds of National Significance on Crown tenure along the Tomaga River (\$3,000) with funds matched by ESC Invasive species team.



### 9.3 Measures of Success of the CZMP

Success of the CZMP will be indicated by the implementation of substantial measures to address the root cause of issues facing the estuary, as well as conclusive documentation of the effectiveness of such measures. Success of the CZMP will be gauged by:

- Stakeholder acceptance;
- Adoption of the plan by Council;
- Incorporation of the plan recommendations into business planning for the responsible agencies;
- Securing sufficient funds to implement the actions;
- Implementation of actions in an efficient and timely manner;
- Uptake of actions by stakeholders and others;
- Positive stakeholder feedback on improvements; and
- Measured improvements in ecosystem health such as improved water quality.

On-going community involvement will be required to ensure successful implementation of the CZMP. This will include:

- Ongoing consultation with interested and committed community groups;
- A high degree of engagement and collaboration with landholders;
- On-ground participation in management actions, particularly local community groups such as Coastcare and recreational groups;
- Consultation and collaboration with local Aboriginal representatives and groups; and
- Education programs.

Achievement of the management plan objectives is reliant on community understanding and effective involvement in the management process.

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## GLOSSARY AND ABBREVIATIONS

Acid sulphate soils (ASS)	Acid sulfate soils are the common name given to soils containing iron sulphides. In Australia, the acid sulfate soils of most concern are those which formed within the past 10,000 years, after the last major sea level rise. When the iron sulphides are exposed to air and produce sulphuric acid, they are known as actual acid sulfate soils. The soil itself can neutralise some of the sulphuric acid. The remaining acid moves through the soil, acidifying soil water, groundwater and, eventually, surface waters.
AHD	Australian Height Datum is a geodetic datum for altitude measurement in Australia. According to Geoscience Australia, "In 1971 the mean sea level for 1966-1968 was assigned the value of 0.000m on the Australian Height Datum at thirty tide gauges around the coast of the Australian continent".
Amenity	A desirable or useful feature or facility of a building or place
Anoxic	An oxygen-free environment.
Anthropogenic	Any phenomenon caused by human activities.
Bacteriological	Related to bacteria (microorganisms involved with infectious diseases and nitrogen fixation)
Bathymetry	Measurement of water depth in lakes, oceans and seas. In other words, bathymetry is the underwater equivalent to topography.
CAP	Catchment Action Plan
Chlorophyll a	The green pigment in plants used to capture and use energy from sunlight to form organic matter (see photosynthesis). Concentrations of chlorophyll a in the water column are used as an indicator for phytoplankton and benthic algae biomass. It provides a useful proxy indicator of the amount of nutrients incorporated into phytoplankton biomass, because phytoplankton have predictable nutrient-to-chlorophyll ratios.
CZMP	Coastal Zone Management Plan
DECCW	Former (NSW) Department of Environment, Climate Change and Water (now OEH)
Diffuse Source Pollution	Non-point source pollution such as sediment or nutrients from catchment runoff or groundwater inputs.
DPI	(NSW) Department of Primary Industries
Ecology	The interactions between organisms and their environment
Ecosystem	Refers to all the biological and physical parts of a biological unit (e.g. an estuary, forest, or planet) and their interconnections.
EMP	Estuary Management Plan
EPS	Estuary Processes Study
ESC	Eurobodalla Shire Council
Estuarine	Part of the river channel with a mix of fresh water and salt (tidal) water
Foreshore	That part of the shore that lies between the mean high tide mark and the mean low tide mark
Hydrodynamics	The motion of a fluid and interactions with its boundaries
Hydrographic	Refers to topographic/bathymetric features of a water body (depth and morphology)
Hydrology	The study of water and its properties, including precipitation onto land and returning to oceans
LEP	Local Environmental Plan
MER	NSW Natural Resources Monitoring, Evaluation and Reporting Strategy
NPWS	National Parks and Wildlife Service
SRCMA	Southern Rivers Catchment Management Authority
OEH	Office of Environment and Heritage



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Physico-chemical	Physical properties dependent on and influencing chemical structure, properties and reactions
Point Source Pollution	A single point of pollutant discharge. For example, effluent from a sewage treatment plant.
Reticulated Sewage System	Sewage piped to a centralised sewage treatment plant for treatment and disposal.
Riparian	Of, on or relating to the banks of a watercourse
Salinity	The level of salt dissolved in the water
Sand shoal	A shallow sand bank or sand bar
Sedimentation	The deposition or accumulation of sediment
SEPP	State Environmental Planning Policy
SQIDs	Stormwater Quality Improvement Devices
STP	Sewage Treatment Plant. Raw sewage is collected from homes and businesses and transported via a network of pipes and pump stations to the sewage treatment plant, a centralised system for treatment and disposal.
Still Water Level	The level of the sea with motions such as wind waves averaged out—averaged over a period of time such that changes in sea level, e.g., due to the tides, also get averaged out.
Terrestrial	Living or growing on land (not aquatic)
Turbidity	A measure of the amount of light-attenuating particles in a water body.



## Appendix 1: Minimum Requirements of the CZMP Guidelines (OEH, 2013a)





Coastal councils are required to prepare draft plans in accordance with the CZMP guidelines adopted by the Minister for the Environment under section 55D of the Coastal Protection Act 1979 (OEH, 2013a). The Guidelines specify the minimum requirements that are to be met when preparing a draft CZMP, in addition to the requirements in the Act. The minimum requirements in the guidelines relate to:

- Preparation of the CZMP;
- Coastal risk management;
- Coastal ecosystem health; and
- Community uses of the coastal zone.

The following tables summarise the minimum requirements and how they have been met in this CZMP and other related planning processes.

**Table 19: Minimum Requirements: CZMP planning process content and outcomes**

Minimum Requirement	Reference
CZMPs are to contain a description of:	
• how the relevant Coastal Management Principles have been considered in preparing the plan	Table 20, below.
• the community and stakeholder consultation process, the key issues raised and how they have been considered	Section 5 and Appendix 3, Draft EMS (Volume 2)
• how the proposed management options were identified, the process followed to evaluate management options, and the outcomes of the process	Section 8
CZMPs are to contain proposed management actions over the CZMP's implementation period in a prioritised implementation schedule which contains:	
• proposed funding arrangements for all actions, including any private sector funding	Section 9
• actions to be implemented through other statutory plans and processes	Sections 1.3, 1.5 and 8
• actions to be carried out by a public authority or relating to land or other assets it owns or manages, where the authority has agreed to these actions (section 55C(2) (b) of the Coastal Protection Act 1979).	Section 8 and 9
• proposed actions to monitor and report to the community on the plan's implementation, and a review timetable.	Section 9
CZMPs are to be prepared using a process that includes:	
• evaluating potential management options by considering social, economic and environmental factors, to identify realistic and affordable actions	Section 8
• consulting with the local community and other relevant stakeholders. The minimum consultation requirement is to publicly exhibit a draft plan for not less than 21 days, with notice of the exhibition arrangements included in a local newspaper (section 55E of the Coastal Protection Act 1979)	Section 3
• considering all submissions made during the consultation period. The draft plan may be amended as a result of these submissions (section 55F of the Coastal Protection Act 1979).	Section 3
CZMPs are to achieve a reasonable balance between any potentially conflicting uses of the coastal zone.	Strategy 5

Coastal Management Principles have been developed to inform strategic considerations in coastal management, including the preparation of CZMPs. The Principles have been considered in the evaluation of the coastal management actions documented in this CZMP as discussed below.

**Table 20: Coastal Management Principles addressed by the CZMP for the Tomaga River Estuary**

Principle		Reference
1	Consider the objects of the Coastal Protection Act 1979 and the goals, objectives and principles of the NSW Coastal Policy 1997	Sections 1.3 and 1.5
2	Optimise links between plans relating to the management of the coastal zone	Sections 1.3 and 1.5
3	Involve the community in decision-making and make coastal information publicly available	Section 3
4	Base decisions on the best available information and reasonable practice; acknowledge the interrelationship between catchment, estuarine and coastal processes; adopt a continuous improvement management approach	Sections 4, 5 and 6
5	The priority for public expenditure is public benefit; public expenditure should cost-effectively achieve the best practical long-term outcomes	Section 8 and 9
6	Adopt a risk management approach to managing risks to public safety and assets; adopt a risk management hierarchy involving avoiding risks where feasible and mitigation where risks cannot be reasonably avoided; adopt interim actions to manage high risks while long-term options are implemented	Sections 6, 8 and 9
7	Adopt an adaptive risk management approach if risks are expected to increase over time, or to accommodate uncertainty in risk predictions	Sections 6, 8 and 9
8	Maintain the condition of high value coastal ecosystems; rehabilitate priority degraded coastal ecosystems	Sections 5 and 6
9	Maintain and improve safe public access to beaches and headlands consistent with the goals of the NSW Coastal Policy	Section 7
10	Support recreational activities consistent with the goals of the NSW Coastal Policy	Section 7

**Table 21: Minimum Requirements for Coastal Risks (OEH, 2013a)**

Minimum Requirement	Reference
A CZMP which addresses coastal risks should include:	
<p>A description of:</p> <ul style="list-style-type: none"> <li>coastal processes within the plan's area, to a level of detail sufficient to inform decision-making</li> <li>the nature and extent of risks to public safety and built assets from coastal hazards</li> <li>projected climate change impacts on risks from coastal hazards (section 55C(f) of the Coastal Protection Act 1979). based on council's adopted sea level rise projections or range of projections. Councils should consider adopting projections that are widely accepted by competent scientific opinion</li> <li>suitable locations where landowners could construct coastal protection works (provided they pay for the maintenance of the works and manage any offsite impacts), subject to the requirements of the Environmental Planning and Assessment Act 1979, and</li> <li>property risk and response categories for all properties located in coastal hazard areas</li> </ul>	Coastal Risk Management components are being addressed in Council's shire-wide CZMP and Tomaga flood study (under preparation)
Proposed actions in the implementation schedule to manage current and projected future risks from coastal hazards, including risks in an estuary from coastal hazards. Actions are to focus on managing the highest risks (section 55C(d) and (e) of the <i>Coastal Protection Act 1979</i> )	
Where the plan proposes the construction of coastal protection works (other than emergency coastal protection works) that are to be funded by the council or a private landowner or both, the proposed arrangements for the adequate maintenance of the works and for managing associated impacts of such works (section 55C(g) of the <i>Coastal Protection Act 1979</i> )	
<p>An emergency action subplan, which is to describe:</p> <ul style="list-style-type: none"> <li>intended emergency actions to be carried out during periods of beach erosion such as coastal protection works for property or asset protection, other than matters dealt with in any plan made under the State Emergency and Rescue Management Act 1989 relating to emergency response (sections 55C(b) and (g) of the Coastal Protection Act 1979)</li> <li>any site-specific requirements for landowner emergency coastal protection works, and</li> <li>the consultation carried out with the owners of land affected by a subplan.</li> </ul>	

**Table 22: Minimum Requirements for Coastal Ecosystems (OEH, 2013a)**

Minimum Requirement	Reference
A CZMP which addresses coastal ecosystem management is to include:	
<p>A description of:</p> <ul style="list-style-type: none"> <li>the health status of estuaries within the plan's area</li> <li>the pressures affecting estuary health status and their relative magnitude</li> <li>projected climate change impacts on estuary health (section 55C(f) of the <i>Coastal Protection Act 1979</i>), based on council's adopted sea level rise projections or range of projections.</li> </ul>	Section 6

Minimum Requirement	Reference
Proposed actions in the implementation schedule to respond to estuary health pressures (section 55C(e) of the <i>Coastal Protection Act 1979</i> )	Section 8
An entrance management policy for intermittently closed and open lakes and lagoons (ICOLLS)	No ICOLLS in Tomaga River Estuary
An estuarine monitoring program, consistent with the NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy.	Section 8

**Table 23: Minimum Requirements for Community Uses (OEH, 2013a)**

Minimum Requirement	Reference
CZMPs are to contain:	
Proposed actions in the implementation schedule that protect and preserve beach environments and beach amenity, and ensure continuing and undiminished public access to beaches, headlands and waterways, particularly where public access is threatened or affected by accretion (section 55C(c) of the <i>Coastal Protection Act 1979</i> )	Section 8
A description of: <ul style="list-style-type: none"> <li>the current access arrangements to beaches, headlands and waterways in the plan's area, their adequacy and any associated environmental impacts,</li> <li>any potential impacts (e.g. erosion, accretion or inundation) on these access arrangements, and</li> <li>the cultural and heritage significance of the plan's area.</li> </ul>	Section 7
Proposed actions in the implementation schedule to manage any environmental or safety impacts from current access arrangements, and to protect or promote the culture and heritage environment	Section 8



## Appendix 2: Review of Other Related Management Plans

*This Appendix summarises the relevant guidelines and management plans developed since the 2005 EMP.*



### ***Eurobodalla Shire Council Local Environmental Plan***

The Eurobodalla Local Environmental Plan (LEP) 2012 aims to make local environmental planning provisions for land in Eurobodalla in accordance with the relevant standard environmental planning instrument under section 33A of the *Environmental Planning and Assessment Act, 1979*. This environmental planning instrument applies to most land in the Eurobodalla Shire and spells out where different types of development may be allowed to happen. Some land is identified as “deferred matter” and is under review by the Minister for Planning and Infrastructure. These areas are still subject to the Eurobodalla Rural LEP 1987 and Eurobodalla Urban LEP 1999.

The Rural Land Strategy Steering Committee was formed to help prepare a rural strategy encompassing all rural lands including the question of land previously proposed to be zoned E3. This zoning was deferred at the time the Minister signed off on the new Local Environment Plan for the Eurobodalla Shire in July 2012.

### ***Eurobodalla Community Strategic Plan***

The Community Strategic Plan ‘one community’ identifies the community’s main priorities and aspirations for the future, and to plan strategies for achieving these goals. In doing this, the planning process considers the issues and pressures that may affect the community, and the level of resources that will realistically be available to achieve its aspirations. Objectives that are relevant to this CZMP are given below.

## **OBJECTIVE 3: OUR COMMUNITY AND ENVIRONMENT ARE IN HARMONY**

**We respect and value our natural environment, understand the effects of our actions and make wise decisions to retain balance.**

How will we get there?

### **3.1 Encourage respectful planning, balanced growth and good design**

### **3.2 Respond to our changing environment**

### **3.3 Value, protect and enhance our natural environment**

#### **Council Role**

- Undertake invasive species programs
- Manage growth and development
- Ensure planning is responsive to the environment and community needs
- Encourage sustainable development
- Plan for the impacts of climate change
- Undertake bush and wetland regeneration
- Provide for conservation of endangered ecological communities and threatened species
- Support Landcare volunteers
- Deliver environment education programs
- Support local emergency services
- Undertake bushfire hazard reduction

#### **Community Role**

- Be active in commenting on new development
- Get involved in activities and events that assist to protect the environment
- Take ownership of our natural environment.
- Retain vegetation on private property
- Dispose of garden waste carefully
- Plant a tree
- Know what to do in an emergency

### ***Batemans Marine Park Operational Plan and Zoning Plan***

Batemans Marine Park was declared on 7 April 2006 and its zoning plan came into effect on 30 June 2007. The marine park is located on the south coast of New South Wales from the most northerly point of Murramarang Beach near Bawley Point to the southern side of Wallaga Lake entrance at Murunna Point. The marine park covers an area of approximately 85,000 hectares and extends from the three nautical mile

offshore limit of NSW waters to mean high water mark within all rivers, estuaries, bays, lagoons and inlets, and saline and brackish coastal lakes (excluding Nargal Lake).

The Batemans Marine Park Operational Plan details management actions being undertaken by the Marine Parks Authority. These actions focus on meeting key objectives related to conservation of marine biodiversity, as well as provision of opportunities for ecologically sustainable use, public appreciation, enjoyment and understanding of the marine park. The operational plan has also been developed in consultation with the Batemans Marine Park Advisory Committee as required by the *Marine Parks Act 1997*.

Marine park objectives and management actions have been organised under the following strategies:

- Identification and adaptive management of threats to marine biodiversity and habitats;
- Protection of high conservation areas and threatened species;
- Assessing developments in and affecting the marine park to minimise impacts;
- Maximising voluntary compliance with the marine park zoning plan;
- Ecologically sustainable management of commercial activities;
- Delivering an ecological, social and economic research and monitoring program;
- Promotion of sustainable tourism and recreational uses, as well as facilitation of a greater appreciation of marine biodiversity; and
- Ensuring management is consistent with the cultural aspirations of Aboriginal people.

The Batemans Marine Park Operational Plan is consistent with and supports the Batemans Marine Park Zoning Plan, which is a regulation that sets out the range of activities that can be undertaken within different areas of the marine park. The Batemans Marine Park Zoning Plan commenced on 30 June 2007 and forms part of the *Marine Parks (Zoning Plans) Regulation 1999*.

The Tomaga River is a Habitat Protection Zone (Figure 67). Most recreational activities are allowed in habitat protection zones, but some restrictions apply to the collection of bait and catching of sharks, rays etc. Limited commercial fishing is permitted in habitat protection zones, but no seine netting, set lines or drift lines. This zoning also influences developments within the marine park (e.g. wharfs, boat ramps) to ensure they concur with the objects of the zone and minimise impacts to key habitats. The provisions of the existing Recreational Fishing Haven in the Tomaga River continue to apply, including allowed use of recreational haul nets that are prohibited in other habitat protection zones. The zoning plan provides a list of fish species that may be taken in habitat protection zones.

Consent may be granted by permit to carry out certain activities that are otherwise prohibited in a marine park or a specific zone, including commercial activities. The circumstances in which consent may be granted are set out in the *Marine Parks (Zoning Plans) Regulation 1999* and the process for applying for consent is included in the *Marine Parks Regulation 2009*. Consistent with the policy, specific conditions can be applied to permitted activities to ensure they are ecologically sustainable and do not unduly impact on the enjoyment of other park users.

In respect to development proposals, the Marine Parks Act (sections 19 and 20) requires that authorities must take into consideration the objects of the Act, permissible uses and the advice from the MPA when consenting and determining development proposals within and in the locality of a marine park. These provisions not only give the MPA powers to influence developments that occur within the boundaries of a marine park, but also to provide comment on developments in the locality of a marine park. Planning approvals in marine parks may be subject to local councils or state government determining authorities or both. Most often, development approvals within marine parks require determination by the NSW Land and Property Management Authority (Crown lands) in consultation with the Marine Parks Authority.





**Figure 67: Map highlighting the zones in the Batemans Marine Park from Moruya to Batemans Bay**

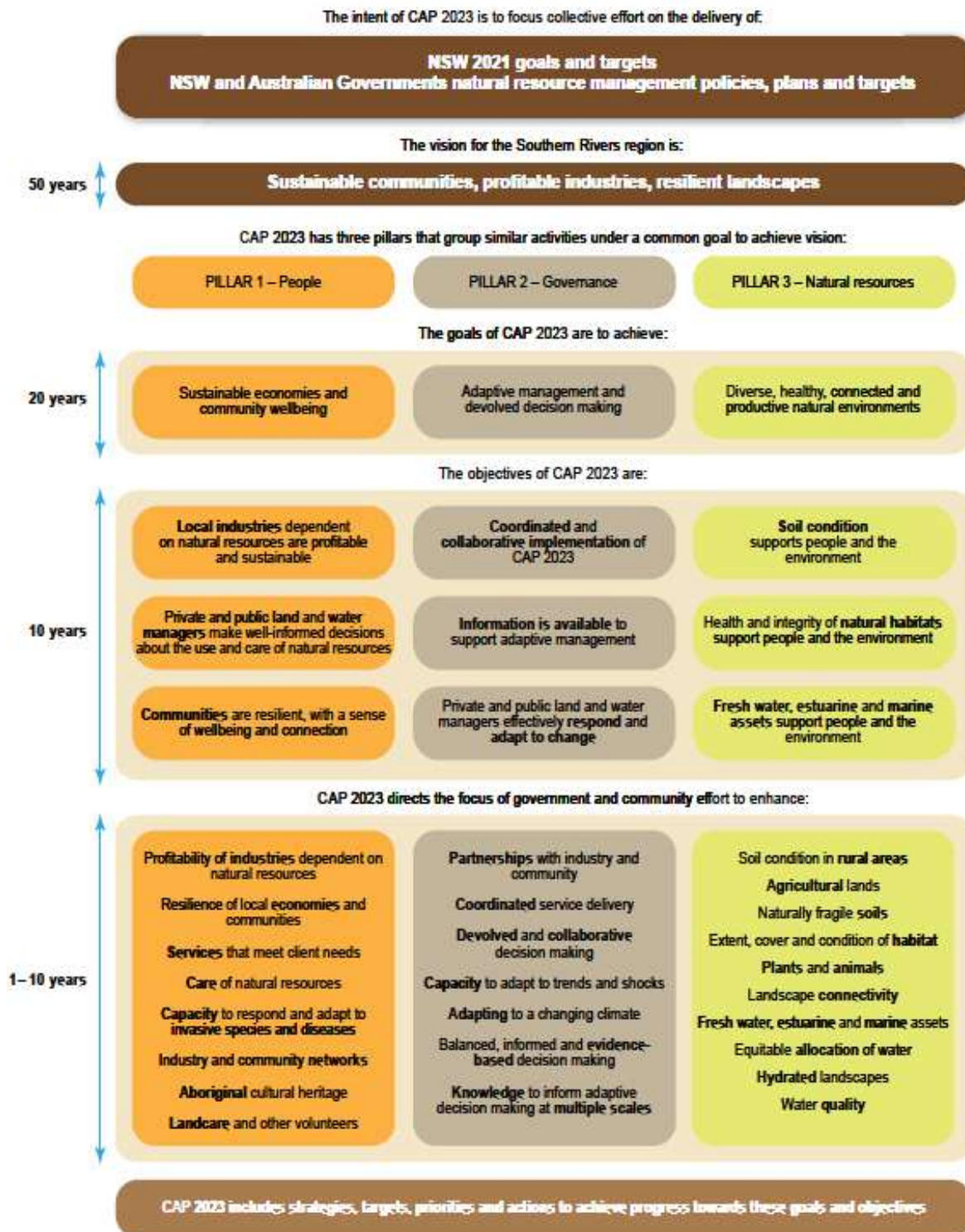
Source: Marine Parks Authority (2010)

### **Southern Rivers CMA Catchment Action Plan**

Catchment Action Plans are statutory, non-regulatory plans under the *Catchment Management Authorities Act 2003*. The Southern Rivers CAP 2023 is a 10-year strategic plan that identifies the priorities and actions for natural resource management in the region. It provides direction for collaborative action and investment by government, community and industry partners. The plan is defined by three pillars – people, governance and natural resources – each with a goal, objectives and targets that set strategic direction and key performance measures for each pillar. Also included are the strategies, priorities and actions required to affect the greatest change (refer Figure 68).

Southern Rivers CMA has adopted a landscape based approach to service delivery. Each of the three landscapes of the Southern Rivers region is defined by its unique combination of social, economic and ecological characteristics (e.g. landform, land use and social structures). Tomaga River Estuary is in the Far South Coast region.

During 2013/14, the SRCMA transitioned to the South East Local Land Services (LLS) Board. From January 2014, Local Land Services will deliver functions currently provided by Catchment Management Authorities (CMAs), Livestock Health & Pest Authorities (LHPAs) and advisory services of Agriculture NSW (part of the Department of Primary Industries). At the commencement of Local Land Services, CAP 2023 will be reviewed to align the strategy to the final regional boundaries, to ensure the full range of services are included in CAP 2023 and to review implementation partners.



**Figure 68: CAP 2023 Strategic Directions**

Source: SRCMA, 2013

Four key investment programs have been developed by South East LLS:

#### 1. Landholder and Community Resilience Program

The objectives of this program are to deliver a clearly defined level of service and support for landholders and groups across the region, providing front line agriculture and natural resource management services. This program recognises the need for LLS to be able to demonstrate that they have been able to provide effective support to those landholders, groups and partners who seek advice to improve their management

of land and water resources. Services will be delivered across the region to ratepayers, Landcare and Aboriginal community groups and other partners, and includes the provision of native vegetation extension services.

This program primarily implements targets in Pillar 1 of Southern Rivers CAP, with a focus on building the knowledge and skills of landholders and community on their use and care of natural resources.

## *2. Profitable and Sustainable Farming Program*

The objectives of this program are to deliver services to priority primary industries, services that support the implementation of practices that increase the profitability and sustainability of industries and enterprises. This program recognises the need for LLS to be able to achieve and demonstrate successful delivery of services to key industry partners, and demonstrate effective commitment and support to the \$200M food and fibre economy of the region.

Services will be negotiated with industry partners and delivered at the enterprise scale, tailored to meet the needs of each industry and enterprise. The priority industries are grazing, dairy and aquaculture, with a focus on meeting the whole of enterprise needs of those industries.

This program primarily implements targets in Pillar 1 of Southern Rivers CAP, but also supports the achievement of Pillar 3 targets.

## *3. Resilient Land and Seascapes Program*

The objectives of this program are to deliver services that achieve strategic and landscape scale changes to the condition of priority natural resource assets. This program recognises the need for LLS to be able to clearly demonstrate that natural resource management investments are well targeted, achieve results and demonstrate an efficient use of public monies.

This program primarily implements targets in Pillar 3 of Southern Rivers CAP, with strong demonstration on how these investment support community and economic outcomes, particularly supporting the \$1.5b pa nature based tourism economy of the region.

## *4. Adaptive Management and Governance Program*

The objectives of this program are build and sustain the core infrastructure and decision making processes that will underpin effective governance and enable adaptive management to be fully integrated into program delivery. This recognises the need that the LLS will be required to demonstrate: the application of evidence based decision-making; □ open, transparent and balanced decision making; efficient client servicing; and report on the achievement of outcomes.

This program primarily implements targets in Pillar 2 of Southern Rivers CAP, as well as meeting key organisational priorities such as communications and internal capacity.

## **Sea Level Rise Strategic Planning**

### *NSW Government policy and guidelines*

In 2009 the NSW Government issued the *NSW Sea Level Policy Statement* and the *Draft Sea Level Rise Planning Guidelines*. These acknowledged that increased sea levels will have significant long-term social, economic and environmental impacts. The policy stated that sea level rise will have medium to long-term impacts and cited that national and international projections of sea level rise along the NSW coast are for a rise of 40cm by 2050 and 90 cm by 2100 (relative to 1990 levels). The policy statement set these levels as benchmarks for councils across the state to use in their planning instruments and processes to assess development applications.

In February 2013, the NSW Government commenced Stage 1 of the NSW Coastal Reforms which included a significant change in their policy position on sea level rise. Underpinning these reforms was the decision to rescind the 2009 NSW Sea Level Policy Statement in September 2012. From this time, the NSW

Government no longer recommended state-wide sea level rise projections. Instead it decided to provide information on available sea level rise projections to assist councils to develop projections relevant to their local area. The NSW Government also began investigating options to provide councils with access to expert advice.

Stage 2 reforms will include:

- Establishing a simpler and more integrated legal and policy framework for coastal management;
- Providing improved guidance and technical advice to councils, while enabling and supporting local decision making; and
- Identifying potential funding options, particularly to implement coastal asset management strategies.

#### *Council Sea Level Rise Planning Policy Response*

In February 2010, and following the NSW Government guidelines, ESC began an extensive community information process to address how to incorporate sea level rise in Council planning instruments. This led to the preparation of a draft Interim Sea Level Rise Adaptation Policy for Council and in July 2010, after considering submissions, legal advice and the NSW Government's guidelines, Council adopted the Interim Sea Level Rise Adaptation Policy as a temporary measure until the full scope of hazards and risk associated with sea level rise were identified through the preparation of a Coastal Zone Management Plan (discussed below). The interim policy's objective is to provide guidance to Council on how the Sea Level Rise threat will be considered and managed to give certainty to landowners, transparency, and to ensure Council's assessment of development applications is consistent.

In June 2013, legal advisers gave a presentation to Eurobodalla Shire councillors on the legal issue of sea level rise. Councillors were advised that the Council had a duty in a number of areas of law to consider climate change, particularly in the area of planning law and that there was a legal obligation for Council to consider sea level rise. The advice went on to say that ESC must rely on the best competent science available and at present that would be the former NSW Government benchmarks which are currently used by Council.

The South Coast Regional Sea Level Rise Planning and Policy Response project is a regional partnership between Eurobodalla Shire Council and Shoalhaven City Council. It will prepare a regional policy and planning response on appropriate benchmarks and guidelines on how to consider sea level rise and fill the gap provided by the NSW Government when it abolished the NSW *Sea Level Rise Policy Statement* in 2012.

The regional approach is supported financially with contributions from both councils and a grant from the NSW Coastal Management Program administered by the Office of Environment and Heritage (OEH). OEH is a funding and technical partner in the project and has a mandate from the Minister to assist local councils with the determination of sea level rise planning considerations.

The aim of this project is to inform the progress of coastal and flood risk management studies and associated land use planning and development controls in the Shoalhaven and Eurobodalla LGAs through:

- The provision of sea level rise projections under conditions of climate change; and
- The development of a risk assessment and policy response framework to future sea level rise.

ESC and Shoalhaven City Council have recently released a Draft *South Coast Regional Sea Level Rise Policy and Planning Framework* (Exhibition Draft, Whitehead & Associates, 2014) which provides recommendations for sea level rise application in the region. The draft Policy provides a review of the new scientific evidence including the new Assessment Report 5 (AR5) from the Intergovernmental Panel for Climate Change (IPCC). In AR5, four Representative Concentration Pathway (RCP) scenarios were adopted. These are prescribed pathways for atmospheric greenhouse gas and aerosol concentrations, together with land use changes. The draft Policy recommends the RCP8.5 projection is used as the basis for decision-making in the Eurobodalla and Shoalhaven regions. RCP8.5 is characterised by increasing



greenhouse gas emissions over time, leading to high concentration levels and a failure to curb warming by 2100 with more or less unabated emissions. This is representative of the “high range” of scenarios that assume no effective policy is adopted to stabilise or reduce global emissions by 2100. In addition, in the absence of detailed, rigorous and justifiable site specific risk assessments, the “High” projection line (with ~ 15% probability of exceedance) has been recommended for adoption for coastal management and planning at present (Whitehead & Associates, 2014).

A comparison between the RCP8.5 scenario and the “benchmark” values from the previous State government sea-level rise policy is provided in Table 24. This policy is yet to be adopted by ESC.

**Table 24: Comparison of Sea Level Rise Projections Recommended in the Draft South Coast Regional Sea Level Rise Policy**

Time	Local Sea-level Rise Projection Based on RCP 8.5 (in metres) <sup>1</sup>			Previous State Policy (approx.) <sup>3</sup>
	Low <sup>2</sup>	Medium <sup>2</sup>	High <sup>2</sup>	
2015	0.00	0.00	0.00	0.0 <sup>1</sup>
2030	0.06	0.07	0.10	
2050	0.16	0.20	0.26	0.35 <sup>1</sup>
2070	0.29	0.39	0.50	
2100	0.53	0.74	0.98	0.85 <sup>1</sup>

<sup>1</sup>Values adjusted by subtracting 50mm to account for apparent rise at Fort Denison between 1990 and the beginning of 2014.

<sup>2</sup>In the absence of detailed, rigorous and justifiable site specific risk assessment which uses all three sets of values, the “High” projection values (with ~ 15% probability of exceedance) are recommended for coastal management and planning, providing that ongoing review of available science and water level data is undertaken to enable adaptation of the approach in future.

<sup>3</sup>To obtain the absolute projected mean sea level elevation relative to AHD, a further 0.08 metres would need to be added to these values.

Source: Whitehead & Associates (2014)

Historically, sea-level rise has been incorporated in a way which ties a given amount of sea level rise to a certain point in time. For example, common practice using the previous state government benchmarks would relate a 0.4m sea-level rise (relative to 1990) to the year 2050 and a 0.9m sea-level rise to the year 2100. The draft policy recognises the uncertainty in the time frames at which a particular rise in sea level would be reached but accepts that sea level will continue to rise at accelerating rates (Whitehead & Associates, 2014). In the draft policy, strategic planning strategies are proposed for coastal hazard planning areas (to be determined as part of the shire-wide CZMP). For waterway access and impacts on estuarine vegetation, the Strategic Planning Hazard Response: Plan and Monitor, covering a period of 35 to 85 years from now has been applied to this CZMP. The relevant high sea level rise projection is 0.98 m relative to the beginning of 2015. With this strategy the policy states that rezoning to enable development is allowed, but steps must be taken to ensure that any long-term land use is fully adaptable to future sea-level rise. Council may choose to inform existing land owners of the future potential for exposure to sea-level rise in this area. However, it is not considered necessary to inform these land owners of a time frame more specific than “more than 35 years” (Whitehead & Associates, 2014).

### **ESC Coastal Zone Management Plan**

Coastal Zone Management planning studies commenced in 2011, with a focus on ten priority Batemans Bay beaches. Baseline assessments of Eurobodalla’s other beaches commenced in November 2012. The

development of a shire-wide CZMP was put on hold while ESC developed its Sea Level Rise Planning Policy Response (discussed above).

### ***On Site Sewage Management Code of Practice***

The purpose of the Code of Practice is to ensure that On-Site Sewage Management Systems meet best practice environmental and health performance standards and provide a sustainable option for wastewater management. ESC developed an OSMS Management Plan in 1998 and implemented it in 1999. The aim of this Code of Practice is to offer guidance in preparing applications to Council, clarify what is required and how to apply the various related documents, and to describe how systems will continue to be monitored once installed.

### ***Acid Sulfate Soils Policy***

This policy is designed to prevent and minimise the environmental consequences caused by the exposure of potentially acid sulfate soils. The policy aims to:

- Promote an integrated framework for dealing with acid sulfate soils;
- Ensure consistency and fairness in the manner in which the Council deals with acid sulfate soils;
- Ensure compliance with legislative requirements under the Environmental Planning and Assessment Act 1979;
- Take such steps as are appropriate to ensure that the environmental consequences caused by the exposure of potentially acid sulfate soils are minimised; and
- Make Council's policies and requirements for acid sulfate soils readily accessible and understandable to the public.

### ***Oyster Industry Sustainable Aquaculture Strategy***

The NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS, DPI, 2014):

- Identifies those areas within NSW estuaries where oyster aquaculture is a suitable and priority outcome;
- Secures resource access rights for present and future oyster farmers throughout NSW;
- Documents and promotes environmental, social and economic best practice for NSW oyster farming and ensures that the principles of ecological sustainable development, community expectations and the needs of other user groups are integrated into the management and operation of the NSW oyster industry;
- Formalises industry's commitment to environmental sustainable practices and a duty of care for the environment in which the industry is located;
- Provides a framework for the operation and development of a viable and sustainable NSW oyster aquaculture industry with a clear approval regime and up-front certainty for existing industry participants, new industry entrants, the community and decision makers;
- Identifies the key water quality parameters necessary for sustainable oyster aquaculture and establishes a mechanism to maintain and where possible improve the environmental conditions required for sustainable oyster production; and
- Ensures that the water quality requirements for oyster growing are considered in the State's land and water management and strategic planning framework.

The strategy has been developed by the NSW government in partnership with the NSW oyster aquaculture industry and local community and other key stakeholders. The strategy sets out best practice in the

identification and use by the oyster aquaculture industry of those estuarine areas suitable as priority oyster aquaculture areas and provides for the protection of water quality in these areas.

The OISAS is as an Aquaculture Industry Development Plan for the purpose of s.143 of the Fisheries Management Act, 1994. State Environmental Planning Policy 62 – Sustainable Aquaculture gives effect to planning provisions for oyster aquaculture.








### Appendix 3: Status of 2005 Estuary Management Plan actions

A summary of the status of actions from the 2005 Plan is given in Table 25, with photographs (taken 28-29 May 2014). Actions that have been undertaken are displayed on Figure 2, page 7.



Table 25: Review of Actions from 2005 EMP

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
<i>Objective 1: Manage the spit to minimise likelihood of breakthrough and to minimise impact on users and the environment if breakthrough does occur</i>								
7.5.1	Reduce pedestrian traffic on the spit. Sand renourishment, fencing and replanting of blowout areas.	ESC	High	Fencing has been installed along dune crest and base of dune on ocean and river sides. Terrace of coir logs installed on dune face on river side. Some signage installed to direct pedestrians away from dune areas. Weed removal and some revegetation have been successful.	Fencing has been replaced as dune recedes. Some signage has been removed. Locations of works to be reviewed to improve outcomes. Revegetation methodology to be reviewed.	Minor	High - Community wants to continue erosion protection works	ESC
<div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>A</p> </div> <div style="text-align: center;">  <p>B</p> </div> <div style="text-align: center;">  <p>C</p> </div> </div> <p><b>Figure 69: Fencing installed at Tomakin spit (river side, A – C: north to south)</b></p>								

Action (Option no. from 2005 EMP)	Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
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A



B



C

**Figure 70: A - Signage installed at Tomakin spit, B – fencing on ocean side and dune crest (looking south), C – fencing on ocean side looking north**



A



B



C

**Figure 71: Coir log terrace, original fence and revegetation at Tomakin Spit**

Source: D. Wiecek, OEH



Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
7.2.3	Allow breakthrough, maintain main entrance. If breakthrough occurs either the old or new channel may take main flow; be flexible as to which to maintain based on natural processes. May require minor dredging to maintain navigability and access to Mossy Point boat ramp.	ESC	High	Breakthrough has not occurred since 2005.	Majority of community do not favour hard engineering solutions (e.g. rock walls) to stabilise dune.	Unknown	High - Consider dune protection options but likely to be similar management approach.	ESC
<i>Objective 2: Moderate erosion of reclaimed land at Jack Buckley Memorial Park</i>								
7.3.1	Toe protection using timber logs	ESC, OEH	Medium	Logs were not chosen as method of protecting toe of bank, with a rock wall being the preferred option. Rock revetment part funded by OEH.	Some erosion at each end of rock works still needs to be addressed.	-	-	ESC
7.3.2	Control runoff through trenching, infiltration bed and planting with coarse grasses etc.	ESC	Medium	Detailed evaluation revealed that planting alone is the most appropriate way to address the runoff. Coarse grasses planted behind wall (refer Figure 72).	Trees have been poisoned. Revegetation should focus on weed management and low-level species to maintain views.	Minor	Completed (trenching and infiltration bed not progressed)	-

Action  (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
Objective 3: Moderate erosion due to stream meandering								
7.4.1	Jack Buckley Memorial Park channel stabilisation through trenching to construct toe, placement of stones/ rock revetment wall. 300 metre wall.	ESC	Low	Refer 7.3.1	Consider continuing rock wall to the north and south (refer Figure 72c). Community wants jetty access for fishing (e.g. for elderly).	Unknown	-	ESC



**Figure 72: A and B – Rock wall bordering Jack Buckley Park, C – upstream end of rock wall**

<b>Action</b> (Option no. from 2005 EMP)		<b>Responsible Body (2005 EMP)</b>	<b>Priority (2005 EMP)</b>	<b>Outcome of Action</b>	<b>Comments</b>	<b>Cost (if applicable)</b>	<b>Priority (2014)</b>	<b>Responsible Body (2014)</b>
7.4.2	Bank protection near George Bass Drive bridge with rock wall, gabion or riprap top. 200 metre wall. Stairs to access beach	ESC	Low	Bank protection works (rock revetment) was undertaken by Roads and Maritime Services upstream of the bridge but not 200m length. Stairs not installed (refer 7.5.2).	Short (140m) area of moderate erosion still present upstream of bridge is vegetated and requires monitoring.  Severe erosion downstream of bridge still present.	Medium	High (currently assessed as moderate erosion)	ESC
7.4.3	Bank protection from Jack Buckley Memorial Park to Tomakin boat ramp. Grading and stabilisation of bank with either rock wall, dumped stone, large logs or gabion mattresses. Replanting exposed bank.	ESC	Low	Rock wall and grading of bank considered to be too expensive and intrusive. Coastcare revegetation work has been undertaken here (Figure 74c).	Consider alternative methods such as wave barrier and planting of mangrove seeds/seedlings in combination with riparian revegetation. Need to maintain access points (currently stairs and log path).	Medium	High (currently assessed as moderate erosion)	ESC

Action (Option no. from 2005 EMP)	Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
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**Figure 73: Bank in front of properties on Sunpatch Parade (west). A – Path access, B - Stair access, C - Coastcare plantings**



**Figure 74: Bank in front of properties on Sunpatch Parade (west) D and E – northern end near Jack Buckley Park**



Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
<i>Objective 4: Protect foreshore habitat</i>								
7.5.1	Reduce pedestrian traffic on the spit (as per Objective 1). Establish board walk and steps as new access from river to beach	ESC	High	Refer Objective 1.	Signage provided for beach access. Additional control of pedestrian access is required.	Low	High	ESC
7.5.2	Provide access to low tide beach near George Bass Drive with steps	ESC	Medium	Not implemented due to high capital and maintenance cost and low use for swimming.	Not required.	-	-	-
7.5.3	Control livestock access to foreshores and wetlands through removal of livestock and fencing	ESC, NSW Fisheries	High	Fisheries NSW/Crown Lands project included livestock exclusion fencing and review of crown grazing leases in upper estuary. Some buffer zones are fenced but still actively grazed.	Consider additional locations for livestock exclusion, revegetation of buffer zones and follow-up work with landholders to keep stock out of fenced-off areas.	Medium	High	LLS, ESC

Action (Option no. from 2005 EMP)	Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
A							
B							
C							

**Figure 75: A and B – Livestock still actively grazing within fenced buffer zone, C – Mogo Zoo animal fencing**

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
7.5.4	Restore riparian vegetation: terminate Crown grazing leases along banks, exclude livestock, fencing, replanting, weed and pest control	ESC, DPI-Crown Lands	High	Refer 7.5.3 above.	-	-	-	-
7.5.5	Monitor and protect intertidal wetlands with survey and photographic records on 3-5 year cycle	ESC, NSW Fisheries, OEH	Medium	Macrophyte mapping undertaken in 2006 and 2012 and reported on Ecosystem Health report cards.	Continue review and report cards as part of MER program.	Low	High	ESC, OEH
<i>Objective 5: Maintain acceptable nutrient and faecal coliform inputs</i>								
7.6.1	Monitor upper estuary water quality	ESC	Medium	Monitored 2011/12 and reported on water quality report card.	Program to continue 2014/15 (then every second year)	Low	High	ESC
7.6.2	Monitor agricultural trends to determine if agriculture a potential future source of nutrient input and if so to encourage farmers to implement best agricultural practices	ESC, DPI	Low	Not implemented. Upper estuary water quality suggests faecal contamination.	To be undertaken as part of LLS programs	-	-	LLS
7.6.3	Encourage landholders to implement best acceptable practices for grazing – e.g. through extension officer, fencing incentives, etc. (see Option 7.5.4)	ESC, DPI	High	Refer 7.5.4, 7.6.2	-	-	-	-

<b>Action</b> (Option no. from 2005 EMP)		<b>Responsible Body (2005 EMP)</b>	<b>Priority (2005 EMP)</b>	<b>Outcome of Action</b>	<b>Comments</b>	<b>Cost (if applicable)</b>	<b>Priority (2014)</b>	<b>Responsible Body (2014)</b>
7.6.4	Public education for reduction of nutrients in urban runoff; continue urban stormwater awareness program	ESC	Ongoing	Community education program about stormwater runoff implemented in 2010.	Program to be continued.	Low	Medium	ESC
7.6.5	Ensure that for new urban developments, storm water is treated off site – implement Water Sensitive Urban Design and best practice subdivision requirements	ESC	High	Shire-wide Residential Zones DCP includes requirements for water sensitive urban design.	Completed as part of shire-wide stormwater management controls.	-	-	-
7.6.6	Rehabilitate and widen riparian zone especially to rehabilitate in upper estuary	ESC	High	Refer Objective 4.	Consider revegetation of riparian zone, improved mowing practices, education about damage to saltmarsh from horse riding and pedestrians.	Medium	High	LLS, ESC






Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
7.6.7	Environmental audits of facilities that may be contributing to nutrient or pollutant input (e.g. bowling club, golf course, zoo)	ESC	Low	Audits not undertaken.	Mogo Zoo has installed treatment facilities for carcass (feed) waste and is currently working with ESC to improve runoff from irrigation of on-site sewage treated effluent.  Suggested approach is based on event monitoring and MER program.	-	-	-
7.6.8	Establish catchment sources of faecal coliform bacteria	ESC	Low	Refer 7.6.1. Event-based monitoring (wet weather) is not undertaken for the estuary.	Event-based monitoring (wet weather) is recommended.	Low	Medium	ESC
<i>Objective 6: Maintain threatened bird species on the spit</i>								
7.7	Watching brief	OEH, NPWS	Maintain	South Coast Shorebird Recovery Program undertaken by NPWS.	To be undertaken as part of NPWS programs	-	-	-
<i>Objective 7: Maintain acceptable sediment inputs</i>								
7.8.1	Implement a policy for reporting breaches of EPA sediment input legislation	ESC, EPA	High	EPA hotline in place (131 555).	To be undertaken as part of EPA programs	-	-	-
7.8.2	Encourage livestock exclusion from the bank.	ESC	High	Refer Objective 4.	-	-	-	-

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
7.8.3	Encourage soil conserving agricultural practices	ESC, Landcare, DPI	Medium	Refer 7.6.2.	To be undertaken as part of LLS programs	-	-	-
7.8.4	Ensure stormwater sediment traps are installed and properly maintained	ESC	Medium	No sediment traps installed	Requires review	-	Medium	ESC
<i>Objective 8: Resolve conflict between users</i>								
7.9.1	Introduce voluntary code of conduct for PWCs - Not recommended		Medium	Regulation by RMS including signage, boating maps and guidelines.	To be undertaken as part of RMS programs	-	-	-
7.9.2	Maintain discussion between Council, NSW Maritime and boat users	ESC, NSW Maritime	Maintain	RMS representatives are actively liaising with boat users and Council.	Ongoing	-	-	-
7.9.3	Reduction of boat speeds in upper estuary	NSW Maritime	High	4 knot speed limit now gazetted throughout estuary.	Complete. Education and enforcement by RMS.	-	-	-
7.9.4	Limit pedestrian access on the spit to fenced walkways (see Option 7.5.1)	ESC	High	Refer Objective 1.	-	-	-	-

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
<i>Objective 9: Manage invasive species</i>								
7.10.1	Progressively remove Bitou Bush and Prickly Pear from the spit – as revegetation establishes	ESC, Landcare	Medium	Undertaken in 2006/07	Ongoing monitoring required.	Low	High	ESC
7.10.2	Monitor the spread of Bitou Bush	ESC, Landcare	Medium	Refer 7.10.1	-	-	-	-
7.10.3	Minimise risk of introduction of invasive marine species	Fisheries NSW	Low	NSW Fisheries has developed a <i>Caluherpa</i> Control Plan and will continue to monitor estuaries where Caulerpa is known to occur (e.g. Batemans Bay).	To be undertaken as part of Fisheries NSW programs	-	-	-
7.10.4	Monitor public lands for weeds	ESC	Medium	Ongoing	Weed monitoring and removal should continue until Council's existing programs.	Low	High	ESC

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
<i>Objective 10: Minimise pollutants entering estuary</i>								
7.11.1	Ensure no pollutants are entering the estuary from the "Koppers Log" site	ESC	High	Mogo plant no longer functional	-	-	-	-
7.11.2	Ensure acid sulphate soils do not pollute estuary	ESC	Medium	ESC adopted its Acid Sulfate Soils Policy in October 2002. The policy applies to all land within the ESC LGA classified as Class 1 to Class 5 on the maps marked "Acid Sulphate Soil Planning Map" deposited in the office of ESC (LEP 2012).	pH is monitored as part of MER program			
<i>Objective 11: Protect seagrass</i>								
7.12.1	Expand existing seagrass study	ESC, Fisheries NSW	Low	Refer 7.5.5.	Complete	-	-	-
7.12.2	Set up channel markers to assist boaters to avoid seagrass beds	NSW Maritime	Medium	Main navigation channel markers are installed and audited by RMS. Seagrass markers have not been installed.	Consider installation of seagrass markers.	Low	Medium	ESC, Fisheries NSW
7.12.3	Public education re protection of seagrass	ESC, NSW Maritime	Medium	Fact sheet, protection plan and mapping available on Fisheries NSW website	Continue education of residents and tourists	Low	High	ESC, Fisheries NSW



Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
								
<p><b>Figure 76: A and B – Navigation markers in Tomaga River</b></p>								
<p><i>Objective 12: Moderate erosion due to boat wake and propeller wash</i></p>								
7.13	Restrict boating speeds to 4 knots in upper estuary; educational signs	NSW Maritime	High	Refer 7.9.3.	Complete	-	-	-

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
<i>Objective 13: Ensure water quality is adequately monitored</i>								
7.14.1	Map water quality requirements based on different uses of different parts of the estuary	ESC, SRCMA	Medium	ESC monitoring program implemented based on MER program.	Ongoing	Low	High	ESC
7.14.2	Monitor water quality after major rainfall events	ESC	Medium	Not undertaken.	Event-based monitoring (wet weather) is recommended.	Low	Medium	ESC
7.14.3	Ensure water quality representative of an upper estuary site is collected	ESC	High	Refer 7.6.1.	Complete.	-	-	-
7.14.4	Ensure appropriate data is collected and analysed, especially nutrients	ESC	High	Chlorophyll a is currently monitored as part of water quality program which is a suitable nutrient status indicator.	The measurement of nutrient concentrations during event-based monitoring may provide further information to assist in the identification of likely sources of pollution, and should be considered where funding permits.	-	-	-

Action (Option no. from 2005 EMP)		Responsible Body (2005 EMP)	Priority (2005 EMP)	Outcome of Action	Comments	Cost (if applicable)	Priority (2014)	Responsible Body (2014)
<i>Objective 14: Maintain the perceived unspoilt nature of the Tomaga Estuary</i>								
7.15.1	Non-proliferation of signage	ESC, NSW Maritime, Marine Park Authority, Fisheries NSW	High	Education and information signs are provided.	Signage may be necessary to improve success of some actions (e.g. access and erosion control).	Low	High	ESC
7.15.2	Protection and restoration of riparian vegetation (see Objective 4)	ESC	High	Refer 7.5.4 and 7.6.6. Riparian vegetation management is undertaken by LLS in upper estuary and by ESC near the entrance and on the spit.	To be continued as part of erosion control works and as identified in Objective 4.	-	-	-
7.15.3	Non-proliferation of rock walling	ESC	Medium	-	Rock walls may be appropriate in some locations but should be designed based on the Environmentally Friendly Seawall Guidelines (DECC, 2009).	Medium	To be assessed for each site.	ESC
7.15.4	Protection of seagrasses (see Objective 11)	Fisheries NSW	Medium	Refer Objective 11	-	-	-	-
7.15.5	Protection of intertidal sand flats	ESC	Medium	Refer 7.6.6. Council was recently bequeathed land that includes mangrove and salt marsh.	To be continued as part of estuarine vegetation management	-	-	-



## Appendix 4: Stakeholder Consultation Activities





## Appendix 5: Estuary Health Report Cards 2010/11 and 2011/12



## Appendix 6: Tomakin Spit Profiles 1992-2011 (OEH, 2012)

This Appendix provides the results of photogrammetry analysis undertaken by OEH from 1962-2011.





## Appendix 7: Survey of Tomakin Spit (OEH, 2014)

This Appendix provides the survey data for Tomakin spit undertaken by OEH in 2014.



## Appendix 8: Potential Grant Funding

This Appendix provides a summary of potential grant funding available to implement this CZMP.



Agency	Program Name	Description	Criteria/Objectives
<i>State Government</i>			
OEH	NSW Estuary Management Program and Coastal Management Program	<p>The NSW Government's Coastal Management Program's primary objective is to provide support to local councils to manage the risks from coastal hazards such as coastal erosion. A secondary objective of the program is to restore degraded coastal habitats. The NSW Government's Estuary Management Program provides support to councils to improve the health of NSW estuaries and understand the potential risks from climate change.</p> <p>The support provided to councils under these programs includes financial assistance to:</p> <ul style="list-style-type: none"> <li>• prepare (or update) coastal zone management plans and associated technical studies (including estuary health and coastal hazard assessments)</li> <li>• undertake actions to manage the risks associated with coastal hazards and to protect or improve coastal environments and estuary health.</li> </ul> <p>Grant offers are subject to availability of funds for each financial year and statewide priorities. Funding of up to 50% of a project's costs will normally be offered for successful grant applications.</p>	<p>There are two grant categories:</p> <ul style="list-style-type: none"> <li>• Coastal management grants; and</li> <li>• Estuary Management Grants</li> </ul> <p>Under the Coastal Management Program, the NSW Government provides coastal management grants to support local government in managing the risks from coastal hazards, such as coastal erosion, and restoring degraded coastal habitats. Under the Estuary Management Program, the NSW Government provides estuary management grants to support local government work to improve the health of NSW estuaries.</p> <p>Projects which can be subsidised under the program include:</p> <ul style="list-style-type: none"> <li>• preparation (or updating) of coastal zone management plans and associated technical studies (including coastal hazard assessments)</li> <li>• action to manage the risks from coastal hazards</li> <li>• action to implement environmental repairs, including habitat restoration and conservation projects</li> <li>• pre-construction activities for projects that are eligible and are likely to proceed to construction</li> <li>• development of management tools (such as education projects).</li> </ul>



Agency	Program Name	Description	Criteria/Objectives
OEH	NSW Floodplain Management Program	<p>The Floodplain Management Program supports the implementation of the NSW Government's Flood Prone Land Policy as outlined in the NSW Government's Floodplain development manual. The primary objective of the policy is to reduce the impacts of flooding and flood liability on communities and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.</p> <p>The Floodplain Management Program provides financial support to councils and eligible public land managers to:</p> <ul style="list-style-type: none"> <li>• make informed decisions on managing flood risk by preparing floodplain risk management plans (and associated background studies) under the floodplain risk management process .</li> <li>• implement floodplain risk management plans to reduce flood risk to both existing and future development, and reduce losses through a range of property, flood and response modification measures as outlined in the manual.</li> <li>• provide essential information to the State Emergency Service to enable the effective preparation and implementation of local flood plans to deal with flood emergency response.</li> </ul>	<p>Continuing staged projects and new projects that may be funded include:</p> <p>Preparation of a flood study (including data collection);</p> <p>Prepare or review floodplain risk management study and plan</p> <p>Investigation, design and (where required) completion of a feasibility study for works identified in a floodplain risk management plan (this stage <b>must</b> be undertaken for any works projects that are likely to exceed a total project cost of \$500,000)</p> <p>Implementation of actions identified in a floodplain risk management plan, including but not limited to:</p> <ul style="list-style-type: none"> <li>• structural works, such as levees, detention basins, flood gates and improved flow conveyance</li> <li>• flood warning systems</li> <li>• evacuation management</li> <li>• voluntary purchase or house raising</li> </ul> <p>Assistance under the program is normally offered by the State Government providing \$2 for every \$1 provided by the council.</p>

Agency	Program Name	Description	Criteria/Objectives
OEH	Environmental Restoration and Rehabilitation Grants	The aim of the Restoration and Rehabilitation (R&R) program is to facilitate projects to prevent or reduce pollution, the waste stream or environmental degradation of any kind, run by community organisations and State and Local government organisations. These projects also aim to improve the capacity of communities and organisations to protect, restore and enhance the environment.	<p>The objectives of the Environmental Restoration and Rehabilitation program are:</p> <ul style="list-style-type: none"> <li>• to restore degraded environmental resources, including rare and endangered ecosystems</li> <li>• to protect important ecosystems and habitats of rare and endangered flora and fauna</li> <li>• to prevent or minimise future environmental damage</li> <li>• to enhance the quality of specific environmental resources</li> <li>• to improve the capacity of eligible organisations to protect, restore and enhance the environment</li> <li>• to undertake resource recovery and waste avoidance projects and to prevent and/or reduce pollution.</li> </ul> <p>The Trust will call for applications to the Restoration and Rehabilitation program in August 2014</p>
OEH	Environmental Education Grants	The aim of the Environmental Education program is to support educational projects or programs that develop or widen the community's knowledge of, skills in, and commitment to protecting the environment and promoting sustainable behaviour.	<p>The Objectives of the Environmental Education Program are:</p> <ul style="list-style-type: none"> <li>• facilitate changes in behaviour of individuals and groups which affect specific environmental problems</li> <li>• develop and promote education projects that improve the environment.</li> </ul>

Agency	Program Name	Description	Criteria/Objectives
OEH	Aboriginal Heritage Projects	Conserving, promoting and supporting NSW Aboriginal heritage: To provide funding for projects that conserve, promote and support Aboriginal heritage in NSW.	<p>Projects eligible for funding:</p> <ul style="list-style-type: none"> <li>• Interpretation of culturally significant Aboriginal places, such as walkways, signs and trails, and mapping of tracks or places</li> <li>• Recording or documenting of significant Aboriginal community events, including contemporary community events</li> <li>• Recording or documenting shared history projects, including showgrounds, race courses, world wars, etc.</li> <li>• Aboriginal cultural heritage tourism</li> <li>• Recording oral histories and collections to increase understanding between generations and communities</li> <li>• Researching Aboriginal heritage places, areas and event(s)</li> <li>• Educating communities on their cultural heritage using media such as brochures, DVDs and publications</li> <li>• Conservation management planning documents or site-based studies</li> <li>• Undertaking physical conservation works to protect Aboriginal sites or items</li> </ul>
DPI (Fisheries and Aquaculture)	Habitat Action Program	<p>Supports the improvement of recreationally important fish populations, engages recreational anglers in fish habitat actions through the Fishers for Fish Habitat project, provides devolved habitat action grants to enhance fisheries in NSW.</p> <p>The Habitat Action Program is funded by the revenue raised by the NSW recreational fishing fee.</p> <p>Habitat Action Grants - 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.</p>	<p>Habitat rehabilitation projects which may be funded include:</p> <ul style="list-style-type: none"> <li>• removal or modification of barriers to fish passage</li> <li>• rehabilitation of riparian lands (river banks, wetlands, mangrove forests, saltmarsh)</li> <li>• re-snagging waterways with timber structure</li> <li>• removal of exotic vegetation from waterways</li> <li>• bank stabilisation works</li> <li>• reinstatement of natural flow regimes</li> </ul> <p>Habitat Action Grants are available in August each year and require the completion of a habitat-specific Funding Application form. Funding applications must relate to the enhancement of recreational fishing through the improvement of fish habitat. Successful projects are usually funded for one year, however funding may be sought for multi-stage projects that take place over a number of years (e.g. two or three year projects).</p>

Agency	Program Name	Description	Criteria/Objectives
Roads and Maritime Services	Partnerships	A 'Partnership' would apply to any funding or value in kind (VIK) made available to individuals or organisations to support specific programs or events deemed mutually beneficial.	<p>Programs or events that help deliver, align with, or raise awareness of key objectives outlined in the Results and Services Plan are eligible and cover:</p> <ul style="list-style-type: none"> <li>ports to support a growing economy</li> <li>safe and sustainable waterways; and</li> <li>improved infrastructure and access to waterways.</li> </ul> <p>Any application for a Partnership with RMS would be considered against the backdrop of financial responsibility of public money and resources. This reinforces the need for all partnerships to demonstrate a clear and direct benefit to the boating, maritime and/or maritime property community aligned with appropriate objectives.</p>
NSW Trade and Investment – Crown Lands	Public Reserves Management Fund	Funding is available to develop, maintain and improve land and facilities, including for recovery from natural disasters and the protection of heritage and the environment.	<p>The Public Reserves Management Fund Program (PRMFP) provides financial support for the development, maintenance and improvement of public reserves.</p> <p>Round 2 of the 2014-15 PRMFP is currently expected to commence in August 2014. Applications will be accepted at that time from the managers of caravan parks, state parks, showgrounds and local parks and reserves.</p>
<i>Federal Government</i>			
Australian Government	Caring for Our Country	Caring for our Country is the Government's natural resource management initiative. It integrates delivery of the Commonwealth's previous natural resource management programs, the Natural Heritage Trust, the National Landcare Program, the Environmental Stewardship Program and the Working on Country Indigenous land and environmental program.	<p>The delivery of the second phase of Caring for our Country will be through two specific streams:</p> <ul style="list-style-type: none"> <li>a Sustainable Environment stream delivered by the Department of the Environment</li> <li>a Sustainable Agriculture stream delivered by the Department of Agriculture.</li> </ul> <p>Some aspects of Caring for our Country will continue to be delivered jointly between the two departments, such as regional delivery for identified regional natural resource management organisations and Reef Rescue.</p>

Agency	Program Name	Description	Criteria/Objectives
Australian Government	Indigenous Heritage Program	The Indigenous Heritage Program (IHP) is an Australian Government initiative that supports the identification, conservation, and promotion (where appropriate) of Indigenous heritage.	<p>Individual project funding for organisations will in general be available up to a maximum of \$100,000 (GST exclusive). Individual applicants will generally be eligible for funding up to \$5000. Applications for more than these amounts may be considered where the applicant demonstrates special circumstances or a genuine requirement for additional funds.</p> <p>The IHP may also help identify places likely to have outstanding Indigenous heritage value to Australia suitable for inclusion on the National Heritage List.</p>
<i>Other</i>			
Local Land Services	Landholder and Community Resilience	<p>This program delivers services to farmers, landholders, Landcare and Aboriginal community groups and other partners across the South East region that seek advice on natural resource and biosecurity management. It focuses on building the knowledge and skills of landowners and the community on:</p> <ul style="list-style-type: none"> <li>• pest plant and animal management</li> <li>• biosecurity and animal welfare</li> <li>• use and care of natural resources</li> <li>• preparedness for natural disaster and biosecurity emergencies.</li> </ul>	<p>Landcare and landholder services - These services increase the engagement, capacity and involvement of landholders, groups and networks to participate in pest plant and animal, biosecurity and natural resource management.</p> <p>Aboriginal community services - These services increase the engagement, capacity and involvement of Aboriginal landholders and community groups to participate in pest plant and animal, biosecurity and natural resource management.</p> <p>Regional Landcare facilitation - These services increase the engagement, capacity and involvement of Landcare groups and networks to participate in pest plant and animal, biosecurity and natural resource management.</p>



Agency	Program Name	Description	Criteria/Objectives
Local Land Services	Profitable and sustainable farming	<p>This program delivers services to farmers and agricultural groups in priority primary production industries (grazing, dairy, mixed farming, cropping, viticulture and aquaculture) to assist the South East region's \$460 million food and fibre economy. It focuses on providing advice and projects that support enterprises and industries to be more profitable and sustainable including:</p> <ul style="list-style-type: none"> <li>• agricultural services</li> <li>• pest plant and animal management</li> <li>• biosecurity and animal welfare</li> <li>• use and care of natural resources</li> <li>• preparedness for natural disaster and biosecurity emergencies</li> </ul>	<p>Grazing industry services - These services support graziers across the South East region to adopt practices that improve the profitability and sustainability of their enterprise.</p> <p>Oyster industry services - These services support oyster farmers across the South East region to adopt practices that improve the profitability and sustainability of their enterprise.</p>
Local Land Services	Resilient land and seascapes	<p>This program delivers services to farmers, landholders and other partners to improve the condition of priority natural resource assets including rivers, wetlands, coastline and wildlife corridors. It supports community and economic outcomes, in particular the South East region's \$2 billion per annum nature-based tourism economy.</p>	<p>Coastal wetlands project - This project supported by the Australian Government's Biodiversity Fund protects and enhances over 1,000 hectares of high priority South East NSW coastal wetlands. The project is being implemented in partnership with private and public land managers and a range of government and non-government organisations.</p>