Tuross River Estuary and Coila Lake: Coastal Management Program




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PROJECT 17-012 – TUROSS AND COILA LAKES CMP

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EXECUTIVE SUMMARY

The Tuross Estuary and Coila Lake Estuary Management Plan (EMP) was adopted in 2005 and has directed on-ground projects and initiatives aimed at protecting and restoring key environmental values of these two estuaries. Many of the high priority projects have been implemented, including biodiversity conservation, foreshore stabilisation, weed control and water quality monitoring. This Coastal Management Program (CMP) for Tuross River Estuary and Coila Lake recognises the achievements of the 2005 EMP and identifies new management issues that have arisen since the original Plan was adopted. The CMP provides the updated plan to direct ongoing management of the estuaries. The CMP addresses the NSW Coastal Management Reforms, in particular the requirements of the *Coastal Management SEPP* which establishes a new, strategic land use planning framework for coastal management and supports implementation of the management objectives set out in the *Coastal Management Act, 2016*.

The study area comprises the reaches of the estuaries from the entrance to the extent of the tidal limits including the tidal waterways, foreshore and adjacent land. The management of these two separate waterways was considered in parallel in a combined CMP consistent with the previous approach because of the close proximity, common community values and similar issues affecting these estuaries.

The upper Tuross River catchment is steep and mostly forested, whilst much of the land of the Tuross River floodplain and surrounding the estuary itself has been cleared for cropping and grazing. The Tuross River Estuary is a wave dominated barrier estuary and consists of a complex array of lakes and channels formed behind a large coastal sand barrier. Estuarine vegetation in the Tuross River Estuary includes saltmarsh and mangroves in the intertidal zone and seagrass beds in the shallow subtidal areas. The estuary supports a range of wildlife, especially birds and is recognised for its ecological importance. The Tuross River Estuary is a recreational fishing haven and a habitat protection zone within Batemans Marine Park.

Coila Lake is a large intermittently closed saline coastal lagoon located to the immediate north of the Tuross River Estuary. The catchment of Coila Lake is relatively small which has resulted in the lake only being open to the ocean intermittently and usually for short periods. Much of the catchment has been cleared for agriculture although Coila Lake itself contains extensive areas of seagrass and is fringed by casuarinas and saltmarsh. The Lake is open to commercial fishing and contains an important habitat for the Greenback prawn. The western section of Coila Lake and Coila Creek is a sanctuary zone within Batemans Marine Park.

Preparation of this CMP has 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 recreational opportunities.

The key management issues addressed in this CMP are:

- Both estuaries, but in particular the Tuross River, experience elevated levels of nutrients and sediment;
- Bank erosion affects estuary health through impacts on water quality and loss of riparian and estuarine vegetation and productive farmland, particularly in the Tuross River Estuary;
- There is a risk of significant change in the alignment of the main Tuross River channel (an avulsion) resulting from erosion of the western banks of Cambathin Island;
- Artificial waterway barriers in the Tuross River Estuary can restrict normal tidal flow and flushing and impact on fish passage;
- Estuarine mapping projects have identified a reduction in seagrass extent in both estuaries;
- Vehicular access to the south-eastern foreshore of Coila Lake is damaging saltmarsh and is causing community concern regarding pedestrian safety, damage to threatened shorebird habitat, damage to

dune structure and dune vegetation and illegal clearing of native vegetation, camping, fires and dumped rubbish;

- Waterway access to Coila Lake and the associated boat ramp infrastructure is not adequate to support existing commercial and recreational activities including tourism;
- Terrestrial weeds, including blackberries and lantana, have been identified within the estuaries; and
- Sea-level rise is expected to increase the average water depths and extend tidal propagation in Tuross River Estuary and Coila Lake which has the potential to significantly impact the estuaries and the surrounding land over the longer-term.

This CMP provides a management framework that is intended to guide coastal management and planning in the Tuross River Estuary and Coila Lake in response to the coastal management objectives with an underlying focus being the protection of community values for the estuaries. The CMP recognises that the estuaries are under pressure from urban and agricultural land use and are subject to often conflicting uses.

The estuaries are managed by local and State government agencies, landholders and the community. The CMP provides an opportunity to continue to implement a sustainable and equitable management approach. The CMP includes a suite of coastal planning and management actions that will ultimately protect and conserve terrestrial and estuarine ecosystems for the enjoyment of all stakeholders. The actions have been developed and prioritised based on the assessed risk of the threats to the estuary values. The CMP actions draw on existing programs and funding and identifies priority actions to be implemented once additional funding becomes available. The CMP targets priority management issues with least cost and highest benefit to maximise the benefits gained, success of the program and increase the success of future funding applications.

Longer-term pressures such as climate change and sea level rise have been considered in the formulation of management actions with the current actions taking any future pressures into account in the design and implementation stages. Adaptive management measures have also been included in response to longer-term threats such as sea level rise.

Actions consist of a combination of studies, investigations and on-ground works and have been formulated through review of actions identified in the 2005 EMP, assessment of priority issues and the contributing threatening processes as well as consideration of stakeholder input. The CMP management actions are shown on Figure 1 to Figure 3.

The CMP actions 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 CMP. In most cases it is expected that in-kind contributions will be provided by Council and therefore the delivery of recommended actions may be influenced by the availability of this funding as well as human resources. Notwithstanding these considerations the actions in the CMP have been timed to reflect the expected availability of funding from all sources.

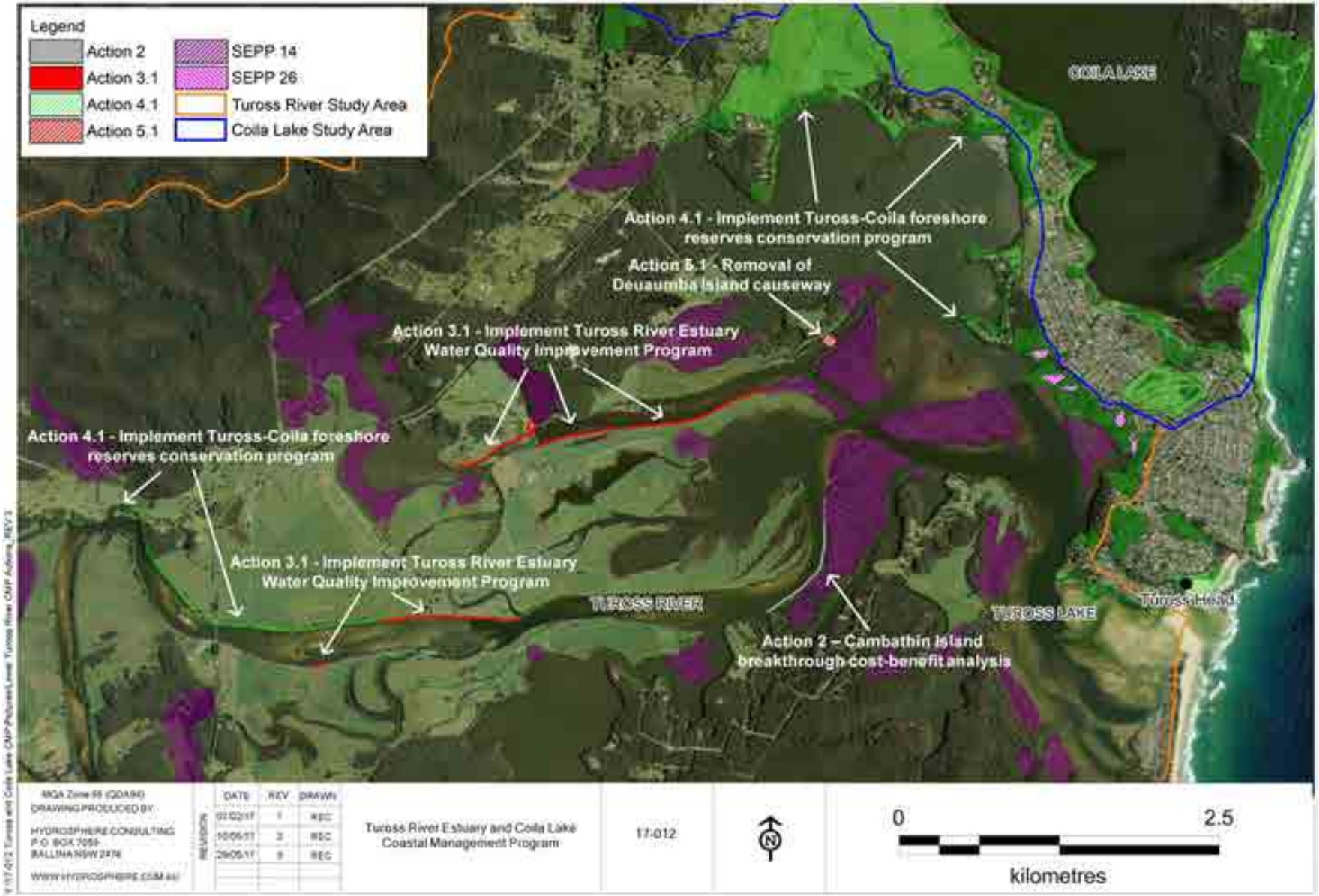

Figure 1: CMP on-ground actions – Tuross River Estuary (lower)

Note: only high priority rehabilitation sites are shown for Action 3.1

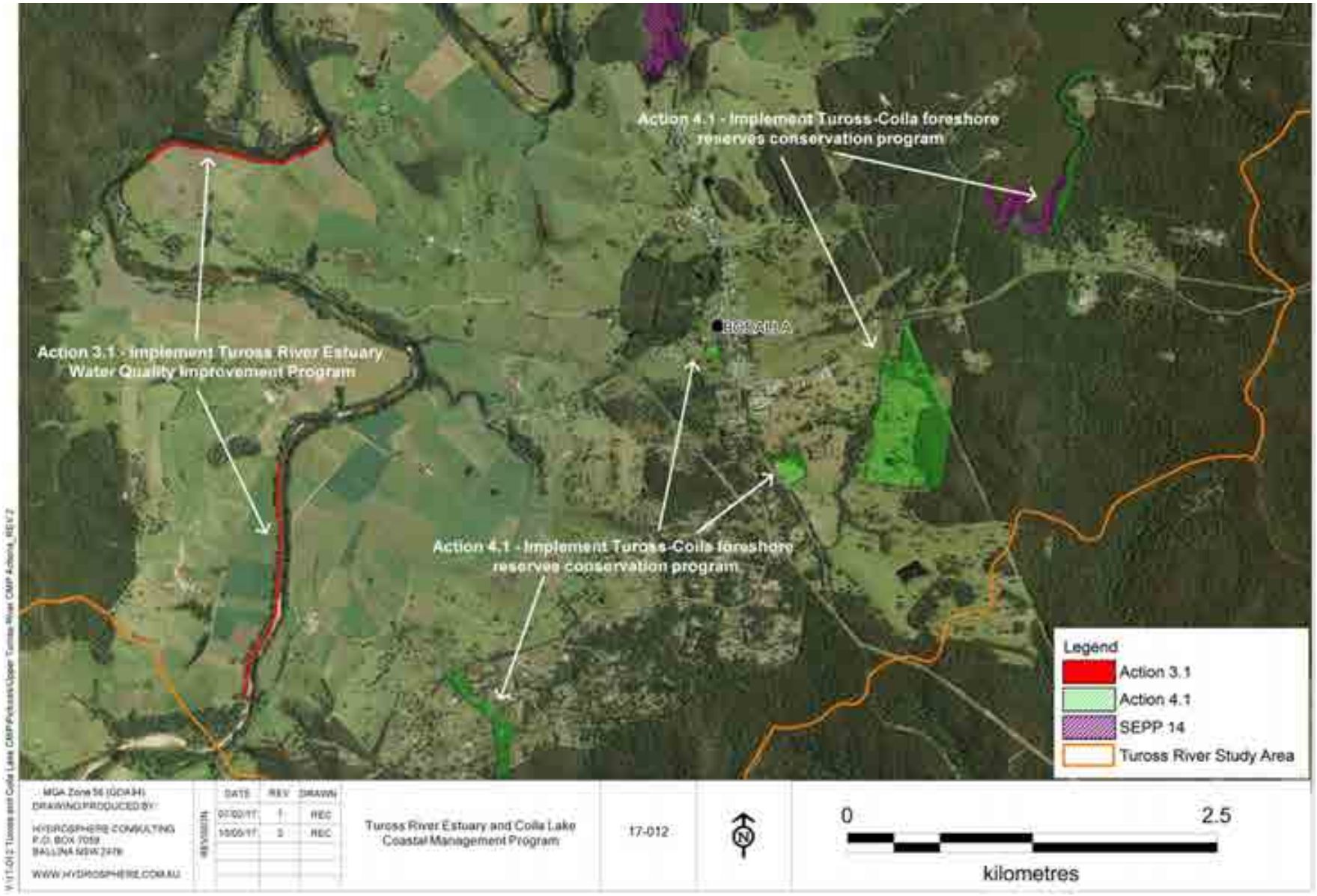

Figure 2: CMP on-ground actions – Tuross River Estuary (mid)

Note: only high priority rehabilitation sites are shown for Action 3.1

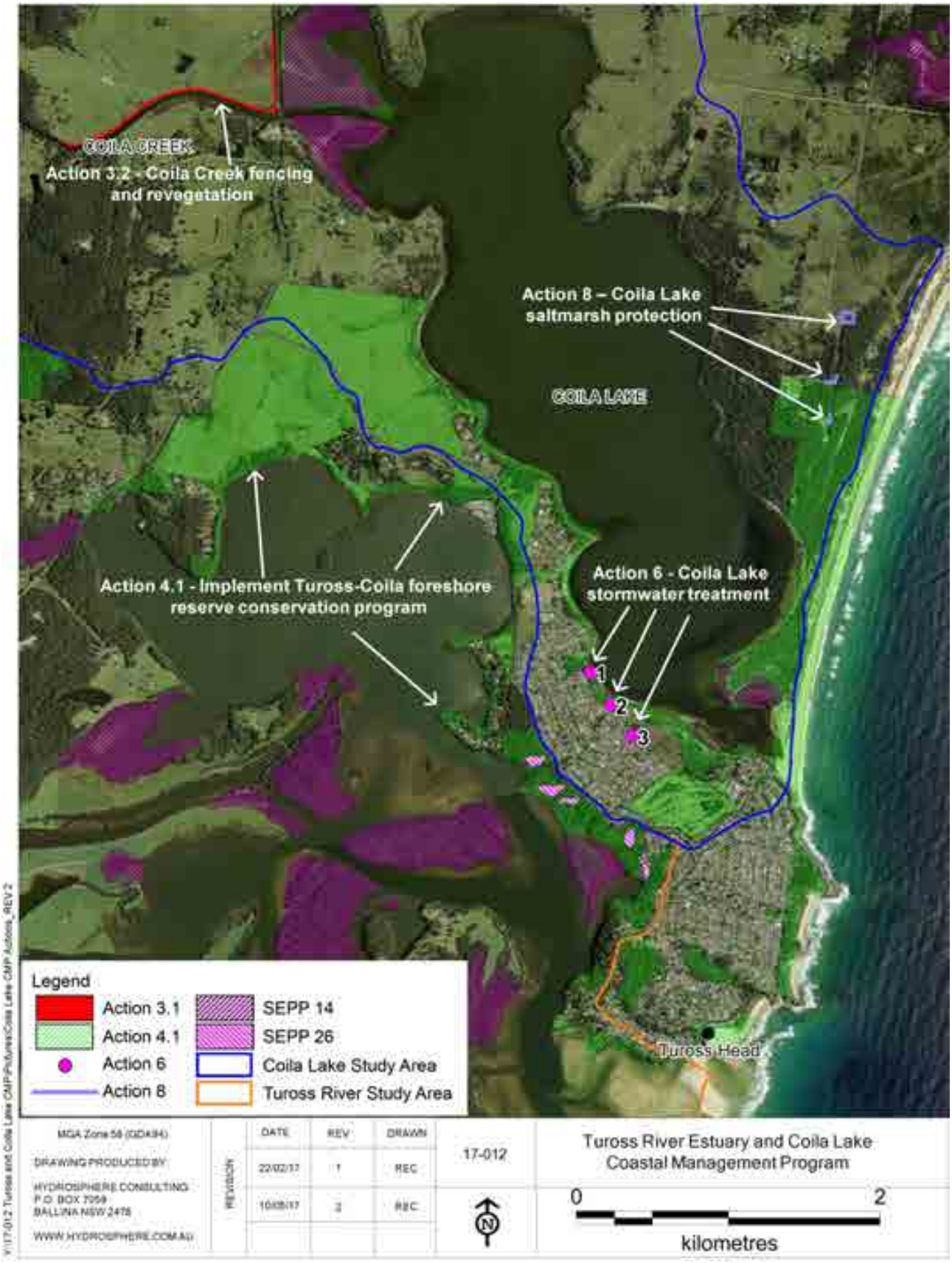

Figure 3: CMP actions – Coila Lake

A Business Plan (Table 1) has been developed to address the identified risks to the estuary values as well as consideration of expected funding availability. The availability of resources, particularly funding, will depend on budget commitments, work programs and the availability of grant funding.

Council responsibilities listed here will be used to inform the ongoing review of the Community Strategic Plan, Delivery Program and Operational Plan.

This CMP will be supported through the continuation of related Council management programs including:

- Land use planning and development controls;
- On-site sewage management program;
- Integrated Water Cycle Management Strategy implementation;
- Urban stormwater education programs;
- Entrance management policies;
- Asset management strategy and plans;
- Weed management program;
- Reserves conservation program; and
- Council maintenance programs.

Other government agency management programs will also contribute to achievement of the CMP objectives including:

- South East LLS extension officer and related projects;
- DPI regulation of NSW Fisheries;
- DPI Food Authority oyster monitoring and management program;
- Marine parks reform; and
- DPI Key Fish Habitat Protection programs.

Table 1: Business Plan - CMP management actions

Action		Priority	Responsible body	Support organisations	10 year cost
1.1	Estuary health monitoring and reporting (every 2 years)	High	ESC Funding	OEH ESC with grant assistance OEH Estuary Management Program	Expenditure is included in Shire wide Estuary health monitoring program
1.2	Estuarine macrophyte mapping and reporting (every 5 yerars)	High	ESC Funding	OEH ESC with grant assistance OEH Estuary Management Program	Expenditure is included in Shire wide Estuary health monitoring program
2	Cambanthin Island breakthrough	Medium	NPWS Potential funding	OEH, LLS, ESC NPWS OEH Estuary Management Program ESC	$35,000

3.1	Implement Tuross River estuary Water Quality Improvement Program (cost estimate for high priority sites only)	High	South East LLS Potential funding	OEH, ESC, Tuross Fishing Club, landholders ESC Environment levy South East LLS Recreation Fishing Trust OEH Estuary Management Program Landowners	$2,200,000
3.2	Coila Creek fencing and revegetation works	Current	ESC/LLS Funding	OEH Landowner	$20,000
3.3	Ongoing assessment and monitoring of erosion risk	High	ESC Funding	OEH OEH Estuary Management Program ESC (staff time)	$30,000
4.1	Implement Tuross-Coila foreshore reserves conservation program	Ongoing	ESC Funding	OEH OEH Estuary Management Program ESC Environment levy	$300,000
5.1	Removal of Deuaumba Island causeway	Low	ESC Funding	OEH OEH Estuary Management Program ESC Environment levy	$60,000
6	Coila Lake stormwater treatment	Low	ESC Potential Funding	 Grants	$215,000
7	Coila Lake waterway access/infrastructure plan	Medium	ESC/RMS Potential Funding	DPI ESC RMS waterways grants DPI	$15,000
8	Coila Lake saltmarsh protection	Medium	ESC Potential funding	DI-Lands, NPWS, OEH ESC Environment levy OEH Estuary Management Program DI-Lands NPWS	$16,000
9	Ongoing liaison with landowners and land managers regarding sea level rise adptation	Low	ESC Potential funding	South East LLS, private land owners, OEH ESC Environment levy OEH Estuary Management Program LLS	Not estimated. Primarily staff time.
10	Review of entrance management policies	Ongoing	ESC Funding	OEH Existing operating budgets	Not estimated. Staff time.
11	Cultural heritage site management	Ongoing	ESC		
			Funding	Existing operating budgets	Not estimated. Staff time.
TOTAL					**$2,891,000**

Abbreviations: ESC: Eurobodalla Shire Council, OEH: Office of Environment and Heritage, LLS: Local Land Services, NPWS: National Parks and Wildlife Service, DPI: Department of Primary Industries, RMS: Roads and Maritime Services, DI - Lands: Department of Industry - Lands

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1. INTRODUCTION

The estuaries of the Tuross River and Coila Lake are located within Eurobodalla Shire on the south coast of New South Wales, approximately 15 km south of Moruya adjacent to the town of Tuross Head.

The Coastal Management Program (CMP) for these estuaries provides a ten year strategic plan for the implementation of key actions that are recommended to achieve the management objectives for the estuaries.

1.1. The Study Area

The study area comprises the reaches of the estuaries from the entrance to the extent of the tidal limits including the tidal waterways, foreshore and adjacent land. Emphasis is placed on the estuaries, however, consideration is also given to the wider catchment which can significantly influence estuarine processes and natural resources. The study area includes areas mapped as Coastal Management Areas (CMAs) under the *Coastal Management Act, 2016* (refer Section 1.5).

1.1.1. Tuross River Estuary

The Tuross River Estuary has a catchment area of 1,814 km². The upper catchment is steep and mostly forested, whilst much of the land of the Tuross River floodplain and surrounding the estuary itself has been cleared for cropping and grazing. The estuary is a semi-mature wave dominated barrier estuary as classified by Roy *et al*., (2001) and consists of a complex array of lakes and channels, all formed behind a large coastal sand barrier. Estuarine vegetation in the Tuross River Estuary includes saltmarshes and mangroves in the intertidal zone and seagrass beds in the shallow subtidal areas. The estuary supports a range of wildlife, especially birds and is recognised for its ecological importance. The Tuross River Estuary is a recreational fishing haven and is protected from commercial fishing with no trawling, mesh nets or haul nets allowed.

Figure 4: Tuross River Estuary

Source: OEH (2017)

1.1.2. Coila Lake

Coila Lake is a large, young intermittently closed saline coastal lagoon (as classified by Roy *et al*., 2001) and is located to the immediate north of the Tuross River Estuary and is separated from the ocean by a ridge of land that is about 0.5 to 1km wide. The catchment of Coila Lake is relatively small (47.6 km²) which has resulted in the lake only being open to the ocean intermittently and usually for short periods. Much of the catchment has been cleared for agriculture although Coila Lake itself contains extensive areas of seagrass and is fringed by casuarinas and saltmarsh. The Lake is open to commercial fishing and contains an important habitat for the Greenback prawn.

Figure 5: Coila Lake

Source: OEH (2017)

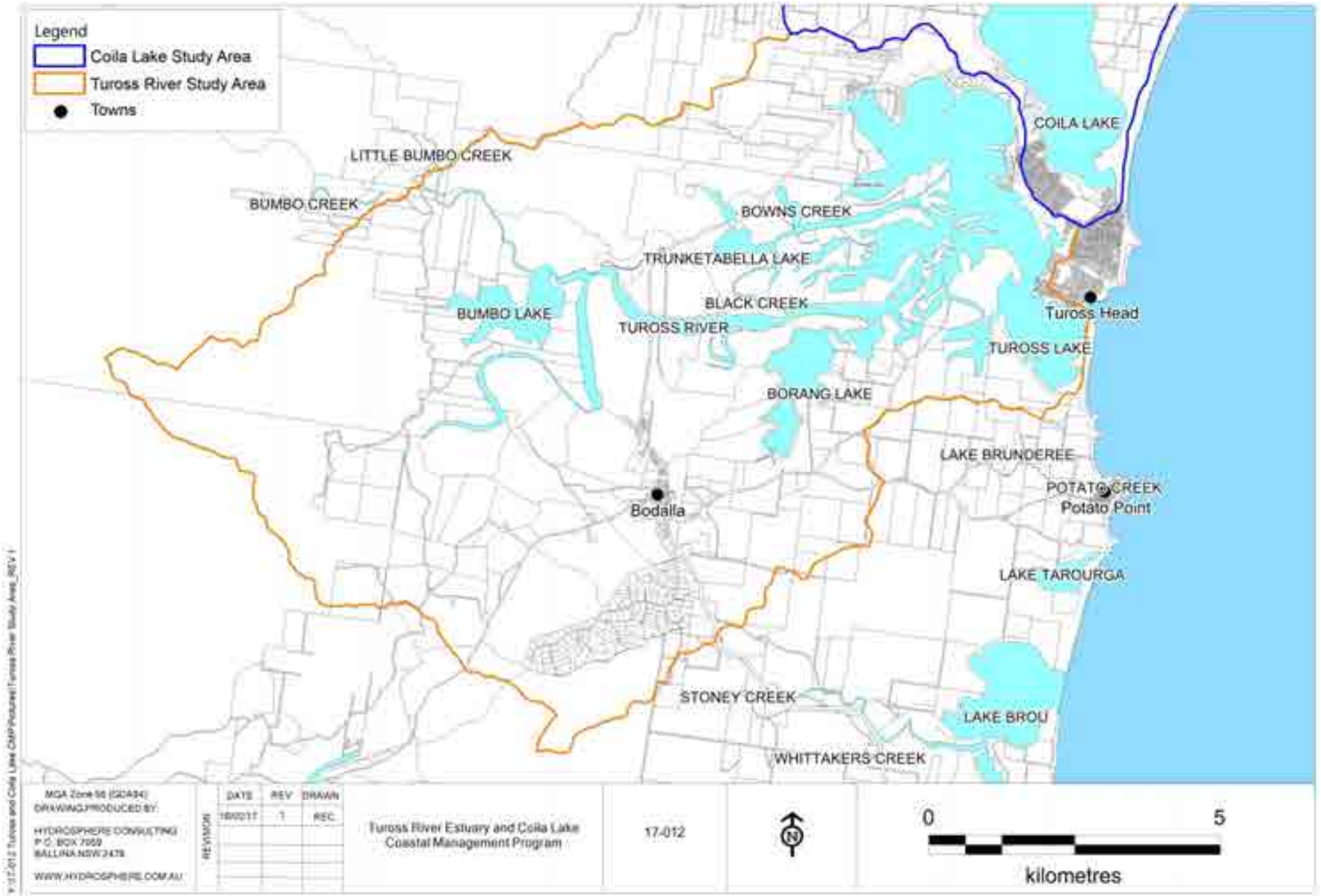


Figure 6: Tuross River Estuary CMP study area

Figure 7: Coila Lake Estuary CMP study area

1.2. Structure of this Coastal Management Program

The main body of this CMP describes the coastal management context, community values, issues and threats facing the Tuross River Estuary and Coila Lake as well as the recommended management actions, their costs and timing. The main sections of the document are as follows:

List of sections

- Section 1 - Introduction: describes the study area, the status of previous management actions, the coastal management process and the management context;
- Section 2 - Community and Stakeholder Consultation: describes previous and current consultation activities and identifies community values;
- Section 3 - Estuary Processes and Estuary Health Status: provides a summary of key estuary processes and estuary health status;
- Section 4 - Management Issues and Threats: summarises the key issues and threats affecting the health of the estuary and presents a risk assessment to assist with prioritisation of responses; and
- Section 5 - Coastal Management Program: discusses the potential range of management responses, the management strategy and the recommended CMP actions.

Additional background information is provides in appendices:

- Appendix A - Mandatory Requirements and Essential Elements;
- Appendix B - Related Management Plans and Programs;
- Appendix C - Status of 2005 Estuary Management Plan Actions;
- Appendix D - Other Estuary Management Projects; and
- Appendix E - Community and Stakeholder Engagement.

This CMP draws on technical information from previous studies and plans prepared for the management of Tuross River Estuary and Coila Lake, in particular the Estuary Processes Study (EPS, Brown and Root, 2001), Estuary Management Study (EMS, WBM, 2004) and the Estuary Management Plan (EMP, WBM, 2005), Review of Environmental Factors for Entrance Management of Coila, Tuross, Kianga, Bullengella and Nangudga Lakes (REFEM, WBM,2010). Additional appendices summarise the technical information in these documents and provide analysis of more recent data:

- Appendix F - Land Use and Development;
- Appendix G - Biodiversity;
- Appendix H - Water Quality;
- Appendix I - Bank Erosion;
- Appendix J - Climate Change Information;
- Appendix K - Entrance Management;
- Appendix L - Community Uses; and
- Appendix M - Cultural Heritage.

1.3. The 2005 Estuary Management Plan

The EMP (WBM, 2005) was completed under the direction of Eurobodalla Shire Council (ESC) and the Tuross/Coila Estuary Management Committee (now disbanded) following the planning process for estuary management prescribed in the NSW Government's 1992 Estuary Management Manual. The management of these two separate waterways was considered in parallel in a combined EMP because of the close

proximity, common community values and similar issues potentially affecting these estuaries. These common factors also meant that community and agency representation on the Committee would be the same for both estuaries.

The 2005 EMP documented management issues derived from background documentation, community consultation activities and input from the Estuary Management Committee. The key management issues addressed in the EMP are shown in Table 2. Many of these issues are ongoing and are still identified as issues in this CMP. Some issues (such as education, biodiversity and management of entrance conditions and land use) have been largely addressed through concurrent management programs.

Table 2: Prioritised key management issues – 2005 EMP

Rank	**Very High Priority**
1	Minimisation of catchment (diffuse) and point-source pollutant loads (INPUTS)
2	Promotion of public education regarding the values of the estuaries (EDUCATION)
3	Conservation of ecological communities and habitats (BIODIVERSITY)
4	Maintenance of high water quality (WATER QUALITY)
	High Priority
5	Bank erosion and sedimentation (EROSION)
6	Sustainable commercial and recreational use of estuaries (USAGE)
7	Management of entrance conditions (ENTRANCE)
	Medium Priority
8	Management of future landuse changes within the catchments (FUTURE)
9	Maintenance of existing recreational and visual amenity (AMENITY)
10	Awareness of cultural heritage values of the estuaries (HERITAGE)

Source: WBM (2005)

The EMP identified management objectives from a wide range of consultation activities (refer Section 2.1):

- Catchment inputs;
- Tidal flushing and catchment inflows;
- Ecological communities and habitats;
- Water quality;
- Erosion and sedimentation;
- Commercial and recreational uses;
- Entrance conditions; and
- Culture and heritage.

A wide range of management strategies was formulated in order to address the management objectives and these were prioritised into 28 management strategies. The EMP identified a total capital expenditure requirement of $3.8 million between 2005 and 2010, largely attributable to stock fencing, riparian revegetation, bank stabilisation works, dredging of Tuross River entrance, sewerage system improvements, stormwater treatment, terrestrial revegetation, construction of new boat ramps and upgrade of existing boat ramps.

The existing EMP has been operational for 11 years with many of the actions recommended in that plan substantially completed or on-going including:

- Identification of high conservation value land in the 2012 LEP;

- Ground-truthing of potential EECs in urban areas;
- The ESC biodiversity program included identification and mapping of conservation priority of Tuross/Coila reserves and rehabilitation of high priority sites;
- Community education programs;
- Fencing of riverbanks;
- Foreshore stabilisation in a number of areas;
- Adoption of entrance management policies for Tuross River Estuary and Coila Lake;
- Development of a water quality improvement program for Tuross River Estuary;
- Review of Integrated Water Cycle Management Strategy and identification of sewerage system improvements;
- On-site sewerage management;
- Ecosystem Health Monitoring Program, estuary health report cards and ongoing water quality monitoring;
- 4 knot speed restriction signs installed at Cambathin Island;
- Implementation of recreational fishing haven (Tuross River Estuary) and Marine Park zoning;
- Water Sensitive Urban Design (WSUD) development controls;
- Feasibility study for appropriate location of new Tuross River boat ramp; and
- Cultural heritage signage.

The actions in the 2005 EMP and their current status are presented in Figure 8. Management actions completed as part of other programs are discussed in 0 including South East LLS rehabilitation projects and DPI Key Fish Habitat Restoration.

Completed on-ground works are shown on the following figure. Many of the actions from the 2005 EMP are on-going and remain relevant to the future management of the estuary.

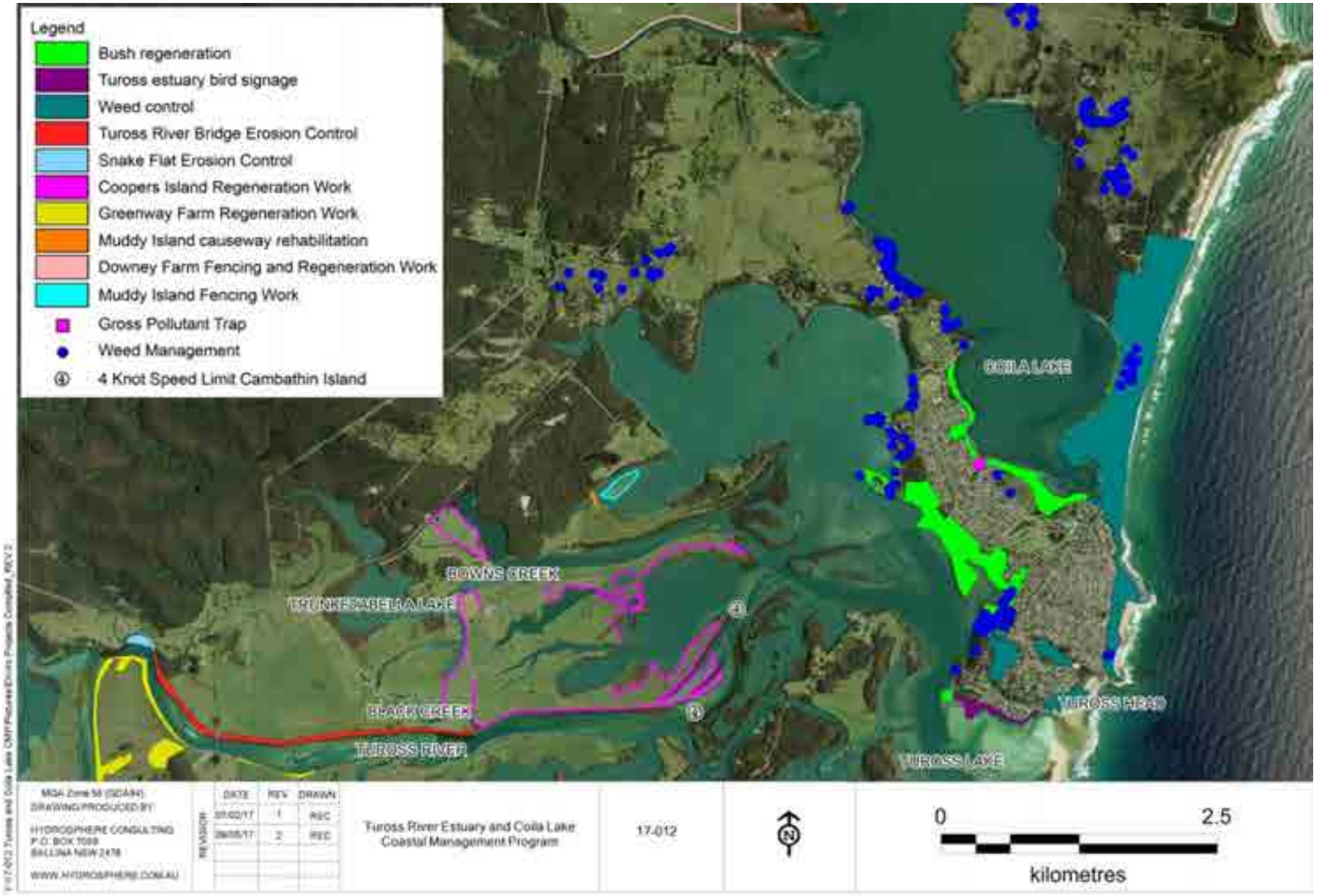


Figure 8: Locations of on-ground works implemented since 2005

1.4. Background to the Coastal Management Program

In 2015/16 ESC received funding through the NSW Government Estuary Management Program to review the 2005 Estuary Management Plan and develop a new plan of management to capture changing views within the community as to how the estuary should be managed.

This CMP for the Tuross River Estuary and Coila Lake estuaries aims to achieve integrated management of the estuaries, consistent with the principles of ecologically sustainable development, the aspirations of the community, and the 12 high-level statutory objects of the *Coastal Management Act, 2016*. The CMP has been prepared in accordance with the draft *Coastal Management Manual 2015*.

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). The CMP 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 update the plan as a current and ongoing management tool for the estuaries.

The NSW Department of Planning and Environment, together with OEH, is currently developing a new coastal management framework for NSW. The *Coastal Management SEPP* will establish a new, strategic land use planning framework for coastal management and support implementation of the management objectives set out in the *Coastal Management Act, 2016*.

The draft *Coastal Management Manual 2015* provides guidance for developing a CMP and assists councils in addressing the requirements of the *Coastal Management Act, 2016*. The manual outlines the mandatory requirements and provides guidance on the preparation, development, adoption and content of a coastal management program. It includes a process for councils to follow when identifying and assessing the vulnerability of coastal environmental, social and economic values and evaluating management actions. It also contains guidance on the integration of a CMP into Council's Integrated Planning and Reporting framework and land use planning. The manual outlines the five stage process for developing and implementing a CMP (Figure 9).

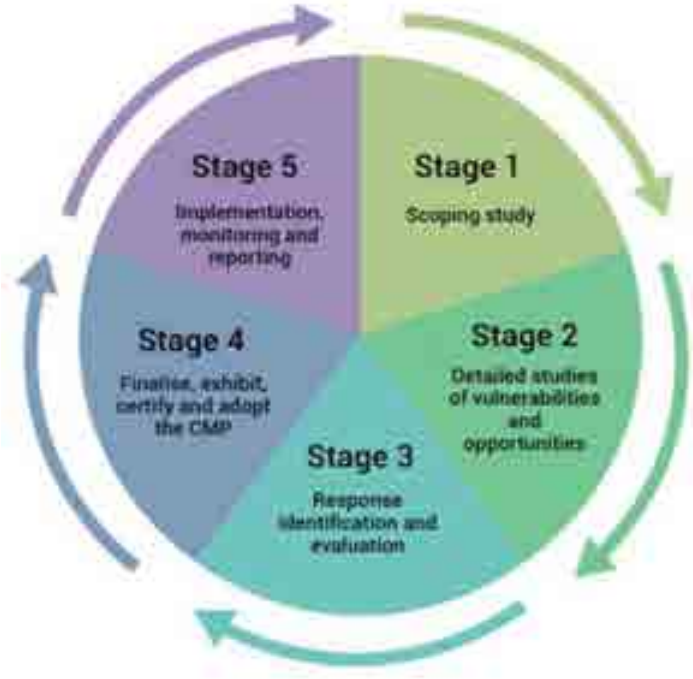


Figure 9: Five stage process for developing a coastal management program

Source: OEH (2015)

The five steps have been applied to this CMP as follows:

- Stage 1: Scoping study – As part of the development of this CMP, ESC prepared a separate Scoping Study defining the legislative context, the study area, Coastal Management Areas, proposed stakeholder engagement, current management issues and management actions;
- Stage 2: Detailed studies of vulnerabilities and opportunities – refer Sections 2.3 and 4 and Appendices F to M;
- Stage 3: Response identification and evaluation – refer Section 5;
- Stage 4: Preparing, exhibiting, finalising, certifying and adopting a CMP – this draft CMP will be publicly exhibited and Council will consider any feedback received prior to requesting certification by the Minister; and
- Stage 5: Implementation, monitoring, evaluating and reporting - ongoing.

As it is intended that the CMP will be submitted to the Minister for Environment for certification, the CMP must meet mandatory requirements. The CMP has been developed according to the mandatory requirements of the draft *Coastal Management Manual 2015/16* (refer Appendix A - Mandatory Requirements and Essential Elements).

1.5. Coastal Management Areas

The *Coastal Management Act, 2016* re-defines the definition of the coastal zone from the former *Coastal Protection Act, 1979* and describes four coastal management areas which have specific management objectives. These four areas are:

- CMA 1 - Coastal wetlands and littoral rainforests - largely based on existing maps under SEPP 26 and SEPP 14 (updated to account for natural changes in their boundaries and distribution) and a 100m proximity area;
- CMA 2 - Coastal vulnerability area – land which is subject to current and future coastal hazards including beach erosion, shoreline recession, entrance instability, coastal inundation, tidal inundation, slope instability and foreshore tidal erosion;
- CMA 3 - Coastal environment area - based on the current coastal zone as defined under the *Coastal Protection Act 1979*, with some modification to include land around coastal lakes. The area is made up of estuaries and a 100m landward area (Tuross River Estuary) and coastal lakes and lagoons and a 500m landward area (Coila Lake), mapped upstream to one kilometre beyond the highest astronomical tide; and
- CMA 4 - The coastal use area - based on the current coastal zone as defined under the *Coastal Protection Act 1979*, with some modification to exclude submerged lands. The area starts at the seaward local government boundary, typically the low water mark and extends to the estuary limit (one kilometre landward of coastal waters, estuaries and coastal lakes).

The CMA 1, CMA 3 and CMA 4 areas (and the surrounding proximity areas for CMA 1) in Eurobodalla Shire have been mapped as part of the consultation phase for the draft *Coastal Management SEPP*. The study area includes CMA 1 (including areas previously mapped as SEPP 14 wetlands and SEPP 26 Littoral Rainforests). CMA 3 and CMA 4 areas are also considered in this CMP. The CMAs within the study area are shown on the following figure (image sourced from the Coastal SEPP Mapping Tool, Geocortex viewer).

The elements related to CMA 2 are not addressed in this CMP apart from hazards relating to the estuary (foreshore/bank erosion, coastal lake entrance instability and tidal inundation). CMA 2 – Coastal vulnerability areas have not yet been mapped for Eurobodalla Shire as part of the draft *Coastal Management SEPP*.

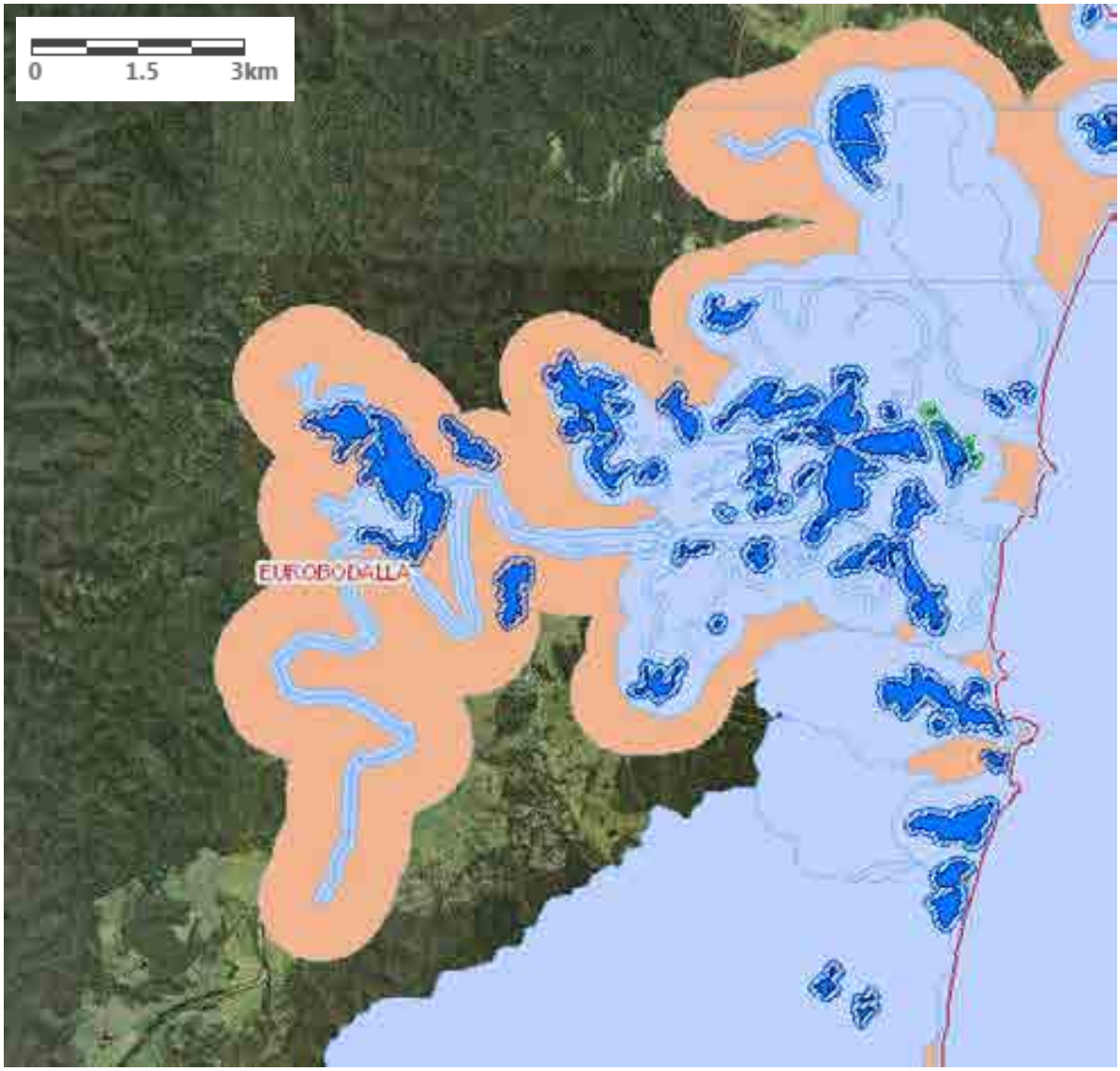


Figure 10: Coastal Management Areas within the study area

CMA 1 - Coastal Wetlands (dark blue) and Proximity Areas (dark blue hatch), CMA 1 - Littoral Rainforests (green) and Proximity Areas (green hatch), CMA 3 – Coastal Environment Area (light blue), CMA 4 – Coastal Use Area (orange)

Source: NSW Department of Planning and Environment (2016). Electronic mapping is not yet available.

This CMP identifies provisional CMA 2 areas that require a management response to mitigate the estuarine coastal hazards. Detailed studies on coastal lake entrance instability have been undertaken for the Tuross River Estuary and Coila Lake and Council has adopted entrance management policies to manage the risks associated with the entrances. While ongoing review of these policies is recommended, no current assets or infrastructure are considered to be at risk due to entrance instability and no additional management response is recommended (refer Appendix K - Entrance Management).

Tidal inundation is predicted to impact the estuaries and the surrounding land over the longer-term with sea level rise resulting in loss of land, impacts on estuarine vegetation and potentially inundation of infrastructure and farmland. While future planning of infrastructure and management of biodiversity will need to consider future water levels and storm events, no current hazards relating to tidal inundation are identified in this CMP. Further investigation and implementation of possible mitigation measures is recommended over the longer-term (refer Section G6.4, Appendix G - Biodiversity and Section L2.4, Appendix L - Community Uses).

Several sites on the Tuross River have been identified where bank erosion is presenting a risk to water quality, estuary health, riparian vegetation, community access and potentially the productivity of adjoining agricultural land. A risk assessment and prioritisation of rehabilitation measures for these sites has been undertaken as part of the *Tuross Estuary Water Quality Improvement Plan* (Southeast Engineering and Environmental, 2016). Provisional CMA 2 areas have been identified as the highest risk bank erosion sites as shown on Figure 11. Further discussion of the determination of the provisional CMA 2 areas is provided in Appendix I - Bank Erosion.

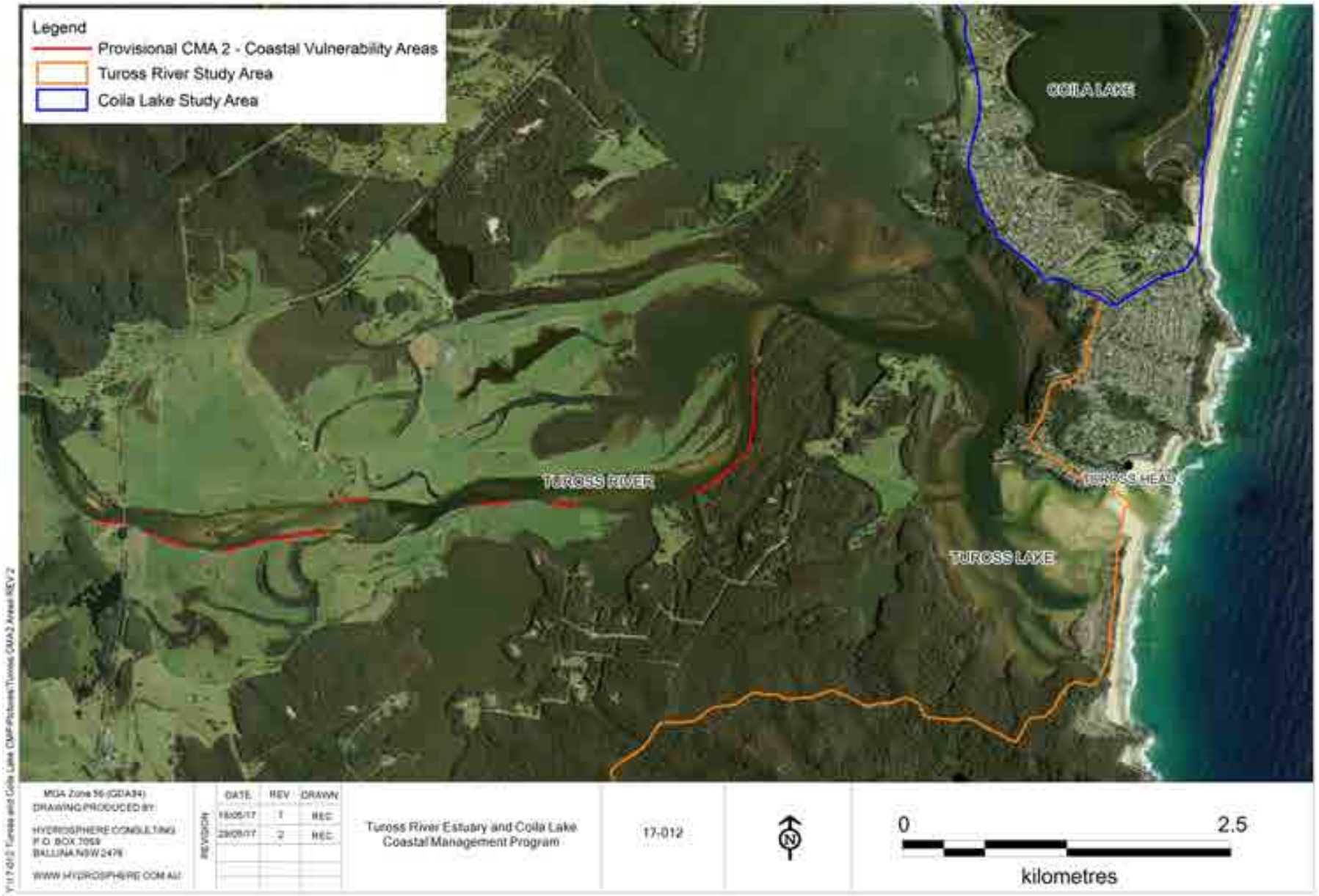


Figure 11: Provisional CMA 2 – Coastal vulnerability areas

1.6. Coastal Management Objectives

The objectives for each CMA are defined within the *Coastal Management Act, 2016*. The Draft Coastal Management SEPP defines how development will be managed in each area. Coastal management objectives for this CMP have been developed from the CMA objectives and community aspirations (Table 3).

Table 3: Coastal management objectives for the Tuross River Estuary and Coila Lake CMP

CMA	Adopted CMP Management Objectives
CMA1 – Coastal Wetlands and Littoral Rainforests[1]	1. to protect coastal wetlands and littoral rainforests in their natural state, including their biological diversity and ecosystem integrity; 2. to promote the rehabilitation and restoration of degraded coastal wetlands and littoral rainforests; 3. to improve the resilience of coastal wetlands and littoral rainforests to the impacts of climate change, including opportunities for migration; 4. to support the social and cultural values of coastal wetlands and littoral rainforests; and 5. to promote the objectives of State policies and programs for wetlands or littoral rainforest management.
CMA2 – Coastal Vulnerability Area	6. managing current and future risks from foreshore/bank erosion, coastal lake instability and tidal inundation; 7. maintaining public access, use and amenity of foreshores; 8. encourage land use that reduces exposure to coastal hazards over time; 9. avoiding adverse impacts on adjoining land, resources and assets; 10. maintaining essential infrastructure; and 11. improving the resilience of coastal communities.
CMA 3 – Coastal Environment Area	12. to protect and enhance the coastal environmental values and natural processes of the estuaries; 13. to enhance natural character, scenic value, biological diversity and ecosystem integrity; 14. to reduce threats to, and improve the resilience of the estuaries; 15. to maintain and improve water quality and estuary health; 16. to maintain the presence of natural features of foreshores; and 17. to maintain and, where practicable, improve public access, amenity and use of estuary foreshores.
CMA 4 – Coastal Use Area	18. to support sustainable coastal economies and ecologically sustainable development; and 19. to protect and enhance the scenic, social and cultural values of the study area through: • Appropriate type, size and scale of development; • Providing adequate public open space and associated public infrastructure; and • Avoiding adverse impacts of development on cultural and built environment heritage.

1. Objectives also apply to the 'proximity area' surrounding the vegetated area, to ensure that development near the coastal wetlands and littoral rainforest considers downstream effects.

1.7. Management Context

The estuaries and catchments consists of extensive areas of State Forest, Crown land, Council reserve, tourist facilities, grazing and horticulture land and urban developments and include a Sanctuary Zone and Habitat Protection Zones as part of the Batemans Marine Park. The estuary is managed and regulated by the following agencies and government authorities:

- ESC - the management of public spaces, assets and facilities;
- South East Local Land Services (LLS) has played a key role in the management of natural resources in the study area. South East LLS has been working in cooperation with ESC, landholders and OEH to deliver incentives aimed at improving biodiversity values and water quality through better industry practices;
- NSW Department of Industry including:
    - Department of Primary Industries (DPI) and the following divisions:
        - DPI Agriculture responsible for increasing the productivity and resilience of the agricultural sector;
        - DPI Fisheries regulates fishing, aquaculture, fish kills, invasive species and species, populations and communities listed as threatened under the *Fisheries Management Act 1994* and manages the Batemans Marine Park, a declared area in which activities are managed for the purpose of conserving marine biodiversity; and
        - NSW Food Authority licenses food processing businesses and works with local councils and NSW Health to ensure food produced, manufactured and sold in NSW is monitored and safe.
    - Department of Industry - 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.
- NSW Department of Planning and Environment including 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 includes both coastal and estuary management planning and the following agencies:
    - National Parks and Wildlife Service – management and conservation of land in national parks and reserves; and
    - Heritage – conservation of Aboriginal and non-Aboriginal heritage.
- Forestry Corporation of NSW – State Forests operational land is managed by the Southern Region - Batemans Bay office; and
- NSW Roads and Maritime Services (RMS) - navigation infrastructure, oil spill and vessel based pollution and boating.

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

- Council programs and strategies:
    - Local Environmental Plan (2012);
    - Community Strategic Plan, Delivery Program and Operational Plan;
    - Eurobodalla Shire Coastal Management Program (in preparation);
    - Residential Land Strategy;
    - Rural Lands Strategy; and
    - Integrated Water Cycle Management Strategy (2016).
- Agency programs in the broader area:
    - Batemans Bay Marine Park Operational Plan and Zoning Plan;
    - Forestry Corporation of NSW management plans; and
    - LLS South East Local Strategic Plan.

2. COMMUNITY AND STAKEHOLDER 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 CMP development process. Consultation activities undertaken for the 2005 EMP and this CMP are discussed in the following sections.

2.1. Previous Consultation Activities

Preparation of the 2005 EMP included:

- A public meeting;
- Liaison with the Estuary Management Committee;
- Print media and radio advertising;
- Community education brochures;
- Community questionnaire;
- Freecall 1800 number;
- Drop-in sessions at shopping centre;
- Attendance at local interest group meetings;
- Discussion with oyster farmers, commercial fishers, government agencies, environmental groups, progress association and individual community members;
- Workshop with government agencies, stakeholders and community representatives; and
- Public exhibition of the Draft EMS and EMP.

The outcomes of the 2005 consultation activities were used to determine the values for the estuary and develop the management objectives and strategies for the 2005 EMP.

At that time, the most common reasons that the Tuross Estuary and Coila Lake were important to the local community were:

- Preservation for future generations;
- Peace and tranquillity afforded by waterways;
- Ability to obtain contaminant free seafood;
- Clear swimming water in waterways;
- Native flora and fauna around waterways;
- Ability to access the waterways; and
- Views to the water around waterways.

The issues that were of most concern to the local community (and their current status) were:

- Tuross River Estuary:
    - overfishing by commercial operators (which subsequently ceased on 1 May 2002);
    - sewage and septic overflows to the estuary – now addressed through Council's Integrated Water Cycle Management Strategy;
    - decreasing water quality in estuary – water quality for ecosystem health continues to be a management issue;

- sediment build-up in the estuary – turbidity continues to be a management issue in relation to water quality;
- entrance closure of estuary – Council has since adopted a revised Entrance Management Policy and this is not currently a significant issue although concerns about entrance closure are ongoing; and
- degradation of wetlands around the estuary - ongoing.

- Coila Lake:
  - sewage and septic overflows to the lake – now addressed through Council's Integrated Water Cycle Management Strategy;
  - overfishing by commercial operators – there continues to be concerns due to the value of Coila Lake for prawning. Management of the fishery is the responsibility of DPI;
  - decreasing water quality in lake – Water quality monitoring indicates that Coila Lake water quality and overall aquatic health is generally better than that of Tuross River Estuary;
  - degradation of wetlands around lake – ongoing;
  - entrance closure of lake – Council has since adopted a revised Entrance Management Policy but this continues to be a concern for the community; and
  - poor land management practices in the catchment of the lake – some bank rehabilitation projects in Coila Creek have been implemented. Land management practices are now more of a concern for the Tuross River Estuary.

2.2. Consultation Activities Undertaken for this CMP

The focus of consultation undertaken for this CMP was:

- Informing the community of the EMP review;
- Allowing the community to raise issues to be addressed in the CMP and validate these issues in the field;
- Liaison with government agencies as required by the draft *Coastal Management Bill, 2016* including identification of any management issues, current projects or statutory requirements associated with the operations of each agency;
- Informing the ESC Coast and Environment Management Advisory Committee (CEMAC) of the outcomes of the EMP review; and
- Public exhibition in accordance with statutory requirements.

Preparation of this CMP included:

- Preparation of a Stakeholder Engagement Strategy (Appendix E);
- Liaison with Council staff and State government agency stakeholders (OEH, DPI, NPWS, South East LLS);
- A community drop-in session;
- A community field trip;
- Correspondence with residents and government agencies to promote the project, encourage input and advertise the community drop-in session and field trip; and
- Ongoing liaison with residents and government agencies.

The draft CMP was presented to the ESC CEMAC and placed on public exhibition so that feedback could be obtained from the community prior to Council adoption.

2.2.1. Issues raised by stakeholders

Issues raised by stakeholders were investigated as part of the development of this CMP and are discussed in detail, as relevant, in the following sections.

Community

The key issues raised by the community during consultation for this CMP were:

- The poor condition of the Kyla Park (Coila Lake) boat ramp, parking of boat trailers and insufficient rubbish bins;
- The lack of research/monitoring into the impact of commercial fishing – while this CMP discusses the recreational and commercial activities within the estuaries, DPI is responsible for the regulation of the NSW fisheries;
- The condition of the Tuross boat ramp;
- Flooding of paddocks and private assets since the trigger point for opening of Coila Lake was raised;
- The time taken to open Coila Lake once the trigger is reached;
- Access to Coila Lake through the National Park;
- Lack of picnic facilities at Monash Avenue reserve;
- Risk of sewage overflow from Tuross Head sewerage system and Bingie STP;
- The potential impact of the barrage on the Tuross estuary entrance;
- The impact of the proposed new southern water supply storage on the condition of Tuross estuary entrance, the oyster industry and ecology of the lower estuary;
- The decline in seagrass in the lower Tuross estuary;
- Odours and algae growth in Coila Lake; and
- Flood debris in the lower Tuross estuary.

The aspects of importance to the community listed in Section 2.1 (2005 EMP) are still considered relevant to the management of the estuaries. Many of the issues raised by stakeholders for this CMP are also consistent with the issues raised during the preparation of the 2005 EMP.

Agency stakeholders

OEH provided input into the CMP scoping study, fieldwork, management issues and options and review of the draft CMP.

DPI – Fisheries and DPI - Marine Parks provided input into the development of the CMP (attached in Appendix E) in relation to:

- Barriers to fish passage;
- Management and regulation of the fishery;
- Management of the Marine Park;
- The replacement or redevelopment of the Tuross boat ramp;
- Ongoing dredging at the site of the current boat ramp;
- Entrance management – Coila Lake;

- Design principles for foreshore protection works;
- Regulation of marine infrastructure works;
- Foreshore development;
- Protection of sensitive areas;
- Marine craft use;
- Management of riparian lands;
- Formalised public marine infrastructure for Coila Lake;
- Vehicle and stock damage to saltmarsh;
- Damage to seagrass from water craft; and
- Water quality protection for aquaculture.

DPI - Food Authority provided data on monitoring of oyster leases within the Tuross River.

South East LLS provided input into the development of the CMP in relation to:

- Projects completed and extension officer services; and
- Grant applications and potential future priorities.

NPWS provided input into the development of the CMP in relation to saltmarsh damage and National Park access road (attached in Appendix E).

2.3. Community Uses and Values

The values of the estuaries held by the local community, along with their general aspirations for the estuaries, were obtained for the 2005 EMP through a detailed program of consultation with the community (refer Section 2.1). These values have been reviewed and updated for this CMP and are summarised below.

- Social and recreational values:
    - Primary recreation - clean waterways for swimming;
    - Fish and prawn stocks – access to contaminant-free seafood;
    - Cultural heritage - the most prominent cultural values and sites around the study area stem from the Aboriginal history and significance of the estuary and surrounding area to the Aboriginal people.
    - Enjoyment of natural beauty;
    - Ability to access the waterways; and
    - Peace and tranquillity.
- Environmental Values:
    - Marine Park - The study area includes a Sanctuary Zone and Habitat Protection Zones within the Batemans Marine Park;
    - Terrestrial biodiversity - Endangered Ecological Communities (EECs) mapped within the study areas include Coastal Saltmarsh, Freshwater Wetlands on Coastal Floodplains, Littoral Rainforest, River Flat Eucalypt Forest on Coastal Floodplains, Swamp Oak Floodplain Forest, Bangalay Sand Forest, Bega and Candelo Dry Grass Forests and Bega Dry Grass Forest and Brogo Wet Vine Forest; and

- Estuarine macrophytes - the estuaries have a large proportion of seagrass beds, swamps, saltmarsh and intertidal sandflats. These are important habitat for fish and are highly valued nursery areas. The mangroves and saltmarshes are in very good condition and nearly all areas are mapped as CMA 1 – coastal wetlands (formerly SEPP 14 wetlands). Approximately 40 % of the banks in the lower and mid-Tuross River Estuary are in CMA 1 – coastal wetland areas and approximately 10 % in Coila Lake.

- Commercial Values:
  - Tourism - the estuaries are an important holiday destination for those people who do not wish to stay in a highly developed environment;
  - Commercial fishing - Coila Lake is utilised for commercial fishing by a number of licensed commercial fishers;
  - Agriculture - the study area supports agricultural land uses (grazing, dairy, horticulture); and
  - Aquaculture - the lower Tuross River Estuary is a priority oyster aquaculture area.

a

b

Figure 12: Examples of community uses and values

a. Recreational fishing. Source: Steffe *et. al.* (2005); b. Agriculture in Tuross River catchment.

3. ESTUARY PROCESSES AND ESTUARY HEALTH STATUS

A summary of the key estuary processes and health status for Tuross River Estuary and Coila Lake is provided in the following sections. Detailed discussions are provided in Appendix F to Appendix M.

3.1. Physical Characteristics

The key physical characteristics of the estuaries are outlined in Table 32.

Table 4: Tuross River Estuary and Coila Lake physical characteristics

Characteristic	Tuross River	Coila Lake	Notes
Catchment area	1,814 km^2	47.6 km^2	
Estuary area	15.5 km^2	7.1 km^2	Includes areas mapped as open water, mangrove and saltmarsh areas.
Estuary volume	18,208 ML	15,442 ML	Based on areas at 0.6 m AHD (Roper *et al.,* 2011)
Average depth	1.2 m	2.3 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 *et al.*, 2011)
Estuarine Macrophytes	Seagrass extent: 1 km^2 Saltmarsh extent: 0.8 km^2 Mangrove extent: 0.4 km^2	Seagrass extent: 1.4 km^2 Saltmarsh extent: 0.3 km^2 Mangrove extent: -	Based on 2012 mapping for Tuross River and 2004/05 mapping for Coila Lake

Source: Roper *et al*. (2011)

3.2. Key Estuary Processes and Health Status

The key estuary processes and ecosystem health indicators are described in detail in the 2001 EPS, the 2004 EMS and the 2005 EMP. Recent information is included in Appendices F to M and summarised in the following sections. The key management issues are further described in Section 4.

3.2.1. Tuross River Estuary

Tuross River Estuary is a complex waterbody comprised of shallow interconnecting channels and lakes. The entrance has generally remained open but was recorded to have closed during the 19th century and more recently closing during the droughts of 2006 and at the end of 2009. The environmental processes within the overall estuary are influenced by the condition of the entrance. The Tuross River Estuary is a barrier system separated from the ocean by a large coastal sand barrier (dune). The dominant coastal processes push sand northwards along South Tuross Beach and into the Tuross River Estuary entrance. The condition of the Tuross entrance is dependent on the relative balance between the longshore sand transport moving along the beach and the entrance scouring potential of freshwater discharges from large flood events (refer Appendix K - Entrance Management). In dry times, the entrance will be heavily shoaled and tend towards closure, while during wet weather the entrance can be quite large (WBM, 2004).

a b

c

Figure 13: Tuross River Estuary study area

a. Tuross River entrance; b. Agriculture in Tuross River catchment; c. Coopers Island oyster leases; d. Mid-estuary

High rainfall within the catchment can result in greater flushing of the entrance pushing sand out to sea, deepening the channel and allowing stronger tidal movement in and out of the estuary. Low rainfall allows coastal processes to build up sand banks in the entrance reducing tidal flushing of the estuary and the ability of marine organisms to migrate in and out of the estuary. Due to the many backwaters and lakes, some areas can experience relatively poor flushing impacting on environmental process within these sections, irrespective of whether the entrance is open, closed or heavily shoaled.

This estuary is recognised for its ecological importance as it is home to abundant and diverse aquatic communities and provides habitat for many protected and endangered species. The Tuross River Estuary is home to abundant estuarine vegetation including mangroves, saltmarsh and seagrass, that provide key habitats for many fish and bird species. A large majority of these areas are zoned as CMA 1 – coastal wetlands which are also classified as 'Key Fish Habitat' under the *Fisheries Management Act, 1994*. These areas are essential nursery grounds for many fish species in this estuary (refer Appendix G - Biodiversity).

Most of the environmental processes within the estuary are related in some way to the condition of the entrance. The degree of entrance constriction affects the tidal range, lag, current speed and hence tidal flushing within the estuary. With limited tidal flushing, especially when the entrance is restricted Borang Lake, Trunketabella Lagoon and Bumbo Lake are considered the most sensitive water bodies to potential water quality issues. Catchment development has increased the rate of erosion of the catchment, and thus the

infilling rate of the estuary and tributaries and erosion of banks due to the removal of riparian vegetation is also contributing to infilling.

Sand build-up at the entrance is the result of coastal processes with the flood-tide delta made up of marine (beach) sands rather than sediments resulting from catchment erosion (BMT WBM, 2010). Floods tend to push sand out of the entrance, allowing tides to move in and out of the estuary freely, Droughts cause the entrance to be heavily shoaled, with the dominant ocean processes pushing sand from the beach into the entrance.

The catchment area is predominantly comprised of conservation areas, National Parks and Nature Reserves, however large sections of land that border the estuary have been cleared for agriculture or urban development (refer Appendix F - Land Use and Development). This has resulted in increased nutrient and sediment run-off from these areas, impacting on water quality and the environmental processes within the estuary. Episodes of elevated sediment and nutrients within the estuary have been recorded, while erosion of estuary banks as a result of both natural and anthropogenic activities has been documented. This impacts not only the environmental processes but also recreational activities including fishing.

Since the 2005 EMP a number of reviews, monitoring programs or mitigation projects have been undertaken and implemented with the goal of improving the health of the Tuross River Estuary. The estuary is considered to be in relatively good condition, impacted by relatively low anthropogenic disturbance, when considering its whole catchment compared to the majority of estuaries along the NSW coast. However it is considered to have the poorest overall health out of the six major estuaries located within the Eurobodalla Shire (Roper *et.al* 2009).

The water quality of Tuross River Estuary is considered to be good in most parts of the mid-lower estuary with water quality suitable for swimming most of the time (refer 2015/16 Water Quality Report Card in Appendix H - Water Quality). However, the water may be susceptible to pollution from potential sources of faecal contamination occasionally. In 2015/16, aquatic health (chlorophyll *a*) was graded from very good to good and turbidity was graded good to fair throughout the estuary.

The overall health of the estuary has been impacted by agricultural and urban development. This has been detrimental to water quality due to increased pollutant loads from sediment and nutrient run-off. Catchment modelling undertaken by OEH and water quality sampling programs have identified possible sources/areas of sediment and nutrient run-off. The data collected as part of the estuarine health monitoring project indicates that water quality and overall health is improving. However turbidity has increased in the last few years potentially as a result of bank erosion and sediment run-off from urban and agricultural areas. This is likely to be impacting on the health of the estuary and is currently being addressed through the Tuross Estuary Water Quality Improvement Plan 2016 which identifies priority areas for bank revegetation and stabilisation (refer Appendix I - Bank Erosion).

Estuarine vegetation provides key habitat for marine organisms, helps to minimise erosion and also act as a buffer and filtration system for sediment and nutrients entering the estuary. Therefore estuarine vegetation has a significant influence on estuarine health. A substantial decrease in estuarine vegetation coverage within the Tuross River Estuary has been documented from the 2012 estuarine mapping project. In particular seagrass and mangroves, which are key nursery areas for both recreational and commercial fish and crustacean species have declined (refer Appendix G6 - Estuarine Vegetation).

3.2.2. Coila Lake

Coila Lake is large shallow ICOLL (intermittently closing and opening lagoon or lake) with a number of small tributaries. Longshore sand transport processes tend to dominate the entrance dynamics resulting in a closed entrance condition for the majority of the time (refer Appendix K - Entrance Management). The Coila Lake entrance can open naturally, normally following a flooding event, however the majority of openings have been artificial (WBM, 2004). Once opened, the lake will remain connected to the sea for a relatively

short period. The length of time that it remains open is dependent on the water level of the lake prior to breakout (and hence the degree of scour at the entrance) and the occurrence of coastal storms (WBM, 2004). The large lake area enables the lake to accommodate long periods of rainfall without opening and to survive long periods of evaporation. The large lake relative to catchment size results in fluvial inflows that are insufficient to overcome the processes of tide and ocean, restricting the lake to being intermittently open. Coila Lake, with its relatively small catchment to waterway size, has low flow rates under average rainfall conditions, which enable entrance berm building to occur quickly following a breakout event (BMT WBM, 2010).

The catchment area for this waterbody is considerably smaller that the Tuross River Estuary. As the entrance is predominantly closed to the ocean the Lake is not regularly flushed compared to the Tuross River. The water level and salinity within the lake impact on the estuarine and riparian vegetation distribution and extent. Seagrass and saltmarsh are both present within the estuary providing ecologically significant habitat. The upper reaches of the estuary are classified as CMA 1 - coastal wetlands and are within the 'Sanctuary Zone' of the Batemans Bay Marine Park (refer Appendix G - Biodiversity).

a

b

c

d

Figure 14: Coila Lake study area

a. Coila Lake entrance; b. Coila Lake south-east shore; c. Coila Creek; d. Kyla Park boat ramp

Sedimentation within the estuary has increased due to development of the catchment (Brown and Root, 2001). The majority of the catchment is forested however substantial agricultural and urban development has occurred around the foreshore of the estuary increasing the potential for sediment and nutrient run-off. This

is likely to be impacting on the water quality in the Lake which not only impacts on ecological processes but also recreational activities and commercial fishing (refer Appendix H - Water Quality).

Water quality monitoring indicates that Coila Lake water quality and overall aquatic health is generally better than that of Tuross River Estuary. The water quality of Coila Lake is considered to be good in most parts of the mid-lower estuary with water quality suitable for swimming most of the time (refer 2015/16 Water Quality Report Card in Appendix H - Water Quality). However, the water may be susceptible to pollution from potential sources of faecal contamination occasionally. In 2015/16, aquatic health (chlorophyll *a*) was graded fair and turbidity was graded good to very good within the estuary. Mapping of estuarine macrophytes undertaken in 2004/05 (refer Appendix G6 - Estuarine Vegetation) indicates that seagrass extent has decreased and saltmarsh area has increased (since 1985).

4. MANAGEMENT ISSUES AND THREATS

4.1. Key Management Issues and Threats

Previous studies and plans have been reviewed to determine the current management issues facing the Tuross River Estuary and Coila Lake including:

- The CMP Scoping Study (ESC, 2016);
- The *Tuross Estuary and Coila Lake Estuary Processes Study* (Brown and Root, 2001);
- The current status of issues and actions identified in the 2005 EMP (refer Appendix C);
- Water quality and estuarine health monitoring including estuary health report cards;
- The *Tuross Estuary Water Quality Improvement Plan* (Southeast Engineering and Environmental, 2016);
- Entrance management policies and environmental assessment (BMT WBM, 2010);
- The *Eurobodalla Shire Integrated Water Cycle Management Strategy and Strategic Business Plan* (Hydrosphere Consulting, 2016)
- Cultural heritage studies;
- ESC sea level rise policy;
- Environmental mapping prepared by ESC;
- Catchment modelling and risk assessments prepared by OEH;
- Historical aerial photography;
- Mapping of SEPP 14 Coastal Wetlands, SEPP 26 Littoral Rainforest and the draft Coastal Management SEPP;
- Estuarine vegetation mapping; and
- Field work undertaken by ESC and OEH to identify bank erosion and estuarine and riparian vegetation issues.

The current management issues were validated through stakeholder consultation and fieldwork.

The issues and their causes are discussed in the following sections with detailed information provided in Appendix H to Appendix L. The key issues are illustrated on Figure 15 and Figure 16.

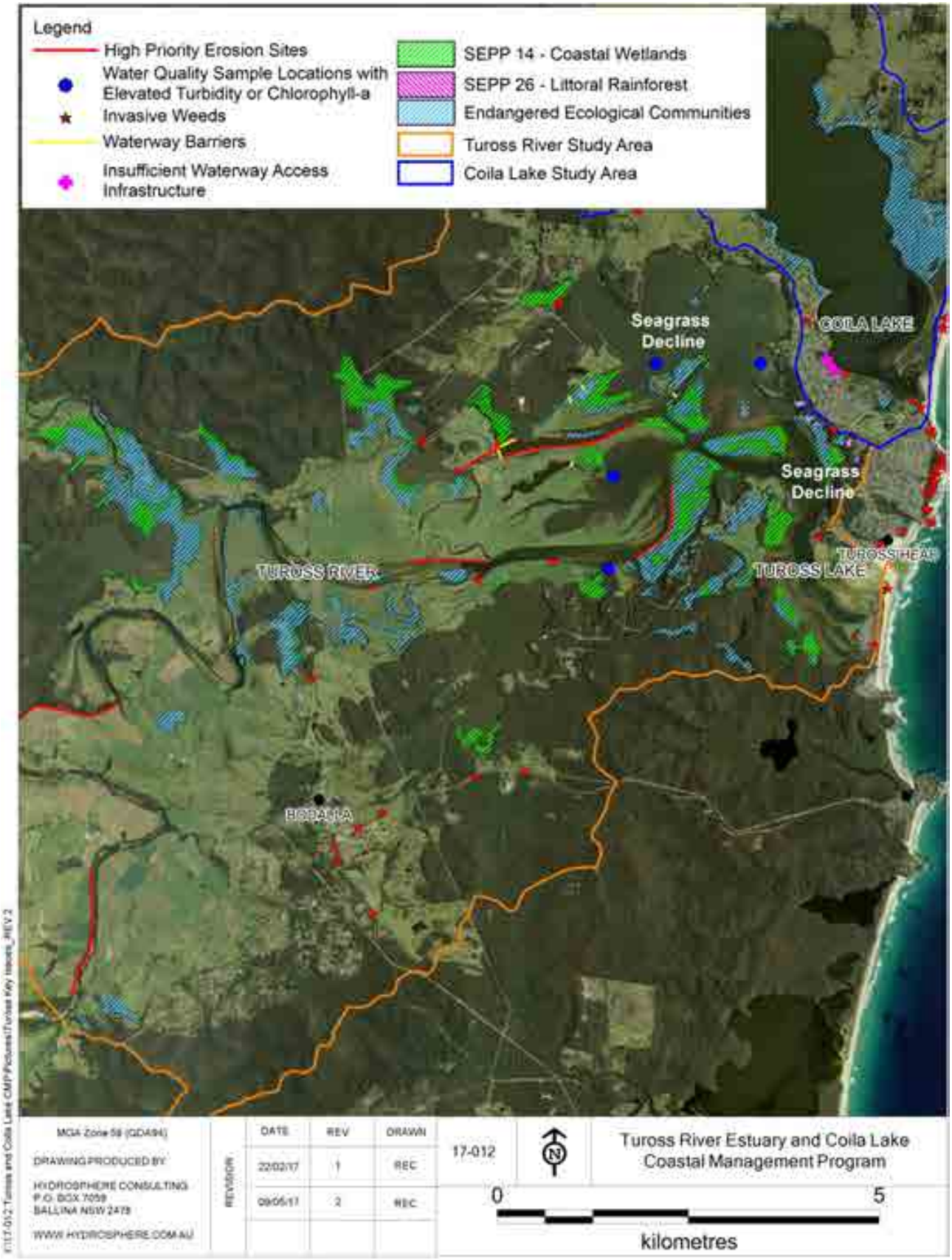


Figure 15: Tuross River Estuary key management issues

Note: Only high priority erosion sites are shown on this figure. All bank erosion sites are shown on Figure 78 in Appendix I.

Figure 16: Coila Lake key management issues

4.1.1. Water quality

Key water quality issues have been determined from the findings of the 2005 EMP, recent routine monitoring of the estuaries in the estuary health monitoring program and the BMT WBM (2011) estuary health monitoring program review. Detailed information is provided in Appendix H - Water Quality.

Most water quality studies highlight that there are activities and processes within the Tuross River Estuary and Coila Lake that are having a detrimental effect on water quality and estuary health. Evaluated chlorophyll *a* (a parameter used to understand levels of phytoplankton biomass and tracking changes in algal growth) and turbidity levels in the estuaries have been historically observed. Anthropogenic(human) activities within the Tuross River and Coila Lake catchments such as urban development (Tuross Head) and primary production (including forestry and agriculture) are linked to these water quality issues. Run-off from these areas can carry elevated levels of sediment and nutrients from areas with extensive land clearing or hard surfaces into the surrounding estuarine habitats. Bank erosion, cattle access to the waterways and lack of riparian vegetation contribute to the elevated chlorophyll *a* and turbidity levels. Stormwater outlets to Coila Lake also cause erosion and ponding in channels as well as transport gravel and sediments from the road surfaces to the estuary.

Water quality monitoring indicates that there are locations within the Tuross River Estuary that are currently experiencing elevated levels of nutrient and sediment input which is detrimental to ecosystem health. A Water Quality Improvement Plan for the Tuross River Estuary identified three frequently observed water quality issues:

- Sediment and nutrient loads associated with agricultural activities, including cropping with no, or limited buffers before runoff reaches watercourses;
- Stock access to the top of bank and/or water's edge with little to no riparian buffer and associated erosion, pollution and nutrient addition effects; and
- Steep banks (sub-vertical) with high exposure to main channel flows (i.e. located on outside bend or other areas where flows are greatest directly alongside the bank) and associated erosion, sedimentation and property loss.

Ecosystem health monitoring suggests Coila Lake water quality is better than that of Tuross River Estuary as water quality parameters have generally below guideline levels for ecosystem health.

Introduction of toxic materials into the estuaries not only impacts on the health of the ecosystem but can also impact on the people who utilise the estuary for recreational and commercial purposes. Both the Tuross River Estuary and Coila Lake are utilised for recreational fishing and water activities, such as boating and swimming, while the Tuross River Estuary is commercially utilised for oyster farming and Coila Lake for prawning. Maintenance of the health of the estuaries is a key component of protecting these values. The Water Quality Report cards indicate that both estuaries are suitable for primary recreation most of the time. Ongoing monitoring will identify any issues with recreational water quality in future.

4.1.2. Bank erosion

Bank erosion has been identified as key issue effecting estuary health through impacts on water quality and loss of riparian and estuarine vegetation and productive farmland, particularly in the Tuross River Estuary (refer Appendix I). This was previously identified as a key issue during the 2005 EMP and continues to be a key management issue for the estuaries. The main causes of erosion have been identified as natural river meander, lack of riparian vegetation cover, boat wash, steepness of banks and bank seepage and sediment composition (Brown and Root, 2001). The 2004 EMS also identified waterway barriers such as the Deuaumba Island causeway and Coopers Island Road weir as causing or contributing to erosion around the Islands and the Four Ways due to the altered tidal and flood flows.

The Water Quality Improvement Plan for the Tuross River Estuary identified the main causes of bank erosion as stock access to the top of bank and/or water's edge with little to no riparian buffer and steep banks with high exposure to main channel flows (refer Section 4.1.1). Bank erosion at sites with limited riparian buffer and steep banks along the Tuross River Estuary main channel are shown in Figure 17.

Figure 17: Examples of active bank erosion observed November 2017 along Tuross River main channel

The risk of significant change in the alignment of the main river channel (avulsion) resulting from erosion of the western banks of Cambathin Island (Figure 18) has been identified previously (Brown and Root, 2001; WBM, 2004) and remains an unresolved issue. The predicted impacts of the breakthrough include loss of estuarine vegetation, the disturbance of fine nutrient rich sediment and areas of high flow within the estuary becoming quiescent.

Figure 18: Bank erosion observed November 2017 along Cambathin Island

4.1.3. Waterway barriers

Artificial waterway barriers within estuaries can restrict normal tidal flow and flushing and impact on fish passage. The 2004 EMS and 2005 EMP identified Deuaumba Island causeway as a tidal restriction which maybe contributing to erosion in the area. Five other causeways that potentially impact tidal flow and fish passage within the Tuross River Estuary have been identified (Section F6, Appendix A). The waterway barriers have the potential to impact other areas of estuarine health such as water quality, fish stocks and ecologically significant estuarine vegetation areas.

During dry periods, the suppressed freshwater flows tend to allow saltwater into the upper reaches of estuary. A temporary barrage has been used to limit the penetration of the saline intrusion. DPI Fisheries (J. Reynolds pers. comm.) has advised that the barrage has not been installed for at least seven years. A portable timber fishway must be installed whenever the barrage is deployed and when the flow is so low to require a barrage there is generally very little fish migration occurring. Prior to the barrage being installed a licence is required from the NSW Office of Water and DPI Fisheries impose any fish passage requirements through this licence.

4.1.4. Impacts on estuarine vegetation

A number of studies have mapped and compared estuarine vegetation in the Tuross River Estuary and Coila Lake, documenting the extent and change in seagrass, mangrove and saltmarsh distribution (Section G6, Appendix G). Three mapping studies have been completed in the Tuross River Estuary, undertaken in 1985, 2004/05 and 2012 (West, 1985; Williams *et.al.,* 2006; DPI Fisheries, 2012). These studies have documented several changes in estuarine vegetation coverage in particular seagrass. From 1985 to 2004/05 there was a 75% increased in seagrass coverage, followed by a 52% decrease from 2004/05 to 2012. Large extents of this decrease occurred adjacent to Bodalla State Forest, Bowns Bay, east of Reedy Island and north of Cooper Island (ESC, 2012). Two mapping studies have been undertaken in the Coila Lake completed in 1985 and 2004/05 (West 1985; Williams *et.al* 2006). These studies documented a 26% decrease in seagrass coverage in the Lake over this time period. Coila Lake was not mapped during the 2012 mapping study.

Decrease in seagrass habitat is a concern as these areas are ecologically significant habitats that are classified as key fish habitats and essential nursery grounds for many commercial and recreational species. However these studies and other documented observations indicate that seagrass distribution varies considerably in these estuaries which is likely to be due to both natural estuarine processes and anthropogenic influences. Seagrass habitats can be impacted through increased pollutant loads resulting in elevated levels of sediment and nutrients in the estuaries which can lead to a decrease in seagrass habitats via smothering and reduced water clarity. Increased pollutant loads within these estuaries as a result of urban and agricultural development within the catchments has been identified as a key issue as discussed in Section 4.1.1.

Saltmarsh is recognised as ecologically significant habitat that is key habitat for many shorebird and marine species including juvenile fish during high tides. Many of these areas are classified as CMA 1 - coastal wetlands within both watercourses and are protected under the *Fisheries Management Act, 1994*. Areas of saltmarsh (including the endangered *Wilsonia rotundifolia*) along Coila Creek have been protected and restored through measures implemented as part of the Eurobodalla Biodiversity Program (refer Section G6.3, Appendix G).

A saltmarsh community located on the south-east shores of Coila Lake (not classified as CMA 1 - coastal wetlands) is currently being impacted by vehicular access. This area is utilised as an informal access to Coila Lake and to Bingie Beach via the bordering dune system. This is having a detrimental impact on the saltmarsh and is a key community concern regarding pedestrian safety, damage to threatened shorebird nests and habitat, damage to dune structure and dune vegetation and illegal clearing of native vegetation, camping, fires and dumped rubbish. The Bingi Dreaming Track, which is of Aboriginal cultural significance, traverses through this areas and is at risk of impact (refer Appendix M). Sea-level rise is also likely to impact this area potentially resulting in decreased saltmarsh coverage as a consequence of ‘coastal squeeze’ (Section G6.4, Appendix G).

Figure 19: Damage to saltmarsh, Coila Lake

A loss of mangroves has been observed around Smarts Creek and Turlinjah during dry periods when the Coila Lake entrance is closed (due to the reduced tidal variation). Once the tidal influence is restored, the mangroves have recovered.

4.1.5. Insufficient waterway access/infrastructure

Appropriate access to both waterways for commercial and recreational purposes is essential to the local community and a key value of the estuaries. Current formalised access to Coila Lake is at Kyla Park and Foam Street on the southwest shoreline of Coila Lake. Both these boat access points are low-lying gravel ramps that require regular grading/resurfacing. These low-lying areas also have the potential to be inundated as a result of sea-level rise, restricting future access to the lake (Section L2.4, Appendix L). The potential closure of the informal access points to the north, the current state of formal access points and the potential impact of sea-level rise means that appropriate measure should be undertaken to upgrade/create appropriate and safe access points for both commercial and recreational waterway users. Limited infrastructure at the existing boat ramps (parking, rubbish bins and lightings) has also been raised as a concern by the community.

Due to its proximity to the estuary entrance the Tuross River estuary boat ramp is subject to movement of the entrance sand shoals, which have been progressively enveloping the ramp access. This has resulted in poor useability of the ramp at low tides. Increased droughts as a projected impact of climate change and the resulting prolonged low water levels may also impact on the serviceability of the Coila Lake ramps due to exposure of mud and shallow water depths at launching points. As part of its asset management planning process, ESC will develop priorities for waterway infrastructure and investigate potential sources of funding.

4.1.6. Terrestrial weeds

Terrestrial weeds, including blackberries and lantana, have been identified within the estuaries (Section G3, Appendix G). The 2005 EMP identified terrestrial invasive weeds as an ongoing issue impacting on biodiversity within the area. ESC currently undertakes inspections and implements mitigation measure to help control invasive species in the area.

4.1.7. Sea level rise

Sea-level rise is expected to increase the average water depths and extend tidal propagation in Tuross River Estuary and Coila Lake (Appendix J). Sea-level rise has the potential to significantly impact the estuaries and the surrounding land over the longer-term. Sea-level rise will result in estuarine vegetation and CMA 1 -

coastal wetlands habitat migration into riparian areas, in particular saltmarsh. This migration will be impacted at a number of locations throughout the estuaries by natural (foreshore banks) and artificial (footpaths, roads and rock walls) barriers (Section G6.4, Appendix G). The will potentially result in loss of key ecologically significant habitat due to 'coastal squeeze'. Loss of land and the impact on estuarine vegetation migration due to agricultural practices is also a key concern, with the potential for sea-level rise to inundate infrastructure and farmland.

Sea-level rise will also inundate waterway access points and impact urban stormwater systems and future planning of infrastructure will need to consider future water levels and storm events.

4.1.8. Entrance management

The environmental processes that occur within both Tuross River Estuary and Coila Lake are linked to entrance dynamics and condition. The management of both entrances is governed by the Entrance Management Policies adopted in 2010 (Appendix K). These polices outline the water level at which a closed entrance is to be artificially opened to prevent inundation of low-lying property. The aim of these policies is to minimise the degree of artificial openings allowing for natural process to govern the entrances.

The current trigger level for Tuross River and Coila Lake entrance opening may result in localised inundation of low-lying properties and infrastructure and has been raised as an issue by some of these landholders. The current entrance management policies require that the breakout levels are progressively increased in the future to facilitate adaptation to future climate change (especially sea level rise), and to reduce the on-going need for artificial entrance intervention.

4.2. Threats to Estuary Values

The following table summarises key management issues affecting the Tuross River Estuary and Coila Lake, the threats and threatening processes contributing to these issues and the estuary values affected by the issues.

Table 5: Management issues, threats and values affected

Management Issue	Location/CMAs	Threatening processes	Social and recreational values affected	Environmental values affected	Commercial values affected
Environmental Issues – Tuross River Estuary					
Water quality – in particular elevated chlorophyll a and turbidity have been observed recently	Mid-estuary: CMA1 – coastal wetlands and littoral rainforests CMA3 – coastal environment area CMA4 – coastal use area	• Agricultural practices – sediment and nutrient runoff, limited riparian buffer, cropping and stock access to banks and waterways at sites shown on Figure 15 • On-site sewage management on rural and semi-rural lots • Urban sewage discharges • Urban stormwater runoff in lower estuary • Bank erosion and sedimentation	• Primary recreation • Fish and prawn stocks • Cultural heritage	• Marine park • Terrestrial biodiversity • Estuarine macrophytes	• Tourism • Aquaculture
Bank erosion causing: • Poor water quality through increased turbidity and nutrients, • Loss of farming land • Avulsion	Mid-upper estuary: CMA1 – coastal wetlands CMA2 – (provisional) coastal vulnerability areas CMA3 – coastal environment area CMA4 – coastal use area	• Agricultural practices – limited riparian buffer, stock access to banks and waterways, • Boat wash • Wind generated waves • Bank seepage • Lack of riparian vegetation • Tidal barriers	• Primary recreation • Fish and prawn stocks • Cultural heritage • Enjoyment of natural beauty	• Marine park Habitat Protection Zone • Terrestrial biodiversity • Estuarine macrophytes	• Tourism • Agriculture • Aquaculture
Loss of seagrass	Lower estuary: CMA1 – coastal wetlands CMA3 – coastal environment area	• Agricultural practices – sediment and nutrient runoff, limited riparian buffer, stock access • Bank erosion and sedimentation • Boats • Urban development • Tidal barriers • Sea level rise	• Fish and prawn stocks • Cultural heritage • Enjoyment of natural beauty	• Marine park Habitat Protection Zone • Estuarine macrophytes	• Aquaculture • Commercial fishing

Management Issue	Location/CMAs	Threatening processes	Social and recreational values affected	Environmental values affected	Commercial values affected
Terrestrial weeds	Lower-mid estuary: CMA3 – coastal environment area	• Land management practices – clearing, sediment and nutrient runoff, limited riparian buffer, waterways; • Urban development – stormwater runoff • Dumping of garden rubbish.	• Enjoyment of natural beauty • Cultural heritage	• Marine park • Terrestrial biodiversity	• Agriculture
Waterway barriers	Muddy Island, Deuaumba Island: CMA1 – coastal wetlands CMA3 – coastal environment area	• Reduced tidal exchange • Fish passage barrier • Sea level rise	• Primary recreation • Fish and prawn stocks	• Marine park • Estuarine macrophytes • Fish breeding/ life cycles	• Agriculture
Sea level rise • Restricted migration of estuarine vegetation	Lower estuary: CMA1 – coastal wetlands CMA3 – coastal environment area CMA4 – coastal use area	• Increased flooding • Higher marine water level • Barriers to migration of estuarine vegetation	• Primary recreation • Ability to access the waterways • Enjoyment of natural beauty	• Marine park • Estuarine macrophytes	• Agriculture
Social Issues – Tuross River Estuary					
Insufficient waterway access/infrastructure • Reduced water access • Decline in tourism	Lower estuary: CMA3 – coastal environment area CMA4 – coastal use area	• Large numbers of holiday visitors • Boat ramp inaccessible at low tide • Sea level rise	• Primary recreation • Enjoyment of natural beauty • Ability to access the waterways		
Sea level rise • Reduced water access	Lower estuary: CMA1 – coastal wetlands CMA3 – coastal environment area CMA4 – coastal use area	• Increased flooding • Higher marine water level • Barriers to migration of estuarine vegetation	• Primary recreation • Ability to access the waterways • Enjoyment of natural beauty	• Marine park • Estuarine macrophytes	• Agriculture

Management Issue	Location/CMAs	Threatening processes	Social and recreational values affected	Environmental values affected	Commercial values affected
Environmental Issues – Coila Lake					
Bank erosion causing: • Poor water quality through increased turbidity and nutrients, • Loss of farming land	Coila Creek: CMA1 – coastal wetlands CMA3 – coastal environment area	• Agricultural practices – limited riparian buffer, stock access to banks and waterways • Bank seepage • Lack of riparian vegetation	• Primary recreation • Fish and prawn stocks • Cultural heritage • Enjoyment of natural beauty	• Marine park Sanctuary Zone • Terrestrial biodiversity • Estuarine macrophytes	• Tourism • Agriculture • Commercial fishing
Loss of seagrass	Lower estuary: CMA1 – coastal wetlands CMA3 – coastal environment area	• Agricultural practices – sediment and nutrient runoff, limited riparian buffer, stock access • Bank erosion and sedimentation • Boats • Urban development • Sea level rise	• Fish and prawn stocks • Cultural heritage • Enjoyment of natural beauty	• Marine park Sanctuary Zone • Estuarine macrophytes	• Commercial fishing
Saltmarsh damage	Lower estuary: CMA1 – coastal wetlands CMA3 – coastal environment area	• Vehicular damage • Agricultural practices – grazing • Sea level rise	• Enjoyment of natural beauty	• Estuarine macrophytes	
Terrestrial weeds	Lower-mid estuary: CMA3 – coastal environment area	• Land management practices – clearing, sediment and nutrient runoff, limited riparian buffer, waterways; • Urban development – stormwater runoff • Dumping of garden rubbish.	• Enjoyment of natural beauty • Cultural heritage	• Marine park • Terrestrial biodiversity	• Agriculture
Sea level rise • Restricted migration of estuarine vegetation	Lower-mid estuary: CMA1 – coastal wetlands CMA3 – coastal environment area CMA4 – coastal use area	• Increased flooding • Higher marine water level • Barriers to migration of estuarine vegetation • Loss of habitat areas	• Primary recreation • Ability to access the waterways • Enjoyment of natural beauty	• Marine park • Estuarine macrophytes	• Agriculture

Management Issue	Location/CMAs	Threatening processes	Social and recreational values affected	Environmental values affected	Commercial values affected
Social Issues – Coila Lake					
Insufficient waterway access/infrastructure	Lower estuary: CMA3 – coastal environment area CMA4 – coastal use area	• Conflicts between recreational and commercial fishers • Informal waterway access points • Lack of bins • Lack of trailer parking • Large numbers of holiday visitors • Ongoing maintenance requirements of gravel ramps • Sea level rise	• Peace and tranquillity • Primary recreation • Fish and prawn stocks • Cultural heritage • Ability to access the waterways • Enjoyment of natural beauty	• Marine park • Estuarine macrophytes	• Commercial fishing
Entrance management regime causing: • Flooding of infrastructure • Flooding of farmland • Reduced waterway access	Entrance: CMA1 – coastal wetlands CMA3 – coastal environment area CMA4 – coastal use area	• Entrance management policy trigger levels • Sea level rise	• Ability to access the waterways • Amenity of private property • Ability to access private property	• Marine park • Estuarine macrophytes	• Agriculture • Commercial fishing
Sea level rise • Reduced water access	Lower-mid estuary: CMA1 – coastal wetlands CMA3 – coastal environment area CMA4 – coastal use area	• Increased flooding • Higher marine water level • Barriers to migration of estuarine vegetation	• Primary recreation • Ability to access the waterways • Enjoyment of natural beauty	• Marine park • Estuarine macrophytes	• Agriculture

4.3. Risk Assessment

4.3.1. Strategic priorities

Strategic responses to the identified management issues and threats have been developed using a risk assessment methodology based on the *Threat and Risk Assessment Framework for the NSW Marine Estate* (Marine Estate Management Authority, 2015). The threats to the estuary values have been prioritised based on the risk (a combination of likelihood of a threat occurring and consequence of the threat) they pose to community values, so that management efforts can focus on addressing the most important issues. This is designed to assess the adequacy of current management approaches and alternative options for addressing priority threats and implement the most cost effective management actions to address the threats.

The risk is a function of the 'likelihood' and 'consequence' of a threat actually being realised as shown in Table 6 and Table 7. The colour-coded risk matrix (Table 8) shows the risk each threat poses to the values, with an overall risk to each value (the bottom row) and an overall risk of each threat (the far-right column).

Table 6: Definition of likelihood and consequence

Likelihood	
Rare	Not expected to impact on the value within the next 20 years
Unlikely	Not expected to impact on the value within the next 10 years but expected within 20 years
Possible	Not expected to impact on the value every year but expected within 10 years
Likely	Not expected to impact on the value continuously but expected every year
Almost certain	Expected to impact on the value frequently or continuously
Consequence	
Insignificant	No impact or only to the extent that it has no discernible effect on the value
Minor	Small or temporary impact on the overall condition of the value
Moderate	Significant effect on the value at a regional level
Major	Value is substantially impacted for an extended period (5-10 years)
Catastrophic	Value is impacted permanently and irreversibly

Source: Adapted from Marine Estate Management Authority (2015)

Table 7: Risk assessment matrix

Likelihood	**Level of Risk**				
Almost certain	Minimal	Low	Moderate	High	High
Likely	Minimal	Low	Moderate	High	High
Possible	Minimal	Minimal	Low	Moderate	High
Unlikely	Minimal	Minimal	Minimal	Low	Moderate
Rare	Minimal	Minimal	Minimal	Low	Low
Consequence level	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**

Source: Adapted from Marine Estate Management Authority (2015)

Table 8: Risk assessment – Tuross River Estuary and Coila Lake threats and values

Management Issue/ Threat (as described in Table 5)	Threatened Social and Recreational Values						Threatened Environmental Values			Threatened Commercial Values				Overall Risk
	Primary recreation	Fish and prawn stocks	Cultural heritage	Enjoyment of natural beauty	Ability to access the waterways	Peace and tranquillity	Marine Park	Terrestrial biodiversity	Estuarine macrophytes	Tourism	Commercial fishing	Agriculture	Aquaculture	
Environmental Issues – Tuross River Estuary														
Agricultural practices	Moderate	Low	Minimal	Minimal	Moderate		Moderate	Moderate	Low	Low	Moderate		Moderate	High
On-site sewage management	Low	Minimal	Minimal	Minimal			Minimal		Low		Moderate		Moderate	Moderate
Urban sewage discharges	Low	Minimal	Minimal	Minimal			Minimal		Low		Moderate		Moderate	Moderate
Urban stormwater runoff	Low	Minimal	Minimal	Minimal			Minimal		Low		Moderate		Moderate	Moderate
Bank erosion causing increased turbidity and nutrients	Moderate	Low	Minimal	Minimal	Moderate		Moderate		Low	Low	Moderate		Moderate	High
Bank erosion resulting in avulsion	Moderate	Minimal	Minimal	Minimal	Minimal		Moderate	High	Minimal	Minimal	Minimal	Low	Low	Moderate
Loss of seagrass		Minimal	Minimal	Minimal			Low		Moderate		Minimal			Minimal
Terrestrial weeds	Minimal		Low	Moderate				Moderate		Minimal		Moderate		Moderate
Waterway barriers	Low	Low							Low				Low	Minimal
Sea level rise restricting migration of estuarine vegetation		Minimal		Minimal			Minimal		Low		Minimal			Minimal
Social Issues – Tuross River Estuary														
Insufficient waterway access/ infrastructure	Moderate			Moderate	Moderate					Moderate	Moderate		Low	Low
Sea level rise reducing water access	Minimal			Minimal	Low					Low	Minimal			Minimal
Sea level rise causing loss of farming land												Moderate		Minimal
Bank erosion causing loss of farming land												High		Minimal

Management Issue/ Threat (as described in Table 5)	Threatened Social and Recreational Values						Threatened Environmental Values			Threatened Commercial Values				Overall Risk
	Primary recreation	Fish and prawn stocks	Cultural heritage	Enjoyment of natural beauty	Ability to access the waterways	Peace and tranquillity	Marine Park	Terrestrial biodiversity	Estuarine macrophytes	Tourism	Commercial fishing	Agriculture	Aquaculture	
Environmental Issues – Coila Lake														
Agricultural practices	Moderate	Low	Minimal	Minimal	Moderate		Moderate		Low	Low	Moderate			High
On-site sewage management	Low	Minimal	Minimal	Minimal			Minimal		Moderate		Moderate			Moderate
Urban sewage discharges	Low	Minimal	Minimal	Minimal			Minimal		Moderate		Moderate			Moderate
Urban stormwater runoff	Low	Minimal	Minimal	Minimal			Minimal		Moderate		Moderate			Moderate
Bank erosion causing turbidity and nutrients	Moderate	Low	Minimal	Minimal	Moderate		Moderate		Low	Low	Moderate			High
Loss of seagrass		Minimal	Minimal	Minimal			Low		Moderate		Minimal			Minimal
Loss of saltmarsh			Minimal	Minimal			Low		Moderate					Minimal
Terrestrial weeds	Minimal		Low	Moderate				Moderate		Minimal		Moderate		Moderate
Sea level rise restricting migration of estuarine vegetation		Minimal		Minimal			Minimal		Low		Minimal			Minimal
Social Issues – Coila Lake														
Insufficient waterway access/ infrastructure	Moderate			Moderate	Moderate					Moderate	Moderate			Low
Sea level rise reducing water access	Minimal			Minimal	Low					Low	Minimal			Minimal
Bank erosion causing loss of farming land												High		Minimal
Overall risk	High	Low	Low	Moderate	Moderate	Minimal	Moderate	Minimal	High	Low	High	Low	Low	

The threats posing the highest risk to the estuary values are agricultural practices and bank erosion causing increased turbidity and nutrients. Many of these threats are a legacy of past agricultural practices such as vegetation clearing and the lack of riparian buffers, stock access to the waterway through unfenced riparian zones and cropping to the top of the banks. The most threatened values are primary recreation, commercial fishing and estuarine macrophytes.

The likely timing and the geographic extent of the threats (temporal and spatial extent) is shown in Table 9.

Table 9: Spatial and temporal effects of the threats

When is the impact likely to start?			
Current	**Next 10 years**	**> 10 years**	**What is the spatial extent of the impact?**
• Terrestrial weeds			**Regional**
• Agricultural practices • On-site sewage management • Urban sewage discharges • Urban stormwater runoff • Bank erosion causing turbidity and nutrients • Loss of seagrass • Bank erosion causing loss of farming land • Insufficient waterway access/ infrastructure	• Bank erosion resulting in avulsion	• Sea level rise restricting migration of estuarine vegetation • Sea level rise reducing water access	**Estuary-wide**
• Waterway barriers • Loss of saltmarsh			**Localised**

Source: Adapted from Marine Estate Management Authority (2015)

The above risk assessment has been used to identify strategic priorities for broad coastal management actions. More detailed risk assessment has been undertaken for rehabilitation of estuary foreshores as discussed in Sections 4.3.2 and 4.3.3.

4.3.2. Prioritisation of bank rehabilitation sites

A preliminary list of priority sites for stabilisation of eroding foreshores in Tuross River Estuary was provided in the 2005 EMP (no assessment was provided on Coila Lake). More recently, the 2016 Tuross Estuary Water Quality Improvement Plan analysed potential sediment and nutrient sources to assist in highlighting areas where water quality management may be a priority. The 2016 Plan identified bank erosion sites and priorities for rehabilitation based on the site attributes and scoring system listed in Table 10. Fourteen high priority bank erosion sites were identified in the plan with 40 medium and 17 lower priority sites. Further detail on prioritisation of bank erosion sites is provided in Appendix I - Bank Erosion.

The Cambathin Island site (within Eurobodalla National Park) was not a high priority on the basis of the 2016 assessment methodology but was included as a high priority site in the 2016 Plan due to the risk of breakthrough (refer Section 4.1.2). Active erosion has recently been observed at the site and the risk of avulsion due to bank erosion at Cambathin Island is still considered to be moderate (refer Table 8).

While this CMP recommends rehabilitation of all sites identified in the 2016 Plan, funding should initially target areas mapped as the highest priority.

Table 10: Site attributes used for prioritisation of bank erosion sites

Site Attribute				
Score	Vegetation Condition	Degree of Exposure	Adjacent Land Use	Stock Impact
1	Dominated by native trees etc., buffer at least 10m wide.	Low - banks stable	Largely undisturbed, stable native vegetation (i.e. national park)	Low - no evidence of stock impact
2	Thin band of vegetation along bank but no buffer behind	Moderate - minor undercutting and slumping	Cleared farm land with stock	Medium - few tracks but minimal impact (low erosion/banks stable)
3	Exposed banks, dominated by pasture grasses, scattered trees may be present but intermittent, no buffer	High - actively eroding, actual or potential for mass failure and sediment liberation	Intense agricultural cropping	High - numerous access tracks, evidence of erosion, no understorey

Source: Southeast Engineering and Environment (2016)

4.3.3. Bushland reserves

ESC has assigned a conservation priority (Conserve and Connect, Enhance, Rehabilitate or Monitor) to Tuross and Coila bushland reserves based on the following ranking factors:

- High conservation value score based on EECs, vegetation type >70% cleared, number of threatened animal species associated with the vegetation type, threatened species, vegetation mapped within state or regional vegetation corridor;
- Reserve size;
- Shape of the reserve; and
- Active Landcare group.

Further detail is provided in Section G4, Appendix G - Biodiversity.

The conservation priority will be used to implement the bushland reserves rehabilitation program for Council controlled foreshore land.

5. COASTAL MANAGEMENT PROGRAM

5.1. Management Responses

A range of responses to the identified threats have been developed from the assessed level of risk and the timeframe and spatial extent of the threats. The proposed actions and strategic management approach is provided in the following table (adapted from *draft NSW Coastal Management Manual Part B, Stage 3*).

Many of the potential actions in Table 11 were included in the 2005 EMP and are already incorporated into existing management programs. Some of these previous actions have been completed, whereas some are partially complete, or are still to be implemented. Ongoing management actions from the 2005 EMP are:

- Restrict stock access to waterways;
- Rural community education – land management practices;
- Urban community education;
- Protection of sensitive/critical habitat areas;
- Pest animal management;
- Bacterial water quality and oyster flesh monitoring;
- Environmental health monitoring;
- Rehabilitation of riparian/foreshore areas;
- Land-use planning and development controls;
- On-site sewerage management and regulation;
- Weed monitoring and management;
- Cultural heritage management; and
- Cultural heritage management.

Actions from the 2005 EMP that are in progress are:

- Sewerage system improvements (capacity upgrades for Bingie sewage treatment plant, sewer pump stations and sewer mains to reduce overflows); and
- Village sewerage schemes (Bodalla and Potato Point).

Actions from the 2005 EMP that are not yet implemented but still recommended are:

- Removal of waterway barriers;
- Stormwater quality improvements;
- Coila Lake waterway access/infrastructure plan; and
- Tuross boat ramp upgrade.

Table 11: Categorisation of actions by strategic management approach

Threat (as described in Table 5)/ Risk management concept	**Strategic approach**			
	Alert - maintain the current management and acknowledge the potential for change	**Active intervention -** risk mitigation, generally intended to improve the resilience threats, vulnerabilities and risks identified	**Avoid future impact –** take action to avoid future risk and create opportunities to protect and enhance	**Allow nature to take its course -** acknowledges that the cost of intervention is high and natural regime may be preferred
Agricultural practices	• Estuary health monitoring – water quality and estuarine macrophytes • Monitoring of riparian/ bank condition • Oyster Industry Sustainable Aquaculture program • Education	• Rehabilitation of priority riparian sites • Removal of waterway barriers • Fencing riparian areas • Revegetation of riparian zones	• Improved farming practices • Land use planning and development controls	• None
On-site sewage management	• Estuary health monitoring – water quality and estuarine macrophytes • ESC On-site sewage management program • Oyster Industry Sustainable Aquaculture program • Education • ESC IWCM Strategy	• Bodalla sewerage scheme to replace on-site sewerage systems • On-site sewage inspection program	• Land use planning and development controls	• None
Urban sewage discharges	• Estuary health monitoring – water quality and estuarine macrophytes • Oyster Industry Sustainable Aquaculture program • ESC IWCM Strategy	• Tuross Head sewerage system improvements	• ESC IWCM Strategy	• Continued assessment of opportunities

Threat (as described in Table 5)/ Risk management concept	**Strategic approach**			
	Alert - maintain the current management and acknowledge the potential for change	**Active intervention -** risk mitigation, generally intended to improve the resilience threats, vulnerabilities and risks identified	**Avoid future impact –** take action to avoid future risk and create opportunities to protect and enhance	**Allow nature to take its course -** acknowledges that the cost of intervention is high and natural regime may be preferred
Urban stormwater runoff	• Estuary health monitoring – water quality and estuarine macrophytes • Education	• Stormwater quality improvement	• Land use planning and development controls	• Continued assessment of opportunities
Bank erosion causing sedimentation	• Estuary health monitoring – water quality and estuarine macrophytes • Monitoring of riparian/ bank condition • Oyster Industry Sustainable Aquaculture program • Education	• Rehabilitation of priority riparian sites • Removal of waterway barriers	• Improved farming practices • Land use planning and development controls	• Continued assessment of opportunities
Bank erosion resulting in avulsion	• Monitoring of riparian/ bank condition • Education • Cost-benefit analysis	• Rehabilitation of priority sites – Cambathin Island	• Continued assessment of opportunities	• Continued assessment of opportunities
Loss of seagrass	• Estuary health monitoring – water quality and estuarine macrophytes • Education and signage	• Rehabilitation of priority riparian sites • Removal of waterway barriers • Boating exclusion zones	• Improved farming practices • Riparian rehabilitation • Marine Park zoning • Boating education	• Continued assessment of opportunities
Terrestrial weeds	• Monitoring of weeds • Education	• Weed removal • ESC Tuross-Coila Reserves Conservation Program	• Improved farming practices • Riparian rehabilitation • Land conservation	• Continued assessment of opportunities
Waterway barriers	• Monitoring and assessment	• Improvements/ upgrades • Removal	• Improved farming practices • Land use planning and development controls	• Continued assessment of opportunities

Threat (as described in Table 5)/ Risk management concept	**Strategic approach**			
	Alert - maintain the current management and acknowledge the potential for change	**Active intervention -** risk mitigation, generally intended to improve the resilience threats, vulnerabilities and risks identified	**Avoid future impact –** take action to avoid future risk and create opportunities to protect and enhance	**Allow nature to take its course -** acknowledges that the cost of intervention is high and natural regime may be preferred
Sea level rise restricting migration of estuarine vegetation	• Estuary health monitoring – water quality and estuarine macrophytes • Sea level rise hazard analysis • Landholder liaison	• Removal of barriers to migration • Land conservation • Farm management plans • Landholder incentives	• Improved farming practices • Land use planning and development controls	• Continued assessment of opportunities
Waterway access/ infrastructure	• Stakeholder consultation	• Retain existing Tuross ramp and fund dredging works in the medium term • Site constraints limit opportunities to upgrade Foam Street boat ramp at Coila • Gravel access to Coila Lake at Kyla Park.	• Continued assessment of opportunities • Maintain option to investigate alternative access to Tuross in the long-term	• Continued assessment of opportunities
Sea level rise reducing water access	• Stakeholder consultation • Sea level rise hazard analysis	• Develop waterway access/ infrastructure plan for Coila Lake • Develop alternative boat ramp site Tuross as a long-term option • Replace assets at end-of-life considering relevant tidal conditions	• Land use planning and development controls	• Continued assessment of opportunities
Bank erosion causing loss of farming land	• Monitoring of riparian/ bank condition • Education and liaison	• Rehabilitation of priority riparian sites • Removal of waterway barriers	• Improved farming practices • Land use planning and development controls	• Continued assessment of opportunities
Damage to saltmarsh	• Monitoring of estuarine macrophytes • Education and signage • Sea level rise hazard analysis	• Restrict vehicular access to Coila Lake	• Improved farming practices • Land use planning and development controls • Marine Park zoning	• Continued assessment of opportunities

5.2. Coastal Management Strategy

This CMP provides a management framework that is intended to guide coastal management and planning in the Tuross River Estuary and Coila Lake in response to the coastal management objectives (Section 1.1) with an underlying focus being the protection of community values for the estuaries (Section 2.3). The CMP recognises that the estuaries are under pressure from urban and agricultural land use and are subject to often conflicting uses.

The estuaries are managed by local and State government agencies, landholders and the community and the CMP provides an opportunity to implement a sustainable and equitable management approach. The CMP includes a suite of coastal planning and management actions that will ultimately protect and conserve terrestrial and estuarine ecosystems for the enjoyment of all stakeholders. The actions have been developed and prioritised based on the assessed risk of the threats to the estuary values as presented in Section 4. The CMP actions draw on existing programs and funding and identifies priority actions to be implemented once additional funding becomes available. The CMP targets priority management issues with least cost and highest benefit to maximise the funding opportunities as well as the success of the program.

Longer-term pressures such as climate change and sea level rise have been considered in the formulation of management actions with the current actions taking any future pressures into account in the design and implementation stages. Adaptive management measures have also been included in response to longer-term threats such as sea level rise.

5.3. Funding and Resources

The CMP actions are expected to be funded through Council and State government contributions, monetary grants and in-kind contributions. However, the availability of 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 CMP. It is important to note that many grants and funding sources are only available up to a limited budget and the available grants change from year to year. It will be necessary to keep abreast of current funding availability throughout the implementation of the CMP and take advantage of funding opportunities as they arise. In most cases it is expected that in-kind contributions will be provided by Council and therefore the delivery of recommended actions may be influenced by the availability of this funding as well as human resources.

Agencies responsible for delivery of actions in this CMP have been consulted during the development of the CMP and have indicated support for the actions. However, delivery of the actions will depend on the availability of funding which is yet to be confirmed. The priority of each action listed in the CMP may be amended to suit resource availability.

Council operates an annual budget through the Environment Levy that is directed towards environmental works and education programs. These funds are extended through grants as they become available. Certification of this CMP will facilitate eligibility for funding of key actions through the OEH Coastal and Estuary Management program. Actions will be prioritised for future applications for external funding with matching contributions from Council's Environmental Program budgets.

Key sources of monetary contributions identified for the CMP actions are:

- ESC environmental levy – collected from ratepayers to fund dune care, estuary management, weed and pest control, environmental monitoring, foreshore protection and studies to develop plans for the protection of waterways and ecological systems;
- ESC stormwater management charge - collected from urban ratepayers to improve the quality of the urban stormwater that is harvested and discharged into waterways. Funds are distributed throughout the Shire according to priority projects;

- Coastal and Estuary Management Program grants – provided by the NSW Government to support local government work to improve the health of NSW estuaries;
- NPWS – funding for rehabilitation works within National Parks;
- Department of Industry (DI) - Lands – for projects on Crown Land; and
- Recreational Fishing Trust – funded from the NSW Recreational Fishing fee to improve recreational fishing in NSW.

Human resources and in-kind contributions are also included from:

- ESC, OEH and South East LLS;
- Landholders;
- Volunteer groups;
- Educational institutions; and
- Recreational groups (such as fishing clubs).

Where actions are implemented through an ongoing concurrent program, additional expenditure and funding have not been included (refer Sections 5.4.9 and 5.4.13).

Achievement of the CMP objectives is reliant on community understanding and effective involvement in the preparation and delivery process. On-going community involvement will be required to ensure actions are implemented including:

- 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 Landcare/Coastcare and recreational groups;
- Consultation and collaboration with local Aboriginal representatives and groups; and
- Education programs.

5.4. Coastal Management Actions

The recommended actions are described in the following sections with on-ground actions shown on the following figures. Actions consist of a combination of studies, investigations and on-ground works and have been formulated through review of actions identified in the 2005 EMP, evaluation of priority issues and the contributing threatening processes as well as consideration of stakeholder input. Some actions require additional design or assessment prior to implementation of on-ground works. Where the cost of on-ground works is not known, this has not been included in the CMP.

The description of each action includes the responsible agencies, support agencies, the current status including funding available and the CMAs addressed by the actions. As electronic mapping of the Coastal Management Areas is not yet available, it is not possible to provide a map of actions linked to the CMAs. The CMA 1 – Coastal Wetlands and Littoral Rainforests areas are based on current mapping of SEPP 14 Wetlands and SEPP 26 Littoral Rainforests.

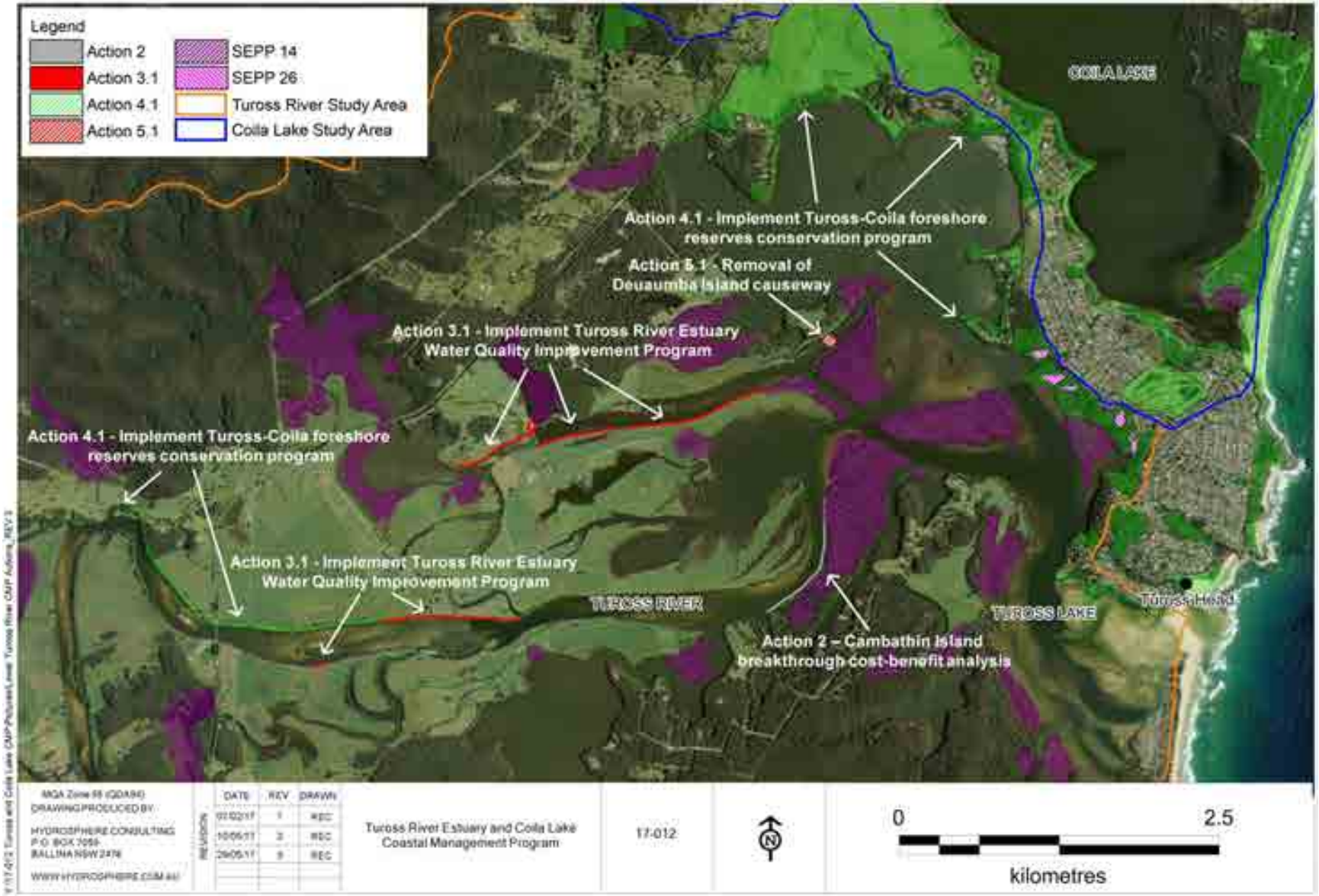


Figure 20: CMP on-ground actions – Tuross River Estuary (lower)

Note: only high priority rehabilitation sites are shown for Action 3.1

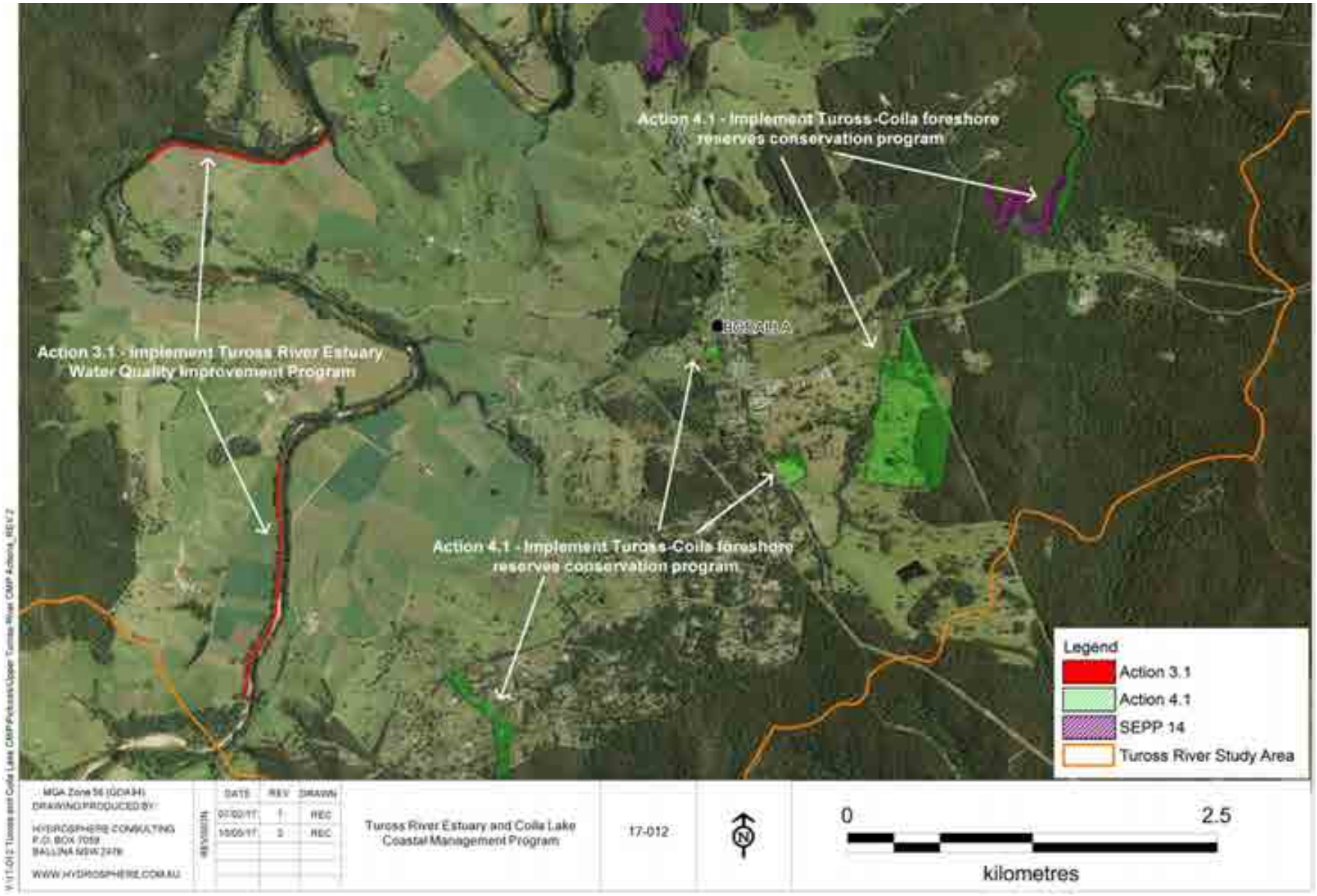


Figure 21: CMP on-ground actions – Tuross River Estuary (mid)

Note: only high priority rehabilitation sites are shown for Action 3.1

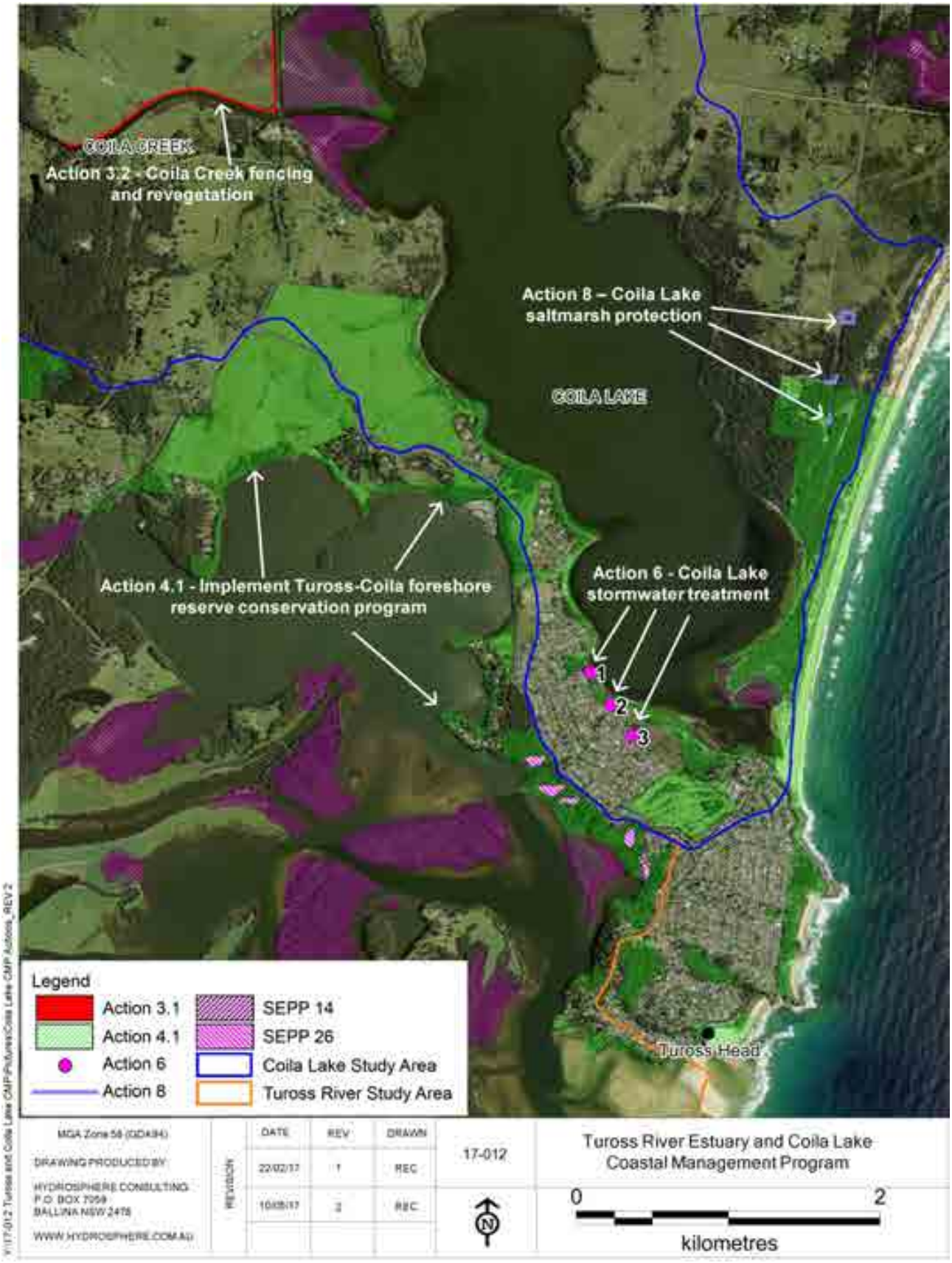


Figure 22: CMP actions – Coila Lake

5.4.1. Estuary health monitoring

Responsibility: ESC Support: OEH

Status: Achieved, will require additional funding to continue

Coastal Management Areas: CMA 1 – Coastal Wetlands and Littoral Rainforests, CMA 2 - (provisional) Coastal Vulnerability Areas, CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

To improve overall health of the Tuross River Estuary and Coila Lake an understanding of water quality is required to enable mitigation measures to target improved water quality and ecosystem health.

Water quality monitoring indicates that the estuaries experience elevated levels of nutrient and sediment input, particularly the Tuross River. This is likely to be due to foreshore erosion, stock access and grazing to the water, lack of riparian buffers and urban runoff. ESC has implemented a water quality monitoring program based on the MER protocols from 2010 to 2016 with monitoring to continue in 2017. Recreational water quality and ecosystem health indicators are reported in the program report cards available on Council's website (http://www.esc.nsw.gov.au/living-in/about/our-natural-environment/estuaries-of-eurobodalla/estuary-health-and-water-quality-monitoring).

Action 1.1 – Estuary health monitoring and reporting

The current MER-aligned monitoring program is considered to provide a good assessment of ecosystem health throughout the estuaries. ESC received a grant in 2015/16 to continue the Eurobodalla Estuary Health Monitoring and Reporting program throughout the shire. This project is the continuation of estuary health monitoring in the Tuross/Coila Estuaries with the preparation of new estuary health report cards that track how well each estuary is being managed over time to inform the community of the current health of the estuaries and provide Council with an understanding of whether management approaches need to change. ESC will continue to apply for grants to continue this program every two years with matching funds provided by Council.

The estuary health monitoring program is not designed to provide detailed information regarding specific pollution sources. This may be required to support specific projects.

Action 1.2 – Estuary macrophyte mapping and reporting

ESC is currently re-mapping the estuarine vegetation of the estuaries with the results likely available by November 2017. Macrophyte mapping of these estuaries will be utilised to further inform the Estuary Health Monitoring program and to develop updated estuary health report cards. A comparative study will be undertaken as part of the mapping project, comparing previous mapping results to identify localities of significant change and provide a discussion on likely causes of significant changes. Seagrass distribution should be a focus of this comparative study due to the changes in area detected from previous mapping exercises in both estuaries. This mapping should ideally be repeated every five years coinciding with the estuary health reporting program.

5.4.2. Cambathin Island erosion assessment

Responsibility: NPWS Support: OEH, South East LLS, ESC

Status: Requires funding and investigations

Coastal Management Areas: CMA 1 – Coastal Wetlands and Littoral Rainforests (SEPP 14 wetland No. 144), CMA 2 - (provisional) Coastal Vulnerability Areas, CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

The 2005 EMP identified the western foreshore of Cambathin Island as a priority site for rehabilitation and recommended stabilisation of the eroding banks to minimise the risk of breakthrough potentially resulting in an avulsion. The 2001 EPS predicted the breakthrough would occur within 15 years based on erosion rates averaging around 1 metre per year at that time. Natural processes, rather than human influences were thought to be causing the erosion as the rate of erosion was consistent over time (Brown and Root, 2001).

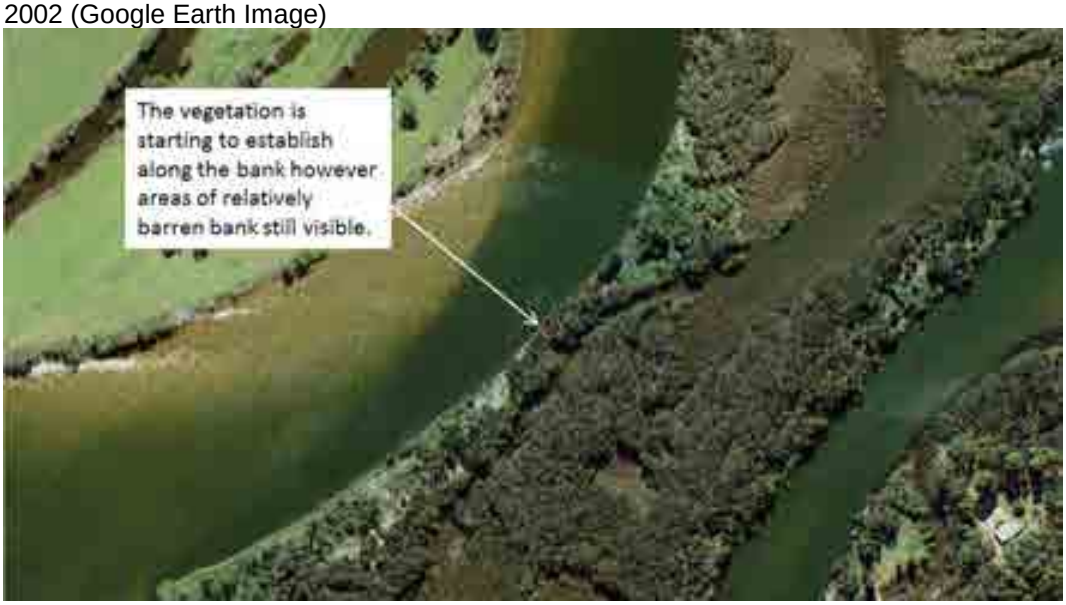
The 2016 Tuross Water Quality Improvement Program recommended a staged management approach for this location as the implications of a breakthrough would have significant water quality impacts for the estuary although immediate water quality issues were not as high as other areas of the estuary:

- Stage 1:
    - Revegetate top of bank with deep rooted vegetation behind scarp (*Casuarina*) particularly where only groundcovers are present;
    - Undertake field investigation of the embankment to identify potential breakthrough points;
    - Undertake a bank edge survey as a reference to compare future bank movement to allow estimation of erosion rates over time; and
    - Where possible compare aerial photogrammetry to determine recent erosion rates against flood events.
- Stage 2:
    - Depending on evidence and investigations from Stage 1, design and construct protection to prevent breakthrough. This requires detailed consideration of extents and tie-in with natural bank to prevent outflanking. Priority should be given to protection of the bank where narrowest band of island exists and where breakthrough is most likely.

Stabilisation techniques including rock toe protection and riparian revegetation are estimated to cost $475,000 (Southeast Engineering and Environmental, 2016). Funding is not currently available for this level of expenditure. As such, it is recommended that the risk of avulsion is further investigated along with an assessment of potential options to address the risk. As the bank becomes narrower, the rehabilitation options become more limited and potentially more costly and this should be considered in the analysis.

There are no recent survey data of this area to determine the current width of the bank, although inspection of current aerial photography in 2010 and 2015 (Figure 23) shows this section of the bank appears to be well vegetated in the most recent aerial photo. However, the canopy is obscuring the view of the bank and it is not possible to determine whether the canopy has grown, or the bank has retreated, or both. Significant on-going erosion has been observed along this foreshore and flooding in June 2016 appears to have exacerbated the undercutting of the banks. Despite the timeframe for avulsion predicted in earlier studies not being realised, the risk of avulsion is still apparent, is increasing with time and is likely to be significantly increased with the occurrence of flood events.

2002 (Google Earth Image)



2010

2014

Figure 23: Potential breakthrough location – western foreshore of Cambathin Island

Cambathin Island is part of the Eurobodalla National Park and under the Plan of Management control measures will be undertaken where erosion has been accelerated by human activity or is threatening significant habitats or other values. The Island is mapped as CMA 1 - coastal wetlands and Swamp Oak Floodplain Forest EEC (refer Appendix G - Biodiversity) and significant modification of the estuary is predicted in the 2001 EPS and 2005 EMP if an avulsion did occur.

Action 2 – Cambathin Island breakthrough cost-benefit analysis

Given the uncertainty with timing and impacts of 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 island morphology, consultation with stakeholders and a cost-benefit analysis based on a clear understanding of the consequences of a breakthrough and the potential options to prevent this. It is recommended that the following actions are implemented:

1. Monitoring of erosion and width of Cambathin Island at critical locations (annual monitoring);
2. Continued liaison with stakeholders (ongoing);
3. Undertake a cost benefit analysis (CBA) including detailed assessment of the potential consequences of avulsion as well as various concepts to address this risk. The methodology should be based on guidance documents included as part of the NSW Coastal Management Manual Toolkit (Using Cost-Benefit Analysis to assess coastal management options). The CBA should include a distributional analysis to identify the costs and benefits for the different parties affected (including ESC, the community and NPWS) and can be used to identify possible equity issues and inform funding decisions. Investigations such as CBAs are currently included in funding priorities for the OEH Coastal and Estuary Grants Program; and
4. Future on-ground actions are to be guided by the CBA, stakeholder input and the monitoring. The cost of any on-ground actions is to be determined by the CBA and have not been included in this CMP.

Annual monitoring of island morphology to track the risk would include a repeat survey of the bank profile (as recommended in the Water Quality Improvement Program). Contributing factors such as soil profile, geological features (if any) as well as vegetative cover and root development should be considered when reporting on monitoring results. The adaptive management approach would consider the prevailing regulatory requirements, ecosystem status, cost of preventative options and the need for action.

5.4.3. Bank rehabilitation

Responsibility: South East LLS **Support: OEH, ESC, NPWS, DPI, Landholders**

Status: Requires funding

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

The protection and restoration/rehabilitation of vegetated riparian corridors is important for maintaining or improving the shape, stability (or geomorphic form) and ecological functions of the Tuross River Estuary. The riparian corridor forms a transition zone between the land (terrestrial environment) and the waterway. Riparian corridors perform a range of important environmental functions such as:

- Providing bed and bank stability and reducing bank and channel erosion;
- Protecting water quality by trapping sediment, nutrients and other contaminants;

- Providing diversity of habitat for terrestrial, riparian and aquatic plants and animals;
- Providing connectivity between wildlife habitats;
- Conveying flood flows and controlling the direction of flood flows;
- Providing an interface or buffer between developments and waterways; and
- Facilitating passive recreational uses.

Although a 40 metre vegetated riparian zone is recommended to achieve the above functions in estuaries (NSW Office of Water, 2012), a minimum 10 metre riparian buffer on agricultural land is recommended to stabilise river banks (Figure 24).

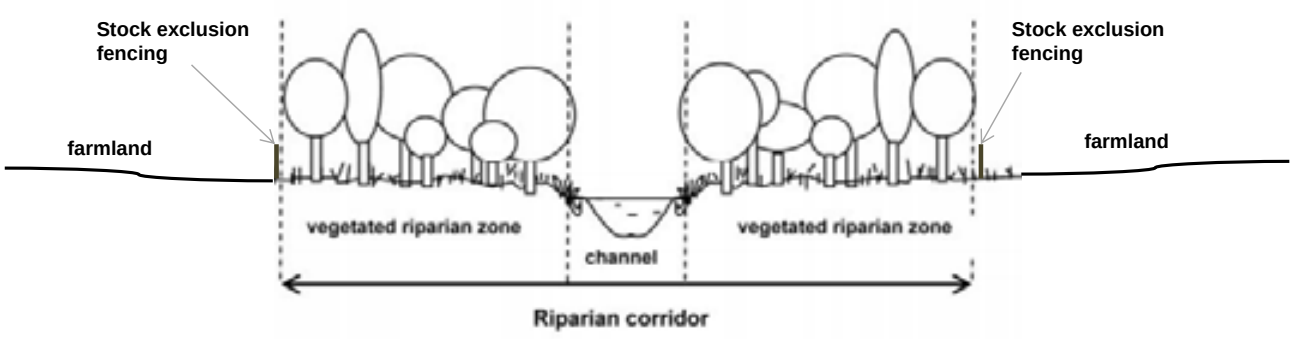


Figure 24: Riparian corridors

Source: Adapted from NSW Office of Water (2012)

Action 3.1 – Implement Tuross River Estuary Water Quality Improvement Plan

Coastal Management Areas: CMA 2 - (provisional) Coastal Vulnerability Areas, CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

All areas identified in the Tuross River Water Quality Improvement Plan (initially targeting areas mapped as highest priority) and sites identified through current South East LLS programs will be the focus for implementation. These will be implemented in a staged approach to target grant funding programs as they become available. Cost estimates in Table 12 have been based on the estimates provided in the Tuross River Water Quality Improvement Plan (Southeast Engineering and Environmental, 2016).

The majority of high priority works are on private lands and South East LLS representatives have been consulting with landholders to develop partnerships for these projects. Funding required to implement the recommendations in the Water Quality Improvement Program will be pursued over time.

All foreshore protection works will be subject to approvals and incorporate design principles outlined in *Environmentally Friendly Seawalls* (DECC, 2009b). Soft options such as plantings are preferred rather than rock which will only be used sparingly and in combination with softer options.

Action 3.2 – Coila Creek fencing and revegetation

Coastal Management Areas: CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

South East LLS and a local landholder have obtained funds for fencing (stock exclusion) and revegetation of 2.5km of Coila Creek and 4.2ha revegetation works through the “Realising the potential of our wetlands” project. This work will be undertaken during 2017.

Action 3.3 – Ongoing assessment of erosion risk

Coastal Management Areas: CMA 1 – Coastal Wetlands and Littoral Rainforests, CMA 2 - (provisional) Coastal Vulnerability Areas, CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

Continued monitoring and assessment of erosion risk throughout the lower Tuross River Estuary and the foreshores of Coila Creek is also recommended every 3 years or following a major flood. The methodology should be consistent with the Tuross Water Quality Improvement Program to enable assessment of change over time.

5.4.4. Rehabilitation of bushland reserves

Responsibility: ESC Support: OEH

Status: Ongoing. Funded through ESC Environmental Levy and OEH grant

Action 4.1 – Implement Tuross-Coila foreshore reserves conservation program

Coastal Management Areas: CMA 1 – Coastal Wetlands and Littoral Rainforests (SEPP 14 wetland No. 146, 146c, 158 & 164a and SEPP 26 littoral rainforest No. 188D, 188E, 188G, 188H & 188I), CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

ESC will continue to implement the bushland reserves conservation program based on the conservation priority developed for all Council controlled foreshore land. This program includes invasive species control and revegetation as discussed in Section G4, Appendix G.

5.4.5. Removal of waterway/tidal barriers

Responsibility: ESC Support: OEH, DPI-Fisheries, South East LLS

Status: Requires funding and investigations

Action 5.1 – Removal of Deuaumba Island causeway

Coastal Management Areas: CMA 1 – Coastal Wetlands (SEPP 14 wetland No. 148), CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

The 2005 EMP identified the Deuaumba Island causeway as a contributor to bank erosion within Bowns Creek and recommended its removal using earthmoving equipment and disposal of the material at an appropriate landfill site or on nearby land. This approach is still considered appropriate and is recommended as an action within this CMP. The disposal of the fill material is likely to require testing and classification of that material and an evaluation of options for disposal to maximise beneficial reuse opportunities is recommended. Approvals for the project under the *Environmental Planning and Assessment Act, 1979* and *Fisheries Management Act, 1994* would be required and it is likely that works would be subject to environmental controls to manage issues such as turbid discharges from the site during excavation works.

Any future upgrades of other waterway crossings should consider tidal flow and fish passage requirements.

5.4.6. Coila Lake stormwater quality improvement

Responsibility: ESC

Status: Requires funding and design

Action 6 – Coila Lake stormwater treatment

Coastal Management Areas: CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

ESC has investigated stormwater treatment options for the three sites on the foreshore reserve of Coila Lake. The sites are shown on Figure 22. The proposed works are:

- Site 1 – series of treatment devices including:
    - Self-draining gross pollutant trap retrofitted on the pipe outlet;
    - A bioretention system following the GPT;
    - A small bioswale planted with native sedges and rushes at outlet two; and
    - Restoration of the natural creek line and the enlargement of the existing small ponds to create self-draining ephemeral free water surface wetlands.
- Site 2 - enlargement of the pond and the adoption of a maintenance program that would include regular inspection and maintenance of the GPT; and
- Site 3 - planting native reeds, rushes, sedges and grasses along the edges of the small channels and around the pond and a stormwater management plan for the golf course.

The proposed works are considered appropriate and are recommended as part of this CMP, however the detailed design/planning for these works should consider upstream soil types, peak discharges and current water quality (which may require event-based monitoring) to confirm the efficacy of proposed treatment options.

These are low priority actions that will require grant funding to support.

5.4.7. Coila Lake waterway access/infrastructure plan

Responsibility: ESC Support: DPI

Status: To be undertaken as part of ESC asset management planning

Action 7 – Coila Lake waterway access/infrastructure plan

Coastal Management Areas: CMA 4 – Coastal Use Area

As part of Council's asset management planning, it is recommended that a strategic plan of management for Coila Lake foreshore reserves is developed including a waterway access and infrastructure plan to address conflicts between waterway users, the function of the current boat ramps and the protection of sensitive habitats. Should the proposed closure of access from the northern side of Coila Lake (refer Section 5.4.8) be realised, there is a need to continue to maintain the existing boat launching facilities at Kyla Park. For example, the recent gravel re-sheeting works recently completed by Council.

The review should address the needs and desires of both the permanent residents, commercial and recreational fishers and the many visitors and holidaymakers to the region. It should also include identification of the works required to maintain, upgrade and replace existing facilities as required for an efficient network of assets as well as looking at what additional facilities may be required to cater for the public use of the waterway and reserves.

Due to the seasonal nature of the use of many of the facilities, the required level of service can be difficult to quantify. It is recommended that peak demand during 'shoulder season' be satisfied to ensure the greatest benefit for the overall community without spending large amounts upgrading facilities that will reach capacity on only a few occasions during the year. Considerations will include:

- The need for safety improvements;
- The need for habitat protection;
- The community desire for the infrastructure;
- The capacity of the existing infrastructure such as parking, rubbish bins, amenities etc.;
- The usage of each facility;
- Longer-term impacts of sea level rise on location and design of facilities – as discussed in Section 5.4.9, the existing Coila Lake foreshore infrastructure adjacent to the urban areas may become a barrier to migration of estuarine vegetation and the design of any future facilities should consider the need to allow migration uninhibited;
- Upgrade and maintenance requirements to achieve the desired levels of service; and
- The ability to gain additional funding for the works.

5.4.8. Saltmarsh protection

Responsibility: ESC Support: DPI, NPWS, OEH, DI-Lands

Status: Requires funding and consultation

Action 8 – Coila Lake saltmarsh protection

Coastal Management Areas: CMA 1 – Coastal Wetlands (SEPP 14 wetland No. 146c), CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

Over recent years the community continues to raise concerns over vehicle access through Eurobodalla National Park and the adjoining Council controlled Crown Land to the eastern Coila Lake foreshore. Issues associated with vehicle access in this area include:

- Damage to coastal saltmarsh;
- Damage to threatened shorebird nests and habitat;
- Damage to dune structure and dune vegetation;
- Illegal clearing of native vegetation;
- Illegal camping, wastewater disposal, fires and dumped rubbish;
- Access management to restrict the risk of fire;
- Ongoing formation of new tracks in sensitive coastal areas; and
- Safety concerns over vehicle and pedestrian interactions.

Works to protect this area from the above damage are proposed by NPWS and ESC and are recommended by this CMP. The works would include installation of bollards at locations shown on Figure 25 and formalisation of a carpark to limit vehicle access within the Eurobodalla National Park. The existing Bingi Dreaming Track would be maintained as a walking track only.

Under the NPWS Plan of Management for Eurobodalla National Park, the access to Coila Lake is identified 'public use'. Closure of the track would therefore require a review of the Plan of Management. However,

closure at the NPWS boundary may be possible in the short term, pending a review of the Plan of Management in future. ESC would liaise with NPWS when the Plan of Management is reviewed to determine the most appropriate long-term option for preventing access to the saltmarsh.

Council and NPWS will liaise with DPI and commercial licenced fishers, DI-Lands and private landholders to implement these works.

Any road closure would require ongoing regulation/policing.

Figure 25: Proposed access restrictions and parking area north of Coila Lake

5.4.9. Estuarine vegetation migration due to sea level rise

Responsibility: ESC Support: OEH, Private landholders

Status: Requires funding and investigations

Coastal Management Areas: CMA 1 – Coastal Wetlands and Littoral Rainforests, CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

This CMP includes a preliminary assessment of the potential migration of estuarine vegetation in the Tuross River Estuary and Coila Lake with sea level rise, the impact of barriers to migration and the potential for land loss. The key findings are:

- Sea level rise will result in migration of saltmarsh communities and conversion of current riparian lands to saltmarsh communities. Agricultural practices such as grazing and mowing may restrict the extent of migration and there is the potential for loss of farmland in some areas;
- There are some natural barriers to migration including foreshore banks which may be sites of increased erosion in future; and

- There are also barriers such as footpaths, roads and rock walls which have the potential to hinder estuarine vegetation migration.

Action 9 – Ongoing liaison with landholders and land managers regarding sea level rise adaption

Where there is the potential for significant impact on estuarine vegetation migration or loss of estuarine vegetation habitat via the influence of anthropogenic constraints or substantial urban or farmland loss, further investigation and implementation of possible mitigation measures is recommended. Examples of potentially affected areas include:

- Coila Lake foreshore – private land west of Princes Highway, Crown reserve on the south-eastern foreshore and Council reserves on the western foreshore adjacent urban areas; and
- Tuross River foreshore – Horse Island (private) and eastern foreshore of Tuross Lake (Council reserve).

For private lands, this would initially involve consultation with landholders as part of existing LSS extension programs. Where agreement can be achieved with landholders, additional investigations in the longer-term would include elevation surveys and the development of landholder agreements to encourage future migration through measures such as stock fencing, wider riparian buffers and weed management. In future, incentives such as land purchase or carbon offsets may be appropriate where significant benefits to estuarine vegetation extent can be demonstrated. The CMP does not include additional costs for these investigations.

The impacts of sea level rise on waterway access will be considered as part of other related management actions, particularly the Coila Lake waterway access/infrastructure plan.

The current entrance management policies require that the breakout levels are progressively increased in the future to facilitate adaptation to future climate change (especially sea level rise), and to reduce the on-going need for artificial entrance intervention. Revised breakout levels and the works necessary to achieve these levels are documented in the policies (refer Appendix K). These works will be addressed in coastal hazard planning to be undertaken for the ESC Coastline Management Program and Council's Asset Management Plans.

5.4.10. Entrance Management

Responsibility: ESC

Status: To be undertaken as part of current ESC staff role

Coastal Management Areas: CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

The Tuross Lakes and Coila Lakes Entrance Management Policies (available from Council's website http://www.esc.nsw.gov.au/living-in/about/our-natural-environment/estuaries-of-eurobodalla/lakes-ref-and-entrance-management-policies) were developed in 2010 to provide a framework to allow Council to proactively manage opening of the lake systems.

Action 10 - Review of entrance management policies

Management of the Tuross River and Coila Lake entrances is a key concern for the community, particularly in relation to flooding of private property. Council will review the policies to add some flexibility with the triggers including potentially providing a range of triggers that may apply for an extended period.

The policies require the breakout levels to be progressively increased in the future to facilitate adaptation to future climate change (especially sea level rise) and to reduce the on-going need for artificial entrance intervention. The policies refer to the former *Sea Level Rise Policy Statement* previously adopted by the NSW Government which is now superseded by the ESC policy (refer Appendix A). The entrance

management policies should be updated with the new climate change benchmarks including a review of the works necessary to achieve the revised trigger levels over time.

5.4.11. Cultural heritage

Responsibility: ESC Support: OEH

Status: To be undertaken as part of ongoing ESC programs or environmental management projects

Coastal Management Areas: CMA 3 – Coastal Environment Area, CMA 4 – Coastal Use Area

The Tuross River Estuary and Coila Lake have 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.

Action 11 – Cultural heritage site management

The cultural heritage action from the 2005 EMP - "identification and protection of significant Aboriginal and European cultural heritage sites" is still relevant and will continue to be implemented by ESC through review of planning documents such as the LEP and through the identification and protection of cultural heritage sites affected by environmental improvement programs. ESC will continue to liaise with OEH regarding the identification and protection of cultural heritage sites within the Shire.

5.4.12. Existing ESC Management Programs

This CMP will be supported through the continuation of related Council management programs including:

- Land use planning and development controls - refer Section B2, Appendix B - Related Management Plans and Programs;
- On-site sewage management program - refer Section B3, Appendix B - Related Management Plans and Programs;
- IWCM Strategy implementation (including upgrade of Bingie STP, reduction of overflows from Tuross Head sewerage system, Bodalla sewerage scheme and water sensitive urban design) - refer Section B5, Appendix B - Related Management Plans and Programs;
- Urban stormwater education programs;
- Entrance management policies (refer Appendix K - Entrance Management) – the policies should be updated to reflect the adopted seal level rise planning benchmarks. Adaption to sea level rise will be addressed in Council's Coastline Management Program and Council's Asset Management Plans;
- Asset management strategy and plans - refer Section B3, Appendix B - Related Management Plans and Programs;
- Weed management program – refer Section G3, Appendix G - Biodiversity;
- Reserves conservation program - refer Section G4, Appendix G - Biodiversity;
- Flood debris clean-up - as required; and
- Algae and targeted water quality monitoring - as required.

5.4.13. Existing Agency Management Programs

Other government agency management programs will also contribute to achievement of the CMP objectives including:

- South East LLS extension officer and related projects;
- DPI regulation of NSW Fisheries;
- DPI Food Authority oyster monitoring and management program;
- Marine parks reform – refer Section B6, Appendix B; and
- DPI Key Fish Habitat Protection programs.

5.5. Business Plan

The recommended management actions have been described in terms of:

- Action description – an outline of the scope of works required (refer Section 5.4); 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. 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 included in the CMP should be confirmed by the results of the study/review; and
- Potential funding sources.

Timing of the delivery of actions should be based on the priorities developed for this CMP but will also depend on the availability of funding. This CMP 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.

The Business Plan (Table 12) has been developed to address the identified risks to the estuary values. Council responsibilities listed here will be used to inform the ongoing review of the Delivery Program and Operational Plan with implementation of the CMP included as an action in these plans. Progress against delivery of the CMP actions and their success will be monitored and reported in Council's Annual Reports.

Council will consult with other responsible parties to obtain acceptance of the actions prior to certification by the Minister.

Table 12: Business Plan - CMP management actions

Action		Priority	Responsible body	Support organisations	10 year cost
1.1	Estuary health monitoring and reporting (every 2 years)	High	ESC Funding	OEH ESC with grant assistance OEH Estuary Management Program	Expenditure is included in Shire wide Estuary health monitoring program
1.2	Estuarine macrophyte mapping and reporting (every 5 yerars)	High	ESC Funding	OEH ESC with grant assistance OEH Estuary Management Program	Expenditure is included in Shire wide Estuary health monitoring program
2	Cambanthin Island breakthrough	Medium	NPWS Potential funding	OEH, LLS, ESC NPWS OEH Estuary Management Program ESC	$35,000
3.1	Implement Tuross River estuary Water Quality Improvement Program (cost estimate for high priority sites only)	High	South East LLS Potential funding	OEH, ESC, Tuross Fishing Club, landholders ESC Environment levy South East LLS Recreation Fishing Trust OEH Estuary Management Program Landowners	$2,200,000
3.2	Coila Creek fencing and revegetation works	Current	ESC/LLS Funding	OEH Landowner	$20,000
3.3	Ongoing assessment and monitoring of erosion risk	High	ESC Funding	OEH OEH Estuary Management Program ESC (staff time)	$30,000
4.1	Implement Tuross-Coila foreshore reserves conservation program	Ongoing	ESC Funding	OEH OEH Estuary Management Program ESC Environment levy	$300,000
5.1	Removal of Deuaumba Island causeway	Low	ESC Funding	OEH OEH Estuary Management Program ESC Environment levy	$60,000
6	Coila Lake stormwater treatment	Low	ESC Potential Funding	 Grants	$215,000
7	Coila Lake waterway access/infrastructure plan	Medium	ESC/RMS Potential Funding	DPI ESC RMS waterways grants DPI	$15,000
8	Coila Lake saltmarsh protection	Medium	ESC Potential funding	DI-Lands, NPWS, OEH ESC Environment levy OEH Estuary Management Program	$16,000

				DI-Lands NPWS	
9	Ongoing liaison with landowners and land managers regarding sea level rise adptation	Low	ESC	South East LLS, private land owners, OEH	Not estimated. Primarily staff time.
			Potential funding	ESC Environment levy OEH Estuary Management Program LLS	
10	Review of entrance management policies	Ongoing	ESC	OEH	Not estimated. Staff time.
			Funding	Existing operating budgets	
11	Cultural heritage site management	Ongoing	ESC		
			Funding	Existing operating budgets	Not estimated. Staff time.
TOTAL					**$2,891,000**

Abbreviations: ESC: Eurobodalla Shire Council, OEH: Office of Environment and Heritage, LLS: Local Land Services, NPWS: National Parks and Wildlife Service, DPI: Department of Primary Industries, RMS: Roads and Maritime Services, DI - Lands: Department of Industry - Lands

ABBREVIATIONS

AHD	Australian height datum
Catch	2005 EMP Strategy - Catchment Inputs
CBA	Cost-benefit analysis
CEMAC	Coastal and Estuary Management Advisory Committee (ESC)
CERAT	Coastal Eutrophication Risk Assessment Tool
CMA	Coastal Management Area
CMP	Coastal Management Program
DI	NSW Department of Industry
DPI	NSW Department of Primary Industries
EEC	Endangered ecological community
Ecol	2005 EMP Strategy - Ecological Communities and Habitats
EHMP	Ecosystem Health Monitoring Program
EMP	Estuary Management Plan
EMS	Estuary Management Study
Entr	2005 EMP Strategy - Entrance Conditions
EPS	Estuary Processes Study
Eros	2005 EMP Strategy - Erosion and Sedimentation
ESC	Eurobodalla Shire Council
Flow	2005 EMP Strategy - Tidal Flushing and Catchment Inflows
Herit	2005 EMP Strategy - Culture and Heritage
ICOLL	Intermittently closing and opening lagoon or lake
IWCM	Integrated Water Cycle Management
KFH	Key fish habitat
LEP	Local Environmental Plan
LGA	Local government area
LLS	(South East) Local Land Services
MER	Monitoring, evaluation and reporting
MPA	Marine Parks Authority
Multi	Combined//Multiple Issues
NPWS	National Parks and Wildlife Service
OEH	Office of Environment and Heritage
OSSM	On-site sewage management

P&E	NSW Department of Planning and Environment
PWC	Personal water craft
RMS	NSW Roads and Maritime Services
SEPP	State Environmental Protection Policy
SRCMA	Southern Rivers Catchment Management Authority
TN	Total nitrogen
TP	Total phosphorous
TSS	Total suspended solids
Uses	2005 EMP Strategy - Commercial and Recreational Uses
WQual	2005 EMP Strategy - Water Quality
WSUD	Water sensitive urban design

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APPENDIX A. MANDATORY REQUIREMENTS AND ESSENTIAL ELEMENTS

This appendix lists the mandatory requirements and essential elements for the preparation of a coastal management program (stages 1 to 4, draft NSW Coastal Management Manual, 2015) and how they have been addressed in this CMP.

Essential Element		Where addressed in this CMP
What are the general requirements for preparing a CMP?		
1	A CMP should be developed and delivered by local councils in the coastal zone. It should be a partnership between councils, state agencies, community groups and individuals. It should address a broad range of coastal management issues that are relevant to the whole community.	Community and stakeholder consultation has been undertaken as part of preparation of this CMP (Section 2).
What area should a CMP cover?		
2	Local councils must determine and map the area that their CMP will cover. This may include any combination of the four coastal management areas, namely: a) coastal wetlands and littoral rainforest areas b) coastal vulnerability areas c) coastal environmental areas (including coastal lakes, lagoons, estuaries headlands and rock platforms, and relevant buffer areas), and d) coastal use areas.	The study area is defined in Section 1.1. The CMAs mapped as part of the draft SEPP are discussed in Section 1.5.
3	Local councils that decide to prepare a CMP must determine whether it is being prepared: a) for all or part of the coastal zone of one local council area b) all or part of the coastal zone of adjoining local council areas located within a coastal sediment compartment (applicable to coastal vulnerability areas including coastal lakes and estuaries). Where adjoining local council areas are located within a single coastal sediment compartment (at the secondary compartment level), their CMPs must reflect this regional context, and c) to include areas adjoining the coastal zone that are integrally connected to the management of that zone, and are contiguous.	This CMP is being prepared for part of the coastal zone of Eurobodalla Shire, covering the Tuross River Estuary and Coila Lake.
How is a CMP prepared in accordance with the manual?		
4	A CMP is to be prepared using the staged process set out in the manual, noting that all stages do not need to be completed if they are not relevant.	The staged development process applied to this CMP is discussed in Section 1.4
5	All councils commencing the preparation or review of a CMP must complete Stage 1 (scoping study) of the process. At the conclusion of the scoping study, councils should take the opportunity to seek advice from OEH and the Coastal Council on which of the subsequent stages are applicable	The Scoping Study was completed by ESC (refer Section 2.3).
6	Councils should take the opportunity to seek advice from OEH and the Coastal Council at the conclusion of key stages of the CMP process.	OEH has been involved throughout the preparation of this CMP. The Coastal Council has not yet been established.
7	Councils should submit a draft CMP that is consistent with the requirements of the Manual to OEH. After exhibition of the draft CMP, Councils should provide a copy of the final draft of the CMP to OEH for review before it is submitted to the Minister for certification. The Minister may refer the CMP to the Coastal Council for advice before the Minister considers certification.	To be completed.

Essential Element		Where addressed in this CMP
What objectives should a CMP aim to achieve?		
8	Councils should identify priority objectives for their coastal management areas. When identifying objectives for a CMP that includes one or more coastal management areas, councils must be consistent with the objectives for coastal management areas as required by the draft CM Bill and proposed CM SEPP. The objectives must align with the objectives identified by the local community in developing the Community Strategic Plan.	Coastal management objectives are discussed in Section 1.1.
Which management issues should be considered?		
9	Councils should identify the priority management issues and opportunities affecting the coastal zone where the program is to apply.	Section 4
What outcomes are required from a CMP process?		
10	The CMP should be developed after the preparation of: a) a Coastal Strategy Statement. The Strategy Statement sets the long-term strategy for the integrated and coordinated management of the coastal zone with a focus on achieving the objectives of the draft CM Bill. This includes identification of: • coastal management issues and opportunities • strategies and actions linked to coastal management areas covered by the CMP including a map of proposed actions b) specific trigger points or indicators of when a strategic approach will no longer be viable. This should be based on thresholds for intolerable and unacceptable risk at that locality, identification of coastal management actions that are council's responsibility, and are consistent with the Strategy Statement. After certification and adoption of the CMP, the final council actions will be incorporated in council's IP&R framework and land use planning system c) identification of coastal management actions that are consistent with the Strategy Statement and require coordination with adjoining councils or are the responsibility of public authorities. The draft CMP should include an acknowledged acceptance of these management actions where they include public authority responsibilities and/or coordination with adjoining councils prior to certification by the Minister, and d) a business plan to demonstrate viable funding of proposed actions.	The CMP Strategy is discussed in Section 5.1. This CMP includes strategies and actions linked to the CMAs (refer Section 5.4 - Coastal Management Actions). Public authority responsibilities are discussed in Section 5. Section 5.5 - Business Plan

Essential Element		Where addressed in this CMP
	A CMP should include: e) a summary statement of the overall CMP Strategy that demonstrates how the CMP provides an integrated and sustainable program of coastal management in line with the Objectives in the draft CM Bill, any regional objectives and the objectives of the council. f) coastal management actions to be implemented by council through IP&R and land use planning processes which are consistent with the Strategy Statement and are the responsibility of the council, in addition the actions to be implemented by adjoining councils (where relevant) and public authorities g) a brief summary of the business plan outlining the key components of the funding strategy for the proposed actions h) where the CMP is being prepared for a coastal vulnerability area, a coastal erosion emergency action sub-plan, and i) a map (or maps) showing linked actions for each relevant coastal management area along the coast. These maps should include adjoining local council areas where cross boundary management needs to be consistent or fully aligned to address issues such as regional scale sediment compartment processes, or where an estuary or wetland and its catchment straddles a council boundary. Supporting documentation for a CMP will include: j) a detailed Coastal Strategy Statement which provides context and objectives and establishes council's strategic direction(s) for the coast. k) a detailed business plan for implementation of the CMP, and l) a listing of all detailed reports relied on in the preparation of the CMP, and a statement as to how to publically access any of the listed documents.	The CMP Strategy is discussed in Section 5.1. This CMP includes strategies and actions linked to the CMAs (refer Section 5.4 - Coastal Management Actions). Section 5.5 - Business Plan As electronic mapping of the Coastal Management Areas is not yet available, it is not possible to provide a map of actions linked to CMAs. The CMAs affected by the actions are listed in the description of the actions in Section 5.4. A list of detailed reports and references will be available on Council's website during the public exhibition phase and following adoption of the CMP.
What actions should be identified?		
11	Councils should identify management actions which reduce risks and contribute to achieving the proposed strategic direction for each coastal management unit. Proposed management responses should reduce consequences or reduce the likelihood of a hazard or threat affecting a vulnerable asset (natural, social or economic). These responses should: a) reflect the vulnerability and opportunities in the coastal management program area b) reduce risks affecting coastal ecosystems and biodiversity and identify opportunities to improve the health of coastal ecosystems c) identify opportunities to improve coastal use, access and amenity, and coast dependent economic activity, and d) be identified in consultation with stakeholders.	Section 5

Essential Element		Where addressed in this CMP
What is required in a business plan for a CMP?		
12	Councils must develop a business plan that demonstrates viable funding mechanisms for proposed coastal management actions that are consistent with their IP&R Resourcing Strategy. In the business plan: a) councils should identify and consider the full capital, operational and maintenance costs of potential coastal management actions b) councils should identify the distribution of costs and benefits of potential management actions. The distribution analysis should consider council, agency, directly affected coastal community stakeholders (such as landholders in coastal hazard areas), indirectly affected coastal community stakeholders and the environment, and c) the costs of coastal management actions should be apportioned among beneficiaries, taking into account capacity to pay.	Section 5.5 - Business Plan
What are the requirements for preparing a CMP for a coastal vulnerability area?		
13	If a CMP is prepared to address a coastal vulnerability area, that program should include all parts of the coastal zone that are: a) vulnerable to existing or potential hazards (including extreme events), or b) likely be affected by coastal hazards over a defined planning horizon. This could include the waters, beaches, dunes and headlands of the open coast, the waters, shorelines and riparian areas of coastal lakes and the shorelines, and the waters, banks, riparian areas and floodplains of estuaries, as far upstream as the tidal limit.	This CMP does not address coastal vulnerability areas.
14	The CMP should be developed to consider potential very large, low probability events and ongoing long-term changes, at timeframes up to, and if appropriate, beyond 100 years. Different levels of hazard and risk assessment detail are appropriate for long-term (less certain) and near-term hazards and risks	
15	The area covered by the CMP should allow for uncertainty about the impacts of future coastal hazards and potential threats to coastal biodiversity and socio-economic assets and their condition	
What are the requirements for taking coastal change into account?		
16	The planning horizons should consider potential coastal change, including a) climate change, including relative sea level rise b) population growth, and c) projected use of coastal land for infrastructure, housing, commercial, recreational and conservation purposes	Appendix F - Land Use and Development and Appendix J - Climate Change Information
17	A CMP may also include opportunities to enhance biodiversity (within coastal wetlands and littoral rainforest areas and coastal environment areas) and social and economic assets and conditions in the coastal zone including enhanced public access and enjoyment of the coastal amenity. The area covered by the CMP should include appropriate buffer areas to allow for uncertainty and change over time.	Appendix J - Climate Change Information

Essential Element		Where addressed in this CMP
How are stakeholders involved in the consultation?		
18	As a minimum, a stakeholder engagement strategy should be prepared and implemented by the council, and should identify relevant stakeholder groups within the community and include adjoining local councils and public authorities, where applicable, and outline methods that will be used to engage each group	Appendix A and Section 2
19	Prior to exhibition, a local council should provide a copy of its draft CMP to OEH for a review of consistency with the draft CM Bill and the manual.	To be completed.
20	A draft CMP must be exhibited for a period of not less than 28 calendar days. Councils must collate submissions made during the exhibition and identify and justify proposed changes to the draft CMP. A final draft CMP must be prepared	To be completed.

APPENDIX B. RELATED MANAGEMENT PLANS AND PROGRAMS

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

B1. 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 CMP are given below.

sustainable communities

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	Community 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	• 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

The preparation of the Tuross/Coila CMP is identified and funded within Council's Delivery Program and Operational Plan under the following actions:

- *S5.5 – Prepare for the impact of climate change on settlements including coastal hazards, flood impacts and bushfire*
- *S5.5.4 – Tuross Estuary Management Plan review.*

The Tuross/Coila Coastal Management Program also aligns with the following actions aimed at delivering the Sustainable Communities vision:

- *S4.1 – undertake environmental protection and restoration works*
- *S4.2 – provide invasive species protection services*

B2. EUROBODALLA SHIRE COUNCIL LOCAL ENVIRONMENTAL PLAN

Local Environmental Plans (LEP) are the primary tool for managing the development and utilisation of land within an LGA in line with the process set out in the *Environmental Planning and Assessment Act 1979* (EP&A Act). A LEP is a legal instrument that imposes standards to control development. LEPs are also used to reserve land for open space, schools, transport or other public purposes as well as to control advertising and protect trees and vegetation and generally comprises a written document and accompanying maps.

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. Council has endorsed a planning proposal to implement the recommendations of the Rural Lands Strategy and to make other amendments to Eurobodalla Local Environmental Plan 2012.

Through Council's LEP and Development Control Plan there are a number of requirements on development within the coastal zone:

- *Clause 5.5 - Development within the coastal zone, sets out Council's requirements as follows:*

  (1) The objectives of this clause are as follows:

  (a) to provide for the protection of the coastal environment of the State for the benefit of both present and future generations through promoting the principles of ecologically sustainable development,

  (b) to implement the principles in the NSW Coastal Policy, and in particular to:

  (i) protect, enhance, maintain and restore the coastal environment, its associated ecosystems, ecological processes and biological diversity and its water quality, and

  (ii) protect and preserve the natural, cultural, recreational and economic attributes of the NSW coast, and

  (iii) provide opportunities for pedestrian public access to and along the coastal foreshore, and

  (iv) recognise and accommodate coastal processes and climate change, and

  (v) protect amenity and scenic quality, and

  (vi) protect and preserve rock platforms, beach environments and beach amenity, and

  (vii) protect and preserve native coastal vegetation, and

  (viii) protect and preserve the marine environment, and

  (ix) ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area, and

  (x) ensure that decisions in relation to new development consider the broader and cumulative impacts on the catchment, and

  (xi) protect Aboriginal cultural places, values and customs, and

  (xii) protect and preserve items of heritage, archaeological or historical significance.

(2) Development consent must not be granted to development on land that is wholly or partly within the coastal zone unless the consent authority has considered:

(a) existing public access to and along the coastal foreshore for pedestrians (including persons with a disability) with a view to:

(i) maintaining existing public access and, where possible, improving that access, and

(ii) identifying opportunities for new public access, and

(b) the suitability of the proposed development, its relationship with the surrounding area and its impact on the natural scenic quality, taking into account:

(i) the type of the proposed development and any associated land uses or activities (including compatibility of any land-based and water-based coastal activities), and

(ii) the location, and

(iii) the bulk, scale, size and overall built form design of any building or work involved, and

(c) the impact of the proposed development on the amenity of the coastal foreshore including:

(i) any significant overshadowing of the coastal foreshore, and

(ii) any loss of views from a public place to the coastal foreshore, and

(d) how the visual amenity and scenic qualities of the coast, including coastal headlands, can be protected, and

(e) how biodiversity and ecosystems, including:

(i) native coastal vegetation and existing wildlife corridors, and

(ii) rock platforms, and

(iii) water quality of coastal waterbodies, and

(iv) native fauna and native flora, and their habitats, can be conserved, and

(f) the cumulative impacts of the proposed development and other development on the coastal catchment.

(3) Development consent must not be granted to development on land that is wholly or partly within the coastal zone unless the consent authority is satisfied that:

(a) the proposed development will not impede or diminish, where practicable, the physical, land-based right of access of the public to or along the coastal foreshore, and

(b) if effluent from the development is disposed of by a non-reticulated system, it will not have a negative effect on the water quality of the sea, or any beach, estuary, coastal lake, coastal creek or other similar body of water, or a rock platform, and

(c) the proposed development will not discharge untreated stormwater into the sea, or any beach, estuary, coastal lake, coastal creek or other similar body of water, or a rock platform, and

(d) the proposed development will not:

(i) be significantly affected by coastal hazards, or

(ii) have a significant impact on coastal hazards, or

(iii) increase the risk of coastal hazards in relation to any other land.

In addition, council has adopted an Interim Coastal Hazards Adaptation Code that gives effect to the relevant provisions within the LEP.

B3. ESC ASSET MANAGEMENT PLANNING

Council has a significant portfolio of community infrastructure assets under its care and control. Council accounts and plans for all of the existing assets under its ownership and any new asset solutions proposed in the Community Strategic Plan and Delivery Program. Supported by Asset Management Plans, the Asset Management Strategy includes Council's endorsed Asset Management Policy and summary plans that identify all built assets under Council's ownership and outline risk management strategies for them.

The Asset Management Strategy is under review in financial year 2016-17.

B4. ESC 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.

B5. ESC INTEGRATED WATER CYCLE MANAGEMENT STRATEGY

ESC reviewed and updated the Integrated Water Cycle Management (IWCM) Strategy in 2016 (Hydrosphere Consulting, 2016). The key issues addressed by 2016 IWCM Strategy are drought security, sewerage system and treatment capacity and the adequacy of village water supply and sewerage services. The IWCM Strategy has been developed from a review of Council's adopted strategic direction and considers the available information in developing ESC's future urban water strategy.

B5.1 Sewerage Systems

The Tuross Head (Bingie) STP is lightly loaded (within design capacity) for the majority of the year. For the Christmas/New Year period, however, the plant loading increases substantially and performance suffers.

The IWCM Strategy includes a combination of operational and minor upgrade works to the Bingie STP plus a capacity upgrade with Stage 1 aeration and chemical dosing, electrical and mechanical upgrades in 2018 and replacement of the STP in 2044 at the end of its design life (60 years).

ESC commissioned a study of the Tuross Head and Turlinjah sewer network. High inflow and infiltration are a cause of non-compliances with Bingie STP licence conditions as well as overflows from the sewage systems during wet weather. The network modelling report identified the upgrades required to avoid overflows during the 1 in 5 year 1 hour rainfall event and 1 in 20 year rainfall event in the Tuross sewerage system. The sewer network modelling also identified catchments that would benefit from sewer relining to reduce inflow and infiltration. The IWCM Strategy includes sewer network rehabilitation and sewer main replacement in the Tuross sewerage system.

B5.2 On-Site Sewerage Management Systems

The 2013 ESC On-Site Sewage Management (OSSM) Code of Practice provides guidance in preparing applications to Council and describes how systems will continue to be monitored once installed. Council is required to implement and maintain an OSSM inspection program by the Department of Local Government and NSW State Legislation. A risk rating is applied to each system to determine the frequency of inspections.

There are OSSM system located throughout the Tuross and Coila Lake catchments including the rural villages of Bodalla, Eurobodalla, Nerrigundah and Bingie. The IWCM Strategy includes the provision of improved sewerage services to rural villages based on the risk assessments undertaken as part of the OSSM inspection program and depending on community consultation and funding. Bodalla sewerage scheme (pressure

sewerage) and Bodalla STP will be constructed by mid-2018. The OSSM systems in Eurobodalla, Nerrigundah and Bingie are considered to be operating satisfactorily.

B5.3 Water Sharing Plans

Tuross River and alluvial aquifer town water sources are currently subject to licences under the *Water Act, 1912.* DPI - Water has prepared a Water Sharing Plan (WSP, under the *Water Management Act, 2000*) for the Tuross River Unregulated and Alluvial Water Sources. The WSP assigns a high priority to water utility licenses and domestic and stock licenses by recommending that available water determinations of 100% are made for these licenses when water allocations are being adjusted as a consequence of any reduction in the availability of water due to an increase in the average annual extraction against the long-term average annual extraction limit. The plan therefore secure water for domestic use by ensuring that water utility and domestic and stock allocations are not eroded by increases in the demand of other users. However, during periods of low and very low river flow the daily extraction limits will be significantly less than urban demand and storages will need to be drawn down to maintain supply.

B5.4 Water Supply Security

The implementation of the WSP will have a significant impact on water supply security (both current systems and the proposed augmentation) due to the reduced ability to access low river flows. Council is progressing the design and approvals for a new 3 GL off-stream storage at Stoney Creek near Bodalla filled by harvesting high flows from the Tuross River. This will become the major component of the next stage of the water supply augmentation combined with increased treatment capacity and transfer from south to north in the longer term.

The proposed augmentation strategy provides a balance between utilisation of the Buckenboura and Moruya/Deua Rivers and the underutilised Tuross river system. The system configuration will provide flexibility in the ability to supply normal demand from the northern system as well as the ability to supply off-peak or restricted demand from the southern system to both the southern and northern systems. The storages and treatment facilities in both the south and the north will also provide redundancy in the event of major asset failure in either part of the system.

B5.5 Water Sensitive Urban Design

Council's Infrastructure Design Standards detail the requirements for the design of infrastructure undertaken on Council, Crown or private land within Eurobodalla Shire. Chapter 11 of the IDS covers stormwater treatment and applies consistent best practice WSUD measures and principles. Related objectives are:

- To ensure treatment methods and associated structures are cost effective from a maintenance and operational perspective and that the risk to the public is minimised as far as practicable;
- To protect and enhance natural water systems within urban environments;
- To integrate stormwater treatment into the landscape, maximising the visual and recreational amenity of developments; and
- To improve the quality of water draining from urban developments into receiving environments.

B6. 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 study area includes a Sanctuary Zone, Habitat Protection Zone and General Use Zones (Figure 26).

Sanctuary Zones provide the highest level of protection for long-term conservation of marine biodiversity. The only activities permitted in Sanctuary Zones are those that do not involve the harming or taking of any plants or animals. All fishing is prohibited in these zones so that marine life can continue to thrive and reproduce. Most recreational activities may be conducted in Sanctuary Zones including swimming, sightseeing, boating, surfing, snorkelling, diving and approved research and educational activities. 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 Tuross 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.

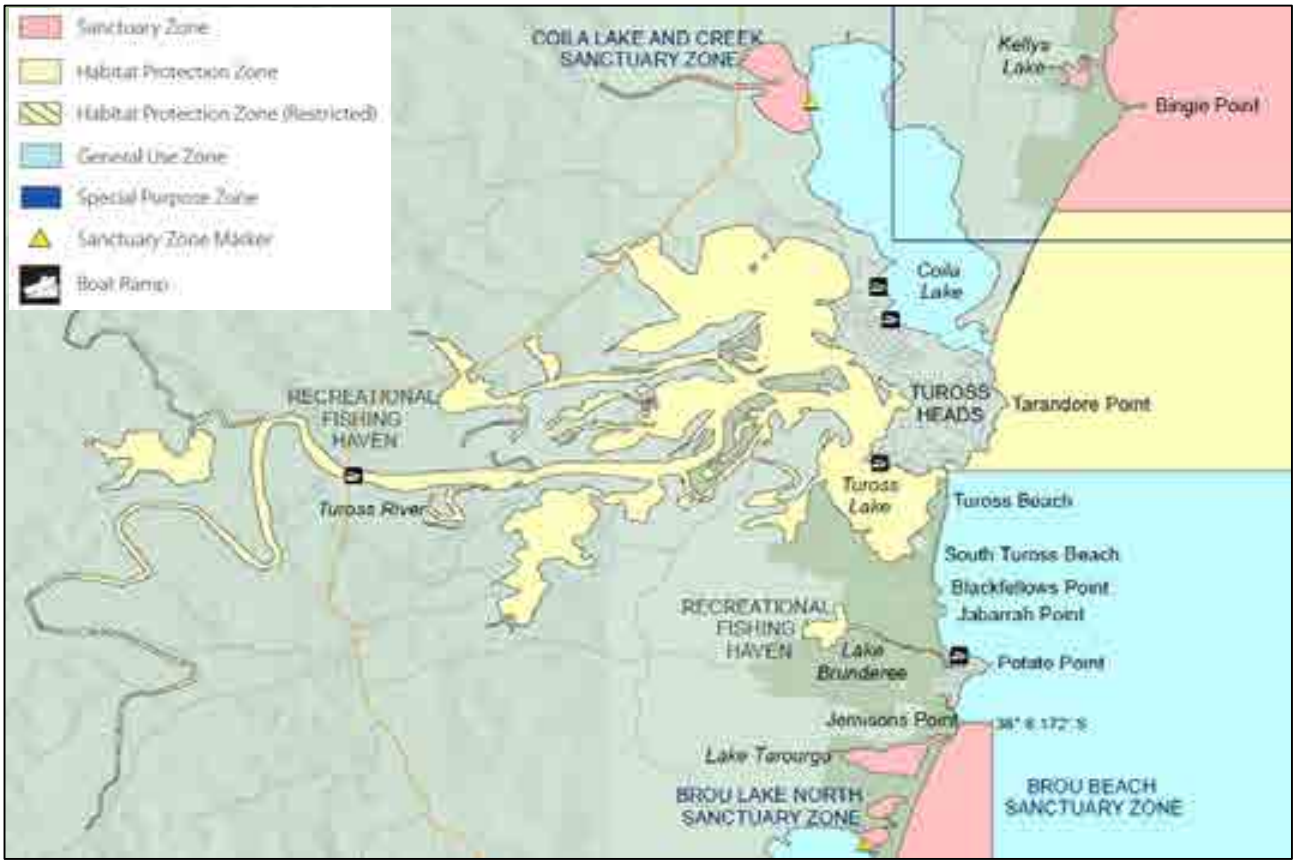


Figure 26: Map highlighting the Marine Park zones in Tuross River Estuary and Coila Lake

Source: Marine Parks Authority (2010)

DPI is developing a new approach to management planning to be piloted at Batemans Marine Park. This process will involve the community and will look at economic, social and environmental values of the parks. The management plans will replace existing separate marine park zoning and operational plans. The new plans will be underpinned by threat and risk assessments and better incorporate all values and uses. The main reforms to marine park management will be:

- Developing a better approach for reviewing management of marine parks (including multiple use zoning);
- Conducting targeted research on the ecological, economic and social aspects of marine protected areas to address key knowledge gaps and applying the information in planning and management;
- Incorporating threat and risk assessments into marine park planning and management;
- Developing ways of incorporating local indigenous knowledge and expertise of land and sea management into the management of marine parks;
- Improving local consultation and engagement processes;
- Developing a performance assessment system for marine parks; and
- Reviewing and updating marine parks legislation.

The following changes have occurred as part of the reforms:

- The replacement of the *Marine Parks Act, 1997* by the newly established *Marine Estate Management Act, 2014*, which provides for strategic and integrated management of the marine estate;

- The replacement of the Marine Parks Regulation 2009, by the Marine Estate Management Regulation 2009; and
- The replacement of the *Marine Parks (Zoning Plan) Regulation, 1999*, by the *Marine Estate Management (Management Rules) Regulation, 1999*.
- The Marine Parks Authority established under previous legislation no longer exists. The new legislation establishes two new advisory bodies:
    - The Marine Estate Management Authority: jointly responsible to the Minister for Primary Industries and Minister for the Environment and includes representatives of agencies involved in managing the NSW marine estate; and
    - The Marine Estate Expert Knowledge Panel: provides independent expert advice spanning economic, social and ecological sciences to the Marine Estate Management Authority.
- The Minister for Primary Industries and Minister for the Environment have joint responsibility for the *Marine Estate Management Act, 2014* and the day to day operations of marine parks are the responsibility of the Department of Primary Industries.

A comprehensive review of the *Marine Estate Management Regulation 2009* and the *Marine Estate Management (Management Rules) Regulation 1999* will be undertaken involving stakeholder consultation. Following this review the new approach to management planning will be piloted at Batemans Marine Park and Solitary Islands Marine Park. This process will include consideration of economic and social values and will result in the development of draft marine park management plans, which will replace existing marine park zoning and operational plans. These new plans will be underpinned by threat and risk assessments and better incorporate all values and uses.

B7. SOUTH EAST LOCAL LAND SERVICES STRATEGIC PLAN

The South East Local Strategic Plan 2016 - 2021 identifies the strategies, actions and priorities for local land services in the region. South East LLS is accountable for delivering services that add value to local industries, enhance natural resources and protect industries from pests and disease and help land managers respond to emergencies like flood and fire. The strategic plan prioritises service delivery on a regional basis, reflecting regional and local priorities. South East LLS seeks to enable land managers to build resilient communities in productive, healthy landscapes. This will require a triple bottom line approach to achieve the goals of:

- Resilient, self-reliant and prepared local communities;
- Biosecure, profitable, productive and sustainable primary industries;
- Healthy, diverse and connected natural environments; and
- Board members and staff who are collaborative, innovative and commercially focused.

B8. OYSTER INDUSTRY SUSTAINABLE AQUACULTURE STRATEGY

The NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS, DPI, 2016):

- 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*. SEPP 62 – Sustainable Aquaculture gives effect to planning provisions for oyster aquaculture.

APPENDIX C. STATUS OF 2005 ESTUARY MANAGEMENT PLAN ACTIONS

A summary of the status of actions from the 2005 Plan is given in Table 13. Actions that have been undertaken are displayed on Figure 8, page 8.

Table 13: Review of Actions from 2005 EMP

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Ecol-1 1/28	Carry out a desktop and field based assessment to identify and map areas within the Tuross and Coila Lake and their catchments that are considered "critical habitat areas", existing environmentally "sensitive areas", and existing "degraded sensitive areas".	Conduct a desk-top assessment (focussing on private freehold land) to identify critical habitat areas, sensitive areas and degraded sensitive areas based on current available mapping and further investigation (based on updated aerial photography) where required.	ESC, OEH, South East LLS	• LEP 2012 contains identification of high conservation value land. • Field work involved in Tuross River Estuary Rehabilitation Program included mapping and GIS. • Ground-truthing of potential EECs at Coila and Tuross urban areas has been completed. • Conservation priority of Tuross/Coila reserves has been identified and mapped. • Layers available on ESC GIS.	Complete.
		Confirm areas of significance by selective ground-truthing by suitably qualified personnel.	ESC, OEH, South East LLS		
		Document and map the areas of significance, and incorporate into Council's GIS.	ESC		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Catch-1 2/28	Develop and implement a rural community education and consultation program specifically targeting upstream landholders, covering topics such as stock fencing, alternative watering sources, revegetation, weed management, efficient use of water allocations, foreshore protection, erosion control, riparian vegetation, and continued use of Best Management Practices within the Tuross Valley and Coila Lake catchments.	Carry out a survey of the rural community regarding existing management practices and existing level of awareness regarding environmental considerations and best management practice.	ESC, South East LLS	• Fish friendly farms- leaflet available. • ESC community support officer and weed officers field days, workshops etc. • E-farm network. • Extension Officer now located with LLS. • Education of visitors is also important.	Ongoing.
		Review existing rural community education programs, including those prepared by Councils, NSW DPI (NSW Agriculture) and other government agencies.	ESC, South East LLS		
		Prepare new material (including brochures, media releases, fridge magnets etc.), as required, covering a range of topics applicable to the Tuross and Coila catchment, and building on the findings of the initial rural community survey (see above).	ESC, South East LLS		
		Distribute education material to rural community and follow up with seminars, workshops, presentations etc., as required or requested. This should be done by a dedicated full-time Landcare / extension officer of Council.	South East LLS		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Multi-2 3/28	Prepare a Tuross estuary / Coila Lake Foreshore Management Plan, addressing bank stabilisation, riparian revegetation and conservation, and sustainable recreational use of foreshores	Review Draft Foreshore Management Plan (presented in Appendix D of the 20005 EMP), revisit prioritisation of foreshore erosion areas, and review current best practice for foreshore stabilisation (particularly low cost alternatives).	ESC, OEH	• Foreshore Management Plan adopted by Council as part of EMP. • Foreshore stabilisation undertaken and/or underway in a number of areas using OEH funding matched with Council contributions. • Areas under Council control complete (refer Strategy Ecol-3 below). • NPWS and private landholders have control over remaining areas. • Water Quality Improvement Plan (2016) identified priority sites for bank stabilisation and South East LLS/OEH/ESC has requested funding for these sites. • South East LLS working with landholder on Coila Creek to install fencing. • Tuross boat ramp investigations have been undertaken.	This CMP includes additional foreshore rehabilitation actions.
		Update Foreshore Management Plan where required and publicly exhibit the plan to obtain community feedback	ESC		
		Gain formal Council approval of the Plan and then implement in accordance with the details of the Plan	ESC, OEH		
Catch-2 4/28	Discourage stock access to natural waterways and foreshores of the Tuross estuary and Coila Lake by fencing, revegetation of riparian zones and providing alternative water sources, as appropriate.	Identify areas that currently have unrestricted access for stock to natural waterways (including private lands, Council lands and Crown land).	ESC, OEH, South East LLS, landholders	• Public lands under council control near complete. • South East LLS currently negotiating working with several private landholders to fence and rehabilitate riverbanks in Tuross River Estuary. • Most areas under ESC control are now fenced. Some Crown land and private land remains unfenced. • Ongoing.	This CMP includes additional foreshore rehabilitation actions.
		Liaise with landholders and stock owners regarding the most effective way to restrict stock access to the riparian zone.	ESC, South East LLS, landholders		
		Implement measures to restrict stock access, such as fencing, revegetation, provision of alternative watering sources (in freshwater areas, as appropriate), provision of compensatory land for grazing as appropriate.	ESC, South East LLS, landholders		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Ecol-3 5/28	Revegetation and preservation of foreshores and riparian zones around the Tuross estuary and Coila Lake.	Confirm riparian areas that have been cleared and are suitable for revegetation, including private and Crown lands and foreshores within Eurobodalla National Park	ESC	• Major bank rehabilitation works completed at Snake Flat including waterway access, cattle grids, fencing and bank stabilisation. Follow-up plantings and maintenance of project over 5-10 year period. • Erosion control at bank toe, fencing and revegetation (25-45m buffer) completed at Tuross River Bridge Reserve. • Projects underway on Coila Lake foreshore. Funding received to extend to Tuross Lake and Kyla Park. • Completed in part through Tuross Estuary Rehabilitation Program.	This CMP includes additional foreshore rehabilitation actions.
		Seek approval / involvement of land owners, as necessary for riparian rehabilitation works	ESC, landholders, South East LLS		
		Replant riparian areas using suitable native and endemic species and plant stock and encourage self-seeding and natural regeneration through fencing and stock exclusion.	ESC, landholders, South East LLS		
		Maintain vegetation until suitably established.	Landholders	• Ongoing management agreements.	
Eros-1 6/28	Stabilise and rehabilitate eroding banks around the foreshores of the Tuross estuary and Coila Lake	Carry out a detailed assessment of main erosion sites within the estuaries, including profile surveys, underwater inspections etc. as appropriate	ESC, OEH, South East LLS	• Visual surveys have been undertaken as part of development of the Tuross Water Quality Improvement Plan and this CMP. • Information forwarded to South East LLS to liaise with NPWS and private landholders. • Completed in part through South East LLS's 'Tuross Estuary Rehabilitation Program' • *Tuross Estuary Water Quality and Improvement Plan* (Southeast Engineering + Environmental, 2016)	This CMP includes additional foreshore rehabilitation actions.
		Prioritise sites for remediation (based on social and environmental considerations) and assess a range of options (including low cost options) to treat the foreshores	ESC, OEH, South East LLS		
		Liaise with landholders regarding access, funding and appropriateness of possible rehabilitation measures	ESC, South East LLS		
		Design and construct most effective remediation options at erosion sites, in priority order	ESC, OEH, South East LLS, landholders		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Entr-1 7/28	Continue to adopt the current Coila Lake Entrance Management Policy and, as identified in the policy, flood-proof or relocate low-lying assets around the lake perimeter	Review the existing Coila Lake Entrance Management Policy and assess the success of implementation since its adoption in 2001 (including flood-proofing, relocation of assets etc.).	ESC, South East LLS, OEH	• Complete - *Review of Environmental Factors for Entrance Management of Coila, Tuross, Kianga, Little, Bullengella and Nangudga Lakes* (BMT WBM, 2010). • Revised policy adopted in 2010. • Updated consent requirements for new development in accordance with entrance management and climate change adaptation strategies are included in the DCP.	The current policy aims to achieve a natural opening regime over the long term.
		Continue to implement the Entrance Management Policy, including the flood-proofing and/or raising of low-lying assets, to ensure that its outcomes can be achieved within the nominated 5 year life of the Policy (i.e. by 2006).	ESC		
		Revise the Coila Lake Entrance Management Policy for a second term (i.e. 2006+) in light of its implementation over the first term and improved knowledge regarding wider impacts of artificial openings of coastal lakes.	ESC, OEH, P&E		
Uses-1 8/28	Prepare a Tuross estuary / Coila Lake Waterway Usage Management Plan	Review Draft Waterway Usage Management Plan (presented in Appendix E of the 2005 EMP).	ESC	• Waterway Usage Management Plan adopted by Council as part of EMP.	This CMP includes waterway usage actions.
		Update Waterway Usage Management Plan and publicly exhibit the plan to obtain community feedback.	RMS		
		Gain formal Council approval of the Plan and then implement in accordance with the details of the Plan	ESC, RMS, DPI Fisheries		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Entr-2 9/28	Investigate and, if appropriate, carry out dredging of the Tuross estuary entrance to reinstate adequate tidal range for oyster farming.	Carry out an assessment of the likely environmental impacts of dredging within the Tuross entrance, including an assessment of expected longevity of the channel, and the economic impacts on oyster industry if not dredged	ESC, oyster farmers, OEH	• Complete - *Tuross Estuary Dredging – Technical Report* (GHD, 2003) and *Review of Environmental Factors for Entrance Management of Coila, Tuross, Kianga, Little, Bullengella and Nangudga Lakes* (BMT WBM, 2010) • Tuross River Entrance Management Policy adopted 2010. • Ongoing small scale dredging of ramp undertaken as required.	The current policy aims to achieve a natural opening regime over the long term.
		Source funding for dredging works, obtain necessary approvals for the works and prepare a specific Entrance Management Policy and Extraction Management Plan for the Tuross estuary, which described the details and protocols for dredging the entrance (including for example exact location of channel to be dredged, location of disposal site, method of operation, environmental controls to be implemented during the works and the necessary timeframe for completion of the works).	ESC, oyster farmers, OEH		
		Implement works in accordance with detailed design of dredging works and stipulated consent / licence conditions.	ESC, oyster farmers, OEH		
Uses-2 10/28	Maintain routine bacterial monitoring of water and oyster flesh within the Tuross estuary	Continue to collect bacterial data from existing locations within the Tuross estuary and Coila Lake (as part of the NSW Food Authority requirements and Beachwatch program).	Oyster farmers, ESC	• The NSW Food Authority conducts testing on oyster meat as part of a Quality Assurance program. The meat is tested as an emergency response following heavy rain or spills as well as periodic quality assurance testing. This testing is a regulatory requirement and is an ongoing program.	Ongoing.
		Incorporate bacterial data into existing water quality database and provide interpretation of data for retrospective and management-based analyses.	Oyster farmers, ESC		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
WQual-3 11/28	Investigate and if considered feasible, construct mini wetlands at the ends of stormwater outlets along the Coila Lake foreshore in Tuross Head.	Carry out catchment modelling to assess likely benefits associated with construction of mini wetlands and to prioritise potential sites.	ESC	• Stormwater treatment options for 3 outlets at Coila Lake foreshore have been investigated. • Project on hold until funding is committed. • One gross pollutant trap has been constructed. • Existing stormwater quality devices are maintained and cleared.	This CMP includes stormwater quality improvement actions.
		Design wetlands (and associated gross pollutant traps) to maximise pollutant removal from urban runoff.	ESC		
		Construct wetlands (and associated gross pollutant traps), in priority order, subject to obtaining necessary funds.	ESC		
		Maintain gross pollutant traps and wetlands in accordance with a specific Wetland Maintenance Plan, and incorporation of Plan into Council's overall stormwater maintenance strategy.	ESC		
WQual-4 12/28	Improve existing sewerage system in Tuross Head to reduce the number of overflows.	Review capacity of existing sewerage system in Tuross Head, considering wet weather inflows and peak demands during summer holiday periods	ESC	• ESC reviewed and updated the Integrated Water Cycle Management (IWCM) Strategy in 2016. The IWCM Strategy (refer Section B5) includes strategies to increase the capacity of Tuross Head STP and sewer network rehabilitation/sewer main replacement to reduce overflows.	Addressed through Council's IWCM Strategy.
		Develop and assess a range of options aimed at increasing capacity of the sewerage system at Tuross Head, if considered necessary	ESC		
		Design and construct the most appropriate measures for improving the sewerage system at Tuross Head in order to minimise the frequency of overflows from the system	ESC		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
WQual-1 13/28	Investigate and where necessary implement changes to on-site sewage treatment / septic systems currently in use within the Tuross estuary and Coila Lake catchments.	Conduct audit of unsewered properties within the Tuross estuary and Coila Lake catchment to identify areas / systems that are significantly deficient.	ESC	• OSSM Code of Practice adopted in 2013 including inspection program and risk rating system. • The IWCM Strategy includes the provision of improved sewerage services to rural villages based on the risk assessments undertaken as part of the OSSM inspection program and depending on community consultation and funding. Bodalla sewerage scheme (pressure sewerage) and Bodalla STP will be constructed by mid-2018. The OSSM systems in Eurobodalla, Nerrigundah and Bingie are considered to be operating satisfactorily	Addressed through Council's IWCM Strategy.
		Canvass ideas and options regarding possible local-scale sewage treatment options, similar to the reed beds at Turlinjah, and connection of 1(c) lands immediately adjacent to urban lands to the reticulated sewerage system.	ESC		
		Assess options for improved treatment of sewage from unsewered properties and implement recommendations, as appropriate.	ESC		
WQual-2 14/28	Carry out environmental health water quality monitoring throughout the Tuross and Coila estuaries	Review the existing water quality monitoring program for Tuross estuary and Coila Lake.	ESC, OEH, South East LLS	• Ecosystem Health Monitoring Program for the Estuaries and Coastal Lakes • Ongoing water quality monitoring program. • Estuary health report cards. • *Tuross Estuary Water Quality and Improvement Plan* (Southeast Engineering + Environmental, 2016) • Data available on ESC website.	Ongoing
		Modify the existing program or prepare a new water quality monitoring program aimed at assessing key indicators of environmental health, and remaining consistent with the available budget for monitoring of the estuaries.	ESC, OEH		
		Carry out monitoring in accordance with Program.	ESC		
		Report findings of monitoring via Council's SoE report or directly to specific web-site (i.e. SEWQP web-site) and provide interpretation of results.	ESC		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Uses-4 15/28	Impose speed limits and no wash zones in sections of the Tuross estuary with eroding riverbanks	Confirm areas of particular environmental sensitivity where speed limits of boats should be reduced and/or no wash zones adopted, e.g. eroding banks, mangrove foreshores, wader habitats etc.	ESC, OEH, RMS, South East LLS	• 4 knot speed restrictions at Cambathin Island, 8 knot limit within Tuross Lake.	NSW RMS is responsible for boating regulations
		Liaise with NSW Maritime Authority (Waterways) and gazettal of additional speed restrictions within the estuaries.	ESC, RMS		
		Install signage indicating new speed restrictions and undertake awareness campaign of local users (e.g. prepare and deliver handout).	RMS		
		Enforce new speed restrictions and issue fines as appropriate.	RMS		
Multi-1 16/28	Develop and implement a Community Education Program for urban and semi-urban (rural residential) landholders around the Tuross estuary and Coila Lake, targeting pollution reduction, existing ecological values, sustainable recreational use of the estuaries and weed/pest management.	Carry out a survey of the urban and rural-residential community regarding existing level of awareness regarding environmental considerations and best practice management.	ESC	• Tuross Lakes Progress Group (TLPG) have expressed that they could help. • Multiple programs completed including stencil spraying of stormwater inlets. • Council-funded brochure developed by TLPG called “Natural & Cultural Heritage of the Tuross peninsula” • On-going – particularly weed education. TLPG distribute above brochure, weed information, hold information evenings etc. and write articles for Tuross News.	Ongoing
		Review existing urban and rural-residential community education programs, including those prepared by Councils, DPI (Agriculture), DEC (EPA) and other government agencies.	ESC		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
		Prepare new material (including brochures, media releases, fridge magnets etc.), as required, covering a range of topics applicable to the Tuross and Coila estuaries, and building on the findings of the initial urban community survey (see above).	ESC, OEH		
		Distribute education material to urban and rural-residential communities. As for the rural program, this should be done by a dedicated part-time landcare / extension officer of Council.	ESC		
		Carry out follow-up survey of the urban and rural-residential community to gauge the level of effectiveness of the education program and to quantify any changes in habits of the community.	ESC		
Ecol-2 17/28	Voluntary revegetation and rehabilitation of existing "degraded sensitive areas" and "critical habitat areas" with incentives provided to landholders for protection or rehabilitation of privately owned lands around the Tuross and Coila Lake and within their upper catchments.	Approach individual private landholders who have lands mapped as being sensitive, but degraded (as identified through implementation of Strategy Ecol-1) and discuss possible arrangements / partnerships for future rehabilitation works.	ESC, OEH, South East LLS	• Completed in part through Tuross Estuary Rehabilitation Program • Ongoing	This CMP includes additional foreshore rehabilitation actions.
		Provide assistance with rehabilitation works in the form of volunteer labour and/or tube stock, fencing materials etc.	ESC, South East LLS		
		Provide incentives for landholders who protect or rehabilitate sensitive areas and encourage the establishment of voluntary conservation agreements over rehabilitated lands.	ESC, South East LLS		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Ecol-6 18/28	Establish additional SEPP 14 Coastal Wetlands around the Tuross and Coila estuaries.	Conduct ground-truthing survey to investigate vegetation communities within fringing wetland areas and determine the appropriateness of new SEPP 14 areas and/or boundary adjustments to existing wetlands.	ESC, P&E	• Wetlands are now mapped as part of draft Coastal Management SEPP (including additional areas). • Environmental Conservation (E2) zones around SEPP 14 wetlands (now CMA 1 - coastal wetlands) are included in new LEP. • Completed in rural LEP (7a Environment protection wetland zone became E2 zone).	Complete.
		Prepare the necessary documentation and submit to the appropriate authorities (DIPNR) for consideration of inclusion under SEPP 14 legislation.	ESC		
		Generate maps of wetland boundary, once gazetted, and incorporate into Council's planning framework.	ESC		
		Inform community of new SEPP-14 areas and statutory implications.	ESC, P&E		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Ecol-4 19/28	Restrict / discourage public and domestic / feral animal access to 'critical habitat areas' around the Tuross estuary and Coila Lake, and within their catchments.	Identify critical habitat areas (to be completed as part of Strategy Ecol-1).	ESC	• Council has prioritised conservation activities within Council reserves. • Completed in part through Tuross Estuary Rehabilitation Program. • Saltmarsh around Coila Creek protected from vehicular access damage as part of Eurobodalla Biodiversity Program. • Some saltmarsh sites in National Park (Coila foreshore) require protection.	This CMP includes actions to protect saltmarsh
		Liaise with landholders to discuss appropriate mechanisms for restricting public and domestic / feral animal access. For public land this would involve discussions with ESC or Department of Lands.	ESC, South East LLS		
		Implement most effective means for restricting or discouraging inappropriate access of critical habitat areas, as determined through landholder negotiations (e.g. bollards, fencing, signage, etc.).	ESC, South East LLS, landholders		
Ecol-5 20/28	Protect / conserve 'critical habitat areas' around the Tuross and Coila estuaries, and within their catchments.	Identify critical habitat areas (to be completed as part of Strategy Ecol-1.	ESC	• Endangered Ecological Communities have been identified. • Field validation completed at sites adjacent to urban areas. • Completed in part through Tuross Estuary Rehabilitation Program • LEP contains riparian zone and HCV overlays that outline additional considerations for development in these areas.	This CMP includes additional foreshore rehabilitation actions.
		Approach individual private landholders who have critical habitat areas to discuss possible arrangements / partnerships for future conservation options, rehabilitation works (if necessary), and possible rezoning of lands to reflect its ecological significance.	ESC, South East LLS		
		Provide assistance with minor rehabilitation works in the form of volunteer labour and/or tube stock.	ESC, South East LLS landholders		
		If considered necessary and agreeable to landholders, amend LEP to rezone critical habitat areas to ensure environmental protection and conservation in the future.	ESC, P&E		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
		Provide incentives for landholders who rehabilitate sensitive areas and encourage the establishment of volunteer conservation agreements over critical habitat areas.	ESC, South East LLS		
Uses-5 21/28	Restrict certain conflicting activities within the Tuross and Coila estuaries.	Assess existing information and canvass community input to determine significant conflicts between various recreational user groups within the Tuross estuary and Coila Lake and between recreational uses and significant environmental values of the estuaries. To be done as part of the Waterway Usage Management Plan (Appendix E of the 2005 EMP).	RMS, DPI Fisheries, MPA	• Community input obtained as part of the CMP development. • Implementation of Marine Park has resulted in changed recreational use. • Marine Park signage, website, pamphlets are available. • Fishing restrictions are in place.	Some conflicts still remain.
		In consultation with the community, develop a plan that aims to minimise conflicts by separating incompatible recreational uses (through location or time restrictions on certain activities).	RMS		
		Provide educational information to the community regarding any changes to the recreational uses of the estuaries.	ESC, RMS		
		Enforce restrictions on certain recreational uses within the estuaries, as necessary, to ensure compliance.	RMS, DPI Fisheries		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Flow-1 22/28	Develop and implement a water sharing plan for the Tuross River that adequately caters for environmental flows required by the stream and estuarine system, as well as domestic and agricultural water supply needs.	ESC, DIPNR and SRCMA to liaise regarding the importance of environmental flows to the Tuross estuary and Coila Lake, and the need to ensure equitable sharing between all users as well as to allow for appropriate flows for the natural system.	DPI Water	• Tuross River and alluvial aquifer town water sources are currently subject to licences under the *Water Act, 1912.* • A draft Water Sharing Plan for the Tuross River Unregulated and Alluvial Water Sources has been developed. • There is a gauging station just upstream from the junction of Swamp Creek. New gauging station is yet to be established. • Daily stream flow as measured at the Tuross River at Eurobodalla gauge (218008).	Addressed through Council's IWCM Strategy.
		Undertake a review of the existing draft Water Sharing Plan for the Tuross Valley. Prepare / revise and implement a formal water sharing plan based on securing adequate 'environmental flows' and balancing other user requirements.	DPI Water		
		Establish a new flow gauging station within the Tuross River that is downstream of river extractors and upstream of the tidal limit.	DPI Water		
Multi-3 23/28	Prepare new policy applicable to all future developments to restrict land use activities and ensure that the Tuross estuary and/or Coila Lake are not degraded as a result of future developments.	Review existing planning framework regarding future development around the Tuross estuary and Coila Lake.	ESC, P&E	• LEP 2012 includes riparian buffers and requirements to consider sensitive coastal locations. • Development controls updated as part of DCP.	Subject to ongoing review by ESC.
		Confirm areas within the estuaries that are particularly susceptible to external loadings.	ESC, OEH, P&E		
		Liaise with landholders of areas that drain to naturally susceptible areas of the estuaries regarding proposed future use of these lands.	ESC, P&E, South East LLS		
		Modify existing planning instruments, development controls, or prepare new planning instrument(s) to restrict the extent and type of development within areas that drain to the naturally susceptible parts of the estuaries.	ESC, P&E		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Ecol-7 24/28	Investigate fish stock trends and commercial and recreational fishing practices in Coila Lake to determine if any seasonal restrictions or upper limits on the number of commercial licences are required.	Carry out surveys on recreational and commercial fishing effort and catch in Coila Lake, as well as surveys on specific important species (i.e. commercially important or threatened/rare species such as Black Bream).	DPI Fisheries, MPA	• DPI website lists research undertaken. • Marine Park zoning now applies • General fishing closures Coila Lake. • Recreational fishing haven – Tuross Lake	Subject to ongoing review by DPI.
		Review results of assessments to identify any potential species that may be affected by overfishing or specific fishing practices that may detrimentally affect the marine environment.	DPI Fisheries		
		If necessary, introduce temporary bans (seasonal or on-going) or modify bag limits on particular species or prohibit specific fishing practices.	DPI Fisheries, MPA		
		Continue to monitor the fish population during any temporary bans / changes to limits, and if improvements are observed, consider making bans / changes permanent, in consultation with the commercial fishers on Coila and the local recreational fishing community.	DPI Fisheries, MPA		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
WQual-5 25/28	Council to adopt a policy requiring WSUD for all new urban developments and to provide incentives for implementation of on-site stormwater treatment and re-use for existing developments around the Tuross estuary and Coila Lake.	Review existing planning framework regarding future development within Eurobodalla Shire Council.	ESC, P&E	• Council's Infrastructure Design Standards (IDS) details the requirements for the design of infrastructure undertaken on Council, Crown or private land within Eurobodalla Shire. • ESC reviewed and updated the Integrated Water Cycle Management (IWCM) Strategy in 2016.	Complete
		Review Council's existing IWCMS and current best practices for WSUD, and determine their applicability to the Tuross and Coila catchments.	ESC, P&E		
		Modify existing planning instruments to include findings of IWCMS, particularly the consideration of WSUD principles, such as on-site stormwater management, rainwater tanks, stormwater and greywater reuse etc.	ESC, P&E		
		Implement community education campaign regarding changes to planning framework.	ESC		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Uses-3 26/28	Upgrade existing public boat ramps and/or establish additional public ramps in both the Tuross Estuary and Coila Lake.	Canvass community input regarding requirements for existing boat ramp upgrades and the need for additional boat ramps. To be done as part of the Waterway Usage Management Plan (Appendix E of 2005 EMP).	ESC, RMS	• Feasibility study for appropriate location of new Tuross boat ramp completed including stakeholder consultation (Royal Haskoning DHV, 2013). • Regional waterway strategy completed by TFNSW/RMS. • ESC infrastructure strategy. • ESC Wharves, Jetties and Boat Ramps Strategy. • 2013 study recommended an alternative boat ramp site on community land adjacent to Hector McWilliam Drive and near Lake Street (Alternative 1 Site) with maintenance dredging at the existing boat ramp as a short-term measure;	This CMP includes waterway usage and infrastructure actions.
		Carry out upgrades to existing ramp, based on community demands, funding and geographic constraints.	ESC, RMS		
		Assess alternative locations for additional boat ramps within the estuaries, if needed, taking into consideration suggestions from community and other stakeholders.	ESC, RMS		
		Liaise with landholders of possible locations for boat ramps regarding options for waterway access and possible compensation of land, as necessary, followed by design and construction of new ramps.	ESC, RMS		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Flow-2 27/28	Remove the Deuaumba Island causeway and investigate the possible removal of other waterway structures that affect normal flows and fish passage.	Liaise with DEC (NPWS) and Department of Lands regarding access and responsibilities for removal of the causeway and bridge to Deuaumba Island and obtain necessary approvals / licences for works.	ESC, DPI Fisheries, P&E	• Bridge removed 2-3 years ago. Causeway still there. • Discussions regarding removing the causeway were held when the bridge was removed. Not a fish barrier but tidal flow restriction. • The temporary barrage is installed if required under licence from NSW Office of Water and fish passage requirements are addressed as part of the licence.	This CMP includes actions to remove waterway barriers.
		Remove the causeway using earthmoving equipment and necessary environmental protection controls (e.g. silt curtains) and dispose of the material at an appropriate landfill site or on nearby land.	ESC, OEH, P&E, South East LLS		
		Assess other structures within the estuaries that may potentially restrict the natural flow of tides through the waterway, or may restrict the passage of fish (e.g. culverts and barrages).	ESC, DPI Fisheries, P&E		
		Remove, replace or modify other structures, as identified, following discussions with relevant landholders and stakeholders.	ESC, landholders, P&E, South East LLS		

Strategy (and Rank in 2005 EMP)		Specific Actions	Responsibility	Outcome of Action	Comments
Herit-1 28/28	Identification and protection of significant Aboriginal and European cultural heritage sites.	Liaise with the Cobowra and Bodalla Local Aboriginal Lands Councils and the local Aboriginal elders regarding identification of sites and general localities of notable cultural significance.	ESC	• Report completed by Cobowra LALC (prior to EMP). Requires more consultation. • Liaise with ESC Heritage Committee and Moruya & District Historical Society. • New LEP takes into account recommendations in Kyla Park Plan of Management No. 27 to rezone Areas of Cultural Significance from 1(a) & 1(c) to Public Open Space. • Some natural heritage signs and one Aboriginal sign installed. • TLPG with funding from Coastcare, ESC & Tuross Head Country Club, have installed large sign at One Tree Point on natural & cultural heritage, including reference to both Aboriginal and European history of the headland; also signs along sea frontage in McWilliam Park and along urban section of Coila Lake foreshore including one Aboriginal history sign. • TLPG brochure on Natural & Cultural Heritage of the Tuross peninsula includes map of the area showing points of interest which could be walked as a heritage trail.	Subject to ongoing review by ESC.
		Carry out a European heritage assessment of the lands within and surrounding the Tuross estuary and Coila Lake.	ESC		
		Incorporate areas and sites of significant heritage value into Council's existing planning framework to ensure that they are preserved in perpetuity and are not compromised by inappropriate future development.	ESC, P&E		
		Liaise with LALCs and historical society / Council and install interpretive signage at strategic locations around the estuary, development of heritage trails etc.	ESC		

Strategies: Catch: Catchment Inputs; Flow: Tidal Flushing and Catchment Inflows; Ecol: Ecological Communities and Habitats; WQual: Water Quality; Eros: Erosion and Sedimentation; Uses: Commercial and Recreational Uses; Entr: Entrance Conditions; Herit: Culture and Heritage; Multi: Combined//Multiple Issues.

APPENDIX D. OTHER ESTUARY MANAGEMENT PROJECTS

This appendix lists the estuary management projects undertaken on private property.

A number of projects have been completed or currently being undertaken on public and private property within the estuaries. These projects involved the collaboration between Council, property owners, associated organisations (i.e. Bega Cheese) and South East LLS (formerly the Southern Rivers Catchment Management Authority). The objectives of these projects are the mitigation, management and rehabilitation of riparian land along the estuary. The projects aim to minimise nutrient and sediment inputs into the estuarine habitat as a result of farming practices, improved riparian corridors, improved soil conditions on properties, prevention and reduce bank erosion and educate farmers on sustainable farming practices.

Table 14 provides a summary of these projects, their current status, achievements and source of funding. Figure 8 on page 8 displays the location and extent of these projects activities.

Table 14: Tuross River Estuary and Coila Lake rehabilitation projects

Project	Location	Status/Timing	Project Achievements/Outputs	Funding	Cost
Landcare – Erosion Control and Revegetation	Cooper's Island Dairy Farm	Completed	200 m of fencing erected	State and Federal Government. Oyster farms SRCMA Property Owner.	NA
Nutrient Budgeting	Cooper's Island Dairy Farm	Completed	Comprehensive soil testing, analysis and mapping of the property	State and Federal Government. SRCMA Property Owner.	NA
Effluent Project	Cooper's Island Dairy Farm	Completed	Trafficable solids trap, pond and wet weather storage, solids storage area, pump, piping, effluent traveller.	State and Federal Government. SRCMA Property Owner.	NA
Erosion Control Works, Fencing and Revegetation ('Pats and Spats' Project)	Cooper's Island Dairy Farm	Completed	>10.5 km of fencing installed. >50 ha of land protected 9,500 plants established 500 m of laneways 1.3 km of erosion control (150 m of rock wall and 1050 m of eco logs) 2 troughs built	State and Federal Government. Oyster farms SRCMA Property Owner	NA
BEMS: Riparian Fencing Project	Greenway Farm (G Matthews & A Blake)	Undertaken and completed in 2006.	4 km of fencing installed protecting ~10 ha remnant riparian veg. 10 troughs installed. 580 m of laneway upgraded.	South East LLS	NA

Project	Location	Status/Timing	Project Achievements/Outputs	Funding	Cost
BEMS: Effluent Project	Greenway Farm (G Matthews & A Blake)	Undertaken in 2009/10 and completed by 2013.	Upgrade of wet weather storage facilities. Assistance with re-use system. Effectively use 18.25 ML/year over life of agreement. System now redundant after sale of farm.	South East LLS	NA
Fish Habitat Project	Greenway Farm (G Matthews & A Blake)	Undertaken 2010, currently all completed except toughs. To be completed by 05/2017	700 m of Tuross River protected and revegetated. 10 ha of wetland protected and enhanced. 1500 plants planted. 580 m laneway upgrade. 3 troughs installed (still to be installed.	Bega Cheese SRCMA Property Owner Fish Habitat Grant BEMS	$76,348
Snake Flat Erosion Control	Snake Flat	Completed in 2016	~ 300 m of fencing Installed. Cattle grid installed. Erosion controls installed.	NA	NA
Tuross River Bridge Erosion Control	Tuross River Bridge (Princess Hwy)	Completed in 2016	~ 2 km of fencing installed. Revegetation and Regeneration of river bank. Erosion control installed.	NA	NA
Muddy Island causeway rehabilitation	Muddy Island causeway	2015	The drainage conduit (50 cm internal diameter wood log) was replaced with box culverts to increase the hydraulic capacity of the causeway, restore tidal flows and hence reconnect wetland communities and aquatic species and restore ecological function of the wetlands.	South East LLS NSW Environmental Trust	NA
Revegetation Works - Tuross River	Chris Turner property (east of Tuross bridge)	2016	Fencing (stock exclusion) and revegetation of 1km of the Tuross River. Fencing and revegetation of 1.3km of the southern side of Black Creek. Total 5.5ha revegetation work.	South East LLS through the Realising the potential of our wetlands project	$42,000

Project	Location	Status/Timing	Project Achievements/Outputs	Funding	Cost
Revegetation and fencing works on north-east side Coila Creek	Wayne Downey property	2017	Fencing (stock exclusion) and revegetation of 2.5km of Coila Creek and 4.2ha revegetation works	South East LLS through the "Realising the potential of our wetlands" project	$20,000

A collaborative project between Industry and Investment NSW and NSW Land and Property Management Authority funded by the 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 Tuross catchment were included in the study (Table 15). 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 15: Priority Crown Land grazing leases and key fish habitat sites in Tuross River

Site	Area (ha)	Riparian length (m)	Key threats	Management Actions Undertaken	Additional recommendations
Tuross Lake, Turlinjah – previously unauthorised grazing of Muddy Island (Crown land, occupants have applied for possessive title)	4	900	• Stock access to CMA 1 - coastal wetlands • Impeded fish passage and hydrology	• Marine Parks Authority approval • Fencing of island • Remediate stock crossing to improve natural hydrology and fish passage	• Formalise tenure - offer tenure and completely fence banks of island from surrounding waterway (at cost to licensee) • If tenure (grazing licence) is refused: remove stock crossing and prohibit grazing.

Site	Area (ha)	Riparian length (m)	Key threats	Management Actions Undertaken	Additional recommendations
Tuross Lake – two wetlands have been hydrologically modified. Northern wetland transformed from estuarine to freshwater system by man-made bank. Southern wetland degraded, potentially used as dairy effluent pond. Earthern crossing alters hydrology and impedes fish passage. Unrestricted stock access to both wetlands.	14	3200	• Stock access to CMA 1 - coastal wetlands • Altered hydrology • Fish passage	• Grazing licence conditions reviewed • Recent South East LLS projects involved installation of fencing, effluent management system and erosion control	• Remediate fish passage obstructions

Source: Industry & Investment NSW (2009)

APPENDIX E. COMMUNITY AND STAKEHOLDER ENGAGEMENT

This appendix provides additional documentation from the stakeholder engagement tasks including:

- *The Community and Stakeholder Engagement Strategy;*
- *Correspondence to and from DPI – Fisheries; and*
- *Correspondence to and from NPWS.*

APPENDIX F. LAND USE AND DEVELOPMENT

F1. ZONING

Table 16 and Figure 27 provide a summary of Eurobodalla LEP 2012 land zoning within the study area. The land zones are not necessarily a reflection of actual current land use but provide an indication of what land uses are permitted in a given area/zone.

Table 16: Study area zoning - Eurobodalla LEP 2012

LEP zoning	Area (ha)	% study area
Coila Lake		
DM Deferred Matter*	474.5	18.1
E1 National Parks and Nature Reserves	50.2	1.9
E2 Environmental Conservation	158.4	6.0
E4 Environmental Living	62.9	2.4
R2 Low Density Residential	81.8	3.1
RE1 Public Recreation	6.6	0.3
RE2 Private Recreation	20.1	0.8
RU1 Primary Production	920.0	35.1
RU3 Forestry	123.1	4.7
SP2 Infrastructure	28.5	1.1
W1 Natural Waterways	693.3	26.5
Tuross River		
DM Deferred Matter*	1878.1	16.9
E1 National Parks and Nature Reserves	275.0	2.5
E2 Environmental Conservation	424.8	3.8
E4 Environmental Living	45.0	0.4
IN1 General Industrial	6.1	0.1
R2 Low Density Residential	31.1	0.3
R3 Medium Density Residential	0.4	0.0
R5 Large Lot Residential	279.8	2.5
RE1 Public Recreation	10.0	0.1
RE2 Private Recreation	4.9	0.0
RU1 Primary Production	3807.1	34.2
RU3 Forestry	2694.6	24.2
RU5 Village	57.7	0.5
SP2 Infrastructure	55.9	0.5
W1 Natural Waterways	1548.0	13.9

* Deferred matter areas under the LEP 2012 are currently zoned as public recreation or primary production under LEP 1987.

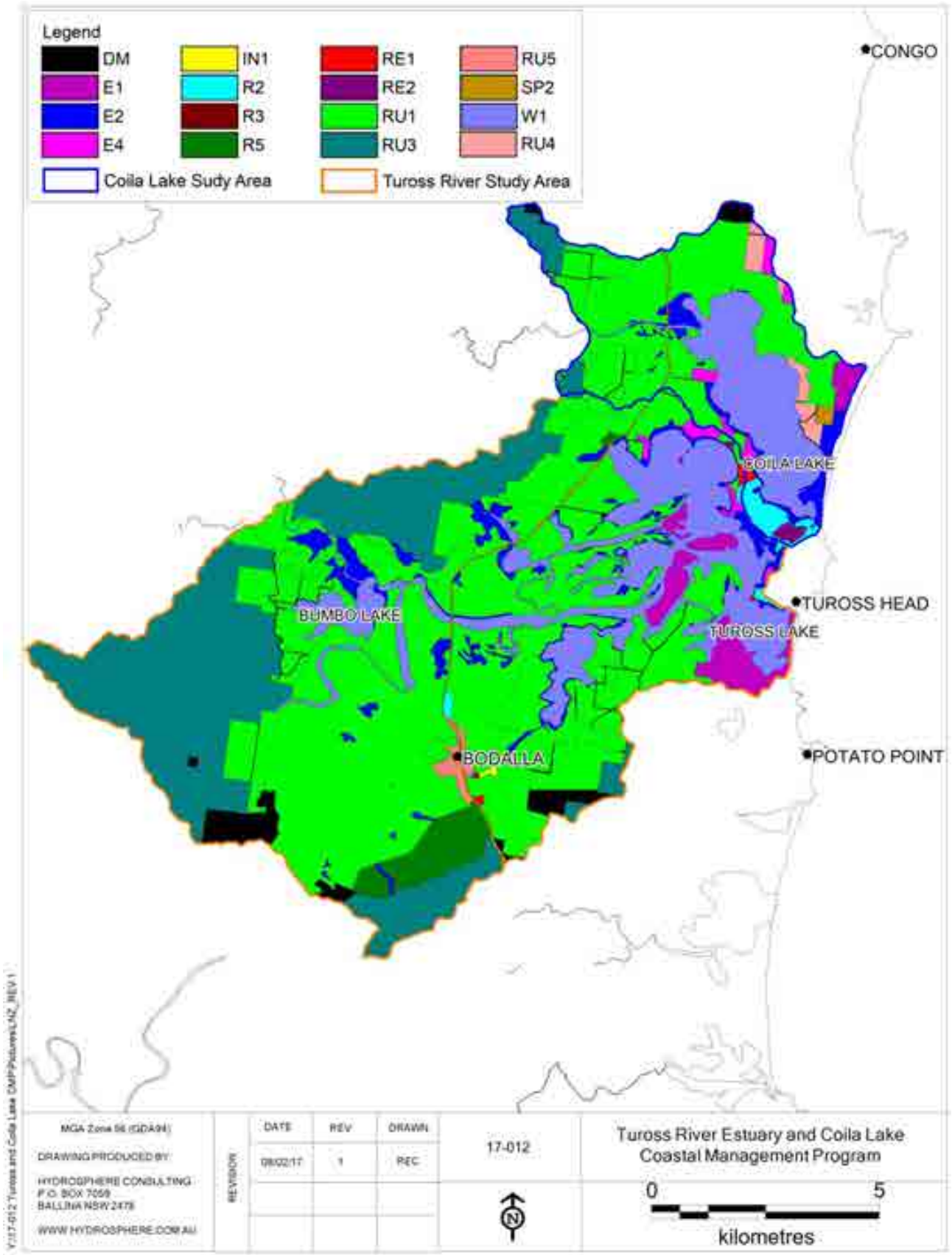


Figure 27: Study area LEP zoning

F2. CURRENT LAND USE

The majority of the Tuross River catchment is forested with approximately 86% of the total catchment under conservation or scrub land use. Approximately 1% of the total catchment is urban with a further 0.1% cleared land. There are small areas of river and wetland with agricultural land uses (grazing, horticulture) making up the remainder of the catchment area (approximately 13%). Within the Tuross River Estuary study area approximately 50% is forested with agricultural land uses covering approximately 32%. Urban areas cover approximately 10% of the study area and are concentrated around Turlinjah and Bodalla and Tuross Heads at the entrance to Tuross Lake.

Forested areas dominate the Coila Lake catchment encompassing approximately 72% of the total catchment with conservation areas concentrated in the upper half of the catchment (outside the study area). The remainder of the catchment is dominated by grazing (19%) and urban areas (6%) in the lower flat areas closer to Coila Lake. Within the study area, grazing is the most wide spread land use (46%) with only 36% of the area forested. Urban land use comprises approximately 14% of the study area and includes areas of Tuross Heads, Coila and the outskirts of Bingie.

Current land use throughout the study area and catchments is shown in Table 17 and Figure 28.

Table 17: Land use within Coila Lake and Tuross River catchments

Land Use	% study area	% total catchment
Coila Lake		
Conservation	8.9	55.6
Grazing	45.5	19.4
River	2.3	1.1
Sand	0.3	0.1
Scrub	26.8	16.4
Urban	13.9	6.4
Wetland	2.2	0.9
Tuross River		
Cleared	0.4	0.1
Conservation	29.3	74.9
Cropping	-	<0.1
DryForb (Dry horticulture)	-	<0.1
Grazing	32.1	11.9
Irrforb10 (Irrigated horticulture)	-	<0.1
Irrig5 (Irrigated pasture)	-	<0.1
IrrTree10	0.1	<0.1
IrrTree5 (Irrigated horticulture)	-	<0.1
River	4.6	0.8

Land Use	% study area	% total catchment
Scrub	20.1	11.1
Treehort (Dry horticulture)	0.0	<0.1
Urban	9.8	0.9
Wetland	3.6	0.2

Source: NSW OEH (2014) CERAT data

F3. URBAN DEVELOPMENT

Tuross Head is a coastal village situated between the entrances of Tuross River Estuary and Coila Lake. The urban area of Tuross Head lies within both the Tuross River study area and Coila Lake study area however the majority of Tuross Head drains directly into the ocean and lies outside the study areas (Figure 28). The majority of the Tuross Head urban area is low density residential however there are relatively large areas of private (golf course) and public (sports grounds) recreation areas. Bodalla is a smaller inland coastal village located in the upper south-western portion of the Tuross River Estuary study area. The main Bodalla Village itself is village zoned however there is a large area of large lot residential zoned land to the south west of the village.

There are no future land release areas identified in the Eurobodalla LEP 2012 mapping within the study area or catchments. Council is aware of a proposed subdivision below the Tuross Head Country Club on the foreshore of Coila Lake.

F1.1 Urban Stormwater

Urban stormwater is a potential source of contamination of waterways. 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 – Coila Lake, Tuross Head and Tuross Lake (Figure 29). Stormwater pollution control devices in the catchments include a trash rack/sediment trap at Monash Avenue, Tuross Head. The quality of stormwater entering Coila Lake was identified as an issue in the 2005 EMP. 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 particularly following rainfall events. This could indicate that urban runoff 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.

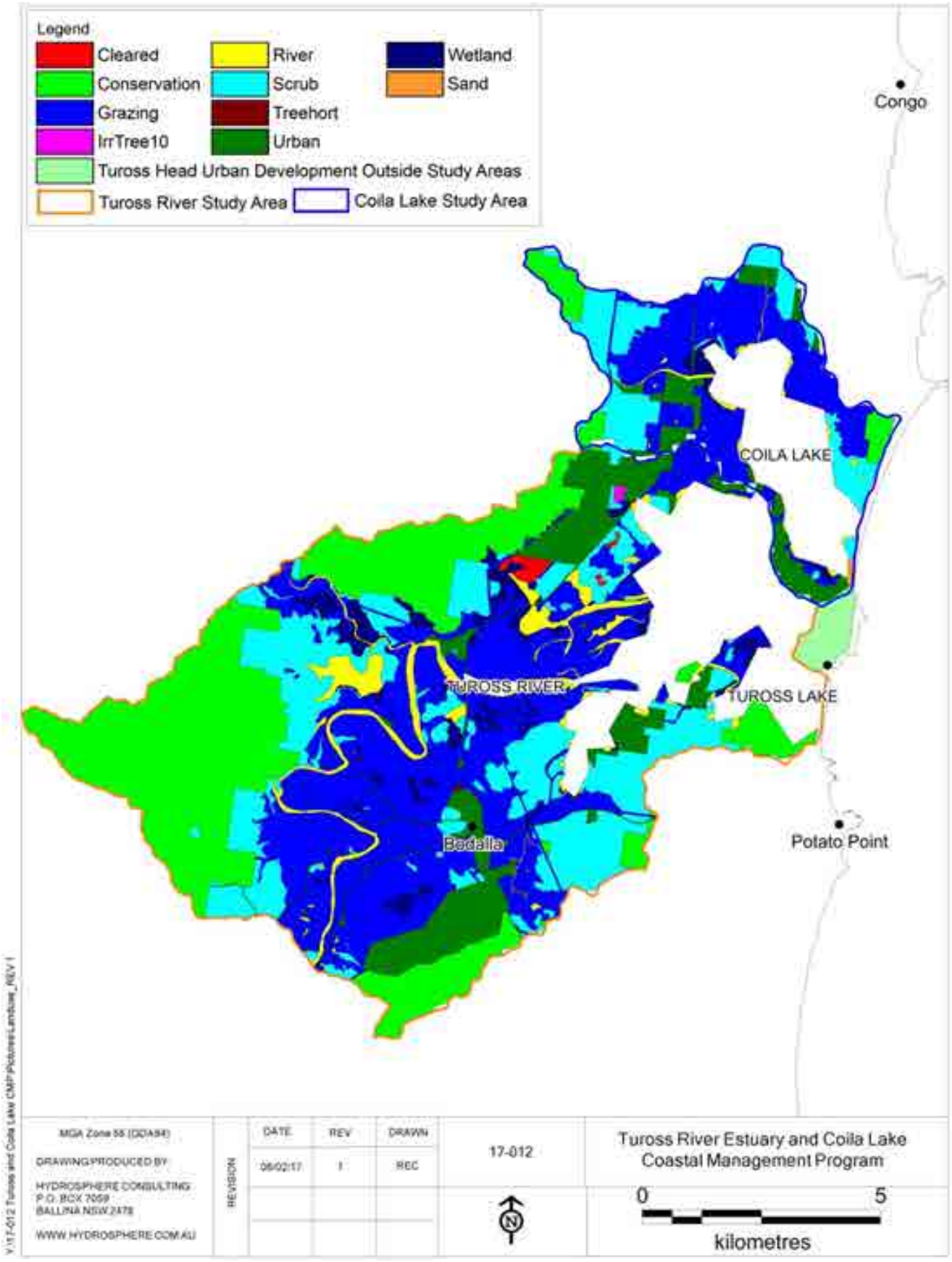


Figure 28: Land use in the Tuross River Estuary and Coila Lake study areas

Figure 29: Urban stormwater systems

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

The 2005 EMP identified stormwater outlets on the Coila Lake foreshore as potential locations for small constructed wetlands. The design of the stormwater drains in these areas has altered the natural flow patterns and redirected stormwater into highly modified channelised drains. Peak flows are pronounced compared to an unaltered condition in which there would have been more infiltration to the groundwater, an increased number of small intermittent streams and more ponding of water. ESC has investigated stormwater treatment options for the three sites on the foreshore reserve of Coila Lake.

F1.2 Sewerage Systems

The Tuross Head sewerage scheme provides sewage collection, transport and treatment facilities for Tuross Head as well as overflows from the effluent reuse system of the Turlinjah Sewerage Scheme which is based on common effluent drainage. Wastewater collected within the Tuross Head Sewerage Scheme is pumped to the Bingie STP which is based on the Intermittent Decant Extended Aeration (IDEA, Pasveer channel) type of secondary treatment process. Secondary treated effluent is either discharged to exfiltration beds, or filtered and pumped to an effluent reuse storage pond. Effluent is pumped from the storage pond to the Tuross Golf Course for irrigation and is also supplied for use in roadworks. The Turlinjah STP consists of two reed beds in series, a UV disinfection unit and a holding tank from which the effluent is supplied to the reuse scheme. Excess flows from the Turlinjah STP are transferred to the Tuross Head STP.

The non-urban areas of the catchment (e.g. Bodalla, Eurobodalla, Nerrigundah and Bingie) are serviced by decentralised wastewater systems such as septic tanks.

The community is concerned about the impact of sewerage systems on the health of the estuaries. ESC has adopted an IWCM Strategy which identifies the required upgrades to Council sewerage systems and the construction of centralised village sewerage schemes (refer Section B5, Appendix B).

F1.3 Population Growth

Population forecasts have been produced for Eurobodalla Shire by Forecast.id for 2011 to 2031 based on data from the 2011 and previous Census. In 2017 the total population of Tuross Head is estimated to be 2,237 people. The population is expected to increase by 88 people to 2,325 by 2027, at an average annual growth rate of 0.34%. This is based on a predicted increase of 31 households during the ten year period. The forecast residential development includes the proposed subdivision between 2022 and 2036 of 86 dwellings and a low level of infill development (2-4 dwellings p.a.).

The projections for the Narooma rural hinterland area (covering the south of the Shire from Tuross Head to the southern and western borders of the LGA, excluding Dalmeny and Narooma) suggest the rural population and number of households are predicted to increase by 0.13% p.a. and 0.5% p.a. respectively over the ten year period.

F4. AGRICULTURE

The primary agricultural activity undertaken in the Tuross River catchment area is dairy farming, a common agricultural pursuit on the NSW south coast. Other agriculture in the area includes cropping, grazing for beef cattle and turf farming. The primary agricultural activity in the Coila Lake catchment is grazing, with dairy farming also present around the lake. Agricultural activities within these study areas utilise water either from the river or farms dams. Agricultural runoff is a potential source of contamination of waterways. Farming practise and activities along the edge of the river are also potential sources of waterway pollution through sediment and nutrient runoff. If river banks are not fenced or the fence has been constructed too close to the bank, cattle have direct access to the foreshore which results in loss of vegetation and bank erosion due to trampling. Both cropping to the top of bank and cattle access to the water and along the river foreshore are evident along large stretches of the Tuross River foreshore and have been targeted for priority fencing and revegetation work.

F5. NATIONAL PARKS AND STATE FOREST

Several national parks are located within the Tuross River catchment including Gulgaga, Eurobodalla, Wadbilliga, Kooraban and Deua National Parks (Figure 30 and Figure 31). Gulgaga, Wadbilliga, Kooraban and Deua National Parks occupy the majority of the upper Tuross River catchment covering approximately 78,000 ha or approximately 42 % of the total Tuross River catchment. Eurobodalla National Park is situated on the coast with the northern extent of the park located within the Tuross River Estuary and Coila Lake study areas. A small area (50 ha) of the national park lies behind the dunes of Bingie Beach within the Coila Lake study area and 275 ha occupies the southern bank and several islands of the lower Tuross River.

Large areas of state forest cover the upper catchments of both the Tuross River Estuary and Coila Lake (Figure 30) with approximately 60,000 ha of state forest occupying 32 % of land across the combined catchments. State forest covers approximately 23% of the Tuross River study area and approximately 5 % of the Coila Lake study area. NSW state forests are managed by the Forestry Corporation of NSW.

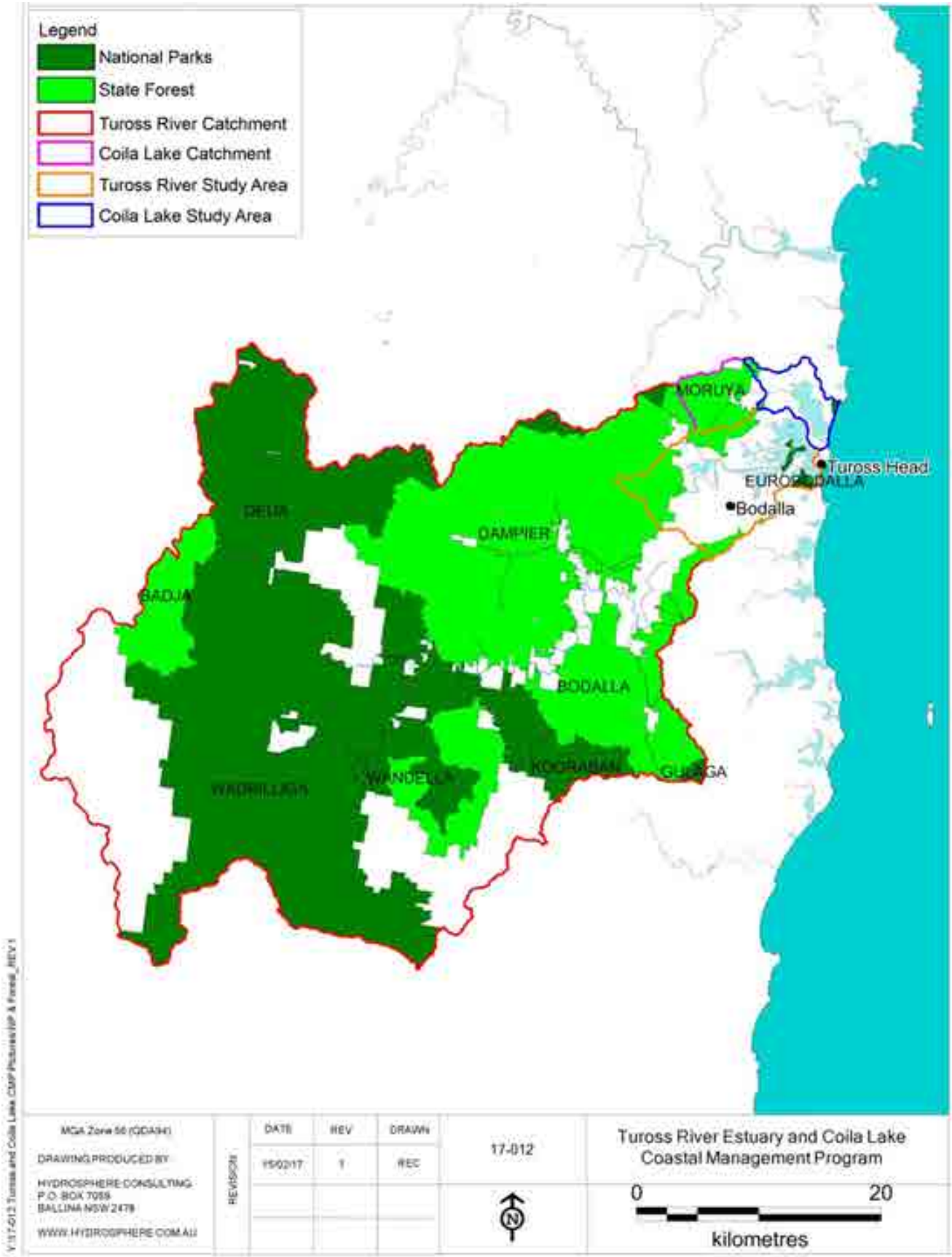


Figure 30: National Parks and state forest located within Tuross River Estuary and Coila Lake catchments

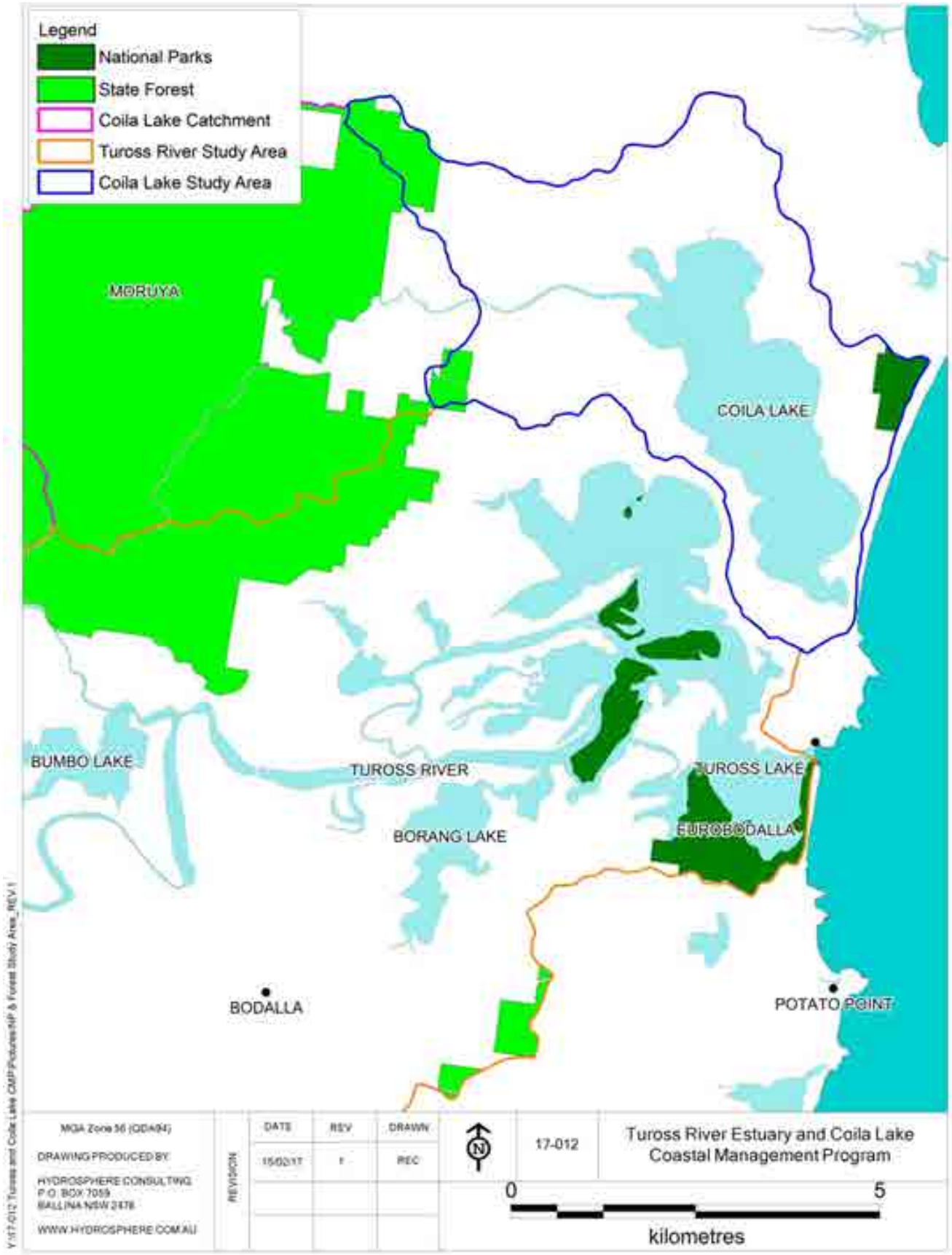


Figure 31: National Parks and state forest located within Tuross River Estuary and Coila Lake study areas

F6. WATERWAY BARRIERS

The 2004 EMS discussed the issues created by waterway barriers in preventing fish passage and restricting tidal flows. The 2005 EMP included an action to remove the Deuaumba Island causeway and investigate the possible removal of other waterway structures that affect normal flows and fish passage. The causeway was constructed to allow access to Deuaumba Island for grazing. The island is now part of the national park. A bridge extension to the causeway was removed in recent years but the causeway remains. This causeway is a tidal flow restriction and may be contributing to erosion around Deuaumba Island and Four Ways (WBM, 2005).

Other waterway barriers in the Tuross River Estuary include (Figure 32):

- The western Muddy Island causeway was remediated by South East LLS in 2015 (refer 0). The project was undertaken to remove the impediment to tidal ventilation and fish passage at Bowns Bay which contains CMA 1 - coastal wetlands, mangroves, saltmarsh EEC and is habitat for the vulnerable fish Australian Grayling. The causeway bisects the wetlands. There appears to be a second causeway that connects Muddy Island to the mainland to the north;
- Coopers Island Road – culverts have been duplicated to improve tidal flows although restriction still remains; and
- Coopers Island wetlands – bank crossings have been constructed to allow stock access and prevent saltwater ingress.

Any upgrade of these waterway crossings should consider improvements to tidal flow.

Figure 32: Waterway barriers in the Tuross River Estuary

APPENDIX G. BIODIVERSITY

G1. TERRESTRIAL VEGETATION

Terrestrial vegetation refers to all non-aquatic and non-estuarine plant species. Large tracts of state forest, natural scrub, conservation and wetland areas comprise approximately 53 % of the Tuross River study area and 38 % of the Coila Lake study area. These can extend to the banks of the estuaries (refer to Figure 28 and Figure 31).

Intact vegetation in catchment areas provides many important ecosystem functions, particularly the maintenance of good water quality. In this regard, the Tuross River Estuary and Coila Lake are in a much better position than many estuarine systems on the NSW coastline that have a greater level of disturbance. However, extensive clearing of terrestrial vegetation to allow for agriculture production has occurred over the past few centuries. Clearing has occurred to the banks of the estuaries with a large majority of these cleared areas utilised for grazing.

Under the 2012 LEP, parts of the study areas are classified as biodiversity areas (Endangered Ecological Community, EEC or extant native vegetation). These are shown on Figure 33 and Figure 34.

EECs known to occur within the Tuross River Estuary study area include:

- Coastal Saltmarsh;
- Freshwater Wetlands on Coastal Floodplains;
- Littoral Rainforest;
- River Flat Eucalypt Forest on Coastal Floodplains, and
- Swamp Oak Floodplain Forest.

EECs known to occur within the Coila Lake study area include:

- Bangalay Sand Forest;
- Bega and Candelo Dry Grass Forests;
- Bega Dry Grass Forest and Brogo Wet Vine Forest;
- Coastal Saltmarsh;
- Littoral Rainforest, and
- Swamp Oak Floodplain Forest.

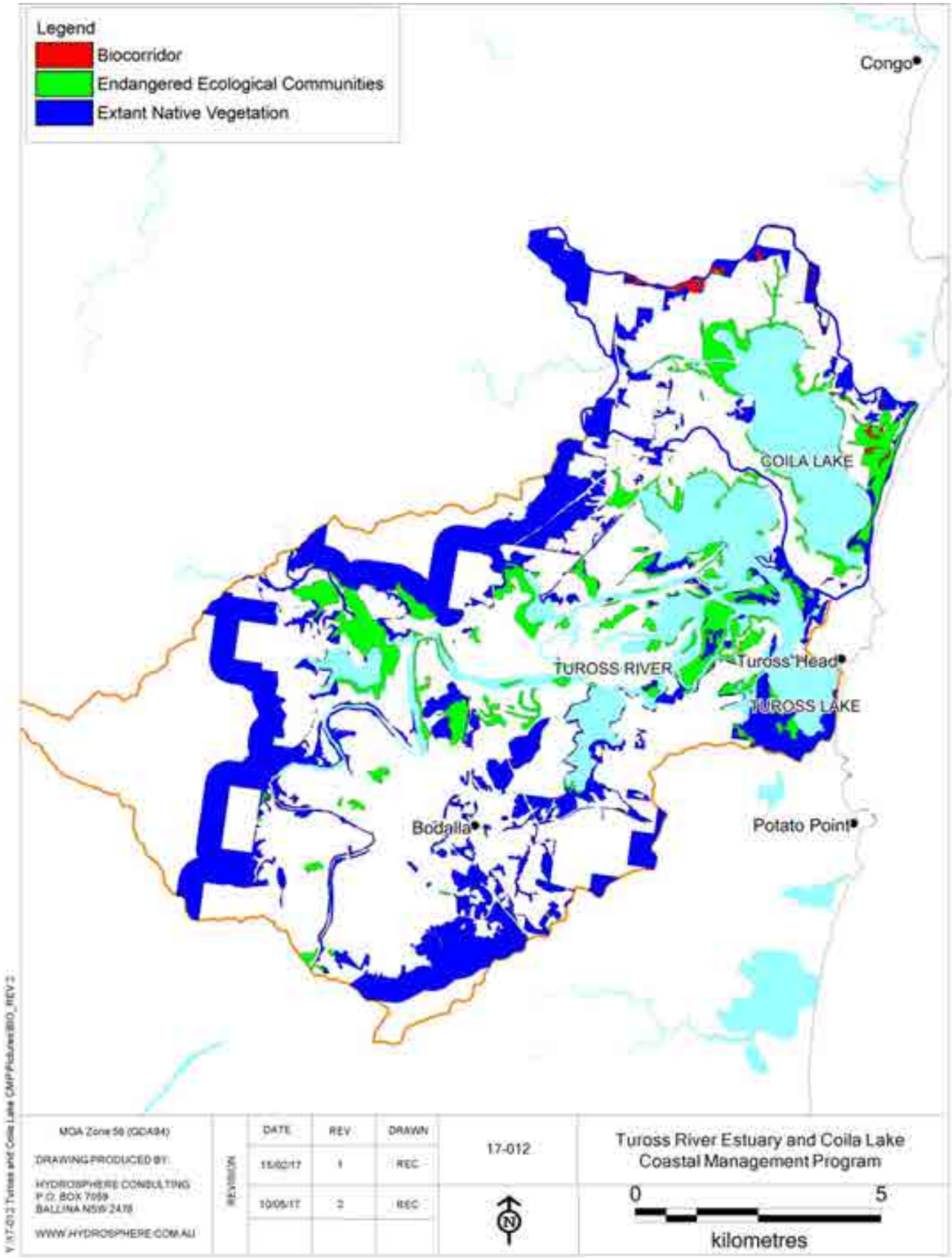


Figure 33: Documented bio-corridors, EECs and extant native vegetation within the study areas

Mapping prepared between 2006 and 2012

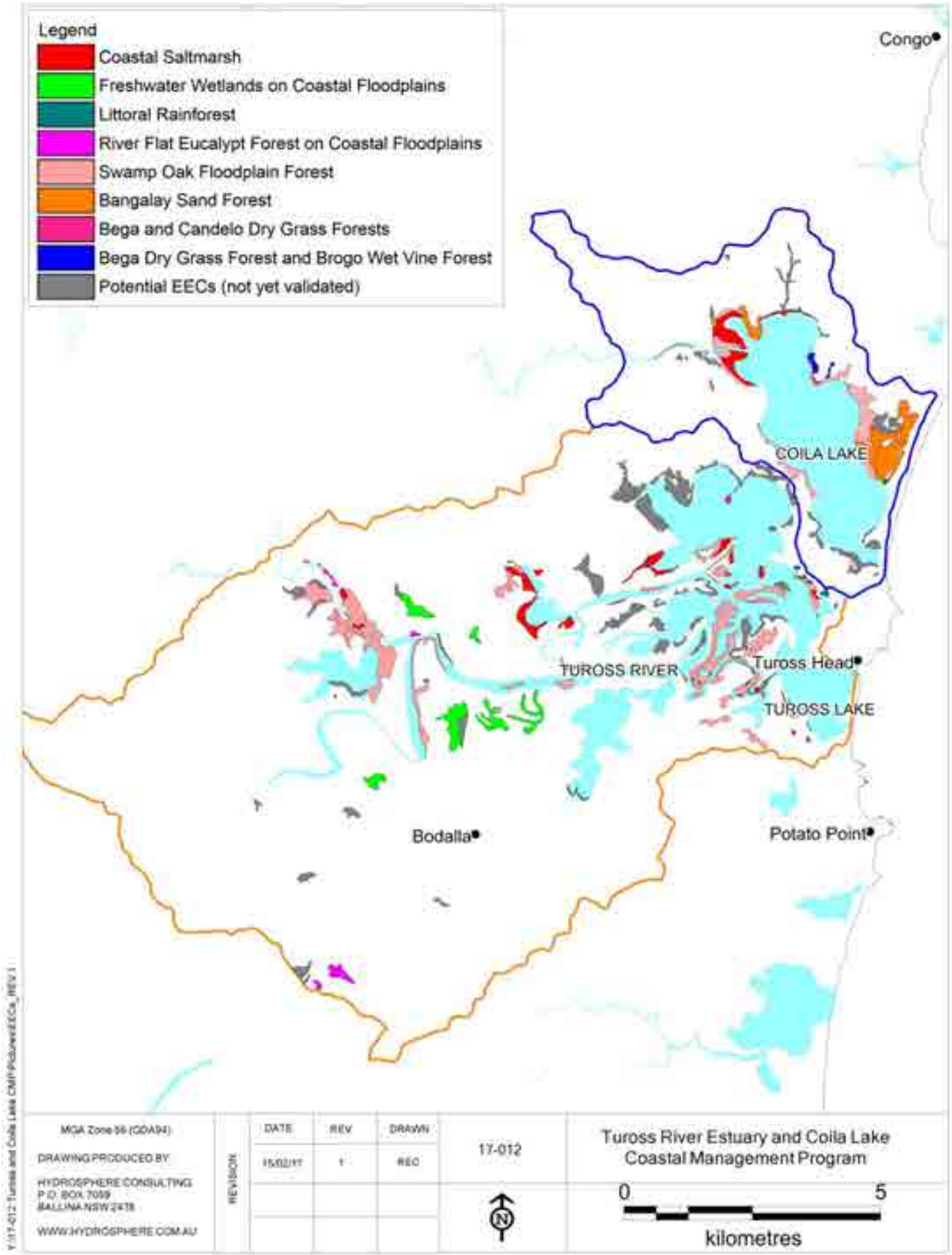


Figure 34: Known (validated) EECs and potential EECs (to be verified) mapped by ESC

Mapping prepared between 2006 and 2012

G2. 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 degradation of the riparian zone can have detrimental effects on the surrounding estuaries or water bodies.

Extensive clearing of riparian vegetation has occurred in the past centuries as a result of urbanisation and clearing for agricultural purposes. The clearing of riparian vegetation was identified as an issue in the 2005 EMP that was contributing to other issues such as water quality and bank destabilisation. The 2005 EMP reported results of the riparian vegetation mapping study undertaken by DLWC. This study classified vegetation as either dense, sparse or absent. The study identified that the riparian vegetation was quite variable around the foreshore of both estuaries. A large majority of the estuaries foreshores were comprised of sparse vegetation, particularly areas bordering farmland. Large section of dense vegetation was also recorded in locations boarded by National Parks and protected Coastal Wetlands and Riparian Rainforest areas as well as private land holdings. Shorelines absent of vegetation were recorded along the banks of Coila Creek and Tuross River, the entrances to both estuaries and a large section bordering Coopers Island. Recent aerial photography suggests that riparian vegetation cover is visible along the majority of the Tuross River Estuary and Coila Lake, however the density of vegetation is still quite variable. Sections of Coopers Island and the main channel of Tuross River and Coila Creek still have areas of very sparse to absent riparian vegetation. Since the 2005 EMP many projects have been undertaken in the past decade or are currently being implemented with the goal of revegetation and bank stabilisation of the riparian zone (refer Appendix C, 0 and Appendix I).

The large areas of Council reserve bordering the Tuross River estuary and Coila Lake make up approximately 20 % and 30 % of river and lake frontage land respectively (refer Section L2.1, Appendix L - Community Uses) which offers 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.

A large proportion of the riparian vegetation along the estuaries has been mapped as either CMA 1 - coastal wetlands, SEPP 26 Littoral Rainforest, Estuarine Vegetation (Mangroves/Saltmarsh) or EECs. Riparian vegetation mapped by ESC is shown on Figure 34 and Figure 35. Estuarine vegetation is discussed in Section G6.

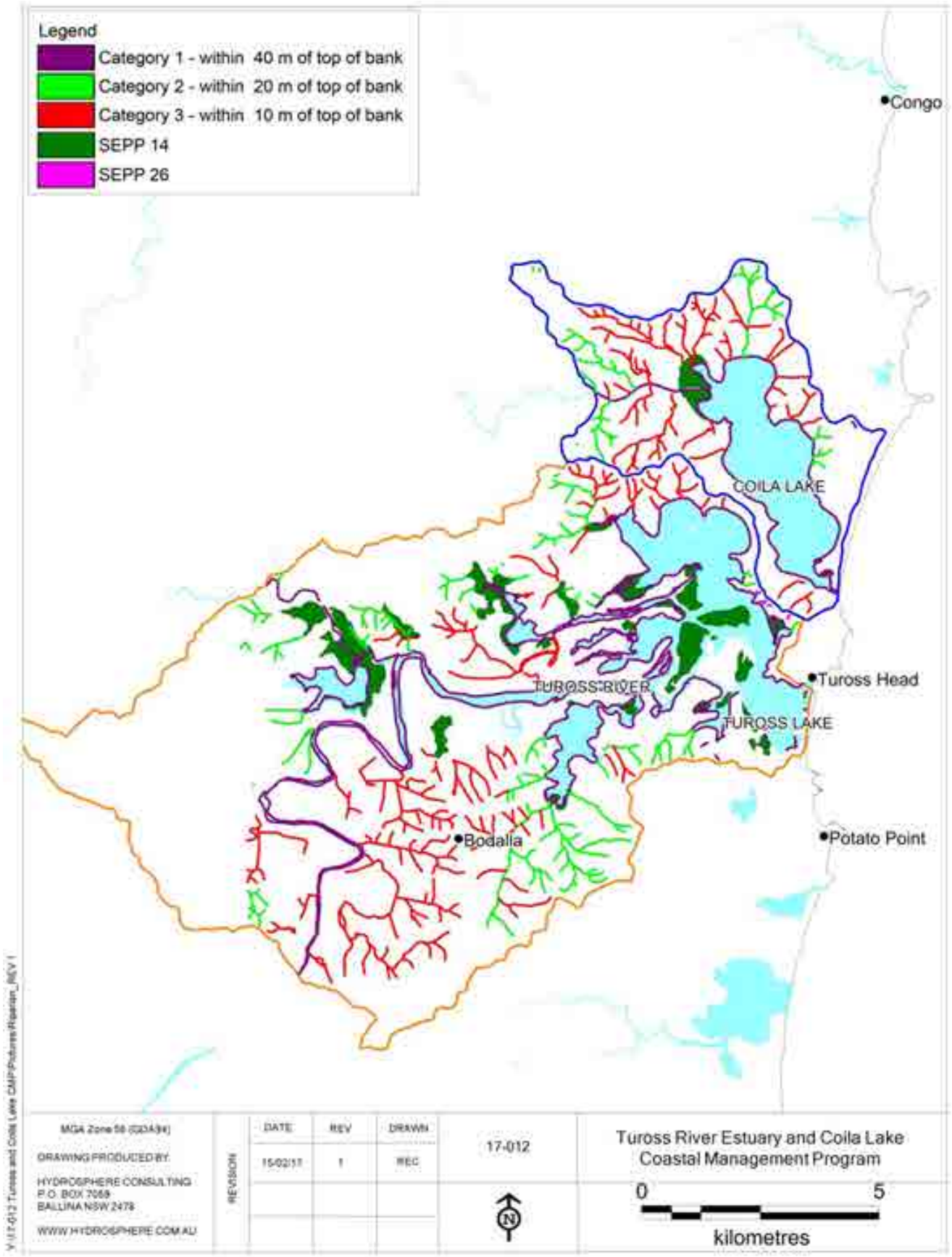


Figure 35: Riparian vegetation

Source: NSW Department of Natural Resources (2005)

Under the 2012 LEP, riparian land along rivers 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

The entire foreshore of Tuross and Coila Lake as well as Tuross River and Coila Creek are classified as Category 1, meaning the riparian land clause applies to all land within 40 m of the top of the bank of these waterbodies/courses. The tributaries running into these areas vary between Category 2 and 3.

Key issues relating to riparian vegetation currently identified or previously identified in the 2005 EMP were:

- Degradation of the riparian zone as a result of current and past anthropogenic impacts;
- Loss of riparian vegetation around the Tuross River Estuary and Coila Lake as a result of bank erosion; and
- Livestock access resulting in vegetation damage and bank erosion.

G3. TERRESTRIAL WEEDS

ESC currently undertakes inspections and implements mitigation measures relating to the management of noxious and invasive weeds. Figure 36 displays the areas were successful control measures have been implemented or problem areas identified during inspections. Inspections have identified key issues areas where invasive species such as lantana and blackberries require control measures to be applied. This process has been implemented as a result of the 2005 EMP identifying it as a key issue impacting biodiversity in the region. 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.

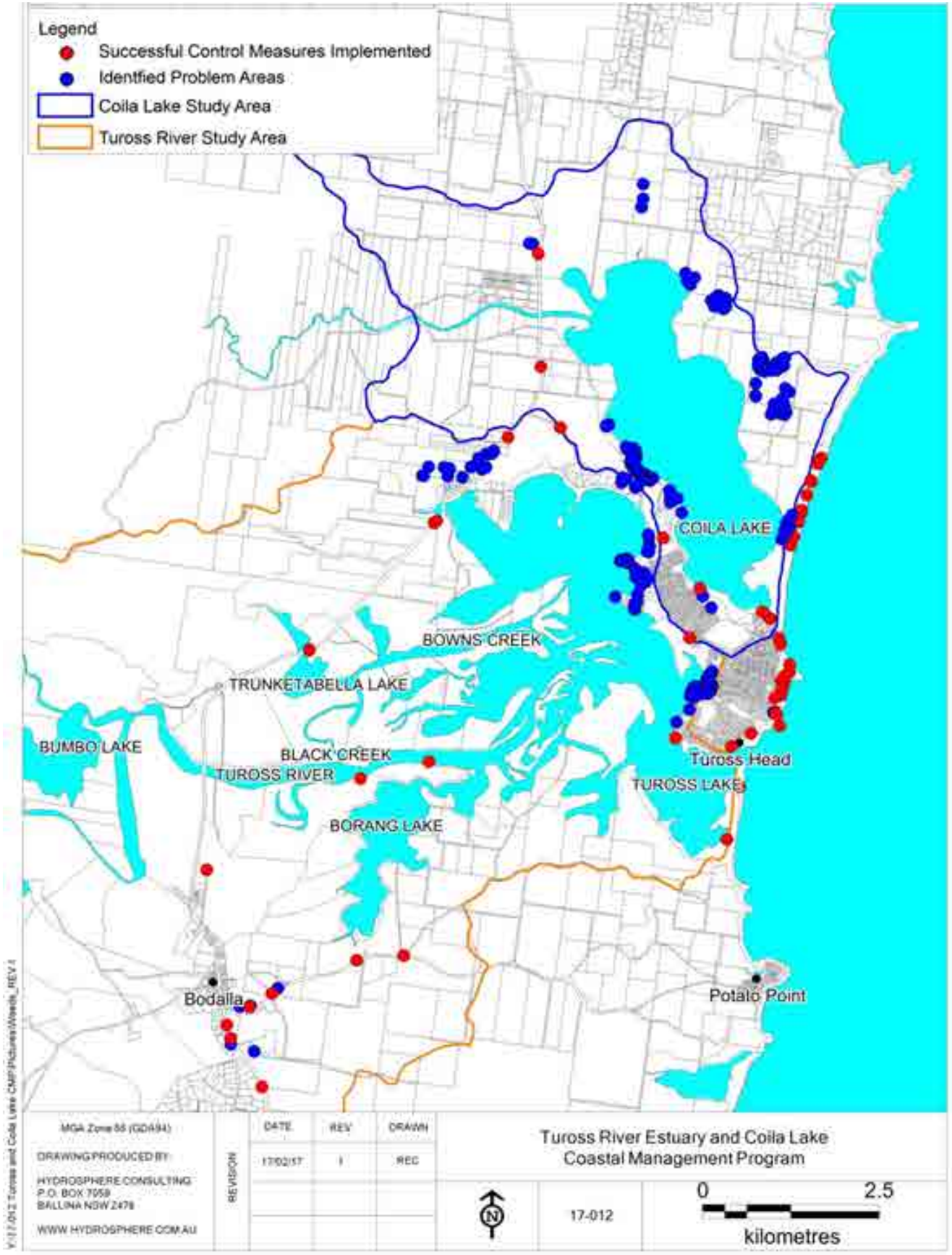


Figure 36: Terrestrial invasive weeds (2016)

G4. TUROSS-COILA RESERVES CONSERVATION PROGRAM

ESC is currently developing levels of service for bushland reserves (Table 18, Figure 37 and Figure 38). A conservation priority has been assigned to Tuross and Coila reserves based on the following ranking factors:

- High conservation value score based on EECs, vegetation type >70% cleared, number of threatened animal species associated with the vegetation type, threatened species, vegetation mapped within state or regional vegetation corridor;
- Reserve size;
- Shape of the reserve; and
- Active Landcare group.

Table 18: Description of ESC level of service for bushland reserves

Conservation Priority	Invasive species control	Revegetation	Landcare groups
Conserve and connect	Eliminate all high threat weeds to the reserve if feasible. Control other weeds as required to limit impacts on biodiversity. Seek collaboration within the local area to achieve integrated pest animal management.	Plan and undertake planting or habitat enhancements to restore diversity and structure within priority areas, to buffer and connect priority areas and/or provides habitat for threatened species.	Support the efforts of existing Landcare groups. Encourage and support the formation of new Landcare groups.
Enhance	Reduce the cover and extent or eliminate high threat weeds within the core areas. Control other weeds as required to limit impacts on biodiversity. Manage pest animal threats according to regional priorities.	Plan and undertaken planting or habitat enhancement in partnership with active Landcare groups.	Develop Landcare group Action Plans in partnership with the group.
Rehabilitate	Prevent the cover and extent of high threat weeds increasing within rehabilitation areas. Prevent the high threat weeds within degraded areas spreading into higher priority areas. Manage pest animal threats according to regional priorities.	Support works undertaken by Landcare groups.	Support the activities of existing Landcare groups. Encourage existing Landcare groups to work within priority areas of the reserve.
Monitor	Prevent high threat weeds within degraded areas spreading into higher priority areas. Manage specific weeds according to regional priorities. Manage pest animal threats according to regional priorities.	Limited revegetation or habitat enhancement works.	Encourage new Landcare groups to work within higher priority reserves.

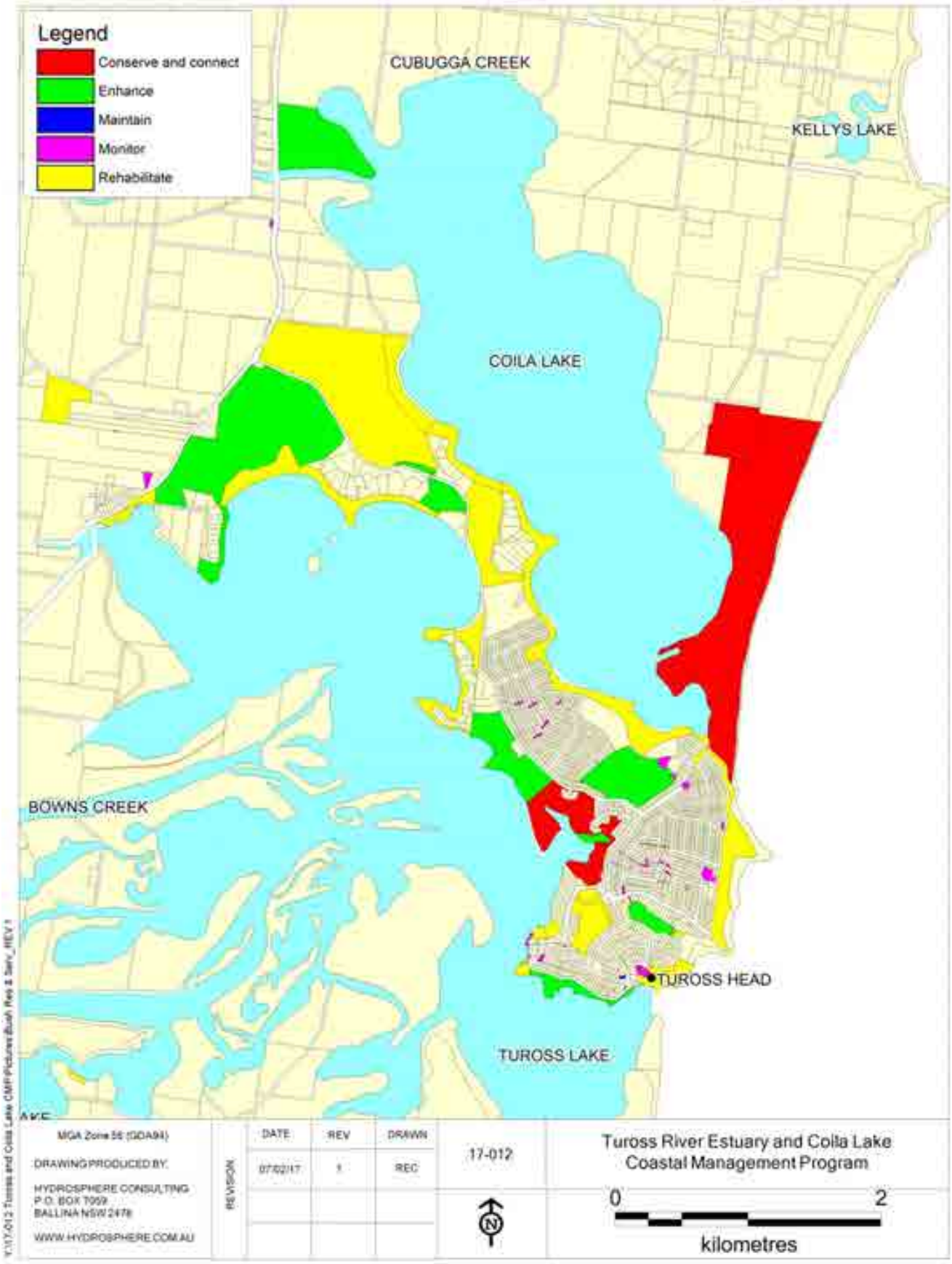


Figure 37: ESC bushland reserves and level of service - eastern section of the study area

Figure 38: ESC bushland reserves and level of service - western section of the study area

G5. AVIFAUNA

The large areal extent and wide diversity of habitats provide diverse feeding and roosting locations for many species of birds which have been recorded in the Tuross River Estuary and Coila Lake area. These include a number of species listed as either endangered or vulnerable under the *Threatened Species Conservation Act, 1995*. The sand spit at South Tuross Beach is an important breeding site for a number of shore birds including the Little Tern, Pied Oystercatcher and Red-capped Plovers. Non-breeding migratory waders such as Godwits, Knots, Curlews and Stints regularly feed around the estuary margins and sand shoals. Migratory birds protected under international agreements also inhabit Coila Lake including the Great Egret, White-bellied Sea-eagle, Little Tern and Crested Tern (WBM, 2004).

G6. ESTUARINE VEGETATION

Estuarine vegetation refers to seagrass, mangroves 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 limits. Saltmarsh communities occur mostly behind mangroves in the upper limits of the intertidal zone and are only inundated briefly on high tides (Figure 39). In an estuary, riparian vegetation is vegetation above the high tide level and generally does not include estuarine vegetation.

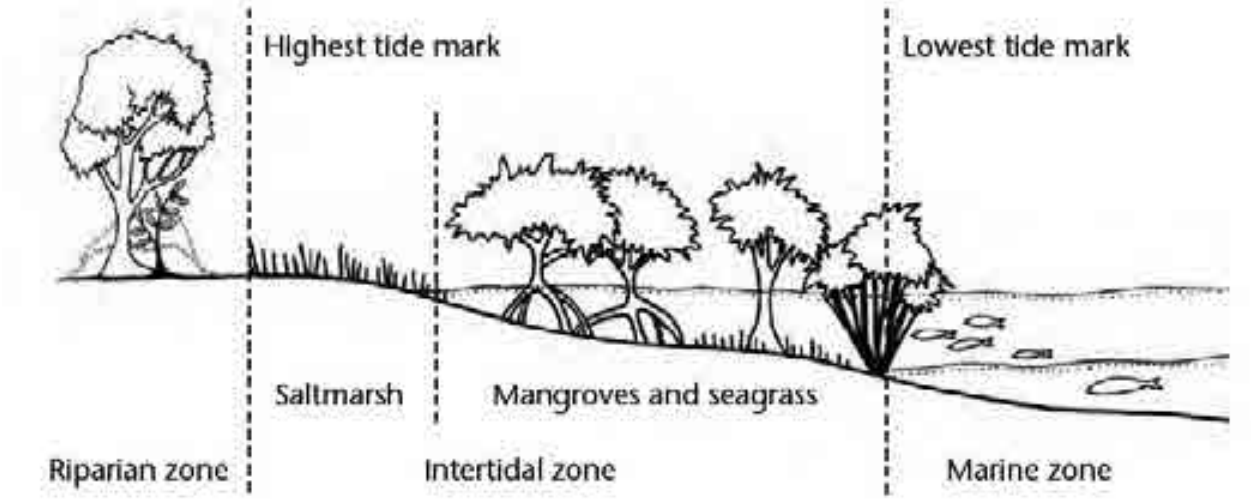


Figure 39: Zonation of estuarine vegetation

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.

Estuarine vegetation are considered ecologically significant habitat that are essential to maintaining a healthy estuarine ecosystem. NSW DPI has jurisdiction over these areas as defined under the *Fisheries Management Act 1994*. Under this act these estuarine habitats are consider key fish habitats that must be protected due to their ecological value. Saltmarsh is also listed under the Threatened Species Conservation Act, 1995 (under OEH jurisdiction). Many of these areas are also located within CMA 1 - coastal wetland areas. Development within

in these areas, including all current mapped estuarine vegetation within both these estuaries, must meet the requirements outlined by NSW DPI and the relevant legislation including the *Environmental Planning and Assessment Act 1979, Fisheries Management Act 1994* and *Threatened Species Conservation Act 1995.*

The available data on estuarine vegetation in the Tuross River Estuary and Coila Lake has been obtained from previous mapping studies undertaken assessing the condition of estuaries and coastal lakes in NSW. These studies were conducted in 1985 by Fisheries NSW and 2004/05 and 2012 by the NSW Department of Primary Industries on behalf of Council and OEH. The comparison between these three studies provides a broad indication of change that is useful for determining whether further investigation and/or action is required to prevent degradation of these areas as a result of anthropogenic activities. However, there are limitations when comparing these types of mapping surveys.

G6.1 Tuross River Historic Distribution

Mapping of estuarine macrophytes (seagrass, saltmarsh and mangroves) in Tuross River Estuary was undertaken in 2004/2005 by Williams et al (2006), previously by West (1985) and again updated in 2012 for Council by NSW DPI (2012). Table 19 and Figure 40 provide a summary and illustration of the extent and observed change in estuarine vegetation areas in the Tuross River Estuary across this period.

Table 19: Estuarine vegetation extent in the Tuross River Estuary recorded during mapping surveys (1985 to 2012)

Macrophyte	Survey				
	1985 (km²)	2004/05 (km²)	2012 (km ²)	1985-2004/05 Change in Area (%)	2004/05-2012 Change in Area (%)
Seagrass	0.45	2.18	1.04	79%	-52%
Mangroves	0.57	0.63	0.41	11%	-35%
Saltmarsh	0.40	0.80	0.79	2%	-2%

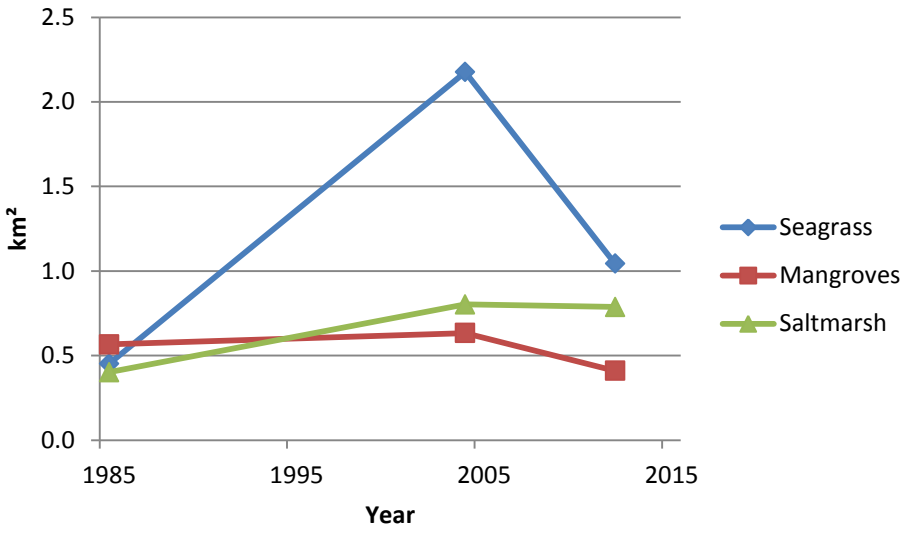


Figure 40: Summary of estuarine vegetation areas within the Tuross River Estuary (1985-2012)

The measured extent of all vegetation types, particularly seagrass increased between 1985-2004/05 but declined between 2004/05 and 2012. Mangrove areas decreased by 35% across the estuary, the cause of which was attributed to extended periods of time when the entrance may have been significantly restricted or

closed resulting in elevated water levels and limited tidal variation, particularly in 2006 (NSW DPI, 2012). Although this was a significant decline, entrance shoaling and closure is an entirely natural process and mangrove loss should be expected as resulting elevated water levels effectively keep mangrove roots continuously submerged leading to dieback (NSW DPI, 2012). Seagrass declined by 52% between 2004/05 and 2012 largely adjacent to Bodalla State Forest, Bowns Bay, east of Reedy Island and north of Cooper Island (ESC, 2012). NSW DPI (2012) noted considerable differences in seagrass distribution between the aerial photo (Jan/April 2010) and on ground seagrass distribution (May/June 2012), particularly in the lower Tuross Lake, suggesting that seagrass distribution varies considerably in this area. Saltmarsh decreased marginally (2%) between 2004/05 and 2012.

It is noted that there are limitations with comparisons between the macrophyte surveys due to the different mapping methods and technology employed. Large errors in the mapping are possible and have been confirmed. The 2004/05 and 2012 surveys used similar methods and technologies.

G6.2 Coila Lake Historic Distribution

Mapping of estuarine macrophytes (seagrass, saltmarsh and mangroves) in the Coila Lake was undertaken in 2004/2005 by Williams et al (2006) and previously by West (1985), however Coila Lake was not included in the NSW DPI (2012) mapping. Table 20 and Figure 44 provide a summary and illustration of the extent and observed change in estuarine vegetation areas in the Tuross River Estuary across this period.

Table 20: Estuarine vegetation extent in the Coila Lake recorded during mapping surveys (1985 to 2005)

Macrophyte	Survey		
	1985 (km ²)	2004/05 (km ²)	1985-2004/05 Change in Area (%)
Seagrass	1.86	1.37	-26%
Mangroves	0	0	0
Saltmarsh	0.32	0.34	8%

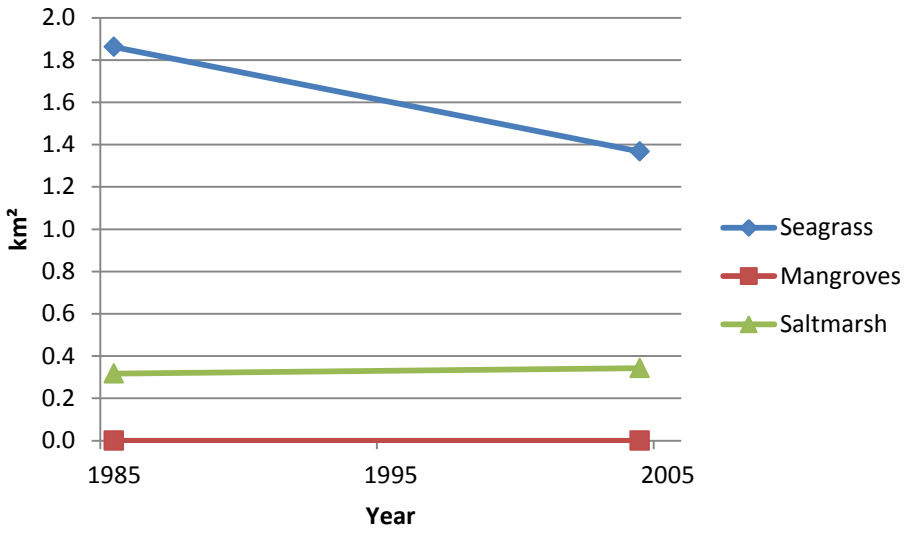


Figure 41: Summary of estuarine vegetation areas within the Coila Lake (1985-2004/05)

No mangroves were recorded in Coila Lake in either 1985 or 2004/05 mapping projects. Approximately 1.86 km² of seagrass was present in 1985 but by 2004/05 this area had decreased by 26% to 1.37 km². Conversely, saltmarsh area had increased by approximately

8% from 0.32 km in 1985 to 0.34 km² in 2004/05. The increase or decrease of estuarine vegetation coverage in Coila Lake is likely attributed to water level, salinity change, water quality and anthropogenic impacts. Varying water levels in the lake can result in either extended periods of inundation or exposure resulting in estuarine vegetation diebacks. The decrease in seagrass coverage in the lake could be due to changes in lake water level and salinity or increased pollutant loads (sediment and nutrient run-off) leading to changes in water clarity (e.g. higher turbidity reducing light available for photosynthesis). Seagrass may also be impacted by direct anthropogenic activities such as commercial fishing in the Lake. These studies and other documented observations have also indicated that seagrass distribution varies considerably.

G6.3 Current Macrophyte Distribution and Health

The current mapped distribution of estuarine vegetation in the Tuross River Estuary and Coila Lake is shown in Figure 44. This is based on the 2012 survey of Tuross River Estuary and the 2004/05 survey of Coila Lake.

Community members have also noted a decrease in seagrass coverage around the Tuross River entrance which is also visible on aerial photography. This may be due to infilling of the estuary at a faster rate than seagrass can colonise, decline in seagrass due to flooding or seasonal influences.

Vehicular access to the south-eastern foreshore of Coila Lake is impacting on the saltmarsh and dunes in this area (Figure 42).

a b

Figure 42: Coila Lake informal access: a - saltmarsh damage; b: Dune scar (November 2016)

The Eurobodalla Biodiversity Program implemented measures to prevent vehicular access to saltmarsh along Coila Creek (including the endangered *Wilsonia rotundifolia*). The project included access barriers and educational signage near Princes Highway.

a

b

Figure 43: Coila Creek saltmarsh protection: a, b – post barrier; b: educational signage

Photos courtesy Eurobodalla Shire Council

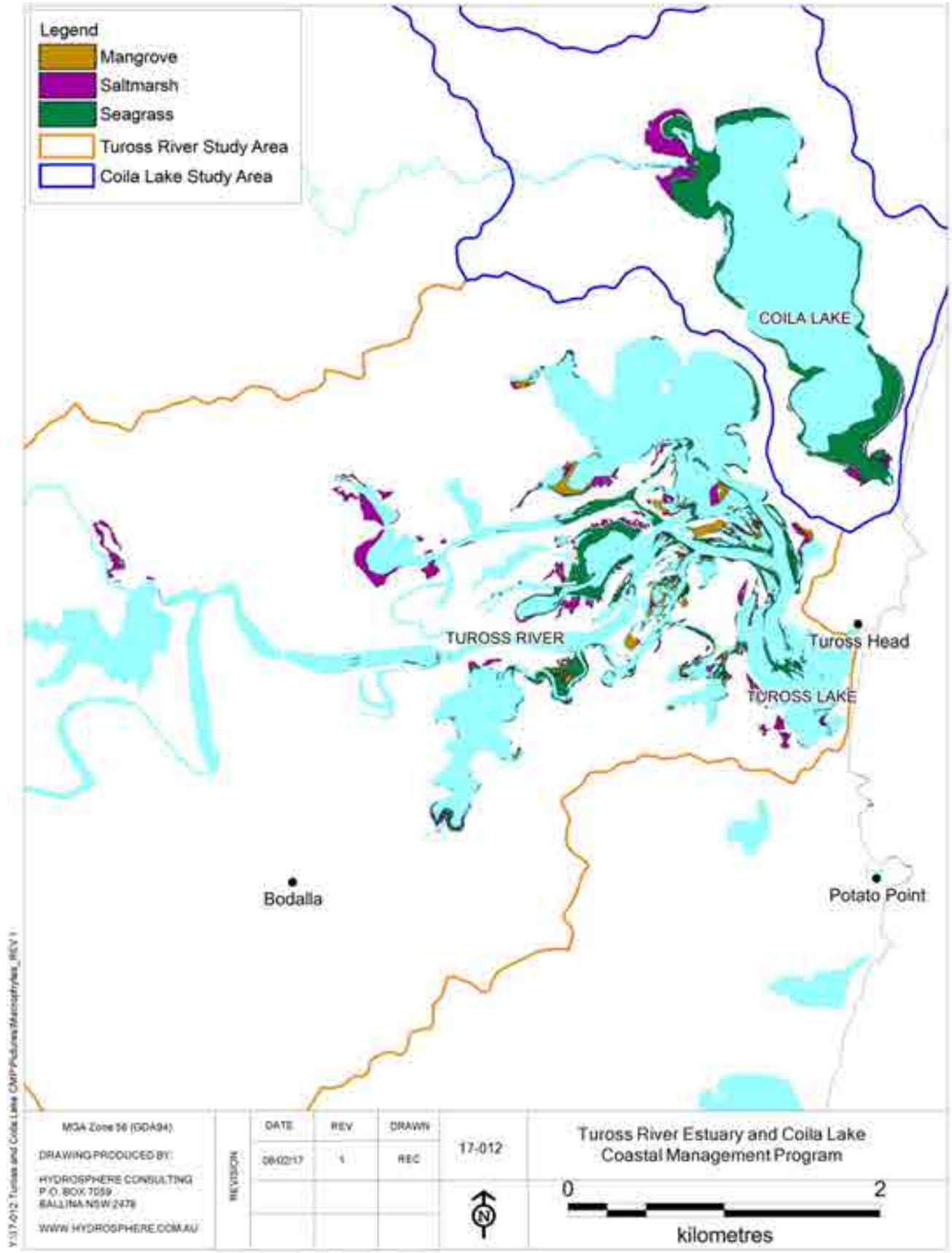


Figure 44: Current known estuarine vegetation areas within the Tuross River Estuary (2012) and Coila Lake (2004/05)

G6.4 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 Tuross River Estuary and Coila Lake estuaries 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, saltmarsh and seagrass areas 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 road, rock walls, retaining walls and urban development on the landward side (DECC, 2009a). The impact has been named "Coastal Squeeze" by the Department of Climate Change, now OEH (Figure 45). 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.

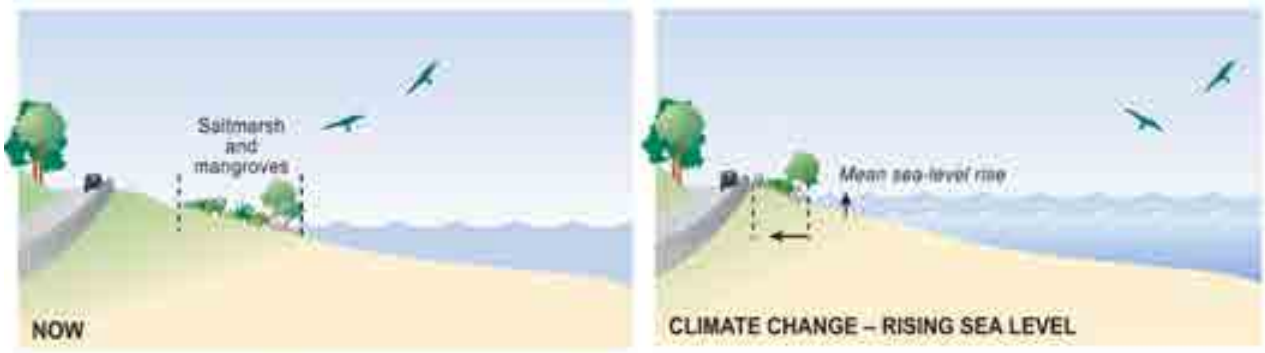


Figure 45: 'Coastal Squeeze' under sea level rise and the impact of development

Source: DECC (2009a)

To examine the likely migration of estuarine vegetation in the Tuross River Estuary and Coila Lake with sea level rise, and the impact of barriers to migration and the potential for land loss, an assessment was undertaken based on vegetation types, topography, land use and the possible future tidal range. Available aerial photography, LIDAR data and known estuarine vegetation extent were utilised to identify and categorise areas based on potential impacts of sea-level rise on estuarine vegetation extent or potential land loss. The focus is on the saltmarsh areas as this habitat is located in the upper limits of the intertidal zone and likely to be impacted the most by anthropogenic constraints resulting in 'Coastal Squeeze'. However, areas of mangroves and seagrass were also assessed. The assessment provides the location, potential impacts and mitigation measures (Coila Lake - Table 21 and Figure 46 and Tuross River - Table 22 and Figure 47). Conceptual diagrams (Figure 48 to Figure 52) have been developed to visualise foreshore locations and potential impacts of sea-level rise, while a scale of importance (Table 23) has been used to rank areas that may require mitigation measure.

The impact of sea-level rise on Coila Lake will be influenced by the entrance management policy (refer Section K3, Appendix K). As Coila Lake entrance is predominately closed, the water level within the lake is influenced by rain events and the occasional entrance opening, either natural or artificial. Exchange across the entrance berm will also influence water levels in the lake. The entrance management policy dictates the conditions (trigger water levels) when artificial entrance opening is to be implemented. It also outlines that the trigger water level conditions for artificial opening will be adjusted in accordance with future climate change including sea-level rise with the goal of reducing the need for artificial entrance intervention over time. Sea-level rise is likely to result in increased sand barrier height between Coila Lake and the ocean, which in turn will increase the water level in the lake and result in the need to increase trigger levels to maintain a natural regime as required by the policy.

The entrance management policy that has been implemented has gone through extensive public consultation and the completion of an REF and is likely not to change significantly in the short-term in terms of the trigger levels but may be adjusted in terms of the duration of inundation periods.

Figure 46: Coila Lake potential sea-level rise impact areas

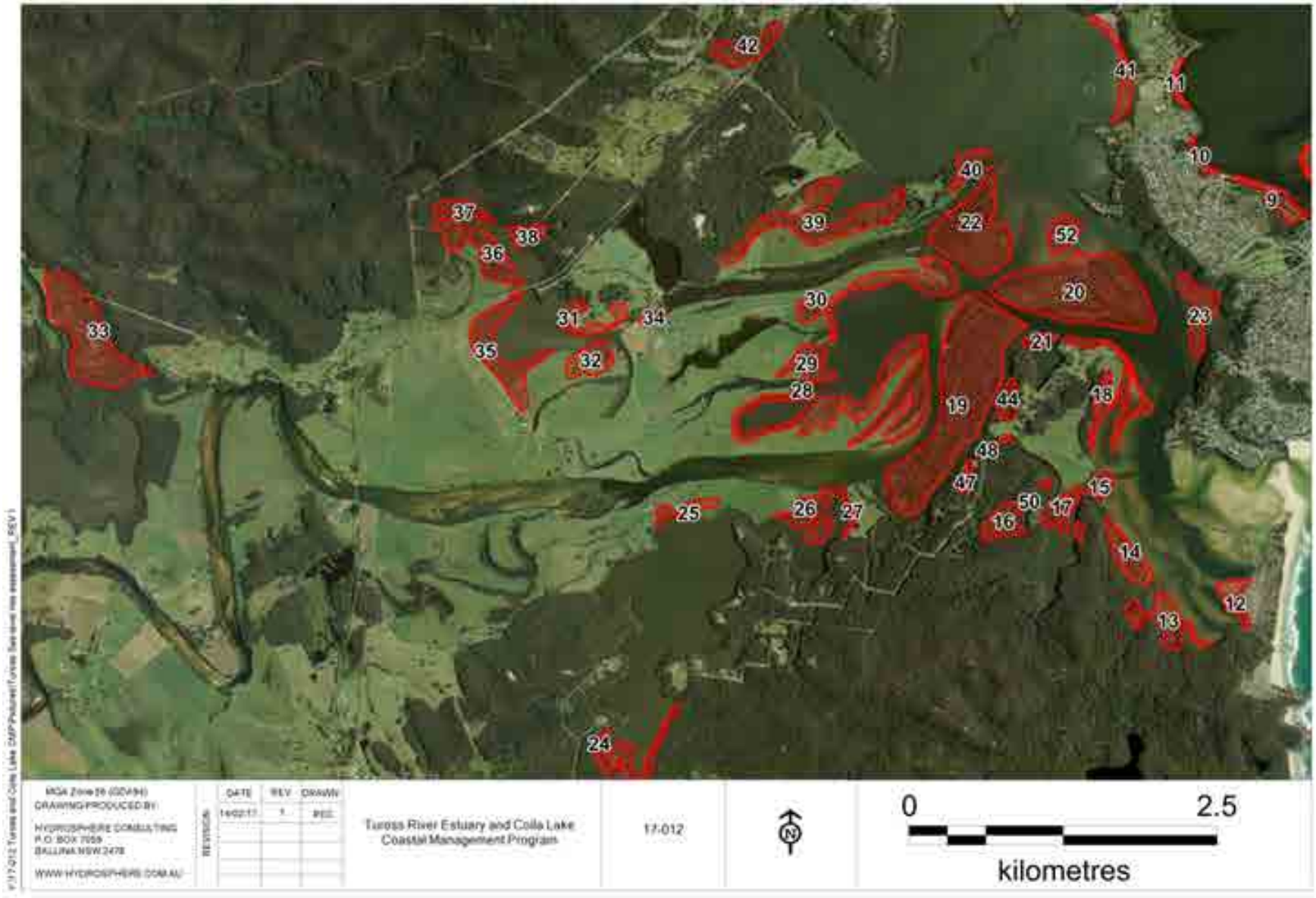


Figure 47: Tuross River Estuary potential sea-level rise impact areas

Table 21: Coila Lake sea-level rise impact areas

Location and Site Description	Sea-level Rise Impact	Potential Mitigation Measures
1 – Low lying farmland used for grazing located in close proximity to CMA 1 - coastal wetlands. Farmer has installed drainage to drain saltmarsh/swampland back into Coila Lake. Conceptual diagram 2 Scale of importance = 1	Sea-level rise will likely result in migration of estuarine vegetation, in particular saltmarsh, onto farmland. Physical barriers that may influence this migration are the Princess Highway between Coila Lake and farmland and farming practices such as grazing and mowing preventing migration. Drainage under the highway should allow for water movement between areas.	Investigate further to understand local topography and the potential area influenced by sea-level rise. Investigate the potential influence of the highway on local hydrology. Consult with the farmer on the possibilities of protecting the area where estuarine vegetation will migrate to.
2, 4, 5 & 6 – Foreshore comprised of low lying saltmarsh areas that gently slopes to sandy beaches adjacent farmland/grassed areas with small areas of riparian vegetation. Conceptual diagram = 2 Scale of importance = 2	Sea-level rise will likely result in estuarine vegetation migration further up the gentle slopes. No barriers are present that might hinder this migration however land uses such as grazing my impact the extent of migration. There is the potential for substantial farmland loss within these areas	These areas should be investigated to confirm no barriers are present or planned to be installed that may hinder estuarine vegetation migration. Surrounding land owners should be consulted on potential land loss and the possibilities of protecting the area where estuarine vegetation will migrate to.
3 – Low lying saltmarsh area that is bordered by sand dunes that connect to Bingie Beach. Conceptual diagram = 1 Scale of importance = 1	Sea-level rise will likely result in migration of estuarine vegetation, in particular saltmarsh, up to the edge of the sand dune creating 'coastal squeeze'. Currently this area is an access point to gain vehicle access to the lake and beach which has resulted in damage to the saltmarsh areas. The 'coastal squeeze' could potentially result in decreased saltmarsh area that is heavily impacted by vehicles.	Vehicle access to the area needs to be prevented with alternative access points to the lake identified or developed.
7 & 8 – Foreshore comprised of low lying shoreline that has a step-up (small vertical bank < 2 m) to higher farmland. Conceptual diagram 3 Scale of importance = 2	Sea-level rise will likely result in 'coastal squeeze' as a result of the foreshore bank creating a barrier. This will mean the area of estuarine vegetation at these locations will decrease and the potential for bank erosion may increase. There are no man-made barriers at these locations that could influence migration or local hydrology. However, these areas have already been impacted due to the entrance management policy.	Consultation with bordering land owners should be undertaken to investigate the potential for erosion control measures, while taking into account the possible loss of estuarine vegetation.

Location and Site Description	Sea-level Rise Impact	Potential Mitigation Measures
9, 10 & 11 – Foreshore comprised of low lying saltmarsh area that gently slopes to sandy beaches following onto urban areas with small patches of riparian vegetation. Includes foreshore structures such as cycleway. Conceptual diagram 4 Scale of importance = 1	Sea-level rise will likely result in estuarine vegetation migration further up the gentle slopes. Barriers such as footpaths, roads and rock walls present, which have the potential to hinder estuarine vegetation migration and result in 'Coastal Squeeze'.	These areas should be investigated to confirm the type of barriers present or planning to be installed that may hinder estuarine vegetation migration. Surrounding land owners should be consulted on potential loss of land due to sea-level rise.

Table 22: Tuross River Estuary sea-level rise impact areas

Location and Site Description	Sea-level Rise Impact	Potential Mitigation Measures
12, 13, 14, 15, 16, 23, 24, 33, 37, 38, 45 & 46 – Foreshore comprised of steep slopes with mangroves, saltmarsh and seagrass. A number of the locations are classified as CMA 1 - coastal wetlands and/or surrounded by national parks. Conceptual diagram 5 Scale of importance = 3	Sea-level rise will likely result in estuarine vegetation migration further up the surrounding slopes. No barriers are present that might hinder this migration however the steepness of the surrounding slopes could result in reduced areas of estuarine vegetation ('Coastal Squeeze').	This area should be left to let nature take its course provided anthropogenic impacts are minimised.
17 & 18 - Low lying foreshore with mangroves, saltmarsh and seagrass. Gently sloping banks that lead to low-lying farmland/grassed areas with small areas of riparian vegetation. Conceptual diagram 2 Scale of importance = 1	Sea-level rise will likely result in estuarine vegetation migration further up the gentle slopes. No barriers are present that might hinder this migration however land uses such as grazing may impact the extent of migration. There is the potential for substantial land loss within these areas.	These areas should be investigated to confirm no barriers are present or planned to be installed that may hinder estuarine vegetation migration. Surrounding land owners should be consulted on the possibilities of protecting the area where estuarine vegetation will migrate to and also investigate the potential area of land loss as a result of sea-level rise.
19, 20 21, 22, 42, 43, 47, 48, 49, 50, 51 & 52 – Foreshore with mangroves, saltmarsh and seagrass. The foreshore topography is gentle sloping riparian vegetation. A number of the locations are classified as CMA 1 - coastal wetlands. Conceptual diagram 2 Scale of importance = 3	Sea-level rise will likely result in estuarine vegetation migration further up the surrounding slopes. No barriers are present that might hinder this migration.	This area should be left to let nature take its course provided anthropogenic impacts are minimised.

Location and Site Description	Sea-level Rise Impact	Potential Mitigation Measures
25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 36, 40 & 44 – Low lying foreshore with mangroves, saltmarsh and seagrass. These areas are surrounded by a step-up (small vertical bank < 2 m) leading to elevated farmland. Conceptual diagram 3 Scale of importance = 2	Sea-level rise will likely result in 'coastal squeeze' as a result of the foreshore banks creating a barrier or erosion of banks leading to loss of farmland. Eroded areas would likely be colonised by estuarine vegetation. There appear to be no barriers at these locations however the Coopers Island Road causeway potentially impacts the local hydrology. Farming practices may also impact some of these locations.	Consultation with land owners should be undertaken to investigate the potential for erosion and possible control measures, while taking into account the possible loss of estuarine vegetation due to 'coastal squeeze'. These areas should be investigated to check barriers and land uses that could impact migration.
41 – Foreshore comprised of low lying estuarine vegetation area that gently slopes to sandy beaches and urban areas (Caravan park) with small patches of riparian vegetation. Conceptual diagram = 4 Scale of importance = 1	Sea-level rise will likely result in estuarine vegetation migration further up the gentle slopes. Barriers such as footpaths, roads, rock walls and buildings have the potential to hinder estuarine vegetation migration and result in 'coastal squeeze'. There is a potential for loss of land.	These areas should be investigated to confirm the type of barriers present or planning to be installed that may hinder estuarine vegetation migration. Surrounding land owners should be consulted on potential loss of land due to sea-level rise.

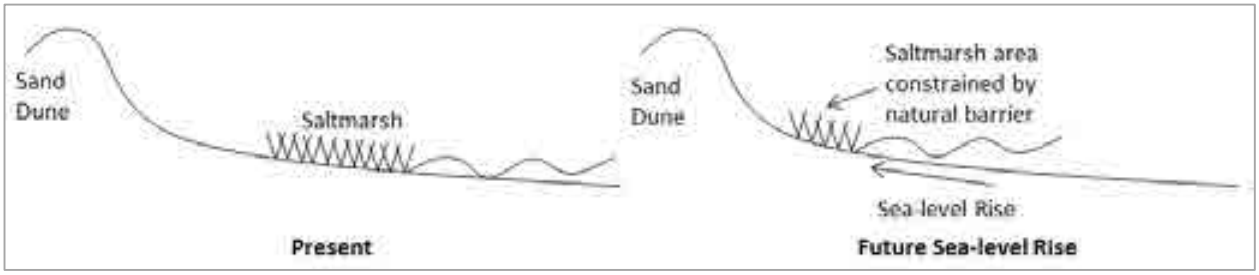


Figure 48: Conceptual Diagram 1 – low-lying areas with natural up-slope barrier

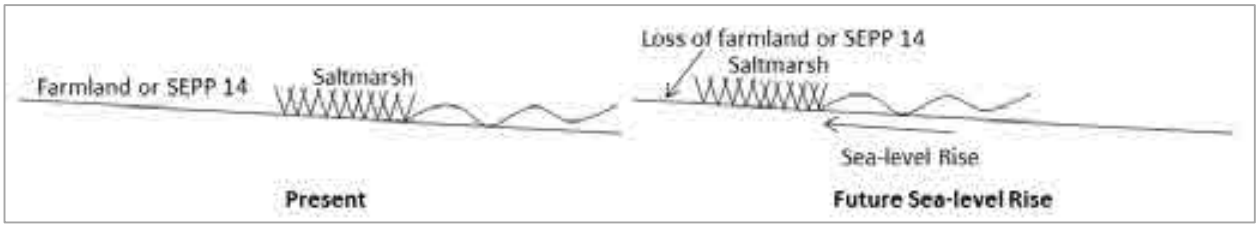


Figure 49: Conceptual Diagram 2 - low-lying areas with no up-slope barrier

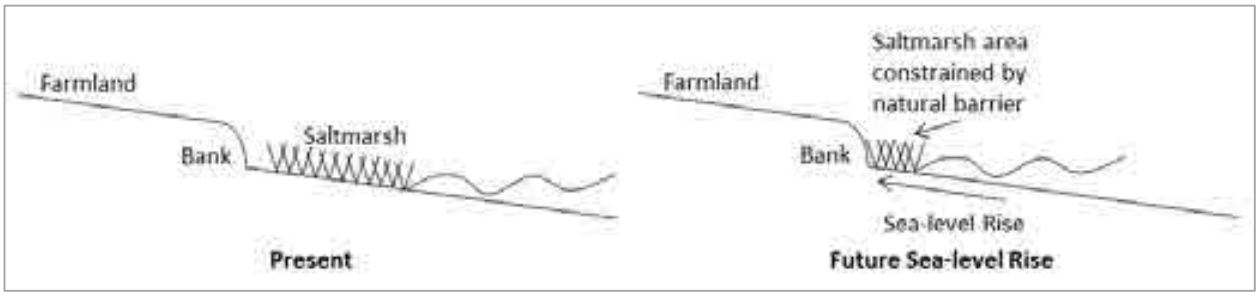


Figure 50: Conceptual Diagram 3 - low-lying areas with steep up-slope bank

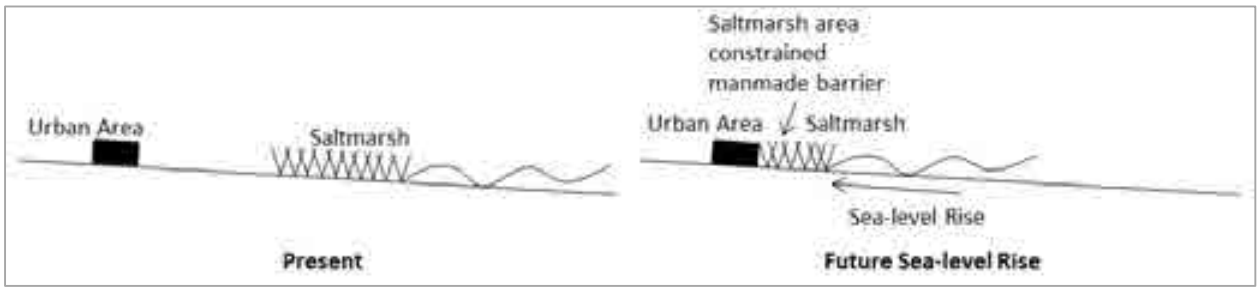


Figure 51: Conceptual Diagram 4 - low-lying areas with urban/constructed up-slope barrier

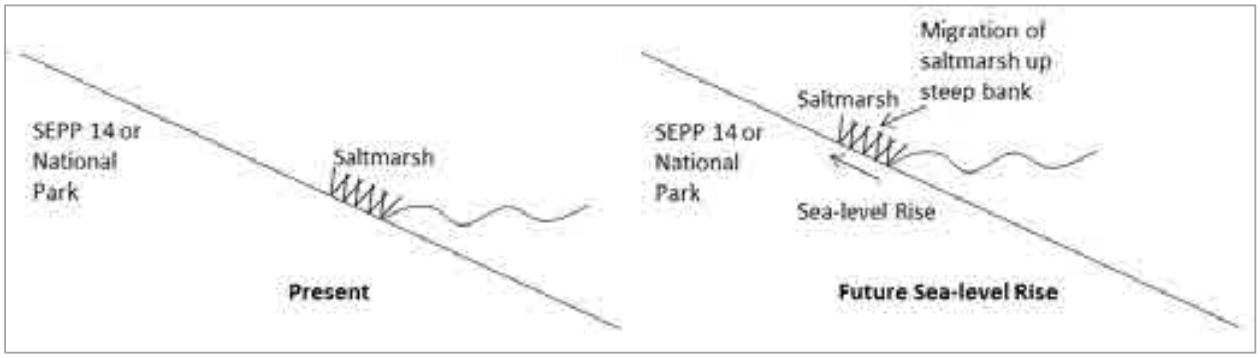


Figure 52: Conceptual Diagram 5 - low-lying areas with steep slope and up-slope conservation area

Table 23: Scale of Importance

Scale	Description
1 (High)	Potential for significant impact on estuarine vegetation migration or loss of estuarine vegetation habitat via the influence of anthropogenic constraints, or potential substantial urban or farmland loss. Requires further investigation and implementation of possible mitigation measures.
2 (Moderate)	Potential impact on estuarine vegetation migration and habitat area or potential for urban or farmland loss. May require further investigation and implementation of possible mitigation measures.
3 (Low)	Potential impacts considered minimal or not as a result of anthropogenic constrains. Location should be left to let nature take its course as long as anthropogenic impacts are minimised.

G7. CMA 1 - COASTAL WETLANDS AND LITTORAL RAINFOREST

The areas designated as coastal wetlands and littoral rainforest under *SEPP 14 – Coastal Wetlands* and *SEPP No. 26 – Littoral Rainforest* within the Tuross River Estuary and Coila Lake catchments are shown on Figure 53. The SEPPs were introduced to protect coastal wetlands and littoral rainforest and stipulate planning and development controls under the *Environmental Planning and Assessment Act 1979* to ensure that developments in or adjacent to these habitats have little to no impact on their values.

A draft *Coastal Management SEPP* has been released for public consultation as part of the new coastal management framework being developed to integrate the current coastal SEPPs - SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection). A small number of new areas have been classified as CMA 1 Coastal wetlands (Section 1.5) within the Tuross River Estuary and Coila Lake catchment areas.

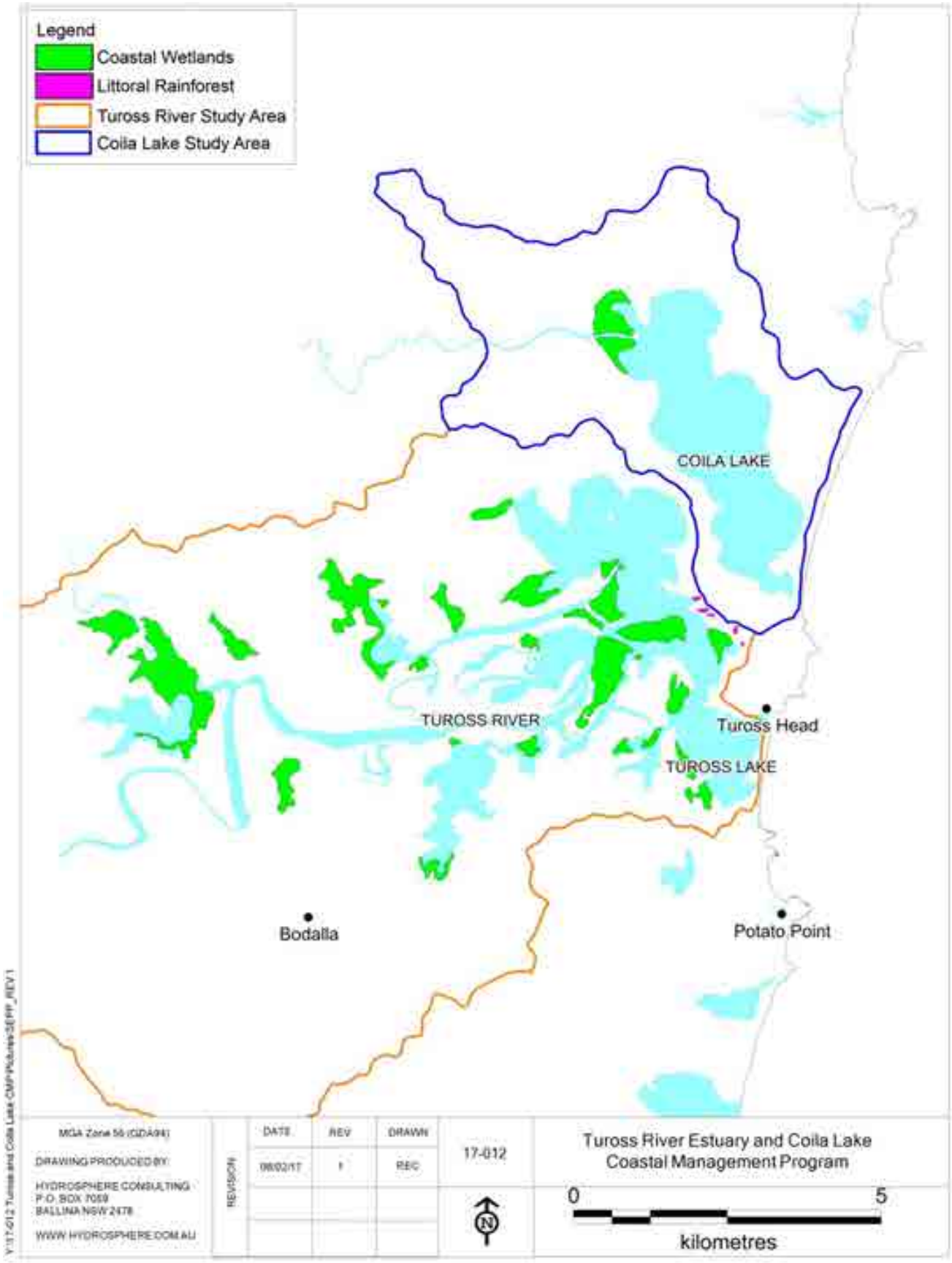


Figure 53: SEPP 14 coastal wetlands and SEPP 26 littoral rainforest

APPENDIX H. WATER QUALITY

Water quality is a fundamental element of a healthy estuarine ecosystem. Water quality influences ecological processes in estuarine environments that support associated native flora and fauna. The water quality of these ecosystems also effect recreational and commercial uses such as swimming and fishing. Therefore maintaining high water quality via minimising anthropogenic impacts is important in preserving a healthy ecosystem. This Appendix lists the available water quality information that has been obtained via monitoring of the Tuross River Estuary and Coila Lake.

H1. EXISTING INFORMATION

Table 24 provides a list of the water quality information available for the Tuross River Estuary and Coila Lake. This list includes details on the data collected, timeframes of data collection, and the key conclusions drawn from the analysis and reporting of results. The majority of the data has been obtained from the BMT WBM (2011) review of the estuarine health monitoring program for the Eurobodalla Shire. This report focuses on water quality data collected from the six key estuaries within ESC governing area, including Tuross River Estuary and Coila Lake between 2005 and 2011.

Table 24: Water quality information available for Tuross River Estuary and Coila Lake

Date, Frequency and Data Type	Reporting	Reporting of Key Findings
Historic water quality data from 2005 to 2010. Monthly monitoring program. Parameters include enterococci, water temperature, salinity, dissolved oxygen, total dissolved solids, pH and turbidity.	Eurobodalla Estuary Health Monitoring Program Review (2011) – Review of water quality data collected prior to 2005 and up to 2011 from the six major estuaries in the Eurobodalla Shire.	• Tuross River Estuary sample locations are not representative of estuarine zones; • Elevated turbidity levels in Tuross River Estuary; • Water quality parameters are generally below guideline levels in Coila Lake.
Water quality data from 2010 to 2011. Parameters include enterococci, water temperature, salinity, dissolved oxygen, total dissolved solids, pH, turbidity and chlorophyll a.	Eurobodalla Estuary Health Monitoring Program Review (2011) – Review of water quality data collected prior to 2005 and up to 2011 from the six major estuaries in the Eurobodalla Shire.	• Chlorophyll *a* median values exceed guideline levels within Tuross River Estuary; • Chlorophyll *a* median values approximately equal to trigger values in Coila Lake.
Estuary health and water quality report cards detailing water quality data collected via ESC monitoring (2010 to 2016)	• Tuross River Estuary Health Report Card 2010-11; • Tuross River Estuary Water Quality Report Card 2012-13; • Tuross River Estuary Water Quality Report Card 2013-14; • Tuross River Estuary Water Quality Report Card 2015-16; • Coila Lake Health Report Card 2010-11; • Coila Lake Water Quality Report Card 2012-13; • Coila Lake Water Quality Report Card 2013-14, and • Coila Lake Water Quality Report Card 2015-16.	Analysis of data conducted by ESC and provided below within each report card.
Review of water quality data collected between 2005 and 2011. Review of summaries on water quality data prior to 2005.	Eurobodalla Estuary Health Monitoring Program Review (2011) – Overall review and recommendations	• Both estuaries show signs of water quality problems, in particular Tuross River Estuary; • Tuross sample locations do not accurately represent estuarine salinity zones; • Water quality monitoring should be modified to align with Southern Rivers Catchment Management Authority (SRCMA) Ecosystem Health Monitoring Programs (EHMP).

Date, Frequency and Data Type	Reporting	Reporting of Key Findings
• South East Water Quality Monitoring Project (SEWQMP) Interpretation of Water Quality Monitoring Program Results (2005) – Water Quality Data collected prior to 2005. Parameters include faecal coliform, dissolved oxygen and pH. • OEH 2008 Data – Water quality collected during 2008 to 2009. Parameters include Chlorophyll a and Turbidity. • Tuross River Estuary and Coila Lake Management Plan 2005.	Eurobodalla Estuary Health Monitoring Program Review (2011) – Review of water quality data collected prior to 2005 and up to 2011 from the six major estuaries in the Eurobodalla Shire.	Two sites within Coila estuary and one site within Tuross estuary displayed levels exceeding the 80th percentile for faecal coliform. Turbidity well below trigger levels for both estuaries. Chlorophyll *a* above trigger values for Tuross estuary.

Table 25 provides a list of previous studies undertaken that involve investigating water quality within the Tuross River Estuary and Coila Lake. This list includes a short summary on the content of each study.

Table 25: Previous relevant studies that investigated or reviewed water quality in the Tuross River or Coila Lake

Study	Content
Tuross Estuary and Coila Lake Estuary Processes Study (2001)	This study reviewed and investigated the physical environment (including water quality), hydraulic processes, sediment dynamics and ecological process that occur within each estuary. Water quality data obtained between 1966 and 1997 was examined. The study identified impacts from anthropogenic activities on the above processes and also provided the information required to develop an Estuary Management Study.
Tuross Estuary and Coila Lake Estuary Management Study (2004)	This study investigated the current uses and features of the estuary in order to determine management objectives and control measures or options to meet these objectives.
Tuross Estuary and Coila Lake Estuary Management Plan (2005)	This EMP describes the management strategies to be implanted for the estuaries and contains a list of recommended activities to be undertaken in order to achieve long term sustainability of the two waterways.
Eurobodalla Estuary Health Monitoring Program Review (2011)	The study reviewed water quality monitoring data collected prior to 2005 and up to 2011 from the six major estuaries in the Eurobodalla Shire. This review highlighted the need to develop a catchment model for Tuross River Catchment.
Tuross Estuary Water Quality Improvement Plan (2016)	The plan was developed following the recommendations produced via Eurobodalla Estuary Health Monitoring Program Review (2011). The plan provides methodology to help improve the water quality in the Tuross River Estuary via identifying and mitigating potential and known sources of sediment and nutrient input.

H1.1 Historic Water Quality Data (2005-2010)

ESC conducted monthly water quality sampling within the Tuross River Estuary and Coila Lake from 2005 to 2010. Water quality data was obtained from seven sample locations within the Tuross River Estuary (Figure 54) and four within Coila Lake (Figure 55). Parameters collected and analysed include enterococci, water temperature, salinity, dissolved oxygen, total dissolved solids, pH and turbidity. These data have been summarised in the box and whisker plots and time series graphs displayed below, Tuross River (Figure 56 to Figure 58) and Coila Lake (Figure 59 to Figure 61), obtained from the BMT WBM (2011) report. The water

quality data has been compared against the adopted guideline trigger values outlined in Table 29. Analysis of these results indicated that most sites sampled within the Tuross River Estuary were representative of the lower estuary. The majority of these sites display a median turbidity value that is equal to or exceeds the guideline values, which may be the result of natural processes. Enterococci values recorded at these sites are below the primary contact guideline levels. Overall Coila Lake water quality is generally within guideline levels, with only a small number of notable spikes observed at two sites.

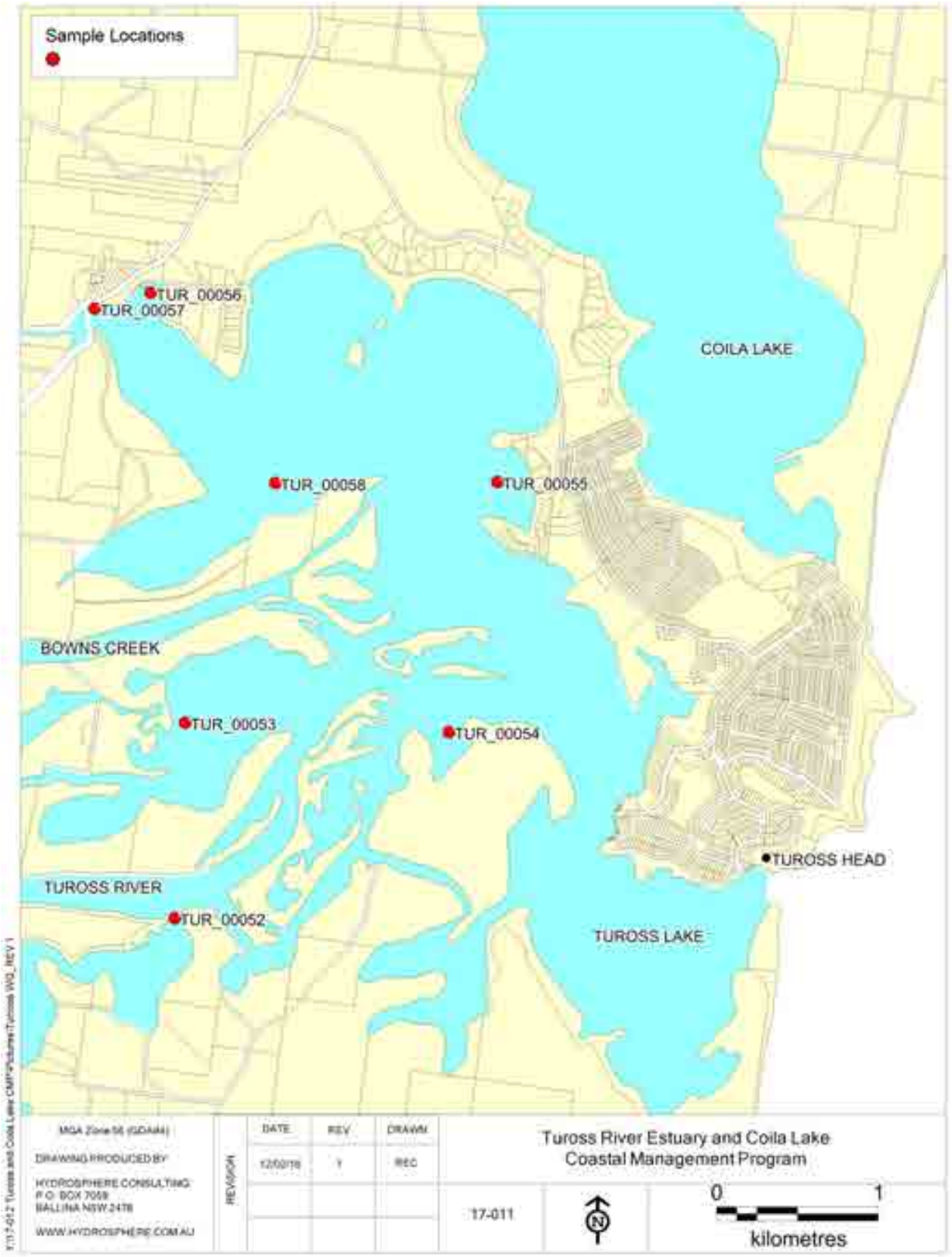


Figure 54: Historic water quality sample locations for Tuross River Estuary

Figure 55: Historic water quality sample locations for Coila Lake

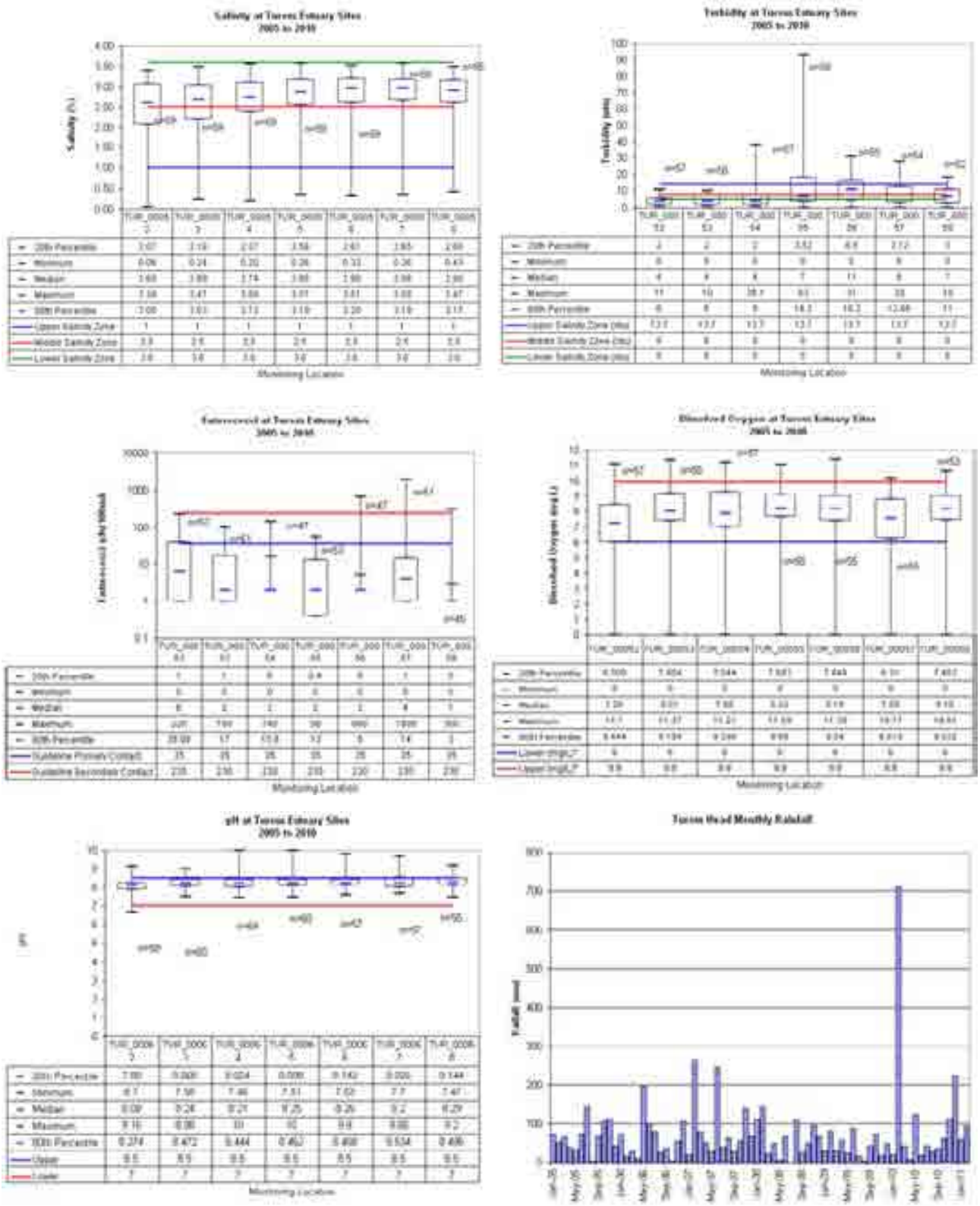


Figure 56: Summary of Tuross River Estuary historic water quality data from 2005 to 2010

Source: BMT WBM (2011)

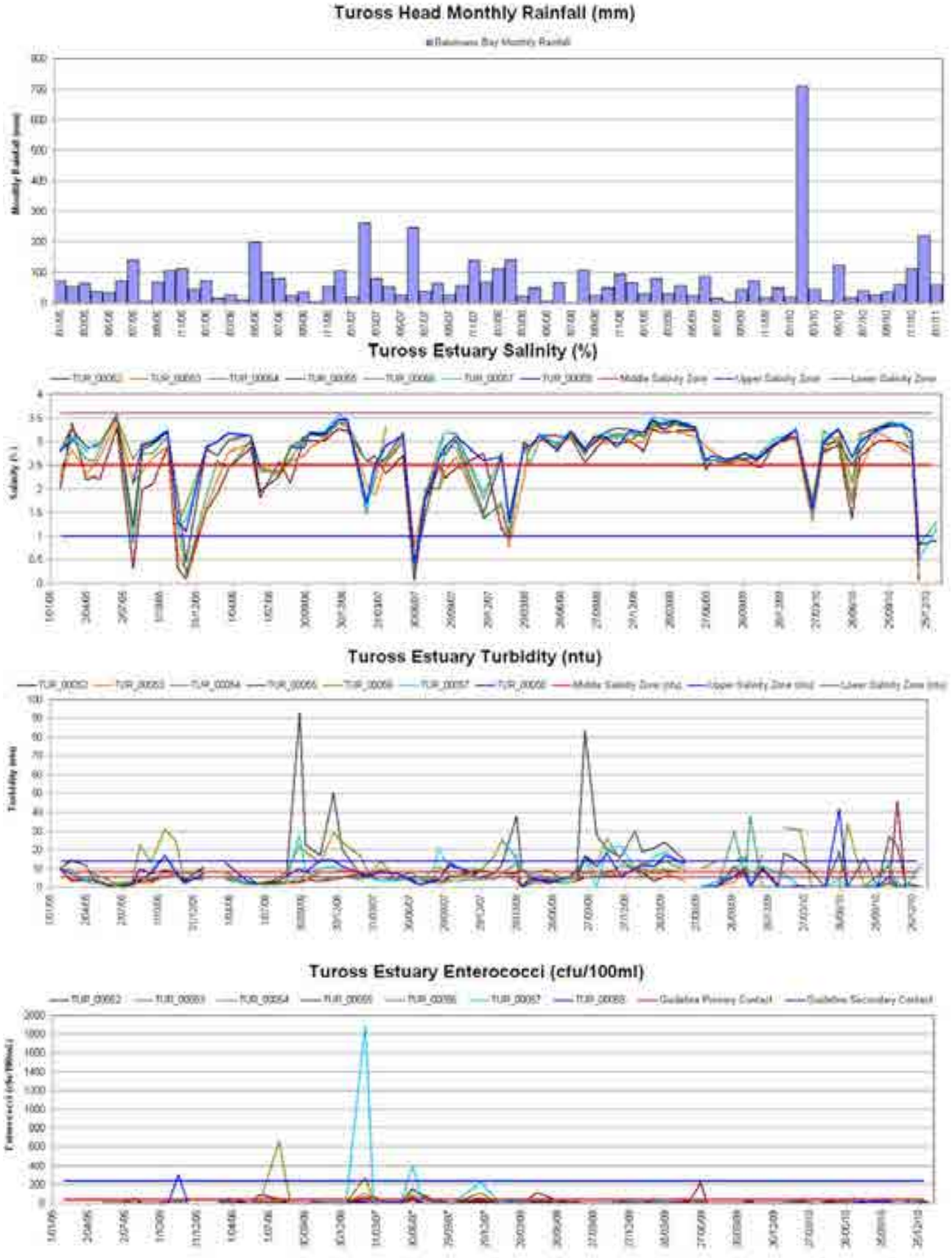


Figure 57: Summary of Tuross River Estuary historic water quality data from 2005 to 2010 (rainfall, salinity, turbidity and enterococci)

Source: BMT WBM (2011)

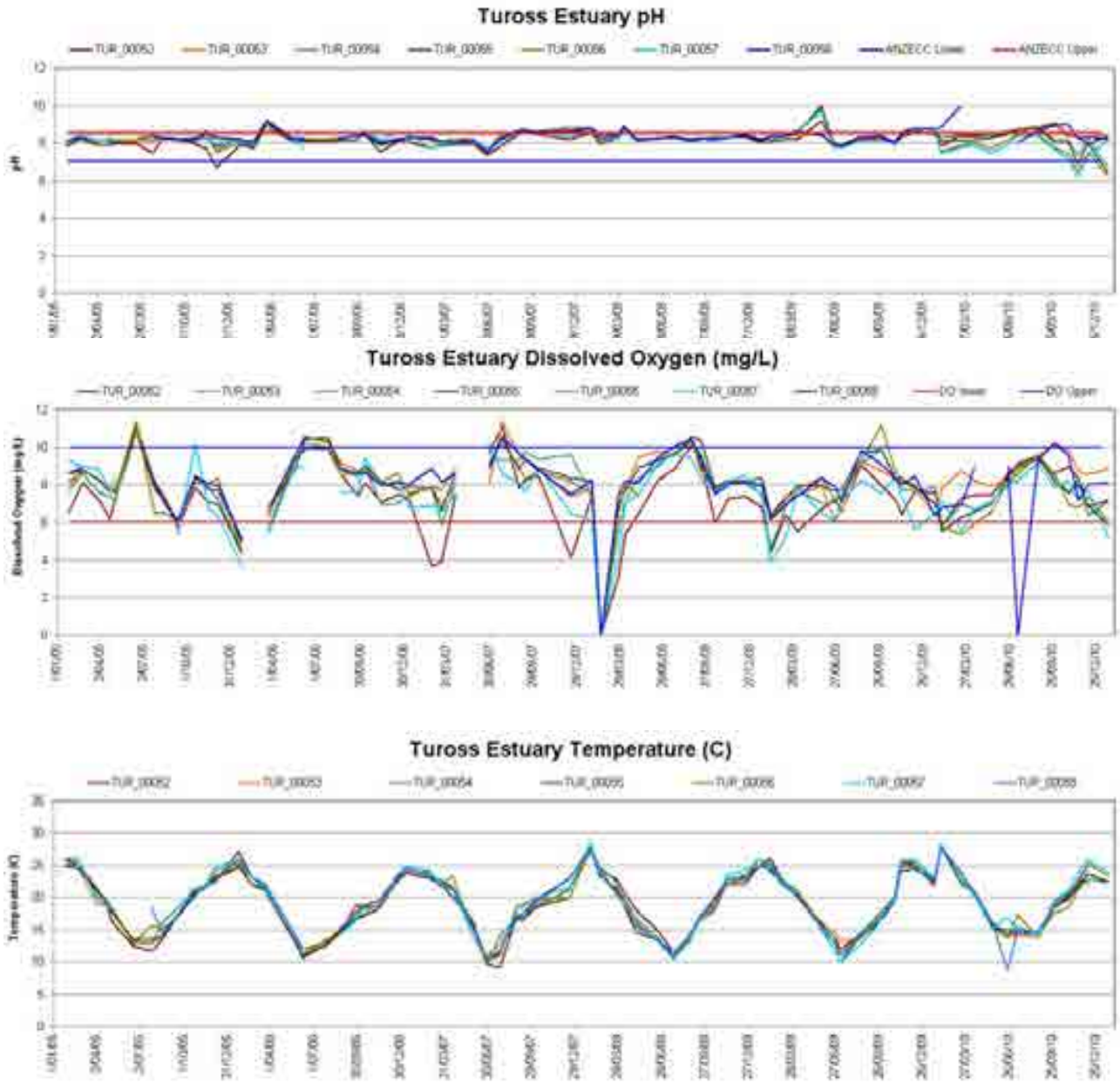


Figure 58: Summary of Tuross River Estuary historic water quality data from 2005 to 2010 (pH, dissolved oxygen and temperature)

Source: BMT WBM (2011)

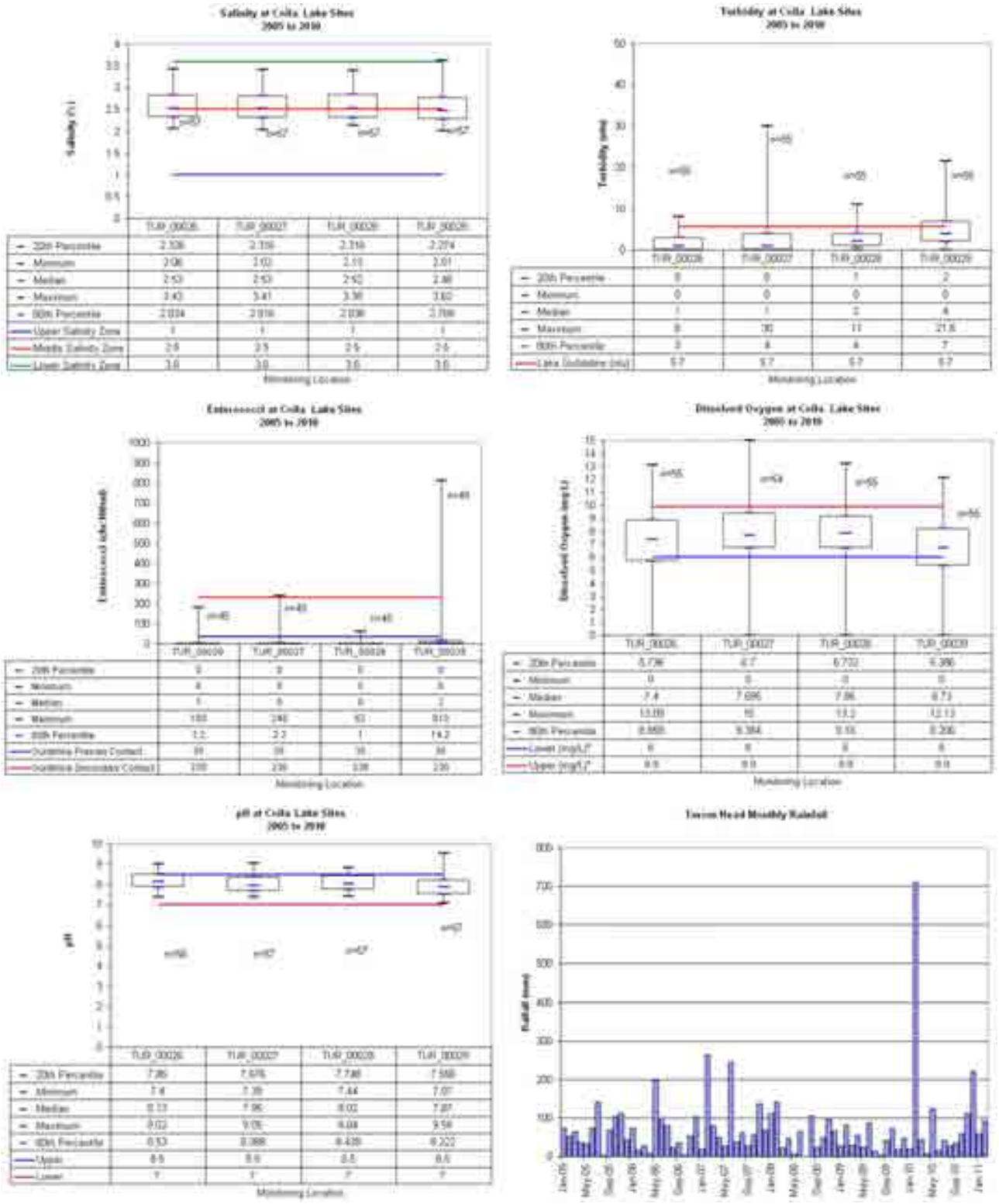


Figure 59: Summary of Coila Lake historic water quality data from 2005 to 2010

Source: BMT WBM (2011)

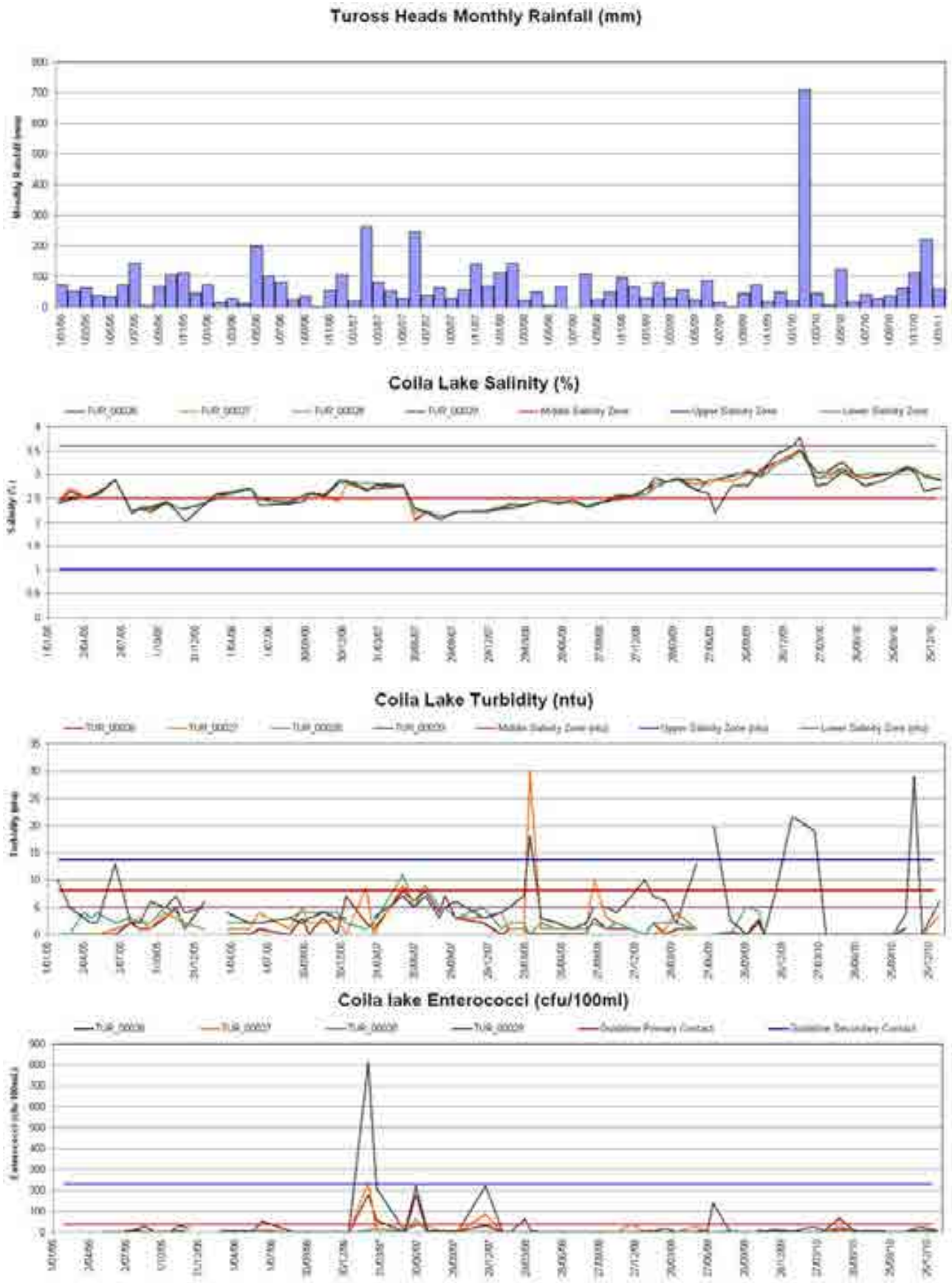


Figure 60: Summary of Coila Lake historic water quality data from 2005 to 2010 (rainfall, salinity, turbidity and enterococci)

Source: BMT WBM (2011)

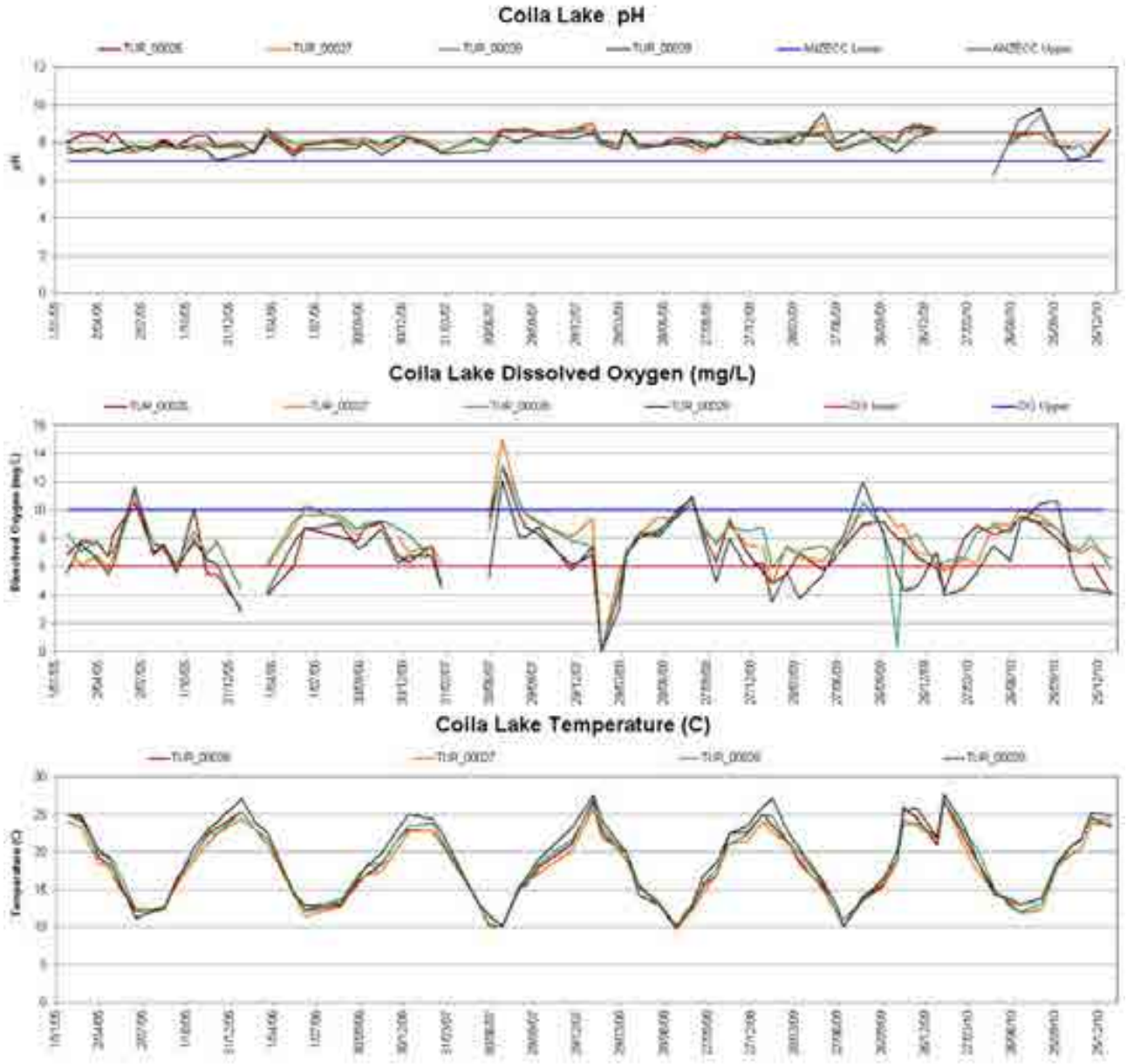


Figure 61: Summary of Coila Lake historic water quality data from 2005 to 2010 (pH, dissolved oxygen and temperature)

Source: BMT WBM (2011)

H1.2 Water Quality Data 2010-2011

Chlorophyll *a* is commonly used to understand levels of phytoplankton biomass and tracking changes in algae growth (Roper et. al., 2011) to measure the influence of sediments and nutrients on water quality and the overall health of estuaries. Phytoplankton biomass levels are influenced by the availability of nutrients, sunlight and water temperature, with warmer water promoting growth. Therefore measuring chlorophyll *a* levels provides an understanding and surrogate for nutrient levels and water quality, with low levels of chlorophyll *a* typically representing a healthy waterbody and consistent elevated levels representing an unhealthy waterbody. Elevated levels of chlorophyll *a* can be the result of increased phosphorus and nitrogen levels and thus an indicator of pollution from anthropogenic sources.

Increased algae growth in waterbodies can result in fish kills due to the depletion of oxygen levels (ANZECC & ARMCANZ 2000; BMT WBM 2011). Turbidly provides a good understanding of water quality by indicating

the level of sediment load in the water column. Increased sediment load can lead to smothering of habitats, limited light penetration, and increased nutrients and toxic materials in the environment.

ESC conducted water quality monitoring of the Tuross River Estuary and Coila Lake from 2010 to 2011. Water quality data was obtained from seven sample locations within the Tuross River Estuary (Figure 54) and four within Coila Lake (Figure 55). Parameters collected and analysed include enterococci, water temperature, salinity, dissolved oxygen, total dissolved solids, pH, turbidity and chlorophyll *a*. A portion of this data, focusing on chlorophyll *a* and turbidity, has been summarised in the box and whisker plots and time series graphs displayed bellow, Tuross River (Figure 62) and Coila Lake (Figure 63) obtained from the BMT WBM (2011) report. The water quality data has been compared against the adopted guideline trigger values outlined in Table 29. Analysis of these results for the Tuross River Estuary indicate that chlorophyll *a* values for all estuary zones exceed the guideline levels, this is indicative of impact sites. However median turbidity levels for this time period do not exceed guideline levels. The analysis of the 2010-2011 Coila Lake data shows that the median chlorophyll *a* values are approximately equal to the trigger values for most sites except TUR_00029. This 2010-2011 data was also analysed in the BMT WBM (2011) report as per OEH MER methodology in order to calculate percentage exceedance of applied guideline values. These were ranked per site using the scale displayed in Table 26. These results are displayed in Table 27 for Tuross River Estuary and Table 28 for Coila Lake.

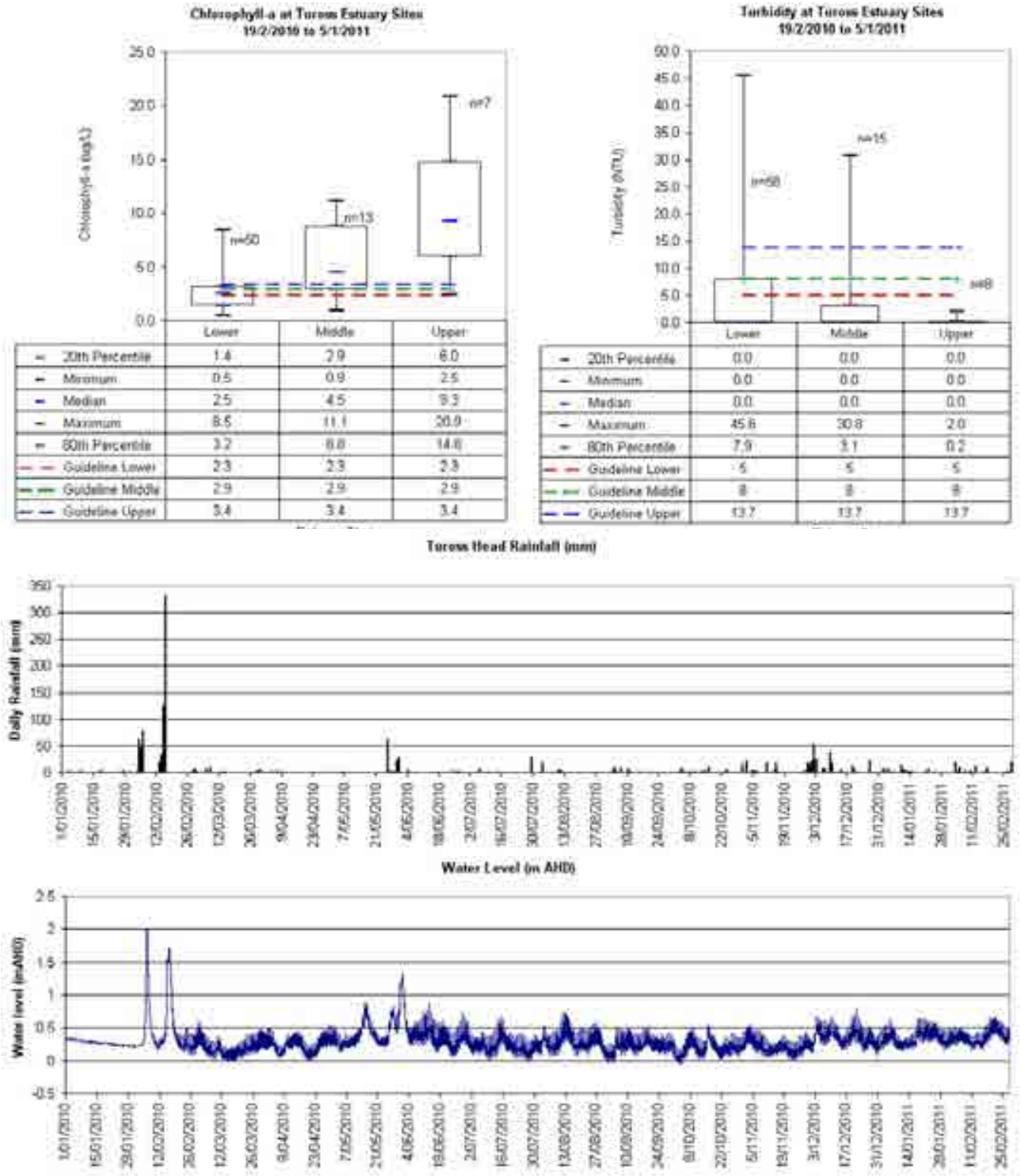


Figure 62: Summary of Tuross River Estuary water quality data from 2010 to 2011 (chlorophyll *a* turbidity, rainfall and water level)

Source: BMT WBM (2011)

Table 26: Percentage exceedance values ranking

Percentage exceedance scale	rating
0-15%	very good
15-30%	Good
30-50%	Fair
50%-75%	poor
75%-100%	Very poor

Source: BMT WBM (2011)

Table 27: Percentage exceedance data – Tuross River Estuary

Tuross	Chlorophyll-a			Turbidity			
	Number of exceedences	Total number of samples	percentage exceedence	Number of exceedences	Total number of samples	percentage exceedence	Condition index (Combined rating)
All sites	45	71	63%	18	81	22%	43%
TUR_00052	5	11	45%	1	11	9%	27%
TUR_00053	8	11	73%	0	11	0%	36%
TUR_00054	5	12	42%	0	12	0%	21%
TUR_00055	9	12	75%	7	12	58%	67%
TUR_00056	2	2	100%	5	12	42%	71%
TUR_00057	9	12	75%	3	12	25%	50%
TUR_00058	7	11	64%	2	11	18%	41%

Source: BMT WBM (2011)

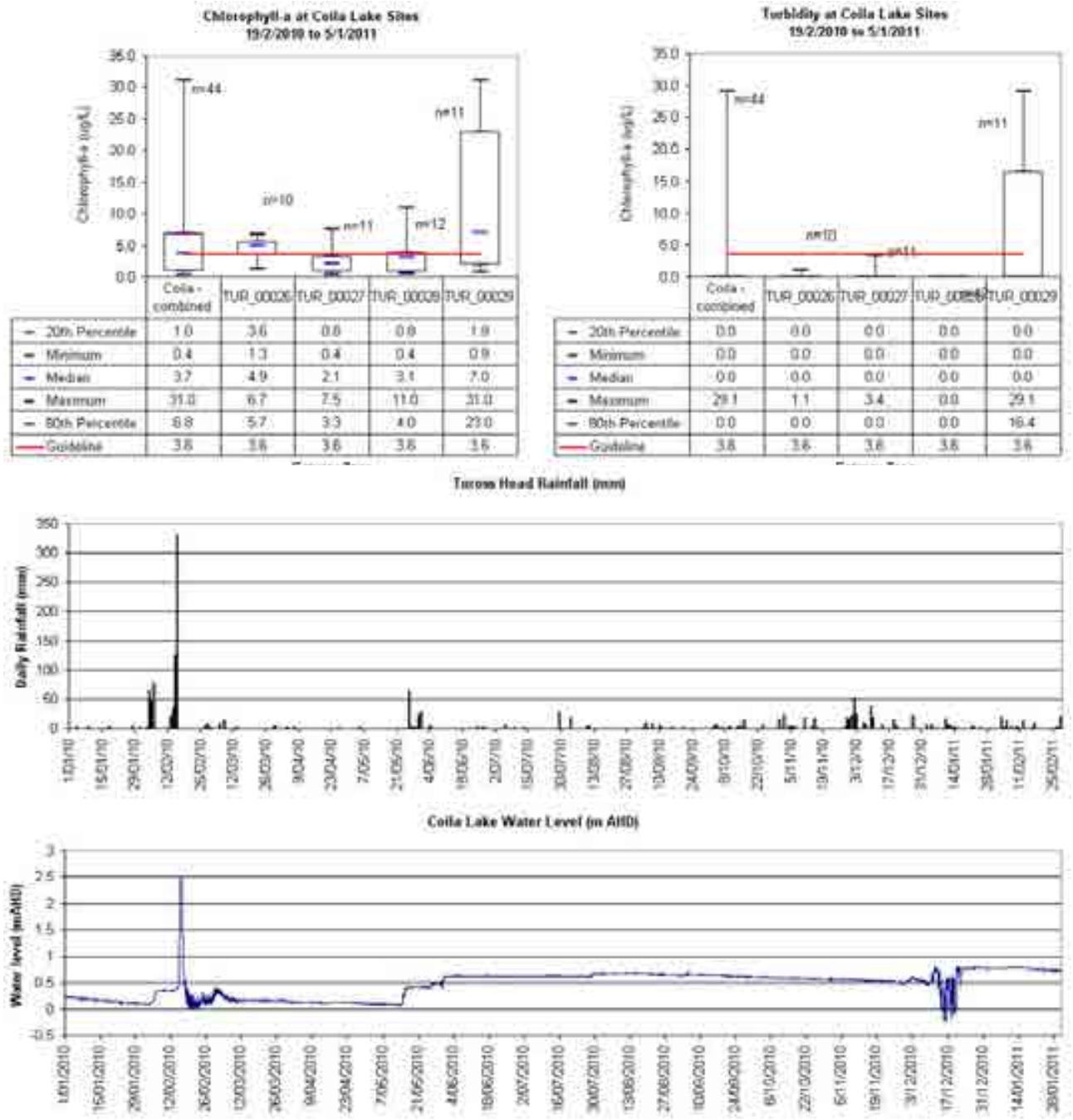


Figure 63: Summary of Coila Lake water quality data from 2010 to 2011 (chlorophyll *a*, turbidity, rainfall and water level)

Source: BMT WBM (2011)

Table 28: Percentage exceedance data – Coila Lake

Coila	Chlorophyll-a			Turbidity			
	Number of exceedences	Total number of samples	percentage exceedence	Number of exceedences	Total number of samples	percentage exceedence	Condition index (Combined rating)
All sites	14	35	40%	1	34	3%	21%
TUR_00026	7	11	64%	0	11	0%	32%
TUR_00027	2	12	17%	1	12	8%	13%
TUR_00028	5	12	42%	0	12	0%	21%

Source: BMT WBM (2011)

H1.3 Water Quality Report Cards

To complement the state government's Monitoring, Evaluation and Reporting (MER) program, ESC has produced estuarine health and water quality report cards since 2010 (available for download from Council's website http://www.esc.nsw.gov.au/living-in/about/our-natural-environment/estuaries-of-eurobodalla/estuary-health-and-water-quality-monitoring). These report cards are produced by monitoring and analysing parameters that are linked to catchment disturbance (chlorophyll *a* and turbidity) and provide indications of water quality levels that are safe for recreational activities (enterococci). The 2010 report cards also included analysis of the estuarine vegetation change between 2006 and 2012 (refer Section G6, Appendix G).

Report cards for Tuross River Estuary indicate a small spike in water samples (<10%) that exceed guidelines values for enterococci levels however all previous years have indicated that the estuary is safe for recreational activities. The report cards also indicate that the percentage of water samples that exceed guideline values of chlorophyll *a*, dissolved oxygen and pH have decreased since the commencement of this monitoring program, however turbidity has increased. The 2015/16 Water Quality Report Card for Tuross River Estuary is included in Figure 64.

Report cards for Coila Lake indicate that enterococci has not been detected in current (2015-16) water samples, an improvement of previous year's results, indicating the water body is safe for recreational activities (refer Figure 65). Water samples that exceed guideline values for chlorophyll *a* have decreased since the commencement of the monitoring program. The report cards indicate that Coila Lake current water quality and overall aquatic health are better than that of Tuross River Estuary.

TUROSS RIVER ESTUARY

Water Quality Report Card 2015-16

Recreational use water quality

Water quality for recreational use at the five sampling locations was considered suitable for swimming most of the time. However, the water may be susceptible to pollution from potential sources of faecal contamination occasionally.

Aquatic health water quality

Chlorophyll a was graded from very good to good and turbidity was graded good to fair throughout the estuary. Other supporting water quality indicators were also sampled but not graded. These results are displayed on the back page.

These grades provide an insight into the water quality of the Tuross River assessed by council between July 2015 and June 2016. Future monitoring will enable us to track how well we are managing the water quality of the River, as well as help determine management actions to improve water quality.

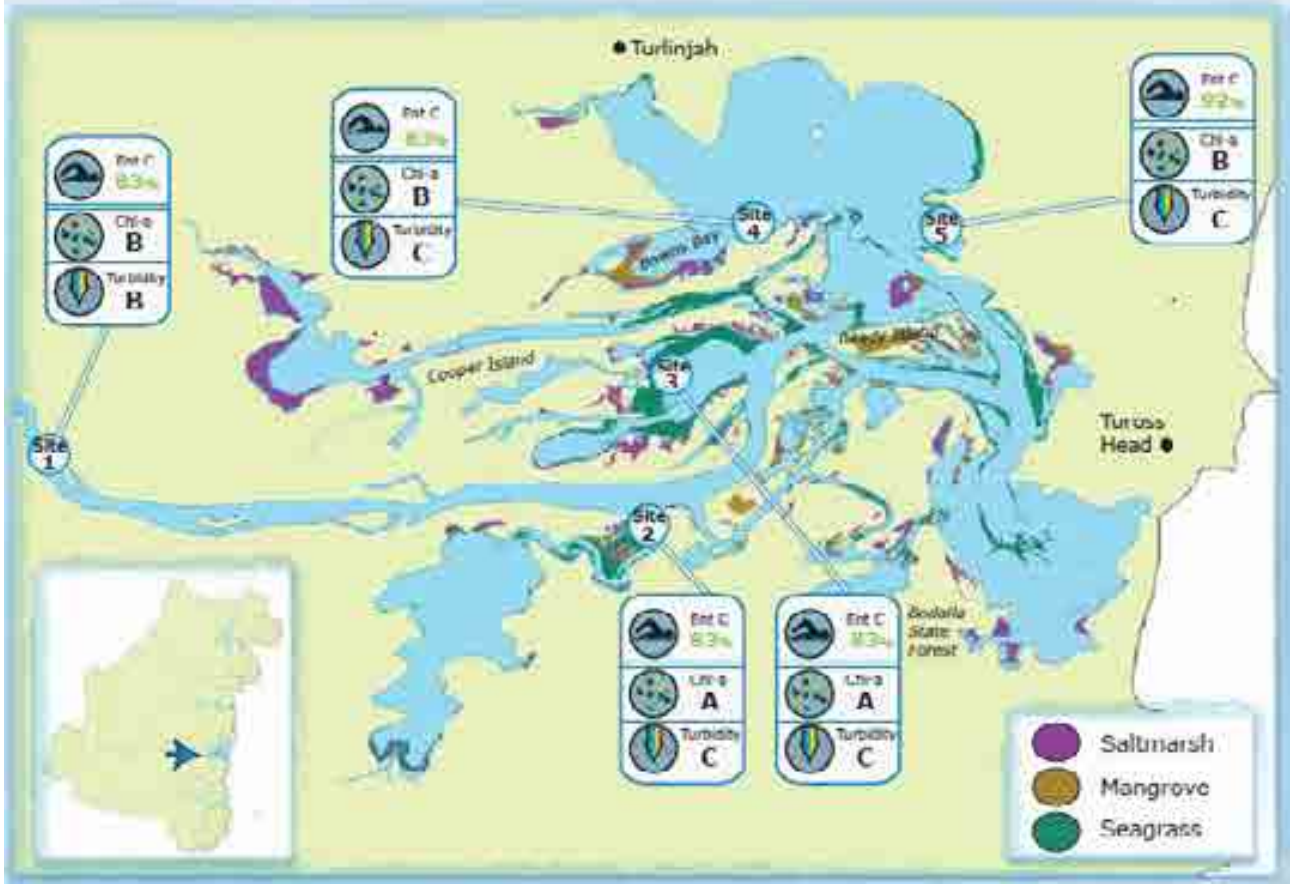
For more detailed information about Council's sampling program, please refer to the accompanying technical report on Council's website.

Estuary information

Catchment area (km^2):	1813.8
Estuary area (km^2):	15.5
Estuary volume (Ml):	18208.2
Entrance:	Open
Average Yearly Rainfall: (Stn No:69067) 2015:	927.6mm 950mm (est)
Land Use (Area): (2005 data)	Urban: 0.9% Forest: 86.3% Rural: 11.8% Other: 1.0%

Water quality grades

A	B	C	D	E
Very good	Good	Fair	Poor	Very poor



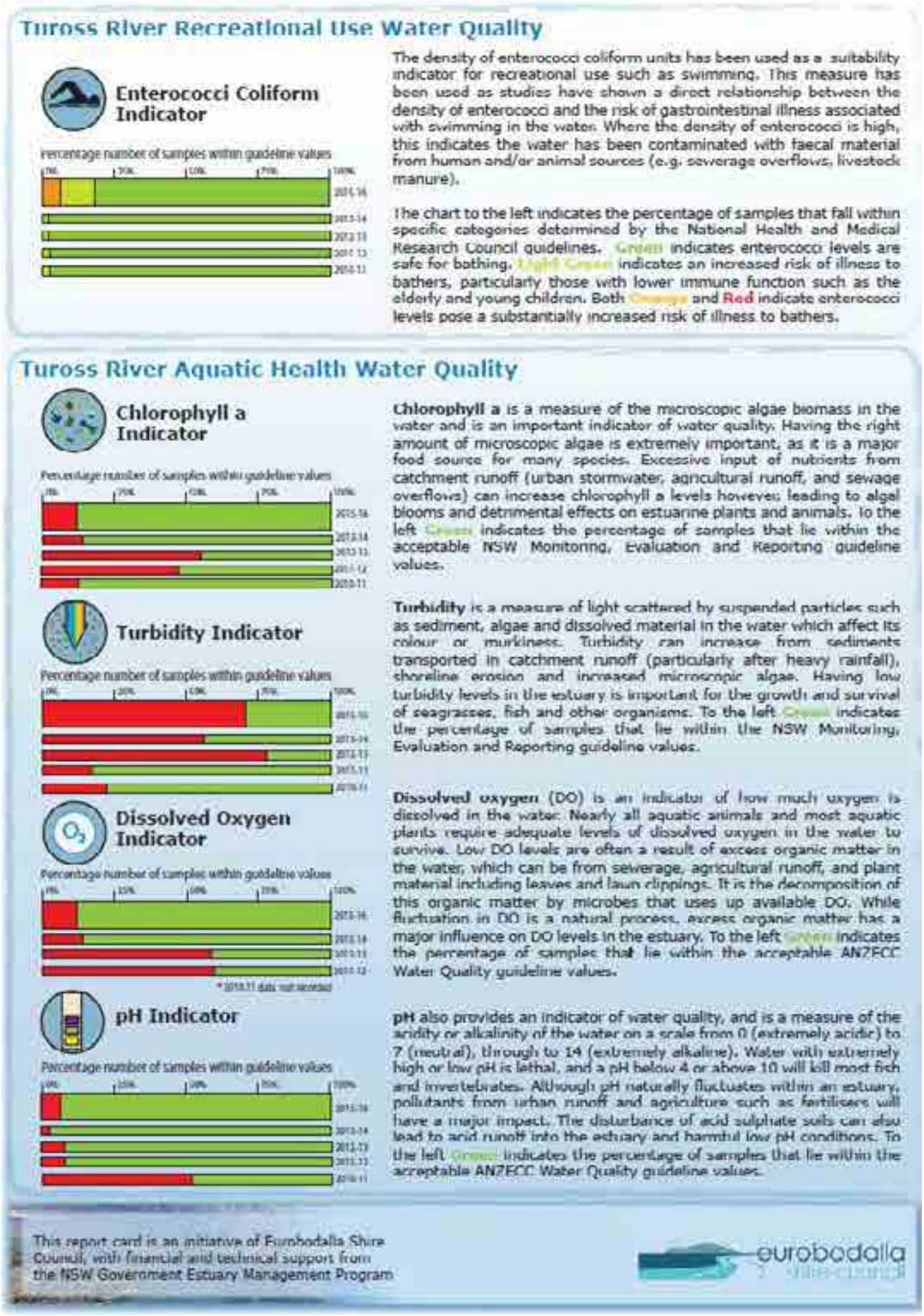


Figure 64: Water Quality Report Card for Tuross River Estuary – 2015/16

COILA LAKE ESTUARY

Water Quality Report Card 2015-16

Recreational use water quality

Water quality for recreational use at the four sampling locations was considered suitable for swimming most of the time. However the water may be susceptible to pollution from potential sources of faecal contamination occasionally.

Aquatic health water quality

Chlorophyll a was graded fair and turbidity was rated very good to good within the estuary. Other supporting water quality indicators were also sampled but not graded. These results are displayed on the back page.

These grades provide an insight into the water quality of the Coila Lake assessed by council between July 2015 and June 2016. Future monitoring will enable us to track how well we are managing the water quality of the Lake, as well as help determine management actions to improve water quality.

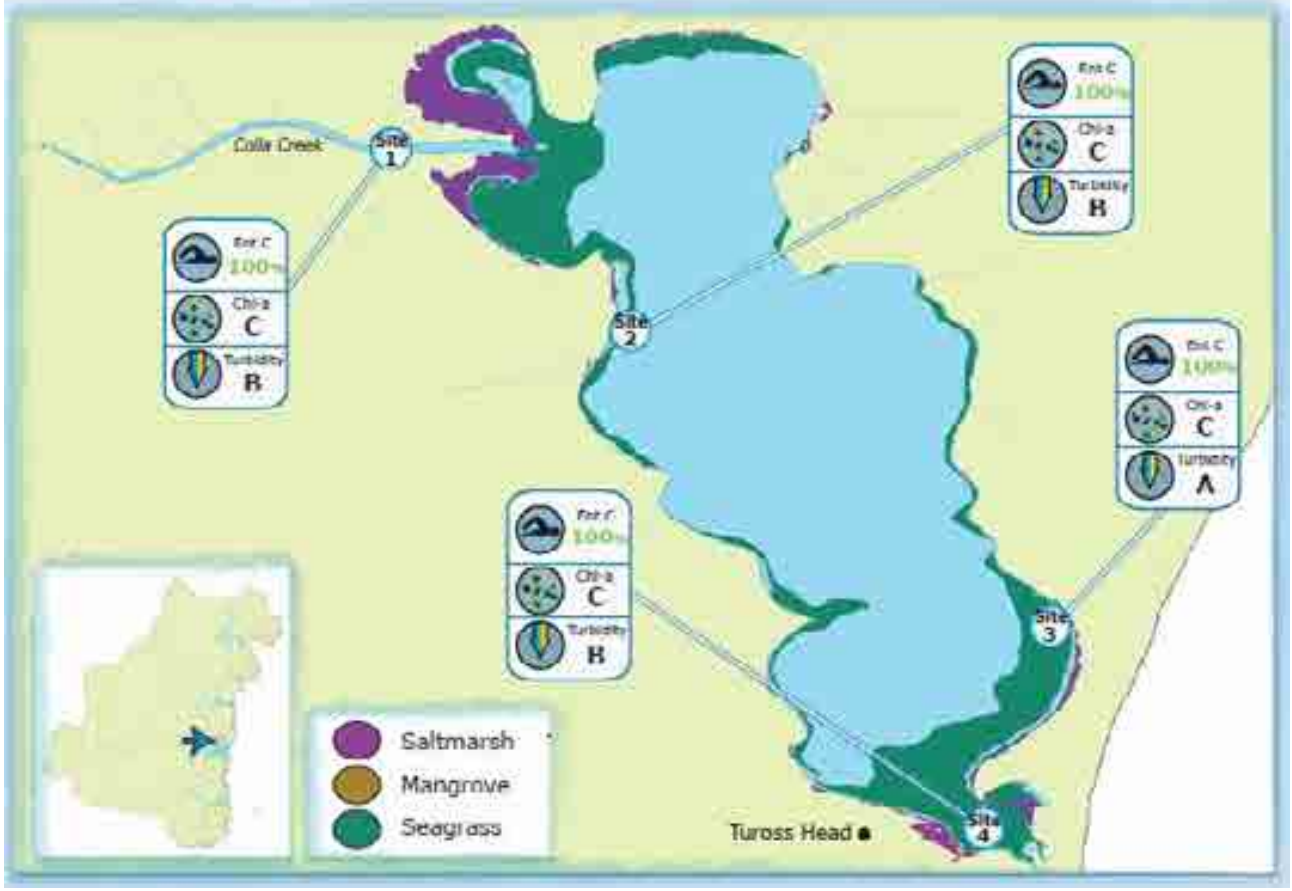
For more detailed information about Council's sampling program, please refer to the accompanying technical report on Council's website.

Estuary information

Catchment area (km^2):	47.5
Estuary area (km^2):	7.1
Estuary volume (Ml):	15441.6
Entrance:	Intermittently open
Average Yearly Rainfall: (Stn No:69067) 2015:	927.2mm 958mm (total)
Land Use (Area): (2005 data)	Urban: 6.2% Forest: 72.0% Rural: 19.0% Others 2.0%

Water quality grades

A	B	C	D	E
Very good	Good	Fair	Poor	Very poor



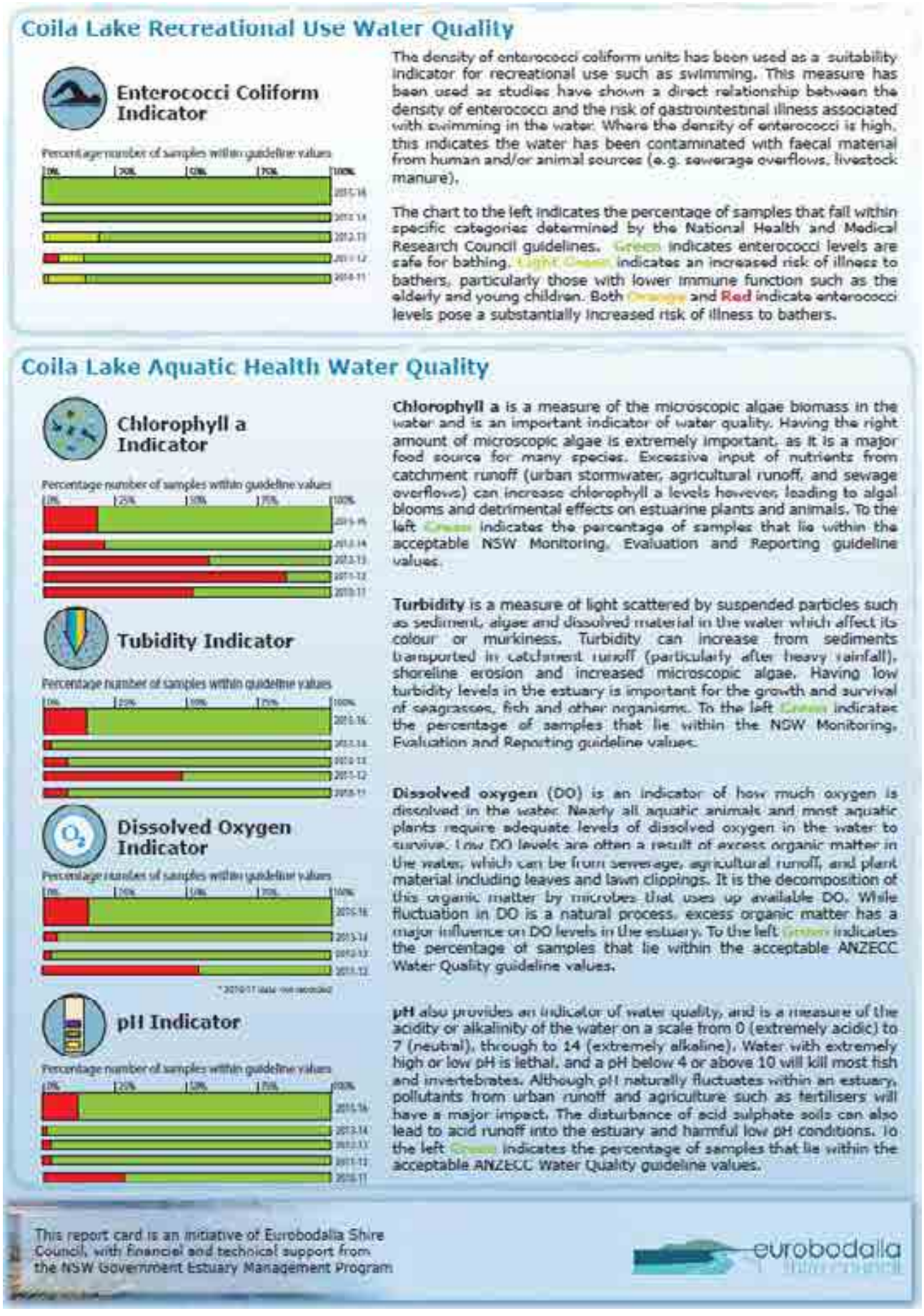


Figure 65: Water Quality Report Card for Coila Lake – 2015/16

H1.4 Eurobodalla Estuary Health Monitoring Program Review (2011)

A review of the estuarine health monitoring program for the Eurobodalla Shire was commissioned by ESC (BMT WBM, 2011). The report reviewed water quality data obtained between 2005 and 2011 (discussed in previous sections) and the sampling regime, protocols and guidelines followed while collecting the data. The report also reviewed water quality data prior to 2005, which are discussed below. The report applied OEH MER methodology when analysing the data and utilised the guideline/trigger values applied to ESC estuaries and lakes supplied by OEH or adopted from ANZECC (2000) recommendations (Table 29).

The outcomes of this report were a number of recommendations with the goal of improving and standardising the ESC estuarine water quality monitoring program which have since been implemented. The review highlighted that both the Tuross River Estuary and Coila Lake both show signs of water quality issues, which may be the result of unrepresentative sample design (poor representation of salinity zones). However the data highlights that Tuross River has the poorest water quality (high chlorophyll *a*) out of the six key ESC estuaries and may require management intervention.

The review recommended that:

- The water quality sampling program is modified to align with the ecosystem health monitoring program;
- The number of sites is reduced in some estuaries and the frequency of sampling increased to fortnightly over the summer period.
- Sample locations are adjusted to more accurately capture the upper, middle and lower section of the estuary (Figure 66);
- ESC consider sampling every two years subject to water quality assessment the following year; and
- Parameters to be tested should include chlorophyll *a*, salinity, turbidity, enterococci, temperature, pH and dissolved oxygen.

The current monitoring has been revised to reflect these recommendations.

Table 29: Adopted guideline/trigger values for ESC estuaries and lakes

Water Quality Parameter	Estuary Zone	Guideline/Trigger Values
Chlorophyll a	Upper <10 ppt salinity	3.4 µg/L
	Middle 10-25 ppt salinity	2.9 µg/L
	Lower >25 ppt salinity	2.3 µg/L
	Lake	3.6 µg/L
Turbidity	Upper <10 ppt salinity	13.7 ntu
	Middle 10-25 ppt salinity	8 ntu
	Lower >25 ppt salinity	5 ntu
	Lake	7.7 ntu
Dissolved Oxygen	(temperature dependent)	6-10 mg/L
Enterococci	Primary contact	35 cfu/100 ml
	Secondary contact	230 cfu/100 ml
pH		7-8.5

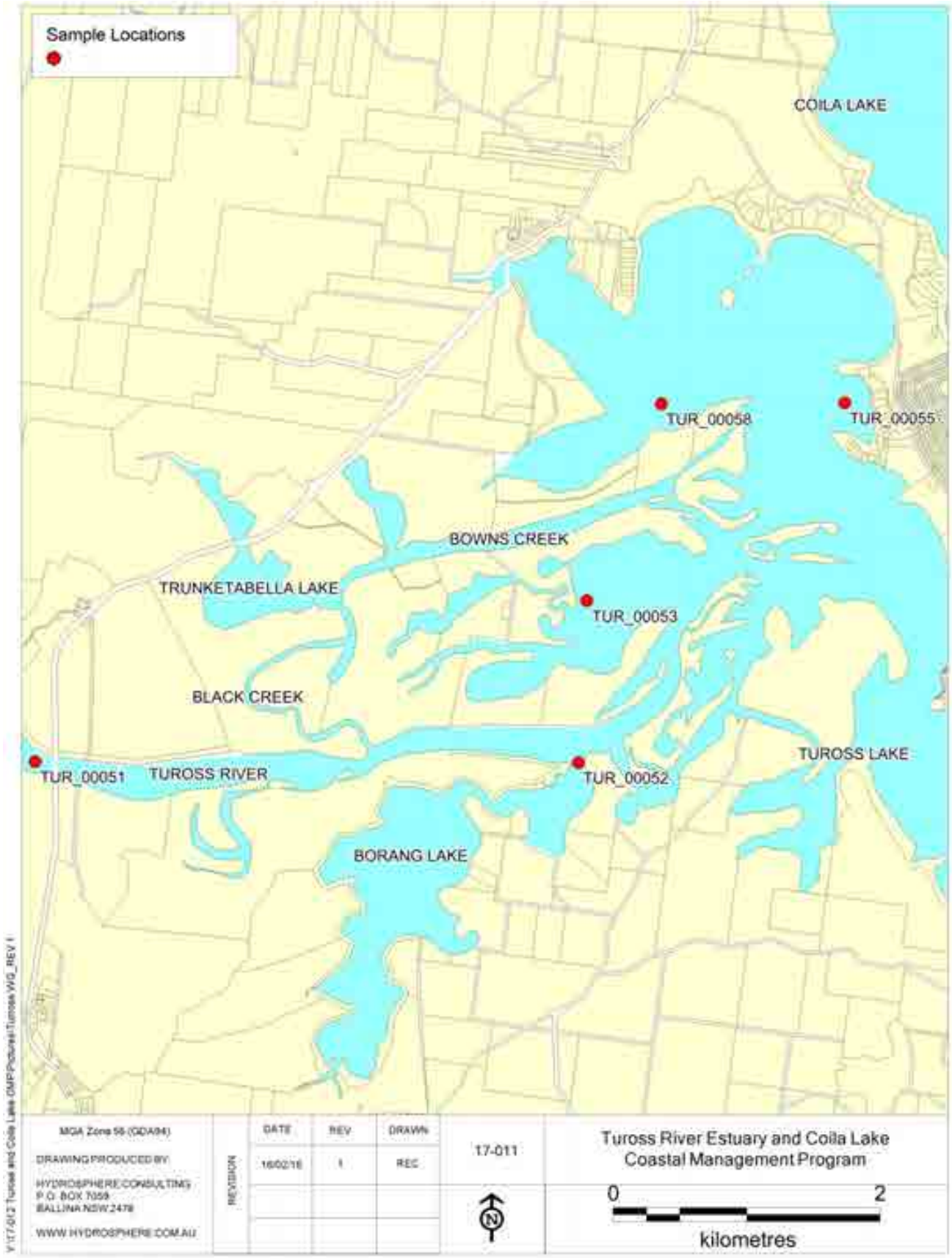


Figure 66: Recommended water quality sample locations for Tuross River Estuary

Source: BMT WBM (2011)

H1.5 Tuross Estuary Water Quality Improvement Plan

BMT WBM (2011) highlighted that Tuross River Estuary suffers from poor water quality when compared with other major estuaries. BMT WBM (2011) recommended catchment modelling be undertaken to identify nutrient and sediment sources. Modelling was completed by OEH to estimate potential high pollutant load areas based on land use, topography and climate parameters and concluded that high risk areas were associated with land utilised for forestry, rural residential development, grazing and agricultural practices.

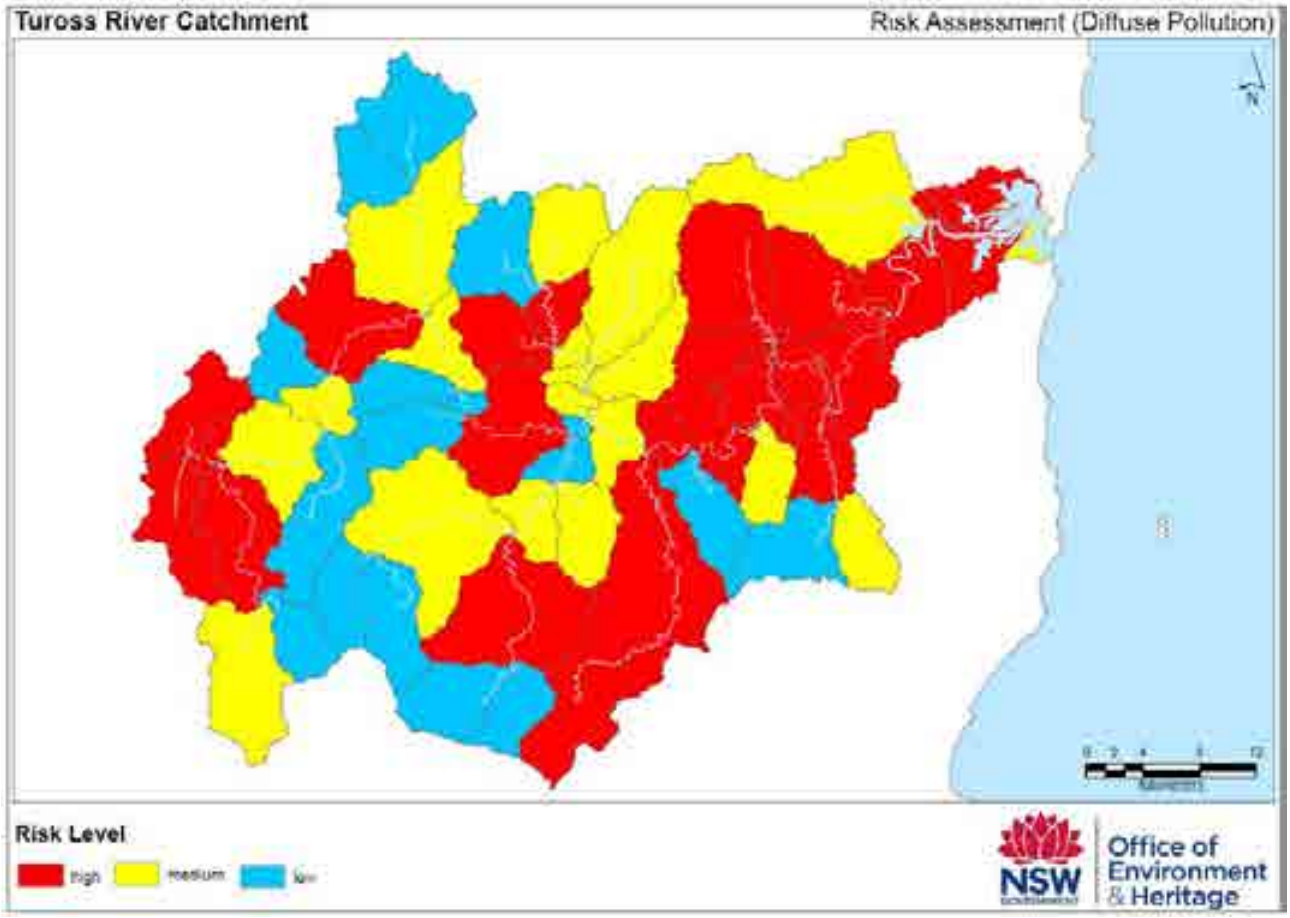


Figure 67: OEH Tuross River catchment modelling output map – risk assessment (diffuse pollution)

Source: Southeast Engineering and Environmental (2016)

Higher resolution modelling of the lower catchment (based on land use mapping, LEP zoning and standard pollution generation rates) was undertaken by OEH for TN loads to gather more detail about potential sediment and nutrient sources and assist in highlighting areas where water quality management may be a priority (Figure 68 to Figure 70).

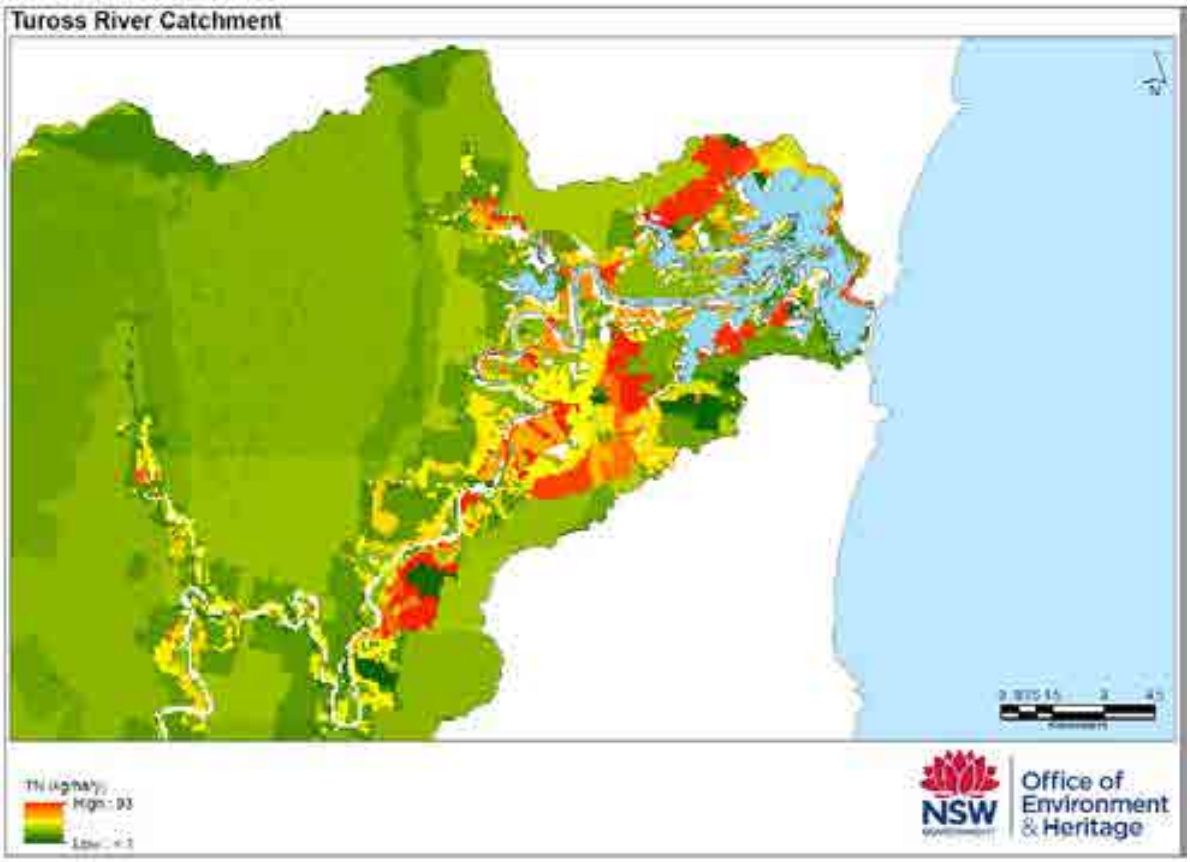


Figure 68: OEH lower Tuross River catchment modelling output map – TN (kg/ha/year)

Source: OEH

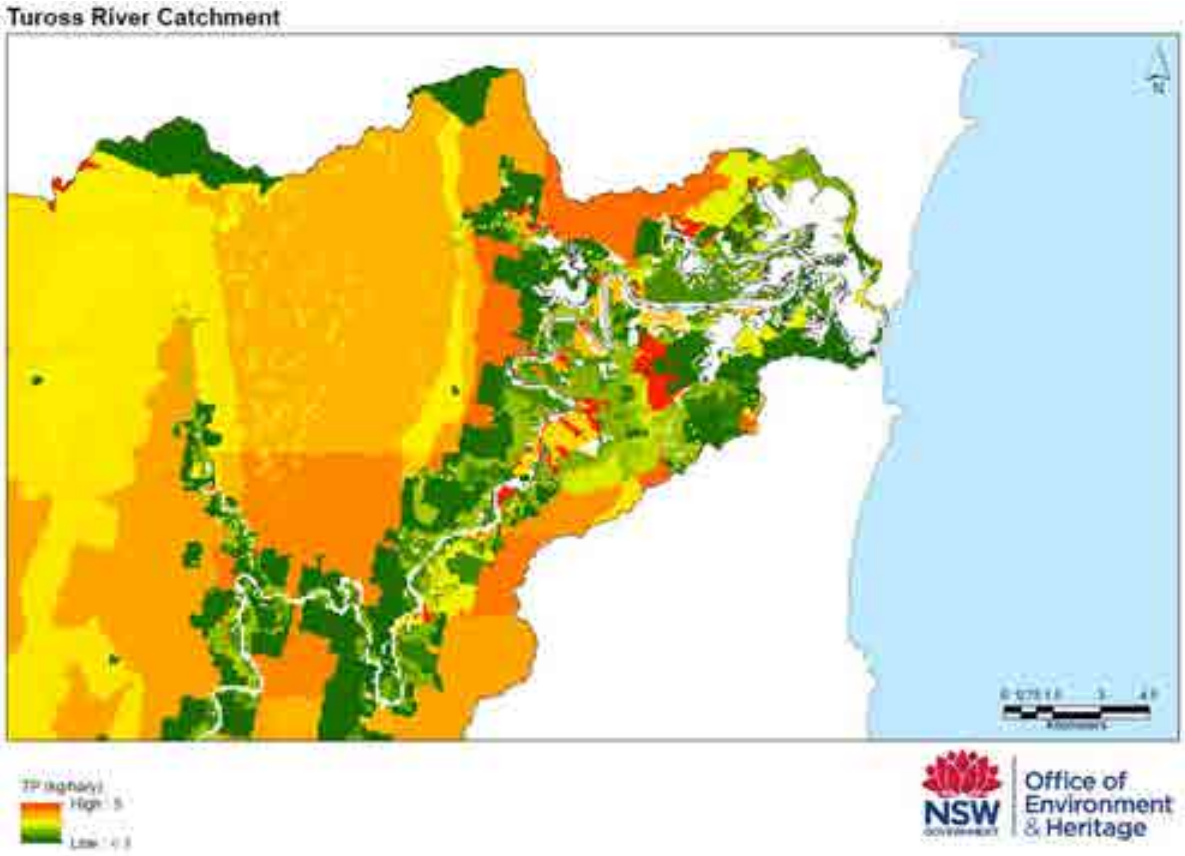


Figure 69: OEH lower Tuross River catchment modelling output map – TP (kg/ha/year)

Source: OEH

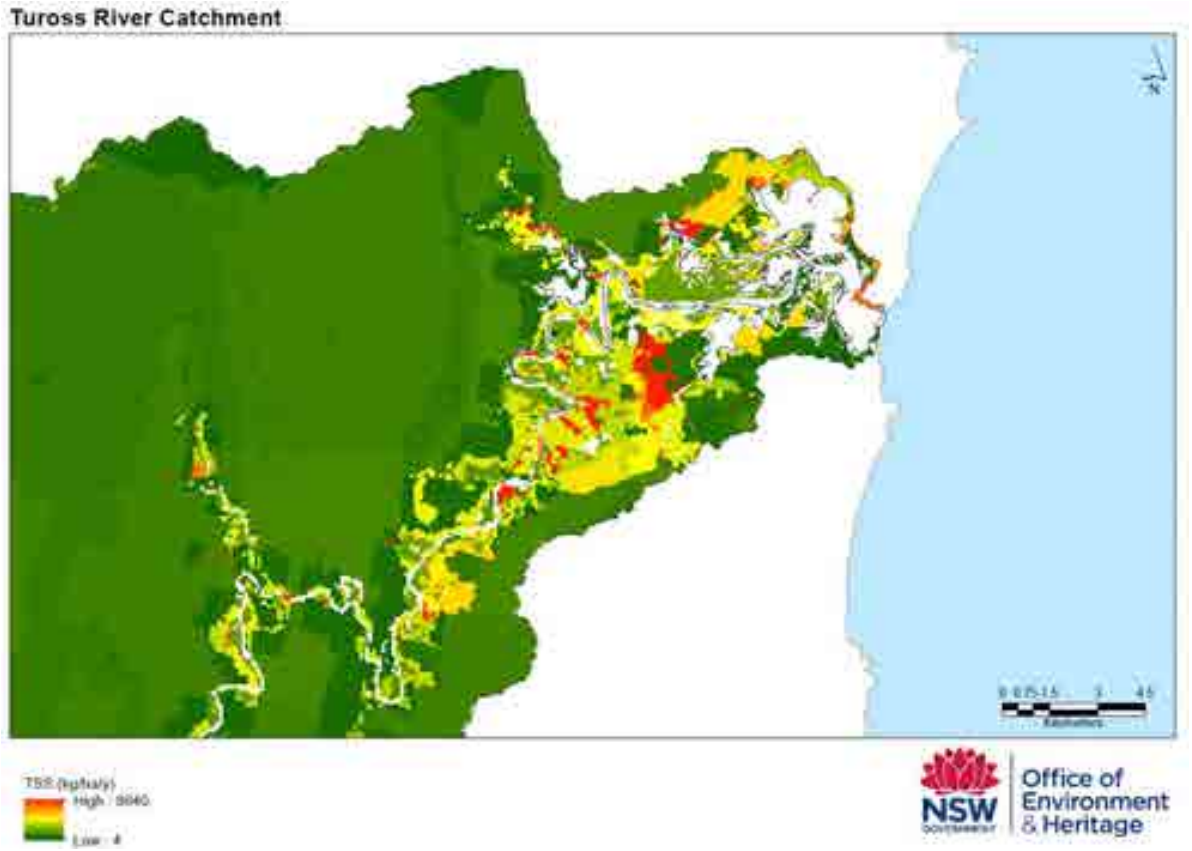


Figure 70: OEH lower Tuross River catchment modelling output map – TSS (kg/ha/year)

Source: OEH

The results of this modelling, also supported by previous studies and management plans, recommended rehabilitation in lower down steam areas of the estuary designed to improving water quality and estuary health with a long-term focus. Detailed field mapping and ground-truthing of potential pollutant source locations was undertaken by ESC and OEH. Analysis at a finer scale was undertaken as part of the OEH Coastal Eutrophication Risk Assessment Tool (CERAT).

At the conclusion of these studies Southeast Engineering and Environmental were commissioned by ESC to develop a Water Quality Improvement Plan for the Tuross River Estuary. This plan was developed utilising the BMT WBM (2011) review, catchment mapping and the field mapping/ground-truthing study. This report identified three frequently observed water quality issues:

- Sediment and nutrient loads associated with agricultural activities, including cropping with no, or limited buffers before runoff reaches watercourses;
- Stock access to the top of bank and/or water's edge with little to no riparian buffer and associated erosion, pollution and nutrient addition effects; and
- Steep banks (sub-vertical) with high exposure to main channel flows (i.e. located on outside bend or other areas where flows are greatest directly alongside the bank) and associated erosion / sedimentation and property loss.

The plan prioritises estuary rehabilitation areas as discussed in Appendix I - Bank Erosion.

H1.6 Oyster Lease Monitoring

Maintaining good water quality is critical to the success of the oyster farming industry in the Tuross River Estuary. Poor water quality can not only impact oyster production but has the potential to impact consumers. Routine bacterial monitoring of water and oyster flesh is undertaken in the Tuross River Estuary. The State

Government's Shellfish Quality Assurance Program (SQAP) outlines bacterial monitoring as a requirement of commercial oyster farmers. The NSW Food Authority regularly tests samples from this estuary for varying phytoplankton species levels known to be harmful. Triggers values for the number of species present in a sample are used to determine if further testing is required (flesh testing), if alerts need to be issued (harvest suspended pending further testing), or public health warnings need to be issued. At present there are no major water bacterial issues in the Tuross River Estuary as a result of water quality.

H1.7 Coila Lake Algae Monitoring

The build-up of algae on the foreshores of Coila Lake has been noted as a community concern, largely due to the odour produced by the algae as it begins to decay as well as the potential impact on the Lake's health and fish stocks. The water level in the lake often reduces during hot summer weather or periods of low rainfall. The growth of algae is a natural process that occurs as the water level in the lake drops from evaporation or entrance opening, resulting in algae being exposed on the foreshore and dying-off, causing the odour. Water quality monitoring (chlorophyll *a* and dissolved oxygen) is undertaken by ESC when these events occur. Current testing has identified that the algae is not toxic and is not having a detrimental impact on the health of the Lake.

H1.8 Coastal Eutrophication Risk Assessment Tool (CERAT)

OEH has 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 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. The catchment models provide estimates of the amounts of nutrients and sediments exported from land-based activities, such as urban development, deforestation and agriculture. This modelling utilises land use and other parameters such as soil type and climate to estimate export of TSS, TN and TP loads from locations within the study area. This provides an indication of potential sources/areas of elevated nutrient and sediment pollutant loads. The models show that the upper and outer reaches of the estuaries and study areas, which are areas that contain state forest, have low exports of sediment and nutrients. The areas identified as potentially higher sediment and nutrient load inputs are largely zoned residential or primary production area.

Figure 71 to Figure 73 provide the spatial results of the latest update to CERAT modelling undertaken for Coila Lake for total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) respectively. The Tuross River Estuary risk mapping presented in Section H1.5 is more recent than the CERAT modelling.

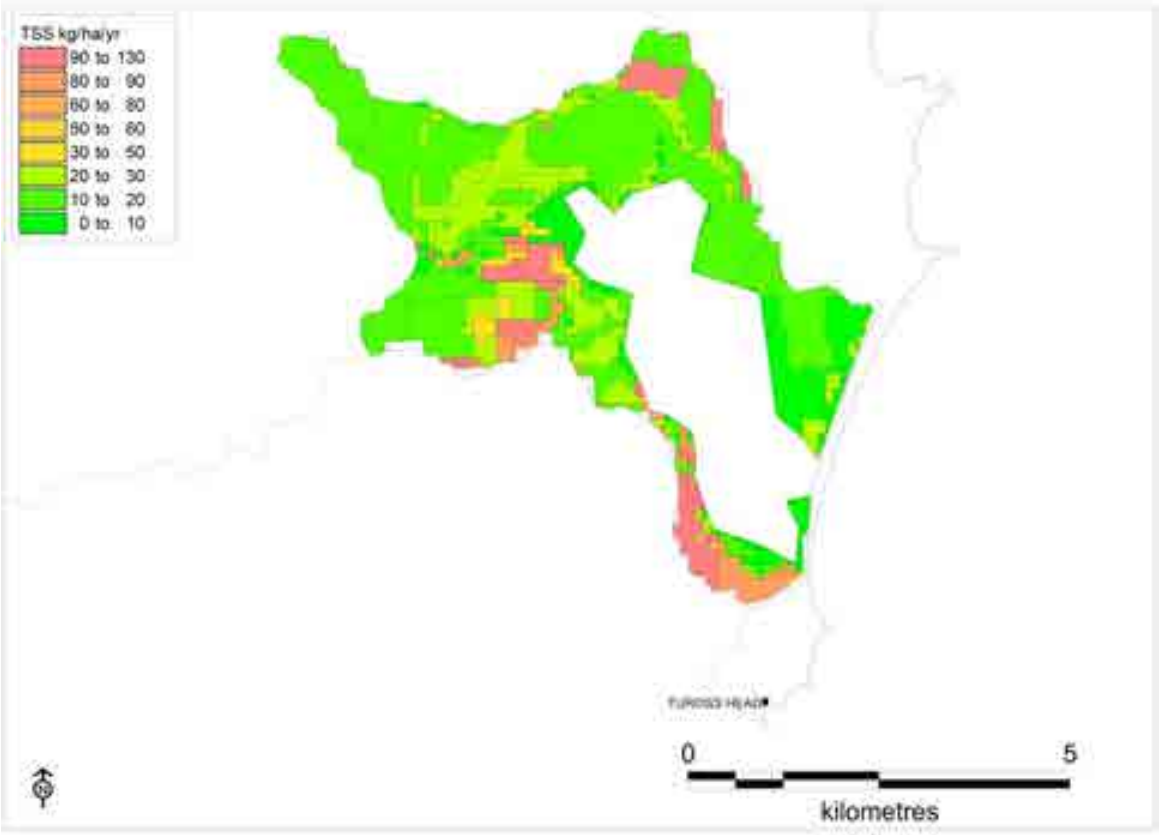


Figure 71: Modelled TSS load for Coila Lake

Source: 2016 CERAT modelling supplied by OEH

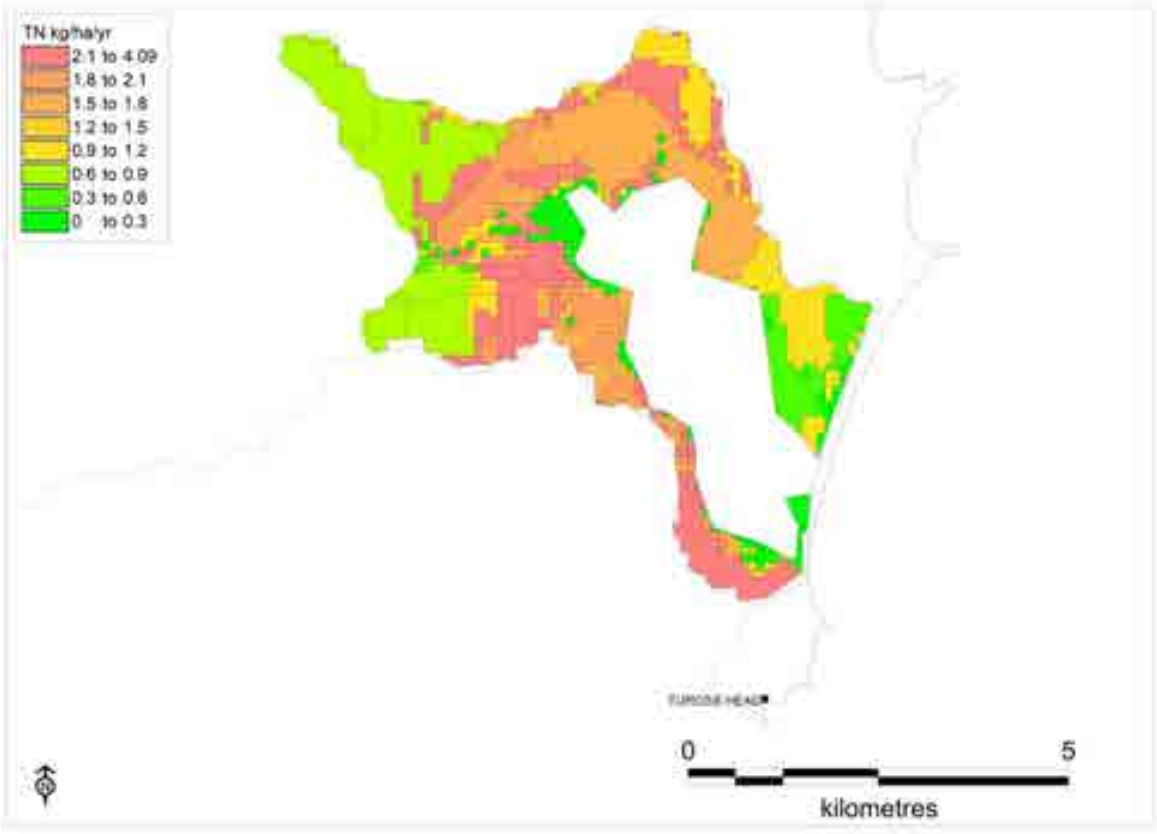


Figure 72: Modelled TN load for Coila Lake

Source: 2016 CERAT modelling supplied by OEH

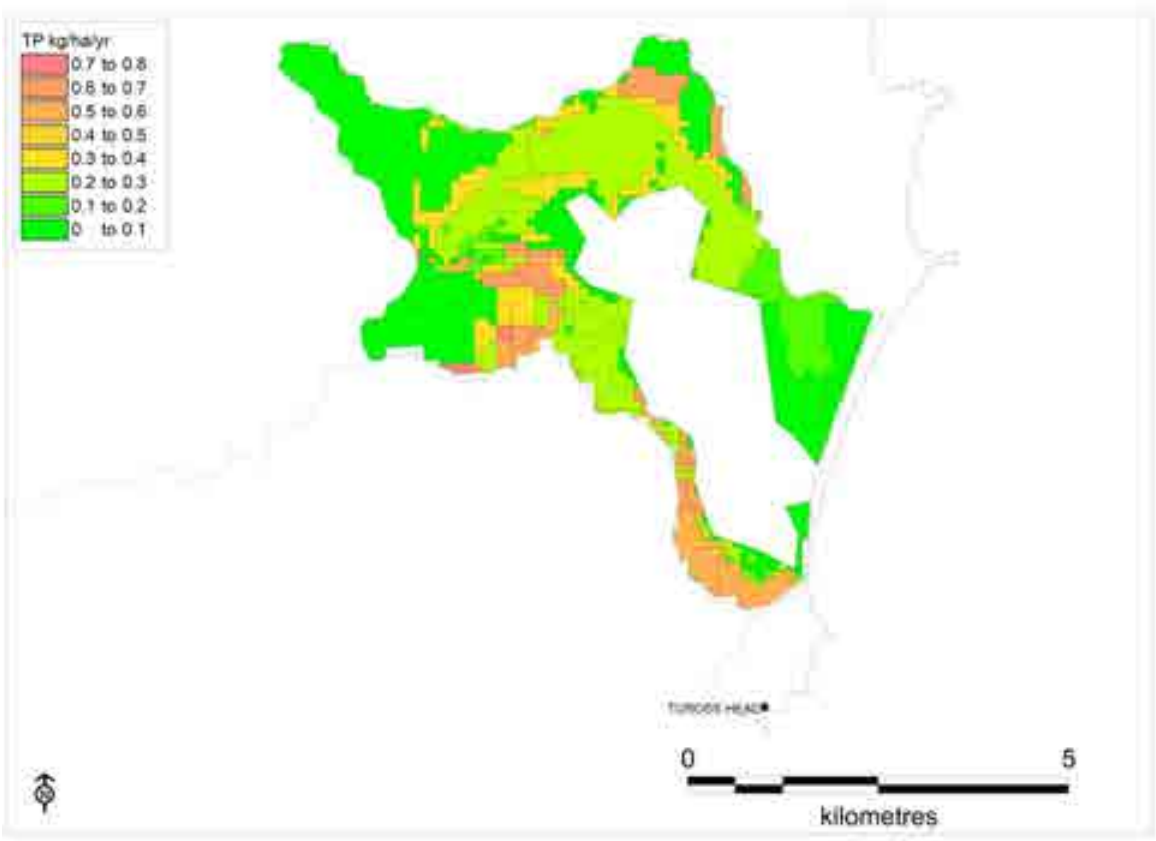


Figure 73: Modelled TP load for Coila Lake

Source: 2016 CERAT modelling supplied by OEH

APPENDIX I. BANK EROSION

I1. PREVIOUS STUDIES

I1.1 EMS and EMP

"Catchment erosion", "loss of land and risks to assets due to bank erosion" and "loss of riparian vegetation due to bank erosion" were discussed as key management issues in the 2004 EMS. A preliminary list of priority sites for stabilisation of eroding foreshores in Tuross Estuary was provided in the 2005 EMP (no assessment was provided on Coila Lake):

1. Brices Creek, between Horse Island and the mainland (due to erosion of a valued Aboriginal midden);
2. Tuross River between Cambathin Island and the Princes Highway bridge, on both the northern and southern foreshores (due to relatively rapid loss of private lands);
3. Tuross River upstream of the highway bridge at Snake Flat (due to relatively rapid loss of private lands);
4. Western foreshore of Cambathin Island; and
5. Southern foreshore of Deuaumba Island.

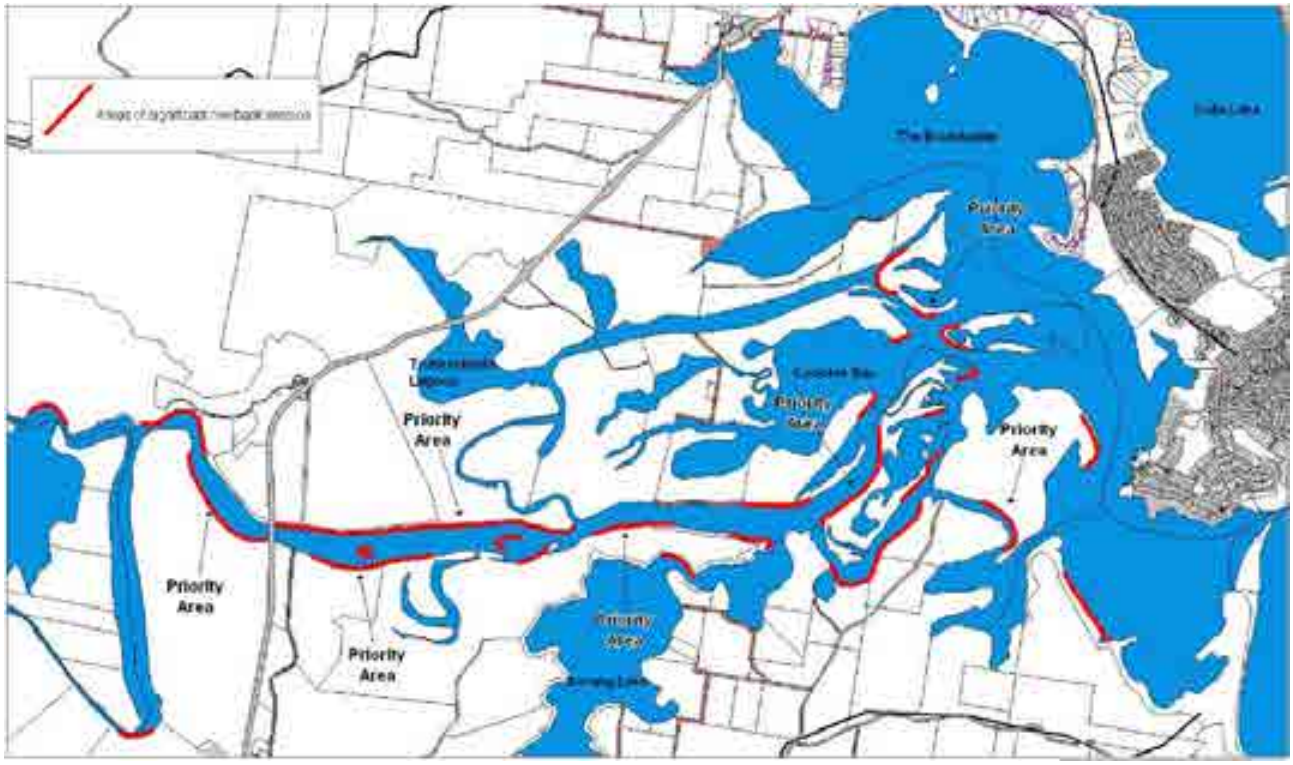


Figure 74: Riverbank erosion identified in the 2005 EMP

Source: WBM (2005)

The 2001 EPS discussed the main causes of erosion:

- The highest rates of bank erosion in the Tuross occur on the outside bend in the main fluvial channel (western side of Cambathin Island, southern side of Cooper Island);
- Erosion rates in back channels are lower than the main channels but boat wash may be a significant factor in back channels;
- Undercutting and toppling occurs where cohesive bank material overlies sandy material. In this type of bank the lower section is more frequently exposed to flowing water. Planar failure or slumping is more likely in weaker material such as sand or silty sand;

- The majority of erosion sites within the Tuross Estuary are characterised by steep or near vertical banks, resulting from scour at the toe of the banks increasing bank slope;
- Wind generated waves are only significant in open expanses of water and are not a significant mechanism of erosion in the Tuross Estuary;
- Although infrequent, boat wash may contribute to erosion;
- Seepage is considered to be a contributing factor, particularly homogeneous banks of fine sands and silt; and
- Although banks are generally protected by grasses, this cover provides minimal resistance to block failure when banks are steep.

The 2004 EMS also identified waterway barriers such as the Deuaumba Island causeway and Coopers Island Road weir as causing or contributing to erosion around the Islands and the Four Ways due to the altered tidal and flood flows.

The 2005 EMP included a Draft Tuross Estuary and Coila Lake Foreshore Management Plan, addressing bank stabilisation, riparian revegetation and conservation and sustainable recreational use of foreshores (Figure 75 and Figure 76) which was adopted as part of the EMP. Priority sites for revegetation in the 2005 EMP included Coopers Island, the northern foreshore of Trunketabella Creek and the northern and southern foreshores of the Tuross River upstream and downstream of the Princes Highway bridge. Within Coila Lake, Priority 1 revegetation works were identified across most of the northern part of the lake (except in the vicinity of the Coila Creek CMA 1 - coastal wetlands). Council land identified for revegetation included the Kyla Park estate on the western shores of Coila Lake, as well as much of the northern shores of The Broadwater in the Tuross estuary. The 2005 EMP also included fencing and revegetation of riparian zones and provision of alternative water sources, as appropriate to discourage stock access to waterways.

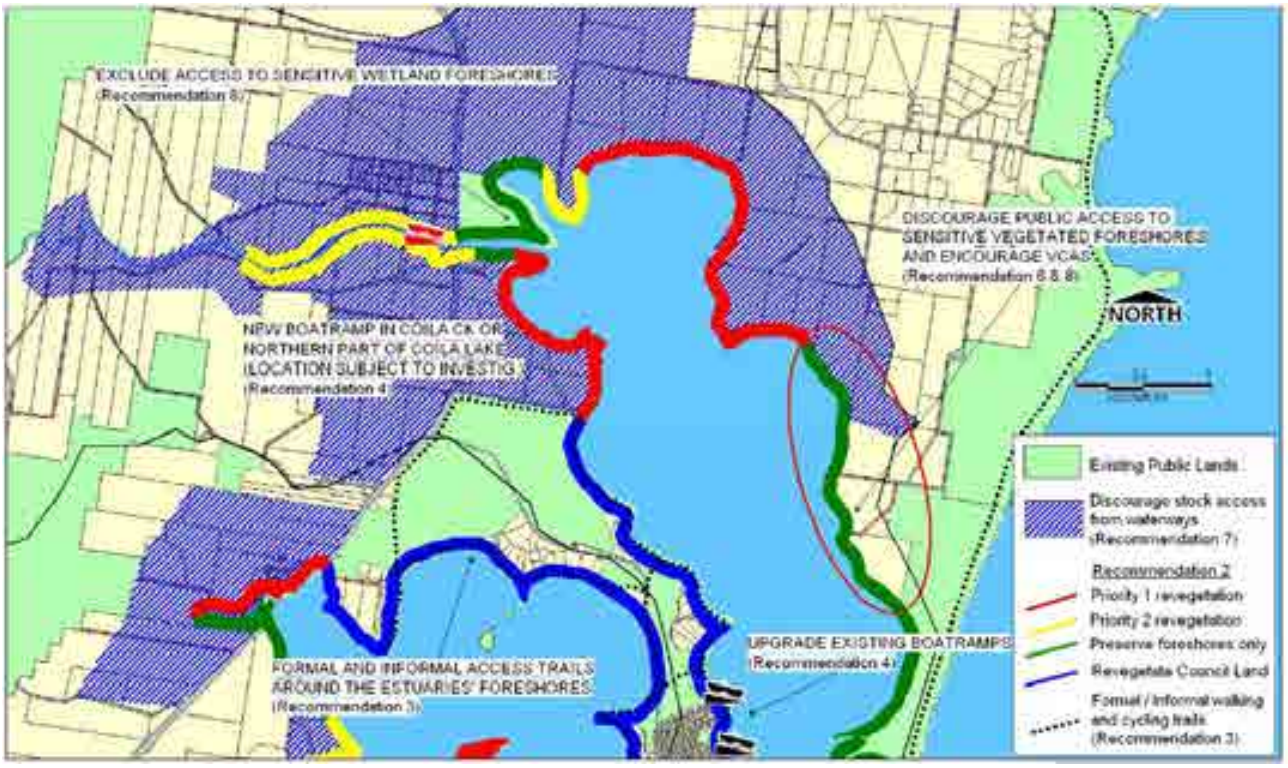


Figure 75: Foreshore management strategies for Coila Lake – 2005 EMP

Source: WBM (2005)

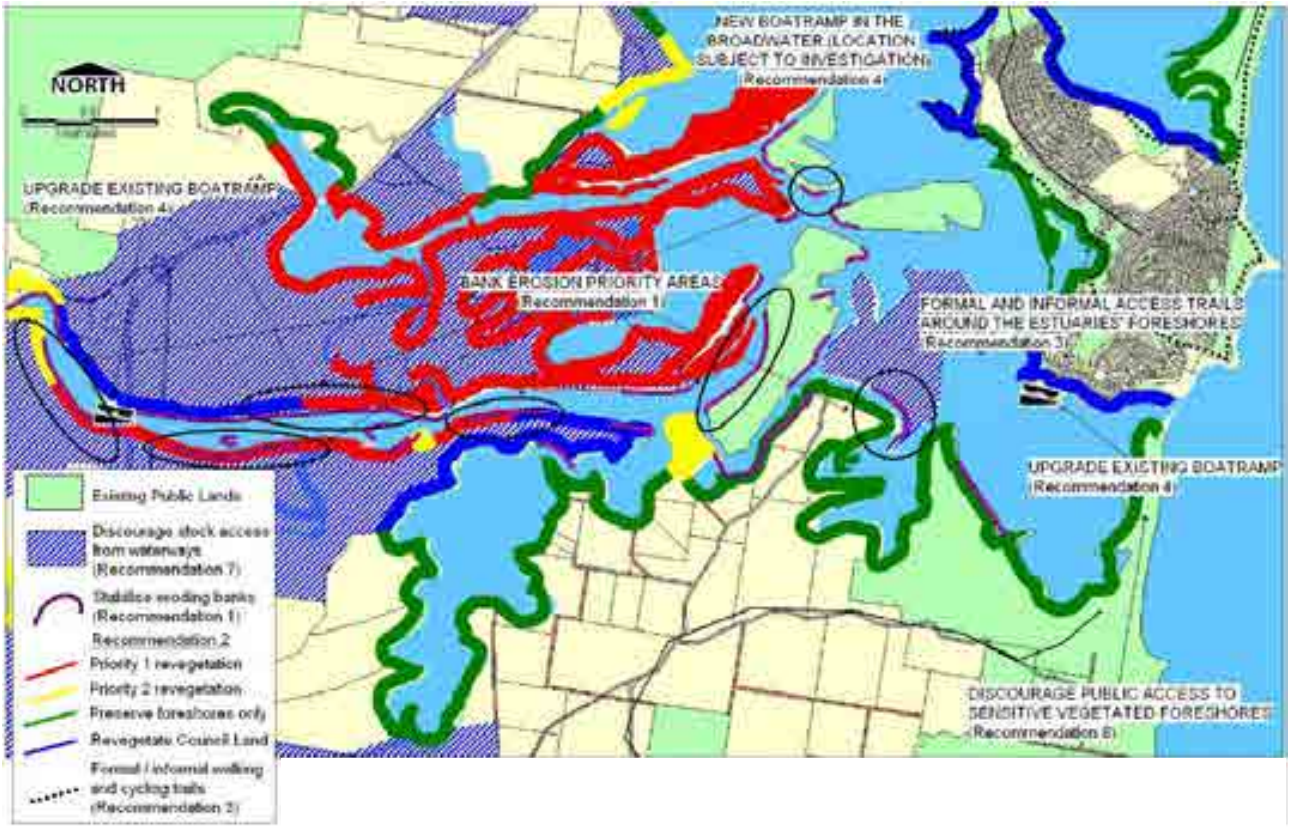


Figure 76: Foreshore management strategies for Tuross Estuary – 2005 EMP

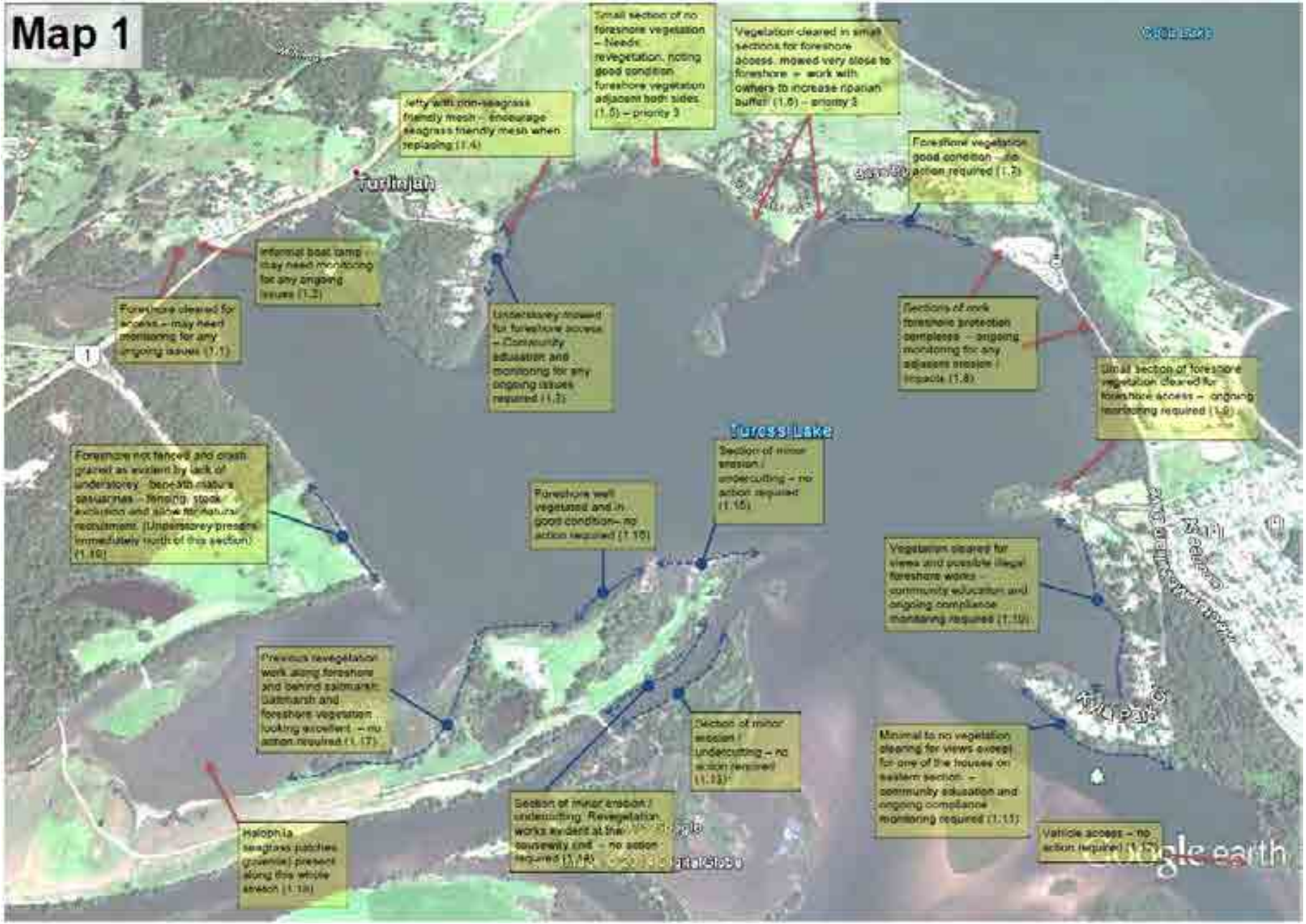
Source: WBM (2005)

I1.2 Tuross River Estuary Water Quality Improvement Plan

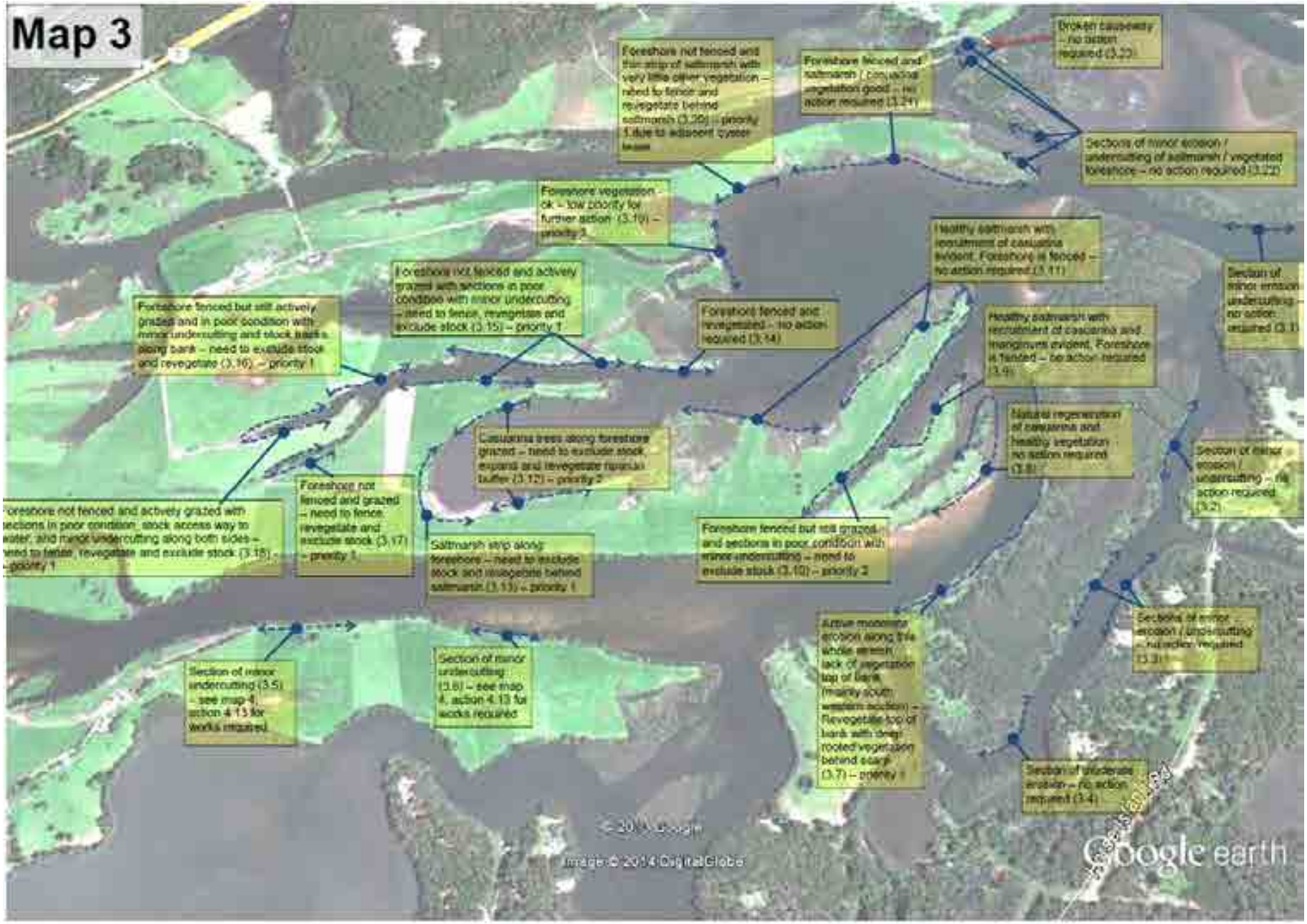
ESC developed a Water Quality Improvement Plan (Southeast Engineering and Environment, 2016) for the Tuross Estuary. Prior to the 2016 Plan, detailed fieldwork mapping was completed by Council and OEH in March 2014. Typical scenarios observed in the fieldwork reported in the Plan included:

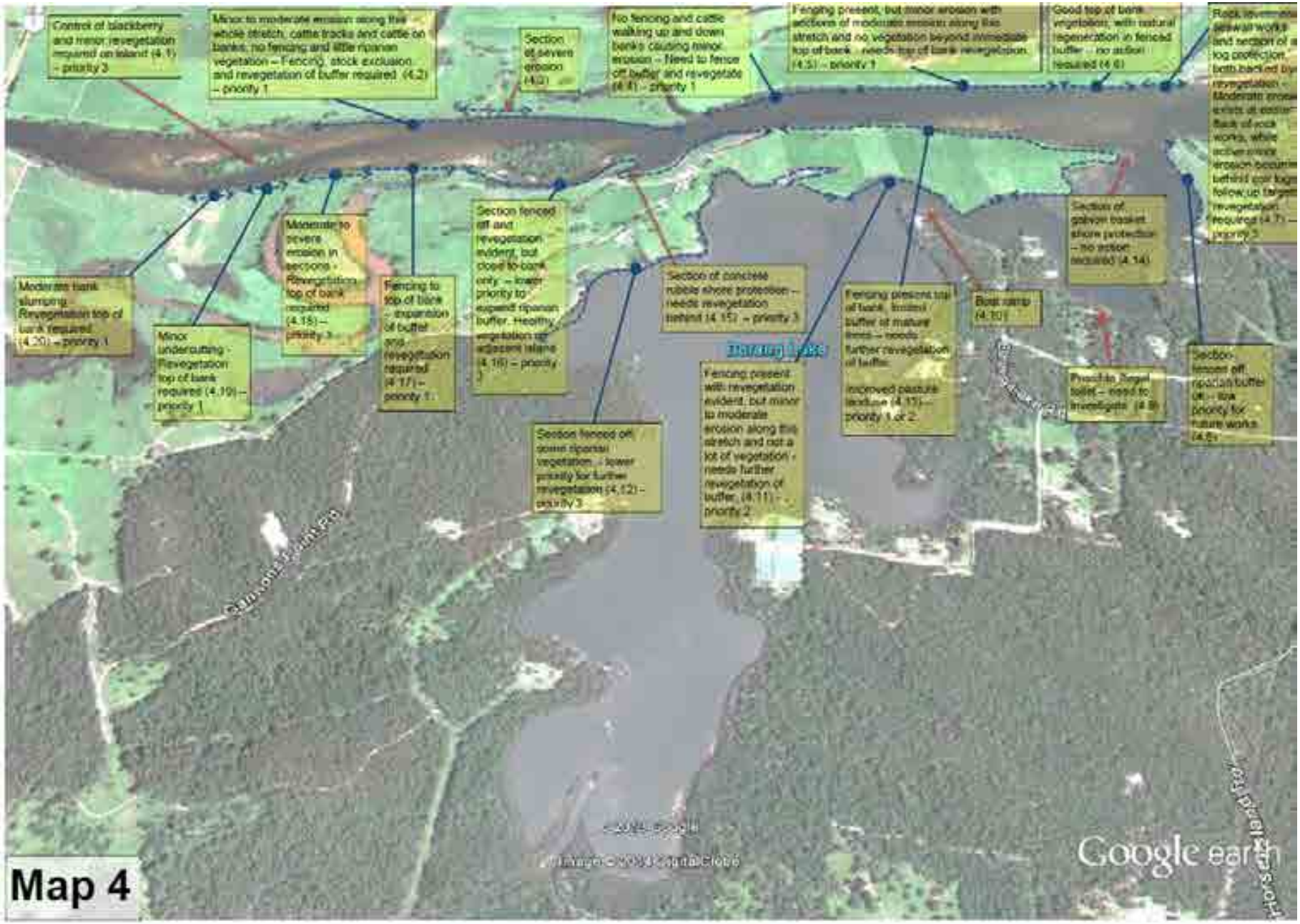
- Small sections of foreshore requiring revegetation infill;
- Ongoing monitoring of existing works (no action);
- Minor, moderate or major erosion - based on descriptions and site visit, erosion severity ranking is related to bank height, extent (i.e. length), presence or lack of foreshore vegetation and whether or not the erosion was active;
- Unvegetated banks in poor condition;
- Limited riparian vegetation;
- Foreshore unfenced and actively grazed;
- Foreshore fenced but evidence of crash grazing;
- Weeds/garden escapees; and
- Intensive cropping/Irrigated pasture to top of bank with limited riparian buffer.

Detailed maps of the fieldwork are provided in the following figures.

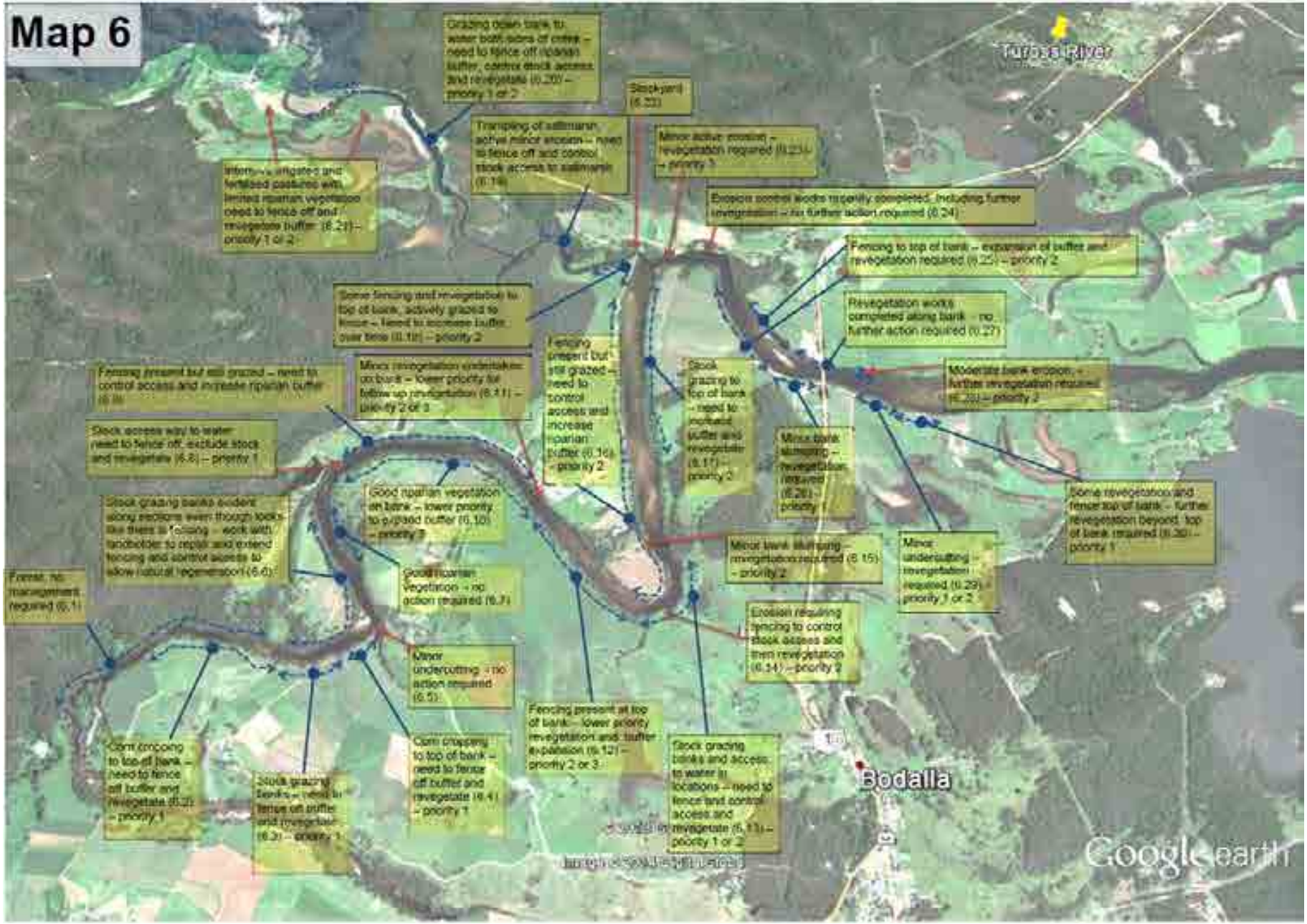

Map 1
Small section of no foreshore vegetation – Needs revegetation, noting good condition foreshore vegetation adjacent both sides (1.5) – priority 3
Vegetation cleared in small sections for foreshore access, mowed very close to foreshore – work with owners to increase riparian buffer (1.6) – priority 3
Jetty with non-seagrass friendly mesh – encourage seagrass friendly mesh when replacing (1.4)
Foreshore vegetation good condition – no action required (1.7)
Turlinjah
Informal boat ramp – may need monitoring for any ongoing issues (1.2)
Foreshore cleared for access – may need monitoring for any ongoing issues (1.1)
Understorey mowed for foreshore access – Community education and monitoring for any ongoing issues required (1.3)
Sections of rock foreshore protection complete – ongoing monitoring for any adjacent erosion / impacts (1.8)
Small section of foreshore vegetation cleared for foreshore access – ongoing monitoring required (1.9)
Tuross Lake
Foreshore not fenced and cattle grazed as evident by lack of understorey – benefit in nature reserve – fencing, stock exclusion and allow for natural recruitment. (Understorey present immediately north of this section) (1.10)
Section of minor erosion / undercutting – no action required (1.15)
Foreshore well vegetated and in good condition– no action required (1.16)
Vegetation cleared for views and possible illegal foreshore works – community education and ongoing compliance monitoring required (1.12)
Previous revegetation work along foreshore and behind saltmarsh. Saltmarsh and foreshore vegetation looking excellent – no action required (1.17)
Section of minor erosion / undercutting – no action required (1.13)
Minimal to no vegetation clearing for views except for one of the houses on eastern section – community education and ongoing compliance monitoring required (1.11)
Section of minor erosion / undercutting. Revegetation works evident at the seaward end – no action required (1.18)
Vehicle access – no action required (1.19)
Halophila seagrass patches (juvenile) present along this whole section (1.19)
Google earth


Map 2
Foreshore well vegetated – no action required (2.11)
Foreshore fenced out set back and gate open for grazing with no understorey – need to exclude stock and either revegetate or allow for natural regeneration (2.12) – priority 3
Tuross Head
Patches of Zostera seagrass through channel (2.10)
Moderate / minor erosion along stretch, grazing to top of bank – needs revegetation top of bank and expansion of buffer (2.8) – priority 2
Weeds – need bush regeneration works (2.14)
Foreshore fenced but crash grazed with sections of minor erosion / undercutting – need to exclude stock and expand riparian vegetation buffer (2.9) – priority 2
Moderate / minor erosion along stretch – needs revegetation (2.13) – priority 2
Minor erosion / undercutting along section – no action required (2.7)
Foreshore fenced and well vegetated – no action required (2.3)
Some garden escapees – need bush regeneration works (2.1)
Small section of minor erosion where foreshore vegetation cleared – needs revegetation (2.4) – priority 2
No seagrass present along this whole stretch (2.2)
Old tavern used for housing / hobbying (2.5)
Oyster leases – appear not to be active and need to confirm (2.6)
Blackfellows Point Rd
Google earth


Map 3
Foreshore not fenced and thin strip of saltmarsh with very little other vegetation – need to fence and revegetate behind saltmarsh (3.20) – priority 1 due to adjacent oyster lease
Foreshore fenced and saltmarsh / coastal vegetation good – no action required (3.21)
Broken causeway – no action required (3.22)
Sections of minor erosion / undercutting of saltmarsh / vegetated foreshore – no action required (3.22)
Foreshore vegetation ok – low priority for further action (3.19) – priority 3
Healthy saltmarsh with recruitment of casuarina evident. Foreshore is fenced – no action required (3.11)
Section of minor erosion undercutting – no action required (3.1)
Foreshore not fenced and actively grazed with sections in poor condition with minor undercutting – need to fence, revegetate and exclude stock (3.15) – priority 1
Foreshore fenced and revegetated – no action required (3.14)
Foreshore fenced and actively grazed and in poor condition with minor undercutting and stock tracks along bank – need to exclude stock and revegetate (3.16) – priority 1
Healthy saltmarsh with recruitment of casuarina and mangroves evident. Foreshore is fenced – no action required (3.9)
Natural regeneration of casuarina and healthy vegetation – no action required (3.8)
Section of minor erosion / undercutting – no action required (3.2)
Casuarina trees along foreshore grazed – need to exclude stock, expand and revegetate riparian buffer (3.12) – priority 2
Foreshore not fenced and actively grazed with sections in poor condition, stock access way to water, and minor undercutting along both sides – need to fence, revegetate and exclude stock (3.18) – priority 1
Foreshore not fenced and grazed – need to fence, revegetate and exclude stock (3.17) – priority 1
Saltmarsh strip along foreshore – need to exclude stock and revegetate behind saltmarsh (3.13) – priority 1
Foreshore fenced but still grazed and sections in poor condition with minor undercutting – need to exclude stock (3.10) – priority 2
Section of minor undercutting (3.5) – see map 4, action 4.13 for works required
Section of minor undercutting (3.6) – see map 4, action 4.13 for works required
Active moderate erosion along the whole stretch, lack of vegetation top of bank (mainly south western section) – Revegetate top of bank with deep rooted vegetation behind scarp (3.7) – priority 1
Section of moderate erosion – no action required (3.4)
Image © 2014 DigitalGlobe
Google earth


Control of blackberry and minor revegetation required on island (4.1) – priority 3
Minor to moderate erosion along this whole stretch; cattle tracks and cattle on banks; no fencing and little riparian vegetation – Fencing, stock exclusion and revegetation of buffer required (4.2) – priority 1
Section of severe erosion (4.3)
No fencing and cattle walking up and down banks causing minor erosion – Need to fence off buffer and revegetate (4.4) – priority 1
Fencing present, but minor erosion with evidence of moderate erosion along this stretch and no vegetation beyond immediate top of bank – needs top of bank revegetation (4.5) – priority 1
Good top of bank vegetation, with natural regeneration in fenced buffer – no action required (4.6)
Moderate bank slumping – Revegetation top of bank required (4.20) – priority 1
Minor undercutting - Revegetation top of bank required (4.10) – priority 1
Moderate to severe erosion in sections - Revegetation top of bank required (4.15) – priority 3
Fencing to top of bank – expansion of buffer and revegetation required (4.17) – priority 1
Section fenced off and revegetation evident, but close to bank only – lower priority to expand riparian buffer. Healthy vegetation on adjacent island (4.16) – priority 3
Section of concrete rubble shore protection – needs revegetation behind (4.15) – priority 3
Fencing present but all bank, limited buffer of mature trees – needs further revegetation of buffer.
Improved pasture landuse (4.11) – priority 1 or 2
Boat ramp (4.19)
Section of gabion basket shore protection – no action required (4.14)
Section fenced off riparian buffer of – low priority for future works (4.8)
Section fenced off riparian vegetation – lower priority for further revegetation (4.12) – priority 3
Fencing present with revegetation evident, but minor to moderate erosion along this stretch and not a lot of vegetation - needs further revegetation of buffer. (4.11) – priority 2
Map 4
Google earth


Map 5
Tuross River
Good foreshore vegetation – no action required (5.8)
Foreshore not fenced and actively grazed to edge with sections of minor undercutting – need to fence, revegetate and exclude stock (5.9) – priority 1
Foreshore not fenced and grazed to water edge – need to fence, revegetate understorey and exclude stock (5.10) – priority 1 or 2
Good foreshore vegetation with revegetation works completed – no action required (5.11)
Good foreshore casuarina dominated vegetation, with only a small foreshore gap requiring revegetation (5.12) – priority 3
Good patches of saltmarsh along foreshore that have been fenced off – revegetation behind saltmarsh required to increase buffer (5.7) – priority 2
Foreshore fenced but has limited riparian vegetation and is still grazed, including stock access into saltmarsh adjacent to the causeway – need to revegetate and exclude stock (5.3) – priority 1
Foreshore not fenced and actively grazed to edge with sections in poor condition with minor undercutting – need to fence, revegetate and exclude stock (5.2) – priority 1
Foreshore not fenced and actively grazed to water edge – need to fence, revegetate and exclude stock (5.1) – priority 1
Foreshore not fenced and grazed but does have some vegetation along the bank – need to fence, revegetate and exclude stock (5.6) – priority 1 or 2
Foreshore fenced and revegetation works completed – low priority for any further revegetation (5.4)
Foreshore fenced for small section, but with patchy vegetation – need to extend fencing and revegetate (5.5) – priority 2
Google earth


Map 6
Tuross River
Bodalla
Google earth
Grazing down bank to water both sides of creek – need to fence off riparian buffer, control stock access and revegetate (6.20) – priority 1 or 2
Stockyard (6.33)
Trampling of saltmarsh, active minor erosion – need to fence off and control stock access to saltmarsh (6.19)
Minor active erosion – revegetation required (6.23) – priority 1
Erosion control works recently completed, including further revegetation – no further action required (6.24)
Fencing to top of bank – expansion of buffer and revegetation required (6.25) – priority 2
Some fencing and revegetation to top of bank, actively grazed to fence – need to increase buffer over time (6.18) – priority 2
Revegetation works completed along bank – no further action required (6.27)
Fencing present but still grazed – need to control access and increase riparian buffer (6.8)
Minor revegetation undertaken on bank – lower priority for follow up revegetation (6.11) – priority 2 or 3
Fencing present but still grazed – need to control access and increase riparian buffer (6.16) – priority 2
Stock grazing to top of bank – need to increase buffer and revegetate (6.17) – priority 2
Moderate bank erosion – further revegetation required (6.28) – priority 2
Stock access way to water need to fence off, exclude stock and revegetate (6.9) – priority 1
Minor bank slumping – revegetation required (6.26) – priority 1
Stock grazing banks evident along sections even though looks like there is fencing – work with landholder to repair and extend fencing and control access to allow natural regeneration (6.6)
Good riparian vegetation on bank – lower priority to grazed buffer (6.10) – priority 3
Some revegetation and fence top of bank – further revegetation beyond top of bank required (6.30) – priority 1
Minor bank slumping – revegetation required (6.15) – priority 2
Minor undercutting – revegetation required (6.29) – priority 1 or 2
Forest, no management required (6.1)
Good riparian vegetation – no action required (6.7)
Erosion requiring fencing to control stock access and then revegetation (6.14) – priority 2
Minor undercutting – no action required (6.5)
Fencing present at top of bank – lower priority revegetation and buffer expansion (6.12) – priority 2 or 3
Corn cropping to top of bank – need to fence off buffer and revegetate (6.3) – priority 1
Corn cropping to top of bank – need to fence off buffer and revegetate (6.4) – priority 1
Stock grazing banks – need to fence off buffer and revegetate (6.2) – priority 1
Stock grazing banks and access to water in locations – need to fence and control access and revegetate (6.13) – priority 1 or 2

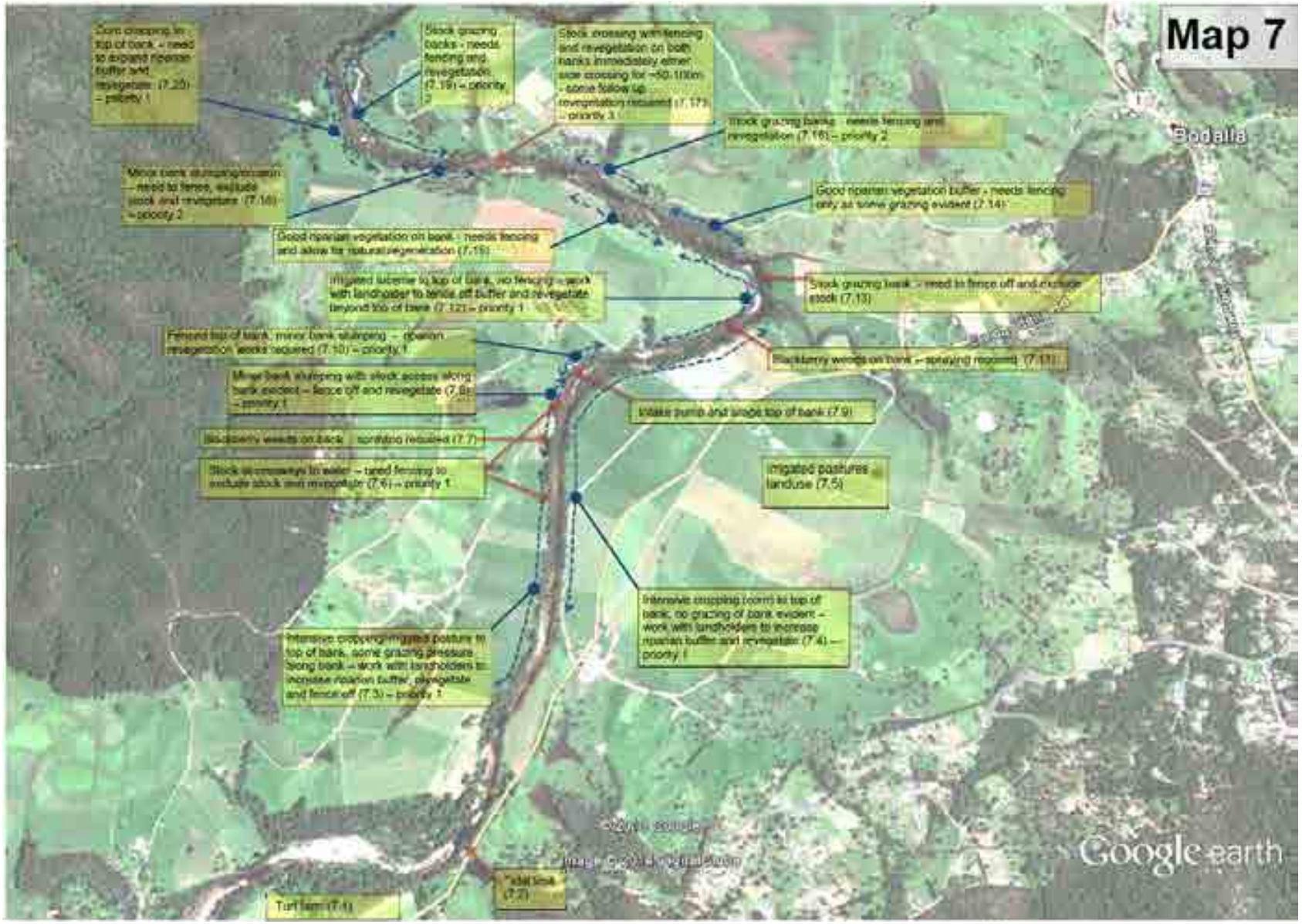


Figure 77: Fieldwork maps 1 to 7 – Tuross River Estuary Water Quality Improvement Plan

Source: Southeast Engineering and Environment (2016)

The 2016 Plan considered methods to progressively improve estuary health by reducing TSS, TN and TP loads entering the estuary and prioritised water quality management sites based on:

- Vegetation condition;
- Degree of exposure;
- Adjacent land use; and
- Stock impact.

The 2016 Plan identified bank erosion sites and priorities for rehabilitation based on the site attributes and scoring system listed in Table 30. Fourteen high priority bank erosion sites were identified in the plan with 40 medium and 17 lower priority sites. All high priority sites are eroding river banks with limited riparian vegetation.

Table 30: Site attributes used for prioritisation of bank erosion sites

Site Attribute				
Score	Vegetation Condition	Degree of Exposure	Adjacent Land Use	Stock Impact
1	Dominated by native trees etc., buffer at least 10m wide.	Low - banks stable	Largely undisturbed, stable native vegetation (i.e. national park)	Low - no evidence of stock impact
2	Thin band of vegetation along bank but no buffer behind	Moderate - minor undercutting and slumping	Cleared farm land with stock	Medium - few tracks but minimal impact (low erosion/banks stable)
3	Exposed banks, dominated by pasture grasses, scattered trees may be present but intermittent, no buffer	High - actively eroding, actual or potential for mass failure and sediment liberation	Intense agricultural cropping	High - numerous access tracks, evidence of erosion, no understorey

Source: Southeast Engineering and Environment (2016)

The prioritisation of the sites for rehabilitation identified in the 2016 Plan is shown on Figure 78.

Figure 78: Prioritisation of bank erosion sites

Source: Southeast Engineering and Environment (2016)

Table 31: Recommended stabilisation techniques and cost estimates for high priority sites

Site	Assumptions	Total cost estimate *	Contribution in kind**	Grant funding
4.2a	Revegetation and fencing along the full length.	$270,259	$ 139,720	$ 130,539
4.3	Revegetation and fencing along the full length.	$104,511	$ 54,183	$ 50,328
4.2b	Revegetation and fencing along the full length 100m of large woody debris as bank stabilisation	$322,374	$ 159,091	$ 163,284
4.2c	Revegetation and fencing along the full length. 20m of coir log bank stabilisation	$ 73,429	$ 37,865	$ 35,564
5.1	Revegetation and fencing along the full length.	$230,288	$ 119,279	$ 111,008
5.2a	Revegetation and fencing along the full length.	$341,192	$ 177,043	$ 164,149
5.2b	Revegetation and fencing along the full length	$311,737	$ 161,696	$ 150,041
5.9a	Revegetation and fencing along the full length.	$349,642	$ 181,498	$ 168,144
5.9b	Allowance of $15000 for drainage management 50m of fencing	$ 19,934	$ 917	$ 19,017
6.2, 6.3 and 6.4	Allowance of $5000 for assessment of landscape and flow paths. 120m of revegetation as a riparian buffer. 500m of fencing	$ 80,670	$ 34,588	$ 46,082
7.3	Allowance of $5000 for assessment of landscape and flow paths. 150m of revegetation as a riparian buffer. 500m of fencing	$ 96,025	$ 42,901	$ 53,124
Cambathin Island - Revegetation, Investigation and Monitoring	400m of revegetation. Site investigation & survey $4000 Photogrammetry comparison allowance $3000	$111,060	$ 55,797	$ 55,263
Cambathin Island - Toe Protection Works	Detailed Design 100m of rock toe protection works Barge establishment & disestablishment & hire Crane hire	$363,608	$ 15,809	$ 347,799

*Total costs include a project management and contingency component. All revegetation projects include maintenance costs over 5 years.

**Potential contributions in kind can include time, materials, plants, labour etc. Estimates are based on 40% of revegetation supply and install costs, 100% of revegetation maintenance costs, 100% of fencing maintenance costs, 40% of coir supply and installation costs and 50% of project management costs in kind.

Source: Southeast Engineering and Environment (2016)

The 2016 Plan discusses the status of the priority sites identified in the 2005 EMP as follows:

1. Brices Creek – moderate erosion is present due to stock activities and lack of riparian buffer. Erosion of the midden is not discussed. NPWS is also not aware of any issues with the midden site. Low to medium priority;
2. Tuross River downstream of highway bridge – some sections of minor to moderate erosion due to cattle impacts, lack of fencing. High priority – Council has since completed rehabilitation works along this section;
3. Snake Flat - Council has since completed rehabilitation works along this section;
4. Cambathin Island – refer below; and
5. Deuaumba Island – not addressed.

The Cambathin Island site (within Eurobodalla National Park) was not a high priority on the basis of the 2016 assessment methodology but was included as a high priority site due to the risk of breakthrough. Many previous studies have identified the eroding bank on the outside bend of Cambathin Island as vulnerable to breakthough which would significantly alter flow patterns in the mid-estuary (an avulsion). This is predicted to result in (Southeast Engineering and Environment, 2016):

- Loss of mangrove wetlands behind the island as tidal flows are diverted;
- Disturbance of fine, nutrient-rich sediments amongst the mangroves and in the back channel behind the island as areas of low flow became a major tidal flow path; and
- Current areas of high flow would become quiescent as flow is directed away from the main channel.

Erosion rates at this site were estimated to be up to 1.0m per year in the Estuary Processes Study (Brown and Root 2001) with breakthrough of the main channel predicted in 2016. Review of current aerial photographs suggest the bank width at the narrowest point of Cambathin Island appears to be similar although the risk of a major flood or progressive tidal flows and wind waves causing an avulsion are still considered to be significant. Floods experienced in June 2016 increased the bank slumping at this site (refer Section I2).

Erosion is recognised as a naturally occurring process in the Eurobodalla National Park Plan of Management. Under the plan, control measures will be undertaken where erosion has been accelerated by human activity or is threatening significant habitats or other values. As resources allow, existing areas of soil erosion will be progressively rehabilitated.

Various stabilisation techniques were considered in the Plan with the recommended technique for each high priority site and project cost estimates shown in Table 31.

In addition to these techniques, this CMP includes an action to address waterway barriers (Deuaumba Island causeway) to restore natural tidal flows in Trunketabella Creek and minimise the risk of erosion in this area.

I2. 2017 FIELDWORK

As part of the preparation of this CMP, sections of the lower Tuross Estuary were inspected with OEH and ESC staff in November 2017 to determine the current condition of the foreshore. This fieldwork noted that erosion along many sites including 4.2a, 4.2b and 3.7 from the 2016 Plan (Figure 78) had been exacerbated by the recent (June 2016) flooding. Active erosion was also observed to the north of site 3.7 (western foreshore of Cambathin Island). Rehabilitation measures implemented near Snake Flat (root balls and log structures) appeared to be effective although there was some erosion at the ends of the log structures. Figure 79 and Figure 80 show examples of existing rehabilitation measures and active erosion sites respectively (with reference to the site numbers on). Completed rehabilitation projects are discussed in Section 1.3 and 0.

a

b

c

Figure 79: Existing bank stabilisation (November 2017)

a – Snake Flat rootball stabilisation, b – Snake Flat log stabilisation with some end erosion, c – rock revetment at site 4.5.

a b c d

Figure 80: Bank condition observed November 2017

a/b – active erosion north of site 3.7 (Cambathin Island), c/d – active erosion along Tuross River main channel sites 4.2a, 4.2b, 4.4 and 4.5.

I3. DETERMINATION OF PROVISIONAL CMA 2 - COASTAL VULNERABILITY AREAS

The Scoping Study (ESC, 2016) identified several sites on the Tuross River where bank erosion is presenting a risk to water quality, estuary health, riparian vegetation, community access and potentially the productivity of adjoining agricultural land. Bank erosion occurs both naturally and as a consequence of anthropogenic activities including historical catchment clearing, boating and adjoining intensive land uses throughout the Tuross River Estuary and upper catchment. Given the scale of the estuary and the requirement in many instances to allow natural estuary processes to occur, it would be impractical to identify each erosion site as a potential CMA 2 – Coastal vulnerability area. This CMP has drawn on past studies, recent field assessments and water quality modelling and monitoring programs to identify provisional CMA 2 Coastal vulnerability areas which require a management response to mitigate the risks in accordance with the assessment and evaluation criteria set out in the draft *Coastal Management Manual 2015/16* (current on OEH website as of 17/05/2017).

As discussed in Section I1.2 above, the *Tuross Estuary Water Quality Improvement Plan* (2016) applied pollutant export modelling prepared by OEH and detailed ground-truthing undertaken by ESC and OEH to identify high risk sites that impact on water quality in the Tuross River Estuary. The pollutant modelling showed the areas of higher risk correspond with catchments where forestry, rural residential development, grazing and agricultural practices are occurring.

The detailed field investigations were undertaken to identify areas of the foreshore that were undergoing erosion or had other issues requiring management intervention. The attributes used to determine and categorise erosion sites into severity categories included:

- Height of the erosion scarp and soil type (including natural rock, sand, mud);
- Presence of extant native vegetation, condition and width of buffers;
- Degree of exposure to mechanisms of erosion such as wind, waves, boat wash and access points for vehicles;
- Height of bank;
- Active erosion site versus recovering site;
- Depositional environment versus high energy environment;
- Presence of mitigation works such as revegetation, log works and rock revetments;
- Adjacent land use;
- Determination of natural process or induced process; and
- Presence of fencing and stock access.

The highest risk sites are identified as provisional CMA 2 – Coastal vulnerability areas (Figure 81). The dynamics of erosion and river processes mean that new erosion sites can develop and the severity of other erosion sites can change over time, which place limitations on the assessment and the mapping of provisional CMA 2 sites that needs to be acknowledged.

Figure 82 shows the process used to determine the provisional CMA 2 areas based on Figure B2.3 of the Manual which outlines the assessment and evaluation process.

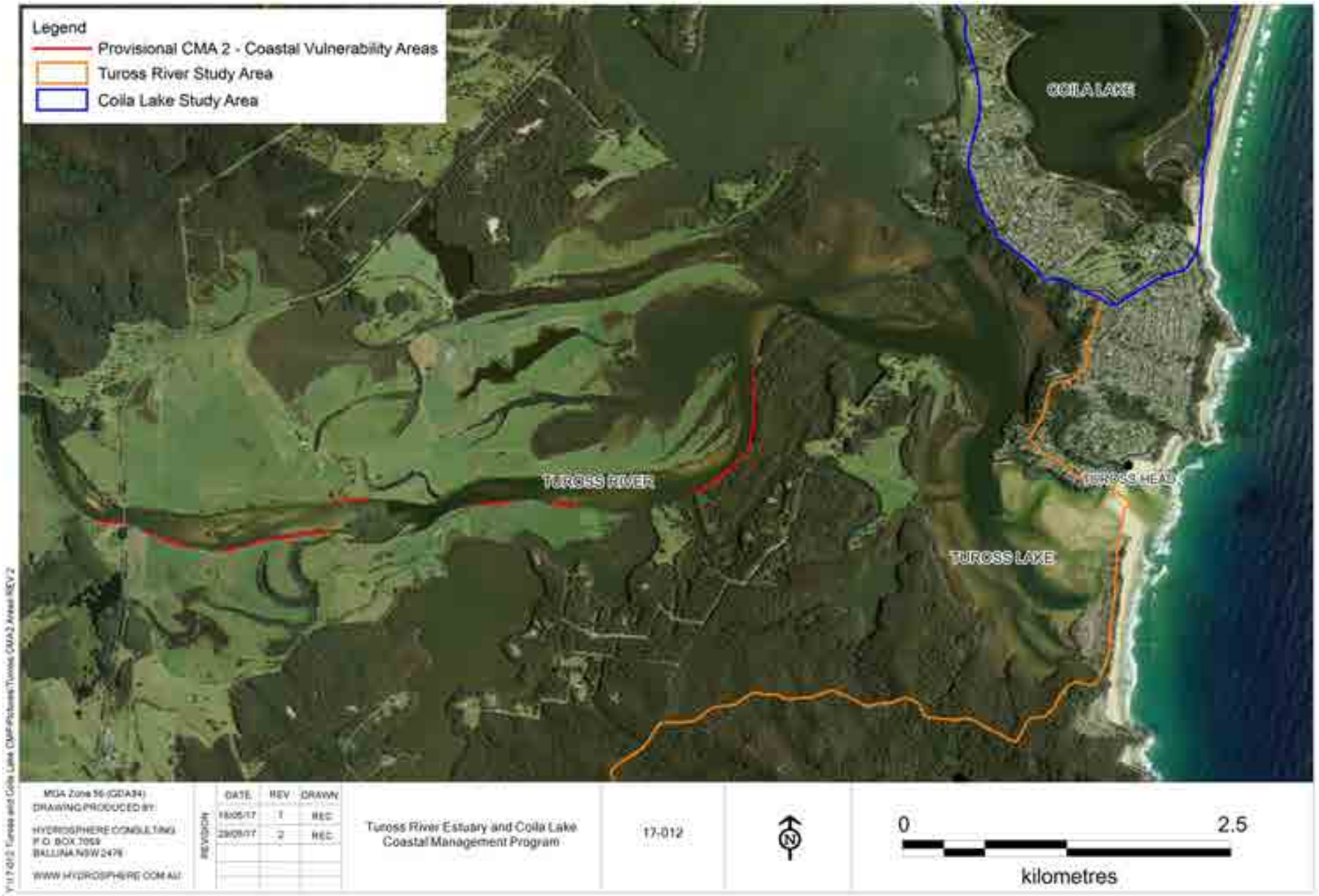


Figure 81: Provisional CMA 2 – Coastal vulnerability areas

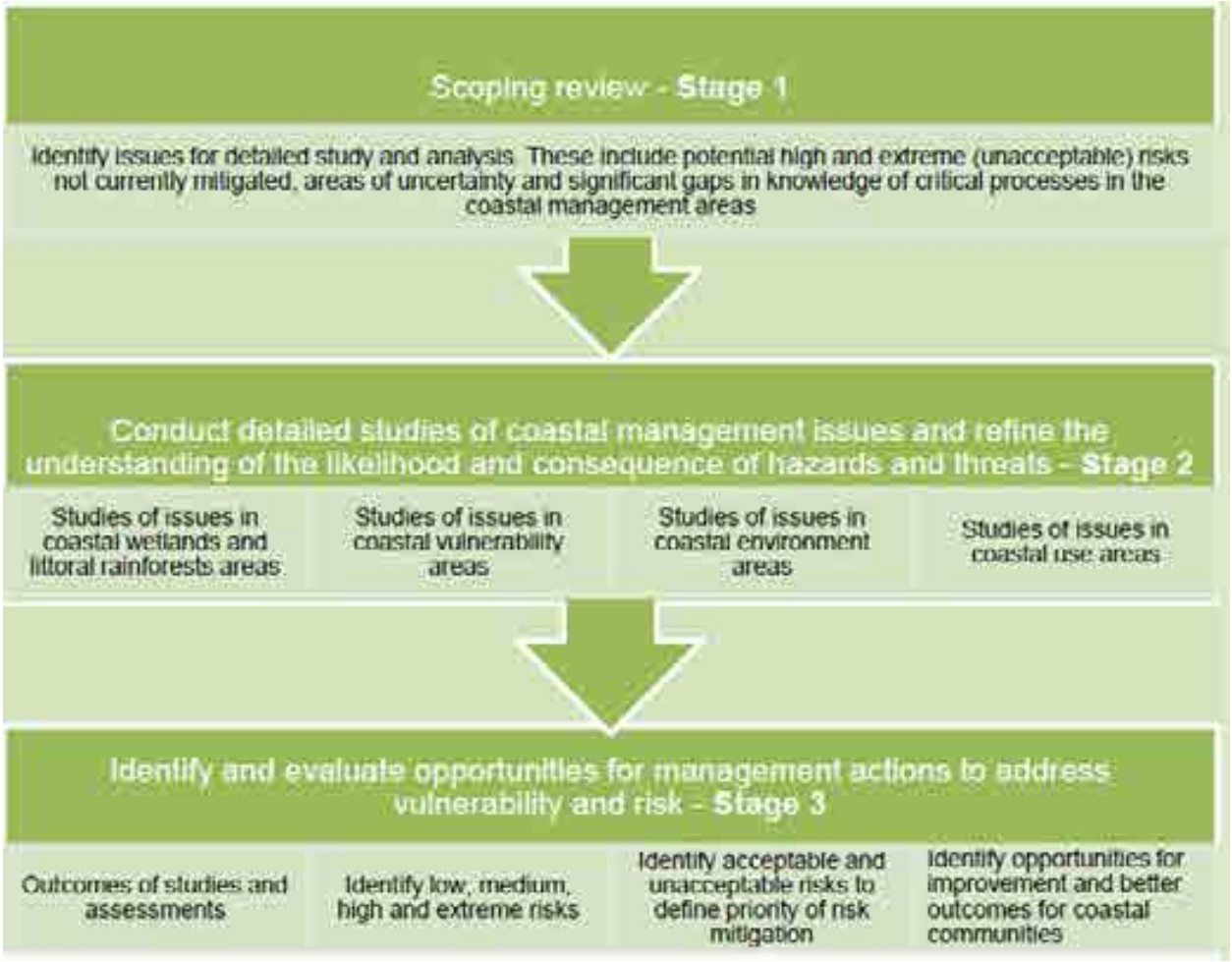


Figure 82: Detailed studies undertaken to identify provisional CMA 2 – Coastal vulnerability areas

Stage 1: The *Tuross Estuary Water Quality Improvement Plan* (2016) and past estuary processes studies identity the issues for detailed study and analysis. In addition, detailed field mapping and ground-truthing by ESC and OEH validated the recent pollutant export modelling along with identifying, photographing and describing high risk sites. The ground-truthing also categorised the sites as acceptable or unacceptable risk in accordance with the draft Manual.

Stage 2: A risk assessment was conducted as part of the *Tuross Estuary Water Quality Improvement Plan* (2016)

Stage 3: A review of past studies and outstanding actions not implemented from the 2005 Estuary Management Plan is presented in this CMP. Bank erosion sites have been identified, mapped and categorised in the field. Field observations were assessed against the pollutant export modelling and recommendations from previous studies. Sites have been assessed as high, medium or low risk. The tolerance of risk was assessed against the acceptable/ unacceptable criteria. The sites were assigned potential mitigation options according to the field observations and water quality modelling results. Preliminary costs for each opportunity were presented in the *Tuross Estuary Water Quality Improvement Plan* (2016) and the Business Plan for this CMP.

I4. CURRENT INITIATIVES

South East LLS (in partnership with OEH, ESC, the Tuross Fishing Club and landholders) applied for funding under the Flagship Fish Habitat Rehabilitation Program (Recreational Fishing Trust) administered by DPI. The project would involve implementation of the stabilisation techniques recommended by the 2016 Plan for some of the priority rehabilitation sites within Tuross Estuary with the aim of improving water quality, estuary health and fish habitat such as seagrasses within in the Tuross River Estuary. If funding is approved, this project would result in:

- 13 km of priority stream bank stabilised through fencing off of stock access;
- 20ha of riparian vegetation restored through revegetation;
- 10ha wetland floodplain protected and enhanced;
- 10 off-steam water points;
- 1,043,000m^2 seagrass beds enhanced and protected from instream pollutants including sediment and nutrients;
- 1km of stream bank protected from erosion with instream fish friendly structures e.g. groynes, woody debris and baffles;
- 500m road sealed from sediment;
- 2ha of EEC saltmarsh and mangrove fish habitat protected from the impact of stock;
- 10 property owners educated on and involved in restoration works; and
- Recreational fishing groups engaged with state and local government departments working towards best practice to increase river health.

The three year project has an estimated cost of $725,000 including $315,000 funded through the Flagship Grant, $120,000 funded through the OEH Estuary/Coastal Management Program, $110,000 contributed by South East LLS, $120,000 funded by ESC and $60,000 in-kind contributions from land-holders.

South East LLS is currently assisting a landholder to install fencing and establish riparian vegetation along approximately 2 km of Coila Creek and an artificial drain. This was a recommended action in the 2005 EMP.

APPENDIX J. CLIMATE CHANGE INFORMATION

J1. 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.

J2. SEA LEVEL RISE PROJECTIONS

Average sea levels are projected to continue to rise throughout the 21st 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 adopted locally relevant projections as appropriate.

ESC and Shoalhaven City Council undertook 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 assessment is documented in the *South Coast Regional Sea Level Rise Policy and Planning Framework* (Whitehead & Associates, 2014). This framework has been used as the basis for planning for sea level rise in the region.

In November 2014, ESC adopted 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); and
- Levels assessed as having a 15% chance of being exceeded.

ESC will apply the adopted sea level rise projections and planning framework for the preparation and review of flood studies and coastal hazard studies for current and future planning conditions. ESC will also apply the adopted sea level rise projections to the planning response framework for the purpose of applying development and planning controls, consistent with the planning periods contained in the framework.

The locally adjusted projections of sea-level rise using the RCP6.0 are shown in Table 32.

Table 32: Locally adjusted projections of sea-level rise for Eurobodalla Shire

Year	RCP6.0 (m)		
	Low	Middle	High
2015	0.00	0.00	0.00
2020	0.02	0.02	0.03
2030	0.05	0.07	0.10
2040	0.08	0.12	0.15

Year	RCP6.0 (m)		
	Low	Middle	High
2050	0.13	0.17	0.23
2060	0.16	0.22	0.30
2070	0.21	0.29	0.39
2080	0.25	0.36	0.50
2090	0.31	0.44	0.61
2100	0.36	0.53	0.72

Source: Whitehead and Associates (2014)

The adopted RCP6.0 (High) projection from this framework is appropriate for long-term estuary management planning. The relevant high sea level rise projection is 0.72 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).

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 estuaries may also be affected by sea level rise. The foreshores may 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).

This CMP addresses the implications of sea level rise for estuarine ecosystem health (Section G6.4, Appendix G) and public access and amenity (Appendix L - Community Uses). Coastal hazards will be addressed separately in Council's Shire-wide Coastline CMP.

APPENDIX K. ENTRANCE MANAGEMENT

K1. TUROSS LAKE ENTRANCE

K1.1 Coastal Processes

The Tuross River Estuary is a barrier system separated from the ocean by a large coastal sand barrier (dune). The dominant coastal processes push sand northwards along South Tuross Beach and into the Tuross Estuary entrance. The condition of the Tuross entrance is dependent on the relative balance between the longshore sand transport moving along the beach and the entrance scouring potential of freshwater discharges from large flood events. In dry times, the entrance will tend towards closure, while during wet weather, the entrance can be quite large (WBM, 2004).

Most of the environmental processes within the estuary are related in some way to the condition of the entrance. The degree of entrance constriction affects the tidal range, lag, current speed and hence tidal flushing within the estuary. With limited tidal flushing, especially when the entrance is restricted Borang Lake, Trunketabella Lagoon and Bumbo Lake are considered the most sensitive water bodies to potential water quality issues. Catchment development and changes in land use have increased the rate of erosion of the catchment, and thus the infilling rate of the estuary and tributaries and erosion of banks due to the removal of riparian vegetation is also contributing to infilling. Sand build-up at the entrance is a result of coastal processes (BMT WBM, 2010) and the amount of rainfall and runoff that scours sand from the entrance.

Historically, the Tuross Lakes entrance has generally remained open, only closing during the drought of 2006 and at the end of 2009. From a review of aerial photographs taken between 1944 and 2002, GHD (2003a) noted that three distinct half-spiral channels have formed as the river delta upstream of the mouth gradually migrated northwards with the northern channel formed from about 1993. Although the southern channels are clearly defined, these are usually closed at the mouth. An aerial photograph from 1971 (refer Table 33) shows the central channel open as a result of a flood event. The central channel is defined during flood events and direct connection to the sea is established although the mouth closes quickly, preventing the ingress of marine sand transported by the dominant coastal processes. Vegetation started to establish on the dune north of the southern headland from 1993 and was well established in 2002, reducing the likelihood of the river mouth moving southward and facilitating the northerly shift of the channel. The northern channel appears to have remained open over time although the size of the channel and position of the mouth are variable (GHD, 2003a). After 1999, the northern part of the channel narrowed and between 2005 and 2007, migrated northwards again.

At the time of writing the 2005 EMP, the Tuross entrance was heavily shoaled with a very small tidal range (WBM, 2005). These conditions persisted until early 2010. Reduced rainfall lead to shoaling of the entrance and complete closure of the estuary mouth occurred in 2006 for the first time in about 70 years. The entrance has since been artificially opened. The entrance is currently approximately 120 m wide (refer Figure 84).

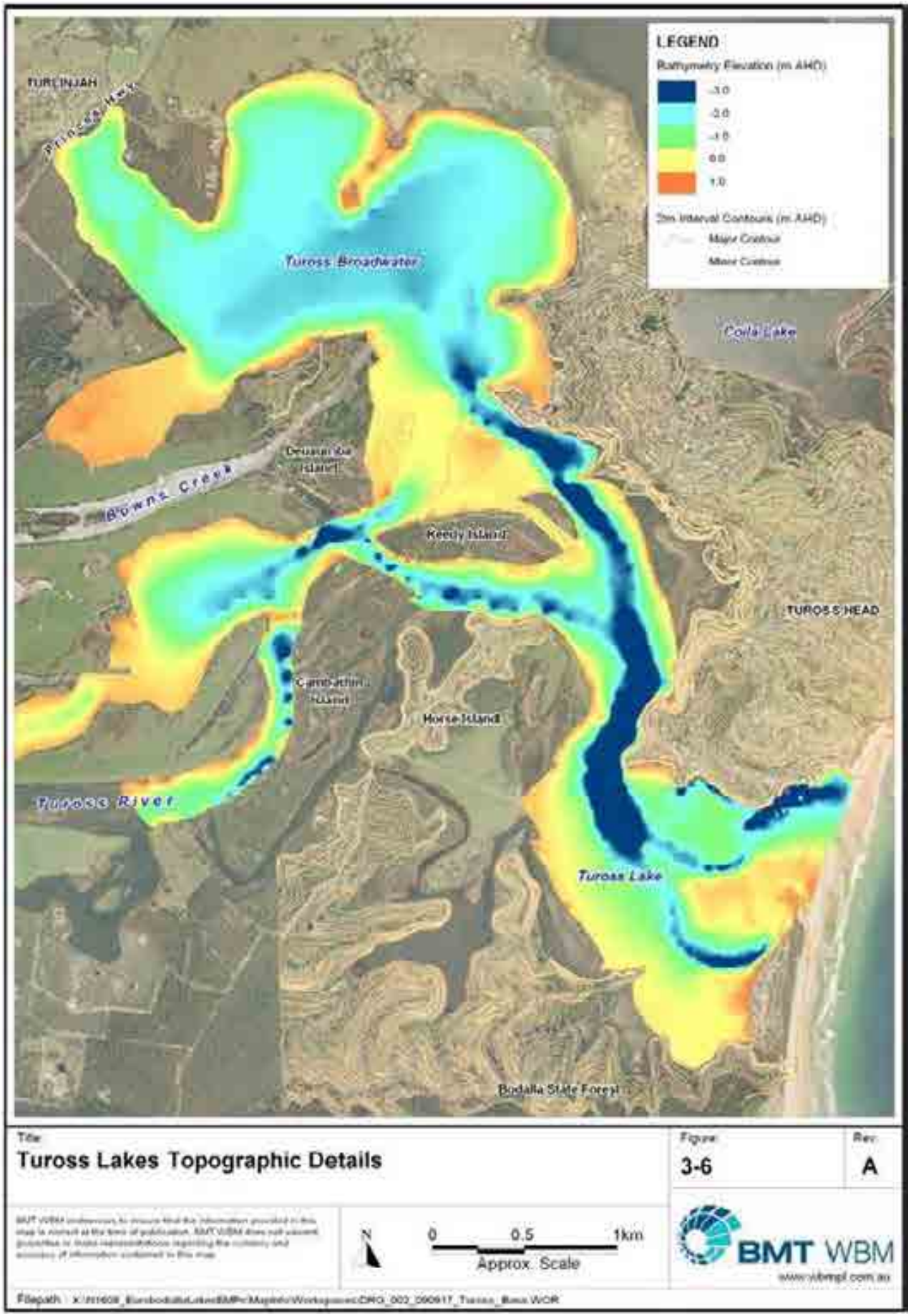


Figure 83: Tuross River lower estuary topographic details

Source: BMT WBM (2010)

Table 33: Historical aerial photography – Tuross River entrance

1971: Both northern and central channels open. Limited dune vegetation. Source: Crown Lands, 1971	

February 1999: Northern channel open with 3 distinct spiral channels. Vegetation extending to ocean. Source: OEH, 1999	
August 2002: northern channel closed and central channel open (entrance migrated to south). Source: Land and Property Information, 2002	

March 2007: Open narrow northern channel with central channel open at same point. Source: Coastal Surveillance, 2007	
Jan 2016: Most recent aerial photo showing open northern channel and closed southern channels. Dense dune vegetation Source: Google Earth, 2017	

Figure 84: Tuross estuary entrance November 2016

In 2003, after a long period of low rainfall, ESC investigated options for maintenance dredging of the Tuross entrance. The primary driver was the reduction in tidal range and threat to the viability of oyster farming (GHD, 2003b). Tidal range data since 1994 is provided in Figure 85. The tidal range gradually decreased to 0.02m in January 2010 then increased to 1.01m in February 2010 with 290mm of rainfall recorded at Tuross in the catchment, creating a larger entrance. Similar results are observed for flood events in March 2011, December 2014 and June/July 2016.

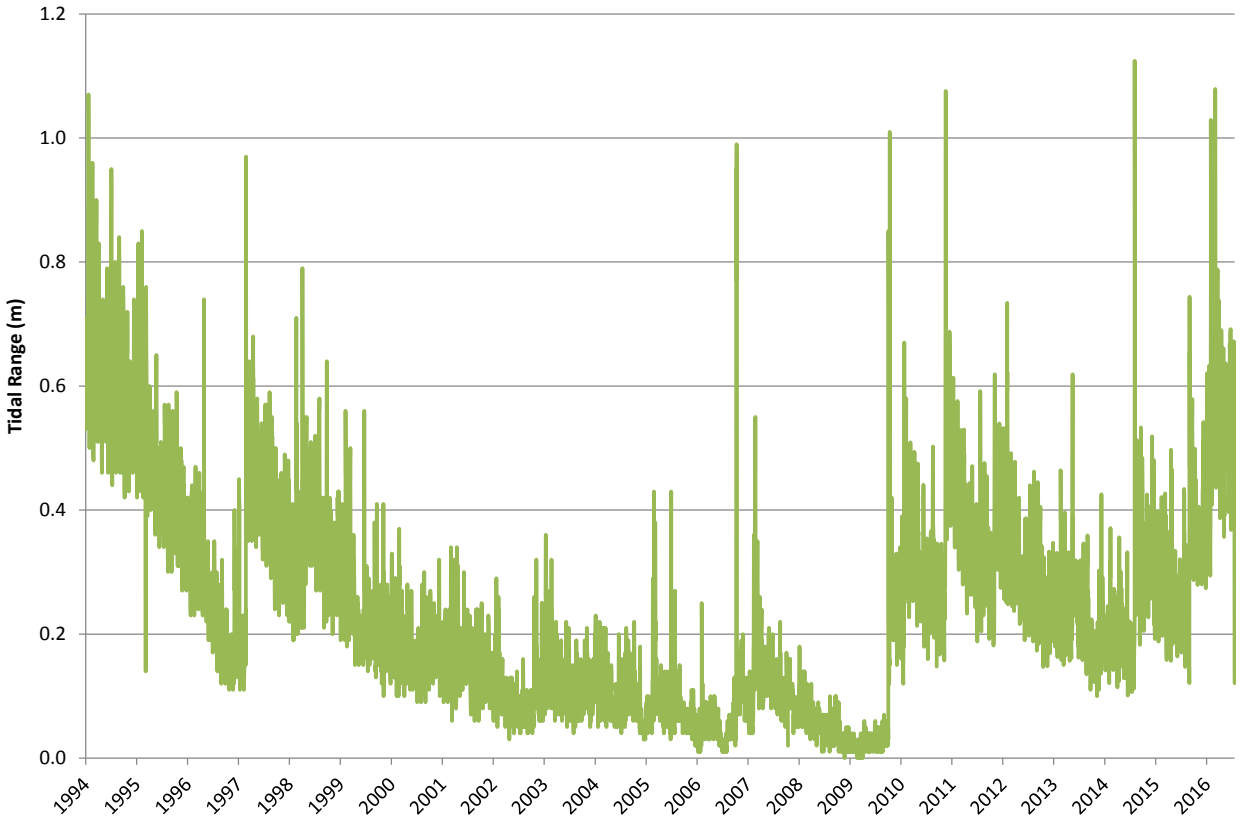


Figure 85: Tidal range – Tuross Head

Source: Station number 218410. Data provided by MHL and OEH.

K1.2 Low-lying Infrastructure

The low lying areas surrounding the lake experience inundation during elevated lake water levels. Private non-rural property around Coila Lake does not become inundated until water levels reach 2.6 m AHD (BMT WBM, 2010).

Table 34: Assets at risk of inundation around Tuross River

Lake level (mAHD)	Asset at risk of inundation
0.7	O'Briens boatshed - decking
0.83	Laing's boatshed - decking
1.11	Sewage pump station (no including electrics)
1.2	O'Briens boatshed - shop
1.37	Redbox Pizza (now closed) – decking
1.6	Laings boatshed - shop
2.0	Hector McWilliams Drive at The Narrows
1.1 – 2.0	Public road beside boat ramp
>2.0	Princes Highway at Trunketabella Creek
>2.0	Lakeside Caravan Park (movable cabins)
2.4	Redbox Pizza (now closed) - residence

Source: adapted from BMT WBM (2010)

K2. COILA LAKE ENTRANCE

K2.1 Coastal Processes

Coila Lake is an intermittently open coastal lagoon which has formed behind a large coastal sand barrier. Longshore sand transport processes tend to dominate the entrance dynamics resulting in a closed entrance condition for the majority of the time. Between March 1975 and November 1999 the Lake's entrance opened 17 times, of which 13 times were induced by human activities. Reasons for artificially opening the entrance are reported to be alleviating flooding of low lying assets to improving water quality, or facilitating prawn and fish recruitment to the lake (WBM, 2004).

Once opened, the lake will remain connected to the sea for a relatively short period. The length of time that it remains open is dependent on the water level of the lake prior to breakout (and hence the degree of scour at the entrance) and the occurrence of coastal storms (WBM, 2004). The large lake area enables the lake to accommodate long periods of rainfall without opening and to survive long periods of evaporation. The large lake relative to catchment size results in fluvial inflows that are insufficient to overcome the processes of tide and ocean, restricting the lake to being intermittently open. Coila Lake, with its relatively small catchment to waterway size, has low flow rates under average rainfall conditions, which enable entrance berm building to occur quickly following a breakout event (BMT WBM, 2010).

Coila Lake exhibits a very small (almost non-existent) flood tide delta, which is likely due to the lake being rarely open for long enough to initiate any substantial flood tide flows capable of transporting marine sands into the lake to form the delta (BMT WBM, 2010).

Significant rainfall was experienced in June 2016 and ESC implemented the entrance management policy to artificially open Coila Lake (8 June 2016) to reduce the risk of flooding.

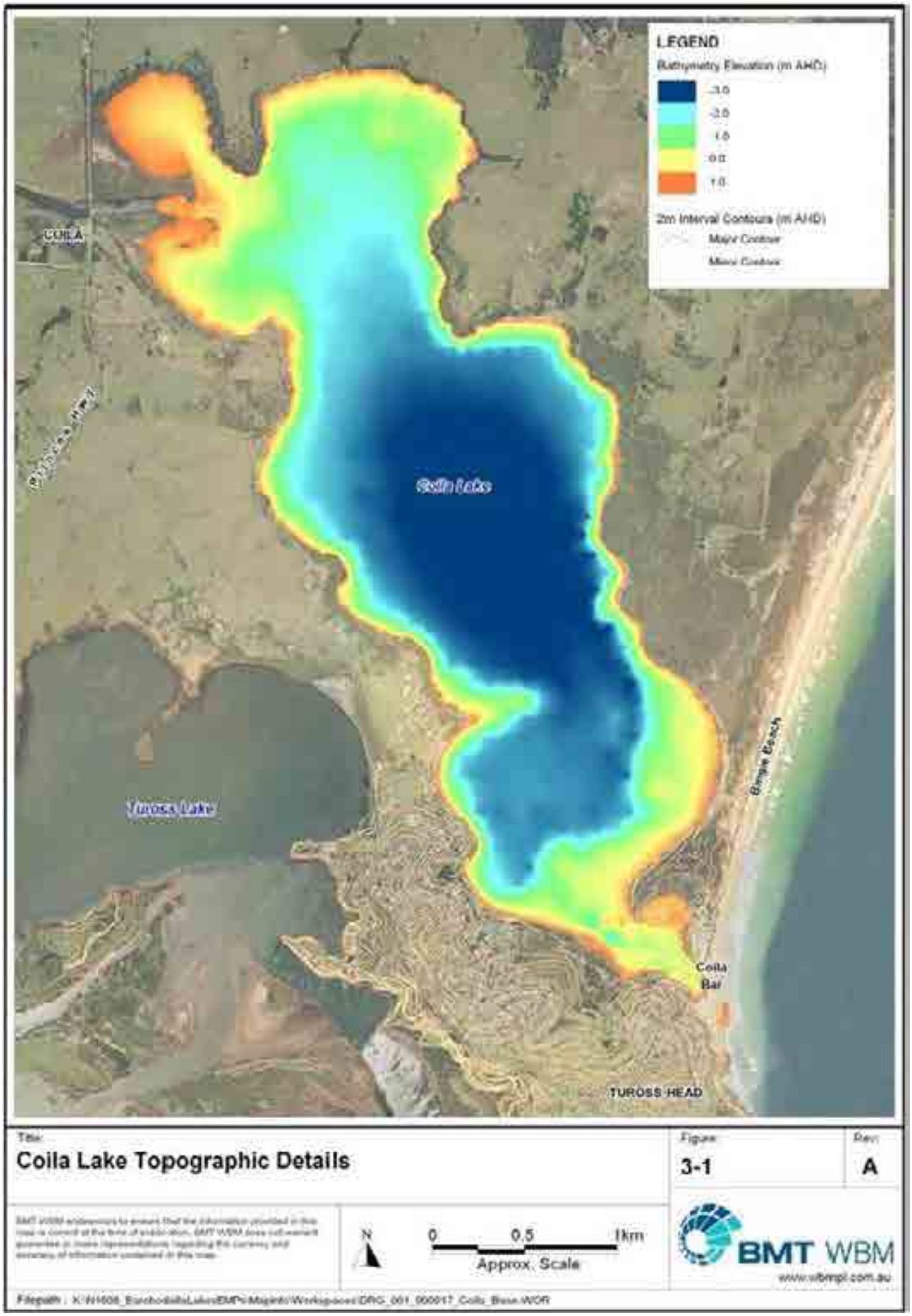


Figure 86: Coila Lake topographic details

Source: BMT WBM (2010)

K2.2 Low-lying Infrastructure

The low lying areas surrounding the lake experience inundation during elevated lake water levels. Private non-rural property around Coila Lake does not become inundated until water levels reach 2.6 m AHD (BMT WBM, 2010).

Table 35: Assets at risk of inundation around Coila Lake

Lake level (mAHD)	Asset at risk of inundation
1.5	Pasture on western side of highway (via artificial drain)
1.8	Gross pollutant trap (Monash Avenue)
2.0	Rural access road west of highway
2.0	Urban stormwater (Monash Avenue/Marion Close)
2.0	Temporary pathway eastern end of lake (to be decommissioned following completion of the cycleway)
2.6	Urban backyards
2.8	Coila Lake cycleway
2.8	Limited access to urban blocks
3.03	Coila Service Station
3.5	Princes Highway

Source: adapted from BMT WBM (2010)

K2.3 Opening of Coila Lake

Historic records of lake openings indicate that the lake may not open natural until it reaches approximately 2.3m AHD. However, this level depends on the beach berm level which varies naturally from approximately 2.0 to 3.5 m AHD. Historically, artificial openings have been undertaken between 1.5 and 2.2 m AHD (Brown and Root, 2001).

K3. CURRENT ENTRANCE MANAGEMENT POLICIES

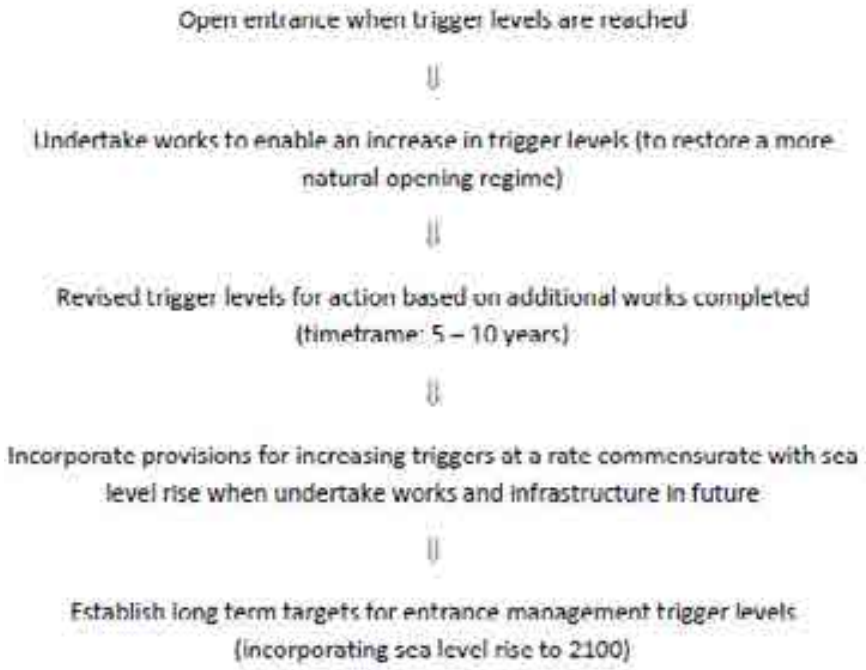
The Tuross Lakes and Coila Lakes Entrance Management Policies (available from Council's website http://www.esc.nsw.gov.au/living-in/about/our-natural-environment/estuaries-of-eurobodalla/lakes-ref-and-entrance-management-policies) were developed in 2010 to provide a framework to allow Council to proactively manage opening of the lake systems.

The policies aim to:

- Facilitate the vertical natural migration of riparian and estuarine ecological communities in response to sea level rise;
- Limit opportunities for ingress of introduced and invasive species to the estuary;
- Minimise impacts on local fisheries resources and other ecological species, where possible; and
- Enable continued existing use of fringing riparian lands for as long as practical.

The policies refer to the former *Sea Level Rise Policy Statement* previously adopted by the NSW Government which is now replaced by the ESC policy (refer Appendix A). The entrance management policies should be updated with the new climate change benchmarks (Appendix J).

The general principles and philosophy of the entrance management policies are:



The following conditions are required to initiate an opening of the Tuross Lake entrance channel:

- Water level > RL 2.0m AHD; or
- Water level > RL 0.80m AHD for 14 days, or
- Higher or lower time period triggers may be negotiated with directly affected business owners, during NSW and ACT school holiday periods and Easter holidays

Diligent monitoring of water levels will occur once water levels exceed 0.7m AHD and the entrance is closed.

The following conditions are required to initiate an opening of the Coila Lake entrance channel:

- Water levels > RL 2.0m AHD; or
- Water levels > RL 1.80m AHD for more than 3 months.

The location of the entrance opening works is shown in Figure 87.

The Policies also requires the breakout levels to be progressively increased in the future to facilitate adaptation to future climate change (especially sea level rise), and to reduce the on-going need for artificial entrance intervention. Revised breakout levels and the works necessary to achieve these levels are documented in the policies.

Figure 87: Location of Tuross and Coila Lakes entrance opening works

Management of the Tuross and Coila Lake entrances is a key concern for the community. Issues raised during consultation for this CMP are addressed in this CMP as follows:

- Flooding of private property (Coila Creek and eastern side of the Princes Highway) since the trigger point for opening of Coila Lake was raised:
    - A property on Coila Creek has been revegetated and while some salt tolerant species have colonised the area, many species have died off. It is recommended that future regeneration activities have regard to potential inundation and include salt tolerant species.
    - For private land that is impacted by the entrance management policy (more frequently inundated due to the raising of the trigger), Council should consider amending the development control policy to allow filling of non-sensitive land. The area in question is adjacent to CMA 1 - coastal wetlands and this should be considered in any proposal for raising of ground levels.
- The time taken to open Coila Lake once the trigger is reached:
    - Access to the Coila bar is steep and structural stability of the sandbar needs to be considered with heavy machinery utilised for dredging. However, agency consultation requirements can be initiated prior to the trigger level being reached to minimise the time taken. Implementation of the policy must be cognisant of lead times and safety issues.
- The potential impact of the barrage on the Tuross estuary entrance:
    - From time to time a temporary sand barrage is built across the river at the tidal limit when local farmers recognise that flows are low and salinity levels reach a point that can be harmful to stock and damage dairying equipment. The barrage is of a temporary nature and washes away with the natural flow of the river therefore is unlikely to affect entrance conditions.

- The impact of the proposed new southern water supply storage on the condition of Tuross estuary entrance, the oyster industry and ecology of the lower estuary:
    - The proposed storage is an off-stream dam accessing high flows in the Tuross River and is unlikely to impact on river conditions during low river flows. The storage will reduce reliance on low river flows (refer ESC IWCM Strategy in Section B5, Appendix B).
- DPI has indicated that Council should be working towards a natural opening regime through planning controls and progressive relocation of infrastructure to allow increasing trigger limits:
    - The policies identify works to be undertaken and proposed time frames to allow revised trigger levels. These include (within the life of this CMP):
        - Establish an alternative temporary access to property north of Coila Creek during times of high lake water level and adjust local stormwater system as necessary (e.g. backwater flaps) by 2020;
        - Provide incentives to rural landowners around Coila Lake to accommodate higher lake water levels (between 2020 and 2040);
        - Convert timber decks of commercial premises around Tuross River to floating pontoon type by 2020;
        - Return of low-lying private property (< RL 2.0m AHD) around Tuross River to public ownership upon opportunistic future sub-division (pending LEP lot sizes and zoning) (between 2020 and 2040);
        - Progressive and opportunistic raising or removal of assets around Tuross River lake fringes (e.g. Sewage Pumping Station) (between 2020 and 2040); and
        - Longer-term actions are also identified (between 2020 and 2060).
    - This CMP considers potential impacts on waterway infrastructure as a result of sea level rise. Coastal hazards relating to private infrastructure will be addressed in Council's shire-wide coastline CMP. The entrance management policies will be reviewed to incorporate the adopted sea level rise benchmarks and any implications for entrance opening triggers.

APPENDIX L. COMMUNITY USES

ESC recognises the importance of community uses of the coastal zone. In this CMP, public access refers to the ability of the general public to gain appropriate access to public lands surrounding the estuaries as well as the waterways.

This appendix provides information on the community uses in the Tuross River Estuary and Coila Lakes Estuary:

- *The current access arrangements, their adequacy and any associated environmental impacts;*
- *Recreational uses of the waterways; and*
- *Commercial uses of the waterways.*

L1. AMENITY

Scenic amenity is valued highly by the local community and visitors. The Tuross River Estuary and Coila Lakes Estuaries are beautiful places 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 the estuaries 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 fishing and boating trends follow this pattern with fishing influenced by the prawn season.

L2. ACCESS

L2.1 Riverfront Land Tenure

Riverfront land tenure for both the Tuross River Estuary and Coila Lake are shown on Figure 88. The banks of Coila Creek and Lake consist of:

- Private land for the majority of the east and north banks of Coila Lake;
- Private land for the majority of Coila Creek;
- Crown reserve along the southeast corner (including the entrance) of Coila Lake, and
- Council land along the south west banks of the lake.

The banks of Tuross River and Lake consist of:

- Council land around Tuross Head and urban areas along the northeast banks of the estuary;
- National Park along the south banks of the lake and a number of the larger islands within the estuary;
- Private land along the majority of the river and associated creeks and bays;
- Crown reserve patches along the river and near urban areas, and
- Private land patches along the river.

Private land comprises a substantial amount of riverfront land tenure for both estuaries which is due to the large areas of agricultural land that boarder the waterbodies. The urban areas that boarder both these estuaries are predominately classified as Council land. Foreshore access to the waterway has not been raised as a management issue.

L2.2 Navigation

RMS representatives frequently patrol, monitor and assess the navigation channel and location of markers in the Tuross River and Coila Lake 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 89 and Figure 90).

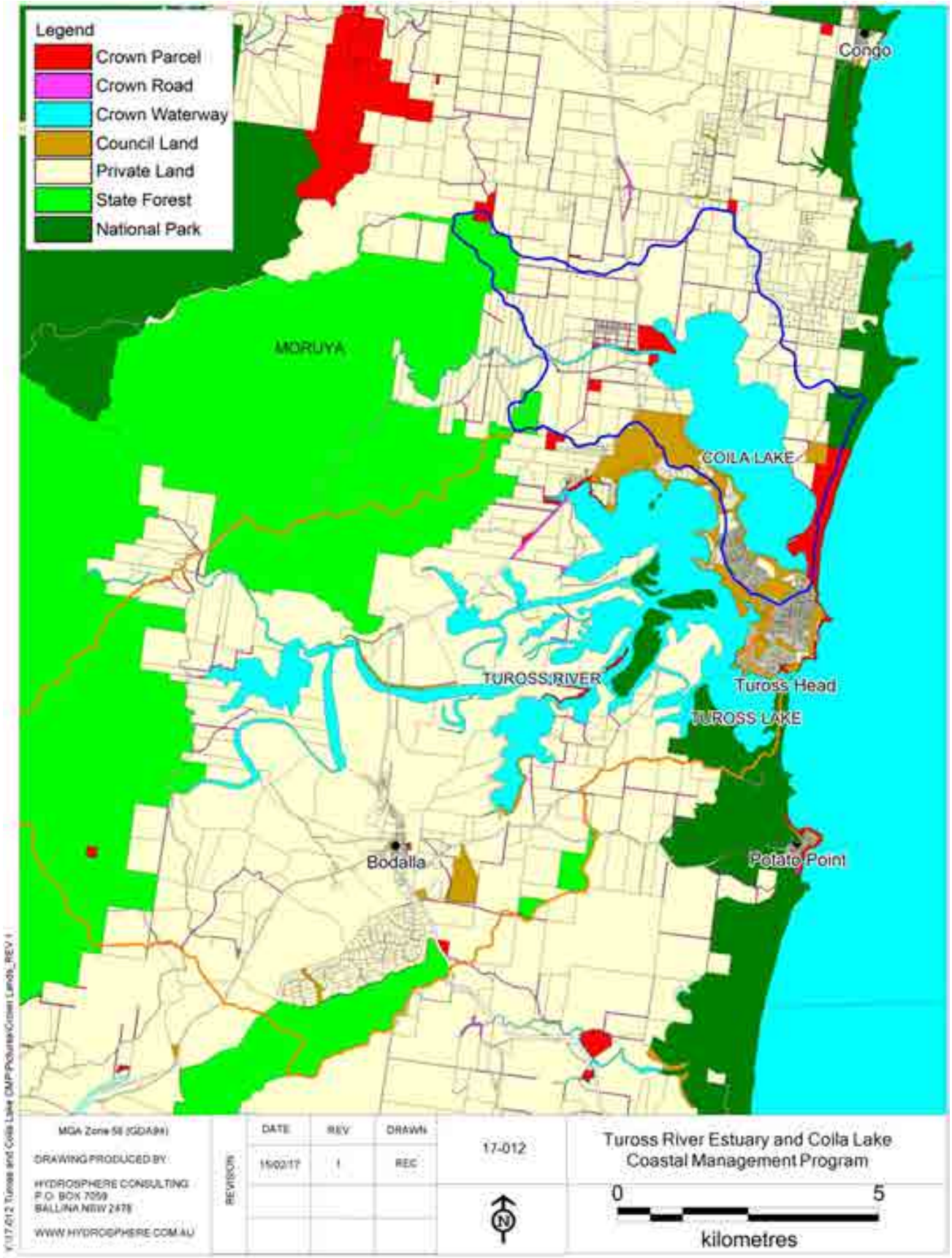


Figure 88: Riverfront land tenure

Figure 89: Boating map for Coila Lake

Source: NSW Transport – Maritime (2013)

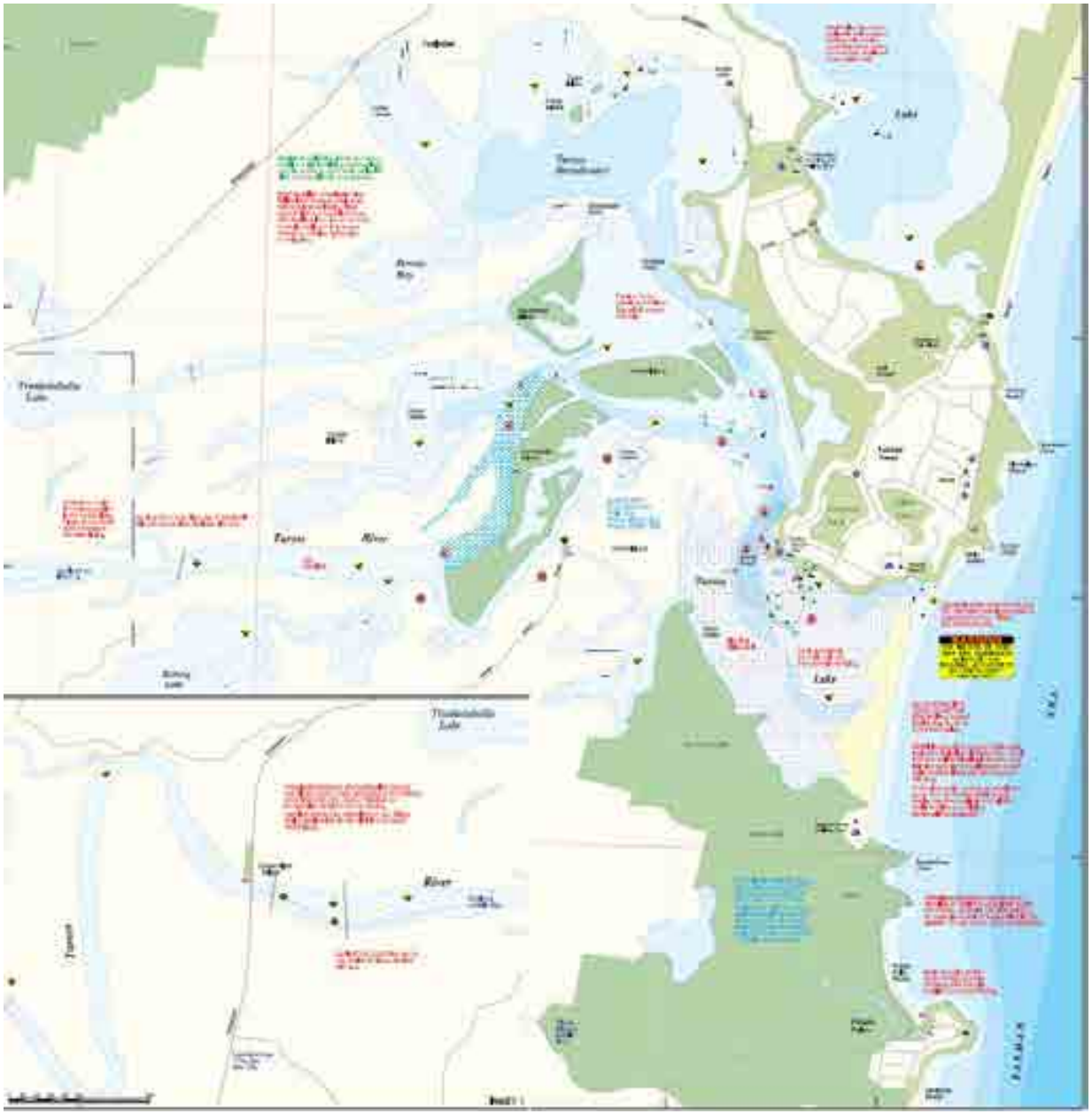


Figure 90: Boating map for Tuross River Estuary

Source: NSW Transport – Maritime (2013)

L2.3 Foreshore Structures and Boating Access

Boat ramps are located at Lavender Bay, Tuross River (concrete), Tuross River Bridge (concrete), Kyla Park, Coila Lake (gravel) and Foam Street, Coila Lake (gravel). The ocean ramp at One Tree Point, Tuross Head has been closed. Commercial jetties exist on the Tuross River for the hire boat businesses and a public jetty is located at Lavender Bay boat ramp.

a

b

c

Figure 91: a – Tuross River boat ramp, Lavender Bay; b – Kyla Park, Coila Lake boat ramp; c – Tuross River bridge boat ramp

The main Tuross River public boat ramp is located within the estuary entrance at the end of a small rocky headland extending from Nelson Parade and is within the Tuross Head township. Due to its proximity to the estuary entrance this boat ramp is subject to movement of the entrance sand shoals, which have been progressively enveloping the ramp access. This has resulted in poor useability of the ramp at low tides. Council has maintained launching depths at the main public ramp on several occasions by excavating an access channel to deeper water during periods of low tidal exchange. In more recent times an improved entrance condition and tidal exchange has increased the rate of growth of the entrance shoals currently impacting the boat ramp (Royal Haskoning DHV, 2013).

ESC received funding through the Better Boating Program (administered by Roads and Maritime Services) to undertake a study to determine a preferred boat ramp option for Tuross River access in the longer term. The study (Royal Haskoning DHV, 2013) focussed on the consideration of four options for improving boat ramp access into Tuross Lake:

- Option A – upgrading the existing boat ramp off Nelson Parade;
- Option B – an alternative boat ramp site on community land adjacent to Hector McWilliam Drive and near Lake Street (Alternative 1 Site);
- Option C – an alternative boat ramp site within Lavender Bay on the southern side of Sandy Point (Alternative 2 Site); and
- Option D – channel maintenance at the existing boat ramp.

Figure 92: Tuross boat ramp options

Source: Royal Haskoning DHV (2013)

The study found that Option B: Alternative Site 1 would be the most beneficial option to pursue as a long term solution to the current problems with water depth and parking capacity at the existing boat ramp. A boat ramp sited on the foreshore of Tuross Lake at this location would provide a reliable water depth for launching whilst also having sufficient areas for car/trailer parking to cater for current demand and as a regional facility

to accommodate future growth in boat ramp usage. Measures to reduce amenity impacts of the Alternative 1 proposal on nearby residents were recommended as part of further design development (Royal Haskoning DHV, 2013).

The cost of the new boat ramp and facilities was estimated as $2.05M in 2013 including design, approvals and construction and contingency. Potential staging was identified as (Figure 93):

- Stage 1: Construction of boat ramp, on ramp pontoon and road access from Kyla Park Close (informal parking in open space area);
- Stage 2: Construction of amenities block, fish cleaning table area, lighting at the ramp and connection of services (power, water, sewer); and
- Stage 3: Formalisation of car/trailer parking areas in one or two stages subject to usage at the new ramp. In this regard it is noted that car parking spaces only require sealing once typical guideline usage is achieved (i.e. 30 to 40 launchings per lane per day, based on normal weekend usage).

As part of its asset management planning process, ESC will develop priorities for waterway infrastructure and investigate potential sources of funding including the NSW Boating Now Program ($10 million has been set aside to fund other regional boating projects in the last two years of the program in 2018 and 2019 with applications in 2017). Relocation of the boat ramp would provide long-term savings to ESC in reduce maintenance costs for the existing boat ramp.

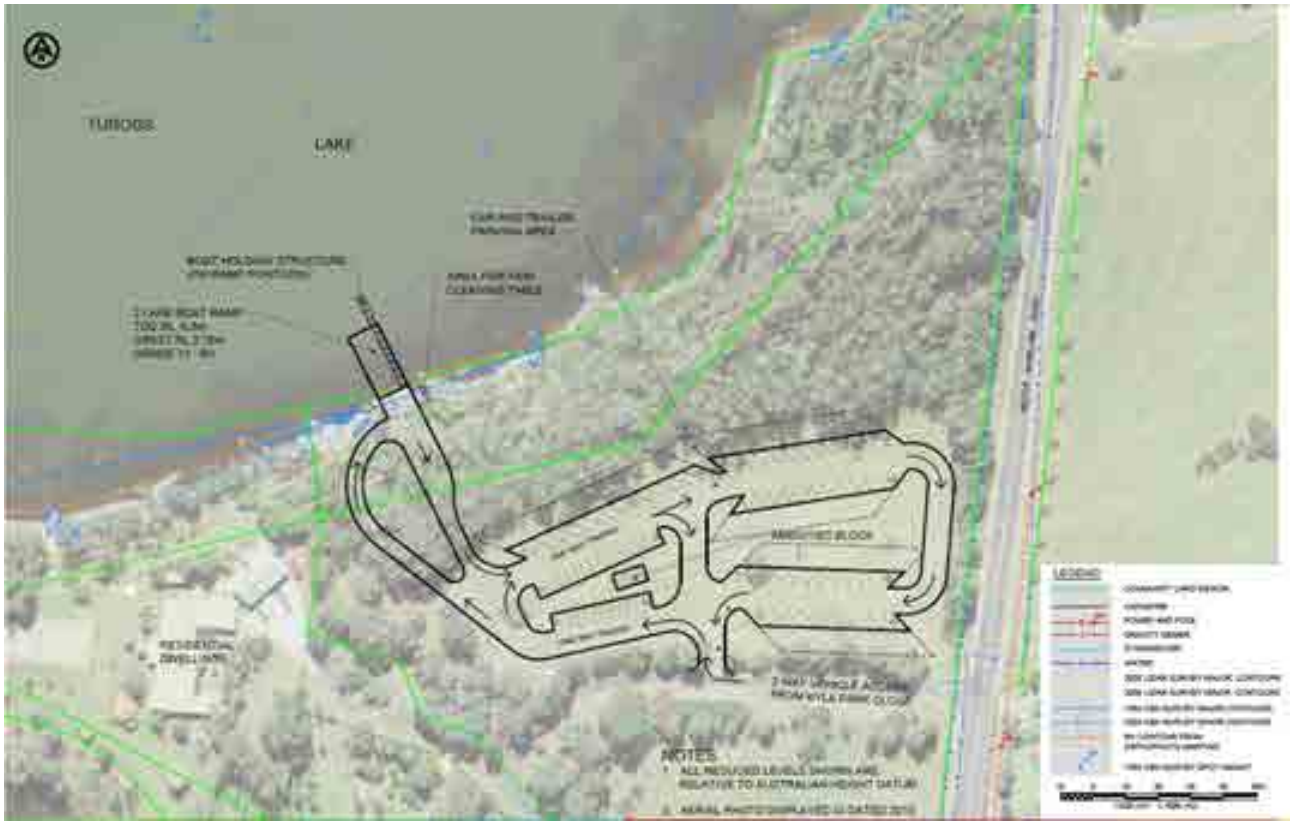


Figure 93: Concept plan - Tuross Head boat ramp relocation investigation, Alternative Site 1

Source: Royal Haskoning DHV (2013)

In the short term, Royal Haskoning DHV (2013) considered that Option D: Channel Maintenance, involving periodic excavation at the ramp toe and maintenance of a sediment basin on the upstream (western) side of the ramp, is an appropriate low cost measure to maintain the amenity of the existing facility whilst a long term solution is being pursued.

L2.4 Impacts on Foreshore Access due to Sea Level Rise

The Tuross River Estuary boat ramps are constructed of concrete and run down to the water from elevated land. Therefore sea level rise may require extension of these ramps in future to ensure ongoing usability of these access points. The public jetty located at Lavender Bay boat ramp may also require raising to a higher elevation. Alternative Site 1 for the proposed boat ramp relocation is located in an area of relatively steep topography that will minimise the impact of sea-level rise on its usability but design of the infrastructure will need to consider future water levels.

Formal access to Coila Lake is obtained via gravel low-lying ramps on the western foreshore. Sea-level rise has the potential to inundate these areas and restrict access to the water over time. Planning for future access to Coila Lake and associated facilities will need to consider future water levels.

L3. WATERWAY USES

The Tuross River Estuary and Coila Lake are an important recreational destination for tourists and local residents and are used for fishing, swimming, boating and nature based activities.

L3.1 Boating

Boating is a popular activity within the Tuross River and Coila with boating generally associated with fishing. Transport for NSW (2015) reported that open runabouts are the dominant registered boat type in the south coast region, accounting for 77% of all registered vessels. Cabin runabouts are also popular, comprising 12% of all vessels. Motor cruisers, yachts, PWCs, and powered catamarans are also registered in the region but these represent a relatively small proportion of the region's total registered vessels.

WBM (2004) noted that boating in some sections of the estuary was thought to be exacerbating bank erosion. Vessel speeds are restricted in several areas throughout the Tuross River Estuary including an 8 knot zone throughout Tuross Lake and a 4 knot zone upstream of the Four-ways adjacent to Cambathin Island. Numerous other no-wash zones are located throughout the estuary. No boating restrictions are in place within Coila Lake however the lake is shallow making navigation in most areas difficult.

Personal water craft (PWC) use is also a popular activity within Tuross River.

L3.2 Recreational and Commercial Fishing

Recreational fishing is a popular recreational activity within the Tuross River Estuary and Coila Lake. Species targeted by recreational anglers include bream, whiting, flathead, luderick, Australian bass, estuary perch, tailor and Australian salmon. Bait species such as Yabbies and poddy mullet are also collected throughout the lower estuary sandflats. Fishers utilise a range of habitats throughout the estuary including shallow sand flats, deep holes, rock walls/ledges, seagrass meadows, woody debris, depending on the species being targeted. Many fish are subject to daily bag limits, which restrict the number of fish legally able to be caught and retained in one day. DPI fisheries officers routinely patrol waterways, boat ramps and foreshores to advise anglers about responsible fishing practices and to ensure compliance with NSW fishing regulations.

Prawning is particularly popular in Coila Lake with the season generally lasting from October to April. Methods employed in Coila Lake include running nets, seine nets and set pocket nets.

Tuross River Estuary and Coila Lake are both located within the Batemans Bay Marine Park. The Tuross estuary is a designated 'Recreational Fishing Haven' (where commercial fishing is prohibited) which aims to provide better angling opportunities for recreational fishers. Two annual recreational catch surveys, pre and post recreational fishing haven, were undertaken by Steffe *et. al.* (2005) within Tuross Lake to assess whether the recreational fisheries in this haven were improving and providing better quality recreational fishing. Overall results indicated that the recreational fishing quality within the area had improved in many

ways since the introduction of the zoning. It was recommended that on-site surveys of the recreational fishery should be repeated regularly (every 3-5 years) to monitor the recreational fishery in the Tuross Lake Estuary.

Up until 1 May 2002, commercial fishing was also carried out within the Tuross estuary, and produced the third largest commercial catch of any estuary on the NSW south coast (WBM, 2004; Gibbs, 1997). Prior to the closure, commercial fish catch within the Tuross estuary had steadily declined, however, reasons for this are not fully known (WBM, 2004).

Fisheries NSW have a requirement for all recreational fishers to purchase fishing licences for both freshwater and saltwater fishing. Income received through the licensing system is used by the NSW government to undertake important research aimed at ensuring a healthy and sustainable fish population in NSW recreational fishing areas and improve fishing facilities and access.

Coila Lake is utilised for commercial fishing by a number of licensed commercial fishers. The industry is primarily made up of small family businesses that rely on high levels of local knowledge and skills learnt over many generations (Fisheries NSW, 2016). The NSW coastal fisheries resource is divided into 10 management zones. Coila Lake lies within zone 8 of the lower south coast region. An Estuary General Fishery operates within Coila Lake targeting a number of species.

WBM (2004) noted that Coila Lake was one of the most intensively commercially fished lakes on the south coast and was amongst the top five major estuaries on the NSW south coast for crustacean and finfish catches. Coila Lake is particularly renowned for prawn productivity and approximately 75% of fishing effort focusses on prawning (WBM, 2004).

Prawn catch has been shown to be related to entrance condition (WBM, 2001) and this is a key concern for prawn fishers. King prawns do not spawn in local oceanic waters or within local lakes and estuaries. If Coila Lake has been closed to the ocean for many years prior to a prawn season, there is likely to be a decrease in prawn catch compared to if the lake has been opened more recently. However, an opening can release prawns back to the ocean so they are not available to catch. The timing of entrance openings is critical to the prawn catch. There must be larvae present at the time of opening to recruit into the lake. Any recruitment to Coila Lake is via larvae carried south on the East Australia Current between April and June. Chance weather conditions can also move larvae into the lake during this period. Opening at other times will have no impact on prawn stocks and could result in prawns migrating out.

Recent media reports suggest abuse of laws relating to recreational catch limits, particularly prawns.

L3.3 Other Recreational Activities

Coila Lake is utilised for recreational sailing. The Batemans Bay Sailing Club are licensed to sail on the lake during the summer months. Motor boats and other craft are available for hire at Tuross.

Both Tuross and Coila Lake and foreshores are popular for a range of other recreational pursuits including kayaking, paddle-boarding, swimming, picnicking, walking nature appreciation.

L3.4 Oyster farming

A relatively large number of oyster leases are located throughout the Tuross River with leases located in Brices Creek, Tuross Lake, Bowns Bay, Coopers Bay and Borang Lake (Figure 94). In 2011/12 there were approximately 110 ha of oyster leases throughout the estuary, down from a peak lease area of 145 ha (NSW DPI, 2014). In 2011-12, 21.4 tonnes or 36,657 dozen oysters were produced from the Tuross estuary, 85% less than the peak production of 137.8 tonnes in 1994/95 (NSW DPI, 2014). WBM (2004) reported that in 2004 there were 80 leases throughout the system held by about 12 farmers.

An Environmental Management System for Tuross Lakes Oyster Farmers was prepared in 2012 in conjunction with OceanWatch Australia and Southern Rivers CMA. The strategy is an industry driven

initiative that outlines a step-by-step process to identify and manage environmental impacts, risks and opportunities of oyster farming in the Tuross.

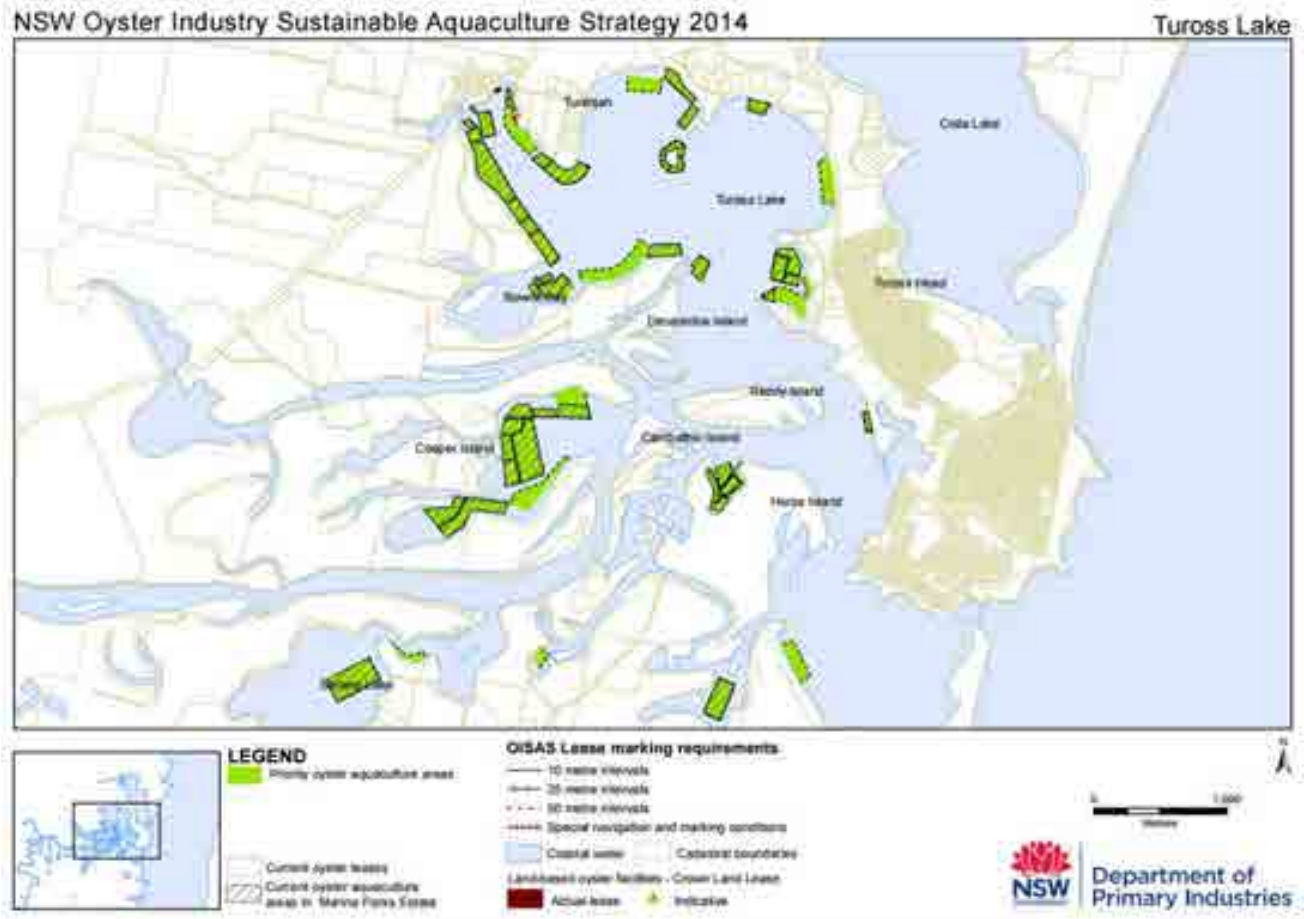


Figure 94: Tuross Lake priority oyster aquaculture areas

Source: DPI (2016)

L3.5 Other Commercial Activities

There are a number of other commercial activities undertaken within the Tuross and Coila Lakes, mainly based around tourism, including:

- Tuross Lakeside Tourist Park – holiday park located on the foreshore of the Tuross Broadwater;
- Tuross Beach Holiday Park – holiday park located at the mouth of Tuross Lake; and
- Cafes – located on the foreshore of Tuross Lake.

L4. WATERWAY USAGE CONFLICTS

Boats can cause damage to seagrass beds through mooring damage, groundings, anchoring and propeller damage. Maritime boating maps (Figure 89) 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 can cause conflicts with other waterway users (particularly fishers and swimmers). PWC use is regulated by RMS with boating maps showing the areas for permitted and prohibited PWC use and handbooks describing regulations. RMS is currently conducting a PWC 'no go' zone trial within the Tuross River system. PWC use is currently restricted to a narrow channel between the boat ramp at Tuross Head and the open ocean with an 8-knot speed restriction (Roads & Maritime, 2016).

The 2005 EMP found that boat waves and propeller wash were contributing to erosion but were not significant compared to natural processes.

Feedback from the community indicates ongoing conflict between commercial and recreational fishers regarding sustainable catch, access to fish stocks and waterway access. DPI manages and regulates both the commercial and recreational fisheries in NSW. While access arrangements are discussed in this CMP, fishing regulation is the responsibility of DPI. A new management plan is currently being developed by NSW Marine Parks and this is expected to address requirements for commercial and recreational fishing (refer Section B3, Appendix B - Related Management Plans and Programs).

APPENDIX M. CULTURAL HERITAGE

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 Tuross River Estuary and Coila Lake have 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. The Tuross estuary and Coila Lake also hold significant European heritage value, with settlement of the foreshore areas spanning more than 150 years.

Tuross Head Peninsula has been continuously occupied by humans for at least the last 6,000 – 7,000 years; the beginning of this period of habitation possibly coinciding with changes in sea level. Aboriginal occupation of Tuross Peninsula and particularly the Tuross Lakes area appears to have been both intense and consistent for the majority of this time as is indicated by the size, depth and apparent antiquity of middens and stone knapping sites found in numerous locations throughout McWilliam Park (an ocean foreshore reserve on the Tuross Peninsula). The Park and particularly Tuross Head (One Tree Point) area appears to have been a principal camp of the 'Brinja Yuin' people whose area of occupation stretched from Moruya to Narooma. In 1847 Aboriginal people from a variety of tribes were rounded up from the local area and placed into a reserve at Turlinjah (ESC, 2003).

The estuaries lie 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 Bodalla and Cobowra Local Aboriginal Land Councils (LALC) represent 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. An Aboriginal Heritage Survey of the Tuross Estuary and Coila Lake completed by the Cobowra Local Aboriginal Lands Council (WBM, 2004) identified numerous sites around the estuaries that are considered culturally significant by the indigenous community. ESC has recently prepared a Cultural Heritage Study to raise awareness of Aboriginal history and Aboriginal connections to the Eurobodalla Shire (Donaldson, S., 2006). Areas of cultural significance identified in the estuaries include:

- The Coila and Tuross Head areas hold a variety of cultural heritage values for Aboriginal people, both past and present. Work related places, camping and living places, recreation and birthplaces as well as ancient ceremonial places;
- Coila Lake is part of traditional fishing grounds, especially for prawning;
- There is a bora ground south west of Coila Lake. The flat lands around Coila Lake were associated with men's ceremonies;
- It is believed that conflict between Aboriginal people and European settlers took place in a gully, north of Coila Lake. It is thought that an associated burial ground also exists;
- A burial site, possibly for Aboriginal people, who died of Yellow Fever in the late 1800s, is located north of Coila Lake;
- Coopers Island was one of a number of primary places Aboriginal families worked in the seasonal farm industry.

- Horse Island is of significance due to the presence of ceremonial burial trees and archaeological evidence indicating the area was used to consume shellfish. The area offers a variety of ecological zones supporting an abundance of natural resources from swans to shellfish.

The Bingi Dreaming track is a coastal walk from Congo to Tuross Head (along the eastern foreshore of Coila Lake) that traces the ancient Song Lines of the Yuin Aboriginal people. The links campsites, ceremonial and trade sites, fresh water and plentiful coastal food sources.

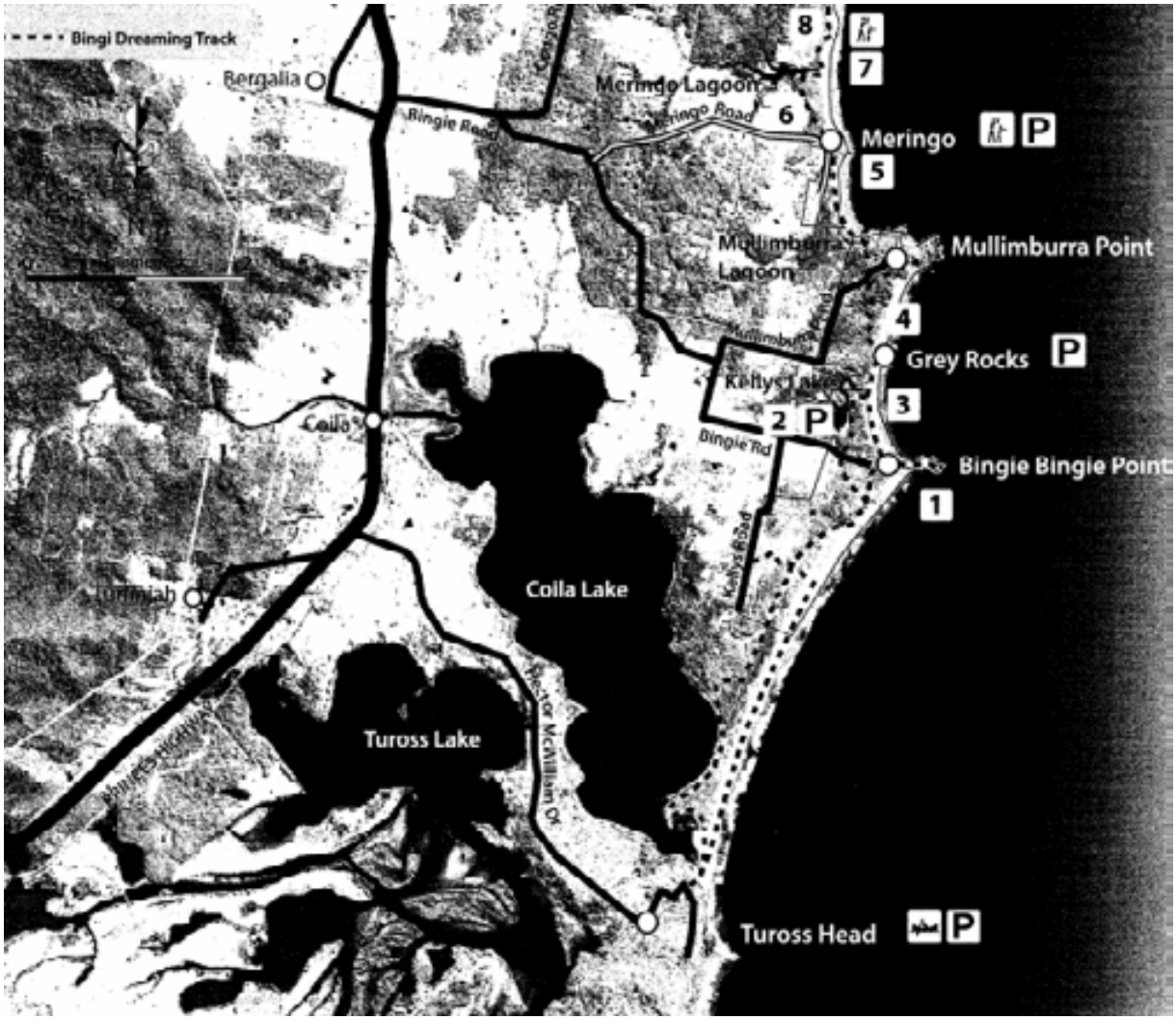


Figure 95: Southern section of Bingi Dreaming Track

Source: Bingi Dreaming Track Brochure, Eurobodalla National Park

Access to Coila Lake is also gained via the north-east of the Lake. There is evidence of damage to saltmarsh areas from 4WD vehicles, motorbikes and boats. A scar on the western foreshore dune suggests that 4WD vehicles are also accessing the beach from this location. Vehicular access creates a risk of impact on cultural heritage as well as pedestrian safety in this location.

The Kyla Park pastoral lands retain remnants of the former Kyla Park farm site. The lands are part of a cultural landscape which has meaningful association with the Brinja Yuin Aboriginal people; and with the 'European' pastoral use of the land for over more than 150 years. The site has a spirit of place which has been retained relatively intact; and free from intrusive development. The lands have district associations with the Hawdon family who have played a pivotal role in the region's dairying industry. The creation of Kyla Park community residential development with its mix of cluster development and associated open pastoral lands is of social significance, as is the esteem with which the Kyla Park pastoral lands are currently held by the local and regional community. The lands are likely to be archaeologically rich, particularly in relation to its 'European' pastoral history (ESC, 2003).

A search of the NPWS Aboriginal Heritage Information Management System (AHIMS) was conducted for the CMP study area. The AHIMS search returned a total of 71 aboriginal sites 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 lies with 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 awareness of cultural heritage values of the estuaries (medium priority). Bank erosion was found to be impacting on a midden site although there is no current information regarding this issue (refer Appendix I).

The Eurobodalla LEP 2012 identifies many heritage items in the study area including:

- Kyla Park Farm Remnants
- Hector McWilliam's Memorial Cairn
- Tuross House and Norfolk Island Pine Tree
- Tuross House Barn
- St David Presbyterian Church
- Timber cottage
- Old Tuross Bakery
- Eva Mylott Memorial
- Red Washed Grain Silo

The 2005 EMP included the following objectives relating to heritage:

- To conserve specific sites of significance around the Tuross estuary and Coila Lake and increase awareness regarding the significance and importance of the estuaries to the indigenous people; and
- To increase the awareness of non-indigenous cultural heritage sites around the Tuross estuary and Coila Lake and conserve these sites for future generations.

The related action in the 2005 EMP was the "identification and protection of significant Aboriginal and European cultural heritage sites" which is still considered to be an important management action.