Central Coast Council

Tuggerah Lakes Estuary Coastal Management Program

Scoping study

Central Coast Council

central coast waterways
tuggerah lakes estuary

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Executive Summary

"Tuggerah Lakes is at a crossroads"

Tuggerah Lakes Expert Panel (Glamore et al., 2020).

Whilst extensive **catchment remediation work** has been undertaken over the past 10-15 years (Central Coast Council, 2020a) in many public reserves, public wetlands, private rural areas and a broad range of foreshore areas, ecological health is not improving at a rate that meets community expectations nor will guarantee the estuary does not suffer irreversible ecological decline (loss of seagrass, more persistent macroalgal and phytoplankton blooms etc) in the future. Ecological health improvements have been measured at over half of our monitoring sites, however gradual declines in Lake Munmorah and Budgewoi Lake, despite the level of investment in catchment improvement works, suggests that more needs to be done in order to turn the situation around and ensure the sustainability of the Tuggerah Lakes estuary.

Tuggerah Lakes and its catchment offer enormous value to the local community in terms of ecosystem services (fertile land, clean air and drinking water and carbon storage), recreational amenity and deeply held cultural and intrinsic values. Many community members shared their waterway values through the Our Coast, Our Waterways survey which highlighted a myriad of options including that clean water, natural beauty, wildlife and good access are things that matter to them.

It is the responsibility of government, at all levels to come together and show leadership in caring for our coastal zone (Glamore et., al, 2020), to make evidence-based decisions and to act on them in a holistic and effective way. Changing the trajectory for Tuggerah Lakes will not be easy. As numerous studies over decades have shown, there is no quick fix to the problems we see in Tuggerah Lakes (Glamore et. al., 2020). Making a change will require a catchment-wide and collaborative approach. However, it is important to acknowledge that Council can only do so much to plan for development and manage public land, and whilst there is plenty of room for improvement, the community as major landholders and waterway users play a fundamental role in what happens next. As we navigate the next steps, it will be important to build on what we already know, reframe our priorities and actions to align with our shared values and work as one to make protecting our waterways both now and into the future a priority.

The Tuggerah Lakes Coastal Management Program (CMP) Scoping Study integrates the recommendations of the Tuggerah Lakes Expert Panel and builds on the successes and learnings from the Tuggerah Lakes Estuary Management Plan (EMP) (Bio-Analysis, 2006). It provides a summary of the strategic, environmental, heritage and future contexts, identifies the purpose, scope, vision and objectives of the CMP and maps out a series of forward planning tasks and milestones which will assist with filling key knowledge gaps and gathering sufficient information to establish an effective and implementable CMP. It is expected that the CMP will take approximately 2.5 years to complete. In the meantime, work to implement the Tuggerah Lakes EMP will continue via a range of internally and grant funded **programs and projects**.

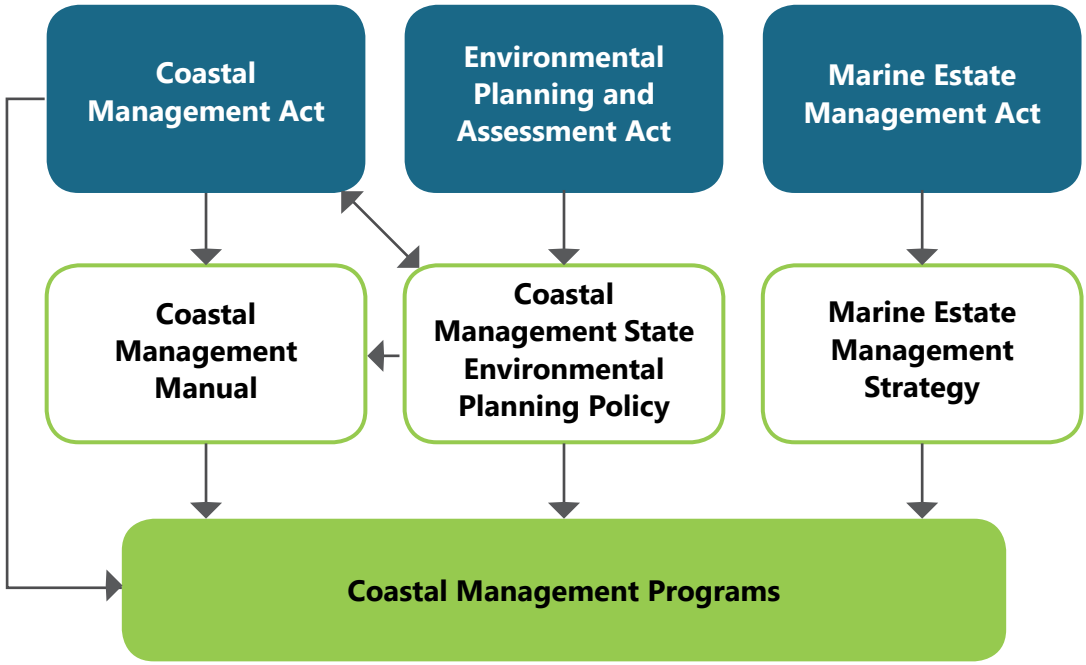
1. Introduction and CMP Strategy

1.1. Introduction and Overview

1.1.1. NSW Coastal Management Framework

The NSW Coastal Management Framework which comprises various key elements including legislation **(see Figure 1.1)**, governs the management of the open coast, estuaries and marine estate of NSW (NSW Government, 2018).

Figure 1.1: NSW Coastal Management Framework



Of particular importance is the Coastal Management Act 2016 that provides the statutory framework for coastal zone management in NSW and the minimum requirements for the preparation of a Coastal Management Program (CMP).

Other relevant legislation is described in **Section 2** and **Appendix C.**

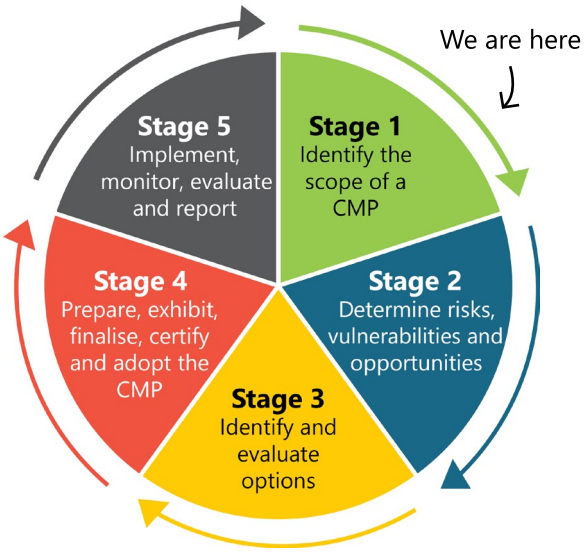
1.1.2. What is a CMP?

The Coastal Management Act 2016 states that "the purpose of a coastal management program is to set the long-term strategy for the co-ordinated management of land within the coastal zone with a focus on achieving the objects of this Act". A CMP achieves this by identifying the key coastal management issues and actions required to address these whilst concurrently considering the local context, objectives, values and priorities of an area.

The mandatory requirements for preparing a CMP are set out in Sections 13 to 18 of the Coastal Management Act 2016 and Part A of the Coast Management Manual. The Manual outlines five stages of preparation and implementation for a CMP, as shown in **Figure 1.2.**

This document relates to Stage 1 of the CMP development and is the Scoping Study for the Tuggerah Lakes Estuary CMP. The CMP, once adopted and certified will supersede the Tuggerah Lakes Estuary Management Plan (EMP) which remains the current certified Coastal Zone Management Plan until December 2021.

Figure 1.2: CMP Development Stages

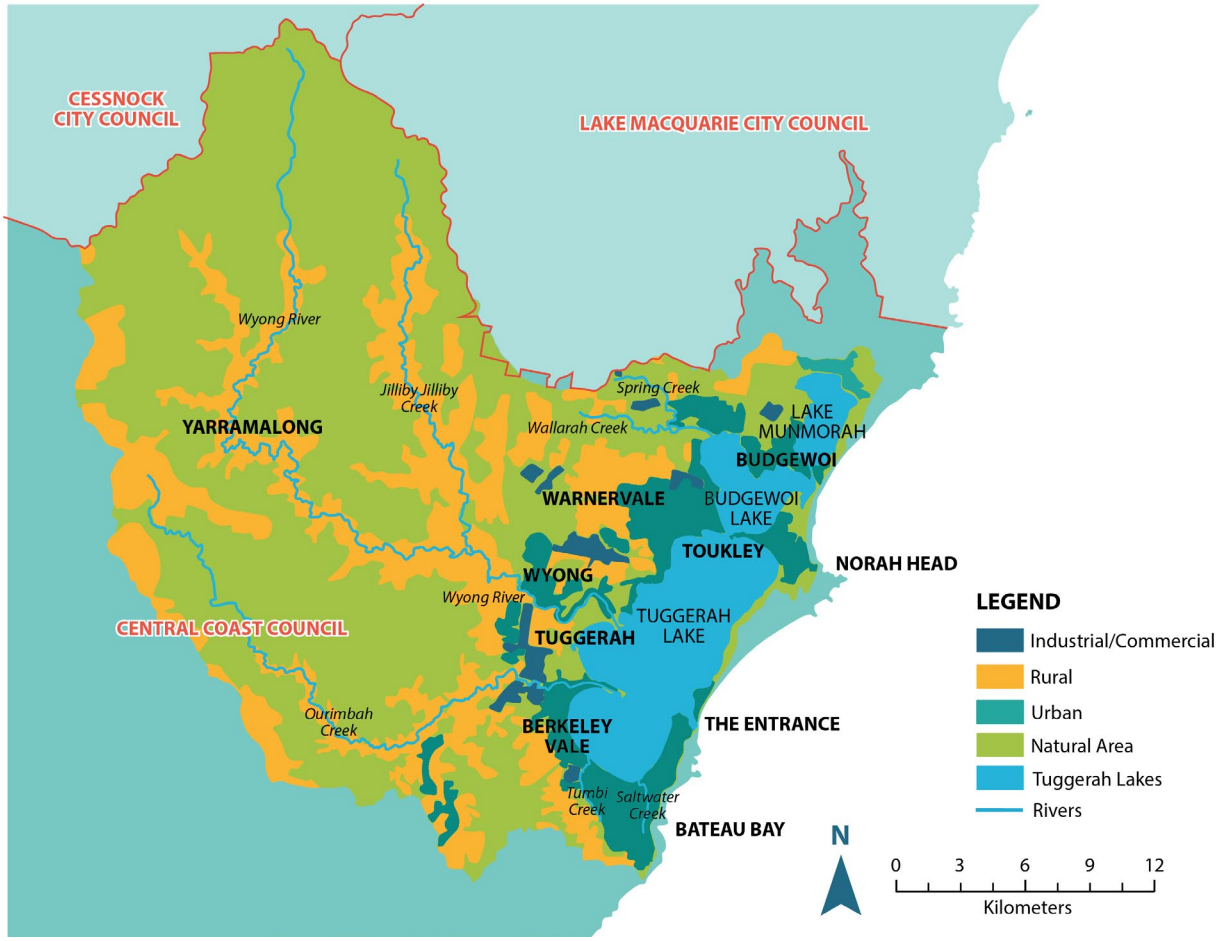


1.1.3. Tuggerah Lakes

Tuggerah Lakes is located on the Central Coast of New South Wales, Australia and forms part of the traditional Country of our First Nations People. Whilst known by different common names, Tuggerah Lake, Budgewoi Lake and Lake Munmorah are collectively known as Tuggerah Lakes and are defined as a "**wave dominated estuary**" of the type "**intermittently closed or open lakes or lagoons" (ICOLLs)**. In 2020, the Tuggerah Lakes Expert Panel highlighted the historic confusion around the name and classification with reference to lakes, lagoons etc. For the sake of this report, the estuarine areas including the brackish feeder rivers and creeks, saltmarshes, low lying foreshores, water bodies and the entrance will be referred to as **"the estuary"**. The broader area of land including freshwater rivers and creeks, coastal wetlands, floodplains, valleys and the plateau will be referred to as **"the catchment"**. The Tuggerah Lakes estuary has a typical water surface area of around 81 square kilometres (OEH, 2013) and an expansive catchment area of approximately 790 square kilometres (MHL, unpublished). The estuary adjoins the Tuggerah Beach embayment via a single narrow ocean entrance that is maintained in an open condition via mechanical intervention.

The Tuggerah Lakes estuary and its catchment are largely contained within the Central Coast Local Government Area (LGA). For the purposes of this report, the "study area" will include the entire catchment, the estuary and the entrance channel, as shown below in Figure 1.3. Where reference is made to the "region", this means the broader Central Coast LGA and the "bioregion" means the Sydney Basin Bioregion which the Central Coast is a part of. Further details on the environmental setting and ecological processes operating within the estuary are provided in **Section 2.5** and **Appendix D**.

Figure 1.3: Tuggerah Lakes Estuary



1.2. Tuggerah Lakes Estuary CMP Strategy

1.2.1. Purpose

The Tuggerah Lakes Estuary CMP will provide a long-term coordinated strategy for the estuary and catchment by working with all stakeholders to outline a direction for managing:

- the ecological health of the estuary and its catchment
- coastal threats and risks, and
- competing community visions for the estuary.

Council will be using the CMP process as a vehicle to better engage with the community and develop coastal management solutions, collaboratively.

This report documents Stage 1 of the CMP process and has been prepared in accordance with the Coastal Management Manual to meet the legislative requirements for a Stage 1 CMP Scoping Study, as established in the *Coastal Management Act 2016*. The purpose of this Scoping Study is to determine the scope of the CMP and define a pathway for progressing subsequent CMP stages by detailing a forward works program and costs to complete Stages 2 to 4 of the CMP.

In practice, this study seeks to provide a useful guide for Council and partner state government agencies in working together to achieve the strategy, vision and objectives for Tuggerah Lakes estuary including both the surrounding coastal zone and the broader catchment.

1.2.2. Vision Statement

The Tuggerah Lakes Expert Panel recently invited community input to define both what the community value and what they consider success to look like (Glamore et. al., 2020). Overall, their work indicated that the community value "diversity in marine and surface ecology, especially bird life and recreation opportunities". From this, a range of different factors contributed to a perception of success including:

- the community could enjoy the estuary for recreation
- the estuary was teeming with bird and aquatic life
- there was less weed, clearer water, sandy bottoms
- appropriate monitoring and management were in place
- the community had a sense of pride in their local area, and
- there were local economic benefits.

This was further articulated through the ***Our Coast, Our Waterways* community survey** where clean water, natural beauty, wildlife and access were key values for waterways across the region. In working collaboratively with the local community, it will be important to explore these values and establish clear, realistic and measurable actions that work towards a realistic, shared vision. A specific study is proposed in Stage 2 of the CMP which will bring together information on uses, values, threats and opportunities, identify achievable medium and long term targets (which are measurable) and link these to specific indicators to allow trends to be tracked through time.

The following draft long-term vision for the Central Coast coastal zone was devised by Council and the two Catchments to Coast Committees (which have since been combined) at this stage based on an appreciation of the community's values and aspirations:

Achieve a healthy and sustainable coastal zone for the whole of the Central Coast both now and into the future, encompassing natural assets, community well-being and resilience.

However, Council's intention is to develop and refine this long-term vision in subsequent stages of CMP development as part of an ongoing conversation with the local community. The long-term vision for Tuggerah Lakes is important and it (along with the identification of issues and preferred solutions) should be a collaborative and shared responsibility between Council, stakeholders and the community.

1.2.3. Objectives

The overarching objective of the Tuggerah Lakes Estuary CMP is to provide a long-term strategy and short-term actions to manage the estuary in an ecologically sustainable manner, for the benefit of the wider community.

Specifically, the CMP aims to:

a) Maintain and improve the ecological health of the estuary and its coastal environment, by protecting the natural processes, natural variability, environmental assets, ecosystem integrity and water quality of the estuary.

b) Support community connection with and use of the estuary, in an ecologically sustainable and culturally sensitive manner.

c) Improve coordination of public authorities that manage the estuary waterway and its catchment.

d) Identify areas for improved management and facilitate good decision making.

e) Acknowledge the cultural value and indigenous use of the system and protect areas and items of cultural heritage significance.

f) Align coastal management planning with local and regional planning, and vice versa.

g) Manage coastal and climate risks proactively, strategically and with consideration of future generations.

h) Collaborate with government and community to manage the estuary and its catchment, through improved collective knowledge and understanding, capacity building, and collective action.

i) Support the overarching strategy for coastal management, objects of the *Coastal Management Act 2016* and objects of the *Marine Estate Management Act 2014*.

2. Strategic Context for Coastal Management

2.1. Strategic direction

The strategic direction for the study area has been devised based on existing visions, directions and strategies outlined in local, regional and state plans, policies and acts. One of the most important visions for the area is that of the local community. The community vision for the Central Coast LGA has been developed through consultation and is documented in ONE Central Coast, Council's Community Strategic Plan 2018 – 2028 (Central Coast Council, 2018). It is *"We are ONE Central Coast. A smart, green and liveable region with a shared sense of belonging and responsibility*". Key themes within ONE Central Coast include *"cherished and protected natural beauty"*, *"balanced and sustainable development"* and *"environmental resources for the future"* (Appendix A: Community and Stakeholder Engagement Strategy provides further details on relevant focus areas). These community priorities and aspirations for the future will be considered in future CMP management decisions to ensure alignment between CMP outcomes and community wishes.

The following is a summary of other key relevant visions and directions:

- **Central Coast Local Strategic Planning Statement 2020** *"The Central Coast of tomorrow will show leadership in place-making, environmental protection, sustainability, infrastructure and community resilience. Our communities will be physically connected through appropriate infrastructure and socially connected through strong relationships and a sense of unity."*
- **Central Coast Regional Plan 2036** *"A healthy natural environment, a flourishing economy and well-connected communities".*
- **Coastal Management Framework 2018** *"aims to have thriving and resilient coastal communities living and working on a healthy coast, now and into the future".*
- **Coastal Management Act 2016** *"manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State".*
- **Marine Estate Management Strategy 2018 – 2028** *"A healthy coast and sea managed for the greatest wellbeing of the community, now and into the future".*
- **Crown Land 2031 – State Strategic Plan for Crown** *"Crown Land supports resilient, sustainable and prosperous communities across NSW."*

2.1.1. Relationship to the Tuggerah Lakes Expert Panel

In February 2020, the NSW Government announced the formation of an independent Expert Panel to investigate the water quality of Tuggerah Lakes in response to ongoing community concern, polarisation and political interest. A panel of eight industry experts was appointed in July 2020 including Associate Professor William Glamore (Chair), Mr Stuart Waters, Dr Katherine Dafforn, Dr Angus Ferguson, Professor Damien Maher, Mrs Sian Fawcett, Ms Nicole Ramilo and Dr David Wainwright. The **Terms of Reference** required the Tuggerah Lakes Expert Panel to consider existing information, previous actions to address water quality and the available science as they relate to the management of water quality in Tuggerah Lakes. Notably the review excluded flooding, however the panel indicated their hope that the information provided in their report would be considered in any updated flood management plan.

The "**Tuggerah Lakes Water Quality Independent Expert Panel Review**" Final Report (Glamore et. al., 2020) was submitted to the NSW Minister for the Environment on 31 December 2020 and was released to the public (including Council) by the NSW Government on 7 May 2021. The Final Report focused on (i) how the entrance influences water quality in the estuary, (ii) the water quality and ecological characteristics of the estuary itself, and (iii) the influence of the adjacent catchment on the estuary's water quality. A series of 52 recommendations were presented throughout the report and are listed in **Appendix F**. It is hoped that in reading this Scoping Study, the community and stakeholders

can see that there has been a genuine effort by Council to holistically integrate the findings of the Expert Panel and past learnings into this and future stages of the CMP. The detail of how findings and recommendations are incorporated into the Forward Plan are also shown in **Section 5.3** and **Table 5.4.**

2.2. Legislation and policy

There are numerous legislative instruments which, to greater or lesser extent, regulate the activities in the Central Coast coastal area and which establish a strategic direction for the Tuggerah Lakes estuary. The more relevant legislative instruments include the:

- *Coastal Management Act 2016*
- *Biodiversity Conservation Act 2016*
- *Biosecurity Act 2015*
- *Environmental Planning and Assessment Act 1979*
- *Protection of the Environment Operations Act 1997*
- *Marine Estate Management Act 2014*
- *Local Government Act 1993*
- *Aboriginal Land Rights Act 1983*
- *Native Title Act 1993*
- *Crown Lands Management Act 2016*
- *National Parks and Wildlife Act 1974*
- *Fisheries Management Act 1994*
- *Heritage Act 1977*
- *Forestry Act 2012*

In addition to above Acts, there are numerous frameworks, policies and plans in place that play a role in informing and guiding the coastal management of the study area. The most relevant documents are listed in **Table 2.1**.

Table 2.1: Strategies, policies and plans relevant to the study area

State-wide

- Marine Estate Management Strategy
- State Environmental Planning Policy (Coastal Management) 2018 (SM SEPP)
- Crown Land 2031 State Strategic Plan for Crown

Regional

- Central Coast Regional Plan 2036
- Local Land Services - Greater Sydney Local Strategic Plan
- Maritime Infrastructure Plan

LGA Specific

- Central Coast Local Strategic Planning Statement (LSPS) 2020
- Central Coast Integrated Planning and Reporting (IP&R) Framework, including
  - Community Strategic Plan 2018-2028 (CSP)
  - Delivery Program and Operational Plan
- Central Coast Local Environmental Plan 2020 (CC LEP)
- Central Coast Development Control Plan 2020 (CC DCP)
- Central Coast Climate Change Policy 2018
- Central Coast Biodiversity Strategy 2020
- Draft Central Coast Greener Places Strategy 2019-2030
- Draft Central Coast Green Grid Project
- Draft Central Coast Active Lifestyles Strategy 2021
- Central Coast Destination Management Plan 2017 (including ECO Destination Certification)
- Tuggerah Lakes Flood Study 1994
- Tuggerah Lakes Floodplain Risk Management Plan (2014)

An overview of the above listed acts, policies and plans that outlines the relevance and role of each in detail is provided in **Appendix C.**

2.3. Governance context

Government agencies are the cornerstone of land management across the study area and will play a central role in the development and implementation of a Tuggerah Lakes Estuary CMP.

Land and waterways areas are owned and/or managed by a number of different government agencies, private individuals and other organisations. In practice, Central Coast Council has been at the forefront of planning and management of the Tuggerah Lakes estuary and catchment. Management efforts by Council over the past decade or more have been supported (and heavily reliant) on the federal government grants which cover some, but not all actions identified in the EMP (e.g. Caring for our Country (2008-13), National Landcare Programme (2014-17), Improving your Local Parks and Environment (2017-20) and Environment Restoration Fund (2020-23)).

Whilst 86% of actions identified in the EMP have been completed or are ongoing as at July 2021 (Appendix E), these have largely focused on priority themes of the relevant grant program, and as a result, the capacity to consistently and holistically deliver on the priority programs and actions has been limited. Greater flexibility and security of funding in future will be integral to successful delivery of the CMP in its entirety.

This approach has recently been endorsed by the Tuggerah Lakes Expert Panel (TLEP) (Glamore et. al., 2020) where both a Stormwater Levy and an Environmental Levy have been recommended to secure a continual baseline funding source for Council and to help avoid the current reliance on ad hoc State or Commonwealth grants. Whilst this is one pathway to secure ongoing, sustainable funding, other options for enhanced catchment, stormwater and sewer network management should also be explored by Council in its role as a land manager and water supply authority.

In addition to new works, this would support ongoing operation and maintenance of natural assets and infrastructure which is generally not fundable through external grants. Grants typically favour initial and/or capital investment over longer-term actions which in the past has seen successful rehabilitation sites decline in condition over time, often returning to their pre-treatment state. Investing in maintenance is a sound long-term strategy whereby costs reduce significantly over time but the initial benefits you set out to achieve (improved habitat, biodiversity, water quality etc) persist. This also applies to the operation (e.g. clean out) and maintenance (e.g. repair) of stormwater treatment assets, which is essential to ensure their effectiveness, but cost-prohibitive when considering the vast number of current and future devices across the Tuggerah Lakes catchment. The TLEP report acknowledges that many other Councils in the region have benefitted significantly from a reliable source of funding such as an Environment Levy or a Stormwater Levy and have expressed their concern that Tuggerah Lakes will fall significantly behind other similar systems without adequate funding.

Funding mechanisms will be explored in more detail as the CMP is developed however it is heartening to know that there is a strong level of support for "more resources being used for the management of waterways and the coast, even if it meant a very small increase in property rates or rent" with 69.2% of respondents to the Stage 1 ***Our Coast, Our Waterways* community survey** indicating that they "strongly agreed" or "somewhat agreed" with the concept (whole LGA). Importantly, if this option is to be pursued, clear and transparent public reporting mechanisms must be in place to ensure funding is directed to CMP priorities.

In addition to funding stability, the TLEP highlighted the criticality of working collaboratively across all levels of government, across Council departmental boundaries and with community to achieve better outcomes for the estuary. One suggested mechanism for this to occur is by establishing a Catchment Coordinator Taskforce (Glamore et al., 2020). Whilst this recommendation is outside of Council's scope and would be a decision for the NSW Government, Council strongly supports the recommendation that the CMP be used as a vehicle to "bring together multiple stakeholders to ensure that the responsibility of managing Tuggerah Lakes is apportioned to those with the delegated legal authority. This should better reflect the various state government authorities who play a critical role in catchment, waterway, fisheries, environmental, transport, and planning for the region" (Glamore et al., 2020).

Key agencies are outlined in Table 2.2 on the following pages with proposed governance structure identified in Figure 5.1.

Table 2.2: Key government agencies / organisations

Agency (TL CMP Role)	Land Ownership / Management and Responsibilities
Central Coast Council (Lead CMP development	**Land Ownership / Management:** • A range of land parcels and reserves (including Council owned and Crown managed land/reserves). **Responsibilities:** • Diverse responsibilities, including water, sewer, roads, drainage, development assessment, public health, parks and playing fields, libraries, local environmental issues, waste disposal and many community services. • Councils to prepare and implement CMPs, in accordance with CM Framework. • May prepare planning proposed to update CMP SEPP mapping.
NSW Department of Planning, Industry and Environment (DPIE) (Technical oversight, funding assistance)	**Land Ownership / Management:** • Refer to specific state government agencies. **Responsibilities:** • A very large/diverse department, responsible for planning and the development of industry. • Supports the Minister responsible for administering the Coastal Management Act. • Provides technical and financial support to councils for coastal management. • Provides technical oversight to councils as part of the NSW Government's Floodplain Management Program. • Develops state-wide coastal management strategies and help address priority issues. • (Agency specific details below).

Agency (TL CMP Role)	Land Ownership / Management and Responsibilities

Department of Planning, Industry and Environment – Crown Lands (DPIE – Crown Lands)
 	
(Partner)
	Land Ownership / Management:
	• Diverse array of land and submerged/ intertidal land (waterway), including:
	  • roads
	  • reserves
	  • land (other)
	  • rivers, estuaries, beaches, and
	  • the seabed (≤ 3 miles from the coast).
	
	Responsibilities:
	• Land below the Mean High Water Mark (MHWM) is Crown land.
	• Tuggerah Lakes is a Crown waterway with submerged Crown land below the MHWM. Crown land includes the seabed and subsoil to three (3) nautical miles from the coastline of NSW that is within the limits of the coastal water of the state.
	• A range of land parcels and reserves (including Council owned and Council managed Crown land) are located along the foreshore and within the catchment.
	• There are several licences and leases issued by DPIE – Crown Lands within the study area for e.g. Licence 368371 is for extraction and beach nourishment at the entrance to Tuggerah Lakes.
	• Council is generally the proponent and determining authority under the EP&A Act for dredging and reclamation (beach nourishment) activities. Before actions are undertaken on Crown land, Council may require a form of authorisation under the *Crown Land Management Act 2016*. Actions must also comply with any *Native Title Act 1993* or *Aboriginal Land Rights Act 1983* requirements and obligations.
	• Supports the Minister responsible for administering the *Crown Land Management Act 2016*.
	• May participate in the development of CMPs and shall have regard to its content.

Fisheries, DPI (Partner)	**Land Ownership / Management:** • Nil **Responsibilities:** • Regulates recreational and commercial fisheries and aquaculture. Regulator and approval authority for activities that are likely to harm marine biodiversity. • Supports the Minister responsible for administering the *Fisheries Management Act*. • Is the determining authority for Fisheries Permits for activities that may harm marine vegetation (e.g. dredging and reclamation, harm to marine vegetation e.g. wrack collection, mangrove pruning/removal). • May participate in the development of CMPs and shall have regard to its content.

Agency (TL CMP Role)	Land Ownership / Management and Responsibilities
National Parks and Wildlife Service (NPWS), DPIE (Partner)	**Land Ownership / Management:** • Wyrrabalong National Park (NP) • Colongra Swamp Nature Reserve (NR) • Munmorah State Conservation Area (SCA) • Tuggerah NR and Tuggerah SCA • Watagans NP, and • Jilliby SCA. **Responsibilities:** • Manages foreshore and catchment land within the NPWS reserve system, for conservation (nature/heritage) and recreational purposes. • May participate in the development of CMPs and shall have regard to its content.
Environment Protection Authority (Partner)	**Land Ownership / Management:** • Nil **Responsibilities:** • Primary environmental regulator NSW. • Administer Environmental Protection Licences (EPL) for activities such as extraction of materials (dredging) and miscellaneous discharge of waters. • May participate in the development of CMPs and shall have regard to its content.
Forestry Corporation (Stakeholder)	**Land Ownership / Management:** • Ourimbah State Forest (SF) • Jilliby SF, and • Olney SF. **Responsibilities:** • Manage NSW State forests, for a variety of purposes including timber production. • May participate in the development of CMPs and shall have regard to its content.

Agency (TL CMP Role)	Land Ownership / Management and Responsibilities
Transport NSW (TfNSW) (incl Maritime and Maritime Infrastructure Delivery Office (MIDO) (Stakeholder)	**Land Ownership / Management:** • Nil. **Responsibilities:** • TfNSW sets the strategic direction for transport and works in partnership with government transport operating agencies and private service providers. • TfNSW Maritime regulate maritime safety for commercial and recreational vessels and their operators. Their role is to promote safe, responsible and sustainable use of waterways, including but not limited to the enforcement of safe on-water vessel practices, the administration of recreational vessel licenses and vessel registrations, and provision of guidance for safe navigation. • TfNSW MIDO is responsible for the direct delivery of a number of maritime infrastructure projects as well as investment in many others across the state. MIDO have responsibility for managing the NSW Government Dredging Program for navigation including the Boating Access Dredging Grants program. Other responsibilities include property administration, policy development, strategic planning and infrastructure management related to commercial and recreational boating –including some of the boat ramps and public jetties, wharves and pontoons across NSW. MIDO have historically provided matched funding for a number of projects in Tuggerah Lakes. • May participate in the development of CMPs and shall have regard for its content.
Marine Rescue NSW (Tuggerah Lakes Unit) (Stakeholder)	**Land Ownership / Management:** • Nil. **Responsibilities:** • Marine Rescue Tuggerah Lakes is responsible for safety on the waters of Tuggerah Lake, Budgewoi Lake and Lake Munmorah. • They operate out of a North Base at Peel Street, Toukley (Budgewoi Lake) and a South Base at Lions Garden Drive, the Entrance North.
State Emergency Service (SES) (Stakeholder)	**Land Ownership / Management:** • Nil. **Responsibilities:** • NSW State Emergency Service (SES) is an emergency and rescue service dedicated to assisting the community including flood and storm emergencies, road accident rescue, vertical rescue, bush search and rescue, evidence searches (both metropolitan and rural) and other forms of specialist rescue that may be required due to local threats. • NSW SES also assists other emergency services when they are performing major operations. These services include the NSW Police Force, the NSW Rural Fire Service, Fire and Rescue NSW and the Ambulance Service of NSW.

In addition, the NSW Government recognises the Darkinjung Local Aboriginal Land Council (LALC) as a unique and significant landowner on the Central Coast with responsibilities to improve, protect and foster the best interests of Aboriginal persons within the region making them a key cultural heritage stakeholder.

A range of representatives from relevant public authorities, the Tuggerah Lakes Expert Panel, expert consultants, the Local Aboriginal Land Council and internal Council departments were involved in development of this Scoping Study, in particular the First-pass Risk Assessment (**Section 3.4**) and Forward Plan (**Section 5**) including:

- NSW Department of Planning Industry and Environment (Environment, Energy and Science; Biodiversity and Conservation Division)
- NSW Department of Planning Industry and Environment (Environment, Energy and Science; Science, Economics and Insights Division)
- Department of Primary Industries (Fisheries)
- Local Land Services
- DPIE - Crown Lands
- Environment Protection Authority (EPA)
- Transport NSW
- Transport NSW (Maritime Infrastructure Delivery Office)
- University of Newcastle, and
- Darkinjung Local Aboriginal Land Council.

Council is committed to continuing to work with all relevant public authorities throughout CMP development (Stages 1-4) and implementation (Stage 5) via formal (Council Committees) and informal (Technical and Stakeholder Working Groups, Community Working Group) means. The relevant public authorities will be engaged through the Technical and Stakeholder Working Groups with collaboration being a key feature of this CMP. More detail is provided in **Section 5.2**.

2.4. Community and Stakeholder Engagement

The Tuggerah Lakes Expert Panel highlighted the fundamental importance of working collaboratively with the local community to develop strategic and measurable plans for Tuggerah Lakes and to integrate them into the CMP. Specific community engagement and communication recommendations included:

- "Focus engagement on learning together rather than solving 'the problem' or 'fixing' the *Lakes*."
- "Work with the community to grow a shared understanding of the *Lakes*' management dilemmas – what is actually going on and what makes managing the *Lakes* so difficult."
- "Build on the dilemma work to co-create a shared picture of the realistic and preferred outcomes for the *Lakes*."
- "Work with the community to design and agree to a decision-making process to determine potential and prioritised management actions, and to implement them."

During early 2021, Council Officers commenced a series of small-scale community focus groups to help devise a Community and Stakeholder Engagement Strategy with these principles in mind. Participants were asked to provide input into engagement methods, reach and gaps/barriers. These conversations informed the key messages, stakeholders and engagement methods and began the process of building transparency, understanding, trust and respect. The Final Community and Stakeholder Engagement Strategy is presented in Appendix A and will be delivered throughout the course of CMP development and implementation.

Consultation commenced for all Central Coast CMPs in April 2021 with the launch of a dedicated online ***Our Coast, Our Waterways*** consultation hub and community survey. The comprehensive engagement program, which fortunately occurred during a period when COVID-19 restrictions had somewhat relaxed is summarised below:

- **3,918** visits to the Your Voice Our Coast project page
- **1168** community survey responses received
- 14 x social media ads across Facebook and Instagram, reaching **62,011 unique users** (263,341 impressions, **2,074 link clicks**).
- Snap chat ads, generating **128,212 impressions**
- 8 x Google display ads, generating **815,340 impressions, 819 clicks**
- 2 e-news articles distributed, generating **97 clicks**
- over **350** respondents entering the focus group candidate pool
- over **220** stakeholder emails sent
- 3 focus groups hosted with over **20 participants**
- over **400** community members reached at pop up and community events, and
- over **500** postcards distributed.

The degree of participation in the community survey is an excellent result and is testament to the level of community interest in our local waterways and the values placed upon them. A few key outcomes for the Tuggerah Lakes catchment included:

- 75% of respondents use our local waterways either daily or weekly.
- 93.3% said that waterways are a significant reason they choose to live on the Central Coast.
- 86.7% said that if waterways access, safety or condition significantly declined they would reduce the frequency of visits and 40% said that they would consider moving away from the Central Coast.
- 80% of respondents think more should be done to enhance waterway access.
- 100% of respondents think more should be done to protect and enhance the natural aspects of waterways such as the cleanliness of water, health of coastal vegetation, and the protection of wildlife.

The Stage 1 Engagement Report is provided in **Appendix B**.

2.4.1. Volunteering for the environment

Central Coast Council's Environmental Volunteering Program supports the community to take a hands-on role in conservation, protection and remediation of our rich environmental heritage. A range of volunteering opportunities exist in bushland, coastal areas, lake foreshores, parklands, cemeteries and high conservation areas such as wildlife corridors and the Coastal Open Space System across the Central Coast.

Each group's volunteer activities and unique purpose are identified by Landcare, Bushcare, Coastcare, Dunecare, Tidy Towns or Friends Of groups. The common thread is an appreciation and understanding of the value of green spaces to the community, the value of habitat connection to larger remnants, and the intrinsic value of healthy, functional ecosystems. Our volunteers play an essential role in making this happen.

The *Our Coast, Our Waterways* community survey indicated that 46% of respondents volunteer time for waterways or assist with events at waterways. Providing ongoing support to these groups through existing and new programs will build upon this growing activism and stewardship of the Tuggerah Lakes catchment and achieve better outcomes for the estuary in the longer term. This should be closely linked to the delivery of the Community and Stakeholder Engagement Strategy (**Appendix A**).

2.5. Environmental context

The **Tuggerah Lakes Expert Panel Final Report (Glamore et. al., 2020)** details the environmental characteristics of the estuary including physical features and processes, habitat extent and health, catchment characteristics and pressures, and potential climate change impacts. For the sake of brevity, only key aspects are reiterated herein and expanded upon in in Appendix D to fully satisfy the requirements of the Coastal Management Manual and CMP Checklist. Readers are encouraged to review the findings of the Tuggerah Lakes Expert Panel, which represents the most comprehensive recent summary of research and scientific understanding of the Tuggerah Lakes estuary and includes significant input from the local community.

The coastal zone within the Central Coast Local Government Area (LGA) is identified under the Coastal Management Act as being part of three coastal sediment compartments: 1) Central Coast, 2) Newcastle Coast (part) and 3) Broken Bay (part). In addition, there are two estuaries identified under the CM Act within the Central Coast LGA - 1) Lake Macquarie and 2) Hawkesbury River (part); Tuggerah Lakes is not included.

As described earlier, the Tuggerah Lakes estuary comprises three shallow, interconnected coastal waterbodies, namely Tuggerah Lake, Budgewoi Lake and Lake Munmorah which are open to the ocean via a heavily shoaled entrance located in the suburb of The Entrance. The entrance channel is naturally variable and has never been considered formally navigable. Tuggerah Lakes is the eighth largest estuary in NSW, occupying an area of approximately 81 square kilometres (OEH, 2013) in total comprising approximately 58.95 square kilometres for Tuggerah Lake, 13.88 square kilometres for Budgewoi Lake and 8.26 square kilometres for Lake Munmorah (OEH, 2013).

The estuary is shallow and perched above sea level at between 0.2 and 0.4m AHD (WMAWater, 2014) with a normal storage volume of approximately 172,000 mega litres, and under these conditions, average depths are 3.0m, 2.0m and 2.5m for Munmorah, Budgewoi and Tuggerah Lakes respectively (Glamore et. al., 2020). It spans across a relatively low-lying and flat floodplain where much of the urban development is situated.

The Tuggerah Lakes catchment is around ten times the size of the waterway itself at approximately 790 square kilometres (MHL, 2021) and takes in the plateaus of Kulnura and Somersby, the river valleys of Dooralong, Yarramalong and Ourimbah, and the floodplains wrapping around the waterway from Lake Munmorah to Bateau Bay. The catchment includes the population centres of Tuggerah, Berkeley Vale, Lake Haven and Toukley, and is the traditional land of the First Nations People.

The Tuggerah Lakes catchment encompasses many habitats from the ridge escarpments through forested hillslopes, alluvial valleys and riparian corridors, freshwater streams, coastal wetlands and saltmarshes, rocky shorelines, soft sediment deposition zones, seagrass and macroalgal beds, and the shallow lake basins. This natural complexity and diversity makes the area important environmentally and socially, and underpins the high value placed upon the estuary and its catchment by the community.

Loss of seagrass and the abundance of seagrass and macroalgal wrack are key focus issues for the community and have been for decades. More detail on seagrass abundance and diversity and wrack formation and fate are provided in **Appendix D.** A review of wrack management practices, procedures, costs, benefits and expectations is proposed in Stage 3 (**Section 5.3**) and will be a key community engagement point.

A host of hydrodynamic and ecological studies of Tuggerah Lakes have repeatedly concluded that the bulk of inflow to Tuggerah Lakes is via catchment runoff, that oceanic influence is limited, and that in order to improve the trajectory of water quality and ecological health, a significant focus should be on sustainable catchment management (Glamore et.al., 2020). In addition, in recognition of the keen community interest in the management of the entrance channel in particular, specific reviews of coastal processes and socio-economic values are proposed in Stage 2 an revised Entrance Management Strategy is proposed in Stage 3 (**Section 5.3**). These will also be key community engagement points during development of the CMP.

The complex ecosystem processes and interrelationships are further described in Appendix D along with the physical features, ecological and anthropogenic processes, habitat condition and extent, threatened species and individual ecosystems

of significance. **In recognition of the significance the catchment plays in the health and function of the estuary, the CMP will apply to the whole catchment area, not just the defined coastal zone.**

2.5.1. Water quality and ecological health

Council appreciates the importance of maintaining and improving the water quality of waterways on the Central Coast and actively undertakes a range of programs to monitor and address both ecological and recreational water quality. These programs are long-standing and provide objective and scientifically valid information to inform the community and underpin management decisions. Without these feedback mechanisms in place, the capacity to understand the effectiveness of management actions and direct future decisions is compromised.

In addition to routine estuary monitoring, both catchment modelling and catchment monitoring (currently in draft) have been undertaken to identify priority catchments and assist in prioritising remediation action. These are further described in **Appendix D** and the results of catchment monitoring work will inform future stages of the CMP.

The influence of groundwater, particularly as a nutrient contamination pathway has recently been explored through a grant funded research initiative at Berkeley Vale (CCC, DPIE, SCU collaboration). Groundwater often has much higher concentrations of nutrients and other contaminants (e.g. heavy metals) than surface waters (Glamore et. al., 2020). In addition to concentrations, it is important to understand groundwater nutrient loads in order to evaluate the impacts, i.e. how much of the nutrient rich groundwater is passing through to the estuary and what effect it is having. Preliminary results indicate that in some places groundwater may be a significant contributor to nearshore water quality decline and more work will be required to explore the extent, impacts and the viability of any potential management and/or treatment options (**Appendix D**). This information will also help to inform future modelling scenarios and build a more holistic picture of ecological health and ecosystem response to catchment stressors.

2.5.1.1. Estuary ecological health monitoring

Ecological health in the Tuggerah Lakes estuary is measured through an objective and scientifically rigorous monitoring, evaluation and reporting program which uses turbidity, chlorophyll-a concentrations and seagrass depth range as the indicators of catchment pressures and system response. A range of other variables are also measured to build a more complete picture of water quality conditions through time. The program is designed to be consistent with the **NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Protocols** and to address locally relevant issues. By following the MER protocols, waterway ecological health can be compared to other estuaries throughout NSW. This program has been in place for Tuggerah Lakes since 2011-12.

A range of land uses and the rate and degree of land use change largely dictate the conditions we see in the **estuary today** (McCann, 2019). Clearing of native vegetation in the catchment paired with urban land use intensification have placed ever increasing pressure on the estuary. Being naturally poorly flushed and shallow, Tuggerah Lakes is inherently more sensitive to these impacts than many other estuaries along the NSW coastline.

Ecological health in the estuary has been improving with 56% of sites exhibiting an improvement, 13% remaining stable and 31% declining over the preceding nine years (**Appendix D**). The CMP process will assist in identifying priority sub-catchments and focus areas. A reasonable starting point would be those sites that routinely receive a fair or lower grade as well as those where minor declines have been observed. The relevant sub-catchments should be prioritised for further investigation by applying a risk-based approach and addressing the most pressing problems first.

On average, ecological health and overall water quality has remained fair (C Grade) to good (B Grade) since the monitoring program began. Locally this can be compared to Lake Macquarie, which is routinely graded excellent (A Grade); Brisbane Water which ranges from fair (C Grade) in the upper estuary to good/excellent (B/A Grade) in the main basins and tidal zones; and the smaller coastal lagoons which range from very poor (Avoca) (F Grade) though fair (Terrigal/Wamberal) (C Grade) and excellent (Cockrone) (A Grade). On a bioregional scale, Lake Illawarra and the coastal lagoons on the northern beaches typically receive similar grades to Tuggerah Lakes using comparable monitoring programs.

Figure 2.15 includes the results from **2019-20** which included an excellent grade for Chittaway Bay, good for Lake Munmorah and the majority of sites in Tuggerah Lake and fair results for Budgewoi Lake and some fringing sites around Tuggerah Lake including Canton Beach, Ourimbah Creek and Tumbi Creek (Central Coast Council, 2020c). For reference:

- **A = Excellent:** The indicators meet all benchmarks for more than most of the year. Equal to the best 20% of scores in NSW
- **B = Good:** The indicators meet all benchmarks for most of the year. Equal to the next 30% of scores in NSW
- **C = Fair:** The indicators meet some benchmarks for part of the year. Equal to the next 30% of scores in NSW
- **D = Poor:** The indicators meet few benchmarks for part of the year. Equal to the next 15% of scores in NSW
- **F = Very Poor:** The indicators never meet benchmarks. Equal to the worst 5% of scores in NSW.

Other more concerning trends over the past few decades include loss of seagrass and saltmarsh, declining condition and physical relocation of seagrass in response to persistent reduced water quality, poor mixing and circulation, nearshore eutrophication and sediment quality decline (McCann, 2019 and **Appendix D**). Whilst the greatest impacts occurred during the 1980's and 90's, recovery is slow and it is unclear what levels of future pressure the estuary can sustain. A trophic shift from a seagrass dominated system to a macroalgal/phytoplankton dominated system is an extremely undesirable outcome and it is recommended that the current catchment models be reviewed and updated to identify sustainable catchment loads and to determine appropriate development controls for future urban growth (**Section 5**).

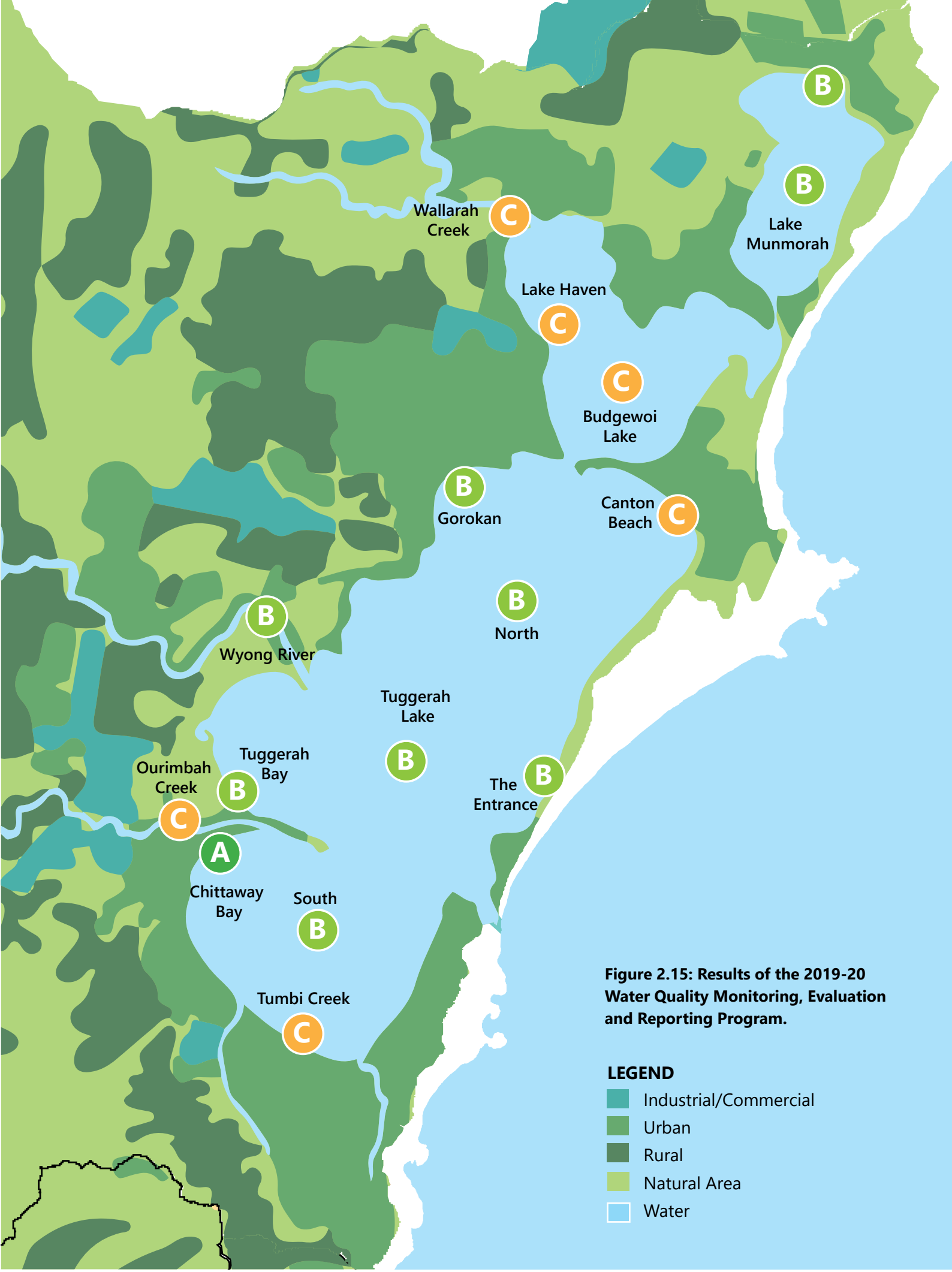


Figure 2.15: Results of the 2019-20 Water Quality Monitoring, Evaluation and Reporting Program.

2.5.1.2. Recreational water quality monitoring

The NSW State of the Beaches Report and the Beachwatch program is a separate program focused on water quality as it relates to recreational swimming guidelines and uses microbial contamination (enterococci bacteria) as the indicator. To monitor water quality for community swim safety, Central Coast Council undertakes routine recreational water quality monitoring at **32 locations on the Central Coast**. In Tuggerah Lakes, sampling is undertaken at Lake Munmorah baths and Canton Beach baths. Sampling nearby but outside of the study area is undertaken at North Entrance Beach, the Entrance Beach and the Entrance ocean baths.

Any beach, waterway, lake or lagoon in a developed or developing area will have less than optimum water quality for recreational purposes. This is particularly relevant for estuarine and lagoon sites where flushing is less frequent. The main impacts on water quality in developed or developing areas are stormwater run-off and sewer overflows and leaks. Poor water quality in urban areas is not a new phenomenon, and waste materials affecting waterways and the ocean is a common issue in both developed and developing countries. Monitoring programs, like NSW Beachwatch and Waterwatch, are undertaken to identify locations that experience water quality declines and to prompt audit investigations and improvement programs. Whilst Beachwatch offers a high-level warning system to flag problem areas, more detailed catchment audits are required where persistent poor results are observed.

The designated swimming sites in Tuggerah Lakes, Canton Beach baths and Lake Munmorah baths routinely receive "poor" ratings in the **NSW State of the Beaches Report**. Whilst this is not uncommon for estuary sites that are assessed using this method, further catchment investigations at Canton Beach are recommended based on recent trends in the 95th percentile enterococci rating and Microbial Assessment Category determined through this program.

North Entrance Beach, the Entrance Beach and the Entrance ocean baths all received "good" ratings in 2019-20 which have remained stable.

2.5.1.3. Water quality expectations and future monitoring

Unfortunately, much of the discourse surrounding Tuggerah Lakes relates to community expectations of what good water quality means and what is achievable for Tuggerah Lakes both now and into the future. As the **Tuggerah Lakes Expert Panel** recently described, many of the issues are complex and interrelated, and undoing the damage already caused will be a long-term proposition that requires intergovernmental commitment and support, integrated evidence-based management, reliable funding, and above all else, collaboration.

An important step in the CMP will be to identify an appropriate water quality and ecological health standard based on realistic expectations and to build in additional variables that target the key concerns of the community. Notably, this should include an evaluation of sediment health, which for Tuggerah Lakes is equally as important as water quality and relates closely to the aesthetic and recreational values the local community hold. Other indicators that align with the key focus areas and CMP objectives should be developed and implemented. **Healthy Land and Water** in South East Queensland provide some great examples of applicable indicators that link to biodiversity, ecological health and community values (social, economic, cultural).

Expansion of existing citizen science programs to support future monitoring is also highly recommended. Well planned and well delivered citizen science can offer additional data along with the benefits of community education and shared learning, empowerment and a shift towards community stewardship and behaviours that support the shared vision.

2.5.2. Significant events since last CZMP

The Tuggerah Lakes Estuary Management Plan (EMP) was certified as the relevant Coastal Zone Management Plan in 2007. Since then, Council has received more than $30.95 million in Australian Government grants to implement relevant aspects of the EMP. A detailed **summary report** was published in 2020 and a current **map of projects** is maintained online. The summary report outlines the actions undertaken to implement the EMP, with 86% of actions being either complete or ongoing. An overview table is also provided in **Appendix E**.

The EMP was prepared during the millennium drought when water scarcity, lower average water levels, poorer shoreline and saltmarsh inundation, and less runoff were more common. The drought broke in 2007 with a number of significant flood events (>1mAHD) to follow including 2007, 2011, 2015, 2016, 2020 and 2021. Whilst the highest flood recorded for the estuary was 2.1 mAHD in June 1949, the most recent flooding events in February 2020 and March 2021 reached heights of 1.67 mAHD and 1.52 mAHD respectively. The 'Pasha Bulker' flood from June 2007 peaked at 1.65 mAHD whilst the February 1990 and March 1977 floods also reached 1.6 mAHD. Flooding and coastal inundation are challenging parts of living on and managing a coastal floodplain. These are not issues that can be solved or prevented, but our collective management of floods, our preparedness for future events and our response to emergencies can improve incrementally by working together with community and lead emergency management agencies. Flooding is managed in accordance with the NSW Government's **Floodplain Management Program** through the development and implementation of Floodplain Risk Management Plans. The CMP will have regard for these plans and where overlap exists, will ensure there are no discrepancies in management recommendations and actions. For more information on **flooding around Tuggerah Lakes** and **preparing for floods**, please visit Council's website.

Climate change and the associate coastal risks were not well identified or explored when the Tuggerah Lakes EMP was prepared. Significantly better

information and estimates have become available since, and Council now has a Climate Change Policy in place. The risks and mitigating measures associated with climate change will be identified and evaluated in more detail as part of this CMP.

In 2014, the Munmorah Power Station was decommissioned. The Power Station has been in operation since 1967 and a range of modifications to the estuary were made to accommodate its operation. The changes to water flow, temperature and salinity that occurred during operation were not lasting after decommissioning, and studies have demonstrated that the changes were not significant enough to have been the primary driver of eutrophication (Glamore et. al., 2020).

In terms of water quality and ecological health, ongoing development pressure across the broader catchment area has potentially reduced the efficacy of improvements made as a result of EMP implementation (**Appendix E**). Significant catchment improvements including riparian, wetland and saltmarsh restoration alongside targeted Water Sensitive Urban Design (WSUD), are not enough to overcome the pressures of ongoing development in the long term. For this CMP to be effective, it will need to build on the extensive pool of existing achievements, information and knowledge and focus heavily on improved land use planning, infill development controls, point source discharge, WSUD in existing urban areas, community education and behaviour change initiatives. These are challenging, long-term programs that will not see changes overnight and will need strong support to achieve.

Fortunately, with the comprehensive understanding of ecological processes in Tuggerah Lakes resulting from decades of detailed research and modelling, a Processes Study is not required to progress the CMP. However, as discussed earlier, refinement and calibration of the catchment models should be undertaken in order to more clearly understand the cause and effect of proposed land use change and to prioritise management actions. In particular, an emerging understanding of groundwater and its impacts on ecological processes health should be further explored.

Finally, a steadily growing population paired with the exponential growth of social media since the early 2000's has led to significantly greater public interest in the current and future health of the estuary. This has resulted in some positives, namely the appointment of the Tuggerah Lakes Expert Panel by the NSW Government in 2020 to provide objective scientific advice on the water quality of Tuggerah Lakes, but also some challenges in the form of the many competing theories, agendas and "solutions" raised to solve the estuary's complex problems and the complex politics that ensues. Fortunately, the Expert Panel Report provides a way through this which is built on mutual respect, trust building, true collaboration and evidence-based decision making. As demonstrated in the Community and Stakeholder Engagement Strategy (**Appendix A**), it is the intention of this CMP to use this opportunity as a fresh start with the community and to work together towards a shared vision for Tuggerah Lakes.

2.6. Socio-economic context

The most recent Australian Bureau of Statistics (ABS) data for the Central Coast LGA (2018) records a resident population for the whole LGA as 342,047. On a 25-year average, the Central Coast population grows at approximately 1% per annum. Tuggerah Lakes is located at the centre of NSW's fastest growing corridor, between Sydney and Newcastle. The Central Coast Regional Plan 2036 forecasts the Central Coast population will increase by 75,500 people from 2016 to 2036, growing to be home to a total of 415,050 individuals. Key growth areas are centred around the suburbs of Wyong and Warnervale with the planned Warnervale Wadalba Land Release Area and Northern Growth Corridor which both sit within the Tuggerah Lakes catchment.

The population within the Tuggerah Lakes catchment is dispersed across a range of urban and rural settings, however the majority of residential development is focused in the coastal zone. There is continued demand for residential development within the region, catering for new households being formed from within the existing population of the Central Coast and people moving to the region (primarily from Sydney). The number of dwellings recorded at 2016 in the Central Coast LGA was 145,958. This is projected to increase to 184,129 by 2036 - an increase of 26.2% (ID, 2021). This has applied significant pressure for residential expansion within the region.

The Central Coast LGA's Gross Regional Product was $15.52 billion in the year ending June 2020, (ID, 2021). Healthcare and social assistance, retail trade and construction are the largest employers generating nearly 50,000 local jobs in 2019/20 (ID, 2021). Tourism is another key industry for the Tuggerah Lakes catchment and the broader Central Coast region. Tourism is an important part of the local economy and tends to be focused on the coastal regions of the LGA. In 2018/19, the total tourism and hospitality sales in Central Coast Council area was $1.93 billion. For 2018/19, there were 875,992 international visitor nights in the Central Coast Council area, accounting for 9.4% of the total visitor nights. The main tourism sector is domestic, with 4,343,114 domestic visitor nights (46.4%) recorded in 2018/19. Domestic day trips revealed similar number at 4,149,784 (44.3%) for the same period.

Further detail on the socio-economic context including discussion on economic performance, infrastructure, population, business, tourism and agriculture is provided in **Appendix C**.

2.7. Heritage and cultural context

2.7.1. Aboriginal heritage

The Tuggerah Lakes estuary and catchment has a rich and long-lasting Aboriginal history and forms part of the traditional Country of the First Nations People. Darkinjung Local Aboriginal Land Council has remit over the traditional boundaries of land extending from the Hawkesbury River in the south, Lake Macquarie in the north, the McDonald River and Wollombi up to Mt Yengo in the west and the Pacific Ocean in the East.

The Darkinjung people have a well-documented heritage with artefacts such as open campsites, axe-grinding grooves, rock engravings, burial areas and stone arrangements abundant in the area. The Darkinjung Local Aboriginal Land Council (2020) asserted that in 2020 there were 2,985 registered Aboriginal sites located within their boundaries.

Aboriginal people have lived within the Australian coastal environment for many thousands of years and continue to have a strong connection with the coast. The waterways have always been a focal point of the Indigenous culture. Local communities used the sites around Tuggerah Lakes estuary for shelter, cultural meetings, traditional burials and hunting. To this day, they cherish the estuary as a source of food and a vital space used for recreation and teaching traditional fishing practices to the young generations.

Census data from 2011 and 2016 show that the Central Coast Council LGA has a growing Indigenous population. The Aboriginal population of the former Wyong Shire Council LGA (which encompasses the study area) has increased from 5,436 (equivalent to 3.5% of total population) in 2011 to 7,787 (or approximately 5% of population) in 2016 (ID, 2021).

2.7.2. European heritage

Heritage consists of the places and objects that we have inherited from the past and that we want to pass on to future generations. The Central Coast region has a diversity of heritage buildings and places ranging from churches, farm structures, hotels, ocean baths, trees, old tracks, wharfs, shops, cemeteries, houses, streetscapes and archaeological sites.

On the Central Coast, there are approximately 500 heritage items and draft heritage items listed on environmental planning instruments and a total of three heritage conservation areas, which encompass areas at Wyong and the Entrance. The Central Coast currently has 22 state heritage listed items within the local government area which fall under the protection of the *NSW Heritage Act 1977*. It also has 364 local heritage items listed under the LEP.

2.8. Future context

The Central Coast is a region undergoing environmental and socio-economic changes. These are expected to continue and be exacerbated in the future. Two of the biggest future challenges for the Tuggerah Lakes estuary are:

- **Population growth and demographic change** – with an ever-growing population and planned growth within the estuary catchment areas, Tuggerah Lakes and its environment will be subject to increasing pressures arising from land use change and intensification.
- **Climate change and its associated coastal risks,** which extend to changes in weather patterns (frequency/intensity of extreme events) plus rising sea levels will drive significant changes to physical and biological characteristics of the coastal environment.

2.8.1. Population growth and development intensification

Growth plans for the region are outlined in the NSW Government's *Central Coast Regional Plan 2036*, which identifies the northern part of the LGA (i.e. Tuggerah Lakes catchment) as the best place to accommodate future growth in the Central Coast. This has been further explored / outlined in subsequent strategic planning documents.

The *Central Coast Local Strategic Planning Statement* (LSPS) estimates that the Central Coast LGA population will grow by 75,500 over the coming 15 years (including 41,500 new dwellings). The future 2036 growth projections are focused on:

- **Emerging Growth Areas:** Greater Warnervale, which encompasses Warnervale and Lake Haven (>3% population growth; ~200 – 900% dwelling/ development increase, relative to 2016);
- **Emerging Town Centre:** Lake Munmorah (>3% growth; ~100-200% dwelling / development increase);
- **Growth Corridor:** Tuggerah to Wyong (2-3% growth; >25-100% dwelling/ development increase);
- Future urban release proposed for Greater Warnervale and Lake Munmorah;
- Infill development proposed for Wyong and The Entrance.

Being a large, shallow estuary with a minor capacity for oceanic flushing, these future development pressures have the potential to change hydrology and further reduce the efficacy of the catchment to absorb and treat excess runoff resulting in additional pollutants, turbidity, and nutrients reaching the estuary via overland and groundwater pathways. This will ultimately compound existing urban impacts and result in further unacceptable ecological health impacts if not managed appropriately. Sound, integrated forward planning across all levels of government will be required to address these complex issues. As noted by the Tuggerah Lakes Expert Panel, the current development planning controls do not ensure that the future water quality in Tuggerah Lakes will be maintained or improved (Glamore et.al., 2020). Future decisions in this area will need to ensure adequate emphasis on water sensitive urban design remains front of mind to ensure the "death by a thousand cuts" approach does not continue. It is not sufficient to manage water quality as a secondary outcome in the land use planning process.

A number of key steps are required in order for this process to be realised, specifically an extension of the existing catchment and receiving waters models to identify sustainable catchment loads and priority catchments. This a key knowledge gap and will be essential in determining what level of future development can be sustained in order to achieve an agreed downstream condition. Further to this, interim and future water quality controls should be revised as a matter of priority to offset future impacts. The Tuggerah Lakes Expert Panel recommend an initial transition to new 'maintain or improve' (from existing 2020 conditions) targets until the sustainable loads are identified. The process to integrate this recommendation is lengthy and should be commenced as early as practicable.

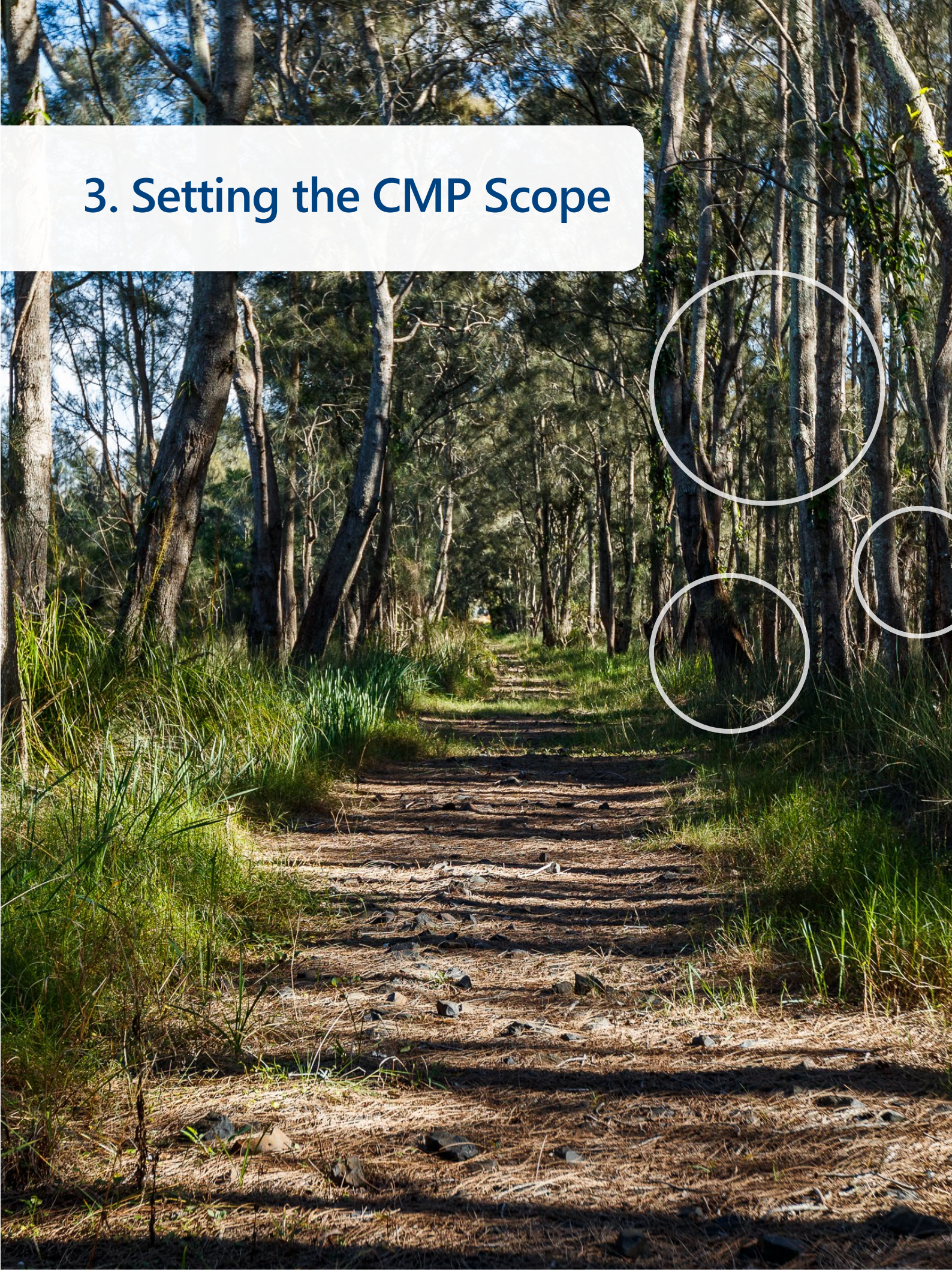
The Stage 1 *Our Coast, Our Waterways* survey, which was designed to ascertain community values and uses of the Central Coast coastal zone, reported that for over 95% of respondents waterways are a significant reason they choose to live on the Central Coast, effective management now and into the future will be paramount **(Appendix B).**

2.8.2. Climate change and its associated coastal risks

The threat of climate change and its implications are expected to put pressure on species, ecosystems, the community, urban areas and industries located within (and those reliant on) the Tuggerah Lakes estuary and its catchment. Council has recently set out the adopted approach to climate change in the **Central Coast Council Climate Change Policy 2018** (Central Coast Council, 2019). The Policy identifies Council's position relating to climate change with a view to maximising the economic, social and environmental wellbeing of the Central Coast community and guides the planning and development of the region as well as supporting community initiatives to respond to climate change.

The CSIRO and Intergovernmental Panel on Climate Change (IPCC) regularly update the projections for key climate change parameters such as sea level rise and temperature and the CoastAdapt website houses the contemporary projections (NCCARF, 2017). The most recent IPCC emissions scenarios used are described as Representative Concentration Pathways (RCPs) and range from very low emission scenarios (RCP2.6) to very high (RCP8.5) emission scenarios. A range of future projections based on these RCP scenarios have been produced for Australian coastal councils (coastadapt.com.au). It is important to note however that the current projections apply a simplified elevation-based filling approach and do not adequately consider the specific entrance conditions that control the interaction between the estuary and the ocean. More detailed localised modelling is required to understand the likely future impacts of predicted sea level rise on the Tuggerah Lakes catchment.

3. Setting the CMP Scope

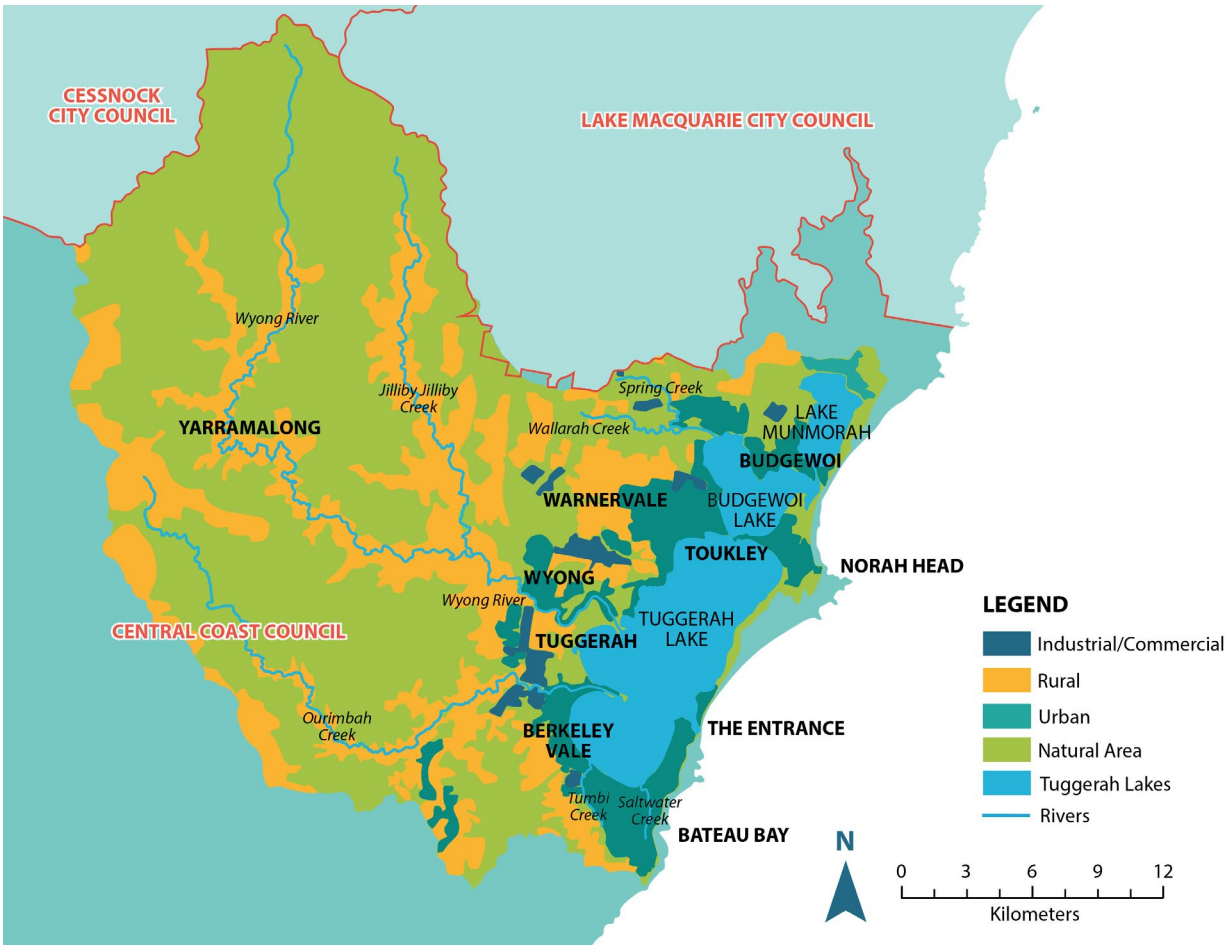


3.1. Geographical scope

As discussed in Section 1.1.3, the geographical scope of Tuggerah Lakes Estuary CMP and the relevant study area includes the estuary, catchment and entrance to the ocean, as shown in Figure 3.1.

The upstream boundary of the CMP aligns with the catchment boundary, in recognition that catchment practices and inputs play a fundamental role in the current and future condition of the rivers, wetlands, coastal use areas and the main waterbody. This approach was recently endorsed by the Tuggerah Lakes Expert Panel (Glamore et. al., 2020). The downstream boundary includes the coastal catchment which drains to Tuggerah Lakes and the entrance compartment. Ocean draining catchments along the southern boundary of Lake Munmorah, Budgewoi Lake and Tuggerah Lake are excluded as are North Entrance Beach and the Entrance Beach. These are captured in the Open Coast and Coastal Lagoon Coastal Management Program being prepared concurrently.

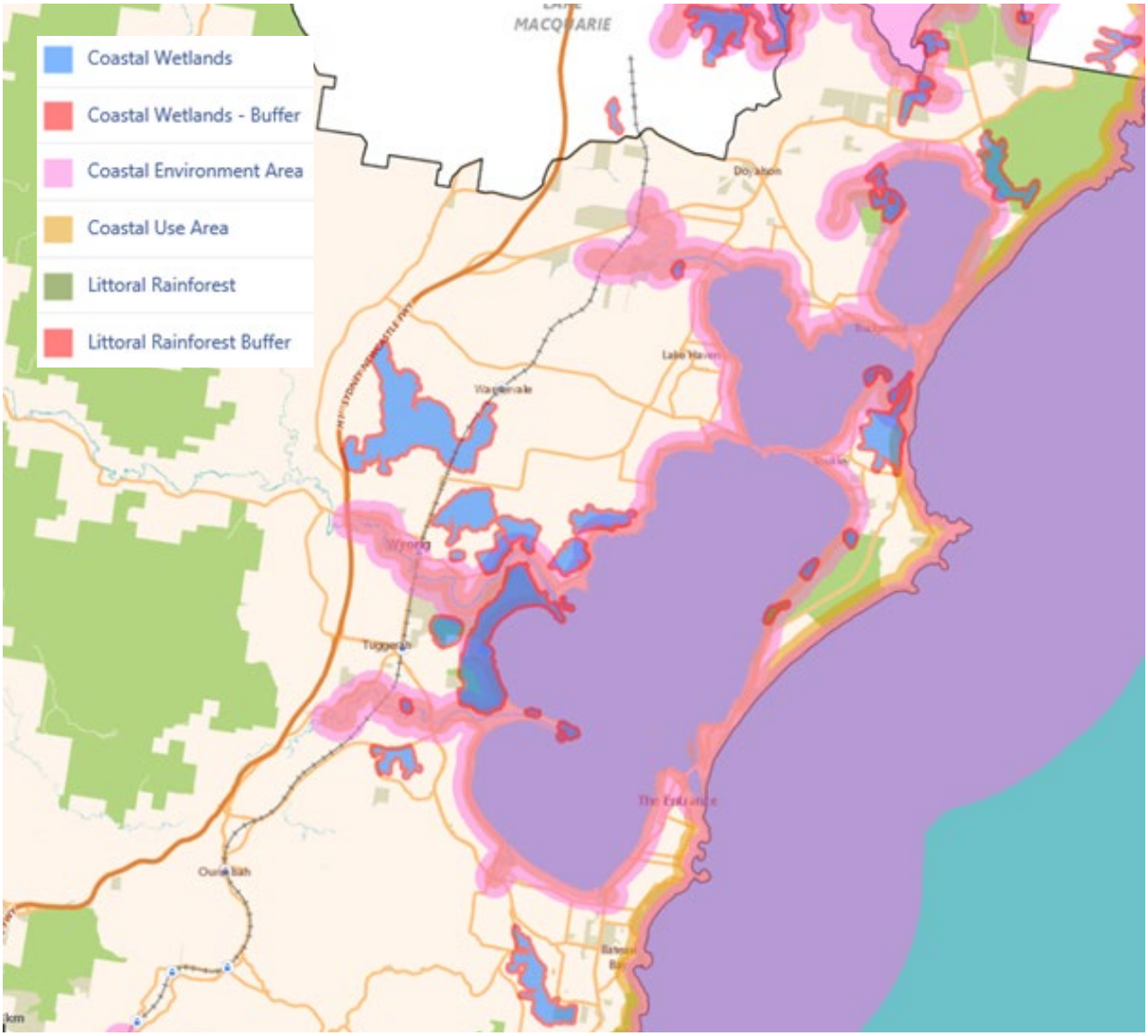
Figure 3.1: Study Area of the Tuggerah Lakes Estuary Coastal Management Program



3.2. Coastal management areas

The Tuggerah Lakes Estuary coastal zone is made up of the four NSW coastal management areas (CMAs), as outlined in the Coastal Management SEPP 2018. The Tuggerah Lakes Estuary CMP will include all four CM SEPP CMAs, as summarised and mapped in Figure 3.2. The Coastal Vulnerability Area is not currently mapped for the Central Coast LGA. It is anticipated that information in relation to coastal hazards collected during the development of CMPs across the region will inform a future planning proposal to define and map the CVA across the Central Coast LGA.

Figure 3.2: CM SEPP Coastal Management Area mapping for Tuggerah Lakes estuary



3.2.1. Coastal Wetlands and Littoral Rainforests

The Tuggerah Lakes estuary has several instances of coastal wetlands (fresh, brackish and saltwater) currently mapped throughout the estuary's catchment. As described in **Appendix D**, more recent local scale mapping provides additional sites which were previously unmapped. This mapping will be used to inform a future planning proposal to update the CM SEPP mapping. A Wetland Refugia study is recommended for Stage 2 to understand relief areas for landward migration of coastal wetlands under future climate change scenarios. Additional mapping and threat identification is not required noting that due to its complexity, Porters Creek Wetland has been evaluated outside of this process. A review of the outcomes of current studies related to Porters Creek Wetland will be required to identify any outstanding knowledge gaps.

According to the current mapping, the largest density of coastal wetlands is found in the area west of Tuggerah Lake across the suburbs of Chittaway Point, Tuggerah, Tacoma South, Tacoma, Tuggerawong, Wyong and Warnervale. Budgewoi Lake has its largest area of mapped coastal wetland located in Noraville bordering the Toukley Golf Course. Lake Munmorah has two sizable coastal wetland areas, one in the Colongra Swamp Nature Reserve and a second in the Munmorah State Conservation Area. There is a small section of littoral rainforest currently mapped on the eastern edge of Tuggerah Lake, located directly north of the Magenta Shores Golf Course (**Appendix D**). Photos showing indicative coastal wetlands within the catchment area are provided in Figure 3.3 and 3.4.

Figure 3.3: Coastal wetlands – A network of freshwater coastal wetlands including Porters Creek Wetland surround the Tuggerah Lakes estuary

Figure 3.4: Coastal Saltmarsh on the foreshore of the Tuggerah Lakes estuary

3.2.2. Coastal Vulnerability

The Coastal Vulnerability Area (CVA) is land which is subject to current and future coastal hazards as defined in the *Coastal Management Act 2016*. Specifically, these include:

a) beach erosion
b) shoreline recession
c) coastal lake or watercourse entrance instability
d) coastal inundation
e) coastal cliff or slope instability
f) tidal inundation, or
g) erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

There is currently no gazetted map of the CVA for NSW within the Coastal Management SEPP. In order to have a CVA gazetted for the study area, hazard mapping that considers each of the coastal hazards and vulnerabilities defined in the *Coastal Management Act 2016* will be required. The coastal hazards relevant to the study area include coastal and tidal inundation, erosion and inundation of foreshores, and entrance instability. A tidal inundation and sea level rise assessment is proposed in Stage 2 of the CMP development (or as an activity to be implemented in Stage 5). The required studies to complete the CVA mapping are outlined in the forward plan in Section 5. This will then be followed by a Planning Proposal to formalise the CVA. Locations that are currently subject to tidal inundation provide an example of areas which may be subject to a future CVA pending the outcome of detailed modelling (Figure 3.5).

Figure 3.5: Coastal vulnerability areas – The Entrance township is an example of a location at risk from both catchment flooding and coastal inundation.

3.2.3. Coastal Environment

The Coastal Environment Area identifies the environmental features of the coastal zone, which in this case applies to the estuary as defined in **Section 1.1.3**. This area is mapped in order to protect and enhance the coastal environmental values and natural processes. **Figure 3.6** is an example of the Coastal Environment Area within the Tuggerah Lakes estuary.

The biophysical processes, current condition and threats within the Coastal Environment Area are well understood for the most part. Realistically, the extent of this zone extends upstream of the mapped estuarine extent, with connectivity of riparian corridors and catchment areas being equally important to the health of the downstream environment. This is described in detail in **Appendix D**. Additional refinement of the ecological response model will be required in Stage 2 to identify pollutant thresholds and sustainable loads to maintain (or improve upon) a desired downstream condition. From there, pollutant reduction targets can be formalised based on evidence and land use planning can be adapted to compensate. This process will be integrally linked with the vision, community values and CMP objectives.

Figure 3.6: Coastal environment – the health of terrestrial and aquatic ecosystems, and connectivity between them is key to the overall health of Tuggerah Lakes

3.2.4. Coastal Use

The coastal use area includes the land adjacent to the estuary that provides scenic, social and cultural values to the community. This area represents some of the most environmentally, economically and socially valuable land in the study area. This is very important to the local community with 100% of respondents to the Stage 1 *Our Coast, Our Waterways* survey indicating that they regularly use the local waterways for recreational purposes. A recreational use study is proposed in Stage 2 (or as an action in Stage 5) to better map out current recreational infrastructure, including usage, condition and connectivity and to identify opportunities to improve recreational connectivity and enhance the user experience. A photograph of a coastal use area is shown in **Figure 3.7.**

A greater understanding of the indigenous context and values will be required and will be explored through a Land and Sea Country Plan, with development to be led by the Local Aboriginal Land Council. More specific spatial plans for foreshore land use will be developed through concurrent programs, including the Foreshore Vegetation Management Plan which is currently under development.

Figure 3.7: Coastal use areas - the estuary is fringed by popular recreational spaces, shared pathways and community facilities. Embellishing these and providing better recreational opportunities should be a key feature of the CMP.

3.3. Coastal management values and issues

To successfully complete the first pass risk assessment, a critical first step is to define the values of the estuary and threatening processes or issues affecting the estuary and its values. Understanding the estuary's environmental, social and economic assets, and benefits (values) provides a pathway to understanding activities or processes that threaten them and that need to be managed through the CMP. The following key values were echoed repeatedly in the *Stage 1 Our Coast, Our Waterways* community survey and follow through from the Tuggerah Lakes EMP:

- Clean waters
- Biodiversity (ecosystem value)
- Geodiversity (form and process value)
- Cultural value
- Amenity, recreation and participation value
- Education and scientific value
- Economic value

The estuary is faced with a range of immediate pressures and future threats, that will be best managed through a strategic and integrated plan. A substantial list of potential threats was developed and reviewed based on a review of existing information and known coastal hazards and risks defined in the CM Act and the Marine Estate Management Authority state-wide **Threat and Risk Assessment**.

Based on outcomes of the stakeholder risk assessment workshop, the findings of the TLEP and the community survey, the following eight priority issue themes that collectively group similar threats were developed. These are:

- governance, engagement and communication
- catchment pressures and development
- ecology and water quality
- entrance management
- foreshore/nearshore and wrack management
- coastal hazards and climate risks
- heritage and culture, and
- resource conflicts and accessibility.

The Tuggerah Lakes Estuary CMP aims to manage the current and future threats to the estuary in a way that protects the values of our community.

3.4. First-pass risk assessment

A first-pass risk assessment was undertaken to identify and prioritise the key issues and threats to the Tuggerah Lakes estuary and its values, as well as assess management arrangements and recognise important knowledge gaps. The aim of this assessment was to determine the severity of known threats in the study area, at present and in the future, so that CMP actions can be directed to focus on the most appropriate risks. It is acknowledged that at this stage in the CMP process, data gaps exist when assessing risk. Highlighting where inadequate information or management arrangements exist through the first-pass risk assessment process will enable the CMP process to fill these data gaps providing a more complete understanding of the risks in subsequent stages. In addition, it will be important to incorporate the future planning horizons into this process to adequately capture risk at these timescales.

The preliminary risk assessment uses a relatively simple scale of low, medium and high level of risk that intrinsically considers the likelihood of each threat and corresponding consequence of potential impacts (rather than a full-scale consequence and likelihood risk matrix approach). A comparable scale of inadequate, moderate and adequate is used to assess adequacy of existing management arrangement and suitability of data.

In documenting risk, a traffic light colour classification (low, medium and high) was used:

Green/Low/Adequate – existing risk under control, risk management in place and working and little change or improvement into the future.

Yellow/Moderate - there is little risk or even if the risk is increasing there is little consequence to the study area, or where the risk is located in a small area.

Red/High - there is current risk, management is not effective and there is residual risk, it is likely to get worse in the future.

The outcomes of the first-pass risk assessment are summarised in **Table 3.1.**

*Risks shown in bold were identified as the highest priority by the community as part of the *Our Coast Our Waterways* community survey.

Table 3.1: First pass risk assessment outcomes

Issue Theme 1: Governance, Engagement and Communication

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Unclear governance and shared responsibilities	• Complex legislation • Existing management plan has strong focus on Council delivery (prepared under old coastal management framework) • Lack of formal engagement/collaboration within Council and between all levels of government • Lack of ownership on management issues, where jurisdictional ambiguity remains • Loss of confidence by the broader community in 'government' as a collective • Missed opportunity to pool resources and work toward common strategy	• Entire study area / Tuggerah Lakes estuary and catchment area	High	High	Moderate	Inadequate
Insufficient or ineffective community engagement	• Lack of engagement resources, capabilities or capacity • Ineffective communication (resources, skills, platforms, messages, processes) • Lack of trust in Council as a source of information • Lack of general awareness of Tuggerah Lakes processes and complexities • Lack of understanding of roles and responsibilities of various stakeholders • Lack of ownership of the issues and solutions • Unrealistic expectations on what can be achieved	• Entire study area / Tuggerah Lakes estuary and catchment area	High	High	Inadequate	Inadequate
Inadequate, inefficient, over and under regulation	• Lack of resources and/or regulations to manage impacts • Poor/illegal practices leading to undesirable impacts	• Entire study area / Tuggerah Lakes estuary and catchment area	High	High	Inadequate	Inadequate
Reliable funding sources and resourcing	• Council's current financial position • Ad hoc external grant funding • Funding rules constraining use and outcomes tied to specific projects that may not necessarily address priority issues from EMP/ CZMP • Ineffective communication (resources, skills, platforms, messages, processes) • Internal silos and time poor staff affect the ability of internal sections to collaborate effectively on complex, multifaceted projects • Lack of staff resources within Council to prioritise and embed actions into other processes (e.g. planning, road and drainage upgrade, operational activities) • Lack of skills/ support to identify opportunities and integrate improved coastal management outcomes into Council activities.	• Entire study area / Tuggerah Lakes estuary and catchment area	High	High	Inadequate	Inadequate

Issue Theme 1: Data and Management

Adequacy of Existing Management Arrangements

The existing management arrangements for governance, engagement and compliance centre on Councils roles, responsibilities, plans and policies. Council has coordinated and delivered a comprehensive range of engagement, education and compliance programs across many coastal value and issue themes previously however these appear to have had mixed response and/or take up. Various legislation is in place which outlines requirements, responsibilities and rules for coastal management and activities including the CM Act and CM SEPP. In the instance of major compliance or governance issues, these can be elevated to the Land and Environment Court. Within the Central Coast region, agency collaboration and distribution of shared responsibilities appears to be unclear for some issues which may be hindering management arrangements in some instances. The existing management arrangements are mostly considered inadequate at present and this is likely to be exacerbated in the future due to under resourcing and increasing governance, engagement and communication pressures and needs.

Suitability of Existing Data and Data Gaps

Information and data regarding engagement, governance and compliance is believed to be generally inadequate. Lack of resources and effective community engagement are key issues for Council that present opportunities to be addressed in Stage 2 and beyond. A diagnostic analysis of the efficacy of past engagement and education programs should be undertaken before further investment is made.

Issue Theme 2: Catchment Pressures and Development

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Catchment development	• Population growth: Regional plan forecast additional 75,500 people and 41,500 dwellings from 2016 to 2036 • **Inappropriate zoning/ planning*** • Growth Corridors and Land Release Areas • Physical and ecological disturbance • Water pollution • Changed tidal flows **(foreshore development*)**	• Warnervale Wadalba Land Release Area • Tuggerah – Wyong Growth Corridor • Northern Growth Corridor • Lake Munmorah • Spring Creek	High	High	Inadequate	Adequate
Urban stormwater runoff and discharges*	• Urban development • Inadequate infrastructure/ controls / compliance • Inadequate pollution reduction targets • Minimal/ no controls for small scale development • Water pollution (sediments/nutrients) • Hydrological changes (increased flows and velocities)	• Current nearshore catchments and heavily urbanised areas • Developments further afield (e.g. Warnervale) • Proposed Growth Corridors and Land Release Areas	High	High	Inadequate	Moderate
Agricultural runoff	• Extensive grazing, intensive animal production, dairies, turf farming, horses • **Water pollution (nutrients, organics)*** • Microbial contamination (non-human sources)	• Wyong River and Ourimbah Creek catchments	Medium	Medium	Inadequate	Moderate
Industrial and commercial land use	• Growth • Power station shutdown • Ash dam impacts • **Point source pollution*** • Groundwater contamination • Hydro/thermal changes	• Berkeley Vale, Tuggerah, Warnervale, Lake Haven and surrounds • Vales Point, Colongra sub-catchment	Medium	Medium	Inadequate	Moderate
Sewage effluent and septic overflows*	• Ageing infrastructure and system capacity • On-site Sewer Management (OSSM) maintenance and regulation • Illegal connections • Planned overflows • **Water pollution (nutrients, microbial contamination)***	• Central Coast region has disproportionate number of overflows when compared with other local regions (EPA pers. comm., 2020). • Designated swimming areas incl Canton Beach (high priority) and Lake Munmorah (moderate to low priority).	High	High	Inadequate	Moderate

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Catchment hydrology changes	• Water supply activity (offtake) • Weirs / other structures • Changes in flows • Changes in vegetation distribution/ strata • Impermeable surfaces • Obstruction in fish passage	• Water supply catchments (Wyong River, Ourimbah Creek) • Porters Creek Wetland • Urbanised catchments with increased impermeable surfaces	Medium	Medium	Inadequate	Inadequate
Rubbish, litter, plastics and other pollutants	• Catchment runoff • Direct dumping • **Water pollution*** • Wildlife disturbance • Amenity issues	• Ubiquitous • Urbanised catchments with increased impermeable surfaces	Medium	Medium / High	Moderate	Moderate
Mining	• Mine approvals within the catchment area and underneath the estuary • Land subsidence • Vegetation die-back • Damage to OSSM infrastructure and subsequent leaks • **Pollution*** • Acute and chronic hydrological changes	• Lake Budgewoi • Wallarah 2 Coal	Low	Low	Adequate	Adequate

Issue Theme 2: Data and Management

Adequacy of Existing Management Arrangements

There are various management policies and planning controls in place to manage the issue of catchment pressures and future development. These include the Local Environment Plan, Development Control Plan, Coastal SEPP and the Central Coast Regional Plan. Currently Council is developing the Draft Lake Munmorah Development Strategy which covers one of the key locations for catchment development pressure. EPA regulations and environmental licences are also applied within the catchment. Infill development around the estuary is one particular issue highlighted as having inadequate management controls in place (Glamore et al., 2020).

Several studies have investigated the above threats for various areas across the study area including: Porters Creek Wetland 2017 (BMT), Berkeley Vale (DPIE, 2021), and the broader Tuggerah Lakes area (DPIE, 2013, Glamore et al., 2020)

Council has a strong commitment to the health of the waterways and catchments across the LGA. Over the past few years Council has:

- expanded the ecological health monitoring program to include freshwater catchments across the Central Coast (although this is constrained and at risk due to current budget limitations)
- Rehabilitated rural and urban streams
- Restored natural wetlands
- Rehabilitated coastal saltmarsh
- Implemented new stormwater improvement devices and maintained existing devices
- Removed thousands of tonnes of sediment and pollutants from stormwater quality improvement devices
- Conducted extensive research and modelling to improve future management

Further details on the implementation of the Tuggerah Lakes Estuary Management Plan are outlined in the data and management section of Issue 4: Ecology and Water Quality.

There are also numerous ongoing programs targeting catchment pressures including water quality monitoring programs such as Beachwatch, MER, GPT maintenance program, community education initiatives etc.

Microbial contamination of recreational waters is evaluated on a broad scale via the Beachwatch Program. Where results are abnormally high for the system type being evaluated (Ocean, estuary, lagoon, ocean bath etc) a catchment audit is undertaken. This methodology was recently developed in partnership between Council and DPIE (**Terrigal and Coastal Lagoon Audit**). Catchment audits are resource intensive requiring background and event-based sampling (replicated), source tracing, network investigations, sub-catchment prioritisation and ultimately remediation. Council is currently fully committed to the Coastal Lagoons Audit, with Terrigal CBD nearing completion and does not have the capacity to include additional sites at this time.

Suitability of Existing Data and Data Gaps

There is currently a reasonable amount of information and data available for many of the key threats presented by catchment pressures and development. Population growth and dwelling number increases are well understood and detailed in strategic planning documents. Knowledge around the key issues presented by stormwater runoff and sewage overflows is moderate and there is room for improvement in these areas. This includes the need for stronger pollutant reduction targets for development, updated catchment modelling to determine sustainable loads and investigations to determine priority issues / areas. Studies and information on catchment hydrology changes are limited to particular areas e.g. Porters Creek Wetland and not more broadly available across the catchment.

Recent investigations of microbial contamination on the Central Coast (**Terrigal and Coastal Lagoon Audit**) have yielded useful results and have established an innovative methodology for identifying, quantifying and tracing the source of microbial contamination. This approach should be applied to Tuggerah Lakes with an initial focus on Canton Beach as time and resources allow. The scale and complexity of catchment infrastructure and range of potential pollutant sources and pathways will require detailed background and event-based sampling and a full audit will take some time to complete. This should be prioritised by considering the current resource capacity to deliver the Terrigal and Coastal Lagoons Audit and existing Pollution Reduction Programs as Council's first priority.

The potential impact of power station operation, decommissioning and ash dam management are key concerns of some parts of the community. The Tuggerah Lakes Expert Panel recommended that the community concerns related to heavy metal contamination from the Vale Point Ash Dam be reviewed as part of the TLCMP. This is beyond the capacity of a Scoping Study and considering existing time and financial pressures and resourcing capacity is likely to be included as a Stage 5 activity to be led by the NSW Government noting that Council is not the landowner nor the regulator for the activity. The results of the state government enquiry into the Ash Dam may have further actions.

Issue Theme 3: Entrance Management

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Entrance training	• Community / political pressure • Lack of education / understanding • Flood management • Changes to natural processes, sediment budget and coastal erosion risks • Physical disturbance • Hydrological modifications to estuary; impacts on other processes • Changes in tidal prism • Safety	• Entire study area / Tuggerah Lakes estuary and catchment area	High	High	Adequate	Adequate
Secondary entrance	• As per entrance training	• The Entrance • Budgewoi Lake	High	High	Adequate	Inadequate
Dredging and spoil placement	• As per entrance training • Water pollution	• The Entrance • Dredge footprint	High	High	Inadequate	Moderate
Mechanical opening / berm modification	• As per entrance training (lesser impact)	• The Entrance	Medium	Medium	Moderate	Moderate
Natural changes in entrance condition	• Wave, tide, and flood water action • Sedimentation, shoaling, shoal movement • Scour and foreshore erosion • Changes to amenity and access • Hydrological changes • Water quality changes (local)	• The Entrance	Low	Low	Moderate	Moderate

Issue Theme 3: Data and Management

Adequacy of Existing Management Arrangements

Tuggerah Lakes is an example of an estuary type known as 'Intermittently Closed and Open Lakes and Lagoons' (ICOLLs) and the entrance of an ICOLL is often closed naturally. Due to this, parts of the tidal delta and intertidal flats near the entrance of Tuggerah Lake have been occasionally dredged for navigation as early as the twentieth century. More recently (since 1993), Council has conducted dredging operations in tidal delta shoals at The Entrance using a mobile dredge, to maintain tidal flushing of the entrance area and to reduce flood risks. When a dredging campaign is undertaken, the dredge moves in stages from upstream to downstream and is operated under an Environmental Protection Licence. The volume of material dredged varies with short- and medium-term weather patterns and sediment dynamics, and therefore the amount of sand which needs to be removed to maintain a slightly open entrance form and maintain tidal flushing. The outer channel (i.e. seaward of The Entrance Bridge) is dredged more frequently than the area upstream of the bridge, along the Terilbah Channel, other channels and sumps (Umwelt, 2011).

Council currently dredges The Entrance Channel as needed with dredging being conducted when one of the following triggers are reached (and thus it is not required every year):

- the throat of the channel (near the southern tip of the sand spit) at The Entrance reduces to an estimated width of less than 15m measured at mid tide level
- the flood tide sand shoals threaten to block the ebb tide dominant channel along the northern/eastern side of the entrance area and/or
- the flood tide shoals threaten to block the main channel east of the bridge.

The most recent dredging activities took place in 2020 when Council removed 30,000 cubic metres of sand.

Council has commissioned the development of the Tuggerah Lakes Entrance Management Study which aims to produce an evidence-based Interim Entrance Management Procedure. The Interim Entrance Management Procedure will inform management in the short term but is expected to be further investigated and refined with community input through the CMP process so it can be formalised. Managing the entrance to Tuggerah Lakes is extremely complex and requires a careful balance between reducing the severity of major catchment floods while protecting the lakes from adverse ocean inundation and minimising disturbances to the community, typical lake water levels, and the unique ecology of Tuggerah Lakes.

Suitability of Existing Data and Data Gaps

A large body of work has been undertaken over the past few decades focusing on the entrance in terms of entrance dynamics, stability, estuary modelling, management options and dredging.

A **summary of entrance studies** was published in 2021 as Stage 1 of the Tuggerah Lakes Entrance Management Strategy. In addition, a water level recorder has been installed on The Entrance Bridge to provide ongoing data that will assist with future entrance dynamics investigations.

Insufficient evidence is available to evaluate the value or feasibility of a second entrance which is a popular notion to alleviate water quality concerns amongst parts of the community (Glamore et al, 2020). The Tuggerah Lakes Expert Panel recommended that potential alternative management strategies be considered and that the community be engaged to develop and assess conceptual management options for a second entrance. This is beyond the capacity of a Scoping Study and considering existing time and financial pressures and resourcing capacity is likely to be included as a Stage 5 activity to be led by the NSW Government as other large-scale entrance modelling exercises have been (Cardno, 2013a&b). As a first step, the impacts/ benefits of a secondary entrance should be evaluated through modelling to inform future investigations. This is included in the Forward Plan (**Table 5.4**).

Issue Theme 4: Ecology and Water Quality

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Changes in estuarine vegetation (seagrass, saltmarsh, estuarine vegetation)	• Catchment development • Entrance management • Reduced water and sediment quality • **Foreshore modification and disturbance*** • **Climate change*** • Loss of habitat • Seagrass reduction (negative feedback loop, retraction > unstable sediment > increased turbidity > retraction) • Nearshore water quality decline (decoupling)	• Tuggerah Lake basin • Foreshores • All areas	High	High	Inadequate	Moderate
Point and diffuse source water pollution	• Urban development • **Stormwater runoff*** • Groundwater pollution • **Sewage overflows*** • Microbial contamination • Land use and hydrology changes • Industrial discharges • **Water pollution (nutrients, toxins, organics)*** • Water quality decline	• Urban fringes, in particular southern and northern aspects of each water body	High	High	Inadequate	Inadequate
Degradation/ clearing of freshwater wetland, riparian and catchment vegetation*	• Urban encroachment • **Land use intensification*** • Land use pressures (**urban runoff***, uncontrolled access etc) • Changes to hydrology • Weeds • **Water pollution***	• Toukley Wetland • Tumbi Wetland • Blue Haven wetlands	High	High	Inadequate	Inadequate
Bank erosion (catchment wide)	• Loss of riparian vegetation • Erosion and sedimentation • Inadequate riparian corridor protection • Mechanical disturbance/stock access • **Stormwater discharge*** • Flooding • **Water pollution (sediments)***	• Wyong River • Ourimbah Creek • Wallarah Creek • Tumbi Creek	Medium	Medium	Inadequate	Inadequate
Invasive species	• Land disturbance • Introduction of weeds and pests • Habitat destruction • Resource competition with native species	• Urban bushland and wetland areas • Roadside vegetation	Medium	Medium	Inadequate	Inadequate
Recreational activities	• Uncontrolled access • Community “management” of foreshores • Balance of recreational and environmental land uses • Habitat destruction • **Water pollution***	• Public foreshores • Private foreshores • Urban bushland and wetlands	Low	Medium	Adequate	Adequate

Issue Theme 4: Data and Management

Adequacy of Existing Management Arrangements

The current Tuggerah Lakes Estuary Management Plan is the primary plan in place which aims to rehabilitate the Tuggerah Lakes estuary and its catchment to support ongoing health and vitality and protect against future impacts. This plan included 100 individual actions of which 86% have been completed or are ongoing (as at June 2020), this includes the following key achievements in terms of ecology and water quality:

- 40km rural stream rehabilitation, 13km urban stream rehabilitation, 2.5ha saltmarsh reconstruction, 29ha saltmarsh rehabilitation and 374ha wetland conservation and restoration
- 37 constructed wetlands and 277 gross pollutant traps
- Ongoing financial support for Environmental Groups (formerly Landcare)
- Long term water quality improvement at multiple locations
- Extensive research and innovation to improve future management

Ongoing actions are being delivered via grant funding as part of the **Tuggerah Lakes Environmental Restoration Fund** project until 2023.

Suitability of Existing Data and Data Gaps

In general, the available data is comprehensive however key gaps are present for ecological response to climate change and sustainable catchment loads. Wetland mapping and condition assessment was recently updated (completed in 2020) to a suitable standard although streambank management plans are outdated and require updating due to the dynamic nature of these systems (completed in 2009). Weed density for wetlands, foreshore bushland parcels and other locations where remediation work have been completed are adequate and are used to track improvement over time. Consolidation of this information into a single, perhaps annually updated map would be beneficial as a tracking tool and to highlight areas where further investment in maintenance is required. A Foreshore Vegetation Management Plan is underway to help map out appropriate uses (environmental, recreational) in consultation with community and to more clearly delineate appropriate actions within each designated zone.

Issue Theme 5: Foreshore/Nearshore and Wrack Management

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Seagrass wrack accumulation	• Natural processes / seagrass shedding • Temporal shift in seagrass distribution • Changes in biomass in response to ecological stressors • **Modified foreshore edges / profiles*** • **Water pollution (nutrients and organics)*** • Poor nearshore circulation • Amenity impacts (clarity, odours) • Community expectations not met	• All foreshore areas • Spring – Long Jetty, Canton Beach, Toukley, Budgewoi, Gorokan (north) • Summer – Killarney Vale, Berkeley Vale, Chittaway Bay (south) • Autumn – Tuggerawong, Gorokan (south) • San Remo, Budgewoi, Munmorah (north)	High	High	Inadequate	Adequate
Organic enrichment of sediment and black ooze formation	• **Urbanisation and modification of foreshores*** • **Water pollution (nutrients and organics)*** • Poor nearshore circulation • Amenity impacts (clarity, odours) • Community expectations not met	• All foreshore areas • Primarily found in areas where seagrass wrack accumulation occurs in combination with muddy shores, limited wave energy and nutrient inputs	High	High	Inadequate	Moderate
Historic foreshore modifications	• Land reclamation • Private ownership • Foreshore structures • Wrack accumulation • Poor hydrological exchange between functional zones (foreshore, nearshore, basins) • Resulting water quality impacts	• Long Jetty to Killarney Vale • Berkeley Vale • Canton Beach • San Remo • Southern Lake Munmorah	Medium	Medium	Inadequate	Moderate
Foreshore development and management*	• Vegetation clearing/mowing • Public/private ownership • Poorly defined management zones • Uncontrolled access • Physical disturbance • Ecological disturbance • User conflict	• Public foreshores • Private foreshores • Natural areas (although limited	Medium	High	Inadequate	Moderate
Ground water pollution	• Land reclamation • Groundwater infiltration through polluted sediments • **Water pollution (nutrients)***	• Berkeley Vale (known) • Multiple other potential locations	High	High	Inadequate	Inadequate

Issue Theme 5: Data and Management

Adequacy of Existing Management Arrangements

Wrack management is a complex issue and an ongoing key priority for the community. There is an existing Wrack Management Strategy in place and a Strategic Wrack Collection Study has been undertaken to inform Council's wrack collection program using up-to-date science (OEH, 2013b). Due to community demand among other physical and financial constraints, holistic delivery of a strategically driven wrack collection program is not being effectively implemented. Council's current wrack harvesting program is extensive and collects approximately 14,000 cubic metres of wrack per year. The program runs on an approximate 8-week rotation schedule between sites. Wrack management is a joint management issue between DPI Fisheries, Crown Land, the EPA and Council and a collaborative approach to planning, funding and delivery will be required to support future modification/ expansion of the program.

Detailed investigations of the types, locations, formation and drivers of oozy sediments have been undertaken. Feasibility assessments were undertaken to treat ooze but were not financially viable. Ooze management should be undertaken by addressing the source of contamination and supporting natural flushing and mixing processes in the estuary. Organic sediment maps are currently being prepared as part of an existing federal grant and it is recommended that this continue at appropriate intervals to benchmark change. A simple transect based method would be a useful addition to the existing MER program.

Ad-hoc foreshore management results in clashes in use and uncertainty around appropriate management approaches and responsibility. Areas like the Long Jetty foreshore where recreation amenity, environmental value, saltmarsh restoration, stormwater management, and education/ interpretation have been integrated provides a useful model which could be applied elsewhere. The Foreshore Vegetation Management Plan will build on this approach and provide a useful nexus to link management actions delivered by Council, community and others and will more clearly delineate management zones, their key purpose/ function and appropriate management actions.

Groundwater pollution is a poorly understood but potentially significant threat to long-term water quality, sediment chemistry and ecological health. Aside from the current research project at Berkeley Vale, no management of groundwater is undertaken.

Suitability of Existing Data and Data Gaps

The issue of seagrass wrack accumulation and oozy sediment formation are relatively well understood with adequate existing information about these threats. There is now an existing understanding by both land managers and the community that saltmarsh plays an important function in terms of wrack management. This is a result of Council's ongoing community education and engagement around this issue. However, community expectations and understanding around the viability of wrack harvesting and management requires further developed and/or adjustment to reflect what is possible in terms of managing the issue.

Sufficient spatial data is available on the location of protected vegetation communities. Additional elevation data would be beneficial to support plans to further connect discrete fragments of saltmarsh, identify landward migration pathways under SLR scenarios and identify potential population shifts over time (swamp oak forest and saltmarsh).

Groundwater pollution is a poorly understood but potentially significant threat to long-term water quality, sediment chemistry and ecological health. Further research into the significance of groundwater as a pollution pathway is required alongside an investigation on what can feasibly be done to reduce groundwater contamination in an estuarine environment. This is a significant knowledge gap that requires consideration as a future action.

A detailed understanding of the impacts of historic foreshore reclamation exists and no further work is required.

Issue Theme 6: Coastal Hazards and Climate Risks

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Coastal and tidal inundation	• Current risk is low because the estuary is protected by a relatively small entrance • East Coast Lows that brings significant catchment runoff and flooding increase this risk. • Tidal inundation of low-lying land • Storm surge flooding of low-lying land • **Future sea level rise***	• Low-lying and foreshore areas • Specific areas yet to be mapped (data gap)	Low	High	Inadequate	Inadequate
Entrance instability	• Channel migration and scour • Event based impacts (floods, storm surges)	• The Entrance	Medium	Medium	Inadequate	Adequate
Foreshore erosion	• Wind wave action • **Stormwater discharge*** • Catchment flooding	• Foreshore areas • Key hotspots yet to be mapped (data gap)	Low	Medium	Adequate	Adequate
Sea Level Rise*	• **Climate change*** • Inundation of foreshore areas • Wetland migration	• Low lying and foreshore areas • Specific areas yet to be mapped (data gap)	Low	High	Inadequate	Inadequate
Coastal erosion	• (open coast hazard)	• N/A – open coast hazard	Low	Low	N/A	N/A
Coastal recession	• (open coast hazard)	• N/A – open coast hazard	Low	Low	N/A	N/A
Cliff and slope instability	• (open coast hazard)	• N/A – open coast hazard	Low	Low	N/A	N/A

Issue Theme 6: Data and Management

Adequacy of Existing Management Arrangements

Government and academic research about future inundation, sea level rise and climate change adaption has been undertaken; however, there is no consistent policy nor long-term adaptation management plan for coastal hazards or climate change threats across the Tuggerah Lakes. Council currently has and is implementing the Tuggerah Lakes Estuary Management Plan however this has limited detail on coastal hazards or climate risks.

Council adopted a **Climate Change Policy 2018** that covers the entire LGA and outlines key policy commitments including those related to risk management and resilience planning. The Policy commits Council to implement actions for mitigation, adaptation and ongoing resilience planning on Climate change including a Sea Level Rise policy to provide a consistent flood planning level for the Central Coast. It is noted that the Sea Level Rise Policy is yet to be developed.

The management arrangements currently in place for entrance instability include Council's dredging program. Council has dredged The Entrance Channel as needed since 1993. The dredge reached the end of its functional life following the dredging program in 2018 and was decommissioned afterwards. Currently dredging is conducted when one of the set triggers are reached and thus it is not required every year. The most recent dredging activities took place in 2020 when Council removed 30,000 cubic metres of sand. An Interim Entrance Management Procedure as part of the **Tuggerah Lakes Entrance Management Study** is currently under development (MHL, 2021) and will inform future steps.

Suitability of Existing Data and Data Gaps

Information and data about coastal inundation and climate change exist mostly at the regional level, with no studies or data about the potential impacts of coastal hazards or climate change specific to the study area. A review of land filling in the catchment concluded that it had insignificant impacts on flood storage. In addition, the Tuggerah Lakes Floodplain Risk Management Study and Plan (2014) that provides flood mapping showing some areas that will be impacted regarding sea level rise.

Generally, the impacts of entrance instability now and in the future are reasonably well documented for Tuggerah Lakes. In terms of entrance instability, it is more a question of what the community is willing to tolerate as there are many complex scenarios influencing what is going to happen within the estuary with regard to sea level rise.

Issue Theme 7: Heritage and Culture

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Loss of Aboriginal cultural heritage	• Management approaches • **Climate change (SLR)*** • Environmental degradation and change	• Tuggerah Lakes Resting Place (listed under the *National Parks and Wildlife Act 1974)*	**Medium**	**Medium**	**Moderate**	**Moderate**
Loss of European heritage	• Management approaches • **Climate change (SLR)***	• Various heritage items listed under the Wyong LEP spread across the catchment. Numerous items located in low-lying areas and foreshore suburbs include The Entrance, The Entrance North, Long Jetty, Tuggerah, Tacoma South, Gorokan, and Buff Point. • Heritage Conservations Areas located at Wyong and Oakland Avenue, The Entrance	**Low**	**Low**	**Adequate**	**Adequate**

Issue Theme 7: Data and Management

Adequacy of Existing Management Arrangements

The existing management arrangements in place across NSW for the protection of cultural and heritage items and place are extensive and firmly embedded within legislation. Current management measures, site listings, schedules and registers at a local, state and national level for heritage items including Council's LEP heritage schedule and due diligence assessments that are required for development or activities around listed sites. Council also has a Heritage Advisory Committee that assists Council in conserving, promoting and celebrating the Central Coast's local heritage and history. The Committee focuses on the identification, registration, conservation and development of the Central Coast's heritage resources.

The Darkinjung Local Aboriginal Land Council is active across the catchment area. Darkinjung LALC work with the NSW National Parks and Wildlife Services to ensure that all discovered sites are recorded and registered with the DPIE and updated in the Aboriginal Heritage Information Management System (AHIMS) Database. The existing management policies and approaches that are currently in place are considered adequate, however the effectiveness of these is limited to known sites. The larger issue involving Aboriginal heritage is the limited knowledge of existing sites and/or sites that haven't been recorded.

Suitability of Existing Data and Data Gaps

The data and information available for Aboriginal and heritage sites is available on the Aboriginal Heritage Information Management System, the NSW Heritage Database, Council's LEP heritage schedule and via DPIE directly. Other heritage and cultural information is documented in various places by Council and Darkinjung LALC.

While there is thought to be a reasonable amount of existing data regarding Aboriginal and European culture and heritage, there is a knowledge gap or opportunity to consolidate knowledge on Aboriginal management, values and approaches to managing Tuggerah Lakes estuary that could be explored further.

Issue Theme 8: Resource Conflicts and Accessibility

Threat	Drivers and Stressors	Key Locations	Current Risk	Future Risk	Existing Management	Existing Data
Insufficient / rundown infrastructure	• Aging infrastructure • Budgetary constraints • Overuse • Population / tourism growth in the region	• This threat applies to the entire study area	Low	Medium	Adequate	Adequate
Recreational and commercial fishing	• Overfishing	• Fishing locations across all three Lakes and at areas along the foreshore of the entire estuary	Low	Low	Adequate	Adequate
Overuse / overcrowding / competition – recreation resources	• Overuse • **Population / tourism growth in the region***	• This threat applies to the entire study area however most notably at key tourist and recreational hotspots including: The Entrance, Tuggerah Lakes Cycleway, and Canton Beach	Low	Medium	Adequate	Adequate

Issue Theme 8: Data and Management

Adequacy of Existing Management Arrangements

A range of management options exist to manage resource use conflict and accessibility across the Estuary. Council Plans of Management for various foreshore areas, land use zoning, and DCPs each regulate infrastructure and usage of public space and the Local Government Act, POEO Act, National Parks and Wildlife Service Act support these. In addition, there are capital works programs, maintenance and facility upgrade programs and Section 7.11 contributions all of which aim to enhance public space usability and access. Council also has additional policies that guide and direct the use of public spaces including the Natural Asset Management Policy and Watercraft Storage on Public Land Policy.

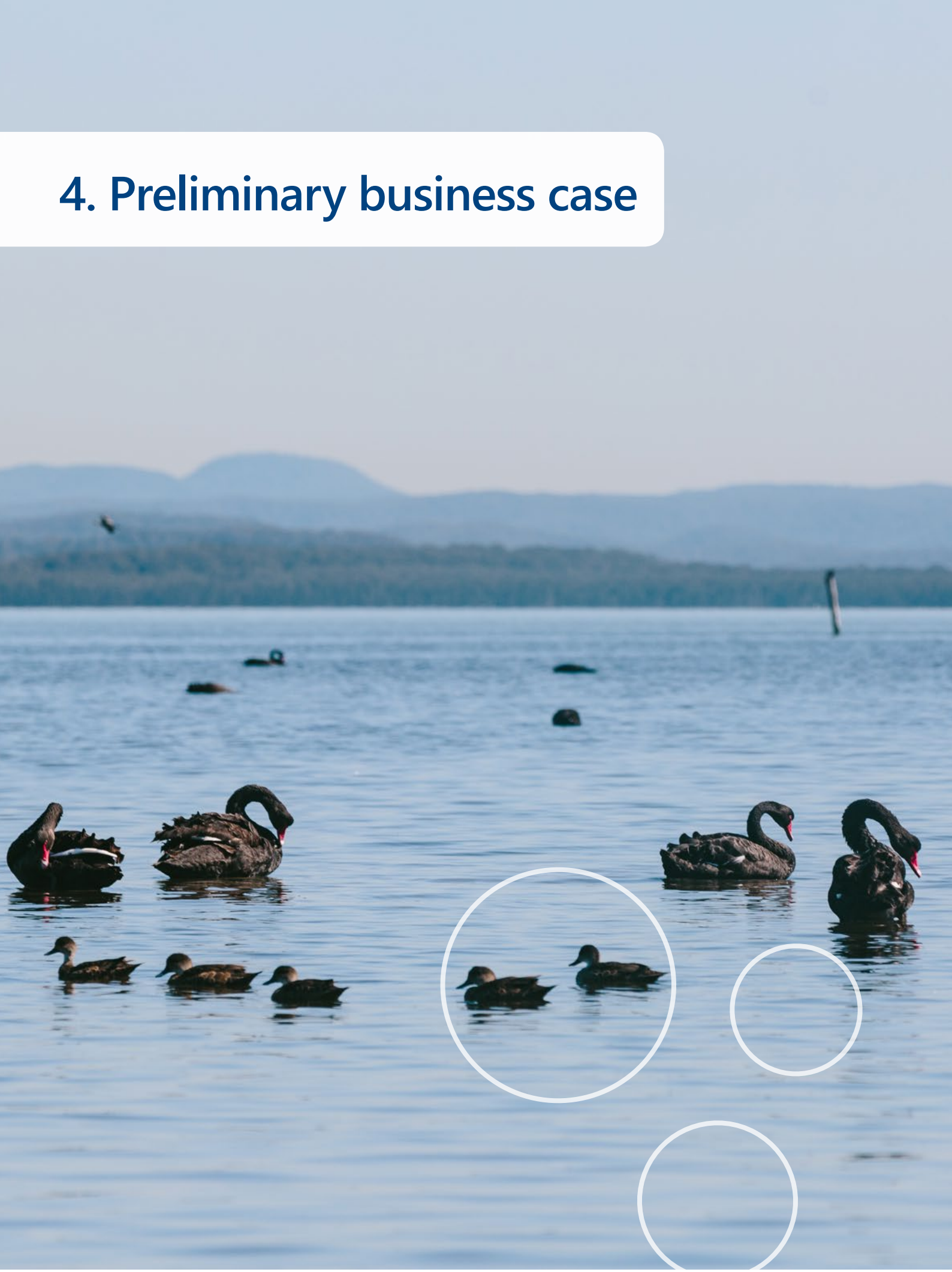
These management measures are considered adequate to manage the risk both now and in the future. The key risk to ensuring adequate management arrangements are in place in the future is likely budgetary constraints.

The implementation of the current Tuggerah Lakes Estuary Management Plan has also resulted in an award-winning community education program as well as the construction of 29km of shared pathway, 32 boat ramps and jetties, and 33 regional and local play spaces.

Suitability of Existing Data and Data Gaps

It is considered that there is adequate existing data and information regarding resource usage, conflicts and accessibility across the Tuggerah Lakes estuary. Much of this information is obtained through community consultation particularly during the development of strategic planning documents such as the Community Strategic Plan. Additional information will undoubtedly be collected during community consultation conducted through the subsequent stages of the CMP development.

4. Preliminary business case



4.1.1. Why does Tuggerah Lakes need a Coastal Management Program?

Tuggerah Lakes has been managed over the past decade or more, through the implementation of the Tuggerah Lakes Estuary Management Plan (EMP), prepared in 2006. The EMP has delivered a range of key achievements, including 50km of rural and urban stream rehabilitation, 374ha of wetland conservation and rehabilitation, 29ha of saltmarsh rehabilitation plus installation of community use assets (shared paths, boat ramps) and stormwater assets (gross pollutant traps, constructed wetlands) (Central Coast Council, 2020a). This has resulted in measurable improvements in ecological health in many places (**Appendix D**) however a gap remains between the current state of the estuary, the current trajectory and the future expectations of both the community and coastal managers.

While the EMP has provided Council with an effective plan for the estuary, it is now somewhat dated and no longer meets current legislative and policy requirement set out by the state government. Further, our understanding of the ecosystem condition and processes have improved over this time. As such, it is a good time to revisit the approach to management through a CMP that is consistent with the NSW coastal management framework.

4.1.2. Benefits of preparing a CMP for Tuggerah Lakes

A CMP aims to deliver coordinated, strategic and integrated management of the study area over the immediate and medium term with consideration of long-term vision and trends (i.e. a 10-year plan that is cognisant of hazards to 2100). Thus, providing a range of benefits and advantages to Council, public authorities and the broader community.

The key benefits associated with preparing the Tuggerah Lakes Estuary CMP include:

- **Informed coastal management understanding and decision making** – The preparation of a CMP provides Council with an opportunity to review and take stock of the management practices currently in place and determine the priorities for coastal management based on a well-considered, clear and guiding state-wide framework. A key impediment to effective coastal management is not having appropriate information and data available for analysis to make well-educated, scientifically informed decisions. The CMP process provides the opportunity to identify and address any relevant gaps in data and information to ensure that the system in question is adequately understood and thus can be best managed.
- **Effective forum for community engagement** – The CMPs development provides a forum for extensive community engagement and consultation to occur with various audiences. Effective community engagement and community awareness of the complex nature of coastal management are key challenges Council experiences on a regular basis. The CMP preparation presents a significant strategic opportunity to improve engagement, educate the community and establish understanding and buy-in from the community regarding the final CMP and its implementation.
- **Limiting coastal risks liability exposure** – Section 733 of the *Local Government Act 1993* provides an exemption from liability for public authorities for advice furnished or actions undertaken in good faith in accordance with a certified CMP. By not pursing a CMP, Council's and state agencies in the study area increase their exposure to liability for decisions made or not made relating to coastal risk. This includes climate change related risks, notably sea level rise, as a core component of the CM Act and the Coastal Manual's requirements for CMPs are to consider climate change related hazards.
- **Balanced environmental, social and economic outcomes** – The Tuggerah Lakes estuary (and catchment area) supports many significant and important environmental, economic, sociocultural values and community benefits. As highlighted in the risk assessment, these values are under increasing pressure due to existing and future threats including coastal hazards (primarily inundation risks), climate change, sea level rise, population growth and development. A CMP will

provide a comprehensive strategic vision and action plan that is locally considered and well balanced in terms of protecting the area's diverse values.

- **Coastal management funding opportunity** – The NSW Coastal and Estuary Management Program is a competitive funding program available for the development of CMPs or the implementation of actions identified in certified CMPs. This program provides technical and financial assistance to councils with $83.6 million made available for coastal management from 2016-17 to 2020-21 (see Section 4.1.3 for details). If a CMP was not developed for Tuggerah Lakes, it is unlikely that Council would be able to fund the coastal management actions that will be required across the study area.
- **Achieving a shared vision for the estuary** – community and stakeholder expectations regarding estuary condition and how the study area should be managed are high with intense dissatisfaction with Council's current approach in some sections of the community. The CMP provides an opportunity to work collaboratively with the community on a long-term strategy to proactively address some of the discontentment. The CMP is likely to exacerbate expectations within the community, however if well thought out consultation and a collaborative approach is undertaken the opportunity to improve the Council-community relationship and achieve a shared vision of the estuary exists.
- **Co-ordinated management approach** – Tuggerah Lakes is exposed to a range of very challenging coastal management issues, with water quality, development pressures, sea level rise, foreshore amenity and channel expectations being most notable. To ensure appropriate consideration and management of this complex system, a coordinated approach to management is crucial. The coastal management framework and CMPs require collaboration between agencies and are supportive of a coordinated approach.

4.1.3. Funding and financing

The estimated total cost of preparing the Tuggerah Lakes Estuary CMP is between approximately $1.4 and $1.9 million. This range provides for uncertainty around the inclusion of studies recommended in the forward plan that are categorised as low and medium priorities.

Various funding streams and opportunities for cost sharing are available to prepare (and then implement) the CMP. Accompanying the coastal management reforms, the NSW Government announced extensive funding via the Coastal and Estuary Grants Program to support the preparation of CMPs (as well the implementation of works identified in certified CMPs). Grant funding through the program is typically allocated on a 2:1 basis so Council (if successful) will only need to provide one-third funding for CMP tasks.

Significant additional funding is allocated to the implementation of the Marine Estate Management Strategy (MEMS) in accordance with strategy priorities. The MEMS identifies urban water pollution from run off as a priority threat and therefore there is scope for Marine Estate Management Authority (MEMA) funding and technical support to assist with water quality studies, more detailed risk assessments and management option review in Stages 2 and 3 (and presumably CMP actions in future). Other opportunities for funding may be available through grant programs such as the NSW Environmental Trust. The Australian Government funded **Tuggerah Lakes Environmental Restoration Fund** project will continue to roll out until 2023.

The Tuggerah Lakes Expert Panel recommended the establishment of both an Environmental Levy (Recommendation 7, Appendix F) and a Stormwater Levy (Recommendation 8, Appendix F) and the recent *Our Coast, Our Waterways* survey indicated that 69.2% of respondents across the LGA would support more resources being used for the management of our waterways and coast, even if it meant a very small increase in their property rates or rent. A comprehensive review of available and potential sources of funding to ensure a sustainable and flexible baseline funding model for the CMP will be developed in Stage 3 as part of the Business Case.

5. CMP Forward Plan

5.1. CMP requirements

The process for preparing a CMP, as outlined in the Manual, prescribes a 5-staged process as previously illustrated in Section 1.1.1. The subsequent stages following on from this Stage 1 Scoping Study are summarised in Table 5.1.

Table 5.1: Summary of next CMP Stages

Stage 2 (Technical Studies) of the CMP process involves undertaking detailed studies to help identify, analyse and evaluate risks, vulnerabilities and opportunities. Stage 2 studies are to support decision-making in the subsequent stages of the CMP planning process. Key aspects of Stage 2 include:

- Engaging with the community and stakeholders
- Refining understanding of key management issues
- Identifying areas exposed to coastal hazards and threats to coastal values
- Analysing and evaluating current and future risks (detailed risk assessment)
- Identifying scenarios for socio-economic change and related opportunities, and
- Identifying timing and priorities for responses, thresholds and lead times.

Stage 3 (Options Assessment) of the CMP process identifies and evaluates possible management options in order to select preferred coastal management actions to address the priority issues affecting the study area. The aim of Stage 3 is to develop strategies that reduce exposure to coastal risk and realise opportunities. Key aspects of Stage 3 include:

- Engaging with the community and stakeholders
- Identifying and collating information on management options
- Evaluating management actions, considering feasibility, viability and acceptability
- Working with public authorities to look at asset implications, management responsibilities etc
- Identifying management pathways and timing of actions (triggers etc), and
- Preparing a business plan for implementation.

Stage 4 (CMP Finalisation) of the CMP process involves a coastal management program being prepared, exhibited and then submitted to the Minister for certification. Once certified, Council then publishes the CMP in the Gazette, at which point it takes effect as a statutory document. Key aspects of Stage 4 include:

- Prepare a draft CMP, that includes: (i) an executive summary; (ii) an introduction; (iii) a snapshot of management issues; (iv) actions to be implemented by Council and/or public authorities; (v) recommended changes to planning controls/maps, where relevant; (vi) a business plan; (vii) a coastal zone emergency action sub plan; (viii) monitoring, evaluation and reporting program; (xi) maps showing the area covered by the CMP and the relevant coastal management areas; (x) a reference list.
- Consult with the community on the draft CMP (minimum: public exhibition for 28-day period)
- Reviewing and adopting the draft CMP Submitting the draft CMP to the Minister for certification (and amending, as required), and
- Publishing the certified CMP in the Gazette.

Stage 5 (CMP Implementation) of the CMP process involves implementing actions in the published CMP. Monitoring, evaluating and reporting on CMP implementation is also undertaken to support amending, reviewing and updating the CMP, as required. Key aspects of Stage 5 include:

- Implementing CMP actions through the IP&R Framework and land use planning system
- Implementing actions in partnership with public authorities where relevant
- Monitoring, evaluating and reporting CMP implementation progress
- Monitoring indicators, trigger points and thresholds for management strategies
- Amending, reviewing and updating the CMP, and
- Reporting to stakeholders and community on outcomes.

5.2. CMP Project Governance Recommendations

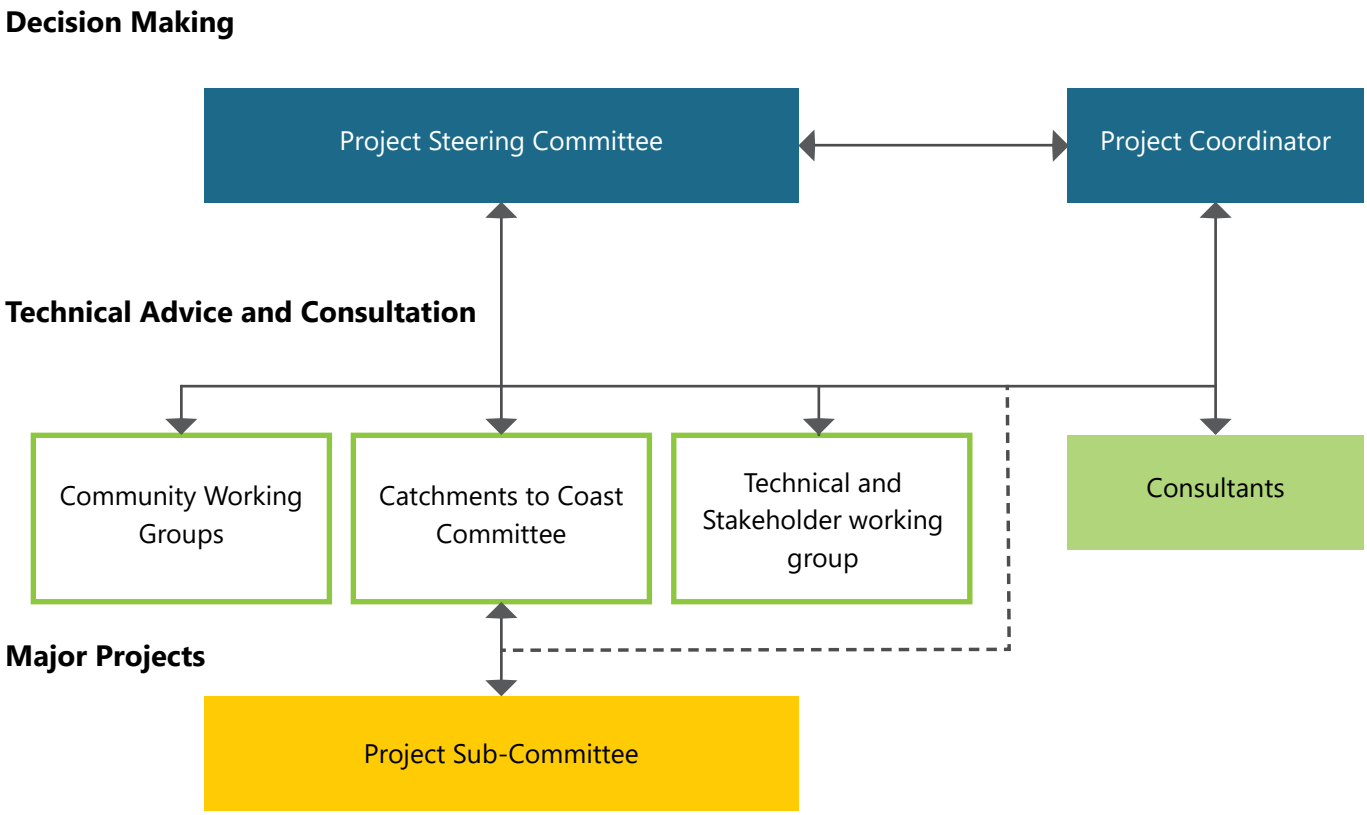
The proposed governance arrangements to be instigated for the Tuggerah Lakes Estuary CMP are summarised in **Table 5.2**.

Table 5.2: Proposed CMP Governance Arrangements

Entity	CMP Role and Responsibility
Central Coast Council	CMP lead – responsible for the preparation, co-ordination and implementation of the Tuggerah Lakes Estuary CMP
Catchments and Coast Committee	Advisory Group used as a mechanism for consultation, advice and feedback to Council staff on implementation and review of the Community Strategic Plan. Primary role is to advise Council and staff on all matters relating to Council's responsibilities in relation to sustainable management of its coastal, estuarine, waterways, catchment and flood liable areas.
Working Groups / Focus Groups	Convened as required to address key issues and resolve key management options. These may be technical in nature or retain a community focus as required by the subject matter.
NSW Government • DPIE – Environment, Energy and Science and Crown Lands • DPI – Fisheries • NSW EPA • Greater Sydney LLS • NPWS • Forestry Corporation • Maritime Infrastructure Delivery Office / Transport for NSW • Other As appropriate	Provide advice and input to the CMP as needed by Council. Written agreement to CMP actions for which they are responsible for implementing (whether as a primary or supporting organisation).
Darkinjung Local Aboriginal Land Council	Key cultural stakeholder to be engaged with through the CMP development and future CMP action implementation as appropriate.
Community	To be engaged with throughout the development of the CMP to facilitate a shared vision of the Lakes to be established and ensure community buy-in and ownership of both the CMP process and final certified CMP.

It is envisaged that decision making will be guided by a Project Steering Committee based on advice provided by specific community, technical and stakeholder working groups (**Figure 5.1**). The Final decision to adopt and to certify the CMP will rest with Council and the Minister for Local Government respectively. A project coordinator is proposed to oversee delivery of subsequent stages. For such a complex and contentious estuary, the level of community and stakeholder engagement and collaboration proposed herein is unlikely to be achieved without this dedicated resource.

Figure 5.1 – Proposed governance structure



The CMP actions should be integrated into the IP&R framework as a means of better connecting the CMP vision, objectives and priority actions into all relevant Council functions. This will provide an important tracking mechanism, will be a significant improvement on the implementation mechanisms that were in place for the EMP and will provide coastal managers with a useful accountability tool to track implementation through Stage 5.

5.3. Forward program

The Tuggerah Lakes Estuary CMP forward program sets out the recommended studies, assessments and reports that are planned to be undertaken in stages 2 to 4 of the CMP. The Forward Plan was derived based on outcomes of the first-pass risk assessment and a review of current management arrangements, existing data and information.

In summary, the Tuggerah Lakes Estuary CMP is estimated to take 2.5 years to prepare and will cost $1,952,500 if all recommended forward program tasks are completed. If the CMP is prepared only undertaking high priority tasks (and reserving low and medium priority tasks for the CMP implementation stage) the total cost to prepare the CMP will be reduced to $1,312,500. **Table 5.3** provides a cost breakdown for preparing the CMP in terms of per stage and based on task priority level.

Table 5.3: Tuggerah Lakes Estuary CMP Forward Plan

Study / Activity	Cost MIN (ex GST)	Cost MAX (ex GST)	Priority (low, med, high)	Time
Stage 2 studies (+ 50% engagement and PM costs)	$745,000	$1,163,750	All	15 months
Stage 3 studies (+ 40% engagement and PM costs)	$470,000	$670,000	All	12 months
Stage 4 studies (+ 10% engagement and PM costs)	$80,000	$118,750	All	3 months
TOTAL COST	**$1,295,000**	**$1,952,500**	**(100%)**	**2.5 years**

Study / Activity	Cost MIN (ex GST)	Cost MAX (ex GST)	Priority (low, med, high)	Time
All stages - high priority studies	$860,000	$1,312,500	High	2.5 years
All stages - medium priority studies	$345,000	$500,000	Medium	2.5 years
All stages - low priority studies	$90,000	$140,000	Low	2.5 years
TOTAL COST	**$1,295,000**	**$1,952,500**	**(100%)**	**2.5 years**

A workflow concept diagram for completing the CMP is illustrated in **Figure 5.2**. This shows the workflow process that is intended to be undertaken and how the activities in each CMP stage fit together.

A prioritised list of the recommended studies and activities required to complete the CMP are listed in **Table 5.4** below. These tasks are categorised into the remaining CMP stages (stages 2 to 4), thus showing at what point each activity is to be undertaken. The scope, budget, timeframes and responsibilities for each task are also outlined.

Note that, the forward program outlines a low and high cost for each task. The cost estimates are based on experience, available information and expert judgement and the cost range is provided to account for uncertainty regarding the level of detail and precise application required to enable a fit for purpose outcome. It is possible that a market response to higher than normal demand will be experienced as many coastal councils undertake these studies concurrently.

Figure 5.2: Tuggerah Lakes Estuary CMP Forward Plan Workflow Conceptualisation

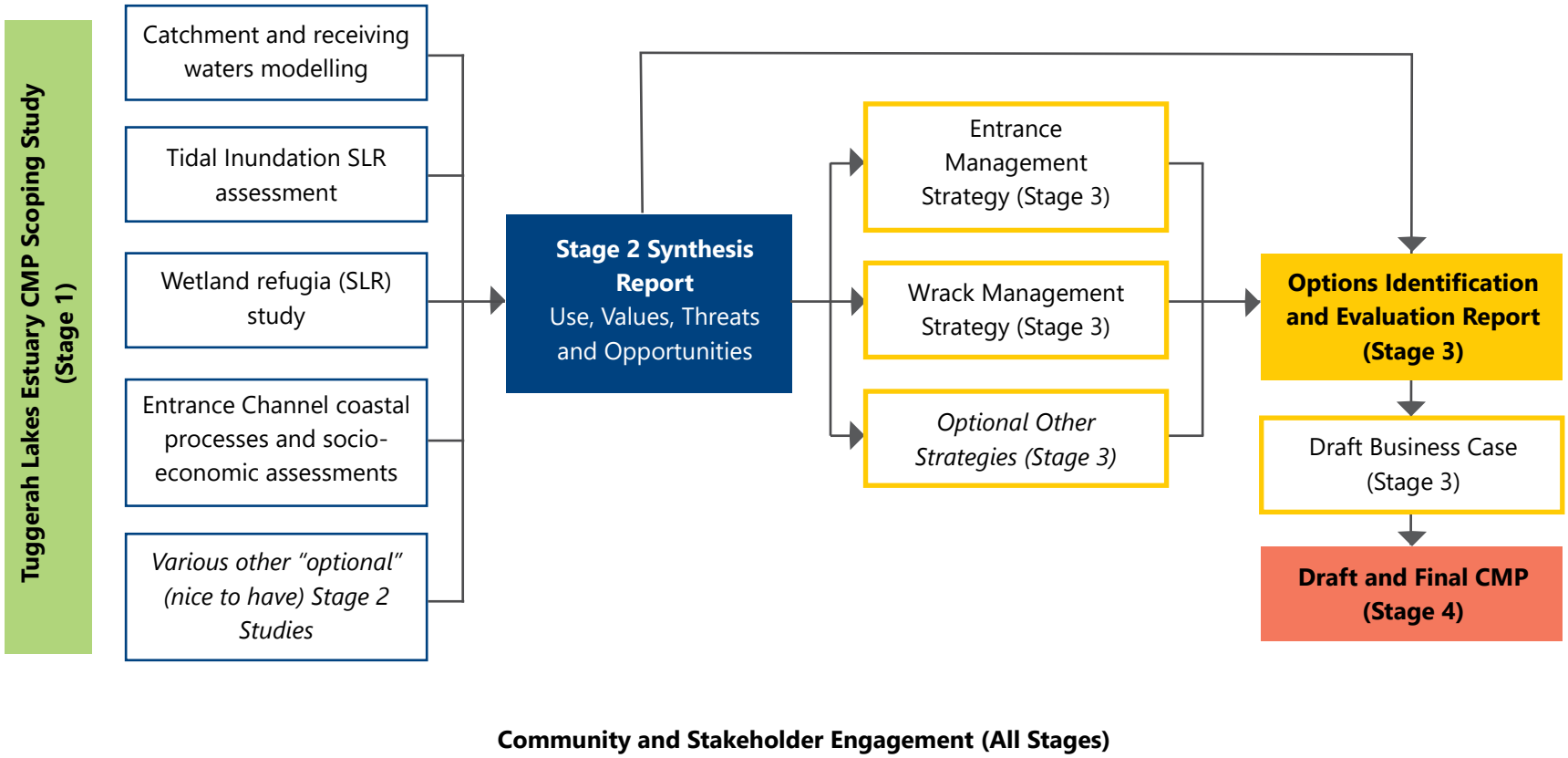


Table 5.4: Tuggerah Lakes Estuary CMP Forward Plan

The following detail provides a key to Table 5.4.

CMP Stages:

- Stage 1 – Scoping Study
- Stage 2 – Technical Studies
- Stage 3 – Options Evaluation
- Stage 4 – CMP Preparation / Finalisation
- Stage 5 – CMP Implementation.

Tuggerah Lakes CMP Issue Theme:

- Issue 1 - Governance, Engagement and Communication (GEC)
- Issue 2 – Catchment Pressures and Development (CPD)
- Issue 3 - Entrance Management (ECM)
- Issue 4 - Ecology and Water Quality (EWQ)
- Issue 5 – Foreshore and Wrack Management (FWM)
- Issue 6 - Coastal Hazards and Climate Risks (CHR)
- Issue 7 - Heritage and Cultural Management (HCM)
- Issue 8 – Community Use, Resource Conflicts and Accessibility (CRA).

TLEP Recommendations:

The Tuggerah Lakes Expert Panel (TLEP) recommendations (Glamore et. al., 2020) are numbered and listed in Appendix F. Council staff have reviewed the recommendations and have undertaken a preliminary assessment to identify appropriate pathways for implementation.

Of the 52 recommendations, in total there are:

- 10 that are considered to be outside of the scope of the CMP
- 21 that are partly achievable through the CMP
- 23 that are achievable through the CMP
- 38 that are to be led by Council (with appropriate NSW Government input/ advice/ support), and
- 16 that Council considers to be appropriate for the NSW Government to lead. A decision on this will be at the discretion of the NSW Department of Planning, Industry and Environment.

Each has been prioritised and linked to the CMP Forward Plan on that basis. The allocation of actions to the NSW Government is based on an evaluation of Council's current and future resourcing capacity and financial situation, and in some cases, a desire to progress select actions in a more timely manner than Council can reasonably achieve.

All Stages – CMP Forward Planning

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
CMP Project Manager									
1.1	All	All	3	• Tender briefs • Grant and contract administration • Project summary report • Website updates	High	$80,000	$120,000	Per annum	Central Coast Council (lead)

Details (scope overview)

- Project Manager to facilitate development of CMP including management and engagement of consultant(s), community working groups, project promotion and community consultation.

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Implement Community and Stakeholder Engagement Strategy (Appendix A)									
1.2	All	GEC / All	2, 3, 9, 10, 11, 12, 24, 25, 27, 29, 42, 43, 51, 52	• See Engagement Strategy (Appendix A) for details	High	$40,000	$75,000	Per annum	Central Coast Council (lead), DPIE (advice/ input)

Details (scope overview)

- Engage with community and stakeholders over duration of CMP development, consistent with engagement strategy framework.
- Revise and update engagement strategy consistent with community needs and available resources.
- Consider establishing community reference groups / working groups.
- Education initiatives including the development of a StoryMap (or similar) to describe known processes and assist with Stages 2 and 3.

Stage 2 – CMP Forward Planning

Catchment Pressures

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Catchment and receiving modelling									
2.1	2	CPD	**17***, 37, 38, 41	• Modelling framework • Technical report • Model handover	High	$150,000	$250,000	9 months	Central Coast Council (lead) DPIE EES (advice/input) *this includes the first step only.

Details (scope overview)

- Review and update the catchment and receiving modelling framework for Tuggerah Lakes, to guide catchment management decision making.
- Evaluate and rectify shortcomings of existing model/s.
- Undertake modelling investigations into:
  - (i) current and future pollutant load estimates.
  - (ii) sustainable pollutant load targets to maintain a healthy estuary and/or achieve pre-determined water quality objectives.
  - (iii) assess potential impacts from projected development scenarios.
  - (iv) performance and cost effectiveness of water quality treatment devices / practices (urban and rural).
  - (v) hydro-ecological impacts from water supply offtake.
  - (vi) confirm assumptions that redirecting nearshore runoff to creeks would achieve improved water quality outcomes.
  - (vii) impacts/ benefits of a secondary entrance to inform future investigations.
  - Accuracy of current average annual flow and average retention time estimates.
- Modelling outputs to guide preparation of *Sustainable Catchment Development Plan* (Optional Stage 3 Study or as CMP Action).
- Link with '*Sustainable Catchment Development Plan*'.

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Review and update creek rehabilitation plans									
2.2	2/5	CPD	40, 45, 49, 50	• Technical reports	Medium	$50,000	$70,000	6 months	Central Coast Council (lead) LLS (advice/input; implementation)

Details (scope overview)

- Review existing creek rehabilitation plans.
- Identify future priority areas for works.
- Update/adjust plans where necessary.
  - This should include consideration of aquatic biodiversity, corridor connectivity and reducing diffuse and point source pollution (e.g. agricultural runoff, turf farms).
- *Note: If not time/cost effective to complete as a Stage 2 activity, identify this as an action in the CMP to be completed though Stage 5 implementation.*

Foreshore and Wrack Management

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Feasibility study into redirecting nearshore stormwater to creeks									
2.3	2/5	FWM	18, 19	• Technical report • Model handover	Low	$10,000	$20,000	3 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Undertake a feasibility assessment into redirecting stormwater flows from nearshore catchments into rivers and creeks - to improve nearshore water quality (reduce pollutant inputs to poorly flushed nearshore zones).
- Use output of catchment modelling to guide approach.
- Stormwater network modelling may be required.
- *Link with 'Nearshore Water Quality Improvement Plan'.*
- *Note: If not time/cost effective to complete as a Stage 2 study, identify this as an action in the CMP to be completed though Stage 5 implementation.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Groundwater investigation									
2.4	2/5	FWM	13, 22	• Technical report	Medium	$80,000	$120,000	9 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Investigate and quantify the role of ground water pollution on nearshore water quality.
- Develop management strategies to manage ground water nutrient inputs, if this is found to be a significant issue.
- *Link with 'Nearshore Water Quality Improvement Plan'.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Shoreline reprofiling feasibility assessment									
2.5	5	FWM	19, 21	• Technical report	Medium	$25,000	$50,000	3 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Complete estuary-wide study into improving connectivity between the foreshore and nearshore areas (both laterally and longitudinally) to improve foreshore function and nearshore water quality – key focus on locations where the natural shoreline gradient has been historically modified.
- Assess feasibility of undertaking large scale shoreline realignment and reprofiling to improve hydrological functioning of nearshore, facilitate saltmarsh establishment and wrack drying. Identify key barriers and work with stakeholders (agencies) that may help to address these constraints. This should integrate with Foreshore Vegetation Management Plan and Active Lifestyles Strategy.
- Review shoreline reprofiling/regrading work completed to date, to identify key learnings that should be applied in any future works.
- Identify priority sites for rehabilitation works.
- *Link with 'Nearshore Water Quality Improvement Plan'*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Coastal Recreational Use Study									
2.6	2/5	CRA	-	• Report • Maps	Medium	$20,000	$30,000	6 months	Central Coast Council (lead)

Details (scope overview)

- Undertake a review of current recreational infrastructure, including usage, condition and connectivity.
- Identify opportunities to improve recreational connectivity and enhance the user experience.
- Linkages to existing environmental activities and assets should be included e.g. Discovery App, interpretive signage, shared pathway network. Consideration of ecological value should also be considered in asset renewal (e.g. replacement of the Memorial Park seawall with an environmentally friendly seawall, incorporating an intertidal encounter area and ICOLL education).
- Include community consultation.
- Provide a list of priority actions to be included in the CMP.
- *Note: If not time/cost effective to complete as a Stage 2 study, identify this as an action in the CMP to be completed though Stage 5 implementation.*

Ecology / Water Quality

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Water quality data collection program – model calibration									
2.7	2	EWQ	23, 37, 38, 41	• Technical report • Dataset	Medium	$20,000	$30,000	9 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Design and implement a water quality data collection program in Tuggerah Lakes and its catchment, to better calibrate and refine the model.
- Review existing catchment and stormwater data and identify gaps
- Design sampling program to characterise water quality of different land uses – to inform model calibration.
- Survey program to better understand fate of river inputs versus inputs from the surrounding perimeter.
- *Link with 'catchment and receiving water modelling'.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Wetland refugia (SLR) study									
2.8	2	EWQ	21	• Technical report • Maps	High	$30,000	$40,000	6 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Investigate coastal wetland migration pathways, refugia and resilience to sea level rise, in addition to any barriers to wetland migration.
- This study should build on tidal inundation study. It may also have implication for prioritisation of shoreline works identified in the shoreline reprofiling assessment (e.g. remove barriers).
- Link with Tuggerah Lakes Wetland Condition Assessment and Mapping Update (Niche, 2020) and Foreshore Vegetation Management Plan.
- *Note: Tidal inundation modelling and mapping data should be fed into this study.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Recreational water quality catchment audit									
2.9	2/5	EWQ CRA	-	• Technical report • Priority sub-catchment maps • Remediation Plan	Medium	$50,000	$80,000	12 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Undertake a detailed catchment audit at priority designated swimming locations (Canton Beach) to identify patterns and sources of microbial contamination. Link to other priority sites under investigation.
- *Note: If not time/cost effective to complete as a Stage 2 study, identify this as an action in the CMP to be completed though Stage 5 implementation.*

Entrance Management

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Entrance Channel coastal processes assessment									
2.10	2	ECM	13, 15, 15a	• Technical report	High	$25,000	$40,000	6 months	Central Coast Council (lead), DPIE (advice/ input), DPIE - Crown Lands (advice/ input; consent), EPA(advice/ input; consent), TfNSW (advice/input)

Details (scope overview)

- Assessment of Entrance Channel coastal processes – to better understand entrance channel behaviour, interaction with estuary hydrodynamic processes, and estuary response from past dredging operations.
- Study to quantify (where sufficient data exists):
  - (i) Review and update the Entrance channel sediment budget and sediment exchange (including record of past dredging/placement volumes and locations),
  - (ii) Estuary water level changes and impacts from varying entrance conditions / past dredging operations,
  - (iii) tidal exchange under varying entrance channel conditions (including pre- and post-dredging), and
  - (iv) water clarity benefits/impacts from dredging.
- *Link with 'Entrance Channel Management Strategy'.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Entrance Channel Socio-economic assessment									
2.11	2	ECM	15a	• Community consultation • Technical report	High	$30,000	$50,000	6 months	Central Coast Council (lead)

Details (scope overview)

- Based on existing and new information, undertake an Entrance Channel socio-economic assessment, that quantifies socio-economic costs and benefits from dredging (local community and economy) and determines if dredging represents a reasonable ongoing investment.
- Targeted consultation will be required.

Coastal Hazards and Climate Risk

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Tidal inundation and SLR Assessment (modelling, mapping)									
2.12	2	CHR	13, 14	• Technical report • Model handover • Maps	High	$25,000	$40,000	9 months	Central Coast Council (lead), DPIE EES (advice/ input)

Details (scope overview)

- Tidal inundation assessment to model and map water levels and extents, under a range of different estuary water level and sea level scenarios. Include appropriate planning horizons to align with CMP requirements.
- Modelling to identify land area inundated due to the incursion of tidal action under average meteorological conditions and current and future climate scenarios.
- Consideration of entrance channel condition/s adopted for the modelling will be needed.

Note: This dataset will support assessment of coastal wetland migration pathways / wetland refugia due to sea level rise.

Heritage and Culture

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Land and Sea Country Plan									
2.13	2/5	HCM	-	• Workshops • Report	Medium	$50,000	$80,000	12 months	Darkinjung LALC (lead) Central Coast Council (advice/ input) DPIE - Crown Lands (advice/ input) LLS (advice/ input)

Details (scope overview)

- Develop a Land and Sea Country Plan that illustrates community priorities and actions regarding land and sea management activities in the Central Coast region.
- This document should be developed in close consultation with the Darkinjung LALC and other Indigenous partners/stakeholders and the local Aboriginal community.

Note: The geographical scope of this plan should be determined in consultation with stakeholders, however it will likely span the greater Central Coast region. This plan will guide implementation and amendment of all Central Coast CMPs and other related natural resource management plans.

Note: If not time/cost effective to complete as a Stage 2 study, identify this as an action in the CMP to be completed though Stage 5 implementation.

Stage 2 Synthesis Report

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Synthesis Report: Community Uses, Values, Threats and Opportunities Assessment									
2.13	2	All	2, 3, 23, 45, multiple	• Workshops (community, Council) • Technical report • Risk register	High	$80,000	$100,000	9 months	Central Coast Council (lead) All stakeholder (advice/ input)

Details (scope overview)

- Prepare a community uses, value, threats and opportunities report, which:
  - (i) brings together all the existing technical information (high level) on processes, values and threats,
  - (ii) Outlines the connections and interrelationships between various issues/areas,
  - (iii) Establishes the management objectives/targets (e.g. water quality condition) for the estuary – in consultation with community and stakeholders, and
  - (iv) Complete a full-scale risk assessment, based on available data and determined objectives.
- This report should be a key consultation touch point with community and stakeholders. Workshops/community sessions are required.
- This report will confirm in a clear and concise manner, the future direction of the estuary and its catchment. As such, outcomes from this report will guide direction of issue specific management strategies (Entrance, Wrack) and inform the options identification and evaluation assessment (Stage 3).
- *Link with 'Wrack Management Strategy', 'Entrance Management Strategy' 'Options identification and evaluation'.*

Stage 3 – CMP Forward Planning

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Update/Revise Wrack Management Strategy									
3.1	3	FWM	1, 2, 9-12, 20, 23, 24	• Workshops (community, Council) • Technical Report (Management Strategy) • Operational Procedure • New approvals and licences, if required	High	$60,000	$80,000	6 months	Central Coast Council (lead)DPIE EES (advice/ input), DPI Fisheries (advice/ input; permits)

Details (scope overview)

- Review and update the existing science-based wrack management strategy, in partnership with experts, stakeholders (internal/external) and community. Include measurable indicators.
- Existing science sound in terms of wrack management for environmental outcomes.
- Consider opportunities to incorporate community needs within the strategy – to achieve a balanced approach that reduces wrack built up and management amenity at select priority community sites.
- Review suitability of available wrack management infrastructure / operational equipment. Revise wrack collection approaches with operational staff inputs, to ensure practicality.
- Look at opportunities for community input to wrack collection.
- Investigate opportunities to improve program costs/sustainability. Example: reuse opportunities, resource recovery exemption from EPA, community partnerships.
- Management recommendations to be prioritised and costed, to support development of a balanced and feasible CMP action implementation table.
- Management recommendations to be scalable based on available resources.
- Include a monitoring program to evaluate alignment of operational works with final strategy (expand on current volume only KPIs).
- *Note: Could be completed as a CMP action.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Prepare an Entrance Channel Management Strategy									
3.2	3	ECM	1, 2, 6, 9-12, 13, 15b, 16, 23	• Workshops (community, Council) • Technical Report (Management Strategy • Operational Procedure • New approvals and licences, if required	High	$60,000	$80,000	6 months	Central Coast Council (lead), DPIE (advice/ input), DPIE - Crown Lands (advice/ input; consent), EPA(advice/ input; consent), TfNSW (advice/input)

Details (scope overview)

- Build on existing Interim Entrance Management Procedure (currently in draft).
- Prepare an Entrance Management Strategy that aligns with clearly defined objectives for managing Tuggerah Lakes and the Entrance Channel.
- Develop clear indicators and triggers for various management activities (including berm management and dredging, if determined to be a reasonable investment in Stage 2 study).
- Develop a practical and transparent monitoring program to identify triggers which builds upon/ formalises the output of the Tuggerah Lakes Entrance Management Study.
- Review and incorporate findings from the Tuggerah Lakes Entrance Management Study and Interim Entrance Management Procedure, in the context of updated objectives.
- Consult with relevant stakeholders and community.
- Work with relevant agencies to determine and agree on a reliable funding structure (potential dredging activities).
- Update approvals and licences if needed noting any potential impact on the Little Tern or their habitat requires both state and federal approvals.
- *Note: Could be completed as a CMP action.*
- *This aligns with an action in the Tuggerah Lakes Floodplain Risk Management Plan (2014).*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Optional: Sustainable Catchment Development Plan									
3.3	5	CPD	1, 2, 5*, 9-12, 21, 26, 27, 28, 29, 30, 31, 32, 33, 35, 37, 38, 39, 45, 46, 47, 48	• Workshop/s • Technical Report (Management Plan) • Standard WSUD drawings	Medium	$100,000	$120,000	12 months	Central Coast Council (lead) All stakeholders (advice/ input) *in the absence of the proposed Taskforce (Glamore et. al, 2020) this activity will be led by Council

Details (scope overview)

- Identify priority catchments, based on modelling and monitoring information.
- Complete a performance audit of existing Stormwater Quality Improvement Devices (SQID) (water quality outputs, cost effectiveness).
- Identify continuing source of funds via IPART or Stormwater Levy.
- Prepare WSUD standard designs for Council and developer projects/purposes.
- Review DCP and Development Assessment consent conditions and deemed to comply planning checklists for Developer and Council.
- Provide planning advice on controls (e.g. single dwelling development) to improve water quality treatment.
- Workshop within Council to understand current practices and build capacity.
- Provide policy advice on stormwater lifecycle costs.
- Include revised water quality targets based on sustainable catchment load modelling.
- Include Porters Creek Wetland as a priority location.
- Management recommendations to be prioritised and costed, to support development of a balanced and feasible CMP action implementation table.
- *Note: Could be completed as an CMP action.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Optional: Prepare a Nearshore Water Quality Improvement Plan									
3.4	5	EWQ	1, 2, 9-12, 18, 19, 20, 21	• Technical Report (Management Plan) • Operating Procedures where applicable	Low	$40,000	$60,000	6 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Use model outputs.
- Consider: Nearshore and basin ecological health, recreational water quality, mixing and circulation and relationship to entrance management.
- Consider groundwater impacts based on current available knowledge.
- *Link to Entrance Management.*
- *Link to Sustainable Catchment Development Plan.*
- *Link to Wrack Management Plan.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Options identification and evaluation									
3.5	3	All	1, 2, 3, 45	• Technical report • Risk register	High	$40,000	$60,000	6 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Identify potential based on outcomes of Stage 2 technical studies, any sub-plans that have been prepared. Ensure options identified for the high/unacceptable risks.
- Evaluate management options through a cost benefits assessment – and drawing on full scale risk assessment.

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
***Optional: Detailed cost benefit economic assessment**									
3.6	3	All	-	• Technical report	Low	$40,000*	$60,000*	3 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Evaluate management options through a cost benefits assessment – and drawing on full scale risk assessment.
  - It may require new survey data (socio-economic profiling) and/or assessment of multiple issues,
  - Therefore, the scope (and cost) of this potential detailed assessment would need to be reviewed, if/when a need has been determined.
- *Link with 'Options identification and evaluation'.*

Number	CMP Stage	Issue Theme	TLEP Recommendation (Appendix F)	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
Draft CMP Business Case									
3.7	3	All	1, 3, 45	• Technical report	High	$10,000	$15,000	3 months	Central Coast Council (lead) DPIE EES (advice/ input)

Details (scope overview)

- Prepare a draft CMP Business Case.
- Business Case to outline capital, operational and maintenance costs of CMP.
- CMP funding and financing, including cost sharing.

Stage 4 – CMP Forward Planning

Number	CMP Stage	Issue Theme	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
CMP Development								
4.1	4	All	• Draft CMP • Final CMP • Exhibition report • Certified CMP	High	$50,000	$70,000	6 months	Central Coast Council (lead)All stakeholders (advice/ input)

Details (scope overview)

- Prepare CMP in line with Stage 1-3 outcomes. Exhibit draft, review, finalise and certify CMP.
- CMP to include:
  1. Executive summary,
  2. Introduction,
  3. A snapshot of issues,
  4. Actions to be implemented by Council or by public authorities,
  5. Whether the CMP identifies recommended changes to the relevant planning controls, including any proposed maps,
  6. A business plan,
  7. Coastal zone emergency action sub plan, if required,
  8. Monitoring, evaluation and reporting program,
  9. Maps, and
  10. Reference list.

Stage 5 – CMP Forward Planning

Number	CMP Stage	Issue Theme	Outputs (dataset, report etc)	Priority (l, m, h)	Cost min	Cost max	Timing	Responsibility (refer to Table 5.2)
CMP Implementation								
5	5	All	• To be determined	High	TBD	TBD	5-10 years	Central Coast Council (lead) DPIE EES (advice/ input; funding) All stakeholders (advice/ input; implementation as per CMP actions)

Details (scope overview)

- Implement CMP over 5-10 year period, within Council's IP&R Framework.
- Agency project partners to implement their actions.

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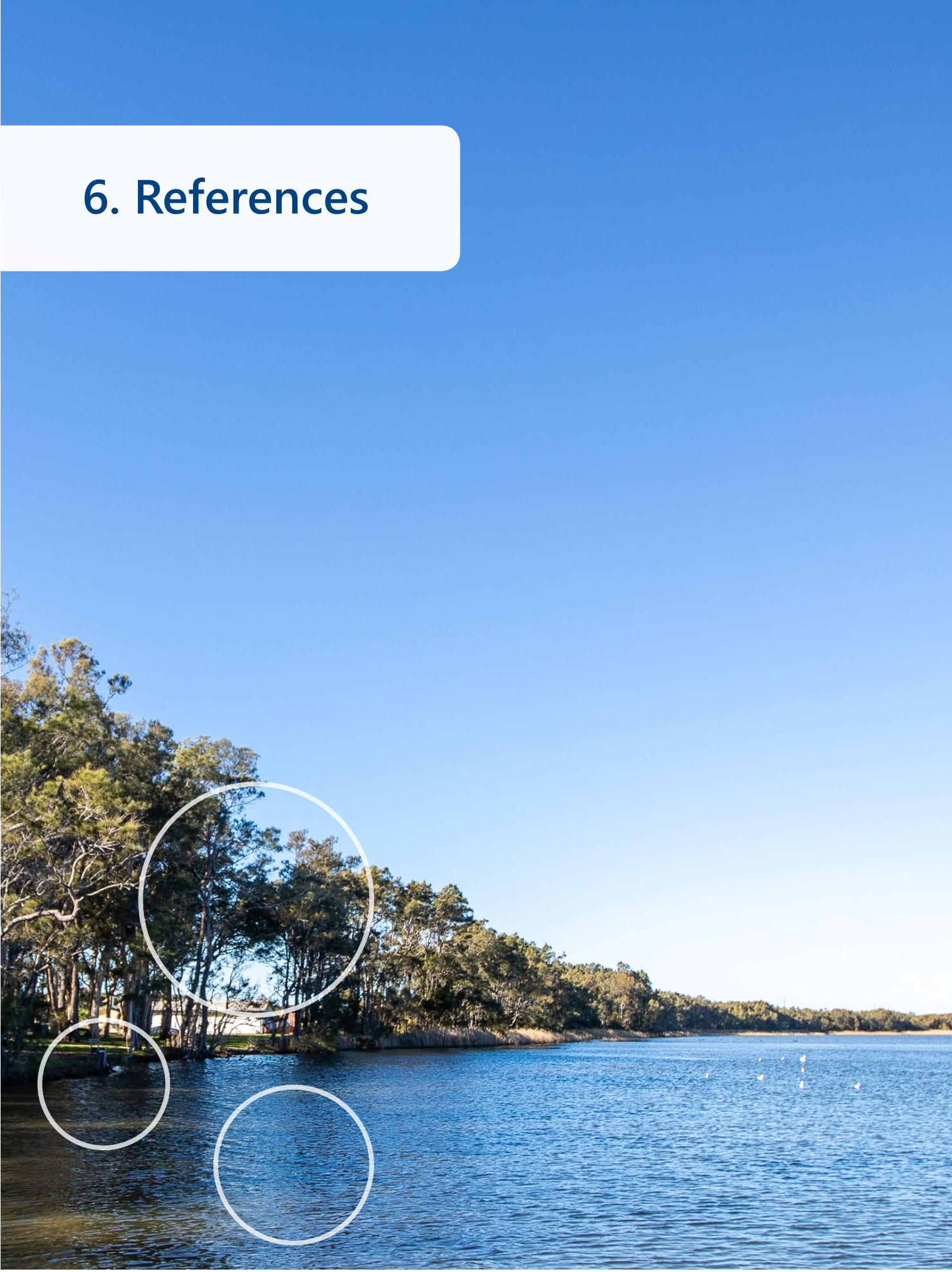

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