WALLIS LAKE
Estuary and Catchment Management Plan

Great Lakes
COUNCIL

This review of the Wallis Lake Estuary Plan (2005) and Wallis Lake Catchment Plan (2003) was produced with financial assistance from the NSW Government through the Office of Environment and Heritage and Great Lakes Council's Environmental Special Rate. This document does not necessarily represent the opinions of the NSW Government or the Office of Environment and Heritage.

Great Lakes Council 2014
Wallis Lake Estuary and Catchment Management Plan

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LIST OF ACRONYMS

AWTS	Aerated Wastewater Treatment System
E&CMP	Estuary and Catchment Management Plan
CAP	Catchment Action Plan
CMP	Catchment Management Plan 2003
CW	Community Wellbeing
DCP	Development Control Plan
DPI	NSW Department of Primary Industry
EH	Ecosystem Health
EMP	Estuary Management Plan 2005
ESR	Environmental Special Rate
GDE	Groundwater Dependent Ecosystem
GLC	Great Lakes Council
GLCG	Great Lakes Catchment Group
GLUG	Great Lakes Underwater Group
GSC	Gloucester Shire Council
GTCC	Greater Taree City Council
Hunter LLS	Hunter Local Land Services, formally Hunter-Central Rivers Catchment Management Authority (HCR CMA)
LEP	Local Environmental Plan
LGA	Local Government Area
MCW	MidCoast Water
NPWS	National Parks and Wildlife Service
NRM	Natural Resource Management
OEH	NSW Office of Environment and Heritage
OSMS	Onsite Sewage Management Strategy
SECEMS	Sediment Erosion Control Environmental Management System
SEPP	State Environmental Planning Policy
WQ	Water Quality
WQIP	Water Quality Improvement Plan
WSLCEC	Wallis and Smith Lakes Coast and Estuary Committee
WSUD	Water Sensitive Urban Design

EXECUTIVE SUMMARY

Wallis Lake and Catchment

Wallis Lake, on NSW's mid-north coast is unique in terms of the varied ecosystems represented in both its waterways and Catchment, as well as being the basis of a state-significant fishing, aquaculture and tourism industry.

Plan Review and Development

This Estuary and Catchment Management Plan (E&CMP) for Wallis Lake has been developed through an extensive review of the existing Wallis Lake Estuary Management Plan (EMP) (2005) and Wallis Lake Catchment Management Plan (CMP) (2003) as well as lengthy internal and external stakeholder engagement. The Great Lakes Water Quality Improvement Plan: Wallis, Smith and Myall Lakes (WQIP) developed in 2009 and subsequent research and management projects have provided the scientific information that underpins this new Management Plan.

A Vision of

> *Community, business and government working together for a healthy, productive and naturally beautiful Wallis Lake and Catchment now and into the future*

as well as supporting Values and Principles have been developed through consultation with key stakeholders.

Community and Stakeholder Consultation

The development and implementation of the Wallis Lake E&CMP has a large number of both direct and indirect stakeholders; from those agencies and industry bodies with direct actions to implement under the plan, to the wider community who rely on the services the Lake and Catchment provides.

A key focus of stakeholder consultation was through engagement of the Wallis and Smiths Lake Coast and Estuary Committee (WSLCEC) and the Great Lakes Catchment Management Group (GLCMG). These two groups oversee and provide stakeholder input and advice to agencies on issues of management in their respective areas. Membership of these two groups is drawn from representatives from industry groups, state agencies, local government, community groups and community members within the committee's area of jurisdiction.

Providing input on the implementation of this plan is within both Committee and Groups' scope and as key agency and industry stakeholders are represented on one or both of these, they represent an important vehicle for effective and efficient agency, industry and community engagement. Given this is a review of two existing plans, community engagement focused on working intensively with these committees. This involved:

- Facilitated workshops with the WSLCEC and GLCMG throughout 2012 and 2013 to develop the shared Vision and Values and review the threats to the catchment and estuary
- Review and update actions from existing Management Plans
- Identify new actions to address emerging threats
- Review of principles in the Plan
- Review of dredging strategy
- Face to face meetings with stakeholders involved in delivering actions to assess progress and identify new ideas that will address emerging threats

The wider general community has also been consulted through:

- Online survey hosted on Great Lakes Council's website
- Face-to-face engagement of community members through public stalls at community events and markets
- Media releases and radio interviews
- Survey of landholders in the sustainable farming program to determine emerging issues
- Independent review of the sustainable farming program to assess effectiveness of the program and determine a way forward for engagement
- Public exhibition of draft Plan

Review of Previous Plans and Lessons Learnt

The implementation of both the Wallis Lake's CMP and EMP has been responsible for delivering significant project outcomes within their target areas.

The Wallis Lake CMP (2003) provided a vision for the future of this significant and sensitive Catchment. The Catchment Plan was a direct response to the 1997 oyster Hepatitis A event that so clearly showcased the social and economic consequences of ecological impairment.

The delivery of actions in the Plan has had a direct positive influence on the health of Wallis Lake and its Catchment. It has delivered significant long term environmental benefits and enhanced community understanding of environmental risks and threats including their management and remediation. The CMP has delivered rural Natural Resource Management (NRM) projects that have permanently conserved important native vegetation through private conservation instruments; protected riparian zones from stock through exclusion fencing and off-stream watering; stabilised actively-eroding areas; revegetated cleared landscapes; and facilitated weed control activities.

Implementation of the CMP has assisted in building the capacity of rural landholders in the Catchment to undertake NRM projects, sustainable land management and best management practices. Further, priority wetlands in the Wallis Lake Catchment have been secured in public conservation ownership and management, allowing the ecosystem services functions of such landscapes to be secured. The project achievements have been delivered in partnership with key associates, including the Hunter-Central Rivers Catchment Management Authority, local government and the rural Catchment community, as well as the support of external funding providers.

In 2005, the Wallis Lake EMP was adopted as the guiding document for the management of Wallis Lake. There has been considerable progress made towards implementing actions in the Plan, and these have delivered major improvements to the condition and quality of management of the Wallis Lake environment. To date, of the 143 listed actions within the Wallis Lake Estuary Management Plan, over 80% have been completed, commenced or are ongoing.

The diversity and breadth of works undertaken within the Wallis Lake Estuary and Catchment in response to these two previous Plans is extensive. Repairing roads, purchasing wetlands, urban retrofitting, land-use planning tools, and a wide-variety of community engagement programs all interact and contribute towards improving Water Quality, Ecosystem Health and Community Wellbeing within the Wallis Lake Estuary and Catchment. The development of this Wallis Lake Estuary and Catchment Management Plan (2014) has utilised the lessons learnt from these plans and supporting projects, to continue to deliver improvements to the condition and quality of management of the Wallis Lake environment.

Management Actions

The Wallis Lake Estuary and Catchment Management Plan has been developed to provide an integrated management strategy for both the estuary system and the broader land catchment area. From the earliest stages of the development of the Plan, it was recognised that these two sections of the Catchment could not be considered in isolation. The health of the Lake and Estuary is fundamentally linked to the health of the entire Catchment.

To achieve the vision of community, business and government working together for a healthy, productive and naturally beautiful Wallis Lake and Catchment, both now and into the future, a series of objectives (see below) has been developed. These objectives are underpinned by a detailed set of actions linked to stakeholder(s) responsible for their implementation. For ease of use, these objectives have been divided into themed management areas labelled: Water Quality, Ecosystem Health, and Community Wellbeing. Although treated separately in the Action Plans, it is acknowledged that these management areas exist in a complex system of humans interacting with nature where working towards one objective will have a multitude of outcomes.

Water Quality (WQ)	
WQ1	Identify and reduce negative impacts on groundwater quality and quantity
WQ2	Reduce the impact of rural land use on water quality
WQ3	Reduce and repair foreshore erosion from water-based activities
WQ4	Reduce the rates of soil erosion and sedimentation from unsealed roads, road construction and maintenance, and construction sites
WQ5	Reduce sediment, acid sulfate soils, chemicals and nutrient loads to waterways from urban areas
WQ6	Reduce the risk of septic waste entering the Wallis Lake Estuary
WQ7	Reduce the impacts of gross pollutants entering waterways
Ecosystem Health (EH)	
EH1	Protect and improve biodiversity, particularly threatened species, populations and ecological communities
EH2	Maintain and improve areas of locally significant native vegetation as well as linkages between key habitat nodes
EH3	Maintain environmental flows, and improve where necessary to reduce the impact of barriers to fish passage
EH4	Reduce the presence and impact of invasive species on terrestrial and aquatic environments
EH5	Maintain and improve riparian vegetation
EH6	Monitor and protect aquatic vegetation including seagrass and sponges
EH7	Maintain and improve wetlands in the Catchment
EH8	Address the threats to local ecosystems arising from climate change and associated sea level rise
Community Wellbeing (CW)	
CW1	Manage recreational fishing, commercial fishing and oyster production for economic and ecological sustainability
CW2	Protect the aesthetic and cultural values of Wallis Lake and its Catchment
CW3	Facilitate safe and sustainable waterway usage of the Wallis Lake Estuary

Implementation

It is recognised that this Plan will be implemented in an environment dictated by potentially conflicting priorities of agencies and landholders within the Catchment. Successful implementation of these actions will be dependent upon a well-designed decision process aligning actions with stakeholder priorities along with available funding opportunities.

As the agency responsible for over 60% of the Wallis Lake Catchment, as well as having the bulk of its population and industry centred within this Catchment, Great Lakes Council has been the agency primarily responsible for developing this Plan. With this in mind, the Wallis Lake Estuary and Catchment Management Plan is guided by Great Lakes Council's Community Strategic Plan (GLC, 2012); in particular Key Direction 1: Embracing and Protecting our Natural Environment. This Strategic Plan, known as Great Lakes 2030, sets out the strategic direction of Great Lakes Council, and is based on the concerns and priorities of the local community.

The Wallis Lake Estuary and Catchment Management Plan will be used to inform Council's fouryear Delivery Program and one year Operational Plans with regard to management actions within the target area. These more specific plans detail how Council intends to deliver on the community's expectations.

It is worth noting that there is some overlap of the recommended management actions within a number of local NRM Plans, in particular the WQIP (2009) , Wallis Lake Wetland Strategy (2010), the Tops to Lakes Initiative (2012) as well as a number of smaller-scale site specific documents such as local Rivercare Plans (GLC, 2003a).

Externally, the key document influencing the Wallis Lake E&CMP is the Catchment Action Plan (CAP) of the Hunter Local Land Services. The CAP is a broad-scale plan, intended to guide the management of the 36,500 km^2 of diverse landscapes within the Hunter area. The Action Plans developed to address the objectives identified in this Wallis Lake E&CMP are both influenced and supported by the Goals and Targets defined in the Hunter-Central Rivers Catchment Action Plan 2013-2023.

A summary of other stakeholder agency plans relevant to the implementation of this document is included as Appendix D.

Governance

The implementation of this Plan is a shared responsibility amongst stakeholders and relies on the participation and agreement of all levels of government and the community. The key agency stakeholders involved in this Plan's implementation include:

- Great Lakes and Greater Taree Councils
- Hunter Local Land Services
- Midcoast Water
- National Parks and Wildlife
- Forestry Corporation
- Department of Primary Industries (Agriculture and Fisheries)
- Roads and Maritime Services
- NSW Trade and Investment (Crown Lands)

All of these key agencies are represented on either the Wallis and Smith Lakes Coastal Estuary Committee or the Great Lakes Catchment Group. Rather than forming a specific committee to oversee the implementation of this Plan, these two committees will operate as the medium for overseeing their respective management areas in this Plan.

Monitoring

For the purposes of the Wallis Lake Estuary and Catchment, there are two levels at which the Wallis Lake E&CMP can and should be assessed; namely the achievement of management and ecological targets.

Measures for monitoring management targets are divided into Primary Performance Measures, Secondary Performance Measures and Secondary Performance Measures (Strategic Outputs). Achievement of these targets will primarily be reported on at the individual project level (eg. as part of project funding requirements), but may also be used as a surrogate where direct ecological targets are difficult to assess. Ecological targets, on the other hand, are a measure of the effectiveness of the completed actions; for instance Turbidity or

Chlorophyll A levels recorded in the Lake and Estuary as indicators of the success of management actions to improve water quality.

A Monitoring Plan has been developed to identify the data on ecological indicators that needs to be collected to evaluate the effectiveness of the Wallis Lake E&CMP (Appendix E). This Plan contains actions that have been identified in: existing Action Plans or which already occur; research projects previously undertaken (to provide baseline data on ecological indicators); as well as those actions that have been identified to address knowledge gaps on existing estuary and catchment processes. These monitoring actions which address specific knowledge gaps (and are not identified in the individual Action Plans in Section 3) are summarised in the Monitoring Action Plan (Section 4.3).

Reporting

Reporting is an essential part of the Wallis Lake E&CMP implementation process which adds accountability to ensure agreed actions are undertaken by the responsible agencies, and that these actions are achieving desired results.

Reporting for this project is based on the stakeholder engagement model used for developing it, and as such, reporting is undertaken at three levels:

- Reporting internally to GLC
- Reporting to key stakeholders through the WSLCEC and GLCG committees
- Reporting to the community of the Wallis Lake Estuary and Catchment

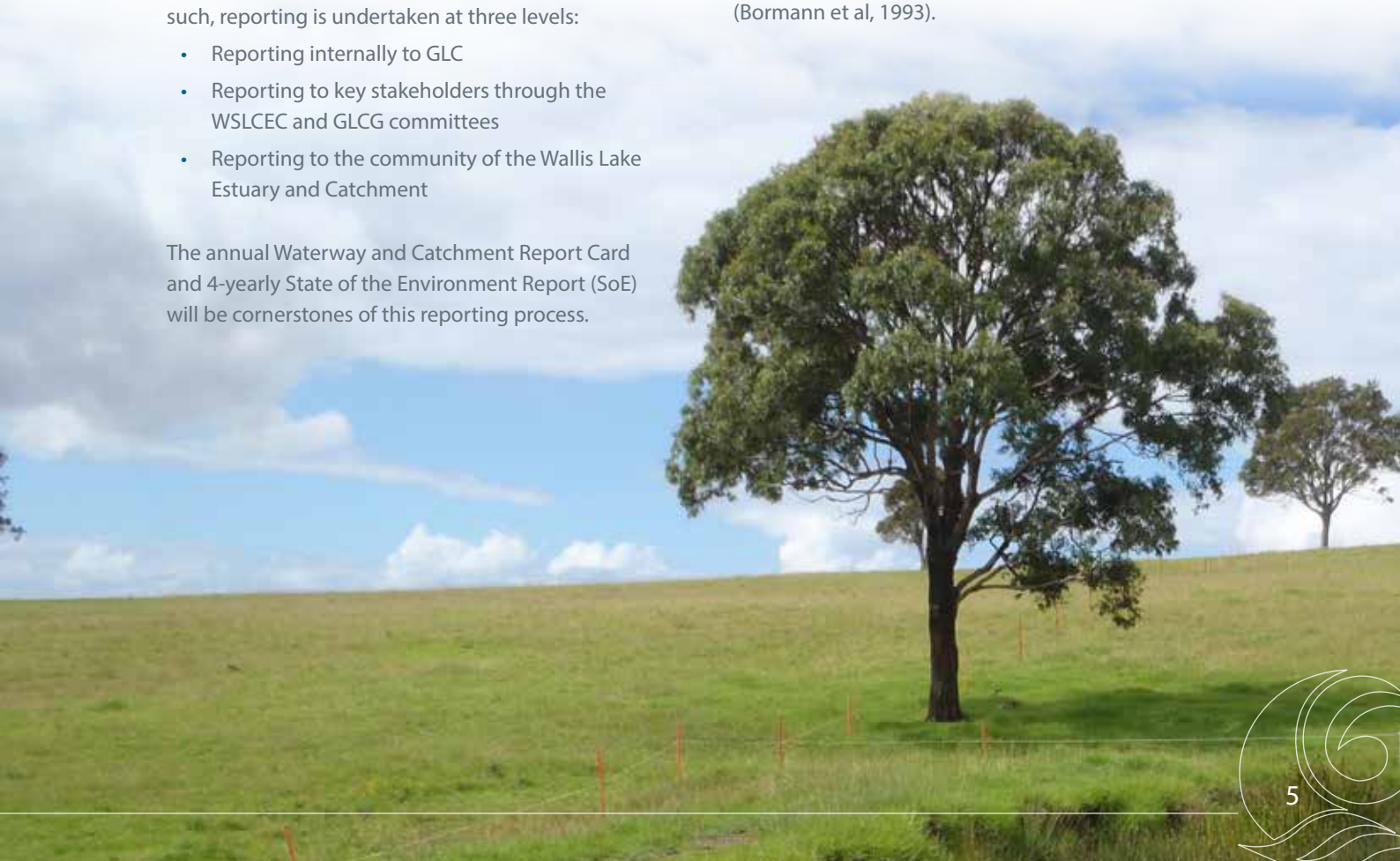
The annual Waterway and Catchment Report Card and 4-yearly State of the Environment Report (SoE) will be cornerstones of this reporting process.

Plan Review

An 8-year full review is proposed for the Wallis Lake E&CMP. This 8-year full review cycle will be supported by a 4-year partial review of the Action and Monitoring Plans. The trigger for this review will be the legislative requirement for all NSW Councils to develop a detailed SoE every four years. The next detailed SoE Report for Great Lakes Council will be in 2016.

There is a large degree of uncertainty surrounding protection and management of the Wallis Lake Estuary and Catchment—a large social-ecological system, managed by multiple parties for multiple uses. There is also constant change in our knowledge about complex natural systems which themselves are dynamic, and this means that our management of the Estuary and Catchment needs to be flexible and able to evolve.

The intent of this plan is to manage uncertainty by utilising planned management actions (Chapter 3) and subsequent monitoring data (Chapter 4.3) to test hypotheses, build understanding of ecosystem dynamics and inform future management decisions. It is a structured cyclical process of learning from doing (Stankey and Allen, 2009), where learning is used to improve the next stage of management (Bormann et al, 1993).



VALUES

People in our community value Wallis Lake and its Catchment for many reasons, including the beauty of the area, the biodiversity, its productivity and economic values for local businesses, and the lifestyle that living here provides.

Threats

Following are the key issues threatening the attributes of Wallis Lake and its Catchment that the community most highly value. These threats primarily come about through the ways in which people historically, and continually, undertake various land uses and activities in the area.

- Elevated sediment and nutrient levels in waterways
- Other waterway pollutants (including litter, pathogens, chemical and oil spills and leachate)
- Loss of ecosystem function and associated services
- Detrimental soil and ground cover management
- Invasive species incursion into terrestrial and aquatic systems
- Climate change and associated sea-level rise
- Impacts of acid leachate from acid sulfate soils
- Increasing human population and development pressures
- Land and waterway use impacting on natural systems

The intent of this Plan is to assist all stakeholders in dealing with these issues and protecting–and restoring–what is valued.

Principles

The ecological health of Wallis Lake Estuary and its Catchment are to be maintained and improved in line with the following principles:

- The ecological needs of the Estuary and Catchment are to be met whilst balancing aesthetic, commercial, recreational and cultural uses
- Significant Aboriginal and European cultural heritage is to be protected
- People are to be informed and empowered to work together for a healthy Catchment and a strong, healthy community
- The management of the Estuary and Catchment is to be based on the precautionary principle, and aim to maintain and improve the resilience of natural systems
- The management of the Estuary and Catchment is to be best practice, adaptive and based on the best available scientific information
- Knowledge gaps are to be identified and addressed to continuously improve management of Wallis Lake and its Catchment

These Values, Threats, Principles and Vision were developed during 2012 and 2013 in consultation with the Wallis and Smiths Lake Coast and Estuary Committee (WSLCEC) and the Great Lakes Catchment Group (GLCG) to guide the review and subsequent development of this new Wallis Lake Estuary and Catchment Management Plan (E&CMP).

VISION

Community, business and government working together for a healthy, productive and naturally beautiful Wallis Lake and Catchment both now and into the future

ABOUT THIS PLAN

Wallis Lake, on NSW's mid-north coast is unique in terms of the varied ecosystems represented in both its waterways and Catchment, as well as being the basis of a state-significant fishing, aquaculture and tourism industry.

This Estuary and Catchment Management Plan for Wallis Lake has been developed through an extensive review of the existing Wallis Lake Estuary Plan (2005) and Wallis Lake Catchment Plan (2003) as well as lengthy internal and external stakeholder engagement. At its heart, it provides recommended management actions to support the Vision developed for the Estuary and Catchment.

This plan has been developed for agency managers, to assist in the prioritisation, funding and implementation of key management actions for the benefit of Wallis Lake Estuary and Catchment, as well as to provide guidance and further information for stakeholders and affected community members on intended actions within the target area.

For ease of use, this document is separated into 4 sections, and can be read as a cohesive document, or individual sections can be utilised by managers to support management decisions:

Table 1. Layout of Wallis Lake E&CMP

Section 1 provides background and context for this document, summarising the current state of the Estuary and Catchment.
Section 2 details the methodology undertaken for the review of the Wallis Lake Catchment Management Plan (GLC, 2003) and the Wallis Lake Estuary Management Plan (GLC, 2005) and the subsequent development of this current Plan, as well as investigating the lessons learnt during the ten-year period since the development of the initial Catchment Management Plan.
Section 3 details the management actions developed by those organisations responsible for managing the Estuary and Catchment to ensure that the Vision set for the Estuary and Catchment continues to be upheld.
Section 4 outlines how this plan will be implemented to ensure actions are undertaken and that the outcomes from these actions are monitored and will serve to inform subsequent review and adjustment of the Plan over time.

1 WALLIS LAKE AND ITS CATCHMENT
Background and Context

1.1 Introduction

Wallis Lake is a sub-tropical estuary situated on the New South Wales mid north coast covering an area of approximately 85 km^2 (Figure 1). It is a large saline barrier lagoon system which is fed fresh water predominantly from the Wallamba, Wallingat, Coolongolook, and the Wang Wauk Rivers.

Wallis Lake is a large, relatively shallow coastal estuary with an average depth of 1.8 m, with a permanent opening to the north east, separating the twin towns of Forster and Tuncurry. A maze of islands and sandbanks has formed at the confluence of the rivers and the entrance channel. The Lake system is kept permanently open by two training walls resulting in considerable tidal exchange between the ocean and the Estuary and maintaining the clear blue waters for which the twin towns of Forster/Tuncurry have become famous (GLC, 2003a). The northern part of the Lake is more heavily influenced by the marine parameters than in the southern part.

The area experiences a mostly summer rainfall regime with an annual average rainfall of between 1000 -1500mm (HCCREMS, 2009). High magnitude flooding can occur during summer, however the flood variability, and hence variability in river discharge, is considerable. This also influences the rate of nutrient and sediment input to the Estuary system.

Figure 1. Map of Wallis Lake Catchment, NSW

Catchment and subcatchments

The Wallis Lake Catchment (see Figure 2) covers 1,292.2 km^2, and has a total waterway area (including the Lake and its tributaries to the tidal limit) of 91.24 km^2 (GLC, 2009).

The Catchment has two broad topographic units: the coastal plain and the inland ridges and valleys. Wallis Lake is situated in a shallow depression between the barrier dune system and the plain. The Catchment soils are generally of low fertility: colluvial and erosional soil landscapes are the most common, and dominate the inland ridges and undulating grazing lands of the western Catchment area (GLC, 2009).

The Catchment is divided into seven primary subcatchments, based on the major drainage networks: Wallamba River, Lower Wallamba River, Wang Wauk River, Minimbah Sandbed, Coolongolook River, Wallingat River, and Wallis Lake Body (Figure 2).

The Wallamba River and Lower Wallamba River subcatchments, totalling 42,957 hectares, drain the northern-most third of the Wallis Lake Catchment, and constitute the most cleared and modified subcatchments for agricultural purposes. The division between these two subcatchments marks the boundary between the predominantly freshwater system to the west and the Lower Wallamba River subcatchment to the east, which has more of a tidal, saline influence.

The Wang Wauk and Coolongolook subcatchments, also significantly modified for agricultural activity, drain 38,964 hectares (30%) of the Catchment.

The Wallingat River subcatchment, draining approximately 17,313ha remains the least modified Wallis Lake subcatchment. More than 12,400ha (72%) of the Wallingat subcatchment is private native forest, state forest or conservation estate.

The Wallis Lake body and its foreshore area, including the townships of Forster and Tuncurry, collect water from an area of 17,779ha.

Administrative boundaries

The broader Wallis Lake Catchment extends over three local government boundaries (see Figure 1).

The Great Lakes Council (GLC) local government area (LGA) includes all or part of every Wallis Lake subcatchment, covering a total of 65% of the entire Catchment. Specifically, the GLC area includes the entirety of the Coolongolook River, Wallingat River and Wallis Lake Body subcatchments, the majority of the Wang Wauk River and Minimbah Sandbed subcatchments, and smaller shares of both the Wallamba River and Lower Wallamba River subcatchments.

The Greater Taree City Council (GTCC) LGA covers a total of 30% of the Wallis Lake Catchment, including the majority of the Wallamba River and Lower Wallamba River subcatchments, and smaller percentages of the Wang Wauk River and Minimbah Sandbed subcatchments.

The Gloucester Shire Council (GSC) LGA covers just 5% of the larger Catchment; specifically, a small portion of the upper Wallamba River subcatchment.

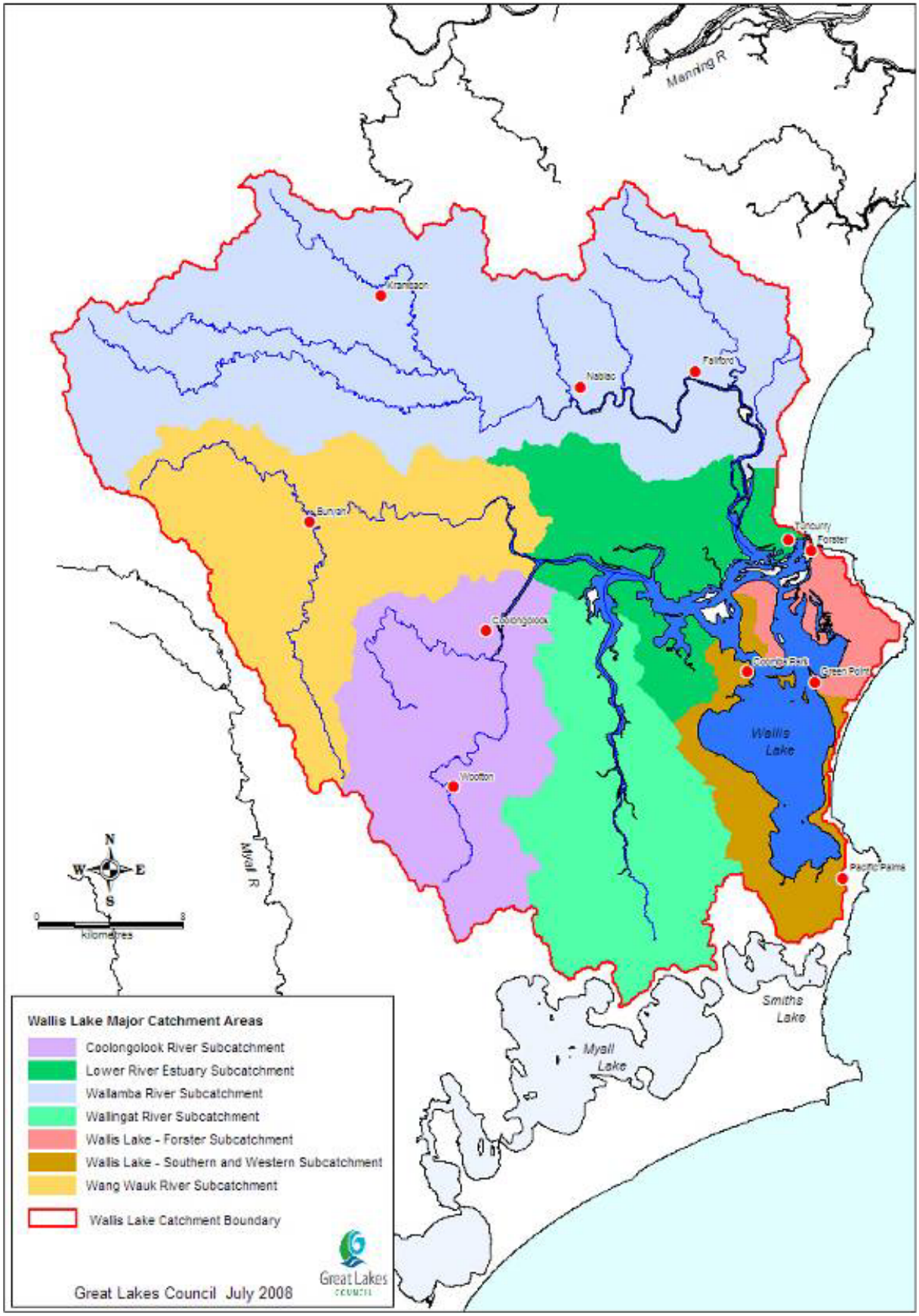
1.1.1 Ecological significance of Wallis Lake and its Catchment

Wallis Lake

The central and southern basins comprise a relatively healthy coastal wetland rich in biodiversity and containing a complex variety of habitats. The most prominent habitat of this coastal estuarine lake is seagrass and macrophyte beds, intertidal sand and mud flats, rocky habitat, sponge gardens, islands and coffee rock. Mangroves and saltmarsh border a large part of the Lake. Cabbage trees, littoral rainforest and floodplain forest which are distinctive to the area, line parts of the shoreline. A number of species that occur in this area are at the limit of their distribution and some species found exclusively in Wallis Lake have not been recorded at other locations (Fiebig, 2010).

Wallis Lake, for instance contains the largest area of estuarine seagrasses in NSW (3190ha), comprising 35% of the total seagrass in the state.

Figure 2. Major subcatchments of Wallis Lake Catchment



Of the five seagrass species present, two are at the limits of their distribution, *Posidonia australis* at the north and *Halodule tridentata* at the south. Although most seagrass species in NSW constitute protected ecological communities, *Posidonia australis* (nominated as an Endangered Ecological Community (EEC)) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) has been identified as endangered in five NSW estuaries south of Wallis Lake. The other species, *Halodule tridentata*, which is relatively widespread (although patchy) in the southern basin of Wallis Lake has not been recorded from any other NSW lake or estuary (Fiebig, 2010).

Wallis Lake also possesses the second largest representation of saltmarsh in the state. Saltmarshes are a widespread and unique component of coastal estuaries in Australia, which represent a merging of land and sea (Umwelt, 2012).

In NSW saltmarshes are in rapid decline and have been listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995* (TSC Act) and as a Vulnerable Ecological Community (VEC) under the EPBC Act. Fragmentation and habitat conversion driven by impacts from climate change; urban and tourism development; and economic uses of coastal resources for agriculture are the greatest threats to saltmarsh. Training of the entrance of the Lake and dredging to maintain navigable channels has also changed the hydrology of the area enough to allow mangroves to expand in several places at the expense of saltmarsh. Historical photographs show this expansion of mangroves over considerable time.

In 1985 West et al (referenced in Umwelt, 2012) recorded a total of 4km^2 of saltmarsh in the Wallis Lake Estuary. It is likely that this figure has declined since that time due to increasing pressures within the Lake system but this has not been accurately quantified.

Wallis Lake is one of the most productive estuarine fisheries in New South Wales. The seagrass, saltmarsh and mangrove areas discussed above are cornerstones of estuarine foodwebs, habitat provision and nursery grounds that support these fisheries. They are pivotal for a sustainable commercial fishing industry. The importance of seagrass meadows to the health of estuaries and sustainable fisheries is further recognised in the *Fisheries Management Act 1994* (FM Act) and the NSW Department of Primary Industry's (DPI) Policy and Guidelines for fish habitat conservation and management (2013a).

These characteristics have supported the listing of Wallis Lake and its adjacent estuarine islands as a *Nationally Important Wetland*. A number of areas within the Wallis Lake Catchment are also classified under State Environmental Planning Policy No. 14-Coastal Wetlands (SEPP 14), designed to protect wetlands from clearing, draining, filling and levee construction.

Vegetation

Approximately 44% of the Catchment has been cleared for agriculture, urban development and infrastructure. The remnant vegetation is highly variable, ranging from lowland wetland ecosystems to dry sclerophyll forests in the hinterland.

Dry sclerophyll forest occurs throughout the Catchment on well-drained sites and this is the most common ecosystem in the Catchment. Rainforests also occur throughout the Catchment but are confined to sheltered valleys and headlands. Wet sclerophyll forests occur on sheltered slopes in the transitional zone between valley rainforests and ridge-top dry sclerophyll forests. Swamp forests mainly occur in poorly drained sites close to the coast. Wet and dry heathlands mainly occur in the north-east of the Catchment. Sedgeland and rushland communities grow in perpetually moist sites.

The Wallis Lake Catchment contains a variety of vegetation communities of state, regional and local conservation significance. Endangered ecological communities occurring in the Catchment are listed below:

Table 2. Ecological Communities occurring in the Wallis Lakes Catchment listed as 'endangered' under the NSW Threatened Species Conservation Act (1995)

Endangered Ecological Communities occurring in the Wallis Lake Catchment
Freshwater wetlands on coastal floodplain
Littoral rainforest
Lowland rainforest on floodplain
Lowland rainforest
Subtropical coastal floodplain forest
Swamp oak floodplain forest
Swamp sclerophyll forest on coastal floodplain
River-flat Eucalypt forest

Fauna

Wallis Lake and its Catchment are visited by 35 JAMBA, CAMBA and ROKAMBA-listed international migratory bird species. These international Migratory Bird Agreements formalise Australia's relationships with Japan (JAMBA), China (CAMBA) and the Republic of Korea (ROCAMBA) respectively with regard to migratory bird conservation and they provide a basis for collaboration on the protection of migratory shorebirds and their habitat.

It has been noted that Wallis Lake is unique in terms of its diversity of sponge fauna. In a survey of 10 coastal lakes in 2002 (Barnes, 2010) Wallis Lake, with ten species, had almost twice as many species as any other lake. Comparatively, sponges and ascidians are absent from the majority of lakes and lagoons in New South Wales. Most species appear restricted in distribution to only one or a few lakes. For example, *Dysidea sp*., *Raspaillia* sp., a species of *Haliclona* and a species of *Halichondria* have only been recorded in Wallis Lake. Of the twelve species so far reported from the southern basin of Wallis Lake only *Chondrilla* c.f. *australiensis* and *Aplysilla* c.f. *sulphurea* could be tentatively identified to species. The remainder are likely to be undescribed and new to science. The impacts considered to be of the greatest potential threat to the survival of this unique community are increased sediment loads and loss of habitat (algal and seagrass meadows) (Barnes, 2010).

Wallis Lake has well over 100 species of fish; 55 species of invertebrates and three species of sea turtles. The northern section of the lake receives transient tropical species under the strong marine influences during summer and autumn, while occasional freshwater species occur at the southern end (Fiebig, 2010).

Of these, the Green Turtle (*Chelonia mydas*) is listed as Vulnerable, and the Loggerhead Turtle is listed as Endangered under both the EPBC Act and the TSC Act. The Hawksbill Turtle (*Eretmochelys imbricate*) has also been recorded in the Estuary and is listed as Vulnerable under the EPBC Act.

Black Cod (*Epinephelus daemelii*) listed as Vulnerable under the FM Act and EPBC Act and Whites Seahorse (*Hippocampus whitei*) have also been recorded in the Estuary.

The Catchment of Wallis Lake with its diverse array of ecological communities also supports a wide range of threatened terrestrial fauna, several examples of which are included in Table 3.

Further information on the ecological characteristics of the Wallis Lake Estuary and Catchment can be found in the Wallis Lake Wetlands Strategy (GLC, 2010).

Table 3. Examples of species listed under the Threatened Species Conservation Act (1995)

Common name	Scientific name	Threatened Species Listing
Koala*	*Petaurus norfolcensis*	Vulnerable
Squirrel glider	*Phascolarctos cinereus*	Vulnerable
Spotted-tailed quoll*	*Dasyurus maculatus*	Vulnerable
Brush-tailed phascogale	*Phascogale tapoatafa*	Vulnerable
Greater broad-nosed bat	*Scoteanax rueppellii*	Vulnerable
Grey-headed flying-fox*	*Pteropus poliocephalus*	Vulnerable
Wallum froglet	*Crinia tinnula*	Vulnerable
Stephen's banded snake	*Hoplocephalus stephensii*	Vulnerable
Osprey*	*Pandion haliaetus*	Vulnerable
Pied oystercatcher	*Haematopus longirostris*	Vulnerable
Black-necked stork	*Ephippiorhynchus asiaticus*	Endangered
Glossy black cockatoo	*Calyptorhynchus lathami*	Vulnerable
Masked owl	*Tyto novaehollandiae*	Vulnerable

* Also listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cth)

1.1.2 Aboriginal history

The cultural heritage of Wallis Lake and its Catchment includes a rich Aboriginal heritage strongly linked to the Lake.

In the Great Lakes district there were two tribes - the **Biripi**, who inhabited the area between Tuncurry, Taree and Gloucester, and the **Worimi**, who occupied the land between Barrington Tops and Forster in the north and Maitland and the Hunter River in the south (GLC, 2012).

The people of the Wallis Lake area, called Wallamba, had one central camp site in the area now known as Coomba Park. This camp site was used until 1843. The Wallamba had up to 500 members before white contact. Their descendants now live in Cabarita, a section of Forster, with a land council administering their affairs.

Sites in the Wallis Lake area reflect the Wallamba's complex interactions with their environment. Middens abound and most are the result of people collecting shellfish, then cooking and eating them not far from where they were found. The many spiritual sites are natural features of the landscape with special significance and include headlands, rocks, caves, creeks and hills. Scarred trees show evidence of the removal of their bark for making containers, canoes, shields and boomerangs (Tobwabba & Morgan, 2001).

1.1.3 European history

The arrival of European settlement defined a major alteration in land use within the Wallis Lake Catchment. The earliest European arrivals were timber cutters and the agricultural activity on the cleared lands included poultry, dairy and beef cattle production as early as the mid-1800s (GLC, 2003).

By the mid-1970s, native vegetation cover had been removed from approximately 44% of the Wallis Lake Catchment (GLC, 2003). Such landscape modification included the clearing of riparian corridors and steep hillslopes, as well as the draining, infilling and mining of substantial areas of coastal wetland and the barrier dune system.

Upon Wallis Lake itself, dredge harvesting and the cultivation of natural oyster beds began in the early 1880s. The formal introduction of oyster production leases in 1884 led to 700 applications covering approximately 5.5km of the Wallis Lake foreshore (GLC, 2009 p.607).

1.1.4 Current community and land use

Although agriculture (particularly unimproved pasture for beef production) continues to dominate the Catchment landscape, in monetary terms the area has moved towards being a 'lifestyle region', with an increase in retirees and 'sea-changers', and tourism and the service industries playing larger parts in the local economy (GLC, 2012).

Wallis Lake itself is one of the most significant producers of Sydney Rock Oysters in Australia and is also central to the local tourism industry, valued at over $315m per year. The Lake is one of NSW's top three producing estuarine fisheries and is utilised extensively for recreation including boating, fishing and swimming (GLC, 2013a).

Figure 3 and Table 4 on the following pages provide a summary of the current land use within the Wallis Lake Catchment[1]. As can be seen from this table, dominant land use types and economic activities in the Wallis Lake Catchment include agriculture; aquaculture; conservation and commercial forestry; urban and rural residential development; and the tourism and coastal retirement sectors (GLC, 2009). The most extensive land use type within the Catchment is grazing (volunteer, naturalised, native or improved pasture) at 35.77%, followed by tree cover on private and unreserved lands at 30%.

1 Note on data used to map land use: This information is intended as a guide only; the data used is an amalgamation from a number of different sources of varying age and accuracy. Also worth noting is that much of the land mapped as 'tree cover on private land' would be grazing land with some remnant native cover. Conversely, sites mapped as 'grazing and rural residential' would still contain some small but important areas of remnant native vegetation.

Figure 3. Summary of land use in Wallis Lake Catchment

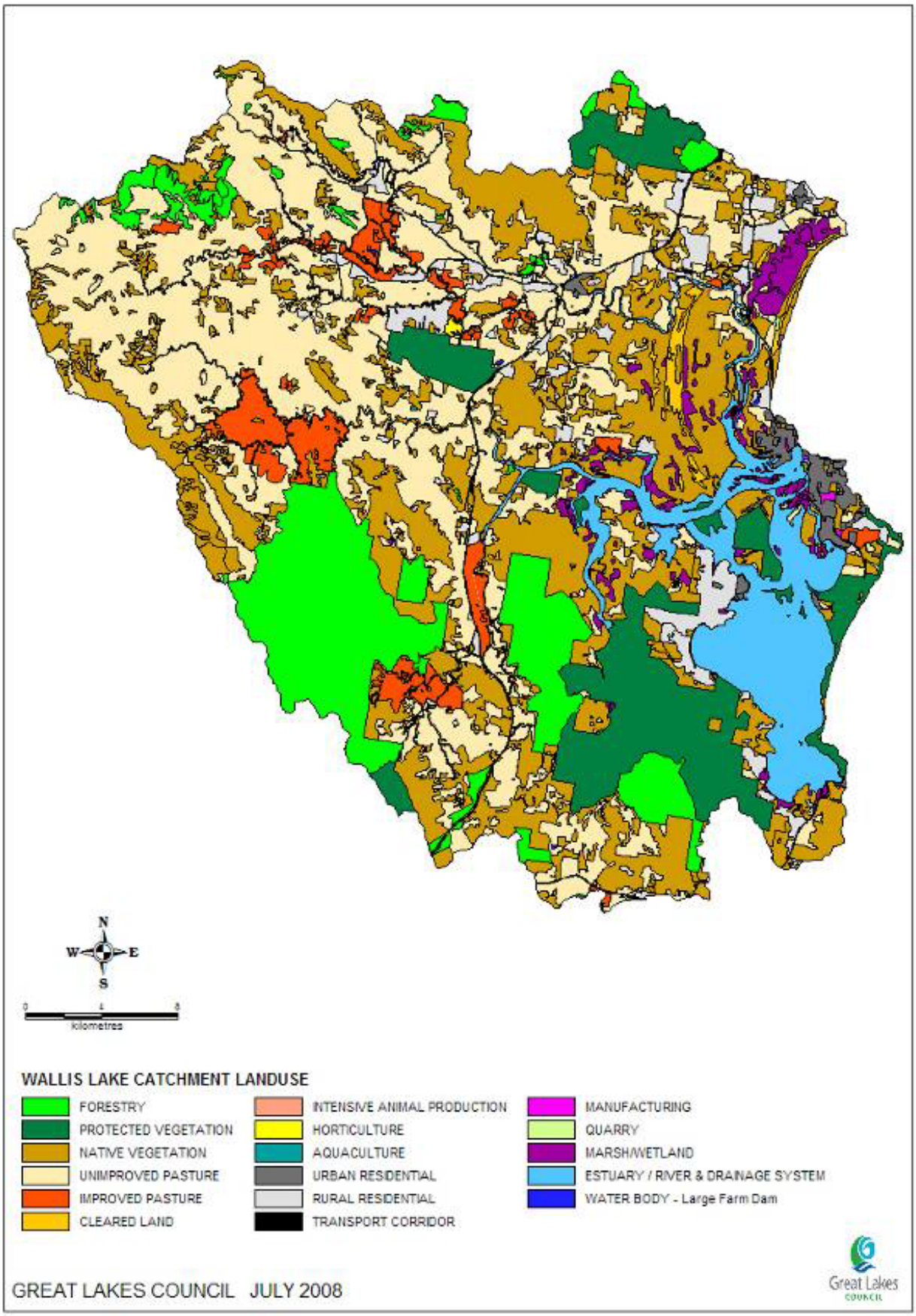


Table 4. Land use by type in Wallis Lake Catchment by area and percentage

Land Use	Area (ha)	Area (%)
Grazing - Native or improved pasture	46156.85	35.77
Grazing - Irrigated, intensive pasture	36.61	0.03
Intensive Animal Production - dairy shed	10.32	0.01
Horticulture - Orchard, vegetable or turf production	76.32	0.06
Aquaculture - Oyster, fish, prawn	22.19	0.02
Tree Cover (30% cover or higher) - on private or unreserved lands	38712.54	30.00
State Forest	13411.76	10.39
Conservation Area - National Park	7752.41	6.01
Conservation Area - Nature Reserve	3509.01	2.72
Wetland - Coastal marsh, mangrove, mudflat or swamp	1936.22	1.50
Water Body - Coastal lake, sand spit or estuarine feature	6581.54	5.10
River & Drainage System - Major river, creek or other incised drainage feature	2595.25	2.01
Water Body - Large farm dam	63.93	0.05
Urban - Rural Residential / Small rural landholdings	4907.02	3.80
Urban - Residential and urban infrastructure	1746.56	1.35
Mining & Quarrying - Restored sand mining area	786.80	0.61
Mining & Quarrying - Construction sand or gravel quarry	106.25	0.08
Transport & Other Corridors - Road or road reserve	639.51	0.50
Total	**129051.11**	**100**

Aquaculture

Oyster production and commercial fishing are essentially aquatic-based activities and are conducted primarily on Wallis Lake, the estuarine sections of the Catchment's rivers and in the open oceanic waters surrounding the Lake entrance. The Catchment waterways and their associated wetland occupy less than 10% of the Catchment area (GLC, 2009)

Figures released by the NSW DPI (Fisheries), supporting Wallis Lake's position as one of the most significant producers of Sydney Rock Oysters in Australia indicate that for the financial year 2011/12, oyster production in Wallis Lake stood at 1,330,703 dozen oysters with a total value of $7,829,950 (DPI, 2013), or almost 30% of the state total.

Wallis Lake supports the fifth largest number of fishing businesses of any NSW estuary (51) and the second largest overall catch (349,125kg) after the Clarence River Estuary (Fiebig, 2010). The species of most significant commercial interest include: sea mullet (*Mugil cephalus*); luderick (*Girella tricuspidata*); dusky flathead (*Platycephalus fuscus*); sand whiting (*Sillago ciliate*); yellow fin bream (*Acanthopagrus australis*); blue swimmer crabs (*Portunus pelagicus*); and a number of prawn species.

The value of the commercial fishing industry to the region is estimated at approximately $22 million per annum, making it one of the largest industries after tourism (Fiebig, 2010).

Agriculture

Beef and dairy grazing, the main agricultural activity within the Catchment, utilises approximately 35.8% of the Wallis Lake Catchment. Grazing is located predominantly in the Wallamba, Wang Wauk and Coolongolook subcatchments.

While, historically, dairy grazing accounted for a large proportion of this land, as noted in the Wallis Lakes CMP (2003), this has significantly reduced over recent years. In 1999, 48 dairies were operating within the Wallis Lake Catchment, and by 2001 that number had fallen to 29 operational dairies. Through research undertaken for the Water Quality Improvement Plan (WQIP) (2009) based on field surveys and personal communication with Catchment landholders, only nine dairies were found to be operational in the Catchment.

Forested land

Together, privately-owned native forest and state forest cover approximately 521.24km^2 (40.39%) of the Catchment. The larger proportion of this, 387.12km^2 is under private ownership.

An increasing area of privately-owned native forest is being managed for conservation purposes under formal agreements with conservation agencies. As of November 2013, 32 landholders in the Wallis Lake Catchment had joined the Land for Wildlife Program, a voluntary registration scheme that assists landholders to maintain wildlife habitats on their land.

Privately owned forests frequently support concurrent land use activities, such as grazing cattle in the understorey, low-volume timber harvesting, private conservation as well as numerous recreational activities (GLC, 2009).

Conservation

Approximately 8.73% of the Catchment is utilised for conservation purposes. This land is under the ownership and management of the NSW National Parks and Wildlife Service. Booti Booti and Wallingat National Parks, on the south eastern and south western sides of Wallis Lake respectively, account for a significant portion of this land use.

Smaller conservation areas, managed as nature reserves are located on most estuarine islands, the northern edge of the Catchment and along the boundary between the Wallamba and Wang Wauk subcatchments. Much of the current conservation estate is located on steeper timbered hill slopes and ridge top landscapes within the Catchment.

Urban/residential development

Urban and rural residential development and its associated infrastructure cover approximately 66.53 km^2 of the Wallis Lake Catchment (5.15%), and support a total population of approximately 25, 159 (GLC, 2014a). The townships of Forster and Tuncurry, with a combined population of 19,509 (GLC, 2014) are located on the north-eastern shore of Wallis Lake and are the largest urbanised areas within the Catchment. Additional coastal population centres include the villages of Hallidays Point, Coomba Park and Pacific Palms. Smaller urban centres in western parts of the Catchment include the villages of Nabiac, Coolongolook, Wootton and Krambach. Due to the region's high tourism appeal, population numbers within the Hallidays Point, Pacific Palms and Forster/Tuncurry townships increase significantly during the summer holiday season.

Based on Council's population forecasts, Forster/Tuncurry will experience a 45% population increase by 2031 from a base of 18,372 in 2006. This would result in an additional 8,300 people living in the study area and increase the resident population to 26,500 (GLC, 2009a). By 2031 it is estimated that this cohort will represent 40% of Great Lakes residents.

Reticulated effluent treatment systems service the larger urban areas of Forster/Tuncurry, Pacific Palms, Green Point, Failford and Nabiac. On-site effluent disposal systems service the remaining rural and rural residential areas. The main unsewered villages are Coomba Park and Coolongolook (GLC, 2009).

Approximately 49.07 km^2 (3.8%) of the Catchment is developed for rural residential purposes. Much of this land is located in the Wallamba River subcatchment surrounding Nabiac, and in the Lower Wallamba River subcatchment surrounding the Failford/Darawank areas. The western and south western shores of Wallis Lake, in the Coomba and Charlotte Bay areas, also support significant areas of rural residential development.

While the population is increasing, a considerable challenge also arises from the ageing of the population. The median age is expected to increase from 44 years in 2006 to 55 years in 2031, and the population aged 65 years and over will more than double. At the same time the proportion of children under 15 years will decline from 19% to 14% of the regional population. These population changes will impact on the type and availability of dwellings that will be needed (DoP, 2009).

For more detailed background information on the history and current land use of Wallis Lake and its Catchment, please refer to Appendix 8 of the Great Lakes Water Quality Improvement Plan (2009)

1.2 Current state of the Catchment (emerging issues and new information)

1.2.1 Waterways Report Card

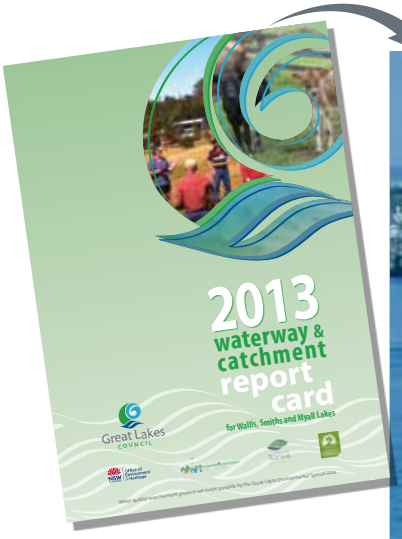
Since 2011 Great Lakes Council has produced Waterway and Catchment Report Cards. These report cards publicise water quality (specifically turbidity and chlorophyll levels) of eight different sites in the Great Lakes LGA. The information collected at the sites is converted into a grading system, comparing them to scores from over 130 sites across New South Wales (Table 5). Further historical data is provided from detailed studies undertaken as a part of the Water Quality Improvement Plan in 2009.

The intention is to continue monitoring and documenting the water quality of the four sites in Wallis Lake regularly building up a longitudinal picture of both short-term fluctuations and long-term trends. This information will be vital in understanding the impacts of different pressures and the effectiveness of management efforts.

Table 5. Summary of scale used for grading of water quality

Grade	Result	Description
A	Excellent	The highest 20% of scores in the state
B	Good	Next 20% of high scores in the state
C	Fair	Middle 40% of scores in the state
D	Poor	Lower 15% of scores in the state
F	Fail	Lowest 5% of scores in the state

Four of the sites monitored for the 2011, '12 and '13 Report Cards occur within the Wallis Lake Catchment: Mid Wallamba River Estuary, Pipers Creek, Wallis Lake, and Charlotte Bay. A summary of these four sites is provided on the next page, drawn from Great Lakes Council's 2013 Waterway and Catchment Report Card for Wallis, Smiths and Myall Lakes.

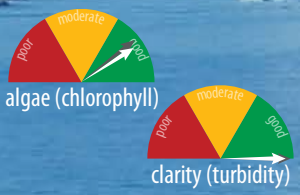


Wallis Lake
Water Quality Report Card

Pipers Creek

B Well done!

2013 B 2012 B 2011 B 2007

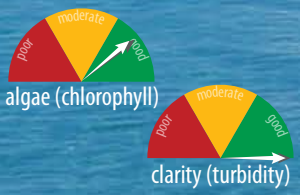


The ecological health in Pipers Creek continues to be good, with results similar to 2011 and 2012. Waters in Pipers Creek remained clear. The nutrient loads from the urban catchment of Forster resulted in algal levels that were still higher than desired, but slightly less than last year.

Wallis Lake

B Good score!

2013 B 2012 A 2011 A 2007

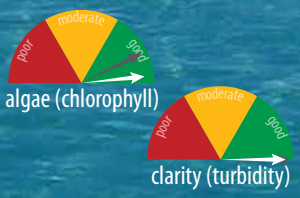


Wallis Lake is of a high conservation value, with abundant seagrass and high biodiversity. Ecological health was good, but has remained below that recorded in 2011. Water clarity was excellent but there was mild growth of algae indicating on-going inputs of nutrients.

Charlotte Bay

A Excellent!

2013 A 2012 A 2011 A 2007

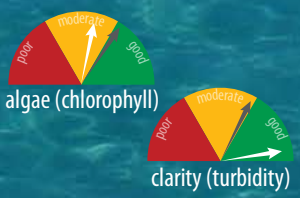


Charlotte Bay is of high conservation value, with abundant seagrass and high biodiversity. Ecological health remained excellent, algal growth is at very low levels, reversing the small increase in algal levels seen last year. Water clarity was excellent.

Mid Wallamba estuary

B Great improvement!

2013 C 2012 D 2011 D 2007



This year the waters of the Wallamba River Estuary improved and are very clear but algal growth is still higher than desired. The clear waters provide lots of light, which combined with nutrients from the catchment resulted in much higher algal levels than last year.

1.2.2 Catchment Landscape Report Card

Native vegetation cover, the connectivity of remnant native vegetation, the extent of lands reserved in permanent public conservation and the extent of lands zoned for environmental protection are all scientifically-recognised indicators of the condition and resilience of the natural landscape.

During 2012, the remnant native vegetation across the Great Lakes LGA was mapped by GLC's GIS division. From this data an interim Catchment Landscape Report Card was produced with the intent to develop a robust community reporting tool containing data on terrestrial habitats and native vegetation that would complement the existing Waterways Report Card.

Further development of this report card has also been identified as an action under the Ecosystem Health Management Actions, to support the objective: 'Maintain and improve areas of locally significant native vegetation as well as linkages between key habitat nodes'.

A summary of the findings from the interim report card which provide a snap shot of the current state of the Catchment is provided below:

Table 6. Overview of Wallis Lake Landscape Report Card

Wallis Lake Subcatchment[2]	Subcatchment Area (ha)	Native Vegetation Cover (%)	Fragmentation (%)	Public Reservation (%)	Environmental Zoning (%)
Wallamba River	332	37.96	86.67	0.00	0.00
Lower Wallamba River	4,265	54.86	77.36	12.31	17.46
Wang Wauk River	16,192	57.29	90.15	0.00	0.00
Coolongolook River	17,649	69.98	88.99	2.69	0.04
Wallingat River	17,289	82.66	85.23	28.94	4.03
Minimbah Sandbeds	11,964	68.73	82.35	3.06	3.39
Wallis Lake	10,552	69.50	81.02	28.84	38.61
WALLIS LAKE CATCHMENT	78,242	68.93	84.98	12.02	7.58
GREAT LAKES LGA	**318,109**	**73.79**	**85.40**	**18.83**	**3.93**

2 Data is limited to the portion of the Wallis Lake Catchment within the Great Lakes LGA (ie Data from GTCC and GSC is not included).

Key findings of the analysis:

- Native Vegetation Cover is calculated on the extent of native vegetation cover present in the landscape. The higher the representation of native vegetation, the more resilient the area will be. The Catchment as a whole has a relatively high representation of vegetation cover (68.93%), however the Wallamba subcatchment in particular has less than 40% vegetation cover.
- Fragmentation is calculated on the percentage of remnants of native vegetation cover that are less than 20-hectares in size. The higher the proportion of small isolated remnants, the less resilient the landscape will be. As can be seen from Table 6, fragmentation of habitats is relatively high both within the Wallis Lake Catchment, and all of its subcatchments.
- Public Reservation is the percentage of the area set aside for permanent public conservation. Both the Wallamba River and Wang Wauk River have no public conservation areas within their catchments, while the presence of Booti Booti and Wallingat National Park serves to protect a relatively large proportion of the Lake and Wallingat River subcatchment.
- Private Reservation has not been identified in this study (for instance, those lands protected through conditions of consent) due to current data gaps. This has been identified as an issue through the Monitoring Plan developed within this Plan (see Chapter 4.3)
- Environmental Zoning is the percentage of the area zoned for environmental protection by the current Local Environmental Plan (LEP). As can be seen from the table, only a small area of both the Catchment and the LGA as a whole has been zoned for environmental protection.

1.2.3 Saltmarsh mapping and assessment

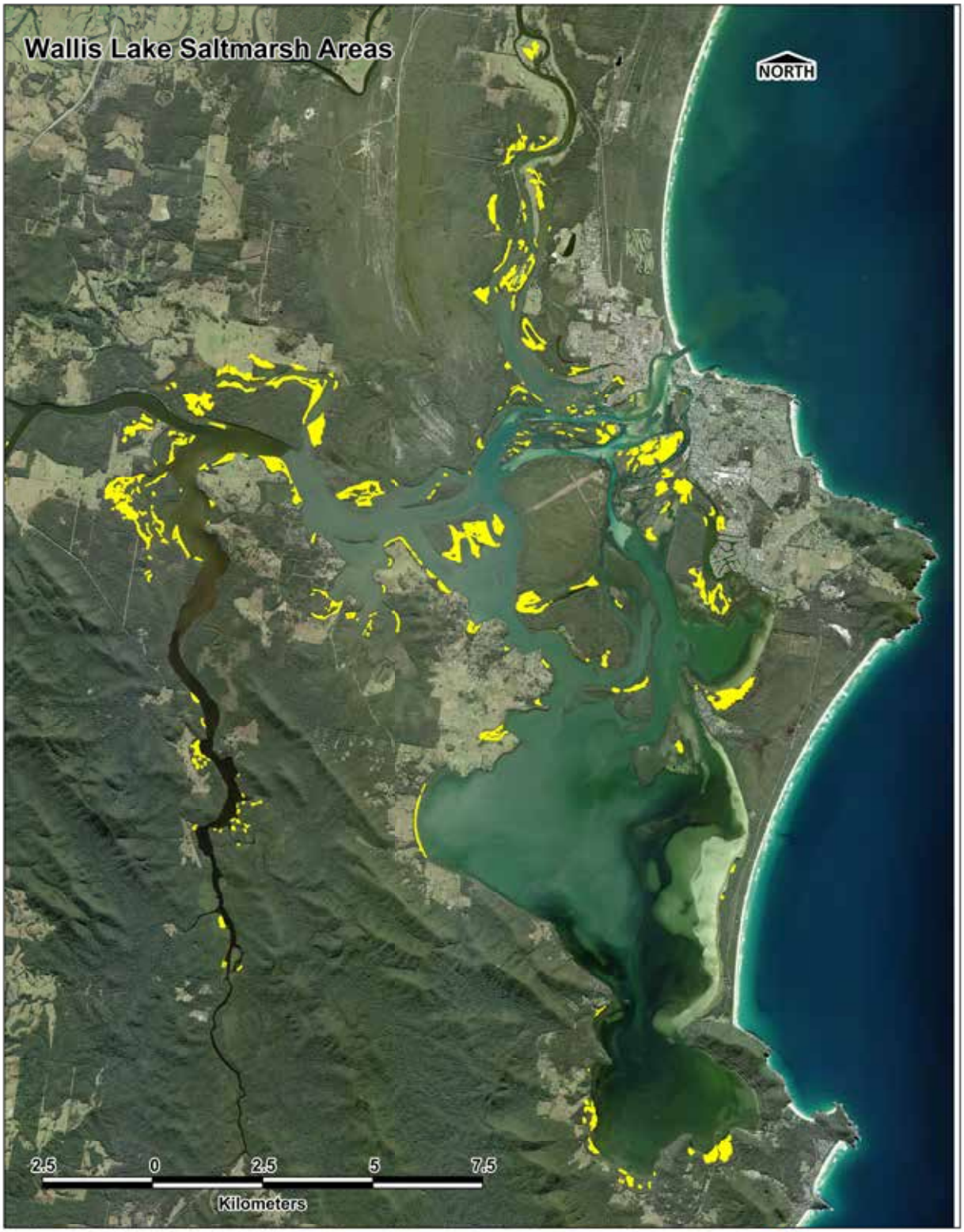
Saltmarsh is a widespread component of the estuarine habitats within Wallis Lake (See Figure 4, as mapped by DPI Fisheries). It is a habitat in decline in NSW and its limited distribution has led to its classification as an Endangered Ecological Community (EEC) in NSW.

In 2012 Umwelt (Australia) Pty Limited was contracted by Great Lakes Council to undertake a condition assessment and develop management considerations for saltmarsh within Wallis Lake. The findings from this report have influenced the actions included in the Action Plan developed to address threats to local ecosystems arising from climate change and associated sea level rise (see EH 8, p.80). A brief summary of the report's key points are provided below:

- Wallis Lake was found to support a wide variety of saltmarsh plants because of its sub-tropical location and the large patches of undisturbed saltmarsh occurring within the bounds of the Lake. These support wide expanses of monocultures such as samphire meadows or salt couch fields, as well as other less common species. A feature of saltmarsh areas identified within Wallis Lake is their capacity to support less common species in large patches.
- Creeping brookweed (*Samolus repens*) has been observed in extensive patches while seablite (*Suaeda Australia*) also occurs in large dense patches.
- Saltmarsh ecosystems in Wallis Lake are under substantial pressure from a range of stressors related to climate change, urban and tourism development, and agriculture. As a result, fragmentation and habitat conversion are the greatest threats to saltmarsh at present. Small fragmented areas of saltmarsh, particularly those surrounded by mangrove, are likely to disappear over time with sea level rise and mangrove incursion. Smaller patches of saltmarsh, although they contain flora consistent with the EEC do not function in the same ecological way.

In 2013 an assessment of the Lake was undertaken to ground truth DPI Fisheries existing mapping data. The resultant mapping will inform GLC's ongoing saltmarsh management actions.

Figure 4. Distribution of Saltmarsh Communities around Wallis Lake as mapped by DPI Fisheries



Great Lakes COUNCIL

1.3 Link between water quality, ecosystem health and community wellbeing.

In 2013 Great Lakes Council in cooperation with the wider community of the LGA created a vision to support the development of a Community Strategic Plan which would function as a blueprint for government authorities to inform development and maintenance of facilities and services within the region into the future (GLC 2012).

The vision of this plan is:

> *A unique and sustainably managed environment balanced with quality lifestyle opportunities created through appropriate development, infrastructure and services*

This vision highlights the importance that the Great Lakes community puts on 'environment' and its subsequent links to the lifestyle and economy of the region. In the Wallis Lake Catchment – where so much of the economy is either directly (in the case of agriculture and aquaculture) or indirectly (in the case of tourism) dependent on the area being healthy, productive and beautiful – concepts of ecosystem health, water quality and community wellbeing are inextricably linked. As noted in the Hunter Cetnral Rivers Catchment Management Authority (HCR CMA) Catchment Action Plan (2013): 'The wellbeing of our community cannot be separated from the successful management of the natural resources we all rely on'.

A healthy ecosystem and thus a high-degree of water quality is critical for our oyster and fishing industries, as well as being a key component of the region's tourism industry. For instance, the entire Great Lakes Area attracts an estimated 1 million visitors a year, contributing $315 million to the local economy. As noted by Richard Old, Great Lakes Tourism and Marketing Manager, "The entire tourism industry in the Great Lakes is tied to the natural environment. This is the reason people choose the Great Lakes over other destinations" (Personal communication, 2012).

To this end, and for ease of use, the E&CMP is divided into three management areas, each with multiple objectives: Water Quality, Ecosystem Health and Community Wellbeing, though in reality, it is clear that these issues are interrelated. Multi-Agency Action Plans have been developed to contribute to the maintenance of each objective.

Due to the interrelation between all of the issues, there are many proposed management actions which address more than one objective or management area. Due to space and usability considerations these actions have not been repeated, but this has been considered in their development.

1.4 Ecosystem services

This interdependence of Community Wellbeing, Water Quality and Ecosystem Health can be further understood through the concept of 'ecosystem services'. Ecosystem services are the benefits and tangible goods provided by the natural environment (See Table 7). A healthy environment is one better able to provide us with what we need to survive and thrive as a community. For example, ecosystems provide us with material goods such as crops, livestock, forest products, fibres and coal (HCR CMA, 2013).

The ecosystem services concept explains the dependence of humans on the natural environment, while reinforcing the interdependency of environmental management and human well-being (Cork, Stoneham & Low 2007). Because of this interdependence, the health of natural systems and the communities which rely on them cannot be managed in isolation. The loss or over-exploitation of these services eventually results in the decrease of the system's ability to be able to recover from acute or chronic pressures. This loss of system 'resilience' can lead to further and accelerating environmental decline (HCR CMA 2013).

Further, the natural resources of the Great Lakes landscape provide the economic foundation for primary production (mainly fish, oysters, beef, dairy products, timber) and resources industries. As such, a functional and resilient natural environment is essential for our economic and social well-being (GLC, 2012a).

Table 7. Examples of ecosystem goods and services. Adapted from Turner et al (2004).

Ecosystem goods and services	Examples
Wildlife corridors and nursery habitat	Fish and crustacean nurseries and roosts for migratory birds
Buffering capacity	Flood control, drought, recovery and refuges from natural and human-induced catastrophic events
Freshwater flows and tidal flushing	Supply of nutrients to the marine environment and removal of pollutants from estuaries
Sediment trapping and shoreline stabilisation	Prevention of soil loss by estuary vegetation, and accumulation of sediment and organic material in riparian habitats
Nutrient supply and cycling	Nutrient supply, nitrogen fixation and nutrient cycling through foods webs and breaking down of wastes
Biodiversity	Diversity of genes, species and ecosystems that ensures continued possibilities both for adaptation and for future use by people in a changing environment
Fisheries	Food and bait production. Commercial, recreational, indigenous and cultivated fisheries (aquaculture)
Extractive industries	Sand and gravel extraction
Nature appreciation	Providing access to estuaries and associated wildlife for viewing and walking
Recreation	Clean and clear water for swimming, sailing, canoeing, water-skiing, kayaking
Aesthetics and amenity	Residential houses, flats, offices and tourist accommodation with scenic views
Transport services	Marinas, harbours, ferries and boat ramps
Cultural Values	Aesthetic, educational, research, spiritual and intrinsic values of estuary systems

1.5 Resilience and tipping points: managing natural resources to maximise future options

The Wallis Lake Estuary and Catchment is composed of linked human and natural systems (often referred to as social-ecological systems) all interacting with each other. These systems change and adapt over time in response to both internal pressures (such as a new business starting up, a change in wetland legislation, or a change of rural land use) and external ones (such as drought, flood, changes in the national economy). In this way the biophysical system constrains and shapes people and their communities, just as people shape the biophysical system (Walker and Salt, 2006).

A resilient social-ecological system has a greater capacity to manage unwelcome surprises by absorbing disturbance (Walker and Salt, 2006). In contrast, a system which has lost its resilience does not require much disturbance for it to suddenly reach a 'tipping point', or threshold, past which it changes completely (HCR CMA 2013).

With this in mind, the intent of this Plan is not to try and manage the individual components of this system independently, but to adopt an holistic approach. The Plan aims to acknowledge that landscapes are dynamic, interconnected systems where people and communities are integral to landscape function (NRC, 2013). The Plan will focus on building the capacity and robustness of these systems to respond to unexpected change. The goal of this plan is to assist the Wallis Lake Estuary and Catchment to continue servicing current demands, without eroding its potential to meet future needs.

2 PLAN REVIEW AND DEVELOPMENT

2.1 Community and stakeholder consultation

Not surprisingly the development and implementation of the Wallis Lake E&CMP has a large number of both direct and indirect stakeholders, stretching from those agencies and industry bodies with direct actions to implement under the Plan, to the wider community who rely on the services the Lake and Catchment provides.

The Wallis and Smiths Lakes Coast and Estuaries Committee (WSLCEC) is a body supported by Great Lakes Council and is the committee which oversees and provides advice to agencies on issues of coastal and estuarine management. Membership of the group comprises representatives from industry groups, state agencies, local government, community groups and community members from the committee's area of jurisdiction.

The Great Lakes Catchment Group (GLCG) is also supported by Great Lakes Council and oversees and provides stakeholder input on issues of catchment and inland waterway management across the catchments of the Wallis, Smith, and Myall Lakes and Karuah River[3]. Membership of the group consists of representatives from industry groups, state agencies, local government, community groups and community members within the committee's area of jurisdiction.

3 At the time of writing the GLCG's formation and role is under review. Overview of this E&CMP will make up a key guiding principle of the Committee's role and function.

Delivering input on the implementation of this Plan is well within the scope of the committees of the WSLCEC and the GLCG, as key agency and industry stakeholders are represented in one or both cases. As such, these committees represent an essential vehicle for effective and efficient engagement of agencies, industry and community towards development and implementation of the Plan. Given this is a review of two existing plans, community engagement focused on working intensively with the committees. This involved:

- Facilitated workshops with the WSLCEC and GLCG throughout 2012 and 2013 to develop shared vision and values, and review the threats to the Estuary and Catchment
- Review and update actions from existing Management Plans
- Identification of new actions to address emerging threats
- Review of principles in the Plan
- Review of dredging strategy
- Face to face meetings with stakeholders involved in delivering management actions to assess progress and identify new ideas to address emerging threats
- Public exhibition of draft document

Those stakeholders with responsibility for implementation of specific actions, as well as those represented on the WSLCEC are shown in Table 8. Further information on individual agency and industry responsibility for actions is included in Appendix D.

Table 8. Agencies and industry bodies responsible for implementation of E&CMP actions

Agencies and industry bodies responsible for implementation of Wallis Lake E&CMP actions	
Great Lakes Council*	GLC
Greater Taree City Council*	GTCC
Gloucester Shire Council	GSC
Wallis Lake Fisherman's Co-Op*	Fishing Co-Op
Wallis Lake Oyster Industry*	Oyster Industry
Forster Local Aboriginal Land Council	FLALC
Local Landholders*	Landholders
Mid North Coast Weeds Consultative Committee	MNCWCC
Office of Environment and Heritage (NSW)*	OEH
Office of Environment and Heritage - National Parks and Wildlife Services*	NPWS
MidCoast Water*	MCW
Hunter Local Land Services*	LLS
NSW Office of Water	NoW
Department of Primary Industries (Fisheries)*	DPI (Fisheries)
Department of Primary Industries (Agriculture)	DPI (Ag)
Roads and Maritime Services*	RMS
NSW Forestry Corporation	Forestry
NSW Trade and Investment - Crown Lands*	Crown Lands
NSW Department of Planning and Environment	DP&E
Department of Environment (C'th)	DoE

* designates current representation on WSLCEC (at time of printing)

Potential stakeholders in the development and implementation of this Plan were analysed through a matrix as to their required involvement in the project; from informing some stakeholders, through to collaborating with and engaging key stakeholders face-to-face to develop the Plan's vision and subsequent actions.

As part of the engagement strategy the wider community was also consulted through:

- Online survey hosted on Great Lakes Council's website
- Face-to-face engagement of community members through public stalls at community events and markets
- Media releases and radio interviews
- Survey of landholders in the sustainable farming program to determine emerging issues
- Independent review of the sustainable farming program to assess effectiveness of the program and determine way forward for engagement
- Public exhibition of draft Plan

2.2 Review of previous Estuary and Catchment Plans

A detailed review of the Wallis Lake Catchment Management Plan (2003) and the Wallis Lake Estuary Plan (2005) has been undertaken as a key step in the development of this Catchment Plan. Key agencies and staff responsible for implementation have been interviewed and this detailed review is included as Appendix A.

The Management Actions developed for Chapter 2 have been designed based on this initial review process, then refined through subsequent workshops, face-to-face interviews and other stakeholder engagement activities.

Wallis Lake Estuary Management Plan (2005)

The objectives of the Wallis Lake Estuary Management Plan were to:

- Conserve, protect and enhance areas of significant cultural, ecological and aesthetic value
- Restore or remediate degraded areas
- Balance the recreational, commercial, social and cultural needs of the Estuary
- Increase the economic value of the Estuary in an ecologically sustainable manner, and
- Increase community awareness of estuarine processes and management issues.

The Wallis Lake Estuary Management Plan set out specific actions to address eight major themes: water quality and flow; ecology; fisheries; oyster aquaculture; sedimentation; foreshore management; waterway usage; and community education. Major on-ground projects which will be ongoing include the Darawakh Creek Wetland restoration; school environmental education; Wallamba River erosion control; urban stormwater quality improvement; Wallis Lake Wetland Strategy implementation; and maintenance dredging.

There has been considerable progress made towards implementing actions in the Plan, and these have delivered major improvements to the condition and quality of management of the Wallis Lake environment. To date, of the 143 listed actions within the Wallis Lake Estuary Management Plan, over 80% have been commenced, completed or are ongoing.

Table 9. Wallis Lake EMP (2005) implementation to date

Summary of Wallis Lake Estuary Management Plan: implementation to date	
Commenced or completed actions	40 (28.0%)
Ongoing actions	58 (40.6%)
Partially commenced actions	17 (11.9%)
Not commenced	28 (19.6%)

Wallis Lake Catchment Management Plan (2003)

Priority actions set out within the Wallis Lakes Catchment Management Plan (2003) include:

- Protect, maintain and enhance natural habitats, processes and values of Wallis Lake and its Catchment
- Develop partnerships with stakeholders to increase community awareness of issues affecting the Catchment
- Administer a committee to oversee natural resource management in the Catchment and supervise the implementation of the Plan
- Develop partnerships with landholders to develop innovative solutions for holistic land management that protect and enhance the natural resources and biodiversity of the Lake and its Catchment
- Acknowledge the traditional owners of the land and their cultural values and aspirations

Many of the actions in the Plan have already been completed but there is still much work to be done. Ongoing priority projects include:

- Improving water quality through nutrient and riparian management, education and erosion control
- Providing support for the protection and regeneration of native vegetation in priority areas
- Engagement with landholders to integrate water quality improvements with production systems
- Sealing of creek and river crossings at priority sites within the Great Lakes gravel road network

The delivery of actions in the Plan have had a direct positive influence on the health of Wallis Lake and its Catchment. The Plan has helped to deliver significant long term environmental benefits and enhanced community understanding of environmental risks and threats as well as their management and remediation. The project has delivered rural NRM projects that have permanently conserved important native vegetation through private conservation instruments; protected riparian zones from stock through exclusion fencing and off-stream watering; stabilised actively-eroding areas; revegetating cleared landscapes; and facilitating weed control activities.

Implementation of the Plan has assisted in building the capacity of rural landholders to undertake NRM projects, sustainable land management and best management practices. Further, priority wetlands in the Wallis Lake Catchment have been secured in public conservation ownership and management, allowing the ecosystem services functions of such landscapes to be established. The project achievements have been delivered in conjunction with key partners, including the Hunter-Central Rivers Catchment Management Authority, Local Government and the rural catchment community, as well as the support of external funding providers.

2.3 Summary of achievements and lessons learnt

Great Lakes Council has had an Environmental Special Rate (ESR) in place since 2001. The ESR has supported significant achievements in relation to the protection, restoration and enhancement of the quality and function of the natural environment; progress towards greater sustainability in the performance of Council and local businesses; and proactive contributions to the social and economic wellbeing and way of life of Great Lakes residents and visitors. In 2013 GLC re-applied to the Independent Pricing and Regulatory Tribunal (IPART) to continue to implement the ESR (the application was successful, and the ESR has been approved until 30th June 2020). This provided Council with an opportunity to assess the activities and programs it had implemented over this time, and examine what had been learnt during this period.

This review is by no means exhaustive, and does not include significant work undertaken by other agencies and businesses within the Catchment, or those works undertaken by Council through its other activities (such as land use planning processes) which are independent of the ESR. Further information on ESR projects is available in Great Lakes Council's Special Rate Variation submission to IPART (GLC, 2013).

A summary of management actions undertaken in the Catchment from 2007-2013 can also be seen in Figure 5.

Figure 6 on the following page, is a summary of the major activities relevant to Wallis Lake that have occurred since the commencement of the ESR, compiled from GLC's Special Rate Variation submission. When examined through the management areas of Water Quality, Ecosystem Health and Community Wellbeing adopted for this Plan, it can be seen that the majority of these projects achieve a multitude of goals across these management areas. Far from being purely 'environmentally' focused, a *holistic* approach has been adopted, acknowledging that human activities impact biophysical processes (eg. provision of ecosystem services such as clean water and arable land for primary production), and these biophysical processes impact on human activities (eg. tourism, recreational fishing, farming).

Figure 5. Management Actions in Wallis Lake Catchment 2007-2013

Combining behaviour change with infrastructure

Figure 6 also highlights that the majority of actions have a large behaviour change component (including landholder involvement and volunteering). Very few of these projects are solely infrastructure-based.

While many of these projects include onground works (eg. fencing or installation of rock fillets) they are not installed in isolation and community education and engagement activities are *essential* to fully achieve desired goals. Large infrastructure projects such as Wallamba riverbank restoration and Water Sensitive Design (WSD) retrofits are also undertaken in concert with engagement of key stakeholders. The urban WSD retrofit in particular is supported by further urban engagement programs (and even staff-led tours of the completed infrastructure) to assist the community in understanding not only the 'what', but the 'why' and 'how' residents in turn can contribute.

The success of many of these infrastructure projects has been dependent on community engagement activities undertaken prior to, during and after implementation to ensure community support, adoption and subsequent behaviour change.

People power

A second lesson highlights the importance of people power in many of these projects—such as volunteer and landholder involvement. Not only is engagement of the community vital to the success of these projects, but a key focus on Participant-Action Learning within these projects underpins many of the activities based on a principle that learning by doing (participating) is a highly effective form of environmental education. Council's urban engagement program involves getting urban residents' hands dirty as they make compost and dig garden beds. Rural land management and sustainable farming groups engage landholders inmending fences and mixing compost teas, while volunteer Bushcare and Coastcare groups regularly identify and remove problem weeds by hand. These activities not only have significant environmental benefits, but also direct health and social benefits for the participants and their communities.

The success of these projects also underlines the importance of encouraging, supporting and championing the work that these individuals achieve, as well as building their capacity to achieve additional goals without being managed or directed by Council (or any other agency).

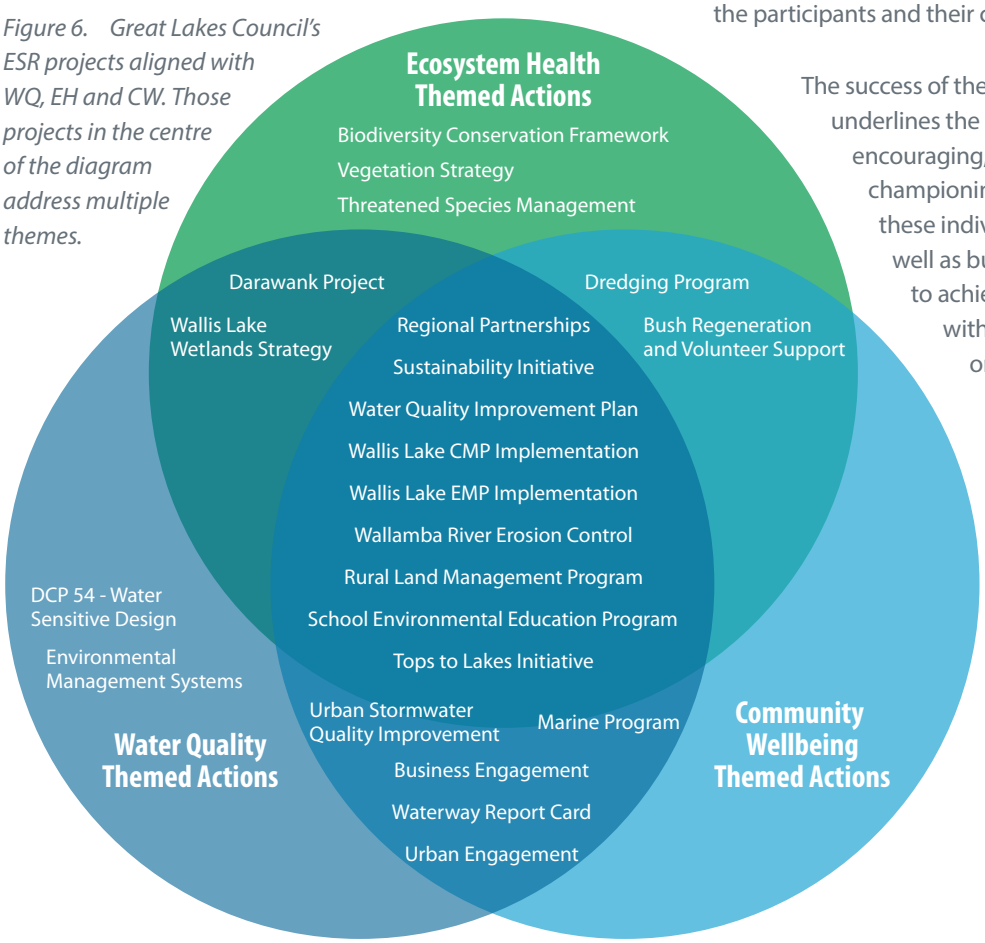


Figure 6. Great Lakes Council's ESR projects aligned with WQ, EH and CW. Those projects in the centre of the diagram address multiple themes.

Strategic preventative works at the source vs remediation of historical degradation

A distinction can be made with regard to those activities employed to retrospectively manage historical environmental degradation (Darawakh Creek/Frogalla Swamp restoration project; retrofitting of urban areas with WSD; replanting cleared riparian land) and those activities used to manage current and predicted future impacts (Great Lakes Development Control Plan 2014 - Water Sensitive Urban Design Section).

Undertaking these preventative measures can also be viewed as occurring at a catchment (or subcatchment) level to reduce the need to undertake costly restoration works around the Estuary at a later date. For instance, the long-term costs of re-establishing a tourism and aquaculture industry that has been devastated by algal blooms or pathogen contamination will be more expensive than the short-term costs of undertaking preventative measures (eg. WSD elements incorporated into new developments or the protection of existing foreshore vegetation). As noted by Healthy Waterways (Abal, Bunn & Dennison, 2005), healthy catchments lead to healthy waterways. This suggests that a proactive approach should be adopted rather than a reactive one.

From a resilience perspective, those catchment-based activities which target impacts within our control will improve the capacity of the Estuary's social-ecological system to respond to unexpected shocks such as flood or drought. Furthermore, improving this system resilience can stop the Estuary passing a tipping-point where it could become a system that doesn't match our current expectations and requirements (such as a turbid waterway with regular algal blooms). Reversing this process may be costly or even impossible.

Preventative works also include protecting those systems and areas that *are* working, and providing valuable ecosystem services. Council's program to purchase land for water quality improvement purposes (particularly wetlands) is part of this management strategy.

The importance of regional partnerships

Partnerships with local industry and community members through the WSLCEC, Karuah Great Lakes Landcare, GLCG, Wallamba River users Memorandum of Understanding (MoU), Small Business Sustainability Program, and a wide raft of other projects, groups and committees have highlighted the benefits of engaging and working with other stakeholders in the region.

A key aspect of a plan such as this is not only the shared vision that it provides Council, industry and government agencies to assist in the creation of cooperative projects specifically for the benefit of Wallis Lake, but also to build the capacity for partnerships to address other shared issues into the future.

Much of the ESR projects to date could only have been achieved through agency and stakeholder partnerships and ongoing community support. The fundamental achievements of many of the projects described in the reports above were critically reliant on establishing, fostering and maintaining effective partnerships.

The importance of internal partnerships to maintaining the health of the Estuary and Catchment, particularly within Council can also not be overstated. Great Lakes Council has adopted a vision in its Community Strategic Plan highlighting the interconnectedness between a sustainable and enhanced environment and quality of life (GLC, 2012). In this way management of the Estuary and Catchment can be directly linked to Council's core business, thereby assisting (and even demanding) inter-departmental cooperation to achieve environmental goals (and thus, social and economic ones as well).

Perhaps the greatest insight gained from these projects is the diversity and breadth of works undertaken within the Wallis Lake Estuary and Catchment. Repairing roads, purchasing wetlands, urban retrofitting, land-use planning tools, and a wide-variety of community engagement programs all interact and contribute towards improving Water Quality, Ecosystem Health and Community Wellbeing within the Wallis Lake Estuary and Catchment. Utilising the lessons learnt from these projects and implementing a high degree of community engagement and capacity building while undertaking strategic preventative measures and continuing to build and increase regional partnerships will greatly enhance the likelihood of success when implementing this Management Plan.

3 MANAGEMENT ACTIONS

The Wallis Lake Estuary and Catchment Management Plan has been developed to provide an integrated management strategy for both the Estuary system and the broader land Catchment area. From the earliest stages of the development of the Plan, it was recognised that these two sections of the Catchment— the freshwater catchment and the lake–estuary system—could not be considered in isolation. The health of the Lake and Estuary is fundamentally linked to the health of the entire Catchment (GLC, 2003). With this context in mind, the following vision for the Wallis Lake Estuary and Catchment has been adopted:

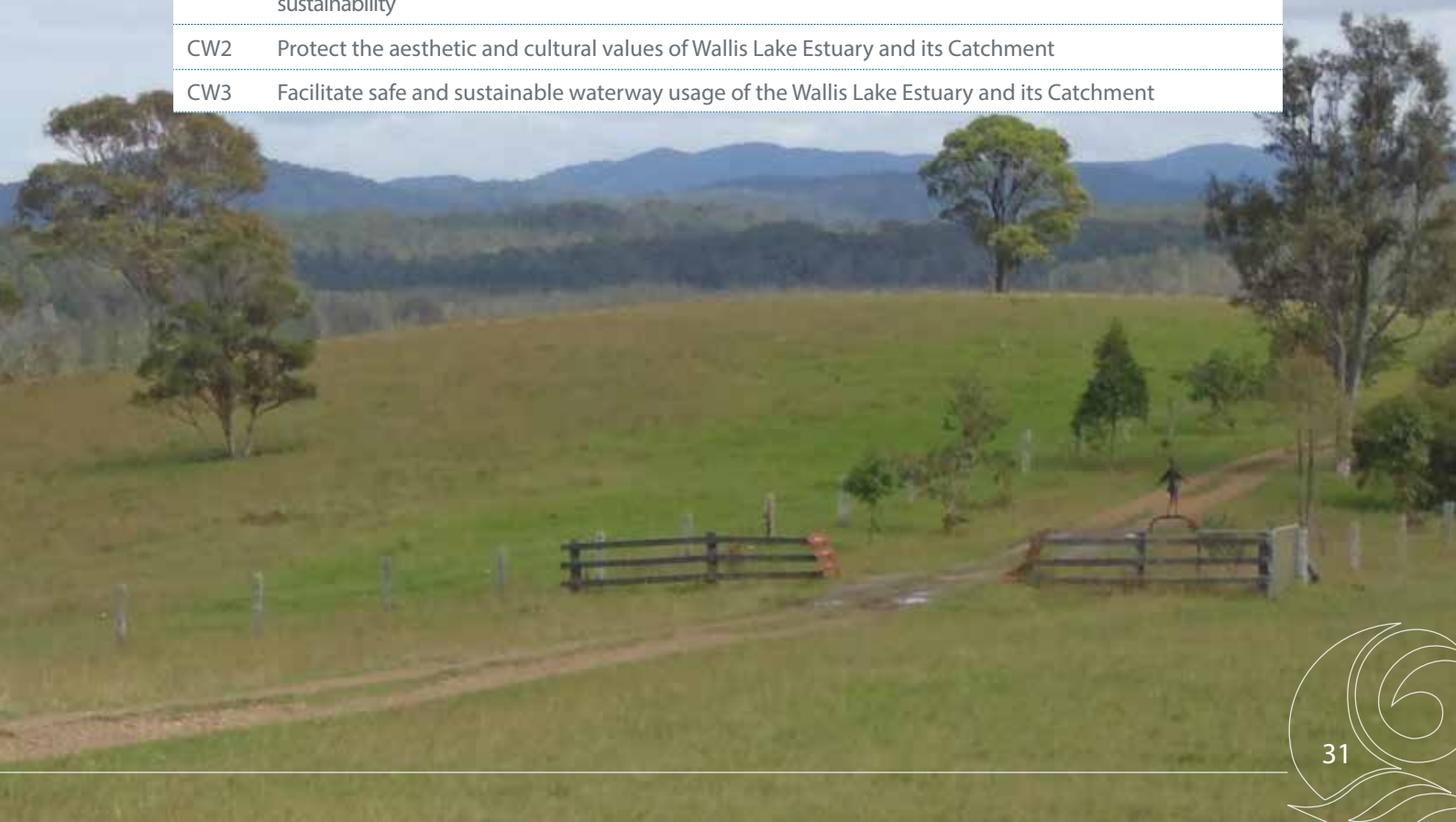
> *People in our community value Wallis Lake and its Catchment for many reasons, including the beauty of the area, the biodiversity, its productivity and economic values for local businesses, and the lifestyle that living here provides.*

To achieve this vision, a series of objectives have been developed through a process of stakeholder consultation and scientific research (Table 10). Each of these objectives is underpinned by an Action-Plan of identified actions and the stakeholder(s) responsible for their implementation, either in a lead or supporting/advocacy role.

For ease of use, these objectives have been divided into themed management areas labelled: Water Quality, Ecosystem Health, and Community Wellbeing themed management areas. Although treated separately in the Action Plans, it is acknowledged that these management areas exist in a complex system of humans interacting with nature where working towards one objective will have a multitude of outcomes: a healthy ecosystem will assist in the provision of improved ecosystem services such as estuary water quality, which will in turn impact on the social and economic wellbeing of the wider community.

Table 10. Wallis Lake Estuary and Catchment Plan Objectives

Water Quality (WQ)	
WQ1	Identify and reduce negative impacts on groundwater quality and quantity
WQ2	Reduce the impact of rural land use on water quality
WQ3	Reduce and repair foreshore erosion from water-based activities
WQ4	Reduce the rates of soil erosion and sedimentation from unsealed roads, road construction and maintenance, and construction sites
WQ5	Reduce sediment, acid sulfate soils, chemicals and nutrient loads to waterways from urban land uses
WQ6	Reduce the risk of septic waste entering Wallis Lake Estuary
WQ7	Reduce the impacts of gross pollutants entering waterways
Ecosystem Health (EH)	
EH1	Protect and improve biodiversity, particularly threatened species, populations and ecological communities
EH2	Maintain and improve areas of locally significant native vegetation as well as linkages between key habitat nodes
EH3	Maintain, and improve where necessary, environmental flows to reduce the impact of barriers to fish passage
EH4	Reduce the presence and impact of invasive species on terrestrial and aquatic environments
EH5	Maintain and improve riparian vegetation
EH6	Monitor and protect aquatic vegetation including seagrass and sponges
EH7	Maintain and improve wetlands in the Catchment
EH8	Address the threats to local ecosystems arising from climate change and associated sea level rise
Community Wellbeing (CW)	
CW1	Manage recreational fishing, commercial fishing and oyster production for economic and ecological sustainability
CW2	Protect the aesthetic and cultural values of Wallis Lake Estuary and its Catchment
CW3	Facilitate safe and sustainable waterway usage of the Wallis Lake Estuary and its Catchment



3.1 Water quality

The suitability of water quality for desired uses has long been recognised as an important issue in Wallis Lake and its waterways. The hepatitis outbreak in 1997 and the toxic blue-green algal bloom in nearby Myall Lakes in 1999 brought the issue of water quality pollution into the public arena, specifically highlighting the impacts that sediments, nutrients and faecal coliforms can have on the suitability of lake waters (WQIP, 2009). Figure 7 below summarises many of the potential stressors on water quality experienced within the Wallis Lake Catchment.

In 2009 the Great Lakes Water Quality Improvement Plan (Wallis, Smith and Myall Lakes) was developed to identify ways to reduce the impacts of sediments, nutrients and faecal coliforms on the Estuary. The primary sources of these pollutants are from varying broad scale human activities in catchments. That is, they are diffuse rather than point-source pollutants.

The objectives and accompanying actions below address the varied impacts of human use on water quality from both land-based (catchment) and water-based activities. These objectives also clearly highlight the interconnectedness of catchment health, estuary health, and the wellbeing of the community: Healthy catchments lead to healthy waterways (Abal, Bunn & Dennison (2005).

Key indicators of water quality within the Estuary are algal growth, as measured by using chlorophyll A levels in the water, and sediment inputs by measuring turbidity (see sidebox).

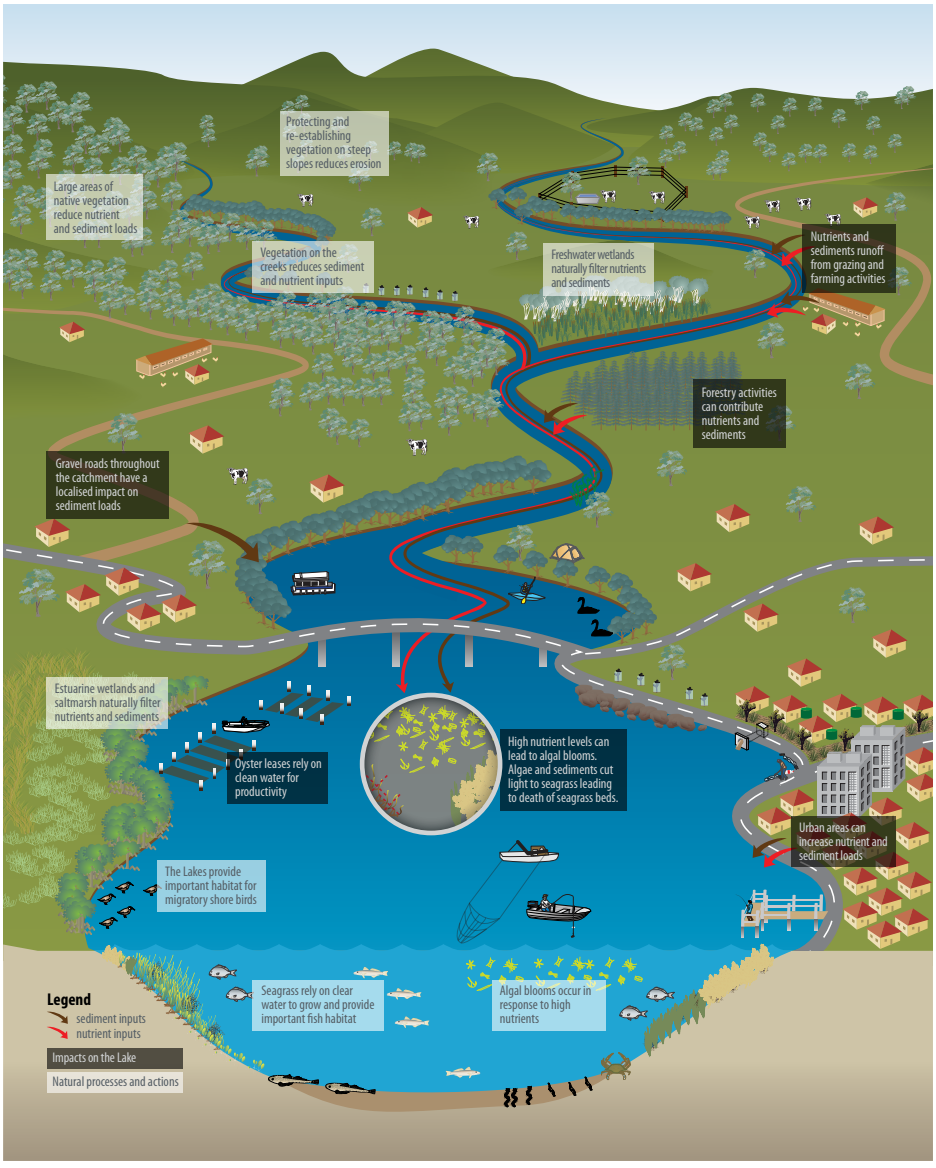


Figure 7. Examples of human-induced impacts on Wallis Lake

Further information on water pollution and estuary and catchment processes can be found in the WQIP (GLC, 2009) and the annual Waterway and Catchment Report Card for Wallis, Smiths and Myall Lakes (GLC, 2013).

Algae

Algae or microscopic plants are always present in waterways but if conditions change and are suited to algal growth, blooms can occur. Blooms may occur if there are a lot of nutrients in the water which can come from urban stormwater, fertiliser runoff from farms and gardens and seepage from septic tanks. Algal blooms can reduce the amount of light reaching seagrass beds limiting their growth. When blooms of algae die and start to decay, the resulting bacterial activity can reduce oxygen concentrations in the water column, possibly leading to fish kills. Chlorophyll is a good measure of the amount of algae in the water as all alga have chlorophyll in their cells giving them their green colour.

Chlorophyll A

Chlorophyll A is a pigment found in plants and is an essential molecule for the process of photosynthesis (the conversion of light energy to chemical energy resulting in the consumption of carbon dioxide and the production of oxygen and sugars). In estuarine and marine waterways, chlorophyll A is present in phytoplankton such as cyanobacteria, diatoms and dinoflagellates. Because chlorophyll A occurs in all phytoplankton it is commonly used as a measure of phytoplankton biomass.

Sediment

Sediment from the land can be washed into waterways when it rains. If land is not properly managed with trees and groundcover, large amounts of sediment can wash into our waterways. Sediment also comes from roads and pathways washing directly into the stormwater and then the estuaries.

Too much sediment in the water reduces the amount of light reaching the bottom and is detrimental to seagrass which require light for growth. Seagrass is critical for the health of estuaries as it provides essential habitat for fish and invertebrates which support bird life and subsequently influence the local tourism and aquaculture industries. Excess amounts of suspended particles can also smother benthic organisms like sponges and seagrass, irritate the gills of fish and transport contaminants. Turbidity provides a measure of sediment in the water.

Turbidity

Turbidity is the measure of light scattering by suspended particles in the water column, providing an indication of water clarity.

WQ1 Identify and reduce negative impacts on groundwater quality and quantity

Original objective/s	State-wide target/s addressed	HCR CAP Goals addressed
EMP: W CMP: G	6	Goal 5, Target 4.

Proposed actions		Responsibilty
WQ1.1	Develop and enact Minimbah Aquifer Management Plan	MCW GLC NoW
WQ1.2	Implement the new Drinking Water Catchment Clause in the Great Lakes Standard Local Environmental Plan (LEP) as it pertains to groundwater	GLC
WQ1.3	Identify and map groundwater dependant ecosystems and potential impacts due to groundwater extraction, exfiltration and/or pollution	NoW GLC MCW
WQ1.4	Investigate the need for a Tuncurry Aquifer Management Plan, particularly in relation to groundwater quality impacting Duck Swamp and the Estuary as well as potential draw down impacting groundwater dependent ecosystems	GLC NoW
WQ1.5	Ensure any future or current developments comply with WQIP and do not adversely impact ground water resources and ground water dependent ecosystems through development assessment	GLC GTCC
WQ1.6	Continue to monitor landfill impacts (Tuncurry and Minimbah) on groundwater as per licence conditions and ensure management of landfill adopts best practice through an EMS	GLC

Objective notes

- NSW Office of Water (NoW) is the licensing and regulatory body for groundwater extraction and recharge
- Treated effluent from Hallidays Point sewage treatment plant is reused on North Tuncurry playing fields, golf course and cemetery, and exfiltrated into the dunal environment near the sewage treatment plant
- Seawater intrusion risk was assessed as part of the Review of Environmental Factors (REF) process for the Minimbah Aquifer. Salinity will be tested as part of ongoing water quality monitoring program. Sea level rise not considered a significant threat with regards to intrusion to the aquifer, as groundwater levels are currently several metres above sea level

Rain infiltrating soil may be drawn up by plants. Otherwise it continues to filter through the soil, topping up aquifers (underground supplies). Within the Wallis Lake Catchment people draw on this water for agricultural and domestic (rural and urban) use.

When this groundwater is depleted, either because too much is drawn off or because compacted impervious surfaces prevent water from penetrating, there are consequences for aquatic ecosystems (Turner et al, 2004). There is also the potential for activities near aquifers to contaminate or pollute this water (eg. run-off from landfills).

Anticipated outcomes	Action notes
Minimbah aquifer managed for environmentally sustainable outcomes, and extraction and infiltration activities demonstrate best-practice management.	Completion of The Minimbah Aquifer Management Plan anticipated to be in 2014. Ongoing regular monitoring of the aquifer occurs at: Minimbah aquifer, Tuncurry aquifer, Hallidays Point sewerage treatment plant.
New developments will not cause any adverse impacts on drinking water quality and flows with specific regard to interception or lowering of the watertable, or any change in groundwater flow direction (Clause 7.2 (3)).	
Groundwater dependent ecosystems mapped and assessed for risk.	Identification and protection of groundwater dependent ecosystems (GDEs) (through, for instance, establishing buffer zones around well recognised GDEs) is incorporated into NoW's Regional Groundwater Plans (currently under review).
Tuncurry aquifer managed for environmentally sustainable outcomes, and extraction activities demonstrate best-practice management. Improved groundwater quality.	Historic spear-point access to Tuncurry aquifer exists on properties within the Tuncurry area. Potential impact of extraction activities to be investigated, particularly during periods of drought and subsequent water restrictions.
Future and current developments do not adversely impact ground water resources.	"Aquifer interference activities" include landfills (past/present), mining, urban development and extraction industries such as coal seam gas. NSW Office of Water (NoW) has developed Risk Assessment Guidelines for Groundwater Dependent Ecosystems.
Monitoring is regularly undertaken to ensure leachate from landfill is not entering adjacent aquifer.	Site testing currently undertaken at Tuncurry (and Minimbah when it becomes operational) landfill as per licence conditions. EMS development also for Transfer Stations.

WQ 2 Reduce the impact of rural land use on water quality

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: W, M, C CMP: 4, 7, 8	5, 9, 19, 11, 12	Goal 4, Targets 1, 2, 3 Goal 5, Target 4, 5 Goal 8, 12, 15

	Proposed actions	Responsibility
WQ2.1	Work with landholders to build their capacity to undertake sustainable farming activities that improve groundcover and reduce direct cattle impacts on waterways including: • Establish stock exclusion riparian fencing, as well as off-stream watering and shade • Identify and remediate priority soil erosion sites • Undertake optimal soil nutrient management • Improve infiltration rates and soil health through promoting beneficial pasture, soil and slope management	GLC LLS GTCC
WQ2.2	Review and update existing rural conservation and development strategies (including Great Lakes Rural Living Strategy, 2009a) to: • Set a conservation framework and guide development for future areas of growth, including identification and management of potential future intensification of rural land use • Explore mechanisms for protecting and rehabilitating steep lands including, but not limited to, options for land use change • Incorporate provisions from Mid North Coast Regional Strategy (DoP, 2009)	GLC GTCC MCW LLS
WQ2.3	Investigate methods to minimise fragmentation and increased land disturbance from rural subdivisions (eg. reduction in minimum lot size, requirement to fence off a stream if subdividing)	GLC

Rural activities have the potential to generate excess amounts of nutrients and sediments. Some rural activities can expose soil to erosion, resulting in large amounts of sediment and attached nutrients that can be transported into waterways. Other activities (eg. Intensive farming, cattle access to streams, inappropriate fertiliser use), if inappropriately managed, have the potential to generate an increased source of pollutants that can be washed off into drains, creeks and rivers. Sediments can also be eroded from stream banks and delivered to coastal lakes during runoff events (GLC, 2009).

Anticipated outcomes	Action notes
Rural landholders in the Wallis Lake Catchment implement a 'whole of farm approach' to managing the impacts of their property on Catchment and Estuary water quality.	Limiting cattle access to waterways improves riparian habitats' capacity to filter nutrients, sediments and the direct impacts of cattle pugging and defecating, thereby improving Catchment water quality. GLC in cooperation with other agencies utilise Participant Action Learning principles to assist landholders in building the capacity to undertake such activities, particularly through the Sustainable Farming Program (WQIP, 2009).
Impacts of intensification of rural land use on Catchment water quality such as intensive cattle and poultry farming, and extractive activities are proactively managed. Steep lands within the Catchment are managed appropriately and, where possible, remediated and protected in perpetuity. Rural land is managed through the land use planning and assessment system to reduce disturbance and the impacts this has on water quality.	Potential land uses include intensive cattle and poultry farming as well as mineral, petroleum or other extractive industries. Great Lakes Council, MidCoast Water and Greater Taree City Council have adopted a common position statement on coal seam gas and extractive industries. Steep lands are particularly susceptible to erosion, especially when over grazed or cleared as identified in WQIP (2009) implementation framework: Catchment management in rural areas. Limited LiDAR mapping has been undertaken of high-risk areas. Rural growth areas identified by the Mid North Coast Regional Strategy (DoP, 2009) within the Wallis Lake Catchment include Nabiac, Wootton, Bunyah, Coomba Park, and Coolongolook.
Rural land is managed through the land use planning and assessment system to reduce fragmentation and increased land disturbance and the impacts this has on water quality.	Guidelines will provide guidance on measures to manage potential water quality issues, such as stipulating a requirement for no change or an improvement in water quality, or the need to fence off a stream when subdividing.

WQ 2 Reduce the impact of rural land use on water quality

Proposed actions		Responsibility
WQ2.4	Enforce provisions in the Great Lakes Standard Local Environment Plan as they pertain to rural land use	GLC
WQ2.5	Implement Wallis Lake Wetland Strategy (2010), monitor and report on the implementation of this strategy as it pertains to water quality and review and update as necessary	GLC
WQ2.6	Develop an efficient and effective system for the capture and sharing of new land management practices	GLC LLS GTCC

Objective notes

- Prioritisation, timing and location of works undertaken or funded are dependent on many factors, including interest of landholders and the focus of external funding
- One-to-one advice offered to landholders is generally the most effective land management change tool, but this is highly budget and resource dependent
- Best Practice Farms and Farm Trials have proven a generally successful method of supporting improvement works, as well as educating the wider farming community
- Subcatchment approaches may be required to balance sustainable farm production and ecological restoration corridors, rather than attempting to manage the entire Catchment simultaneously. Contributions of pollutants from specific subcatchments in the Wallis Lake Catchment are discussed in detail in the WQIP (Appendix 6, 2009)

Anticipated outcomes	Action notes
Rural land is managed through the land use planning and assessment system to reduce fragmentation and increased land disturbance, and the impacts this has on water quality. Development within the rural Catchment maintains or improves water quality.	Environmental provisions in the GLC LEP (2014): • Acid Sulfate Soils (Clause 7.1) • Earthworks (Clause 7.2) • Stormwater Management (Clause 7.5) • Drinking Water Catchments (Clause 7.6) • Riparian Land and Watercourses (Clause 7.7) • Wetlands (Clause 7.8) • Limited Development on Foreshore Area (Clause 7.10) • Significant Extractive Resources (7.14)
There is a demonstrated achievement with regard to the stated vision, guiding principles and actions of the Wallis Lake Wetland Strategy, so that there is a net improvement in wetland condition, conservation status and management.	The key elements of the Wallis Lake Wetland Strategy that are relevant to this Plan include: Private land conservation of wetlands Strategic and prioritised acquisition and public reservation. Key sites include West Swamp, Minimbah Creek and Wallingat River Investigate Ramsar listing of Wallis Lake Monitor wetland health and function
New land management practices can be easily recorded, mapped, and subsequently accessed. Such a system will allow quantification of program outputs, analysis of the effectiveness of programs, and identification of areas where future land use management programs may need to be targeted.	Hunter LLS currently map management practices from projects where LLS is a key partner. GLC's Management Practices GIS is a register of management practice changes across the Great Lakes LGA, undertaken or supported by GLC.

WQ 3 Reduce and repair foreshore erosion from water-based activities

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: M, U, W	5, 7, 9	Goal 4, Target 1
CMP: 3, 4, 8, 10		Goal 5, Target 5

Proposed actions		Responsibility
WQ3.1	Identify and prioritise foreshore areas in need of protection from erosion	GLC RMS
WQ3.2	Develop and implement Best Management Practice for riparian stabilisation in high-wash areas according to priority and opportunity	GLC RMS
WQ3.3	Continue to implement and periodically review the Wallamba River memorandum of understanding (MoU) regarding the management of powerboat recreational activities	GLC RMS
WQ3.4	Monitor and assess the impacts and appropriateness of wakeboarding, water-skiing and other powerboat recreational activities in the Wallingat River upstream of the Broadwater and the Coolongolook River	GLC RMS

Objective notes

- Objective EH.5 *Maintain and improve riparian vegetation* is also an important aspect of achieving this objective

While many of the impacts on water quality come from land-based activities, human use of the Lake and waterways can also affect water quality. In this context, actions targeting waterway use (such as powerboat-based recreational activities) are identified, as well as those protecting and managing areas that are particularly susceptible to these impacts (such as erodible foreshores).

Anticipated outcomes	Action notes
Foreshore areas at most threat from erosion are identified, prioritised and managed appropriately.	Benchmarks for Wallamba River erosion were set during monitoring leading up to the development of the Wallamba River MoU.
The impacts of waterway use on the foreshores of Wallis Lake and its Estuaries are mitigated, and degraded sites are protected and rehabilitated.	Primary method currently used is the establishment of bank protection structures in the form of rock fillets and the encouragement of mangrove establishment. Revegetation of riparian zone and other activities discussed in WQ2.1 also support this outcome.
Government agencies and private users of the waterways continue to work together to ensure that erosion of the foreshore and riparian zone is minimised.	Latest version adopted in 2011. The MoU is applicable for 20 years, and can be reviewed every 5 years.
Current and future sites identified for intensive recreational use of waterways are managed appropriately.	

WQ 4 Reduce the rates of soil erosion and sedimentation from unsealed roads, road construction and maintenance, and construction sites

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: W, S, M, C CMP: 4, 7, 8	6	Goal 5, Target 4.

Proposed actions		Responsibility
WQ4.1	Identify and prioritise areas of erosion and sediment input to Wallis Lake from unsealed roads and creek crossings and undertake mitigation activities according to priority	GLC GTCC, NPWS
WQ4.2	Revise GLC's Erosion and Sediment Control Policy to align with state government standards	GLC GTCC
WQ4.3	Engage internal staff to reduce sedimentation and erosion from GLC projects through the continued implementation of GLC's Sediment and Erosion Control Environmental Management System (SECEMS)	GLC GTCC
WQ4.4	Expand SECEMS to address management of SEC on unsealed roads	GLC GTCC
WQ4.5	Develop a building & construction education program that increases the capacity of architects, designers and builders to implement best practice SEC	GLC GTCC
WQ4.6	Include driveway specifications for SEC and sealing in high-risk locations in the requirements for Development Applications in rural and rural-residential areas	GLC

Unsealed roads (predominantly in rural areas) can be a large source of localised sediment and nutrient loads which are flushed into the Estuary during rain events. As more sediments are washed into the Lake, the water becomes more murky (turbid) and transmits less light.

Plants such as seagrasses which depend on light for photosynthesis can be particularly impacted by turbid water. Similarly, if seagrasses are physically covered by sediments washed into the water as a result of eroded soils, they are smothered and die (GLC, 2009).

Anticipated outcomes	Action notes
Rates of erosion and sedimentation from unsealed roads and creek crossings is reduced, leading to decreased rates of sedimentation in Wallis Lake and waterways.	Actions include sealing of roads, stabilisation and repair (or closure) of unsealed roads, as well as sealing creek crossings and/or approaches to creek crossings.
GLC's SEC policy reflects current best-practice management.	Great Lakes Council's SEC policy needs to be updated to reflect recent planning changes and staff training. NSW standards are included in the Managing Urban Stormwater: Soils and Construction Volume 1 ('The Blue Book') (Landcom, 2004) and Volume 2 (Dept of Environment and Climate Change, 2004).
Great Lakes Council and Greater Taree City Council staff set a consistently high standard with regard to management of SEC during road construction and maintenance activities.	In 2011 Great Lakes Council and Greater Taree City Council developed and implemented an environmental management system to support internal staff to execute best-practice SEC during road construction and maintenance. The EMS is based on a system of continuous improvement, where the ongoing implementation, review and adaptation of this system will ensure council maintains a best-practice approach to sediment and erosion control.
Great Lakes Council and Greater Taree City Council staff set a consistently high standard with regard to management of SEC during unsealed road maintenance activities.	
Private builders and construction workers within the Catchment proactively implement best management practice SEC.	Ongoing engagement of a variety of stakeholders is important to ensure that businesses, residents, builders, councils, developers and real estate agents can assist with implementing the WQIP (2009) and know what they can do to help protect and improve water quality within the Catchment.
High-risk areas requiring SEC or sealing of driveways are identified. Landowners become aware of the SEC impacts of unsealed driveways, and these impacts can be subsequently reduced, leading to reduced rates of sedimentation in Wallis Lake and waterways.	Unsealed driveways can be a significant source of sedimentation. Sealing or maintaining driveways to a desired standard can reduce these impacts.

WQ 5 Reduce sediment, acid sulfate soils, chemicals and nutrient loads to waterways from urban areas

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: W, S, C, F	5, 7, 9	Goal 5, Target 5
CMP: 4, 5, 7, 8, 10		Goal 8, Target 12,

Proposed actions		Responsibility
WQ5.1	Implement the WQIP (2009) as it relates to urban areas including: • Continue to implement, review and update the Water Sensitive Design section of the Great Lakes DCP for greenfield sites and redevelopment • Retrofitting of existing areas to improve WQ in line with WQIP and Stormwater Strategy • Incorporate WSD into urban road design and infrastructure development • Implement effective maintenance schedule for Council's WSD facilities and incorporate into asset database • Engage developers to proactively investigate WSD facilities and incorporate maintenance of these facilities during the planning stage • Integrate WSD policy with existing road design guidelines	GLC GTCC
WQ5.2	Develop a WSD education and capacity building program for key urban stakeholders within the community including: developers; building designers and architects; real estate agents; businesses; and residents. • Engage private builders and construction workers to raises awareness of the importance of WSD practices and how to construct and maintain devices	GLC
WQ5.3	Adopt and implement the Wallis Lake Stormwater Management Plan (Forster-Tuncurry), to improve water quality and overall ecological condition of Wallis Lake	GLC
WQ5.4	Develop a Stormwater Management Plan for Coomba Park	GLC
WQ5.5	Assess the impacts of excessive sediment build-up at stormwater drains, and remediate if required (for instance Pipers Creek & Bay)	GLC

Urban areas have a small land use footprint, but high sediment loading rates (Abal, Bunn & Dennison (2005) due to high flow rates. The rainfall that once infiltrated the ground through native vegetation now meets impervious surfaces such as roofs, roads and footpaths and runs directly into stormwater drains and the Estuary. This stormwater runoff carries with it pollutants such as sediments and nutrients from houses, roads, lawns and pets (GLC, 2012b).

In Wallis Lake, areas such as Pipers Creek and Pipers Bay receive the majority of stormwater runoff from the Forster urban area, and as such have previously experienced large algal blooms and shown signs of poor ecological health.

Acid sulfate soils (ASS) are naturally occurring soils and sediments containing iron sulphides. When ASS are exposed to air the iron sulphides react with oxygen and water to produce a variety of compounds including sulfuric acid which can then lead to water quality impacts.

Anticipated outcomes	Action notes
Council practices ensure a consistent application of WSD principles across the organisation to maximise opportunities and benefits to waterways by integrating the management of water quality with water quantity. Wallis Lake maintains or improves its current water quality standards. The ecological health of Pipers Creek which receives significant run-off from the urban Catchment in particular, remains within acceptable levels of chlorophyll and turbidity.	Adapt the Water Sensitive Design section of the Great Lakes DCP as required to make it more effective and accessible for the community. Supporting information could include fact sheets, standards, training, etc. Pollutants include organic contaminants (incl faecal coliforms), suspended solids, sediment, nitrogen, phosphorous, pathogens, heavy metals, pesticides, herbicides and gross pollutants.
The wider community becomes aware of the impact their choices have on water quality, and over time adapt their choices and behaviour to proactively manage or avoid these impacts, as well as accept and support the installation and maintenance of WSD solutions to water quality. Developers, builders and construction workers are aware of their responsibilities pertaining to WSD and proactively incorporate it into their planning process.	Further detail and recommendations for this action are available in the WQIP (2009). Sustainable gardening groups have recently been trialled within Forster. Utilising a Participatory Action Learning model to engage with the community about their own impacts on water quality and how they can mitigate these impacts, this program has been very successful and will inform future engagement activities within the urban community.
Key sites within the urban Catchment are managed to improve stormwater quality, and reduce stormwater quantity. All council policies and plans relating to water management in the Wallis Lake urban and peri-urban Catchments are aligned.	The Wallis Lake Stormwater Management Plan breaks the Forster/Tuncurry stormwater catchment into subcatchments and identifies specific actions to manage stormwater impacts in each of these subcatchments.
Impacts on water quality from Coomba Park and surrounds are identified and prioritised for action.	
Stormwater drains efficiently transport water from urban areas to Wallis Lake without unnecessarily increasing sediment loads.	Historic loads of sediment accrue in stormwater drains over time. This sediment may slowly be pushed from stormwater drains into the Lake during rain events. If it is assessed (for instance, through video monitoring) that this is occurring and presents significant WQ impacts to Wallis Lake, these sediment loads (where feasible) may need to be removed.

WQ 5

Reduce sediment, acid sulfate soils, chemicals and nutrient loads to waterways from urban areas

Proposed actions		Responsibility
WQ5.6	Utilise opportunities in development assessment and land use planning (for instance, rezoning) for the protection of existing drainage lines and stormwater channels to improve the quality of water entering Wallis Lake	GLC
WQ5.7	Protect identified wetlands, foreshore vegetation and remnant long-lived, deep-rooted vegetation in urban areas to maintain water quality	GLC
WQ5.8	Implement rainwater tank retrofitting program in urban areas	MCW GLC
WQ5.9	Ensure appropriate development and enforce new provisions in the Great Lakes Standard Local Environment Plan (LEP) 2014 as they pertain to urban land use and foreshore development	GLC

Anticipated outcomes	Action notes
Existing drainage lines are remediated or revegetated where possible to improve stormwater quality and reduce stormwater quantity.	
These vegetated areas are protected (and revegetated where required) into perpetuity to improve the quality and reduce the quantity of stormwater flows into Wallis Lake.	Key sites include: • Charlotte Bay • Pipers Bay Foreshore and subcatchment • South Forster and Pipers Creek subcatchment • Big Island
Increase in community awareness of the benefits of watertanks (including WQ benefits) and subsequent increased uptake within urban areas.	Significant water savings and stormwater flow reductions can accompany the widespread implementation of water tanks. It is estimated that in Forster a 5,000L watertank could see the following stormwater/potable water benefits: 22% reduction in annual average stormwater flows and up to 40% reduction in the areal extent of stormwater treatment infrastructure (WQIP, 2009).
Development within the urban Catchment maintains or improves water quality. Development in the foreshore area will not impact on natural foreshore processes or affect the significance and amenity of the area.	Environmental provisions in the GLC LEP (2014): • Acid Sulfate Soils (Clause 7.1) • Earthworks (Clause 7.2) • Stormwater Management (Clause 7.5) • Riparian Land and Watercourses (Clause 7.7) • Wetlands (Clause 7.8) • Limited Development on Foreshore Area (Clause 7.10) • Development at Seven Mile Beach, The Lakes Way, Forster (Clause 7.15) • Development at Carmona Drive, South Forster (Clause 7.19) • Limited Development on Foreshore Area (Clause 7.10)

WQ 6 Reduce the risk of septic waste entering the Wallis Lake Estuary

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: W, C	5, 7, 9, 12	Goal 5, Target 5
CMP: 7, 10		Goal 8, Targets 12, 13

Proposed actions		Responsibility
WQ6.1	Continue to implement the Great Lakes Council Onsite Sewerage Management Strategy: • All systems are inspected to determine if they are operating satisfactorily • Systems identified as high-risk, or those that are operating poorly are inspected more frequently • Pump-out records are monitored to ensure systems are not overflowing or being illegally emptied • Aerated Wastewater Treatment System(AWTS) reports are monitored to ensure owners are aware of maintenance that is required • Approval and ongoing monitoring of AWTS contractors to ensure qualified technicians are carrying out quality services • Water monitoring programs to ensure pollution is not occurring from failing systems • Implement Council's Onsite Sewage Management Development Assessment Framework	GLC
WQ6.2	Maintain toilet and pump-out facilities on islands in Wallis Lake, adapt to peak usage times and assess need for additional pump out sites	GLC
WQ6.3	Pursue 1:100 year flood level as benchmark for siting new onsite effluent system disposal areas	GLC GTCC
WQ6.4	Ensure all houseboats on Wallis Lake waterways contain greywater holding tanks and negotiate the phase out of houseboats (commercial and private) without greywater holding tanks	RMS
WQ6.5	Continue to educate and engage with boat owners to monitor the effectiveness and efficiency of holding tanks, and minimise potential sewage dumping from vessels utilising or mooring in Wallis Lake	RMS GLC

Inadequate sewage treatment and disposal can pose a significant threat to public and environmental health. Within the Wallis Lake Catchment, MidCoast Water manages the reticulated sewage system which supplies the majority of the population.

Rural and some small village areas however generally rely on individual on-site sewage management systems (OSMS) for wastewater treatment and disposal. If these systems are inappropriately sited, or incorrectly managed and maintained , OSMSs can pose a significant risk of effluent entering nearby waterways or seeping into ground water (GLC, 2012b). Aquaculture in particular can be severely affected by such events as the harmful bacteria and virus present in untreated effluent can accumulate in filter feeding organisms such as oysters (GLC, 2009).

Anticipated outcomes	Action notes
The risks to the WQ of Wallis Lake and its Estuaries presented by existing and proposed on-site sewage management systems is managed within an acceptable level. Owners of OSMSs and potential developers are aware of their responsibilities with respect to siting of OSMSs and their subsequent operation and maintenance.	Council's on-site sewerage management program was developed under the guidance of NSW Health and the Department of Local Government, and reflects the directions and goals of the *Environment & Health Protection Guidelines: On-site Sewage Management for Single Households* and *AS/NZ 1547:2000 (On-site domestic-wastewater management)*. At time of writing the GLC On-site Sewage Management Strategy is currently under review. The Development Assessment Framework utilises a risk-based approach to set out Council's levels of investigation, acceptable solutions (deemed to satisfy) and minimum standards for sewage management in unsewered areas.
Effluent does not enter Wallis Lake from toilets located on Islands.	Island toilets have limited capacity, and the maintenance strategy reflects increased demand for pump-out during peak usage times (eg. summer and Easter school holidays).
OSMSs are located above major flood levels, thereby reducing risk of intrusion to Wallis Lake during flood events.	Current requirement is that new tanks and electrical components are located above the 1:100 year flood level, while the effluent disposal area is allowed at the 1:20 year flood level.
No untreated dumping from vessels occurs within Catchment.	At time of writing, all commercial boats within Wallis Lake Estuary are fully compliant.
No dumping occurs from vessels utilising or moored in Wallis Lake and Estuaries.	The discharge of untreated sewage from vessels into navigable waters is prohibited under the *Protection of Environmental Operations Act*. The discharge of treated sewage from vessels into certain sensitive waters ('no discharge-zones') is prohibited—this includes all inland waterways, intermittently opening lagoons, Aquatic Reserves and Marine Parks; and all waters within 500 metres of aquaculture, bathing, mooring and anchoring areas, persons in the water, beaches and marinas. As a result of these 'no discharge zones', Wallis Lake is effectively a no discharge zone.

WQ 7 Reduce the impacts of gross pollutants entering waterways

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: W, C	3, 5, 7, 9, 12	Goal 5, Target 5
CMP: 10		Goal 8, Targets 12, 13

Proposed actions		Responsibility
WQ7.1	Investigate options for the installation of additional gross pollutant traps (GPTs) on urban waterways and ensure appropriate maintenance of existing GPTs	GLC GTCC
WQ7.2	Run regular clean-ups (involving volunteers, where possible) of waterways and the Lake including: • Great Lakes Underwater Group (GLUG) annual clean-up of the breakwaters • Record and publicise litter collection data in national marine debris database	GLC GTCC LLS
WQ7.3	Investigate the effectiveness of targeted Catchment litter management in key subcatchments	GLC
WQ7.4	Ensure adequate receptacles are provided for waste, and that they're emptied and maintained	GLC GTCC
WQ7.5	Engage the general community regarding both the sources of litter and the impacts it has on waterways, native flora and fauna	GLC GTCC LLS
WQ7.6	Engage commercial and recreational fishers regarding the impacts of fishing debris on the Estuarine and Lake environment	GLC DPI (Fisheries) Fishing Co-op

Litter is a major problem in Australia and it poses a number of important environmental, social and aesthetic problems:

- Danger to marine life through entanglement or ingestion
- Danger to native animals by polluting their food and water
- Choked waterways and blocked drains causing floods
- Danger of causing health risks (eg. broken glass, syringes, fishing tackle, animal faeces)
- Excessive litter—if people see litter around, they may be more likely to contribute (SCEW, 2008)

Litter can move from where it's deposited in the catchment (such as urban areas, public parks and picnic areas) into estuaries via wind and stormwater: 80% of litter removed from the marine environment originates from land. The vast majority of this litter (70%) is non-biodegradable plastics.

Marine debris and gross pollutants entering the Estuary from recreational boats and commercial activities are also a problem in the Catchment.

Anticipated outcomes	Action notes
Total gross-pollutants entering Wallis Lake from urban areas are reduced.	
Reduce the amount of gross-pollutants in Lake and waterways, particularly bulky items.	
A 'catchment approach' to managing gross-pollutants at their source is investigated and potentially trialled, rather than collecting them where they enter the Lake system, thereby reducing gross-pollutants entering Wallis Lake.	
Total gross-pollutants entering Wallis Lake from urban areas are reduced.	
Volunteers, schools and key user groups will be targeted, educated, and empowered to make changes in their daily consumer activity contributing to stewardship of local beaches and foreshores and pride in their contribution to this global environmental issue.	Successful engagement of the local community and fostering local stewardship of our waterways is essential to ensuring long term reductions in gross-pollutants entering Wallis Lake (and subsequently coastal areas). Gross-pollutants entering the Wallis Lake system can subsequently enter marine environments. 'Injury and fatality to marine life caused by ingestion of, or entanglement in, harmful marine debris' has been listed as a key threatening process under the Environment Protection and Biodiversity Conservation Act 1999 (Cth).
Commercial and recreational fishers are aware of the impacts of their activities on Wallis Lake and take steps to minimise these impacts.	DPI (Fisheries) undertakes an advisory and compliance role in this regard. Minimising the impact of abandoned and lost hoop-nets and crab traps on turtles and other wildlife is also of concern in this action.

WQ 7

Reduce the impacts of gross pollutants entering waterways

Proposed actions		Responsibility
WQ7.7	Continue to initiate and support campaigns to reduce reliance on plastic bags and other single-use plastics in the community	GLC GTCC
WQ7.8	Develop programs targeting engagement of visitors (and local tourism businesses) to the region during peak times to reduce their concentrated impact on waterways	GLC DPI (Fisheries) LLS

Anticipated outcomes	Action notes
Community and business are aware of the impacts of their daily lifestyle choices on Wallis Lake and take steps to minimise these impacts.	'Tangler' bins are provided at various locations around the Lake for recreational fishers to deposit their tangled fishing lines.
Visitors to the region are aware of the impacts of their recreational activities on Wallis Lake and take steps to minimise these impacts.	During peak holiday periods (particularly summer and Easter holidays) the Great Lakes experiences a significant growth in population from tourism and a subsequent increase in gross-pollutants entering waterways. Many of these visitors are attracted to this region because of the iconic blue waters of Wallis Lake, and as such its WQ. Behavioural change in these visitors (many of whom are returning visitors) is essential to ensure long term reductions in gross-pollutants entering Wallis Lake and adjacent coastal areas. Scope for this action to be delivered through visitor information centres. DPI (Fisheries) holds fishing clinics during holiday periods to educate children/teens (8-14yrs) on appropriate fishing activities.

3.2 Ecosystem health

The land resources of the Wallis Lake Catchment underpin the Catchment's health. Maintaining the quality of these land resources is therefore crucial to the maintenance of the services that these ecosystems provide (GLC, 2003). The loss or over-exploitation of these services eventually results in decreased system 'resillience' which can lead to further and accelerating environmental decline.

The Wallis Lake Estuary and Catchment support a variety of unique landscapes and vegetation communities as well as a diversity of plants and animals. The Catchment has 51 different vegetation communities, ranging from lowland wetland ecosystems to dry sclerophyll forests. Of these vegetation communities, 32 are classified as being of high conservation value. Because of this diversity of its habitats, the Catchment is home to an abundance of flora and fauna, including a number of migratory species (GLC, 2003).

Human impacts are placing increased pressure on the variety of species present and the integrity of habitats within the region. The loss of habitat, altered ecosystem structure, declining habitat quality and loss of connectivity of ecosystems are all threats to the health of these ecosystems. Unless these threats are managed appropriately, the extent of biodiversity currently present in the region will decrease.

As highlighted in Chapter 3, while these ecosystems may now rely on our intervention and protection, we in turn rely on the services that they provide to support our social and economic systems.

The objectives and accompanying action plans below address key threats to the quality of ecosystem health in the Catchment including maintenance and protection of native vegetation (including riparian and estuarine communities), threatened species, environmental flows and connectivity as well as reducing the impacts of invasive species.

EH 1 Protect and improve biodiversity, particularly threatened species, populations and ecological communities

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: E, C	2, 3, 8	Goal 6, Target 9
CMP: 1		Goal 8, Target 15

Proposed actions		Responsibility
EH1.1	Develop and implement an over-arching Biodiversity Strategy for the Great Lakes LGA. Monitor and report on the implementation of the strategy and coordinate reviews and updates	GLC
EH1.2	Prioritise the development and implementation of specific threatened biodiversity action plans within the Great Lakes LGA, based on an assessment of risk	GLC, GTCC, OEH
EH1.3	Prioritise the protection and improvement of areas deemed as locally significant vegetation or high priority habitat for important biodiversity	GLC, GTCC, LLS, OEH
EH1.4	Implement the NSW Threatened Species Priorities Action Statements (PAS) and published recovery plans for threatened species (including federally listed threatened species), populations and ecological communities in the Wallis Lake Catchment. Monitor the outcomes of such activities	OEH, GLC, GTCC, DoE, LLS
EH1.5	Continue to promote and provide support to local volunteer environmental groups	GLC, GTCC, LLS, OEH

The Wallis Lake Catchment is a region of high biological diversity and importance. The Estuary itself is listed as a Nationally Important Wetland; which contains the largest area of estuarine seagrass in the state and the second largest representation of saltmarsh in the state (after Port Stephens); while almost 50 threatened fauna species (GLC, 2010) and 8 endangered ecological communities occur within the Catchment.

To manage this rich biological diversity, developing a strategic approach to conservation is a central focus of this objective. This can be achieved using the different state and federal strategies, plans and priorities in cooperation with local land use planning provisions to develop a comprehensive plan to conserve biodiversity across the Catchment and the LGA, with a particular focus on threatened species, populations and ecological communities.

Anticipated outcomes	Action notes
Biodiversity in the Wallis Lake Catchment is maintained or improved. Species do not become extinct in the wild and the conservation status and the number of proactively conserved populations of threatened and important biodiversity (including species, populations and ecological communities) is increased. Further, that biodiversity is managed in a landscape context.	Incorporate a Local Biodiversity Offset Strategy as an appendix to this broader strategy.
Threatened biodiversity is understood and managed in a manner that reverses declines, protects from local extinctions, and enhances conservation status, resilience and abundance/representation in both an individual as well as a landscape context.	Action plans should discuss the species local distribution, habitat, status and key pressures and include implementation measures to assist conservation and recovery. Action plans need to be adaptive and evolving. (Eg. Forster Squirrel Glider Action Plan)
High priority habitat for important biodiversity is recognised, mapped, described and managed such that biodiversity in the Wallis Lake Catchment is maintained and ultimately improved.	To be achieved through planning controls, strategic acquisitions, decision-making and other available means.
Threatened biodiversity is prevented from becoming extinct in the wild and is recovered to a position of viability in the Wallis Lake Catchment. Key threats are identified and managed and there is effective and coordinated action to protect and recover populations and habitat.	
There are effective, coordinated volunteer groups conducting supervised and prioritised restoration and conservation actions in important habitats across the Wallis Lake Catchment such that biodiversity is maintained or improved and threatened biodiversity is protected and recovered.	Volunteer groups include, but are not limited to Landcare, Dunecare, Coastcare, Bushcare, Great Lakes Underwater Group and Dad's Army. Prioritise the efforts of such groups to deliver biodiversity outcomes of substance.

EH 1 Protect and restore biodiversity, particularly threatened species, populations and ecological communities

Proposed actions		Responsibility
EH1.6	Continue to educate and inform the community regarding the importance of biodiversity, including protecting and restoring habitat for threatened species, populations and communities. Engage with the community on the benefits of natural areas	GLC, GTCC, LLS, OEH
EH1.7	Adopt and implement a model NRM clause for terrestrial biodiversity in the Great Lakes Local Environmental Plan (LEP)	GLC
EH1.8	Pursue collaborations with researchers to design and deliver threatened and important biodiversity research and management programs such as the Forster Local Squirrel Glider Study (Niche Environment and Heritage, 2013). Implement the priority recommendations arising from threatened species investigations and research	GLC, OEH, academic/research institutions
EH1.9	Collate and update a map of all public and private conservation lands in the Catchment Ensure permanently protected land (including covenanted lands, development offsets and important habitats identified by the NSW Land and Environment Court) is zoned for Environmental Protection through amendments to Great Lakes LEP 2014	GLC DP&E

Objective notes

- Further detail on significant Communities, Populations and Species of the Wallis Lake Catchment, as well as key threatening processes is included in the Wallis Lake Wetlands Strategy (2010)

Anticipated outcomes	Action notes
There is a greater awareness of biodiversity issues in the local community, leading to behavioural change and acceptance of the need for effective biodiversity conservation and enhancement programs.	Education to include specific information regarding local species and communities so people know what needs protecting in the area. Also the impacts of various pressures such as litter and habitat loss. Also need to provide information regarding statutory controls and responsibilities.
Biodiversity in the Wallis Lake Catchment (and wider Great Lakes LGA) is maintained and improved through strategic and targeted planning controls embedded within the LEP. Biodiversity issues are demonstrably considered and managed within the regulation of land use.	
Effective, applied research is conducted by independent bodies to address knowledge gaps about the protection and recovery of biodiversity, including threatened species. Priority actions arising from research is implemented to ensure that biodiversity is maintained and ultimately improved upon and important populations and habitat are managed and restored.	
Relevant authorities have mapped and can readily identify all permanently protected public and private lands in the Wallis Lake Catchment. At the first available opportunity, all such lands are zoned in the applicable LEP for the highest level of Environmental Protection. By doing so, the area of land conserved and managed by provisions of the zoning system and the LEP is increased and there is greater awareness of the spatial locations of protected land for applied conservation management (connectivity, reserve establishment, etc.).	It is particularly important that all development offsets be conserved and managed in the zoning system. All Conservation Property Vegetation Plans (PVPs), Biobanking sites, Registered Property Agreements, Voluntary Conservation Agreements, sites protected by conditions of a consent as well as relevant public lands are identified and zoned for protection.

EH 2 Maintain and improve areas of locally significant native vegetation as well as linkages between key habitat nodes

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: E, C CMP: 8	1, 2, 3, 4, 5, 8, 11, 12	Goal 6, Target 7, 8

Proposed actions		Responsibility
EH2.1	Implement the Tops to Lakes Initiative, monitor and report on outcomes and review and update, as necessary	GLC, GTCC, LLS
EH2.2	Ensure that native vegetation clearing on private land (including private native forestry) complies with statutory controls and regulations	OEH, LLS
EH2.3	Continue to monitor and report regularly on native vegetation cover, fragmentation, public reservation and environmental zoning of catchments across the Great Lakes LGA • Develop a Great Lakes Catchment Landscape Report Card to assist in reporting the results of monitoring to the Great Lakes community	GLC
EH2.4	Continue to promote and support biodiversity and habitat conservation on private land	GLC, GTCC, LLS

Wallis Lake Catchment has high vegetation biodiversity with 51 vegetation communities, ranging from lowland wetland ecosystems to dry sclerophyll forests. Because of the diversity of its habitats the Catchment is home to an abundance of flora and fauna, including a number of migratory species.

The loss of habitat, altered ecosystem structure, declining habitat and loss of connectivity of ecosystems have the potential to reduce Catchment biodiversity (GLC, 2003), as well as have direct and immediate impacts on land uses through processes such as erosion and loss of water quality.

A key focus of these management actions is the implementation of the Tops to Lakes Initiative that aims to achieve the conservation and re-establishment of landscape-scale biodiversity, and habitat resilience and connectivity across the Great Lakes (GLC, 2012a).

Anticipated outcomes	Action notes
The natural habitats of the Wallis Lake Catchment are protected, restored and connected in a manner that provides for biodiversity conservation and sustainable production/development. Important ecosystem services functions of the natural landscapes are recognised, protected and, where required, reinstated.	
Unlawful and inappropriate clearing of native vegetation is avoided. Where native vegetation has been cleared unlawfully, swift and effective regulation, compliance and remediation actions are identified and implemented. Regulation of the clearing of native vegetation recognises the 'maintain or improve' principle and is under-pinned by a common understanding of the importance of native vegetation for biodiversity and other ecosystem services values.	
A reliable system of up-to-date landscape information is collated and published to inform knowledge of trends and enhance effective and priority-based decision-making and management interventions. Through the production of regular Great Lakes Catchment Landscape Report Cards or equivalent, the landscape grades of the seven subcatchments of the Wallis Lake Catchment are maintained or improved. Priority actions associated with restoration, protection and revegetation are implemented and monitored.	
Effective biodiversity conservation relies not only on a comprehensive, adequate and representative reserve system, but also on relevant and effective private land conservation, within production and development landscapes. The relevant authorities shall continue to provide extension and support services for private land conservation in a manner that complements the public conservation reserve system. To achieve this, all relevant mechanisms shall be utilised including conservation covenants, conservation zoning and voluntary mechanisms.	Through programs such as Land for Wildlife, Conservation Agreements, and Property Vegetation Plans.

EH 2 Maintain and improve areas of locally significant native vegetation as well as linkages between key habitat nodes

Proposed actions		Responsibility
EH2.5	Develop and implement a Great Lakes Vegetation Strategy, monitor and report on outcomes. Review and update, as necessary	GLC
EH2.6	Progress the development of a Great Lakes vegetation classification scheme and fine-scale, accurate vegetation community mapping. Review and update as necessary	GLC, GTCC, OEH

Objective notes

- Fostering mutually beneficial partnerships with landowners is a crucial aspect of successful protection of significant vegetation, and especially for the formation of unbroken regional, sub-regional and local wildlife corridors

	Anticipated outcomes	Action notes
	Vegetation in the Wallis Lake Catchment is maintained or improved. The conservation status of vegetation communities is improved and functional and self-sustaining native vegetation is managed in a landscape context. Fragmentation of vegetation shall be reduced and the condition of native vegetation shall be enhanced. Vegetation that is considered to be regionally significant or threatened shall be protected and enhanced.	
	Council shall work progressively on the compilation of a suitably fine-scale and accurate vegetation community description and a map for the LGA (and Wallis Lake Catchment). The vegetation community shall be progressively enhanced and updated, as new information is available. The outputs of the vegetation mapping program shall be used to inform management, including the identification of conservation and restoration priorities.	Accurate vegetation community description and mapping is very important for ecological decision-making.

EH 3 Maintain, and improve where necessary, environmental flows and reduce the impact of barriers to fish passage

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: F	2, 3, 5, 7, 8, 9, 12	Goal 5, Target 4
CMP: 3		Goal 6, Target 7
		Goal 8, Target 14

Proposed actions		Responsibility
EH3.1	Install and maintain effective fishways at Dyers Crossing and other crossings according to DPI (Fisheries) identified priorities and opportunities	DPI (Fisheries), LLS, GLC, GTCC
EH3.2	Ensure compliance with the Lower North Coast unregulated and alluvial water sources Water Sharing Plan	NoW, Landholders
EH3.3	Include water quality, water sharing legislation and environmental flow information in rural landholder extension and education programs	NoW, GLC, GTCC, DPI (Ag), LLS
EH3.4	Target invasive species which block natural flows in waterways where consistent with agency priorities	MNCWCC, GLC, NPWS

Maintaining appropriate water flows is critical to maintaining fish and invertebrate populations, aquatic plants, riparian vegetation, channel morphology and water quality. Connectivity between flood plains and the aquatic environment is important for fish moving upstream or downstream for feeding, breeding and spawning. As in the terrestrial environment, maintaining diversity of habitats within streams and riparian zones is important for biodiversity. This includes maintaining diversity of the water flow regime (GLC 2003).

All freshwater fish need to move freely between the various areas of their habitat, although the scale of movement probably varies from species to species.

Barriers to fish movement include weirs, causeways and culverts which block passage and increase flow velocity. Physical barriers such as weirs and causeways present major restrictions to fish movement which can cause local extinctions or greatly reduce fish abundance and diversity (GLC 2003).

The intent of these management actions is to ensure that natural flows and volumes of water within the Catchment are sustainably managed for ecosystem services, riverine and catchment health, and production values, while ensuring that native fish populations and movements, as well as the ecosystem that they are a part of, are restored.

Anticipated outcomes	Action notes
Structures that impede the natural movement of fish are progressively remediated or managed by the removal of such barriers or the establishment of effective fishways on a priority basis. Native fish populations and movements, and the ecosystems they are a part of in the Wallis Lake Catchment, are restored.	A spatial and descriptive database of fish barriers is to be maintained and updated. Appropriate research and monitoring activities are to be conducted to better understand the ecological impacts of fish barriers and the best practice management responses to enhancing fish movement processes in rivers and streams of the Wallis Lake Catchment.
Natural flows and volumes of water are sustainably managed for ecosystem services, riverine and catchment health and production values.	
Enhanced knowledge of water flows and volumes, and the sustainable management and protection of such, leads to better management of water resources, improved flows and water quality in riverine and groundwater systems as well as reduced risk associated with unlawful or damaging water extraction.	Planning controls pertaining to maintenance of pre-disturbance environmental flows is incorporated into Great Lakes Development Control Plan, Water Sensitive Design Section.
Priority infestations of terrestrial, riparian and aquatic weeds that block natural flows in waterways are reduced. Where feasible, such outbreaks shall be eradicated. Information is collated on the spatial location of infestations of weeds that disrupt natural water flows.	Species include willows, invasive reed species, coral trees, camphor laurel, and aquatic weeds such as salvinia, parrots feather, and alligator weed.

EH4 Reduce the presence and impact of invasive species on terrestrial and aquatic environments

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: E, C CMP: 6	1, 3, 4, 8, 12	Goal 6, Target 9

Proposed actions		Responsibility
EH4.1	Continue to work with local landholders to strategically control and reduce weed impacts on farming land and the natural environment	MNCWCC, GLC, LLS, GTCC
EH4.2	Continue to educate businesses. government agencies and the community regarding the impacts of invasive plant and animal species and their role in control and surveillance	MNCWCC, GLC, NPWS, LLS, GTCC
EH4.3	Implement the NSW Biosecurity Strategy 2013-2021 and the relevant outcomes of the NSW Strategic Review of Weed Management (2013-14). Continue to implement the DPI Fisheries Bio-security Program, reviewing and updating as necessary	LLS, GLC, GTCC, MNCWCC, DPI (Fisheries), Crown Lands, Fishing Co-op
EH4.4	Work collaboratively with multiple landholders and agencies to establish a prioritised and cross-tenure approach to monitoring and managing terrestrial vertebrate pests within the Catchment (and across the Great Lakes LGA) consistent with state and regional management plans and priorities	MNCWCC, GLC, NPWS, LLS, GTCC, OEH, DPI (Ag), Forestry, Crown Lands, local landholders

Invasive plant species are a significant concern in NSW, with over 170 weed species listed as noxious, 53 species listed as invasive native scrub and several hundred recognised as a threat to biodiversity, with an estimated cost to NSW of $1.2billion of lost productivity each year alone (NRC, 2013a).

Environmental weeds can cause loss of biodiversity by invading natural ecosystems and altering habitat, out-competing and displacing native species, choking wetlands and waterways, and altering fire regimes (GLC, 2003). Invasive vertebrate pests such as wild dogs, feral pigs, rabbits, foxes, feral goats and feral cats also cause significant economic, environmental and social impacts within the Catchment and across Australia.

The following actions incorporate a collaborative, cross-tenure and prioritised approach to managing invasive pest threats to the Wallis Lake Catchment. Implementation of these actions is dependent on a well-designed decision process aligning actions with stakeholder agency priorities and available funding opportunities. For instance, NPWS has an existing (5-year) Regional Pest Management Strategy (2012-17) in place. As a major landholder within the Catchment, collaborative activities to manage pests and weeds within the Catchment should take into account and incorporate these existing priorities in order to leverage support and resources.

Anticipated outcomes	Action notes
Through strategic, multi-tenure and coordinated programs, there is no net increase – and ultimately – a net reduction in the distribution and biomass of priority agricultural and environmental weeds in the Wallis Lake Catchment; such that production losses and biodiversity impacts/ecosystem services reductions, due to weeds, are minimised and avoided. Further, no new outbreaks of threatening or problematic weeds occur, as a consequence of surveillance and immediate coordinated action.	• Focus on building landholder knowledge and capacity • Assist landholders to apply for funding for control works • Engage with existing groups and programs • Agencies are to coordinate multi-tenure or tenure-blind surveillance and control programs
There is increased knowledge and awareness within the community as to the impacts of weeds and feral pests, the identification of such and the measures associated with surveillance, control and management. This results in increased participation in tenure-blind, coordinated and strategic programs.	Employ diverse methods such as workshops, field days, information packages, articles in local publications, booklets, etc. Offer awareness and capacity building for weed and feral animal control as an extension to other programs such as sustainable farming, bushcare, sustainable gardening, schools education, etc. Educate aquarium shops regarding aquatic weed species. Online shops could be targeted at state government level.
Agency and community actions relating to biosecurity is strategic, coordinated, proactive and based on best management practice. This results in the efficient identification, suppression and monitoring of new outbreaks of threatening weeds and pests and the minimisation of risks associated with importation or spread of threatening pests and weeds.	Inform stakeholders of current and potential pest species, how they can help reduce the spread of these species, and their reporting responsibilities. Respond effectively to reported instances of pest species outbreaks.
Feral pest animal distribution, abundance and impact are better understood. Control programs are implemented based on priorities, reflecting management of the impact of pest animals on production, the natural environment and other social and economic values. In this manner, feral pest animal impacts are reduced. Isolated occurrences are eradicated and new infestations are identified and managed.	Feral pest animal management in the Wallis Lake Catchment requires a tenure-blind, strategic and cooperative approach. Vertebrate Pest Management Strategy to be based on the NSW Invasive Species Plan.

EH4 Reduce the presence and impact of invasive species on terrestrial and aquatic environments

Proposed actions		Responsibility
EH4.5	Work collaboratively with multiple landholders and agencies to establish a prioritised and cross-tenure approach to managing invasive weeds within the Catchment (and across the Great Lakes LGA) consistent with state and regional management plans and priorities	MNCWCC GLC, NPWS, LLS, GTCC, OEH, DPI (Ag), Crown Lands, Forestry, local landholders
EH4.6	Work collaboratively and across tenures to implement the Weeds Action Program and the MNCWCC Regional Weed Management System as it aligns with agency priorities	MNCWCC, GLC, NPWS, LLS, GTCC
EH4.7	Prepare and implement specific control action plans for critical outbreaks of high priority weeds and vertebrate pet animals where required	MNCWCC, GLC, NPWS, LLS, GTCC, Forestry
EH4.8	Implement relevant actions set out in approved Threat Abatement Plans (TAP) across the Catchment where relevant	GLC, NPWS, LLS, GTCC, OEH, DPI, Forestry, multi agencies, local landholders

Objective notes

- It is important to take into account and allow for the differing, and potentially competing, priorities and interests of agencies involved in invasive species control
- Compromise needs to be made by all parties involved, due to the importance of a cooperative and strategic approach. This is of particular importance when it comes to the implementation of the Rapid Response Program
- Cross-agency partnerships on pest species control improve the chance of receiving grant funding

Anticipated outcomes	Action notes
Priority weed distribution, abundance and impact are better understood. Control programs are implemented based on priorities, reflecting management of the impact of weeds on production, the natural environment and other social and economic values. In this manner, weed impacts are reduced, isolated occurrences are eradicated and new infestations are identified and managed.	Weed management in the Wallis Lake Catchment requires a tenure-blind, strategic and cooperative approach. To be based on the MNCWCC Regional Weeds Strategy and the results of the NSW Strategic Review of Weed Management (2013 – 14).
Weed management is undertaken by all agencies in a strategic and coordinated fashion. Available funding is directed to specified priorities.	
High priority weeds and feral animals are managed strategically across landscapes and across agencies. Specific, explicit and coordinated objectives are established for priority weeds and feral animals to reduce spatial distribution, abundance and negative effects of priority weeds and feral pests.	
There is demonstrable progress in reducing the impact of key threatening processes on natural landscapes and threatened biodiversity. TAP implementation shall be multi-tenure, multi-agency and coordinated.	Current TAPs include: • Rabbits (Commonwealth EPBC Act) • Unmanaged goats (Commonwealth EPBC Act) • Red fox (Commonwealth EPBC Act) • Feral cats (Commonwealth EPBC Act) • Feral pigs (Commonwealth EPBC Act) • Cane toads (Commonwealth EPBC Act) • Bitou bush and boneseed (NSW TSC Act) • Red fox (*Vulpes vulpes*) (NSW TSC Act) • Plague minnow (*Gambusia holbrooki*) (NSW TSC Act)

EH 5 Maintain and improve riparian vegetation

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: E, M, C	1, 5, 9	Goal 4, Target 1
CMP: 8		Goal 6, Target 7

Proposed actions		Responsibility
EH5.1	Develop and implement mapping processes to monitor the presence and condition of riparian areas across the Wallis Lake Catchment	GLC, LLS, GTCC
EH5.2	Develop and implement a Riparian Vegetation Management Strategy to prioritise interventions and actions. Complete Foreshore Management Plan for Wallis Lake	GLC, GTCC
EH5.3	Conduct riparian vegetation protection, establishment and rehabilitation works according to priority and opportunity, incorporating works on both public and private land	GLC, LLS, GTCC
EH5.4	Phase the removal of stock from riparian zones in identified Foreshore Crown Reserves and manage Crown Foreshores for conservation purposes. Zone identified Crown Foreshores for Environmental Protection within the relevant Local Environmental Plans	Crown Lands, GLC, GTCC

Riparian land is any land which adjoins, directly influences or is influenced by a body of water. While riparian land is generally associated with streams, billabongs, wetlands and lakes, it also includes farm dams, drainage lines, the floodplains connected to streams and estuaries, and tidal interchange areas (HCR CMA, 2007).

Destruction of riparian vegetation compromises the water filtering capacity and sediment stabilisation of these areas, thus impacting on water quality. Riparian vegetation can reduce nutrient, thermal, light and bacterial pollution; increase fish stocks by providing suitable aquatic habitat; and help to limit algal growth by decreasing nutrients and light. Healthy riparian land will also maintain stable stream channel shape by controlling erosion and sedimentation. It is often argued that 'healthy riparian zones mean healthy streams' (Abal, Bunn & Dennison, 2005).

Well maintained riparian land can also increase a property's value through retaining fertile soils and preventing erosion, as well as providing shade, shelter and habitat (HCR CMA, 2007).

In this context, these actions work in concert with WQ3, by targeting land-based pressures on riparian vegetation, while WQ3 primarily targets the impacts of water-based activities on foreshores, impacts which will be exacerbated as riparian vegetation is removed from foreshore areas.

Anticipated outcomes	Action notes
A standardised method is adopted and implemented to regularly map the spatial extent and condition of riparian zones across the Wallis Lake Catchment. Discussion reports are prepared to guide adaptive management, including the identification of priority intervention sites for riparian vegetation re-establishment and restoration.	
There is no net loss in the presence of existing riparian vegetation from a 2013 baseline and ultimately there is demonstrated increase in the area of riparian zones that contain functional native vegetation and thus the condition of riparian vegetation is enhanced and restored. Riparian vegetation interventions are based on priorities and coordinated by way of strategic plans.	Consider land acquisitions of priority riparian zones including the possible use of revolving funds (private/ public partnerships, development incentives etc).
There is an overall net positive trend in the area and condition of riparian vegetation and there is no further decline or reduction in the 2013 area and condition of riparian vegetation within the Wallis Lake Catchment.	Enacted through planning controls, promoted and supported through programs. This should prioritise the funding and administration of offstream watering projects. Utilise and promote the full suite of funding opportunities for riparian protection and management including carbon farming and biodiversity initiatives.
There is demonstrated progress towards the achievement of 100% of foreshore Crown Land in the Wallis Lake Catchment with stock excluded by 2018.	Suggested steps to achieve this action are outlined in the WQIP (2009) (Table 3.3.2 p265).

EH 5 Maintain and improve riparian vegetation

Proposed actions		Responsibility
EH5.5	Coordinate and deliver education and awareness programs with regards to the importance of riparian areas • Eg. restore degraded islands in Wallis Lake including Cockatoo, Mather and Long and Miles Islands	GLC, LLS, GTCC
EH5.6	Actively pursue opportunities to research the ecosystem services functions of riparian zones and the best management practice approach to riparian protection and restoration	GLC, LLS, GTCC, research institutions

Objective notes

- Action WQ2.1 (Establish stock exclusion riparian fencing, as well as off-stream watering and shade) is a crucial step toward achieving this objective
- This objective is an important aspect to achieving objective Action WQ3 : Reduce and repair foreshore erosion from water-based activities.

Anticipated outcomes	Action notes
There is a greater understanding by the community of the importance of vegetated riparian zones for the protection of water quality, the provision of ecosystem services and the connectivity of the natural landscape, as well as the need for effective protection and restoration of such areas. Further, this enhanced knowledge contributes to net improvements in the extent and condition of riparian zones that contain native vegetation through the exclusion of stock and the management of weeds and other threats.	Use all available means and techniques including field days, workshops and case studies. Use successful sites such as the Durness/ Borland Landcare Corridor to demonstrate and promote riparian restoration works.
There is published research addressing knowledge gaps which lead to enhanced local management but which also contributes to enhanced general knowledge.	

EH 6 Monitor and protect aquatic vegetation including seagrass and sponges

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: E	5, 9	Goal 6, Target 8, 9 Goal 8, Target 13

Proposed actions		Responsibility
EH6.1	Continue with seagrass surveys on a regular basis	GLC, DPI (Fisheries)
EH6.2	Promote the importance of seagrass and other aquatic habitats, and their protection to stakeholders and the general community	GLC, DPI (Fisheries)
EH6.3	Promote appropriate behaviours to minimise impacts on seagrass beds, including promotion of seagrass friendly moorings	RMS, DPI (Fisheries)
EH6.4	Dredge the sand bar encroaching on *Posidonia australis* beds between Wallis and Tonys Point Islands	GLC, Crown Lands OEH
EH6.5	Identify, and where appropriate, establish and promote locations of powerboat exclusion zones in important and sensitive seagrass beds	RMS
EH6.6	Actively pursue opportunities to collaborate with researchers on seagrass health and distribution trends in Wallis Lake	GLC
EH6.7	Protect sponge communities by preventing the loss of valuable seagrass and macro-algal habitats	GLC

Wallis Lake contains the largest area of estuarine seagrasses in NSW, comprising 35% of the total seagrass in the state. Of the five species recorded in the lake, two are at the limits of their distribution, and one (*Halodule tridentata*) has not been recorded from any other NSW lake or estuary.

Wallis Lake's extensive seagrass meadows support a relatively diverse assemblage of sponges compared to other coastal lakes and lagoons in New South Wales. Furthermore, many of the sponges previously found in Wallis Lake are likely to be undescribed and new to science (Barnes, 2010). These seagrass meadows are also pivotal to supporting Wallis Lake's extensive recreational and commercial fishing industry.

Key threats to seagrass and sponges, as well as other aquatic vegetation, is deterioration of water quality through increased sediment loading, as well as impacts from human use of the Estuary and encroachment on seagrass beds from sand bars.

Anticipated outcomes	Action notes
The spatial distribution of seagrass is regularly mapped and trends in distribution are reported and used in adaptive estuary management.	Investigate opportunities to form partnerships with universities, colleges etc. for studying and monitoring. Remote sensing mapping should be used to monitor the extent of seagrass beds.
There is demonstrated greater understanding by the community and key stakeholders (boaters and fishers in particular) of aquatic vegetation and habitats, and the importance of their protection. Opportunities for regular education and delivery of key messages are taken where possible. Increased awareness leads to a net reduction in the physical damage of seagrass and other important estuarine communities by Lake users.	To be achieved through diverse means such as signage, maps, and information added to any boating media. Through boat hire sheds, bait sellers, boat ramps etc. Promote seagrass importance for fish populations. Focus on holiday periods. Education should be part of licensing process.
A net reduction in the extent of damage done to seagrass beds by boating activities. There is an increase in the installation and usage of seagrass friendly moorings and a net reduction in moorings of a type that damage seagrass beds and other important estuarine habitats.	
The sand bar is dredged as required in an ecologically and hydrologically responsible manner. The *Posidonia australis* beds between Wallis and Tonys Point Islands are kept free of sand encroachment.	REF for dredging works has been completed, awaiting funding (currently low priority works). Crown lands to review REF and consider approval. (See Appendix B, Draft Wallis Lake Dredging Program)
There is a net reduction of propeller chop and other power boat related disturbance of important seagrass beds and other estuarine habitats.	Also refer action CW3.1: Allocate, promote and monitor management areas, speed restriction zones, powerboat and jet ski -free zones in Wallis Lake and tributaries.
Research papers are prepared which lead to better understanding and adaptive management of the broader Estuary.	
There is no loss of sponge species in Wallis Lake and the spatial distribution and abundance of sponges in Wallis Lake is maintained and increased.	In particular the large beds of *Lamprothamnion* in the southern portion of Wallis Lake should be protected in accordance with the recommendations of: Sponges and Ascidians of the Southern Basin of Wallis Lake, New South Wales (Barnes, 2010).

EH 7 Maintain and improve wetlands in the Catchment

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: E, C	1, 4, 8	Goal 4, Target 3
CMP: 2		Goal 5, Targets 4
		Goal 6, Targets 7, 8
		Goal 8, Targets 15, 14

Proposed actions		Responsibility
EH7.1	Map the occurrence and condition of wetlands. Identify priorities for management and action	GLC, LLS
EH7.2	Implement the Wallis Lake Wetlands Strategy, monitor and report on the implementation of this Strategy and review and update as necessary	GLC

Healthy wetlands are dynamic living entities which provide services such as nurseries for recreational and commercial fisheries; opportunities for tourism; support for sustainable timber production; grazing and apiculture; as well as a cultural focus for many regional communities, including Aboriginal communities (DECCW, 2010).

All wetlands are integral to landscape processes such as nutrient cycling, detention and slow release of flood water, and trapping of sediments. Wetlands also form a vital component of regional and national biodiversity by providing habitat for a wide range of animals and plants (DECCW, 2010).

Pressures on wetlands in the Wallis Lake Catchment include altered hydrological regimes, infilling due to sedimentation, elevated nutrient loads, weed invasion, land reclamation and physical disturbance due to grazing (GLC, 2003). Furthermore, wetland habitats are likely to be seriously impacted by global sea level rise associated with climate change. In recognition of these issues, in 2011 Great Lakes Council adopted the Wallis Lakes Wetland Strategy.

Anticipated outcomes	Action notes
Spatially accurate wetland maps are prepared and utilised in NRM decision making. A standardised method for the rapid assessment of wetland condition is devised and adopted.	Prioritisation to be based on biodiversity, water quality improvement, ecosystem function values.
There is demonstrated achievement with regard to the stated vision, guiding principles and actions of the Wallis Lake Wetland Strategy, such that there is net improvement in wetland distribution, condition, conservation status and public ownership over time. In particular: • There is a net increase in the area of wetlands of the Wallis Lake Catchment zoned for environmental protection in the LEP • Wetlands in the Wallis Lake Catchment are not lost or diminished, but if such loss is unavoidable, then offsets are used such that wetland habitat and function is maintained or improved • Wetland function is generally enhanced There is a net increase in the area of wetland in the Wallis Lake Catchment that is, publicly or privately, permanently conserved • Wetlands on Crown Land and Council land are effectively managed • The floodplains and catchments of wetlands are better managed and wetlands are protected by way of established buffers and linkages • Development is effectively regulated and controlled to avoid impacts on wetlands and to restore and enhance wetland function and conservation • Research is conducted on local wetlands, their functions and their restoration management • The community is educated about the importance of wetlands	The key elements of the Wallis Lake Wetland Strategy that are relevant to this Plan include: • Private land conservation of wetlands • Strategic and prioritised acquisition and public reservation • Investigate Ramsar listing of Wallis Lake • Monitor wetland health and function

EH 7 Maintain and improve wetlands in the Catchment

Proposed actions		Responsibility
EH7.3	Adopt and implement a model NRM clause for wetlands in the Great Lakes Local Environmental Plan (LEP)	GLC
EH7.4	Continue to rehabilitate purchased wetlands and investigate and pursue further strategic purchases of wetlands	GLC
EH7.5	Continue to educate and engage the community regarding general and local wetland values and issues	GLC, GTCC, NPWS, LLS
EH7.6	Focus on wetland protection, restoration and management on private lands	GLC, LLS
EH7.7	Protect natural wetlands from grazing pressures	GLC, GTCC, LLS
EH7.8	Pursue collaborations with researchers to design and deliver wetland condition assessment and reporting	GLC

Anticipated outcomes	Action notes
Wetland NRM clause adopted and enforced such that wetlands are better protected, restored and managed.	Local wetland map layer to be created in order to enable implementation of the new LEP.
There is a net addition of wetlands in GLC and OEH tenure. Further, that acquired wetland condition and function is enhanced through management interventions and restoration activities, such as drain-infilling, weed and feral animal control, access management and revegetation.	
There is greater awareness and appreciation in the local community about the critical roles of wetlands in ecosystem services provisions, leading to behavioural changes and acceptance of the need for wetland protection and restoration programs.	Employ diverse methods such as workshops, field days, information package for home-owners, articles in local publications, booklets etc. Incorporate with other programs such as sustainable farming, bushcare, sustainable gardening, schools education etc.
The net area of privately conserved wetlands is increased and the general condition of privately held wetlands is enhanced.	Despite the best endeavours of relevant agencies in conservation and acquisition programs, proper wetland protection and restoration programs will rely on commitments of private landholders to the protection and conservation management of wetlands on their landholdings. (Also refer to action EH2.6) Programs for private land conservation include Land for Wildlife, Conservation Agreements, and Property Vegetation Plans.
The area of natural wetlands that is protected is increased and their natural abilities to filter nutrients and sediments are maintained or improved, through strategic stock exclusion of wetland habitats.	Suggested steps to achieve this action are outlined in the WQIP (2009) (Table 3.3.2 p268).
Effective, applied and published research is undertaken which contributes to enhanced wetland conservation and restoration programs within the Catchment.	

EH 8 Address the threats to local ecosystems arising from climate change and associated sea level rise

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
none	3, 9	Goal 6, Target 9 Goal 8, Target 15

Proposed actions		Responsibility
EH8.1	Continue to investigate threats posed to different landscapes and ecosystems by climate change and sea level rise, as well as mitigation and adaptation options for all land managers	GLC, LLS, NPWS, OEH, GTCC
EH8.2	Prioritise the adaptive management of areas and ecosystems most at threat from climate change and sea level rise	OEH, LLS, GLC, GTCC, Crown Lands
EH8.3	Continue to monitor the condition and extent of saltmarsh around Wallis Lake	GLC, DPI (Fisheries)
EH8.4	Investigate opportunities to purchase or otherwise protect suitable areas to act as buffer zones to allow for ecosystem migration based on predicted sea level rise impacts on Wallis Lake and Estuaries	GLC, OEH
EH8.5	Implement appropriate management actions from: Condition Assessment and Management Considerations for Saltmarsh in Wallis Lake (Umwelt, 2012) and any subsequent reports	GLC, OEH

Climate change is emerging as a serious threat to native species and ecosystems and is expected to be an ongoing challenge to the effective conservation of these assets. Rising temperatures and sea levels and climate-induced changes in fire regimes, water quality and ocean chemistry (such as acidification) will have a wide-ranging impact on biodiversity in NSW. Climate change is also expected to intensify existing threats to biodiversity, such as habitat loss, weeds and pest animals, and drought (DECCW, 2010a).

Saltmarsh is a habitat in decline in NSW and its limited distribution has led to its classification as an Endangered Ecological Community. As a habitat representing the meeting of land and water, it is susceptible to rising sea levels, as well as a variety of other pressures such as urban and tourism development and economic uses of coastal resources for agriculture (Umwelt, 2012). With this in mind, actions within this Plan aim to proactively manage saltmarsh habitats within the estuary with a view to achieving a no net loss of saltmarsh areas within the Wallis Lake Estuary.

Anticipated outcomes	Action notes
Various management reports are produced that investigate at-risk ecological communities and landscapes from sea level rise and related climate change. The outcomes of these management reports lead to the adoption of actions that boost resilience and increase protection of at-risk landscapes and communities.	
Risk maps based on modelling and field assessments are prepared and used to inform management planning for the protection, management or offsetting of predicted impacts. Over time, there should be the best endeavours to protect and manage functional areas of at-risk areas and ecosystems.	
The regular monitoring of saltmarsh is undertaken to allow for analysis of change over time. This increased knowledge and understanding is used to inform future management strategies.	
Potential buffer zones or migration areas are identified and managed in advance of actual sea-level rise related impacts such that the area of at-risk communities, habitats or populations is maintained over time.	
There are management interventions adopted to achieve a no net loss over time of saltmarsh areas within the Wallis Lake Estuary.	Keep abreast of saltmarsh management techniques being undertaken elsewhere, and the success or otherwise of different techniques.

3.3 Community wellbeing

Wallis Lake possesses the largest Sydney Rock Oyster industry in NSW, a substantial fishery that supports up to 51 commercial fishers and attracts thousands of recreational users every year as part of a $315 million tourist industry.

The Estuary and Catchment possesses significant cultural and aesthetic values for its traditional owners and those who currently call the region home, as well as being a driving force behind regular return of visitors to the area. This Plan aims to balance these uses to ensure that the natural resources of the Estuary and Catchment are managed sustainably for now and the ongoing enjoyment of future generations.

CW 1 Manage recreational fishing, commercial fishing and oyster production for economic and ecological sustainability

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: F, C, O, W	2, 3, 5, 7, 9, 12	Goal 8, Target 13
CMP: 10		Goal 10, Target 21

Proposed actions		Responsibility
CW1.1	Ensure commercial fishers continue to comply with the Fishery Management Strategy for the Estuary General Fishery and that the Code of Practice is readily available to fishers	DPI (Fisheries) Fishing Co-op
CW1.2	Implement the Environmental Management System for Wallis Lake Estuary – General Fishery, and review/update as opportunity allows	Fishing Co-op DPI (Fisheries)
CW1.3	Promote the DPI (Fisheries) Responsible Fishing Guidelines and the Wallis Lake District Recreational Fishing Guide, and support the application of the National Code of Practice for Recreational & Sport Fishing (2001) to local recreational fishers	DPI (Fisheries)
CW1.4	Investigate options for the monitoring of recreational fishing catch	DPI (Fisheries)
CW1.5	Support a broad communication and education program addressing sustainable management of the Wallis Lake fishery	Fishing Co-op DPI (Fisheries) GLC

Estuary fisheries have a high productivity as well as providing nursery habitat areas for fish caught in fresh, estuarine and marine waters (Turner et al, 2004). Wallis Lake in particular supports a large number of commercial fishers and oyster growers. Key actions to manage these extractive activities relate to industry and government developed: Codes of Practice, Environmental Management Systems and Strategies.

The Lake and waterways also support significant numbers of recreational fishers, particularly during peak holiday periods. The extent and subsequent impact of these activities is difficult to quantify and management of these activities is primarily based around education and compliance.

Anticipated outcomes	Action notes
All commercial fishing within the Wallis Lake Estuary is undertaken in a sustainable manner to preserve fisheries for the future.	This comprises the majority of the work currently undertaken by DPI (Fisheries) staff in the Wallis Lake area. Primary methodologies relate to an advisory and compliance enforcement role. Approximately 75% of fishers in the Wallis Lake system belong to the Wallis Lake Fisherman's Co-op (the other 25% includes individual fishers, and those from Taree and Newcastle Co-Ops).
Seafood harvested on behalf of the community is undertaken as sustainably as current technology and techniques allow, and improved as new technology and techniques are developed.	EMS originally prepared by the Wallis Lake Estuary general fishers and SeaNet NSW (A project of Ocean Watch Australia).
Local recreational fishers are aware of and familiar with the guidelines, and recreational fishing is undertaken in a responsible manner to minimise impact on the environment and other members of the community.	
Most appropriate method for monitoring recreational fishing catch in Wallis Lake Estuary determined and implemented. Information gathered through monitoring used to determine sustainable fishing levels and inform future policy.	One-off study undertaken in Wallis Lake in 2000, and a state-wide survey is being undertaken by DPI (Fisheries) in 2013/14.
A greater understanding amongst professional and recreational fishers, as well as the general community regarding the importance of a healthy aquatic environment and all fishing being undertaken in a sustainable manner.	Important issues to cover in education and communication program include: the link between the management of land based activity, wetland health etc. to fishery health and fish stock recruitment; the importance of mangroves, saltmarsh, seagrass and other natural environments; bag and size limits (and, importantly, the reasons for these); closed seasons; the impacts of various activities such as anchoring and propeller chop; and threatened and protected species. The research done by commercial fishers could also be publicised as well as utilising experienced Wallis Lake fisherman to assist in communication programs.

CW 1 Manage recreational fishing, commercial fishing and oyster production for economic and ecological sustainability

Proposed actions		Responsibility
CW1.6	Implement the National Climate Change Action Plan for Fisheries and Aquaculture and review and update as necessary	DPI (Fisheries) Fishing Co-op Oyster Industry
CW1.7	Continue to support the implementation of the NSW Oyster Industry Sustainable Aquaculture Strategy (OISAS)	Oyster Industry DPI (Fisheries) WLSQAP GLC
CW1.8	Undertake a collaborative effort to audit and manage land-based oyster industry infrastructure to ensure environmental conditions of leases are being met	Crown Lands Oyster Industry DPI (Fisheries)

Anticipated outcomes	Action notes
Local fishers are aware of the potential impacts of climate change and their role in its mitigation. Local fishers have strategies in place to adapt to climate change impacts.	
Oyster production levels and quality maintained within the Wallis Lakes Estuary.	OISAS last reviewed in 2012 (new version yet to be released). DPI (Fisheries) has compliance and advisory role.
Negative environmental impacts from land-based oyster industry infrastructure is reduced.	Crown Lands management primarily occurs through leasing and licensing compliance.

CW 2 Protect the cultural and aesthetic values of Wallis Lake and its Catchment

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: W, F, M, C	12	Goal 9, Targets 16, 19

Proposed actions		Responsibility
CW2.1	Where activities are being proposed or undertaken—identify, monitor and protect sites of known significant Aboriginal and European heritage, and where there is uncertainty about the value of culture and heritage, a precautionary approach is adopted	GLC, GTCC, NPWS, Crown Lands, LLS, FLALC
CW2.2	Incorporate information regarding local Aboriginal cultural history and connection to land in educational material for the community and visitors	GLC, GTCC NPWS, LLS, FLALC
CW2.3	Continue to implement the ongoing strategies of the Indigenous Fisheries Strategy and Implementation Plan	DPI (Fisheries) FLALC
CW2.4	Develop site-specific foreshore management plans for Pacific Palms, Pipers Bay, Little Street foreshore and Tuncurry, and ensure appropriate and sensitive foreshore development through land use planning tools	GLC Crown Lands
CW2.5	Seek funding to develop the Forster Keys/Little St walkway	GLC

Objective notes

- One of the most important aspects of the aesthetic value of the area is for the Lake and waterways being in a clean and healthy state. Therefore, all of the activities detailed under the Water Quality theme (as well as the environmental services provided by the Ecosystem Health section) will contribute greatly to addressing this objective

The rich natural resources of Wallis Lake Estuary and Catchment have supported human habitation for thousands of years. In more recent times these resources combined with the aesthetic values of the area such as the crystal clear waters of the Lake and extensive vistas of vegetated foreshores (particularly on the western side) continue to attract new residents and visitors to the area.

Such a long history of habitation in the area has created strong bonds with these cultural and aesthetic values of the Lake and Catchment, and this Plan seeks to balance these values and ensure they are maintained.

Anticipated outcomes	Action notes
New developments and projects identify and consider potential impacts on Aboriginal and European heritage, as well as the aesthetic values of Wallis Lake and its Catchment, and liaise with relevant stakeholders to pursue appropriate outcomes.	Activities must comply with the National Parks and Wildlife Act 1974, which protects Aboriginal objects and Aboriginal places in NSW. It is an offence to do any of the following without an exemption or defence (penalties apply): • Knowingly harm or desecrate an Aboriginal object (the 'knowing' offence) • Harm or desecrate an Aboriginal object or Aboriginal place (the 'strict liability' offence)
The Biripi and Worimi are acknowledged as the traditional owners of the Wallis Lake Catchment, and respect and understanding of Aboriginal cultural heritage values is promoted to all people in the Wallis Lake Catchment.	
Aboriginal communities are involved in the stewardship of fisheries' resources and traditional fishing activities are protected and enhanced.	
Development in the foreshore area will not impact on natural foreshore processes or affect the significance and amenity of the area. Appropriate uses of foreshore reserves are identified and promoted.	The Wallis Lake Wetland Strategy covers the management of much of the Wallis Lake foreshore area. See WQIP (p. 317) for further detail on: Recommendations for the improved management of foreshore and urban riparian areas. A Forster/Tuncurry Crown Harbour Masterplan has been developed for the area and at time of writing is exhibited for comments from the community. The project includes an MoU between Crown Lands and Great Lakes Council.
Facilitate active community use of foreshore areas and connectivity between key areas of the Forster urban footprint.	Feasibility study has been completed. This walkway is part of the Forster/Tuncurry Crown Harbour Masterplan.

CW3 Facilitate safe and sustainable waterway usage of the Wallis Lake Estuary

Original objective/s	State-wide target/s addressed	HCR CAP goals addressed
EMP: U, W, C CMP: 10	5, 7, 9, 12	Goal 9, 19

Proposed actions		Responsibility
CW3.1	Allocate, promote and monitor management areas, speed restriction zones, powerboat and jet ski-restricted zones in Wallis Lake and tributaries	RMS
CW3.2	Promote and provide information about the importance of safe and sustainable waterway use	RMS
CW3.3	Continue to implement Recreational Boating Infrastructure Strategy, and review and update as required	GLC RMS
CW3.4	Implement the Wallis Lake Dredging Maintenance Program in consultation with relevant authorities for navigation channels. Support sustainable dredging of oyster leases in 'protocol' area	GLC RMS Crown Lands Oyster Industry
CW3.5	Facilitate appropriate use of islands within the Wallis Lake Estuary and educate the community on the natural and cultural heritage values of the islands	GLC NPWS Crown Lands

Objective Notes

- The Wallamba River Memorandum of Understanding is a key document in continuing to ensure the safe and sustainable use of the Wallis Lake Estuary (see W3.3)

Wallis Lake and its waterways experience a high degree of usage between commercial fishers, oyster growers and recreational users. This Plan provides strategies to proactively manage these uses and mitigate the potential for tension between conflicting users.

Anticipated outcomes	Action notes
Impacts of vessels on other users of the Estuary, as well as environmental impacts are managed appropriately.	Through marker buoys, information displays and maps at boat ramps, boat sheds and bait shops. Areas allocated to unrestricted powerboat use should likewise be promoted. Also refer Action EH6.5: Establish and promote locations of powerboat exclusion zones in important and sensitive seagrass beds.
Users of the Estuary are aware of their impacts on other users and the environment, and adapt their behaviour appropriately.	Information to be provided through a variety of avenues, including posters, brochures, booklets and signage at boat ramps, boat sheds and as part of licensing process. Tours of sensitive and high value areas could improve understanding and compliance.
Facilities and infrastructure meet the needs of Estuary users for safe and sustainable use of their waterway.	The GLC Recreational Boating Infrastructure Strategy initially prioritises high-use sites and seeks to align with other agency infrastructure plans (eg. RMS).
In accordance with best practice and subject to relevant approvals identified navigation channels and oyster lease areas are kept clear, to facilitate safe usage of the Estuary.	Draft Wallis Lakes Navigation Dredging Program included as Appendix B. Also refer to EH6.4: Dredging the sandbar encroaching on posidonia australis beds between Wallis and Tonys Point.
Public appreciation, enjoyment and understanding of the islands within Wallis Lake Estuary is facilitated in the context of environmental protection—including managing the impacts of visitors and residents on accessible sites to avoid degradation.	A Draft Plan of Management for the Wallis Lake Nature Reserves (incorporating Wallis Island, Coolongolook, Regatta Island, Mills Island, Yahoo Island, Bandicoot Island, Flat Island and Durands Island Nature Reserves) was developed in 2013.

4 IMPLEMENTATION

This Plan recognises that it will be implemented in an environment dictated by potentially conflicting priorities of agencies and landholders within the Catchment. Successful implementation of these actions will be dependent upon a well-designed decision process aligning actions with stakeholder priorities and available funding opportunities (as per Figure 8 below).

While Council and other agency officers are very experienced in adopting an entrepreneurial approach to seeking targeted project funding[4], one of the main threats to effective management of natural resources is the lack of a long term structured funding program that can support a systematic program of actions, and recognises the risks and benefits for various stakeholders.

With this in mind, a conscious effort has been made in this Plan to steer away from assigning priorities to each action, as it is acknowledged that 'priority' may be viewed differently by each stakeholder and may also change relative to available funding priorities of state and federal agencies.

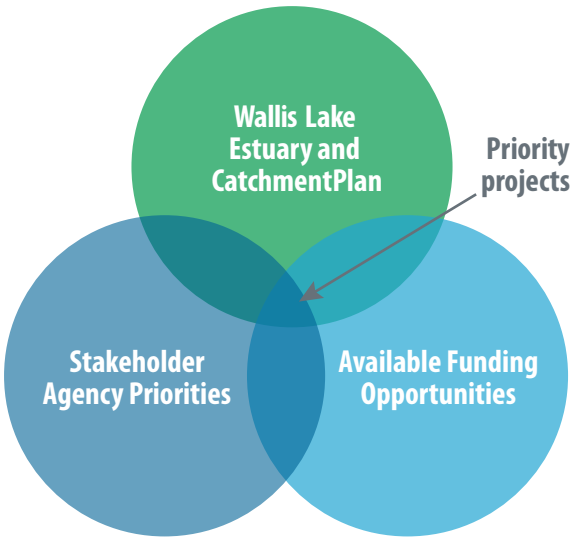


Figure 8. Decision process for implementation of Estuary and Catchment Plan

It is also acknowledged that agency *responsibility*, while supported by agencies, does not necessarily equal agency *priority*. Great Lakes Council as the largest and key coordinating land manager in the Catchment has responsibility for the bulk of the actions identified in this Plan. It is likely to prioritise many of these actions very highly in its own corporate planning processes (as well as the acknowledged links between water quality, healthy ecosystems and community wellbeing identified through the development of the Great Lakes 2030 plan). This may differ for regional or state-based agencies with priorities that cover a larger area. For instance, what may be a regional priority for NPWS, may not be a priority at the local Wallis Lake Catchment scale, and vice versa. However, through ongoing dialogue and by building on existing collaborative processes both at the staff and managerial levels, as well as through the formal structure of the WSLCEC and GLCG, actions that suit multiple parties, and which can be carried out across multiple tenures can be implemented.

It should also be noted that some management actions detailed in the Action Plans represent a step-wise progression towards achieving an overall outcome and therefore the implementation of certain actions will facilitate the successful implementation of successive actions. Actions focused on landholder education (eg. EH4.2) for instance will support subsequent management actions on private land (eg. EH4.1).

4 Further information on current and potential sources of funding for implementing actions is provided in the Wallis, Smiths and Myall Water Quality Improvement Plan (Section 3.8)

4.1 Context: relationship to other plans

4.1.1 Great Lakes Council

As the agency responsible for over 60% of the Wallis Lake Catchment, Great Lakes Council has been the agency primarily responsible for developing this Plan. With this in mind, the Wallis Lake Estuary and Catchment Management Plan is guided by Great Lakes Council's Community Strategic Plan (GLC, 2012), in particular Key Direction 1. This Plan, known as Great Lakes 2030, sets out the strategic direction of Great Lakes Council, and is based on the concerns and priorities of the local community.

Key Direction 1: our environment
Objective 1: Protect and maintain the natural environment so it is healthy and diverse
Objective 2: Ensure that development is sensitive to our natural environment
Objective 3: Prepare for the impact of sea level rise and climate change
Objective 4: Sustainably manage our waste

The Wallis Lake Estuary and Catchment Management Plan will then be used to inform Council's Four Year Delivery Program and One Year Operational Plans. These are more specific plans detailing how Council intends to deliver on the community's expectations.

It is worth noting that there is some overlap of the recommended management actions from a number of local NRM plans, in particular WQIP (2009) , Wallis Lake Wetland Strategy (2010), the Tops to Lakes Initiative (2012) as well as a number of smaller-scale site specific documents such as local Rivercare Plans (GLC, 2003a).

The intention of the Wallis Lake E&CMP is to work in concert with all other relevant local plans, whilst acting as the overarching NRM plan for the unique environment of the Wallis Lake Estuary and Catchment. Every effort has been made to complement and reference other relevant local plans whilst avoiding needless repetition.

Externally, the key document influencing the Wallis Lake E&CMP is the Catchment Action Plan (CAP) of the Hunter Local Land Services. The CAP is a broad-scale plan, intended to guide the management of the 36,500 km^2 of diverse landscapes within the Hunter area. The Wallis Lake Estuary and Catchment Management Plan is informed by and intended to help deliver on the Catchment Goals outlined in the CAP through locally relevant projects.

4.1.2 Hunter-Central Rivers Catchment Action Plan

The action plans developed to address the objectives identified in this Wallis Lake E&CMP are both influenced, and supported by, the Goals and Targets defined in the Hunter-Central Rivers Catchment Action Plan (CAP) 2013-2023. These Goals, and where they cross over with the Objectives identified in this Management Plan, are identified in Table 11 on the next page.

In summary, the Hunter-Central Rivers CAP, GLC and other Agency's NRM plans and strategies and state and national legislation in concert with the Great Lakes 2030 Plan all influence the implementation (and development) of the Wallis Lake E&CMP, as shown in Figure 9 on the next page. Further information on key documents and legislation influencing this Plan is included as Appendix C.

Table 11. Comparison of Wallis Lake E&CMP with Hunter-Central Rivers CAP

Hunter Central Rivers Catchment Action Plan	Wallis Lake Estuary and Catchment Management Plan
Goals	**Objectives**
Goal 1: Governance and Planning	Chapter 4.2
Goal 2: Knowledge and Research	Incorporated directly into actions; Chapter 4.4; Monitoring Action Plan
Goal 3: Empowerment and Community Capacity	Chapter 2.1 Chapter 4.2 WQ2; WQ4; WQ5
Goal 4: Land and Soil	WQ2; WQ3; WQ4; EH5; EH7
Goal 5: Freshwater (including groundwater and wetlands)	WQ1; WQ2; WQ3; WQ4; WQ5; WQ6;WQ7; EH3; EH7
Goal 6: Biodiversity (terrestrial and aquatic)	EH1; EH2; EH3; EH5; EH6; EH7; EH8
Goal 7: Air	
Goal 8: Estuary and Marine Environments	WQ2; WQ4; WQ5;WQ7; CW1; EH1; EH3; EH6; EH7; EH8
Goal 9: Community Wellbeing	WQ4; WQ6; CW2; CW3; EH4
Goal 10: Economic Prosperity	CW1;

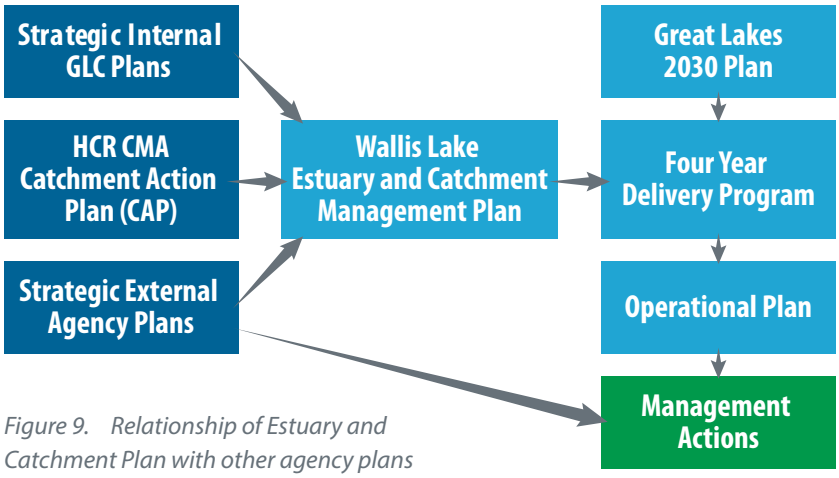


Figure 9. Relationship of Estuary and Catchment Plan with other agency plans

4.2 Governance

The implementation of this Plan is a shared responsibility amongst stakeholders and relies on the participation and agreement of all levels of government and the community. A brief summary of the key agencies involved in managing the Catchment is provided below:

Great Lakes Council plays a lead role in many aspects of catchment and lake management in the region, including land use planning; stormwater management; pollution control generally; community education; and advocacy on behalf of the Lake and the community's interests in the Lake. To this end, it has the lead role in implementing the Wallis Lake E&CMP.

30% of the catchment of Wallis Lake is in the **Greater Taree City Council** local government area. GTCC therefore has a key role to play managing rural land - both broad acre and residential. Its contributions are primarily through joint funding (with GLC) of a catchment management officer (supported by an MoU), and liaison with GLC regarding rural land development proposals (on an exceptions basis).

The Hunter Local Land Services (formally Hunter-Central Rivers Catchment Management Authority) coordinates natural resource and environmental management in a region extending from Lake Macquarie to Taree LGAs, and inland to the Upper Hunter. The Wallis Lake E&CMP has been developed to support those goals and targets identified in their Catchment Action Plan 2013-2023 (see Table 11). The Hunter LLS is also an important source of funding and advice, particularly for rural land management.

As the water and sewerage authority, **MidCoast Water** has a key role to play in all water cycle management decisions. Three places where their activities intersect helpfully with lake protection are: i) encouraging the use of rainwater tanks; ii) developing and supporting recycled water reuse schemes; and iii) water supply catchment management.

In 2007, Statements of Joint Intent were developed between Great Lakes Council and these three organisations to support the Great Lakes Coastal Catchments Initiative and the subsequent implementation of the Water Quality Improvement Plan (GLC, 2009) across the Great Lakes region. The professional relationships developed through this process persist to this day, and will support the ongoing implementation of this E&CMP.

National Parks & Wildlife and Forestry Corporation has an important role as manager of national parks and public forestry in the Wallis Lake Catchment (accounting for almost 20% of the Catchment). Appropriate management of this land use is very beneficial for the Estuary, and regulations around park and forest use ensure these areas will continue to provide valuable ecosystem services throughout the Catchment.

The Department of Primary Industries (Agriculture and Fisheries) fisheries and aquaculture management has considerable importance for the Estuary. It is primarily their role as educators and regulators that are most important to the health of the Estuary and Catchment. The research arms of these organisations are crucial partners in monitoring the health of the Estuary. Similarly, **Roads and Maritime Services**, has a significant regulatory and educational role, as well as working with GLC to manage boating infrastructure within the Estuary.

NSW Trade and Investment (Crown lands) is an extensive landholder within the Catchment, and works closely with Great Lakes Council (and GTCC) who manage a large proportion of these lands on behalf of the organisation.

Division of responsibility for implementation of the E&CMP and its intent by these organisations is summarised in Table 12 on the next page. Agency responsibility for specific management actions is also included in Appendix D.

Table 12. Stakeholder responsibilities for Wallis Lake E&CMP

Stakeholder	Responsibilities
Great Lakes Council	• Where relevant, implement actions outlined in Plan • Nominate or employ accountable personnel to report to and participate in quarterly meetings of the WSLCEC and GLCG to oversee coordination and implementation of the Plan • Provide feedback to stakeholder organisations on the progress of implementation and issues arising • Initiate periodic review of Plan in cooperation with other stakeholders • Enforce legislation and water quality guidelines • Include specifications in contracts and leases requiring contractors/ leasers to adopt relevant guidelines • Develop open and effective partnerships with local community and local Aboriginal people to encourage involvement in natural resource planning, biodiversity conservation and pursue outcomes of substance for cultural heritage protection • Demonstrate leadership and deliver consistent decision-making with regards to the strategic, coordinated and informed management of natural resources in the Wallis Lake Estuary and Catchment
Other Local Government Authorities, State Government agencies and public authorities: • Greater Taree City Council • Office of Environment & Heritage • National Parks and Wildlife Services • MidCoast Water • Local Land Services • NSW Department of Primary Industries • NSW Office of Water • Roads and Maritime Services • Forestry Corporation • Crown Lands	• Where relevant, implement actions outlined in Plan • Nominate accountable personnel to report to and participate in quarterly WSLCEC or GLCG meetings to oversee coordination and implementation of the plan, as well as providing feedback on the progress of implementation and issues arising • Enforce legislation and water quality guidelines as outlined in the Plan • Include specifications in contracts and leases requiring contractors/ leasers to adopt relevant guidelines • Develop open and effective partnerships with local Aboriginal people to encourage involvement in natural resource planning, biodiversity conservation and pursue outcomes of substance for cultural heritage protection • Demonstrate leadership and deliver consistent decision-making with regards to the strategic, coordinated and informed management of natural resources in the Wallis Lake Estuary and Catchment
Local industry groups: • Wallis Lake Fishermen's Cooperative • Oyster Growers • Tourism	• Where relevant, implement actions outlined in Plan • Work with local community, council and government agencies to promote and address the sustainable management of the Wallis Lake fishery and oyster industries through existing programs • Nominate accountable personnel to participate in quarterly WSLCEC or GLCG meetings to oversee coordination and implementation of the Plan
Local community groups and landholders including: • Forster Local Aboriginal Land Council • Landcare groups • Progress associations	• Assist with implementation of actions outlined in the Plan where appropriate • Demand meaningful engagement with the relevant management agencies and processes • Involvement where possible in the WSLCEC or GLCG to oversee coordination and implementation of the Plan

4.2.1 Overseeing committee

The Wallis and Smiths Lake Coast and Estuary Committee (WSLCEC) is a body supported by Great Lakes Council that advises and provides input to the implementation of key plans and strategies pertaining to issues of coastal and estuarine management. Membership of the group comprises representatives from industry groups, state agencies, local government, community groups and community members within the committee's area of jurisdiction.

The Great Lakes Catchment Group is a body supported by Great Lakes Council that provides advice to Agencies on issues of catchment and inland waters management across the catchments of the Wallis, Smith, and Myall Lakes and Karuah River[5]. Membership of the group comprises representatives from industry groups, state agencies, local government, community groups and community members within the committee's area of jurisdiction.

Providing input on the implementation of this plan is within both committees' scope and all of the key agency and industry stakeholders are represented on one or both of these committees.

Rather than form a committee specifically with the intention of implementing this Plan, these two committees will operate as the medium for overseeing their respective management areas in this Plan.

4.2.2 Formal agreements

Formal agreements such as Memorandums of Understanding (MoU) and Statements of Joint Intent (SoJI) have previously been established between stakeholder groups within the Wallis Lake Estuary and Catchment to support management actions:

- The Wallamba River MoU was established in 2004 to ensure that boating procedures and practices maximise user safety, responsibility and enjoyment; protect the recreational and environmental values of the waterway; and provide a consistent approach to existing and anticipated future issues. Signatories included Great Lakes Council, caravan park owners, Hunter LLS, water skiers representatives, RMS, and the WSLCEC.
- SoJIs were established between Great Lakes Council, Hunter LLS, MidCoast Water and Greater Taree City Council in 2007 to implement the Coastal Catchments Initiative and develop a Water Quality Improvement Plan for Wallis, Smith and Myall Lakes.
- A MoU has been developed between MNCWCC and local councils on the Mid-north Coast (including GLC and GTCC) to support the implementation of the region's Strategic Invasive Weeds Plan 2010-2015.
- A MoU between Great Lakes Council, Midcoast Water and Greater Taree City Council to support the implementation of the Environmental Trust's Urban Sustainability Project across the Wallis Lake Catchment was adopted in 2009.
- At the time of writing a MoU is being developed between Great Lakes Council, Karuah-Great Lakes Landcare and Hunter LLS to support improved natural resource management across the catchments of Wallis Lake, Smiths Lake, Myall Lakes and Karuah River. Implementation of the Wallis Lake Estuary and Catchment Plan is incorporated into the MoU.

Implementation of the original Wallis Lake Catchment Plan and Wallis Lake Estuary Plan has successfully developed effective working relationships between stakeholder groups, as well as through formal groups and committees such as WSLCEC and the GLCG. Due to the wide-ranging nature of the actions in this Plan as well as the existing formal agreements and positive relations between stakeholders, a formal agreement is not being developed for the implementation of this Plan. However, individual agreements may need to be developed on an as-needs basis. Instances where this may be triggered include (but are not limited to):

- Where high-level political support from multiple agencies would be advantageous to implementing management actions
- Where the specific activities undertaken by multiple agencies need to be identified to reduce complexity and avoid duplication of effort

5 At the time of writing the GLCG's formation and role is under review. Providing advice on the implementation of this E&CMP will be a key guiding principle for defining the committee's role and function.

4.3 Monitoring

It is challenging to measure the overall 'condition' of a large Social-Ecological System (SES) such as the Wallis Lake Estuary and Catchment.

For the purposes of the Wallis Lake Estuary and Catchment, there are two levels at which the Wallis Lake E&CMP can and should be assessed; namely the achievement of management and ecological targets.

Measures for monitoring management targets are divided into **Primary Performance Measures, Secondary Performance Measures and Secondary Performance Measures (Strategic Outputs)**. Achievement of these targets will primarily be reported on at the individual project level (eg. as part of project funding requirements), but may also be used as a surrogate where direct ecological targets are difficult to assess.

Ecological targets, on the other hand, are a measure of the effectiveness of the completed actions as demonstrated in Table 13 below.

Table 13. Overview of monitoring for E&CMP

Measurement type	Description	Example
Primary Performance Measures	'are actions being implemented?'	5/37 Water Quality actions were implemented in 2014/15.
Secondary Performance Measure (Management Targets)	'measuring outputs'	• 200 metres of stock exclusion fencing installed in 2014/15 • 150 volunteers participated in Catchment clean-ups in 2014/15
Secondary Performance Measures (Strategic Outputs)	'identified plans, strategies, etc. to be developed as a part of the E&CMP'	• Great Lakes Biodiversity Strategy • Minimbah Aquifer Management Plan
Tertiary Performance Measures (Ecological Targets)	'are the management outputs leading to objectives being satisfied?'	Annual Water Quality Report Card indicates that clarity (turbidity) in 2014/15Wallis Lake has improved

By their nature, ecological targets are more complex and harder to measure, but are also the most important measure of the overall success of the Plan. The monitoring and evaluation of ecological targets is also the most crucial information to feed back into the reporting and review process (4.3 & 4.6).

A Monitoring Plan has been developed to identify the data on ecological indicators that needs to be collected to evaluate the effectiveness of the Wallis Lake E&CMP. This Plan is included as an appendix (Appendix E). It contains actions that have been identified in existing Action Plans or which already occur, research projects previously undertaken (to provide baseline data on ecological indicators) as well as those actions that have been identified to address knowledge gaps on existing estuary and catchment processes.

These monitoring actions which address specific knowledge gaps (and are not identified in the individual Action Plans in Chapter 3) are summarised below in the Monitoring Action Plan. These monitoring actions are identified as priorities, however, it is acknowledged that monitoring of ecological targets is often difficult, requires a long term commitment, and is frequently highly resource intensive. With this in mind, implementation of the Monitoring Action Plan (similar to implementation of the Action Plans described in Chapter 3) is dependent on a well-designed decision process aligning actions with stakeholder agency (and landholder) priorities and available funding opportunities.

Monitoring of community wellbeing

As well as monitoring ecological indicators, the objectives in the Community Wellbeing Management Area (3.3) require monitoring of community satisfaction to determine whether aesthetic and cultural values are being protected, or that safe usage of the waterways is being maintained.

Monitoring of these objectives is able to be incorporated into the regular Great Lakes Community Research (GLC, 2012c) program, based on a satisfaction survey. This survey identifies the Great Lakes community's satisfaction with a variety of issues including Council services. Although not specifically targeted at the Wallis Lake Catchment, with the large proportion of residents and industry supported by the Lake and its Catchment, general perspectives can be extrapolated from this survey.

The survey also provides additional information on the community's perception of water quality and ecosystem health, which will assist in monitoring of the E&CMP success. Issues identified in the 2012 survey relevant to the E&CMP include:

Table 14. Alignment of Great Lakes Community research program with E&CMP objectives

2. Road maintenance - unsealed	WQ4
4. Stormwater drainage	WQ5
8. Street scaping/town beautification	CW2
11. Parks and reserves	CW2
14. Boat ramps and wharves	CW2, CW3
16. Litter bins in public places	CW2, WQ7
21. Protection of heritage	CW2
22. Planning for the future of the community	CW1
25. Litter control	WQ7
28. Promoting safety and preventing crime	CW3
32. Assisting local business operators	CW1
34. Protection of the natural environment	EH1, EH2
35. Protection of waterways	WQ (all)

Wallis Lake Estuary and Catchment Monitoring Action Plan

HCR CAP goals addressed

2. Knowledge and research

		Responsibility	Anticipated outcomes
M1	Regular aerial mapping (recommended 5-yearly) to measure longitudinal status of native vegetation (growth or decline)	GLC, LLS, DPI	Changes to ecological communities can be tracked over an extended period of time and managed appropriately
M2	Biodiversity surveys/census of GLC managed reserves	GLC, OEH	Reserves managed for conservation purposes are surveyed to determine the extent and status of key species throughout the Catchment
M3	Continue plot-based monitoring program	GLC	Changes to identified ecological communities are monitored over time to assess status and potential threats
M4	Investigate potential for spectral imaging to identify priority weeds and weed hotspots	GLC, DPI, MNCWCC	Methodologies are developed and implemented to cost-effectively monitor priority weed species across the Catchment
M5	Undertake 10 year mapping of foreshore vegetation, type, density, condition assessment	GLC, LLS	Changes to ecological communities can be tracked over an extended period of time and managed appropriately
M6	Assess groundwater quality discharge to Duck Swamp	GLC, NoW	Groundwater quality discharge to Duck Swamp is determined, and (where required) appropriate strategies are developed
M7	Repeat AusRivas study to investigate changes in upper Catchment over a 10 year period	GLC, LLS, OEH	Changes in upper Catchment since initial study are identified and appropriate management strategies are developed and implemented
M8	Continue to implement an ongoing water quality monitoring program to support management actions and inform the community, such as the annual Waterways and Catchment Report Card	GLC, OEH	Ecological indicators of water quality of key waterways within the Great Lakes LGA (as well as their dependence on rural and urban land uses) are regularly monitored and publicised to the community
M9	Repeat Wallamba River Erosion Survey	GLC	Changes to the Wallamba River profile are monitored over time and managed appropriately
M10	Periodic audit of GLC Sediment & Erosion EMS implementation and Sediment & Erosion Policy.	GLC	GLC implements best-practice sediment and erosion control during development and road-maintenance projects
M11	Undertake periodic hydro-survey of priority navigation channels to determine maintenance trigger	GLC	Maintenance dredging is undertaken in a timely and efficient manner. Maintenance dredging activities are adapted in line with new information
M12	Investigate incorporation of additional community satisfaction questions relevant to implementation of the E&CMP into the GLC Community Research program	GLC	Community satisfaction with E&CMP implementation is monitored

Link to management objectives	Action notes
EH1, EH3, EH5, EH7	Vegetation mapping in this context is used both as a direct measure of the extent of ecological communities, as well as a surrogate (modelling) for direct surveying of threatened species across the Catchment.
EH1	On ground surveys are undertaken to ground truth the data developed through aerial mapping processes (M1).
EH2, EH4	On ground longitudinal monitoring of permanent plots is undertaken to ground truth the data developed through aerial mapping processes (M1).
EH4	
EH5	The intent is to develop a baseline map of foreshore vegetation that can be used to track long term changes in ground cover.
WQ1	
WQ2, WQ3, WQ4, WQ6	The AusRivas study program was undertaken in 1999 examining key sites in the upper reaches of the Wallis Lake Catchment. This study underpinned the development of the 2003 Wallis Lake Catchment Management Plan.
EH6, WQ2, WQ3, WQ4, WQ5, WQ6	Since 2011 an annual Waterways and Catchment report has been produced to provide information to the community on the health of key waterways throughout the Great Lakes. Each report provides information on ecological indicators including algae (chlorophyll) and clarity (turbidity) as well as subsequent data and case studies based on an annual community relevant theme. Monitoring sites within Wallis Lake relate to both urban (eg. Pipers Bay) and rural (Mid Wallamba Estuary) nutrient and sediment inputs.
EH5, WQ3	This study is based on key sites along the Wallamba River. Since commencement of this study several of the sites experiencing high rates of erosion have been managed through installation of rock fillets and re-establishment of riparian vegetation.
WQ4	
CW3	Further detail on priority navigation channels is included in Wallis Lake Navigation Dredging Program (Appendix B).
CW2, CW3	Great Lakes Council undertakes a regular Community Research program.

4.4 Reporting

Reporting is an essential part of the Wallis Lake E&CMP implementation process which adds accountability to ensure agreed actions are undertaken by the responsible agencies, and that they are achieving desired results.

Reporting also helps to keep all stakeholders, including the broader community, informed regarding works being undertaken and the importance of ongoing environmental management of the Estuary and Catchment. Understanding of issues and management requirements leads to increased support for resourcing further works.

Reporting for this project is based on the stakeholder engagement model used for developing it, and as such, reporting is undertaken at three levels:

Great Lakes Council internal reporting processes

- As the Wallis Lake Estuary and Catchment Management Plan will be used to inform Council's Four Year Delivery Program and One Year Operational Plans, the requisite annual and four-yearly reporting will naturally include reflection on the progress of the Wallis Lake E&CMP. Inclusion of State of the Environment (SoE) reporting in these four-yearly cycles will provide the opportunity to review the Plan and its successes
- Project Managers will report to Council as key projects are implemented and completed (as well as key milestones as required)
- Development of the annual Waterway and Catchment Report Card will be a key tool for reporting to Council, community and the WSLCEC. This Report Card is also the main tool for reporting on and summarising tertiary performance measures (see Table 13. p98) relevant to Catchment water quality

Reporting to key stakeholders: Wallis and Smiths Lakes Coast and Estuary Committee and Great Lakes Catchment Group

- Meetings of the WSLCEC and GLCG are held quarterly and reports from project managers are submitted to the committees. Projects or issues requiring committee decisions or involvement are added to the agenda for discussion as they arise
- The committees undertake an annual review process, and this will include a review of primary and secondary performance measures from the Monitoring Plan

Reporting to the community of the Wallis Lake Catchment

- Council's internal annual report as well as the SoE report is made available to the general community and all stakeholders
- The annual Waterway and Catchment Report Card provides information to the community on the state of key sites in the Wallis Lake Estuary and Catchment
- The quarterly Creek to Coast newsletter provides information to the community on key management actions undertaken within the Catchment
- Ad hoc media releases (also reported on the Council website) as well as community education events are used as an opportunity to both inform the community of actions undertaken, and also to consult with them on which areas within the Catchment need further management action

The reporting matrix for this plan is outlined in Table 15 on the next page. This methodology will ensure that all stakeholders are regularly engaged, and actions are reported at appropriate times. The methodology is also linked to existing actions to reduce the need for creation and subsequent maintenance of new reporting procedures. This reporting also supports the Plan review process (chapter 4.5).

Table 15. E&CMP reporting framework

	As Required	Annual	Four yearly
Internal Council reporting processes	Report to Council meetings as key projects are implemented and completed	GLC Operational Plan reporting	Delivery Plan reporting
		Waterway and Catchment Report Card	State of the Environment Report
Stakeholder reporting processes	Regular face-to-face engagement through shared projects	Quarterly WSLCEC meetings	State of the Environment Report
		Quarterly GLCG meetings	
		Waterway and Catchment Report Card	
		Annual review of WSLCEC and GLCG activities	
Community reporting processes	Quarterly Creek to Coast newsletter will highlight implementation and completion of key projects	Waterway and Catchment Report Card	State of the Environment Report
	Media releases and website updates will highlight implementation and completion of key projects	GLC Operational plan reporting	
	Regular face-to-face community and school engagement activities	Quarterly WSLCEC meetings	
		Quarterly GLCG meetings	
		Annual review of WSLCEC and GLCG activities	

4.5 Plan review

An eight-year full review (based on a cycle of continuous improvement: Plan, Act, Check, Review) is proposed for the Wallis Lake E&CMP. This eight-year full review cycle will be supported by a four-year partial review of the Action and Monitoring Plans. The trigger for this review will be the legislative requirement for all NSW Councils to develop a detailed State of the Environment Report (SoE) every four years. The next detailed SOE for Great Lakes Council will be in 2016.

Review of the plan will also be based on 2 x 4 years of compiled data from the E&CMP's Monitoring Plan:

Review of primary and secondary metrics: This process is to involve a thorough examination of progress against all stated Actions, with particular emphasis on enquiry into Actions not progressed. Any lack of progress on Actions should be examined carefully to determine causes.

Review of tertiary metrics: While it is recognised that improvements in system resilience as well as the provision of ecosystem services can take a long time to be demonstrated, 2 x 4 years will provide a significant amount of data to inform decisions as to whether implemented management actions are having a desired effect on water quality, ecosystem health and community wellbeing.

Utilising an adaptive management framework the review will also target key aspects of system implementation to ensure that learnings from management outcomes (and new information) are successfully incorporated into future iterations of the plan:

Governance: Including stakeholders and stakeholder engagement processes[6]. Are the WSLCEC and GLCG still the most appropriate methods of engaging key stakeholders? Are there other methods that could or should be used?

Monitoring: Is the Monitoring Action Plan appropriate? Has it been possible to implement all desired monitoring actions? Are there better or more cost effective methodologies that could be utilised?

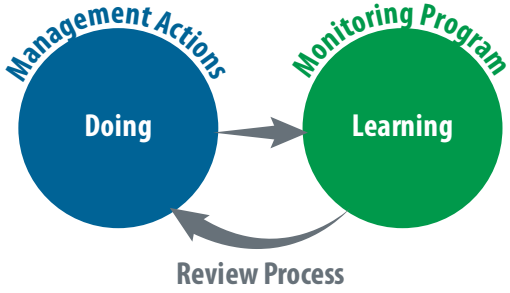
Reporting: Has the proposed methodology been successful in conveying information to the community and stakeholders, and is the information that's being conveyed appropriate? Are there more effective or new means of informing stakeholders that could be incorporated into these processes?

4.5.1 Managing uncertainty

Complete understanding of a complex system such as a catchment or estuary is, and always will be, incomplete (Gunderson and Light, 2006). There is therefore a large degree of uncertainty surrounding protection and management of the Wallis Lake Estuary and Catchment—a large social-ecological system, which is managed by multiple parties for multiple uses. There is also constant change in our knowledge about complex natural systems which themselves are dynamic, and this means that our management of the Estuary and Catchment needs to be flexible and able to evolve.

This uncertainty is addressed by always seeking to improve the knowledge base available for decision making. The intent of this Plan is therefore to utilise planned management actions (Chapter 3) and subsequent monitoring data (Chapter 4.3) to test hypotheses, build understanding of ecosystem dynamics and inform future management decisions. In this context, it is a structured cyclical process of *learning* from *doing* (Stankey and Allen, 2009), where *learning* is used to improve the next stage of management (Bormann et al, 1993). As can be seen in the Monitoring Program developed for this Plan (Appendix E), planned monitoring actions have been developed and linked to determining the success of management actions (see Figure 10 below). This can also be described as 'what would we expect to see if management was working well?' (Jones, 2009).

Figure 10. Managing uncertainty through an adaptive management process



6 The WSLCEC undertakes an annual review of committee operations which will also provide data to support this review process

A formal review process has been developed, based on an eight year review cycle (and four year partial review) based on the trigger of a legislated requirement to produce a detailed State of the Environment Report for the LGA. However, for the plan to be flexible and able to adapt, other triggers have been identified that may prompt a partial or full review of the Plan, its attendant management actions and its monitoring plan. Table 16 (below) highlights a list of triggers that will prompt a partial review, primarily examining action plans in light of new information or operating environment. Major events may however trigger a full Plan review.

Table 16. Wallis Lake Estuary and Catchment Plan triggers for review

Formal reviews	Four year partial review - SOE Development
	Eight year full review - SOE Development
Natural shocks	Major flood
	Major drought
	Major earthquake
	Severe fire season
Governance changes	Major change in funding
	Major change to government policy or legislation
Environmental change	Significant new knowledge, eg. climate change
	Irreversible environmental change occurs, eg. species extinction
	More local species listed as vulnerable or threatened
	Significant local or regional vegetation loss
	Significant new risk identified
Socio-economic shocks	Recession
	Industry failure or significant adjustment (eg. Fisheries or Aquaculture)
	Emergence of major new industry (eg. intensive agriculture or mining)
	Disease epidemic
	Fall in community wellbeing
	Rapid unplanned population change

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a. Wallis Lake Estuary Management Plan Actions (2005)

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
W.1.1	Implement the ~~*Wallis Lake*~~ *Forster Tuncurry stormwater management plan*	$200,000 per year	Immediate (B2)	GLC	8 wetlands constructed and maintained by council, maintaining 3 developer wetlands, additional 7 bioretention, refurbished 2 wetlands, 2 GPT's, 130 litter baskets, applied WQ objectives through WSD DCP, stormwater education, revising plan. Modify	FUTURE: Adopt and implement FT SW Mgt Plan
W.1.2	Conduct creek rehabilitation of existing drainage lines/stormwater channels to enhance nutrient reduction mechanisms in-stream at Pennington Creek, Wyuna Creek, Dunnes Creek, Pipers Creek, Muddy Creek and Wallis Creek.	$25,000	High (C2)	GLC, Waterwatch	Tree planting in Pennington Creek and testing of water quality in Pennington and Dunnes Creeks through the Waterwatch program No progress, modify	This work mostly achieved through strategic planning actions. Need to change emphasis of the Action to Strat. Planning. Onus of rehabilitation falls to landholders/ developers.
W.1.3	Prepare protocols for the frequency of maintenance/clean-out of SQIDs and regular clean-out stormwater GPTs , and conduct regular maintenance of all SQIDs and GPTs in accordance with this protocol	$5,000 + $40,000 per year	Medium (B5)	GLC	Protocol for wetlands and bioretention established, update of asset register required. Partly complete, ongoing, modify	
W.1.4	Develop and implement a scientific monitoring program to assess the effectiveness of recently constructed SQIDs and assess the need for any new SQIDs	$20,000	Medium (B5)	GLC	Complete	Monitored Kularoo wetland during WQIP. Current monitoring of bioretention. FUTURE: No, focus on receiving waters.
W.1.5	Develop and implement a water sensitive urban design DCP for all future urban developments in the Great Lakes Shire	$10,000	Medium (B5)	GLC	DIPNR introduced the Building Sustainability Index (BASIX) as a planning tool to assess water and energy efficiency of new residential developments. A BASIX certificate will only be approved for proposed developments that will be built to use 40% less mains supply water and produce 25% less greenhouse gas emissions (increasing to 40% from July 2006).	FUTURE: Adapt as it is required to make more effective and include Rural land use (some) + additions/ alterations, and improve supporting info.
W.1.6	Continue to enforce the GLC sediment and erosion control policy 1995 for all urban developments	Staff time	Medium (B5)	GLC	Ongoing, policy reviewed, modify	Future: Review and adopt policy

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
W.2.1	Continue to implement the soil erosion, surface water quality, riparian zones and estuary action plans of the WLCMP to reduce nutrient and sediment run-off from the rural catchment	In WLCMP budget	Immediate (B1)	Coordinated by WaLI group, CMA	Commenced 2002; 11.6 ha active erosion controlled, 12,634 native trees planted Ongoing, modify to reflect WQIP	
W.2.2	Where appropriate, continue to provide incentive schemes to protect and enhance riparian vegetation in rural land areas eg riverbank fencing through a devolved grant system	$200,000 per year	Immediate (B2)	GLC, DIPNR, Lands	49 km riverbank fenced Ongoing	
W.3.1	Conduct an audit of slipway operations	$10,000	High (D2)	GLC, DEC	No progress	
W.3.2	Continue investigating environmentally friendly alternatives to anti-fouling paints and encourage their usage when available	Staff time	High (D2)	DEC, GLC, Waterways	Unknown progress, review. EPA?	
W.3.3	Encourage the adoption of new engine technology to reduce the impacts of emissions and communicate this through the *Wallis Lake boating plan of management*	$2,000 + staff time	High (B4)	WLEMIC, GLC, Waterways	Review and modify	
W.3.4	Review the activity of filling of petrol tanks from pumps at boatsheds located on jetties and consider the installation of drip trays over which tanks must be filled	$5,000	Medium (D4)	GLC, boatshed owners	No progress, review	
W.3.5	Prepare and adopt a *Wallis Lake spill strategy* to deal with accidental point source pollution events eg petrochemical spills, bilge pump malfunction	$20,000	Immediate (C1)	GLC, DEC, DPI, Waterways, Fire Brigade	No progress, review	
W.4.1	Implement the *Darawakh/Frogalla Wetland Management Plan* to reduce the leaching of acid products into the Wallamba River from Darawakh Creek	$1 million	Immediate (C1)	GLC, GTCC, DIPNR, DEC, Midcoast	Acquired over 900ha of wetland, floodgates removed, drains filled, nearing completion, set up research programs Modify	This is an "outstanding success story". Works undertaken since '03. Specific achievements are outlined in the Restoration Mgt Plan. Action needs to be re-worded to "continue to implement"
W.4.2	Continue to implement of the acid sulfate soils action plan of the WLCMP	In WLCMP budget	Immediate (B2)	Coordinated by WaLI group, CMA	Unknown progress Review	
W.4.3	Progress the gazetting and implementation of the ASS LEP, and prepare and adopt a DCP for all works in high probability ASS areas	$50,000 + staff time	High (B3)	GLC	ASS incorporated in new environmental provisions in GLC LEP 2014 (Clause 7.1)	
W.5.1	Continue with septic tank inspections under the Septic√Safe program	In GLC budget	Immediate (C1)	GLC, land owners	Ongoing	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
W.5.2	Progress investigations into the most cost effective and environmentally suitable wastewater management scheme for Coomba Park and begin planning for the implementation of this scheme	TBD	Immediate (C1)	MidCoast	Ongoing/ Unknown progress	GLC implemented Onsite Sewage Management Strategy (currently under review)
W.6.1	Establish baseline water quality conditions prior to any further major development within the catchment	$15,000 per year	Immediate (A3)	GLC	Complete with WQIP research	
W.6.2	Implement the Forster/Tuncurry CDS to ensure that buffer zones and water sensitive urban design are upheld for all new developments	Staff time	High (B3)	GLC	Ongoing, negations occur during re-zoning	Mat helps implement buffer zone aspect, not WSUD. "Consultation Development Strategy" (?) - protecting lands of high ecosystem value Future: Ongoing
W.6.3	Recognise areas with long flushing times sufficient for algal blooms to occur if nutrient loading increases in future planning for development	Staff time	Immediate (B2)	GLC	Complete with WQIP research	
W.6.4	Continue to maximise opportunities for sustainable water re-use schemes for new urban developments in Forster	$50,000	High (B4)	MidCoast, GLC	Ongoing	
W.7.1	Ensure a coordinated response to the occurrence of phytoplankton blooms by clarifying the roles and responsibilities of various authorities	$2,000	High (B3)	GLC, DPI, MidCoast, DEC, DIPNR	Complete, Regional Algal Co-ordinating committee established	
W.7.2	Facilitate data sharing of phytoplankton counts and water quality analyses for monitoring and performance testing purposes	Staff time	Medium (B4)	GLC, Food Authority, local oyster growers	Review, Modify	
W.8.1	Continue investigations into opening up the northern end of Pipers Creek to increase flushing and hence water quality in the Pipers Creek and Forster Keys area	$10,000	Long-term (E4)	GLC, WLEMIC	Completed, delete	
W.8.2	Conduct a feasibility study/cost-benefit analysis of opening up the canal under King George Parade, Forster Keys, to allow an increased flow between Sailfish waterway and the waterway to the north of King George	$5,000	Long-term (E4)	GLC	Review	
W.9.1	All hire boats to have secured garbage bins	$10,000	High (B4)	Boatshed owners	Unknown progress/RMS, review	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
W.9.2	Encourage visitors to the islands to take their litter away with them by erecting signage at reserve areas	$5,000	High (B4)	GLC	Completed, delete	
W.9.3	Add a paragraph to the information/ maps supplied by boatshed businesses encouraging visitors to the islands in Wallis Lake to take their litter away with them, and stating that when visiting islands tourists may be stepping onto Aboriginal Land and to please respect this by not littering	Nominal	High (B4)	Boatshed owners, Forster ALC	Not complete, review.	
W.10.1	Continue to enforce regulations regarding treated effluent discharge from vessels in areas close to oyster leases, wetlands, townships etc.	Staff time	Immediate (B1)	Waterways, GLC	Ongoing	
W.10.2	Continue to ensure that all new houseboats contain greywater holding tanks and phase out houseboats (commercial and private) without greywater holding tanks (action 10.19 of the WLCMP)	Staff time	High (B3)	Waterways, GLC	Ongoing	
W.10.3	Progress the development and implementation of a CoP for blackwater and greywater for fishing boats when moored at the Wallis Lake Fish Co-op in Cape Hawke Harbour	$5,000	High (D1)	Fish Coop, GLC	Review, Modify	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
E.1.1	Progress the development and implementation of a *Wallis Lake wetland management strategy* and ensure that it embraces the recommendations from the wetlands action plan of the WLCMP including: • applying for RAMSAR listing • conducting an inventory and assessment of wetlands • acquire or conserve wetlands of high ecosystem services value or where threatened by cumulative deterioration on private land • adopting and implementing best practice wetland management guidelines • developing and implementing revegetation and rehabilitation programs • monitoring wetland health (at mangrove and saltmarsh key habitat sites) • ~~developing and~~ implementing community education and awareness programs GLC's Vegetation and Biodiversity Conservation and Management Framework should recognise the *Wallis Lake wetland management strategy* and all other relevant aspects of the WLEMP	$140,000 + $2.5 million for buy back	Immediate (B2)	GLC, DEC, DIPNR	135.5 ha wetland protected by stock exclusion Developed Wetland Strategy, research to prepare for Ramsar listing for Wallis Lake, acquisition of Wallamba Island, Darawakh Wetland, Mininbar Wetlands, ongoing rehabilitation of wetlands purchased, limited monitoring of saltmarsh, limited community education through field days to Darawakh wetland.	Include new point: - undertake an adaptive review of the WLWMS at some stage
E.1.2	Continue to encourage voluntary property agreements for the conservation of significant areas of wetland on private property	Staff time	Immediate (B2)	GLC	This should be CMA, ongoing	These two points are covered by the Wetland Mgt Strategy, and so can be dropped from Plan.
E.1.3	Explore agreements with DEC and DIPNR to acquire and manage areas of wetland with significant conservation and ecosystem services value	Staff time	Immediate (B2)	GLC, DEC, DIPNR	Purchase of wetlands with OEH funds and Darawakh wetland MoU to be managed by NPWS. Ongoing.	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
E.2.1	Identify 'proceed with care' zones for motor vessels in areas of shallow seagrass beds, especially beds of *Posidonia australis*. Areas to consider include: • South of Pelican Island • Pipers Bay • Goldens Bay • Tonys Bay • Charlotte Bay Care should be taken to ensure that 'proceed with care' zones are consistent with areas being considered under the Estuary General Fishery Management Strategy for Wallis Lake and any other relevant planning instruments	$10,000	Immediate (B1)	WLEMIC, DPI, Waterways, GLC	No progress, review	
E.2.3	Consider deploying demarcation buoys at 'proceed with care' zones	$15,000	High (B3)	DPI, GLC, Waterways	Considered too difficult, delete or modify	
E.3.1	Consider dredging the sand bar encroaching on P*osidonia australis* beds between Wallis and Tonys Point Islands	$250,000	High (D1)	GLC, DPI	REF completed, low priority, awaiting funding	
E.3.2	Assess and report impacts of sediment from stormwater and run-off on seagrass through the seagrass monitoring project	$25,000	Medium (B5)	GLC	Some seagrass monitoring has been undertaken through community seagrass monitoring program, limited analysis. Review, Modify	Community monitoring program produced essentially unusable data. Community Env. Network has set up a database and a new comm. monitoring program. On ground works are difficult for volunteers.
E.4.1	Monitor the growth of *Microdictyon* sp and *Chaetomorpha* sp as part of the SMP at the Paradise Marina and Pipers Creek sites to assess any possible impacts of overgrowth of seagrass	Staff + volunteer time	Medium (D4)	GLC	Seagrass epiphyte monitoring via false seagrass program	This Action is too specific. Chaetomorpha is not epiphytic, grows in water column. Epiphytic algae monitoring is happening via false seagrass program. Not monitoring spp., just algal biomass. 4 test sites in Pipers Bay and 4 control sites in Lake.
E.4.2	Investigate the possibility of facilitating a 'Dads navy' in the Forster Keys and Pipers Creek area	$2,000	Medium (D4)	GLC, DPI	Dads Navy set up to remove rubbish, Review, Modify	
E.5.1	Continue with *Posidonia australis* surveys on a regular basis	$5,000 + staff time	Medium (B5)	GLC	First survey conducted in 2002 Completed, Review, Modify	1st Action re: seagrass monitoring needs to be along the lines of "Develop an achievable monitoring program/ investigate options".

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
E.5.2	Continue the seagrass monitoring program, coordinated under the HLP	In HLP budget	Medium (B5)	GLC	Completed with limited data analysis, Review, Modify	V complex to monitor successfully, so many variables, incl. seasonal. Important. Needs to be kept in Plan. Successful program needs to be carefully planned and properly staffed & resourced. Need to be careful how seagrass data is interpreted. Work with DPI?
E.5.3	Record the timing, frequency, magnitude, location and species of phytoplankton and macro-algae blooms	Staff time	High (A5)	GLC	See E.5.1 (E.4.1?), Ongoing.	
E.6.1	Employ a river keeper or other paid worker to maintain and restore vegetation in riparian zones	$80,000 per year	Immediate (A3)	GLC, DIPNR, Waterways	Over 4km riverbank restored along Wallamba River using contractors, Modify	
E.6.2	Conduct a riparian vegetation assessment	$20,000 + staff time	High (B3)	GLC, DIPNR, Waterways, Lands	No progress, Modify	This is important to keep in, but currently too general. Areas of native veg have been mapped in-house. We also have drainage line maps - bringing them together would give basic riparian veg model. Break this Action up?
E.6.3	Concentrate revegetation and restoration efforts in priority areas identified in the riparian vegetation assessment	$50,000 + staff time	High (B3)	GLC, DIPNR, Waterways, Lands, Landcare	No progress as there is no mapping but priority areas have been addressed see E.6.1 , Modify	Following on from above - "Create Riparian Mgt Strategy, and then implement. This Action is being implemented through other programs, eg Sus Ag, and through CMA support etc. Areas of riparian veg are being protected, but currently not strategic/ prioritised.
E.6.4	Develop and execute a control program for weeds of national significance including Ground and Climbing Asparagus, Mother of Millions, Lantana, African Boxthorn, Pampas Grass, Bridal Creeper and Bitou Bush on Cut, Bells, Mathers, Long, Cockatoo, Oaky and Godwins Islands List of WONS is inaccurate/ out of date	$10,000 per year	High (C3)	Lands, GLC	Island restoration program and riverbank restoration efforts have removed weeds, partly completed, Modify	Received money from WetlandCare Australia. Developed a weeds control plan for the islands. Work is done on the basis of the prioritisation of the islands- the ones most likely to recover are worked on first. Plan put together in 2008, still relevant, continuing to be implemented.
E.6.5	Monitor and enforce compliance with SEPP 14, the Native Vegetation Act and tree preservation orders to reduce the incidence of illegal clearing of foreshore vegetation	Staff time	High (D2)	GLC + DIPNR	Case by case investigations, ongoing	SEPP 14 and Native Veg Act belong to CMA and OEH. Not really an Action for the Plan, as is simply stating legislative responsibility. Drop?
E.6.6	Continue to provide technical support and training to local Landcare groups	$50,000 per year	Medium (B5)	CMA	Support for 9 groups, Ongoing	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
E.7.1	Support the findings of the *Shorebird assessment and marine values data collation program* and incorporate into future estuary and foreshore management and conservation planning	Staff time	Immediate (A3)	DEC, GLC	No progress, Review	
E.7.2	Continue to protect migratory birds and bird habitat under JAMBA and CAMBA international agreements	Staff time	High (B3)	All levels of Government	Review, Modify to make the action clearer, too general	Again, stating legislative responsibility. Drop?
F.1.1	Implement action 10.5 of the WLCMP to facilitate free passage of fish by maintaining or constructing fishways at Locketts Crossing, Clarksons Crossing, Dargavilles Road Crossing and at the Old Butter Factory Weir at Dyers Crossing	$150,000	Immediate (B1)	WaLI group, CMA, GLC, GTCC, DPI, RTA, DIPNR	Lockets crossing, Clarksons Crossing, Dargavilles Road Crossing have fishways Review progress on remaining Weir	
F.1.2	Evaluate the findings of the Manning bioregional assessment conducted by the Marine Parks Authority in consultation with NSW DPI and Department of Environment and Conservation	Staff time	High (A4)	WLEMIC, DPI, DEC	Delete as there is now a Marine Park	
F.2.1	Ensure that the commercial fishery operates in accordance with the *Estuary general fishery management strategy* (EGFMS)	Staff time	Immediate (B1)	DPI	Ongoing	
F.2.2	Support the development of a code of practice for the NSW estuary general fishery and communicate through a workshop	$2,000 + staff time	High (B3)	Ocean Watch, Fish Coop, DPI, WLEMIC	Unknown, Review	
F.3.1	Consider conducting a survey of recreational fishing effort in Wallis Lake during both peak and non-peak holiday periods	$200,000	Immediate (A2)	DPI, WLEMIC	Unknown progress, Review	
F.3.2	Evaluate the forthcoming management strategy for recreational fishing in NSW	Staff time	Immediate (A2)	WLEMIC, DPI,	Unknown progress, Review	
F.4.1	Evaluate the I*ndigenous fisheries strategy and implementation plan*	Staff time	Immediate (A2)	WLEMIC , DPI, Forster ALC,	Unknown Progress, Review	
O.1.1	Support the implementation of OISAS	Staff time	High (C3)	DPI, WLEMIC, Food Authority, oyster growers	Complete, currently under review, Modify	
O.1.2	Prepare and implement an Oyster Industry Development Plan for Wallis Lake in accordance with the Fisheries Management Act 1994	TBD	High (C3)	DPI, WLEMIC, oyster growers	Unknown Progress, Review	
O.1.3	Support the Aquaculture Lease Survey Project	Staff time	Medium (C4)	WLEMIC, DPI, oyster growers	Complete, Delete	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
O.1.4	Maintain water and shellfish sampling through the NSW Shellfish Program in Wallis Lake	Industry funded	High (C2)	Oyster growers, Food Authority		
O.1.5	Assess derelict oyster aquaculture lease material in Wallis Lake and prioritise its removal	$10,000	Medium (E2)	DPI, oyster growers, Lands, GLC	Part completion, Review	
O.1.6	Continue to support research to determine the carrying capacity and sustainable stocking densities of oysters in Wallis Lake	$5,000 per year	Medium (C4)	DPI, WLEMIC	Unknown Progress, Review	
O.1.7	Ensure that oyster aquaculture lease operations remain within the permitted designated area	$5,000 + staff time	Medium (C4)	DPI	Unknown Progress, Review	
O.1.8	Continue to encourage the phase out of tar treated timber infrastructure on oyster leases and encourage the adoption of environmentally sustainable alternatives in Wallis Lake	$2,000 + staff time	Medium (C4)	DPI, WLEMIC, oyster growers	Some progress on this action but details unknown, Review	
O.1.9	Facilitate the disposal of wooden oyster stick waste from Wallis Lake oyster growers to the Taree tip	$500 + staff time	Medium (C4)	GTCC, GLC, oyster growers	Unknown Progress, Review	
O.2.1	Progress an Oyster Aquaculture Industry Land Assessment to address sustainability issues related to land based activities associated with the industry	TBD	High (C3)	Lands, WLEMIC, oyster growers	Some progress, details unknown, Review	
O.2.2	Consider depuration requirements for any possible relocations of the land based component of the oyster aquaculture industry as a result of O.2.1, and start planning and setting aside land in suitable locations immediately	$10,000 + staff time	High (C3)	Lands	Possibly delete, unknown Progress, Review	
O.2.3	Consider the compatibility of oyster depuration and culling sheds with other activities in foreshore management planning	Staff time	Medium (C4)	GLC	Complete, crown harbour study	
S.1.1	Conduct a hydrosurvey and sediment dynamics modelling analysis of the island/ entrance area of the lake	$70,000	Immediate (B2)	GLC, DIPNR	Complete, delete	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
S.1.2	Prepare REF/EIS/SEE as appropriate and obtain all other relevant approvals and conduct urgent dredging operations in the following prioritised order: 1. Point Road boat ramp Complete 2. northern point of Godwin Island Ongoing 3. entrance to Pipers Creek Complete 4. bridge end of Breckenridge channel Complete 5. southern point of the entrance to Ohmas Bay Complete 6. north-eastern point of Wallis Island Complete	$1M	High (B3)	GLC, DIPNR, Lands, Waterways, DPI	Majority completed, delete	
S.2.1	Conduct an assessment of major stormwater drains to determine where sediment build-up is impacting on habitat quality or impeding passage and compromising the safety of waterway users	$15,000 + staff time	Medium (C4)	GLC	No progress, Review	
S.2.2	Prepare REF/EIS/SEE as appropriate and obtain all other relevant approvals and dredge or excavate sediment build-up at stormwater drains identified above (S.2.1)	TBD	Long-term (D5)	GLC	No progress, Review	
S.3.1	Continue investigations into the development and operation of a permanent sand deposit area on Tern Island subject to development approval	$1 million	High (B4)	GLC, DIPNR, Lands	EIS completed (Webb, McKeown and Associates 2004) Issues identified, too difficult, Delete	
S.3.2	Rehabilitate Godwin and Cockatoo Islands once a permanent sand deposition area is operational	$350,000	High (B3)	GLC, DIPNR, Lands	Not complete as no deposition site is identify, Delete	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
S.3.3	Prepare a *Wallis Lake maintenance dredging strategy* by: • adapting the *Wallis Lake oyster lease maintenance dredging protocol* to form Chapter 1 • developing protocols for the maintenance of major navigation channels ensuring safe depths for water vessel passage to form Chapter 2, and • developing protocols for the removal of sediment build-up at major stormwater drains to form Chapter 3	$40,000	Medium (B5)	GLC, DIPNR, Lands	Not complete, Review	
S.3.4	Conduct periodic hydrosurveys to monitor the rate of infilling of dredged areas from action S.1.2	$20,000	Medium (B5)	Lands	Complete, ongoing	Also GLC responsibilty. See (draft) Wallis Lake Maintenance Dredging Program
M.1.1	Follow action 10.1 of the WLCMP to develop and implement a foreshore management plan for the Wallis Lake foreshores, estuarine islands and coastal beaches consistent with the objectives of the NSW Government's Flood Prone Lands Policy	$50,000	High (B3)	WLEMIC, GLC, DEC, DIPNR, DPI, Lands	Coastal Management Plan currently being prepared, Research progress on foreshore plans, Review, Modify	
M.1.2	Develop and implement a *Wallis Lake private jetties and foreshore structures management strategy* and DCP to manage the future development of all new private pontoons, boat ramps, jetties and moorings. The DCP should outline best practice techniques for all works associated with the Wallis Lake foreshores	$40,000	Immediate (A2)	GLC, DIPNR, Lands, DPI, Waterways	Not Complete, keep	Wallis Lake Boating Infrastructure Strategy, adopted 2012
M.1.3	Maintain conservation zonings on islands to ensure protection from development pressure, and ensure that only low key environmentally sustainable development occurs near foreshores and on islands eg Wallis Island, Tonys Point Island.	Staff time	Immediate (B2)	GLC	Modify, conservation zonings are maintained, ongoing	Being achieved through Council's Principal LEP and consent process. Drop?
M.1.4	Be aware of the unauthorised construction of foreshore structures via regular foreshore reviews and order their subjection to the Development Approval process or their removal as appropriate	$10,000	Medium (D3)	Lands, GLC	Unknown Progress, Review	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
M.1.5	Continue investigations into the construction of an environmentally friendly and educational foreshore boardwalk for Pipers Creek	$200,000	Medium (D3)	GLC, Lands	Feasibility study completed in 2005 Completed but not progressed due to funding, Modify	
M.2.1	Assess and quantify island erosion using historical charts* and aerial photography * Mr Bruce Parsons of Forster holds historical charts of the island/entrance area available for studies.	$15,000	Medium (C4)	WLEMIC	Not Completed, not a major issue, delete	
M.2.2	Determine the likelihood and severity of future erosion of the islands from the sediment dynamics modelling analysis (see action S.1.1)	$10,000 + staff time	Medium (C4)	GLC	Not Completed but hydrodynamic models could be run to answer this question, Delete	
M.2.3	From M.2.2, investigate installing appropriate bank protection measures where it is deemed necessary	TBD	Medium (C4)	Lands, GLC, DIPNR	Delete due to dynamic nature of estuary, not necessary due to limited erosion	
M.3.1	Conduct a bank assessment of foreshore reserves and identify and prioritise bank protection structures in need of repair, and areas in need of further protection from erosion	$15,000	Medium (D3)	GLC	Complete	
M.3.2	Conduct repairs on retaining walls identified in M.3.1, and consider constructing new bank protection structures where necessary as identified in M.3.1	TBD	Medium (D3)	GLC	Review, Modify	
M.3.3	Formalise access areas to the estuary at Rest Point Road reserve by constructing at least two sets of steps leading to the water and transplant *Juncas* sp (Tussock Rush) to stabilise the surrounding bank	$20,000	High (D2)	GLC	Rock fillets established on Darawakh Reserve, Rest Point Road, Review	
M.3.4	Formalise an access area to the estuary at Darawakh reserve (ie. platform) and encourage revegetation and bank protection of the surrounding foreshore area by mangroves and casuarinas	$50,000	High (D2)	GLC, Waterways, DIPNR	Complete, delete	
M.4.1	Assess signage on islands marking the location of toilets and ensure that signage can be easily sighted from the waterway	$1,000 + staff time	Long-term (E5)	GLC, DEC	Complete, delete	
M.4.2	Ensure that foreshore reserve areas are regularly maintained for general tidiness and lawn mowing	Staff time	Long-term (D5)	GLC	Complete, ongoing	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
M.5.1	Restrict vehicle access to the informal foreshore road from the end of Wharf Road to Green Point Drive, Green Point, by constructing boom gates at either end to ensure that it is accessed by approved user groups only	$5,000	Medium (D4)	GLC	Not complete, review, modify	
M.5.2	Assess and remediate drainage problems on the eastern edge of the informal foreshore road from the end of Wharf Road to Green Point Drive, Green Point	$5,000	Medium (D4)	GLC	Unknown progress, Review, Modify	
M.5.3	Seal the Paradise Marina car park on Little Street, Forster, to prevent erosion and the input of sediment into Breckenridge Channel	$60,000	High (D3)	GLC (engineering)	Complete, delete	
M.5.4	Identify and prioritise areas of erosion and sediment input to the Lake and detail steps required to stabilise and repair such areas	$10,000	High (D3)	GLC	Not complete, keep	
M.6.1	Implement the *Lower Wallamba River rivercare plan*	$50,000 per year	Immediate (C1)	GLC, DIPNR, Waterways, private land holders	4km Rock fillets, MoU with Ski industry, revegetation, relocated Mans Road, ongoing	
M.6.2	Continue to maintain and enforce no-wash zones to avoid unnecessary erosion	Staff time	High (C3)	Waterways	Ongoing	
M.7.1	Encourage and facilitate sustainable stock management practices in riparian zones	Staff time	Immediate (B2)	Lands, GLC, DIPNR	Some stock fenced along Wallamba River, Sustainable Farming Program ongoing	
M.7.2	Evaluate the findings of the Crown Land assessment at Wallis Lake and the Wallamba River	Staff time	Immediate (B2)	Lands, GLC, DIPNR	Unknown progress, Review	
M.7.3	Consider the complete removal of stock from riparian zones in the foreshore Crown Reserve pending the results from M.7.2	TBD	Immediate (B2)	Lands, GLC, DIPNR	Unknown progress, Review	
M.8.1	Reduce trip hazards by repairing foreshore footpaths that are worn or have slumped as a result of undercutting bank erosion	TBD	Medium (E2)	GLC	Review and Delete - should be in an asset management plan	
M.8.2	Assess the height of signage at public foreshore areas and ensure that minimum heights are maintained	$5,000	Medium (E2)	GLC, Waterways, DPI, RVCP	Review and Delete - should be in an asset management plan	
M.8.3	Consider constructing a viewing area behind the Wallis Lake Fish Coop on Leo Amato Close, Tuncurry, to reduce conflict between the public and fishermen when unloading catches from fishing vessels	TBD	Medium (E2)	GLC, Fish Coop	Review and Delete - should be in an asset management plan	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
U.1.1	Develop and implement a *Wallis Lake boating plan of management* (to update the *Great Lakes waterway recreation strategy* study) including surveying user needs and addressing: • pump-out facilities • public moorings (including the provision of deepwater moorings) • public jetties • public boat launching facilities • equitable use of paddle craft and motor vessels • appropriate recreational use in particular areas of the estuary eg kite surfing in the island/entrance area, jet skiing at high speeds during peak periods in the island/entrance area and conflicts with swimmers The *Wallis Lake boating plan of management* should recognise areas of seagrass, mangrove, saltmarsh and other ecologically significant areas in the estuary and ensure appropriate boating use in these areas	$40,000	High (B3)	Waterways, GLC, DPI, WLEMIC	Not complete, Review, Modify	
U.1.2	Consider erecting signage at boat launching areas (particularly Point Road Tuncurry and Forster regional boat ramp) advising motor vessels of best practices when passing paddle craft on the waterway	$1,500	Medium (D3)	GLC, Waterways	Complete (check) , delete	
U.1.3	Consider providing dinghy storage racks at the Oxley Park and Pipers Bay foreshore reserves	$15,000	Medium (D3)	GLC	Not complete, Review in waterways facilities strategy, delete	
U.1.4	Take the necessary steps to effect that the Green Cathedral (Tiona) is no longer a navigation hazard 1. Investigate heritage value 2. If of heritage value, demarcate as appropriate including a lit marker 3. If not of heritage value, consider removal	TBD	Medium (E2)	GLC, Waterways	Review with view to deleting	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
U.2.1	Erect signage on prominent points of Cut Island, Wallis Island, Pitchford Island (Shallow Bay) and at Junction Point (Coolongolook/ Wallingat confluence)	$3,500	High (B3)	GLC, DEC, Waterways	Unknown progress, Review	
U.2.2	Ensure that channel markers are maintained and replaced promptly when damaged	In Waterways budget	High (B3)	Waterways	Ongoing	
U.2.3	Consider providing channel markers (1 or 2) to demarcate the shallow area on the southern side of Bandicoot Island	$1,000	Medium (D3)	Waterways	Unknown progress, Review	
U.2.4	Consider providing lit channel markers in the Wallamba Broadwater (3) and at Hells Gate (1)	$20,000	Medium (D3)	Waterways	Unknown progress, Review	
U.3.1	Ensure commitment to a memorandum of understanding (MoU) finalised in 2004 to restrict water-skiing and other power boat recreational activities on the Wallamba River to the area between Mill Road, Failford, and Gereeba Island	$200,000 + staff time	Immediate (C1)	GLC, WLEMIC, caravan parks, waterways, water-skiers	MoU signed with skiers, ongoing negations with wake boarders, Reviewed MoU in 2011, Modify	
U.3.2	Protect the Wallingat River upstream of the broadwater and the Coolongolook River from the impacts of any possible increase in water-skiing and wakeboarding activity as a result of the restrictions in action U.3.1	$5,000 + staff time	High (B4)	GLC, WLEMIC, Waterways	No progress, ongoing	
U.3.3	Investigate restricting damage from wakeboarding and wakeboarding boats or prohibiting as required on the Wallamba River	Staff time	Medium (C4)	WLEMIC, Waterways	Completed, alternate area identified for wake boarding in Wallis Lake, Modify for ongoing implementation	
C.1.1	Report pollutant loads (gross and suspended solids) removed from SQIDs to the community via SoE reports, local media etc	Staff time	High (B4)	GLC	Ongoing, Review, Modify	Info goes in SoE.
C.1.2	Continue to hold stormwater and wetland community education days on a regular basis providing information on the operating principles of SQIDs and best practice techniques for fertiliser usage, car washing, pet and garden waste disposal	In HLP budget	High (B4)	GLC	1:1 meetings with residents around wetlands and proposed Bioretention systems, 2 formal tours of Bioretention, ongoing, Modify	Future - Catchment model, Bio-retention tours
C.1.3	Continue to provide educational signage at locations of all new SQIDs	$2,000 per new SQID	High (B4)	GLC	Ongoing	May be too specific. Ongoing - at selected sites

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
C.1.4	Utilise community group newsletters and meetings and local media to increase awareness of the link between high nutrient concentrations in stormwater and estuarine algal blooms and disseminate information on best practice techniques for fertiliser usage, car washing, pet and garden waste disposal	$500 + staff time	High (B4)	GLC	Ongoing, stormwater scampers with School students, newsletters to residents surrounding Bioretention sites	Stormwater Scampers not done anymore, but currently running a schools program under CFOC project.
C.1.5	Expand and follow up on best practice audits for businesses as part of the *Healthy lakes business program*	In HLP budget	Medium(B5)	GLC	Established Sustainable Business Program, Modify	
C.2.1	Continue to encourage rural nutrient management strategies as described in action 7.3 of the WLCMP including: • developing nutrient management plans for individual properties • ensuring appropriate zoning and planning provisions to protect water quality in floodplains • implementing best practice floodplain management guidelines to reduce sediment and nutrient input to waterways • installing dairy effluent management systems • continuing the dung beetle release program • conducting soil testing to identify appropriate nutrient needs • using appropriate application of fertilisers • using slow release fertilisers	Catchment Officer Staff time	High (B4)	WaLI group, CMA, NSW Ag, Landholders	Ongoing through Sustainable Farming Program, Modify	
C.2.2	Continue to work with community groups / Landcare groups / subcatchment management committees to disseminate information on soil and nutrient management strategies	Staff time	High (B4)	WaLI group, CMA	Ongoing through Sustainable Farming Program, Modify	
C.2.3	Prepare educational material on soil and nutrient management and distribute to landholders in the Wallis Lake catchment	$2,500	High (B4)	WaLI group, CMA	Ongoing through Sustainable Farming Program, Modify	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
C.3.1	Hold community education field days on a regular basis with talks and guided tours of local areas with significant habitat value	$1,500 per year	Medium (B5)	GLC, DPI	Wetland tours of P Palms, Darawakh, ongoing	
C.3.2	Utilise community group newsletters and the GLC website to disseminate information on the physical features and ecological roles of estuarine habitats and groundwater	Staff time	Medium (B5)	GLC	Creek to Coast regular updates on wetland projects, modify, ongoing	
C.3.3	Prepare an education information pack or similar on the physical features and ecological roles of estuarine habitats and distribute to residents around the estuary	$15,000	Medium (B5)	GLC	Review, with view to delete Modify and Combine all (C.3) actions	
C.4.1	Develop and distribute a pamphlet outlining best practice guidelines for human-dolphin interactions specific to dolphins (see section 13.7)	$5,000	High (C2)	DEC, WLEMIC	Not complete, Review	
C.4.2	Consider erecting signage summarising boat operator guidelines when dolphins are encountered at the Forster Harbour and Point Road (Tuncurry) boat ramps	$1,500	High (C3)	DEC, WLEMIC	Not complete, Reveiw	
C.5.1	Ensure advanced notification of public meetings to allow holiday home owners in the area sufficient time to plan attendance (eg in quarterly notices), and utilise local media to advertise upcoming meetings and plan review periods	Staff time + $600* meeting	High (A5)	GLC	Ongoing, Modify all actions to represent our approach to engagement	
C.5.2	Provide opportunities for individual consultations with community members on estuary and foreshore plans	Staff time	High (A5)	GLC	Ongoing	
C.5.3	Ensure adequate feedback is given for all submissions received on estuary and foreshore plans	Staff time	Medium (C5)	GLC	Ongoing	
C.5.4	Ensure the WLEMIC is familiar with all estuary and foreshore plans and encourage representatives to report back to their represented stakeholder groups	Nil	Medium (C5)	WLEMIC	Ongoing	
C.5.5	Identify the Natural Systems and Estuaries Branch of GLC for public contact on environmental matters	$500	Medium (C5)	GLC	Delete	

No.	Action	Cost	Priority	Responsibility	Progress 2012	Comments
C.6.1	Report monitoring information through SoE, GLC website and local media and organise media coverage of all on ground estuary and foreshore management works	Staff time	Medium (B5)	GLC	Report Card on estuary health, ongoing, modify	Future: Report Cards and also project-by-project basis
C.6.2	Make all plans that form the planning framework for the maintenance and improvement of estuarine health (see Figure 8.1) available to the public over the internet and at GLC	Staff time	Medium (C5)	GLC	Complete, ongoing	
C.6.3	Make educational pamphlets available at motels, boatsheds and real estate agents etc	$2,500	Medium (B5)	GLC, WLEMIC	Modify to reflect Steps to Sustainable Tourism	Achieved through Sustainable Business Program
C.6.4	Continue to coordinate community education efforts under the Healthy Lakes Program	Staff time	Medium (B5)	GLC	Review, Modify	While community education programs continue, they are generally on a project-basis. Not much happening under the 'Healthy Lakes Program' banner anymore

b) Wallis Lake Catchment Management Plan Actions (2003)

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
1.1	To ensure the remaining biodiversity and ecological functioning of the catchment is protected through appropriate planning instrument/s including provisions for protection of: • SEPP areas • Wetlands, riparian zones and lake foreshores - some work • Significant terrestrial and aquatic habitats Fisheries mgt ?? Mangroves, threatened species • Surface water quality Done through WSD DCP 54 and WQIP • Ground water quality x • Areas with high soil erosion potential x • Acid sulfate soils (in terrestrial and aquatic areas) LEP amendments, DCP • Areas with limitations for on-site effluent disposal	Catchment vegetation mapped by June 2001 Review LEPs to ensure that zonings are environmentally appropriate by December 2002 Catchment protection areas identified and protected through zoning or planning provisions by December 2003 No loss of wetlands or riparian vegetation	WLCMIC Councils NPWS DLWC DUAP	This is a very important point/Action. A lot has been done on zoning in the past 10 years Some wetlands protected through zoning. SEPP 14 wetlands are being zoned E2 under the new LEP. DCP 54 adopted Dec 2011, commenced Jan 2012 for large scale development and July 2012 for sml scale. Sets targets for devel and redevel. FUTURE: DCP or Planning consistancy for rural land, eg chicken sheds. DCP - Review applicability to rural land and introduce additions and alterations for SSD
1.2	Ensure adoption of the catchment management plan through Development Control Plans and assessment process that requires compliance with the catchment management plan and Regional Environment Plan	To be implemented by December 2003	WLCMIC Councils	These actions are happening through the assessment process - property boundaries (minimising veg clearing along boundary fencelines), restricting riparian rights, road sealing
1.3	Incorporate environmental enhancement opportunities in development proposals	Councils to develop an off-set policy for achieving no net loss of native vegetation by 2003	Councils	
1.4	Participate in the development of the Karuah-Great Lakes Regional Vegetation Management Plan to ensure that catchment vegetation and biodiversity issues are incorporated into the regional plan including: • Establishment of regional fauna corridors • Protection of habitat of sedentary and migratory species • Vegetation management guidelines for maintenance of habitat structure and function – food, nesting, shelter • Regeneration of habitat • Managing environmental weeds • Control of dogs, foxes and cats	Karuah-Great Lakes Regional Vegetation Management Plan to be completed by December 2003	Councils WLCMIC Community	R Veg Mgt Plans no longer exist. None since 2004

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
1.5	Develop and implement Voluntary Conservation Agreements/ Property Agreements/ Management Contracts over regionally significant vegetation and habitat including: • Isolated trees - especially those representative of vegetation that has been extensively cleared • Food and habitat trees and other habitat features • Wetlands and riparian zones • Habitat corridors	XX hectares of regionally significant vegetation to be managed under some form of conservation agreement by 2010	WLCMIC NPWS DLWC KGLRVC Landholders	Change to GLC, ongoing
1.6	Develop and implement regeneration programs for degraded habitat focussing on significant vegetation and habitat of threatened species	Re-establish native vegetation in XX hectares of extensively cleared native vegetation types by 2010 Re-establish native vegetation in XX hectares of local and regional corridors, riparian zones and recharge zones by 2005	WLCMIC DLWC KGLRVC Landholders Community	Ongoing Change to GLC
1.7	Develop and implement Recovery Plans for Endangered Species	Recovery plans for all Endangered Species in the catchment in place by 2010	NPWS	Recovery Plans relevent to area incl: * State Recovery Plan for Yellow-Bellied Glider * State Recovery Plan for Red Goshawk * State Recovery Plan for Bush Stone-Curlew * national Recovery Plan for Swift Parrot
1.8	Implement coordinated management measures for rabbits, foxes, feral deer, feral pigs and feral dogs	Plan for coordinated management in place by June 2002 Annual control campaigns	RLPB SF NPWS Councils Landholders	Incorporate into new plan Current Threat Abatement Plans include: • Rabbits (Commonwealth EPBC Act) • Unmanaged goats (Commonwealth EPBC Act) • Red Fox (Commonwealth EPBC Act) • Feral Cats (Commonwealth EPBC Act) • Feral Pigs (Commonwealth EPBC Act) • Cane Toads (Commonwealth EPBC Act) • Bitou Bush and Boneseed (NSW TSC Act) • Red Fox (Vulpes vulpes) (NSW TSC Act) • Gambusia holbrooki (plague minnow) (NSW TSC Act)

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
1.9	Develop and implement a volunteer BushCare Program for public lands including: • Establishment of clear guidelines and responsibilities for bush regeneration groups • Provide financial or in-kind assistance for approved projects • Assistance with the development of ~~management~~ plans should be "work plans" • Training in bush regeneration techniques - sporadic • Development of volunteer register √ • Networking and information sharing between volunteer groups √ • Involvement of volunteers in biodiversity monitoring - aspirational	Guidelines and responsibilities to be developed by December 2001 Assistance with development of management plans, and training on an as-needs basis Financial and in-kind support Ongoing networking	GLC Community	There are currently 22 active groups. Work planning needs to be revisited. Networking & info sharing happens thru Belle meeting w GL Coastal Land Mgt Group 1/4ly to 6mthly.
1. 10	Adopt and enforce guidelines on companion animals to minimise impacts on native fauna especially in known habitat areas	Guidelines adopted as part of amended Local Environmental Plan	Councils Community	Covered in Council's Companion Animal Management Plan.
1.11	Support the adoption of long-line fishing with other techniques less harmful to sea birds	Ongoing	WLCMIC	Supported, but not necessarily related to catchment plan
1.12	Monitor the distribution of threatened species and habitat	Database of threatened species already in place – maintenance of database ongoing	WLCMIC NPWS Community	Ongoing, incorporate into new Plan
1.13	Develop an inventory and maps of catchment biodiversity including: • Feeding, roosting and nesting sites	Vegetation mapping with attached indicative species lists by June 2001	GLC Community NPWS	Some mapping of native veg areas has been completed. Tops to Lakes is a coordinated strategic plan to recognise the value of lands of high ecosystem service values.
1.14	Raise community awareness and participation in biodiversity conservation and management including: • Guidelines for biodiversity and vegetation management x Guidelines no longer considered the way to go • Promoting the biodiversity value of conservation areas in the catchment Achieved through bushcare program, and Sus Farming • Threatened species and their habitat requirements √ • Use of appropriate fire regimes for habitat maintenance x • Environmental weeds √ • Sustainable farming practices (including vegetation management) √ • Responsible pet ownership √ Companion Animals Plan • Schools program √	Funding for education officer to be sought Education program to be developed and implemented by December 2003	WLCMIC Community DLWC Councils LNCCMB Waterways NSW Fisheries Commercial fishers GLC Fishing Clubs Education	This Action and the one above could be deleted, and replaced with something relating to the visions and principles of Tops to Lakes We can't get recurrent funding for ongoing education program. Achieved through aspects of other projects/ programs

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
2.1	Apply for listing of Wallis Lake wetlands and lakebed under the RAMSAR International Convention on Wetlands and implement the management criteria under this convention	Application prepared and submitted by June 2002	WLCMIC NPWS	RAMSAR study undertaken in 2010. Add GLC
2.2	Complete the inventory and assessment of wetlands focusing on lowland wetlands. Assessment should include ecological status and identification of threatening processes.	Wetland inventory to be conducted by December 2002	WLCMIC DLWC	Wallis Lake Wetlands Strategy completed 2010 Add GLC
2.3	Purchase wetlands on private lands that are threatened or have high conservation values. Link the purchase of wetlands to the continued development of NSW Reserve System	Priority wetlands to be identified by December 2002 Purchase negotiations to commence by December 2003	WLCMIC	Change to GLC + CMA Ongoing, Wallis Lake Wetlands Strategy
2.4	Adopt and implement best practice wetland management guidelines to maintain hydrological, habitat and biodiversity values including: • Provisions in statutory planning instruments • Maintain natural hydrological regimes (including groundwater) • Retain buffer zones around wetlands • Prevent grazing in wetlands • Fence off wetlands on public lands • Manage aquatic weeds • Ensure water entering wetlands is of good quality (including groundwater) • Minimise use of herbicides and pesticides in the vicinity of wetlands and use alternatives wherever possible • Ensure that legislation and guidelines are adopted in water and land management plans and strategies	Guidelines adopted and promoted by June 2003 Ongoing implementation of best practice wetland management	WLCMIC DLWC Landholders	Ongoing, Wallis Lake Wetlands Strategy Wetlands (Clause 7.8) in GLC LEP (2014)
2.5	Develop and implement programs for regeneration and rehabilitation of degraded wetlands including: • Restoring original hydrological cycles • Revegetation (with an emphasis on regeneration) • Managing noxious and environmental weeds	Programs to be developed by June 2003 80% of degraded wetlands to be rehabilitated by 2010	WLCMIC DLWC Landholders	Ongoing, Wallis Lake Wetlands Strategy
2.6	Monitor wetland health with specific reporting on saltmarshes	Indicators to be identified by December 2002 Monitoring to be ongoing	WLCMIC DLWC	Periodic Fisheries aerial studies. 2010 Umwelt Study. 2014 ground-truthing of Aerial studies

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
2.7	Develop and implement a community education and awareness program highlighting the value of wetlands including: • Landholder education regarding best practice wetland management • Distribution and support of wetland management guidelines - achieved through workshops rather than guidelines • Appoint Community/Landholder Education and Awareness Officer	Funding for education officer to be sought Education program to be developed and implemented by December 2003	WLCMIC Community DLWC LNCCMB GLC	Achieved through Sus Farming Program (CfoC grant). Workshops with Louise Duff Some wetalnd educ for landholders inc 'wet pasture mgt' workshop, dams and off-stream watering- through CfoC grant (don't know about long-term). Also 'value of wetlands' articles in C to C.
3.1	Develop a water sharing plan that will maintain and enhance aquatic ecosystems including consideration of the flow requirements for current and potential threatened species	To be developed by December 2003	LNCWMC Community	Lower North Coast unregulated and alluvial water sources Water Sharing Plan
3.2	Review the need for all weirs	To be developed by December 2001	Fisheries	adressing barriers to fish passage incorporated into new Plan
3.3	Adopt interim environmental flow objectives for the Wallis Lake catchment until specific guidelines are developed	To be implemented immediately	WLCMIC LNCWMC	Review
3.4	Develop environmental flow guidelines including: • Protection of low and high flows • Protection of "freshes" • Flow variability • Minimise effects of weirs and other structures on water flow Limit floodplain harvesting Encourage water use efficiency	All renewed or new licences to contain conditions to share water in times of low flow Guidelines to be developed by December 2001	WLCMIC LNCWMC DLWC Fisheries Community	Planning controls pertaining to Maintenance of pre-disturbance environmental flows is incorporated into DCP- 54
3.5	Develop and implement an environmental flow monitoring program to ensure that flows are adequate for achieving the environmental objectives	Ongoing	WLCMIC	Incomplete, review
3.6	Develop and implement a water quality education and awareness program including environmental flows as part of the Water Efficiency on Farms Program	To be developed and implemented by December 2002	WLCMIC NSW Ag	Review
4.1	Identify priority soil erosion sites for remedial works including: • Farms • Roads and drains • Riparian zones	Sites to be identified and prioritised by June 2002	WLCMIC Councils	We need a map of steep lands- bare areas can become a priority for reveg works Some has been done for the Wang Wauk Management Plan

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
4.2	Develop subcatchment plans for : • Wang Wauk River • Wallamba River • Koribakh Creek • Coolongolook River • Wallingat River Subcatchment plans should incorporate the use of large woody debris where existing stream control structures are failing and not being replaced due to lack of large trees.	Draft plan completed Plan commenced Commence planning by December 2003 Commence planning by January 2006 Commence planning by January 2010	WLCMIC DLWC Landholders	Incomplete progress, review
4.3	Rehabilitate high priority soil erosion sites including : • Fencing and stock access management • Off-stream shade and stock watering • Revegetation, particularly of gullies, incised water courses, riparian zones and steep land >18 degrees • Sealing of gravel roads in high priority soil erosion areas	Rehabilitation works to commence on high priority soil erosion sites by December 2001 75% of the 2001 area of active soil erosion to be stabilised and revegetated by 2010 Permanent native vegetation cover is established in XX% of areas of highly erodible soils and/or steep unstable slopes by 2010	WLCMIC Landholders DLWC Councils	First 2 points - NHT incentives offered 04-05, now incentives through CMA. Note - erosion control on private land is all voluntary, so not really appropriate as an Action. Council has undertaken road sealing at creek crossings - eg Possum Pie Rd, Wootton and Wang Wauk. This Action v broad & difficult to implement- landholders need to be on board. Some of our Best Practice Farms are reducing their erosion. Field days to BP Farms, also workshops held. Ppl put incontact w CMA for incentive funding when they enquire to us. Prioritisation hasn't happened; work done on basis of interest from landholders.
4.4	Implement soil erosion rehabilitation works identified in the Wang Wauk subcatchment plan	Rehabilitation works to commence by October 2001	Landholders Landcare DLWC	Unknown progress, review
4.5	Improve soil health and reduce soil erosion through Property Management Plans/Property Agreements/Management Contracts including: • Managing soil nutrients to maintain soil structure, maintain productivity, minimise runoff and minimise soil and nutrient losses • Fencing according to land capability to ensure that all land is being used within its physical limitations • Managing grazing pressure • Maintaining adequate groundcover on grazing lands • Maintaining a permanent cover of trees, shrubs and grasses on all steep unstable slopes • Maintaining or re-establishing vegetation along gully lines and within riparian zones	Management plans are developed for 50% of properties in high priority areas by 2006 Soil health is improved so that by 2010, 20% of agricultural land is classed as very good A minimum of 70% groundcover is maintained on all grazing lands by 2010 Permanent native vegetation cover is established in XX% of areas of highly erodible soils and/or steep unstable slopes by 2010	WLCMIC DLWC NSW Ag Landholders	Ongoing, Sustainable Farming Program, incorporate into new Plan

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
5.1	Ensure sustainable management of acid sulfate soils (ASS) through a Local Environment Plan with environmental planning and development consent controls that minimise the adverse impacts of ASS especially in relation to activities that would disturb groundwater or soils in areas identified as having ASS	LEP to be prepared by June 2001 LEP to be adopted by December 2001	WLCMIC Councils	Complete
5.2	Prepare and maintain Acid Sulfate Soil Risk Maps including coverage of the waterways	Ongoing as assessments identify potential or actual acid sulfate soils	DLWC	Complete
5.3	Produce land use zoning maps that reflect ASS risk including coverage of the waterways	Land use zoning maps identifying ASS risk to be produced by December 2003	Councils	Complete
5.4	Adopt mitigation and management strategies as outlined in the Acid Sulfate Soil Manual prepared by Acid Sulfate Soils Management Advisory Committee (ASSMAC)	Management strategies to be adopted by local government authorities by December 2001	Councils Landholders	Environmental provisions in GLC LEP 2014Acid Sulfate Soils (Clause 7.1)
5.5	Ensure that best management practice is adopted on all development that is to occur where actual sulfate soils have been identified within 1 metre of the surface or there is a high probability of acid sulfate soils within 1 metre of the surface	Ongoing as development applications are made to Councils No unmanaged oxidation of potential acid sulfate soils to occur	Councils	Environmental provisions in GLC LEP 2014Acid Sulfate Soils (Clause 7.1)
5.6	Manage acid sulfate producing areas to reduce production of sulfuric acid	Management program to be developed by December 2001 All identified acid producing areas to be rehabilitated by 2010	Councils	Darawakh/Frogalla Wetland Management Plan - very successful project
5.7	Quantify and model rates of acid drainage production in areas of actual sulfate soils	Investigations under way	GLC	Complete
5.8	Monitor water quality around Darawakh Creek, Bungwahl Creek, Wallamba River and Dunnes Creek to gauge loads and concentrations of ASS run off	Ongoing	GLC	Darawakh/Frogalla Wetland Management Plan - very successful project
5.9	Develop and implement an education and awareness program on management of potential and actual acid sulfate soils targeted at land managers including: • Identification of depth of iron sulphide layer on individual properties • Recognition of acid sulfate soils • Management techniques for acid sulfate soils	Funding for education officer to be sought Education program to be developed and implemented by December 2003	WLCMIC Councils Community	Darawakh/Frogalla Wetland Management Plan - very successful project
5.10	Research management techniques for acid sulfate soil rehabilitation in Darawakh Creek	In association with rehabilitation works	GLC	Darawakh/Frogalla Wetland Management Plan - very successful project

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
6.1	Develop and implement a coordinated regional control program for noxious and environmental weeds including: • Identification and prioritisation of weeds of regional significance • Coordinated control strategies for high priority weeds • Standard operating procedures for weed control activities • Management of weeds on public land • Contract specifications for all contractors - this is standard. Delete • Establishment of a database of weed control resources and contacts - have databases of plans, contractors, volunteers, other resources	Mid North Coast Weeds Advisory Committee already in place Draft plans for Bitou Bush, Blackberry, Crofton Weed, Giant Parramatta Grass, Green Cestrum and Salvinia complete Complete Regional Weed Control Strategy in place by December 2002	RLPB MNCWAC NPWS SF Councils Landholders	A lot done through the Mid North Coast Weeds Co-ordinating Ctte (MNCWCC). Recently formulated a Weeds Action Program. Recently signed an MoU with nearby Councils, to undertake cross-boundary control programs and implement Rapid Response Plans. Current Plans in place include: Communications Plan, Regional Inspection Plan, High Risk Pathways and Sites Mgt Plan, Weed Mgt Plans for widespread weeds (Class 4), MERI Plan, Weed Incursion Plan, Education Plan.
6.2	Seek funding for effective long-term control of noxious and environmental weeds	Ongoing	WLCMIC MNCWAC	Ongoing. See MNCWCC Regional Weed Strategy
6.3	Encourage best practice weed management through property management planning including native vegetation conservation	Ongoing	MNCWAC DLWC	Ongoing. See MNCWCC Regional Weed Strategy
6.4	Gain Memorandum of Understanding (MoU) with local nurseries and garden clubs to prevent promotion and sales of problem environmental weed species	MoU in place by December 2002	WLCMIC Councils	Nursery industry used to have a rep on the MNCWCC, and currently looking to replace. Through the DPI, we have strong liaison w the nursery ind; consulting re: weed risk assessments and appropriate spp for sale and ban.
6.5	Monitor the distribution of noxious species and serious environmental weeds	Weed distribution maps for Bitou Bush, Blackberry, Crofton Weed, Giant Parramatta Grass, Green Cestrum and Salvinia complete Maps of remaining weeds of regional significance prepared by December 2002	Councils MNCWAC	All high priority weeds mapped through aerial, on-ground etc. Limited by funding and resources, need updated data capturing.
6.6	Maintain weed distribution maps on Geographic Information Systems (GIS)	Ongoing	WLCMIC MNCWAC	Ongoing. See MNCWCC Regional Weed Strategy

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
6.7	Raise community awareness and participation in weed management including: • Weeds information pack for new owners MNCWCC I has developed a weed book (not nec for new owners) • Regional weeds education resource kit MNCWCC has produced a CDROM • Weed control calendar showing priority regional weeds, optimum times for control and control techniques √ dev. by MNCWCC • Weed identification and control methods field days √ • Farm hygiene, grazing management and pasture maintenance • Obligations under the Noxious Weed Control Act • Impacts of weeds on biodiversity • Environmental weeds	Information development undertaken as part of the Mid North Coast Regional Weed Control Strategy by December 2002 Ongoing education	WLCMIC Community NSW Ag Councils MNCWAC	Sporadic w/shops targetting vols run. Weeds info shared via Creek to Coast newsletter. Weed ID & control meth field days run by Belle & TI, cover last 2 points. They attend all local shows with a live weed display. Hold community workshops and train local authorities. Active members of NSW No Space 4 Weeds (media advertising cttee). Have monthly article in Town & Country (thru MNCWCC). Booklet put together for educ of public and authorities. 46,00 copies released around State, will be re-printing. Farm hygiene and weed mgt covered in w/shops run through CfoC - TI has given presentations. Weed information goes into C to C. Sus Farming Groups get sent relevant weed info
7.1	Ensure the retention and enhancement of vegetation cover in the catchment especially wetlands, riparian zones and erosion hazard areas to protect water quality through: • ~~Regional Vegetation Management Plan (RVMP)~~ • ~~Appropriate statutory plan~~ • Floodplain Management Plan • Wetland and Riparian Zone Action Plan - Wallis Lake Wetlands Strategy • Soil Erosion Action Plan x	No net loss of catchment vegetation No loss of core habitat No loss of riparian vegetation RVMP developed by June 2003 with ongoing implementation	WLCMIC DLWC KGLRVC Councils	May come back to Tops to Lakes
7.2	Adopt long-term water quality targets for Wallis Lake catchment waters including: • Review all water quality assessment to date • Determine appropriate water quality objectives for subcatchments with reference to the impact of catchment geology and soils on background water quality • Identify potential key sources of point and diffuse pollution in the subcatchments • Determine the capacity of receiving water to assimilate nutrients • Indicate links between nutrient loads and environmental response	20% reduction of total nutrient load at freshwater end-of-system monitoring points in the Wallamba River and Pipers Creek by 2010 5% reduction of total nutrient load at freshwater end-of-system monitoring points in the Wang Wauk, Coolongolook and Wallingat Rivers by 2010 Reduce total nitrogen load to Wallis Lake to 2 tonnes N/km^2/y by 2010 No net increase of nutrients in southern Wallis Lake	LNCWMC LNCCMB WLCMIC DLWC WLEMC	Water Quality targets developed through WQIP

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
7.3	Work with landholders to implement rural nutrient management strategies including: • Develop nutrient management plans for individual properties • Appropriate zoning and planning provisions to ensure that the water quality protection values of floodplains are protected • Best Practice Floodplain Management Guidelines to reduce the inputs of sediment and nutrients to waterways • Installation of dairy effluent management systems - there's not much dairy in the area anymore • Dung beetle release program using a range of species for different seasonal conditions • Soil testing to identify appropriate nutrient needs • Appropriate application of fertilisers • Use of slow release fertilisers	Implementation of best management practice for fertiliser use and dairy effluent management using Agriculture NSW guidelines by December 2003 Ongoing implementation of dung beetle release program – already substantially implemented Education on best practice fertiliser application at point of sale by December 2002	WLCMIC NSW Ag Landholders Councils	Sus Farming people receive info on not over-applying fertilizers. There have been dung beetle w/shops, and one release possibly done, currently looking to do a farm trial. Soil testing is done on all farms that join the Sus Farming groups, Best Prac farms and farm trials. Have done w/shops on compost teas & biological fertilisers and promote their use. Training people in ID work with microscopes (for soils & compost teas)
7.4	License and monitor dairy effluent management systems	100% of dairy effluent systems to be licensed by December 2003 Ongoing monitoring and auditing of dairy effluent systems	Councils ??	Many dairies in the area have closed; we're not in touch with any. Council would not be in a position to do this anyway.
7.5	Develop and implement long-term stormwater management plans and strategies for all urban and village areas including: • Pacific Palms/Charlottes Bay • Tallwoods/Hallidays Point • Coomba Park √ • Nabiac - In development - predominantly quantity focussed, not quality. • Green Point • ~~Coolongolook~~	Stormwater management plans to be developed and implemented by December 2002 All new housing developments to incorporate water sensitive urban design including stormwater infiltration by December 2002 This is achieved through DCP 54	WLCMIC Councils	Combine w 7.7 None of these have been drafted but Forster Tuncrry SW Plan has been reviewed (currently draft). Not sure if we need to do these Plans as WQIP determined focus should be on Pipers Crk.
7.6	Implement On-site Sewage Management Strategy including: • System for approvals • Monitoring of existing systems to ensure they meet guidelines • Maintain records on all installations and pumpouts • Reporting on implementation in the State of the Environment reports Education on installation, operation and maintenance of on-site sewage management systems	100% compliance with guidelines for on-site sewage management for single households by 2005	WLCMIC Councils Landholders	Complete/ongoing. GLC OSMS currently under review

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
7.7	Implement ~~Wallis Lake Stormwater Source Control Strategy~~ including: (now Forster/Tuncurry Stormwater Plan) • Constructed wetland in Pipers Creek catchment √ • Stormwater Education Officer √ • Stormwater strategy for L leg in Pipers Creek catchment √ • ~~Gross pollutant trap in Pipers Creek~~ • Townsend Street constructed wetland √ • Muddy Creek constructed wetland √ - this was constructed then re-furbished 2010	To be installed by December 2001 Commenced May 2001 To be completed by June 2001 To be installed by December 2002 To be installed by December 2001 To be installed by December 2003	WLCMIC GLC Landholders	Combine w 7.5 FUTURE: implement F/T SW Mgt Plan
7.8	Maintain stormwater drains and gross pollutant traps Done regularly by maintenance staff	Ongoing	Councils	Unnecesary Action? Or combine w 7.7 and 7.5 Remove action
7.9	Develop guidelines for logging on private land and farm forestry to ensure that water quality objectives are met	Guidelines in place by December 2002	WLCMIC	See Private Native forestry Code 2007, rivate Native Forestry Code of Practice 2007 and Native Vegetation Regulation 2013
7. 10	Ensure that sewage effluent discharge complies with water quality guidelines specified in the licence	Ongoing	MidCoast Water	Ongoing
7.11	~~Ensure all works meet water quality guidelines~~ Yes, WQ targets were applied for new developments, now supported by DCP 54	All new developments to meet interim Water Quality Guidelines and, when developed, Lower North Coast Water Quality Guidelines	Councils Contractors	"Implement EMS" - sediment and erosion. Implement and improve DCP 54 and supporting info
7.12	Develop and implement a strategic water quality monitoring program including: • Identification of monitoring parameters and timetable • Long-term monitoring to identify nutrient loads in surface waters This point and above achieved through the Report Cards - estuarine health monitoring Not nec, as we have Ecosys Health Aseess • End-of-freshwater system monitoring to monitor change x too hard Data collected (one-off) for WQIP - no need for long-term monitoring • Community based sample collection – WaterWatch Program √ MidCoast MC run WW, Schools program • Distribution of monitoring results and interpretation - *Report Cards* Report Cards and WQIP results • Ongoing involvement of schools √ MidCoast New schools program + April's Stormwater Scampers • Publicly accessible database of water quality monitoring results Report Card? Potentially available through MCw on request	Review existing water quality monitoring program by December 2001 Identify suitable water quality indicators in association with Water Quality Guidelines by June 2002 Monitoring program implemented by June 2002 Database developed by June 2002	WLCMIC DLWC Councils Community MidCoast Water	(1st point) Yes, WQIP- collected nutrients, turb, ecological data then led to ident of WQ indicators for Ecosystem Health Assessment (ChlA + turbidity) for Report Cards. FUTURE: - Report Cards (pos every 2 yrs). - Support schools and Wwatch

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
7.13	Expand WaterWatch Program to include all community based monitoring groups with monitoring to include subcatchment audits	Ongoing as groups are identified	WLCMIC Community	Review
7.14	Develop and implement an education and awareness program on water quality including: • Rural water quality management (including stock management, vegetation management, run-off control strategies) • Urban water quality management (including stormwater, fertiliser use, impacts of pets, waste management and litter) WSUD work + Gardening/ food prod. Aprils' work + Sus Gardening • Groundwater still relevant? • Maintenance of rural roads and stormwater drains (targeted at Councils and contractors. See also Soil Erosion Action Plan) - Sml amount of training on rural road mgt • Schools program - will probably never have an ongoing, proactive schools program - Catchment Stories with classes on request • Develop information brochures to explain catchment water quality issues - will be done in conjunction w Catchment Model, but not currently a priority - Stormwater Program had brochures, + case studies for Report Cards, tours of WQ gardens and presentations on urban WQ	Funding for education officer to be sought Education program to be developed and implemented by December 2003	WLCMIC DLWC EPA Councils DLWC Education	Healthy Lakes Business Partners '05? had s/w focus. Urban Stormwater Ed program '07. Urban Sus Program (USP) ~'09 - '11 (water qual focus). Engagement materials created for bioretantion (WSUD). Programs put together for schools, eg Stormwater Scamper. Seagrass monitoring project. Now - Catchment Model Outdoor staff trained in erosion + sed control improvements + developing an EMS. FUTURE: -Report Cards, Targeted schools program, Catchment trailer schedule and materials, Sus Gardening, Sus Farming. Also ongoing audits for ESC (eros, sed control).
8.1	Manage Crown lands in riparian zones, and lake foreshores for conservation purposes	Management policy for Crown Lands currently under review to be in place by December 2003	WLCMIC DLWC	Ongoing
8.2	Conserve riparian zones containing remnants of the Weeping Myrtle/Water Gum sub-alliance as identified in Royal Botanic Gardens survey through a combination of Property Agreements (under the Native Vegetation Incentive Fund), Management Contracts (under the NVIF), Property Management Plans, Voluntary Conservation Agreements and/ or other financial incentives to undertake on-ground works			Include riparian revegetation/conservation activities in new Plan
8.3	Protect, restore and manage riparian zones in private ownership through a combination of Property Agreements (under the Native Vegetation Incentive Fund), Management Contracts (under the NVIF), Property Management Plans, Voluntary Conservation Agreements (VCA) and/or other financial incentives to undertake on-ground works	Restoration of priority wetlands and riparian zones commenced by June 2002 VCA negotiations commenced by June 2002	WLCMIC NPWS DLWC Landholders	Ongoing. Land for Wildlife program; Wallis Lake Wetlands Strategy, Tops to Lakes Strategy

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
8.4	Provide assistance to landholders to implement best practice riparian zone management including on-ground works such as: • installation of off-stream shade and watering points • streambank fencing • regeneration and revegetation (using a diversity of riparian species including large trees such as Flooded Gum to supply large woody debris)	Funding has been sought	WLCMIC GLC CMA	We provide a lot of information regarding these in a lot of different materials. Also covered in Best Prac farms and w/shops. We promote CMA incentives grants, which help fund these works.
8.5	Re-establish native vegetation adjacent to waterways through voluntary projects including a combination of: installation of off-stream shade and watering points streambank fencing regeneration and revegetation (using a diversity of riparian species including large trees such as Flooded Gum to supply large woody debris)	Riparian vegetation re-established in 25% of areas currently identified as being in poor or very poor condition by 2005 and in 25% of areas currently identified as being in moderate condition by 2010	WLCMIC Landholders Landcare DLWC	Ongoing. Include riparian revegetation activities in new Plan
8.6	Adopt and implement Best Practice Riparian Zone Management Guidelines including: • Provisions in statutory planning instruments • Best practice farm management • Managing stock access to waterways • Off-stream shade and watering schemes • Fencing of vegetation and revegetation where required • Maintaining groundcover in riparian zones • Managing noxious and environmental weeds	Guidelines adopted and promoted by June 2002 Ongoing implementation of best practice riparian zone management	WLCMIC DLWC Landholders MNCWAC	incomplete - incorporate into new Plan
8.7	Hold field days to promote riparian zone management guidelines	As needed	Landcare	Ongoing eg. Sustainable Farming Program
8.8	Assess stream geomorphology in the catchment using the River Styles approach to prioritise stream rehabilitation projects based on their recovery potential	As needed	WLCMIC	Incomplete, review
8.9	Monitor riparian zone health	Identify indicators by June 2002 Ongoing monitoring	WLCMIC DLWC	Ongoing - incorporate into new Plan Potential to be mapped through remote sensing - incorporated into new Plan

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
8. 10	Develop and implement a community education and awareness program highlighting the importance of riparian management including: • Best practice farm management, including soil conservation and vegetation management highlighting the benefits of good management • Distribution and support of riparian vegetation management guidelines • Community/Landholder Education and Awareness Officer • Obligations under the Native Vegetation Conservation Act	Funding for education officer to be sought Education program to be developed by June 2002 Education package to be delivered to 50% of properties fronting riparian areas by December 2002 Remainder of education program to be implemented by December 2003	WLCMIC Community DLWC LNCCMB GLC	We don't have a formal program for this - it happens on an ad-hoc basis. Happens through C to C, as well as most env media coming ou of Council, Catchment model etc.
9.1	Develop a groundwater risk assessment process as a screening process for development and to raise awareness of issues leading to groundwater contamination x	To be undertaken as part of land use strategies	GLC	Amend
9.2	Assess the potential impacts of all current and future developments on groundwater quality and quantity and ensure appropriate land use controls are applied including: • Potential threat of proposed development - Nutrients + sediments - we apply the targets in DCP 54 for rezong & subdivisions. Required to have a SW Strategy • Acid sulfate risk assessment - we do have AS mapping now • Assessment of cumulative impacts • Vulnerability of groundwater system • Beneficial use or environmental value of groundwater system • Land use in groundwater recharge areas	Ongoing as development applications are received and land use strategies are developed	Councils	Keep. Office of Water. Happens anyway through development assesment. Could merge Action w similar. Implementation of WQIP to prevent contamination of aquifers. Achieve protection of groundwater resources through LEP? planning instruments.
9.3	Protect the Minimbah aquifer and its recharge area through appropriate zoning	Zoning by June 2002 No net increase in pollutants	GLC MidCoast Water	Still a very valid Action. Incorpo into new Plan

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
9.4	~~Prepare and implement groundwater management guidelines to maintain sufficient quantity groundwater for future potable use including:~~ • ~~Groundwater vulnerability and sensitivity mapping~~ • ~~Groundwater risk assessment process~~ • ~~Protection of groundwater aquifer and recharge areas through appropriate zoning~~ • ~~Protection of wetlands hydraulically linked to groundwater~~ • ~~Maintenance of watertable above potential ASS layers~~ • ~~Incorporate groundwater quality and quantity objectives into all new and renewed groundwater licences~~ • ~~Buffer zones restricting groundwater use in close proximity to wetlands, streambanks and remnant vegetation.~~	 To be commenced by June 2006 To be completed by June 2002 To be implemented by June 2004	WLCMIC MidCoast Water GLC	MidCoast Water
9.5	Monitor groundwater quality and groundwater extraction: • Minimbah aquifer • Tuncurry aquifer • Tuncurry Sewage Treatment Plant • Hallidays Point Sewage Treatment Plant • Coastal areas where there are shallow bores and spear point systems	Ongoing	WLCMIC MidCoast Water	Ongoing
9.6	Develop and implement a water quality education and awareness program, including groundwater quality and quantity protection measures	Funding for education officer to be sought Education program to be developed and implemented by December 2003	WLCMIC DLWC	Ongoing, incl GLC Education officer employed by MCW

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
10.1	Develop and implement a Foreshore Management Plan to protect the habitat values of Wallis Lake foreshores, estuarine islands and coastal beaches including: • Planning provisions or land use zoning to protect the foreshore reserve through appropriate statutory plans under the Environmental Planning & Assessment Act - not currently seperately zoned - talk to Alex • Protection of mangroves, saltmarshes and water quality values • Consideration of fish habitat protection areas • Strategies for protection of Aboriginal sites • Protection of areas susceptible to bank erosion • Provision of public infrastructure • Provision of buffer zones between development and environmentally sensitive areas such as wetlands • Provision of appropriate access and recreational use areas that retain environmental values • Management of environmental weeds and vertebrate pests • Control of domestic animals • Protection of seabird and migratory bird roosting, nesting and forage sites	Foreshore Management Plan completed by December 2003 Catchment vegetation mapped by June 2001 Review of LEPs to ensure that zonings are environmentally appropriate by December 2002 Catchment protection areas identified and protected through amendment of zoning or planning provisions by December 2003	WLEMC Councils NPWS DLWC DUAP	Has not been done. Would be a good thing to get done - still a valid Action.

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
10.2	Develop and implement an estuary management plan covering waterway use to protect the habitat values of aquatic ecosystems including: • Planning provisions or zoning to protect wetlands, aquatic and intertidal habitat through appropriate statutory plans under the Environmental Planning & Assessment Act • Management of marine sand migration over *Posidonia* beds • Fish habitat protection areas • Balancing commercial and recreational uses of the waterway • Management of impacts of waterway use and detailing management areas • Provision of parking, boat ramps, wharves and moorings that will allow an environmentally sustainable level of waterway use • Maintenance of navigation channels • Identify oyster leases subject to rapid siltation from sand movement in the lower estuary • Produce maps and signage to communicate plan • Seagrass monitoring program		GLC Community WLEMC	EMP completed, adopted 2005.
10.3	Develop and implement Wallis Lake Fish Habitat Protection Plan and incorporate recommendations into the Waterway Use Plan, Foreshore Management Plan and appropriate statutory plans under the Environmental Planning & Assessment Act	To be prepared by December 2004	WLEMC Fisheries GLC	
10.4	Participate in the development of the Estuary General Fishery Management Strategy to ensure that an ecologically sustainable balance is achieved between commercial and recreational uses of fish resources in Wallis Lake	Estuary General Fishery Management Plan to be reviewed and completed by December 2001		Complete
10.5	Install and maintain effective fishways at : • Locketts Crossing at the tidal limit of the Coolongolook River done • Clarksons Crossing at the tidal limit of the Wallamba River done • Dargavilles Road crossing on the Wallamba River done • Old Butter Factory Weir on Khoribakh Creek at Dyers Crossing being looked into	Sites to be reviewed and remediation works commenced where required by December 2001	WLCMIC Fisheries Councils	Fisheries driven. Majority complete, Dyers Crossing incorporated into new Plan

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
10.6	Prepare and adopt a statutory plan for access and usage to protect water quality, areas susceptible to bank erosion, habitat and fauna of Wallis Lake, estuarine islands, foreshores and coastal beaches through either planning provisions or land use zoning in a Regional Environmental Plan including: • Recommendations from the Fish Habitat Protection Plan • Recommendations from the Foreshore Management Plan • Recommendations from the Estuary Management Plan	Plan to be completed by December 2002	GLC	Regional Environmental Plans no longer exist. Drop action? Now in GLLEP, check w Roger.
10.7	Restrict water skiing to areas identified as less susceptible to erosion as agreed between stakeholders	A two year trial to restrict boat speed and wash from Failford Cattle Crossing to a point near the end of Willow Point Road has been agreed and is currently in place	WLEMC Waterways	Wallamba River MoU
10.8	Remove wake boarding using artificial weights from the Wallamba River	Restrictions to be imposed by December 2002	WLCMIC Waterways	Wallamba River MoU
10.9	Upstream of Forster-Tuncurry Road bridge, restrict access of vessels over 6m to vessels with functioning on-board effluent storage systems (not including work boats)	To be implemented immediately	Waterways GLC	Contact Brett Ryan
10.11	Demarcate management areas, speed restriction zones, etc as identified in the ~~Fish Habitat Protection Plan~~, Foreshore Management Plan and Estuary Management Plan for waterway traffic through a system of marker buoys, information displays at boat ramps and maps	System in place by December 2002	Waterways GLC Fisheries DLWC	Review, add RMS RMS Wallis Lake Boating Plan currently in draft
10.12	Develop and implement a maintenance dredging program including:- • Developing a program for maintenance dredging √ of navigation channels and specific oyster lease areas √ • Prepare dredging strategy to minimise adverse impacts of dredging on bank erosion, aquatic habitat, and to avoid disturbance of acid sulfate soils x Change • Environmentally sustainable disposal of dredge spoil √ (this goes w/out saying)	Program developed as part of Estuary Management Plan by February 2002	GLC	Action to be kept in some form
10.13	Maintain island toilet facilities and the vessel pumpout facilities at the Forster Marina and install effluent pumpout facilities at Coomba Park and Pacific Palms	Pumpout facilities to be installed by 2003		Ongoing. Pump out facilities: Incomplete, see Boating Infrastrucutre Plan for priority boating infrastrucutre for Wallis Lake

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
10.14	Establish a riverbank erosion monitoring program on the lower Wallamba River to determine the effectiveness of speed restriction and access trial, riparian fencing and regeneration	Speed restriction and access trials to commence by December 2001 Monitoring stations established by December 2001	WLCMIC Waterways GLC Community	Complete/ongoing - Wallamba River Erosion Survey 2002-08 Include in new Plan as part of monitorign program
10.15	Conduct further research on water and sediment quality parameters to identify the health of the estuary functioning including: • Develop a whole-of-system monitoring program to report on faecal coliforms - oyster quality assurance program • Refine estimates of critical nutrient loads - WQIP - Through WQIP assessed the nutrient loads from land uses + assessed ecological health of estuary + set targets for future improvement • Gather additional data on the dispersion of cattle faeces throughout Wallis Lake, especially near oyster leases and human activities √ • Examine water quality in the rivers using a combination of de-nitrification efficiency and other sediment indicators beyond the tidal excursion √ • Monitor water and sediment qualities in the Wallis Lake during spring-summer months when organic carbon and nutrients are probably higher than winter times √ Monitoring used for the Report Cards	Sediment nutrient flux assessment conducted every 5 years	WLCMIC GLC DLWC	WQIP, ongoing water quality monitoring (eg. Chlorophyll A, Turbidity, Sea grass health)
10.16	Monitor aquatic health including: • Island forming areas in the Wallamba River • Dry period refuge pools in the Wang Wauk River • Depth measurements through key large refuge pools X • ~~Sediment fluxes~~ X • Benthic biodiversity X • Abundance, diversity and health of fish populations - Periodic studies (2010) • Sediment assessment in rivers and lakebed • Presence of exotic species needs clarification	Aquatic health assessment undertaken at appropriate intervals, eg, every 5 years	GLC DLWC	Report Cards - measure Chlor A and turbidity. There's also seagrass monitoring. This Action needs to be brought up to date.

Action No.	Action	Target and timing	Responsibility	Progress and Comments 2012
10.17	Develop and support a community and industry seagrass monitoring program including: • Trial closures to netting to assess long-term effects of haul netting on seagrass meadows • Seasonal community structure and distribution of seagrasses • Health of seagrasses (algal growth) • Annual monitoring of sentinel sites, • Seagrass Change Assessment Program especially data relating to the changing distribution of *Posidonia* • Impacts of Stormwater outlets on seagrasses • Remote sensing monitoring of seagrass	To commence by May 2001 To be conducted every four years and incorporated in the State of the Environment Reports Distribution maps to be completed by June 2002 Conduct remote sensing of seagrass meadows every 10 years	WLCMIC GLC Community Commercial Fishers NSW Fisheries DLWC	Combine w above Much of this is too vague, the issues are too complex, and the ideas are simply aspirational. Bob Creese and Tim Glasby (Fisheries) are doing Statewide monitoring programs. Fisheries also doing education around SG. DPI did aerial mapping in sth WL in 2010, F Keys '11. Should be done 5 yrly to monitor long-term change/ decline. But so many variables (seasonal, weather etc), it's v hard.
10.18	Monitor commercial and recreational fishing effort and catch	Include in GLC annual State of the Environment Reports	NSW Fisheries Fishing clubs GLC	Commercial ongoing through DPI (Fisheries) On-off recreational study in 2000, statewide survey being undertaken by DPI in 2013/14
10.19	Ensure all new houseboats contain greywater holding tanks and negotiate the phase out of houseboats (commercial and private) without greywater holding tanks	Immediate steps taken to ensure all new houseboats contain greywater holding tanks	GLC Waterways	Keep
10. 20	Raise community awareness and participation in estuarine biodiversity conservation and management including: • Threatened species and their habitat requirements - this point and 3rd - Marine Discovery Series/ Summer Coastcare -rockpool -seagrass -saltmarsh • Urban stormwater management • Protection of aquatic ecosystems • Seagrass awareness brochure - this should be revisited, one we have has done 2001, also Sponge brochure • Reducing boating impacts on seagrass - DPI/ Waterways • Sustainable fishing practices - DPI • Responsible pet ownership • Effluent disposal - Enviro health • Protection of foreshore and wetland vegetation to filter catchment runoff - field days. Coomba/ Palms wetlands. Sporadic, responds to funded projects	Funding for education officer to be sought Education program to be developed and implemented by December 2003	WLCMIC Community DLWC Councils LNCCMB Waterways NSW Fisheries Wallis Lake Fishermen's Coop GLC Fishing Clubs Education	"Engage people regarding urban stormwater quality"

APPENDIX B

Wallis Lake Navigation Dredging Program

1. About this Plan

1.1 Wallis Lake Estuary

Wallis Lake is a large sub-tropical Estuary situated on the New South Wales mid north coast covering an area of approximately 85 km^2. It is a large saline barrier lagoon system which is fed fresh water predominantly from the Wallingat, Coolongolook, and Wang Wauk Rivers.

The Lake is a large, relatively shallow coastal Estuary with an average depth of 1.8m, with a permanent opening to the north east, separating the twin towns of Forster and Tuncurry. A complex maze of islands, sandbanks and interconnecting channels has formed at the confluence of the rivers and the entrance channel. The ocean inlet to the Estuary is constrained by rock walls and breakwaters on both the northern (Tuncurry) and southern (Forster) sides of the channel.

The Estuary is prone to shoaling by marine sand which can seriously affect navigation and impact Estuary related industries (aquaculture and fisheries), tourism and recreation[7].

1.1.1 Hydrodynamics and morphology

Prior to breakwater construction, the inlet to Wallis Lake was choked with sand transported by littoral drift. The southern (Forster) breakwater was constructed in 1898. While improving the tidal conveyance, entrance navigability was often compromised and, in 1966, the southern breakwater was extended some 90m and the 460m northern (Tuncurry) breakwater was constructed.

Training of the entrance increased the hydraulic efficiency of the Estuary to tidal flows. It is likely that this in turn resulted in a significant increase in the scouring of the lower Estuary. Evidence of this comes from a lakeward progradation of the marine delta drop-overs. It is also likely that marine sand deposits in the lower Estuary were transported out of the Estuary via the ocean inlet. Littoral drift is likely to have moved sediments–supplied to the coastal compartment by the Estuary–north onto Nine Mile Beach.

Analysis of hydrographic surveys of the lower Wallis Lake Estuary has identified recent changes in the morphology of the Estuary:

- The most noticeable changes appear to be significant sediment accumulation in the entrance area of the Estuary and the scouring of the navigation channel in the entrance area. It is also observed that the Middle Ground and the Point Road Channel shoals have grown considerably over the 12 year period
- Other notable changes include the scouring and deepening of the Estuary inlet between the training walls, and evidence of infilling in the navigation channel along the Tuncurry foreshores. Deposition of sediment on the lee slope (ocean side) of the entrance bar can also be observed[8]

Further upstream of the entrance, significant sediment accumulation at 'The Step' was observed.

1.2 Development of the Plan

This Plan details the key sites identified for future maintenance dredging for (primarily) navigation purposes (Figure 1. page 149).

These sites have been identified through key research reports:

- Wallis Lake: Dredging and Disposal Options Assessment (2011) by WorleyParsons
- Coastal Process Report: Hydrodynamic and Sediment Transport Assessment of Wallis Lake Dredging (Preliminary Draft) (2011) by WorleyParsons
- Wallis Lake Dredging Assessment (2011) by SMEC

Under SEPP (Infrastructure) 2007, Great Lakes Council, in partnership with the Land and Property Management Authority (the proponent and determining authorities), has an obligation under Part V of the Environmental Planning and Assessment Act 1979 (EP&A Act 1979), to consider the likely environmental impacts of the proposed maintenance dredging and dredge spoil emplacement activities and to consider the appropriate level of environmental assessment that is required.

7 WorleyParsons (2011) Wallis Lake: Dredging & Disposal Options Assessment, Great Lakes Council, New South Wales.

8 Adapted from WorleyParsons (2011) Coastal Process Report: Hydrodynamic and Sediment Transport Assessment of Wallis Lake Dredging. Further detailed information on hydrodynamics and morphology of Wallis Lake can be found within this report

In this context, Reviews of Environmental Factors (REFs) have been developed for proposed dredging projects in order to provide sufficient information on all matters arising from the proposed activity which affect, or are likely to affect, the environment. These REFs allow Council to determine whether a more detailed environment assessment is required (ie. if the REF reveals that the proposal is likely to have a significant impact on the environment then an Environmental Impact Statement (EIS) will be required in support of the proposal) or whether the project can proceed.

This report also includes summarised information from the following REFs:

Review of Environmental Factors	Year	Project status
Proposed maintenance dredging of Tuncurry Channel, Wallis Lake	2013	Project completed January 2013
Proposed dredging of Mather Island East Channel, Godwin Island Channel and oyster leases in 'The Paddock', Wallis Lake	2012	Project completed November 2012
Proposed maintenance dredging of Breckenridge Channel and the Jonnel Cove navigation channel	2011	Project completed July 2011
Proposed dredging of 'The Step', Wallis Lake	2011	Proposed
Proposed maintenance dredging of Tuncurry Channel, Wallis Lake	2010	Project completed June 2010
Proposed maintenance dredging of the entrance of Pipers Bay, Pipers Channel, Wallis Lake	2010	Project completed May 2010

1.3 Identifying priority sites for maintenance dredging

Potential sites for maintenance dredging within Wallis Lake have been identified in the reports mentioned in Section 1.2. Selection and prioritisation of these sites has been based on an assessment of:

- Community benefit test: Who and how many users use the channel
- Hydrodynamic assessment of options:
- Changes to shoaling patterns (the Wallis Lake flood tide delta is very dynamic)
- Changes to hydrodynamics and tidal regimes
- Channel longevity and subsequent frequency of maintenance dredging required
- Channel configuration and detailed design
- Environmental sensitivity: sediment type; impacts on oyster industry, fishery and habitats (including seagrass) and off-site impacts
- Availability of suitable deposition sites
- Cost (pumping distance, soil management, frequency)

Significant community consultation has been undertaken during the development of the hydrodynamic and dredging assessment studies of Wallis Lake as well as Council's formal community consultation processes associated with undertaking large-scale dredging projects. Recreational users and industry (tourism operators, oyster industry) have been and continue to be engaged throughout the ongoing process of assessing and undertaking proposed dredging activities in Wallis Lake.

Through the process outlined above, the following priority dredging sites have been identified for ongoing maintenance dredging (Figure 1):

1. Tuncurry Channel, Point Rd
2. Breckenridge Channel
3. Jonnel Cove/Point Rd Channel
4. Mather Island East Channel (incl. Godwin Island Channel and The Paddock)
5. Miles Island West Channel
6. Pipers Creek/Pipers Bay Channel
7. Wyuna Drainage Reserve/Canal
8. The Step Channel

The following sites have also been identified for maintenance dredging, but are of a lower priority due to channel longevity or high cost of removing dredging spoil:

- The Western Step Channel
- The Wang Wauk (Boomers) Channel

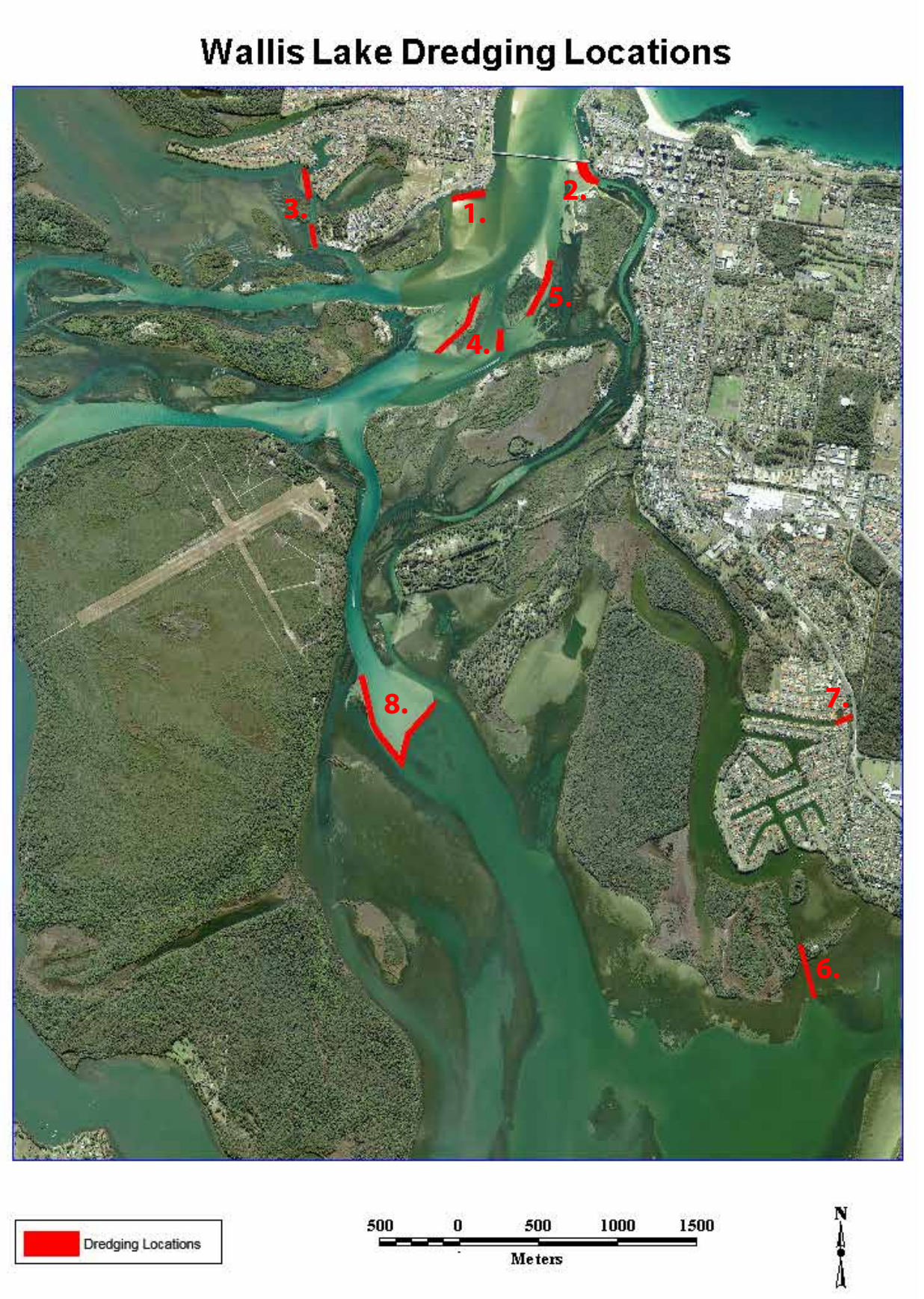


Figure 1. Priority dredging sites in Wallis Lake

1.4 Summary of recent and proposed dredging sites

The table below details the dredging projects that have been undertaken in the last 10 years as well as those proposed sites which haven't been dredged recently. Outcomes and lessons from these projects have been incorporated into this program for future dredging proposals.

Location	Design depth (m AHD)	Width (m)	Length (m)	Date dredged	Infill rate	Duration (years)	Monitoring survey
Tuncurry Channel	-2.5	20	200	Jan 2013 Jun 2010	Rapid	3-5	Nov-12
Mather Island East Channel, Godwin Island and The Paddock	-2.5	20	450	Nov 2012	Med	7	
Jonnel Cove/Point Rd Channel	-2	25	160	Sep 2011	Slow	7-10	
Breckenridge Channel	-2.2	30	60	May 2011	Rapid	5	
Pipers Creek/Pipers Bay Channel	-1.7	15	180	May 2010	Slow	15	Jul-11
Wyuna Drainage Reserve/Canal	-1.3		50	1998	Slow	16	
Miles Island West Channel	-2.0		1140	na	Med	7	
The Step Channel	-2.5	30	700	na	Rapid	5	
The Western Step Channel	-2.5	30	1270	na	Slow	16-20	
The Wang Wauk (Boomers) Channel	-2.5	30	600	na	Rapid	1	

Deposition site	Notes
Temporary deposition at Fazio Park	Not a great site, but critical due to high use. Sand needs to be trucked away. High maintenance site.
Tern Island	Recreation boating, fishing, oyster lease access.
Temporary deposition on Ohmas Reserve (Point Rd)	Mostly small craft, some larger. Not done for 20 years prior to 2011. Having some erosive impact on oyster lease due to increased velocity.
Miles Island sand spit	Very busy, but critical due to high use. Small craft use only. Provides beach for recreation.
Temporary deposition at Forster Keys Foreshore, Victor Avenue	Small craft only, narrow but long site. Slow infill of <200m^3/yr. Trucked away, costly $24 per metre^3
Temporary use of public land upstream of Lakes Way	Subject to infill from Catchment erosion.
Tuncurry Beach or Tern Island	On flood tide delta, very mobile/dynamic, recreational boat and oyster industry access. Suffers silting and shallowing. Gets pinched off.
Limited options. Will need private deposition sites (one-off sites only)	Not high priority, partly self-maintaining. Recreation boat and cruise boat route. Delta growing into lake and causing loss of seagrass.
Will need to transport upstream	Remote site, long, high cost to dredge and remove sand. Improve navigation to Coolongolook River.
	Unviable. Very dynamic, hence rapid infill.

2. Priority sites for maintenance dredging

2.1 Tuncurry Channel, Point Rd

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Tuncurry Channel, Point Rd	-2.5	20	200	3-5	Jan 2013	5,840

Tuncurry Channel is located opposite the Tuncurry boat ramp in Wallis Lake (Figure 2, page 153). Point Rd boat ramp in Tuncurry is one of the busiest ramps on the east coast (NSW Roads and Maritime Services report that this is in the top 5% of ramps in term of volumes of boats being launched). The useability of the facility is jeopardised by sand deposition within the Tuncurry Channel adjacent to the Point Rd boat ramp. Historically there has been a need to dredge Tuncurry Channel periodically to maintain navigation:

In 2010, a total of 17,800m^3 of sand was dredged from the channel to maintain safe navigation (-2.2m AHD).

A hydrodynamic survey was completed in November 2012 following concerns that the channel had significantly narrowed and shallowed. The hydrodynamic survey indicated that the channel had substantially refilled in volume with 14,200m^3 deposited since June 2010. Dredging was subsequently undertaken in January 2013, approximately 200 metres downstream from the boat ramp to the entrance of Tuncurry Channel from Wallis Lake to a depth of -2.5m AHD.

Fazio Park temporary deposition site is typically used for this site (2010 & 2013). Sand was also taken to Tern Island in 2013. Tern Island is now full.

Tern Island has been used historically as a disposal site for dredge spoil, with the elevated nature of the island (areas above mean sea level) as it is today being created from dredge spoil deposition from oyster leases and public channel. Tern Island had previously been identified as a suitable site for a renewable sand depot, with the aim of minimising any further degradation of the existing deposition sites and Wallis Lake in general.

A post-dredge hydrographic survey was undertaken in 2013 and is available in Appendix 1.

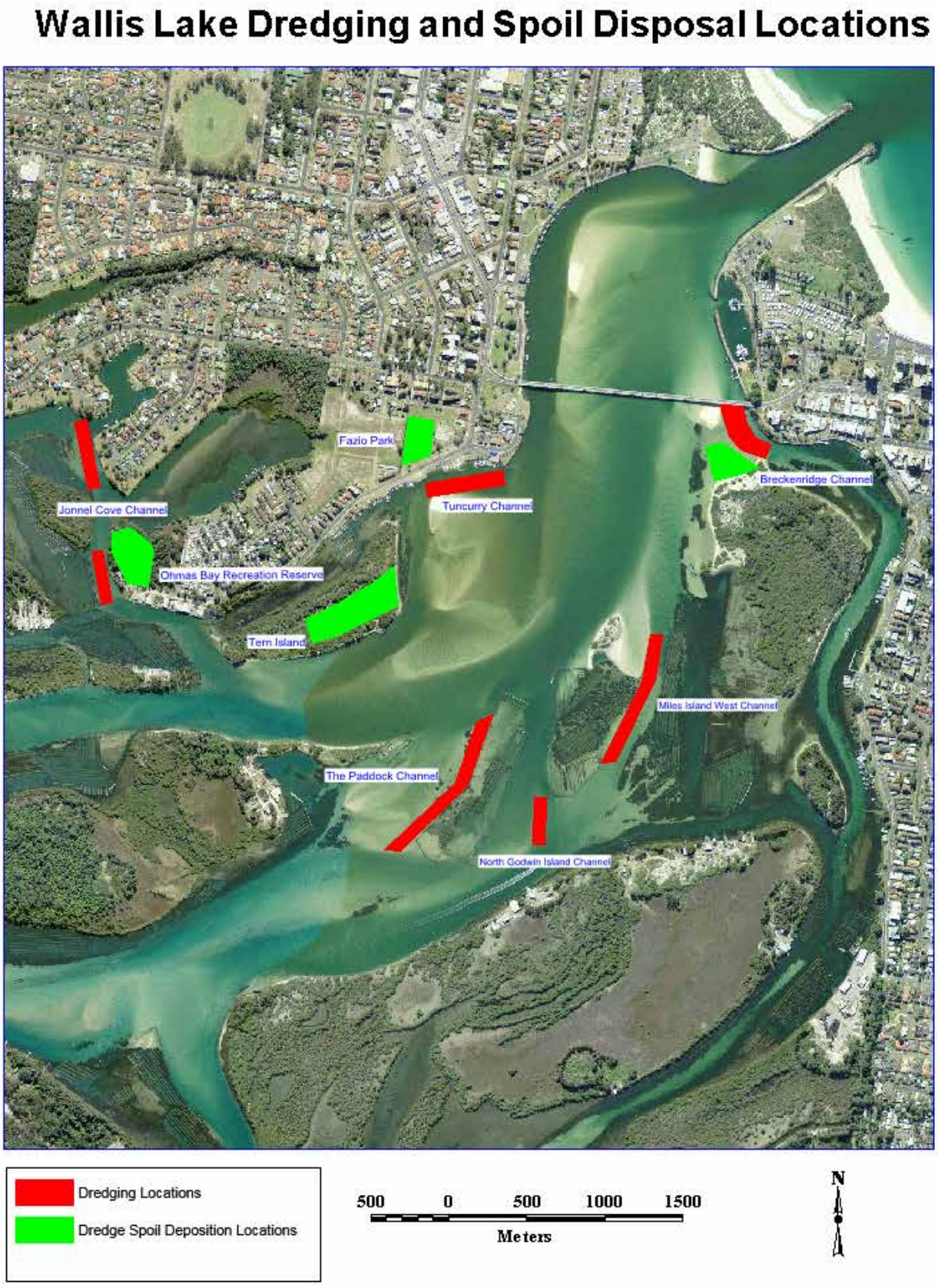


Figure 2. Wallis Lake (Northern Section) dredging and deposition sites

2.2 Breckenridge Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Breckenridge Channel	-2.2	30	60	5	Jul 2011	4,300

Breckenridge Channel is one of the busiest navigation channels within Wallis Lake and provides access to the popular 'Forster Sand Spit' which accommodates large numbers of visitors over peak tourism periods. Shoaling has occurred at the northern end of the channel to the south of the Forster/Tuncurry Bridge. The sand shoal is restricting navigation through the channel and is contributing to the erosion of the northern foreshore of Miles Island (Figure 2, page 153).

Since 1971 Breckenridge Channel is recorded as having been dredged four times with total sand extraction being approximately 25,000m^3 for the purpose of maintaining safe navigation. This site was most recently dredged in 2011.

In June 2011 an area approximately 60m long and 30m wide was dredged to a depth of -2.2m AHD to allow for continued safe navigation through the channel. Dredging spoil was transferred and deposited to the northern side of Miles Island for the purpose of foreshore renourishment and establishment of a popular beach.

The pre-dredge hydrographic survey undertaken during this process is included in Appendix 1.

2.3 Jonnel Cove/Point Rd Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Jonnel Cove/Point Rd Channel	-2	25	160	7-10	Jun 2011	8,000

Jonnel Cove/Point Rd Channel provides access from Jonnel Cove to Wallis Lake for approximately 30 canal properties, many of which have private moorings. The channel also provides a popular and direct route for vessels travelling from Ohmas Bay to the Wallamba Broadwater and Wallamba Cove (Muddy Creek) (Figure 2, page 153). Jonnel Cove Channel and Jonnel Cove itself (an artificial canal) were created sometime around 1975.

In 2011 dredging was undertaken to mitigate against shoaling which was occurring within the channel, restricting navigation through the channel and obstructing access to Ohmas Bay. An area 160m long and 25m wide was dredged to a depth of -2.2m ADH to allow for safe navigation from Jonnel Cove to Wallis Island. Dredging spoil was temporarily stored at Ohmas Bay Recreation Reserve and the adjoining Ohmas Bay and Wallis Lake Foreshore prior to haulage away to its final destination.

The hydrographic survey undertaken in support of this dredging program is included in Appendix 1.

2.4 Mather Island East Channel (including Godwin Island Channel and The Paddock)

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Mather Island East Channel	-2.5	20	450	7	Nov 2012	21,000 (incl Godwin)
Godwin Island Channel	-2.5	20	50	7	Nov 2012	
The Paddock Channel	<-2	20	50	7	Nov 2012	6,000

Mather Island East channel is a public channel within Wallis Lake which provides access between Tern Island and Godwin Island Channels and also to the southern side of Mather Island and nearby Wallis Island.The channel also provides tidal flow and access to oyster leases. This section of Wallis Lake is known as 'The Paddock' and is a popular fishing and recreational area particularly during the summer months (Figure 2, page 153). Previous hydrographic surveys indicate that scouring is occurring at the northern end of the channel, while sand shoaling has taken place along the remaining stretch of the channel extending south to the navigation channel north of Godwin Island. Shoaling is restricting the natural tidal flows through the channel and heavily impacting on navigation and the function and productivity of the adjoining oyster leases.

2.4.1 Godwin Island Channel

The navigational channel north of Godwin Island is a popular channel which provides access between The Paddock oyster leases (from the main Wallis Lake Channel to Godwin Island), Wallis Island and numerous other islands and enclosed water in the southern sections of Wallis Lake. This channel also links up with Breckenridge Channel to the east and is utilised regularly by commercial boat operators. In 2012, sand shoaling at the southern end of the channel was restricting safe navigation as well as reducing tidal flows which was having a detrimental impact on the adjoining oyster leases.

In November 2012 dredging was carried out in Mather Island East Channel and Godwin Island Channel and sand was transported to a temporary deposition site at Fazio Park, Tuncurry, prior to haulage off site.

The dredging removed 21,200m^3 of marine sand from the channel at a width of 20m and a depth of -2.5m AHD in order to allow natural tidal flows back into the oyster leases and to reinstate safe navigation of the channel for commercial and recreational users.

2.4.2 Paddock Channel

Oyster leases are largely dependent on a stable mean water level that varies with tidal cycles. Leases are set at levels sufficient to allow for periodic inundation and drying conditions to be achieved in order to provide optimum growth conditions.

Historic sand build up in this area can therefore impact heavily on the existing oyster leases within the western section of The Paddock, and in 2012 a number of these leases were completely filled with sand, rendering them unsuitable for oyster production. In 2012 dredging was undertaken of sand built up within five oyster leases within The Paddock with the objective of restoring tidal flows and reinstating productivity to the affected oyster leases (paid for by industry with State Government assistance).

A public channel through the centre of The Paddock was also maintained.

A post-dredge hydrographic survey was undertaken of the area in 2013 and is included in Appendix 1.

2.5 Miles Island West Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Miles Island West channel	-2.5	20	19400	7	na	15,000

Miles Island West Channel provides recreational and oyster industry boat access to and from the main channel (Figure 2, page 153).

This Channel is on the flood tide delta, and is thus very mobile/dynamic. The channel suffers silting and shallowing as well as getting pinched off.

A proposed deposition site for dredging of this channel would be Tuncurry Beach, a portion on Miles Island and potentially Little Tern Island.

2.6 Pipers Creek/Pipers Bay Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Pipers Creek/Pipers Bay Channel	-1.7	15	180	15	May 2010	4,504

Pipers Creek Channel (hereafter referred to as 'Pipers Channel') is the only navigation channel from the urbanised Forster Keys area to the Wallis Lake body and its entrance. Forster Keys has a public boat ramp and is an important access point for public recreational boating to the Wallis Lake waterway. Furthermore, there are approximately 350 residences at Forster Keys with direct canal frontage, many of which have private jetties and boat ramps and utilise Pipers Channel for access to the Lake (Figure 3, page 157).

Maintaining safe boating access and navigation within the Pipers Channel is considered vital and has considerable community benefits. This is the fundamental objective of past and proposed dredging.

From available records, Pipers Channel was dredged in the late 1960s/early 1970s. This dredging work cut an artificial channel to allow boat access to and from Pipers Creek into Wallis Lake. In recent years, local hydrodynamics have resulted in the channel slowly shallowing and infilling. Reports from NSW Maritime have indicated the slow shallowing of the channel has resulted in craft, particularly larger craft, running aground during low tides.

In May 2010 the site was dredged and spoil was temporarily deposited onto Forster Keys Foreshore Reserve. The material was then removed and utilised as fill for a nearby sports field.

The maintenance dredging was limited to the shoaling sand bank located at the entrance of the Pipers Channel, and extended 180m along the sand bank to a design depth of -1.7AHD. This channel is for small craft only, and is therefore a narrow, but long site. It also has a slow rate of infill <200m^3/year.

A pre-dredge hydrographic survey of Pipers Creek was undertaken in 2010 and is included Appendix 1.

* Dunns Creek (Boomerang Cove) at the end of Tea Tree Road, a channel into Pipers Bay, has been privately dredged and 2000m^3 were taken out in 2013. Prior to this it was last dredged in the late 1990s.

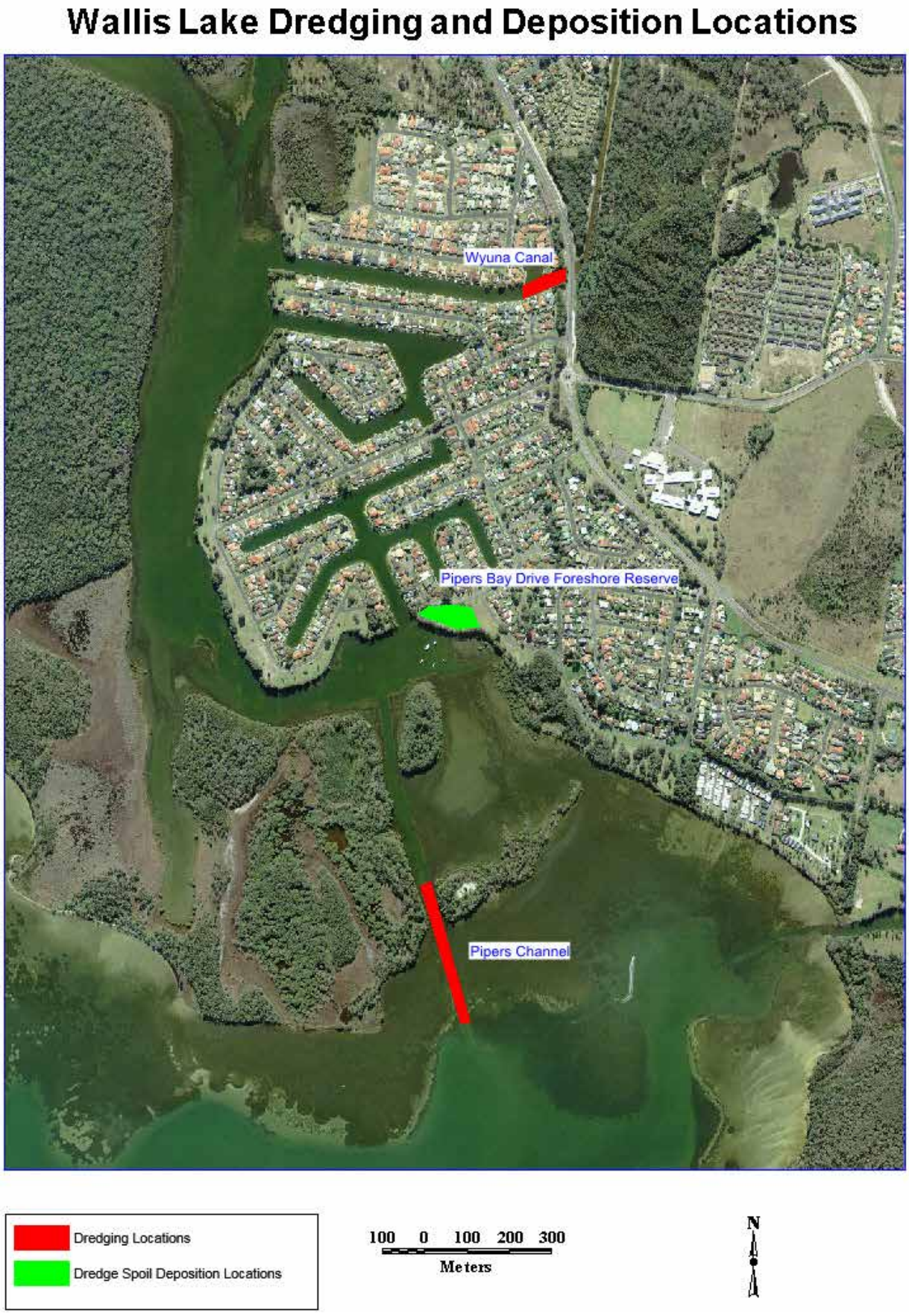


Figure 3. Wallis Lake (Southern Section) dredging and deposition sites

2.7 Wyuna Drainage Reserve/Canal

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
Wyuna Drainage Reserve/Canal	-1.3	width of canal	50	15	1998	1000

Wyuna Canal is used for small craft access from a limited number of local residents off Kenrose Street in Forster (Figure 3, page 157).

The canal is subject to infill from Catchment erosion and was last dredged in 1998. A hydrographic survey of the drainage reserve and adjacent harbour shore waterway in 2012 (Appendix 1) confirmed that siltation rates in the canal are not rapid, with infill only now returning to the same levels as before dredging in 1998.

It is a very difficult site to dredge due to the type of material to be removed and the limited space for deposition and treatment.

At time of writing, dredging is proposed for this site in the second half of 2014, pending availability of dredge operators and securing all necessary approvals.

2.8 The Step Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
The Step Channel	-2.5	30	700	5	na	29,000

The Step Channel is a large actively migrating sand shoal which is located on the eastern side of Wallis Island (between Wallis and Tonys Point Islands). The sand shoal is migrating in a southerly direction (i.e. upstream) by approximately 5m/year (Figure 4, page 159).

The navigation channel associated with The Step provides the main (and most direct) access from the Estuary entrance and boat ramps around Forster/Tuncurry for recreational and commercial vessels travelling to and from Forster Keys, Green Point and the southern sections of Wallis Lake. It is also part of the route used by the 'Free Spirit' for commercial cruises. The ongoing movement of the sand shoal has compromised navigation through this area. The maintenance of safe vessel access and navigation through The Step is considered necessary and will have benefits for both recreational and commercial users of the Lake (eg. tourist /sightseeing boats, commercial fishing and oyster farming) users of the Lake.

The southerly movement of The Step threatens to directly bury/smother the dense and extensive seagrass beds which occur on the eastern side of Wallis Island and fringe the sand shoal. The seagrass beds which are located directly upstream of the sand shoal consist mainly of the species *Posidonia australis* (strapweed), with *Zostera capricorni* (eelgrass / ribbonweed) occurring further upstream and scattered through the *P. australis* beds. There is also the potential for the sand shoal to threaten the *Posidonia* and *Zostera* beds occurring to the south and east of Hadleys Island.

Dredging of The Step is proposed along the western side of the sand shoal which is where the natural channel forms. It is proposed that the channel be dredged to a depth of -2.5m ADH, with a width of 30m. A dredge length of 700m is proposed, totalling a dredging area of 20,900m^2 and a volume of 15,000m^3.

Dredging will also involve removal of a 20-20m strip of sand from the encroaching face of The Step to reduce the impact on seagrass beds through channel migration.

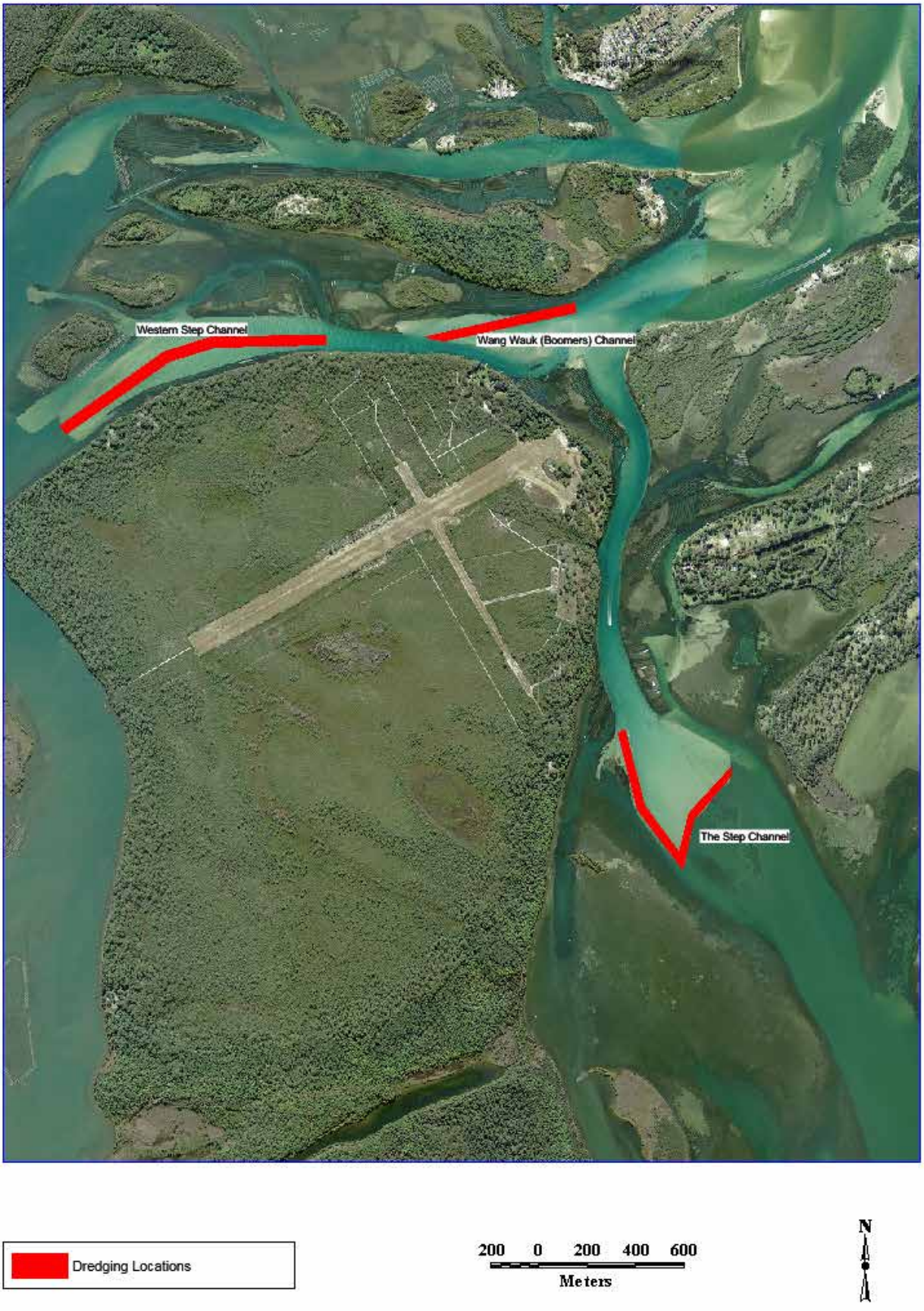


Figure 4. Wallis Lake (Western Section) dredging sites

2.9 The Western Step Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
The Western Step Channel	-2.5	30	1270	16-20	na	30,000

The Western Step Channel is located on the north western corner of Wallis Island and allows access to the Coolongolook River and western side of Wallis Lake. The channel has a current depth of -1m AHD, which limits its use.

While dredging of the navigation channel at The Western Step is considered a feasible option to improve navigation to the Coolongolook River area and the western side of Wallis Lake, some impacts are expected on tidal flows with a significant increase in the tidal prism upstream as a result of the channel deepening.

Dredging area and length is quite long (1.2 km) and therefore removal of a large amount of sediment would be expected, making this a costly option. As this is a remote site, it is also expected that there would be significant costs associated with transporting and deposition of dredging spoil. Expected refilling rates of a dredged channel are quite low, resulting in potentially a long maintenance duration of 20 years.

Alternate access routes to the Coolongolook River (and Western portions of the Lake) do however exist.

2.10 The Wang Wauk (Boomers) Channel

	Design depth (m AHD)	Width (m)	Length (m)	Duration (years)	Last dredged	Volume last dredged (m^3)
The Wang Wauk (Boomers) Channel	-2.5	30	600	1	na	7,000

The Wang Wauk (Boomers) Channel is located on the northern tip of Wallis Island and provides access to the western portions of Wallis Lake (as well as The Western Step). Currently the channel has a mean depth of -1m AHD.

Current speeds in this area are quite high (relative to other potential dredging sites) and thus tidal sediment transport is also very active. Channel infilling would therefore be estimated to occur rapidly following dredging (+/- 1 year) making dredging of this site unviable.

3. Deposition sites

Identifying appropriate deposition sites which are accessible from proposed dredging locations is one of the primary limiting factors to dredging activities in Wallis Lake. An overview of potential disposal sites from WorleyParsons (2011) is provided below.

Site	Estimated capacity (m^3)
Tern Island	Currently full
Shoal under Forster side of Bridge	10,000
South side of Mather Island	5,000
Tuncurry Beach dune/ swale	30,000
Tuncurry Beach	30,000+

3.1 Tern Island

Tern Island has been used historically as a disposal site for dredge spoil, with the elevated nature of the island (areas above mean sea level) as it is today being created from dredge spoil deposition. Tern Island had previously been identified as a suitable site for a renewable sand deposition site (REF completed in 2003), with the aim of minimising any further degradation of the existing deposition sites and Wallis Lake in general. This is still an option subject to approval, but may be best used as a temporary deposition site (up to 2 years).

Sand from Tern Island has been identified as being of value for fill sand for development and (if screened) for construction industry.

Tern Island was most recently used for deposition of sand from dredging of the Tuncurry Channel in 2013, as well as Mather Island East and for oyster leases. The site is currently at capacity, but there is potential to use it as a renewable deposition site, however, there are substantial planning and financial issues to overcome if this is to occur.

Little Tern Island may also be a potential deposition site for dredging of The Paddock. It is however a very dynamic site, liable to erode quickly and thus not a very reliable site.

3.2 Shoal under Forster side of bridge and Miles Island

This area is popular for swimming and wading, and deposition of sand in this area could enhance recreational amenity. However, deposition of sediment in this area could impact on adjacent seagrass meadows. If this option is considered, the potential for sand moving off the shoal into Breckenridge Channel will need to be assessed.

Sand was deposited here from maintenance dredging of the Breckenridge Channel in 2011.

Similarly, sand has also previously been deposited on the northern tip of Miles Island approaching this shoal.

3.3 South side of Mather Island Spit

The eastern tip of Mather Island was formed from dredged spoil to protect water quality within The Paddock from flows discharging from the Wallamba River.

Deposition of sediment in this area could provide protection against breakthrough of the narrow spit which prevents flood flows from the Wallamba River from directly impacting on The Paddock. Based on model outputs very low current speeds are experienced at this proposed site and it is therefore likely that disposed material would generally be stable. The site is however is constrained and can only hold small loads (5,000m^3).

There could be impacts on seagrasses in this area and the spit is classified as SEPP No.14 wetland.

3.4 Victor Avenue

Victor Avenue has previously been used as a temporary deposition site for dredging activities within Pipers Creek/Pipers Bay.

3.5 Ohmas Recreation Reserve, Point Rd

Ohmas Reserve has previously been used as a temporary deposition site for dredging activities within Jonnel Cove, Point Rd Channel.

3.6 Fazio Park, Point Rd Channel

Fazio Park has been used as a deposition site for previous dredging of the Tuncurry Channel, and could likely be used again for dredging of other sites near this location.

Like Ohmas Recreation Reserve, Fazio Park is however only a temporary site and as such additional costs will be associated with both transportation to and from the site, as well as the transaction costs associated with determining a final location for deposited sediment. Fazio Park also has a restricted volume due to space for deposition basin (max 15,000m^3).

3.7 Tuncurry Beach and dune

Tuncurry Beach has been identified by Council as a future (+/- 15 years) disposal site for marine sands dredged from Wallis Lake. Sand could either be pumped onto the active beach profile or into the dune system. It has also been suggested that sand could be pumped into the swale landward of the foredune to reduce its width (vegetation cover has not established as well or as quickly in this area as expected, because it does not receive the cooling breezes in summer. In addition the foredune is very narrow just to the north of the beach access way from the Rockpool carpark. Accordingly there is potential for a breakthrough in this location during a major ocean storm which could then flood the swale. Hence filling a section of the swale behind this area to increase the width of the foredune would be beneficial.

While Tuncurry Beach is not subject to long term recession due to sediment loss, shoreline recession is likely to occur on other beaches within the LGA as a result of sea level rise, and there may be scope/ demand for nourishment of other beaches from future dredging projects.

Potential for a pipeline to Tuncurry Beach from either the end of Point Rd or Boatland Marine has also been assessed and feasibility costs based on pipe supply, trench excavation and backfilling is provided below:

Location	Approx. pipe diameter (mm)	Estimated cost (+/50%)
Pipeline from Tuncurry Beach to Boatland Marine (1330m)	200	$330,000
	300	$530,000
Pipeline from Tuncurry Beach to the end of Point Rd (2210m)	200	$550,000
	300	$890,000

3.8 Sand for building and construction industry

Sand from dredging projects within Wallis Lake has previously been used for building and construction projects and there may be further scope for this in the future. Combining commercial use of dredged material with funding contributions from state government may help offset the total cost of dredging. Sale of dredged sand, and therefore, suitability of temporary deposition sites (such as Fazio Park) will be determined on an as-needs basis.

4. Monitoring

Follow-up hydrodynamic surveys will be undertaken for all dredging projects to verify infill rates against benchmarks. Dynamic sites with rapid infill rates that are dredged on a regular one-two year basis will incorporate follow-up surveys into development of REFs for subsequent dredging or within two years (whichever comes first). These sites include:

- Tuncurry Channel
- Breckenridge Channel
- Mather Island East

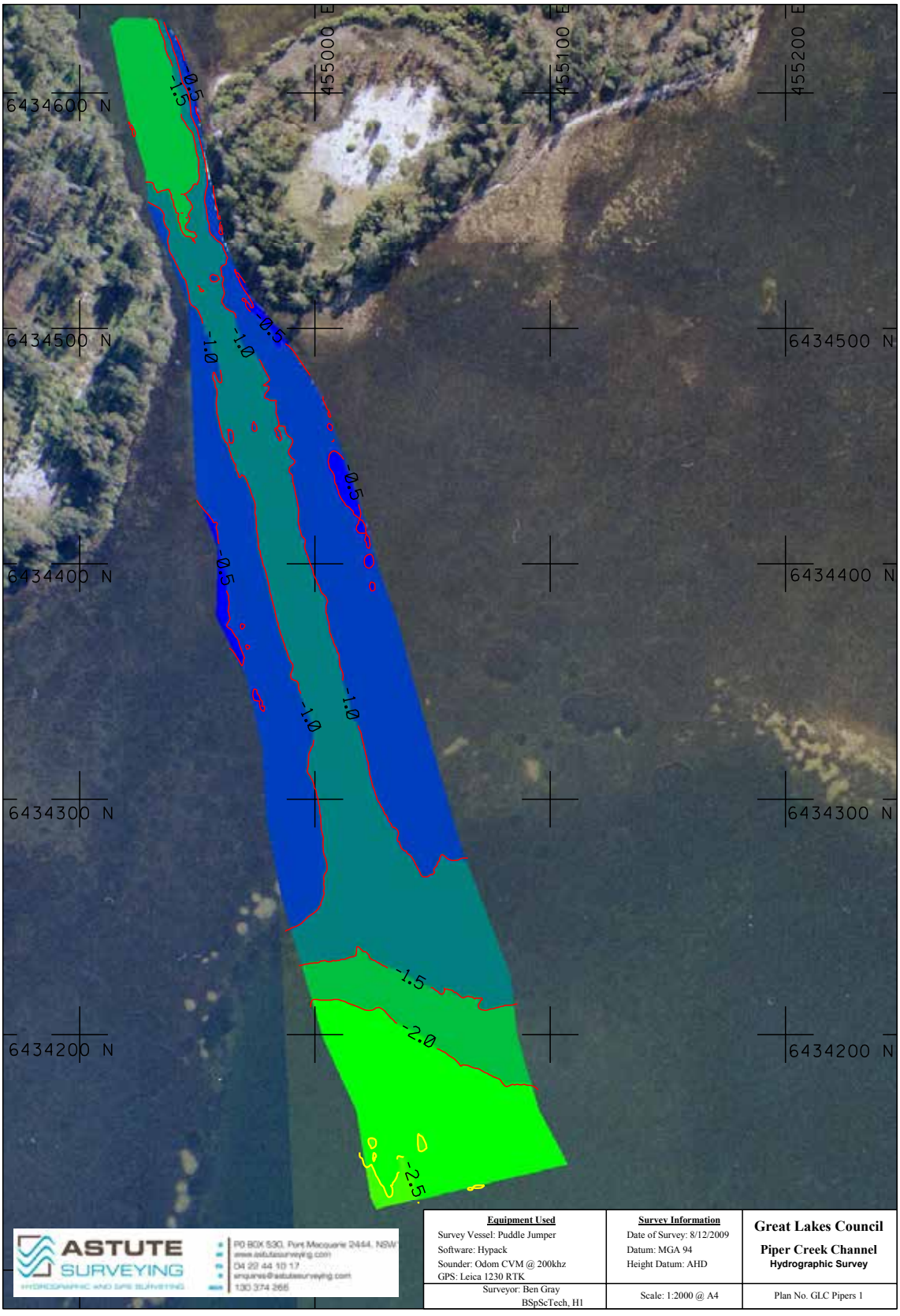
In 2015 another hydrodynamic survey will be undertaken to verify infill rates and benchmarks. Currently Pipers Creek, Wyuna Canal and Jonnel Channel are identified as slow infill sites.

A summary of recent and proposed monitoring surveys is included below:

	Monitoring survey
Pipers Creek/Canal	2011
Tuncurry Channel	2013
Wyuna Canal	2013
Breckenridge Channel	2015
Mather Island East incl. The Paddock	2013/2015
The Step	2015

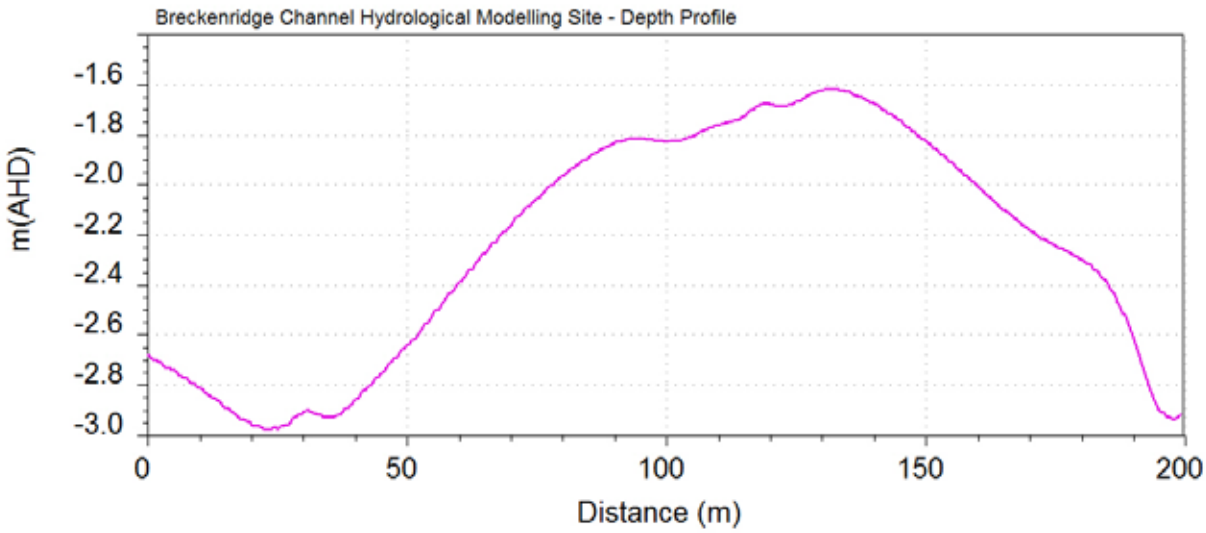
Appendix 1: Hydrographic Surveys

1. Pipers Canal Hydrographic Survey Pre-dredge 2011

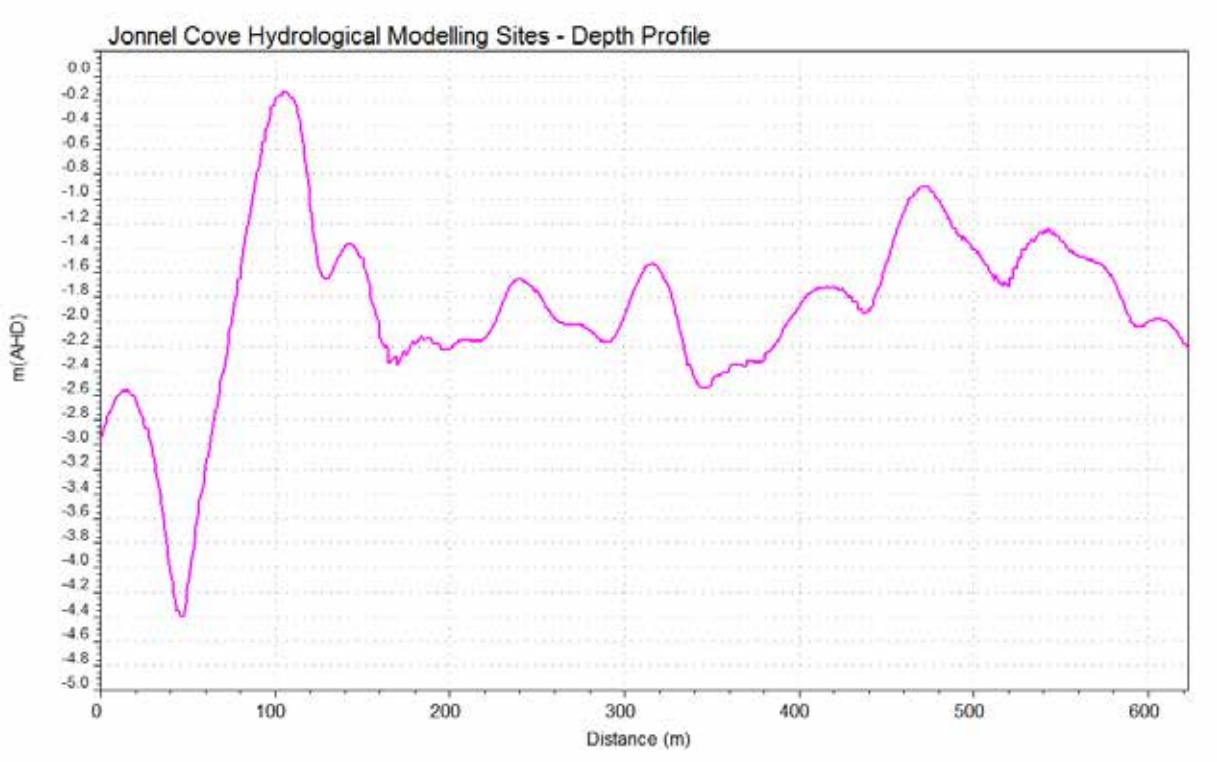


2. Breckenridge Depth Profile a. Pre-dredge 2011

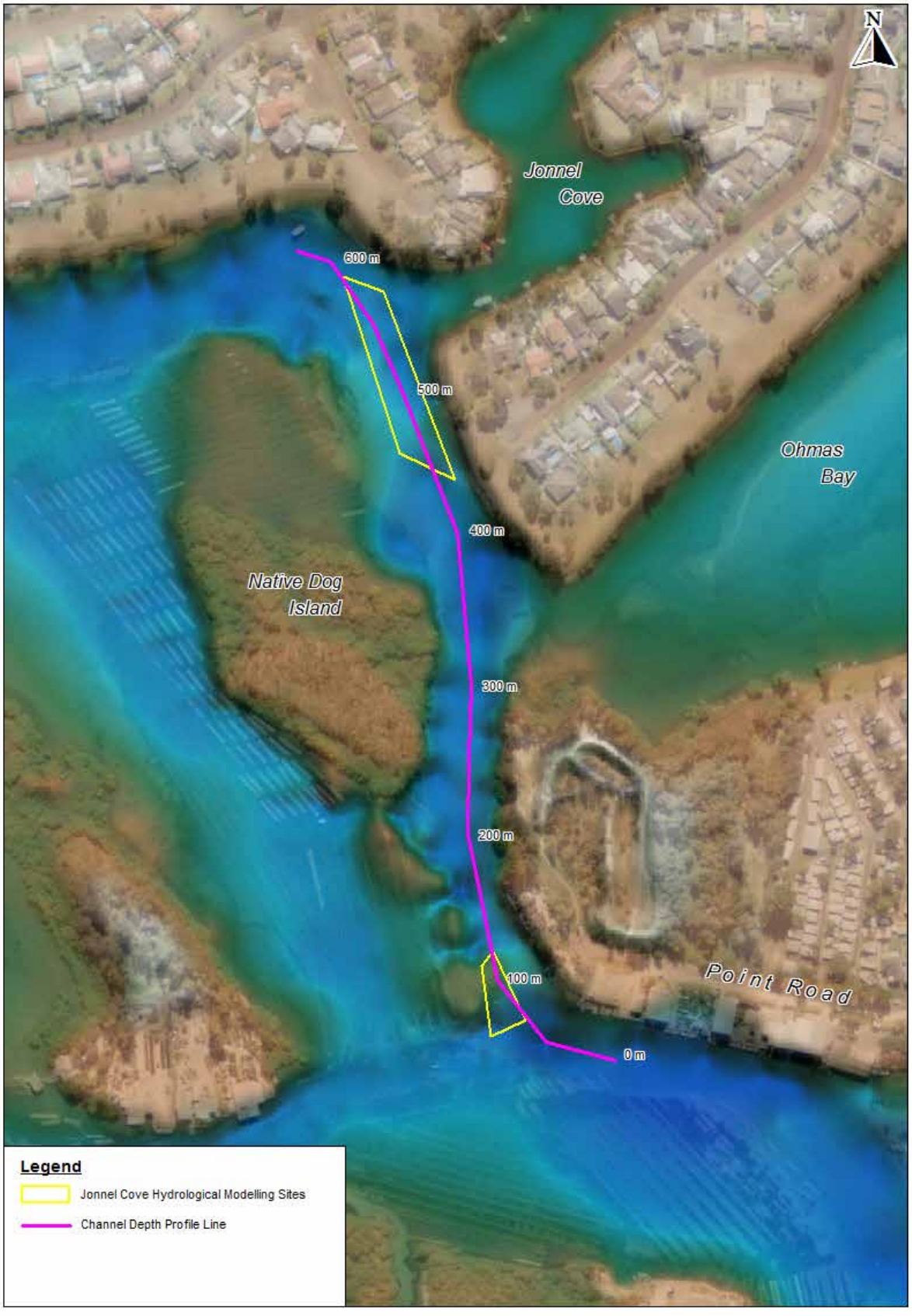
3. Breckenridge Depth Profile b. Pre-dredge 2011



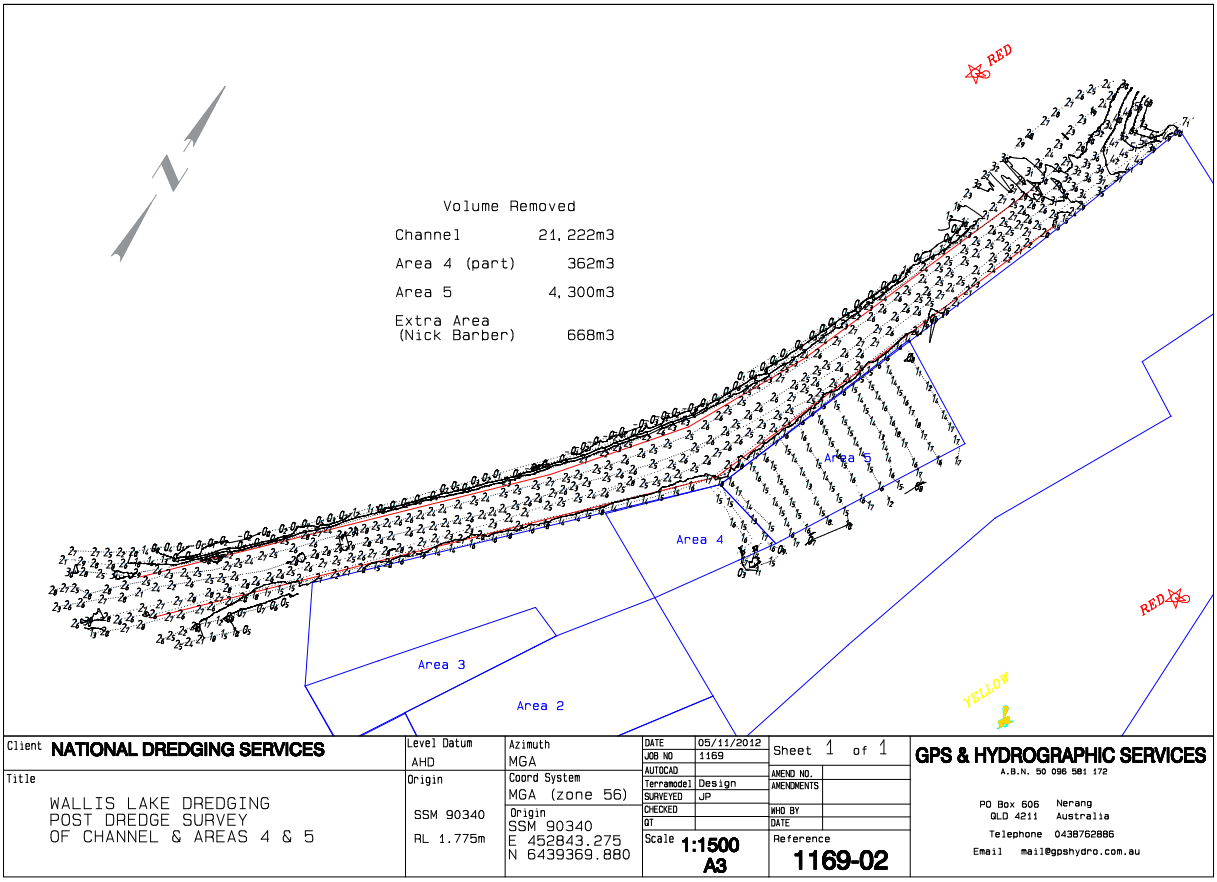
4. Jonnel Cove Depth Profile a. Pre-dredge 2011



5. Jonnel Cove Depth Profile b. Pre-dredge 2011

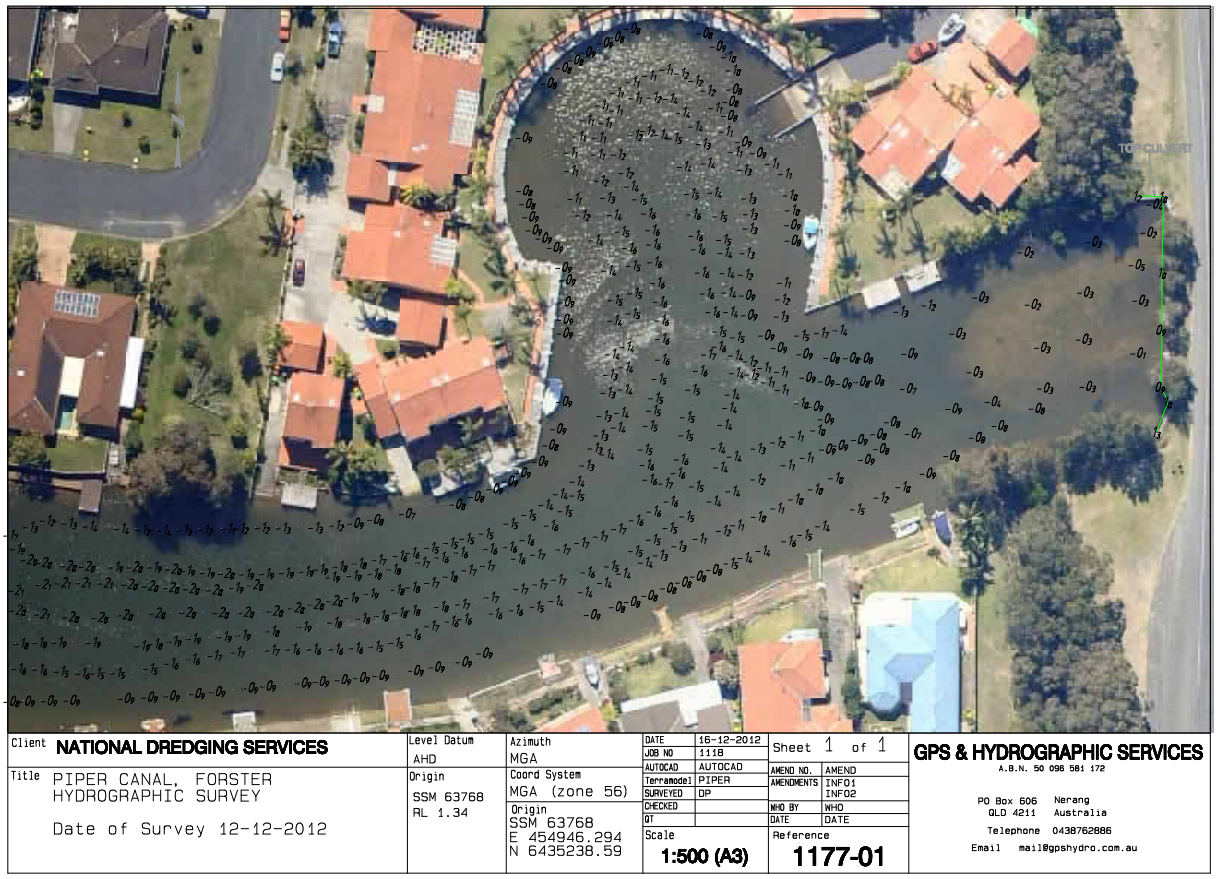


6. The Paddock Hydrographic Survey Post-dredge 2013



7. Tuncurry Channel Hydrographic Survey Post-dredge 2013

8. Wyuna Canal Pre-dredge 2013



Client **NATIONAL DREDGING SERVICES**	Level Datum AHD	Azimuth MGA	DATE 16-12-2012	Sheet 1 of 1	**GPS & HYDROGRAPHIC SERVICES** A.B.N. 50 096 581 172
Title PIPER CANAL, FORSTER HYDROGRAPHIC SURVEY Date of Survey 12-12-2012	Origin SSM 63768 RL 1.34	Coord System MGA (zone 56) Origin SSM 63768 E 454946.294 N 6435238.59	JOB NO 1118 AUTOCAD AUTOCAD Terramodel PIPER SURVEYED DP CHECKED QT Scale 1:500 (A3)	AMEND NO. AMEND AMENDMENTS INFO1 INFO2 WHO BY WHO DATE DATE Reference 1177-01	PO Box 606 Nerang QLD 4211 Australia Telephone 0438762886 Email mail@gpshydro.com.au

APPENDIX C

Related plans, documents and strategies

Agency	Title	Adopted
GLC	Wallis Lake Maintenance Plan for Dredging (Draft)	2014
	Great Lakes Local Environment Plan (LEP)	2014
	Great Lakes Development and Construction Plan (DCP)	2014
	Great Lakes Council Delivery Plan	2013-2017
	Tops to Lakes Initiative	2013
	Wallis Lake Foreshore (Floodplain) Risk Management Study and Plan	2012
	Great Lakes Recreation Boating Infrastructure Strategy	2012
	Great Lakes 2030 - Community Strategic Plan	2012
	Forster/Tuncurry Stormwater Management Plan	2012
	Wallis Lake Wetlands Strategy	2009
	Great Lakes Water Quality Improvement Plan	2009
	Great Lakes Rural Living Strategy	2009
	Forster Tuncurry Employment Lands Strategy	2009
	South Forster Structure Plan	2007
	Great Lakes Heritage Study	2007
	Housing Strategy for Forster Tuncurry	2006
	Wallis Lake Estuary Management Plan	2005
	Mid Wallamba River Rivercare Plan	2005
	Great Lakes Rural Living Strategy	2004
	Forster Tuncurry Conservation and Development Strategy	2004
	Darawahk Creek & Frogalla Swamp Wetland Management Plan	2004
	Wallis Lake Catchment Management Plan	2003
	Lower Wallamba River Rivercare Plan	2003
	Erosion and Sediment Control Policy	2002
	Plan of Management 7 - Coomba Reserves 5101	
	Plan of Management 6 - Coomba Aquatic Club	
	Plan of Management 4 - Tuncurry Foreshore	
	Plan of Management 3 - Coomba Foreshore	
	Plan of Management 2 - Natural Areas - Foreshores	
	Landscape Master Plan - Little Street Foreshore	

Agency	Title	Adopted
MNCWCC	MNCWCC Regional Weed Management System	2010-2015
GTCC	Environmental Action Plan	2013
	Hallidays Point Development and Conservation Strategy Review	2006
	Framework for Integrated Water Cycle Management	2005
	Greater Taree Urban Stormwater Management Plan	2000
MCW	Sustainable Water Cycle Management Strategy	2008
NPWS	Draft Plan of Management: Wallis Lake Nature Reserves	2013
	Regional Pest Management Strategy - Lower North Coast	2012-2017
	Wallingat National Park Plan of Management	2010
	Booti Booti State Recreation Area Plan of Management	1987
Hunter LLS	Hunter Central Rivers Catchment Action Plan	2013-2023
Crown Lands	Regional Reserves Strategy	2006
	Forster Tuncurry Crown Harbour Masterplan (Draft for comment)	2013
DPI (Fisheries)	Fisheries NSW Strategic Plan	2012-2015
	NSW Oyster Industry Sustainable Aquaculture Strategy	2006
	Fishery Management Strategy for the Estuary General Fishery	2003
RMS	Wallis Lake Boating Plan (Draft)	2014
Forestry	Weed Management Plan - Central Region	2006
	Ecologically Sustainable Forest Management Plan - Northern Region	2005
NoW	Water Sharing Plan: Lower North Coast Unregulated and Alluvial	2009
OEH	NSW Biosecurity Strategy	2013-2021
	Mid North Coast Regional Conservation Plan (Draft)	2011
	New South Wales Natural Resources Monitoring, Evaluation and Reporting Strategy	2010-2015
	NSW Biodiversity Strategy (Draft)	2010-2015
DP&E	Mid North Coast Regional Planning Strategy	2009

APPENDIX D

Agency responsibility

Agency	WQ.1 G/water	WQ.2 Rural	WQ.3 Foreshore	WQ.4 SEC	WQ.5 Urban
GLC	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6, 7
GTCC	5	1, 2, 6		1, 2, 3, 4, 5	1
Hunter LLS		1, 2, 6			
NPWS				1,	
MCW	1, 3	2			8
NoW	1, 3, 4				
DPI (Fisheries)					
RMS			1, 2, 3, 4		

Agency	CW.1 Comm and rec fishing + oysters	CW.2 Cultural and aesthetic	CW.3 Safe waterway usage
GLC	7, 5	1, 2, 4, 5	3, 4, 5
GTCC		1, 2	
Hunter LLS		1, 2	
NPWS		1, 2	5
Crown Lands	8	1	4, 5
DPI (Ag)			
DPI (Fisheries)	1, 2, 3, 4, 5, 6, 7, 8	3	
DPI (Fish) Research	5, 6		
Fishing Co-op	1, 2, 6		
RMS			1, 2, 3, 4
Oyster Industry	4, 7, 8		4
FLALC		1, 2, 3	

WQ.6 Septic	WQ.7 Gross-pollutants
1, 2, 3, 5	1, 2, 3, 4, 5, 6, 7, 8
3	1, 2, 4, 5, 7
	2, 5, 8
	6,8
4, 5	

Agency	EH.1 Biodiversity	EH.2 Native veg	EH.3 Envirol flows	EH.4 Invasive species
GLC	1, 2, 3, 4, 5, 6, 7, 8, 9	1, 3, 4, 5, 6, 7	1, 3, 4	1, 2, 3, 4, 5, 6, 7, 8
GTCC	2, 3, 4, 5, 6	1, 4, 6	1, 3	1, 2, 3, 4, 5, 6, 7, 8
Hunter LLS	3, 4, 5, 6	1, 2, 4	1, 3	1, 2, 3, 4, 5, 6, 7, 8
NPWS			4	2, 4, 5, 6, 7, 8
MCW				
OEH	2, 3, 4, 5, 6, 8	2, 6		4, 5, 8
DPI (Ag)			3	4, 5
NoW			2, 3	
DPI (Fisheries)			1	3
DPI (Fish) Research				
Forestry				4, 5, 7, 8
MNCWCC			4	1, 2, 3, 4, 6, 7
Fishing Co-op				3
Crown Lands				3, 4, 5
RMS				
Dept of Enviro (C'th)	4			
DP&E	9			

	EH.5 Riparian veg	EH.6 Aquatic veg	EH.7 Wetlands	EH.8 Climate change/sea level
	1, 2, 3, 4, 5, 6	1, 2, 4, 6, 7	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 5
	1, 2, 3, 4, 5, 6		5, 7	1, 2
	1, 3, 5, 6		1, 5, 6, 7	1, 2
			5	
		4		1, 2, 4, 5
		1, 2, 3		3
		1		3
	4	4		2
		3, 5		

APPENDIX E

Wallis Lake Estuary and Catchment Monitoring Program

Objectives	Key desired outcomes[6]	What ecological monitoring do we currently do that addresses these objectives?
	'What would we expect to see if management was working well?'	**'How *do* we know we're satisfying our objectives?'**
EH 1 Protect and restore biodiversity, particularly threatened species, populations and ecological communities	• Threatened species, populations and ecological communities are protected either on public or private land	• Plot based monitoring of native vegetation commenced in 2013. Initial two year monitoring of a previous project • Forster Local Squirrel Glider Study (2013)
EH 2 Maintain and improve areas of locally significant native vegetation as well as linkages between key habitat nodes	• Percentage of native vegetation cover within Catchment is increased • Threatened species, populations and ecological communities are protected either on either public or private land	• Plot based monitoring of native vegetation commenced in 2013. Initial two-year monitoring of a previous project
EH 3 Maintain, and improve where necessary, environmental flows and reduce the impact of barriers to fish passage	• Fish can freely migrate up and down stream • Natural flows are maintained, and not blocked by invasive weed species or human interventions	• Macrophytes, fishes and invertebrates of Wallis Lake (Glasby & van den Broek, 2010)
EH 4 Reduce the presence and impact of invasive species on terrestrial and aquatic environments	• The presence and occurrence of invasive species is halted, and reduced where possible, and their impacts mitigated • The presence of invasive vertebrate species is reduced, and their impacts mitigated	• Plot based monitoring of native vegetation commenced in 2013. Initial two-year monitoring of a previous project • Ongoing implementation of the MNCWCC Regional Weeds Management System and its supporting monitoring plan
EH 5 Maintain and improve riparian vegetation	• Riparian cover is maintained, and increased where possible	• AusRivas Report into primary rivers of Wallis Lake Catchment (1999, incorporated into GLC, 2003) • Wallamba River Erosion Survey (2002-08)

Management actions identified in Plan	Additional monitoring actions recommended (Monitoring Action Plan)
'How *will* we know we're satisfying our objectives?'	**'How *can* we know we're satisfying our objectives?'**
	• Regular aerial mapping (eg. five yearly) to measure longitudinal status of native vegetation (growth or decline) • Vegetation mapping as a substitute to direct surveying of threatened species (modelling) • Biodiversity surveys/census of Council managed reserves
• Collate and update a map of all public and private conservation lands in the Catchment (EH1.9) • Landscape Report Card (EH2.3) • Monitor native veg cover etc. (EH2.4) • Veg classification scheme + fine scale mapping (EH2.8) • Number of landholders participating in Land for Wildlife (EH2.6)	• Continue plot-based monitoring program
• Number of fishways installed/barriers removed (EH3.1)	• Investigate potential for spectral imaging to identify priority weeds and weed hotspots
	• Investigate potential for spectral imaging to identify priority weeds and weed hotspots • Continue plot-based monitoring program
• Riparian mapping (EH5.1) • Collate and update a map of all public and private conservation lands in the catchment (EH1.9) • Landscape Report Card (EH2.3) • Monitor native veg cover etc. (EH2.4) • Veg classification scheme + fine scale mapping (EH2.8)	• Undertake ten year mapping of foreshore veg, type, density, condition assessment • Repeat AusRivas study to investigate changes in upper catchment over a ten year period • Repeat Wallamba River Erosion Survey

Objectives	Key desired outcomes[6]	What ecological monitoring do we currently do that addresses these objectives?
EH 6 Monitor aquatic vegetation and promote the protection of seagrass	• Current health and extent of seagrass beds and sponges are maintained	• Sponge survey (Barnes, 2010) • Aerial monitoring of seagrass in Wallis Lake (DPI, 2013) • On ground research into epiphytic growth on seagrass (commenced 2013)
EH 7 Maintain and improve wetlands in the Catchment	• Wetlands are identified and protected where possible, and external threats to wetlands are minimised	
EH 8 Address the threats to local ecosystems arising from climate change and associated sea level rise	• Coastal and foreshore ecosystems have the capacity to adapt to climate change and sea level rise (eg. Through establishment of buffer zones)	• Condition assessment and Management considerations for Saltmarsh in Wallis Lake (Umwelt, 2012)
CW 1 Manage Recreational fishing, commercial fishing and oyster production for economic and ecological sustainability	• The Estuary is able to continue supporting viable fishing and aquaculture industries as well as recreational fishing opportunities	• Macrophytes, fishes and invertebrates of Wallis Lake (Glasby & van den Broek, 2010) • Annual Oyster Production reporting (DPI) • Annual fisheries catch (DPI)
CW 2 Protect cultural and aesthetic values of Wallis Lake and its Catchment	• The cultural and aesthetic aspects of Wallis Lake (and Catchment) that make the area special are maintained	• Great Lakes Community Research Report (GLC, 2012c)
CW 3 Facilitate safe and sustainable usage of the Wallis Lake Estuary	• Visitors and residents can continue to use the waterways for business and recreational purposes without fear of injury	• Great Lakes Community Research Report (GLC, 2012c)

Management actions identified in Plan	Additional monitoring actions recommended (Monitoring Action Plan)
• EH6.1 Seagrass Surveys	• Continue to implement an ongoing water quality monitoring program to support management actions and inform the community (eg. Report Card)
• Map wetlands (EH.1) • Collate and update a map of all public and private conservation lands in the Catchment (EH1.9) • Landscape Report Card (EH2.3) • Monitor native veg cover etc (EH2.4) • Veg classification scheme + fine scale mapping (EH2.8) • Riparian Mapping (EH5.1) • Pursue collaborations with researchers (EH7.8)	
• Monitor condition and extent of saltmarsh(EH8.3)	
• Monitoring of recreational catch (CW1.4)	
	• Investigate incorporation of additional community satisfaction questions relevant to implementation of the E&CMP into the GLC Community Research program
	• Investigate incorporation of additional community satisfaction questions relevant to implementation of the E&CMP into the GLC Community Research program Periodic hydrosurvey of priority navigation channels to determine maintenance trigger

Objectives	Key desired outcomes[6]	What ecological monitoring do we currently do that addresses these objectives?
WQ 1 Identify and reduce negative impacts on groundwater quality and quantity	• Groundwater quality and quantity is maintained at current levels	• Bore monitoring at Tuncurry and Minimbah landfills for potential groundwater contamination as per EPA licences • MCW undertakes a regular monitoring program with regard to the Minimbah aquifer, Tuncurry aquifer and Hallidays Point sewerage treatment plant
WQ 2 Reduce the impact of rural land use on water quality	• Rural landholders are aware of their potential impacts on water quality and manage their land and activities appropriately	• Development and distribution of a Catchment and Waterways Report Card (2011-)
WQ 3 Control and mitigate waterway use erosion of the foreshore and riparian zone	• Current state is maintained by protecting from future erosion • Landholders and waterway users modify activities to reduce incidents of erosion	• Development and distribution of a Catchment and Waterways Report Card (2011-) • Wallamba River Erosion Survey (2002-08)
WQ 4 Reduce the rates of soil erosion and sedimentation from unsealed roads, road construction and maintenance, and construction sites	• There is no net increase of sediment (and nutrient) loads in waterways	• Development and distribution of a Catchment and Waterways Report Card (2011-) • On ground research into epiphytic growth on seagrass (commenced 2013) • Compliance and monitoring activities are incorporated into GLC's Erosion and Sediment Control EMS
WQ 5 Reduce sediment, acid sulfate soils, chemicals and nutrient loads to waterways from urban areas	• There is no net increase in sediment, acidity, chemical and nutrient loads in waterways	• Development and distribution of a Catchment and Waterways Report Card (2011-) • Aerial monitoring of seagrass in Wallis Lake (DPI, 2013) • On ground research into epiphytic growth on seagrass (commenced 2013)

Management actions identified in Plan	Additional monitoring actions recommended (Monitoring Action Plan)
• Map groundwater ecosystems (WQ1.3)	• Assess groundwater quality discharge to Duck Swamp
	• Continue to implement an ongoing water quality monitoring program to support management actions and inform the community (eg. Report Card) • Repeat AusRivas study to investigate changes in upper Catchment over a ten year period
	• Repeat AusRivas study to investigate changes in upper Catchment over a ten year period • Repeat Wallamba River Erosion Survey • Continue to implement an ongoing water quality monitoring program to support management actions and inform the community (eg. Report Card)
	• Repeat AusRivas study to investigate changes in upper Catchment over a ten year period • Continue to implement an ongoing water quality monitoring program to support management actions and inform the community (eg. Report Card)
	• Continue to implement an ongoing water quality monitoring program to support management actions and inform the community (eg. Report Card) • Periodic audit of Council Sediment & Erosion EMS implementation and Sediment & Erosion Policy

Objectives	Key desired outcomes[6]	What ecological monitoring do we currently do that addresses these objectives?
WQ6 Reduce the risk of septic waste entering the Wallis Lake Estuary	• There are no incidents of septic waste entering waterways • The *risk* of septic waste entering waterways is managed and reduced	• Implementation of Onsite Sewerage Management System and Onsite Sewerage Assessment Framework • Reporting of pollution events
WQ7 Reduce the impacts of gross pollutants entering waterways	• No gross pollutants or debris is seen floating in waterways or Catchment • No occurrences of native species death attributed to gross pollutants	• Data from periodic litter collection activities is included in the national marine database

9 Adapted from Jones, G (2009) The adaptive management system for the Tasmanian wilderness world heritage area - linking management planning with effectiveness evaluation in All, C. and Stankey, G. (eds) Adaptive Environmental Management, Dordrecht, Springer.

Management actions identified in Plan	Additional monitoring actions recommended (Monitoring Action Plan)
	• Continue to implement an ongoing water quality monitoring program to support management actions and inform the community (eg. Report Card) • Repeat AusRivas study to investigate changes in upper Catchment over a ten year period
• Record and publicise litter collection data in national marine debris database (W7.2)	

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